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Number 21

ABSTRACTS

Growth Through Agricultural Progress

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UNITED STATES DEPARTMENT OF AGRICULTURE

"ABSTRACTS of recent published material on Soil and Water Conservation" is abstracted by Charles B. Crook in the Soil and Water Conservation Research Division of the Agricultural Research Service.

They are issued at irregular intervals, and their purpose is to bring together a summary of current published information about soil and water conservation for ready reference of those actively engaged in soil and water conservation work. Reprints of abstracted articles are generally not available in the Division. Requests for reprints should be sent to authors or institutions--addresses have been appended to abstract.

The abstract consists principally of articles published from January 1 to August 30, 1960.

The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" of the Soil Conservation Service. Mr. Crook is abstracting completely enough so article need not be consulted unless details are required. In case of a review, or a "how-to-do-it" article then the abstract is not complete. Abstracted articles are not editorialized and the language of the author is used wherever possible. In foreign articles, the units of measure are converted to usual American units. Tables are included where they help to present the information. When an entire number of a publication is devoted to reviewing one subject then the entire publication is abstracted as one article giving title and authors of each paper included in the publication. Abbreviations of journals and addresses are the standard ones set up by the U. S. D. A. Library in U. S. D. A. Misc. Pub. 765, July, 1958.

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R. S. Dyal, Soil and Water Conservation Research Division, Agricultural Research Service, U. S. Department of Agriculture, Plant Industry Station, Beltsville, Maryland.

CONTENTS

WATERSHED ENGINEERING

Watershed Development

Pavelis, G. A., and Timmons, J. F. PROGRAMMING SMALL WATERSHED DEVELOPMENT. J. Farm Econ. 42: 225-240. 1960.

Current programs for coordinating soil and water management on a small watershed basis provide both challenges and opportunities for improved economic analysis of resource development. Upstream proposals for combining the purposes of flood or other forms of damage control with provision for consumptive and nonconsumptive water uses imply a need for multipurpose planning concepts. Local sponsorship is a condition for Federal assistance in the Public Law 566 projects and is legalized in most States enabling legislation. The requirement means that planners must reconcile the economic objectives of farmers who control watershed uplands with those of other private or public units affected by upland use.

The crux of watershed planning, however, is the formulation of optimal development programs, which may be defined as programs achieving these objectives of development: (1) Maximizing discounted net returns from watershed resources; (2) allocating development costs equitably among various private or public participants; and (3) devising arrangements whereby acceptable programs can be financed, installed, and maintained.

ARS, USDA, and Iowa State U., Ames, Iowa.

Lull, H. W. WATERSHED MANAGEMENT RESEARCH IN THE NORTHEAST. J. Forestry 58: 285-287. 1960.

The Northeast has an urgent concern for its water resource. It has a big stake in watershed management research. In total area of this region is small: it comprises only

7 percent of the area of the United States. Yet it contains 29 percent of the nation's total population. Its population density is more than four times the national average. In this 12-state region (it includes the New England States and New York, Pennsylvania, New Jersey, Delaware, Maryland, and West Virginia), most of its 44 million people are concentrated along the coast and in inland cities situated along major rivers.

Thirty experimental watersheds in the Northeast are being studied to determine how forest cover, and changes in cover, affect streamflow--water yield, distribution in time, and water quality.

Sustained interest in this subject may be expected with continuing and growing realization that the water resource has limits bounded by seasonal availability and storage availability, and with increasing knowledge of the effect of forest management on water yield.

Northeastern Forest Expt. Sta., FS, USDA, Upper Darby, Pa.

Dunford, E. G. WATERSHED MANAGEMENT RESEARCH IN THE LAKE STATES, INTERMOUNTAIN, AND PACIFIC NORTHWEST REGIONS. J. Forestry 58: 288-290. 1960.

From Lake Huron to Puget Sound lies an expanse embracing two major mountain systems, wide bands of virgin timberland, and intervening areas of grassy plains. Including the Great Basin of Utah and Nevada, the area supplies water to four major rivers--the Columbia, Missouri, Mississippi, and Colorado.

Most watershed management research in forests and ranges of this 10-state area is done by the U.S. Forest Service, but important contributions also come from other sources. Some of the state universities and two forest-industry research organizations are adding to knowledge of watershed management through their investigations of forest soils.

Activities by the Forest Service are centered in three units--the Pacific Northwest, Intermountain, and Lake States Experiment Stations, headquartered respectively at Portland, Oregon; Ogden, Utah; and St. Paul, Minnesota.

In the past five years, the small corps of workers carrying on watershed research in the Lake States--Intermountain--Pacific Northwest area has tripled, and a similar rate of growth in the next decade is a minimum requirement to keep pace with research needs. Many in this added force should be specialists because there will be growing emphasis on basic principles. If present plans are followed, at least two regional laboratories will provide centers for fundamental research in soils, erosion, and hydrology. The trend will be toward studies that tell not only what happens in watersheds--but also why.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

McArdle, R. E. WATERSHED MANAGEMENT ON WILD LANDS. J. Forestry 58: 259-265. 1960.

The whole issue of watershed management is complex and difficult. There are no simple solutions. As the population and economy and thus the demand for water expand rapidly, more attention will have to be directed to the watershed and its management. We need to think, talk, plan, and practice more watershed management. At the same time we have to keep in mind other forest and range resources that cannot be appreciably sacrificed in favor of water. We should formulate a clearer national water policy and thereby achieve wider understanding of the issue among all the people. We need to find some way to enlist the cooperation of millions of small landowners.

Regardless of the difficulties, water is the most important natural resource issue before us as a people. Each of us is vitally involved, and obligated to practice and promote more intensive watershed management at every opportunity. The health of our watersheds can well determine the economic health of our communities and our nation. With well managed watersheds we can grow in strength and prosperity.

FS, USDA, Washington 25, D.C.

Sinclair, J. D. WATERSHED MANAGEMENT RESEARCH IN SOUTHERN CALIFORNIA'S BRUSH COVERED MOUNTAINS. J. Forestry 58: 266-268. 1960.

More than eight million of southern California's residents live in metropolitan centers and intensely developed valleys fringing the Pacific Ocean. These people have much at stake in the rugged mountains of the coastal ranges that separate them from desert areas to the east. The mountains are the source of two-thirds of their water even though much is imported hundreds of miles. These mountains can also be the source of disastrous floods, and the effectiveness of vital flood control works can be impaired by debris from the mountains.

To aid in the solution of these problems the San Dimas Experimental Forest was established by the Forest Service in 1933 as a center for watershed research. The forest, an area of 17,000 acres, is situated on the southern, brush-covered slopes of the San Gabriel Mountains, about 30 miles northeast of Los Angeles.

The broad objectives of the work undertaken at San Dimas are (1) to learn what happens to rain falling on brush-covered watersheds in terms of water yields and losses, and how water and soil movement are influenced by watershed features such as vegetation, soil, and geology; and (2) to apply this information in the management of watersheds to increase yields of good water and decrease flood flows and erosion.

This article gives a brief account of what research has been carried on and work in progress at the San Dimas Experimental Forest since 1933.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Hewlett, J. D., and Metz, L. J. WATERSHED MANAGEMENT RESEARCH IN THE SOUTHEAST. J. Forestry 58: 269-271. 1960.

Research to determine the effects of forest vegetation and land management practices on the components of the water cycle are carried out by the Southeastern Forest Experiment Station primarily at two locations. Most of the work has been done at the Coweeta Hydrologic Laboratory, located in the mountains of North Carolina in the region of maximum rainfall in the eastern United States. At the Union Research Center, in the piedmont of South Carolina, studies have been oriented toward the problems of rehabilitation of depleted watershed lands. Also, rather intensive studies of soil moisture have been made at this location.

The principal job of watershed research is to learn how to utilize the water that falls to the ground to the fullest advantage. As more information accumulates about principles of watershed behavior, it will be put to practical tests on watershed lands of the Southeast. Logging studies on pilot areas in the mountains have already provided examples of how watershed lands can be better managed in terms of multiple use objectives. And rehabilitation methods worked out by research in the piedmont are finding many applications on depleted lands of the region. Continued research and application of research findings is a must if we are to make optimum use of our water resource--one of the most important resources we get from forested lands.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N. C.

Reynolds, H. G. WATERSHED MANAGEMENT RESEARCH IN ARIZONA AND NEW MEXICO. J. Forestry 58: 275-278. 1960.

Watershed management research in Arizona and New Mexico began on a modest basis about 1910. By 1935 research in soil stabilization and reduction of sedimentation was greatly increased. More recently, the possibility of augmenting water yields has received more and more emphasis. This paper briefly discusses current watershed management research of the U. S. Forest Service in the Southwest.

The Southwest (Arizona and New Mexico) is characterized in general by low water yields and high rates of sedimentation. Information for managing watersheds is urgently needed because an increasing population is demanding a greater supply of water and other products, such as timber, livestock, game, and recreation from the watersheds. Research by the Forest Service is emphasizing water yields at the higher elevations, coordinating watershed with timber and range management in the intermediate zones, and

reducing flood flows and sedimentation at the lower elevations. Solution of the many watershed management problems is a searching challenge to the ingenuity and imagination of researchers. Efforts should be fully repaid by the development of watershed management practices that will permit more intensive yet better use of watersheds by an expanding population.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

Love, L. D., and Goodell, B. C. WATERSHED RESEARCH ON THE FRASER EXPERIMENTAL FOREST. J. Forestry 58: 272-275. 1960.

The Fraser Experimental Forest is located in the Rocky Mountains of Colorado, about 65 miles northwest of Denver and 5 miles south of the town of Fraser. It has an elevation range of 9,000 to nearly 13,000 feet and is representative of much of the high, water-yielding lands of the central Rocky Mountains where melting snow forms the principal source of four major rivers. Dense stands of Englemann spruce, subalpine fir, and lodgepole pine cover most of these headwater areas, but at higher elevations alpine tundra and rock surfaces are extensive.

Although a prime source of water, the Colorado Rockies receive but moderate amounts of precipitation. On areas above 9,000 feet, annual precipitation does not average more than 30 to 40 inches and decreases rapidly with lower elevation. Of the 30 to 40 inches, 60 to 80 percent occurs as snow, which begins to presist on the ground during October and accumulates with little or no loss by melting until the spring thaw in April, May, and June.

This snowpack and its environment, particularly its forest environment, has been a subject of some study at the Fraser Experimental Forest for 20 years.

This report gives a brief history of the research work at this station in the past, describes the work currently under way, and gives some future research goals.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

Kilbourne, R. WATERSHED IMPROVEMENT IN THE TENNESSEE VALLEY. J. Forestry 58: 294-296. 1960.

The Tennessee Valley covers some 26 million acres in 125 counties of seven states. It lies in a region of relatively high rainfall--52 inches a year on the average. From 6,000-foot peaks in the rugged Southern Appalachians of western North Carolina, the Valley drops south, west, and then north to an elevation of 302 feet at Paducah, Kentucky.

Over 54 percent of the Valley (14 million acres) is forested. And another million acres of open, idle, and eroding land is generally recognized as being in need of reforestation. Private forest owners number 245,000 and they control 11.5 million acres. The 18 percent of forest land in public ownership is chiefly in national forests, national parks, and military installations. TVA owns less than 170,000 acres of forested land along the Tennessee River and its tributaries.

The plan for controlling water in the Tennessee River and its major tributaries is based on an integrated system of 31 dams and reservoirs. They provide 12 million acre-feet of flood storage capacity during flood seasons, a 650-mile navigation channel from the Ohio River to Knoxville, and about 15 billion kwh of electric power annually.

While these dams and reservoirs were built and are operated for flood control, navigation, and power production, the waters and shorelines also serve more than a hundred industrial plants with investments of about $750 million. Investments in recreation facilities on TVA reservoirs by individuals, states, and local organizations now total $82 million and in 1958 the reservoirs attracted 36 million person-day visits of a recreational nature.

Backing up and supplementing its river control program, TVA also participates in cooperative programs aimed at protecting and developing the watershed. This includes a vigorous and effective cooperative program in the agricultural phases of watershed protection and improvement.

TVA, Norris, Tenn.

Craddock, G. W. FLOODS CONTROLLED ON DAVIS COUNTY WATERSHEDS. J. Forestry 58: 291-293. 1960.

Severe mountain born floods came to Davis County, California in northern Utah in 1923 and 1930. These floods were nothing like the gradual rise of streamflow to moderately high and readily handled discharges that occurred each spring during the snowmelt season. Instead, they came suddenly in midsummer as churning, barely fluid masses of mud, gravel, and rock. Some of the floods carried boulders weighing up to 100 tons.

The discharges spread out from canyon mouths to engulf homes, block highways, and bury farm lands under raw sediment up to 6 feet in depth. Several persons were killed. Flood damages exceeded $1 million, or nearly one-fifth of the assessed value of all property in that part of the country.

A study of the area strongly indicated that floods could be controlled at their source by restoring the capacity of the watershed mantle to absorb and hold the torrential rainfall. The Forest Service developed a program of four remedial measures. These included the establishment of organized fire control on all of the mountain lands, elimination of livestock grazing on the flood producing watersheds, seeding of perennial grasses on depleted sites, and construction of contour trenches on the gullied flood source areas.

Contour trenches were proposed for several reasons. They were needed to break up the gully system, prevent storm runoff from flowing into the headwater channels and, by trapping water in the trenches, provide favorable soil moisture conditions for regrowth of vegetation. The trenches were spaced at about 25-foot intervals and have a capacity for storing 75 percent of a 2-inch rain on the slopes between the trenches.

Plant cover thickened quickly on the intensively treated watersheds. Adequate densities of plant and litter for controlling storm runoff were soon attained on all but the most severely eroded sites, and even on them the trenches trapped the runoff. With this recovery of vegetation also came control of streamflow.

Since 1936, the mountain lands in the experimental area have been subjected to more than 300 summer rains. Most were of the short duration-high intensity "cloudburst" type. Rainfall rates for 5 minutes have been as high as 8.50 inches per hour.

No mud-rock floods developed in any of the intensively treated watersheds under the impact of these rains. During the most intense rains, the steady summer flow of the streams from the intensively treated watersheds as well as from the undamaged Centerville Watershed was interrupted by only short duration surges. The maximum discharges of 2 to 5 C.S.M. (cu. ft. per sec. per square mi.) during these stormflow surges are less than most of the discharges which occur in the spring from snowmelt.

Mud-rock floods continue to occur on the untreated and only partially treated watersheds in the experimental area.

Watershed rehabilitation in Davis County, while effectively preventing destructive floods, has had relatively little effect on water yields. Annual discharge from the treated Parrish watershed has decreased about 0.1 area inch per year during the 22-year period 1936-1958. Most of the decrease occurred in the first 11 years. The greatest monthly decreases have occurred in March, April, and May, during snowmelt. June flows have increased slightly. Flows in other summer and the fall months are practically unchanged.

The upstream flood control measures used in Davis County have been applied in recent years on other damaged watersheds in Utah, Nevada, and Idaho.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Moser, B. D. TEAM EFFORT SOLVES ANNUAL FLOOD PROBLEM. Land & Water Conserv. 2(6): 12-13. 1960.

After flood-testing their newly completed watershed project this past winter, the people of Saar Valley in Whatcom county, Washington, report more gains from their team undertaking than they had hoped for.

The Saar Creek project, a little Small Watershed "566er" in its first flood season took charge of a 26 year record flow so well that improved channels used only two-thirds of their capacity. And for the first time in the memory of the valley's residents, farmlands, roads, and homes at flood stage were high and dry.

To complete Washington's first small watershed project and successfully contain Saar Valley floods, cost the federal government $59,958, Whatcom county, $11,290; Drainage Improvement District No. 15, $8,584 and Washington State Department of Conservation $4,257.

Flood works consisted of constructing a channel of a size and design that would safely handle the flow of drainage water of four separate units--Saar Creek, Mud Slough, and Sleasman Ditches Nos. 1 and 2.

SCS, USDA, Bellingham, Wash.

Crouse, G. GOOD FISHING IN SPORTSMAN'S LAKE AND FLOOD PREVENTION ON TIGER CREEK. Soil Conserv. 25: 246-247. 1960.

An example of the far-reaching benefits that can be realized by cooperative planning to take full advantage of opportunities afforded for watershed protection and multiple use of impoundments under Public Law 566 (the Watershed Protection and Flood Prevention Act) has been completion of Sportsman's Lake in Seminole County.

The lake, one of 60 detention reservoirs planned to help control floods on Wewoka Creek, was recently opened for public fishing by the State Department of Wildlife Conservation. While there are many larger bodies of water in the sooner State, none have been built with a greater measure of cooperation on the part of governmental agencies, together with a full measure of encouragement and support from local groups.

The lake was built by the State Department of Wildlife Conservation with technical and financial assistance from the Soil Conservation Service. The State department was reimbursed for 75 percent of its share of the cost from Federal funds derived from Dingell-Johnson and Pittman-Robertson apportionments.

The 355-acre lake was built on a 1,900-acre tract acquired by the wildlife department as a game management area after sportsmen and others interested in such a project had encouraged the joint enterprise. An automatic drawdown, the principal spillway, provides for a constant level with an additional ten feet of floodwater storage during heavy rainfall periods.

Cost of construction amounted to $132,282 in Wildlife Department funds, and $108,056.25 in Federal funds provided by the Soil Conservation Service.

But the benefit by no means ends with the lake as a recreational center. Far greater value will be realized from flood prevention benefits. Tiger Creek is a branch of Wewoka Creek. Rampant Wewoka Creek is one of the worst actors in the State during flood periods and has caused extensive damage to farmland, highways, other public utilities, and municipalities.

Editor, Okla Wildlife.

Strate, R. TROUT--A CROP OF THE LAND. Soil Conserv. 25: 243-245. 1960.

The idea that fish--and specifically trout--are a product of the land is the guiding principle behind a new kind of watershed improvement program on the White River in west central Michigan. It is expected to result in better fishing, better farming, and a higher standard of living for all folks who live in the 132,000-acre watershed.

Spring floods, with their load of silt from the uplands, were filling holes, covering up spawning beds, and lowering the stream's ability to raise food for fish. The lack of escape cover and hiding places, pollution from barnyards, and many other discouraging conditions were noted.

Trout probably are one of the best barometers of the kind of land use we have in a watershed. They are directly affected by water temperatures, silt flowing into streams from the uplands, the lack of shade because the timber has been cut, or pollution from a factory dumping commercial waste into the stream. Improper land use probably had been the major factor in causing the brook trout to move farther north and the grayling to become only a memory.

Control of streambank erosion and stabilization of the stream bottom drew first priority. Banks were graded, sodded or seeded on the face, and protected at the top with rock riprap. Log aprons, jetties, and streambank plantings were begun. Over a mile of rock riprap alone was needed.

Some of the structures used in the streams were single and double wing deflectors, boom covers, pine stump and sodded log covers, abutment dams, and gravel spawning boxes.

Proper land drainage, contour striperopping, better crop rotations, improved seeds and seeding methods, trees planted on marginal and submarginal areas, windbreaks and wildlife area improvements are only a few of the effective conservation practices being encouraged.

The major part of the work on all 131 miles of streams in the White watershed has now been completed. A total of 149 sections of streambank have been protected; 974 stream habitat structures placed; the five beaver dams removed; and underspill dam constructed and water temperature downstream lowered by 10 degrees; 231 rods of woven wire fence constructed to prevent livestock from grazing banks; and 750,000 trees purchased and planted by landowners.

SCS, USDA, Fremont, Mich.

Wooldridge, D. D. WATERSHED DISTURBANCE FROM TRACTOR AND SKYLINE CRANE LOGGING. J. Forestry 58: 369-372. 1960.

As logging operations in the West continue to move further into the mountains, an increasing volume of timber is being harvested from steep slopes. In these areas, where access is more difficult, road-building costs are greater. And on precipitous mountainsides, soil normally disturbed in logging is more susceptible to damaging slough and erosion. Because of these problems, many acres of timberland are considered inoperable with conventional logging methods.

In a comparative study of logging methods, soil disturbance caused by a Wyssen Skyline Crane was only a quarter of that caused by a standard crawler tractor operation. Soil disturbance on the Skyline Crane area was found on fewer transects, less damage was evident in the residual stand, and less road construction was needed. These advantages suggest the possibility of using skyline logging systems for harvesting timber in municipal watersheds and other areas previously closed to logging because of erosive soil conditions or steep, broken terrain.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg.

Hydrology

Minshall, N. E. PREDICTING STORM RUNOFF ON SMALL EXPERIMENTAL WATERSHED. J. Hydraul. Div., ASCE 86(HY 8): 17-38. Aug. 1960.

Careful estimates of rates and amounts of runoff are required for design of flood retarding and channel stabilizing structures, and bridges and culverts in small upstream watersheds. The period of record of many of the small experimental watersheds in the United States is too short to permit direct analysis for reliable estimates of the magnitude and frequency of storm runoff. A method is presented for extending the period of runoff records based on analysis of existing short term records of rainfall and runoff for the watershed, and a longer record of the rainfall alone. The method involves: (1) Estimating storm runoff volumes from the rainfall pattern and antecedent rainfall; and (2) distributing this runoff through an adaption of the unit hydrograph principle. A method is also presented for developing synthetic unit hydrographs for ungaged areas.

Watershed Tech. Res. Br., SWCRD, ARS, USDA, Madison, Wisc.

Hartman, M. A., Baird, R. W., Pope, J. B., and Knisel, W. G. DETERMINING RAINFALL--RUNOFF--RETENTION RELATIONSHIPS. Tex. Agr. Expt. Sta. MP-404, 7 pp. 1960.

A method is presented for predicting daily runoff from native meadow watersheds in the Blacklands of Texas. The method is developed from daily rainfall (P), runoff (Q), intercept constant (a), slope constant (b), and antecedent soil moisture (ASM) data from

an experimental watershed. Evaluation of the constants in the equation $\frac{P}{P-Q} = a + bP$ by reference to ASM data resulted in a logical mathematical procedure that allows extension of the relationship beyond the range of experimental data.

SWCRD, ARS, USDA, and Tex. Agr. Expt. Sta., College Station, Tex.

Geology

Leapold, L. B., and Wolman, M. G. RIVER MEANDERS. Geol. Soc. Amer. B. 71: 769-793. 1960.

Most river curves have nearly the same value of the ratio of curvature radius to channel width, in the range of 2 to 3. Meanders formed by meltwater on the surface of glaciers, and by the main current of the Gulf Stream, have a relation of meander length to channel width similar to rivers. Because such meanders carry no sediment, the shapes of curves in rivers are evidently determined primarily by the dynamics of flow rather than by relation to debris load.

Velocity distributions along river curves provide a generalized picture of flow characteristics. Evidence on flow resistance in curved channels suggests that a basic aspect of meander mechanics may be related to the distribution of energy loss provided by a particular configuration or curvature. No general theory of meanders is as yet satisfactory, however; in fact, present evidence suggests that no single theory will explain the formation and characteristics of all meanders and that few of the physical principles involved have yet been clearly identified.

Johns Hopkins U., Baltimore, Md.

Colby, B. R. DISCONTINUOUS RATING CURVES FOR PIGEON ROOST AND CUFFAWA CREEKS IN NORTHERN MISSISSIPPI. U.S.D.A., A.R.S. 41-36, 31 pp. 1960.

The channels of Pigeon Roost Creek and the lower part of its major tributary Cuffawa Creek are straight and have been excavated through flat bottom land. The stable, brushy banks scour very little. The streambeds are relatively level from bank to bank, consist of unusually uniform sand (median diameter 0.4 mm.), and have slopes of about 1 or 2 feet per 1,000 feet. The slopes of tributary streams are usually much steeper but, except for the small streams, the beds are mostly sand.

Streamflow measurements for five gaging stations on Pigeon Roost and Cuffawa Creeks define discontinuous stage-discharge relationships. At some intermediate stages, the flow at times may be double that at other times for the same gage height. Above and below the rather narrow range of uncertain discharge, the measurements plot reasonably close to average curves. The low-velocity curve represents the stage-discharge relationship for flow over a bed of loose sand dunes, and the high-velocity curve represents the relationship for flow over a plane bed or combination of plane and antidune bed. At six other gaging stations, which have beds of sand but steeper slopes, the stage-discharge relationships show no apparent discontinuity.

The water-surface slopes and the average elevation of the sand bed are relatively constant at each station for which discontinuities in the stage-discharge relationship were defined. The discontinuities are due to much lower resistance to flow at some times than at others at the same gage height. When the velocities are high and resistance is low, the streambed may be relatively plane or have standing waves above antidunes along the middle of the channel. Intermediate bed configurations also may exist at times.

Discontinuities definable by streamflow measurements are to be expected in channels that have: (1) Beds of uniform sand; (2) a dune bed at some flows and a plane bed or a combination of plane and antidune bed at some higher flows; (3) uniform lateral and longitudinal distribution of flow; and (4) slopes low enough for the transition to occur at appreciable depths of flow. Few channels have all these characteristics. Uniform sand beds and uniform distribution of flow are rare outside of flumes. This is why discontinuous stage-discharge relationships in natural streams have seldom been defined. If the distribution

of flow is not uniform, a continuous stage-discharge relationship may be defined even though the other requirements for a discontinuity are present.

Satisfactory streamflow records can be computed from the two curves of a discontinuous stage-discharge relationship and from interpolated curves of instantaneous discharge during periods when neither the low- nor high-velocity curve applies, if the transitions are clear cut. That is, the streamflow records can be computed with generally sufficient accuracy if the entire bed of the channel has only one type of bed configuration at a time except for brief periods of transition. Frequent streamflow measurements may be required if different bed configurations exist within a short reach of channel for considerable periods of time.

Computation of the discharge of fine sediment is probably as accurate for stations that have large differences in bed resistance as at other stations if the streamflow can be computed accurately. Either kind of station requires periodic determination of the concentration of the fine sediment. For stations that have large differences in resistance, both sampling of the concentration of coarse sediment and computation of its discharge may be appreciably less accurate if the resistance and bed configuration vary.

At stations where the streambed may have different configurations across a section or along a short reach of channel, the resistance to flow may be indeterminate for considerable periods of time. At such stations a definite discontinuity in the stage-discharge relationship may or may not exist.

ARS, USDA, Inform. Div., Washington 25, D. C.

Anderson, H. W., Coleman, G. B., and Zinke, P. J. SUMMER SLIDES AND WINTER SCOUR....DRY-WET EROSION IN SOUTHERN CALIFORNIA MOUNTAINS. U.S.D.A., F.S. Tech. Paper 36, 12 pp. 1959.

To plan erosion control measures in the watersheds of southern California, we must know where the debris is coming from, how it is moved from the slopes, and something of the kinds of materials making up the debris.

This cooperative study showed that the highest rates of debris movement were from the steep front-country sites that faced south. Annual debris movement from these sites averaged 5 tons per acre of rock, soil, and organic matter. This was 5 to 10 times as much as from other sites.

During the 5-year period of study, dry-season debris movement exceeded wet-season movement on most of the sites; thus a large part of the debris movement from slopes into channels is seemingly independent of rainfall. Very little debris was flushed from the channels by the below-normal winter streamflow. Most of it still lies in the channels, a constant threat.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Palmer, R. S. GULLIES OF NEW ENGLAND RIVER VALLEYS. J. Soil and Water Conserv. 15(4): 180-182. 1960.

An evaluation of the problems arising from accelerated erosion in the New England river valleys was made. Special emphasis was placed on the Connecticut River valley because of its economic importance to the region. Methods of controlling gullies are discussed. The use of trees for controlling gullies was not recommended.

SWCRD, ARS, USDA, Durham, N.H.

Spraberry, J. A., Woodburn, R., and McHenry, J. R. SEDIMENT DELIVERY RATIO STUDIES IN MISSISSIPPI. I. A PRELIMINARY REPORT. Agron. J. 52: 434-436. 1960.

An evaluation of the erosion susceptibility of watersheds in the loessialcapped hills of northern Mississippi was made using two equations for the computation of gross erosion. The computed gross erosion values varied greatly from watershed to watershed. However, the two equations employed gave statistically similar results. The sediment delivery percentages computed for the various watersheds also varied greatly, but the

differences were not correlated with size or location of the watersheds. Some physical characteristic, or characteristics, associated with the watershed and not correctly evaluated in the gross erosion computation is considered the cause of this variation in the sediment delivery percentage.

Watershed Tech. Res. Br., SWCRD, ARS, USDA, Oxford, Miss.

Borland, W. M., and Miller, C. R. SEDIMENT PROBLEMS OF THE LOWER COLORADO RIVER. J. Hydraul. Div., ASCE, 86 (HY 4): 61-87. Apr. 1960.

The construction of Hoover Dam and other structures on the Lower Colorado River has essentially solved the flood problems, created a firm irrigation water supply, and provided a large block of hydroelectric power. However, these structures did not eliminate the problems of river control, but only changed their character. The channel aggradation and degradation that have occurred with the construction of water diversion and storage facilities have created a series of varied river control problems that require rectification. These river alterations are continuing and rectification needs will continue as long as sediment-contributing reaches of the river remain uncontrolled.

Rectification work, and planning for such work, is in various stages of development. In the river reach between Davis Dam and Topock, channel dredging is underway to create a new fully controlled channel. Work in this reach is 85% completed. The channel has been designed to be compatible with existing and future sediment load, bed material, discharge, and hydraulic factors. In the Palo Verde Diversion Dam to Imperial Diversion Dam reach, studies are currently underway and a report will be made soon presenting a plan for river rectification. The plan will probably involve bank control, channel straightening and realinement, and a substantial cut-off channel in the Cibola Valley. Downstream from Imperial Dam, sediment and hydraulic data are being collected, and studies and analyses are being carried out for the purpose of determining river regulation water requirements and to provide a constant check on river channel developments. Various items of river rectification work are carried out as required within these major river reaches to correct a localized channel problem.

Sediment movement and hydraulic data are collected on a regular basis at strategic locations throughout the Lower Colorado River Basin. Total sediment transport sampling stations are established or dropped as required by the detailed study program.

Since the river channel aggradation and degradation results from a shuffling and reshuffling of riverbed and bank materials above and below major structures, planning and design for river rectification is aimed at obtaining eventual complete control between these major control points. Since any work must be justified on the basis of benefits to be received, it is not possible to carry out a complete construction program between major structures, but, rather, work must be concentrated on reaches or sections where benefits will justify the rectification costs. This intermediate type work is planned as an integral part of the overall river control program, however.

River rectification work generally involves channel straightening and realinement, utilizing cut-offs, riprap placement, training structures, and levees. The method used, in each case, is selected on the basis of existing and probable future conditions. Improvements in methods of control are constantly being made from the experience gained on work accomplished so far, and the analysis of newly collected sediment, hydraulic, and hydrologic data. Present indications are that future needs for river rectification will be in the Palo Verde Diversion Dam to International Boundary reach. The most urgent need at present is in the Cibola Valley.

Hydrology Br., Bur. Reclam., Denver, Colo.

Toffaleti, F. B. SEDIMENTATION ASPECTS IN DIVERSION AT OLD RIVER. J. Hydraul. Div., ASCE, 86 (HY 6): 37-46. June 1960.

It is concluded from the data presented that the distributary system of the Mississippi River in the vicinity of the latitude of Old River is in a state of imbalance in sediment transport capacity. This imbalance has been found to exist within the leveed portion of the Atchafalaya River itself during large floods, and more importantly in its relation with supplying streams in all types of water years from low to high, when considered on an annual basis.

The end result of this state of imbalance can lead in only one direction--continuous annual enlargement of the Atchafalaya River regardless of water type year. In substantiation of these findings from the standpoint of sediment transport capacities, it is a matter of record that the rating curve for the Simmesport discharge range, during the period 1951-58, lowered 2 ft. at approximate bankfull discharge. In this seven-year period there were no high-water years; three of the years were of medium-year magnitude and four were low-water years.

Hydrology Br., U.S. Army Engin. Div., Vicksburg, Miss.

Davis, I. F., Jr. COLORADO'S GROUND WATER PROBLEMS: THE ECONOMIC PICTURE. Colo. State U., Expt. Sta., B. 506-S, 32 pp. 1960.

Colorado's ground water problem is not so much one of actually running out of water. The main problem is being able to recognize when we are using too much water too fast and then doing something about it. Much of the problem stems from the adverse legal and economic consequences of developing more and more ground water to meet the urgency of pumping shortages.

Sound water management starts with an understanding of ground water and the legal rights to its use and calls for a knowledge of the economic rules affecting ground water use. This bulletin discusses the economic rules the farmer needs to guide him in the use of ground water.

Colo. State U. Expt. Sta., Fort Collins, Colo.

Engineering Design

Beasley, R. P., Meyer, L. D., and Smerdon, E. T. CANOPY INLET FOR CLOSED CONDUITS. Agr. Engin. 41: 226-228. 1960.

A closed-conduit spillway with a canopy inlet is a simple structure which is relatively inexpensive and easy to install. A series of laboratory tests were made on scale models of the structure to determine its hydraulic characteristics and the design dimensions of the inlet. The performance and capacity of the structure as predicted from the laboratory tests were verified by field tests on a full-scale structure.

The tube flowed full with a depth of water at the inlet ranging from 1.4 times the tube diameter for a tube slope of 4 percent to 1.7 times the tube diameter for a tube slope of 32 percent. Vortices had no measurable effect on the performance or capacity of the structure. Variations in the shape of the approach channel or the direction of flow in the approach channel had no measurable effect on the performance or capacity of the structure. The roughness and length of the tube had no measurable effect on the entrance head at which the tube flowed full. The entrance loss coefficient for the canopy inlet is approximately 1.5. The demensions for construction of canopy inlet structures are given.

U. Mo., Agr. Expt. Sta., Columbia, Mo.

Culp, M. M. TWO-STAGE RESERVOIR INLETS AN IMPORTANT TOOL WHEN PROPERLY DESIGNED. Agr. Engin. 41: 506-507. 1960.

A two-stage reservoir inlet is an inlet in which the flow enters the inlet first at a low-stage opening (usually an orifice), and later, if the inflow into the reservoir is sufficient, at a higher stage. The discharge through the high stage is controlled first by weir flow, and later by full-pipe flow conditions in the drop inlet.

The design and layout of the two-stage inlet has been improved and its characteristics extended to other important functional uses as the result of experience and careful contemplation of its basic characteristics and their application to other problems.

The principal uses and advantages of two-stage inlets as now used are:

1. In upstream flood prevention work the structure may be proportioned so that all floods up to those of a specific frequency are regulated by the low-stage orifice, or so that sufficient volume of the flood will be delayed by the storage between the low and the high-stage inlets that the peak discharge from the uncontrolled area

below the retarding dams will pass successive downstream reaches before the increase in discharge through the high-stage inlet gets to these same successive reaches where damage is to be reduced. These design procedures result in more economical proportioning of retarding dams because they permit variation of the principal spillway capacity and of the storage in the reservoir and associated earth embankment costs, in such a way that the resulting retarding or multiple-purpose dam can be built at a minimum cost. It is unnecessary in many cases of upstream flood control to regulate all of a 25, 50, or 100-year flood at very low outflow rates in order to accomplish the economically justified flood control.

2. Retarding dams placed above channels that are unstable and eroding can be designed for the two-stage inlet. The erosion may be in the form of bank erosion, gully degradation or head cutting (overfalls moving up the channel). In such cases where it is necessary to stabilize the channel either by vegetation or structural control, a retarding dam or a multiple-purpose grade control and retarding dam located near the upstream end of the eroding channel can be very helpful. In this situation, a two-stage inlet may be particularly helpful since it permits a major reduction in the peak rate of discharge to be carried by the channel for a major part of the total volume of flow which will pass the dam. This is particularly true where the channels are such that out-of-bank or flood plain flow seldom occurs. Regulation of the discharge through the low-stage inlet is a powerful tool in the control of velocity in the channel downstream. Many variations of this basic concept are possible.
3. The two-stage inlet permits the safe use of a covered inlet. This covered inlet and the associated trash guard layout is the most effective antivortex device and trash guard being used today for drop-inlet spillways.
4. The two-stage inlet is a powerful tool when used wisely and with proper design.

SCS, USDA, Washington, D. C.

Blaisdell, F. W. HOOD INLET FOR CLOSED CONDUIT SPILLWAYS. J. Hydraul. Div., ASCE 86 (HY 5): 7-31. May 1960.

The hood inlet for closed conduit spillways is formed by cutting a circular pipe at an angle and placing the pipe so that the crown projects beyond the invert. This forms a hood over the pipe entrance.

The use of the hood inlet causes the pipe to fill with little or no submergence of the inlet crown. This filling occurs even though the pipe is laid on a slope that is hydraulically steep. Smooth pipes having slopes greater than about 1.5%, and corrugated pipes having slopes greater than about 8% are hydraulically steep. Therefore, many highway culverts and other drainage structures fall into this steep category and will not fill unless the entrance receives special attention.

The capacity and performance of the spillway for variations of the hood inlet length, the conduit slope, the wall thickness, and the approach conditions are described. The great effect of vortices on the spillway capacity is shown and anti-vortex devices are developed. Scour in the vicinity of the hood inlet is determined for various sizes of stone and equations for the scour-hole dimensions are presented.

St. Anthony Falls Hydraul. Lab., ARS, USDA, Minneapolis, Minn.

Simons, D. B., and Richardson, E. V. RESISTANCE TO FLOW IN ALLUVIAL CHANNELS. J. Hydraul. Div., ASCE 86 (HY 5): 73-99. May 1960.

Resistance to flow in alluvial channels varies between wide limits and is extremely complex because the form of the bed roughness is a function of fluid properties, flow and sediment characteristics, and channel geometry. The major forms of bed roughness that were determined from experiments and that are discussed in this report are:

1. Tranquil flow regime, $F_r < 1$: (1) Plane bed without bed material movement; (2) ripples; (3) dunes with ripples superposed; (4) dunes; and (5) transition from dunes to plane bed.
2. Rapid flow regime, $F_r > 1.$: (1) Plane bed; (2) symmetrical standing waves; and (3) antidunes.

In the tranquil flow regime the resistance to flow, as measured by the Chezy coefficient of discharge $C/\sqrt{g}$, was 14.0 for the plane bed without movement, varied from 7.8 to 12.4 for ripples, and from 7.4 to 12.8 for dunes. The large $C/\sqrt{g}$ values for the ripples or dunes were associated with the deepest depths, and hence, the smallest relative roughness.

In the rapid flow regime $C/\sqrt{g}$ carried from 13.9 to 27.0. The largest $C/\sqrt{g}$ value occurred with a plane bed and plane water surface. Standing waves, in general, had larger values of $C/\sqrt{g}$ than antidunes. This resulted from the dissipation of energy by the breaking waves. The value of $C/\sqrt{g}$ could be reduced further for antidune flow but for the fact that the period of time and length of flume occupies by breaking waves was small in comparison with the total time and length of flume.

It was observed that with the bed material and the flume used in the experiments, dunes started to wash out and resistance to flow decreased when F_r 0.6. In the transition from dunes to plane bed $C/\sqrt{g}$ varied from 10.0 to 14.1. The magnitude of $C/\sqrt{g}$ increased as the percentage of the bed which was covered with dunes decreased. Also, there was a hysteresis when the dune bed changed to standing waves which depended on the form of the bed prior to the change. That is, with discharge constant, a larger slope was required to change from a dune bed to a standing wave bed than was required to change from standing wave bed to dune bed.

For certain size gradations of bed material, if the slope of the energy grade line is close to critical slope, a change in stage causes dunes to change to plane bed or standing waves or vice versa. This phenomenon occurs in many natural streams and produces a discontinuity in the stage discharge relation. However, because of the hysteresis that is associated with such a change in bed form, the stage at which the discontinuity develops depends on whether the stage is rising or falling and on the rate of change of discharge with time.

U.S. Geol. Survey, Fort Collins, Colo.

Chatry, F. M. FLOOD DISTRIBUTION PROBLEMS BELOW OLD RIVER. J. Hydraul. Div., ASCE 86 (HY 8): 1-15. Aug. 1960.

Any plan for the control of floods below Old River must possess the following attributes: (1) It must be capable of safely distributing the maximum peak flows that may reasonably be expected to occur; (2) it must accomplish this distribution with a minimum of economic disruption; and (3) it must be adaptable to changing conditions, so that its effectiveness may remain unimpaired in the future.

The system described is shown to satisfy these requirements. It can be operated in a planned and predictable manner for peak total flows at the latitude of Old River up to and including 3,030,000 cfs, a value that has been established by extensive meteorological and hydrological studies as the largest likely to occur. With the exception of the West Atchafalya Floodway, which will operate less often than once every hundred years, the economic disruption deriving from system operation is not great. It varies from negligible in the case of an operation of Bonnet Carre Spillway to minor for a Morganza Floodway operation. And the overall system's flexibility and adaptability are such that the end of its useful life cannot now be foreseen. With the system operating, the threat of damaging overflow below Old River has been virtually eliminated.

U.S. Army Engr., Dist. New Orleans, New Orleans, La.

Ground Water Recharge

Clyma, W., and Jensen, M. E. FLOCCULENT USED TO REMOVE SEDIMENTS FROM PLAYA LAKE WATER USED FOR GROUNDWATER RECHARGE. Tex. Agr. Expt. Sta. College Station, Tex. Prog., Rpt. 2144, 7 pp. 1960.

A commercial flocculent reduced the amount of silt plus clay entering a recharge well in a 24-hour period 49 percent. The quantity of silt plus clay removed from the well during the 1-hour pumping cycle following recharge was 2.4 percent of the amount that

entered the well. The combination of the flocculent and pumping cycle resulted in 50.2 percent less sediments in the well, compared with 7 to 10 percent removed using the pumping cycle alone.

SWCRD, ARS, USDA, and Tex. Agr. Expt. Sta., College Station, Tex.

Suter, M., and Harmeson, R. H. ARTIFICIAL GROUND-WATER RECHARGE AT PEORIA. Ill. State Water Survey B. 48, 48 pp. 1960.

Research and demonstration of the pit method of artificial recharge at Peoria and its contribution to solution of the problem of declining ground-water levels are reported. Excessive withdrawals from the glacial drift aquifer at Peoria had resulted in progressive decline of the ground-water levels and remedial measures were urgently needed.

Ground-water resources at Peoria are developed from three well fields and must meet the demands of the municipal supply as well as a variety of major water-using industries. Prior to 1959, most water needs were furnished from these ground-water resources. Since that time treatment facilities have been developed for direct use of water from the Illinois River.

The types of recharge pits and operating techniques developed by the Illinois State Water Survey and those which were built by local industries are described, and summaries of operating records over an eight-year period show capacity and cost information.

By means of pits, artificial recharge is conducted at high infiltration rates; operating costs are low in comparison to the cost of treating river water for direct use; practical methods of maintaining satisfactory infiltration rates have been developed; ground-water temperatures have been maintained within desirable limits; and a significant contribution has been made toward stopping the recession of local ground-water levels.

Maximum infiltration rates of 175 feet per day have been reached in the experimental Pit No. 2 constructed by the Water Survey, and rates higher than 200 feet per day have been achieved in the pit of Bemis Bro. Bag Company. Mean annual rates for three successive seasons of concurrent operation of the two Water Survey recharge pits were between 102.8 and 54.5 feet per day in Pit No. 2 and between 41.2 and 38.7 feet per day in Pit No. 1.

The cost summaries show that the operating cost has been approximately two cents per thousand gallons recharged. This is substantially less than the limit of six cents per thousand gallons which had been estimated as the maximum to be attractive commercially. The unit cost of recharge was reduced during the years that both pits were operated for the reason that the quantity of water recharged was increased while the cost of supervision of operation remained almost constant. Annual replacement of filter media enables higher recharge rates. Unit costs per thousand gallons recharged were almost identical whether the pit was cleaned annually or operated two or three years between cleanings.

Pea gravel serves as an effective filtration media, while allowing a practical rate of infiltration over long periods of time. Bacterial analyses of samples taken since the pea gravel was first used have shown no deterioration in santiary quality of the ground water. Repeated use of the pea gravel caused no significant reduction in the average daily recharge rate in Pit No. 1 and resulted in slight reductions in the rate of Pit No. 2. The pea gravel was replaced after three seasons of use because the concentration of silt was approaching the saturation limit of its void spaces. Temporary increases in recharge rate can be obtained by removing part of the accumulated silt with a suction cleaner.

The effects of recharge on ground-water temperatures have been beneficial in general. Most industries using ground water from the Central Well Field prefer cool water. Approximately 80 percent of the entire recharge has been conducted when the temperature of the river is lower than the normal average ground-water temperatures. As a consequence, the ground-water temperatures are being reduced below those values which were observed prior to the use of artificial recharge. This effect reaches as far as 2800 feet from the pits. The short period of recharge during the summer of 1956 produced higher than desirable temperatures within 500 feet of the pits but did not result in significant increases beyond that radius.

It appears that artificial recharge with the four Peoria pits has contributed materially to raising the ground-water levels in the wellfields in Peoria, and that continued operation of these pits is essential to maintaining the ground water at desirable levels.

Tables and Graphs.

State Water Survey Div., Urbana, Ill.

WATER MANAGEMENT

Irrigation

Blaney, H. F. DETERMINING IRRIGATION REQUIREMENTS FROM CONSUMPTIVE USE WATER RATES. 5th Int'l. Cong. Agr. Engin. Trans., Brussels, Belgium, 1:292-304. 1960.

A knowledge of irrigation requirements based on consumptive use of water is essential in planning irrigation projects, farm irrigation system layouts, and for improving irrigation practices. Conservation of water supplies, as well as of soils, is of first importance in agricultural economy. In basin-wide investigations of water utilization and in water conservation surveys, valley consumptive water requirement is one of the most important factors to be considered. Engineers and other technicians have expressed an urgent need for information on irrigation requirements in connection with farm planning programs for areas where few data are available.

This paper presents the results of measurements of consumptive use for different irrigated crops. A formula is developed for computing monthly consumptive use from climatological data, when measurements are not available. Determining irrigation requirements from consumptive use rates and irrigation efficiencies are illustrated by examples of computations for several crops.

Disregarding the unmeasured factors, consumptive use varies with the temperature, daytime hours, and available moisture (precipitation, irrigation water, or natural ground water). By multiplying the mean monthly temperature (t) by the monthly percent of daytime hours of the year (p), there is obtained a monthly consumptive use factor (f). It is assumed that the consumptive use varies directly as this factor when an ample water supply is available. Expressed mathematically,

$U = KF$ = sum of Rf where

- U = Consumptive use (or evapotranspiration) in inches for any period.
- F = Sum of the monthly consumptive-use factors for the period (sum of the products of mean monthly temperature and monthly percent of daytime hours of the year).
- K = Empirical consumptive-use coefficient (growing period).
- t = Mean monthly temperature, in degrees Fahrenheit.
- p = Monthly percent of daytime hours of the year.
- $f = \frac{x}{100}$ = monthly consumptive-use factor.
- k = Monthly consumptive-use coefficient.

$u = Rf$ = monthly consumptive-use in inches.

The consumptive-use factor (F) for any period may be computed for areas for which monthly temperature records are available. Then by knowing the consumptive-use coefficient (K) for a particular plant in some locality, an estimate of the use by the same vegetation in some other area may be made by application of the formula $U = KF$.

Consumptive-use coefficients (K) have been computed by the formula $K = U/F$ for important irrigated crops. The resulting coefficients, believed to be suitable for normal conditions, are presented in table form in the article. In areas where data are available, the farm planner or technican can compute coefficients to fit local conditions.

SWCRD, ARS, USDA, Los Angeles, Calif.

Kroth, E. M., Jamison, V. C., and Grogger, H. E. SOIL MOISTURE SURVEY OF SOME REPRESENTATIVE MISSOURI SOIL TYPES. U.S.D.A., A.R.S. 41-34, 57 pp. 1960.

Knowledge of the amount of water retained by a soil that is usable for growing plants is of value to farmers, designers of irrigation systems, and a wide range of researchers interested in plant-soil relationships. The concept of available water capacity was developed in connection with the irrigated soils of western United States, and the method for its determination was worked out by research personnel in that area. As irrigation

increased in the humid sections of the United States, interest in the determination of available water-holding capacity of soils capable of being irrigated during periods of drought has developed.

An available water-holding capacity survey was begun in 1955 for the major soil types of Missouri. A technical soil description of each soil type is given along with the chemical analysis, mechanical analysis, and the available water per inch for each horizon of each soil type.

ARS, USDA, Inform. Div., Washington 25, D. C.

Shaw, R. H., Barger, G. L., and Dale, R. F. PRECIPITATION PROBABILITIES IN THE NORTH CENTRAL STATES. Mo. Agr. Expt. Sta. B. 753 (North Central Reg. P. No. 115) 72 pp. 1960.

The analysis of precipitation probabilities in a large area such as the North Central Region of the United States requires the handling of a large volume of data.

It was decided to use the 54-year period from March, 1901, through February, 1955, as the length of record. At some stations this length was not attainable; at others, a longer record was available and was sometimes used to increase the length of record or to substitute for missing years. The maximum length record used was 61 years, the minimum 25, but only 10 stations had less than 40 years of record, and only four had greater than 55 years.

A network of approximately 10 stations in most states was believed to be adequate for regional analysis. The total number analyzed was 125 for the 12 states.

Two alternatives for determining probabilities were considered: (1) Computing the probabilities directly from the tabulated frequencies; and (2) fitting a mathematical function to these tabulations and computing the probabilities from this function.

It was believed that the latter method would produce more accurate probabilities by bringing all the observed amounts into play and removing class interval bias resulting from observing and tabulating practices. The method of analysis selected involved the fitting of the incomplete gamma distribution to precipitation totals.

In selecting the length of period to be used, there was considerable interest in a short period, such as 3 days. However, the distribution used does not adequately fit such periods, and precipitation totals for 1-, 2-, and 3-week periods starting every week of the year were selected as those to be analyzed. The precipitation levels for which probabilities have been computed are: none or trace, at least 0.02, 0.06, 0.1, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0, 2.4, 2.8, 3.2, 4.0, 6.0, 8.0, and 10.0 inches.

U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

Gerard, C. J., Burleson, C. A., Bloodworth, M. E., Cowley, W. R., and Biggar, J. W. EFFECT OF IRRIGATION WATER QUALITY AND SOIL AMENDMENTS ON CROP YIELDS AND PHYSICO-CHEMICAL PROPERTIES OF THE SOIL. Tex. Agr. Expt. Sta. MP-441, 17 pp. 1960.

An experiment was initiated in October 1954 at the Lower Rio Grande Valley Experiment Station, Weslaco, Texas, to study the effects of water quality and amendment treatments on yields of cotton and vegetables over a 4-year period.

Yield data indicated that poor quality water with good management can be used to supplement low supplies of good quality water on soils such as Willacy fsl. Because poor quality water causes a deterioration of soil structure and usually decreases yields of salt-sensitive crops, water of questionable quality should be used with discretion and caution.

In a rotation of cotton, lettuce, and cabbage, cotton yields were not significantly reduced by poor quality well water, but the lettuce and cabbage yields were significantly reduced.

A cropping system of continuous cotton and lettuce (or cabbage) caused marked reduction in cotton yields, where both good and poor quality water were used. It seems imperative that soil-improving crops should be grown periodically on soils such as Willacy fsl to maintain their productivity.

Well water caused accumulation of salts and exchangeable soluble sodium in the soil. Salt accumulations were investigated and noted to a depth of 5 feet.

Amendments did modify the physical and chemical properties of the Willacy fsl. Amendments influenced soil crusting and exchangeable and soluble cations in the soil. However, sulfur, krilium, and gypsum failed to offset the influence of well water on lettuce and cabbage yields. This is probably because lettuce and cabbage are salt-sensitive crops. Amendments did not appreciably influence salt accumulations in the soil irrigated with well water.

Modulus of rupture, an index of crusting, was positively correlated with exchangeable sodium. Well water, which increased the exchangeable sodium in the soil, increased soil crusting and hardness and usually decreased the infiltration of water into the soil.

The relationships between estimated sodium percentages and exchangeable sodium percentages of the soil are discussed. The estimated sodium percentages are calculated by the formula proposed by U.S. Salinity Laboratory, Riverside, California. The applicability of this formula seems to vary with soil depth and climatic conditions.

Tex. Agr. Expt. Sta., College Station, Tex.

Peele, T. C., Webb, H. J., and Bullock, J. F. CHEMICAL COMPOSITION OF IRRIGATION WATERS IN THE SOUTH CAROLINA COASTAL PLAIN AND EFFECTS OF CHLORIDES IN IRRIGATION WATER ON THE QUALITY OF FLUE-CURED TOBACCO. Agron. J. 52: 464-467. 1960.

Chemical analyses of water from 146 excavated ponds, 38 impounded ponds, 37 wells, and 18 streams used or available for irrigating tobacco were made in 1955. The average values of the constituents found in water samples from the excavated ponds in parts per million were chloride 12, sulfate 5, sodium 9, potassium 2, calcium 6, and magnesium 1. The composition of the water from impounded ponds and streams was about the same as from the excavated ponds while the deep wells contained less chloride and more calcium and sodium. Investigations of the effects of irrigating tobacco with water containing 5, 25, 75, and 225 p.p.m. chloride showed increases in percent chloride over the unirrigated tobacco of--0.02, 0.10, 0.32, and 0.76%, respectively, in 1955 and 0.06, 0.21, 0.36, and 0.88% in 1956. The chlorine content of the tobacco increased 0.009% for each pound of chlorine added by the irrigation water based on all treatments for the 2-year period. The tobacco received 2 irrigations each year, but slightly more water was applied per irrigation in 1956. Reducing sugars in the tobacco increased as the chloride content increased. No significant differences in nicotine content of the tobacco were found by additions of different amounts of chloride to the irrigation water, but it was lower in all tobacco from irrigated plots than from the unirrigated ones. The commercial value was not affected significantly by the chloride content of the irrigation water, but tests indicated tobacco irrigated with water containing 225 p.p.m. chloride had poorer smoking quality.

S.C. Agr. Expt. Sta., Clemson, S.C.

Hall, W. A. DESIGN OF IRRIGATION BORDER CHECKS. Agr. Engin. 41: 439-442. 1960.

A method for designing a border irrigation system for maximum application efficiency is proposed. The method uses the infiltration characteristics of the soil and the predicted advance of the wetting front down the check. A sufficiently wide range of discharge rates should be used to give a broad picture and to insure that all points of interest will be included.

The procedure permits selection of the optimum border length. It also permits selection of the optimum rate of discharge and the optimum depth of application when the border length is determined. It permits calculation of the probable application efficiency.

When none of the solutions obtained, using most probable values of slope, roughness and unevenness (puddle factor) are acceptable, calculations may be repeated to predict these values of these parameters which might give a more satisfactory solution.

All of the values obtained are limited by other factors not considered here, such as erosion control, salinity control, drainage problems, etc. The solution accepted must be within these limits.

U. Calif., Los Angeles, Calif.

Lauritzen, C. W. LAY-FLAT TUBING: A PROMISING IRRIGATION DEVELOPMENT. Farm and Home Sci. 18: 68-70. 1957.

Tests with lay-flat tubing for conveying and distributing water were begun at Logan about ten years ago. The name, lay-flat, is used to designate a tubing which lies flat when empty. Materials used in the construction of this tubing have included canvas, supported and unsupported plastic fabrics, and now butyl. When used to convey water, lay-flat tubing assumes a rounded shape, the degree of roundness depending on the internal pressure. A hydrostatic head of about four pipe diameters is necessary to give the tubing a fully round cross section.

Most of the tubings on the market have not been entirely satisfactory; and because of this, lay-flat tubing has not been used extensively for conveying and distributing irrigation water. The two factors primarily responsible for this slow acceptance have been the poor durability and the lack of convenient coupling and diversion devices. Better durability of polyethylene and vinyl film has been achieved through the addition of pigments and the use of different plasticizers, antioxidants, and sterilants in the case of vinyl. Recently, a method was devised for what appears to be good polyethylene nylon laminate, and a lay-flat tubing fabricated from butyl is now commercially available.

Studies indicate that butyl is extremely durable and lay-flat tubing fabricated from butyl should give good service. Butyl is a synthetic rubber, the same material from which inner tubes are made. Characteristic of rubber is its ability to stretch and its recovery properties. Unsupported butyl sheeting can be used successfully for conveying water at low pressures. If tubing is to be used for conveying water at high pressures, it will be necessary to have a supported structure, whether the tubing is of the butyl, vinyl, or polyethylene type. Many kinds of supporting fabrics may be used. One of the best of these, because of its high strength, is nylon. Another that has possibilities is fiberglass. Both of these, together with several other types of materials, have been used in the fabrication of experimental structures. Supporting materials, such as nylon, in addition to increasing the strength of the structure, increase its resistance to snagging and abrasion.

There is a possibility that lay-flat tubing eventually may be used as a substitute for aluminum pipe in laterals, or even main lines, in sprinkling systems. In this event, high strength material would have to be used. There are some advantages to the use of lay-flat tubing for sprinkler laterals. If moved by reeling, they would save labor. Much work, however, remains to be done before such possibilities become practical.

Utah State U., Col. Agr., Agr. Expt. Sta., Logan, Utah.

Willardson, L. S. IRRIGATION FOR MARSHLANDS. International Comn. Irrig. and Drain. 4th Congress. Madrid, Spain. Quest. 11: 139-144. 1960.

The existence of swampy or waterlogged areas indicates a close balance between the water supply and the water needs of the area. Extreme excesses of water cause lakes to be formed instead of marshes. Some irrigation water supply scheme must be included in the reclamation plan to replace that removed from the area by drainage. Irrigation water may be provided by pumping ground water, sub-irrigation, pumping from drains, or storage upstream of the water causing the problem. Some methods of providing water for the area may also eliminate the drainage problem.

SWCRD, ARS, USDA, Logan, Utah.

Dragon, P. F. EVERYTHING IN THE WATER. Irrig. Engin. and Maintenance 10(6): 23-24. 1960.

Feeding plants through irrigation water has helped the farmer raise his crop yields per acre to figures unattainable 10 years ago. In the near future, soluble chemicals in irrigation water will regulate plant growth, exterminate insects, destroy plant fungi, kill weeds, and suppress plant diseases.

There are three periods to a ferti-irrigation lateral line set. Water in the first part, fertilizer in the middle, water at the end. The correct size fertilizer injector is determined by two things (1) the amount of fertilizer to be applied on a per acre basis, and (2) the header pipe line size. The applicator must be charged with the correct amount of

fertilizer for each lateral line set on a per acre basis. There is no corrosion problem because the fertilizer concentration is only in the applicator--not in the pipe lines.

The adjustable streamlined venturi is located in the main line to avoid moving the fertilizer injector. If the main pipe line is portable, then the venturi is equipped with quick couplers, and this assembly is then used like any other length of aluminum pipe, whether fertilizing or irrigating. If the feeder line is made of steel, then it will only require about a half hour of field welding time to make the installation. The adjustable venturi is located away from all valves.

The mixing and injection is automatically done hydraulically, and the fertilizer does not leave the top of the applicator until it is in complete solution. Fertilizer injection can be seen through transparent hoses. Rate of injection can be dialed to any speed. Injection is done at a point of turbulence.

Most fertilizer companies are manufacturing a complete line of water soluble plant food. Dry fertilizers are only effective when in solution at the feeder root zone. The following are being injected: dry solubles, liquid formulas, fish oil, pesticides, soil amendments and some small pasture seeds. Fertilizers are generally applied throughout the growing season.

Applying fertilizers through a sprinkler irrigation system gives full control as to timing and depth of injection. The adjustable streamlined venturi makes it possible to adjust to particular g.p.m. and psi. Testing various fertilizers and quantities becomes very simple on different lateral line sets. The fertilizer injection period can be so regulated on sandy soils as to prevent leaching beyond the root zone. Uneven application of irrigation water by means other than sprinkling may leach fertilizer out of the root zone, resulting in a substantial loss. In addition, sprinkler fertilization provides better timing of application of both water and fertilizer to achieve greater production of higher quality crops.

Dragon Engin. Co., Oakland, Calif.

Thomas, C. W. WORLD PRACTICES IN WATER MEASUREMENT AT TURNOUTS. J. Irrig. and Drain. Div., ASCE 86 (IR 2): 29-54. June 1960.

Measuring devices at farm turnouts on open channel irrigation systems are discussed under six general functional classifications. Illustrations of each classification in use in different parts of the world are cited. Conclusions regarding the type of device best suited to meet local requirements are not drawn. However, by directing attention to the different techniques followed, a design incorporating the desirable elements of several of these techniques might eventually be developed.

Bur. Reclam., U.S. Dept. Interior, Denver, Colo.

van't Woudt, B. D. RECENT DEVELOPMENTS IN BOOM SPRINKLER IRRIGATION. International Commission on Irrig. and Drain. 4th Congress, Quest. 12, pp. 463-471. 1958.

The weaknesses of conventional sprinkler irrigation, utilizing rotating sprinklers are: (1) A circular distribution pattern, leading to inefficient overlap of adjacent circles; and (2) distortion of the ideal distribution pattern by wind thrust, leading to uneven water distribution within the circle covered.

To overcome the first objection, a square-pattern boom sprinkler has been developed in Hawaii. This type of sprinkler is still experimental and all the difficulties have not yet been ironed out.

To overcome the second objection, advances have been made by the introduction of long boom (cantilevered) arms with nozzles placed along these arms.

Simultaneously, plot irrigators have been developed by which water is dropped vertically from a boom arm attached to a machine straddling along a track. The same principle has been applied to some commercial units. A description is given of the implications of this machine for large-scale use. Some hydraulic and mechanical problems remain to be solved.

U. Hawaii, Honolulu, Hawaii.

Drainage

Myers, V. I. PROCEDURES FOR EVALUATING DRAINAGE PROJECT FEASIBILITY. International Comn. Irrig. and Drain. 4th Cong. Madrid, Spain, Question 11: 17-32. 1960.

A number of unsatisfactory drainage projects throughout a wide area have been due to lack of sound understanding of soils, engineering design, or poor maintenance. In many areas, promoters failed to take into consideration the economics of farm development after drainage was completed. Successful agricultural drainage in the United States has reclaimed millions of acres and increased their productivity.

In planning the drainage phase of irrigation projects, the following should be considered: (1) Determination of the drainage requirements of soils and plants; (2) interpretation of soil characteristics, physical land features, and agronomic factors in terms of drainage requirements; (3) determination of the measures that are necessary to achieve the drainage requirements; and (4) translation of the drainage measures into economic considerations.

The Lahontan Irrigation Project, which lies in the vicinity of Fallon, Nevada, is an example of where the four main considerations described in this paper are being used as a framework from which to determine project drainage feasibility.

On the basis of soil surveys, geologic studies, and other available information, drainage groups of soils have been established that serve as a basis for conducting detailed technical and economic studies.

The most important consideration in grouping the soils is the manner in which the soil was formed. A number of other soil factors and drainage characteristics also help to determine the grouping of soils. From an economic standpoint, the most important characteristic is the inherent productivity of the soils.

In the drainage studies, two or three farms were selected as being representatives of each drainage group. Extensive engineering and soils data were collected on each of the farms to serve as a basis for irrigation and drainage recommendations and for conducting economic studies.

SWCRD, ARS, USDA, Reno, Nev.

Groves, E. R. THEIR FINDING NEW CHEAP DRAINAGE METHOD. Ohio Farm. 225: 12. June 18, 1960.

One of the newest ideas for lowering the cost of draining farm land is an invention of Date and Floyd Summers, two dairy farmers of Trumball Co., Ohio.

The machine is being patented. Stated simply it places a strip of slag or gravel in the soil below plow level, with use of a subsoiler that has been remodeled.

It is not a system that will replace standard drain tile. It will be valuable to drain corners too short for a tiling machine; for occasional low spots between tile lines; and for places that need some help during the wettest part of the year, where extensions of the tile system doesn't seem practical.

Ohio Farmer, Cleveland, Ohio.

Lutz, J. F. THE INTERRELATIONSHIPS OF SOIL PHYSICAL CONDITIONS AND DRAINAGE. N. C. Agr. Expt. Sta. Tech. B. 193, 27 pp. 1960.

There are approximately 7,600,000 acres of poorly drained land in eastern North Carolina. The drainage conditions of this acreage vary from swamp to only slightly poorly drained. Part of it is suitable for cultivation in dry seasons without artificial drainage, but in wet seasons poor crop yields result. By far the largest part of the acreage is unsuited for crop production without artifical drainage and much of it cannot be drained because of location or elevation.

A summary of the soils that need drainage before they are suitable for the growing of most common crops follows: upland soils--5,189,000 acres; stream terrace soils--150,000 acres; first bottom soils--210,000 acres; swamp--400,000 acres; tidal marsh--194,000 acres; organic soils (peat and muck)--1,500,000 acres; total--7,643,000 acres.

Approximately 850,000 acres have been artificially drained and are in cultivation. Drainage operations are under way practically all the time in certain sections of North Carolina and undoubtedly attempts are being made to drain many acres that probably will not become productive. An important problem in drainage of organic soils is the danger of destruction by fire once they are adequately drained. Furthermore, the physical properties of some mineral soils change quite drastically upon drainage and may become practically unfit for cultivation because of a poor physical condition.

To study the effects of drainage on certain soil properties and the effects of soil properties on drainage, experiments were started at several locations in 1946 and 1947. This paper reports on studies on the physical properties of the soils.

The objectives of the experiment, from the standpoint of soils are: (1) To evaluate certain soil factors affecting drainage; and (2) to evaluate the effects of various soil management and drainage practices on soil properties and on plant growth.

Agr. Expt. Sta., N.C. State Col., Raleigh, N.C.

Storage and Conveyance

Estes, H. N. A MULTI-PURPOSE DAM IN TENNESSEE FOR FLOOD PREVENTION AND FISH AND WILDLIFE DEVELOPMENT. Soil Conserv. 25: 247-248. 1960.

Floodwater retarding structure No. 4 in the Thompson Creek watershed will be the first such structure in Tennessee designed for both flood prevention and fish and wildlife benefits. It is the 34th such structure in the Nation built under provisions of Public Law 566, the Watershed Protection and Flood Prevention Act.

Thompson Creek watershed covers about 30 square miles in Weakley and Henry Counties, Tenn.

The State Commission negotiated with the local sponsoring organizations to join them as a sponsor. The structure was redesigned to serve the multiple-purpose use. The normal pool was increased from 56 acres to 184 acres. Total storage capacity was increased from 975 acre-feet to 2,423 acre-feet. The new capacity provides for 210 acre-feet of sediment storage, 890 acre-feet for flood water detention, and 1,323 acre-feet for water supply pool.

The multiple-purpose structure is estimated to cost $154,000. Estimated cost of the original structure planned was $76,000. The Federal Government and sponsors will share equally in the difference of $78,000. Under the approved cost-sharing arrangements for the multiple-purpose structure, the Government is furnishing $65,000 for construction cost and $28,000 for engineering services, amounting to a total cost of $93,000.

The Tennessee Game and Fish Commission has built a number of small lakes for fish and wildlife in Tennessee. The average cost per acre of surface area has been $700. This Thompson Creek Lake will cost them $332 an acre.

Asst. State Conserv., SCS, USDA, Nashville, Tenn.

Haushild, W., and Kruse, G. UNSTEADY FLOW OF GROUND WATER INTO A SURFACE RESERVOIR. J. Hydraul. Div., ASCE 86(HY 7): 13-20. July 1960.

Prediction of the water table position and the amount of water discharged where groundwater is flowing from an aquifer to a surface reservoir has not been exact. The nonlinear partial differential equation that describes the shape of the water table is difficult to solve.

Approximate solutions obtained by two different methods for the nonlinear equation are presented. Both approximate solutions agree better with experimental results than does the exact solution of the simplified linear equation for the flow.

U.S. Geol. Survey, U.S. Dept. Interior, Colo. State U., Fort Collins, Colo.

Blackburn, W. C. A REVIEW OF THE USE OF CHEMICAL SEALANTS FOR REDUCTION OF CANAL SEEPAGE LOSSES: LOWER-COST CANAL LINING PROGRAM. U.S.D.A. Bur. Reclam. Analy. Lab. Rpt. CH-102, 17 pp. Biblio. 1960.

The chemical soil sealants are materials which are applied to the canal subgrade where they react chemically to form solid of semisolid gels, deposit precipitates in the soil voids, or otherwise render the subgrade impervious to water. Various methods of application may be used such as surface spraying, subsurface injection, or addition of the chemicals to the canal water, the method selected depending upon the type of sealant used, and the environmental conditions existing at the application site.

This report: (1) Presents a brief historical review of typical investigative work performed in the field of chemical soil sealants; (2) discusses some of the types of chemical available and possible methods of application; (3) recommends future investigative work; and (4) provides a selected bibliography of literature pertaining to this subject.

Div. Engin. Lab., Bur. Reclam., USDA, Denver, Colo.

Glukhov, I. G. SEEPAGE OF WATER FROM CANALS IN LOESS FORMATIONS AND SUBSIDENCE PHENOMENA IN IRRIGATED AREAS. Gidrotekhnika i Melioratsiya 8(10): 9-18. (Translated from Russian PST Cat. 137, OTS. 60-21152.)

When canals are constructed in loess formations--in loess soils and loess-like loams--subsidence phenomena often occur, whose remedy entails considerable expenditure. Subsidence, combined with mechanical piping in loess soils, is a grave and dangerous phenomenon, which owing to its suddenness and consequences, resembles local earthquakes.

In a study of this problem the author concluded:

1. Wetting in the vicinity of canals takes place throughout the thickness of the loess formation, down to ground water level (capillary zone) and, as proved by experiments is a function mainly of the time when water is let into the canal.
2. Gravitational waters (above 15%) moves almost vertically, spreading sideways, in most cases, up to 4 m (157.5 in.) from the water line of the canal.
3. To wet loess formations so as to eliminate subsidence below hydraulic structures (canals, pumping stations, etc.), a sufficient quantity of water is needed to wet the ground to its full saturation capacity, or as experiments have shown a quantity 1.4 times greater than the maximum molecular moisture capacity.
4. Laboratory experiments with loess soils of the third and fourth flood terraces of the Vakhsha River (Ak-Gaza Canal) have demonstrated, that it is practically impossible to obtain complete moisture saturation, as, owing to trapped air in the pores, only 70% of the pores can be filled with water.
5. The low natural moisture content of loess soils of the Vakhsha River is not a sign of subsiding grounds. Loess on different sites may show an identical moisture content, and yet have different unit weights: e.g. a moisture content of 5%, and a unit weight of 1.25 or 1.50. In the first instance the ground is susceptible to subsidence, whereas in the second it was so in the past, as judged from geological conditions, but has subsequently consolidated, and under the influence of wetting and the hot climate, has acquired "primary" moisture content.
6. In the wetting zone of canals the infiltrating water may exist in a capillary state, so that galleries under canals may encounter wet ground and not a ground-water table.
7. In the planning of new irrigation areas on loess soils it is indispensable to take into account the phenomena of subsidence. The area should be irrigated before cropping so that the land will have a chance to subside.

$0.50. Off. Tech. Serv., U.S. Dept. Commerce, Washington 25, D.C.

Soil Structure

Trollope, D. H., and Chan, C. K. SOIL STRUCTURE AND THE STEP-STRAIN PHENOMENON. Soil Mech. and Found. Div., ASCE 86 (SM 2): 1-39. Apr. 1960.

On the basis of the soil structure hypothesis presented, it has been postulated that a composite soil can be represented as coarse (sand, silt) grains distributed at random in a colloidal (clay) matrix.

When such a soil is subjected to sufficiently high shear stresses a yield condition is first developed in the colloidal matrix. This condition of matrix yield is achieved when the applied shear stresses are sufficient to force the colloid particles into such a position that they tend to be oriented parallel to one another and in the direction of the potential failure surface. Subsequently, it is thought that the coarser grains migrate in such a way that additional shear resistance, in the form of intergranular friction, is developed in the zone of potential failure. Ultimately, complete shear failure will occur when the maximum possible intergranular friction is developed in addition to the yield strength of the matrix. This mechanism is put forward as an explanation of the phenomenon of step-strain behavior which has been observed in the laboratory. Tests on Wyoming bentonite have shown what may be described as typical matric characteristics whereas similar t tests on Vicksburg sic indicate typical matrix behavior in the initial stages followed by the development of step-strain characteristics.

The term step-strain has been introduced because the phenomenon shows up as a series of steps in the stress-strain diagram and also as a step in deformation time studies of the soil concerned.

The appearance of step-strain behavior is considered to be dependent on the structural order (sensitivity) of the matrix. If, at yield, the matrix loses more strength, due to local remolding, than can be replaced by developed intergranular friction, then clearly the maximum strength of the soil is a function only of the matrix yield strength.

It is further suggested that because of a possible similarity of basic mechanisms entailed in relative translation of both course and fine grained particles, the shear strength of a soil may be described as:

shear strength = colloidal friction + intergranular friction

The study of these aspects of soil structure led to the conclusion that the nature of the matrix would have a considerable influence of the creep behavior of a soil and also on its response to repeated loading.

Tests have tended to show that whereas a soil which exhibits step-strain characteristics is liable to develop lower strengths under long term loading, then in normal unconfined compression tests (creep-strength loss), a soil that develops its strength only from the matrix does not show a similar loss. Furthermore, soils exhibiting step-strain characteristics also show much greater deformation under repeated loads.

The importance of rate and sequence of loading on the ultimate strength measured under conditions of no over-all volume change was demonstrated. Tests have tended to show that if subfailure loads are applied to a soil specimen, under these loads the shear resistance of the soil increases with time. This has been attributed to improvement in the colloidal structure and to the associated dissipation of pore pressures in the potential failure zone.

Many factors influence the strength and deformation characteristics of soils when stressed at constant volume. The conclusion of greatest practical significance, however, is that the variation in ultimate strength of a given clay-type soil, under differing stress conditions, is largely determined by the characteristics of the colloid fraction of the soil.

U. Melbourne, Melbourne, Australia.

Zur, B., and Reed, L. W. AGGREGATE STABILITY AND OTHER PROPERTIES OF A KIRKLAND SILT LOAM SOIL. Okla. State U. Expt. Sta. Processed Ser. P-346, 13 pp. 1960.

Aggregate stability, particle size distribution, percolation rate, cation exchange capacity, organic matter, nitrogen, and exchangeable cations were determined on a Kirkland sil soil from continuous grass and continuous cotton plots. The chemical and mechanical properties of the aggregate changed with decrease in size of the aggregates and were markedly different from the whole soil. Manure at the rate of five tons per acre every three years was not effective in maintaining aggregate stability, water percolation rate, organic matter, or total nitrogen.

Continuous cultivation of soils, and cultivation plus organic matter addition, with no attempt to maintain soil fertility, results in greatly reduced structural stability and decrease in soil organic matter and nitrogen. Whether the stability and organic matter content of aggregates of the soil is due to organic matter or other factors cannot be concluded from this study; however, cultivation without organic matter or fertility maintenance does reduce markedly the amount and stability of aggregates.

Okla. State U. Expt. Sta., Stillwater, Okla.

Flocker, J., and Menary, R. C. SOME PHYSIOLOGICAL RESPONSES IN TWO TOMATO VARIETIES ASSOCIATED WITH LEVELS OF SOIL BULK DENSITY. Hilgardia 30: 101-121. 1960.

It is generally accepted that high soil densities restrict plant growth but the physiological reasons are not entirely known. Some quantitative data are given in an endeavor to define soil compaction in terms of plant composition and growth.

Increased time of emergence was the first observable symptom of decreased plant vigor in tomato seedlings grown at high soil densities. Average day of emergence at soil density 1.7 was one day longer than at density 1.4. The average air space at this level of density was 7 percent. The data indicate that soil air spaces below 7 percent were inhibitory to rate of emergence of tomato seedlings.

Height, bud count, fruit number, fruit weight, and dry weight of tomato plants varied with changes in the densities of the soil medium. Plant height nine weeks after planting was 50 percent less at soil density 1.1 than at 1.7. Bud counts at the same stage of growth showed that plants grown at densities of 1.4 and 1.1 were respectively three and four times greater than the count at density 1.7. Nineteen weeks after planting day, fruit number and fresh-fruit weight still gave the same trend as indicated above for plant height. Maximum root development was restricted to the top inch of the soil for those plants growing in pots compacted to a density of 1.7. A soil density of 1.4 was sufficient to restrict lateral root development in the 4-to-6-inch soil layer.

Anthocyanin accumulation occurred in the leaves and stems of tomatoes grown at soil densities 1.7 and 1.4. This phenomenon became less apparent ten weeks after planting. Sugar and protein analyses of the young leaves and stems show that high protein and low sugar content are characteristic of tomatoes grown on compacted soils.

At soil density level of 1.1, absorption of Ca^{45} fertilizer by young tomato plants (nine weeks) was not increased by increasing soil applications from 30 to 60 p.p.m.

Fertilizer application of 30 and 60 p.p.m. Ca^{45} significantly increased total calcium per shoot nine weeks after planting. This effect was not apparent nineteen weeks after planting.

Maximum calcium absorption (mg/plant) and percentage of Ca^{45} derived from applied Ca^{45} fertilizer occurred at density 1.4. Doubling the application rate of Ca^{45} fertilizer from 30 to 60 p.p.m. generally doubled the percentage of Ca^{45} that was absorbed by the plant.

Ca^{45} fertilizer applications of 30 and 60 p.p.m. decreased phosphorus absorption (p.p.m.) by tomatoes grown at densities 1.1 and 1.4, respectively. Sixty p.p.m. of Ca^{45} applied to the soil at density 1.7 reduced the total amount of phosphorus absorbed by the plant. Lack of phosphorus absorption was probably a factor contributing to the sharp decrease in dry weight and fruit number at that soil density.

Ca^{45} fertilizer applied at 30 and 60 p.p.m. increased magnesium uptake of young tomatoes about 100 percent above that where no Ca^{45} was applied to the soil. Chemical

analysis of tomato shoots nineteen weeks after planting showed that the effects produced by increasing the level of soil density constituted a more important factor in determining magnesium uptake than the rate of Ca^{45} fertilizer application. This lack of absorption of magnesium at soil density 1.7 was probably due to the inadequate distribution of roots throughout the depth of soil. The nine-week period was apparently not long enough for this root condition to show its effect on the nutrient status of the plant.

Some varietal characteristics were noted during this investigation. Tomato variety Sutton's Best of All initiated 100 percent more flower buds than did variety Pearson after nine weeks' growth. After nineteen weeks' growth, Sutton's Best of All (SBA) outyielded Pearson, in number and weight of fruit, by about 100 percent. Total dry weight and moisture content of shoots were about 16 to 20 percent higher for SBA than for Pearson. SBA tissue contained about 1,800 p.p.m. (dry weight) more calcium than did Pearson tissue. Total uptake of calcium by SBA shoots exceeded that of Pearson shoots by about 80 mg. per plant.

Although the percentage of phosphorus in plant tissue was highest for variety Pearson, total uptake was the same for each variety. Apparently, each variety has about the same ability to absorb phosphorus from the soil. Effects of increased soil density decreased phosphorus absorption by the tomato plant.

Magnesium followed the same trend as calcium. Variety SBA had about 2,000 p.p.m. (dry weight) more magnesium than did Pearson. Total uptake of magnesium by SBA exceeded that of Pearson by about 90 mg. per plant. The rootstocks of SBA tended to increase the magnesium and calcium content of Pearson scions. Pearson rootstocks had the opposite effect on SBA scions.

U. Calif., Berkeley, Calif.

Ram, D. N., and Zwerman, P. J. INFLUENCE OF MANAGEMENT SYSTEMS AND COVER CROPS ON SOIL PHYSICAL CONDITIONS. Agron. J. 52: 473-476. 1960.

Effects of five different treatments on water stability of aggregates, bulk density, and soil moisture were studied on Honeoye sil at Marcellus, New York. The five treatments under an intensive vegetable rotation included two check treatments and three with cover crops, two of which included woodchips as a carrier in organic amendment. Also included on a subplot basis were two levels of fertilization, one-fourth recommended and recommended plus additional nitrogen.

Domestic rye grass was used as the cover crop. Additional woodchips with rye grass maintained the water stability of aggregates. Combination of the two was more effective than cover crops alone. The degree of water stability of aggregates was positively correlated with the soil organic matter content.

The water stability of aggregates was lowest in August under the cover crop and the checks, but it was highest at this time under cover crop plus woodchip treatments. Macro-aggregates were subject to more seasonal variations than micro-aggregates.

Heavy fertilization tended to decrease the water stability of macro-aggregates and increase the proportion of stable micro-aggregates.

The bulk density of the soil was positively correlated with the water stability of aggregates. It was also influenced by the tillage and climatic factors.

Moisture content of the soil on a weight basis was related to season.

Cornell U., Ithaca, N.Y.

Soil-Water-Relationships

Beetle, A. A. AGRICULTURAL PROBLEMS IN ARID AND SEMIARID ENVIRONMENTS. Wyo. Agr. Expt. Sta. B. 367, 64 pp. 1960.

A symposium held before the thirty-fifth annual meeting of the Southwestern and Rocky Mountain Division of the American Association for the Advancement of Science and the thirtieth annual meeting of the Colorado-Wyoming Academy of Science, May 6-7, 1959. University of Wyoming, Laramie, Wyoming. The following papers were presented.

Dregne, H. E. SOIL PROBLEMS IN IRRIGATED AGRICULTURE. N. Mex. State U. State College, N. Mex.

Klages, K. H. CROP ADAPTATION IN RELATION TO THE ECONOMIC USE OF WATER. U. Idaho, Moscow, Idaho.

Heerwagen, A. RANGE ECOLOGY APPLIED TO THE ARID LANDS OF THE SOUTHWESTERN UNITED STATES. SCS, USDA, 321 New Customhouse, Denver, Colo.

Myers, L. E. CONSERVATION OF IRRIGATION WATER SUPPLIES IN ARID CLIMATES. Southwest Water Conservation Lab., SWCRD, ARS, USDA, Tempe, Ariz.

Robertson, D. W. PROBLEMS IN GENETICS AND BREEDING IN THE SOUTHWEST. Colo. State U., Fort Collins, Colo.

Allen, R. W. SOME ECOLOGICAL ASPECTS OF INTERNAL PARASITISM IN ARID ENVIRONMENTS. ADP, ARS, USDA, State Expt. Sta., University Park, New Mex.

Streets, R. B. EFFECT OF A SEMIARID ENVIRONMENT ON PLANT DISEASES U. Ariz., Tuscon, Ariz.

Fletcher, J. E. SUMMARY REMARKS. SWCRD, ARS, Boise, Idaho.

U. Wyo., Laramie, Wyo.

Blake, G. R., Allred, E. R., van Bavel, C. H. M., and Whisler, F. D. AGRICULTURAL DROUGHT AND MOISTURE EXCESSES IN MINNESOTA. Minn. Agr. Expt. Sta. Tech. B. 235, 36 pp. 1960.

This study predicts drought probability, i.e., the number of days per month or season that rainfall is insufficient to supply the needs of growing plants after available soil moisture is depleted for Minnesota. The data are based on a statistical study of past amount and distribution of rainfall at 22 stations. Fundamental information is given on average monthly evapotranspiration at some stations. There is also a summary of the amount of precipitation in excess of plant needs and of the ability of soils to store it.

Information of this nature is basic to water planning for both agricultural and urban uses. In agriculture, for example, it can serve as a guide in problems of irrigation need and in the disposal of excess water.

Charts, tables, and graphs.

SWCRD, ARS, USDA, and U. Minn., St. Paul, Minn.

Parks, W. L., and Knetsch, J. L. UTILIZING DROUGHT-DAYS IN EVALUATING IRRIGATION AND FERTILITY RESPONSE STUDIES. Soil Sci. Soc. Amer. Proc. 24: 289-293. 1960.

It is expected that a crop grown during a year of insufficient moisture will economically require less fertilizer than a similar crop grown with an ample supply of moisture. Likewise, crop response to supplemental irrigation would be greater during a year of low rainfall than during a year of adequate rainfall.

The moisture deficiencies may be expressed as "drought-days" for any specific soil-crop-fertility situation. Incorporating "drought-days" as a production function to characterize the factor-product relationship as shown in the general equation below permits an evaluation of the effects of drought on yield and on the interactions with other variables such as fertility.

$$Y = b_o + b_1 N + b_2 N^2 + b_3 D + b_4 D^2 + b_5 ND$$

Where Y = yield, N = pounds of nitrogen per acre and D = drought-days or drought index.

A history of drought conditions for an area may then be used to obtain probabilities of the frequency of occurrence of varying degrees of drought and consequently the effect on yield outcome. This permits the presentation of yield outcome in terms of risks for various inputs rather than as single valued outcomes.

Irrigation may be expected to reduce the number of drought-days encountered in any cropping situation. Expressing crop yields as a function of drought-days and fertility level permits the evaluation of irrigation on yield and subsequent crop income. Combining this with the probabilities for drought occurrence provides a means for determining the expected irrigation response in an area and attaching probability statements relative to such a response.

U. Tenn. Agr. Expt. Sta., Knoxville, Tenn.

van Bavel, C. H. M. USE OF CLIMATIC DATA IN GUIDING WATER MANAGEMENT OF THE FARM. In Amer. Assoc. For The Advancement of Sci., WATER AND AGRICULTURE, pp. 89-100. 1960.

A discussion of the decisions that must be made in farm water management and how climatic data can be used as a guide for these decisions.

SWCRD, ARS, USDA, Tempe, Ariz.

Willis, W. O. EVAPORATION FROM LAYERED SOILS IN THE PRESENCE OF A WATER TABLE. Soil Sci. Soc. Amer. Proc. 24: 239-242. 1960.

Evaporation from two-layered soil systems with varying depths to water table is described for steady-state conditions. The difference in evaporation rate from a system of fine-textured soil overlying a coarse soil compared to a homogeneous profile of fine-textured soil may be relatively small. A reversed condition of layers may have a large effect on evaporation rates.

It appears that for many practical purposes the presence of inhomogeneities may be of little consequence when the water table is relatively deep. It also appears that a weighted-average capillary conductivity curve might give satisfactory results in calculating estimated evaporation rates.

SWCRD, ARS, USDA, Mandan, N. Dak.

Nixon, P. R., and Lawless, G. P. TRANSLOCATION OF MOISTURE WITH TIME IN UNSATURATED SOIL PROFILES. J. Geophysical Res. 65: 655-661. 1960.

Downward translocation of moisture in soil profiles under various types of natural vegetation and a denuded plot was observed during a prolonged rainless period. Moisture determinations were made to 20-foot depths with a neutron-scattering moisture meter. The observations were made as part of a study of ground-water recharge by deep penetration of rain water. The significant magnitude that translocated moisture may reach is illustrated by data obtained in sand under brush cover. In this case, deeply translocated moisture was equal to 159 percent of evapotranspiration during the first rainless month. Approximately 31 percent of the moisture content of a 20-foot profile under a denuded plot was lost by downward movement from the first to the 240th day of a rainless period. The moisture content W of various soil layers under the plot varied with time T according to the relation $W = a\ T^{-b}$ (W is the moisture content of the soil layer, expressed as the equivalent depth of water in inches, and T is time in days since wetting. The Constants a and b are peculiar to the soil layer.)

SWCRD, ARS, USDA, Lompoc, Calif.

Reeve, R. C. THE TRANSMISSION OF WATER BY SOILS AS INFLUENCED BY CHEMICAL AND PHYSICAL PROPERTIES. 5th Int'l. Cong. Agr. Engin. Trans., Brussels, Belgium. 1: 21-32. 1960.

Data from investigators on this subject have been reviewed and the pertinent information evaluated. Hydraulic conductivity of soils is not constant. For a given soil the hydraulic conductivity may vary several hundredfold with time. An expotential relationship of the type $y = \frac{i}{b} \ln \frac{a}{t}$ (where, t = time after water first emerges from the soil column, y = hydraulic conductivity, i = driving force or gradient, and a and b are constants for

each soil) describes the change in hydraulic conductivity with time up to 30 or 40 hours. This time period is of importance in many irrigation and drainage processes.

The exchangeable sodium percentage of the soil and the electrolyte concentration of the water are the primary factors with which the hydraulic conductivity of a given soil varies. Hydraulic conductivity of soil can be expressed in terms of exchangeable sodium percentage as a function of time. Because both the exchangeable sodium percentage and electrolyte concentration of the water in the soil vary with the time--and space--dependent processes of leaching and cation exchange, hydraulic conductivity also varies with time and space. The rate at which hydraulic conductivity changes with time is related to the total specific surface of the soil. Thus it may be possible to obtain information on hydraulic conductivity of a large number of soils by critical examination of only a few.

The properties of flow that govern flow in the unsaturated state are affected similarly to those for the saturated case. The relationship between soil-water diffusivity has been quantitatively evaluated in terms of exchangeable sodium percentage of the soil and the electrolyte content of the water.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif.

Mathers, A. C., Viets, F. G., Jr., Jensen, M. E., and Sletten, W. H. RELATIONSHIP OF NITROGEN AND GRAIN SORGHUM YIELD UNDER THREE MOISTURE REGIMES. Agron. J. 52: 443-446. 1960.

A water-management-fertilizer experiment with grain sorghum was initiated on Pullman sicl in 1956. Since there were no yield response or significant differences in N uptake in 1956, a residual N study was conducted in 1957 to determine the disposition of applied N.

Soil samples were taken to a depth of 6 feet by 6-inch increments to 1 foot and by 1-foot increments from 1 to 6 feet deep before sorghum was planted in June 1957 and again in January 1958. Three replications of 3 moisture levels (preplant irrigation to 6 feet, medium moisture level, high moisture level) in all combinations with 4 fertilizer levels applied in 1956 (0, 60, 120, 240 pounds of N with 30 pounds of P_2O_5) were sampled. These samples were analyzed for nitrate and nitrifiable N.

Correlation values of nitrate N in the soil with grain or N yield were highest on the high moisture level treatments. These results indicate that, without irrigation, soil tests for N are limited in value for semiarid or arid areas.

The correlation coefficients of nitrate N with grain or N yield increase to the 3-foot depth on the medium moisture level and to the 4-foot depth on the high moisture level. Since over 30% of the nitrate used on these moisture levels was from the fourth foot, it is necessary to sample to 4 feet to predict yield from nitrate determinations.

Much lower correlations were obtained between nitrate plus nitrifiable N and grain or N yield than between nitrate N and grain or N yield. Near maximum yields were obtained from 140 pounds of nitrate or nitrate plus fertilizer N per acre.

SWCRD, ARS, USDA, Bushland, Tex.

van't Woudt, B. D. PARTICLE COATINGS AFFECTING THE WETTABILITY OF SOILS. J. Geophysical Res. 64(2): 263-267. 1959.

The fundamental principles underlying the process of wetting show that a reduction in the surface tension of a solid substance to be wetted reduces the wettability. Conversely a reduction in the surface tension of the applied liquid increases the wettability. The wetting of a soil, which exhibits water-repellency in an air-dry state, can sometimes be achieved by leaving water in contact with this soil. There is some evidence that this wetting is achieved by an interaction of the solid and the liquid phase, leading to a reduction in the surface tension of the liquid. The phenomenon of advancing and receding angle of contact had led to an hypothesis that the angle of contact changes as the soil wets up or dries out. Some evidence is presented which does not support such an assumption, as the angle of contact seems fixed at a moisture content just above air-dry. There is some evidence that under certain conditions an improvement in the base status of the soil may lead to improved wettability. Particle coatings by hydrophobic films are in some cases responsible for the observed water-repellency. There is some evidence that this

film is strongly adsorbed. No quantitative relationship could be detected between the characteristics of substances extracted by chloroform from a problem soil and the degree of unwettability of such a soil.

U. Hawaii, Honolulu, Hawaii.

Lime

Heddleson, M. R. ALUMINUM IN YOUR SOIL MAY INCREASE NEED FOR LIME. Crops and Soils 12(6): 9. 1960.

Aluminum in soils can cause an error in the lime requirement as determined by soil test. Farmers in northeastern Ohio have reported that lime "needs" indicated by laboratory tests were as much as 50 percent less than the amount of lime actually required for correcting the soil acidity.

Further testing showed that these soils contained large amounts of aluminum. It was of a type that could be extracted by acid solutions. Amounts of this "extractable aluminum" in Ohio soils ranged from traces up to as much as 8,000 pounds per acre, depending on the kind of soil and the chemical used for extraction.

Excess aluminum is related to liming in two ways. First, it can contribute to soil acidity, making acid soils more acid. Second, the aluminum is more soluble in the soil-water solution of acid soils and can be a factor contributing to poor plant growth.

Acid soils are caused by both hydrogen and aluminum ions. In most soils, the acidity is due largely to the hydrogen ions. But where the soil minerals are high in aluminum content, the aluminum gradually dissolves and enters the soil solution, thus contributing to the total acidity of the soil.

When lime is added to soils in which the acidity is due to aluminum ions, the positively-charged aluminum combines with the negatively-charged part of the water molecule-the hydroxyl ion-to form a solid mineral. This leaves the positively-charged part of the water molecule-the hydrogen ion-free to contribute to soil acidity. Thus, the neutralizing benefit from the liming material is smaller than expected, and the soil remains partly acid.

In order to accurately predict lime needs from a soil test, the test should measure not only the acidity due to hydrogen but also that due to aluminum.

Ohio State U., Columbus, Ohio.

Soil Chemistry

Olsen, R. A., Peech, M. THE SIGNIFICANCE OF THE SUSPENSION EFFECT IN THE UPTAKE OF CATIONS BY PLANTS FROM SOIL-WATER SYSTEMS. Soil Sci. Soc. Amer. Proc. 24: 257-261. 1960.

The significance of the suspension effect (greater cation concentration or activity in the soil suspension than in the equilibrium dialyzate) in determining the uptake of cations by plant roots was evaluated by comparing the rate of uptake of Rb^+ and Ca^{++} by excised roots of barley and mung beans from a suspension of clay or cation-exchange resin with that from the corresponding equilibrium dialyzate. Although the cation concentration of the clay or resin suspension greatly exceeded that of the corresponding equilibrium dialyzate, the rate of uptake of Rb^+ or Ca^{++} by the roots was found to be exactly the same from both the suspension and its equilibrium dialyzate.

The results of this study are at variance with the prediction of the contact-exchange theory but are in agreement with the deductions based on theoretical considerations of the consequences of the root surface or volume charge distribution. The significant conclusion that may be drawn, however, is that the composition of the soil solution or the equilibrium dialyzate should completely characterize the ionic environment of plant roots in soil-water systems.

Jr. Author, Cornell U., Ithaca, N. Y.

Cook, M. G., and Hutcheson, T. B., Jr. SOIL POTASSIUM REACTIONS AS RELATED TO CLAY MINERALOGY OF SELECTED KENTUCKY SOILS. Soil Sci. Soc. Amer. Proc. 24: 252-256. 1960.

Potassium fixation and release characteristics of selected Kentucky soils differing in apparent K-supplying power were studied and related to their clay mineralogy. The clay fractions of Heitt, Eden, and Maddox soils possessed greater amounts of illite than Maury, Bedford, and Tilsit soils; thus illite is most likely the seat of high K-supplying power. Soils of high K-supplying power to plants contained more exchangeable K than soils of indicated low to medium K-supplying power. Upon drying A, B, and C horizon samples of each soil, K generally tended to be fixed when the initial exchangeable K level was high (above about 0.5 me. per 100 g.) and to be released at a low exchangeable K level.

The vermiculite present in the clay fractions of the soils of indicated high K-supplying power was easily collapsed from 14Å. to 10Å. by K-saturation. The ease of contraction suggests that the interlayer charge is relatively large and that the predominant lattice charge is probably tetrahedral, being inherited from micaceous minerals. When collapse was restricted, weathering has been sufficiently severe to reduce the high lattice charge and/or hydroxy-Al groups in the interlayer position prevent collapse of the lattice structure.

Jr. Author, U. Ky., Lexington, Ky.

Vazhenin, I. G., and Kareseva, G. I. FORMS OF POTASSIUM IN THE SOIL AND POTASSIUM NUTRITION OF PLANTS. Soviet Soil Sci. 3: 272-281. Mar. 1959.

Potassium nutrition of plants was studied and the authors concluded:

1. All forms of soil potassium participate in the potassium nutrition of plants: intensively exchangeable, extensively exchangeable, and non-exchangeable. The less soluble the form of potassium, the more active the role of the plant itself in assimilating potassium.
2. The better the external conditions for the plant's development and growth, the greater the assimilative capacity (mobilizing capacity) of the plant: favorable media reaction, abundant water supply, abundant supply of air and nutritive elements, including potassium.
3. Under favorable nutritional conditions, plants are capable of assimilating a considerable quantity of soil potassium (non-exchangeable) from both sand and sandy loam soils, if there is a preponderance of primary potassium-bearing minerals (micas, feldspars) in the sand and silt fractions.
4. The abundant supplies of potassium in sierozems and chestnut soils are not only explained by the fact that they contain large amounts of exchangeable potassium, but also by the fact that the potassium-bearing minerals in their clay (colloidal) fraction (hydromicas, micas, and spars) are easily soluble and assimilated.
5. To study the composition and state of potassium-bearing minerals in the soil and their fertility characteristics as related to potassium, it is desirable not only to determine its available forms, but also its slightly-available forms by using acid extracts.

Amer. Inst. of Biol. Sci., 2000 P. St., N.W., Washington 6, D.C.

Williams, M. C. EFFECT OF SODIUM AND POTASSIUM SALTS ON GROWTH AND OXALATE CONTENT OF HALOGETON. Plant Physiology 35(4): 500-505. 1960.

Halogeton absorbed large quantities of Na. This element may be absorbed as a number of salt forms, but NaCl appears to be the principal salt absorbed in the desert. The leaves of both desert and greenhouse plants contained a maximum of 6.1 to 7.8 me Na (dry weight basis) during the growing season. Under natural conditions, the major portion of the Na absorbed is metabolized as sodium oxalate.

Halogeton which received no added Na in its nutrition exhibited poor growth and vigor. Leaf oxalate content, growth, and succulence were greatly increased when Na as NaCl was added to the basic solution.

Halogeton which received no added Na substituted K in concentration in the leaves. When Na was available in at least 0.001 N concentration, the plant absorbed more of this cation than K. Potassium did not completely substitute for Na in promoting growth and vigor or in the formation of soluble oxalates.

Plants which were grown in Na alone were slightly more vigorous and somewhat larger than those which were grown in solutions containing KCl. Greater quantities of soluble oxalates occurred in plants which received Na.

Although no optimum concentration for Cl in the basic solution was established, the data suggest that the Cl requirement of halogeton is greater than that which would be supplied by most nutrient cultures now recommended for hydroponic research.

A 0.1 N concentration of NaCl in the nutrient solution was most effective in promoting growth, vigor, physical size, and abundant oxalate formation. When halogeton was grown in solutions containing 0.01 N NaCl or above, only soluble oxalates were formed.

Sodium was essential for vigorous growth of halogeton.

Utah State U., Logan, Utah.

Smith, D. H., and Clark, F. E. VOLATILE LOSSES OF NITROGEN FROM ACID OR NEUTRAL SOILS OR SOLUTIONS CONTAINING NITRITE AND AMMONIUM IONS. Soil Sci. 90: 86-92. 1960.

Conditions favoring the reaction between ammonium and nitrite ions in soils and solutions and the extent of nitrogen evolution from such systems were investigated by means of gas-solid chromatography and mineral nitrogen analyses.

Solution studies confirmed the importance of acidity reactant concentration, and the presence of a nitric oxide atmosphere in promoting the reaction of ammonium and nitrite ions to yield molecular nitrogen. In the presence of oxygen, the tendency for nitrite to convert chemically to nitrate was three to four times as strong as for it to react with ammonium ion. The conversion to nitrate was even more rapid in aerobic soil.

In soils, the reaction between the ammonium and nitrite ions to form nitrogen gas did not appear to be nearly as important as the reduction of nitrite to nitrogen gas by some component of the soil complex. Evolution of N_2 and N_2O and diminution of substrate ammonium were observed. The presence of soil interfered with the ammonium-nitrite reaction.

There was no evidence of loss of nitrogen as nitric oxide or nitrogen dioxide from moist and aerobic soil.

Jr. Author, SWCRD, ARS, USDA, Fort Collins, Colo.

Wright, B. C., and Peech, M. CHARACTERIZATION OF PHOSPHATE REACTION PRODUCTS IN ACID SOILS BY THE APPLICATION OF SOLUBILITY CRITERIA. Soil Sci. 90: 32-43. 1960.

A study of phosphate reaction products in acid soils was made by the application of solubility criteria. Soils that had been fertilized with phosphate but to which no phosphate had been added for at least 5 years prior to the time of sampling were selected for this study.

Two of these soils were subjected to 5 successive extractions with 0.01 *M* $CaCl_2$ in order to determine the effect of depletion of soluble phosphate in soils on the constancy of the variscite solubility product. The average pK_{sp} value of variscite was found to be 30.4 ± 0.1, which is very near the correct value of 30.5 for pure variscite. Although the pK_{sp} values of variscite ranged from 29.5 to 31.3, the value for any given soil remained constant during the five successive extractions despite the removal of relatively large amounts of phosphate. It was shown that the constancy of the ion product of variscite observed in many of these soils could not have been due to some mechanism that maintained a constant concentration of Al^{+3}, H^+, and $H_2PO_4^-$ on the surface of the clay particles.

Thirty-four soil samples were subjected to an extraction procedure which consisted of a first extraction for 24 hours with 0.01 *M* $CaCl_2$, a second extraction for 72 hours with 0.01 *M* $CaCl_2$, and a third extraction for 72 hours with 0.01 *M* $CaCl_2$, which was also 0.001 *M* with respect to HCl. The average pK_{sp} value of variscite for the fertilized

and unfertilized soils in the second extract was found to be 30.3 ± 0.1 and 30.9 ± 0.1, respectively, but in most instances the variscite pK_{sp} value increased significantly in the third extract. By assuming that the substitution of Fe^{+3} for Al^{+3} in the variscite lattice results in the formation of a continuous series of ideal solid solutions, the activity of variscite in aqueous solution in equilibrium with the mineral was shown to be equal to $K_{spv} \cdot X_v$, in which K_{spv} is the solubility product of pure variscite and X_v is the mole fraction of variscite in the crystal. Likewise the activity of strengite in the same aqueous solution was shown to be equal to $K_{sps} \cdot X_s$, in which K_{sps} is the solubility product of pure strengite and X_s is the mole fraction of strengite in the same crystal. Thus, substitution of Fe for Al in the variscite lattice should lead to higher observed pK_{sp} values for both variscite and strengite.

Fractionation of the soil inorganic phosphorus revealed that the native phosphorus of most of these soils was present in the form of iron phosphate. Phosphate fertilization was found to increase primarily the iron phosphate fraction in all soils, except Greenville and Mardin, in which the fertilizer phosphate was found to be converted almost entirely into aluminum phosphate.

These findings would support the conclusion that some crystalline phosphate mineral of the variscite-strengite isomorphous series was the ultimate reaction product of applied phosphate in these acid soils.

Jr. Author, N. Y. State Col. Agr., Cornell U., Ithaca, N. Y.

Huffman, E. O., Cate, W. E., and Deming, M. E. RATES AND MECHANISMS OF DISSOLUTION OF SOME FERRIC PHOSPHATES. Soil Sci. 90: 8-15. 1960.

Chemical and kinetic aspects of three possible soil phosphates--calcium ferric phosphate, strengite, and colloidal ferric phosphate--were explored. None of the materials dissolves congruently in phosphoric acid solutions of pH 3 and 4, in water, nor in ammonium hydroxide solutions. Strengite and, by inference, colloidal ferric phosphate, dissolve readily in the stable triple-point solution of the system $CaO\text{-}P_2O_5\text{-}H_2O$, the probable immediate environment of a granule of monocalcium phosphate in the soil. The rates of solution of phosphorus from the three ferric phosphates in water are in the order, strengite $\cong$ colloidal ferric phosphate $\ll$ calcium ferric phosphate. The rate for strengite and colloidal ferric phosphate is lower than that for fluorapatite.

Electron microscopy, the kinetic data, and plant response in the greenhouse indicate a high degree of similarity between strengite and colloidal ferric phosphate.

TVA, Wilson Dam, Alabama.

Coleman, N. T., Thorup, J. T., and Jackson, W. A. PHOSPHATE-SORPTION REACTIONS THAT INVOLVE EXCHANGEABLE Al. Soil Sci. 90: 1-7. 1960.

The amounts of phosphate sorbed by 60 subsoil samples from the North Carolina Piedmont were correlated with exchangeable Al content. The regression equation was: $y = 0.077 + 0.703x$; the correlation coefficient was 0.838. The removal of exchangeable Al by salt-leaching reduced phosphate-sorption by soils that contained appreciable quantities of this ion. Sorption by soils such as the Cecil, which contain little exchangeable Al but large quantities of iron and aluminum oxide or hydroxide minerals, was not affected by salt-leaching.

Montmorillonite, saturated with Na, K, or Ca by salt-leaching, sorbed little phosphate. Al-montmorillonite bound quantities of phosphate equivalent to the exchangeable Al, but only under conditions where Al hydrolysis was encouraged. Phosphate binding was maximum at pH 7 in salt-free Al clay systems, and was near maximum at pH 4 in the presence of chloride salts, which served to displace Al from exchange sites.

It was suggested that phosphate-binding reactions which involve exchangeable Al ions lead to the formation of a substance with the overall composition of variscite, and that 2 moles of H ion are produced for each mole of product which is formed.

N. C. State Col., Raleigh, N. C.

Thomas, R. L., and Lynch, D. L. QUANTITATIVE FRACTIONATION OF ORGANIC PHOSPHORUS COMPOUNDS IN SOME ALBERTA SOILS. Canad. J. Soil Sci. 40: 113-120. 1960.

Soil samples from the A and B horizons of nine virgin profiles and from the A_2 horizons of two of the profiles were analysed for organic phosphorus content. The nine profiles represented five of the major soil zones of Alberta. Organic Phosphorus extracted with HCl and NaOH treatments was separated into three fractions using an anion exchange column. The three fractions contained unidentified phosphorus compounds, meso-inositol hexaphosphate and a supposed isomer of meso-inositol hexaphosphate respectively.

The unidentified compounds in the A horizons contained the major proportion of the organic phosphorus. Of the two inositol hexaphosphate compounds measured, the supposed isomer was present in larger quantities than the meso form with the exception of the Hemaruka soil in which the meso form was slightly higher. The three fractions together accounted for only 54.0 percent of the total organic phosphorus.

The largest amounts of organic phosphorus in the B horizons also occurred in fraction 1. However, in the B horizons this fraction accounted for 63.4 percent of the total organic phosphorus in comparison to the 42.2 percent in the first fraction of the A horizons. The total of the two inositol hexaphosphate compounds in the B horizons accounted for only 2.8 percent of the total organic phosphorus while in the A horizons the same compounds accounted for 11.8 percent of the total organic phosphorus. Of the 2.8 percent organic phosphorus that was present as inositol hexaphosphate in the B horizons, the greatest proportion was in the meso form, while the reverse was true of the A horizons.

The A_2 horizons contained 6.9 percent of the total organic phosphorus in the inositol hexaphosphate form, with the larger amount in the meso form.

U. Alberta, Edmonton, Alberta, Canada.

Hsu, P. H., and Jackson, M. L. INORGANIC PHOSPHATE TRANSFORMATIONS BY CHEMICAL WEATHERING IN SOILS AS INFLUENCED BY pH. Soil Sci. 90: 16-24. 1960.

The solubilities of the stable soil calcium, aluminum, and iron phosphates, as represented by hydroxyapatite, variscite, and strengite, respectively, are plotted as a function of pH on the basis of their solubility products. The solubilities of aluminum and iron phosphates, when controlled by the cation activities of the corresponding hydroxides, are close to each other in most of the soil pH range. The aluminum and iron phosphates have solubility approximately equal to calcium phosphate between pH 6 and 7, depending on the magnitude of cation activities from various solid phases such as gibbsite, aluminosilicates, hydrous iron oxides, calcium carbonate, exchangeable calcium, and possibly from soluble salts. Above this pH range, the calcium phosphate is more stable than aluminum and iron phosphates, particularly in the presence of calcium carbonate; below this range, the aluminum and iron phosphates are more stable than calcium phosphate.

The inorganic phosphate fractions of several gray-brown podzolic soils developed from calcareous parent materials are closely related to soil pH. The phosphate in calcareous soil horizons analyzed was mainly bonded to calcium. As the calcium carbonate leached out and the soil reaction dropped to below pH 7 during the processes of soil development, calcium phosphate decreased and aluminum and iron phosphates increased.

The plot of the percentage of active inorganic phosphate in the B and C horizons of soils against pH gave a smooth curve for each individual profile. The position of the curve shifted for different soils, all deviating from the equilibrium position. Deviation from equilibrium can be interpreted by the heterogeneity of the soil within any horizon. Some phosphate is dissolved from calcium phosphate and precipitated as aluminum and iron phosphates even in soil horizons above pH 7, probably in locally acid root and leaching channels. When strongly acidic, highly weathered soils underwent an increase in pH by $CaCO_3$ addition, a slow back-transformation to calcium phosphate occurred but considerable aluminum phosphate and iron phosphate persisted. The rapid fall in calcium phosphate as the soil pH dropped from 6.5 to 4.5, together with the above phenomena, give evidence that the transformations of phosphate in soils are mainly controlled by pH, but that the rates of transformation are controlled by the slow rate of diffusion of ions along

moisture films joining particles of different species. Iron oxide coatings further slow the rate of back-transformation. Reducing conditions promoted the formation of aluminum phosphate instead of iron phosphate.

Jr. Author, U. Wisc., Madison, Wisc.

Olsen, S. R., Watanabe, F. S., and Cole, C. V. SOIL PROPERTIES AFFECTING THE SOLUBILITY OF CALCIUM PHOSPHATES. Soil Sci. 90: 44-50. 1960.

The pK_{sp} value for $CaHPO_4 \cdot 2H_2O$ was found to be 6.56 at 25° C. Measurements were made in water and various salt solutions at a constant CO_2 pressure of 0.04 atmosphere. These data agree with the value reported for $CaHPO_4 \cdot 2H_2O$ measured in dilute H_3PO_4 solutions.

Values for $pCaHPO_4$ in a calcite plus $CaHPO_4 \cdot 2H_2O$ system were greater than 6.56 in a pH range of 6.6 to 7.6, indicating that $CaHOP_4 \cdot 2H_2O$ is unstable and that it changed to a less soluble form. When using a higher P_{CO_2}, the pH was maintained at 6.04, the $pCaHPO_4$ value in the presence of calcite was the same as $CaHPO_4 \cdot 2H_2O$ in water.

Solubility of phosphorus from $CaHPO_4 \cdot 2H_2O$ and hydroxyapatite was greater in 0.01 *M* solutions of $CaSO_4$ or K_2SO_4 than in equal concentrations of the chloride salts. The $pCaHPO_4$ and pHA values were essentially constant, however, for the sulfate and chloride salts when corrections were made for the amount of undissociated $CaSO_4$. The sulfate ion was adsorbed by the hydroxyapatite crystals, but it was not adsorbed by DCPD (dicalcium phosphate). A similar effect of sulfate versus chloride salts was observed on the solubility of phosphorus in calcareous soils, but only a part of the differences in ion products were accounted for by undissociated $CaSO_4$.

Solubility of phosphorus in calcareous soils increases as the soil: H_2O ratio rises. The ion product, or $pCaHPO_4$, decreases. The true nature of the soil: H_2O ratio effect was not determined, but a possible reaction mechanism is that SO_4- and CO_3- exchange for HPO_4- on the surface of soil phosphates. Both SO_4- and CO_3- increased as the soil: H_2O ratio increased. Silica and organic matter are suggested as possible additional factors, but these constituents were not investigated.

The effects on calcium phosphate of calcite, sulfate versus chloride salts, and soil: H_2O ratio indicate some of the problems encountered in attempts to apply solubility product principles to determine the nature of the reaction products between soil and fertilizer phosphorus. An important phenomenon used to explain the data in this paper is the formation of undissociated molecules or ion-pairs of $CaSO_4$.

SWCRD, ARS, USDA, Colo. State U., Fort Collins, Colo.

Brown, W. E. BEHAVIOR OF SLIGHTLY SOLUBLE CALCIUM PHOSPHATES AS REVEALED BY PHASE-EQUILIBRIUM CALCULATIONS. Soil Sci. 90: 51-57. 1960.

Solubility isotherms for $CaHPO_4 \cdot 2H_2O$, $Ca_4H(PO_4)_3 \cdot 3H_2O$, and $Ca_5(PO_4)_3OH$ are given for the three-component system, CaO-P_2O_5-H_2O for values of pH above 4. These are shown to nearly superimpose over a considerable range of concentrations. The electroneutrality surface that relates pH to calcium and phosphorus concentrations is shown to have two very steep faces, which explains the near superpositioning of the isotherms.

A quantity referred to as the electroneutrality unbalance, which represents the sum of effects of ions foreign to the three-component system, is shown to be a variable useful for describing the effects of additional components; for this reason, it is believed to have applicability to soils. Two other electroneutrality surfaces, described briefly, relate pH with calcium and phosphorus concentrations of solutions which are saturated with respect to gypsum or calcite.

TVA, Wilson Dam, Ala.

Moreno, E. C., Linsay, W. L., and Osborn, G. REACTIONS OF DICALCIUM PHOSPHATE DIHYDRATE IN SOILS. Soil Sci. 90: 58-68. 1960.

Results of equilibrations of dicalcium phosphate (DCPD) with soil, strongly suggest that the solution in fertilizer reaction zones where DCPD is present remains saturated

with respect to this salt. A continuous removal of P from solution was interpreted as a reaction of phosphate in solution with hydrous oxides of iron and aluminum. The rise in pH resulting from this reaction caused DCPD to precipitate and the solution composition to change along the solubility isotherm for DCPD.

Solubilized soil organic matter complexed calcium in appreciable quantities at pH values above 6, introducing apparent supersaturation conditions with respect to DCPD. The rate of precipitation of octocalcium phosphate, expected to form in DCPD-saturated solutions at pH values above 6.4, was also reduced by the presence of organic matter. Thus, the solution composition did not correspond to that of the singular point between octocalcium phosphate and DCPD, as had been anticipated on the basis of phase rule considerations.

TVA, Wilson Dam, Ala.

Bardsley, C. E., and Lancaster, J. D. DETERMINATION OF RESERVE SULFUR AND SOLUBLE SULFATES IN SOILS. Soil Sci. Soc. Amer. Proc. 24: 265-268. 1960.

Organic and reduced inorganic sulfur (reserve sulfur) are converted to sulfates by ignition of a soil-sodium bicarbonate mixture at 500°C. Converted and soluble sulfates (soil sulfur) are then extracted with a solution that is 2*N* to HAc and 0.1*N* to NaH_2PO_4. H_2O and determined turbidimetrically as $BaSO_4$ after acidifying a portion of the filtrate with 1:1 HCl. Acceptable recovery of sulfur has been obtained from elemental sulfur, plant material, methionine, cystine, and cysteine.

Soluble sulfates are extracted from a separate sample with 0.5*N* NH_4OAc + 0.25 *N* HAc. Activated charcoal is added to decolorize the extract. A portion of the filtrate is acidified with 1:1 HCl containing a "seed" solution of sulfate, and sulfur is determined turbidimetrically as $BaSO_4$. Reserve sulfur is the difference between soil sulfur and soluble sulfates.

The multiple correlation of reserve and sulfate-sulfur with total nitrogen in soils was highly significant (R = 0.971). Reserve sulfur was highly correlated with yield of sulfur from three harvests of white clover grown in the greenhouse (R = 0.790). The relation of reserve sulfur and sulfates to the sulfur status of soils is discussed.

SWCRD, ARS, USDA, State College, Miss.

Hendricks, S. B. THE USE OF RADIOISOTOPES IN ION ABSORPTION BY PLANTS. Tex. Agr. Expt. Sta. P. E. 72-60: 42-46. 1960.

Results obtained with use of radioisotopes in following the absorption of alkali, alkaline earth, and phosphate ions by plant roots are treated on the basis of Michaelis-Menten kinetics as an example of active transport. Phosphate ion accumulation is associated with "high energy" bond formation during the absorption process in both barley roots and yeast cells.

SWCRD, ARS, USDA, Beltsville, Md.

Williams, M. C. BIOCHEMICAL ANALYSIS, GERMINATION, AND PRODUCTION OF BLACK AND BROWN SEED OF HALOGETON GLOMERATUS. Weeds 8(3) 452-461. 1960.

Halogeton glomeratus was first discovered in the United States growing in the vicinity of Wells, Nevada, in 1934-35. Since that time it has invaded Utah, Nevada, Wyoming, Montana, Colorado, Idaho, Oregon, and California. The total area it infests now exceeds 11 million acres.

Halogeton has been responsible for the death of numerous sheep in Nevada, Utah, and Idaho. While the sheep industry has not lost an excessive total number of sheep, individual raisers have had rather spectacular losses that have brought the halogeton problem to the attention of the public. Economic losses from deaths of sheep alone are no longer serious, because shepherds have learned to avoid ranges where halogeton constitutes a large percentage of the available forage. When losses do occur, however, the number of sheep killed are frequently 50 or more.

The major economic loss due to halogeton today is the reduced grazing value of millions of acres of western range land where it has become a serious pest. This loss becomes increasingly serious as halogeton moves from strictly desert areas into the more productive range lands.

Halogeton produces both brown and black seeds. The investigations reported here were conducted to determine biochemical differences between black and brown seeds, factors influencing production, and the possible role of the brown seeds in halogeton infestation.

The authors concluded:

1. Black seeds stored the major portion of their reserves as sucrose, while the reserves of brown seeds occurred principally as starch. Brown seeds had a higher total carbohydrate reserve. Black seeds contained twice as much protein.
2. Black seeds germinated rapidly. Brown seeds were viable, but germinated very poorly.
3. The role of the brown seeds remains obscure. One possible function would be a delayed germination period which would extend the viability of seed over several years. Laboratory observations have shown that brown seed loses its viability rapidly after 4 years, but that its ability to germinate did not increase during that time.
4. Brown seeds are formed as a first photoperiodic response to the shortening days of midsummer. The setting of black seeds in the greenhouse could be prevented by supplementing normal day length until midnight with light of 60-400 fc intensity.
5. Plants artificially induced to produce only brown seeds formed additional flowers that gave rise to black seeds when placed on short days. The plants died immediately after the production of black seeds.
6. Halogeton germinated after August 15 and grown continuously on normal daylight formed only black seeds.
7. Intermediate type seeds were observed.

CRD, ARS, USDA, Logan, Utah.

Soil Physics

Odell, R. T., Thornburn, T. H., and McKensie, L. J. RELATIONSHIPS OF ATTERBERG LIMITS TO SOME OTHER PROPERTIES OF ILLINOIS SOILS. Soil Sci. Soc. Amer. Proc. 24: 297-300. 1960.

Multiple correlations were determined between liquid limit, plastic limit, and plasticity index and various combinations of standard physical and chemical determinations (cation-exchange capacity, percent or organic carbon, percent of < 0.002-mm. clay percent of montmorillonite in the clay separate, percent of illite in the clay separate, and percent of 0.05- to 0.002-mm. silt) on a wide range of Illinois soils.

Multiple correlation coefficients of 0.959, 0.887, and 0.938 were obtained between liquid limit, plastic limit, and plasticity index, respectively, and three soil properties (percent of organic carbon, percent of clay, and percent of montmorillonite in the clay separate), indicating that there is a very close relationship between Atterberg limits and these three soil properties. If additional soil properties, such as percent of silt and percent of illite in the clay separate, are included in the analysis the correlation coefficients are increased only slightly. Lower, but highly significant correlations were also obtained between each of the Atterberg limits and cation-exchange capacity, and a combination of percent of organic carbon and percent of clay.

U. Ill., Urbana, Ill.

Dyal, R. S. PHYSICAL AND CHEMICAL PROPERTIES OF SOME PEATS USED AS SOIL AMENDMENTS. Soil Sci. Soc. Amer. Proc. 24: 268-271. 1960.

More than half a million tons of peat are sold annually in the United States for soil improvement. The properties of interest to the buyer and seller are discussed and data for these properties given. Dry organic matter of peats as sold are reported as follows: bulk 26.6, bale 66.4, and moisture-proof packages 37.7 pounds per 100 pounds of peat.

The pressure-plate and pressure-membrane procedures, as used in soils work, are shown to be satisfactory for measuring moisture-retention properties of peats.

SWCRD, ARS, USDA, Beltsville, Md.

Soil Biology

Rouatt, J. W., Katznelson, H., and Payne, T. M. B. STATISTICAL EVALUATION OF THE RHIZOSPHERE EFFECT. Soil Sci. Soc. Amer. Proc. 24: 270-273. 1960.

The paired t-test was used to analyze the results of a microbiological study of soil on the surface of plant roots and soil apart from the roots. The increase in the numbers of bacteria, actinomycetes, fungi and protozoa in the rhizosphere soil of wheat was highly significant as was the increased incidence of ammonifying and denitrifying bacteria and "radiobacter" types. Anaerobes and aerobic cellulose decomposers were also more abundant on the root surface but not algae, anaerobic cellulose decomposers, spore formers, or Azotobacter. Essentially similar results were obtained with barley and soybean plants. The preferential stimulation in the rhizosphere of bacteria requiring amino acids for optimal growth and the relative decrease in the proportion of those requiring factors in yeast and soil extracts were found to be highly significant with the three crops studied. However, the absolute numbers of both these groups of bacteria are higher in the rhizosphere soil.

Microbiology Res. Inst., Res. Br. Canada Dept. Agr., Central Expt. Farm, Ottawa, Ontario, Canada.

Welch, L. F., and Scott, A. D. NITRIFICATION OF FIXED AMMONIUM IN CLAY MINERALS AS AFFECTED BY ADDED POTASSIUM. Soil Sci. 90: 79-85. 1960.

An active culture of nitrifying bacteria was developed in a low-K nutrient solution (0.55 p.p.m. K). This culture was then used to study the effect of added K on the release and subsequent nitrification of fixed NH_4 in dried, NH_4-saturated samples of Wyoming bentonite, Grundite illite, and three vermiculities. In this investigation the NH_4 in the clay minerals that was not removed by a hot KOH distillation was regarded as being fixed.

Most of the NH_4 in the vermiculite samples was fixed, yet it was as available to nitrifying bacteria as the NH_4 in $(NH_4)_2SO_4$ when there was only the K of the low-K nutrient solution present. At least 45 percent of the fixed NH_4 in bentonite was also nitrified under these conditions, but it was evident in both the bentonite and illite experiments that some of the NH_4 in these clay minerals was not available at even the O-p.p.m. level of added K. This unavailable NH_4 in the bentonite and illite samples was probably fixed NH_4, but its unavailability did not appear to be due to the blocking effect of K.

The results obtained in this investigation show that K does interfere with the nitrification of fixed NH_4 in clay minerals. When there was only the minimum amount of K required by the nitrifying bacteria present, much of the fixed NH_4 in the vermiculite and bentonite samples was available for nitrification. Then, as the amount of K added was increased there was a decrease in the amount of NH_4 in these clay minerals that was nitrified. Similar additions of K did not affect the nitrification results obtained with $(NH_4)_2SO_4$. Thus, it may be concluded that the added K interfered with the nitrification of the NH_4 in the clay minerals because it blocked the release of fixed NH_4.

J. Paper J-3712, Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

Schnitzer, M., and Wright, J. R. NITRIC ACID OXIDATION OF THE ORGANIC MATTER OF A PODZOL. Soil Sci. Soc. Amer. Proc. 24: 273-276. 1960.

The organic matter of the A_o and B_h horizons of a podzol was oxidized with 1:1 nitric acid. About 60% of the organic matter of both materials was converted to CO_2. In the oxidation product of the A_o material, succinic, glutaric, adipic, benzene tetra- and penta-carboxylic, and picric acids were identified. The oxidation product of the B_h material contained benzene tetre- and penta-carboxylic and picric acids but no aliphatic carboxylic acids. The acids identified represented about 5% of the original organic matter of

both materials. The results suggest that the organic matter of the B_h contained more aromatic structures than that of the A_o horizon. The possible significance of the acids identified with regard to the chemical structure of the organic matter preparations from both horizons is discussed.

Soil Res. Inst., Res. Br., Canada Dept. Agr., Ottawa, Canada.

Eno, C. F. NITRATE PRODUCTION IN THE FIELD BY INCUBATING THE SOIL IN POLYETHYLENE BAGS. Soil Sci. Soc. Amer. Proc. 24: 277-279. 1960.

Nitrate production was studied in the field by incubation of the soil in pint polyethylene bags during the 1958-59 winter season. This technique permits the diurnal changes in soil temperature to be taken into consideration in studying microbial processes, such as nitrification.

Laboratory studies showed that the rate of nitrification in soil contained in the bags was equal to that contained in ventilated bottles. The bags were tightly closed against the soil and secured with rubber bands. Only slight losses in soil moisture occurred during a 6-week period of incubation. Polyethylene is permeable to oxygen and carbon dioxide. No nitrate difused through the polyethylene bags in a 24-week period.

Field studies were made using bags of soil buried at a depth of 4 inches for periods of 1 to 6 weeks. Although soil temperatures at this depth were never below freezing, they varied sufficiently to result in considerable changes in the rate of nitrate production.

This technique should also prove to be of considerable value in evaluating nitrification in climates where the soil is frozen or at a temperature near freezing during a portion of the year.

Agr. Expt. Sta., U. Fla., Gainesville, Fla.

Tyler, K. B., and Broadbent, F. E. NITRITE TRANSFORMATIONS IN CALIFORNIA SOILS. Soil Sci. Soc. Amer. Proc. 24: 279-282. 1960.

Incubation studies of factors influencing nitrite oxidation in four California soils were conducted at two temperatures--45° and 75° F. In acid soils nitrite transformations were found to be highly sensitive to nitrite concentration in the soil and were inhibited by very low levels. Nitrite had less effect on the second step of nitrification in alkaline soils. Nitrite oxidizers were shown to be very sensitive to low temperature soil conditions.

Although nitrite disappeared rapidly following addition to acid soils, little nitrate was produced during the incubation period. Much of the nitrite-nitrogen was lost from the system. Experiments using acid soils which had been sterilized showed similar losses in added nitrite-nitrogen and lead to the conclusion that these losses result from nonbiological processes. Studies to determine the nature of these losses suggest nitrogen gas as the principal product.

Investigations of respiration rates of the soil population where various concentrations of nitrite were added reveal that nitrites inhibit the respiratory activity of the soil microorganisms as a whole and not merely the nitrifying group. Very low concentrations were inhibitory in acid soils; however, in a calcareous soil more than a hundredfold increase in nitrite concentration was required to achieve the same magnitude of respiratory inhibition.

U. Calif., Davis, Calif.

Broadbent, F. E. FACTORS INFLUENCING THE DECOMPOSITION OF ORGANIC SOILS OF THE CALIFORNIA DELTA. Hilgardia 29(13): 587-612. 1960.

Since the subsidence rate in the peat and muck lands of the California Delta is approximately double that reported in other areas, reasons for the high decomposition rate were investigated.

Estimates of decomposition in field soils based on ash analyses failed to account for all the subsidence which has occurred, suggesting that considerable soil has been lost by means other than aerobic decomposition of the layers above the ground water level. Other possibilities are wind erosion and anaerobic decomposition below the water table.

Appreciable decomposition rates measured in peat incubated under conditions of limited oxygen supply suggest that anaerobic decomposition contributes to subsidence in the field.

Alternate wetting and drying were found to accelerate the rate of decomposition. Immediately after each wetting a high rate was observed, which declined gradually. Mixture of peat and muck soils with mineral soils was found to increase, rather than retard, loss of carbon from the organic soils. This was partly due to the higher pH of the mineral soils in some instances, but a similar effect was observed when no pH change occurred. Addition of plant residues to peat soils tends to counteract the effects of subsidence, even though normal amounts of residues are insufficient to maintain the soil elevation.

Evidence is presented, which indicates that subsidence rates in the Delta may be decreasing, and may eventually attain values comparable with those reported elsewhere. The experiments suggest that as a means of conserving peat and muck soils infrequent cultivation, high water table, and maximum return of crop residues to the soil are desirable.

U. Calif., Berkeley, Calif.

Routley, D. G., and Sullivan, J. T. TOXIC AND NUTRITIONAL EFFECTS OF ORGANIC COMPOUNDS ON LADINO CLOVER SEEDLINGS. Agron. J. 52: 317-319. 1960.

Ladino clover seedlings were grown in test tubes in sand culture to which were added, singly, 95 organic compounds at concentrations up to 1,000 p.p.m. The toxicity to the seedlings of the compounds when added to a complete inorganic nutrient and the availability of the nitrogen of the compounds when added to a nitrogen-free nutrient were observed after 30 days. In general, amino acids and compounds related to nucleic acids were nontoxic and most of them were able to supply nitrogen to the seedlings. Aklaloids and some antibiotics (except penicillin) were highly toxic and those which contained nitrogen were unable to supply it to the seedlings. Some non-nitrogenous acids were nontoxic or toxic only at the highest concentrations.

Paper No. 2394 in the J. Ser. of the Pa. Agr. Expt. Sta., University Park, Pa.

Persidsky, D. J., and Wilde, S. A. THE EFFECT OF BIOCIDES ON THE SURVIVAL OF MYCORRHIZAL FUNGI. J. Forestry 58: 522-524. 1960.

Forest soil harboring mycorrhizal fungi was treated with a combination of chlordane, thiosan, and allyl alcohol, applied at different rates. In order to find out the effect of these toxic chemicals on the survival and behavior of mycorrhizal fungi, the biocide-treated soil was used for inoculation of mycorrhiza-free prairie soils. The latter were seeded to Monterey pine and the subsequent growth of seedlings revealed that a heavy application of eradicants completely annihilates the mycorrhiza-forming organisms. A light application of the chemicals has permitted the survival of some fungi, but depressed about 50 percent of their growth-promoting efficiency. Several simple methods of reestablishing fertility in biocide-treated soils are suggested.

U. Wisc., Madison, Wisc.

EROSION CONTROL

Erosion Equasion

Wischmeier, W. H. CROPPING-MANAGEMENT FACTOR EVALUATIONS FOR A UNIVERSAL SOIL-LOSS EQUATION. Soil Sci. Soc. Amer. Proc. 24: 322-326. 1960.

About 8,000 plot-years of soil-loss and related data assembled from 21 states were analyzed to evaluate influences of vegetal growth, crop sequence, tillage practices, fertility, and residue management on erosion of soil by rainfall. Specific-crop data were grouped according to relatively homogeneous intervals such as the respective rough fallow, seedbed, establishment, growing crop, and residue periods. For each such period, measured soil losses under specific combinations of crop sequence and management were compared with corresponding losses from bare fallow. Not only canopy protection, but

the residual effects of prior cropping and management as well, differed significantly for the respective crop-stage periods. Soil losses for each crop-stage period under various sequences and management levels are presented in tabular form as percentages of losses from fallow under identical rainfall. The table was designed for use with rainfall erosion index maps and monthly distribution curves computed from localized rainfall records as discussed in "A Rainfall Erosion Index for a Universal Soil-Loss Equation" (Soil Sci. Soc. Am. Proc. 23: 246-249. 1959). Combined with the erosion index and other factors comprising the soil-loss equation, the tabulated values will help to provide valuable guides for conservation farm planning adapted to the local rainfall pattern.

SWCRD, ARS, USDA, Lafayette, Ind.

General

King, B. PASTURES, PINES, AND PONDS: HEAL EROSION SCARS OF FAIRFIELD COUNTY. Soil Conserv. 26(1): 3-5. 1960.

Visitors who travel the main highways or county roads of Fairfield County, S. C., see few tilled acres. But they see a seemingly endless expanse of pastures and pines. Dotting the landscape are hundreds of farm ponds.

It is difficult to imagine, therefore, that when Hugh H. Bennett wrote his famous "Soil Erosion, A National Menace" in 1928, he cited Fairfield County as an outstanding example of land destruction through misuse. Of conditions there he wrote:

> "A single county in the southern part of the Piedmont Region was found by actual survey to contain 90,000 acres of land, largely cultivated at one time, which has been ruined by erosion. The whole area has been dissected by gullies, and bedrock is exposed in thousands of places. Here and there islands or peninsulas of arable land have been left between hideous gullies, but most of the remnants are too small to cultivate."

In warning that "the extent of this devastation is yearly growing larger" he added, prophetically, that the land still had value for growing pines and for pasture. It is these two conservation uses that have so transformed the landscape of Fairfield County.

The larger gullies are still there. But today these gullied areas are producing valuable pine timber and pulpwood. And the tree growth is slowly but surely healing the scars of erosion that were so evident on the landscape 30-odd years ago.

Operators of more than 800 of the 1,500 farm units in the county are cooperating with the Fairfield Soil Conservation District. In recent years they have planted more than 11,000 acres to pines, 15,000 acres to improved pasture, and have built 560 farm ponds, as a part of their farm conservation plans developed with the help of SCS technicians assigned to the district.

Livestock numbers have increased steadily with the development of improved pastures. Current reports show about 4,500 dairy cattle, 8,000 beef cattle, and 4,500 hogs.

Sixteen sawmills and 3 planing mills operate in the county, employing 324 people. The annual capacity of all the mills is 40,845,000 board-feet of lumber. Pulpwood has become a 1 1/2-million-dollar industry. It has far outstripped cotton as the county's principal cash crop. In recent years, annual production has exceeded 100,000 cords.

SCS, USDA, Spartanburg, S. C.

Free, G. R. EROSION CHARACTERISTICS OF RAINFALL. Agr. Engin. 41: 447-449, 455. 1960.

Small pans of a standard soil (Honeyeye sil) and a standard sand at constant high levels of moisture were exposed to natural rainfall for 59 exposure periods from 1954 through 1958. The relationships between splash erosion losses for both materials with calculated energy values for rainfall were exponential and of the parabolic type. Splash losses from sand, totaling nearly 1,600 tons per acre for the 5-year period, were more than three times those from soil.

Only three storms during the 5-year period caused washoff losses of sand or soil. Totals for the 5-year period for either sand or soil were about one ton per acre. High

intensity rain of appreciable time duration combined with some packing and sealing by antecedent rainfall were required before sand or soil was removed in runoff from these small areas.

The relationship of ratios of infiltration to runoff for both materials with calculated energy values for rainfall were exponential and of the hyperbolic type. Although over-all values of ratios for sand and soil were similar, those for soil tended to decrease more rapidly with increasing amounts of energy than those for the sand.

SWCRD, ARS, USDA, Cornell U., Ithaca, N.Y.

Bisal, F. THE EFFECT OF RAINDROP SIZE AND IMPACT VELOCITY ON SAND-SPLASH. Canad. J. Soil Sci. 40: 242-245. 1960.

A mathematical relationship was developed which gives the amount of sand splashed from a splash cup when raindrop size and impact velocity are known. The amount of sand splashed was used as an index of the effective energy of the raindrops.

This relationship is expressed as: $G = KDV^{1.4}$ where G is the amount of sand splashed (gm.), K is a constant for the sand, D is the diameter of the drops (mm.), and V is the impact velocity of the drops (m./sec.).

Expt. Farm Res. Br., Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

Ram, D. N., Vittum, M. T., and Zwerman, P. J. AN EVALUATION OF CERTAIN WINTER COVER CROPS FOR THE CONTROL OF SPLASH EROSION. Agron. J. 52: 479-482. 1960.

The amount of soil splash on a bare field was affected by the total amount of rainfall and its intensity. A greater amount of rainfall, a greater intensity, or both caused more soil splash.

Cover crops controlled splash erosion. The domestic ryegrass was the best cover crop, followed by alfalfa, and then field brome. The effectiveness was related to plant characteristics. The higher, more densely standing cover crop decreased the splash erosion more effectively. Neither height nor density alone gave as complete a picture as the consideration of the relationship of the spatial volume to the beneficial results from a cover crop. The measurement of such effectiveness gave a tool for the evaluation of the different cover crops in checking the splash erosion during the particular season of their growth when the soil splash is more hazardous.

Agron. Paper 491, N.Y. State Agr. Sta., Geneva, N.Y.

Meyer, L. D. USE OF THE RAINULATOR FOR RUNOFF PLOT RESEARCH. Soil Sci. Soc. Amer. Proc. 24: 319-322. 1960.

The portable rainfall simulator, known as the rainulator, which has been recently developed at Lafayette, Indiana, was designed for use as a research tool to aid in more rapidly evaluating factors that influence erosion, runoff, and infiltration. Intensities of 2 1/2 or 5 inches per hour with near the kinetic energy of natural rainfall at these intensities are produced. Other characteristics which are desirable for runoff and erosion research on rectangular field plots are embodied in the design. The number and length of plots to which simulated rainfall may be applied simultaneously may be varied by varying the number of units used.

The rainulator will be used primarily for obtaining comparative evaluations of various topographic, soil, water, crop, and management factors under field plot conditions. Numerous factors are well suited to study by this method. The types of comparisons and evaluations which are and are not well adapted to study on rectangular field plots in general and specifically with the rainulator are also discussed.

SWCRD, ARS, USDA, Lafayette, Ind.

Weakly, H. E. THE EFFECT OF HPAN SOIL CONDITIONER ON RUNOFF, EROSION AND SOIL AGGREGATION. J. Soil and Water Conserv. 15(4): 169-171. 1960.

A series of five plots was established in 1952 on Sharpsburg sicl with an 8.5 percent slope and so arranged that rainfall runoff and erosion from them could be measured. Plots were 7 x 28 feet in size. One plot was left in the normal or untreated condition; three others were treated with 1,000 pounds, 2,000 pounds, and 4,000 pounds respectively, of the chemical soil conditioner HPAN, and a fifth plot was given a 5,000 pound per acre straw mulch.

The HPAN was applied but once during the study. The straw mulch was renewed every two years, the usual life of such mulch. Runoff was not measured in 1955 and 1956, so these years do not appear in the tables. No crops or weed growth were permitted on the plots except in 1955 when oats were grown.

Table 1.--Record of rainfall and runoff from HPAN treated, straw mulched, and untreated plots (1952-1958)

Year	Total annual rainfall (inches)	Treatment				
			HPAN--lbs./acre			Straw 5,000 lbs./acre
		None	1,000	2,000	4,000	
		Runoff in inches				
1952	31.54	4.80	4.20	3.07	2.88	0.39
1953	18.38	1.39	1.21	0.61	0.20	.30
1954	30.57	9.02	7.11	6.26	4.89	1.04
1957	36.06	3.89	3.65	3.25	2.34	--
1958	35.61	4.83	4.72	4.27	5.01	1.62
Total	152.16	24.00	20.89	17.46	15.32	3.35
Runoff--% of total rainfall		15.8	13.7	11.5	10.1	2.2
Relative runoff		100.0	87.0	72.8	63.8	9.2
Runoff 1952-54, % of total rainfall		18.9	15.6	12.4	11.2	2.2
Runoff 1957-58, % of total rainfall		12.2	11.7	10.5	10.3	2.2

Table 2.--Seasonal and total erosional loss of soil from plots with three rates of HPAN application as compared to an untreated plot and a straw mulched plot

Year	Treatment				
		HPAN--lbs./acre			Straw 5,000 lbs./acre
	None	1,000	2,000	4,000	
	Erosion--tons per acre				
1952	22.2	11.1	2.3	2.4	0.1
1953	7.4	5.6	1.9	0.5	0.5
1954	57.3	34.5	21.6	13.7	0.6
1957	9.2	9.9	7.6	1.6	0.0
1958	9.1	4.5	7.8	7.2	0.8
Total	105.2	55.6	41.2	25.4	2.0
Relative erosion	100.0	62.3	39.2	24.1	1.9
Tons of soil removed per inch of runoff	4.38	2.66	2.36	1.66	0.59
Tons of soil removed per inch of runoff(1952-1954)	5.71	4.09	2.60	1.85	0.69
Tons of soil removed per inch of runoff(1957-1958)	2.10	1.72	2.05	1.20	0.49

The chemical soil conditioner HPAN shows an effect upon water intake, soil erosion, and aggregation over a reasonably wide range of rates of application. This material is not, however, nearly so efficient at increasing intake or decreasing erosion losses as a 5,000 pound per acre straw mulch.

SWCRD, ARS, USDA, Lincoln, Nebr.

Critical Areas

Lowry, G. L. CONIFER ESTABLISHMENT ON COAL SPOILS AS INFLUENCED BY CERTAIN SITE FACTORS AND ORGANIC ADDITIONS AT PLANTING TIME. Soil Sci. Soc. Amer. Proc. 24: 316-318. 1960.

Eight conifer species were planted on Ohio spoil banks at five locations of widely different site characteristics. At any one location five tree species and three root mulch treatments were tried. Mulch treatments included: (1) No treatment; (2) steam-sterilized sawdust mulch; and (3) unsteamed sawdust mulch. One pint of mulch was placed in the tree root zone at planting time.

Results of 2-year measurements indicated significant survival differences between tree species on all areas where average survival was greater than 10%. On acid spoils pitch pine appeared best when considering both survival and total height. Jack pine, white pine, and ponderosa pine were intermediate while shortleaf pine was consistently poor. On mildly acid clay spoils northern white cedar was best while eastern red cedar, ponderosa pine, and jack pine were intermediate.

Significant differences due to mulch treatments were noted, especially on very strongly acid sandy spoils where raw mulch showed a 90% increase in survival over the controls. Steamed mulch resulted in some increase in survival on sandy areas, but a decrease in survival when used on areas high in silt and clay. No difference in seedling height resulted from these treatments.

Certain site and soil factors were studied to determine their effect on seedling survival. Of the factors studied only moisture equivalent, sand content, and reaction were significant.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Limstrom, G. A. FORESTATION OF STRIP-MINED LAND IN THE CENTRAL STATES. U.S.D.A. Agr. Hbk. 166, 74 pp. 1959.

Strip mining for coal in the Central States region of the United States has created a new type of land surface, with many unique problems related to its rehabilitation and use. One of the best ways to reclaim strip-mined land is by forestation. Most of this land is suitable for the planting of trees and the production of some forest crops, including Christmas trees, posts, mine timbers, pulpwood, poles, and possibly piling and sawtimber. Other benefits of forestation include soil and water conservation and improvements for recreational use.

Forestation usually means planting because neither natural forestation nor direct seeding have proved to be successful ways to establish forest cover on strip-mined land. The soils created by strip mining, generally consisting of material from many rock strata overturned in the mining, are more variable and complex than normal soils derived from a single kind of parent material.

So, to grow trees successfully on strip-mined land, one must carefully evaluate each site and select species that are suitable. Some of the important site factors directly affecting establishment and growth of trees on strip-mined land are the following: (1) *Physical characteristics of bank materials.*--These characteristics include the percentage of stone and the soil texture, structure, and consistency. (2) *Chemical reaction.*--Acidity of bank surfaces, commonly expressed as pH, sometimes limits survival and growth of trees. A pH of less than 4.0 generally indicates that the area is nonplantable. (3) *Topography.*--Exposure or aspect has little effect on early survival and growth; but on many areas growth is better on lower than upper slopes. And (4) *Vegetation or cover.*--A dense ground cover reduces survival and growth of many pines and some hardwoods planted on strip-mined land. Overhead cover, sometimes favorable for establishment and early growth, may be a deterrent to later development.

These site conditions in turn are determined and influenced by several things, such as the parent material, methods of mining, grading, and erosion. In addition to the site conditions one must consider susceptibility to insects and diseases, seed source, quality of planting stock, and season of planting.

The use of black locust in mixed plantings, if carefully planned with respect to proportions used and cultural measures needed, will result in better growth of many associated species, such as yellow-poplar, black walnut, red oak, sweetgum, green and white ash, and eastern redcedar. Specific recommendations for planting 23 species are listed.

Growth and yield data for trees growing on strip-mined land are lacking, but indications are that trees planted on such sites will produce salable crops in as short a time as comparable old-field plantations.

FS, USDA, Inform. Div., Washington 25, D. C.

Bethlahmy, N. SURFACE RUNOFF AND EROSION--RELATED PROBLEMS OF TIMBER HARVESTING. J. Soil and Water Conserv. 15(4): 158-161. 1960.

Logging affects the hydrologic characteristics and behavior of watersheds. The effects may be severe or light depending upon the methods used, the degree of planning, and the attention paid to details in execution. Roads for logging are a prime source of erosion and contribute directly to stream siltation. Roads for skidding likewise are responsible for such damages, but possibly to a lesser extent. The harmful effects of all roads can be minimized by good planning. Animal, tractor, and cable logging affect the land surface in different degrees of severity. The effects of tractor logging may be particularly severe in mountainous terrain. Research is needed to define the type of logging best suited to a particular site and to innovate improved logging methods. Controlled burning to eliminate logging debris cannot be condemmed wholesale; additional research is needed to fully assess the total effect of this practice.

Pacific Northwest Forest & Range Expt. Sta., FS, USDA, Portland, Oreg.

Harrold, L. L., and Roberts, R. L., Jr. WINTER RUNOFF FROM SNOW AND FROZEN GROUND. Mich. Q. B. 43 (1): 154-169. 1960.

In 1940 a research project, designed to study and evaluate the important factors in snow and frozen ground hydrology, was established at Michigan State University, East Lansing, Michigan. Two cultivated watersheds were extensively instrumented on University land, and one wooded watershed at the nearby Rose Lake Wildlife Experiment Station.

The area of each of the three watersheds is about two acres. The aspect of the two cultivated watersheds in N-NW. The average slope of watershed A is 6 percent, and that of watershed B is 6.5 percent. The soils of the watersheds are well-drained fine sandy loams and loamy fine sands and of glacial origin. Both watersheds were basically in a rotation of corn with cover crop, oats, and two years of hay.

The data and discussion in this report constitute only a simple graphical presentation of basic summaries of some measured factors which are believed to influence precipitation-runoff relations during periods of freezing and thawing of the soil mantle and accumulation and melting of snow. It is clearly apparent, however, that the relationships among the factors shown on the graphs are not simple.

The runoffs that occurred on January 14, 1947 and February 12-13, 1949 indicate the difficulties that are encountered in the measurement of snow-water storage and snowfall. At both times the runoff was greater than the indicated available water.

Differences that seem to be explained by one variable (cover) are shown by the runoffs of April 5, 1947. On that date, over 2.5 inches of rain fell on a thawed surface underlain with frozen soil on both watersheds. Runoff from A (corn stubble with rye winter cover) was about 1.8 inches, compared with less than 0.6 inch on B (alfalfa-brome.) March 19, 1948 indicates the effect of two variables (cover and occurrence of frost.) The soil on watershed A (alfalfa-brome) was not frozen, but on watershed B (corn stubble with rye winter cover) there was a surface thaw underlain with frozen soil. A rain of 2.5 inches caused a runoff from A of about 0.6 inch and from B, over 2 inches.

January 18-19, 1949 and March 31, 1949 point to the effect of some unmeasured factor. In January, over 1.5 inches of rain and sleet fell with runoffs from both watersheds of over 1 inch, but in March, over 1.5 inches of rain and snow fell with no runoff from A and very little from B. On both dates the soil was not frozen and the soil moisture content was similar.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

SOIL MANAGEMENT

Cropping Practices

Laws, W. D., and Simpson, B. J. GRAIN SORGHUM IN FARMING SYSTEMS FOR THE BLACKLANDS. Hoblitzelle Agr. Lab. B. 8, 22 pp. 1960.

The authors summarize their work on grain sorghum as follows: (1) All the rotations, whether fertilized or not, produced significantly more grain sorghum than the continuous sorghum not fertilized. (2) The wheat-cotton-grain sorghum rotation not fertilized averaged 466 pounds more grain sorghum per acre over an eleven-year period than the continuous grain sorghum. (3) Of the nine other systems, only five gave grain sorghum yields significantly better than the system of wheat, cotton, and grain sorghum not fertilized. (4) The data indicate that fertilizer in the farming systems was more important in grain sorghum production than crop rotation. As long as the fertilizer application was equal, it made little difference whether the non-row crop was wheat, Hubam clover, or grass sod. And (5) results of this experiment show that wheat following sorghum in the unfertilized rotation produced an average of 16.4 bushels per acre per year for eleven years, while continuous wheat not fertilized produced 16.5 bushels per acre per year over the same period. There is no evidence in these data to indicate that sorghum will have an adverse effect on wheat yields over a long period of time.

In five of the eleven years, wheat following sorghum produced less than wheat following wheat. These were generally the years of low rainfall. In these five years, the wheat following wheat averaged 16.4 bushels per acre and wheat following sorghum averaged 10.5 bushels per acre. During the other six years, wheat following sorghum averaged 21.3 bushels per acre and wheat following wheat averaged 16.6 bushels per acre.

Hoblitzelle Agr. Lab., Tex. Res. Found., Renner, Tex.

Laws, W. D., and Simpson, B. J. FARMING SYSTEMS FOR COTTON PRODUCTION IN THE BLACKLANDS. Hoblitzelle Agr. Lab. B. 9, 23 pp. 1960.

The authors summarize their work on farming systems for cotton production as follows: (1) All systems receiving fertilizer produced significantly more seed cotton than the continuous cotton not fertilized. (2) The wheat-cotton grain sorghum rotation not fertilized produced an average of 106 pounds of seed cotton more per year for 11 years than the continuous cotton not fertilized. (3) None of the fertilized rotations was significantly better (statistically) than the continuous cotton fertilized. However, the wheat-cotton-grain sorghum rotation with all crops fertilized produced an 11 year average of 68 pounds per acre more seed cotton than continuous cotton, and the sod-cotton-grain sorghum system with fertilization produced a 10 year (1949-58) average of 86 pounds of seed cotton per acre per year more than continuous cotton. (4) The data indicate that fertilizer in the farming system was more important in seed cotton production than crop rotation. In a factorial experiment with a wheat-cotton-grain sorghum rotation and fertilizer, the 11 year average increase due to fertilization was 127 pounds of seed cotton per acre per year, while the average increase due to rotation was 88 pounds of seed cotton per acre per year. In the experiment using a rotation of Hubam sweet clover-cotton-grain sorghum the 6 year average increase due to fertilizer was 51 pounds of seed cotton while the increase due to the rotation was 29 pounds. (5) The response of cotton to fertilizer and rotation was similar to that of grain sorghum grown in these same system. And (6) When summarized on a crop year basis there was a significant correlation between total rainfall and average annual seed cotton yield.

Hoblitzelle Agr. Lab., Tex. Res. Found., Renner, Tex.

Willis, W. H. THE INFLUENCE OF FOUR CROPPING SYSTEMS ON THE NITROGEN AND ORGANIC MATTER CONTENTS OF RICHLAND SILT LOAM. La. Agr. Expt. Sta. B. 535, 27 pp. 1960.

A lysimeter experiment was conducted to determine the influence of four cropping systems on the gains and losses of nitrogen and the accumulations of nitrogen and organic matter in Richland sil, a Mississippi terrace soil, for a six-year period. The four cropping systems were: (1) Continuous cover of white clover and Dallisgrass with one-half the clipped forage returned to the soil surface; (2) continuous Dallisgrass with one-half the clipped forage returned to the soil surface; (3) cotton following an inoculated winter legume turned into the soil as green manure; and (4) cotton grown with 60 to 72 pounds of fertilizer nitrogen per acre, one-half the nitrogen applied at planting and the remainder used as a side dressing.

The pH of the soil was maintained near 6.5 by additions of dolomitic limestone. The soil in all plots was fertilized with available phosphorus and potassium each spring at the rate of 72 pounds per acre each of P_2O_5 and K_2O.

The study was continued for seven years and the last six years' results are reported. During the course of the study the amounts of nitrogen added in fertilizer and in rainfall and the amounts removed in harvested plant material and lost by leaching were measured. Soil analyses were made, for nitrogen and organic matter content. The changes in nitrogen and organic matter contents of the soil were determined and the following conclusions drawn:

1. Water losses by percolation were influenced more by the nature and distribution of rainfall than by total amount of rainfall or cropping system. An average of about 50 percent of the rainfall was lost by percolation during the six-year period. The largest percolation, 76.9 to 85.4 percent of the rainfall, occurred during a year when total rainfall was near average but when a few heavy rains fell on wet soil.
2. Nitrogen brought down to the soil in rain water varied from 4.0 to 13.3 pounds per acre per year and averaged 9.4 pounds. An average of 54 percent of the nitrogen in the rainfall was ammonium nitrogen.
3. Nitrogen losses by leaching varied from 2.0 to 95.4 pounds per acre per year. Losses were reduced by the presence of continuous cover. In the cultivated plots nitrogen losses were larger from the soil where more nitrogen was accumulating. During one year of the experiment nitrogen losses by leaching from soil cropped to cotton were equivalent to over two-thirds of that added as fertilizer.
4. Grass without clover could not be produced without occasional additions of fertilizer nitrogen. A mean annual yield of 4,722 pounds of clover and grass was obtained when one-half the forage was returned and no fertilizer nitrogen added. The average annual nitrogen removal in the harvested forage was 111 pounds per acre in clover and grass and 21 pounds in grass grown with fertilizer nitrogen.
5. Inoculated legumes produced an average of 5,108 pounds of dry matter, which was turned under as green manure before cotton was planted. This material contained an average of 184 pounds of nitrogen per acre per year. Approximately one-half this amount of nitrogen became available for the succeeding cotton crop and produced an average of 21 percent more seed cotton than 72 pounds of fertilizer nitrogen.
6. The average annual increase in nitrogen was 206, 64, 190, and 11 pounds per acre, respectively, for the clover and grass, grass alone, cotton after vetch and cotton with fertilizer systems. The average annual increase in the nitrogen content of the soil under each of the four systems was 91, 79, 106, and 21 pounds per acre, respectively. The mean annual increase of 190 pounds of nitrogen per acre in the system where leguminous green manure was grown was about equal to the 184 pounds of nitrogen turned under each spring in the legume green manure. The annual accumulation in soil nitrogen was equal to slightly over one-half the amount of nitrogen turned in the legume green manure.
7. The two cropping systems: (1) Continuous clover and grass with half the forage returned to the soil surface; and (2) cotton following legume green manure, gave significant increases in the nitrogen and organic matter contents of the soil as compared with cotton grown with fertilizer nitrogen. The quantity of cottoncrop

residue that was produced with annual applications of fertilizer nitrogen was not sufficient to appreciably increase soil nitrogen and organic matter.

8. The nonsymbiotic nitrogen-fixing bacteria of the genus Azotobacter appeared in the soil when conditions favorable for their growth had been established. These organisms were of some value in increasing the nitrogen content of the soil. Their principal effect was apparent in the soil under grass sod, where an average of 64 pounds of nitrogen per acre per year accumulated. The grass residue with a relatively low nitrogen content provided a suitable energy source for nitrogen fixation.

Agr. Expt. Sta., La. State U. and Agr. and Mech. Col., University Station, La.

Stickler, F. C., and Laude, H. H. EFFECT OF ROW SPACING AND PLANT POPULATION ON PERFORMANCE OF CORN, GRAIN SORGHUM AND FORAGE SORGHUM. Agron. J. 52: 275-277. 1960.

Row spacing and plant population studies were conducted with corn, grain sorghum, and forage sorghum in eastern Kansas.

Grain and stover yields of corn were not influenced by the plant populations or row spacings employed, although a significant response was noted from cultivating narrow rows. Relative evaporative power of the air within the crop was not affected by row spacing or plant population. Light intensity at the soil surface and soil temperature were greater in 40-inch than in 20-inch rows. Corn performance in narrow uncultivated rows was unsatisfactory.

Grain sorghum yields were higher with 78,000 than with 52,000 plants per acre and a significant plant population X row spacing interaction was noted. Atmometer bulb evaporative losses were 52, 57, 73, 78 and 100% in 10-, 16-, 20-, 24-, and 40-inch rows, respectively. Soil temperature, light intensity, and water loss from the soil surface were less in narrow than in wide (40-inch) rows. No significant differences in soil moisture depletion during the growing season were found among spacing treatments.

Results of the corn and grain sorghum tests suggest that successful narrow-row culture of coarse cereals requires a high plant population.

Silage yields of Atlas sorgo indicated that this crop could be grown satisfactorily in narrow rows.

Kans. Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

Horner, G. M. EFFECT OF CROPPING SYSTEMS ON RUNOFF, EROSION, AND WHEAT YIELDS. Agron. J. 52: 342-344. 1960.

Effects of cropping systems on runoff, erosion, and crop yields were measured on Palouse sil at Pullman, Washington.

Kind and amount of cover provided during the winter season was the dominant factor affecting runoff and erosion. Land seeded or prepared for seeding to winter wheat was more vulnerable to erosion losses than any other winter cover condition common to the area.

Land cropped to an 8-year alfalfa rotation had one-fifth as much erosion as land cropped to the summer fallow-winter wheat system. The order of effectiveness for erosion control of different rotations was as follows: alfalfa, sweet-clover, Hubam clover and wheat, peas (green manure) and wheat, peas (seed) and wheat, and summer fallow and wheat.

Total nitrogen in the soil was increased during the period of the experiment by crop rotations that included a legume used as green manure or hay. The fallow practice resulted in the greatest reduction of soil nitrogen.

Wheat following sweetclover-grass or alfalfa-grass had about 50% greater yield than wheat grown without fertilization in the fallow-wheat or pea-wheat systems.

SWCRD, ARS, USDA, Pullman, Wash.

Shrader, W. D., Pesek, J., and Moldenhauer, W. C. WHAT ABOUT CONTINUOUS CORN? Iowa Farm. Sci. 14(9): 3-5. 1960.

Both actual practice and experimental work have indicated that it's possible to get good corn yields when corn is grown continuously on some Iowa soils. Continuous corn is feasible on more or less level areas where erosion isn't a problem. It's not now feasible to control erosion under continuous row-cropping on slopes of more than 5 percent. On gentle slopes of only 2 to 5 percent, erosion can be controlled only with special practices. Most of our work with continuous corn has been on more or less level areas of medium-textured soils.

Relative 1953-1958 average yields of continuous and rotation corn at six Iowa locations

Location	Average yield (bu./A.)		Yield of continuous corn as a percentage of rotation corn
	Rotation corn	Continuous corn	
Carrington-Clyde Farm, Independence			
Rotation experiment	98	99	101
Runoff experiment	102	97	95
Soil Conservation Farm, Clarinda	75	77	102
Pasture Improvement Farm, Albia	72	58	81
Southern Iowa Farm, Bloomfield	96	105	110
Seymour-Shelby Farms, Seymour	76	80	105
Grundy-Shelby Farm, Beaconsfield	78	71	92
AVERAGE	85	84	98

The main feature of fertilizer needs for continuous corn is the need for additional nitrogen. About 80 to 120 pounds per acre annually is needed for corn grown continuously on soils of average fertility. Over a period of years, a field of corn, if the stalks aren't removed, will use significantly less potassium and about the same amount or slightly less phosphorus than a field in a rotation with oats and hay.

The limited amount of work that has been done under conditions of high fertility indicates that the organic matter level and soil tilth can be kept at satisfactory levels for crop production with continuous corn.

The results of soil moisture studies in recent dry years indicate more available water in soils previously in corn than in soils previously in legume meadow.

The use of modern chemicals and cultural practices permits weed, insect, and disease control in either continuous or rotation corn. Some weeds and insects are easier to control in a rotation, while others may be easier to control with continuous corn. No serious plant diseases threaten the Iowa corn crop at present. But corn grown continuously "invites" a buildup of soil-borne diseases, and growers will have to remain alert for signs of damage.

The growing of a single crop tends to concentrate the demand for labor and equipment and to increase the risk of financial loss in case of either a crop failure or a low price of corn.

Iowa State U., Ames, Iowa.

Haas, H. J., and Boatwright, G. O. LET'S TAKE ANOTHER LOOK AT SUMMER FALLOW IN THE NORTHERN PLAINS. J. Soil and Water Conserv. 15(4): 176-179. 1960.

Is summer fallow necessary? This is a question that is receiving considerable attention in some of the northern states of the Great Plains.

Increased yields brought about by summer fallow have in the past been attributed mainly to moisture conserved during the summer fallow period. Recent information, however, leads one to believe that increased available plant nutrients may be one of the

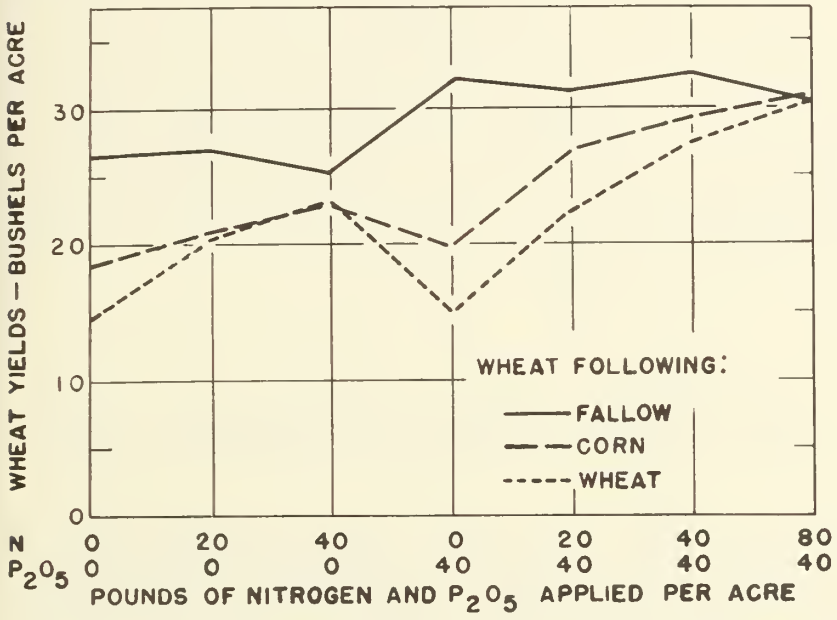
major benefits of this practice. It has also been shown that certain crops can be substituted for summer fallow and that such cropping systems together with applications of sufficient fertilizer compare favorable with summer fallow for small grain production.

Summer fallow is still a necessary evil in some sections of the Great Plains where moisture is more limiting, but wherever it is practiced, it is one of the principle sources of difficulty experienced with wind and water erosion. Stubble mulching has alleviated the erosion problem on fallow to a certain extent but it has not eliminated it entirely.

Recent work at Mandan, North Dakota, shows that fertilizers are effective in reducing the yield advantage of fallow. These studies were conducted on rotation plots which had been in operation for 40 years and which did not receive fertilizers during that period.

Beginning in 1955 and continuing through 1957, various combinations of nitrogen and phosphorus fertilizers were applied to each crop in the rotations. Annual precipitation in 1955 was 18.3 inches, 16.6 in 1956, and 15.4 in 1957, compared to a long time average of 16.0 inches.

Wheat yields from seven of the fertilizer treatments following fallow, corn, and wheat are presented in the figure. Where wheat followed corn the land was disked, and where wheat followed wheat or fallow, initial tillage was with a moldboard plow. Yields of the check plots (0-0 treatment) were greatly affected by the preceding cropping treatment.



Yields of wheat from different fertilizer treatments following fallow, corn, and wheat, at Mandan, North Dakota.

It is not implied that summer fallow should be eliminated immediately from the Great Plains region as a whole. As better moisture-conservation practices are devised the acreage of summer fallow can be limited still further, and eventually the final goal should be to eliminate summer fallow entirely. In many areas of the Great Plains, sufficient water is received to produce a profitable crop if most of it could be conserved and made available to the succeeding crop. If methods can be found which would conserve two-thirds of the moisture which falls during this period, than as much moisture would be stored in the soil by the first spring after harvest as during the entire fallow period.

Let's take another look at fallow and make certain that the benefits obtained from this practice are due mainly to moisture and not solely to the increased supply of available nutrients. The latter can be supplied by fertilizer.

SWCRD, ARS, USDA, Mandan, N. Dak.

Kincaid, R. R. CROP ROTATION AND FALLOWING IN RELATION TO TOBACCO DISEASE CONTROL. The Bot. Rev. 26: 261-276. 1960.

Experiments during the past 30 years have put rotation on a more sound scientific basis and uncovered reasons for the superiority of one rotation over another. Soil-borne diseases have often had a controlling influence on the outcome of the tobacco crop. However, other factors, including soil fertility, also must be considered in a choice of rotations.

Rotations recommended from the standpoint of tobacco disease control are those which may be expected to decrease soil infestation by tobacco pathogens, as shown by a reduction in the incidence of the soil-borne disease on the succeeding tobacco crop.

Soil-borne diseases of tobacco which have been found amendable to control by crop rotation include some caused by nematodes, fungi, bacteria, viruses, and parasitic seed plants. One other, brown root rot, is considered to be caused by toxic residues resulting from the decomposition of certain preceding crops and evidently has been confused in many instances with nematode root rot.

Available literature on crop rotation and fallowing in relation to tobacco disease control is reviewed in the following account for each disease as listed. The effects of plant-parasitic nematodes in aggravating certain fungus and bacterial diseases, and the idea of varying rather than fixed, rotation are also discussed. Diseases considered and their causal agents are: Root knot--(Meloidogyne spp.); Brown root rot--Toxic residues; Nematode root rot--(Pratylenchus spp.); Stunt--(Tylenchorhynchus claytoni); Blackshank--(Phytophthora parasitica var. nicotianae); Black root rot--(Thielaviopsis basicola); Fusarium wilt--(Fusarium oxysporum var. nicotianae); Stem rot--(Sclerotium rolfsii); Sclerotinia disease--(Sclerotinia sclerotiorum); Brown spot--(Alternaria longipes); Bacterial (Granville) wilt--(Pseudomonas solanacearum); Wildfire--(Pseudomonas tabaci); Angular leaf spot--(Pseudomonas angulata); Mosaic--Tobacco mosaic virus; Broomrape--(Orobanche spp.); Witchweed--(Striga spp.).

J. Ser. No. 738, Fla. Agr. Expt. Sta., Gainesville, Fla.

Rea, H. E. SODIUM DALAPON--GRASS KILLER. Tex. Agr. Expt. Sta. MP-423, 8 pp. 1960.

Sodium dalapon in water is an outstanding grass-killer. Texas farmers use this herbicide mostly for controlling Johnsongrass and Bermudagrass along fences, roads, and ditches and for spot-spraying Johnsongrass in cotton. Home owners and others also use it for controlling nutgrass.

Dalapon sprays, with and without sodium TCA, have been used at College Station since 1953. Spraying in non-crop areas ordinarily was with a quick-acting power spraygun controlled by the driver of a pick-up truck or tractor or by a man on foot. Non-selective spraying in cotton was mostly with a Texas Slidegun, but sometimes men walking behind a tractor sprayer used power sprayguns. Selective spraying in cotton usually was with a Texas Jetgun.

Spraying non-crop infestations of these grasses was most practical when it was used to supplement tillage or mowing, or was used to treat spotted stands and infested sites inaccessible for mechanical control. Costs for broadcast spraying of large acreages were prohibitive.

Treating spring growth, about 10 inches tall but before the boot stage, with 20 pounds of dalapon in 100 gallons of water was most effective for controlling Johnsongrass on non-crop sites. Three or four applications at about 10-day intervals ordinarily eradicated the grass at a cost of about $40 a mile for a 4-foot strip.

A 30-pound dalapon spray, or a mixture of 20 pounds of dalapon and 40 of TCA in 100 gallons of water, was more reliable for treating Johnsongrass after the boot stage of growth. Eradication usually required three to five treatments and cost $75 to $100 a mile.

A 20-pound dalapon spray was effective for treating fresh growth of undisturbed Bermudagrass and usually eradicated the grass after three applications 10 to 14 days apart. Costs for this treatment were similar but usually lower than for eradicating 10-inch Johnsongrass. A 30 pound dalapon spray or the dalapon-TCA mixture was more reliable for treating rank growth of succulent Bermudagrass.

A 40-pound dalapon spray was most effective for treating spotted stands of nutgrass and infestations around structures. Four or more applications at intervals needed to keep the nutgrass killed to the ground were required for eradication. Costs for this treatment were high and varied widely.

Non-selective, spot-application of dalapon sprays in cotton was used for rapid eradication of Johnsongrass infestations occupying 10 percent or less of the row space and mostly in widely scattered small clumps at a cost of $3 to $8 an acre. Cotton in the treated spots was killed by the first spraying. Treating the grass at or prior to the 10-inch stage of growth was less hazardous to cotton plants around the spots than treating taller grass. A spray containing 20 pounds of dalapon and 40 of TCA in 100 gallons of water killed the grass promptly, and, under favorable rainfall conditions, eradicated or nearly eradicated it after a single treatment.

Selective application of dalapon spray was used to treat 3 to 5-inch Johnsongrass sprouts left in the cotton row after cultivation. Only an occasional cotton plant was accidentally killed by such treatments. Eradicating infestations of 10 percent or less by this method cost $9 to $18 an acre when 20 pounds of dalapon in 100 gallons of water were applied, and $6 to $12 an acre when a 10-pound dalapon spray was used. The safe and economical limit for this practice was about a 20 percent infestation.

Texas. Agr. Expt. Sta., College Station, Tex.

Hamilton, K. C., Arle, H. F., and McRae, G. N. CONTROL AND IDENTIFICATION OF CROP WEEDS IN SOUTHERN ARIZONA. Ariz. Agr. Expt. Sta. B. 296 Rev., 67 pp. 1960.

Current weed control practices in irrigated crops of southern Arizona are summarized. It contains illustrations and descriptions of the most serious weeds. The bulletin was prepared to aid farmers in: (1) Identifying the common weeds of irrigated fields and (2) selecting the proper methods to control these weeds.

Agr. Expt. Sta., U. Ariz., Tucson, Ariz.

Friesen, G., and Shebeski, L. H. ECONOMIC LOSSES CAUSED BY WEED COMPETITION IN MANITOBA GRAIN FIELDS. I. WEED SPECIES, THEIR RELATIVE ABUNDANCE AND THEIR EFFECT ON CROP YIELDS. Canad. J. Plant Sci. 40: 457-467. 1960.

Economic losses caused by weed competition in Manitoba grain crops were studied on 142 farm fields during a 3-year period, 1956 to 1958 inclusive. Fields were located at intervals of 6 miles along main roads and were all within a 60-mile radius of Winnipeg. Immediately after seeding, ten paired plots, each 4 feet square, were staked in each field. One member of each pair of plots was kept free of weeds by hand pulling at weekly intervals. The species of weeds present and the relative numbers were recorded. As the crops reached maturity a square-yard sample from each plot was harvested for yield determinations.

Twenty-eight species of weeds were found growing in the fields. Weed counts ranged from 0 in the cleanest field to 2,143 weeds per square yard in the weediest field, with an over-all recorded average of 224 weeds per square yard. Reductions in crop yields due to weed competition in individual fields ranged from no apparent decrease to 61.5 percent. The average reduction in crop yields for all fields over the 3-year period was 15.25 percent. This represents an average annual loss in Manitoba of 28,657,070 bushels of grain, valued at approximately $32,379,537.

U. Manitoba, Winnipeg, Manitoba, Canada.

Crop Residue Management

Norstadt, F. A., and McCalla, T. M. INFLUENCE OF STUBBLE MULCHING ON ORGANIC MATTER AND NITROGEN CONTENT OF THE SOIL. Agron. J. 52: 477-479. 1960.

The effect of continuous stubble mulching and plowing on readily oxidizable organic matter, carbon, and nitrogen was evaluated in a series of 9 plot replications established for 19 years and in 4 replications established for 14 years on Sharpsburg sicl. Increases in readily oxidizable organic matter, carbon, and nitrogen with stubble mulching ranged from 5 to 10% and were concentrated in the surface inch of soil. There were no measurable differences between tillage treatments at depths of 1 to 6 and 6 to 12 inches. The nature of the organic matter, as measured by these analyses, apparently was not affected by tillage practices. Correlation coefficients between readily oxidizable organic matter and carbon indicate a close agreement of changes in one with changes in the other, but there was a tendency for the subtilled plots to show a lower correlation.

Jr. Author, SWCRD, ARS, USDA.

Tillage

Stolzy, L. H., Szuszkiewicz, T. E., Garber, M. J. and Harding, R. B. EFFECTS OF SOIL MANAGEMENT PRACTICES ON INFILTRATION RATES. Soil Sci. 89: 338-341. 1960.

In a study of citrus orchards with a compacted soil layer due to cultural practices, the following conclusions were drawn: (1) Nontillage improved the infiltration rates; (2) wood sawdust and shavings mulches had no apparent effect on infiltration rates; and (3) chiseling alone and in conjunction with fumigation had no measurable affect on infiltration rates.

U. Calif., Citrus Expt. Sta., Riverside, Calif.

W. R. Gill, and McCreery, W. F. RELATION OF SIZE OF CUT TO TILLAGE TOOL EFFICIENCY. Agr. Engin. 41: 372-374, 381. 1960.

The size of cut of a tillage tool in a consolidated cohesive soil is an important factor in the resultant meanweight diameter of the clods. The principle of utilization of small cuts might be profitably considered in the design and employment of tillage tools in hard soils.

A method to determine the efficiency of tillage tools and methods based upon an equivalent amount of work done to the soil has been developed. It would appear that smaller size cuts are more efficient than larger cuts for a tool shaped like a plow moldboard, even though more fuel would be consumed in drawing the tool through the soil.

Nat'l Tillage Machinery Lab., AERD, ARS, USDA, Auburn, Okla.

Taylor, R. BIG TOOTH CHEWS UP FRESNO SOILS. West. Crops and Farm Mangt. 9(8): 15. 1960.

For two years the Navelencia Soil Conservation District's "big tooth" has been ripping 52 inches down into southeastern Fresno County's hardpan soils.

Leveling this rolling grainland for tree and row crops brought the hardpan and an 8-inch layer of claypan to the surface in many places. District officials felt ripping--real deep ripping--was the answer. Now they enthusiastically point to fields ripped in the past two years that show good drainage. During heavy rains these ripped areas are the only fields free of surface water.

The ripper is mixing the San Joaquin-type soil well when used on 3-ft. center. Only time can determine the permanent drainage improvement and the improvement of percolation in the pack sand below the tooth's 52-inch bite. This ripping method holds promise for other types of soils with hardpan barriers.

The district charges ranchers a flat rate for the equipment and, when this is combined with the cost of fuel and operators for the two tractors needed to pull the ripper, the cost averages $30 to $50 an acre.

West. Crops and Farm Mangt., 4511 Produce Plaza, Los Angeles, Calif.

National Tillage Machinery Research Laboratory PUBLICATIONS LIST ON TILLAGE AND TRACTION. U.S.D.A., A.R.S. 42-40, 14 pp. 1960.

This list of publications (1925-59) represents the results of research at the National Tillage Machinery Laboratory at Auburn, Alabama. Such publications are an important contribution to the scientific literature of tillage and traction equipment and related phases of soil science. In many cases they report findings of research from which cooperating equipment-manufacturing companies have obtained data that helped them to serve the American farmer better.

Early publications in the list report the results of research by agricultural engineers of the Alabama Agricultural Experiment Station. Results of this research led to a cooperative project with the United States Department of Agriculture and this in turn influenced the establishment of the Laboratory in 1935.

ARS, USDA, Inform. Div., Washington 25, D.C.

Fertility Requirements for Conservation Farming

Tremblay, F. T. FERTILIZER PLACEMENT: PUT IT WHERE IT COUNTS! Western Crops and Farm Mangt. 9(4): 18-20. 1960.

Putting fertilizer where it counts is the art of putting fertilizer at the right place at the right time to bring about maximum crop yields of superior quality.

Dollar increases per acre from proper placement alone have run as high as $215 for pole beans, $105 for broccoli, $450 for cucumbers, $280 for market peas, $60 for potatoes, and $20 for field peas. With some crops, such as sweet corn, cucumbers, and tomatoes, band placement can push the crop to the extent that the operator can harvest 10 days to weeks earlier than he could otherwise. And getting in on an earlier market can often spell the difference between success and failure.

By definition, proper placement of fertilizer could include a number of methods of application such as: (1) Banding; (2) side-dressing, (3) application in the irrigation water; (4) foliar spray; or (5) broadcasting. There is no one best method for all soils and crops, and sometimes a combination of methods results in the most economical yields. The advantages and disadvantages of the various methods for different types of fertilizer are discussed.

Pacific Northwest Region. Dir., Nat'l Plant Food Inst.

Hardesty, J. O. FERTILIZER CONDITIONING. Agr. Chem. 15(6): 53-54. 1960.

A review of some significant data pertaining to the causes and alleviation of poor physical condition in mixed fertilizers is discussed. Effects of present-day ammoniating solutions on the physical condition of mixtures is also considered.

SWCRD, ARS, USDA, Beltsville, Md.

Boawn, L. C., Nelson, C. E., Viets, F. G., Jr., and Crawford, C. L. NITROGEN CARRIER AND NITROGEN RATE INFLUENCE ON SOIL PROPERTIES AND NUTRIENT UPTAKE BY CROPS. Wash. Agr. Expt. Sta. B. 614, 24 pp. 1960.

A crop sequence of sorghum, potatoes, sugar beets, and sorghum was grown on plots treated factorially with three N carriers and three rates of N. Corn was grown 2 years following this sequence to remove residual N. Data were taken for yields, soil pH, changes in exchangeable and soluble soil cations, and for leaf content and uptake of N, P, K, Ca, Mg, and Mn. Crop residues were removed from the plots after harvest. All crops were irrigated carefully to provide adequate water, yet prevent or minimize leaching of nitrate.

Soil pH in the 0-8 inch depth was lowered from 7.4 to a minimum of 6.0 by $(NH_4)_2SO_4$ applied at a rate of 160 pounds N/A. The effect of NH_4NO_3 was less, and $Ca(NO_3)_2$ had no effect on pH. Application of $Ca(NO_3)_2$ and 5 tons of lime annually increased pH.

Soil samples taken after the carrier had been applied annually for 4 years showed only slight changes in both exchangeable and soluble cations in the surface 8 inches.

Nitrogen uptake by sorghum, for both years that it was grown, was approximately 1.4 times greater from plots fertilized with $(NH_4)_2SO_4$ than from plots where $Ca(NO_3)_2$ fertilizer was used. The uptake of N from NH_4NO_3 was intermediate both years. Similar difference occurred in grain yields. In contrast, N source had no effect on N uptake nor on yields of potatoes and sugar beets.

The total recovery of applied N by the crops, including the two corn crops, was remarkably good. Recovery averaged 85.7 percent for the 160 pound N rate, 84.9 percent for the 80 pound rate, and 73.1 percent for the 40 pound rate. For the sequence sorghum-potatoes-sugar beets there was no significant difference in recovery of nitrogen from the three N carriers even though $(NH_4)_2SO_4$ was much superior for sorghum. At the end of 6 years, recovery of nitrogen was 88.4 percent from $(NH_4)_2SO_4$, 85.9 percent from NH_4NO_3, 82.7 percent from NH_4NO_3, 82.7 percent from $Ca(NO_3)_2$ and 76.1 percent from $Ca(NO_3)_2$ plus lime where 160 pounds of N was applied annually for 4 years. The recovery of nitrogen was inversely related to soil pH, owing chiefly to the specific behavior of sorghum and possibly corn.

The treatments applied did not appear to have pronounced influence on P availability. The P concentration in sorghum tops remained constant with increase in plant size, but decreased in potato and sugar beet tops as the plant size increased, owning to N rate.

The uptake of Ca, K, and Mg was not influenced markedly by the treatments imposed. In each crop, the sums of these cations, expressed on the basis of milli-equivalents per 100 grams, were fairly constant over a wide range in plant size. In general, as the rate of N was increased, the uptake of Ca and Mg in me./100 g. was increased and the uptake of K decreased.

Nitrogen application had a pronounced effect on Mn uptake, especially when the crop was potatoes or sugar beets. Manganese concentration in potato tops was increased from 54 to 144 p.p.m., and in sugar beet tops from 193 to 385 p.p.m. by application of $(NH_4)_2SO_4$. In both cases, the Mn concentrations are highly correlated with soil pH.

The concentrations of P, Ca, K, Mg, and Mn in leaf tissues could not be evaluated as determinant of yields because they intended to be highly correlated with leaf N which had a highly significant effect on yield.

SWCRD, ARS, USDA, and Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

McBeath, D. K., and Toogood, J. A. THE EFFECT OF NITROGEN TOP DRESSING ON YIELD AND PROTEIN CONTENT OF NITROGEN-DEFICIENT CEREALS. Canada J. Soil Sci. 40: 130-135. 1960.

Top dressings of ammonium nitrate were made during the growing season to crops of barley and oats showing symptoms of acute nitrogen deficiency. The addition of nitrogen in the early stages of plant growth resulted in increased vegetative growth and increased yields. Applications of nitrogen delayed until the shot-blade stage had little effect on yield, but substantially increased the protein content. The yield of protein per acre was increased with high rates of fertilization, regardless of whether the effect of the added nitrogen was to increase yield or protein content.

U. Alberta, Edmonton, Alberta, Canada.

Painter, L. I., and Singleton, P. C. EFFECT OF FOUR NITROGEN CARRIERS ON YIELD OF CROPS AND ON PHYSICAL AND CHEMICAL PROPERTIES OF SOIL. Wyo. Agr. Expt. Sta. B. 365, 12 pp. 1960.

Two greenhouse trials and 4 field tests were conducted to measure the effect of 4 different carriers on crop yields and soil properties.

The greenhouse trials indicated that the type of nitrogen most effective for increasing plant yields was governed by the type of plant grown. Barley and sunflowers responded best to ammonium nitrogen; tomatoes responded best to nitrate-nitrogen materials. The effect of the 4 nitrogen fertilizers on soil properties corresponded directly to the acidifying power of the material used, with ammonium sulfate inducing the greatest change in pH_s (pH reading of saturated soil paste) settling volume, modulus of rupture, air/water permeability ratio, and sodium-to-calcium-plus-magnesium ratio. The effects were more pronounced and of practical magnitude only on the synthetic alkali soil.

Field experiments indicated that the four sources of nitrogen were equally effective for increasing yields of corn, small grain, and sugar beets on soils at Torrington, Powell, and Riverton, Wyoming.

The effect of the different sources of nitrogen on soil properties generally corresponded with the acidifying power of the material used. Application of ammonium sulfate induced the greatest change in pH_s, pH_5 (pH reading of 1:5 soil/water suspension), ECe (Electrical conductivity of saturation extract in mmhos 1 cm), and soluble calcium plus magnesium. These changes were statistically significant but of small magnitude and would probably not warrant selective use for plant growth, except on soils with extremely adverse conditions as a result of high sodium.

U. Wyo., Agr. Expt. Sta., Laramie, Wyo.

Brage, B. L., Zich, W. R., and Fine, L. O. THE GERMINATION OF SMALL GRAIN AND CORN AS INFLUENCED BY UREA AND OTHER NITROGENOUS FERTILIZERS. Soil Sci. Soc. Amer. Proc. 24: 294-296. 1960.

Field experiments comparing the use of urea to other fertilizers were performed. The fertilizer was placed with the seed in all but two experiments.

Urea containing 2.5% biuret reduced stands of small grain by 30% when the equivalent of 20 pounds nitrogen per acre was applied with the seed. Ammonium nitrate at 80 pounds nitrogen per acre caused a reduction in stand of 10%. Stands were depressed by 25 and 60% when 40 and 80 pounds nitrogen, respectively, as reagent urea were used per acre.

Urea, containing 10% biuret, applied broadcast at 160 pounds nitrogen per acre, caused no damage to germination of either corn or barley.

Urea was intermediate between ammonium carbonate (most damaging) and ammonium nitrate in a greenhouse germination trial.

When fertilizer was mixed with the soil in the laboratory, considerable ammonia was evolved from the soil atmosphere by aeration when either urea, ammonium hydroxide, or ammonium carbonate was used. Only traces of ammonia were removed from soils treated with either ammonium nitrate, ammonium sulfate, or biuret. Ammonia gas formed from urea, and the contaminant biuret in urea, are therefore both instrumental in causing commercial urea to be toxic to germinating seeds.

S. Dak. Agr. Expt. Sta., Brookings, S. Dak.

Clark, K. G., and Lamont, T. G. CORRELATION BETWEEN NITRIFICATION AND ACTIVITY INDEXES OF UREA FORMALDEHYDE IN MIXED FERTILIZER. J. Assoc. Off. Agr. Chem. 43: 504-506. 1960.

Collaborative studies were conducted in 1959 on the nitrogen activity index procedures for evaluating the quality of the water-insoluble nitrogen contents of urea-formaldehyde reaction products and mixed fertilizers formulated to contain such products.

The Associate Referee on Nitrogen in Fertilizers distributed four samples of mixed fertilizer and one sample of a urea-formaldehyde material for these studies.

This paper presents the results of nitrification studies conducted on the samples submitted to the collaborators and indicates the relationship found between the activity and nitrification indexes.

SWCRD, ARS, USDA, Beltsville, Md.

MacLeod, L. B., Bishop, R. F., Jackson, L. P., MacEachern, C. R., and Goring, E. T. A LONG-TERM FIELD EXPERIMENT WITH COMMERCIAL FERTILIZERS AND MANURE. I. FERTILITY LEVELS AND CROP YIELDS IN A ROTATION OF SWEDES, OATS AND HAY. Canad. J. Soil Sci. 40: 136-145. 1960.

In the field experiment, conducted from 1936-57; a rotation of swedes, oats, and hay was followed and treatments included commercial fertilizers and manure.

Changes in the chemical composition of the soil during the experiment included significant decreases in soil organic matter, total nitrogen, and cation capacity. In no case was the initial content of exchangeable potassium maintained and although changes in adsorbed and easily acid-soluble phosphorus were negligible with a number of treatments only one resulted in a significant increase.

The treatments were applied in the swede year and yield differences with this crop were greater than for either the oats or hay. Data for the latter two crops indicated that with most of the treatments there was a tendency for yields to decline as the experiment progressed. This was not the case with swedes where variation in yields with rotation cycles was greater than it was in the case of oats or hay. There was a considerable residual effect from manure, and phosphorus had a greater effect on yields than either nitrogen or potassium.

Contribution No. 104 Expt. Farm, Nappon, Novia Scotia, Canada.

Jedele, D. G., and Hansen, E. L. HANDLING HOG MANURE AS A LIQUID. U. Ill. Col. Agr. Ext. Serv. C. 820, 8 pp. 1960.

Manure handling has become a major problem for farmers who are raising large numbers of swine in confinement. This is especially true for swine growers who clean regularly instead of using a built-up litter system. Since hog manure is never really solid, liquefying all of the manure is one way to handle it. As used in this circular, the term "liquid manure" means both urine and feces mixed with water.

Washing floors regularly is an aid to sanitation and gives better control of odors and flies, Properly planned, a washing system can also save time and labor.

The liquid manure is at least as valuable for fertility as the same manure handled in solid form, and returning it to the land is a commendable practice. While in storage, there is some bacterial action that causes decomposition and release of ammonia to the air. Then, because storage capacity is usually limited, the manure must sometimes be spread at a time when the land can't make best use of it.

Some excess liquids are not soaked up in the bedding under any livestock program. One method of handling manure, then, is to remove the solids with the usual equipment but have controlled disposal of the excess liquids. Another plan that works well for some northern Illinois swine growers is to handle the manure as a solid in the winter and as a liquid in the summer. In a third system, all manure from a confinement hog operation is handled in liquid form year around. Bedding is used sparingly or completely eliminated. A closed building is recommended in order to maintain above-freezing temperatures. Under-floor heat may be advisable.

A liquid-manure system consists of floors, gutters, underground tanks, and some method of disposal.

Good conservation practices require returning manure to the land. Liquid must be moved out of storage throughout the year, often causing a burden during times of peak labor demands on the farm. Frequently it is difficult to find a convenient place to put the manure because sometimes the land is not suitable for travel with heavy equipment and at other times the crops are too high to drive through. Because of these difficulties, underground or lagoon-disposal methods of wasting the manure are also discussed.

Most Illinois farmers with liquid-manure systems are spreading the material on cornland for as long as they can drive through the crop. Then they spread it on pastures.

To dispose of the effuent from a septic tank, an underground disposal system is used. The design of this system should follow accepted practices for household-disposal systems. Hooking onto a field tile from the septic tank is not recommended. This practice may cause pollution farther downstream.

Lagoon disposal is a method that does away with the storage tank and pumping-and-spreading equipment. The liquid manure flows into a lagoon or pond where it is stabilized by bacterial action. The fertility value of the manure is wasted, but the savings in equipment and labor offset most of the loss. Although lagoons have been used for city sewage and factory wastes for years, they have had only limited trial for manure disposal. Manure is much more concentrated than domestic wastes, however, and no one knows at present how well the lagoons will continue to work or what maintenance problems may arise.

Farmers who are using lagoons report no problems with odors or flies. Naturally, you can expect some odors on still, humid days in the summer and for a period in the spring while the lagoon reestablished itself after it has been frozen over in the winter. You should place the hog operation, including the lagoon, on the side of the farmhouse away from prevailing winds. If the lagoon is located next to the concrete finishing floor, manure can be scraped or washed directly into it; or if the lagoon is to serve several buildings, manure can be piped to it through 6-inch to 8-inch sewer tile. Fall on the tile should be 2 feet per 100 feet. The inlet pipe can discharge into the lagoon above the surface of the water.

AERD, ARS, USDA, and Coop. Ext. Work in Agr. and Home Econ., U. Ill., Col. Agr., Urbana, Ill.

Francki, R. I. B. STUDIES IN MANURIAL VALUES OF SEAWEEDS: I. EFFECTS OF PACHYMENIA HIMANTOPHORA AND DURVILLEA ANTARCTICA MEALS ON PLANT GROWTH. Plant and Soil 12(4): 297-310. 1960.

Investigations have been undertaken into the manurial values of two New Zealand seaweed species, Pachymenia himantophora Rhodophyceae and Durvillea antarctica Phaeophyceae. Chemical analyses have shown that Durvillea is richer than Pachymenia in cations and chloride but poorer in nitrogen and sulphur. When applied to soil in the form of dry meal Pachymenia was found to stimulate the growth of tomato seedlings on some soils and depress it on others; Durvillea, on the other hand, depressed growth on all the soil types used. Experiments indicated that the salts contained in the seaweeds were not harmful to plant growth.

Pachymenia may be inhibitory to plant growth on some soils through causing a greatly increased manganese uptake and there was an indication that in treated soils the level of available phosphate was lowered, at least initially. Durvillea is thought to induce nitrogen deficiency in soils by virtue of its high C/N ratio; this is, however, unlikely to be the sole factor responsible.

Effects of seaweeds on soil conditions are complex and can involve many factors: the manurial values of a species cannot be judged solely on its mineral analysis.

Botany Dept., U. Auckland, New Zealand.

Francki, R. I. B. STUDIES IN MANURIAL VALUES OF SEAWEEDS: II. EFFECTS OF PACHYMENIA HIMANTOPHORA AND DURVILLEA ANTARCTICA ON THE IMMOBILIZATION OF NITROGEN IN SOIL. Plant and Soil 12(4): 311-323. 1960.

The effects of applying dry meals from the seaweeds Pachymenia himantophora and Durvillea antarctica on the inorganic nitrogen metabolism and microbiological activity of soils has been investigated. Glasshouse trials have shown that plants grown on Durvillea-treated soil suffer from nitrogen deficiency which can be reversed by the addition of ammonium nitrate. Both the seaweeds, and in particular Durvillea, were found to immobilize inorganic nitrogen in soils. This removal of available nitrogen is considered to be due to the greatly stimulated microbiological activity shown to take place following seaweed treatment.

Botany Dept., U. Auckland, New Zealand.

Lathwell, D. J., Cope, J. T., Jr., and Webb, J. R. LIQUID FERTILIZERS AS SOURCES OF PHOSPHORUS FOR FIELD CROPS. Agron. J. 52: 251-254. 1960.

Field experiments were made in the Southeastern States, Iowa, and New York from 1956 to 1958 to evaluate TVA experimental solid and liquid fertilizers as sources of P for corn, oats, wheat, and cotton. Fertilizer materials used were concentrated superphosphate, diammonium phosphate, ammonium metaphosphate, ammoniated wet process phosphoric acid, ammoniated superphosphoric acid, and phosphoric acid.

In most experiments, response was similar to P applied from the same material in liquid and solid forms. Likewise, response to liquids was similar in response to concentrated superphosphate. It is likely that under many conditions response to liquid materials would be greater than that to solid materials containing a rather low proportion of water-soluble P. In general, under a wide range of conditions liquid fertilizers are as satisfactory as equivalent solid fertilizers for many crops. Since these liquid materials generally do not contain sulfur and some are acid forming, they should in such cases be supplemented with sulfur and lime if used continuously on soils sensitive to these limitations.

Cornell U., Agr. Expt. Sta., N. Y. State Col. Agr., Ithaca, N. Y.

Doll, E. C., Miller, H. F., and Freeman, J. F. INITIAL AND RESIDUAL EFFECTS OF ROCK PHOSPHATE AND SUPERPHOSPHATE. Agron. J. 52: 247-250. 1960.

In 1931, phosphate applications to certain plots of the Campbellsville experiment field were discontinued after 1,032 and 258 pounds P per acre had been applied as rock phosphate (RP) and superphosphate (SP), respectively, during the preceding 12 years, and on the Greenville field after 812 and 203 pounds of P, respectively, had been applied during the preceding 18 years. Applications were continued on other plots, totaling 1,216 and 304 pounds of P per acre as RP and SP, respectively, after 26 years at Campbellsville, and 1,420 and 458 pounds of P, respectively, after 27 years at Greenville. In a rotation of corn, wheat, and grass-legume hay, average yields of corn and hay were highest when RP was continued and wheat yields highest when SP was continued. Yield trends, calculated as linear and quadratic regressions of yields on years, indicated that yields of all crops increased throughout the experiment by continued application of RP and SP. When SP was discontinued, yields of all crops except hay at Campbellsville decreased rapidly; but when RP was discontinued, yields of all crops except hay at Greenville tended to increase. However, the rate of increase when RP was discontinued was always less than when applications were continued.

In another rotation of corn, wheat, and hay at Greenville, yields with RP were lower initially than yields with concentrated superphosphate (CSP), but after 4 years yields from residual applications of RP were greater than those from residual CSP. With burley tobacco at Campbellsville, yields obtained from an application of 600 pounds of P_2O_5 per acre as RP were nearly as high in the second year and as high or higher the third and fourth years, as those obtained with CSP applied initially to supply 120 pounds P_2O_5 per acre and annually thereafter to supply 60 pounds of P_2O_5.

Ky. Agr. Expt. Sta., U. Ky., Lexington, Ky.

Ensminger, L. E. RESIDUAL VALUE OF PHOSPHATES. Ala. Agr. Expt. Sta. B. 322, 20 pp. 1960.

Numerous field tests have been conducted since 1930 to determine the residual value of phosphorus in terms of crop yields. In many cases extractable phosphorus was correlated with yields for calibrating soil test methods. Radiophosphorus has also been used to evaluate the availability of accumulated phosphorus in soils.

Results of residual phosphorus studies to date are summarized as follows: (1) Soil analysis data showed that applied phosphorus accumulated in soils and the extent of accumulation was in proportion to the amount applied. (2) Yields of cotton, vetch, and Ladino clover showed residual effects that were directly related to past phosphate fertilization. Where moderate amounts of phosphorus had been applied, crop yields usually decreased when application was discontinued. Where high amounts of phosphorus had accumulated, yields were not reduced much when phosphorus was discontinued.

(3) Considerable residual effects were obtained from all sources studied as measured by crop yields. For any particular source, the residual effect was directly related to the amounts that had been added. Basic slag gave the greatest residual effect of any of the sources. (4) Even though accumulated phosphorus is chemically fixed by soils, yield data show that it is of considerable value in crop production and should be considered in making fertilizer recommendations. And (5) extractable phosphorus content of soils was directly related to yield response to residual phosphorus. This relationship is the basis for making phosphorus fertilizer recommendations by soil test.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

Taylor, A. W., Gurney, E. L., and Lindsay, W. L. AN EVALUATION OF SOME IRON AND ALUMINUM PHOSPHATES AS SOURCES OF PHOSPHATE FOR PLANTS. Soil Sci. 90: 25-31. 1960.

Well-characterized samples of seven iron and aluminum phosphates were used as sources of phosphate for three successive crops of corn grown in a phosphate-deficient soil in the greenhouse.

Calcium ferric phosphate ($H_4CaFe_2(PO_4)_4 \cdot 5H_2O$), potassium taranakite ($H_6K_3Al_5(PO_4) \cdot 18H_2O$), colloidal aluminum phosphate, and colloidal iron phosphate, all of which are believed to be formed by the action of acid solutions of fertilizers upon soil, were found to be relatively good sources of phosphorus and cannot be regarded as responsible for the "fixation" of phosphate from water-soluble fertilizers.

An acidic potassium iron phosphate, $H_8KFe_3 \cdot (PO_4)_6 \cdot 6H_2O$ was found to be a very poor source of phosphate.

Synthetic preparations of aluminum and iron leucophosphites, $KAl_2(PO_4)_2 OH \cdot 2H_2O$ and $KFe_2 \cdot (PO_4)_2OH \cdot 2H_2O$, showed only a slight response over that of the untreated soil.

TVA, Wilson Dam, Ala.

Rouse, R. D. POTASSIUM REQUIREMENTS OF CROPS ON ALABAMA SOILS. Ala. Agr. Expt. Sta. B. 324, 29 pp. 1960.

Studies have been conducted throughout the State to determine the potassium need of crops grown on the various soils. The results of potassium studies up to the present time lead to the following conclusions: (1) Soils vary in their capacity to supply potassium and even the most productive soils of Alabama require additions of potassium fertilizer to offset that lost by cropping and leaching. (2) Crops vary in potassium needs and in ability to obtain sufficient potassium from the soil. This necessitates different potassium recommendations on the same soil for different crops and cropping systems. (3) Soils that are low in available soil potassium should receive potassium fertilizer additions large enough to build up the level if maximum production is to be obtained. (4) No advantage was found from dividing potassium fertilizer for cotton into a planting application and a sidedressing. However, when the planting application is inadequate a response is obtained from a sidedressing. (5) In cotton production, sodium should not be considered as a substitute for potassium when fertilizing for maximum yields. And (6) because of original differences in soil levels and differences resulting from past cropping and fertilization, the most efficient potassium recommendation for a given crop on a particular field can be given only when the soil test value for potassium is known.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

Leggett, G. E., and Crawford, C. L. POTASH MAY REDUCE PLANT UPTAKE OF AMMONIUM NITROGEN. Crops and Soils 12(5): 21. 1960.

The availability of ammonium fertilizer added to certain soils may be seriously decreased by applying potassium fertilizer, according to greenhouse tests.

Many soils contain clay minerals which can hold ammonium or potassium between their plate-like layers. Thus, when ammonium or potassium fertilizer is added to a soil containing this type of clay, part of the added nutrients are trapped in the clay minerals.

Before this trapped ammonium can be released for use by plants, the plate-like layers must expand to allow the ammonium to escape. The amount of fixed ammonium held by the clay depends on the amounts of "free" ammonium or potassium present, since the latter prevent the clay minerals from expanding.

The effect of the "free" ammonium is only temporary, since it is soon converted to the nitrate form of nitrogen. But the amount of potassium may be increased by applying potash fertilizers, thus blocking the escape of the trapped ammonium.

Greenhouse tests showed that potassium fertilization decreased the amount of nitrogen taken up by Sudangrass, when ammonium fertilizer had been added to a Palouse sil. This soil can fix 560 pounds of nitrogen per acre in the plow layer.

Rate and placement of the ammonium and potassium fertilizers determined how much the availability of the ammonium was decreased by the potassium. Sudangrass took up less nitrogen from the soil where the ammonium and potassium fertilizers were mixed together in the soil, or together in the same band, than when the two materials were placed separately in the soil. Separate placement sometimes eliminated entirely any fixation of ammonium.

When a nitrate form of nitrogen fertilizer was used, potassium fertilizer had no effect on the amount of nitrogen taken up by the Sudangrass. And potassium fertilizer had no effect on plant uptake of either ammonium.

Only certain of the clay minerals have the expanding-type layers which trap nutrients. Montmorillonite and vermiculite are two such minerals, and both are commonly found in soils of the Midwest and West. Kaolinite is an example of the nonexpanding clay which cannot fix ammonium.. It is commonly found in Southern and Eastern soils.

Irrig. Expt. Sta., Prosser, Wash.

Hogg, D. E. MAGNESIUM LOSSES FROM HOROTIU SANDY LOAM FOLLOWING APPLICATION OF POTASSIUM CHLORIDE. New Zealand J. Agr. Res. 3: 377-383. 1960.

Laboratory and field investigations on Horotiu sl indicate a loss of magnesium as a result of KCl topdressing. Losses are increased by the addition of nitrogenous fertilizers. KCl applications cause a greater initial loss of magnesium than do K_2SO_4 applications.

Rukuhia Soil Res. Sta., Dept. Agr., Hamilton, New Zealand.

Shepherd, L., Kawton, K., and Davis, J. F. THE EFFECTIVENESS OF VARIOUS MANGANESE MATERIALS IN SUPPLYING MANGANESE TO CROPS. Soil Sci. Soc. Amer. Proc. 24: 218-221. 1960.

Field tests on Houghton muck and greenhouse studies on alkaline organic and mineral soils were conducted to determine the comparative effectiveness of several manganese carriers as measured by yield response and manganese content of crops. Spray, broadcast, and banding methods of application were studied in field tests and mixing vs. banding of carriers was studied in the greenhouse. Carriers used in the field studies were manganese sulfate, NuM, Mangasoil, NuManese, and FN 239 B frit. In addition to the above five carriers, FN 502 frit and disodium manganous EDTA were used in the greenhouse. The indicator crops were onions in the field, and corn, beans, and wheat in the greenhouse.

In field studies, the methods of application in order of effectiveness in increasing the yield of onions were banding, broadcasting, and spraying. In 1957, where the manganese carriers were mixed with the basic fertilizer and banded 2 inches below the seed, a significant yield response to manganese was obtained regardless of the carrier used. No difference was observed between carriers or rates applied (10 and 20 pounds of manganese per acre).

Greenhouse results indicated a high residual value on Houghton muck for Mn EDTA followed by FN 239 B, NuManese and manganese sulfate. The difference between the later two was nonsignificant. On the mineral soil, mixing the carriers throughout the soil gave a significant yield response only with the wheat crop when compared to band applications.

Mich. Agr. Expt. Sta., East Lansing, Mich.

Leyden, R. F., and Toth, S. J. BEHAVIOR OF ZINC SULFATE AS FOLIAR APPLICATIONS AND AS SOIL APPLICATIONS IN SOME NEW JERSEY SOILS. Soil Sci. 89: 223-228. 1960.

The absorption and translocation of Zinc-65 via foliage and root applications to different plants were studied in sand-solution culture. The fate of $ZnSO_4$ applications applied to the Norton, Nixon, and Lawrenceville soils was determined by tagging the $ZnSO_4$ with Zinc-65.

Foliar applications of $ZnSO_4$ tagged, with Zinc-65 are absorbed and, to some extent, distributed throughout the soybean, tomato, and corn plants: with soybeans and tomatoes, the amount of Zinc-65 absorbed via the foliage was considerably less than that absorbed through the roots. The corn plant, however, absorbed more Zinc-65 through foliage than from root application.

In general, doubling the standard micro-nutrient level of all elements except zinc, which was kept constant, increased root absorption of Zinc-65 but did not influence foliar absorption.

As the pH of the soil was increased, zinc contents of tomato tops decreased. In general, increases in soil pH tended to increase plant uptake of native soil zinc and to decrease absorption of fertilizer zinc. However, when the rate of fertilizer zinc was increased from 50 to 100 pounds of $ZnSO_4$ an acre, the absorption of native soil zinc decreased.

Studies of the residual effect of $ZnSO_4$ applications indicated that with a depletion of the native supply of available zinc in the soil, more of the zinc absorbed by the plant came from fertilizer zinc.

Less than 5 percent of the fertilizer zinc applied was recovered in two harvests of tomato tops, and recovery tended to decrease with increasing soil pH levels.

Residual fertilizer zinc remaining in the soil after the removal of two crops of tomatoes was largely in a form soluble in 0.1 N HCl in the Nixon and Lawrenceville soils, and in forms insoluble in 0.1 N HCl in the Norton soil.

U. Ga., Athens, Ga.

Wilcox, L. V. BORON INJURY TO PLANTS. U.S.D.A., A.R.S. Agr. Inform. B. 211, 7 pp. 1960.

Boron is essential for normal growth of all plants, but the quantity required is extremely small. In some areas, especially where there is abundant rainfall, the soils are low in boron and characteristic boron-deficiency symptoms may develop on many plants. In other areas boron is excessive, and crop injury due to boron toxicity is not uncommon.

Boron has been found in toxic concentrations in the soils of many arid regions of the world. In the United States it is confined almost exclusively to the irrigated area of the west. The total area in which boron toxicity is a problem is not large, but the injury sometimes is very severe.

The purposes of this bulletin are: (1) To discuss the nature and source of boron; (2) to describe boron-toxicity symptoms; and (3) to suggest remedies for boron toxicity.

ARS, USDA, Inform. Div., Washington 25, D.C.

Bingham, F. T., and Garber, M. J. SOLUBILITY AND AVAILABILITY OF MICRONUTRIENTS IN RELATION TO PHOSPHORUS FERTILIZATION. Soil Sci. Soc. Amer. Proc. 24: 209-213. 1960.

Availability of B, Cu, Fe, Mn, Mo, and Zn in relation to excesses of $Ca(H_2PO_4)_2$ was studied with sour orange seedlings as indicators for induced interactions created in 19 different soils. To separate the effect of the carrier from that due to phosphorus, $Ca(H_2PO_4)_2$, H_3PO_4, KH_2PO_4, and $NH_4H_2PO_4$ sources were also used in a separate experiment. Chemical analyses of water extracts from the latter experiment provided the solubility data as controlled by excesses of P.

Regardless of source, excess P resulted in acute Cu deficiency; and in the case of acid soils, reduced uptake of B and Zn usually followed excess P fertilization. Excessive P fertilization of acid soils resulted in increased Mn and Mo uptake, whereas in alkaline

soils excessive P reduced the availability of Mo. Solubility of Mn, B, and Mo paralleled uptake data. Cu and Zn solubilities were increased by excessive P fertilization. Mechanisms pertinent to the various P interactions are discussed with the major emphasis placed on P-Cu antagonism.

U. Calif., Riverside, Calif.

Anderson, C. H., Hoyt, P. B., and Pawlowski, S. H. FERTILIZER STUDIES WITH WHEAT, OATS AND BARLEY GROWN ON GREY WOODED AND BLACK SOILS IN THE PEACE RIVER REGION OF NORTHWESTERN CANADA. Canad. J. Soil Sci. 40: 199-206. 1960.

In each of 5 consecutive years, 1951-55, 12 fertilizer treatments were made to wheat, oats, and barley grown on fallowed land and on stubble land cropped to cereals the previous year. The tests were located on three Grey Wooded soils and one Black soil. Fertilizer response of all three cereals was greater on fallow than on stubble, Phosphate gave much higher yield increases than nitrogen on fallow. Phosphate and nitrogen gave about equal increases on stubble for the Grey Wooded soils but phosphate gave a greater increase on the Black soil. Differences in yield response from nitrogen also occurred among the Grey Wooded soils. A few responses were obtained to potash.

P. B. Hoyt--Canada Dept. Agr. Beaverlodge, Alberta, Canada.

Sherman, M. S. USDA'S 50 YEARS OF FERTILIZER TECHNOLOGY RESEARCH. Commercial Fertilizer 101(2): 33-34. 1960.

A report of the 50 years of fertilizer technology research carried on by the United States Department of Agriculture.

ARS, USDA, Beltsville, Md.

Salinity and Alkali Problems

Reeve, R. C., and Bower, C. A. USE OF HIGH-SALT AS A FLOCCULANT AND SOURCE OF DIVALENT CATIONS FOR RECLAIMING SODIC SOILS. Soil Sci.: 139-144. 1960.

A method for reclaiming sodic soils that makes use of high-salt waters as a flocculant and as a source of divalent cations is proposed. Use is made of the flocculating effect that high electrolyte concentration has on soil permeability, and of the valence-dilution effect on the exchange of divalent cations from the water for adsorbed sodium in the soil. The sodium-adsorption ratio (SAR) is a convenient means by which this principle can be shown to apply. The change in SAR upon dilution of a water containing the common cations Ca, Mg, and Na is given by the equation $(SAR)_{dil} = (SAR)_s d^{-1/2}$ where $(SAR)_{dil}$ is the sodium-adsorption ratio that results from diluing a water having an initial value (SAR_s, and d = the dilution factor. Experimental data are presented for the reclamation of a sodic soil in laboratory columns. Four treatments, consisting of successive dilutions of Salton Sea water with Colorado River water, were used. In all cases and for all treatments, the exchangeable-sodium percentage was reduced from an initial value of 39 to a final value of about 5. There was a marked difference in the length of time and in the amount of water required for reclamation by the various treatments. Where 3 successive dilution-steps were used (d = 4, 16, and 64) followed with Colorado River Water as the final equilibrating water, complete equilibration of the experimental soil column was accomplished in 12 days; in comparison 120 days were required for the column leached with Colorado River water only. There was, moreover, a 30-fold increase in hydraulic conductivity for the high-salt water treatments. Of considerable practical significance was the fact that for the dilution treatments less than 10 percent of the total amount of water used was Salton Sea water. For the best treatment (the 3 dilutions mentioned above), 94 percent of the total amount of water used was Colorado River water. In other words, by this treatment, complete equilibration of the experimental soil column was accomplished

with 0.4 foot of Salton Sea water combined with 6.0 feet of Colorado River water, and this was accomplished in one-tenth the time required for Colorado River water alone.

U.S. Salinity Lab., SWCRD, ARS, USDA, Riverside, Calif.

Climatic Influences

U.S. National Arboretum, PLANT HARDINESS ZONE MAP. U.S.D.A., A.R.S. Misc. P. 814, 2 pp. 1960.

This map shows in moderate detail the expected minimum temperatures of most of the horticulturally important areas of the United States (excluding Alaska and Hawaii) and Canada. It shows 10 different zones, each of which represents an area of winter hardiness for certain ornamental plants.

Cold hardiness zones for the United States area of this map are based on isotherms of average minimum winter temperatures for the years 1899 through 1938. Readjustments were made for 34 States on the basis of January mean minimum temperatures for 1931 through 1952, as published by the U.S. Weather Bureau.

Data for the adjacent area in Canada were provided by the Canadian Meteorological Division, and are based on a 20- to 40-year period.

Data from both sources in the United States and Canada have been modified or reinterpreted in many localities to conform with recent and more detailed information provided by State experiment stations and numerous individual cooperators.

ARS, USDA, Inform. Div., Washington 25, D.C.

Adams, W. E., and Twersky, M. EFFECT OF SOIL FERTILITY ON WINTER KILLING OF COASTAL BERMUDAGRASS. Agron. J. 52: 325-326. 1960.

Coastal bermudagrass was grown in a factorial experiment from 1955 to 1957 with 4 rates each of N, P_2O_5, and K_2O ranging from 0-0-0 to 400-200-200 pounds per acre. In the spring of 1958 large differences were observed in winter killing, following one of the severest winters on record. Stand estimates and forage yields showed these differences were related to the amounts of applied nitrogen and potash.

At each N level survival increased with increasing levels of applied K_2O. However, at any given K_2O level, winter killing increased with increasing levels of applied nitrogen. Winter survival was favored by high ratio of applied K_2O to N.

SWCRD, ARS, USDA, Watkinsville, Ga.

Nielsen, K. F., Halstead, R. L., MacLean, A. J., Holmes, R. M., and Bourget, S. J. THE INFLUENCE OF SOIL TEMPERATURE ON THE GROWTH AND MINERAL COMPOSITION OF OATS. Canad. J. Soil Sci. 40: 255-263. 1960.

Oats grown with different nutrient treatments in temperature-controlled soil in the greenhouse produced higher yields of grain and straw when soil temperature was increased from 41° to 67° F. Yields were usually less at 80° F. than at 41° F. This relationship between growth and soil temperature was also apparent at the heading stage. At 7th leaf, however, the best temperature for growth varied with nutrient treatment. Root yields usually decreased with increase in soil temperature.

Increasing soil temperature from 41° to 67° F. increased uptake of N, P, and K. In many instances increases in the concentration of N, P, and K in the plant contributed to these increases in uptake. The effect of soil temperature on uptake was more consistent for P than for other elements.

Nitrates and native phosphorus in incubated soil samples increased with increase in temperature from 41° to 80° F. but exchangeable K values were not affected.

Expt. Farm, Swift Current, Saskatchenan, Canada.

Anderson, O. E. THE EFFECT OF LOW TEMPERATURES ON NITRIFICATION OF AMMONIA IN CECIL SANDY LOAM. Soil Sci. Soc. Amer. Proc. 24: 286-289. 1960.

Anhydrous ammonia (HN_3) at the rate of 150 p. p. m. NH_4-N was applied to samples of Cecil sl in the laboratory in a manner simulating field application. Initial concentration at the center of the absorption zone was 800 p. p. m. NH_4-N. NH_4NO_3 at rates 0, 50, 100, 200, and 400 p. p. m. NH_4-N was also applied to the Cecil soil. Nitrification occurring at 37°, 42°, 47°, and 52° F. was studied. Nitrification, though negligible, occurred in all samples at 37° F. At 42°, nitrification became noticeably active by the 3- to 6-week period in NH_3 samples, and NH_4NO_3 samples treated with 50 p. p. m. NH_4-NO_3. Compared to the latter, nitrate accumulation decreased as NH_4NO_3 concentration increased. This effect was particularly noticeable at 47° and 52° F. where nitrification of NH_3 and NH_4NO_3, up to 100 p. p. m. NH_4-N, was moderate. At 52° F. nitrification approached completion in the 50 p. p. m. NH_4-N samples by the 9th week, and in the NH_3 samples by the 12th week. Nitrate accumulation during 12 weeks expressed as a percentage of that occurring at 52° F. was 93, 51, and 8% at 47°, 42°, and 37° F., respectively, in NH_4NO_3 samples treated with 50 p. p. m. NH_4-N. In samples treated with NH_3 it was 72, 35, and 4%, respectively, at the same temperatures.

Ga. Expt. Sta., Experiment, Ga.

Holmes, R. M., and Robertson, G. W. SOIL HEAVING IN ALFALFA PLOTS IN RELATION TO SOIL AND AIR TEMPERATURE. Canad. J. Soil Sci. 40: 212-218. 1960.

A simple frost heavometer has been described, and data presented which indicate that measurements of soil frost heaving of field plots may be obtained. The data show the protective effect of snow on field plots and strongly support the view that serious heaving in field plots mainly occurs during periods of limited snow cover and fluctuating soil and air temperatures, particularly when variations are near the freezing-point. It is also suggested that conditions of alternate freezing and thawing favor heaving because these conditions also favor the accumulation of water near or at the surface. Periods of steady cold under the conditions of this study produced only slight heaving, possibly because of insufficient moisture within the soil profile.

Canada Dept. Agr., Ottawa, Ontario, Canada.

Von Pogrell, H., and Kidder, E. H. EXPERIMENTAL STUDY OF CRITICAL LEAF TEMPERATURE IN REGARD TO FROST PROTECTION BY SPRINKLING. Mich. Agr. Expt. Sta., Q. B. 42: 615-621. 1960.

Bean leaves were subcooled under various conditions in a radiation frost chamber to determine the critical temperature at which freezing would take place. The lowest undamaging temperature was taken as the critical temperature. The results are discussed in regard to practical application of sprinkling as an anti-frost measure.

Without any treatment the bean leaves used in these experiments were subcooled to 27.5 - 28.0° F.

Mechanical shocking of subcooled leaves resulted in freezing of the leaves at higher temperatures than when the shocks were omitted.

Ice-coating of the leaves followed by further subcooling had the effect of raising the damaging level above that of leaves naturally subcooled.

Ice-coating and mechanical shocks raised the critical leaf temperature to the freezing point of the cell sap. Successful frost protection requires a plant temperature above the freezing point of the cell sap.

Sprinkling should start when the air temperature is 32° F. because under subcooled conditions the ice formation and the mechanical shocks of the first wettings can cause considerable damage.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Terrien, H. P., and Smith, D. THE ASSOCIATION OF FLOWERING HABIT WITH WINTER SURVIVAL IN RED AND ALSIKE CLOVER DURING THE SEEDLING YEAR OF GROWTH. Canad. J. Plant Sci. 40: 335-344. 1960.

The percentage of plants that flowered in the seedling year in spaced populations of red and alsike clovers at Madison and Arlington, Wisconsin, was highest in the earliest seedings (May 15) and decreased with later seeding dates. No plants flowered in the July 15th seedings. The percentage of winterkilling during the first winter was higher in the flowering plants of each clover than in the non-flowering plants. Differences in flowering and winter survival were noted among clover strains and in winter survival among plant types within strains.

Prevention of flowering in medium red clover by removing flower buds, flowering stems and/or elongating tillers resulted in greater vegetative vigor and winter survival. Plants that were allowed to flower freely in the seedling year in spaced populations had a smaller number of non-flowering crown tillers, a smaller width of crown, a lower dry weight of crown, root and total available carbohydrates in the roots, less root branching, a slightly lower percentage of total available carbohydrates in the roots, and more winterkilling during the first winter than plants that were prevented from flowering. These responses may help in part to explain the benefits attributed to clipping red clover in the seedling year.

Jr. Author, Wisc. Agr..Expt. Sta., Madison, Wisc.

Carlson, G. E., and Atkins, R. E. EFFECT OF FREEZING TEMPERATURES ON SEED VIABILITY AND SEEDLING VIGOR OF GRAIN SORGHUM. Agron. J. 52: 329-333. 1960.

The effect of freezing temperatures on grain sorghum seed of varying moisture content was manifest primarily as a reduction in viability, with no appreciable reduction in seedling vigor. Reduction in viability was dependent upon differences in genotype, freezing temperature, duration at freezing temperature, and grain moisture content.

J. Paper No. J-3731, Iowa Agr. and Home Econ. Expt. Sta., Ames, Iowa.

McEvoy, E. T. INFLUENCE OF CULTURE SOLUTION TEMPERATURE ON UPTAKE OF PHOSPHORUS BY FLUE-CURED TOBACCO PLANTS. Canad. J. Plant Sci. 40: 211-217. 1960.

The influence of the temperature of the culture medium on the uptake of phosphorus by flue-cured tobacco plants was studied in solution culture, using radioactive phosphorus. p^{32} uptake increased significantly with temperature increase from 10° to 35° C. for absorption periods of 2, 4, and 6 days. There was a further increase in p^{32} uptake at 40° for absorption periods of 2 and 4 days but a decrease after 4 days. Increase in root growth during the absorption periods bore no relation to increase in p^{32} uptake with increasing temperature.

Canada Dept. Agr. Ottawa, Ontario, Canada.

Army, T. J., and Hanson, W. D. MOISTURE AND TEMPERATURE INFLUENCES ON SPRING WHEAT PRODUCTION IN THE PLAINS AREA OF MONTANA. U.S.D.A. Prod. Res. Rpt. No. 35, 25 pp. 1960.

Through the use of simple correlation and multiple regression techniques, the relation of soil moisture supply at seeding and those of precipitation and total daily maximum temperatures within the growing season to yield of spring wheat were studied in the Plains area of Montana. The study was based on data for spring wheat grown continuously and also alternated with fallow at each of two stations, respectively, covered periods of 31 and 34 years.

Cumulative frequencies of yield levels were calculated for continuous cropping and for cropping alternated with fallowing at each station.

Grain yield at both Havre and Huntley was significantly correlated with soil moisture supply at seeding. Cropping system had little effect on the degree of correlation. Precipitation between seeding and heading appeared to be more critical in relation to yield than precipitation in the remainder of the growing season. Correlation with yield was higher for temperatures after heading than for precipitation after heading. Multiple regression analyses indicated that about 66 to 85 percent of the variation in spring wheat yield was associated with variation in the independent variables studied.

A method was developed for estimating the prospective spring wheat yield at seeding and progressively improving the estimate as the growing season advances.

ARS, USDA, Inform Div., Washington 25, D. C.

Steward, F. C., Crane, F., Millar, K., Zacharius, R. M., Rabson, R., and Margolis, D. NUTRITIONAL AND ENVIRONMENTAL EFFECTS ON THE NITROGEN METABOLISM OF PLANTS. Symposia of the Soc. For Expt. Biol., 13: 148-176. 1959.

The following factors are now recognized as important in determining the quantity and composition of the soluble nitrogen of plants: (1) Long and short days. (2) Lack of major mineral nutrients effects of which may interact with those of day length. (3) The balance of the major mineral nutrients, particularly K and Ca, which may also interact with day length. (4) Night temperature which may override the effects of photoperiod. (5) Diurnal variations, which reflect the balance between the metabolism in the dark and in the light, and which are therefore modified by the photoperiod. This effect influences the behaviour of leaves either subjected to, or recovering from, major mineral deficiency (for example, sulphur) as well as those receiving full nutrient. (6) Acute lack of trace elements influences greatly the total amount and the composition of the soluble nitrogen fraction in ways which are characteristic of the different trace elements. And (7) contrasts in the soluble nitrogen compounds produced under nitrate and ammonium nutrition of tomato plants leads to the diagnosis of effects on the pool of soluble nitrogen compounds which are due to lack of manganese and molybdenum and to resupply of these elements.

Work of this kind involves the need for rigorous control of a baffling array of variables in order to discern their effects upon a great array of soluble nitrogen compounds. To comprehend the interplay of so many parameters, special interpretative techniques are clearly required. The frequency with which the environmental or nutritional effects are made manifest by responses in the prominent constituents of the pool of soluble nitrogen compounds (asparagine, glutamine, γ-aminobutyric acid, arginine, and the dicarboxylic acids) or by the selective accumulation of compounds that are not normally present in quantity, emphasizes that the meeting ground of nitrogen and carbohydrate metabolism (via the keto acids) is an area in which the causal metabolic effects of these variables may often be located. This seems to be so in the case of photoperiod and thermal periodicity, which disturb the balance (in mint plants) between protein synthesis and breakdown and between carboxylation and decarboxylation in one direction or another, and lead to accumulation of different metabolites. Whereas Gregory, Spear & Thimann (1954) found photo-induction in a short day (long night) plant (Kalanchoe) to be associated with carboxylation *in the dark* and decarboxylation in the light, the nitrogen metabolism of the long day mint plant seems to require that the C_5 carboxylated products and their derivatives (glutamine) accumulate more in the light. The important point is, however, that both types of investigation focus attention on the area of metabolism in which keto acids, the tricarboxylic acid cycle and nitrogen compounds converge.

Cornell U., Ithaca, N. Y.

Mulching

Webster, G. R., and Adamson, R. M. EFFECTS OF SAWDUST USED AS A MULCH AND AS A SOIL AMENDMENT ON SOIL TEMPERATURES UNDER IRRIGATED AND UNIRRIGATED CONDITIONS. Canad. J. Soil Sci. 40: 207-211. 1960.

Soil temperature readings were taken at 7.30 a.m., noon, and 5 p.m. over a 3-year period (2 years without and 1 year with irrigation) at a point 4 inches below the surface

of sawdust-mulched, sawdust-incorporated, and check plots. The effect of blackened sawdust mulch on soil temperatures was also studied. Marked differences between soil temperatures was also studied. Marked differences between soil tempertures in the various treatments were found, the greatest being during July when the difference between the average maximum and minimum air temperature was also greatest. Soil temperatures were lower in the sawdust-mulched than in the check plots, except at 7.30 a.m. under irrigation when readings were higher throughout the season in the mulched plot. After August under irrigated conditions and after October without irrigation a reversal took place, and the soil temperatures became higher under the mulch than in the check due to the slower heat loss from the mulched soil. Incorporating sawdust had only a slight effect upon soil temperatures, but blackening the mulch markedly reduced the soil temperature differences between mulched and unmulched treatments.

Canada Dept. Agr., Saanichton, British Columbia, Canada.

PLANT MANAGEMENT

Pastures and Haylands

Miller, H. W., Hoglund, O. K., and Hafenrichter, A. L. GRASSES, LEGUMES, AND CULTURAL METHODS FOR IMPROVING PASTURE PRODUCTION AND AIDING CONSERVATION ON SALINE-ALKALI LAND. Calif. Dept. Nat. Resources, Div. Soil Conserv. B. 1, 24 pp. 1959.

Cultural methods and species for the conversion of low-producing native cover to improved irrigated pasture on fine-textured saline-alkali soils were studied in the Los Banos Soil Conservation District in the San Joaquin Valley of California. The vegetative cover was sparse. The dominant plants were saltgrass, (Distichlis stricta); gumweed, (Grindelia camporum); and Australian saltbush, (Atriplex semibaccata). Annuals such as mouse barley, (Hordeum leporinum); sour clover, (Melilotus indica); and red brome, (Bromus rubens), were present. Grazing capacity was very low.

The site was plowed, leveled, treated with two rates of gypsum and with gypsum and manure, ponded, and flushed. Then it was allowed to dry, was releveled, bordered, preirrigated, and a fine firm seedbed was prepared in the early fall. A selected pasture mixture of Goars fescue, (Festuca arundinacea var. aspera), and narrowleaf trefoil, (Lotus corniculatus var. tenuis), was diluted with rice hulls, treated with fungicide, inoculated, and seeded with a double disk grain drill.

Excellent stands of the Goars fescue-trefoil mixture were obtained on all treatments. The stand of trefoil was reduced where the combination of gypsum and manure was used. Preparatory cropping to grain-vetch hay or to Sudangrass had no advantage over direct seeding.

Highest yield in the first season, 6.01 tons of hay per acre, was obtained in three cuttings from the plot receiving 3 tons of gypsum. In the second season the greatest production was 7.07 tons from the 6-ton gypsum plot. In both seasons the plots receiving no amendments were much lower in yield: 2.19 tons and 3.02 tons respectively. The differences were highly significant.

All plots were grazed together in the third and fourth seasons. They provided 390 and 230 cow-days of grazing, which produced 328 and 188 pounds of butterfat respectively. The pasture provided an additional 50 animal-unit days of grazing for dry dairy stock. The optimum grazing capacity of those plots that received only gypsum as a soil amendment was calculated and values of 370, 410, 490, and 353 standard animal-unit days of grazing per acre, respectively, were obtained for the four seasons. No supplemental fertilizers were applied to these plots.

Root production in the surface 8 inches of soil was 8.8 tons per acre in the third season and 14.2 tons at the end of the tenth season. Beneficial effects on soil structure and texture and on moisture infiltration were evident.

Tall fescue; tall wheatgrass, (Agropyron elongatum); and Hardinggrass, (Phalaris stenoptera); were the superior grasses of the 17 selected species tested in pure stands. Goars fescue was superior to Alta fescue. Narrowleaf trefoil was the only legume of the six included which performed satisfactorily.

Fertilizer, ammonium phosphate-sulfate (16-20-0), increased yields of all grasses in pure stands. The increment of dry matter per pound of nitrogen applied was 30 pounds for the adapted species, Goars fescue, tall wheatgrass, and Hardinggrass, but only 21 pounds for the unadapted orchardgrass.

Applications of nitrogen at different times during the growing season gave direct response, but the magnitude varied with the known seasonal activity of the species. There was no carryover effect. The application of P_2O_5 to these grasses did not influence yield. --Auth. abst.

SCS, USDA, Pleasanton, Calif.

Ensminger, L. E., and Evans, E. M. ESTABLISHMENT AND MAINTENANCE OF WHITE CLOVER-GRASS PASTURES IN ALABAMA. Ala. Agr. Expt. Sta. B. 327, 22 pp. 1960.

Field tests have been conducted during the past 20 years to determine the response of clover-grass pastures to lime, nitrogen, phosphorus, and potassium. In some experiments, frequency of application was also studied. The results are summarized as follows: (1) Lime is necessary for establishment and maintenance of clovers. (2) Nitrogen applications increased forage yields and beef gains from Dallisgrass pastures that did not have satisfactory stands of clover. (3) Soils not previously well fertilized are very deficient in phosphorus. Heavy applications are needed for establishment of clover-grass mixtures. Phosphorus status of soils depends on past fertilization. (4) Most soils require potassium for establishment and maintenance of clover-grass pastures. Removal of large amounts of hay or silage will soon result in a potassium deficiency, especially on sandy soils. (5) Frequency of applying phosphorus and potassium fertilizers to pastures on medium- to heavy-textured soils was not a critical factor. On such soils, applications at 2- to 3-year intervals produced as much forage as did annual applications when total amounts of fertilizer were equal for the period. And (6) phosphorus content of clover grown on well-fertilized land is usually above the critical level for all types of cattle.

Agr. Expt. Sta., Auburn U., Auburn, Ala.

Gervais, P. EFFECTS OF VARYING LEVELS OF PHOSPHORUS AND POTASSIUM APPLICATIONS ON PRODUCTIVITY, AND BOTANICAL AND CHEMICAL COMPOSITION OF A LADINO CLOVER-TIMOTHY ASSOCIATION. Canad. J. Soil Sci. 40: 185-198. 1960.

Phosphorus and potassium were applied separately at five levels--0, 60, 120, 180 and 240 lbs. per acre--and in all combinations prior to seeding a ladino clover-timothy mixture. Plots were cut four times per season to a height of 3 inches. Forage yields were obtained during 1954, 1955, and 1956 from a seeding made in 1953 on Coaticook sil soil at the Experimental Farm, Lennoxville, Quebec.

Phosphorus fertilization had no significant effect on clover yields but caused distinct increases in timothy yields in 1954 and 1955. Clover yields increased linearly with increasing levels of potassium up to 120 lbs. per acre in 1954 and up to 180 lbs. in 1955. In 1956, the increase in yields was a linear function of rates of potassium application. Potassium fertilization depressed timothy yields in 1954 but had no effect in 1955 and 1956. The percentage of clover in the harvested forage tended to increase with increasing rates of potassium and to decrease with increasing rates of phosphorus. The reverse was true for timothy. The chemical composition of each forage fraction is also presented.

Canada Dept. Agr., Lennoxville, Quebec, Canada.

Gervais, P. EFFECTS OF CUTTING TREATMENTS ON LADINO CLOVER GROWN ALONE AND IN MIXTURE WITH GRASSES: I. PRODUCTIVITY AND BOTANICAL COMPOSITION OF FORAGE. Canad. J. Plant Sci. 40: 317-327. 1960.

Ladino clover, grown alone and in mixture with timothy and smooth bromegrass, was cut two, four, and six times per season to a height of 1 1/2 and 3 inches. Forage yields were collected in 1955 and 1956 from a seeding made in 1954 at the Experimental Farm, Lennoxville, Quebec.

Ladino clover yielded more clover when grown alone than when associated with a grass. The mixtures did not differ in clover yields. In the grass fraction, timothy out-yielded bromegrass in 1955 only. Mixtures produced more total forage than Ladino clover alone. Cutting to 1 1/2 inches gave higher fraction and total yields during both years than cutting to 3 inches, except in the grass fraction in 1956. The mixtures yielded more clover but much less grass and total production when cut four times than when cut twice. The lower yields occurred with six cuttings. With Ladino clover alone, increased frequency of cutting depressed yields. The mixed swards contained the most clover when cut four times to 1 1/2 inches and the least when cut twice to 3 inches.

Canada Dept. Agr., Lennoxville, Quebec, Canada.

Gervais, P. EFFECTS OF CUTTING TREATMENTS ON LADINO CLOVER GROWN ALONE AND IN MIXTURE WITH GRASSES II. CHEMICAL COMPOSITION OF FORAGE. Canad. J. Plant Sci. 40: 328-333. 1960.

Ladino clover grown alone and in mixture with timothy and smooth bromegrass was cut two, four and six times per season to a height of 1 1/2 and 3 inches. Forage harvested in 1955 and 1956 from a seeding made in 1954 at the Experimental Farm, Lennoxville, Quebec, was chemically analysed.

Ladino clover contained more K but less N-free extract and Ca when grown alone than when associated with a grass. Bromegrass had a higher content of crude protein, ash, P and K, and a lower content of N-free extract than timothy.

Height of cutting failed to modify the chemical composition of the grasses. In the clover, close cutting reduced the fat and K contents and increased the ash content.

The crude protein content increased and the crude fibre and N-free extract contents decreased in both forage fractions with increasing cutting frequencies. Fat was highest in the clover cut four times and in the grasses cut four and six times. The ash content in the clover was not significantly altered by cutting frequency but tended to decrease with increasing maturity in the grasses. The Ca content was lowest in the clover cut six times and in the grasses cut twice. In both forage fractions, the P and K contents were higher with either four or six cuttings than with two cuttings.

Canada Dept. Agr., Lennoxville, Quebec, Canada.

Foth, H. D., Swenson, R. M., and Cook, R. L. ESTABLISHMENT AND FERTILIZATION OF LEGUME-BROMEGRASS HAY. Mich. Agr. Expt. Sta. Q. B. 42: 744-756. 1960.

Considerable uncertainty has existed with the establishment of legume and legume-grass mixtures in Michigan. This has been particularly true in regard to their establishment in winter wheat. Experiments initiated in 1951 were designed to study certain management factors contributing to this uncertainty. Those studied in regard to establishment were planting date, type of companion crop and fertilizer rate and analysis. Factors studied concerning maintenance of the stands were fertilizer rate, analysis and time of application.

The author made the following conclusions:

1. Yields of alfalfa-bromegrass in the first harvest year were closely related to establishment treatment. Differences were related to moisture supply, plant competition, and time of seeding. Seedings made in wheat in the fall or spring, or alone after oats harvest, were considerably inferior to those made with oats in April or those made alone on fallowed land in April, June and August.
2. The effect of establishment treatment on yields decreased with time. However, seedings made with wheat remained inferior throughout the four-year harvest period.
3. Alfalfa-bromegrass seedings made over wheat in the spring out-yielded those made in the fall with wheat.
4. Nitrogen fertilization of fall-sown alfalfa-bromegrass increased forage yields in one case out of two.
5. Nitrogen fertilization, up to 60 lbs. of nitrogen per acre at establishment of alfalfa-bromegrass in the spring, or as a topdressing on established stands, did not affect the yield of forage.

6. Nitrogen fertilization, up to 60 lbs. of nitrogen per acre, of red clover-bromegrass at establishment resulted in small decreases in the yield of forage the following year.
7. Phosphorus and potassium fertilization gave highly significant increases in yield of alfalfa-bromegrass forage when applied at the time of establishment or as a topdressing on established stands. Fertilizers applied at establishment resulted in yield differences which lasted for three cuttings.
8. Phosphorus and potassium fertilization at establishment of red clover-bromegrass resulted in significant increases in yield three cuttings out of four.
9. Fertilizers applied when the companion crops and seedings were established, increased significantly the yields of both the companion crop and the forage the following year.
10. The botanical composition of alfalfa-bromegrass hay was greatly influenced by establishment treatment and to a smaller extent by phosphorus and potassium fertilization. During the first harvest year, the fertilized plots produced forage which had a greater percent of alfalfa than the non-fertilized plots, while the reverse was true for the fourth harvest year.
11. Phosphorus and potassium fertilization of red clover-bromegrass at establishment resulted in a 30 percent increase in the amount of red clover in the forage. Topdressing with phosphorus and potassium in the spring had no effect.
12. Sixty lbs. of nitrogen per acre had little or no effect on the percent of alfalfa or red clover in the forage.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Tewari, G. P., and Schmid, A. R. THE PRODUCTION AND BOTANICAL COMPOSITION OF ALFALFA-GRASS COMBINATIONS AND THE INFLUENCE OF THE LEGUME ON THE ASSOCIATED GRASSES. Agron. J. 52: 267-269. 1960.

Alfalfa-grass mixtures yielded more forage with slightly higher alfalfa content than the same combinations with alfalfa and grasses in alternate rows six inches apart. Growing the alfalfa and grasses as alternate double or triple rows resulted in considerable yield reduction as compared to alternate single rows or mixtures. Grass in rows 6 inches from an alfalfa row had higher yield and protein content than in rows 12, 18, or 24 inches from an alfalfa row.

Paper No. 4214 Scientific J. Series, Minn. Agr. Expt. Sta., U. Minn., St. Paul, Minn.

Brown, B. A., Deckers, A. M., Sprague, M. A., MacDonald, H. A., Teel, M. R., and Washko, J. W. BAND AND BROADCAST SEEDING OF ALFALFA-BROMEGRASS IN THE NORTHEAST. Md. U. Agr. Expt. Sta. B. A-108 (Northeast Reg. Pub. No. 41), 35 pp. 1960.

A regional experiment comparing broadcast and band seeding methods with various levels of P_2O_5 and K_2O was conducted at the following Northeast Agricultural Experiment Station; Connecticut, Maryland, New Jersey, New York, and Pennsylvania.

The results can be summarized as follows: (1) Band seeding was found to be a good method for establishing stands of alfalfa-bromegrass and promoted early seedling development; (2) band seeding was superior to broadcast seeding only on soils with low fertility levels and during seasons when environmental conditions were unfavorable; (3) on soils of moderate to high fertility and under favorable environmental conditions even though band seeding favored early seedling development this advantage did not manifest itself in higher forage yields during the first harvest year; (4) at Connecticut when severe winter heaving was a problem, better plant survival was obtained on the band seeded plots; (5) in general, plant responses were small following applications of P_2O_5 or K_2O_5 at the 40 or 80 lbs. per acre level; and (6) plant counts, tiller numbers and crown weight of plants did not appear to be materially influenced by methods of seeding.

U. Md., Agr. Expt. Sta., College Park, Md.

Terman, G. L., Doll, E. C., and Lutz, J. A., Jr. RATE, SOURCE, TIME, AND METHOD OF APPLYING PHOSPHATES FOR ALFALFA AND LEGUME-GRASS HAY AND PASTURE. Agron. J. 52: 261-264. 1960.

Various rates, sources, times, and methods of application of P were compared for a grazed legume-grass mixture in Kentucky and on alfalfa or legume-grass mixture for hay in Kentucky, North Carolina, Tennessee, and Virginia.

Time of application affected yields much more than did method of application or source of P. There was very little difference in yields among concentrated superphosphate, ordinary superphosphate, calcium metaphosphate, and fused tricalcium phosphate on the grazed plots or among concentrated superphosphate, calcium metaphosphate, and ammonium metaphosphate for hay. A calcined leached zone phosphate ore was less effective for hay than the other more soluble phosphates.

Forage yields were higher the first year of harvest with heavy initial broadcast applications than with smaller broadcast or topdressed applications. Yields in following years with only the initial application usually became progressively poorer, as compared to yields with smaller annual topdressings. Percent P in the herbage followed similar trends as for yields of hay. P was consistently higher in herbage grown with applied phosphates than with none.

E. C. Doll, U. Ky., Lexington, Ky.

Carter, C. R., and Foth, H. D. THE EFFECT OF NITROGEN FERTILIZER ON YIELD AND PROTEIN CONTENT OF ALFALFA AND COMPANION CROPS. Mich. Agr. Expt. Sta. Q. B. 42: 737-743. 1960.

Field observations in 1952 showed that nitrogen fertilization resulted in more rapid establishment and growth of alfalfa seedlings established in wheat the previous fall. Uncertainty existed, however, in regard to the effect of nitrogen on the yield of forage. This led to experiments to determine the extent and significance of the effect of nitrogen fertilization on yield and protein content of alfalfa and companion crops. This paper presents the results of experiments where nitrogen fertilizer was applied to: (1) Alfalfa grown in the greenhouse; (2) seedings made in the field with three different companion crops; and (3) established stands of the crop.

From these trials the authors made the following conclusion about nitrogen fertilization: (1) Increased yield and protein content of alfalfa grown in the greenhouse; (2) did not increase yield or protein content of alfalfa, established with or without a companion crop, when fertilizer was applied at the time of establishment in the field; (3) did not increase yield or protein content of forage when applied to established stands of alfalfa; (4) increased yields and protein content of the grain of companion crops; and (5) reduced the first cutting yield of alfalfa forage, which was established in wheat, when the nitrogen was applied at the rate of 20 lbs. per acre as a top dressing in the spring.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Tossell, W. E., and Fulkerson, R. S. RATE OF SEEDING AND ROW SPACING OF AN OAT COMPANION CROP IN RELATION TO FORAGE SEEDLING ESTABLISHMENT. Canad. J. Plant Sci. 40: 500-508. 1960.

Nine rates of seeding and two spacings of an oat companion crop were studied in relation to seedling establishment in hay-pasture mixtures at Guelph. Variations in these managements had pronounced effects on establishment in 2 of the 4 years during which the studies were conducted.

Species responded differently to the managements with red clover and timothy most sensitive, alfalfa and orchard intermediate, and bromegrass least sensitive as assessed by the number of plants established. Satisfactory stands were obtained under an oat companion crop in 7-inch drills. Reduction of the oat seeding rate from the commonly used rate in Ontario of 2 1/2 bushels per acre to 1 1/2 bushels did not reduce oat yields in any of the 3 years in which oat yield data were collected. This seeding rate reduction allowed the establishment of more alfalfa plants with increased seedling vigor and so provides more assurance for stand establishment. Increasing the oat row spacing from 7 inches to

14 inches for the 1 1/2-bushel oat rate reduced oat yields 14.3 percent but improved alfalfa stands slightly and increased the vigor of most species. This management might be useful on problem sites and in special situations where high levels of plant population are desired.

Ontario Agr. Col., Guelph, Ontario, Canada.

Thurlow, D. L., and Smith, F. W. ROCK PHOSPHATE AND SUPERPHOSPHATE AS SOURCES OF PHOSPHORUS AND CALCIUM FOR ALFALFA. Agron. J. 52: 313-317. 1960.

Four soils, (Parsons sil, Bates fsl, Cherokee sil, and Idana sicl.) were used to compare superphosphate and rock phosphate as sources of P for alfalfa. Abilities of rock phosphate and $Ca(OH)_2$ to supply Ca to plants and to the exchange complex were compared. Alfalfa yields and accumulations of both Ca and P were used to measure effectiveness of the soil amendments. Effects of treatments on soil chemical properties were investigated.

Yields always were increased by application of lime and usually by application of superphosphate alone and sometimes by application of rock phosphate alone. Combinations of rock phosphate and lime increased yields from two soils. Plant uptake of P was increased by superphosphate treatments and certain rock phosphate treatments. Plant uptake of Ca was increased more by liming than by other treatments. Rock phosphate treatment increased plant uptake of Ca from 2 of the 4 soils.

Exchangeable soil Ca was increased consistently by liming but not by rock phosphate treatment. Chemically "available" P was increased more by application of superphosphate than by rock phosphate treatment.

Kans. Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

Parsons, J. L., and Davis, R. R. FORAGE PRODUCTION OF VERNAL ALFALFA UNDER DIFFERENTIAL CUTTING AND PHOSPHORUS FERTILIZATION. Agron. J. 52: 441-443. 1960.

Field studies were conducted at Wooster, Ohio, to compare 6 cutting schedules on 3 phosphorus levels using Vernal alfalfa. Factors studied include dry matter production, protein production, and stand.

A 5-cutting schedule gave lowest yield, injured the stand severely, but had the highest protein percentage. A 3-cutting schedule produced the maximum yield of dry matter, retained the maximum stand, and the lowest percent protein. Total protein of the 3-cutting schedule was equal to that of the highest 4-cutting treatment.

A comparison of four 4-cutting schedules starting at 2 dates in the spring indicated that maximum protein production could be obtained by cutting at 35-day intervals starting in late May. Likewise, maximum dry matter was produced by the 4-cutting schedules that started in late May. Better stand longevity was observed on that 4-cutting treatment that started in late May and ended by September 10.

Phosphorus application increased dry matter significantly ($P > .01$) on all schedules. The relative dry matter increase due to phosphorus was least on the 3-cutting schedule and greatest on a 4-cutting schedule. Protein percentage and alfalfa stand were improved by phosphorus fertilization.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Seamands, W. J., and Lang, R. NITROGEN FERTILIZATION OF CRESTED WHEATGRASS IN SOUTHEASTERN WYOMING. Wyo. Agr. Expt. Sta. B. 364, 16 pp. 1960.

The influence of various rates of nitrogen fertilizer upon the hay yield and stand of dryland crested wheatgrass was studied over a period of six years at the Archer Substation in southeastern Wyoming.

Nitrogen fertilization increased hay yields in all years with the exception of 1954, an extreme drought year, when there was not enough growth to warrant harvest. Based on the 6-year average, the most efficient rate of fertilization of those tested was the 66 lbs. of nitrogen per acre treatment, which gave an average yield of 6.7 lbs, additional hay per

pound of nitrogen applied. Higher nitrogen rates produced more total tonnage but at considerably less efficiency. Based only on 1957 yield results, the 66 and the 99 lbs. of N per acre were the most efficient in that they each yielded an additional 15 lbs. of hay for each lb. of N applied.

Residual effect upon hay yield was not significant except in 1953, when all tests with treatment rates above the 33 lbs. of N applied in 1952 resulted in significantly higher yields than the check plot.

The amount of precipitation in storms of 1 inch or under during the period of from April 1 to May 15 each year was found to be closely correlated to the yield of hay. Water evaporation from a free surface during the same period showed an inverse relationship to yield.

The 6-year average percentage ground cover of crested wheat-grass was inversely related to the amount of nitrogen applied per acre. Of the treatments tested, the loss in crested wheatgrass stand varied from 0 to 2 percent for the 33 and the 66 lbs. of nitrogen treatment, to 10 percent from plots treated with 198 lbs. of nitrogen per acre.

The 6-year average percentage ground cover of forbs was directly related to increased applications of nitrogen applied per acre. Rates of 66 lbs. or more caused some increase in forb stand with an average of 10 percent from the 66 lbs. rate of 38 percent stand increase from treatments of 198 lbs. of nitrogen per acre.

U. Wyo., Agr. Expt. Sta., Laramie, Wyo.

Duell, R. W. UTILIZATION OF FERTILIZER BY SIX PASTURE GRASSES. Agron. J. 52: 277-279. 1960.

Six pasture grasses were subjected to 3 rates of 10-10-10 fertilizer applied each spring. Differences between species and responses to fertilization were reported in terms of dry weight yields and content of protein, phosphorus, and potassium for the seasons 1956-1958.

Yields of all grasses were increased markedly in the first two cuttings by each increment of fertilizer. Little or no fertilizer effect was found in yields of the third or fourth annual cuttings. Interactions between grasses and fertilizer rates indicated that grasses such as orchardgrass and Kentucky bluegrass were much more responsive than were reed canarygrass and bromegrass.

Other observations in favor of Kentucky bluegrass as a pasture species are that its yield was generally lower than most commonly recommended grasses in the first cutting taken when pasturage is usually in surplus, and its yield was superior in later cuttings when pasturage is generally deficient.

The mineral and protein content of all grasses increased similarly with each increment of fertilizer. A more positive relationship existed between fertilization and nutrients in plant material of the first cuttings than in later cuttings. Data on potassium content showed regular seasonal and annual declines. This was shown to be due to the removal of more potassium by cropping than was applied as fertilizer.

Reed canarygrass was consistently the highest species in protein content and Alta fescue the lowest. Orchardgrass and reed canarygrass were highest in potassium content and Kentucky bluegrass was the lowest.

Although timothy and bromegrass appeared to have been depleted each fall, stands of all species appeared adequate each following spring.

N.J. Agr. Expt. Sta., Rutgers--The State U., New Brunswick, N.J.

Brown, B. A., Munsell, R. I., and King, A. V. PASTURE INVESTIGATIONS: FERTILIZATION AND RENOVATION OF GRAZED, PERMANENT PASTURE. Conn. (Storrs) Agr. Expt. Sta. B. 350, 27 pp. 1960.

The effects of several surface applied fertilizers on the soil and vegetation of run-out permanent pasture land and the effect on the production of digestible nutrients on this land were measured from 1924 to 1954.

Before treatment the Paxton 1 soil was strongly acid (pH 5.2), very low in readily available phosphorus and low in exchangeable potassium.

The initial vegetation consisted chiefly of bent (Agrostis) and poverty (Danthonia) grasses, huckleberry, and bayberry bushes, and gray birch, oak, ash, maple, and hickory trees. Kentucky bluegrass and native white clover were present in very small amounts.

The soil was sampled by one, two, and three inch layers about every third year until 1941, and again in 1955. Analyses showed that dolomitic limestone at two or more tons per acre finally reduced the acidity and increased calcium and magnesium to depths of seven or more inches.

Most of the increases in readily available phosphorus, due to additions of superphosphate, occurred in the upper two inches of soil but very small increases were found in the fourth inch.

Soil samples of the zero to six inch horizon in 1921, the year after the removal of brush and trees, and in 1946, showed that under grazing management with no tillage, the organic matter and nitrogen contents had increased appreciably on all but one of seven plots during the 25-year period. These increases were not closely correlated with fertilization.

Within a year after the first fertilizer treatments marked increases in bluegrass and white clover had occurred on all plots which had received superphosphate. In later years, superphosphate alone did not result in as high stands of bluegrass and white clover as the superphosphate plus limestone treatment. Muriate of potash, with superphosphate or superphosphate and limestone, tended to favor white clover. Nitrogenous fertilizers, chiefly from Calnitro and Uramon, applied with superphosphate and potash or with superphosphate, potash and limestone, caused large increases in bluegrass but decreases in clover. The bent grasses were affected less by fertilization than either bluegrass or white clover. Poverty grass soon disappeared on all pastures which received superphosphate.

Herbaceous weeds were even more prevalent on limestone and potash plots than on the unfertilized check. Canadian thistles increased on the nitrogen pastures. With the exception of juniper and hawthorn, control of bushes was no problem on the fertilized pastures; but without mowing or spraying with herbicides, they increased rapidly on the unfertilized check.

In comparison with the unfertilized check which averaged approximately 500 lbs. of digestible nutrients per acre per year, superphosphate alone increased the pasturage (as measured by grazing) by about 70 percent in each of three periods between 1924 and 1941 and by about 50 percent from 1943 to 1954. The 30 year average increase approximated 60 percent.

Superphosphate plus limestone increased production by about 125 percent for the first 18 years after treatment and by nearly 90 percent the last 12 seasons. The 30 year average was more than double the unfertilized check.

An "optimum" mineral plot which received superphosphate, limestone, and potash every year from 1943 to 1954 produced 30 percent more feed than the less liberally fertilized superphosphate-limestone-potash pastures.

Omission of superphosphate after the 1924 application had very serious effects on production. Omission of limestone after 1924 had no appreciable effects on yields.

Potash had only small effects on production. This was in marked contrast to adjacent land run out by mowing.

In all periods, nitrogenous fertilizers, with the minerals, increased the pasturage by approximately 200 percent of the unfertilized plot's production or by about 50 percent of the superphosphate and limestone yields. Spring applied nitrogen was particularly effective in advancing the dates of first grazing and was much more effective in increasing total production than June or August applications.

On a P-Lime-K plot, poultry manure at two tons per acre in 1947 and 1948 raised the production from 1947 through 1950 to the level of a N-P-Lime-K pasture.

Fertilization of any kind did not influence appreciably the marked decline in production which occurred from May to October.

Repeated seedings of Ladino clover on pastures heavily grazed in May and June to reduce competition of grasses, and either disked or sprayed with a herbicide to kill the existing vegetation, failed in most cases to establish much clover.

Where Ladino was established it disappeared in less than two years even when the pastures were mowed after each grazing period.

Birdsfoot trefoil seeded in 1943 without any tillage or herbicide treatments also failed to become established in important amounts.

It is concluded that the fertilization of untilled, non-seeded permanent pastures will produce additional forage in May and June at a very low cost.

Storrs Agr. Expt. Sta., Col. Agr., U. Conn., Storrs, Conn.

Jones, M. B., and Evans, R. A. BOTANICAL COMPOSITION CHANGES IN ANNUAL GRASSLAND AS AFFECTED BY FERTILIZATION AND GRAZING. Agron. J. 52: 459-461. 1960.

Changes in botanical composition resulting from applications of nitrogen and phosphorus, with and without sheep grazing, on the annual range type of California were studied at two locations. The first site was unimproved resident-range and the second had been seeded to sub, rose, and crimson clovers, hardinggrass, and soft chess.

The percentage of soft chess at the resident-range location was increased by nitrogen fertilization on grazed plots for 2 of 3 years but increased only the first year on ungrazed plots. Percentage of soft chess on the reseeded-range area was increased both years by nitrogen fertilization when grazed but decreased when protected.

The percentage of ripgut on the resident-range site was increased by phosphorus fertilization, and this increase was less on grazed plots than on ungrazed. On the seeded site, where available phosphorus was adequate, ripgut was increased by nitrogen fertilization. Grazing reduced the percentage of ripgut at both locations.

Slender wild oats and broadleaf filaree, which were major components of the forage at the resident-range site only, were particularly responsive to nitrogen and both decreased in abundance when grazed. Little fertilizer effect could be measured in filaree on grazed plots.

In general, clovers were decreased by nitrogen fertilization, but subclover appeared to be an exception in 1958. Phosphorus increased the clovers. The percentage of clovers at the resident-range site and crimson clover at the seeded site decreased under grazing while rose and subclovers were increased by grazing.

U. Calif., Davis, Calif.

Beaty, E. R., McCreery, R. A., and Powell, J. D. RESPONSE OF PENSACOLA BAHIAGRASS TO NITROGEN FERTILIZATION. Agron. J. 52: 453-455. 1960.

Three years' data from a field experiment with Pensacola bahiagrass showed that forage yields with no nitrogen fertilization averaged approximately 3,000 pounds per acre annually. Nitrogen rates of 25, 50, and 100 pounds produced yields of approximately 4,000, 5,000, and 7,100 pounds of dry forage. In this nitrogen application range, 25 pounds of nitrogen produced about 1,000 pounds of dry forage. When 240 pounds of nitrogen were applied, almost 9,200 pounds of forage were produced. In the 100 to 240 pound nitrogen application range, 67 pounds of nitrogen were required to produce 1,000 pounds of dry forage. Rate of nitrogen application did not materially influence seasonal forage distribution.

Monthly harvests were made, and seasonal production trends were determined. June and July accounted for an average of 64% of total production while April and May accounted for 12% and August and September accounted for 24%.

Low production during August and September was caused by drouth, while April and May production was influenced by moisture and temperature.

Fifty pounds or less of applied nitrogen did not alter the nitrogen content of the forage. One hundred or 240 pounds of applied nitrogen increased the nitrogen content of the forage at all harvest dates.

Phosphorus content of Pensacola bahiagrass was unusually high for a grass. It equalled or exceeded the calcium content throughout the season and averaged 41% greater. This indicates that when bahiagrass is grown on sandy soils, special attention should be given to phosphorus fertilization.

Ga. Agr. Expt. Sta., Col. Agr., U. Ga., Athens, Ga.

Vicente-Chandler, J., and Pearson, R. W. NITROGEN FERTILIZATION OF HOT CLIMATE GRASSES. Soil Conserv. 25(12): 269-272. 1960.

The yield potential of grasses in the tropics is much greater than in temperate regions because of the year-round growing season. If this potential is to be exploited, heavy fertilization, especially with nitrogen, is necessary. The requirements and problems of nitrogen fertilization of hot-climate grasses are much like those of temperate regions except that they are magnified.

The results presented here are from experiments carried out in Puerto Rico where the mean annual temperature is about 75° F. with a maximum average monthly variation of only 10°. Maximum day-length variation is less than two hours during the year and rainfall is about 74 inches yearly.

Napiergrass (Pennisetum purpureum), Guineagrass (Panicum maximum), Paragrass (Panicum purpurascens), and molassesgrass (Melinis minutiflora) are among the most widely used grasses of the humid tropics. In recent years pangolagrass (Digitaria decumbens) has shown promise of becoming an important addition.

Napiergrass has consistently shown the highest yield potential of the five grasses studied, and the largest response to nitrogen fertilization. This grass yielded 7 1/2 tons of dry forage without nitrogen, but nearly 3 times as much when 800 pounds of nitrogen was applied. The fertilized grass produced 130 tons of green forage, enough to feed about 6 cows per acre. Molassesgrass, on the other hand, had a very low yield potential, producing a maximum yield of around six tons of dry matter. Its yield was not increased by applying more than 200 pounds of nitrogen. The other grasses showed strong yield increases up to 400- or 800-pound applications of nitrogen. Forage composition was markedly affected by nitrogen fertilization.

Even with the best management, including splitting the fertilizer into six applications annually, only about one-half of the applied nitrogen was recovered in the forage.

The use of high nitrogen rates raised other problems. One of the most serious of these was the residual acidity created in the soil. At high rates of ammonium sources of nitrogen, extreme soil acidity was developed in only two or three years. Another problem encountered with heavy nitrogen fertilization is burning of the grass. Nitrogen fertilization also can change the species composition of pastures.

Many factors influence the effective use of nitrogen by grasses. Temperature and variation in daylight affected the growth rate of grasses appreciably. Moisture is the chief climatic factor determining yields and response of grasses to nitrogen in the tropics. Guineagrass, for example, yielded only 6 tons of dry forage and responded to only the 100-pound rate of nitrogen with 35 inches of rainfall. With 80 inches, or with irrigation, this grass yielded about 17 tons and responded to 400-800 pounds of nitrogen per acre.

The grasses themselves have different inherent productive capacities. This is reflected in their response to nitrogen.

Management practices can strongly affect yields and response of grasses to nitrogen fertilization. Napier, Para, and Pangola grasses yielded about a third more over a two-year period when cut close to the ground every 60 days than when cut to about eight inches. Yields of Guineagrass were unaffected by cutting height, while molassesgrass was killed out by close cutting.

Frequency of cutting strongly affects forage yields and efficiency of nitrogen fertilizer. Napiergrass receiving 800 pounds of nitrogen produced 12, 22, and 37 tons of dry forage per acre yearly when the grass was cut at 40-, 60-, and 90-day intervals, respectively. Quality of the forage decreased with length of harvest interval.

Whether the grasses are harvested by cutting or grazing also strongly affects yields and response to nitrogen fertilizer.

Availability of other nutrients often sharply limits the response of grasses to nitrogen. Tremendous quantities of nutrients may be removed from the soil in forage produced by properly managed, heavily fertilized grasses. The forage from one field of heavily fertilized Napiergrass actually contained 670 pounds of nitrogen, 270 pounds of phosphate, 550 pounds of potash, 120 pounds of calcium, and 120 pounds of magnesium per acre. Nutrients are soon depleted in even the most fertile soils. Initial nutrient content of the soil is not a major factor in determining its long range possibilities for production of intensively managed grasses.

Potassium in particular must be carefully considered. The following tabulation shows how strongly potash can affect yields when all other nutrients are provided in abundance.

Potash applied (lbs. per acre)	Dry forage produced (lbs. per acre)	
	Guineagrass	Nappiergrass
0	9,900	5,000
200	22,300	23,600
400	30,600	27,800
800	32,800	36,400

SWCRD, ARS, USDA, Rio Piedras, Puerto Rico.

Tabor, P. TEAMS OF GRASSES FOR THE SOUTHEAST. Soil Conserv. 25: 232-235. 1960.

Many farmers of the Southeast are now using teams of grasses for their farms. They are finding that no one grass can adequately fill all their forage and conservation needs.

A grass team common on the peninsula of Florida is Pangola and Pensacola Bahia. The former endures more water, more alkalinity, and uses heavy doses of commercial fertilizers efficiently. The latter is superior on poorer soils, survives imperfect management, and endures light-to-medium frosts better.

Coastal Bermuda replaces Pangola near the upper boundary of Florida and continues in a humid belt about 1,000 miles long east and west and 200 miles wide. It performs splendidly on well-drained, highly fertilized soils. It endures local drought but languishes on ordinary soils with limited fertilization and on wet areas. It is used for both grazing and hay.

In the Midsouth, tall fescue, rescue, and Kentucky bluegrass reach their practical southern limits and Pensacola Bahia, Dallis, and Coastal Bermuda approach their northern limits. An example is found on the farm of J. C. Richter, Madison, Georgia, with Coastal and Common Bermuda, Pensacola Bahia, Dallis, tall fescue, and Kentucky bluegrass planted in the same field.

SCS, USDA, Athens, Ga.

Rogler, G. A. RELATION OF SEED DORMANCY OF INDIAN RICEGRASS (ORYZOPSIS HYMENOIDES (ROEM. & SCHULT) RICKER.) TO AGE AND TREATMENT. Agron. J. 52: 470-473. 1960.

Studies were conducted with Indian ricegrass to determine the relation of age of seed and treatment to new-seed dormancy and the results summarized as follows: (1) Seed of 754 lots of Indian ricegrass involving seven strains was tested for germination over a 17-year period. (2) New-seed dormancy was pronounced with an average germination of only 2.8% for 1-year-old seed. (3) Germination increased each year for 6 years to a maximum of 47.4%. (4) Germination decreased to a low of 1.5% after 17 years. (5) Wide variation was evident between strains and between years of harvest in degree of newseed dormancy, age at which peak germination was reached, and period of seed viability. (6) Germination of seed of individual plants within a geographic strain showed wide variation in germination characteristics. (7) One- and two-year-old seed showed a marked increase in germination when soaked in water at 2° to 4° C. for 40 days. And (8) strains showed wide variation in the reduction of seed dormancy by soaking in water. Germination of two-year-old seed of one strain was not increased by this treatment.

CRD, ARS, USDA, Mandan, N. Dak.

Rogler, G. A. RELATION OF SEED DORMANCY OF GREEN NEEDLEGRASS (STIPA VIRIDULA TRIN.) TO AGE AND TREATMENT. Agron. J. 52: 467-469. 1960.

Studies conducted with green needlegrass to determine the relation of age of seed and treatment to new-seed dormancy were summarized as follows: (1) Seed of 538 lots of green needlegrass involving 12 strains was tested for germination over a 13-year period. (2) New-seed dormancy was pronounced, with one-year-old seed germinating 26.4%. (3) Germination increased each year for 7 years until a peak of 71.6% was reached. (4) The rate of decrease in germination after the peak at 7 years was approximately the same as the rate of increase up to 7 years. Seed 21 years old germinated only 1.7%. (5) There was wide variation between strains and between years of harvest in degree of new-seed dormancy, age at which peak germination was reached, and period of seed viability. (6) New seed soaked in water for 20 days at 2° to 4° C. showed high germinability compared with that of unsoaked seed. (7) Stratification in moist sand at 2° to 4° C. was superior in breaking dormancy to soaking in water or holding moist seed in a bag for all treatment periods. (8) Stratification for 60 days gave the highest germination of new seed of all treatment periods tested. And (9) seed held under dry storage for one year after 60 days of stratification showed no loss in germination.

CRD, ARS, USDA, Mandan, N. Dak.

Agricultural Research Service, UTILIZING FORAGE FROM IMPROVED PASTURES. U.S.D.A., A.R.S. 22-53, 9 pp. 1960.

Improved pastures can provide some of the most economical farm-grown nutrients for livestock. For this to be possible, use of pasture forage must be managed so that plants are efficiently grazed or harvested when nutritious, but are protected from damage by overuse. This requires skillful management of the timing and intensity of forage use, based on thorough knowledge of both plants and livestock.

Three modern systems of pasture forage utilization--rotation grazing, strip grazing, and green feeding--provide guidelines and patterns that can aid in bringing about efficient forage use.

The three systems were developed to meet different requirements in the use of forage. They have certain features in common. No one system can be said to answer the needs of every farm. All three generally are used to accomplish a common purpose: As an aid in bringing about maximum net dollar returns from pasture and livestock.

This report describes the three systems, notes some of their limitations and possibilities, and points up the important role of effective management in their successful use.

ARS, USDA, Inform. Div., Washington 25, D.C.

Agricultural Research Service. HIGH QUALITY HAY. U.S.D.A., A.R.S. 22-52, 15 pp. 1960.

The national hay crop varies in quality more than any other great crop. Hay of good quality makes a balanced feed on which ruminants can grow normally and produce up to moderate levels. Poor hay is low in nutrients.

Research has established three general rules for improving quality of hay crops: (1) Aim for high nutrient content in the growing plants; (2) cut early when nutrients are near peak; and (3) dry rapidly to conserve feeding value. The following are guidelines for applying these rules with present knowledge: (1) Many forages can provide hay of good feeding value. Legumes are normally richer than grasses in protein and in carotene (pro-vitamin A). But, grasses well managed can provide adequate nutrients for a dependable feed. (2) In many areas, legume-grass mixtures are preferable choices for crop production, also for palatability of the feed. (3) Whatever the forage, leafy, not stemmy, varieties are always preferable for their favorable proportions of protein, vitamins, and minerals. (4) Use of varieties bred for specific advantages, such as resistance to troublesome pests, reduces production costs, gives larger yields, and improves quality and persistency of stands. Buying seed certified for true-to-variety performance is advised. (5) Production of good hay crops merits the use of fertilizer, lime, water management, and pest control measures, as needed. (6) Early cutting yields more nutrients per acre

and better feeding returns. (7) Efficient haymaking aims at two goals: to reduce moisture to a safe storage level and to conserve all possible green color and leaves. And (8) rapid drying saves feeding value of hay because the slower the drying the greater the nutrient losses, and rain can severely damage a potentially good hay. Conditioning devices that promote uniform drying of swaths are worth considering as aids to speed field drying. Applying forced air to speed the final drying stage gives consistent advantages in climate areas where rain is a hazard.

ARS, USDA, Inform. Div., Washington 25, D.C.

Fellows, I. R. FORAGE PRODUCTION AND USE ON CONNECTICUT DAIRY FARMS. Conn. (Storrs) Agr. Expt. Sta. B. 352, 36 pp. 1960.

Two surveys were conducted of samples of Connecticut dairy farms and the results were summarized to obtain a description of present forage practices and to identify typical organizations and operations. The number of cows in the dairy herd was used as a basis to divide the sample farms into five groups. On the average, dairy farmers in all groups showed relative shortages of forage. This shortage ranged from 15 to 28 percent of total requirements for the different groups.

Three methods of adjusting to an inadequate forage supply are discussed in detail. The high points of each are as follows: (1) Increasing forage by improved production practices; (2) increasing forage through the use of more land; and (3) purchase feed substitutes.

The income effect of an improved forage production program was tested by estimating the change in expenses, returns, and net farm income. Budgets were prepared on representative farms in each size group. Three plans for utilizing additional forage were tested. Briefly, they considered the use of extra forage to reduce concentrates feeding, to raise the level of net energy intake, and to support a large dairy herd.

Under existing price relationships in Connecticut, it was demonstrated that by increasing the use of high quality forage, milk production could be maintained, even though concentrate intake was cut. Farm costs remained at approximately the same level but net farm income increased through this adjustment. Greater increases in net farm income were possible through increased feeding of forage and the continued feeding of concentrate at relatively high levels. Even greater improvement in net income was possible through a forage feeding program somewhat below the maximum, or free choice level, and increased dependence upon net energy from purchased sources, and an increase in herd numbers to exploit the capacity of other farm resources.

The greatest net changes are possible on dairy farms with small herds. Many of these farms have high proportions of grasses and relatively low proportions of legumes in the cropping system. Rotation plans to displace grass mixtures with ladino or alfalfa can increase forage production. Coupled with this, greatly intensified fertilization can increase crop yields. Through these reorganizations, increases of 80 percent in total quantity of forage are possible. Better seasonal distributions of forage resources can be planned to insure a more constant forage intake from pastures and harvested forage. Unused surpluses in the early pasture season can be harvested and fed in the form of grass silage in the months of diminishing pastures. Adjustments in feeding levels of concentrate with forage intake at a maximum result in increases in net farm income which may run as high as 65 percent in present herd arrangements. With an increased herd, net farm income can be increased by over 100 percent, even though total expenses increase by 19 percent.

A similar adjustment pattern is adaptable to the larger farms. Operators of larger farms already tend to have a larger proportion of legumes in their forage programs and practice more intensive fertilization. As a result, proportional increases in production are not as great. However, reorganization of cropping practices can result in more even feeding. Increased fertilization can also produce higher forage yields on the larger farms. The availability of more forage makes possible optimum forage intake with reduced concentrate feeding. Increases in net farm income are possible both in present herd arrangements and in larger herds. Optimum forage intake can be coupled with high levels of concentrate feeding to effect potential increases in average milk production.

Substantial increases in forage production on farms in all size groups would be possible if some land areas now in pasture and woodland were renovated and used more intensively for forage production.

Storrs Agr. Expt. Sta., Col. Agr., U. Conn., Storrs, Conn.

Slack, S. T., Kennedy, W. K., Turk, K. L., Reid, J. T., and Trimberger, G. W. EFFECT OF CURING METHODS AND STAGE OF MATURITY UPON FEEDING VALUE OF ROUGHAGES: PART II. DIFFERENT LEVELS OF GRAIN. Cornell U. Agr. Expt. Sta. B. 957, 40 pp. 1960.

This series of trials, conducted over a 5-year period, clearly demonstrates the superiority of early-harvested forages in promoting and sustaining high milk production.

The differences in milk production favoring the early-cut forages were more marked in the 20-week continuous feeding trials than in the 5-week change-over-designed feeding trials. Milk production was increased 48 percent on early silage, and 29 percent on early barn-dried hay, in the continuous trial, as compared with 16 percent for both roughages in the change-over-designed feeding trial, over production on late field-cured hay.

Significantly more milk was produced on early silage than on early barn-dried hay, based on dry-matter intake. Body weight and condition were maintained better on early-silage-fed cows than on those receiving early barn-dried hay or late field-cured hay.

Dairy cows cannot or will not consume enough day matter from roughages, whether early-cut or late-cut, to compensate for a deduction in grain-feeding level. However, cows will produce more milk on a low grain level and early-harvested forages than they will on a higher level of grain and late-cut forages--thus demonstrating the grain-saving power of early-harvested forages.

Cornell U. Agr. Expt. Sta., N. Y. State Col. Agr., Ithaca, N. Y.

Kirk, W. G., Peacock, F. M., Hodges, E. M., and McCaleb, J. E. VALUE OF PANGOLA HAY AND SILAGE IN STEER FATTENING RATIONS. Fla. Agr. Expt. Sta. B. 621, 20 pp. 1960.

Three feeding trials, each with 6 lots of steers, compared the value of pangola hay and silage as roughage feeds in the fattening ration. Lots 1, 2, and 3 were full-fed hay and Lots 4, 5, and 6, silage. All lots received the same amount of cottonseed meal, 41 percent protein. Lots 1 and 4 were fed roughage and cottonseed meal. Lots 2 and 5 were fed limited amounts of citrus pulp and citrus molasses in addition to roughage, while Lots 3 and 6 were full-fed roughage, pulp, and molasses.

Steers fed hay and cottonseed meal had an average daily gain of 1.15 pounds and required 780 pounds TDN (total digestible nutrients) per 100 pounds gain, while those fed silage and cottonseed meal gained 1.29 pounds and required 807 pounds TDN. These rations cannot be considered satisfactory for fattening as the steers improved only two thirds of a slaughter grade, from Utility to Low Standard, in 122 days on feed.

Steers fed a limited amount of citrus pulp and citrus molasses in addition to hay and cottonseed meal gained an average of 1.86 pounds daily and consumed 640 pounds TDN for 100 pounds gain. Similar steers fed the same concentrate ration with silage replacing hay gained 1.94 pounds and required 627 pounds TDN. These rations did not contain sufficient nutrients to promote rapid gains, being low in both TDN and digestible protein. Slaughter grade improved from High Utility to Low Good for Lot 2 and from Utility to High Standard for Lot 5.

Steers full-fed both hay and a concentrate ration of citrus pulp and citrus molasses had an average daily gain of 2.27 pounds and required 618 pounds TDN per 100 pounds gain, while others full-fed silage plus concentrates gained 2.40 pounds daily and required 604 pounds TDN. These gains were satisfactory, but the rations were low in digestible protein and TDN and contained too much roughage for economical utilization of nutrients for fattening. Full-fed steers improved 2 slaughter grades, from Utility to Good in 122 days on feed.

These trials indicated that giving steers either pangola hay or silage free choice, even when full-fed citrus pulp and citrus molasses, resulted in: (1) Larger intake of roughage than necessary to keep the digestive system functioning properly; and (2) increased TDN per unit of gain.

There was a highly significant difference in rate of gain and TDN required for gains among steers receiving different levels of roughage and concentrates, with high roughage rations resulting in lower gains and less efficient feed utilization.

U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Slack, S. E., Kennedy, W. K., Turk, K. L., and Boyce, O. A. EFFECTS OF CHOPPING ON FEEDING VALUE OF HAYS. Cornell U. Agr. Expt. Sta. B. 950, 28 pp. 1960.

The results of 2 years of investigations with 24 cows have shown that barn-dried chopped hay or field-cured chopped hay have no appreciable advantage in feeding value over field-cured baled hay as measured by hay consumption and milk production if the forages were all cut on the same day. The cows consumed daily an average of 31.4 pounds of barn-dried chopped hay, 29.5 pounds field-cured chopped hay, and 29.4 pounds field-cured baled hay from a first-year meadow. The cows consumed 27.2 pounds of barn-dried chopped hay, 27.0 pounds field-cured chopped hay, and 27.9 pounds field-cured baled hay from a second-year meadow. The average daily production of 4% fat-corrected milk for the above roughages was as follows: 34.0, 33.8, 34.0, 35.6, 34.7, and 35.3 pounds.

During the 2 years, comparisons were made between first-year meadow and second-year meadow and the 3 methods of harvesting. The cows fed on hay harvested by any method from the first-year meadow consumed slightly more dry matter, 30.1 pounds, compared with 27.4 pounds eaten by cows given hay from second-year meadow. This was a significant difference in dry-matter consumption. However, no significant difference was shown in milk production between a first- and second-year meadow. Average 4% fat-corrected milk production on first-year meadow was 33.9 pounds and for second-year meadow 35.2 pounds. Cows consuming first-year meadow hay also gained significantly in body weight over the cows consuming second-year meadow hay.

The forages were all cut at the same time from a first-year and second-year meadow for the different curing treatments. All the forages were harvested without severe weather damage. The barn-dried chopped hay was generally greener in color and graded approximately one federal grade higher than the other hays.

An average of the records for the 2 years indicates that the barn-dried chopped method resulted in greater preservation of dry matter per acre than the field-cured chopped or baled methods. There was an increase of 12.5 percent in dry matter preserved in the barn-dried chopped over the field-cured baled hay, and 7.9 percent over that preserved in the field-cured chopped. Field-cured chopped method showed a 4.6 percent increase in dry matter per acre over the field-cured baled method. Only slight differences were noted between the field losses for field-cured chopped and field-cured baled forage in most observations. However, in 1955 an extremely high field loss for field-cured baled hay compared with field-cured chopped hay resulted in an average figure that shows a greater dry-matter saving per acre for the field-cured chopped method.

Chopping of hay, either field-cured or for barn drying, resulted in a somewhat slower field operation. This is an important consideration in early June, when weather is a hazard. Smaller daily acreages for harvesting and processing must be planned than if a baling method is to be used.

Cornell U. Agr. Expt. Sta., N.Y. State Col. Agr., Ithaca, N.Y.

Milne, C. M. MECHANICAL HAY CONDITIONING. Maine Agr. Expt. Sta. B. 590, 16 pp. 1960.

Any machine or process which offers the possibility of reducing the required field drying time of forage crops reduces the exposure of the crop to weather hazards and therefore deserves consideration in the hay harvesting system.

Agricultural engineers of the Maine Agricultural Experiment Stations have been conducting tests since 1956 to obtain information on the performance of various types of hay

conditioners. On the basis of this study and of the experience gained in doing the work these conclusions seem justified:

1. Hay conditioning, whether through the use of a crusher, crimper, or flail harvester, can significantly reduce the required field drying time of forage crops, in some cases by 30 percent or more.
2. In general, uniform crushing will result in more rapid drying than will uniform crimping.
3. Conditioning has a greater effect on legumes than on grasses--the thicker the stem, the greater the effect.
4. In the ordinary hay curing process a tedder is of little or no value.
5. The lacerating action of a flail harvester used for cutting forage for hay produces a more rapid drying rate than can be obtained by the other types of conditioners.
6. The purpose of using a hay conditioner is to reduce the number of days and nights the hay must be left in the field. From this standpoint there is seldom any difference among the various types of conditioners.
7. Field cured hay with or without conditioning is subject to serious shattering losses. Legume hay is particularly susceptible to these losses.
8. The objective of any hay harvesting system should be to get the hay into storage economically, dependably, and as quickly as possible. At the same time as much of the original quality and quantity as possible should be preserved. At present the most feasible system for approaching this objective is the combination of hay conditioning and forced air drying.

Maine Agr. Expt. Sta., U. Maine, Orono, Maine.

Kepner, R. A., Goss, J. R., Meyer, J. H., and Jones, L. G. EVALUATION OF HAY CONDITIONING EFFECTS. Agr. Engin. 41: 299-304. 1960.

Conditioned hay often dried to 20 percent moisture content by the end of the second afternoon after mowing (30 to 35 hr), but a curing time of 3 to 5 days was required to reach an early-morning moisture content of 20 percent for baling. Under the conditions of these tests, part of the advantage of faster daytime curing of conditioned hay was lost by greater moisture pickup at night. Curing times with either crimpers or smooth-roll crushers were usually 2 days less than for unconditioned hay.

Field losses due to mowing and conditioning exceeded those due to mowing without conditioning, by an average of 1.1 percent of the crop with the smooth-roll crushers at moderate roll pressures and 3.6 percent of the crop with the crimpers.

Crimped hay averaged about 1/2 percentage point lower in protein and 1 percentage point higher in crude fiber than rolled or unconditioned hay. Conditioned hay showed a slight advantage in carotene content at the time of baling, but no advantage after several months of storage.

In feeding trials with sheep there were no consistent differences between results obtained with crimped, rolled, and unconditioned hay.

When first-cutting hay was fed to sheep, the gain per 100 lb. of feed supplied (including waste) was 65 percent greater with pellets (made from bales) than with baled hay feed direct. With good hay from two other cuttings, the advantage was only 20 percent.

U. Calif., Davis, Calif.

Dailey, R. T., Shaw, M. D., and McAlexander, R. H. ESTIMATES OF SUPPLEMENTAL WATER NEEDED BY FORAGE CROPS IN PENNSYLVANIA. Pa. Agr. Expt. Sta. B. 669, 36 pp. 1960.

The predication of supplemental water needs of forage crops and the practical application of information of this kind is reported in this study.

To make estimates of supplemental water needs, daily rainfall data for 36 Pennsylvania weather stations for a 31-year period, 1926 through 1956, were obtained. Consumptive use of water for various crops was estimated by the Blaney-Criddle method. On the basis of consumptive use of water by crops and the daily rainfall during the 31-year period, estimates of water needs through irrigation were determined. From these data,

predictions of future supplemental water requirements were made which apply to forages and other crops that could be produced on most of the irrigable soils in the State.

A wide range in supplemental water needs was found among the areas represented by the several weather stations for crops on similar soils. Also, areas with relatively low average temperatures during the summer months did not have water needs as great as areas with relatively high monthly temperatures.

Several applications can be made of results of this study. The data provide individuals with information on the number of growing seasons that an irrigation system might be used and with estimates of the amounts of supplemental water that various forage crops require. These data can be used by irrigation designers in planning of systems on farms and in estimating water storage requirements. A method is explained in the text for using the consumptive use rates by crops in "bank account" system for determining when to irrigate during the season.

The results of this study give information on the amounts of water that would be needed by crops 3, 5, and 7 out of 10 years. This information is useful in determining whether or not to purchase an irrigation system; however, expected returns from irrigation along with information on alternative uses of capital are needed before a decision can be made on the profitability of an investment in an irrigation system.

Pa. State U., Col. Agr., Agr. Expt. Sta., University Park, Pa.

Kincaid, C., Carter, R. C., Copenhaver, J. S., McClaugherty, F. S., Lillard, J. H., Jones, N. J., and Moody, J. R. SUPPLEMENTAL IRRIGATION OF PERMANENT PASTURE FOR BEEF CATTLE. Va. Agr. Expt. Sta. B. 513, 22 pp. 1960.

Steers were used to measure liveweight gains when grazing irrigated and non-irrigated pastures during a 60 year period. During 3 of the 6 years, steers gained 42 pounds more per head during the season when grazing irrigated as compared with non-irrigated pastures. Liveweight gains per steer were similar for the other 3 years. An average yearly increase in liveweight of 20 pounds per head may be expected from irrigated pastures and this increase in liveweight gain would increase the slaughter and carcass grades by 1/6 to 1/4 of a grade.

The increases in liveweight gain from irrigated pastures during dry seasons may be interrelated to the following: (1) More pasturage and selective grazing which increases feed intake and its digestibility; (2) encourages the production of leafy herbage which is more palatable and digestible than accumulated pasturage of nonirrigated pastures; and (3) irrigation improves the amount of clover in pastures. Animal gains are generally higher from grazing grass-clover mixtures than from grasses alone.

The increase in carrying capacity of irrigated pastures was more important than total liveweight gains of individual steers. During the last 3 years when carrying capacity was measured rather accurately, the irrigated pastures carried 12% more animal units than the non-irrigated pastures during the first 56-day period in the grazing season. The carrying capacity for the second 56-day grazing period was increased by 45%, and that of the third 56-day period by 54% as a result of irrigation. Irrigation may increase the carrying capacity for the season by 35% or by as much as 50% during the drier summer months.

A grazier determines the pasture stocking rate ahead of the grazing season, usually during the preceding fall, when most of the stocker cattle are purchased. The usual practice is to plan for an average season where surplus pasturage occurs during wet years and a shortage in dry years. The supply of forage in midsummer is the limiting factor. Supplemental irrigation makes it possible to increase the production of pasturage in this period, thereby increasing the carrying capacity throughout the season.

It may be most practical to plan near the source of irrigation water an area of highly productive supplemental pasture which might be harvested for silage or hay in the spring and then irrigated during the summer months for grazing. A recommended mixture of orchardgrass and ladino clover or of alfalfa, orchardgrass, and ladino clover might be used for such a supplementary grazing plan.

Pasture irrigation also has other beneficial effects. It has been observed that irrigation increases the productive life of pasture because shallow rooted species, such as ladino clover and white clover, are more productive under favorable moisture conditions.

SWCRD, ARS, USDA, and TVA, and Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

Campbell, R. E., Larson, W. E., Aasheim, T. S., and Brown, P. L. ALFALFA RESPONSE TO IRRIGATION FREQUENCIES IN THE PRESENCE OF A WATER TABLE. Agron. J. 52: 437-441. 1960.

Variable frequencies of irrigation were applied to an established stand of alfalfa on a field with a water table at a depth of from 5 to 9 feet. Over a 4-year period, alfalfa receiving 6 irrigations per season yielded only 0.4 tons of hay per acre per year more than nonirrigated alfalfa. Appreciable salt accumulation occurred in the 3- to 7-foot soil depth under the nonirrigated treatment.

Phosphorus uptake was less in the nonirrigated treatment than in those receiving 3 or 6 irrigations, but the phosphorus content in all treatments was above the critical level.

SWCRD, ARS, USDA, Huntley, Mont.

Gardner, E. H., Jackson, T. L., Webster, G. R., and Turley, R. H. SOME EFFECTS OF FERTILIZATION ON THE YIELD, BOTANICAL AND CHEMICAL COMPOSITION OF IRRIGATED GRASS AND GRASS-CLOVER PASTURE SWARDS. Canad. J. Plant Sci. 40: 546-562. 1960.

In an irrigated pasture experiment on Vancouver Island, on a soil deficient in available nitrogen and potassium but apparently containing sufficient available phosphorus, calcium, and magnesium for adequate plant growth, an irrigated Ladino clover-grass mixture greatly outproduced a grass mixture on a forage, protein, and mineral nutrient yield basis. In order to attain even a moderate yield with a grass mixture, heavy fertilization with nitrogen and potassium was necessary. Nitrogen fertilization was not essential to high yields with the Ladino clover-grass mixture. Nitrogen fertilization tended to decrease the percent Ladino clover and the protein and calcium content in the clover-grass forage and increased the protein content of the grass herbage. The calcium content of the grass herbage was decreased by nitrogen fertilization. The phosphorus and magnesium contents of the clover-grass and grass herbage were not appreciably altered by nitrogen fertilization. Decreasing the time interval between nitrogen applications resulted in a more even production of dry matter over the growing season but did not increase the total seasonal yield. Potassium fertilization increased the yield of both mixtures and increased the percent clover in the grass-clover sward. Multi-annual potassium applications were required for the elimination of plant potassium deficiency symptoms and the applied potassium was quickly absorbed by the plants. Grass herbage contained more potassium, slightly more phosphorus, and less calcium, magnesium, and nitrogen than grass-clover herbage.

Oreg. State Col., Corvallis, Oreg.

Bennett, O. L., and Doss, B. D. EFFECT OF SOIL MOISTURE LEVEL ON ROOT DISTRIBUTION OF COOL-SEASON FORAGE SPECIES. Agron. J. 52: 204-207. 1960.

The effects of 3 soil moisture levels--produced by irrigation when 30, 65, or 80% of the available soil moisture had been removed in the root zone--on root development of 8 cool-season forage species were determined. Root patterns were characterized by taking 3-inch core samples, soil monolith samples, and soil moisture extraction patterns.

The amount of roots and the rooting depth varied with the species and soil moisture level. The effective rooting depth decreased as soil moisture level increased. Roots from core samples show that over 70% of the total weight of roots was found in the surface 12 inches of soil for all species except tall fescue. Soil moisture extraction was used with reasonable accuracy to estimate effective rooting depths.

SWCRD, ARS, USDA, Thorsby, Ala.

Willhite, F. M. MOUNTAIN MEADOW FERTILIZATION. Intermountain Meadow and Range Fertilization Conf., Colo. State U., 4 pp. Feb. 1960.

Soil fertility evaluations under good irrigation practices were run concurrently over a wide range of climates and soils (Hayden, Colorado, on heavy, silty clay-loam with a low rate of water intake and 90 frost-free days; Gunnison, Colorado, on deep loam soil with average water intake rate and 70 frost-free days; and Fairplay, Colorado, on shallow, sandy-loam soil with high water intake rate and 50 frost-free days).

The authors summarize their study as follows: Use of nitrogen on a mountain meadow, either from a legume or commercial source, in combination with other improved mountain meadow practices, does increase forage production and accomplishes the rancher's requirements of: (1) Checking declining yields; (2) supplying the extra forage needed to permit improvement of the range; and (3) giving greater efficiency in the use of his natural resources--soil and water. In order to obtain optimum beneficial use of nitrogen and also receive more return on capital investment, it is necessary that the rancher improve efficiency of the other factors of production. In a similar manner, beneficial effects of these improvements cannot be realized unless nitrogen is used. The rancher must apply his skills to disciplines in water, soil, plant fertility, climate, and range and livestock management simultaneously for the purpose of increasing his overall ranch efficiency if he is to receive the income necessary to pay dividends on his investment.

SWCRD, ARS, USDA, Grand Junction, Colorado.

Dowler, C. C., and Willard, C. J. USING HERBICIDES ON ALFALFA AND BIRDSFOOT TREFOIL. Ohio Agr. Expt. Sta. Res. B. 859, 19 pp. 1960.

Pre-emergence applications of all phenoxy herbicides in alfalfa and birdsfoot trefoil were unsatisfactory, giving poor weed control or severe injury to the legumes.

As post-emergence treatments on alfalfa and birdsfoot trefoil, the phenoxybutyric compounds had a much greater margin of safety than the phenoxyacetic compounds. One to two lbs. per acre of 4-(2,4-DB) applied as an early post-emergence treatment caused little or no injury to the legumes and gave satisfactory control of lambsquarters and pigweed. In general, 4-(MCPB) was more toxic to alfalfa and birdsfoot trefoil and gave poorer weed control than 4-(2,4-DB).

One-fourth lb. per acre of 2,4-D post-emergence did not harm alfalfa or birdsfoot trefoil. However, this rate gave poor control of most broadleaf weeds. Higher rates of 2,4-D caused considerable injury to the legumes.

Good to excellent control of German millet was obtained from post-emergence treatments of dalapon at one to four lbs. per acre, with little injury to alfalfa and birdsfoot trefoil. Ryegrass and broadleaf weeds were not controlled by dalapon.

Combinations of dalapon and the phenoxybutrics gave good overall weed control in alfalfa and birdsfoot trefoil. Dalapon at two lbs. per acre plus 4-(2,4-DB) at one lb. per acre applied at the two-to-four-leaf stage was the most satisfactory combination from the standpoint of weed control and lack of injury to the legumes.

Pre-emergence treatments of EPTC at three to six lbs. per acre gave excellent control of grassy weeds and fair control of pigweed and lambsquarters without injuring alfalfa or birdsfoot trefoil. This herbicide gave a significant increase in yield of 1957 summer seeded alfalfa.

Post-emergence applications of DNBP up to three lbs. per acre gave good control of most broadleaf weeds and poor control of grassy weeds with some injury to alfalfa and birdsfoot trefoil. Above three lbs. per acre, DNBP severely injured these crops.

Pre- and post-emergence treatments of neburon from one to four pounds per acre did not injure alfalfa or birdsfoot trefoil. Grass control was poor and the control of lambsquarters and pigweed ranged from poor to excellent.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Peters, E. J., and Davis, F. S. CONTROL OF WEEDS IN LEGUME SEEDINGS WITH 4-(2,4-DB), DALAPON, AND TCA. Weeds 8(3): 349-367. 1960.

An amine and an ester of 4-(2,4-DB) were compared for effects on legumes and weeds. Highest yields of alfalfa were obtained with 1 lb. /A of amine. Rates above 1 lb. of amine or rates of 1 lb. or more of the ester did not increase yields of alfalfa appreciably above the check. Two lb. /A of dalapon plus 1 lb. /A of 4-(2,4-DB) reduced yields of alfalfa and red clover as compared with 1 lb. /A of 4-(2,4-DB) alone.

Two lb. /A of dalapon in combination with 1 lb. /A of 4-(2,4-DB) resulted in yields of birdsfoot trefoil about 3 times greater than when 1 lb. of 4-(2,4-DB) was used alone.

Red clover was tolerant to all rates of 4-(2,4-DB) and its use resulted in increases in yields ranging from 46 to 96 percent above the check. No reduction in yield occurred from the use of 4-(2,4-DB), but dalapon reduced yields of red clover.

Alfalfa stands were not affected by any of the herbicides. Red clover stands were reduced and trefoil stands increased by the use of dalapon in combination with 4-(2,4-DB).

One and 2 lb. /A rates of an ester of 4-(2,4-DB) were compared in combinations with 8 lb. /A of TCA, 2 lb. /A of dalapon and 3 lb. /A of dalapon. Half of the plots received a second application of 2 lb. /A of dalapon after the first cutting.

Spraying with 1 or 2 lb. /A of 4-(2,4-DB) post-emergence nearly eliminated broad-leaved weeds and increased the yields of the first cutting of seedling alfalfa. Control of broad-leaved weeds and yields of alfalfa were similar with both rates of 4-(2,4-DB). During the dry season of 1957, the removal of broad-leaved weeds from the first cutting increased yields of alfalfa in the second cutting. TCA at 8 lb. /A and dalapon at 2 or 3 lb. /A reduced yields of weed grasses and also reduced the yields of alfalfa somewhat. Dalapon was less injurious to alfalfa and more effective than TCA for control of weed grasses. Two lb. /A of dalapon was less injurious to alfalfa than 3 lb. Supplemental treatments with 2 lb. /A of dalapon after the first cutting were effective for controlling weed grasses but reduced the yields of the second cutting of alfalfa. The number of alfalfa plants present was unaffected by treatments.

Yields of birdsfoot trefoil were increased when broad-leaved weeds were reduced with 4-(2,4-DB). Stands of birdsfoot trefoil were slightly improved by treatments with 4-(2,4-DB) where grasses were controlled by early treatment with dalapon at 3 lb. /A, but under some conditions treatments with 4-(2,4-DB) resulted in reduced stands.

The 3-lb. rate of dalapon was more effective than the 2-lb. rate of dalapon or the 8-lb. rate of TCA for controlling weed grasses and increasing the yield and stands of birdsfoot trefoil. These herbicides were effective only when broad-leaved weeds were controlled with 4-(2,4-DB).

CRD, ARS, USDA, Columbia, Mo.

Houston, B. R., Erwin, D. C., Stanford, E. H., Allen, M. W., Hall, D. H., and Paulus, A. O. DISEASES OF ALFALFA IN CALIFORNIA. Calif. Agr. Expt. Sta. Ext. Serv. C. 485, 20 pp. 1960.

Alfalfa diseases are in many instances the limiting factor in maintaining a profitable stand in California.

Yield and quality of both hay and seed may be greatly reduced by attacks of organisms upon leaves, stems, and roots.

It is important that a disease be identified before control is attempted because suggested treatments for one disease may differ greatly from those recommended for another.

This circular describes and illustrates the most important alfalfa diseases in California--their distribution and seasonal occurrence--and makes control recommendations where possible.

Calif. Agr. Expt. Sta., Ext. Serv., Davis, Calif.

Dayton, W. A. NOTES ON WESTERN RANGE FORBS: EQUISETACEAE THROUGH FUMARIACEAE. U.S.D.A. Agr. Hbk. 161, 254 pp. 1960.

A handbook on the economic value and identification of western range forbs.

Forbs (range weeds), vary enormously in palatability, and they embrace a large majority of our poisonous plants. However, because of their great number, diversity, and ubiquity, they are not of great importance to all kinds of livestock and herbivorous wildlife but perhaps especially so to sheep. The genera and species annotated for the various families included here were selected on the basis of importance (for grazing, as poisonous plants, etc.); interest (peculiarities, miscellaneous values); and commonness and abundance. About one-fourth of the range forbs in the 11 Far Western States are covered.

FS, USDA, Inform. Div., Washington 25, D.C.

Reynolds, H. G. MANAGING GRASS-SHRUB CATTLE RANGES IN THE SOUTHWEST. U.S.D.A. Hbk. 162, 40 pp. 1959.

The grass-shrub type at Santa Rita Experimental Range, about 30 miles south of Tucson, Arizona is described. Recommendations for management of the type and improvement in practices are based upon intensive work on the experimental range and observations elsewhere. Many of the recommendations are applicable, possibly with local modifications, over the entire grass-shrub range.

The following recommendations for managing grass-shrub ranges were summarized by the authors:

1. Perennial grasses provide the most important forage on grass-shrub rangelands. Management should be aimed at maintaining a vigorous and productive supply of these grasses.
2. Among the climatic factors, precipitation has the greatest influence upon range productivity.
3. Production and composition of range vegetation varies greatly with annual rainfall and soil conditions. A rancher should recognize the desirable species and know their seasons of growth and periods of preference by livestock.
4. Ranchers should recognize and strive for the best possible range condition. The main factors affecting forage production are weather, mesquite or other woody plant invasion, grazing, rodents, and rabbits.
5. Range maintenance is dependent upon proper utilization of the annual forage crop. Annual and periodic adjustments in stocking are essential for proper use of the forage crop. Annual weight removal of perennial grasses should be between 35 and 55 percent.
6. The practice of making seasonal shifts of livestock on the range benefits both plants and animals. Summer annuals can be utilized during the summer period, perennial grasses during the winter, and browse during the spring.
7. Proper distribution of grazing is essential for optimum use of grass-shrub rangelands. This can be achieved by fencing range units of a size to accommodate 50 to 100 animal units, developing water to the extent practical, and using salt and supplements to draw animals into lightly used areas.
8. Periodic stocking adjustments are essential for proper use of the variable forage supply. By maintaining a flexible herd with breeding animals making up 40 to 60 percent of the herd, downward adjustments can be made during dry years without reducing the breeding herd. In above-average years, excess forage can be utilized by holding over weaners or by purchasing growing animals.
9. A well-organized program of range improvement is desirable on grass-shrub rangelands. This should include plans for shrub suppression and forage restoration through revegetation should be considered where needed.

FS, USDA, Inform. Div., Washington 25, D.C.

Ehrenreich, J. H. RELEASING UNDERSTORY PINE INCREASED HERBAGE PRODUCTION. U.S.D.A., F.S., Central States Forest Expt. Sta., Sta. Note 139, 2 pp. 1959.

A study was begun in 1955 to determine how spraying undesirable hardwoods with herbicides to release underplanted pine trees would affect yield of herbaceous vegetation.

This study was made in an oak stand that had been underplanted with pine in 1941. Hardwood cover ranged from dense sprout reproduction and saplings to dominating, cull, sawlog-size trees. Hardwood crown cover was about 90 to 95 percent; about half of this was understory and about half overstory cover. The underplanted pines were from 1 to 25 feet in height. Herbaceous vegetation consisted mostly of little bluestem (Andropogon sloparius), poverty oat grass (Danthonia spicata), and sedge (Carex spp.) with various legumes and other forbs. The soil on the area is Clarksville stony loam.

Aerial and hand applications of herbicides were used in this study. In June 1955, 2, 4, 5-T was aerially applied at the rate of 2 pounds acid equivalent per acre in 4.5 gallons of fuel oil. The hand spraying was done in July 1955 by applying 2, 4, 5-T (at 20 pounds a.h.g.) in fuel oil to foliage of trees less than 3 feet tall, to low cut stumps of trees 3 feet tall to 3 inches d.b.h., and to low frills in trees larger than 3 inches d.b.h.

Reducing the hardwood crown cover to about 20 to 30 percent by hand spraying with 2, 4, 5-T resulted generally in a 5 to 6 fold increase in herbage production for at least 3 years. Aerial spraying increased herbage production by more than 17 times the first year after treatment but production dropped back to slightly less than that on hand-sprayed areas the second and third years.

The reason for this spurt was that aerial spraying quickly defoliated the larger hardwood trees, opening up the stand and providing an immediate stimulus to herbaceous cover. On hand-sprayed areas the larger trees defoliated more slowly because they were killed from the boles instead of the crowns. Competition from the regrowth of hardwoods and rapid growth of released pine decreased herbaceous production the second and third years on aerial-sprayed area and the third year on hand-sprayed areas.

The temporary increase in herbage production on oak-pine land sprayed to release the understory pine provides a source of forage that could be used by both livestock and wildlife.

Central States Forest Expt. Sta., FS, USDA, Columbia, Mo.

Behrens, R., and Morton, H. L. MESQUITE ROOT INHIBITION TESTS TO STUDY INHIBITORY ACTIVITY, ABSORPTION AND TRANSLOCATION OF 2, 4-D and 2, 4, 5-T. Weeds 8(3): 427-435. 1960.

The inhibition of mesquite root elongation was used to study the inhibitory activity, absorption, and basipetal translocation of sublethal concentrations of 2, 4-D and 2, 4, 5-T. The inhibitory activity of 2, 4-D exceeded that of 2, 4, 5-T when these compounds were added to the root bathing medium. On the other hand, 2, 4, 5-T exhibited greater inhibitory activity than 2, 4-D when applied to the cotyledons. Root inhibition was first apparent from four to six hours after cotyledonary applications. Ethanol, diesel fuel, and acetone-nontoxic oil carriers did not readily penetrate mesquite cotyledons unless the epidermis was ruptured. Absorption of 2, 4, 5-T by cotyledons was greatest when acetone-nontoxic oil was used as carrier. The effectiveness of the carriers correlated with the surface area wetted by the drop applied. Repeated applications of 2, 4-D and 2, 4, 5-T to the cotyledons caused little or no impairment of basipetal translocation 48 to 72 hours after initial application.

Jr. Author, CRD, ARS, USDA, College Station, Texas.

Major, J., McKell, C. M., and Berry, L. J. IMPROVEMENT OF MEDUSAHEAD-INFESTED RANGELAND. Calif. Agr. Expt. Sta. Ext. Serv. L. 123, 8 pp. 1960.

Medusahead, (Elymus Caput-medusae) an annual weedy grass is invading California's rangelends at a serious rate. Grazing capacity on some ranches has been reduced as much as 75 percent.

Small spot infestations must be controlled even at a high cost, to ensure against spread of the weed to uninfested areas. Chemicals applied at the proper time and rate are effective in controlling medusahead. Reseeding spot infestations is a necessary follow-up treatment.

On widespread, long-established stands of medusahead, chemical control is not economically feasible. Under such conditions, the more productive locations should be chosen for improvement by burning and cultivation, combined with the seeding of legumes fertilized with phosphorus or sulfur, or the seeding of aggressive, locally adapted perennial grasses. Seeding operations should be followed by proper livestock management.

On lands where reseeding is inappropriate, a systematic program of reburning may be followed.

This leaflet describes and illustrates medusahead and gives the various recommended practices of control under different conditions.

Calif. Agr. Expt. Sta., Ext. Serv., Davis, Calif.

Lind, C. ANCHOR CHAIN NEW CONSERVATION TOOL. Our Public Lands, Bur. Land. Mangt. U.S. Dept. Int. 9(3): 7-9, 14-15. 1960.

Stands of pinon and juniper (cedar) located in suitable areas are selected and subjected to control measures using an anchor chain. "Control" means uprooting the trees to encourage a better growth of grass. This is done simply by dragging the chain between two track-type tractors. Although there are no hard and fast rules concerning the requirements of either the tractors or chain, there are certain desirable standards for both.

A tractor developing 85 drawbar horsepower is desirable. Smaller units have been used but are naturally somewhat slower and must clear a narrower swath. Rough terrain or thick stands of timber also makes a larger tractor more desirable.

The standards used in selecting an anchor chain are the length of the chain and the weight per link. A chain about 180 feet long is preferable since shorter chains have a tendency to pull the tractors toward the middle of the swath, thus reducing the efficiency of the tractors. Anchor chains weighing 46 pounds per link remain closer to the ground and do not ride over the trees as easily as lighter chains, although chains weighing 36 pounds per link have been used satisfactorily.

Several factors influence the speed (and the subsequent cost) of a "chaining" operation. They are the size of the tractors, topography, size and density of the trees, soil and rock, and weather.

Anchor chaining costs about $4 an acre; a substantial saving over bulldozing.

Bur. Land Mangt., U.S. Dept. Int., Cannon City Dist. Off., Cannon City, Colo.

Jones, M. B., and Evans, R. A. BOTANICAL COMPOSITION CHANGES IN ANNUAL GRASSLAND AS AFFECTED BY FERTILIZATION AND GRAZING. Agron. J. 52: 459-461. 1960.

Changes in botanical composition resulting from applications of nitrogen and phosphorus, with and without sheep grazing, on the annual range type of California were studied at two locations. The first site was unimproved resident-range and the second had been seeded to sub, rose, and crimson clovers, hardinggrass, and soft chess.

The percentage of soft chess at the resident-range location was increased by nitrogen fertilization on grazed plots for 2 of 3 years but increased only the first year on ungrazed plots. Percentage of soft chess on the reseeded-range area was increased both years by nitrogen fertilization when grazed but decreased when protected.

The percentage of ripgut on the resident-range site was increased by phosphorus fertilization, and this increase was less on grazed plots than on ungrazed. On the seeded site, where available phosphorus was adequate, ripgut was increased by nitrogen fertilization. Grazing reduced the percentage of ripgut at both locations.

Slender wild oats and broadleaf filaree, which were major components of the forage at the resident-range site only, were particularly responsive to nitrogen and both decreased in abundance when grazed. Little fertilizer effect could be measured in filaree on grazed plots.

In general, clovers were decreased by nitrogen fertilization, but subclover appeared to be an exception in 1958. Phosphorus increased the clovers. The percentage of clovers at the resident-range site and crimson clover at the seeded site decreased under grazing while rose and subclovers were increased by grazing.

U. Calif., Hopland Field Sta., Hopland, Calif.

Chiasson, T. C. THE EFFECTS OF VARIOUS INCREMENTS OF N, P, and K ON THE YIELD AND BOTANICAL COMPOSITION OF PERMANENT PASTURES. Canad. J. Plant Sci. 40: 235-247. 1960.

Applications of N, P, and K to an area grazed and unfertilized for over 30 years resulted in some immediate and marked improvements in yields and botanical composition. Phosphorus, at rates up to 80 pounds per acre, brought about the most marked improvement. This element was responsible for highly significant increases in yield, increased wild white clover, and useful grasses and decreased weeds, moss, and bare ground markedly. Potassium, up to 60 pounds per acre, also gave highly significant increases in yield. Potassium had relatively little effect on the prevalence of species at first, but by the fourth year had maintained white clover better than phosphorus and had also decreased weeds and moss. Nitrogen, at 15 pounds per acre, increased yields each year but only during the early part of the season. Thirty pounds per acre was superior to the 15-pounds rate one year only and this was also during the early part of the season. It actually tended to decrease yields during July and August. The effect of nitrogen on botanical composition was largely to decrease the percentage of wild white clover with a corresponding increase in grasses.

Canada Dept. Agr., Fredericton, New Brunswick, Canada.

Evans, R. A. DIFFERENTIAL RESPONSES OF THREE SPECIES OF THE ANNUAL GRASSLAND TYPE TO PLANT COMPETITION AND MINERAL NUTRITION. Ecology 41(2): 305-310. 1960.

The effects of intra- and interspecific competition at different levels of nitrogen and phosphorus among 3 major species of the annual grassland type of California (B. mollis, E. botrys, and F. megalura) were studied.

Plants of the 3 species were grown in pots in a greenhouse. Variables of the experiment were intra- and interspecific combinations of planting, densities of planting, and levels of soil nitrogen and phosphorus.

Results indicated that competition was effective through differences in nitrogen uptake by the constituent species. With a high phosphorus level these differences resulted in changes in yield. With low phosphorus they were expressed as differences in nitrogen percentages and minimized yield changes.

Factors of interspecific competition were differential shading and differential ability for uptake of nitrogen. One was more important than the other depending upon the species and species combination.

CRD, ARS, USDA, Reno, Nevada.

Plant Materials

Smith, T. J., Gish, P. T., and Williams, A. S. VARIETAL TESTS OF SUDANGRASS AND PEARL MILLET IN VIRGINIA, 1954-1959. Va. Agr. Expt. Sta. Res. Rpt. 38, 33 pp. 1960.

Sudangrass and pearl millet are high yielding annual summer grasses well adapted as supplementary forage crops for Virginia, and are suited for summer grazing during periods of drought when pastures normally produce little growth. They furnish hay practically equal in feeding value to other non-legume roughages, and make acceptable ensilage when properly handled.

New varieties of sudangrass and pearl millet are being developed and introduced in different regions of the United States. Only by a continuous evaluation program can adequate information be obtained on the adaptation of these varieties to Virginia Conditions.

A brief discussion has been given on the potential prussic acid content of sudangrass, hay and pasture management for both sudangrass and pearl millet, rates and methods of seeding, and the diseases affecting the 2 crops.

From the data obtained to date, the following conclusions have been reached: (1) Although there was wide variation in yields between varieties within each crop and between crops according to location and growing seasons, the better varieties of both sudangrass and millet yielded about the same. For all 24 test years, Piper sudangrass averaged 3.06 tons per acre of cured hay and Common pearl millet 3.18 tons. Pearl millet was slower growing in the seedling stage and slightly coarser than sudangrass. (2) In 2 years, or 8 test years, the crops were harvested under hay (2 or 3 cuttings) and pasture (3 or 4 cuttings) management. Higher yields were obtained under hay management, i.e. with fewer cuttings. These crops should be harvested only once or twice, depending upon the growing season when used for hay or ensilage in order to get maximum yields. In normal growing seasons pasture management requires not more than 3 cuttings. (3) There is considerable difference in yield and disease resistance between different varieties of sudangrass. Some of the newer varieties are superior in both yield and disease resistance to older varieties. Sweet sudangrass, of high palatability, is an important variety in areas of slight disease. However, it is being removed from the Virginia recommended list because of its high disease susceptibility under State conditions. (4) Some of the newer varieties of pearl millet are more vigorous, more leafy, high yielding, and later maturing than Commercial pearl millet. Of these, certified Gahi - 1 is the only one that has been placed on the recommended list. None of the millet varieties shows any appreciable damage from disease. (5) In the 1959 tests, DeKalb Sudax SX-11 and the 3 Texas experimental hybrids produced high yields at all locations. The leaves were larger and the stalks coarser than the standard sudangrasses. And (6) three perennial sudangrasses (sorgrass and 2 strains of (Sorghum almum) were included in the 1959 tests. All 3 hybrids produced yields and quality below the better varieties of sudangrass and pearl millet with the exception of Sorghum grass, a strain of Sorghum almum, which produced high yields at 2 of the 4 locations. Virginia seed law prohibits scale of seed of any of these perennial types of sorghum.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

Harlan, J. R., and Kneebone, W. R. WOODWARD SAND BLUESTEM. Okla. State U. Expt. Sta. B. B-561, 10 pp. 1960.

Woodward sand bluestem, released in 1955, was developed for the southern Great Plains. It is superior to common sand bluestem in seedling vigor, leafiness, seed production, and adaptability to combine harvest. Woodward also produces more vegetative growth in the seeding year than most common sources. This early vegetative growth, along with a greater than average degree of spread, makes it an excellent variety for conservation purposes.

Populations of Woodward sand bluestem plants include a wide range of different types, but many of the differences are superficial. Most plants are of moderate height, leafy, and somewhat resistant to foliar diseases. They tend to spread more than ordinary sand bluestem. Plants are fine to medium stemmed, with an abundance of flowers near the top of the plant. Seed-set is generally excellent.

As a variety, Woodward is superior to common source in: (1) Seedling vigor and emergence; (2) leafiness and resistance to leaf diseases; (3) desirable plant height, basal spread, and head placement; and (4) flower production and seed-set. Compared with good local common, Woodward has been outstanding in seed yield but somewhat low in forage production. Because of its leafiness and relatively fine stems, however, Woodward probably produces as much or more usable forage than do common sources.

Sand bluestem is one of the most productive native grasses on sandy soil in the southern Great Plains. It will grow well in medium textured soils in central Oklahoma and Kansas, but for best growth requires progressively lighter soils as precipitation decreases to the west. It occurs naturally on sands in eastern Colorado, in eastern New Mexico, and in the Texas and Oklahoma Panhandles. The Woodward variety can be grown

wherever sand bluestem occurs in the southern Great Plains, but is best adapted north of U.S. Highway 70.

CRD, ARS, USDA, and Agr. Expt. Sta., Okla. State U., Stillwater, Okla.

Rogler, G. A. GROWING CRESTED WHEATGRASS IN THE WESTERN STATES. U.S.D.A. L. 469, 8 pp. 1960.

Crested wheatgrass, a perennial bunchgrass from central Asia, is hardy, drought resistant, and long lived. It has been the most successful of all introduced grasses in the northern Great Plains. It is used for seeding cultivated areas and is popular for reseeding abandoned croplands. It volunteers freely from shattered seed; good stands often develop from thin initial stands.

Crested wheatgrass can be grazed in early spring at a much heavier rate than native range, and it is ready for grazing 2 to 3 weeks earlier. Because it can be grazed early and is palatable and nutritious in the early stage of growth, it is valuable for calving and lambing pastures.

If it is cut after heading but before flowering, crested wheatgrass makes good hay. The hay cures easily and remains green in the stack much longer than the hay made from many other grasses.

Crested wheatgrass also can be used for roadside plantings, erosion control, and wildlife cover.

Two named varieties of crested wheatgrass are available--Nordan and Summit.

Nordan was developed at the U.S. Northern Great Plains Field Station, ARS., Mandan, N. Dak. It was released in North Dakota in 1954.

Nordan is superior to commercial crested wheatgrass in the following characteristics: (1) The seed is pure; (2) seeds are larger, with little or no awn; (3) seedling vigor and first-year growth are greater and stands are easier to establish; (4) the plants, heads, and seeds are more uniform; (5) plants are more erect and resistant to lodging; and (6) heads are more compact.

This variety is widely adapted and is now grown throughout the West. Seed is available in quantity.

Summit, developed in Canada, was selected from commercial crested wheatgrass. It is grown primarily in Canada.

This is a complete culture and care leaflet on crested wheatgrass.

ARS, USDA, Inform. Div., Washington 25, D. C.

Schwendiman, J. L. TALL WHEATGRASS GAINS STATURE. Crops and Soils 12(5): 12-13, 23. 1960.

Tall wheatgrass looks like a promising forage crop find for the West. Introduced from the salt marshes of northern Turkey and the Soviet Union by the USDA during the Thirties, this perennial bunch-type grass is used widely in many areas, particularly where alkali soils are a problem.

A tall-growing, bunch-type wheatgrass, it is quite palatable and highly productive when properly managed. It matures 2 weeks later than crested wheatgrass and as much as 30 days later than tall fescue. Tall wheatgrass provides excellent grazing during late summer when other grasses are no longer productive.

The seed is large, seedlings are vigorous and stands are readily established. This grass is disease resistant and is presently being used as a source of rust resistance in wheat breeding.

Tall wheatgrass (Agropyron elongatum) is one of the few grasses well adapted to alkali and salt-affected soils. It gives high yields on irrigated or sub-irrigated salty soils, as well as on wet or dryland alkali soils of the Intermountain West--even at elevations from 4,500 to 6,000 feet.

Cultural methods are important for successful establishment of tall wheatgrass. But where excessive water, salt, or alkali conditions are not present, seedlings are easily established by: (1) Eliminating the existing vegetation; (2) preparing a good seedbed; (3) seeding in the early spring; (4) protecting young plants from grazing until well established; and (5) using selective herbicides to reduce weeds when necessary. Establishing

grasses on salty soils can be difficult, and the most critical period is the early stages of seedling growth. Tall wheatgrass has a high tolerance to alkalinity and it has been established successfully on soils having a pH as high as 10.1. However, where severe salt conditions are present, certain practices should be used to lower the salt concentration and reduce the hazard to grass seedlings.

The practice of letting the plants mature and cutting a seed crop the first year is recommended as it will help the stand in the following two ways: (1) By letting the plants grow up, they can establish a good root system; and (2) by leaving an 8-inch stubble when harvesting the seed crop, close grazing can be prevented during the following season.

Spring grazing can start when the soil is dry enough to prevent trampling damage and as soon as the new plant growth is at least 8 inches high. When plants start to head, clip growth back to this 8-inch stubble so as to insure palatable green forage and a suitable protective stubble cover.

Tall wheatgrass will be utilized only sparingly if more palatable species are abundant. But observations indicate that it is eaten readily by animals in fields where Alta fescue or Reed canarygrass are also present.

Of the several selections and introductions of tall wheatgrass, Alkar is the one best adapted and used most widely in the Pacific Northwest. Alkar was developed primarily for its high tolerance to alkali soils and its productivity on saline and saline-alkali soils. It grows well on soils having a salt concentration of 6,300 p.p.m. and will grow in concentrations as high as 10,000 p.p.m. or 1 percent salt. The kind and amount of salt, its distribution in the soil profile, and the available moisture are important factors affecting the production on these soils.

The carrying capacity of Alkar varies with location, type of soil, growing season and management. Depending on conditions, beef cattle have produced gains ranging from 100 to 800 pounds per acre in tall wheatgrass trials throughout the West.

For silage, Alkar should be cut between the heading and soft-dough stage. This assures maximum yield as the plants are still green and succulent. Chopping and packing are necessary. Seven to 22 tons of green weight (or 2 1/2 to 7 tons dry weight) per acre have been reported. For feeding cattle, it is nearly equal to corn silage in nutritional value.

Hay production usually ranges from 1 to 5 tons per acre, depending on whether the hayfields are irrigated or dryland, but 7.3 tons of tall wheatgrass hay has been produced. For the best quality hay, Alkar should be cut at the heading stage, when it has 10 to 12 percent protein.

Whether used for pasture by cattle or sheep, as silage, or as hay, tall wheatgrass--especially the Alkar variety--is the most productive forage plant adapted to salt-affected soils of the West.

Plant Material Cent., SCS, USDA, Pullman, Wash.

Hanson, A. A. GRASS VARIETIES IN THE UNITED STATES. U.S.D.A. Agr. Hbk. 170, 72 pp. 1959.

A handbook prepared as a reference for technical workers interested in the origin and current status of named and experimental grass varieties in the United States. Information on source material, previous names or experimental numbers, characteristics ascribed to varieties by originating stations, and seed supplies has not been previously available in a readily accessible form.

At least 90 grasses are used to some extent on most farms in the United States either for forage or for conservation and soil improvement. In addition, the forage grasses are utilized on some 400 million acres of open grazing land and woodland ranges that are not on farms. The grasses provide about 48 percent of the total livestock feed requirements as pasture and about 12 percent as hay. Grasses for turf in lawns, parks, playgrounds, airports, cemeteries, roadsides, golf courses, and other uses occupy more than 14 million acres and affect almost the entire population of the country.

Most of our major grasses have been introduced--a process that started with early pioneer settlements along the borders of what is now the continental United States. Chance introductions were followed in time by organized plant explorations sponsored by the

United States Department of Agriculture (USDA), as well as by the direct exchange of seed and plant material between American and foreign research workers.

An attempt has been made in this handbook to limit entries to those varieties and experimental strains that have been distributed rather widely for testing purposes. Exceptions have been included where a particular name or number might have appeared in the literature and questions could be raised as to origin or status; for example, Michigan B-2 smooth brome. In addition, brief descriptions have been included of several foreign varieties that have been distributed through the regional testing program of the Grass and Turf Section, USDA.

No attempt has been made to appraise the relative merits of the grass varieties. Several of the varieties are obsolete, and others have failed to exhibit any particular promise in comparative tests.

ARS, USDA, Inform. Div., Washington 25, D.C.

Stephens, J. H., and Marchant, W. H. BAHIAGRASS FOR PASTURES. Ga. Agr. Expt. Sta. B. N.S. 67, 18 pp. 1960.

Bahiagrass is native to South America. There are wide variations within the species. Four general types under discussion are: short narrow-leaf, short broad-leaf, narrow long leaf, and long broad-leaf. The last two types are the ones suited for pasture grasses.

Bahiagrass is adapted to a wide range of soil types of the Coastal Plain. A good seed bed should be prepared and seed planted at the rate of about 15 pounds per acre in February or March on upland soils and April or May on low, moist soils. About 300 pounds of 4-12-12 and a light top dressing of 20 to 30 pounds of nitrogen per acre will hasten establishment during the first year. Seed should be planted 1/4- to 1/2-inch deep and packed into the soil. Mowings should be frequent during the first year to control weeds. Grazing the first year should be delayed until mid-summer to avoid trampling and injuring young seedlings.

Bahiagrass produces a good yield of seed, but the seed mature progressively--not all at one time. Combined seed should be dried at once after harvest to prevent heating. Where a large volume of seed is harvested, an artificial drier is recommended.

Bahiagrass growth slows under extremely dry conditions, but recovery is rapid when rains occur. Bahiagrass also recovers rapidly after mowing.

Winter burning of Bahiagrass does very little damage if the cover is light; however, burning of heavy litter can inflict serious injury. Careful management is required to grow legumes in Bahiagrass sod.

Bahiagrass, with its abundance of viable seed, could be a pest under some rare conditions, but under most farm conditions of the Coastal Plain it is not a serious problem. Seedling plants are delicate and in rotation give less trouble than crabgrass.

Ergot (Claviceps paspali) is the most serious disease on some varieties of Bahiagrass. Argentine is a variety susceptible to ergot.

Fertilizer grazing tests on Pensacola Bahiagrass show responses to nitrogen fertilization. Where less than 30 pounds of nitrogen is used, the sod tends to thin out and weed competition increases. Crimson clover and lupines when interplanted in Bahiagrass are not always dependable as a source of nitrogen, and Bahiagrass in association with these legumes produced about the same as when 50 pounds of nitrogen was applied.

Five varieties and hybrids of Bahiagrass were tested at the 100-pound rate of nitrogen fertilizer level. The highest yielder was Tifhi-1 followed by Pensacola and P.I. 158,822.

A palatability test indicated that the long, broad-leaf types are more palatable to cattle. It also indicated that the more highly fertilized Bahiagrass is preferred over the lighter fertilized grass. Under grazing tests, however, the highest beef-producing varieties were the lowest in palatability rating.

CRD, ARS, USDA, and Ga. Agr. Expt. Sta., U. Ga., Col. Agr., Athens, Ga.

Chamblee, D. S. ADAPTATION AND PERFORMANCE OF FORAGE SPECIES. N. C. Agr. Expt. Sta. B. 411, 47 pp. 1960.

This is a summary of certain variety and strain tests of forage crops in North Carolina conducted between 1943 and 1958.

PERENNIAL GRASSES--Tall fescue, orchardgrass, and Kentucky bluegrass are the best adapted cool season perennial grasses for use in North Carolina. Potomac orchardgrass is the best variety of orchardgrass available, whereas Kentucky 31 and alta tall fescue are the better two varieties of tall fescue. Coastal Bermuda grass is the best adapted perennial warm season grass for the drained soils of the Coastal Plain and Piedmont area. Suwannee Bermuda is subject to winter damage in North Carolina. Coastal Bermuda grass is especially well adapted to deep sandy soils and high yields of forage may be obtained during midsummer if properly fertilized.

PERENNIAL LEGUMES--Ladino clover is generally the most widely adapted and productive pasture-type legume for North Carolina. Ladino is more productive and persistent than the intermediate white clovers. Birdsfoot trefoil shows promise as a pasture legume at elevations of 2,600 feet and above in the Mountain area of Northwestern North Carolina. Alfalfa is well adapted to most upland soils of the Mountain, Piedmont, and Coastal Plain. Atlantic, Williamsburg, and Oklahoma Common are widely adapted in North Carolina. DuPuits and Narragansett have performed best in the Mountain area only, while Buffalo is the highest producer on wilt infested soils. On the sandy soils of the Coastal Plain, sericea lespedeza is generally used in preference to alfalfa as a hay or grazing plant. Sericea will produce 1 1/2 to 2 1/2 tons of hay annually. Red clover is a short-lived perennial and is best adapted to well-drained soils of Upper Piedmont and Mountains.

PERENNIAL LEGUME-GRASS MIXTURES--For general pasture use, Ladino-orchardgrass and Ladino-tall fescue are the most widely adapted and productive pasture mixtures for North Carolina. Alfalfa-orchardgrass is adapted to most drained soils of the Piedmont and Mountain areas, and this mixture is generally used alternately for hay, silage, and grazing. Mixtures such as Bermuda grass-annual lespedeza and Dallisgrass-lepedeza will provide extra grazing during the midsummer period. They are particularly useful on sandy loams.

WINTER ANNUAL GRASSES--The main winter annual grasses utilized for forage in North Carolina are the small grains and Italian ryegrass. Small grains are utilized to advantage for grazing and silage. Generally abruzzi rye is considered superior for early fall and early winter grazing, whereas barley and oats usually furnish more grazing in the spring of the year.

SUMMER AND WINTER ANNUAL LEGUMES--The annual lespedezas and soybeans are the most widely adapted and utilized summer annual legumes for hay and grazing in North Carolina. Kobe is well adapted to upland loams and low-lying, poorly-drained soils of the Coastal Plain and Southern Piedmont, and generally produces more forage in the Coastal Plain than Korean. In the Mountain area Korean is more frequently utilized, since Kobe is often killed by frost before the seed mature. Two varieties of Korean, Rowan, and Climax, are superior under certain conditions in North Carolina. Rowan is superior on root-knot nematode infested soils. The annual lespedezas are usually seeded in late winter in small grain, and about one to two tons of dry forage per acre may be expected in one year. Soybeans are also widely adapted in North Carolina and are frequently seeded for silage, hay, or grazing. Crimson clover is usually superior to other winter annuals grown in North Carolina, except on the deeper sands where hairy vetch is better adapted. Hairy vetch will grow on most medium drained soils of the state.

SUMMER ANNUAL GRASSES--Pearl millet (cattail millet) and sudangrass are quick growing summer annuals capable of producing two to four tons of dry forage per acre within an eight- to 12-week period during the summer. Pearl millet is much better adapted to the sandy soils of the Coastal Plain area of North Carolina than sudangrass. Starr millet is a more leafy variety which produces lower dry matter yield than common; however, in grazing studies starr has been approximately equal to pearl in production of total digestible nutrients.

Agr. Expt. Sta., N. C. State Col., Raleigh, N. C.

Welton, K. INTRODUCTION OF NEW PLANT MATERIALS IN THE CORNBELT STATES. J. Soil and Water Conserv. 15(4): 162-166. 1960.

Thousands of new plant materials have been tested and evaluated in the Cornbelt States to facilitate soil and water conservation programs. Many of these plants are now serving a useful purpose on farms and ranches. The search for new plants to provide for a particular conservation need continues.

This article is the first in a series of two papers. It generally covers what has been done and how the work is organized in the new plant materials centers.

SCS, USDA, East Lansing, Mich.

Hanson, C. H., Garrison, C. S., and Graumann, H. O. ALFALFA VARIETIES IN THE UNITED STATES. U.S.D.A., A.R.S., Agr. Handbook 177, 30 pp. 1960.

Alfalfa is grown on about 30 million acres throughout most of the United States. Consequently, the crop is subjected to a wide range of climatic, disease, and insect conditions. Choosing an adapted variety and planting good seed are prerequisites to profitable production. Many varieties have been developed that are resistant to certain diseases and to insects, that are winter hardy, and that respond to certain management requirements. Therefore, it is important that seed to be planted should be adapted to a given area. This can be done if growers will check the varietal identification on the seed tag and select suitable varieties. Buying certified seed is one of the best assurances of obtaining seed true to variety name.

Resistant varieties should be planted in areas where bacterial wilt, spotted alfalfa aphid, and stem nematode are serious production problems. The following varieties are resistant to--

Bacterial wilt		Spotted alfalfa aphid	Stem nematode
Buffalo	Ranger	Cody	Lahontan
Caliverde	Teton	Lahontan	
Cody	Vernal	Moapa	
Lahontan	Zia	Zia	

A brief description of the leading alfalfa varieties grown in the United States is given by showing: (1) Origin; (2) genetic stocks used for maintaining variety; (3) plant characteristics; (4) winter hardiness; (5) area of adaptation; and (6) estimated 1958 acreage.

ARS, USDA, Inform. Div., Washington 25, D.C.

Hildebrand, S. C., Clanahan, D. L., Erdmann, M. H., Nelson, L. V., and Cargo, W. FIELD CROP RECOMMENDATIONS FOR MICHIGAN 1960-61. Mich. State U. Coop. Ext. Serv., Ext. Folder F. 289, 28 pp. 1960.

The crop varieties recommended for Michigan and some important cropping practices used in the production of field crops are given.

Michigan soils vary widely; from very light sands to heavy clays and organic soils. They vary from droughty to wet soils. Similarly, the climatic conditions vary considerably from north to south with differences in elevation and distance from the Great Lakes. With such a divergence of soil and climatic conditions, the kind of crops and crop varieties varies considerably. Recommendations are necessarily for a general area.

The recommendations are based on field trials conducted at Michigan State University and at various places throughout the State. No one variety or cultural practice is best under all conditions.

Mich. State U., Coop. Ext. Serv., East Lansing, Mich.

Allan, P. F., and Steiner, W. W. AUTUMN OLIVE--FOR WILDLIFE AND OTHER CONSERVATION USES. U.S.D.A. L. 458, 8 pp. 1960.

People in the East who want to attract wildlife, conserve soil, beautify odd areas, establish plant barriers, or make ornamental plantings will find autumn olive a valuable plant.

Autumn olive (Elaeagnus umbellata) is known as autumn elaeagnus and pink-fruited elaeagnus. Autumn olive was introduced in this country about 1830 from China or Japan. It is related to several other introduced plants--the Russian-olive, the summer olive, and some others--as well as to the native silverberry of the West.

Autumn olive is a wide-spreading shrub, often growing as high as 10 to 15 feet. Its main trunk and large branches are dark brown; the smaller branches and twigs are yellowish brown and rather spiny. Leaves of autumn olive are from 2 to 3 inches long and have wavy edges. They range in shape from slender to oblong and are spaced alternately on the twigs. The upper sides of the leaves are green with silvery scales, while the undersides are silvery with brown scales. Autumn olive sheds its leaves in the fall.

In May autumn olive has an abundance of sweet-scented flowers. They are yellow, small (about one-quarter inch long), and trumpet shaped. The flowers grow singly or in clusters along the twigs and small branches.

When autumn-olive berries ripen in September, they are red with brown scales. They average about one-quarter inch long. Within the fleshy covering is a pit or seed--long, soft, and ribbed. The berries that do not fall to the ground in early fall turn yellowish brown and raisinlike. Berry crops are heavy and dependable.

This is a complete culture and care leaflet on the growing of Autumn Olive.

ARS, USDA, Inform. Div., Washington 25, D.C.

Woodlands

Stoeckeler, J. H. SOIL FACTORS AFFECTING THE GROWTH OF QUAKING ASPEN FORESTS IN THE LAKE STATES. Minn. Agr. Expt. Sta. Tech. B. 233, 48 pp. 1960.

Quaking aspen on 103 plots on mineral soil and one on peat in northern Minnesota and northern Wisconsin were examined with the objective of isolating the major soil factors that have an effect on the site index. This was used as an index of productivity. Field examination consisted of site index by means of standardized age-height relationships. On 70 of the plots, soil samples were taken from pits, or from auger holes, by horizons in some plots and by fixed depths at 0 to 36 inches in others. These were analyzed in the laboratory. In all 104 plots, depth to the permanent water table was determined if it was within 8 feet of the surface. On 34 plots, holes were bored and texture was estimated by feel and classified as sand, loamy sand, sandy loam, etc.

U. Minn., Agr. Expt. Sta., St. Paul, Minn.

Myers, C. A., and Van Deusen, J. L. SITE INDEX OF PONDEROSA PINE IN THE BLACK HILLS FROM SOIL AND TOPOGRAPHY. J. Forestry 58: 548-551, 554-555. 1960.

Equations for estimating site index have been developed for the two major timber producing areas of the Black Hills and Bear Lodge Mountains. These two areas are: (1) Crystalline, where the soil has been formed from metamorphic and igneous rocks; and (2) limestone, with soil formed wholly or primarily from limestone. A total of 107 1/5-acre plots were examined on both areas, with site index and important soil and topographic characteristics recorded for each plot.

In the Crystalline Area site index can be estimated with four easily measured variables: (1) Soil depth to the top of the C horizon; (2) distance of sampling point up the slope expressed as a percentage of total slope length; (3) grade or percent of slope; and (4) aspect. The standard error of estimate was about 8 percent at average site index, 54 feet.

Two variables are required to estimate site index in the Limestone Area: (1) Soil depth to the top of the C horizon, and (2) percent distance up the slope. The standard error of estimate was about 7 percent at average site index, 58 feet.

On both areas soil depth accounted for most of the variance in site index, while slope position was second in importance. Only in the Crystalline Area did aspect and slope percent appear statistically significant.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo.

Row, C. SOIL-SITE RELATIONS OF OLD-FIELD SLASH PINE PLANTATIONS IN CAROLINA SANDHILLS. J. Forestry 58: 704-707. 1960.

Data were collected from 127 plots in slash pine plantations on old fields in the Sandhills of South and North Carolina in order to correlate height growth with soil factors.

Statistical analysis demonstrated that heights of slash plantations can be estimated from their age and two soil variables: Depth to a fine-textured horizon, and thickness of the A horizon.

An estimate of 25-year site index for a prospective planting area can be made when measurements of the soil variables are inserted either into the estimating equation or into the simplified graphic solution provided in this article.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

Vaartaja, O. ECOTYPIC VARIATION OF PHOTOPERIODIC RESPONSE IN TREES ESPECIALLY IN TWO POPULUS SPECIES. Forest Sci. 6: 200-206. 1960.

The photoperiodic responses of seedlings of Populus deltoides and P. tremuloides from northern and southern origins were tested experimentally. The northern seedlings were inhibited by longer days than the southern seedlings. This interaction of photoperiod and origin was expressed in stem length, total dry weight, dry weight of stem without leaves, dry weight of tops with leaves, dry weight of roots, and number of leaves.

The longest inhibitory (critical) day-length was correlated with the latitude of the seed source. It is suggested that the photoperiodic response and ecotypes in these species have evolved in the populations of latitudinally distant sites as an indirect mechanism in utilization of the warm season and in preparation against the cold season.

The weight of the root systems was found to be much greater in Saskatchewan aspen than in Wisconsin aspen (except under the critical day-length that inhibited Saskatchewan seedlings but not those from Wisconsin). This appears to be a genetic adaptation to the cold soils in the north.

Forest Biol. Lab., Saskatoon, Saskatchewan, Canada.

Curtis, J. D., and Lynch, D. W. SILVICS OF PONDEROSA PINE. Intermountain Forest and Range Expt. Sta. Misc. P. 12, 37 pp. 1957.

Boe, K. N. SILVICS OF WESTERN LARCH. Intermountain Forest and Range Expt. Sta. Misc. P. 16. 1958.

Roe, A. L. SILVICS OF BLACK COTTONWOOD. Intermountain Forest and Range Expt. Sta. Misc. P. 17. 1958.

Tackle, D. SILVICS OF LODGEPOLE PINE. Intermountain Forest and Range Expt. Sta. Misc. P. 19, 24 pp. 1959.

Boyd, R. J. SILVICS OF WESTERN REDCEDAR. Intermountain Forest and Range Expt. Sta. Misc. P. 20, 14 pp. 1959.

Foiles, M. W. SILVICS OF GRAND FIR. Intermountain Forest and Range Expt. Sta. Misc. P. 21, 12 pp. 1959.

These six silvics manuals are published by the Intermountain Forest and Range Experiment Station as part of a larger project sponsored by the U.S. Forest Service. Silvics of Western White Pine will be published later.

Information in these manuals was based on selected references and unpublished data. Each manual is a distribution, culture, and care bulletin for each species.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Gammon, A. D., Rudolph, V. J., and Arend, J. L. REGENERATION FOLLOWING CLEARCUTTING OF OAK DURING A SEED YEAR. J. Forestry 58: 711-715. 1960.

Reproduction following clearcutting of an excellent 45-acre oak stand in 1960 in southern Michigan was studied. The stand composition before cutting was primarily red and white oak, with lesser volumes of sugar maple, yellow-poplar, elm, white ash, and red maple. The reproduction was examined 2, 3, 5, and 7 years after logging.

Sprouts comprised a minor portion of the reproduction at each examination--less than 9 percent in 1952, and 3 percent in 1957. With the exception of red oak and red maple, sprouts did not contribute significantly to the restocking of the stand. In 1952, there were 13,900 seedlings per acre, mostly less than 6 inches tall. By 1955, seedlings decreased to 12,220 with the greatest mortality occurring in yellow-poplar. A few stems were 10 feet tall. In 1957, there were 8,720 seedlings per acre, of which 71 percent were survivors from those tallied in 1952. Most stems were in the large-seedling class, but the small- and large-sapling classes were well represented. The numbers of red oak and sugar maple had remained relatively stable while yellow-poplar decreased very markedly at each of the last two examinations.

Sugar maple, and white ash have the greatest representation in the two sapling classes. Yellow-poplar has developed well through the small sapling class, but is sparsely represented in the large sapling class. Red oak made a poor showing in numbers, but the sprouts grew rapidly, and are the tallest of all the reproduction. They occur in clumps however, and are poorly distributed over the area for future stand value.

Rabbit browsing damage increased from 3 percent of all the reproduction in 1952, to 36 percent in 1957. Browsing by rabbits has been severely detrimental to the height growth of red oak and red maple reproduction.

Clearcutting of this oak stand has been followed by adequate reproduction to form a fully stocked new forest stand. However, the composition of the new stand bears little resemblance to that of the previous stand. The important species forming the new stand are white ash, sugar maple, American elm, black cherry, and red maple, in that order. The small number of oaks now present occur in clumps of sprout origin, and their distribution in the stand is poor. Red oak seedlings have remained relatively unchanged in height since 1953, three years after the cutting, primarily because of very severe browsing damage by rabbits.

The clear-cutting method has not resulted in obtaining adequate oak reproduction in the new stand on this area. For proper oak management, harvest cuttings must be tailored to existing stand conditions. But of equal or greater importance, intensive cultural practices such as early cleanings, must follow to bring more oak through the initial establishment period. Temporary control measures to reduce the rabbit population would be helpful in permitting the oak seedlings to continue satisfactory early height growth.

In the absence of follow-up measures, conversion of oak stands to stands of more tolerant mixed hardwoods will follow cutting even as heavy as clearcutting.

U.S. Forest Service, Oakland, Calif.

Haupt, H. F. VARIATION IN AREAL DISTURBANCE PRODUCED BY HARVESTING METHODS IN PONDEROSA PINE. J. Forestry 58: 634-639. 1960.

Some disturbance of the forest floor, primarily the baring of soil by tree felling, log skidding and bunching, and by road building, is inevitable in timber harvesting operations. The extent and kind of soil disturbance incidental to logging ponderosa pine lands of the West are especially important because unnecessary disturbance not only takes land out of tree production temporarily or permanently; but these logged lands may also become sources of damaging run-off and sediment.

Measurements of the area bared by harvesting activities were made on 838 acres of the Boise Basin Experimental Forest near Idaho City, Idaho, in 1954 and 1955. This experimental forest typifies much of the pine land of central and southern Idaho; it has steep

slopes, a loose sandy soil derived from granite, and a dominant forest cover of old-growth ponderosa pine (Pinus ponderosa Laws).

The area of soil bared by harvesting timber on 16 compartments on the Boise Basin Experimental Forest is closely related to the number and volume of trees removed. Timber was harvested by the stem selection method or reproduction on eight compartments; group selection was used on the other eight. As the intensity of timber cut by single tree selection and group selection increased from 1,500 to 6,500 trees per square mile, the area of soil bared increased from 29 to 114 acres and from 29 to 84 acres per square mile, respectively. Greater tree dispersion and less repeat usage of skidtrails and haul roads account for more bared soil in single tree harvesting compartments. In group selection, tractor size showed no significant difference in areal disturbance. Results of this study indicate that group selection timber cutting caused less soil disturbance than single tree selection in this central Idaho area.

Intermountain Forest and Range Expt. Sta., FS, USDA, Ogden, Utah.

Zahner, R., and Whitmore, F. W. EARLY GROWTH OF RADICALLY THINNED LOBLOLLY PINE. J. Forestry 58: 628-634. 1960.

In 1954, a 9 year-old loblolly pine plantation was radically thinned to test the feasibility of growing sawlogs on a short rotation.

In one treatment (sawlogs-only) the plantation was thinned to 100 crop trees per acre. A second treatment (sawlogs-pulpwood) removed all trees whose crowns were within 5 feet of the crowns of 100 crop trees per acre; a pulpwood thinning in 1957 again released the crop trees. In both treatments, about 50 trees will remain for the final sawlog harvest. The crop trees are pruned periodically.

The control treatment was thinned from below to 85 square feet of basal area at 3-year intervals, but not pruned.

Diameter growth in the 5 years since 1954 has been 4.3 inches for the sawlogs-only, 3.4 inches for the sawlogs-pulpwood, and 1.9 inches for the control treatments. Growth was related to crown and root development and to available soil moisture.

The widely spaced trees made diameter growth into late fall each year, while the controls ceased growth by midsummer, when they had depleted soil moisture.

Trees in the heavily thinned plots were free to grow unhindered for the first few years after treatment, but their roots quickly filled the available soil area and they were no longer competition-free at the end of 5 years.

Height-growth was not stimulated by the heavy thinnings. The wood of the heavily thinned trees has normal density for young loblolly pine.

School of Natural Resources, U. Mich., Ann Arbor, Mich.

Hopkins, H. G., and Anderson, L. N. THE MARDEN BRUSH CUTTER FOR SLASH DISPOSAL AND GROUND PREPARATION. J. Forestry 58: 377-379. 1960.

A Marden Brush Cutter pulled by a D-8 tractor was used on Rogue River National Forest to treat lodgepole pine slash on clearcut units with results that appear favorable. Results were less favorable when the same machine was used to prepare a brush field with a sedge ground cover for planting. Cost of treatment varied from $15 per acre for single working of the brush field to about $36 per acre for double or crossworking the slash area. Retention of the humus and potential humus on the site is considered a major advantage of this type of treatment.

Rogue River Natl. Forest, Medford, Oreg.

Della-Bianca, L., and Dils, R. E. SOME EFFECTS OF STAND DENSITY IN A RED PINE PLANTATION ON SOIL MOISTURE, SOIL TEMPERATURE, AND RADIAL GROWTH. J. Forestry 58: 373-379. 1960.

Thinning of dense, even-aged forest stands is commonly practiced to increase the rate of growth, improve composition and grade, and obtain greater total yield by recovering and using material which would otherwise be lost. Whether the increase in growth

after thinning is due to more favorable conditions of light, microclimate, soil moisture, or a combination of factors is uncertain. During 1953 studies were conducted in a 39-year-old red pine (Pinus resinosa Ait.) plantation in northern Lower Michigan to measure the influence of varying stand densities on soil moisture, soil temperature, and radial growth.

During the growing season a greater amount of moisture is found near the soil surface and precipitation contributes to soil moisture recharge primarily in the upper few inches of the soil mantle. However, this moisture is used rapidly during dry periods. The depletion rate at the lower depths remain relatively constant throughout the growing season.

At the 6-inch depth there was a significant (up to the 20 percent level) difference in soil moisture between the forested compartments for 13 of the 18 weeks of the growing season. The soil moisture differences between compartments were less at the lower depths and, except for the period preceding the growing season, the statistical significance was generally confined to the 10- and 20-percent levels.

Decreasing the stand basal area rendered an initial supply of soil moisture available in larger quantities over a given period of time for the remaining trees; during the growing season this temporary increase in available soil moisture of the A horizon contributed to increased radial growth of the thinned stands.

Soil temperatures between the forested compartments were not significantly different, but there was a significant difference between soil temperatures of the open field and the red pine stand.

Rogue River Natl. Forest, Medford, Oreg.

Neebe, D. J., and Fletcher, P. W. THINNING OF EASTERN COTTONWOOD IN MISSOURI. Mo. Agr. Expt. Sta. Res. B. 733, 20 pp. 1960.

In the spring of 1953, a thinning investigation was established in an eight-year-old plantation and an eight-year-old natural stand of cottonwood trees to study their development and response to thinning.

During the following 6 years it was found that: (1) Cubic-foot volume growth on the thinned plots was about the same as the growth on the unthinned plots; (2) thinning increased the average quality of the trees because the smallest and most poorly formed trees were removed in thinning and growth was concentrated on the best trees; (3) thinning increased the growth of trees under 8 inches d. b. h. (diameter breast high) more than those above 8 inches d. b. h.; (4) heavy thinning stimulated diameter growth of individual trees more than light thinning; (5) the net basal area change was greater on the thinned plots because fewer trees died; and (6) handling costs at the time of final harvest should be reduced by thinning as there will be fewer but larger trees to cut.

Eastern cottonwood (Populus deltoides Bartr.) occurs naturally over most of the eastern United States. The best growth occurs on bottomland sites of the Mississippi River and its tributaries. In recent years many plantations have been established on bottomland sites.

Cent. States Forest Expt. Sta., FS, USDA, and U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

Storey, T. G., and Merkel, E. P. MORTALITY IN A LONGLEAF-SLASH PINE STAND FOLLOWING A WINTER WILDFIRE. J. Forestry 58: 206-210. 1960.

Results from this study show that chances of longleaf and slash pine mortality from damage by winter headfires can be estimated by the amount of crown consumed. Approximately equal proportions of large and small trees of both species died from equal amount of crown consumption.

Nearly 9 trees in 10 died when more than half their needles were consumed by flame and 4 trees in 10 succumbed when less than half their crowns were consumed. Even 100 percent needle browning caused no mortality. Presumably this was because initial temperatures of the buds and cambium were low and were not raised to their lethal temperatures by the fire.

Height of bark char on the stem in percent of tree height also was related to mortality. Approximately 9 trees in 10 died when 80 percent or more of the stem was charred and 4 trees in 10 died when 60 to 80 percent of the stem was blackened. Morality was very slight

where stems were charred less than 60 percent of their lengths. Bark char has several advantages over crown damage as an indicator of mortality.

Above-normal rainfall and below-normal temperature conditions the first 3 months following the fire were favorable for survival of fire-damaged trees. However, the general drought condition in the area before the fire persisted for another year.

The mortality indicators developed in this study are limited in application to other situations having similar air temperature (45° F.), fire (headfire), beetle (light attack), and antecedent weather (fairly normal) conditions. Air temperature was probably the most significant weather factor in reducing mortality. It is quite possible that morality would have been double or triple had the Buckhead fire burned in an air temperature of 90° F.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N. C.

Beaufait, W. R. SOME EFFECTS OF HIGH TEMPERATURES ON THE CONES AND SEEDS OF JACK PINE. Forest Sci. 6: 194-199. 1960.

The process by which mature serotinous cones of jack pine open to disperse their seeds has been described, note being made of the need for temperatures exceeding 140° F. to break resinous bonds on cone scales. The function of structural variation in the cone as a cause of reflection of the individual scale has been discussed.

Tests were conducted which show the dependence of cone opening on ambient atmospheric humidity. Cone moisture content was found to vary in nature from 350 percent of oven dry weight when green to 7 percent when mature. Mature cones were found to be at equilibrium with atmospheric moisture. Further desiccation of cones at extremely low temperatures was achieved under laboratory conditions, but the stresses incurred failed to break resinous seals on the cone scales.

Cones taken from a collection representing serotinous trees in all parts of northern Lower Michigan were exposed to temperatures ranging from 200° F. in 100-degree intervals for periods up to five minutes. They responded consistently by opening in a range from 80 seconds at 200° F. to 2 seconds at 1300° F. The cones ignited in 60 seconds at 700° F.; in only 2 seconds at 1300° F. Cones which ignited retained no visable seeds while unignited cones suffered but little reduction in the germinative capacity of their seeds.

Normally extracted jack pine seeds were also exposed to high temperatures and demonstrated an ability to remain viable until the wings ashed and the seed coats cracked from the heat. At 700° F. this occurred between 10 and 15 seconds' exposure; at 1000° F., between 0 and 5 seconds.

The results suggest that the high temperatures incurred in the crowns of standing trees during prescribed burns will not impair the viability of the seeds in serotinous cones, but should aid their dispersion.

Ford Forestery Cent., Mich. Col. Mining and Tech., Houghton, Mich.

Bilan, M. V. STIMULATION OF CONE AND SEED PRODUCTION IN POLE-SIZE LOBLOLLY PINE. Forest Sci. 6: 207-220. 1960.

Beginning in 1952 a 5-year study was initiated on effects of crown release, partial girdling, wiring, and banding of stems on cone production of pulpwood-size loblolly pine trees.

Full crown release was the most successful method of stimulating cone and seed production. It resulted in a sevenfold increase in cone production the third year after release and in a fourfold increase the fourth year. Crown release almost doubled the number of viable seeds per cone and increased diameter growth and crown development.

Available light and soil moisture conditions were improved to a great extent in the released portion of the stand. The soil in the unreleased portion of the stand remained at the wilting percentage approximately twice as long as did the soil in the released portion of the stand.

Partial girdling and wiring of stems did not contribute significantly to cone and seed production of released or unreleased trees, but such treatments decreased diameter growth and reduced the live-crown ratio of unreleased trees. Banding suppressed cone

production of released and unreleased trees and reduced by one-half the number of viable seeds per cone in the released trees.

In released trees cones borne on branches in the third whorl from the tip and above had more viable seeds per cone than did cones borne on the branches below the fourth whorl from the tip.

Regardless of treatment, cone production of experimental trees in 1954-55 was positively correlated with cone production in 1951-53. In addition to previous fruitfulness, cone production of released trees in 1954 and 1955 was also positively correlated with the amount of nitrogen in the bark and wood of the 1- to 2-year-old twigs in the upper part of the crown. The lateral crown area was positively correlated with cone production by unreleased trees in 1954 and 1955.

Neither the total amount of carbohydrate reserves in the bark and wood of 1- to 2-year-old twigs in the upper part of the crowns, nor the carbon-nitrogen ratio during the winter of 1954-55 was significantly correlated with cone production in 1954 and 1955.

Application of results in silvicultural practice was discussed, and preharvest crown release was recommended as a biologically sound and economically profitable silvicultural practice for stimulation of seed production in pole-size loblolly pine.

Dept. Foresters, Stephen F. Austin State Col., Nacogdoches, Texas.

Thorbjornsen, E. A CONE PRODUCTION STUDY IN LOBLOLLY PINE ON THE COASTAL PLAIN OF NORTH CAROLINA. J. Forestry 58: 543-547. 1960.

Cone production in loblolly pine on the Coastal Plain of North Carolina was studied during 1957 and 1958 and the following results were obtained: (1) Superior trees previously selected in the North Carolina State-Industry Cooperative Forest Tree Improvement Program have a cone production capacity not inferior to that of "woods-run" crop trees. (2) The association between d. b. h. (diameter breast high) or stem volume and cone production is significant at the 0. 1 percent level. About one-third of the total variation in cone production is accounted for by either of these variables. (3) Total tree height accounts for only 13 percent of the variation. (4) The sample correlation coefficient between branch volume and cone production was significant at the 0. 1 percent level. However, the relationship may not be strictly linear, the yield of cones becoming constant rather abruptly at a branch volume of approximately four cubic feet. (5) Length of live crowns accounts for only 13 percent of the variation, and the crown length-tree length ratio has no predictive value. (6) The proportion of buds producing female "flower" primordia, rather than total number of buds, determines the fecundity of a tree. (7) There was no difference in cone production between trees growing on average or high sites. And (8) the presence or absence of old cones gives a good estimate of future cone crops. More than 41 percent of the total variation can be accounted for by this observation.

Agr. Expt. Sta., U. Tenn., Knoxville, Tenn.

Slocum, G. K., and Maki, T. E. EFFECTS OF DESICCATION ON PUDDLED VERSUS BARE-ROOTED LOBLOLLY PINE (PINUS TAEDA L.) AND LONGLEAF PINE (P. PALUSTRIS MILL.) PLANTING STOCK. J. Forestry 58: 528-531. 1960.

A study of loblolly and longleaf pine planting stock was undertaken at Raleigh, N. C., in February 1956 to determine the effects of desiccation on seedling survival and vigor. Bare-rooted versus mud-coated roots were subjected to desiccation in an unheated shed for periods of 1 1/2, 3, 6, and 12 days, after which they were planted in replicated randomized plots in prepared soil in the nursery. Survival trends were tallied during the first growing season, and shoot growth of loblolly pine was measured also.

At the end of the first growing season it was found that: (1) Survival of longleaf stock with mud-coated roots for all durations of desiccation averaged 94. 8 percent, and of loblolly, 100 percent. Bare-rooted stock of longleaf averaged only 80. 4 percent, and of loblolly pine, 92. 8 percent. (2) Duration of desiccation up to 12 days had no effect on survival of either longleaf or loblolly pine stock with mud-coated roots. With bare-rooted stock, survival of longleaf dropped to 74 percent after 6 days, and to 50 percent after 12 days of desiccation; bare-rooted loblolly stock held up well through the sixth day (98 percent survival), but by the twelfth day, survival dropped to 66 percent. And, (3) shoot

growth of loblolly stock with the mud-protected roots was unaffected by duration of desiccation, but with bare-rooted stock, 12 days of desiccation reduced current shoot growth 29 percent below the bare-root control stock.

Jr. Author, N. C. State Col., Raleigh, N. C.

Switzer, G. L. EXPOSURE AND PLANTING DEPTH EFFECTS ON LOBLOLLY PINE PLANTING STOCK ON POORLY DRAINED SITES. J. Forestry 58: 390-391. 1960.

A study of the effect of root exposure and planting depth on the initial performance of bare-rooted loblolly pine planting stock on two poorly drained sites in Northeast Mississippi indicates that for these conditions it is important to keep root exposure at a minimum and to plant the seedlings at or only slightly below the original ground line.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Grisez, J. J. SLASH HELPS PROTECT SEEDLINGS FROM DEER BROWSING. J. Forestry 58: 385-387. 1960.

A survey of tree reproduction in relation to logging slash and deer was made 5 years after a heavy cutting in a black cherry-beech-maple stand. The study showed that substantially larger numbers of stems of the commonly browsed species were found in the slash piles than in the intervening openings, and that the incidence of browsing on existing stems was much less in the slash. The obvious conclusion is that slash exerts a definite protective effect.

In areas where deer browsing limits reproduction, hardwood slash should be looked upon as a blessing, and not just as a fire hazard. Close utilization of tops for products such as fuelwood would reduce the volume of slash and the protection it affords. In respect to the fire hazard, there is little reason to lop or burn slash in most eastern hardwood regions, particularly in the northern hardwood type. But this study shows that in regions where deer are abundant, there is a good reason not to reduce the slash.

There are some possibilities for deliberately using slash to protect seedlings: trees might be felled into openings where reproduction is desired in such a way that the tops are in groups of 2 or 3, but not on top of each other; or, slash might be piled over wild seedlings.

Northeastern Forest Expt. Sta., FS, USDA, Upper Darby, Pa.

Murphey, W. R. DURABILITY OF THREE SPECIES OF WOOD AFTER TREATMENT. Ohio Agr. Expt. Sta. Res. C. 86, 11 pp. 1960.

In 1944, as a portion of the program in fence post research, a project was initiated to examine the effectiveness of three fungicides and three treatments on three species of wood. Creosote, copper napthenate, and copper tallate preservatives were used in pressure treatment, hot and cold butt treatment, and 15-second dip treatment to American elm, sugar maple, and southern yellow pine posts. The tests were terminated after 15 years service life because it was felt the post had yielded sufficient information to permit conclusions to be drawn on the above variables.

Annual Cost of Posts

	Years of service	Cost of* perservative (cents)	Cost† per post per year
Pressure-Creosote			
American elm	30	6.2	4.2
Sugar maple	30	8.5	4.2
Southern yellow pine	30	7.7	4.2
Pressure-Copper Naphthenate			
American elm	30	8.5	4.2
Sugar maple	30	7.2	4.2
Southern yellow pine	30	9.7	4.2
Hot and Cold Butt-Creosote			
American elm	7	7.5	16.8
Sugar maple	9	4.5	12.6
Southern yellow pine	9	4.5	12.6
Hot and Cold Butt-Copper Naphthenate			
American elm	7	6.1	16.8
Sugar maple	7	5.6	16.5
Southern yellow pine	9	1.6	12.1
Dip-Creosote			
American elm	8.2	0.7	6.1
Sugar maple	8.4	0.4	6.0
Southern yellow pine	5.8	0.5	8.6
Dip-Copper Naphthenate			
American elm	10	2.4	5.0
Sugar maple	7	1.6	6.6
Southern yellow pine	11	1.1	4.9
Untreated			
American elm	5		8.0
Sugar maple	5		8.0
Southern yellow pine	7		5.7

* Cost calculated on test retentions. Creosote @ $1.88 per pound; copper naphthenate @ $2.25 per pound (5%).

† Cost calculated on pressure posts at $1.25 per post. Untreated posts @ $0.40 per post.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Peevy, F. A. CONTROLLING SOUTHERN WEED TREES WITH HERBICIDES. J. Forestry 58: 708-710. 1960.

A number of herbicides applied by several methods have been evaluated during the past 15 years at the Alexandria Research Center of the Southern Forest Experiment Station. Herbicides applied to individual trees or as a foliar spray are effective for killing woody plants. The method of control to be used depends on the size of stems, density of stand, size, and location of area to be treated, and personal preference of the landowner. Effective methods of controlling weed trees with herbicides are discussed.

Approximate costs of various herbicidal treatments used for woody-plant control

Types of application	Chemical	Concentration	Dose per inch of diameter	Chemical and labor costs[1]
				Cents
Tree injection	2,4,5-T ester	4 lb. of 2,4,5-T in 19 gal. of diesel oil	8 ml. (1.5 tsp)	.3/inch d.b.h.
Soil injection	Fenuron	16 lb. per 100 gal. of water	60 ml. (4 tbsp)	.8/inch d.b.h.
Stem frills	2,4,5-T ester	8 lb. of 2,4,5-T in 98 gal. of diesel oil	21 ml. (1 1/3 tbsp)[2]	.5/inch d.b.h.
Stem frills	Ammate	2 lb. per gal. of water	21 ml. (1 1/3 tbsp)	.5/inch d.b.h.
Stem notches (cups)	Ammate	Ammate crystals	1/4 oz. by weight[3] (1.5 tsp)	.7/inch d.b.h.
Basal stem spray	2,4,5-T ester	8 lb. of 2,4,5-T in 98 gal. of diesel oil	48 ml.[4] (3.2 tbsp)	.6/inch d.b.h.
Stumps	2,4,5-T ester	16 lb. of 2,4,5-T in 96 gal. of oil	48 ml.[5] (3.2 tbsp)	.6/inch d.b.h.
Stumps	Ammate	Ammate crystals	1/4 oz by weight (1.5 tsp)	.7/inch d.b.h.
Foliar spray (ground)	Ammate	3/4 lb. per gal. of water	100 gal. per acre	$22/acre
Foliar spray (ground)	2,4,5-T	4 lb. 2,4,5-T to 98 gal. of water and 2 gal. of oil	100 gal. per acre[6]	$12/acre
Aerial foliar spray	2,4,5-T ester	2 lb. 2,4,5-T in 3.5 gal. of water and 1.5 gal. of oil	2 lb. per acre in 5 gal. carrier	$7.50 to $9/acre

[1] Labor cost is based on $1.25 per hour and cost of chemicals based on: $8.50 per gal. for 2,4,5-T ester containing 4 lb. acid/equivalent; $24.50 per hundred pounds for Ammate; $0.147 per gallon for diesel oil; $3.00 per pound for Fenuron.
[2] Wet frills thoroughly.
[3] Apply 1/2 oz. (1 tablespoonful) in notches made inches apart edge to edge.
[4] Thoroughly wet lower 12 inches of tree trunk.
[5] Wet entire above-ground surface of stumps.
[6] Thoroughly wet foliage and twigs.

CRD, ARS, USDA, Alexandria, La.

Dumbroff, E. B. AERIAL FOLIAGE SPRAYS FAIL TO ERADICATE SCRUB OAKS ON FLORIDA SANDHILLS. J. Forestry 58: 397-398. 1960.

Establishment of pine plantations on the sandhills of northwest Florida necessitates almost complete removal of the brush and grass that compete for soil moisture on these dry sites.

Effectiveness of the phytocides was measured two growing seasons after application. The best control of turkey oak and saw-palmetto, as well as the best over-all control, was achieved with the propylene glycol butyl ether ester of 2-(2,4,5-TP) at three pounds acid equivalent per acre in a non-phytotoxic oil-water carrier. The same phytocide, but in a diluent of diesel oil and water, produced the greatest mortality in sand post oak. Bluejack oak was controlled best by the iso-octyl ester of 2,4,5-T in water at three pounds acid equivalent per acre.

These performances were relative. Not even the best phytocide controlled the scrub trees to the extent required for successful pine establishment and growth. Furthermore, grasses were little affected by any phytocide application, and grass is often more detrimental to pine survival on these dry sites than are the scrub trees. Use of phytocides for sandhills site preparation therefore cannot be recommended at this time.

Southern Forest Expt. Sta., FS, USDA, New Orleans, La.

Leaf, A. L., Johnson, J. W., and Smith, R. E., Jr. BIOCIDAL PROPERTIES OF ARSENIC TRIOXIDE: I. ARSENIC TRIOXIDE AS A PHYTOCIDE ON SOUTHEASTERN COASTAL PLAIN SOIL. State U. N. Y., Res. Found., Col. Forestry, Syracuse, N. Y. 13 pp. 1960.

Leaf, A. L., and Smith, R. E., Jr. BIOCIDAL PROPERTIES OF ARSENIC TRIOXIDE. II. ARSENIC TRIOXIDE AS A PHYTOCIDE ON NORTHEASTERN GLACIATED SOIL. State U. N. Y., Res. Found., Col. Forestry, Syracuse, N. Y. 12 pp. 1960.

Leaf, A. L., and Smith, R. E., Jr. BIOCIDAL PROPERTIES OF ARSENIC TRIOXIDE. III. ARSENIC TRIOXIDE AS A PHYTOCIDE ON APPLACHIAN MOUNTAIN SOIL. State U. N. Y., Res. Found., Col. Forestry, Syracuse, N. Y. 13 pp. 1960.

Phytocides or plant killers are important in any area where control of undesirable vegetation is needed to reduce fire hazards and allow convenient access. It has been demonstrated previously that arsenic trioxide has a potential use as an effective, long-lasting, safe and economical phytocide. But the toxic properties of this form of arsenic varies with environmental factors of climate, soil, and vegetation.

These papers report on the different phases of a project to determine the phytocidal value of arsenic trioxide under different environmental conditions of the northeastern United States.

State U. Col. Forestry, Syracuse U., Syracuse, N. Y.

Austin, R. C., and Strand, R. F. THE USE OF SLOWLY SOLUBLE FERTILIZERS IN FOREST PLANTING IN THE PACIFIC NORTHWEST. J. Forestry 58: 619-627. 1960.

Slow initial growth rate of planted seedlings may lengthen the effective rotation and increase the possibility of plantation failures. Efforts by a forest research group to stimulate early growth of planted conifers with fertilizers did not meet with any appreciable success until tablets or pellets of fertilizer material were placed directly in the planting hole. The fertilizer materials used in this manner had to be bland to avoid root injury, slowly soluble to give sustained benefits, and have a high concentration of nutrient elements to be feasible to transport and handle.

After several false starts, urea-formaldehyde resin was selected as a highly concentrated slowly soluble source of nitrogen. Both superphosphate and phosphoric acid were used in combination with urea-formaldehyde for the original test series.

Field trials at Cathlamet, Wash., indicated after two growing seasons that the type D pellet, and a commercial resin, Uramite, in combination with superphosphate, significantly increased height growth and basal stem diameter (42 percent and 24 percent respectively) of Douglas-fir when used in combination with a site treatment (bracken fern removal by clipping several times during the growing season).

The remaining tailormade resins were less effective than the commercial resin, Uramite with superphosphate. Fertilizer pellets with phosphoric acid as a phosphorus source caused several times the amount of seedling mortality as compared to the control or to the other pellet types.

At Beacon Rock Tree Farm near Washougal, Wash., very limited responses were evident with fertilizer pellets for Douglas-fir and practically no responses for noble fir. Removal of bracken fern increased survival and decreased height growth which is opposite to the effect of fern removal at Cathlamet Tree Farm. The failure of the pellet fertilizer to improve growth rate at Beacon Rock Tree Farm as compared to Cathlamet Tree Farm may be due to differences in climatic growth factors reflected by this fundamental difference in the reaction of the seedling to the removal of the brush cover.

Sitka spruce and Douglas-fir seedlings responded in height growth (26 percent and 20 percent respectively) after the first growing season to an application of pellet fertilizer at a scarification trial area on Clatsop Tree Farm near Astoria, Ore. Height growth of planted grand fir seedlings was not affected by the fertilizer treatment.

Grand fir at Tahkenitch Tree Farm on the south central Oregon coast treated with a 5 gm. capsule of superphosphate or calcium monohydrogen phosphate had a 20 percent increase in total height over the control seedlings despite a significant reduction in height growth caused by this treatment after the first growing season. True firs may be initially sensitive to fertilizer applications. The total height of Monterey pine was also increased over three growing seasons by applications of phosphorus especially superphosphate (40 percent). This is the one instance in the series of field trials where phosphorus has proved to be a definite advantage. The sandy soil at Tahkenitch in contrast to the finer textured soils on other trial areas may account for the effectiveness of phosphorus fertilization as well as the lack of growth and mortality differences between resins.

Hybrid pine (attenuata X radiata) showed a significant height growth increase the first growing season while Sitka spruce responded significantly in the second growing season.

Results of a 1959 examination indicate that trends of seedling fertilizer response have continued to a lesser degree through the third growing season on trials at Cathlamet and Tahkenitch Tree Farms. Second growing season results from Beacon Rock and Clatsop Tree Farms show increased responses for all species (especially grand and noble fir) in the cleared or scarified portion of the trial areas.

Central Res. Dept., Crown Zellebach Corp., Camas, Wash.

White, D. P. FERTILIZERS FOR CHRISTMAS TREES. Mich. State Coop. Ext. Serv. Ext. Folder F-291, 6 pp. 1960.

The prime requirements of a quality Christmas tree are dense, luxuriant foliage of good color on a symmetrical crown without excessive height. Retention of second and third year needles is also desirable. These characteristics indicate vigor which goes hand-in-hand with increased resistance to insects and disease. The proper use of fertilizers can help to produce vigorous, good quality trees.

Species which demand more from the site, such as spruce, Douglas fir, the true firs, and white pine, will almost always respond favorably to adequate applications of fertilizer on poorer sandy soils, and in certain circumstances on more fertile sites. Even red pine, although not a favored Christmas tree species, will show better color and needle length after fertilization where it is growing on a site so poor as to show severe yellowing. Scotch pine on most Michigan sites will not need fertilization.

Poor color, particularly during the growing season, short needles and shoot growth, and early needle fall are general symptoms of low vigor.

In certain situations, applications of single nutrients, like nitrogen or potash on humus deficient soils, may be enough for satisfactory growth improvement. However, unless we know which elements are deficient, it is good practice to apply a complete fertilizer.

Granular fertilizer with an analysis of 12-12-12, 12-6-12, or 14-7-7 will give satisfactory response on those situations where fertility is limiting. The 2-1-1 ratio is recommended for field soils of sandy loam or loam texture where nitrogen is likely to be the limiting element: The fertilizer should be placed on the ground in a band around the individual trees at the edge of the crown, staying away from the central stem (not closer than 6 inches). This will provide a maximum amount of nutrients at the feeding tips of the roots without giving excessive stimulation to competing weed or brush vegetation.

A safe but adequate application for plantation trees that have been established for two to three years would be 4 ounces of the above fertilizer. For larger trees, one to two years before harvest 1/2 to 1 pound of the complete material is a safe application.

Machine application of the fertilizer in a narrow surface-applied band along the row may be feasible. A number of plantations have been treated by hand broadcast application or with mechanical spreaders. This method is probably the only practical approach for large acreages. However, there is more loss of material by leaching and excessive stimulation of unwanted weed growth with broadcast treatment.

A word of caution: Avoid field crop fertilizers which contain minor elements. Even small quantities of boron or other minor elements required for field crops may be toxic to evergreens.

The use of soil amendments on sites with heavy weed or sod growth is not generally recommended unless the proper form of weed control is also used.

Mich. State U. Coop. Ext. Serv., East Lansing, Mich.

Hosner, J. F. RELATIVE TOLERANCE TO COMPLETE INUNDATION OF FOURTEEN BOTTOMLAND TREE SPECIES. Forest Sci. 6: 246-251. 1960.

This study shows that under the conditions of the test there is considerable variation in the ability of different bottomland species to withstand complete submergence. For the species tested these relative tolerances to complete inundation indicate a definite range from most to least tolerant as follows: silver maple, buttonbush, boxelder, black willow, cottonwood, green ash, American elm, pin oak, sycamore, red maple, shumard oak, redgum, hackberry, and cherrybark oak.

High water in some bottomland areas exercises a selective killing effect on reproduction and thereby affects the makeup of individual stands. However, many species exhibit a greater or lesser tolerance of flooding than species-site relationships indicate. This means that other factors also play an important part in determining the regeneration and succession of tree species in bottomland hardwoods. Water apparently is most likely to become the limiting factor only on sites that are consistently flooded for fairly long

periods of time during the growing season, such as true swamps, deep sloughs, and backwater areas.

South. Ill. U., Carbondale, Ill.

Gruzdev, D. M. EFFECT OF SOIL SALINITY ON GROWTH OF OAK AND OTHER SPECIES UNDER IRRIGATED CONDITIONS IN AZERBAYDZHAN SSR. Soviet Soil Sci. 3: 352-360. Mar. 1959.

To determine the effect of the degree of soil-salinity on the growth of oak, walnut, persimmon, pine, and European plane tree, and other tree-shrubs, a number of special test plots on strips of forest land and in irrigated zone nurseries were planted; also special pot experiments with various species of oak were conducted. The experiments considered: the care of seedlings, their growth in terms of both height and diameter, quantity of leaves, crown dimensions, dry weight of the seedlings, depth of root penetration into the soil, root structure and distribution, as well as salt content in the leaves, stalks, and tops of the trees under investigation. On each plot, determinations were made of HCO_3, Cl, SO_4 and of solid residue based on the soil horizons.

The authors concluded:

1. The salinity of one-meter-thick (39.37 in.) layer of flood-plain forest and sierozem soils, showing solid residue in excess of 0.4%-0.6%, reduces the growth and survival of a majority of trees under irrigated conditions by 1 1/2 to 2 times or more. Such soil salinity affects particularly the accumulation of dry matter, the development of leaf surfaces, and the morphological and anatomical structure of root systems. The roots, upon reaching saline horizons, stop their growth, die, and are decomposed. An insignificant quantity of healthy roots, upon reaching saline soil horizons, are deflected to one or another side and continue their growth horizontally, developing in layers in which soil salinity, as a result of care and irrigation, is considerably reduced.
2. The weak tree growth in saline soils is explained by the relatively high concentration of chlorine ions, which retards the water consumption of the plants and exposes them to water and salt starvation. Saline soils should be used in forestation only after they have been leached, and protective plantings must take into account the individual salt tolerance of trees and shrubs; a minimum of four to five vegetative irrigations must be carried out.
3. Trees in the irrigated zone of Azerbaydzhan, in terms of their ability to withstand soil salinity, may be classified as follows: (1) In saline soils showing 0.6%-1.5% of solid residue in a one-meter layer, Tamarisk and narrow-leaf wild olive will grow successfully; (2) with soil salinity at 0.2%-0.6%, pine, elm, American plane tree, mulberry, white acacia, honey locust, sophora, melia, osage orange, pomegranate, and amorpha will grow satisfactorily; and (3) in saline soils of 0.15%-0.20% salinity the following will grow well: poplar (Canadian, white-leaf, and pyramidal), green ash, western catalpa, oak (long-stalk and chestnut), walnut, persimmon, willow, and other species.

Amer. Inst. of Biol. Sci., 2000 P. St., N. W., Washington 6, D. C.

Kailidis, D. S., and Strong, F. C. DAMPING-OFF OF BLACK PINE, (PINUS NIGRA, ARN.) Mich. Q. B. 43(1): 14-42. 1960.

The causal agents of damping-off of black pine in Michigan forest nursery soils proved to be, in order of their prevalence, Fusarium oxysporum, F. solani, F. moniliforme, Rhizoctonia solani, Pythium irregulare, P. ultimum and P. debaryanum.

Rhizoctonia solani was the most pathogenic species, with Fusarium solani second and Pythium irregulare third, followed by F. moniliforme and F. oxysporum. P. ultimum was about equal in pathogenicity with F. oxysporum and P. debaryanum was slightly less pathogenic.

In culture studies, Pythium generally grew better at pH 5.5 and in temperatures between 20° and 30° C. Rhizoctonia grew faster between 20° and 30°., and at the lowest temperature tested (12° C.) was slower than Pythium. Rhizoctonia grew well at pH 4.5, 5.5, and 6.5, and its growth at pH 8.0 was satisfactory. Fusarium was adapted to a

wider range of environmental conditions than the other genera. Fusarium grew slower than Pythium and Rhizoctonia, but the difference among the species and strains tested in various environments were less than those of the other two genera.

When the pathogenic fungi were grown together by pairs on potato dextrose agar, antibiosis was observed in some cases. Fusarium solani strain 3 exhibited antibiosis with F. oxysporium and F. moniliforme as well as with Rhizoctonia solani. R. solani strain 1 was antagonistic to Pythium ultimum and partially so to P. irregulare. The three Pythium specis showed no antibiotic effects among their own genus.

Studies on black pine seed germination showed that moisture is necessary for initiation of seed germination. After a few days, aeration became the critical factor, and total germination was best at the lowest moisture content tested. At constant temperature, black pine seed germination showed two optima at 24° and 31° C. Alternating temperatures resulted in the same germination if one temperature of the combination was favorable or optimum. But if alternative temperatures were neither one favorable, this condition stimulated germination above that at either temperature when constant.

As to the relation of black pine seed germination and pH of the soil, it was found that at pH 4.5 total germination number was approximately twice that at pH 8.5, and it occurred in much less time. This is correlated to the occurrence of damping-off, since rapidly germinating seed and fast growing seedlings reach their resistant stage sooner and can escape damping-off. Black pine seedlings reach maturity 25 to 27 days after emergence. At pH 4.5, the pre-emergence and total damping-off were less than at pH 7.0 and pH 8.5 in soil infested with pure cultures of Fusarium and Rhizoctonia.

Soil type and fertility also influence occurrence of damping-off of black pine seedlings. Losses were less in a soil of medium fertility than in either sand or muck soil.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Buchanan, W. D. INSECTS ASSOCIATED WITH WOUNDS ON TREES THAT DEVELOP OAK WILT. J. Econ. Entomology 53: 578-581. 1960.

In the period 1955 thru 1958, the incidence of oak wilt caused by the fungus Ceratocystus fagacearum Bretz, in black and scarlet oaks was significantly higher in trees that were blazed with an ax or wounded by boring auger holes in their trunks than it was in similar trees that were given a puncture-type wound or were not wounded. However, no infections developed in trees that were wounded before April 11 or after May 6. In all cases oak wilt developed the same season that the tree was wounded.

It seems likely that such insects as sapbeetles, wood roaches, and carpenter ants carried the inoculum to the trees that developed oak wilt. This is concluded because one or more of these insects was caught in traps that were stapled in auger holes on trees that developed oak wilt. However, the source of the inoculum is unknown, because no oak wilt fungus mats or other recognized sources of the fungus were found in systematic surveys made within and around the five plots.

Central States Forest Expt. Sta., FS, USDA, Columbia, Mo.

Schuder, D. L. THE ZIMMERMAN PINE MOTH (DIORYCTRIA ZIMMERMANI (GROTE). Purdue U. Res. B. 698, 8 pp. 1960.

The Zimmerman pine moth is an increasingly more prevalent pest of pine trees in the Midwest. It is capable of attacking and causing severe damage to most pine species commonly grown in the North Central area of the United States. The pine moth larvae tunnel in the pith of new tree growth and burrow beneath the bark in the whorl area, leaving dead branches, white resin masses, and sawdust-like frass on the injured tree. Infested whorls often become enlarged and burl-like. The Zimmerman larva is about 3/4 of an inch long, with a brown head and a pink body covered with black spots. Adults are most abundant in mid-August, but since they are nocturnal, are seldom seen. Pruning and spraying with DDT will control this insect.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Caribbean Commission. SYMPOSIUM ON A COFFEE DEMONSTRATION TOUR OF COSTA RICA, EL SALVADOR & GUATEMALA, CENTRAL AMERICA. Caribbean Commission, 28 pp. 1958.

The following four papers on the culture and processing of coffee in the different areas of the tour are presented:

Webster, C. C. SOME OBSERVATIONS ON ARABIC COFFEE GROWING IN COSTA RICA. Imperial Col. Trop. Agr., St. Augustine, Trinidad, West Indies.

Hernandez, E. REPORT ON A COFFEE DEMONSTRATION TOUR IN CENTRAL AMERICA. Agr. Expt. Sta., Rio Piedras, Puerto Rico.

Pitt, R. S., and Atkins, C. D. W. REPORT ON A COFFEE DEMONSTRATION TOUR OF COSTA RICA, EL SALVADOR AND GUATEMALA. Agr. Dept. Belize, British Honduras.

Gertsch, M. E. COFFEE DRYING. Esso Standard Oil, Havana, Cuba.

Caribbean Commission, Port of Spain, Trinidad, West Indies.

Sachs, B., and Sylvain, P. G., eds. ADVANCES IN COFFEE PRODUCTION TECHNOLOGY. Coffee & Tea Industries, 95 pp. 1959.

This unusual issue of Coffee & Tea Industries contains the special section, "Advances in Coffee Production Technology".

The following technical articles are reported:

1. de T. Alvim, P. RECENT ADVANCES IN OUR KNOWLEDGE OF COFFEE TREES: I. PHYSIOLOGY. Instituto Interamericano de Ciencas, Agricolas de la O.E.A., Zona Andina, Lima, Peru.
2. Carvalbo, A. RECENT ADVANCES IN OUR KNOWLEDGE OF COFFEE TREES: II. GENETICS. Instituto Agronomico, Campinas, Brazil.
3. Mendes, A. J. RECENT ADVANCES IN OUR KNOWLEDGE OF COFFEE TREES: III. CYTOLOGY. Instituto Agronomico, Campinas, Brazil.
4. Dedecca, D. M. RECENT ADVANCES IN OUR KNOWLEDGE OF COFFEE TREES: IV. ANATOMY. Instituto Agronomico, Campinas, Brazil.
5. Krug, C. A. THE SUPPLY OF BETTER PLANTING MATERIAL: I. ARABICAS. Food and Agriculture Organization of the U.N., Rome, Italy.
6. Ferwerda, F. P. THE SUPPLY OF BETTER PLANTING MATERIAL: II. CANEPHORAS (ROBUSTAS). Institute of Agricultural Plant Breeding, Wageningen, The Netherlands.
7. Fernie, L. M. THE SUPPLY OF BETTER PLANTING MATERIAL: III. ASEXUAL PROPAGATION OF COFFEE. Coffee Research Station, Lyamungu, Moshi, Tanganyika, Africa.
8. Cooil, B. J., and Fukunaga, E. T. MINERAL NUTRITION: I. HIGH FERTILIZER APPLICATIONS AND THEIR EFFECTS ON COFFEE YIELDS. University of Hawaii, Honolulu, Hawaii.
9. Muller, L. MINERAL NUTRITION: II. DETECTION AND CONTROL OF ESSENTIAL ELEMENT DEFICIENCIES. Instituto Interamericano de Ciencas Agricolas, Turrialba, Costa Rica.
10. Medcalf, J. C. BETTER CONTROL OF WATER SUPPLY FOR COFFEE PRODUCTION. IBEC Research Institute, Matao, E.F.A., S.P., Brazil.
11. Cowgill, W. H. THE SUN-HEDGE SYSTEM OF COFFEE GROWING. Office of Food and Agriculture, International Cooperation Administration, Washington, D.C.

12. Zelensky, V. THE MECHANIZATION OF CULTURAL OPERATIONS. Ingenieur des Services d'Agriculture F. O. M., Chef de la Région Agricole Ouest, Daloa, Ivory Coast, French West Africa.

13. de Castro, F. S. SOIL CONSERVATION ON COFFEE PLANTATIONS. Federacion Nacional de Cafeteros, Bogota, Columbia.

14. Robinson, J. B. D. CHEMICAL WEED CONTROL IN COFFEE. Coffee Research Station, Department of Agriculture, Nairobi, Kenya, Africa.

15. Wellman, F. L. RECENT SPRAYING FOR CONTROL OF COFFEE DISEASES. Agricultural Experiment Station, University of Puerto Rico, Rio Piedras, Puerto Rico.

16. d'Oliveira, B. SELECTION OF COFFEE TYPES RESISTANT TO THE HEMILEIA LEAF RUST. Centro de Investigacão das Ferrugens do Cafeeiro, Estacão Agronómica Nacional, Oeiras, Portugal.

17. Melville, A. R. BIOLOGICAL CONTROL OF INSECT PESTS IN COFFEE. Department of Agriculture, Nairobi, Kenya, Africa.

18. de Gialluly, M. FACTORS AFFECTING THE INHERENT QUALITY OF GREEN COFFEE. Instituto Interamericano de Ciencas Agricolas, Turrialba, Costa Rica.

Coffee & Tea Industries, 106 Water Street, New York, N. Y.

Fruit and Nut Crops

Roberts, O. C. CAUSES AND EFFECTS OF MECHANICAL INJURIES TO MCINTOSH APPLES. Mass. Agr. Expt. Sta. B. 520, 39 pp. 1960.

From a study of the handling of McIntosh apples in orchards, storages, packing houses, and retail stores from 1954 to 1959, the following conclusions have been drawn: (1) With adequate supervision and generally good management, McIntosh apples can be harvested with a minimum of mechanical injury; (2) excessive mechanical injury occurred between the orchard and the packing house in most cases; (3) the use of mechanical grading machines does not necessarily cause excessive bruising and punctures; (4) with freedom from bruises and skin punctures combined, the cell carton was superior to other types of packages studied for the transportation of McIntosh apples; (5) the type of package is less important than careful handling of the fruit since this study shows that McIntosh apples can be handled within Massachusetts in any type of package without excessive bruising when sufficient care is used; (6) apples held continually under refrigeration, especially while on display reach the consumer in a more acceptable condition than those not so refrigerated; (7) the principal cause of inferior McIntosh apples in retail stores was mechanical injury; (8) apples as delivered direct to stores by growers were not materially superior as to grade than those displayed for sale in the same stores; (9) growers are not adequately familiar with grade standards or are careless in their use of them; (10) packaging in polyethylene bags in the store by store personnel is less desirable than packaging in the grower's packing house; and (11) Massachusetts growers are doing an excellent job controlling insects and diseases and thus, insect and disease blemishes are materially less important than mechanical injury as a cause for inferior fruit that is offered to the consuming public.

Agr. Expt. Sta., U. Mass., Amherst, Mass.

Pflug, I. J., and Dewey, D. H. UNLOADING SOFT-FLESHED FRUIT FROM BULK BOXES. Mich. Q. B. 43(1): 132-141. 1960.

The principles of operation and important design features of a machine for unloading bulk boxes of fruit by water floatation and transfer was described and illustrated. The operating principle on which the design of this apparatus is based has proved to be sound through six months of severe field service. Bruising and skin puncturing of relatively

soft apples were not excessive, but improvements in the design of the removal conveyor and drier would further decrease damage.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Hartmann, H. T., Opitz, K., and Hoffman, R. M. PRUNING OLIVES IN CALIFORNIA. Calif. Agr. Expt. Sta. B. 771, 30 pp. 1960.

Olive growers in California have used many different methods in pruning their trees, both bearing and nonbearing. Such methods range from no pruning to very severe pruning. No specific procedures for training young trees are generally followed.

This bulletin reviews the literature, and reports additional research on: (1) Methods for training young trees to induce early bearing and, at the same time, develop a mechanically strong tree framework; and (2) methods of pruning bearing trees to induce maximum yields over a period of years consistent with large fruits, ease of harvesting, and insect and disease control.

Research has shown that:

1. In nonbearing olive trees, any pruning retards vegetative growth, but some training is necessary to develop a strong trunk and a well-branched primary scaffold system. Light summer pruning during the first several years will achieve that purpose.
2. In bearing olive trees, pruning reduces yields in proportion to the removal of fruit-bearing wood. Limit all pruning to cutting with some definite objective: (1) To ease harvesting and spraying, to reduce disease and insect damage: (a) Remove dead wood, suckers, and watersprouts; (b) thin out dense, brushy growth in the fruiting area; and (c) remove excess scaffold branches; and (2) to keep trees down to reasonable heights: (a) Head back the upright and lateral branches; and (b) cut back large limbs of trees grown too high.
3. Bearing olive trees may be pruned at any time of the year. In orchards infected with olive knot, prune in the summer to reduce spreading of the bacteria.

U. Calif., Calif. Agr. Expt. Sta., Davis, Calif.

Kennard, W. C., and Winters, H. F. SOME FRUITS AND NUTS FOR THE TROPICS. U.S.D.A., A.R.S. Misc. P. 801, 135 pp. 1960.

Since its establishment in 1901, the Federal Experiment Station at Mayaguez, Puerto Rico, has been actively engaged in the introduction and testing of tropical and subtropical plants from many parts of the world. Three circulars describing and illustrating some of the ornamental vines, shrubs, and large-leaved plants in this collection have been published.

This publication deals with the edible fruits and nuts in this collection. In addition, those that are native to or have become naturalized in Puerto Rico have been included. No attempt has been made to discuss all tropical and subtropical fruit and nut plants. The citrus fruits, avocado, papaya, mango, olive, date, coconut, and bananas are not included since they can be considered as major tropical fruits.

The tropical and subtropical areas of the world are particularly well supplied with fruit and nut species. They vary greatly in flavor, shape, quality, and season of maturity; hence, they are of interest to fruit growers and homeowners in the Southern United States and in the tropical areas under the American flag. Similarly, horticulturists, both professional and amateur, throughout the Tropics and subtropics of the world stand to benefit by establishing trial plantings of these potentially important crops. Little is known about many of these plants, but some have commercial possibilities, especially after they have become known and a demand has been created.

ARS, USDA, Inform, Div., Washington 25, D.C.

Zych, C. C., and Powell, D. STRAWBERRY GROWING IN ILLINOIS. Ill. Ext. Serv. C. 819, 56 pp. 1960.

A culture and care bulletin on strawberry growing in Illinois.

Ext. Serv. Agr. and Home Econ., U. Ill., Col. Agr., Urbana, Ill.

Powell, D., Meyer, R. H., and Owen, F. W. PEST CONTROL IN COMMERCIAL FRUIT PLANTINGS. U. Ill. Agr. Ext. Serv. C. 821, 44 pp. 1960.

The battle against insects, diseases, and other pests in Illinois orchards must be fought every year. To help in the fight, various experimental agencies are constantly working out better methods of pest control. This circular brings together the latest recommendations from the Illinois, Kentucky, and Indiana Experiment Stations, the Illinois Natural History Survey, and the U. S. Department of Agriculture. You may need to adjust these recommendations to suit your own conditions--but don't experiment with untested materials and methods. To do so may mean disaster.

Pest-control measures are so closely linked with other operations that they cannot be easily separated. This circular therefore includes the practices recommended for quality fruit--not just adequate pest control. For efficient operation, orchard practices must be well organized.

ARS, USDA, Ill. State Natl. Hist. Survey, and Coop. Ext. Work in Agr. and Home Econ, Col. Agr., Urbana, Ill.

Phillips, A. M., Large, J. R., and Cole, J. R. INSECTS AND DISEASES OF THE PECAN IN FLORIDA. Fla. Agr. Expt. Sta. B. 619, 84 pp. 1960.

Control of pecan insect pests and diseases is seldom easy. In some situations and circumstances control is almost impossible, even with the highly effective pesticides now available. Pecan trees, (Carya illinoensis Engel. & Graeben), often reach a height of 60 feet or more, with a correspondingly wide spread of branches. A powerful machine capable of delivering spray at high pressure is needed to deliver the pesticide to the upper portions of large trees. Many Floridians have a few pecan trees about their homes and a large portion of the commercial pecan orchards contain only a few acres. To all these persons the cost of high power spray equipment is prohibitive and they must use other methods of pest control.

Many varieties of pecans are now available and new ones are occassionally being developed. Varieties differ in many ways, including their response or relationship to diseases. Persons planting new trees should keep these facts in mind and select varieties that will be relatively free of trouble or that will yield well in spite of attack by diseases. Trees which are constantly ravaged by diseases can be topworked to more desirable varieties and thus be made to produce better crops of nuts.

The information is designed to help pecan growers to understand their pest and disease problems better and to enable them to use the most effective means of control at their disposal.

ERD, ARS, USDA and U. Fla., Agr. Expt. Sta., Gainesville, Fla.

Field Crops

Tharp, W. H. THE COTTON PLANT. HOW IT GROWS AND WHY ITS GROWTH VARIES. U. S. D. A., A. R. S. Agr. Handbook 178, 17 pp. 1960.

Success in cotton farming is becoming more and more dependent upon precision practices that have been developed through research and experience. The cotton grower of today finds its advantageous to make use of the many advances in the mechanization of production and harvest of the crop; to be prepared to apply chemicals, if necessary, for himself with the best fertilizer formulas and efficient methods of applying them; and at times to irrigate the crop, if he can.

Much information has been published on different phases of the culture and harvest of cotton. This information has been supplemented with guidance and on-the-farm advice by personnel in agricultural research, extension, and educational services. This handbook supplements further the information currently available to the cotton grower, by explaining how the cotton plant grows, from sprouting to maturity, and how its development is affected by environmental conditions and cultural practices.

ARS, USDA, Inform. Div., Washington 25, D. C.

Helmy, H., Joham, H. E., and Hall, W. C. MAGNESIUM NUTRITION OF AMERICAN UPLAND AND EGYPTIAN COTTONS. Tex. Agr. Expt. Sta. MP-411, 16 pp. 1960.

The effects of various substrate magnesium levels on symptoms of magnesium deficiency, growth, fruiting, chloroplast pigments, carbohydrates, and elemental composition at different stages were studied in American Upland (Stoneville Z-106) and Egyptian (Pima S-1) cottons grown in nutrient solution under greenhouse conditions.

The characteristic foliage symptoms of magnesium deficiency appeared first in the lower leaves of Pima S-1 plants which were more sensitive to magnesium deficiency than the Stoneville Z-106 variety. Low substrate magnesium restricted chlorophyll and carotenoid pigment synthesis and was correlated with foliage chlorosis. Growth, as measured by stem height and dry plant weight, and fruiting were postively correlated with magnesium supply. The number of flowers, percentage boll set, and relative fruitfulness of the Stoneville Z-106 plants increased with increasing magnesium. Magnesium deficiency caused a delay in flowering of the Pima S-1 plants.

Carbohydrate content and distribution as affected by magnesium supply were studied. At 45 days of age carbohydrates were inversely correlated with substrate magnesium. During the early stages of magnesium deficiency the distribution of carbohydrates indicated that transport and utilization of carbohydrates are restricted more than photosynthesis by lack of the element. By 85 days of age, although magnesium deficiency had restricted carbohydrate synthesis, carbohydrate translocation and use were still more adversely affected. An inverse relation was noted between leaf carbohydrates and magnesium availability while carbohydrate levels of stems and roots were more directly correlated with the magnesium supply. Differences in the susceptibility of the two cottons to magnesium deficiency, as reflected in a greater reduction in carbohydrates in the Pima S-1 plants at the lower levels of magnesium supply, were demonstrated. In addition to the reported effects for calcium and boron, magnesium deficiency was noted to restrict carbohydrate distribution. It was concluded that magnesium affects sugar translocation indirectly through its more critical functions in cellular activity, and that magnesium deficiency limits other phases of metabolism long before it limits photosynthesis through its essential role in chlorophyll.

Magnesium content of the cotton plants reflected a positive correlation with the magnesium supply on which they were grown. The foliage contained the highest magnesium content. Comparison of leaf magnesium to relative chlorophylls showed them to be interrelated. Calcium content was strongly, and potassium content weakly, negatively correlated with magnesium supply. As a result, decreased magnesium accumulation at the low magnesium levels was compensated for largely by increased calcium and potassium accumulation.

Leaf phosphorus was inversely related to substrate magnesium in both varieties while little influence of magnesium treatment on nitrogen content was noted in the Stoneville Z-106 plants. The old leaves of the magnesium deficient Pima plants accumulated nitrate nitrogen while a direct relation between total nitrogen and substrate magnesium was observed in the young leaves of that variety.

Tex. Agr. Expt. Sta., College Station, Tex.

Colwick, R. F. WEED CONTROL EQUIPMENT AND METHODS FOR MECHANIZED COTTON PRODUCTION. Southern Coop. Ser. B. 71, 48 pp. 1960.

This is the third regional bulletin resulting from research on the mechanization of cotton production under regional projects S-2, and W-24. Much of the research reported herein was done in cooperation with scientists working on chemical weed control under the regional project S-18.

Research on the engineering aspects of cotton production is carried on in twelve states extending from coast to coast. Four major producing areas whose differing growing conditions tend to segregate them into general working areas for purposes of research are recognized as: (1) The Southeast; (2) Mid-South; (3) Southwest; and (4) the Far West. Weed control problems differ widely among these general areas and in many cases between states or even within states.

An effort was made to give, in summary form, the results that have been most typical in a state or area. No attempt was made to summarize each chapter because of the complexity of the subjects and the wide variety of conditions covered.

All phases of production have an interlocking effect on the succeeding operations in a mechanized operation. The influences of other production steps such as land preparation and planting which include crop residue disposal, land leveling or smoothing, seedbed preparation, fertilization, and pre-planting weed control measures are considered in relation to weed control.

Miss. Agr. Expt. Sta., State College, Miss.

Hightower, B. G., and Gaines, J. C. RESIDUAL TOXICITIES OF INSECTICIDES TO COTTON INSECTS. Tex. Agr. Expt. Sta. B. 951, 11 pp. 1960.

Results of experiments conducted to determine the effect of natural or simulated climatic conditions on the residual toxicities of several species of cotton pests are summarized.

In tests on the boll weevil with the chlorinated hydrocarbon insecticides, the residual properties of endrin and Sevin appeared to be quite similar under a variety of weathering conditions. Based on residual properties alone, toxaphene and dieldrin ranked with endrin and Sevin, but the initial toxicities of dieldrin and endrin to the boll weevil were appreciably greater than those of toxaphene. The mortality rate among weevils confined on spray residues of these insecticides was reduced by 20 to 30 percent after exposure of the residues to simulated wind or rain. This reduction could result in failure to control the boll weevil under field conditions.

The residual properties of aldrin and BHC were inferior to those of endrin, Sevin, dieldrin, and toxaphene under a variety of climatic conditions. The results obtained with heptachlor were erratic.

The results obtained in tests on the boll weevil were similar to the data from tests with the cotton leafworm, the salt-marsh caterpillar, and the garden webworm.

Among the organophosphorus insecticides used in tests on the boll weevil, Guthion appeared to be more resistant to weathering than malathion, methyl parathion, or Phosdrin. Malathion appeared to have residual properties intermediate between those of Guthion and methyl parathion, while the period of residual effectiveness of Phosdrin was very short under all conditions.

Simulated rain was the only weathering agent which appreciably reduced the residual toxicity of Guthion. In general, weathering did not reduce the residual toxicities of the organophosphorus insecticides as much in tests with cotton aphids and spider mites as in tests with the boll weevil.

When treated plants were held under varying temperature and humidity conditions for 48 hours prior to the release of insects on the plants, the residual toxicities of all the insecticides tested were reduced appreciably.

Losses in residual effectiveness among insecticidal dusts exposed to wind and rain usually were greater than among sprays of the same materials.

Tex. Agr. Expt. Sta., College Station, Tex.

Johnson, W. H., Henson, W. H., Hassler, F. J., and Watkins, R. W. BULK CURING OF BRIGHT LEAF TOBACCO; A CURING OPERATION COMPATIBLE WITH MECHANIZATION. Agr. Engin. 41: 511-515, 517. 1960.

The research and development of a curing operation which is more compatible with mechanization of bright-leaf tobacco than conventional curing is described. The feasibility of bulk curing was well established by laboratory studies during 1955 to 1957.

During 1958 an applied study in bulk curing of intact leaf was conducted in which laboratory techniques and findings were extended to encompass a pilot operation, intermediate between laboratory and field operations. The curing system was designed for simplicity of loading and unloading racks of bulked tobacco, regulation of air flow and temperature schedules which enhance the quality of the cured product, and maximum operational efficiency.

Results of curing in the pilot operation show a possibility for acceptance of bulk-cured tobacco by the tobacco industry. Chemical results showed no significant differences between bulk (intact) and conventionally cured tobacco. Smoking tests rated bulk-cured tobacco as suitable for cigarettes. Representative samples of the bulk-cured leaf averaged $62 per cwt. on the open market, with a high of $70 per cwt. Possibilities for achieving advantages over the conventional curing method are discussed.

The described engineering advancements in bulk curing are presently well adapted for conventional harvesting, but there is also the important possibility of integrating mechanical harvesting with bulk curing. Since many requirements for leaf selectivity and orientation in the barning operations are eliminated by bulk curing, this method offers simplifications in the total mechanization of the harvesting and curing operations.

N. C. State Col., Raleigh, N. C.

Mullins, T. PRODUCTION PRACTICES AND COSTS AND RETURNS FOR MAJOR ENTERPRISES ON RICE FARMS IN THE DELTA AREA OF MISSISSIPPI. Miss. State U. Agr. Expt. Sta., B. 595, 24 pp. 1960.

Modern rice farming was extended to the Mississippi Delta immediately following World War II. In the absence of acreage controls, production expanded rapidly. The acreage grown in 10 Delta counties in Mississippi increased from 7,000 acres in 1949 to 69,000 in 1954. In 1959, about 360 farmers in these counties had rice allotments totaling about 45,000 acres.

This new component of Delta agriculture has emerged as a substantial source of income for the area. Also, it has imposed major adjustments on the farms involved.

Rice production requires heavy capital investment in specialized farming equipment, in irrigation wells and water distribution systems, and in drying and storage facilities. Approximately one-third of the total cost of growing rice is attributed to interest, depreciation, and overhead.

This report is concerned primarily with those characteristics of rice farms that are important in determining the economics of resource uses and adjustments. Compared with other farms in the Delta, rice farms are somewhat distinctive in kinds of resources used, average size of units, amounts of capital required, rotation systems followed, and in many of the cultural practices associated with the growing of rice. In general, these features of rice farming in the Delta have not been adequately described and evaluated, although much interest in rice farming has been generated in recent years.

Particular attention is given to summarizing the field operations used in growing rice; the usual quantities of materials, man labor, and machinery time used on rice; and the costs and returns for rice and other enterprises commonly found on rice farms.

FERD, ARS, USDA, and Miss. State U. Agr. Expt. Sta., State College, Miss.

Sorenson, J. W., Jr., and Crane, L. E. DRYING ROUGH RICE IN STORAGE. Tex. Agr. Expt. Sta. B. 952, 19 pp. 1960.

Research was conducted at the Rice-Pasture Experiment Station near Beaumont during 7 crop years (1952-53 through 1958-59) to determine the engineering problems and the practicability of drying rough rice in storage in Texas. Drying rice in storage means drying rice in the same bin in which it is to be stored.

Rough rice, with initial moisture contents of 15.0 to 23.0 percent, was dried at depths of 4 to 10 feet with both unheated and heated air. After the moisture content was reduced to a safe storage level of 12 to 13 percent, it was held in storage in the same bin in which it was dried from 3 to 6.5 months.

Drying rice in storage has limitations. However, these tests show that rice can be dried in storage in the rice-producing area of Texas without quality loss. Building and equipment requirements for drying rice in storage are given.

To prevent loss in grade, milling yields, and germination with both unheated air and supplemental heat, an air flow rate of 9.0 cubic feet per minute (c.f.m.) per barrel (2.5 c.f.m. per bushel) was found necessary to dry rice with an initial moisture content of 20 percent. The maximum depth of rice for the most economical drying was 8 feet at this moisture level.

A simple fan operating schedule, based on pushing air up through the rice, was developed. Loading storage bins to a depth of 2 to 3 feet in succession until all storage space was utilized, resulted in the maximum fan capacity on the wettest rice. This procedure also resulted in faster drying and reduced the possibility of damage from molds.

Supplemental heat was found to be practical during prolonged periods of high humidity or late in the season during cold weather. The temperature of the air entering the rice may be raised 12° above outside air temperature, but should not exceed 95° F. after heating.

In unheated air and supplemental heat-drying applications under Texas conditions, the moisture in the wettest layer of rice had to be reduced below 16 percent in 15 days, or less, to prevent loss in grade from discolored kernels. Further reduction in moisture to a safe storage level of 12.5 percent was accomplished over a longer period of time without loss in grade.

An air flow rate of 0.4 c.f.m. per barrel (1/10 c.f.m. per bushel) was effective for holding undried rice with an initial moisture content of 18 to 19 percent for 9 days without grade loss from discolored kernels.

Aeration was effective in maintaining the condition of rice after it was dried to a safe storage level. Rice in each bin was aerated as often as necessary to reduce the temperatures in the rice to 60° F. or less. Fans were operated when the outside air temperature was 10° F. or more below the average rice temperature, except during foggy or rainy periods. Fan and air distribution systems used for drying also were satisfactory for aeration.

Tex. Agr. Expt. Sta., College Station, Tex.

Eden, W. G., and Brogden, C. A. SYSTEMIC INSECTICIDES FOR THRIPS CONTROL ON PEANUTS. Auburn U. Agr. Expt. Sta., Prog. Rpt. Ser. 77, 3 pp. 1960.

Thrips occur to some degree on peanuts every year. When infestations are heavy, yields may be reduced unless control measures are followed.

Thrips can be controlled with dusts of 5 percent DDT or 10 percent toxaphene; however, treating after the damage appeared did not result in significant yield increases.

Phorate systemic insecticide, applied as a soil treatment at 1 pound of technical material per acre at or just prior to planting resulted in effective thrips control and good yield increases. Phorate granules, 20 pounds of 5 percent per acre, put in the row at planting time is a good method of application. Phorate was not compatible with 0-14-14 fertilizer. Until further research is conducted, it is questionable whether fertilizer mixtures should be used. Phorate soil treatments caused injury to peanut plants in early May of 1959. The plants recovered in a few weeks. There were practically no phorate residues in foliage or nuts during the growing season and none at harvest following application of 1 or 2 pounds of phorate per acre as a soil treatment. Studies made on taste, color, and texture of raw and roasted peanuts and on peanut butter revealed that phorate soil treatments had no effect on peanuts. Phorate is a highly toxic organic phosphorus compound. Extreme caution must be observed in its use.

Auburn U., Agr. Expt. Sta., Auburn, Ala.

Porter, K. B., Jensen, M. E., and Sletten, W. H. THE EFFECT OF ROW SPACING, FERTILIZER AND PLANTING RATE ON THE YIELD AND WATER USE OF IRRIGATED GRAIN SORGHUM. Agron. J. 52: 431-434. 1960.

The effects of row spacing, fertilizer level, and planting rate on the production of irrigated grain sorghum were studied in 1956, 1957, and 1958. Grain yields were significantly higher at the 12- and 20-inch row spacings than at the 30- and 40-inch spacings on the high fertilizer level. Average grain and forage yields at the 40-inch spacing were

significantly less than those at the narrower spacings. Planting rates had little influence on grain yield but the heavier planting rates produced the higher yields of forage.

A more uniform distribution of plants over the cropped area is believed to have resulted in more efficient use of moisture, nutrients, and solar energy and, consequently, in higher grain yields at the narrower row spacings.

Total water use, rate of water use, and water-use efficiency were determined at the high nitrogen level. Row spacings and planting rate had little influence on the total water use but plants at the narrower spacings tended to use water at a greater rate early in the season. The average yields of grain per acre-inch of water used were 314, 317, 297, and 273 pounds for the 12-, 20-, 30-, and 40-inch row spacings, respectively.

Data are presented with respect to the influence of the three variables on number of plants per acre, heads per acre, tillering, head weight, bushel weight, plant height, date of first bloom, and the incidence of head smut.

Tex. Agr. Expt. Sta., Southwestern Great Plains Field Sta., Bushland, Tex.

Fisher, F. L., and Smith, O. E. THE INFLUENCE OF NUTRIENT BALANCE ON YIELD AND LODGING OF TEXAS HYBRID CORN NO. 28. Agron. J. 52: 201-204. 1960.

A complete factorial fertilizer experiment of 4 rates of nitrogen (N) (0, 40, 80, and 120 pounds per acre) and 3 rates each of P_2O_5 and K_2O (0, 40, and 80 pounds per acre) with 3 replications was conducted for 3 years on a Hockley fsl at Prairie View, Texas. The fertilizer was applied annually to the same plots each spring. A heavy green manure crop of cowpeas was plowed down prior to starting the fertilizer test.

Yield of grain was not affected by applied nitrogen due in part to the green manure crop, increased plant lodging, and low soil moisture during part of the growth cycles. Phosphorus or potassium when applied alone or together significantly increased grain production. Lodging was significantly increased by nitrogen alone or in combination with phosphorus, while potassium alone or in combination with the other nutrients significantly reduced lodging. Nutrient deficiency symptoms were apparent when nutrients were not applied in balanced ratios.

Tex. Agr. Expt. Sta., College Station, Tex.

Agricultural Research Service. MAKING THE MOST OF WET CORN. U.S.D.A., A.R.S. 22-56, 32 pp. 1960.

The question of how to make the most of wet corn is becoming an increasingly important one in the farm economy because of a number of technological developments.

Although field shelling still accounts for only 4 to 5 percent of the total corn crop harvested for grain, this method of harvesting is increasing rapidly and promises to have a tremendous impact on corn production. A comparatively recent development (mostly since 1954), field shelling requires mechanical drying facilities or sealed storage for handling the shelled grain.

Other, long-term trends that have contributed to the growing importance of wet corn include: (1) The increased availability and improvement in equipment for drying and storing high-moisture corn; (2) farm mechanization--particularly the swing to mechanical harvesting which puts a premium on early harvest to obtain maximum yields; and (3) higher yields from hybrids requiring a long growing season.

Drying as ear corn by natural ventilation--either in the field or in the crib--is still the method used to condition most of the corn crop for storage. But a variety of other possibilities are now open to growers, including: Harvesting the corn at a high moisture content either as shelled or ear corn and drying it mechanically with unheated air, supplemental heat, or heated air; or storing the corn without drying in sealed (airtight) storage facilities.

ARS, USDA, Inform. Div., Washington 25, D. C.

Lassiter, C. A., Boyd, J. S., and Benne, E. J. STORAGE OF HIGH MOISTURE CORN IN UPRIGHT SILOS AND ITS FEEDING VALUE FOR DAIRY COWS. Mich. Q. B. 43(1): 58-66. 1960.

Studies on the feeding value of high-moisture corn stored in conventional upright silos show that this practice offers farmers in the northern states an alternative method of storing and utilizing such corn. The following conclusions are based on two-year results: (1) High-moisture corn can be stored satisfactorily in conventional upright silos with little spoilage loss by covering it with a plastic sheet until the feeding period is started. (2) Once the silos are opened, the corn must be fed at a rate rapid enough to avoid excessive spoilage. At least 20 to 25 dairy cows should be fed from a 12-foot diameter silo. (3) Spoilage was least with corn containing from 25 to 35 percent moisture. (4) Based on its dry matter content, the feeding value of high-moisture corn appears to be equal to, but not greater than, that of dry corn. And (5) results of passage trials with unground shelled corn indicate that this type of corn should be ground before storage.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Hansen, E. L. SILO STORAGE OF HIGH-MOISTURE SHELLED CORN. Agr. Engin. 41: 296-298, 309. 1960.

Controlled feeding tests on sheep, beef, and dairy animals show that feeding value of high-moisture shelled corn silage is equal to dry corn. This was true of corn with moisture contents up to 30 percent. At 35 percent moisture, the performance of swine was not as good as on dry corn.

Field losses were least at 30 percent kernel moisture at harvest. Harvesting and unloading equipment performed well at this moisture.

Storage losses amounted to only 3 percent (energy loss). Discoloration of the corn occurred on top when only one inch a day was removed but animals did not refuse it and performed well on it.

U. Ill., Urbana, Ill.

Genter, C. F. CORN AND OTHER CROPS FOR SILAGE IN VIRGINIA. Va. Agr. Expt. Sta. B. 516, 37 pp. 1960.

The use of silage in Virginia is on the increase. Although many crops have been used for silage in Virginia, corn remains the major silage crop. Corn silage properly prepared is a palatable, nutritious feed. For best silage it should be harvested in the late dent or early glaze period when most of the leaves are still green and most of the kernels are dented. At this stage, the silage will contain around 68 to 70% moisture and the ears round 45 to 50% moisture. Corn harvested too early tends to be low in nutrients and soggy. Corn harvested too mature for silage may not pack well in the silo and may mold.

Results reported were obtained from many experiments conducted in Virginia to compare different types of crops, crop varieties, mixtures of crops, and methods of crop production for silage. The silage crops include corn, grain sorghum, forage sorghum, soybeans, millet, and sudangrass. "Crop varieties" were primarily varieties of corn and sorghum.

Because of the range in plant types and maturities of types and varieties of crops, neither total green weights nor total dry weights were satisfactory criteria by themselves for evaluating crops for silage. The total yield of nutrients in corn silage is related closely to yield of grain. Roughly half of the dry weight and about two-thirds of the total digestible nutrients (TDN) of a productive corn plant are contained in the ear. Variations in relative yields of grain or in percent of grain may affect greatly the relative amounts of TDN produced and the digestibility of the silage. Consequently, in most cases, separations of plant parts and calculations of TDN and digestibility were made.

Forage sorghum compared to corn was high in green weight, comparable in dry weight, but low in TDN and digestibility. Corn produced more than twice as much grain and half as much stalk as sorghum. Leaf content of sorghum was similar to corn. Corn has a much higher grain to stalk ratio than sorghum and was about 10% more digestible than sorghum.

Mixtures of crops generally did not produce yields higher than those of the dominant crop in the mixture when it was grown alone. Soybeans was a poor competitor in broadcast mixtures and usually made up around 5% of the total yield in row mixtures. Likewise, sorghum tended to be a poor competitor in mixtures.

Broadcast crops and mixtures yielded poorly compared to row crops, and should be considered for silage in Virginia only as emergency crops.

Corn hybrids that produce the most grain usually produce the most TDN per acre and the most highly digestible silage. Later maturing hybrids with the same yields of grain as earlier ones produce more TDN per acre but slightly lower digestibility because the plants are larger.

Very late varieties and hybrids are low in ear production and TDN, and likely are to be too high in moisture when cut for silage.

Rate of planting experiments with silage corn show increases in TDN production up to 19,000 plants per acre. Earlier hybrids are smaller and have higher optimum rates of planting than later ones. Maximum yield of nutrients was not associated with any maturity class of hybrid, but was produced by the hybrid which at its optimum rate of planting produced the highest yield of grain.

On the basis of these data, corn appears to be the best crop for silage in Virginia for either TDN production per acre or percent digestibility. The corn hybrids which produce the highest yields of grain should be the ones chosen for use as silage.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

Kirk, V. M. CORN INSECTS IN SOUTH CAROLINA. S. C. Agr. Expt. Sta. B. 478, 38 pp. 1960.

Corn is the most important feed crop grown in South Carolina. Farmers in the state annually plant about 1 million acres, or one-fourth of their cropland, to corn. However, this acreage does not produce enough corn to meet their needs; considerable corn is bought from other states.

Poor stands, reduced yields, and lowered grain quality due to the attacks by certain insects can be greatly and profitably improved through proper application of control measures. These measures must be based on a thorough knowledge of the life of these pests and the injury they cause. This bulletin brings together the latest information concerning life histories of corn insects, recognition of damage, and control measures recommended or suggested.

S. C. Agr. Expt. Sta., Clemson Agr. Col., Clemson, S. C.

Koehler, B. CORNSTALK ROTS IN ILLINOIS. U. Ill. Agr. Expt. Sta. B. 658, 90 pp. 1960.

Ten different stalk rot diseases are described and illustrated. Discussions of experimental work are confined largely to rots caused by (Diplodia zeae) and (Gibberella zeae) because, as a rule, they are the most important stalk diseases in Illinois. The other eight diseases, in the order in which they are discussed, are: Fusarium, Charcoal, Bacterial, and Pythium stalk rot and Nigrospora, Phaeocytosporella, Pyrenochaeta, and Stewart's disease stalk infection.

When stalk rot damage was above average, a negative correlation was obtained between stalk not severity and yield in all but 1 of 15 hybrid corn tests conducted over a period of years. Most of these correlations were highly significant. Actual losses in yield were also determined in these tests. The average difference between the ten hybrids with lowest score for stalk rot in each test and the ten with the highest score in the five most recent large-scale tests was 10 bushels per acre.

Eight factors influencing natural rot development are discussed. Weather conditions and inherited resistance appear to be the most important of the variables influencing the prevalence of stalk rots. Data are presented to show that susceptibility to (D. zeae) and (G. zeae) is associated with the ability to produce high yields. Earliness was associated with susceptibility, even though differences in the time to reach maturity were small. Premature partial loss of green leaf area, regardless of the cause, increased susceptibility to rot produced by (D. zeae and G. zeae). On the other hand, the rot associated

with infestation by the European corn borer was produced mainly by (Fusarium moniliforme). Unbalanced soil fertility was always conducive to stalk rot. This was especially apparent when it involved low potassium and high nitrogen. Under some conditions, high fertility by itself had the same effect.

Stalk rot diseases can be checked, but they can not be entirely controlled. Since hybrids differ in resistance, the use of the more resistant ones is recommended. Under present tendencies toward higher soil fertility, higher plant populations, and more intensive cropping, breeding for better resistance is needed. Balance soil fertility, particularly with respect to adequate potassium as indicated by tests, is important. Hybrids that utilize the full growing season are usually less susceptible to stalk rot than those that mature a little earlier. Crop rotation, moderate rates of planting, and avoidance of excessive use of fertilizers can be expected to help to some extent in reducing stalk rot damage.

U. Ill., Agr. Expt. Sta., Urbana, Ill.

Chapin, J. S., and Smith, F. W. GERMINATION OF WHEAT AT VARIOUS LEVELS OF SOIL MOISTURE AS AFFECTED BY APPLICATIONS OF AMMONIUM NITRATE AND MURIATE OF POTASH. Soil Sci. 89: 322-327. 1960.

The effects of ammonium nitrate and muriate of potash on germination when placed in contact with Ponca wheat seed was studied. Six trials were conducted in a closed germination chamber, which maintained relative humidity near 100 percent. Fertilizer application rates corresponded to 20, 40, 60, 80, and 100 pounds per acre of either N or K_2O. Unfertilized cultures were used as controls. Light silty clay loam soil, with various moisture contents, was used as the germination medium. Seed and fertilizer treatments were placed in intimate contact with each other in a common furrow.

These trials indicate that: (1) Variation in soil moisture percentage, from just below the permanent wilting point to field capacity, caused but slight variation in germination of Ponca wheat seed when fertilizer was not used; (2) fertilizer salts placed with seed at planting time in soil that was at or near field capacity had little effect upon final germination, there was some delay in seedling emergence, however, with the heavier rates of application causing the greatest delay; (3) if fertilizers were placed in direct contact with the seed and if the soil moisture was at or near the permanent wilting point, germination was reduced greatly or even prevented by heavy applications of fertilizers; and (4) a given amount of nitrogen from ammonium nitrate delayed germination more and caused greater final losses in germination than did the same amount of K_2O supplied by muriate of potash.

Kans. Agr. Expt. Sta., Manhattan, Kans.

Haus, T. E., Robertson, D. W., Brandon, J. F., Paulson, W. H., and Tucker, R. H. WINTER WHEAT PRODUCTION IN COLORADO. Colo. State U. Expt. Sta. B. 507-S, 27 pp. 1960.

Winter wheat is planted on more acres than any other crop in Colorado, 2,007,000 acres being planted in 1957. Production is almost exclusively of the hard-red type which is used principally in making bread flour.

Fallow is recommended as a land preparation for the crop on non-irrigated land. This method of preparation controls weeds and stores soil moisture to assure a better yield. During the 17-year period, 1941 to 1957 inclusive, the use of fallow as a land preparation method at the Akron Station gave yields better than the seven-bushel per acre "break-even" yield.

Planting of winter wheat after September 10 lessens the danger of root rots and of Hessian fly damage, which reduce yields. Seeding of 30 pounds per acre has been found to be an adequate seeding rate.

The use of nitrogen fertilizer on sandy land is recommended. Its use on so-called hard land may give an economical return in wet years but it does not appear that fertilizer application is necessary every year.

Winter wheat should not be combined until the moisture content is 14 percent or lower. Wheat stored with higher moisture content is liable to heat damage with resultant price dockage.

Of the important wheat diseases, bunt can be controlled by seed treatment, wheat streak mosaic and root rots can be controlled by timely planting, and loose smut can be controlled by the hot water treatment. Rusts cannot be practically controlled by any present chemical means. Early maturing varieties often escape severe rust damage. Dwarf bunt can only be controlled by using resistant varieties such as Wasatch.

Most of the insects that attack wheat can be controlled by timely application of insecticides.

The varieties recommended for the state are Cheyenne and Nebred for the northeastern wheat producing areas, Wichita, Bison, and Comanche for the central and southern areas, Pawnee where Hessian fly may be a problem, and Wasatch for the dwarf bunt areas of the western part of the state.

Colo. State U. Expt. Sta., Fort Collins, Colo.

Nelson, C. E. EFFECTS OF PLANT POPULATIONS AND NITROGEN FERTILIZER RATES ON THREE VARIETIES OF IRRIGATED SPRING WHEAT. Wash. Agr. Expt. Sta. B. 611, 11 pp. 1960.

The effects of plant populations and nitrogen fertilization on lodging, yields, bushel weight, and other plant characteristics, of three varieties of irrigated spring wheat were studied.

Differences in yield of grain among varieties were not significant. The three varieties were grown at plant populations ranging from 6 to 41 plants per square foot. Yields increased with increasing plant populations up to about 27 plants per square foot.

Because kernel sizes differ, it would require 108, 136, and 103 pounds of seed per acre respectively for Marfed, Pilcraw, and Lemhi 53 varieties of wheat to obtain 27 plants per square foot.

Marfed had an average bushel weight of 61.6 lbs. and was not affected by any treatment. The Pilcraw bushel weights ranged from 59.1 to 60.4 lbs., increasing in general with increasing plant population. Lemhi 53 decreased in bushel weight with increasing plant population. Marfed ranked first, Pilcraw second, and Lemhi 53 third in bushel weight for all treatments.

Lemhi 53 wheat tillered less than Marfed and Pilcraw, the latter two being the same. Tillering decreased with increasing plant populations. The linear regression of tillers per plant with plant population was the same for Marfed and Lemhi 53, except that the intercept for Lemhi 53 was much lower than for Marfed. The slope of the regression line for Pilcraw was much steeper than that for the other two varieties, showing that it tillered less than the others with increasing plant populations.

A mechanical method of breaking the culms gave a high negative correlation with lodging. The breakage force, applied at a uniform velocity, was provided by a power driven breakage machine designed especially for use with the wheat culms. This device was found well suited to large "solid seeded" plots.

The culm-breakage data showed that Pilcraw was considerably better than the other two varieties in lodging resistance. Lemhi 53 ranked second and Marfed third in lodging resistance. The average height difference between varieties was only 1.4 inches. Since the varieties produced the same yields, the plant height and grain weight per plant would have little or no influence on natural lodging.

The curvilinear regression of culm-breakage on plant population showed that the lodging resistance did not decrease appreciably with plant population beyond 30 plants per square foot. This can be accounted for by the above-normal temperatures in May, June, and July which reduced plant growth and yields below that expected with cooler temperatures for the same month.

Wash. Agr. Expt. Sta., Inst. Agr. Sci., Wash. State U., Pullman, Wash.

Miller, M. H., and Ashton, G. C. THE INFLUENCE OF FERTILIZER PLACEMENT AND RATE OF NITROGEN ON FERTILIZER PHOSPHORUS UTILIZATION BY OATS AS STUDIED USING A CENTRAL COMPOSITE DESIGN. Canad. J. Soil Sci. 40: 157-167. 1960.

A greenhouse study was conducted to determine the optimum fertilizer phosphorus placement for oats and to determine the influence of nitrogen rate on the absorption of

fertilizer phosphorus. A central composite design in three variables was used to permit the development of quadratic equations to express the response criteria as functions of the placement variables--horizontal distance and depth from the seed--and rate of nitrogen.

The fertilizer phosphorus absorption was determined at four stages of growth, the last stage being 58 days after planting. The dry weight of tops, total phosphorus content and percent of the phosphorus derived from the fertilizer were determined at the completion of the experiment 58 days after planting.

At the 14-day stage, fertilizer phosphorus absorption was greatest from fertilizer placed with the seed, but at the 28- and 42-day stages, was greatest from fertilizer placed 1 inch to the side and 2 or 3 inches below the seed. At the 58-day stage, fertilizer placed with the seed resulted in the greatest absorption of fertilizer phosphorus. The influence of placement on the percent of the plant phosphorus that was derived from the fertilizer was similar to that on fertilizer phosphorus absorption.

Nitrogen increased fertilizer phosphorus absorption at all but the 14-day stage, increased plant weight to a lesser extent and decreased the percent phosphorus in the tops at the 58-day stage.

Ontario Agr. Col., Guelph, Ontario, Canada.

Dickson, A. D., Clemens, H., and Standridge, N. THE INFLUENCE OF THE WILD OAT HERBICIDE, BARBAN, ON BARLEY COMPOSITION, GERMINATION, AND MALT QUALITY. U.S.D.A., A.R.S. 34-13, 7 pp. 1960.

The chemical 4-chloro-2-butynyl N-(3-chlorophenyl) carbamate (barban) has shown promise as a wild oat herbicide.

Traill barley grown near Fargo, N. Dak., in 1959 was sprayed with two concentrations of barban at several stages of development of the plants. Parkland barley grown at Winnipeg, Manitoba, Canada, was sprayed with the same concentrations of the chemical at similar stages of development. In both cases, comparable untreated samples were available.

On the basis of 1 year's test with two barley varieties, spraying barley with barban in early seedling stages had no effect on barley composition or malt quality. Rate of growth during germination and malting may be reduced slightly in some cases.

ARS, USDA, Inform. Div., Washington 25, D. C.

Schien, R. D. PHYSIOLOGIC AND PATHOGENIC SPECIALIZATION OF RHYNCHOSPORIUM SECALIS. Pa. Agr. Expt. Sta. B. 664, 29 pp. 1960.

Isolates of the barley scald fungus (Rhynchosporium secalis) were obtained from Pennsylvania, North Carolina, Tennessee, Michigan, South Dakota, and California. In a series of tests, seven barley varieties were inoculated with each of these isolates. Seven distinct pathogenic races of the organism were thus determined. In addition, it was found that one of the isolates from California was capable of infecting several wild grasses. This raises the possibility that barley is not safe from attack by Rhynchosporium from wild grasses growing near commercial barley plantations.

In other studies, 991 varieties and lines from the world collection of winter barleys were tested against the seven races. As a result of this work, three varieties were found to be immune to attack while four others were found to be so infrequently attacked as to make excellent sources of resistance in breeding programs.

Studies showing the cultural variability of the organism are reported in the concluding section of this bulletin. Responses to pH, various nitrogen sources, vitamins, and carbohydrates are given. Starch digestion was accomplished by an alpha-amylase which was found to diffuse through the agar far in advance of the mycelium.

Pa. State U., Col. Agr., Agr. Expt. Sta., University Park, Pa.

Nelson, W. L. SOIL FERTILITY IN SOYBEAN PRODUCTION. Soybean Digest 20(5): 10-12. 1960.

Profitable responses can be obtained with fertilizers on soybeans--though not at all locations.

High fertility is required for high yields of soybeans. Forty bushel of soybeans will remove 35 lbs. of P_2O_5 in the grain and 10 lbs. of P_2O_5 in the stover, and 55 lbs. of K_2O in the grain and 25 lbs. of K_2O in the stover. One hundred and twenty bushels of corn will remove 42 lbs. of P_2O_5 in the grain and 25 lbs. of P_2O_5 in the stover, and 30 lbs. of K_2O in the grain and 95 lbs. of K_2O in the stover.

Lime is the 1st point to check. Follow soil test recommendations.

Phosphorus--On soils low in P, phosphorus at planting time gives soybeans a faster start and helps them get ahead of weeds. Phosphorus starvation shows only as stunted growth.

Potassium--Potash deficiency up to time of bloom is shown as yellowing on the edges and cupping of leaves. Later symptoms may be shown as slow maturity, late defoliation, and low yields.

Nitrogen--In general, soybeans do not require fertilizer nitrogen when properly inoculated and when grown under conditions of adequate lime, P, and K.

Manganese--Deficiency of Mn may show on soybeans grown in soils above ph 7.0 and sometimes down to pH 6.3 on poorly drained soils high in organic matter. It can be remedied by 10 lbs. per acre of manganese sulphate as a spray or 25 lbs. in the fertilizer.

Iron--Iron deficiencies may appear in some years and can be remedied with iron sulphate.

Placement--Soybeans are very sensitive to high amounts of fertilizer close to or with the seed.

Rotation fertilization--For the grower that looks ahead it is most profitable to plan a fertility program for the rotation which will boost soybeans yields along with all crops in rotation. Soybeans can use residual fertility provided enough is applied on previous crops.

The fertility needs of soybeans is dependent on what is in the soil. To do a high class job of soybean production the first step is to get a soil test.

Midwest Dir., Amer. Potash Inst., Lafayette, Ind.

Atkins, I. M., Reyes, L., and Merkle, O. G. FLAX PRODUCTION IN TEXAS. Tex. Agr. Expt. Sta. B. 957, 13 pp. 1960.

Trial seedings of flax are recorded in Texas as early as 1900 but commercial flax growing started in 1938. Favorable seasons and war needs stimulated the acreage which reached a maximum of 349,000 in 1949 and a maximum value of $7,722,000 in 1948. The drouth years, 1951 to 1956, greatly reduced the acreage but by 1960 it had increased to 80,000 acres.

All Texas flax is fall sown, the commercial acreage at present being concentrated in an eight-county area of South Texas ranging roughly from Corpus Christi northward to San Antonio. Cold tolerant winter-type varieties can be grown successfully as far north as Waco but little is grown now. Trials in North Central Texas at Denton prove that spring seeding in this area is possible but the crop has not become established commercially. Trial seedings on the High Plains have not been successful to date.

Flax is grown for the seed from which linseed oil is extracted. The meal is a valuable supplemental feed of approximately 35 percent protein and 3 percent oil. No fiber flax is grown in Texas. The flax straw is of little value under Texas conditions.

The flax crop which is seeded in South Texas in late November or early December, fits well into rotations of cotton, Sudangrass, grain sorghum, or vegetables where it sometimes is grown in a two-crop 1-year rotation since flax is harvested in May. The "tighter" textured, fertile soils usually are used for flax. A few growers seed flax in rows but most of the crop is drilled on a firm seedbed free of weeds. Fertilizers are profitable only when there is adequate moisture or the crop is grown under irrigation. Weeds should be controlled by preplanting cultivation or by herbicidal sprays.

The northern spring-type varieties Deoro and B 5128 are the most popular varieties and are among the higher yielding strains in tests at Beeville and Kennedy. Smaller acreages of Linda, Crystal, Redwood, and others are grown. The cold-tolerant varieties (Turkey, Newturk, and Caldwell) were distributed to Texas growers but only a small acreage is grown now. The short season California varieties such as Punjab were grown in the Lower Rio Grande Valley for a time but are no longer grown.

The fall-sown flax crop usually is not damaged seriously by diseases. Rust, pasmo, wilt, and seedling blights have caused some damage. During the dry seasons, 1955-57, curly top attacked flax in Texas causing moderate damage. Traces of aster yellows have been observed. These diseases are discussed briefly.

CRD, ARS, USDA, and Tex. Agr. Expt. Sta., College Station, Tex.

Larsen, A. EXPERIMENTS ON THE NET ASSIMILATION RATE OF FLAX (LINUM USITATISSIMUM). Acta Agr. Scandinavia 10 (2-3): 226-236. 1960.

Trials were made by growing flax in pot cultures on soil with different contents of water, and measuring the leaf area at intervals during the growth period in the years 1958 and 1959. The trials included in both years groups were kept watered to 20, 30, 45, 65, and 90% of field capacity. The trials also included four groups which were subjected to periods of drought at varying times. Since, apart from the weather, growth conditions were the same in both years, the results of the trials give information about the effect of these conditions upon net assimilation.

The trials showed that the leaf area in both years rose steadily in proportion to the amount of available water. The assimilative capacity of the leaf system per unit of area and time was independent of the size of total leaf area within the limits of this experiment, i.e., from L.A.I. (Leaf Area Index) of approximately 2 and up to L.A.I. of 7; it was also independent of the available water-supply which has varied between 20 and 90% of field capacity. The amount of dry matter produced, y, increased lineally with the green-leaf integral, x, in the groups 1-5, where the soil's water content varied between 20% and 90% of field capacity, according to the equation $y = k(x - a)$. The factor k, or, as it is called here, the net assimilative effect of the leaves, was in 1958 and 1959 0.56 and 0.81 respectively. Thus it was 45% greater in 1959, than in 1958. This must be due to the greater number of sunshine hours (45%) and to the greater temperature sum (19%) which were observed in 1959 during the growing period of the flax.

If a period of drought is sufficiently long, the plants cannot survive merely by wholly or partly closing their stomata or by rolling up their leaves. They must also reduce their leaf area, adjusting it to the changed water-supply conditions. In this way a loss of dry matter occurs resulting directly from the leaf decrease, and indirectly from the reduced assimilation caused by the closing of the stomata; possibly there may be a respiratory loss as well. This respiratory loss plus variations in volume and weight of the root system are presumably responsible for the relatively low k values in certain groups where drought occurred during the growth period. Although the growth period was lengthened, this was not sufficient to compensate for the loss caused by decrease in the assimilative leaf area.

Drought occurring in the latter part of the growth period has shortened the growth period and this has caused a relative increase in the net assimilative effect. The production of dry matter is also here, owing to the rapid decrease in assimilating area, lower than that found under normal ripening conditions.

Statens Forsøgsstation, Aarslev, Denmark.

Bennett, C. W. SUGAR BEET YELLOWS DISEASE IN THE UNITED STATES. U.S.D.A., A.R.S. Tech. B. 1218, 63 pp. 1960.

The disease known as beet virus yellows or beet yellows has been present in beetfields in Europe for many years. It was not identified in the United States until 1951. The distribution of the disease is now practically worldwide in areas that produce sugar beets.

The causal virus has an extensive potential host range. Crop plants that are affected include sugar beet, table beet, Swiss chard, other close relatives of sugar beet, and spinach. The causal virus has been transmitted to at least 66 species of plants representing

12 families. Chief symptoms on sugar beet consist of yellowing of mature leaves, often followed by necrosis of areas between veins, and thickening of the entire leaf. Certain virus strains also produce vein clearing or vein yellowing in young leaves in the earlier stages of development of the disease. Certain of the weed hosts, as chickweed and Australian saltbush, are symptomless carriers of the virus, at least under most environmental conditions.

In areas where extensive infection occurs in early stages of plant development, yellows causes marked decreases in yield of roots. In replicated plot tests at Riverside and Salinas, Calif., the disease reduced yields as much as 47 percent and sucrose content from 0.1 to 3.1 percentage points. Reduction in yield in areas where the disease is most prevalent probably reaches 25 percent, or more. Yellows may increase injury by cercospora leaf spot and by curly top in areas where these diseases are prevalent.

The causal virus is transmitted by a number of species of aphids, the most important being the green peach aphid. Seven of 14 species of aphids tested, however, did not prove to be vectors. The virus was not transmitted by species of Cuscuta. Tests showed that the virus was present in dodder growing on diseased plants, but the virus was soon lost when the dodder was transmitted to sugar beet, to Chenopodium murale, and to C. capitatum by juice inoculation. Best results were obtained with C. capitatum from inoculations during the winter months. Local necrotic lesions, about 1 mm. in diameter, were produced. Production of local lesions was not always followed by systemic infection.

The virus has a thermal inactivation point between 50° and 55° C. At room temperature it was active in plant juice after 24 hours but not after 48 hours. A small amount of infection was obtained from juice diluted 1 to 5,000 but no infection was obtained from dilutions of 1 to 10,000. The virus was active in frozen plant extracts after 12 months.

The yellows virus exists in the United States as a complex of strains, ranging in virulence from those that produce mild yellowing on older leaves of sugar beet to strains that produce vein clearing on young leaves and marked yellowing and necrosis on older leaves.

No evidence was obtained that one strain of virus protects against infection or injury by a second strain. Six strains, or isolates, covering a range of virulence, are described.

Green peach aphids acquired virus from diseased plants in a feeding period of 10 minutes, and they obtained a maximum virus charge in a feeding period of 6 hours.

The yellows virus appears to be introduced into both parenchyma and phloem by aphid vectors, but introduction into the parenchyma alone delays systemic infection.

Beet plants apparently do not increase appreciably in resistance to infection with age.

In chronically diseased beet plants concentration of virus appeared to be higher in leaves just reaching maturity than in old or very young leaves.

Possible control measures consist of: (1) Spraying to control vectors; (2) destruction of sources of infection; (3) selection of planting dates to avoid infection; and (4) development and use of resistant varieties.

Control of aphid vectors with aphicides appears to be uneconomical in coastal areas of California where aphid populations are high throughout the season, but use of aphicides may be profitable in inland areas where aphid populations drop to low levels in late May or June. Destruction of wild and escaped beets and other sources of infection reduces or delays infection in some areas. At present no varieties with high degrees of resistance are available, but it seems probable that varieties considerably more resistant than those now in use may be produced.

ARS, USDA, Inform. Div., Washington 25, D. C.

Morton, C. T., and Buchele, W. F. EMERGENCE ENERGY OF PLANT SEEDLINGS. Agr. Engin. 41: 428-431, 453-454. 1960.

A penetrometer was designed, developed, and fabricated that measured relative emergence energy requirements of plant seedlings. Basic information concerning the seed environment for maximum emergence of plant seedlings was collected in a series of laboratory experiments. Data obtained in this study shows that the emergence-energy requirements increased directly with soil-compaction pressure, initial soil-moisture content, depth of planting, amount of surface drying, and indirectly with moisture content at time of measurement. As the seedling diameter increased, the emergence energy

increased. Thus, a bean seedling would require more energy for emergence than a corn seedling. Applying compaction pressure at the seed level and preventing evaporation from the soil surface reduced the emergence energy.

The results of this study indicate that planters for corn, beans, sugar beets, etc., should be designed to press the seed into moist soil and then cover with loose soil for maximum seedling emergence.

Several methods of reducing the energy required for emergence of plant seedlings were suggested.

The authors summarize their work as follows: (1) The energy required for emergence increased directly with compaction pressure, initial soil moisture content, amount of soil-surface drying, and indirectly with moisture content at time of measurement. (2) When the soil was permitted to dry, a marked reduction in the emergence was realized for various planting depths by applying the compacting pressure at seed level as compared to applying the compaction pressure at the soil surface. (3) When the soil moisture was held constant by preventing evaporation, the mechanical strength of the soil surface increased only slightly with aging. For various planting depths, the energy required for emergence of the mechanical seedling was reduced markedly as compared to a drying condition. (4) Depth of shearing position of the inverted cone below the soil surface was independent of surface-compaction pressure at constant soil moisture and tended to increase slightly when the surface was subjected to drying. And (5) energy required for emergence and depth of shearing below the soil surface increased with the mechanical seedling diameter.

Tractor and Implement Div., Ford Motor Co., Detroit, Mich.

Cotton, R. T., Walkden, H. H., White, G. D., and Wilbur, D. A. CAUSES OF OUTBREAKS OF STORED-GRAIN INSECTS. Kans. Agr. Expt. Sta. B. 416, 35 pp. 1960.

Outbreaks of stored-grain insects originate chiefly from small indigenous populations that maintain themselves under adverse conditions, or in local situations, until conditions favor expansion. These local infestations may be supplemented by infestation transported to farms in infested feeds, grain screenings, or other dried foodstuffs, by field infestation, or by migration by flight.

It is characteristic of most insect pests of stored-grain products that generations are short, the rate of reproduction is high, and individuals are long-lived. The most important factors affecting the rise or fall of insect populations in stored grain are food supply, temperature and moisture, parasites, and control of preventive measures.

Food is nearly always present in abundance, but sanitation and good housekeeping will prevent small colonies of insects from surviving in accumulations of waste grain and feed near grain storage.

The temperature and moisture content of grain can be controlled sufficiently to make conditions less favorable for insect survival and reproduction. Grain with a mositure content below 11 percent does not favor rapid reproduction of insects and the most destructive weevils soon die in grain with a moisture content below 9 percent. Grain temperatures below 60° F. stop reproduction, and many insects die from starvation when grain temperatures drop to 40° F.

Parasites are seldom of great importance in preventing or controlling insect infestations in stored grain, but at times are effective in destroying infestations of moths.

The most successful methods of preventing or controlling insect infestation of farm-stored grain can be summed up in a few simple directions: (1) Store in weather-tight, rodent-proof bins; (2) clean out all bins before loading with grains; (3) spray walls and floors of bins and adjacent woodwork of farm buildings and the surrounding ground area with a residual type spray; (4) clean up and dispose of litter, waste grain, and feed that have accumulated in and around farm buildings; (5) avoid storing market grain in animal shelters or hay barns; (6) apply protectants to the grain during or immediately after harvest or fumigate two to eight weeks after placing small grains and shelled corn in storage; and (7) inspect frequently and refumigate if an infestation is discovered.

Agr. Expt. Sta., Kansas State U., Manhattan, Kans.

Vegetable Crops

Carew, J., Janes, R., Potter, H. S., and Lucas, R. THE HOME VEGETABLE GARDEN. Mich. Coop. Ext. Serv. Ext. B. E-4, 13 Rev., 90 pp. 1960.

A revised, complete, culture and care bulletin on the home vegetable garden, including insect and disease control recommendations.

Mich. State U., Coop. Ext. Serv., East Lansing, Mich.

Jackson, W. A., and Thomas, G. W. EFFECTS OF KCL AND DOLOMITIC LIMESTONE ON GROWTH AND ION UPTAKE OF THE SWEET POTATO. Soil Sci. 89: 347-352. 1960.

The sweet potato, a plant requiring high rates of K for root enlargement, usually is grown on sandy soils. This leads to problems of leaching and nutrient balance. In this study, sweet potatoes were grown, at rates of K up to 0.6 me. per 100 g. (468 pounds per acre), with three rates of dolomitic limestone on a Norfolk ls soil. The conclusions drawn from this work are: (1) K was lost by leaching from the surface 12 inches of the soil early in the season, but this K was more than accounted for in plants, except at the highest KCl rate by final harvest. This probably was due either to deeper root penetration and accumulation or to upward salt movement in the soil. (2) K uptake by plants was very closely correlated with growth of enlarged roots. Over 300 pounds of K per acre was taken up by some treatments with a linear increase in yield. Treatments receiving no KCl produced virtually no enlarged roots. And (3) plots which did not receive Mg in the form of dolomitic limestone suffered from sever Mg deficiency at high K rates. Yield of roots, however, did not suffer as greatly as the appearance of tops indicated.

N. C. State Col., Raleigh, N. C.

Brasher, E. P., and Ralph, E. H. EFFECTS OF CERTAIN NUTRITIONAL AND CULTURAL PRACTICES ON THE YIELD OF OLD ASPARAGUS PLANTINGS. Del. Agr. Expt. Sta. B. 332(T), 16 pp. 1960.

Experimental studies were conducted for six years at the University of Delaware Agricultural Substation near Georgetown to determine the effects of commercial fertilizers, chicken manure, ridge culture, monuron, and certain combinations of these treatments on the yield of asparagus.

With spring-applied fertilizers it was found that 800 pounds per acre of a 5-10-10 produced greater yields than did 1,600 or 2,400 pounds of the same fertilizer. With a 5-10-15 fertilizer, 1,600 pounds per acre was superior to 800 and 2,400 pounds of the same fertilizer.

A 5-10-15 fertilizer supplying 80 pounds of nitrogen, 160 of P_2O_5, and 240 pounds of potash per acre was the best of the four formulas tested. The time of application of asparagus fertilizers made little or no difference.

Over-the-row method of fertilizer application was superior to the broadcast method in the period from 1953-1955. In the 1957-1959 period, the broadcast method was superior.

A sidedressing of potash at the rate of 100 pounds per acre in early August definitely increased yields when only 1,600 pounds per acre of a 5-10-10 fertilizer had been used prior to the harvest season. No side-dressing response occurred when 1,600 pounds per acre of 5-10-15 had been used prior to the harvest season. Sidedressing with 40 pounds of nitrogen per acre in August either reduced yields or had no effect on them.

A combination of production practices which included 1,600 pounds per acre of a 5-10-15 fertilizer, ridge culture, and 1.6 pounds per acre of monuron twice annually was found to be the best treatment in the entire experiment.

All commercial fertilizers studied were superior to chicken manure.

Poor-producing plots were brought to a high level of productivity within two or three years with the use of a 5-10-15 fertilizer, ridge culture, and monuron.

U. Del., Agr. Expt. Sta., Newark, Del.

Stout, B. A., and Ries, S. K. DEVELOPMENT OF A MECHANICAL TOMATO HARVESTER MACHINE BASED ON THE ONCE-OVER HARVESTING PRINCIPLE. Agr. Engin. 41: 682-685. 1960.

A mechanical tomato harvester was developed based on the "once-over" harvesting principle. The plants are cut off just below the soil surface and elevated to a shaker bed which reciprocates with a 4-in. stroke at 175 to 200 cycles per minute. All the fruit is shaken from the plant onto an inclined rubber belt. The tomatoes roll down the slope into a conveyor while the dirt and foreign material is carried up the slope and discarded. The fruit is stored in any suitable container.

This principle of harvesting requires a variety which has concentrated fruit set (i.e., a high ratio of ripe to green fruit at harvest time) in addition to the usual requirements of processing tomato varieties. Several promising varieties are being developed by the plant breeders.

Mechanical harvester tests were conducted on ten varieties at the Michigan State University horticultural farm and two varieties in commercial fields. Mechanically harvested yields from the more promising varieties in the Michigan State University plots ranged from 2.0 to 9.9 tons of ripe fruit per acre. Eighteen tons per acre were obtained in one mechanically harvested commercial field.

Mich. State U., East Lansing, Mich.

Flocker, W. J., Timm, H., and Vomocil, J. A. EFFECT OF SOIL COMPACTION ON TOMATO AND POTATO YIELDS. Agron. J. 52: 345-348. 1960.

Harvesting equipment operated in the fall when soil moisture contents are generally near saturation compact many vegetable-producing soils. The results are relatively high bulk densities (at least in the upper 6 inches), reduced infiltration rates, a high degree of cloddiness, and hard clods. Compaction is generally alleviated somewhat during the winter by the wetting and drying of the soil. In Yolo fsl, densities and infiltration rates for noncompacted plots and severely compacted plots changed during the winter, each approaching the values of moderately compacted plots.

Yield of tomatoes on these plots was not significantly reduced by compaction treatment. A possible explanation is that the tomato plant has a fairly vigorous and extensive rooting system which exhausts the surface soil of its available water between irrigations. The data indicate that transplanting to excessively cloddy soil did not reduce plant survival, demonstrating that the tomato can withstand considerable punishment. Compaction possibly delayed the growth processes as indicated by fresh weight of tomato plants four weeks after planting. This reduction did not influence the early bearing of fruit, as indicated by yields from the first pick.

Potato yields and quality, in contrast, were both affected by compaction. Total yield and yield of U.S. No. 1 grade were reduced more than 50% in both varieties tested. Two possible explanations can be offered: (1) Emergence data show that compaction reduced the emergence of shoots from the seed piece. It was not determined whether this reduction can be attributed to increased density or increased cloddiness. Observations in the field indicate that cloddiness played the dominant role, though both conditions were probably involved. Large air pockets were present in the beds, and any seed piece that fell into one of these pockets dried sufficiently to reduce vigor of shoots as was observed in several instances. And (2) the potato plant is naturally shallow-rooted, and compaction further limited the volume of soil the roots could explore.

U. Calif., Davis, Calif.

Robinson, D. B., Ayers, G. W., and Campbell, J. E. CHEMICAL CONTROL OF BLACKLEG, DRY ROT AND VERTICILLIUM WILT OF POTATO. Amer. Potato J. 37: 203-212. 1960.

A number of chemical proprietary compounds were tested for the control of blackleg, dry rot, and Verticillium wilt in potato. In most, but not all instances, blackleg was controlled by treatment of seed pieces with mercuric chloride, Semesan Bel, or Agristrep. Phygon, Spergon, Dithane Z78, Captan, Terramine, Karathane, Sulfuron, Kolo 100, and lime gave little or no control.

Dry rot and Verticillium wilt originating in seed stocks were controlled by seed treatment with Semesan Bel and acid mercuric chloride. Captan, Spergon, Phygon, Dithane Z78, and Agri-mycin 500 proved ineffective. Dry rot in stored potatoes was most effectively controlled by tuber treatment with Semesan Bel or Agri-mycin 500 (42.4 percent copper).

Combinations of two or more of these diseases were controlled by Semesan Bel alone and by combinations of Semesan Bel and Agristrep, but not by combinations of Captan and Agristrep. Pronounced phytotoxicity always followed treatment with mercuric chloride, and occasionally followed treatment with Semesan Bel, but under good cultural conditions Semesan Bel gave marked disease control and did not adversely affect stands.

Res. Lab., Res. Br., Canada Dept. Agr., Charlottetown, Prince Edward Island, Canada.

Vittum, M. T., Sayre, C. B., and Clark, B. E. EXPERIMENTS WITH AN IMPROVED DRILL FOR FERTILIZING AND PLANTING PROCESSING PEAS. N. Y. State Agr. Expt. Sta. B. 787, 34 pp. 1960.

An experimental drill was tested for three years to determine its advantages over conventional equipment for planting pea seed. This drill was designed to: (1) Place fertilizer in a band to the side of each row and at depths ranging from 0 to 5 inches below the level of the seed; (2) space seed uniformly within the row; (3) place seed at a uniform depth; and (4) press the soil uniformly around the seed and to cover it with loose soil.

The fertilizer placement feature, the uniform depth of seeding, and the uniform compaction of the soil surrounding the seed combined to give more uniform performance and higher yields than obtained with conventional pea fertilization and planting equipment.

The experimental drill did not noticeably improve the spacing of seed within the row, and it caused only slightly less injury to seed passing through its metering mechanism than did conventional fluted feed drills.

New York pea growers could produce peas much more efficiently if an implement containing the good features of this experimental drill were commercially available.

N. Y. State Agr. Expt. Sta., Cornell U., Geneva, N. Y.

Rawlins, W. A., Sloan, M. J., Strong, R. G., and Ellington, J. J. THE ONION MAGGOT AND ITS CONTROL. Cornell U. Agr. Expt. Sta. B. 947, 18 pp. 1960.

The upsurge in onion maggot infestations beginning in the early part of the 1950's has been successfully controlled by insecticide seed or soil treatments. Application has been greatly simplified by adapting the treatments to the currently recommended methods of suppressing the onion smut fungus. In the case of seed treatment the insecticide was added as part of the coating on the exteriors of the seeds. Aldrin and parathion, on the basis of experimental experience and grower usage, is favored over dieldrin, heptachlor, chlordane, and lindane, but parathion is more difficult to handle than aldrin. Consequently it is not recommended.

The choice of in-the-row application is a wider one with three very effective methods (drench, dust, and granules) and four insecticides (aldrin, dieldrin, heptachlor, and parathion) to choose from. Drench is most poplar at the present time but the granular application offers advantages that may bring it to the forefront in the future.

Cornell U. Agr. Expt. Sta., N. Y. State Col. Agr., Ithaca, N. Y.

Guyer, G., Wells, A., Andersen, A. L., and DeZeeuw, D. J. AN EVALUATION OF SYSTEMIC INSECTICIDES FOR CONTROL OF INSECTS ON SNAP AND FIELD BEANS. Mich. Agr. Expt. Sta. Q. B. 42: 827-835. 1960.

Evaluation of the control of bean insects by using systemic insecticides was conducted over a three-year period. Results indicate: (1) The application of the systemic materials directly to the seed often resulted in serious phytotoxicity problems; (2) a 1-pound application of phorate or Di-syston, applied as a granulated formulation, significantly increased yield of snap beans as well as reduced Mexican bean beetle damage and the incidence of bean mosiac; (3) in the Sanilac, Michelite, and cranberry varieties of field beans, there was no significant increase in the yields resulting from systemic treatments;

(4) when granulated phorate was applied with fertilizer to the dark red kidney variety of field beans, there was a significant increase in yield; (5) snap beans treated with phorate seed treatment as well as granulated formulations had no toxic residues in the harvested product; and (6) field beans treated with phorate granulated formulations had no toxic residues in the dried beans at harvest.

Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Endo, R. M., and Linn, M. B. THE WHITE-RUST DISEASE OF HORSERADISH. U. Ill. Agr. Expt. Sta. B. 655, 56 pp. 1960.

A large portion of the horseradish grown in the United States is raised in Illinois. Its most damaging foliage disease is white rust, which is caused by the fungus pathogen, (Albugo candida (Pers. ex Chev.) Kuntze). The extensive leaf damage due to white rust prevents normal root growth and hence results in severe crop losses. The fungus is also believed to cause a crown, or head, rot of the root.

A study of the factors governing the germination of the fungus, the initiation and development of the disease, and the various methods by which the fungus may overwinter, brought out several control measures for white rust. These include: (1) Taking sets only from the terminal end of the primary root and immediately separating the sets from the primary roots as soon as they are harvested; (2) elimination before planting of all sets showing discolored, swollen, or cracked lesions; (3) immediate eradication of plants showing systemic infection in the spring and summer; and (4) killing horseradish foliage by mechanical means at least seven days before harvest to lessen the possibility of viable conidia falling onto the roots before they are placed in storage.

U. Ill., Agr. Expt. Sta., Urbana, Ill.

Reid, W. J., Jr., and Cuthbert, F. P., Jr. APHIDS ON LEAFY VEGETABLES: HOW TO CONTROL THEM. U.S.D.A. Farm. B. 2148, 16 pp. 1960.

Aphids, often called plant lice, are small, soft-bodied insects that suck juice from plants. They are present wherever crops are grown.

Aphids cause heavy losses to growers of leafy vegetables by: (1) Reducing vigor and yield of plants; (2) contaminating edible parts; (3) transmitting destructive virus diseases of plants; and (4) killing plants, if infestation is heavy.

Most species of aphids are about 1/16 inch long. Species differ in color. Some individuals of most species have wings; others do not. Male aphids are rare. Females of all species give birth to living young in the summer. When cold weather approaches, females of most species mate and lay eggs. Females live about a month, and produce 80 to 100 young.

This farmers bulletin is written for the commercial grower of leafly vegetables. It gives the recommended control for the different species of aphids for the different garden crops, and the precautions to use when applying the different insecticides.

ARS, USDA, Inform. Div., Washington 25, D. C.

ECONOMIC AND SOCIAL

Costs and Returns

Cole, J. F. COST OF PUMPING IRRIGATION WATER IN THE ESTANCIA VALLEY OF NEW MEXICO. N. Mex. Agr. Expt. Sta. B. 444, 34 pp. 1960.

There are approximately 220 irrigation wells in the area. Cost data were obtained from a stratified random sample of 33 wells. The average acreage served per well was 101 and the average lift was 109 feet. The average discharge measured in 1957 was 928 gallons per minute. Pumping plants operated an average of 1,801 hours, pumping an average of 283 acre-feet of water or 2.8 acre-feet of water per acre irrigated. Sixty-one percent of the well installations used overnight storage reservoirs. Most of the farms used unlined ditches for farm distribution of water.

In 1957, 45 percent of the irrigation wells were powered by electricity. There were a few diesel-powered pumps, but most of the remaining 55 percent of the power units used butane. Total investment in pumping plant and equipment averaged $6,251 for all types of power.

Overhead or fixed costs, including depreciation, interest on investment, taxes, and insurance, averaged $583 yearly per pumping plant. Depreciation accounted for 62 percent of overhead charges. The average overhead cost per plant per hour of operation was 32.4 cents and per acre-foot pumped, $2.06.

About 82 percent of operating costs were charges for fuel or electricity. The average fuel or electricity cost per hour was 63.3 cents and per acre-foot $4.03. Over-all efficiency has an important influence on the amount of fuel or electricity consumed. In areas where lifts are increasing and pump yields declining, it is difficult to maintain peak operating efficiency. Careful selection of original equipment and prompt installation of well-designed replacement components, when needed will result in lower operating costs.

The average total cost of pumping for all plants studied in 1957 was 96 cents per hour of operation or $6.09 per acre-foot pumped. The average total cost per acre-foot, per foot of lift, was 5.5 cents for all plants. Average total costs per acre-foot ranged from $3.42 to over $16. Over-all plant efficiencies averaged 55 percent of electric-powered pumping plants, almost 11.5 percent for butane-powered plants, and 18.25 percent for diesel-powered plants.

Both fixed and total costs per acre-foot decline as the number of acre-feet pumped increase. To minimize pumping costs, pumps should be used on sufficient acreage to spread fixed costs. In some irrigated areas where pump capacity is greater than needed to irrigate the pump owner's farm, pumping plants are used jointly on two or more farms under some form of contract between the pump owner and non-owner user.

The average total cost of water per acre ranged from $6.90 for barley to $24.92 for potatoes.

Agr. Expt. Sta., N. Mex. State U. Agr., Engin., and Sci., University Park, N. Mex.

Thorfinnson, T. F., Swanson, N. P., and Epp, A. W. COST OF DISTRIBUTING IRRIGATION WATER BY THE SPRINKLER METHOD. Nebr. Agr. Expt. Sta. B. SB 455, 34 pp. 1960.

Irrigation from wells is increasing rapidly in central Nebraska. Farmers are using both gravity and sprinkler systems and need information on comparative costs. To determine the cost of irrigating corn, alfalfa, small grains, and pasture by the sprinkler method and to evaluate the composition and performance of the sprinkler systems, a study was made in the area in 1957.

Investment in well, pump, power unit, and sprinkler equipment averaged $9,822 per well as reported by a sample of farmers. About half of the investment was for sprinkler equipment. Depth of the wells varied from 60 to more than 300 feet, averaging 177 feet.

Average man-hours of labor per acre for one irrigation were 1.7 for corn, 1.5 for milo, and 1.2 for alfalfa and wheat. Tractor time was approximately the same for all crops, 0.16 to 0.19 hours per acre.

Cost of distributing water by sprinkler (excluding pumping costs) averaged $11.04 per acre for milo, with 6.7 acre-inches of water applied; $15.40 for corn, with 8.7 inches applied; and $13.81 on alfalfa, with 9 inches applied. From 40 to 50 percent of the cost consisted of depreciation, taxes, and interest; the variable costs of fuel for pressure in the line, repairs on equipment, and labor in moving the equipment accounted for the rest. Cost varied widely among farms.

With corn valued at $1.00 per bushel, the value of the additional yield attributable to irrigation and fertilizer would exceed the cost of these inputs by an average of $16.67 per acre. This is the additional return above total additional costs, including cost of pumping.

On this basis, returns varied greatly among farms. Of 54 farmers irrigating corn, 12 lost from a few dollars to $25 per acre; others realized increased profits up to $50. If only cash costs are considered, the added net return from irrigation would have averaged $26.48, and only five farmers would have lost money.

SWCRD, ARS, USDA, and Nebr. Agr. Expt. Sta., Lincoln, Nebr.

Smith, W. G., McDaniel, W. E., and Scarborough, E. N. IRRIGATION IN DELAWARE. Del. Agr. Expt. Sta. B. 335 (Tech.), 28 pp. 1960.

This presents information on irrigation which can be used as a general guide by Delaware farmers. Two hundred and six farm records were obtained from farmers irrigating in the three Delaware counties in the years 1956 to 1958. Potatoes constituted the most important irrigated crop.

Total investment in irrigation, including source of water, ranged from $6,281 per farm or $481 per acre irrigated, on farms with less than 25 irrigated acres, to $21,096 per farm or $97 per acre irrigated on farms with 150 or more irrigated acres. Fixed cost per acre on farms with less than 25 acres irrigated averaged $51.18 per acre as compared to $8.84 on farms with 150 or more irrigated acres. Average variable costs ranged from $19.90 per acre for farms with less than 25 acres to $6.90 per acre for farms with 150 or more irrigated acres. Total irrigation costs per acre averaged from $71.08 per acre for farms with less than 25 irrigated acres to $15.74 per acre for farms with 150 or more irrigated acres.

The increased yield per acre that is necessary to pay for irrigation costs varies from year to year. This exists because of the variation between years in: (1) Number of acres irrigated per farm; (2) number of irrigations per year; (3) total amount of water applied; (4) price per unit of labor and supplies; and (5) price received per unit for the crop produced. Farms having less than 25 irrigated acres required 19.30 cwt. of potatoes in 1956 and 50.78 cwt. in 1958 to pay for total costs of irrigation or a difference between years of 31.48 cwt. The difference in the requirements between the same years for farms irrigating a total of 150 or more acres was only 5.73 cwt. (4.58 cwt. in 1956 and 10.31 cwt. in 1958). Similar figures are presented for other irrigated crops.

The principal reasons given by the 96 percent of the farmers who believed irrigation would prove profitable were: (1) It increased crop yield and quality of product; (2) it provided an insurance against drought and might pay for itself in one dry year; and (3) it "saved the crop" in a dry year.

Eighty-two percent of the farmers interviewed indicated they would purchase an irrigation system again if they did not own one, and six percent were undecided.

Sprinkler irrigation systems that represent the minimum capital outlay are described for areas of 10, 25, 50, and 100 acres. These systems assume unlimited water supply, unlimited labor, and fields adjacent to the water source. Investment ranged from $153 per acre for ten acres to $97 per acre for 100 acres.

The amount of investment capital available, management levels, operating costs, yields, and prices received vary from farm to farm. Therefore, it is necessary for each individual farmer to appraise his own situation before he can decide whether irrigation will be profitable on his farm. This report should only be used as a guide or bench mark by farmers making decisions about irrigation.

U. Del., Agr. Expt. Sta., Newark, Del.

Perkins, F. A. ORGANIZATION AND MANAGEMENT OF 42 MAINE COMMERCIAL APPLE FARMS. Maine Agr. Expt. Sta. B. 589, 34 pp. 1960.

Orchard farm management practices and the costs and returns of producing apples on small, medium, and large sized farms were studied. The basic information covers the period July 1, 1956 to June 30, 1957. Approximately one-third of the commercial apple growers in Maine are represented.

The 1956 commercial apple crop for the state at 820,000 bushels was 18 percent under the 10-year average for 1948-57. A smaller crop both in the state and nationally, however, resulted in relatively favorable prices for apples during the 1956-57 season. The average price received by Maine growers for the 1956 crop was $2.60 per bushel and compares to $2.44 for the previous 10-year average.

The average acreage of the farms in this study was 260 of which 71 acres were in crops. Sixty percent of the cropland was in apples. The farms ranged from 6 to 250 acres of orchard per farm and averaged 43 acres. Farms with less than 20 acres of orchard were designated as small while those with 21 to 40 acres were considered medium sized. A large farm was one with over 40 acres of orchard.

Twenty-eight percent of the trees reported were under ten years of age and were classified as non-bearing trees. The average number of trees per acre was 43. The 1956 yield for all varieties averaged 284 bushels per bearing acre and 6.6 bushels per bearing tree. Two-thirds of the apple crop was of the McIntosh variety.

The average capital investment per farm was $41,432.

Average annual receipts amounted to $23,043 per farm. Apple sales averaged $17,798 and represented 77 percent of the receipts. Wages from work off the farm was an important source of income to growers with small orchards.

Average annual expenses per farm were $18,213. Containers and supplies, labor, and spray and dust materials were the most important items of expense. Labor alone accounted for 34 percent of the total expense.

The average labor income per operator was $2,805 and ranged from a loss of $8,000 to a gain of over $12,000. Over one-third of the operators had labor incomes in excess of $4,000.

The cost of producing and marketing apples during the 1956 season ranged from $373 to $730 per acre of bearing trees and averaged $601 per acre or $2.12 a bushel. Of the total costs in producing and selling apples 40 percent was accounted for by the growing operations, 17 percent was spent in harvesting the apples, and 43 percent was represented by marketing costs.

The average cost of growing apples ranged from $187 per acre on the medium sized farms to $261 on the large farms and averaged $239 per acre or 84 cents per bushel for the 42 farms. The two most important cost items were labor and spray or dust materials. Together they represented 52 percent of the total growing cost.

Average harvesting costs ranged from $64 per acre on the medium sized farms to $121 per acre on the large farms. The average harvesting cost for the 42 farms was $101 per acre or 36 cents per bushel.

Marketing costs were computed for the various size groups and averaged $88 per acre for the small farms, $122 for the medium farms, and $348 for the large farms. The average for all farms was $261 per acre or 92 cents per bushel.

The return from the sale of apples for the 42 farms ranged from $319 per acre for the small farms to $874 on the large farms and averaged $691 per acre or $2.44 per bushel for all farms. Return per bushel averaged $1.34, $1.94, and $2.69 on the small, medium, and large farms respectively.

The larger farm businesses had an average net gain of $144 per acre or 45 cents per bushel. This compares with a net gain of $22 per acre or 10 cents per bushel for the medium sized farms and to an average loss of $76 per acre or 33 cents per bushel for the small farms. The net gain for all farms averaged $90 per acre or 32 cents per bushel.

The average orchardist used 49 hours of labor per acre for growing apples and caring for his orchard. The pruning and brush removal operation required 15.7 hours per acre. Spraying and dusting ranked second at 6.6 hours. Thinning was third and averaged 4 hours per acre.

Eighty-eight percent of the labor required was hired. The hourly wage rate ranged from 75 cents to $2.00 per hour. The most common value given for labor was $1.00 per hour.

Growers applied an average of 12 spray or dust applications during the 1956 season at a cost of $51 per bearing acre. The cost per application ranged from $3.55 per acre for the small farms to $4.83 on the large farms and averaged $4.25 per acre for the 42 farms.

Farmers whose orchard yielded less than 200 bushels per acre had a growing cost of $1.39 per bushel. With yields of 300 bushels or more per acre the growing cost averaged 73 cents per bushel. The average yield per acre for all farms was 284 bushels and the average cost of growing apples was 84 cents per bushel.

Net returns ranged from a loss of 16 cents per bushel for yields under 200 bushels per acre to a gain of 54 cents when the yields were 300 bushels or over.

Most apple growers can substantially enhance their incomes and increase their chances for success by: (1) Aiming for larger sized businesses; (2) increasing yields; and (3) improving overall farm management efficiency.

Maine Agr. Expt. Sta., U. Maine, Orono, Maine.

Grah, R. F. EFFECTS OF INITIAL STOCKING ON FINANCIAL RETURN FROM YOUNG-GROWTH DOUGLAS-FIR. Hilgardia 29(14): 613-679. 1960.

Understocking of commercial Douglas-fir stand may markedly reduce financial return. This experiment was designed to study the effects of initial understocking, to analyze them within a financial framework, and to provide guides for the economic management of young-growth Douglas-fir stands. Four model stands at initial stocking rates of 25, 50, 75, and 100 percent of normal stand values formed the basis of the experiment. Results were as follows: (1) Difference in total physical output between initially understocked and fully-stocked stands is minor, but quality of output, as measured by sawmill and peeler logs, is much lower in the understock stands. Maximum reductions in net income and soil expectation values (at 3 percent interest) were $612 and $44 per acre, respectively, for stands of low initial stocking. (2) Pruning and planting (at 3 percent) are feasible means of eliminating or reducing the quality differential on some stands and sites. However, the level of profitability varies between stocking and site, and is highest on fully-stocked, highest-site lands. Thus, where funds for management inputs are limited, they should be allocated first to stands of high initial stocking and best sites. (3) When the interest rate was figured at 5 percent, it was found that natural stands of the initial stocking levels and sites studied here can be profitably operated at that rate. And (4) under the 5 percent rate, maximum soil expectation values were reduced substantially, and rotation ages were shortened. In addition, there was little difference in soil expectation values between the initially understocked and fully-stocked stands. The study indicates that a "do-nothing" policy with respect to fill-in planting and pruning is the most profitable one.

U. Calif., Berkeley, Calif.

Schlomer, F. C. THE SOCIAL AND ECONOMIC IMPORTANCE OF WHEAT. In Progressive Wheat Production. Vol. 4, Centre d'Etude de l'Azote, Geneva, Switzerland. pp. 1-27. 1960.

The world's wheat economy is changing rapidly. This survey attempts to bring out the dynamics of the situation as it has developed early in the second half of the twentieth century. In the main, it leaves developments in the huge Eurasian landblock formed by Eastern Europe, the Soviet Union, Continental China, and its neighbors, to special chapters in this volume, and confines itself to what may be called the Polycentric World because of the great variety of aims, institutions, and methods of agricultural policies. Even so, it has to deal with a great number of complex problems.

Wheat is in increasing demand, but production in certain Western countries has outrun consumption, creating abnormally large carryover stocks. Wheat prices and currents of international trade depend, as a rule, on government action. A progressive economic and social world policy for wheat should strive for a new equilibrium on higher levels of world consumption through lower prices and would require reductions in the cost of marginal production in many countries.

Econ. Dept., FAO, Rome, Italy.

Bird, R., and Wilson, D. W. OPPORTUNITIES FOR REDUCING FARM MACHINERY COSTS IN THE OZARKS OF EASTERN MISSOURI. Mo. Agr. Expt. Sta. Res. B. 730, 20 pp. 1960.

Machinery costs, including depreciation, made up about 40 percent of all expenses of operating the farm business in the Ozarks of eastern Missouri in 1955. These costs were high because expensive machines were used and the number of acres cultivated per farm was small.

In this area, most farming operations are performed with tractor power. On the average farm in 1955, operating expenses for machinery such as fuel, oil, grease, and repairs were $7.35 per tillable acre. Including fixed costs such as depreciation, interest on the capital invested in the machinery, taxes, shelter, and insurance, the average machinery costs for farmers in the area was $17.09 per tillable acre.

Eighty-four percent of the farmers in the Ozarks of eastern Missouri harvested crops from fewer than 50 acres in 1954. It appears that the machinery costs of their farms could have been materially reduced through greater annual use of each machine. The adjustment toward higher levels of annual use could be accomplished by increasing the size of the farm unit, by custom hiring the work done, through joint ownership of equipment, or by leasing the necessary equipment. Currently, custom hiring offers the most feasible solution of the problem. It appears that in most instances where a farmer used his machinery on fewer than 75 acres of crops, he would have saved in 1955 by hiring all of his cropping work done rather than by owning the machinery and doing the work himself.

Tables and Graphs.

FERD, ARS, USDA, and U. Mo., Col. Agr., Agr. Expt. Sta., Columbia, Mo.

Walker, J. A., and Shaudys, E. T. MOW HAY DRYERS--THEIR USE, INVESTMENT COST AND OPERATING EXPENSE. Ohio Agr. Expt. Sta. Res. C. 85, 11 pp. 1960.

The benefits of mow drying hay are not without additional costs. This study considers: (1) The costs of installing a mow dryer without air heating facilities; and (2) the annual costs of using this equipment to dry hay. Information on installation, capacity, costs, and experience was obtained for 14 dryers located on 12 farms. In the attempt to locate farms with mow dryers, three were found with dryers that were no longer in use.

The authors concluded: (1) Ten of the 12 farmers reported using mow drying equipment for a dairy cattle enterprise. This high quality mow dried hay was primarily fed to high producing milk cows. (2) All of the farmers were satisfied with the performance of their mow dryers. Better quality hay was cited by most farmers. (3) The added cost of mow drying hay over field curing was $1.94 per ton for 42 inch fans and $2.42 per ton for 36 inch fans when used to 80 and 50 tons capacity respectively. (4) The additional costs of mow drying must be offset by the reduction in quanity or quality losses. The period of time between cutting and storing hay was reduced at least one day. (5) Universally, rain damaged hay was field cured and stored in mows that were not equipped with a dryer. (6) Most of the hay was chopped. All of the dryer installations except one was designed and built for chopped hay; however, 4 of the 14 dryers were presently used for baled hay. As long as air could be forced through hay, whether baled or chopped, the hay could be dried. (7) Farmers reported that the inflexibility of their mow dryer was a disadvantage. Money invested in a mow dryer can only be recovered by the returns from top quality hay fed to productive livestock. And (8) two of the men reported that if they had it to do over they would buy a field conditioner in preference to the mow dryer.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Cole, G. L., McDaniel, W. E., and Mitchell, W. H. HAY DRYING COSTS AND RETURNS. Del. Agr. Expt. Sta. B. 334 (Tech.), 32 pp. 1960.

In a controlled experiment at the University of Delaware Hay Research Farm during 1958 and 1959, two heat-cured hay treatments (one baled at 30 percent moisture and the other at 45 percent) significantly outyielded plots that were field-cured (baled at 20 percent moisture) and mow-cured (placed on drier at 25 percent moisture and dried with unheated air). Field dry matter losses increased sharply as the hay dropped below 30 percent moisture in the field.

The average crude protein content of the hay in 1958 ranged from 18.30 percent for the field-cured hay to 21.43 for the treatment baled at 45 percent moisture and heat-cured. The difference was statistically significant. In 1959 the average crude protein content was lower for each respective treatment, but the percent crude protein for the field-cured hay was significantly less than for the three remaining treatments.

Visual grading indicated that heat-curing produced hay significantly greener and leafier than field-cured hay. The field-cured hay also was significantly more musty and moldy than the artifically-cured hay.

When only the calculated value of the increased yield and digestible protein content of the hay attributed to artificial curing was considered, the increased gross returns per

acre ranged from $4.47 for the mow-cured hay to $33.32 per acre for the hay baled at 45 percent moisture and heat-cured as compared to field-cured hay. When the heat-cured hay was sold for race and pleasure horse consumption, however, it returned an additional $20.00 per ton over field-cured hay.

The costs of three drying systems are compared. A mow drier would have an initial investment of $675. Total drying costs per ton with 100 tons of hay dried annually would be $1.36 with variable costs amounting to $0.82 of the total. A four-wagon drier and a platform drier, both using supplemental heat, would have respective investments of $3,500 and $3,475. If 250 tons of hay are dried annually with each system, the total drying costs would be $3.97 per ton if the four-wagon drier is used, and $4.93 per ton for the platform system. Variable drying costs to reduce the moisture content from 30 to 15 percent would be $2.16 for the four-wagon system and $3.21 for the platform system. The higher variable cost for the platform drier is due primarily to additional labor needed to rehandle the hay. If the moisture content is reduced from 45 to 15 percent by heat drying, the variable costs would be $8.66 per ton for the wagon system and $13.84 per ton for the platform drier.

If a dairyman considers only the increases in yield and per cent protein for the two harvest seasons, he would not be able to recover total drying costs per acre using a mow drying system. Approximately 225 tons of hay would have to be dried annually to recover total drying costs using a four-wagon drier and reducing the moisture content from 30 to 15 percent. It would not be profitable for the dairyman to reduce the moisture content from 45 to 15 percent if only the additional yield and protein is considered.

The platform drying system of comparable investment and capacity to the wagon system would not be profitable for a dairyman to use when only additional yield and digestible protein is considered since returns per acre at either moisture removal level (15 and 30 points removed) are not great enough to offset the total drying costs per acre.

U. Del., Agr. Expt. Sta., Newark, Del.

Moore, C. V., Shaudys, E. T., and Sitterley, J. H. COST OF STORING AND FEEDING CHOPPED AND BALED HAY. Ohio Agr. Expt. Sta. Res. B. 854, 12 pp. 1960.

This study was conducted to provide information on the cost of storing and feeding baled and chopped hay. The authors concluded: (1) Costs of storing chopped and baled hay were similar on the farms studied. (2) Equipment and labor costs were higher for feeding chopped hay than for baled hay. (3) The distance hay had to be transported in the mow affected the time required to feed both chopped and baled hay. (4) Transporting and feeding time accounted for a large part of the total hay handling time. However, the overhead time of climbing in and out of the mow and between hay drops could be spread over more pounds of hay if two feedings could be thrown down at one time. Also, once a day feeding could be used to an advantage on some farms. (5) Tons of storage capacity affect the storage cost per ton. Large capacity storage structures have a lower cost per ton of capacity than small barns. (6) Open sided hay barns had lower costs for less than 100 tons than a sided pole barn. Over 100 tons, the costs per ton were similar. Investment and annual storage cost per ton declines very slowly after a capacity of 100 tons is reached. (7) Costs of hay storage increase rapidly when less than the capacity of the barn is used. And (8) waste was considered a major problem by farmers feeding baled hay.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Shaudys, E. T., Sitterley, J. H., and Studebaker, J. A. COSTS OF STORING GRASS-LEGUME SILAGE. Ohio Agr. Expt. Sta. Res. B. 853, 28 pp. 1960.

Grass-legume silage use has rapidly increased on Ohio farms during the last decade. Three basic types of silos: upright, bunker, and trench were found in use. Information was obtained on 149 silos by survey interview with 104 farmers. Depending on the availability of meadow crops, labor, capital, and availabilities of forages, a particular type of silo may be advantageous for a certain farm.

Both investment and annual storage costs were important to farmers in deciding which type of silo to build. Investment costs per ton of capacity were highest for upright silos

and lowest for trenches. Economics were realized in all types with large capacity silos. Low capital requirements were an advantage of horizontal silos for many farmers.

Small upright silo owners, 100 tons and under, experienced higher annual storage costs per ton than either bunker or trench users. Large upright silos, 300 tons and over, had slightly lower annual cost per ton than bunker or trenches. Spoilage losses for grass silage were valued at about $7.25 per ton. This was the cost per ton of producing, harvesting, and filling silos with grass-legume silage.

Spoilage could be valued at the out-of-pocket filling costs on farms where factors other than forage limit livestock numbers. Cost of spoilage losses may be extremely high on farms where livestock numbers are limited by forage supplies. This cost might be the net return realized from the additional livestock that could be carried if spoilage had not occurred. Spoilage losses can be reduced by using low cost plastic sheeting for establishing a seal and preventing weathering. Corn silage spoilage losses would generally have higher values than grass-legume silage.

Total spoilage losses tended to increase in proportion to capacity of bunker and trench silos. Small increases in spoilage losses were experienced with larger capacity upright silos. Spoilage loss was primarily a function of the exposed surface area. The average spoilage loss per ton of feedable silage was $0.31 per ton for upright silos, $0.89 per ton for trench silos, $1.07 per ton for bunker silos, and $1.59 per ton for stack silos.

Investment costs per ton were lower in larger capacity upright and horizontal silos. Considering investment and spoilage loss costs, large bunker and trench silos had slightly higher annual storage costs than large upright silos.

The following factors were considered important in the selection of a silo structure: (1) Low investment costs favor horizontal silos. (2) Low spoilage losses favor upright silos. (3) Spoilage is the largest annual cost in horizontal silos. USDA investigators reduced spoilage losses in horizontals comparable to uprights with the use of low cost plastic sheeting. (4) Both beef and dairy cattle were satisfactorily fed from all types of silos studied. (5) Esthetic values favor upright silos. The tall structure enhances pride. (6) Farm or local labor was used in the construction of horizontal silos providing an opportunity for reducing out-of-pocket investment expenditures. (7) A solid floor and approaches were necessary for satisfactory horizontal silo use. (8) Self-feeding at a low cost was being done in several horizontal silos. Large investment in equipment is necessary for automatic or self-feeding from uprights. And (9) optimum location of the silo structures is often more difficult to obtain with horizontals than upright silos.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Wiegmann, F., Anderson, H., and Johnston, J. COSTS AND RETURNS ON 138 LOUISIANA DAIRY FARMS. La. Agr. Expt. Sta. B. 536, 28 pp. 1960.

Total average investment per dairy farm increased from $8,843 at 50,000 pounds of annual production to $60,483 at 450,000 pounds of production on the 138 dairy farms in this study. Average investment per 100 pounds of milk produced decreased from $17.69, when 50,000 pounds were produced per year, to $13.87 when 250,000 pounds of milk were produced per year, to $13.44 when 450,000 pounds of milk were produced annually.

Labor used on dairy farms in Louisiana varied greatly at all levels of production. For example, labor used at production levels of 60,000 varied from 2,000 to 4,000 hours and at 150,000 pounds varied from approximately 2,000 to over 8,000 hours. Part of the difference may be due to use of pipeline milkers and bulk tanks, as well as other labor-saving equipment on some farms. A considerable amount of labor inefficiency is also present on some farms. Production per cow plays an important role. High-producing cows require very little, if any, more labor than low-producing ones.

Cash costs decreased from $5.67 per 100 pounds of milk produced at a production level of 50,000 pounds per year, to $3.51 per 100 pounds in herds producing 250,000 pounds annually, and to $3.27 per 100 pounds when herds produced 450,000 pounds of milk per year. Cash costs plus depreciation on buildings and equipment and interest on investment were $7.41, $4.26, and $3.91, respectively, at 50,000 pound, 250,000 pound, and 450,000 pound production levels. Average total production costs (including unpaid family labor) were $10.14, $6.94, $5.87, $5.02, and $4.45 per 100 pounds at the 50,000, 100,000, 150,000, 250,000, and 450,000 pound levels of production.

The average price received for milk by the farms included in the study was $5.54 per 100 pounds.

The average production per cow for all 5,298 cows included in the study was 4,827 pounds per year. The "breakeven" point was at about 4,800 pounds of milk per cow per year. At this rate of production all costs, including family labor, were covered by returns.

Purchased feed was the largest single cash cost item in milk production (49 percent of cash cost). The next largest cash cost item was "other costs" (25.37 percent of cash costs) including milk hauling, breeding fees, supplies, utilities, veterinarian expenses, and other miscellaneous expenses. Many of these "other cost" items are incurred in direct relation to amount of milk produced.

While costs of milk production increased with average production per cow, net income per cow also increased. Net income over cash cost varied from $48 for 3,000-pound-producing cows to $257 for 8,000 pounds or more production per cow. Net income per cow over total costs increased from $8.59 in herds averaging between 4,001-5,000 pounds per cow per year to $153.60 in herds averaging over 8,000 pounds per cow per year. In herds where average production per cow was between 3,001 and 4,000 pounds of milk per year, average net loss per cow was $3.77.

A forty-cow milking herd represents an economic family size dairy enterprise in Louisiana. In 38 herds having between 31 and 40 cows, average cash production costs were $3.61 for each 100 pounds of milk produced. Smaller herds (21 to 30 cows) had an average cash production cost of $3.79.

A minimum of about 180,000 pounds of milk per year was necessary for milk sales to cover total production costs on the farms in this study. About 130,000 pounds of milk production per farm was necessary for gross returns to the dairy to equal total costs.

This study shows that cash costs plus depreciation and interest on investment averaged $8,909 for the production of 200,000 pounds of milk in 1957. At this level of production $11,048 was received from the sale of milk alone leaving a labor income from milk sales alone of $2,141 per year. From average gross returns per farm (milk sales plus other dairy income), the labor income or money available for family living averaged $2,876 at the 200,000 pound level of production.

La. State U. and Agr. and Mech. Col., Agr. Expt. Sta., University Station, La.

Shepherd, G., Paulsen, A., Kutish, F., Kaldor, D., Heifner, R., and Futrell, G. PRODUCTION, PRICE AND INCOME ESTIMATES AND PROJECTIONS FOR THE FEED-LIVESTOCK ECONOMY UNDER SPECIFIED CONTROL AND MARKET-CLEARING CONDITIONS. Iowa Agr. and Home Econ. Expt. Sta. Spec. Rpt. 27, 20 pp. 1960.

This report includes estimates made for the purpose of answering three questions:

1. What would the production, prices, and revenues of grains and livestock have been from 1951 to 1958 if feed grain and wheat stocks had been held at their 1952 levels? The analysis in this report leads to the following findings: The feed grains that went into stocks would have been fed to livestock. The consumption of feed grains by livestock would have had to be 6.3 percent greater than it was. If the increases in the stocks of wheat had also been fed, the consumption of grains by livestock would have increased 10.3 percent. The estimates of the effects on grain and livestock prices of feeding these extra quantities are given in Table A.

Table A.--United States average farm price of livestock and grain products, actual, and estimated with higher levels of feed consumption, 1952-58

	Actual average prices	Estimated average prices with grain consumption increased	
		6.3 percent	10.3 percent
Beef cattle, average price received by farmers, $ per cwt.	18.03	17.15	16.59
Hogs, average price received by farmers, $ per cwt.	18.23	14.77	12.58
Corn, $ per bushel, at a 1:13 ratio to hog prices	1.32	1.13	0.97

The decreases in prices estimated above would have reduced total agricultural cash receipts about 10.6 percent. Cash expenses would have decreased only about 1.2 percent. Total net cash income from farming would have decreased about 34 percent. Retail prices for livestock products would have declined, per capita consumption would have increased, and expenditures for these foods by an average family of four would have decreased about 6 percent.

2. What would happen to prices and incomes over the next few years if the 1959 program were continued unchanged? In investigating this question, several assumptions were made. These include continued growth of population and income per capita, average weather, increases in crop yields according to trend, and 37 million acres in the conservation reserve by 1962. Under these assumptions, it was estimated that production of feed grains would decline in 1960 to about the 1958 level and then expand as yields per acre increased. Livestock production would expand somewhat; grain stocks would increase steadily. Prices of livestock would decline to the levels shown in table B.

Table B.--United States average farm price, 1958-59 actual and 1961-62 projected, with current farm programs continued

	1958	1959	1961	1962
Hogs ($/cwt.)	19.00	14.50	16.00	14.50
Beef cattle ($/cwt.)	21.00	22.50	20.00	17.50
Eggs (cents/doz.)	.38	.32	.30	.30

Retail prices for livestock would decline and consumption of red meat, poultry, and milk per capita would increase considerably. If marketing margins continue to rise as in the past, total expenditures by a family of four on livestock products would remain about constant.

3. What would happen to production, prices, and incomes over the next few years if price supports were abandoned and stocks held at their present levels? The assumptions in this case with respect to the general economy, weather and yields were the same as those under question 2. Several other crucial assumptions are listed below: (1) The present stocks of feed grains, wheat, and cotton would not be reduced during the period. (2) Export subsidies on agricultural commodities would be eliminated. (3) The conservation reserve would continue through the 1960 crop year with an additional 5 million acres added in 1960 to bring the total to 28 million acres. No new contracts would be signed for 1961 or later years. Old contracts would not be renewed as they expired. Under these assumptions, it was estimated that prices would decline to the levels shown in table C.

Table C.--Prices of livestock and grain products, 1957-59 actual and 1960-63 projected, under free market conditions

	1957-58	1958-59	1960-61	1962-63
Livestock				
Hogs ($/cwt.)	19.00	15.70	14.20	11.00
Beef cattle ($/cwt.)	21.90	23.00	20.90	12.00
Crops				
Corn ($/bu.)	1.12	1.13	.79	.66
Wheat ($/bu.)	1.93	1.72	1.67	.74

Under these assumptions, it was estimated that production of the four traditional feed grains would be below the 1958 and 1959 levels. Wheat and cotton production would expand. Wheat would become a feed grain. Total feed grain production including wheat would expand steadily until 1962. Total feed grain would be about as large, with average weather, as the high production of 1959.

Utilization of feed grains in all outlets would expand. Livestock production and slaughter would expand in response to lower feed grain prices. Since livestock marketings would expand faster than population, prices would fall. The estimated prices of selected livestock and grain are shown in table C.

By 1962-63, the estimated value of all livestock and livestock products marketed would be about 21 percent below the value of all livestock and livestock products marketed in 1958-59.

With marketing margins continuing to rise, retail prices of livestock would decline, total consumption per capita would increase, and expenditures of an average family of four for livestock products would decline 6.7 percent or about $46 per year from 1959 to 1963.

Agr. and Home Econ. Expt. Sta., Iowa State U. of Sci. and Tech., Ames, Iowa.

Heady, E. O., Baumann, R. V., and Orazem, F. ADJUSTMENTS TO MEET CHANGES IN PRICES AND TO IMPROVE INCOMES ON DAIRY FARMS IN NORTHEASTERN IOWA (AN APPLICATION OF PROGRAMMING METHODS IN DERIVING SUPPLY RESPONSES AND IMPUTED RESOURCE VALUES). Iowa Agr. Expt. Sta. Res. B. 480: 791-811. 1960.

The general objectives of this study are: (1) To determine the effects of a decline in milk prices on the organization of dairy farms and their incomes in northeastern Iowa; (2) to identify adjustments which dairymen can make in their crop and livestock production programs to offset lower milk prices; (3) to provide farm operators and those who counsel them with information to facilitate the process of adjustments on individual farms; and (4) to provide guidance for those who will decide future policies in this area.

The study is concerned with 160-acre farms, the modal size on Tama-Downs soils in northeastern Iowa. Optimum plans are developed for one- and two-man farms with various amounts of operating capital. Both usual and improved practices in crop and livestock production are considered. Linear programming is used as the empirical tool for analyzing production adjustment possibilities for the different farm situations considered in this study. The analysis was made on the basis of 1950-54 price levels projected to 1960 and prices of milk that are 20 percent lower than the projections to 1960. While the results apply to 160-acre farms with given quantities of resources, they also may be indicative of what farmers in other situations could do.

A 20-percent decline in the projected price of milk reduces net farm income of a typical one-man farm by an average of 9.2 percent. To offset this decline in net income from lower prices, an operator of a 160-acre one-man farm could either improve his cropping program, improve the production practices of his livestock enterprises, or reorganize both his cropping and his livestock programs.

Improved practices in the dairy enterprise alone on a one-man farm with $3,000 operating capital would not make up the loss in net income from a price decline of 20 percent for milk. Improved practices in both the dairy and the hog enterprises, however, would more than offset the price decline. Improvement of practices for both the crops and livestock would increase net income by about 24 percent, even at the lower price for milk. A one-man farm with $4,500 operating capital could increase net income from the additional investment by $339 if usual practices were used for both crops and livestock. If improved, rather than usual, practices were used with $4,500 operating capital, income could be increased by about 28 percent, even at the lower milk prices. If the same adjustments were made on a two-man farm with $4,500 operating capital, income would be increased by about 40 percent, even with the lower milk prices. Improved practices on the livestock enterprises alone would increase income by about 22 percent. Both simple and complex adjustments can be made to meet price declines.

Variable prices were used in the programming analysis to determine the price range over which particular enterprise combinations appear stable. In general, prices for hogs and dairy products can range widely before a new plan is required to maximize profits.

Marginal value productivities were computed for scarce resources on one-man and two-man farms. These quantities indicated that farms operating with limited resources could, under efficient management practices, use more resources for a profitable expansion of their business operations.

The types of adjustments outlined in this study can reduce the per-unit cost of producing milk and increase the value productivity of resources on individual farms. If all or a majority of farmers make similar adjustments, however, the mass effect might be to reduce prices further.

Agr. and Home Econ. Expt. Sta., Iowa State U., Ames, Iowa.

Johnson, R. G., and Nodland, T. R. LABOR USED IN CATTLE FEEDING. Minn. Agr. Expt. Sta. B. 451, 16 pp. 1960.

Fattening cattle for market is a major enterprise on many Minnesota farms. During certain seasons of the year, available labor may limit the size of the enterprise because of conflicting demands for labor for feeder cattle chores and for crop production.

To provide a guide for farmers in fitting the cattle-feeding program to labor available, labor requirements were estimated for tasks involved in feeding varying numbers of cattle. Labor per acre for typical crops and its seasonal distribution were estimated also. Data for these estimates were provided by 59 farmers in Southern Minnesota from records they kept during the 1956-57 feeding season.

Experiences of these farmers indicate that larger lots require less labor per head than smaller lots, even with similar equipment. In a typical feeding program, 40 head of cattle use 423 hours per year, while adding more cattle would increase this time by only 104 hours for each 20 head. Some practices found to reduce labor needs are feeding grain only once a day when cattle are on a limited feed of grain; bedding less often than every other day; and removing manure only once or twice a year.

Minn. Agr. Expt. Sta., St. Paul, Minn.

Greve, R. W., Plaxico, J. S., and Lagrone, W. F. PRODUCTION AND INCOME VARIABILITY OF ALTERNATIVE FARM ENTERPRISES IN NORTHWEST OKLAHOMA. Okla. State U. Expt. Sta. B. B-563, 38 pp. 1960.

Variable production and prices have caused farm and ranch incomes in northwestern Oklahoma to be erratic. The variability of production, price, and income per acre has been determined for the four main enterprises: wheat, grain sorghum, steer, and cow-calf system.

Based on 16 years of yield data, 1942-57, grain sorghum had a greater production variability than any of the other three enterprises. Beef production from a cow herd had the most stable production. Wheat production was less variable than grain sorghum, but more variable than either of the beef enterprises. The buy-sell steer enterprise was considerably more variable than production from a beef cow herd.

Probably because of price-support programs, wheat prices were less variable in 1942-57 than were prices of other enterprises. Beef cattle prices were less stable than those of wheat and grain sorghum. A positive correlation existed between historical prices for all combinations of the four enterprises during the 16 years. Price correlations between calves and yearling steers were highly significant. Also highly significant price correlations were found when wheat was paired with steers and with calves.

Per acre gross and net returns were computed for wheat, grain sorghum, and the two systems of beef production for the year 1942-57.

Three price series--actual, deflated, and constant--were combined with production to obtain three sets of gross income. Variable production costs only were subtracted from gross returns; thus, the returns above selected cash costs are returns to land, labor, capital, risk, and management.

Estimated returns above specified cash costs with historical prices and costs indicate that: (1) Cropland used for wheat production had a much higher return per acre ($19.02) than did grain sorghum ($10.14). Also, the coefficient of variation of per acre returns from wheat was 42.9 percent compared with 68.2 percent for grain sorghum. And (2) rangeland grazed by steers averaged $4.95 per acre return for the 16 years. A cow-calf enterprise on similar range returned $3.00 per acre above specified cash costs. The coefficient of variation of returns from the steer enterprise was 79.1 percent compared with 45.7 percent for the cow-calf enterprise.

The use of a deflated series of prices or a constant price had little effect on the variability of net returns from wheat and grain sorghums. In contrast, the use of constant prices significantly reduced the variability of net returns from the livestock enterprises.

Each of the three tests for bunchiness (runs of specified duration, 4-year moving averages, and nonparametric statistical test) suggest the presence of cycles of bunches in each of the series of data tested. The tendency of the cow-calf data to bunch near the mean with a very low coefficient of variation emphasizes the relative stability of cow-calf production. On the other hand, the relatively high coefficients of variation for the other series, along with bunching tendencies, emphasizes the importance of reserves and long-term planning in the Great Plains.

Obviously, farmers and ranchers are more interested in the bunching of incomes than in production or rainfall. Analysis suggests that income tend to bunch to an even greater degree than yields or rates of production.

The small amount of correlation between wheat returns and the returns from each of the other chief farm enterprises may imply a stabilizing effect when enterprises are combined. No systematic evaluation of income effects of combination of enterprises has been considered in this analysis. Present data indicate that adding grain sorghum to a straight wheat-cropping system would reduce the variability of annual returns as well as the overall average returns per acre of cropland.

FERD, ARS, USDA, and Agr. Expt. Sta., Okla. State U., Stillwater, Okla.

Saunders, F. B. CAPITAL STRUCTURE AND PRODUCTIVITY ON FAMILY-OPERATED FARMS: COASTAL PLAIN AREA OF GEORGIA. Ga. Agr. Expt. Sta. B. N.S. 75, 39 pp. 1960.

The problem of isolating changes in capital structures and levels that would provide guides for profitable increases in the volume of business on family-operated farms in the Coastal Plain Area was studied. The specific objectives of the study were: (1) To determine the relationship between specified kinds and amounts of resources and the volume of business on family-operated farms by types and geographic areas; (2) to estimate marginal value productivities of capital resources for different capital levels and structures; and (3) to evaluate the implications of these findings for future adjustments on family-operated farms.

Multiple regression procedures were employed to estimate production functions from basic resource and income data obtained for 659 family-operated farms financed by the Farmers Home Administration. Production functions, of the Cobb-Douglas type, were determined for the 659 farms considered as a group irrespective of type and also for cotton, dairy, peanut, general, tobacco, and hog types of farms. The results of the regression analyses showed that variations in the amounts of four forms of capital--real

estate, productive livestock, machinery and equipment, and cash operating expenses--were associated with 74 percent or more of the variation in gross cash farm incomes on all of the types of farms except hog farms (61 percent).

These production functions were utilized to estimate incomes and marginal productivities of the different capital resources for different capital levels and structures. These marginal returns were then compared with costs to isolate "break-even points" for each capital resource by types of farms. Although the analyses showed that the specific changes in capital structure that would be profitable vary not only by type of farm but also for different capital levels for a given type of farm, the results lend support to the following conclusions: (1) The volume of business on these farms must be increased if net cash incomes sufficient to provide for overhead expenses, family living, and debt repayment are obtained; (2) profitable expansion in the volume of business will require considerable additional capital investments; (3) additional cash operating expenses would be profitable on the cotton and tobacco farms at all levels of capital and also on the dairy farms provided other resources are also at high levels; (4) additional investments in productive livestock would be profitable on the dairy and hog farms and also on the cotton, peanut, and general farms for the higher capital levels; (5) investments in machinery and equipment could be expanded profitably on general, peanut, and tobacco farms at all capital levels; (6) the marginal returns to real estate investments were relatively low on all types of farms except the hog farms; and (7) generally, except for the specific exceptions mentioned above, the results of these analyses indicate that profitable expansion in capital use on these family-operated farms should be in the form of more working capital--that is, either machinery and equipment, productive livestock or cash operating expenses--rather than in additional fixed real estate investments.

Ga. Agr. Expt. Sta., U. Ga., Col. Agr., Athens, Ga.

Montgomery, J. P. LOUISIANA FARM PRODUCTS PRICES, 1910-1959. La. Agr. Expt. Sta. B. 530, 72 pp. 1960.

The purposes of this publication are: (1) To present the cash monthly and seasonal average prices received by Louisiana farmers for each of the more important farm products from 1910 through 1959; (2) to present in tabular form monthly, seasonal, and annual price relatives for the important products; (3) to provide weighted aggregate index numbers of prices received by farmers for related groups of farm products; (4) to present indexes of monthly and weighted average annual prices received for farm products by Louisiana farmers; and (5) to provide price data needed to make historical comparisons of current prices and price relatives with prices for farm products since 1910.

La. State U. and Agr. and Mech. Col., Agr. Expt. Sta., University Station, La.

Helfinstine, R. D. FARM PLANS FOR WHEAT FARMERS IN NORTH CENTRAL SOUTH DAKOTA. S. Dak. Agr. Expt. Sta. B. 488, 40 pp. 1960.

Some of the questions that face farmers in north central South Dakota concerning their most profitable production plans under wheat-acreage restrictions were studied. The method used was to estimate future rates of production for crops and livestock in the area; to estimate future prices and costs and usual size of farm; and to budget alternative crop and livestock organizations so as to find the one that will be most profitable and stable.

This analysis brought out that a grain system of farming (small grain-corn-small grain) using commercial fertilizer was more profitable than one using alfalfa or sweet clover. Either feeder-cattle and hog-raising enterprises or lamb and hog raising enterprises were combined profitably with this system.

Further analysis indicated that on the 800-acre and 1,280-acre farms, buying and fattening additional feeder cattle increased earnings. The same cropping plan of small grain-corn-small grain was budgeted as being the most profitable, but part of the corn acreage was harvested as corn silage to supply roughage.

Analysis under different growing conditions showed that substituting grain sorghum for corn under favorable growing conditions was profitable on most of the soil groups.

Increasing the size of business by adding more land up to at least a 1,280-acre farm or by increasing the number of litters of pigs raised up to the limit of feed supplies increased earnings.

The value of flexible farm plans that can be changed to meet unfavorable or very favorable growing conditions and economic situations was brought out. These farm plans gave a more even level of income over a period of years than other plans.

Agr. Expt. Sta., S. Dak. State Col., Brookings, S. Dak.

Schmidt, J. R., and Christiansen, R. A. POTENTIAL CROP AND LIVESTOCK PRODUCTION AND NET FARM INCOME ON DOMINANT SOILS IN NORTHWEST WISCONSIN. Wisc. Agr. Expt. Sta. Res. B. 219, 71 pp. 1960.

A profitable farm operation depends upon many things, including the amount of resources available, the productivity of these resources, and the degree of efficiency or level of management with which the resources are utilized. This study focuses particular attention upon the most basic farm resource, the soil itself. The study analyses the potential productivity of the dominant soils in Northwest Wisconsin and compares this potential productivity with that actually obtained on some of the "better-managed" farms.

More specifically, this study attempts to answer these questions: (1) What cropping practices are followed and what crop yields are now obtained on farms of the dominant soil types in Northwest Wisconsin? (2) What are the recommended cropping practices and potential yields on these soils? And (3) how might a shift from past to recommended cropping practices be expected to alter livestock production and net income on farms of the various soil types?

The investigation had two general objectives: (1) To determine yields of the principal crops by major or dominant soil types in Northwest Wisconsin, under actual and recommended cropland practices; and (2) to evaluate the effect on livestock programs and net farm income of changing from actual to recommended cropping practices.

Agr. Expt. Sta., U. Wisc., Madison, Wisc.

Institutional and Educational

Food and Agriculture Organization of the United Nations. THE STATE OF FOOD AND AGRICULTURE 1959. Food and Agr. Organ. of U.N. C 59/7, 197 pp. 1959.

The most pressing problems of food and agriculture at the present time are centered in the economically less-developed countries of the world. In the more highly-developed countries a level of productivity has been reached which makes it possible for the relatively small percentage of the population engaged in agriculture to provide a nutritionally adequate diet for the rest of the population, and also to earn incomes which, even though they usually lag behind incomes in other occupations, are far in advance of those of farmers in less-developed countries. A major problem, in some instances, is how to dispose of the abundant supplies resulting from the great advances in agricultural methods made during the last few decades.

In the less-developed countries, although a large part of their population is engaged in agriculture, production is often too low to satisfy even the simple, and generally nutritionally inadequate, diets imposed by their general poverty. Many less-developed countries have therefore had either to curtail exports, thus reducing badly needed earnings of foreign exchange, or alternatively to rely increasingly on food imports. In either case their capacity to import capital goods for general economic development has been seriously impaired.

In emergencies, invaluable help has been received from the surplus supplies accumulated in more developed countries. In the long run, the twin problems of rural poverty and inadequate food supplies in less-developed countries can be overcome only by building up their own agricultures. It is therefore of the highest importance to determine what social, economic, and technical improvements are needed to bring this about. For until then, the extreme poverty of the cultivators in many less-developed countries will continue, food supplies will remain precarious, and economic progress as a whole will be seriously delayed.

These are the central themes of this year's annual report on the state of food and agriculture. After a brief general summary, there is the usual chapter analyzing current developments in the world food and agricultural situation and in agricultural policies. The recession in the more-industrialized countries led to a fall both in the volume and prices of agricultural exports, especially of raw materials. This seriously weakened the economic position of agricultural exporting countries, among them most of the less-developed countries.

The general survey is followed by two special chapters. The first of these examines the levels of living among farm people in countries at different stages of economic development, and how they compare with those in other occupations. It goes on to consider the underlying factors which account for the disparities in incomes and levels of living between farm and non-farm people, and the still greater disparities between farm people in less- and more-developed countries.

The second of the special chapters examines the more practical problems of agricultural development in the less-developed countries. It is concerned with the ways of providing farmers with the technical knowledge and the credit and investment resources without which no substantial improvement is possible and to the measures needed to create an economic and social environment favorable to agricultural expansion.

Handicapped by ignorance, poverty, and debt, the cultivator in many less-developed countries must face great fluctuations of price, and because of his lack of resources must usually sell immediately after the harvest when prices are lowest. If he improves his methods of farming, much of the benefit of his increased output may go to the merchant or landlord to whom he is indebted. Often he has so little security of tenure that he has no real inducement to improve his holding.

The whole report underlines the need for an integrated approach if agricultural and general economic development is to be fully effective. It brings out that while agricultural development must keep pace with other sectors, progress in these sectors in turn hinges on a parallel development in agriculture.

$2.00 from Columbia U. Press, International Doc. Serv., 2960 Broadway, New York, N. Y.

Garlock, F. L., Scofield, W. H., Stocker, F. D., Hansing, F. D., and Dallavalle, Q. F. THE BALANCE SHEET OF AGRICULTURE, 1960. U.S.D.A., A.R.S. Agr. Inform. B. 232, 36 pp. 1960.

The balance sheet brings together the assets and liabilities of agriculture as though it were one large enterprise. It is the 16th in a series that contain comparable annual estimates beginning in 1940. The annual changes shown provide a means of appraising the effects of developments in both the farm and nonfarm sectors of the economy on the financial structure of agriculture.

This report shows farm assets and farm debts at the beginning of 1960 and selected earlier years. It deals mainly with changes in the financial situation of agriculture that occurred during 1959.

In using and interpreting the balance sheet, it should be remembered that the data are aggregates and that they do not show the distribution of assets and debts among owner-operators, tenants, and landlords, nor do the data permit full separation of the farm firm as a production unit from the farm family as a consumption unit.

Numerous charts, tables, and graphs.

ARS, USDA, Inform. Div., Washington 25, D. C.

Johnson, H. A., and Haren, C. C. URBANIZATION AND CHANGING LAND USES. U.S.D.A. Misc. P. 825, 212 pp. 1960.

The face of our national landscape is changing. Our rapidly growing population, our ever-rising standards of living, our evolving luxuriant technology, and our new ways of life make changes in land use mandatory as our Nation progresses. This process of change is not new; it began in dim history and will continue so long as man strives to improve his condition. We notice the changes now because we are living now; and probably also because the effects of several major forces seem to have become concentrated during the last few years.

Land uses are changing most obviously, if not most rapidly, in zones or areas in which urban uses are expanding onto former farm and forest lands and swallowing agrarian hamlets that lie in their path. Change often involves conflicts of interest and basic misunderstandings among groups and individuals. Society lives by laws, customs, and practices acceptable to the majority. Good decisions concerning desirable changes in the rules can be made only when individuals understand the problems, the range of possible solutions, and the consequences of their action or inaction.

This annotated bibliography was compiled as one of the early steps in an economic appraisal of impacts of urban growth on rural land use by the Farm Economics Research Division, Agricultural Research Service.

ARS, USDA, Inform Div., Washington 25, D. C.

Miller, W. G. FARM TENURE PERSPECTIVE OF VERTICAL INTEGRATION. J. Farm. Econ. 42: 307-316. 1960.

Integration of farm activities with those of other firms is rapidly gaining importance as an institution affecting agriculture. The character of the contractual arrangements incident to integration raises new farm tenure problems. For one thing, the programs of vertical integration constitute economic reorganizations in which the ownership interests in farm resources and the control over these resources may be redistributed. From another aspect, such farm tenure circumstances as leasing may serve either as restraints to or as factors conducive to the adoption and expansion of integration programs. Because of these two aspects--the impact of integration or tenure relationships on the one hand, and the tenure-related conditions that affect entry into integration contracts on the other hand--vertical integration in agriculture presents a "two-phased" problem in the analysis of farm tenure.

Even though these problems are recognized, they are emphasized relatively little in the literature on vertical integration. Some general propositions on vertical integration from a farm tenure viewpoint are given. The tenure-related conditions that may influence farmers' entry into integration are first examined. Next, the nature of farm tenure relationships under integrated organizations is discussed.

ARS, USDA, Washington 25, D. C.

Henderson, H. A. A PROGRESS REPORT OF A STUDY OF THE ECONOMIC STATUS AND OPPORTUNITIES OF RURAL PEOPLE. Tenn. Agr. Expt. Sta. B. 312, 30 pp. 1960.

The rural population of the upper East Tennessee Valley is made up largely of older people. The modal and median age of household heads is about 50 years. By 1967 it will likely be even older--about 55.

The advanced age is reflected in the proportion of people who are employable. Only 5 percent of the households have more than one employable male and 46 percent have no employable males in the household.

Rural areas contain much nonfarm activity. Sixty percent of the households have at least one nonfarm worker. About half of the rural households sell no agricultural products and are classified as nonfarm households, and about half of the farm households have more nonfarm income than farm sales.

There is also some farm activity among rural nonfarm households. More than a third have 3 acres or more of land, and about 1 in 5 households produced as much as $150 in farm products for home consumption.

Dairy and tobacco are the major farm enterprises in the area. Almost 60 percent of the farms sold dairy products and/or tobacco and nothing else of importance. More than 80 percent had one of these enterprises.

The people in the area have an average net worth of almost $12,000. Eighty-two percent of all households and 84 percent of farm operators are landowners.

Much of the total income is noncash in nature and from nonfarm sources. Fifty-seven percent have over $3,000 net earnings from all sources. Only 2 percent of the households have more than 3,000 in net cash farm income. On the other hand, 43 percent have that

much in net cash income from all sources. Median earnings per person amount to $1,000. An average of $900 of total earnings is in the form of home-produced products used by the family.

There is considerable underemployment in the area. About half of the households could do more work than they now do.

There are essentially two large economic groups of households in the area: I--Households with earning and adjustment possibilities limited because of age, physical handicap, widowhood, lack of education, etc., of the household head; and II--households with adjustment possibilities, including households with younger male heads who have no restricting characteristic. Fifty-nine percent of the households were in group I and 41 percent in group II. Within each group of households are many individuals who may make adjustments. About 6.7 percent of the total population is made up of people who are between the ages of 14 and 25 and who have completed at least 8 years of schooling.

Solutions to problems of the different adjustment groups are interrelated. As resources are released by group I through retirement, they will be available to the other group for enlarging or establishing their businesses. If the older group can be made self-sufficient, it will relieve the burdens of the other group. If households in group II can obtain enough resources to expand their businesses, this will provide employment for themselves and the younger individuals. If the individuals can find employment, they can contribute to community welfare rather than look to the community for support. Anyone who tries to solve problems of one group should also consider the effect on other groups.

The households as units are stable; however, individuals tend to be mobile. More than half of the household heads have lived in the same house for at least 10 years. Half of the households have had members who obtained nonfarm jobs within the last 7 years and about half of these jobs were 100 or more miles from home.

FERD, ARS, USDA, and U. Tenn., Agr. Expt. Sta., Knoxville, Tenn.

Metzler, W. H., and Sargent, F. O. INCOMES OF MIGRATORY AGRICULTURAL WORKERS. Tex. Agr. Expt. Sta. B. 950, 12 pp. 1960.

A survey was made concerning income of the migratory workers located in South Texas during the winter of 1956-57. The survey was made in six cities with large settlements of migratory farmworkers. These cities were San Antonio, Crystal City, Eagle Pass, Laredo, Weslaco, and Robstown.

South Texas migratory workers can be classified into three major groups according to their range of movement. About a third move within the State only and engage mainly picking cotton. Another third migrate to the sugar beet, vegetable, and fruit areas around the Great Lakes, in the Rocky Mountain area or along the Pacific Coast. The third group works in these same out-of-state areas and then returns to engage in the cotton harvest in Texas.

Practically all were underemployed. They averaged only 131 days of work during 1956. Heads of households averaged 174 days of work. The unemployment rate at the home base was twice as great as while they were on the road.

During 1956, the average earnings per worker were $781, but male heads of households averaged $1,145. Less than one-fourth of this was earned at the home base; hence, migratory labor was a major source of their income.

In the 446 households surveyed, there was a total of 1,334 workers. Approximately half of these were household heads or their wives (49 percent). Working wives were only a little more than half as numerous as working husbands.

Approximately three-fourths of the husbands were 25 to 55 years of age, with the largest number being in the 45 to 54 age group. Most of the working wives were 25 to 34 years of age.

One-fifth of the workers were school children at the time of the survey.

Several major trends are working toward an improved situation for migratory workers. They are: (1) Permanent movement of migratory workers to other states and reduction of labor surpluses at the home base during the winter; (2) development of annual workers' plans which correlate movement of the workers with local labor needs during the season; (3) development of better means of school-attendance administration so as to

reduce the loss in educational advantages; and (4) more careful regulation of transportation, housing, and sanitation so as to bring the living and working conditions of these people more in line with acceptable minimum standards.

Tex. Agr. Expt. Sta., College Station, Tex.

Bolton, B. INCOME AND RELATED CHARACTERISTICS OF RURAL HOUSEHOLDS IN THE CENTRAL LOUISIANA MIXED FARMING AREA. La. State U. and Agr. and Mech. Col. D.A.E. Mimeo. C. 257, 91 pp. 1960.

In 1957, almost a third of the open-country households in the Central Louisiana Mixed Farming Area were farm households.

Less than half the nonfarm families received $2,000 or more in money income during 1956. Low incomes tended to be heavily concentrated among Negro families, families with heads 54 years old or older, families with heads less than 4 years of schooling, and families with heads who were retired, unemployed, or on welfare.

The farm households were divided about equally among commercial farms without nonfarm income, commercial farms with nonfarm income, and part-time or residential units. For both groups of small commercial farms, the lower income classes tended to have larger than proportionate shares of Negro operators, operators with less than 4 years of schooling, renters and sharecroppers, very small farms, and cotton farms.

On commercial farms, incomes increased substantially as size of farm increased. For white operators, both farm and nonfarm income tended to increase with increasing education and with increasing age through the 45 to 54 year age group. These age-education income relationships were not indicated for Negro operators.

Relatively few of the low-income families in the nonfarm group are likely to be in position to make changes to increase income. The problem of income is not acute for most of this group, however, as a large proportion of those with incomes of less than $2,000 were retired people with one or two persons per household.

Opportunities for nonfarm employment were limited by such factors as age and education for about three-fourths of the operators of commercial farms with incomes of less than $1,000 and for about a third of the operators with incomes ranging between $1,000 and $2,000. But among this group with limited nonfarm opportunities are many farmers who control sufficient land and capital to make in-place farm adjustments to increase income.

Most part-time and residential farmers could increase farm incomes even within the framework of small farm size and little capital, because the present level of farm receipts and income on these farms is so low.

FERD, ARS, USDA, and La. State U. Agr. Expt. Sta., University Station, La.

Agricultural Research Service. CHANGES IN FARM PRODUCTION AND EFFICIENCY: A SUMMARY REPORT.* U.S.D.A., A.R.S. Stat. B. 233 Rev., 48 pp. 1960.

* Supplement I. 12 pp. 1960.
* Supplement II. 12 pp. 1960.
* Supplement III. 12 pp. 1960.

This annual publication is designed specifically to present the major statistical series on farm production, production inputs, and efficiency. It provides in one place the latest information for each of the several series that have been developed to appraise such things as production in peace and war, changes in farm inputs and practices, improvement in labor productivity, and progress of farm mechanization.

Supplement I contains 10 regional tables of index numbers of farm production for each of the groups of livestock and crops shown in table 1 of this publication.

Supplement II contains 10 regional tables of index numbers of man-hours of farm labor used for each of the groups of livestock and crops shown in table 17 of this publication.

Supplement III contains 10 regional tables of index numbers of farm production per man-hour for each of the groups of livestock and crops shown in table 19 of this publication.

ARS, USDA, Inform. Div., Washington 25, D.C.

Strickler, P. E., and Hines, C. A. NUMBERS OF SELECTED MACHINES AND EQUIPMENT ON FARMS WITH RELATED DATA. U.S.D.A. Statis. B. 258, 30 pp. 1960.

The period 1955-58 was one in which domestic shipments of machinery and equipment for farm use were at a low level compared with shipments in the period that spanned the last 2 census years. Farmers supplied themselves with tractors and field equipment when the ratio of the prices they received to the prices they paid for machinery was relatively high. But the number of units and the price per unit does not tell the entire story. Many of the machines shipped in recent years were larger and more efficient than earlier models, and thus were capable of more and better work.

Annual average shipments of principal machines during the last 4 years compared with shipments between the census years 1950 and 1954 ranged from a 43-percent reduction in number of wheel tractors to a 2-percent gain in number of pickup balers.

When purchases of new machines were high, apparently many of the old machines were traded in and dealers' stocks of used equipment increased. Since around 1954 farmers have bought less new equipment, but purchases of used equipment have increased. Apparently, this is an important factor in the gain in numbers of machines on farms since the 1954 census. Continuing increases in numbers of machines and reductions in the number of farms have resulted in marked increases in the number of machines per farm.

In recent years, self-propelled machines have increased in number and variety. Self-propelled combines have been available for about 20 years. More recently, corn-pickers and picker-shellers, balers, forage harvesters, windrowers, sprayers, and dusters have been made available as independent operating units.

The data in this report concern the numbers of power units and selected machines and equipment on farms. Related data such as annual shipments of machines, cash receipts of farmers, and index numbers of prices received and prices paid by farmers are included, also the data were summarized by seven size-of-farm groups within each State. These results were weighted by the number of farms in each group from the 1954 Census of Agriculture.

Charts, graphs, and tables.

ARS, USDA, Inform. Div., Washington 25, D.C.

Kanel, D. OPPORTUNITIES FOR BEGINNING FARMERS, WHY ARE THEY LIMITED? U. of Nebr. Agr. Expt. Sta. B. 452 (North Central Region. P 102), 27 pp. 1960.

Opportunities for beginning farmers have been limited since World War 1. In the period 1945-54, only 16 percent of the farms in 13 North Central States became available to beginning farmers, although 31 percent were vacated by older farmers leaving farming. The net difference is accounted for by farm enlargement and the resulting decrease of 15 percent in the total number of farms.

At these rates, farming opportunities were available for only a third of the boys born on farms. The remaining two thirds entered nonfarm occupations.

There is wide recognition of the increasing amounts of capital that are needed for farming. But lack of capital is only part of the difficulty facing young men who want to enter farming.

More important is the decrease in number of farms that has resulted from the efforts of many families to enlarge their farms. Savings, access to credit, and experience as farm managers are important in renting or purchasing farms. Because they do not have these, many young men without substantial family assistance are not able to compete successfully for farms that become available.

Many families are making great efforts to stay in farming, to enlarge their farms, and to help their young people get started in farming. They are using their savings and the credit available to them. Families compete with each other, and this competition is intense enough to drive up the prices of land. To make additional credit available to enable more young people to start farming would only increase the number of people able to compete for land without increasing the number of opportunities to farm.

Requirements for food and fiber in the decades ahead will be met without increasing labor requirements in agriculture; rather, it is likely that present trends of decreasing farm numbers will continue. Much of the public discussion of this trend is confused by

the image of farm families uprooted from their farms and forced to find jobs in cities. Instead, the major impact of the decrease in farm numbers is to limit the farming opportunities available to young people. This limitation of opportunities for starting in farming is probably the least painful way in which the enlargement of family farms can proceed.

Farm youth who enter nonfarm occupations face problems of adjustment. But these problems are generally less difficult than those that established farmers and their families would face in trying to change from farming to other occupations. Also, preparing young people to make these adjustments is easier than attempting to help older farm families leave farming. Public programs in the fields of education, vocational counseling, employment service, and credit can be used to help farm people make the necessary adjustments.

U. Nebr., Agr. Expt. Sta., Lincoln, Nebr.

Reiss, F. J. GETTING STARTED AND ESTABLISHED IN FARMING: WITH AND WITHOUT FAMILY HELP. U. Ill. Col. Agr. Ext. Serv. C. 822 (North Central Region. Ext. P. No. 8), 52 pp. 1960.

Getting established as a farm operator means more than getting started. It means achieving security of tenure on a farm with an adequate volume of business, exercising a major degree of managerial control, and owning a controlling equity in the farm-operating capital. As farms grow larger, more mechanized in operation, and more specialized in productive organization, the problem of getting started and getting established is largely one of meeting higher requirements in land, capital, and management. One-man farms may easily require a tenant investment, though not as net worth, of $15,000 for efficient utilization of labor, or a total investment, including real estate, of $50,000 or more.

Finding an adequate farm is a primary problem for young families, particularly for those without kinship ties to land. Most beginning farmers start either as tenants or in some operating agreement with their parents or other farm owners who are often close relatives.

Crop-share leases are popular with beginning farmers who do not have substantial family help. They are flexible with regard to size of the initial operation, allow an independent start with a minimum of initial capital, and, compared with livestock operations, place a limited managerial requirement on the young operator.

Some leasing arrangements make it possible for landlords to contribute part or all of the initial operating capital. Labor-share leases and father-son agreements, for example, require little or no capital from the beginning farmer. The young man's rate of progress from such a start depends heavily on volume of business and his managerial ability. The livestock-share lease allows the landlord to make greater contributions of both capital and management than he would probably otherwise make.

Any lease agreement for beginning farmers should encourage and allow an adequate volume of business, provide for an equitable division of costs and returns, and assure compensation for any unexhausted improvements that the young tenant may leave.

Part-time farming is a possible intermediate step toward full-time farming. It can minimize the amount of land and capital required for a start in farming as an owner-operator or part-owner, but progress toward full-time farming may be slow.

Buying land is an acceptable alternative to renting when security of tenure under a lease is a problem, when capital and credit resources permit buying enough land for efficient operation, and when buying will not impair the level of operational and improvement capital necessary for efficient operation. Some young farmers can get possession of farmland with minimum down payments by using land contracts. These are low-equity transfer devices. Some desirable provisions in such contracts include adequate length of repayment period, provision for repayments, provision for converting the contract to mortgage financing, and an adequate grace period before default procedures may be initiated.

For beginning farm families, savings, gifts and inheritances, borrowings (including the use of family-owned machinery and equipment), and leasing and contractual arrangements constitute the sources of farm operating capital.

The amount of capital these families need for making a start can be minimized in three ways: (1) By shifting capital requirements to the land owner through appropriate tenure arrangements; (2) by substituting labor for capital; and (3) by substituting smaller annual cash payments for larger capital investments.

Four trends likely to characterize farming in the near future are: (1) Larger and fewer farms; (2) more capital associated with one man's labor; (3) further specialization in agricultural production; and (4) a growing complexity of managerial functions in agriculture.

Coop. Ext. Work in Agr. and Home Econ., U. Ill., Col. Agr., Urbana, Ill.

O'Byrne, J. C., Krausz, N.G.P., Harl, N. E., and Jurgenson, H. THE FARM CORPORATION. Coop. Ext. Service, Iowa State U. Sci. and Technology Pamphlet 273 (North Central Region Ext. P. 11), 19 pp. 1960.

Three basic forms of farm business organization are the sole proprietorship, the partnership, and the corporation. Variations of these forms have resulted in the limited partnership and the "corporation-taxed-like-a-partnership."

The sole proprietorship is a one-man operation. There may be many employees or hired persons, but the proprietor owns, runs, and manages his own business.

A partnership is an aggregation of owners. Two or more persons contribute their assets to the business and share with each other the management, responsibility, profits, and losses. Each partner pledges his faith in his partners and stands liable for the actions of all partners, within the scope of partnership activities.

A limited partnership is a special form of partnership permitted by state statute to have one or more partners whose liability for partnership debts and obligations is limited to their investment in the business. A limited partner is just an investor; if he participates in management, he becomes liable for all partnership obligations just like a general partner. A limited partnership must have at least one general partner who handles the management of the business and who is fully liable for all partnership debts and obligations.

A corporation is an artificial being created under state law. It is a separate business entity distinct from its owners, who are called shareholders because they own shares or interests in the corporation. The major characteristic of the corporate form of business organization is this sharp line of distinction between the business and the owners. The corporation is a separate legal person as well as a separate taxpayer.

The pseudo-corporation or the corporation-taxed-like-a-partnership is a creation of federal tax law. It is a corporation in all respects except that the corporate entity pays no income tax because each shareholder-owner reports his share of corporate income for income tax purposes.

This bulletin discusses the nature of a corporation, some of the advantages and disadvantages of incorporating a family farm, taxation of corporations and pseudo-corporations, the process of incorporation. and the operation of a farm corporation.

Cooperative Ext. Serv., Iowa State U. Sci. and Tech., Ames, Iowa.

Loftsgard, L. D., and Lembke, M. J. USE OF THE CONTRACT FOR DEED FOR LAND PURCHASES IN NORTH DAKOTA. N. Dak. Agr. Expt. Sta. B. 424, 15 pp. 1960.

The contract for deed can benefit both buyer and seller if it is used intelligently and honorably. It is neither an answer to the needs of all buyers nor the most advantageous method for all sellers to dispose of their land. But the frequency with which land contracts are being used demonstrates that this method of land transfer is an important device for attaining land ownership in North Dakota.

The most attractive aspect of the land contract to the buyer appears to be the relatively low down payment. However, a low down payment should not be the only criteria used when deciding whether or not to buy a farm. Subsequent installment payments in relation to the farm's capacity to produce is of paramount importance in making a final decision. Accordingly, a land owner seeking to sell his land by a contract for deed should not be lured by prospects of interst payments only. Selection of a prudent buyer may save lawsuits later that cost more than collections gained in interest payments.

Before entering into a contract for deed, it is advisable for both buyer and seller to get competent legal aid and counsel. Attorney fees for legal counsel in drawing up the contract may be sound investment for legal protection at a later date. Oftentimes, legal advice tends to point out important provisions and factors which otherwise may not have been recognized by either buyer or seller.

An important factor to keep in mind is that the provisions in a contract for deed are flexible. They can be written to coincide directly with the transfer situation involved. Certain minimum provisions are required but many more can be added or tailored to the specific need and wants of each party.

N. Dak. Agr. Expt. Sta., Fargo, N. Dak.

Krausz, N. G. P. INSTALLMENT LAND CONTRACTS FOR FARMLAND. U. Ill. Ext. Serv. C. 823, 24 pp. 1960.

Advantages of the Installment Land Contract are:

1. Advantages to the buyer are: (1) Low down payment; (2) installments often equivalent to rent; (3) safety in making permanent improvements; (4) all profits belong to buyer; and (5) interest rates may be lower.
2. Advantages to the seller are: (1) Probable savings on income and estate taxes; (2) retention of investment in the farm; (3) an annuity for retirement; (4) interest as income; and (5) ease in making family transfers.

Disadvantages of the Installment Land Contract are:

1. Disadvantages to both buyer and seller are: (1) Fluctuations in land values; (2) fluctuations in price of farm products; and (3) fluctuations in interest rates.
2. Disadvantages to the buyer are: (1) Possibility of forfeiture; (2) payment of taxes and other ownership costs; and (3) substantial interest cost.
3. Disadvantages to the seller are: (1) Possibility of loss upon buyer's default; and (2) full purchase price not available for immediate investment.

The author makes the following conclusions: Installment land contracts have worked out very well in a period of rising land values and farily high farm income. They may not work out so well if there should be a long term of low farm income and decreasing land values. Safety for the buyer is increased by a substantial down payment, by a long-term contract to keep installments in line with earning capacity and a satisfactory standard of living, and by incorporating into the contract many of the provisions described in this circular. A fair and complete contract also gives the seller greater assurance that installments and interest payments will be made, and prevents disputes that might arise in the absence of a detailed contract.

A sample contract form is included that should give those about to enter into an installment land contract and, possibly, their attorneys some ideas about what the contract should contain. It is not meant to be an exact model of the contract that the parties will want drafted by their attorneys.

Ext. Serv. Agr. and Home Econ., U. Ill., Col. Agr., Urbana, Ill.

Borton, M. E., and Ellis, H. H. SOME LEGAL ASPECTS OF WATER USE IN LOUISIANA. La. Agr. Expt. Sta. B. 537, 114 pp. 1960.

A report on the legal aspects of water use in Louisiana, particularly as they apply to agriculture.

FERD, ARS, USDA, and La. State U. and Agr. and Mech. Col., Agr. Expt. Sta., University Station, La.

Strohbehn, R. W., and Wunderlich, G. LAND OWNERSHIP IN THE GREAT PLAINS STATES, 1958: A STATISTICAL SUMMARY. U.S.D.A., A.R.S. Stat. B. 261, 80 pp. 1960.

This report is a statistical summary of information obtained in a survey of landowners in the 10 Great Plains States, conducted during the winter of 1957-58. It was designed to discover the characteristics of landowners and to reveal trends, if any, taking place in the ownership pattern within the Great Plains States.

The land ownership survey was a part of a larger research project, including land tenure, farm finance, and land market problems in the Great Plains Region, carried out by the Farm Economics Research Division, Agricultural Research Service, United States Department of Agriculture.

ARS, USDA, Inform. Div., Washington 25, D.C.

Outlook and Situation Board. CURRENT DEVELOPMENTS IN THE FARM REAL ESTATE MARKET NOVEMBER 1959--MARCH 1960. U.S.D.A., A.R.S. 43-126 (C.D.-55) 30 pp. 1960.

After advances of 6 to 8 percent a year in 1956, 1957, and 1958, farm real estate values increased 3 percent in the year ended March 1, 1960. Although annual increases were less than in 1958-59 in all regions, the slowdown was most pronounced in the Corn Belt, Lake States, and Northern Plains. Values in these States this March averaged 1 or 2 percent higher than a year earlier.

Changes in market values in the 4 months ended March 1, 1960, were largely nominal, as values changed 1 percent or less in 30 States. However, values in only 4 States (Maine, Minnesota, Missouri, and New Jersey) were as much as 2 percent below last November. Most of the 14 States that showed increases of 2 or 3 percent were in the western half of the country. The national index advanced to 173 (1947-49=100), 2 index points, or 1 percent, above last November, a new record high.

Demand for farmland appeared to be noticeably lower in the Corn Belt this last winter and early spring compared with a year earlier. Elsewhere, demand remained about the same to a little lower. Farm listings continued at about the same low level as in the last 3 years. The rate of sales this spring was probably only a little lower nationally but was down more sharply in the Corn Belt.

The total market value of farm real estate was estimated at $129.1 billion on March 1, 1960, $4 billion, or 3 percent, more than a year earlier. The average value per acre advanced to $111.46 per acre. The market value of farm buildings remained about the same as a year earlier but was a slightly smaller proportion of the total value of land and buildings.

A sharp increase in the use of land contracts to finance land purchases in 1959-60, particularly in the Corn Belt States, contributed to an increase in the proportion of all sales that were credit-financed. The proportion credit-financed was estimated at about 70 percent of all purchases, the highest in recent years. The dollar volume of new mortgage loans made or committed in the first quarter of 1960 was somewhat lower than in the same period of 1959.

ARS, USDA, Inform. Div., Washington 25, D.C.

Fischer, L. K., Burkholder, R., and Muehlbeier, J. THE FARM REAL ESTATE MARKET IN NEBRASKA. Nebr. Agr. Expt. Sta. B. SB 456, 22 pp. 1960.

The land market in Nebraska is mainly a parcel market involving the purchase and sale of tracts of land which are not complete farms. A considerable number of the tracts sold were operated as complete farms prior to the sale but were incorporated into existing farms by the purchasers. This reflects the trend toward larger farms.

The majority of the land transfers in the sample were between farmers. A large proportion of the sellers were farmers who were leaving agriculture or who were reducing the scale of their operations. An even larger proportion of the buyers were farmers, most of whom were looking for land to add to their present farms.

The bulk of the transfers were between individuals within the local communities. Prospective sellers apparently seldom looked for buyers from distant areas. And most buyers limited their search for land mainly to the immediate locality in which they lived.

Location in close proximity to their present operations were of particular importance to that large proportion of purchasers who were buying for farm enlargement. They attached considerable "site value" to tracts of land which were well located with respect to their present farms. On the other hand, location of tracts relative to towns or hard-surfaced raods had no significant effect on price.

The land transferred in each of the areas was considered to be representative in quality of the land throughout the respective areas. Furthermore, for those tracts with buildings, the improvements were judged to be comparable to others in the vicinity. Consequently, the average sale price of the land which sold was a reasonable estimate of the average market value of land at that time in each of the areas studied.

No specific attempt was made in this study to determine the rate at which land changed hands. However, from this and other studies it is apparent that the land market is relatively inactive. In most areas of the State few tracts of land are being put up for sale.

An increasing proportion of the transfers of land are being accomplished with the use of purchase in any given area. A prospective purchaser feels impelled because of this scarcity to bid more aggressively for an available tract which fills his needs.

Unlike the owners of reproducible goods, the owners of land do not normally place additional land on the market in response to rising prices. Both owners and prospective buyers of land have a speculative interest in holding title to land in a rising market. And since the land market tends to reflect general economic conditions few distress sales occur during a period of rising land prices. Conversely, during periods of economic depression a great many tracts come on the market in spite of falling prices. By increasing the number of acres he operates, a farmer may be able to reduce the cost per unit of production by increased scale of operations and fuller use of previously under-employed resources. Well-established farmers so motivated appeared willing and able to outbid other prospective purchasers for much of the land that came on the market.

Improvements in efficiency of operations of the larger unit may enchance the value of a tract of land to an active farmer beyond its value to other buyers. Furthermore, these purchasers were able to finance the purchase at a price that some persons may believe to be too high.

FERD, ARS, USDA, and U. Nebr., Col. Agr., Agr. Expt. Sta., Lincoln, Nebr.

Ramsbacher, H. H., Pine, W. H., Otto, M. L., and Pallesen, J. E. TRENDS IN LAND VALUES IN KANSAS. Kans. Agr. Expt. Sta. B. 422, 23 pp. 1960.

Farm real estate values in Kansas were 3.3 times higher in 1959 than in 1940. Net farm income per acre reached a peak in 1947 and then followed a general downward trend, with a sharp increase in 1958.

Purchases for farm enlargement accounted for 68 percent of the 1959 farm transfers in the Kansas winter wheat area.

Number of farm transfers per 1,000 Kansas farms decreased rapidly from the 1944 high of 92 sales per 1,000 farms to 40 sales per 1,000 farms in 1959.

Approximately 50 percent of all Kansas farm sales in recent years was credit financed. Farm real estate debt was $284 million in 1940 and $306 million in 1959.

Total value of land in farms in Kansas was $1.4 billion in 1940 and $4.6 billion in 1958. Debt in relation to land values decreased from 19 percent to 7 percent during the 1940-59 period.

Cash rents for farmland and pastureland have increased with land values. During the 1940-59 period cash rents were approximately 6 percent of farmland values and 5 percent of pastureland values.

Active farmers purchased 74 percent of the farms sold (voluntarily) in 1958. Retired farmers bought 5 percent and other buyers bought 21 percent.

Thirty percent of the sellers in 1958 were active farmers; 24 percent, retired farmers; 29 percent, estates; and all others, 17 percent.

Increases and decreases in land values have not been the same in all areas of Kansas.

Agr. Expt. Sta., Kans. State U., Manhattan, Kans.

Maier, F. H., Hedrick, J. L., and Gibson, W. L., Jr. THE SALE VALUE OF FLUE-CURED TOBACCO ALLOTMENTS. Va. Agr. Expt. Sta. Tech. B. 148 (P. 35 Southeast Land Tenure Res. Committees) 51 pp. 1960.

The market value of flue-cured tobacco allotments--the portion of the sale value of flue-cured tobacco farms that may be attributed to tobacco allotments was studied. Data were obtained from 3 producing areas for the period 1954-57. During the last 3 years of

this period, tobacco allotments were cut successively 5, 12, and 20% below the previous year's allotment.

Two specialized flue-cured tobacco regions were studied--Pittsylvania County in the Piedmont of the south-central Virginia; and Greene, Wilson, and Pitt Counties in the Coastal Plain of east-central North Carolina. Off-farm employment was somewhat more common in the former than the latter. In the third area-Forsyth and Guilford Counties in the Piedmont of north-central North Carolina--off-farm job opportunities and other urban influences on farming were more prevalent and tobacco farming was less important as a source of income.

Sources of the data were county deed books, real property tax assessment records, and the files of county Agricultural Stabilization and Conservation offices. The study employed a multiple regression analysis of the selling price of farms as determined by such independent variables as size of tobacco allotment, acres of cropland, value of buildings, and acres of non-cropland.

An important part of the expected future benefits of the flue-cured tobacco program has been capitalized into the selling price of farms. The following estimates indicate the approximate market values of an acre of flue-cured tobacco allotment (without any associated land or buildings) for the specialized areas during years observed:

	1954	1955	1956	1957
Pittsylvania County.....	$962	$1,205	$1,523	$1,673
Greene, Wilson, and Pitt Counties ..	1,290	1,800	2,040	2,500

In Forsyth and Guilford Counties, the influence of tobacco allotment on the selling price of farms seemed small compared with that in specialized tobacco areas. The stronger urban influences and their effect on farm land values made the statistical analysis less conclusive.

Reductions in allotments per farm during 1955-1957 caused most of the increase in value of allotments per acre. This indicates that increases in yield per acre, which made the allotment cuts necessary, increased net income per acre of tobacco and partly offset the decline in size of allotment per farm.

Differences among areas in availability of jobs and in wage rates for farm labor apparently tend to cause differences in the market values attached to tobacco allotments. If higher returns must be paid to labor used in tobacco production, the return remaining for the owner of an allotment is reduced.

FERD, ARS, USDA, and Agr. Expt. Sta. Va. Polytech Inst., Blacksburg, Va.

Stewart, C. E. RECENT LAND AND GROUND-WATER DEVELOPMENT IN UTAH UNDER THE DESERT LAND ACT: AN ECONOMIC APPRAISAL. Utah Agr. Expt. Sta. B. 418, 36 pp. 1960.

The Desert Land Act was passed in 1877. The intent of the legislation was to provide opportunities for private individuals to develop irrigated family farms with their own capital and resources from public land in 13 Western States. The legislation is still in effect.

Activity was limited during several decades before 1945. But from 1948 to 1957, at least 400 applications for 100,000 acres of public land were made in Utah. This activity was based on ground-water development in scattered areas. High farm incomes, improved ground-water technology, prospects of minerals and oil, speculation, and desire for farm ownership were among the factors that stimulated this enlarged demand. High capital requirement, poor water supplies and land resources, distance from markets and population centers, lack of information, and administrative difficulties often deterred activity.

Few family farms were developed in Utah under the program during this period. Only small acreages were cleared and irrigated. Some ventures were successful and opportunities exist for further success. The magnitude of these opportunities hinges on supplies of ground water.

Nearly 65 percent of all applications during the 10 years were rejected and closed because of poor soil and water resources or because applicants failed to meet requirements of the act. Final proof and patent were achieved for only 25 of 400 applications. Only 82, or a fifth of all applications, were allowed, thus permitting the applicants to proceed with development.

Forty-three detailed records covering applications for 55 desert-land tracts totaling 15,613 acres were obtained by interview. These records included 28 of the 40 applications allowed in the five areas during the 10-year period. These 28 applications were for a total of 8,300 acres. This report gives the results of this study.

FERD, ARS, USDA, and Utah Agr. Expt. Sta., Utah State U., Logan, Utah.

Holland, H. F. GOVERNMENT PROGRAMS FOR AGRICULTURE FOR WHEAT. Oreg. Agr. Expt. Sta. B. 572, 27 pp. 1960.

Part-time and inadequate size farms constitute one set of problems. Commercial, family farms of adequate size are another problem.

Over the last several decades adoption of new technology in agricultural production has greatly increased the output per acre and per man, and still greater production is assured in the future.

Although per capita consumption of most all other goods has changed in the United States over the last 50 years, very little change has occurred in the total amount of food eaten per person, despite larger incomes, more advertising and promotion, better foods, food fads, and changes in diet.

The agricultural industry of the United States is producing too much for available markets, and it will continue to do so for some time unless adjustments are made. If production and consumption are to come into balance, principal choices are: (1) Increase population; (2) increase exports; (3) reduce production; or (4) combine these methods.

In a capitalistic economy, products which are scarce stimulate higher prices and larger profits. But agricultural products are in abundant supply, so economics would indicate lower prices and smaller profits. Alternatives are: (1) Ignore economics and pay money out of the public treasury as is being done; (2) accept economic laws and reduce quantities of agricultural products; (3) market to more advantages; or (4) combine the three.

As money incomes go up in agriculture, competition for land increases, and land prices rise. The increased income is capitalized into land values.

Are money incomes a sufficiently satisfactory measure of real incomes to serve as the basis for large scale redistribution of national income by a government agricultural program? Millions of workers, farmers, and non-farmers, would not change their incomes available to them. They prefer what they have and where they are to higher paid work elsewhere.

Most of the programs are not intended to solve basic problems of a single commodity, or of United States agriculture. Consideration and appraisal of various programs have indicated strong points and weaknesses in all of them.

Lowering food prices and expanding domestic demand by raising incomes and improving diets are not by themselves a solution to the surplus problem.

Lower farm prices are not the answer. A large crop of wheat would be purchased at lower prices than a small crop, but the total value of the small crop would be greater than the value of the large crop.

Dividing the wheat market into its various segments (food, feed, industrial, and export uses) could return farmers much more for a crop than a single market would return.

Rigid prices set above the equilibrium price are troublemakers for nonperishable products--surpluses accumulate.

Moving-average prices of recent years, without supports, would soon approximate, equilibrium prices.

Forward prices would be equilibrium prices and would not solve the wheat or agricultural problem for those who think equilibrium prices are too low.

Flexible price supports trend to increase variations in prices and production, because of the delayed response of agriculture to lower prices. Averages of flexible prices would approximate equilibrium prices.

Government removal of land from farming on a scale to accomplish basic objectives probably is not presently acceptable to the nation. However, it would: (1) Reduce production to whatever levels were desired; (2) in the long run it could be relatively inexpensive because of future land sales; (3) farm income could be raised to desired levels; (4) administration would be relatively easy; and (5) the program would apply almost automatically to the entire United States agricultural plant.

The Wheat Stabilization Act applies particularly to wheat, which it would place in a relatively favored position. It would not apply to the overall price-income-surplus problem of United States agriculture, it would increase wheat production, and its administration would be difficult and expensive. However, it would remove production controls and still reduce government stocks of wheat, it would permit selling nonfood wheat for feed at free market prices, and by government action it would divide the market into segments to increase returns to producers.

A compensatory price plan would be difficult to administer, costly on a continuing basis if it really increased incomes, and would involve direct payments from the Treasury. But it would provide abundant foods at free, market prices; it might be adapted to all United States agriculture; and money payments would be made directly to farmers to supplement their other incomes.

Agr. Expt. Sta., Oreg. State Col., Corvallis, Oreg.

Andrews, R. A., and Frick, G. E. THE IMPACT OF THE FEDERAL SOIL BANK PROGRAM ON THE ECONOMY OF COOS COUNTY NEW HAMPSHIRE 1956-1959. N.H. Agr. Expt. Sta., Sta. B. 468, 51 pp. 1960.

The Conservation Reserve Program has not changed total agricultural production in the county significantly. Only a few commercial farms are enrolled in the Program. Most of the acreage came from uneconomic units.

Total income to the county remains about the same. The expenditure of the income will change, with more spent on consumer goods and less on farm supplies and services.

Nonparticipating farmers face increased cost through a reduction in sources of supplemental hay for feed and of land for expanding farm size. Costs of marketing and other services will not be affected.

The Program has eased the transition of some people and many acres of land out of agriculture. Desirable forest stands were established and conservation of resources is enhanced.

FERD, ARS, USDA, and ASC, USDA, and Agr. Expt. Sta. Durham, N.H.

Christensen, R. P., and Micka, E. S. THE CONSERVATION RESERVE PROGRAM IN MAINE: EFFECTS IN AROOSTOCK, FRANKLIN, AND KENNEBEC COUNTIES. U.S.D.A., A.R.S. 43-123, 31 pp. 1960.

The Conservation Reserve Program was initiated in 1956 to help farmers adjust production to market outlets, to conserve soil and other natural resources, and to help improve farm income. It is one part of the Soil Bank Program. The other part, the Acreage Reserve Program, was discontinued in 1958. Under the Acreage Reserve Program, farmers received rental payments for reducing acreages of allotment crops, such as wheat, cotton, rice, tobacco, and corn, in commercial areas. The Conservation Reserve Program has continued in effect in all States, but 1960 is the last year in which new contracts can be made under present legislation.

From 1956 through 1959, approximately 9 percent of the farm owners in Maine put an acreage equivalent to 8 percent of all cropland in the State in the Conservation Reserve. About 86 percent of this land is on farms with all eligible land placed in the program. About 18 percent has been or will be planted to forest trees.

The study reports findings from field surveys made to learn about effects of the Conservation Reserve Program in two areas of Maine: (1) Aroostook County; and (2) Franklin and Kennebec Counties. These surveys were made late in 1958 after farm owners had made application for participation under the 1959 program.

ARS, USDA, Inform. Div., Washington 25, D.C.

Foster, A. B. KNOX COUNTY REVIVES THROUGH GOOD LEADERSHIP OF DISTRICT SUPERVISORS. Soil Conserv. 26(1): 6-8. 1960.

The Knox County Soil Conservation District in Indiana owes its success to outstanding leadership of the district governing body more than to any other single factor.

Knox County is located in southwestern Indiana between the Wabash and White Rivers. Because of the early settlement and a type of soil that is particularly erosive, the decline of the land was severe and extensive.

Most of the soils are of a type, however, that responds to good treatment. Once good land use and proper conservation practices were applied, even the worst-eroded soils have proven to be highly productive. And good land use and conservation are becoming the rule on a great part of the county under the district's conservation program.

The chief problems--drought, erosion, and poor drainage--still exist on the farms that have not yet adopted conservation plans. Erosion and drainage have been solved on the farms of the cooperators and drought hazard has been greatly reduced as a result.

Out of 1,665 operating units in the county there were 1,021 district cooperators with 805 basic conservation plans as of January 1, 1960. Of 302,546 acres of agricultural land in the district, 111,000 are covered by these basic plans. A total of 150,627 acres is included in the land owned or operated by the cooperators.

Among the accomplishments on the land are 509 miles of terraces; 572 ponds; 126 miles of diversion terraces; 32,703 acres of conservation crop rotations; 271 miles of tile drains; and 161 miles of open drains on over 16,000 acres of highly productive bottomlands which high water and flooding had previously rendered almost useless.

According to agricultural census reports, cash farm income rose from $3,445,863 in 1940 to $13,991,041 in 1954, the latest available figures. Bank deposits at the American National Bank in Vincennes rose from $4,236,335 in 1940 to $16,659,125 in 1959. At the Security Bank and Trust Company, deposits were $4,037,683 in 1943 and $12,018,997 in 1959.

The outstanding leadership of the district supervisors, the high caliber of farmers who became cooperators, and the excellent quality of the technical assistance furnished by the SCS were all major factors in the success of the district. But we cannot overlook the fact that complete endorsement of the district's program was given by other organizations.

SCS, USDA, Milwaukee, Wisc.

Haren, C. C. CONSERVATION FARMING IN SELECTED AREAS OF THE SOUTHERN PIEDMONT. U.S.D.A., A.R.S. 43-120, 59 pp. 1960.

Approximately 80 percent of the survey acreage in Spartanburg County, S.C., and Walton County, Ga., is capable of development for farming purposes. About a fourth of the total could be used safely for row crops each year, and more than half for other crops or pasture. The rest is suited chiefly to timber production and related uses or is occupied by farmsteads and other miscellaneous uses.

Part of the land withdrawn from farming before 1953 was steep, eroded, or otherwise unsatisfactory even for pasture. Much of the other land in woods or open but unused for crops or pasture in 1953 would be of limited value for cotton or corn. But it could be redeveloped for production of winter grains, hay or forage, or to supply pasture or grazing for dairy or beef cattle.

In 1955, a high percentage of the land diverted from cotton as a result of the reapplication of allotments was used for other crops or shifted to pasture. A reduction of about 25 percent in the acreage of crops for harvest in 1958 stemmed mainly from the temporary assignment to the Acreage Reserve of most of the acres allocated to cotton. Although some crop and pasture fields were turned out or planted to protective crops for other reasons, nearly as many acres were restored to farming.

A major reduction in the number of acres planted to cotton, combined with a slight decrease in the acreage of corn, was reflected in a decline in the percentage of the cropland in row crops from about two-thirds in 1953 to a third in 1958.

Often, choices of land, both for cotton and for setting aside in the Acreage Reserve were limited by the quality of the open land available in relation to the operator's requirements for cotton, other crops, and pasture.

Recent and prospective changes in ownership and operation are paving the way for overcoming traditional obstacles to a more complete as well as conservational use of the land resources in the survey and adjacent areas.

Further improvements in yields per acre of corn and other crops and in carrying capacities of pastures would help to meet the expanding demands for feed and roughages

in these and neighboring States. Of equal importance, greater yields and carrying capacities per acre would enable additional operators, who were previously handicapped by lack of sufficient land, to shift partly if not completely from cotton.

Progress has been made in diversifying operations and adopting other conservation practices in the survey areas by farmers who have been in position to replace all or most of their cotton with other crops or improved pasture, either with or without buying more land. Elsewhere, progress has been retarded by the necessity for continuing to rely on cotton as the chief or an important source of income, and by inability to fully develop potentials for other crops and pasture, or to plant protective crops or trees on land not needed for agriculture in the immediate future or of little if any economic value for farming purposes.

ARS, USDA, Inform Div., Washington 25, D. C.

BIOLOGY

Fish

Guerra, L. V. FISH POND FERTILIZATION. Tex. Game and Fish 18(3): 16-19. 1960.

The result of fertilizing water is the production of increased amounts of microscopic algae, which in turn are used as food by zooplankton. These zooplankton are eaten by the small insects and young fish. The insects and small fish are then taken as food by larger fish, and finally these fish are made available to the fishermen who catch them either for sport or food.

The advantages and disadvantages of organic and inorganic fertilizers are discussed.

Fertilizer and lime recommendations for fish pond fertilization in different parts of Texas are given. Fertilizer should never be placed in water more than five feet deep. It should be placed along the shoreline in two or three feet of water. Fertilizers may be applied by the hand broadcast methods along the lake shoreline, if walking is possible. Fertilizer application may also be made by using a boat to haul the materials to the desired areas, then dropping the material over the side. Fertilizers should be applied heavily along the shoreline on the prevailing wind side, because the wind and wave action in this location will help to distribute the nutrients throughout the lake. If a flowing stream enters the lake, the fertilizers, especially agricultural lime, should be introduced in the stream to obtain better distribution.

Fertilization recommendations and methods should not be used without a word of caution. Often fish die-offs will occur in lakes because the right measures were not observed. Applications of fertilizer should be started at the earliest possible time in the spring. For the first application not more than half the total recommended amount for the year's program should be used. Subsequent applications are made by dividing the remaining amount in four equal parts and applying each as the turbidity of color from a "bloom" disappears.

The proper spacing of fertilizer and its later applications will usually provide and maintain a "bloom" in the water throughout the plant-growing season. This is of vital importance in partially retarding or eliminating plant growth. Under no circumstances should fertilization of a stock pond or lake be started after the first of June in many parts of the State, because the water temperatures are already high and oxygen content low. At this time, the danger of a fish kill due to the depletion of available oxygen is probable--almost certain.

No address given.

Brumsted, H. B. STOCKING FARM FISH PONDS. Cornell Ext. B. 1046, 4 pp. 1960.

Increasing numbers of rural landowners who have a pond or who plan to build one consider stocking fish. This leaflet furnishes general information to help determine whether to stock and what to stock; and it outlines procedures for accomplishing the practice. Recommendations are based on a decade of Cornell University research which, since 1952, has been done in cooperation with the New York State Conservation Department.

STOCKING RECOMMENDATIONS

Species	Number per acre of water surface	Size of fish	Season to stock	Restocking
TROUT				
Brook (Speckled) or Rainbow	300 to 600* fall fingerlings	5 to 6 inches	fall--after mid-Sept.	fall fingerlings only, same rate, every 2nd or 3rd year
BASS-BLUEGILL				
Bass	100 fingerlings	1 to 2 inches	summer	none necessary
Bluegill	500 to 1,000 fingerlings	1/2 to 1 inch	summer, same year, or preferably, one year after bass	
BASS-SHINER				
Bass	100 fingerlings	1 to 2 inches	summer	none necessary
Golden Shiners	200 to 400 *adult*	3 to 4 inches	summer, same year as bass	

* Lowest trout stocking rates recommended for ponds in areas of infertile low-lime soils.

N. Y. State Col. Agr., State U., Cornell U., Ithaca, N. Y.

Eipper, A. W. MANAGING FARM PONDS FOR TROUT PRODUCTION. Cornell Ext. B. 1036, 31 pp. 1960.

There are over 16,000 farm ponds in New York State and new ones are being constructed at the rate of about 1,000 a year. Of the various farm pond uses, fishing is one of the most popular, and many New York farm ponds are stocked with trout. Fishing is a source of recreation for the whole family, and trout are a real table delicacy.

This publication discusses: (1) Factors to consider in deciding whether or not to stock trout; (2) design and construction features particularly valuable in trout ponds; (3) results that can be expected from a trout pond; (4) where and how to obtain trout for a farm pond; and (5) management practices for obtaining the most trout fishing from your pond.

Information presented is based largely on results of ten years' work on 70 ponds in Central New York State. The recommendations given should apply to farm ponds throughout New York that have surface areas up to two acres and maximum depths from seven to fifteen feet.

N. Y. State Col. Agr., State U., Cornell U., Ithaca, N. Y.

Gebhards, S. V. THE USE OF CHEMICALS IN FISHERIES MANAGEMENT. Idaho Wildlife Rev. 12(6): 3-4. 1960.

ROTENONE

The diameter of the blood capillaries in fish is just sufficient to allow the passage of the red blood cells in single file. Rotenone causes constriction of the capillaries which prevents passage of the red blood cells into the gill filaments. Thus the fish is unable to absorb oxygen from the water and quickly suffocates.

Fish are able to detect even slight concentrations of rotenone and will attempt to move out of waters into springs, seeps, backwaters, or any area which is free of rotenone. Streams are extremely difficult, if not impossible, to eradicate completely because of this. In lakes or reservoirs which have an extensive stream system draining into them, re-infestation from the stream drainage is almost inevitable.

In fishery management, rotenone is applied in powdered form or in liquid emulsion. Detoxification of the water generally takes place in two to six weeks, depending upon water temperatures and water chemistry.

The average treatment cost using rotenone is about $1.00 per acre-foot of water treated. Treatment of large bodies of water with rotenone is expensive because of the large quantity of material required and the labor involved to disperse the toxicant.

TOXAPHENE

During the past few years toxaphene, another insecticide, has been gaining widespread use in fish eradication in the United States and Canada. Toxaphene is a synthetic chlorinated hydrocarbon with the formula $C_{10}H_{10}Cl_8$. It is a cumulative poison that attacks the central nervous system in fish, causing paralysis and eventual respiratory failure.

Although toxaphene is highly poisonous in concentrated form, it is not dangerous to humans or livestock when used in concentrations applied for fish eradication. Only one gallon of commercial toxaphene is necessary to treat 14,377,000 gallons of water.

The reaction of fish to toxaphene is slow compared to rotenone. Quite often fish may not show signs of distress for 48 hours, with a die-off period continuing for several months.

Toxaphene has two great advantages over rotenone--ease of application and reduced cost. By using the liquid form, the desired amount is merely dripped into the water from a moving boat. With this method, two men alone can treat up to 100,000 acre-feet of water in a day. Cost of treatment with toxaphene is only about $0.07 per acre-foot of water.

The principal disadvantage of toxaphene is its stability, which often results in long periods of toxicity. A number of factors are involved in the breakdown of toxaphene in water--micro-organisms, soil particles, water chemistry, temperature, water depth, circulation, and inflow of fresh water.

No address given.

Webb, B. THE USE OF PESTICIDES IN RELATION TO FISH AND WILDLIFE. Idaho Wildlife Rev. 12(5): 11-12. 1960.

The use and misuse of herbicides and insecticides as they affect fish and wildlife are discussed.

Properly used, pesticides can be a great boon to mankind, but misused, they can become tragically destructive. The following precautions are taken from a list prepared by some authorities in the field. When using these substances: (1) The most selective product should be used. (2) Application should be in strict accordance with prescribed recommendations, should be used only where needed, and should be restricted to the minimum effective amount. (3) Greater concern should be accorded to widespread application than to local use. Serious effects are more likely to result from treatments over large areas. (4) Field biologists or county agents should participate in the formulation of use procedures, and should be consulted at any time when pesticides are to be applied over a wide area. (5) All cases of suspected hazard or loss from pesticides in the field should be investigated thoroughly. Losses of farm animals should also be studied since all freely ranging animals are exposed to pesticides in much the same way as wildlife. (6) Cultural and biological means of control should be substituted for chemical wherever possible. And (7) for the greatest safety, routine applications of pesticides should be avoided. Entomologists, farm advisors, or other competent authorities are usually available to judge the need for control chemicals.

No address given.

Virginia Commission of Game and Inland Fisheries. YOU CAN DO IT--PROVIDE FOOD FOR WILDLIFE. Va. Wildlife 21(3): 16-17, 21. 1960.

This article explains how to supply and what food to supply for rabbits, quail, squirrel, grouse, turkey, deer, and waterfowl.

Richmond, Va.

Virginia Commission of Game and Inland Fisheries. YOU CAN DO IT--PROVIDE COVER FOR WILDLIFE. Va. Wildlife 21(4) 6-7. 1960.

This article explains how to supply and what cover to supply for rabbits, quail, squirrel, turkey, deer, and bear.

Richmond, Va.

Korschgen, L. J. PLANTS FOR WILDLIFE. Mo. Conserv. 21(5): 1-3. 1960.

The most common plant types for wildlife habitat in Missouri are listed and ways these plants fit in with wildlife management are given.

The foremost needs in improving game habitat are food, cover, and water. Water must be available where it can be reached safely. Food and cover are needed by wildlife at all times. The more closely they are associated and distributed over an area, the greater the advantage to wildlife. Adequate nutritious food is necessary to maintain an animal's vitality and to meet requirements for reproduction. Cover is necessary for raising young, for shelter from weather and enemies, and for resting places.

Most of the food and cover are provided by plants. Often a single plant type provides both: it may serve as food during fall, winter, and spring, and loafing or resting cover during the summer.

Land use practices that improve wildlife habitat are recommended. In addition annual food plots, sericea and shrub lespedeza plantings, and improvement of fenced pond and odd areas are recommended.

A table is presented giving the common plants (in Missouri) useful in wildlife management for food and cover for the following game: quail, dove, pheasant, prairie chicken, turkey, rabbits, and squirrels.

No address given.

Giles, R. H., Jr. SALT AS A GAME MANAGEMENT TOOL. Va. Wildlife 21(8): 16-17. 1960.

A review of the conflicting literature on the use of salt as a game management tool is presented. The author concludes that: "We need much more knowledge of this centuries-old technique of salting just as we do for many other techniques of forest game management. The answer to the problem can be gained by thorough research, critical field observations, and the cautious and planned continuation of the technique."

No address given.

Giltz, M. L., and Stockdale, T. M. THE RED-WINGED BLACKBIRD STORY. Ohio Agr. Expt. Sta. Sp. C. 95, 19 pp. 1960.

The increase in the blackbird population in Ohio has created a major threat to some of the state's best cornfields. So severe is the attack in major distress areas that some farmers are taking their land out of corn production and planting other crops in which birds have little interest.

The blackbird is important as a destroyer of many harmful insects. Nevertheless, the blackbird situation is so critical, especially in areas near water or marshes, that farmers located near such areas look upon this bird as a major enemy. It is difficult to thrill to the blackbird's song knowing that these birds, congregating in huge flocks, can seriously damage a cornfield in a surprisingly short time.

This report, while not intended to give a total answer to the complex blackbird problem, is an up-to-date summary of information gathered about the blackbird in Ohio in order to find clues to its control. Emphasis is placed on questions commonly asked about the bird itself, its habits, and its control.

What a farmer can do: (1) Mow meadows one or two weeks earlier. This will kill many young blackbirds. Use a flushing bar to reduce slaughter of pheasants and other ground-nesting birds. (2) Keep meadows free of weeds. (3) Eliminate trees and shrubs in or near cornfields. (4) Plant at same time as your neighbors. (5) Shift from corn to crops immune to bird damage. And (6) scare birds off by patrolling or with noisemaking devices.

Ohio Agr. Expt. Sta., Wooster, Ohio.

Hyde, R. K., and Harlow, R. F. FACTS ABOUT FLORIDA DEER. Fla. Wildlife 14(3): 29-32. 1960.

A descriptive article on proper deer management in Florida for increased deer production in the state.

Biologists, Game Mangt. Div., Fla.

Roy, D. F. DEER BROWSING AND DOUGLAS-FIR SEEDLING GROWTH IN NORTHWESTERN CALIFORNIA. J. Forestry 58: 518-521. 1960.

Damage to conifer seedlings by deer browsing in northwestern California varies from place to place. The severity of browsing damage appears to be related to the amount of preferred browse species growing on an area. Browsing, although generally not fatal to conifer seedlings, seriously reduces height growth when repeated year after year.

Crop and garden damage by deer in California is heavy and continues to increase along with damage to conifer seedlings. Deer populations seem to reach maximum densities in areas where vegetation is disturbed. Logging is one of the principal influences which increases the deer-carrying capacity of forest land. When browse high on the palatability scale is scanty or lacking, the land manager attempting to regenerate a stand of trees is faced with a problem of damage caused by browsing deer.

We have to learn how to live with the deer, to allow and encourage the maximum population with the minimum of damage to their range and to our crops.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif.

Palmer-Jones, T. EFFECT ON HONEY BEES OF SOME CHEMICAL WEEDKILLERS. New Zealand J. Agr. Res. 3(3): 485-490. 1960.

The butyl and butoxyethanol esters of 2, 4, 5-T (2, 4, 5-trichloro-phenoxyacetic acid) are hormone weedkillers in common commercial use. The effect of these substances on honey bees was tested in the laboratory, in observation hives, and in the field. Their use does not constitute a hazard to bees.

The two principal defoliants used at present on white clover are a mixture of 50% dinitro-ortho-secondary-butyl-phenol (DNBP) plus 10% dinitro-ortho-secondary-amyl-phenol (DNAP) and a 40% solution of penta-chloro-phenol (PCP). These phenolic weedkillers are toxic to bees, but highly repellent and so unlikely to be picked up directly on a crop by bees. However, during application, some bees might be sprayed and poisoning of other bees through contact or fumigant action might then occur inside the hive. Experiments conducted in observation hives clearly showed that only bees actually sprayed died and there was no transfer of poison or lasting hive disorganization.

Animal Res. Sta., Dept. Agr., Wallaceville, New Zealand.

Shearer, L. A. USE OF DUGOUTS BY BREEDING DUCKS. J. Wildlife Mangt. 24: 213-215. 1960.

In the spring of 1958, the Soil Conservation Service, in cooperation with four soil conservation districts in east central South Dakota, initiated field studies to determine the use made of dugouts by ducks during the courting and breeding season.

Thirty-three dugouts were selected in grassland. Some were new and some were several years old. Surrounding cover varied from good to sparse. Although all of the dugouts were located within the pothole section of the state, no natural wet areas were located closer than a quarter of a mile from any dugout due to drouth conditions and a lack of runoff from melting snow.

To determine usage by breeding and courting ducks, each dugout was visited nine times between April 14 and May 26, 1958. A total of 275 ducks were observed during this period on the 33 dugouts. These were mainly blue-winged teal (Anas discors), pintail (A. acuta), mallard (A. platyrhynchos), shoveller (Spatula clypeata), lesser scaup (Aythya affinis), green-winged teal (Anas carolinensis), and gadwall (A. strepera).

All but four of the dugouts were being used by ducks during the period of observation. Some, however, showed much heavier usage than others. To determine the reasons for the differences in intensity of use, observations were made on the type of vegetation surrounding the dugout and the water level.

These limited observations would indicate: (1) Ducks of several species use dugouts during the breeding and courting season; (2) use of dugouts is greater where the cover is rated as good than where it is rated as fair or poor; and (3) dugouts that are full are used more frequently than those with water 1 to 7 feet below ground level.

SCS, USDA, Huron, S. Dak.

Vaught, R. W. GEESE BY THE TUB-FULL. Mo. Conserv. 2(7): 6-7, 10. 1960.

The trouble encounted in the Trimble Wildlife Area in Missouri in raising wild Canada geese is recounted. Old wash tubs on stumps above the water solved the predator trouble. By 1960, twenty five pair were nesting in the area and of these 16 selected the galvanized wash tubs for their home sites.

No address given.

Yocom, C. F., and Hansen, H. A. POPULATION STUDIES OF WATERFOWL IN EASTERN WASHINGTON. J. Wildlife Mangt. 24: 237-250. 1960.

These studies carried on in Washington show the importance of suitable habitat for the production of large populations of waterfowl. Some parts of the Columbia Basin area in central Washington are becoming more important for nesting waterfowl because of increased irrigation. This trend was anticipated when studies were started in the summer of 1947.

Weather conditions in March and April are important factors affecting the production of early nesting species of waterfowl for a particular year. Cold dry springs are conducive to poor production of mallards. Under these conditions: (1) Many females do not renest if the first attempts fail to produce a brood; (2) many unsuccessful females congregate in flocks on the breeding grounds; (3) the peak of hatching is much later than normal; (4) the total number of broods drops; (5) the number of individuals per brood drops; and (6) the total number of mallards tabulated on the breeding grounds during the summer drops.

The total number of potholes, marshes, and lakes with water in them determines the total production of waterfowl in an area. The reduction of such bodies of water from 1950 to 1955 caused the total population of waterfowl on the breeding grounds in Washington to drop from a high of over 700,000 to a low of less than 400,000 birds.

Div. Natl. Resources, Humboldt State Col., Arcata, Calif.

Earle, J. B. MORE AND BETTER FOOD CROPS BRING MORE GEESE AND DUCKS TO THEIR WINTER REFUGE. Soil Conserv. 25: 176-177. 1960.

More than 8,000 wild geese are now wintering on the Santee Wildlife Refuge near Summerton, S. C., where only 50 geese were found 7 years ago. Also, an estimated 35,000 ducks visit this refuge each year, whereas only a few thousand could be counted a few years ago. The phenomenal increases in the number of waterfowl are due mainly to the systematic increase in the food supply that was brought about by the refuge managers.

The waterfowl food crops are grown according to a definite plan that was worked out by the refuge managers and SCS technicians. The cropping plan is designed not only to increase the food supply for geese and ducks, but also to conserve and rebuild the productivity of the soil.

Wind erosion has always been a problem on the light sandy soils of the refuge, where there are large open spaces of land and water and strong winds during the winter and spring.

Mulch farming has been instituted, and seems to provide a satisfactory solution for the wind erosion problem.

Small grains, corn, soybeans, and crotalaria are the principal crops grown on the refuge. Small grain, mainly wheat, is planted on the 250 acres of open land each fall. It is used primarily for grazing by geese during the winter. After the geese leave in the early spring, a large part of the area is planted to corn or crotalaria. The corn and crotalaria are planted, separately, in the growing grain without any seedbed preparation. The growing grain gives adequate ground cover against wind erosion until the main blowing season has passed; then it is gradually worked into the soil during the process of cultivation. Since the geese will not eat the corn unless the stalks are chopped down, this is done each fall with a rotary mower.

A part of the small grain is allowed to mature, and produces seed for planting the next year's crop. After this grain is combined, soybeans are planted in the stubble, without prior seedbed preparation. Only a small part of the soybeans are harvested in the fall--just enough to provide seed for the next year's plantings. The remainder is left for geese and duck food.

Over the years, the cropping system and residue management practices have helped build up the organic matter and fertility of the soil. Yields of both corn and small grains are increasing and wind erosion had ceased to be a serious problem.

SCS, USDA, Columbia, S. C.

Davison, V. E., and Neely, W. W. MANAGING FARM FIELDS, WETLANDS, AND WATERS FOR WILD DUCKS IN THE SOUTH. U.S.D.A. Farm. B. 2144, 14 pp. 1960.

Farmers can make good use of some of their farm land and waters and aid in the Nation's conservation of wild ducks by growing good duck foods as part of their soil and water conservation plan. Wild ducks offer pleasant recreation for land owners and operators and their guests. And the sale of shooting rights can add to farm income, bring more money into the community, and provide dependable hunting.

Most farmers in the South can attract wild ducks to their farms--to hunt or simply to see. To have ducks on your farm, you must have food for them. Your success, provided you have suitable soil and water conditions, will depend on having the right plants.

This bulletin describes the kind of food-producing duck fields, marshes, and ponds that can be established on land and explains management practices for them. These practices apply to the South where the conservation of wild ducks requires winter food and resting areas rather than summer food and nesting cover.

ARS, USDA, Inform. Div., Washington 25, D.C.

Guerra, L. V. AQUATIC VEGETATION CONTROL. Tex. Game and Fish 18(7): 6-10. 1960.

Much can be said, pro and con, about the actual value of aquatic plant life to a lake. Most plants will be of some benefit to a lake if they are present only in small areas and are not too dense. Some plants provide food for waterfowl, others encourage the production

of aquatic invertebrates, which serve as food for the fish, and to some extent or another, all aquatic plants act as oxygen producers maintaining oxygen rich environment for the fish. They also form spawning beds for the fish. When lakes have fluctuating water levels, exposed plants usually die and decay. These dead plants serve to fertilize a lake when it refills.

All plants tend to get out of control subject to weather and water conditions. Oftentimes, prolific plants will take over a lake and their worth as food for waterfowl, cover and nests for insects and fish diminish.

Thickly vegetated areas in lakes provide almost impenetrable cover for some of the more prolific sunfishes. These areas are where the less desirable sunfishes hide when lean, hungry bass threaten them.

When excessive plant growth has remained unchecked, its control by chemical means is almost mandatory. Manual control of some emergent plants, such as cattails and bulrushes, is desirable, especially for small patches.

Chemical control may seem costly until some of the advantages are considered. The wise and judicious use of chemicals to control aquatic vegetation can work in several ways for the lake owner. Some of the results of using chemicals are: (1) The destruction of excessive vegetation; (2) removal of protective cover for the more prolific sunfishes overpopulating a lake where sufficient fishing pressure is not maintained; (3) abundant food for bass and other game fish; (4) needed fertilization which in turn produces a bloom and color to the water; (5) the bloom acts as a partial shade from the sun, retarding or preventing further growth of most of the aquatic plants; and (6) weed-free angling again.

Chemical treatments of vegetation should be done at the right time, usually late spring or early summer when all the vegetation is young and tender and has not yet produced seeds. In most cases these seeds are not affected by treatment.

Vegetation control should not be attempted in the summer or late summer months. At this time of year the oxygen content of water is usually low. This is true in many parts of the state, especially in south Texas. The oxygen consuming effect of decaying plants may lead to an oxygen depletion and a kill of the fish in the lake. One application of sodium arsenite should control plants for the spring and summer. There have been no harmful effects observed on fish or waterfowl from the use of sodium arsenite in the recommended concentrations. A much higher concentration than is normally recommended would be needed to produce any harmful effects.

If it becomes necessary to treat a vegetation-choked lake in the summer, the lake should be treated in three successive steps. One-third of a lake should be treated with the required dosage for that portion of the lake. As soon as the vegetation dies and disintegrates in the first treated section, the second section should be treated, and after its vegetation is gone the final section can be treated. This system of application has been used many times without causing a fish kill to occur.

No address given.

SUPPLEMENT

Problems Affecting Application

Entomology Research Division. OBSERVATIONS ON THE BIOLOGY OF THE IMPORTED FIRE ANT. U.S.D.A., A.R.S. 33-49, 21 pp. 1958.

The imported fire ant (Solenopsis saevissima richteri Forel) is an annoying and destructive pest in the Southern States. It stings man and animals and damages a wide variety of crops. The large mounds it builds to house the colonies are unsightly and interfere with agricultural operations. This ant was first found in the vicinity of Mobile, Ala.

Along the gulf coast winged fire ants may be found almost any time of year. They usually make their mating flights in the spring. A newly mated queen digs a small brood chamber, lays a few eggs, and rears the first brood; subsequent broods are reared by the workers. Eggs hatch in 8 to 10 days, the larval stage lasts 6 to 12 days, and the pupal stage 9 to 16 days. The workers construct the mound, guard the colony, and forage for food. Except during excavation or mating flights, there are no visible openings in the

mound; workers enter and leave by underground tunnels, the openings of which are some distance away.

Mounds are built in various types of soil, both dry and wet. On low ground they are conspicuous and firmly constructed. In loose, sandy soils they sometimes disappear in hot weather, when the ants do little or no maintenance work.

This fire ant attacks various kinds of insects, but with little reduction in their numbers. It also feeds on honeydew from several insects. Argentine ants sometimes attack imported fire ant colonies, but usually without success.

ARS, USDA, Inform. Div., Washington 25, D. C.

Good, J. M. PLANT NEMATODES AND SOIL MANAGEMENT SYSTEMS. Soil Conserv. 25: 249-251. 1960.

The fact that plant-parasitic nematodes are an important factor in soil management has long been recognized by growers of certain crops. Farmers growing sugar beets in the Western States have been using rotations for control of the sugar beet nematode for many years. Nematode control by use of chemicals has become a standard practice in the pineapple fields of Hawaii; and a large percentage of the flue-cured tobacco in the Southern States is now grown on fields treated with nematocides. More and more vegetable growers and cotton farmers are becoming users of nematocides as trials have made their advantages apparent.

The author describes many types of nematodes and the damage they do to different crops.

In summary, the following points should be remembered if nematode damage is to be reduced: (1) Look for indications of nematode damage and try to find out what species are causing trouble; (2) use a wide variety of crop plants in long rotations, avoiding susceptible plants as much as possible; (3) use small grains and grasses instead of legumes as cover crops where root-knot is a problem; (4) use nematode-resistant varieties when they are available and suitable for the region; and (5) destroy the roots of plants badly infected with nematodes immediately after harvest. These measures are more effective in preventing nematodes from increasing than they are for controlling large populations once they have become established. Soil fumigation with nematocides should be considered when nematodes become a limiting factor in economic production of crops, provided the crops have sufficient value to justify the cost of fumigation.

CRD, ARS, USDA, Tifton, Ga.

Zuckerman, B. M., and Coughlin, J. W. NEMATODES ASSOCIATED WITH SOME CROP PLANTS IN MASSACHUSETTS. Mass. Agr. Expt. Sta. B. 521, 18 pp. 1960.

A survey to determine the distribution and types of stylet-bearing nematodes inhabiting Massachusetts soils was initiated in June 1958. Though nematodes had been recognized in the past as being pests of a small number of crops in this area, most was known of root knot nematodes, a few other endoparasitic forms, and above-ground feeders, while little was known of the types of ectoparasites present and the damage done by these forms. This study represents the first attempt at obtaining information concerning the distribution of plant parasitic nematodes within Massachusetts.

Since the cranberry is the most important export crop of Massachusetts, emphasis was placed on identifying the nematodes associated with this host. Only one species of plant parasitic nematode has been previously reported from this crop. A total of 355 cranberry soil samples were collected from 160 different bogs during this study. In addition, 106 samples from 11 other hosts located in various parts of the state were examined for nematodes. The data gathered in this study are presented in two sections: the first relating to the nematodes of cranberry soil and the second to nematodes associated with other hosts.

Known or suspected plant parasitic nematodes from nine genera were obtained from at least 10.0% of the cranberry bogs sampled. Fifteen other genera were found less often. Stylet-bearing nematodes were recovered from each of the 355 processed samples.

Hemicycliophora spp. were the principal stylet-bearing form encountered, occurring in 72.5% of the bogs sampled. Often they existed in large numbers.

Tylenchus spp. were the most widespread, having been obtained from 73.1% of the bogs sampled. Occasionally they were found in large numbers, but were never the principal stylet-bearing form.

Agr. Expt. Sta., U. Mass., Amherst, Mass.

Technical Committee of the Colorado Cooperative Pocket Gopher Project. POCKET GOPHERS IN COLORADO. Colo. State U. Expt. Sta. B. 508-S, 26 pp. 1960.

Pocket gophers and their habits are described and some of the basic information necessary for a control program are presented. This is a "progress report" on research with pocket gophers in Colorado.

As land and range management practices change so does the relationship change between the field rodents and agriculture and grazing.

Colo. State U. Expt. Sta., Fort Collins, Colo.

Henderson, R. C., Jones, J. H., and Smith, R. M. STILBESTROL IMPLANTATION--PASTURE AND FEEDLOT. Tex. Agr. Expt. Sta. Prog. Rpt. 2142, 4 pp. 1960.

Conservation farming studies on the Blackland Prairies necessarily involve beef cattle management practices which may increase production.

Steers implanted with stilbestrol at the start of the drylot fattening period made slightly more gain than steers implanted for a preceding 148-day pasture period and reimplanted for the drylot. Stilbestrol implantation, whether for pasture or drylot only, or for both pasture and drylot, increased gains significantly.

A pasture period of 148 days, from February 16 to July 14, 1959, and a drylot feeding period of 104 days, from July 14 to October 26, 1959, were used in the growing and fattening of 96 yearling steers at the Blackland Experiment Station, Temple, Texas.

Steers implanted for the 148-day pasture period made 46 pounds more gain per head than non-implanted steers. Those implanted only for the pasture period and those not implanted for either pasture or feedlot made equal feedlot gain.

Steers implanted only at the start of the pasture period were the most desirable in carcass grade, and those implanted only for the feedlot period were the least desirables.

ARS, USDA, and Tex. Agr. Expt. Sta., College Station, Tex.

Soil-Plant Relationships

Spencer, W. F. EFFECTS OF HEAVY APPLICATIONS OF PHOSPHATE AND LIME ON NUTRIENT UPTAKE, GROWTH, FREEZE INJURY, AND ROOT DISTRIBUTION OF GRAPEFRUIT TREES. Soil Sci. 89: 311-318. 1960.

Heavy rates of phosphate, with and without limestone, were applied to Ruby Red grapefruit trees growing on previously uncropped Lakeland fs at Lake Alfred, Florida. The effect of treatment on tree growth, freeze injury, root concentration, nutrient uptake, and soil pH are reported.

Tree measurements showed that trees receiving phosphate alone, or in combination with limestone, were significantly smaller than trees receiving limestone only.

Trees receiving phosphate were more severly injured by cold temperatures during the winter of 1957-58 than trees not receiving phosphate.

Phosphate applications markedly reduced the concentration of feeder roots, especially in the surface foot of soil.

The effects of high rates of limestone on soil pH were apparent to depths of at least 4 feet. Triple superphosphate plus limestone applications resulted in a considerably lower pH than the same rates of limestone applied alone.

Nutrient uptake as measured by leaf and root analyses were effected by both phosphate and lime application. The leaf content of P, Ca, and Mn was increased, and that of K, Mg, Fe, Cu, B, and Al decreased, by superphosphate applications. Limestone applications

increased Ca, P, and Fe, but decreased the N, K, Mn, Mg, Cu, Zn, and Al in leaves. Root composition, especially with respect to the minor elements, Zn and Mn, appeared to be closely related to soil pH.

Trees without any source of added calcium were calcium-deficient after 5 years.

Fla. Citrus Expt. Sta., Lake Alfred, Fla.

Kilmer, V. J., Bennett, O. L., Stahly, V. F., and Timmons, D. R. YIELD AND MINERAL COMPOSITION OF EIGHT FORAGE SPECIES GROWN AT FOUR LEVELS OF SOIL MOISTURE. Agron. J. 52: 282-285. 1960.

Eight forage species were established in field plots and subsequently grown at 4 different soil moisture levels. The concentrations of N, P, K, Ca, Mg, S, B, Mn, Fe, Al, Cu, and Na were determined in the above-ground portions of the plants produced during a 34-day period of growth. A direct effect of soil moisture level on the cation concentration in the species studied was not observed. The concentrations of nitrogen, sulfur, and boron in the plants were not significantly affected by variations in the soil moisture supply. However, the concentration of phosphorus in all eight species increased as soil moisture supply increased. The general over-all effect of increasing the soil moisture supply was to increase the total uptake by plants of all of the major elements considered in this study.

SWCRD, ARS, USDA, Beltsville, Md.

Thompson, J. F., Morris, C. J., and Gering, R. K. THE EFFECT OF MINERAL SUPPLY ON THE AMINO ACID COMPOSITION OF PLANTS. Qualitas Plantarium et Material Vegetables. 6(3-4): 261-275. 1960.

Turnip plants have been grown under conditions of normal mineral nutrition and with deficiencies of nitrogen, phosphorus, sulfur, potassium, calcium, or magnesium. The uncombined amino acids were separated from the protein fraction.

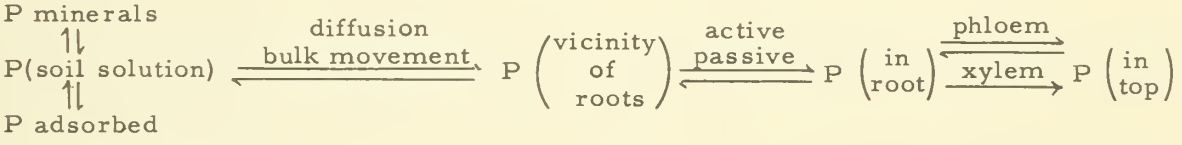
The protein fraction of the leaves was analyzed for constituent amino acids. It was found that there were considerable differences in protein level between deficient and normal leaves but that the relative composition of the protein fraction was only slightly affected.

The non-protein amino acids were profoundly influenced by mineral nutrition. The differences in amino acid concentrations suggested that the lack of various macronutrients affected the metabolism of amino acids in many ways.

U.S. Plant Soil and Nutr. Lab., SWCRD, ARS, USDA, Ithaca, N. Y.

Fried, M., and Shariro, R. E. SOIL-PLANT RELATIONS IN PHOSPHORUS UPTAKE. Soil Sci. 90: 69-76. 1960.

Soil-plant relations in phosphate absorption by the plant can be described by the following equation



where P is a phosphate ion.

The concentration of phosphate in the soil solution is determined by the nature of the solid phase and is best described by adsorption equations, insofar as seasonal growth of crops is concerned. The phosphate ion moves toward the roots by diffusion but more importantly, along with the bulk of the water movement. The ion is either stored by the soil in the vicinity of the root or moves into the root either by an active or passive process. The probable process is the active one, involving a carrier mechanism and described by

such biological constants as a carrier concentration, a reaction rate constant, and an apparent dissociation constant. The ions that reach the transpiration stream move upward along with the stream and are removed by the living cells along the path. The ions are then used for metabolism and growth.

SWCRD, ARS, USDA, Beltsville, Md.

Parups, E. V., Nielsen, K. F., and Bourget, S. J. THE GROWTH, NICOTINE AND PHOSPHORUS CONTENT OF TOBACCO GROWN AT DIFFERENT SOIL TEMPERATURE, MOISTURE AND PHOSPHORUS LEVELS. Canad. J. Plant Sci. 40: 516-523. 1960.

Growth, nicotine, and phosphorus content of tobacco, as influenced by soil temperature, soil moisture, and soil phosphorus levels, were investigated by growing the flue-cured variety Hicks in a combination of three soil temperatures, four soil moistures, and three soil phosphorus treatments.

Soil temperature of 22° C. and soil moisture of 75 percent of available moisture appeared to be the best for the over-all growth of tobacco. The over-all growth was a little lower at the 30° C. soil temperature than at the 22° C. temperature while at the 14° C. temperature it was very poor. Nicotine and phosphorus content in leaf tissue decreased with decreasing soil temperature. A decrease in soil moisture decreased the growth but increased the nicotine content of tobacco. Phosphorus content was influenced little by soil moisture treatments. Low soil moisture treatments were more detrimental to growth of tobacco at the low soil temperature than at the higher ones. Phosphorus produced growth responses at the low soil temperature only. Nicotine content was not influenced by soil phosphorus treatments. Phosphorus applications increased the leaf phosphorus content. At the 14° C. soil temperature there was an increase in leaf and stalk weight and leaf area with added phosphorus while at the 22° and 30° C. increases with soil temperature were very small. Stalk weights increased with increasing phosphorus applications at the higher but not at the lower soil moisture levels. The growth was decreased more at the soil temperature of 14° C. and soil moisture treatments of 25, and near 0 percent of available moisture than at the soil temperature of 22° and 30° C. At the low soil moisture phosphorus applications decreased root growth while at the higher soil moisture treatments this phosphorus effect was reversed.

Canada Dept. Agr., Ottawa, Ontario, Canada.

Shupe, L. G., and Thorne, J. L. BRISKET DISEASE. Farm and Home Sci. 18: 58-59. 1957.

Brisket disease affects animals after they have been grazing on high mountain ranges during the summer months. However, it sometimes affects animals on areas at lower elevations. It has occurred during winter and spring months before cattle were moved to the higher summer ranges.

The disease manifests itself as a severe depression with respiratory difficulty and loss of appetite. Affected animals stand away from other animals. They usually have a rough hair coat, a distended abdomen caused by an accumulation of fluid in the abdominal cavity, and often have a profuse diarrhea. Frequently they have a swollen brisket caused by an accumulation of fluid under the skin and in the adjacent tissue. The swelling may extend up to the neck and may also become prominent in the throat region. The condition often terminates in immediate death. Forced driving of affected animals may prove fatal.

Earlier research in Utah was centered on the role of trace minerals. But the findings indicate that trace minerals probably are of little significance in altering the incidence of the disease or in curing it.

Information available indicates that brisket disease does not occur on all high elevation range areas. For this reason the plants on ranges where the disease is prevalent have been studied. These suspected plants are uncommon in areas where the disease does not occur. However, experimental findings indicate that the plants are not significant causative agents of brisket disease. Suspected plants are marsh marigold (Calthaleptosepala DC.), yellow flowered buttercup (Ranunculus sp.), and groundsel (Senecio).

Changes in the environment may alter the course of the disease. Confinement on high quality feeds, or removal into areas of lower altitudes with good quality feed will aid in recovery. The stage of the disease when the animal is found is the most significant single factor affecting the outcome of the animal. A small number of animals recover without treatment.

Intensive post mortem studies of animals with brisket disease are pointing out clues which may lead eventually to its cause and therewith to a means of preventing the disease in range livestock.

Utah State U., Col. Agr., Agr. Expt. Sta., Logan, Utah.

Radioactive Fallout

Agricultural Research Service. RADIOACTIVE FALLOUT IN TIME OF EMERGENCY: EFFECTS UPON AGRICULTURE. U.S.D.A., A.R.S. 22-55, 43 pp. 1960.

Indications are that the total effect of radioactive fallout on American agriculture in case of nuclear attack would be serious. A series of nuclear explosions in populated areas would create hazards of severe radiation injury to farm people and their livestock. Radioactive contamination of food, feed, and water would increase the hazard. Residual contamination in the soil would continue the problem over a long period of time.

On the other hand, research is providing the basic knowledge and specific means which can help to lessen the seriousness of these widespread effects. Knowing the radiation level in his area, the farmer can take several protective and remedial measures.

SHELTER: The most vitally important measure for the protection of farm families in time of emergency is to seek shelter quickly and stay there as long as possible. The interval between a warning of possible attack or the explosion and arrival of fallout may provide the time to get the family and livestock under cover. By taking advantage of the protection of shelter, many families and their livestock could escape injury or death.

FOOD, FEED, AND WATER: By protecting a sufficient quantity of food, feed, and water from fresh fallout contamination, farm families can prevent internal radiation damage when the intensity is at high levels.

MAXIMUM WORK TIMES: Farmers who observe the maximum work times suggested for alternating shelter and out-of-doors work periods can gradually assume duties and still take advantage of recommended protection against radiation injury.

FOOD DECONTAMINATION: Some of the food that has been contaminated can be made safe for consumption by following suggested methods for decontamination or by allowing time for sufficient decay of radioactivity. Such food could be used for farm families, the community, or salvaged for market.

RECLAIMING THE SOIL: Some contaminated farm land could be maintained in production by diverting it to its safest use, or by decontamination through the method best suited to the conditions.

These are some of the safeguards available now against fallout damage. Research in radioactive fallout is being continued. New knowledge is expected to lead to improved methods of protecting American agriculture against hazards of fallout in time of emergency.

ARS, USDA, Inform. Div., Washington 25, D.C.

Vose, P. B., and Koontz, H. V. THE UPTAKE OF STRONTIUM AND CALCIUM FROM SOILS BY GRASSES AND LEGUMES AND THE POSSIBLE SIGNIFICANCE IN RELATION TO SR-90 FALLOUT. Hilgardia 29(12): 575-585. 1960.

Sixteen species and strains of forage legumes and grasses were grown on three different soils, similar in texture and pH but varying in strontium and calcium content. The plant tops and the soils were analyzed for strontium and calcium. A method was developed, using X-ray emission, spectrography, for the analysis of strontium.

The results indicate three significant features: (1) Every legume species takes up more strontium than grass; (2) within either the grasses or the legumes the variation in strontium content between species and varieties is not marked; and (3) the amount of strontium taken up is directly related to the calcium taken up.

A grass diet for dairy cows has an advantage over a legume diet in that both strontium and calcium levels are lower, and a higher calcium supplement can be added to the grass diet to greatly decrease the Sr/Ca ratio before calcium toxicity results. It seems reasonable that the strontium (or Sr-90) content of milk can be reduced by a factor of about 8 when cows are fed grass supplemented with calcium.

U. Calif., Berkeley, Calif.

Menzel, R. G. RADIOISOTOPES IN SOILS: EFFECTS OF AMENDMENTS ON AVAILABILITY. in Symposium "Radioisotopes in the Biosphere". Cent. For Continuation Study, U. Minn., Minneapolis, Minn. pp. 37-46. 1960.

The effects of amendments on availability of Sr^{90} in the soil are rather small. Additions of lime, gypsum, fertilizers, or organic matter in practical doses usually reduce uptake by less than half. Only the addition of calcium-bearing amendments appears to affect the ratio of Sr^{90} and calcium in the plant products. Combinations of soil amendments and tillage practices can probably be worked out for specific soil conditions that will reduce uptake more than any single amendment would. The optimum use of soil amendments for maximum crop production may often coincide with their optimum use for reduction of Sr^{90} uptake. Amendments may have larger effects on the availability of other fission products, such as Ru^{106}, Cs^{137}, and Ce^{144}, but these fission products are normally less of a hazard than Sr^{90}.

SWCRD, ARS, USDA, Beltsville, Md.

Fried, M., and Heald, W. R. RADIOISOTOPES IN SOILS: SOIL-PLANT RELATIONSHIP. in Symposium "Radioisotopes in the Biosphere". Cent. For Continuation Study, U. Minn., Minneapolis, Minn. pp. 47-60. 1960.

The soil-plant factors that determine the movement of elements from the soil to the tops of the plants are examined. The discussion is limited primarily to two elements, rubidium and strontium, both to illustrate the general processes and to show how the radioisotopes of these elements have been used.

The radioisotope of rubidium has been widely used because it is similar to potassium and the radioisotopes of potassium are only of limited use. The radioisotope of strontium has been widely used primarily because it is important in fallout.

The uptake of ions by plants grown in soils is a dynamic process, involving both soil and plant factors. By evaluating all of these interdependent factors, particularly with reference to rates and mechanisms, soil-plant relationships can be understood and utilized.

SWCRD, ARS, USDA, Beltsville, Md.

Titlyanova, A. A., and Timofeyeva, N. A. MOBILITY OF COMPOUNDS OF COBALT, STRONTIUM, AND CESIUM IN THE SOIL. Soviet Soil Sci. 3: 346-351. Mar. 1959.

Dynamic experiments were conducted to study the sorption and desorption of microamounts of cobalt, strontium, and cesium by the soil under investigation; these experiments showed that strontium is the most mobile of these elements. During sorption from a solution with soil filters, strontium most rapidly passes into the filtrate, and the percentage that passes into the filtrate increases with the increase in the number of volumes of solution passed. Strontium is easily leached and can be fully desorbed by the soil. The study of the distribution of strontium in the filter after sorption and after desorption, as well as the data obtained earlier, indicate that this element maintained good mobility in the soil as a result of exchange reactions. It is adsorbed by the inactive layer of the soil, desorbed from there in the solution and sorbed anew by the next inactive layer. In this manner, strontium, during desorption, is quite uniformly distributed over the soil filter; its movement in the soil is not limited to a band, but is continuous.

Microamounts of cobalt and cesium are considerably less mobile, with the low mobility being peculiar to cesium. In the experiments, cobalt passed into the filtrate to the extent of 3 to 4% during sorption and during desorption was leached even though to a very small extent, cesium appeared in the filtrate during sorption only to the extent of 0.5%,

and was not desorbed at all. The results of the static experiments confirm the results of the dynamic experiments. Sorption of cesium is influenced only by potassium; the potassium content in solution during the dynamic experiment did not exceed 0.1 meq/l. Sorption of cobalt is reduced by calcium and magnesium cations; their general content in solution from which cobalt was sorbed during the dynamic experiments reached 2.1 meq/l. This probably explains the high mobility of cobalt, as compared to that of cesium, determined in the experiments.

It was determined in static experiments that sorption of cesium by the soil is specifically affected by potassium, while sorption of cobalt is influenced by calcium and magnesium. This fact indicates that during sorption of cesium and cobalt by the soil, nonsoluble compounds of these elements are formed. Potassium is an element that is very close to cesium in its chemical properties and it can form the same compounds in the soil as cesium; however, compounds formed by potassium are more easily soluble. When large quantities of both are present in solutions, potassium probably competes with cesium during the formation of these nonsoluble compounds and serves to reduce cesium absorption by the soil. The same assumption may be made with respect to systems: soil - calcium salt solution-cobalt, and soil - magnesium salt solution-cobalt. Thus, only assumptions may be made about the uptake by the soil of microamounts of cobalt and cesium; these assumptions still require proof.

Amer. Inst. of Biol. Sci., 2000 P. St., N.W., Washington 6, D.C.

Nishita, H., Romney, E. M., Alexander, G. V., and Larson, K. H. INFLUENCE OF K AND CS ON RELEASE OF CS 137 FROM THREE SOILS. Soil Sci. 89: 167-176. 1960.

Experiments were conducted to study the influence of stable K and Cs amendments on the uptake of Cs-137 by Ladino clover upon prolonged cropping of contaminated soils. The soils studied were Aiken sicl, Hansford sl, and Vina l.

The addition of K to soils containing relative high level K was ineffective in reducing Cs-137 uptake by plants, but after the soil K was reduced to a low level by cropping, the addition of K to soils reduced Cs-137 uptake by plants. This implies that K added to a soil may reduce Cs-137 uptake by plants when the soil is low in K content but not when high in K. The Cs-137 uptake by plants increased as the K concentration in the soil was reduced by cropping.

The addition of small amounts of Cs to the soil markedly increased Cs-137 uptake by plants and reduced K uptake. The addition of Cs even at a level severely injurious to plants increased Cs-137 uptake rather than reduced it. The threshold level for producing injury to clover appeared to be around 4.5×10^4 me. Cs. per g. soil in Vina 1. The toxic effect of Cs added in injurious amount to the soil was alleviated by the addition of K.

The amount of Cs and K uptake by plants depended on the soil type. Uptake of Cs-137 by plants was in the order Hanford > Aiken > Vina, and, concurrently, K uptake was in the reverse order.

U. Calif., Los Angeles, Calif.

SOIL SURVEYS

Genesis and Morphology

Collinson, D. W., and Runcorn, S. K. POLAR WANDERING AND CONTINENTAL DRIFT: EVIDENCE FROM PALEOMAGNETIC OBSERVATIONS IN THE UNITED STATES. Geol. Soc. Amer. B. 71: 915-958. 1960.

Further studies of the paleomagnetic directions of red sandstones and siltstones of various geological ages in the United States are described. Usually the directions of magnetization of samples from a formation at one site are grouped symmetrically about a mean direction. From such a mean direction the position of the pole for that geological age can be calculated. There are, however, magnetically unstable formations in which the directions of magnetization are distributed approximately in the plane containing the present dipole field at the site and the original direction of the magnetic field. This

planar distribution is the result of a superposition of a secondary magnetization on the original one. The former is thought to be a viscous or chemical magnetization acquired in the last 1,000-1,000,000 years.

Pole positions calculated from mean directions at different sites are consistent for the same formation and for different formations of the same geological age.

The study confirms the general trend of the polar-wandering curve for North America obtained by Runcorn, which lies around the northern Pacific Ocean: the pole being in the central tropical Pacific in late Precambrian time, moving across to the tropical western Pacific in the early Paleozoic and to Asia in the late Paleozoic and early Mesozoic. The data also show that the polar-wandering curve for North America is displaced westward relative to that for Europe, as Runcorn showed, and provide an estimate for the amount of drift between the two continents since Mesozoic time, which is of the order of 30° in longitude.

Mus. North. Ariz., Flagstaff, Ariz.

Byrne, J. V., and Emery, K. O. SEDIMENTS OF THE GULF OF CALIFORNIA. Geol. Soc. Amer. B. 71: 983-1010. 1960.

The Gulf of California is an elongate trough bordered by highlands on the west and mostly by lowlands on the east. Fault scraps divide its floor into a succession of closed basins separated by ridges, some of which are capped by islands. Water flows into the open sea along the east side and leaves along the west side after partial evaporation. About half of the runoff from land reaching the gulf enters at its head via the Colorado River, but dilution of the gulf water is not evident. Winter upswelling caused by northwesterly winds brings high-nutrient (including high-silica) water to the surface where diatoms and other phytoplankton flourish so abundantly that they discolor the water. On death, the siliceous frustules fall to the bottom forming diatomaceous muds in the middle third of the gulf. High-organic matter in the muds is also a result of high production in surface waters and of anaerobic conditions within the sediments, although not in the water above them. Sediments of the northern third of the gulf are deltaic, and those of the southern third are normal marine green muds. Sands and gravels composed of shell debris and detritus from land are concentrated along the shores and in channels between islands where tidal currents are swift.

Dept. Oceanog., Oreg. State Col., Corvallis, Oreg.

McMaster, R. L. SEDIMENTS OF NARRAGANSETT BAY SYSTEM AND RHODE ISLAND SOUND, RHODE ISLAND. J. Sedimentary Petrology 30: 249-274. 1960.

Gravel, sand, silt, and clay content was determined for 942 samples from the bays and adjacent inner shelf to a distance of some 20 miles off the Rhode Island coast.

In the Narragansett Bay system clayey silt and sand-silt-clay are the most abundant sediments although sand is important locally. Neither the Bay system nor the inner shelf contain a predominant clay type of sediment. Primarily, sediments are derived from the unconsolidated subaerial and subaqueous glacial and post-glacial deposits. It is believed that the sediment available for deposition is composed of some fine and very fine sand, silt, and clay, but the quantity is very small. During the period in which present environmental conditions have been effective clayey silt and sand-silt-clay have accumulated for the most part in the more protected middle and upper areas of the Bay system. The depositional sites for the finest of these sediments may be the result of the peculiarities of surface tidal current flow. Areas which show marked gradational changes in texture probably indicate significant local variations in current activity along the bottom interface. In general, toward the lower reaches of the Bay passages the sediments show a progressive change to coarser textures.

On the inner shelf the predominant sediment type is clean, well-sorted sand. Apparently gravel is concentrated along two major trends which are generally associated with the two submarine elevation features that cross the area. A well-defined depositional zone of sandy silt and silty sand, believed to be the result of non-tidal drift, begins near the entrances to Narragansett Bay and follows the trend of a winding submarine slope toward the southwest and Block Island Sound. A tongue of sand which lies adjacent to the Rhode

Island mainland from Point Judith into lower West Passage owes its origin to the northerly moving longshore current which pushes into the Bay from Block Island Sound.

In the Bay system and certain areas on the inner shelf unburied glacial or post-glacial lag deposits juxtapose with recently accumulated fine sediments.

Present environmental forces are not responsible for the creation of the major submarine topographic features of the region, but in the Bay depositional processes of recent environmental conditions have had considerable success in burying sedimentary deposits of previous environments.

U. R.I., Kingston, R.I.

Rubin, M. CHANGES IN WISCONSIN GLACIAL STAGE CHRONOLOGY BY C^{14} DATING. Amer. Geophysical Union Trans. 41: 288-289. 1960.

Progress has been extremely rapid in the field of pleistocene chronology in the past few years. This is due to advances in C^{14} dating and to the development of other dating methods. With the modification of the original counting of C^{14} using the solid carbon method, to the present gas counting techniques, more and more laboratories were initiated. Today, more than 35 laboratories throughout the world are turning out dates for geologists, archeologists, botanists, and geochemists. The new techniques, including gas counting with a variety of gases, scintillation counting, isotopic enrichment, and ionium-uranium decay methods, have extended the range of absolute dating to include the entire last glacial stage.

To summarize the present state of chronology of the Wisconsin stage, the last advance into the Great Lakes area culminated approximately 11,000 years ago, and the beginning of the entire stage occurred sometime between 70,000 and 100,000 years ago. Between 70,000 or 100,000 years ago and approximately 28,000 years ago, there was either one very long substage, or several shorter ones. The Iowan age till of Iowa is included here. From 28,000 to 22,000 years ago, Farmdale substage deposits were laid down. Some workers believe that from 22,000 to 12,000 years ago, only one substage occurred, encompassing deposits known previously as Iowan loess of Illinois, Tazewell drift, Cary drift, and Mankato drift. The Two Creeks substage was a short pause during the later advances of the Wisconsin stage, and was terminated by the Valers substage with the readvance of the ice approximately 11,000 years ago. The Valders substage ended with the retreat of ice into the Hudson Bay area and is arbitrarily terminated at approximately 8,500 years ago.

U.S. Geol. Survey, Washington 25, D.C.

Cooper, A. W. AN EXAMPLE OF THE ROLE OF MICROCLIMATE IN SOIL GENESIS. Soil Sci. 90: 109-120. 1960.

As a part of a microclimate-vegetation study in southeastern Michigan, data were accumulated to illustrate a situation in which microclimate seems to be a major factor in soil genesis.

The south slopes studies had higher relative light intensities, maximum air temperatures, evaporation rates, and soil temperature. North slopes had somewhat lower minimum air temperatures and higher soil-moisture values. The surface horizons of south slopes underwent cycles of freezing and thawing in winter and cycles of wetting and drying in spring and summer that did not occur on north slopes.

The north and south slopes studies were characterized by different types of soil weathering. The solum was shallowest at the top of south slopes and deepest on north slopes. The A horizon also was shallowest at the top of south slopes. The B horizon was redder in hue and finer in texture, containing significantly more silt and clay, on south slopes.

It is concluded that the higher soil temperatures and cycles of freezing and thawing and of wetting and drying found on south slopes promote greater chemical and biotic weathering and are, thus, major factors accounting for the greater clay content of the B horizons of these soils. Furthermore, topographically influenced microclimates offer the

pedologist situations in which the role of biotic and topographic factors can be more easily studied because parent material, regional climate, and time can be considered constant.

N. C. State Col., Raleigh, N. C.

Richmond, G. M. GLACIATION OF THE EAST SLOPE OF ROCKY MOUNTAIN NATIONAL PARK, COLORADO. Geol. Soc. Amer. B. 71: 1371-1382. 1960.

The east slope of Rocky Mountain National Park has been glaciated at least three times during the Pleistocene, and two small rejuvenations of the ice have occurred in recent time. In Tahosa Valley, east of Longs Peak, the oldest or pre-Bull glaciation appears to be of pre-canyon origin, although the broad valley surface on which the deposits rest may have been entrenched by the canyon before the ice advanced over it. Deposits of a younger questionable pre-Bull Lake glaciation postdate canyon cutting along Fall River.

The interglaciation separating pre-Bull Lake from Bull Lake glaciation was of sufficient magnitude for deep weathering to have occurred, but little canyon erosion appears to have taken place at this time in the park.

Bull Lake glaciation was marked by two stades during which two distinct sets of moraines were formed. The major glaciers were 6 to 10 miles long and terminated just outside the Park boundary at altitudes of 7,800 to 9,000 feet.

During the interglaciation separating the Bull Lake and Pinedale glaciations the ice probably disappeared entirely from the mountains. A mature zonal soil developed, and erosion of 20 to 30 feet took place locally along major streams below the terminal moraines.

During Pinedale time, glaciers failed to reoccupy some cirques that had been occupied in Bull Lake time. The Pinedale glaciation was characterized by three stades. During the early advance, glaciers in general attained a position immediately in back of moraines of Bull Lake glaciation but locally overlapped these moraines and in one place breached them. Moraines of the middle stade probably mark a readvance of the ice that on Fall River breached the terminal moraine of the early stade and in Moraine Park reached the same position attained during that stade. Elsewhere, the middle stade recorded a recession of the ice of at least 2 miles resulting in glaciers 3 to 8 miles long. During the late stade of Pinedale glaciation, the ice everywhere receded markedly and tended to subdivide into tongues that failed to coalesce in the major canyons. These glaciers ranged from 2 to 5 miles in length. A radiocarbon date from peat at the base of a bog on one of these deposits, the type locality of the Wisconsin IV or Long Draw substage of Ray, is 6,170 ± 240 years (Rubin and Suess, 1955). The peat is gradational downward into glacial silt, outwash gravel, and till, suggesting that it began to form shortly after recession of the ice.

A variety of evidence suggests that the Pinedale glaciers disappeared entirely from the mountains during the succeeding postglacial optimum or alithermal age and that freeze and thaw processes ceased to be effective on cirque headwalls and adjacent upland slopes. An immature zonal soil formed and erosion of a few feet occurred along major streams below the terminal moraines of Pinedale glaciation. These moraines probably retained shallow lakes at this time.

Small glaciers, formed during Neoglaciation, failed to reoccupy many cirques occupied in Pinedale time and developed only in the more sheltered parts of others. Two advances of the ice, the Temple Lake and historic stades, are recorded. Both are included within the Little Ice Age of Matthes (1939; 1940), and both include local evidence of at least two secondary pulsations. Most of the ice bodies were less than half a mile long.

Deposits in the La Sal Mountains, Utah, which are correlated with the Temple Lake stade have been dated as 2800 ± 200 years old (Rubin and Suess, 1955) and are estimated to have formed from about 3,800 to about 2,000 years ago. The historic stade may have attained its last maximum in Rocky Mountain National Park about 1860. Thirteen small glaciers and stagnant ice bodies are relict from this advance in the area at present.

US Geol. Survey, Denver, Colo.

Koschmann, A. H. MINERAL PARAGENESIS OF PRECAMBRIAN ROCKS IN THE TENMILE RANGE, COLORADO. Geol. Soc. Amer. B. 71: 1357-1370. 1960.

A Precambrian complex of granulite, gneiss, and migmatite, intruded by numerous plutons of granite rocks correlated with the Silver Plume granite, is exposed in a long narrow belt along the crest and upper slopes of the Tenmile Range, Colorado. The metamorphic rocks are predominantly felsic; bands, lenses, and irregular bodies of mafic rocks rich in biotite, hornblende, and locally in sillimanite and garnet, are interlayered with the felsic rocks. The major lithologic variations in the metamorphic rock complex are believed to be due chiefly to variations in the original sedimentary rocks, which probably were interbedded sandstone, shale, and limestone.

The metamorphic rocks and the Silver Plume granite reveal the age relations of quartz and the feldspars, and these relations afford considerable information on the origin and progressive transformation of the rocks. Quartz is the earliest mineral in the metamorphic rocks and is probably a relict mineral of a sandstone. It has been partially replaced by feldspar. It occurs chiefly in irregular clusters, some of which show sutured grains, enclosed in a ramifying network of feldspar. Irregular small apophyses, barbs, and prongs of feldspar penetrate the quartz clusters along grain boundaries and healed fractures in the quartz. In some of the least feldspathized quartzose metamorphic rocks the feldspar is clearly interstitial to the quartz. Quartz also occurs in feldspar as small spherical inclusions. The relations of the quartz to the feldspars show clearly that a quartzose host rock was replaced by feldspar along quartz grain boundaries, pre-existing healed fractures, and margins of shadowy areas in strained quartz grains.

The textural relations of the other principal minerals in the metamorphic rocks show that plagioclase formed earlier than the microcline and that the micas were the last of the principal minerals to form.

Identical paragenetic relations are found in the Silver Plume granite, and the writer concludes that the Silver Plume granite was derived by partial fusion of quartzose metamorphic rocks.

US Geol. Survey, Denver, Colo.

Eardley, A. J., and Gyosdetsky, V. ANALYSIS OF PLEISTOCENE CORE FROM GREAT SALT LAKE, UTAH. Geol. Soc. Amer. B. 71: 1323-1344. 1960.

A continuous core was taken to a depth of 650 feet on the shore of Great Lake, 1 mile north-northeast of the Saltair resort, about halfway between Oquirrh Mountains and Antelope Island, Utah. Its contents and properties were examined and analyzed for the Pleistocene record of lakes and climatic changes. Of significance in the interpretation were Ca and Mg carbonates, clay minerals, sand fractions, volcanic ashes, soils, radioactivity, laminations, oölites and fecal pellets, ostracodes, mollusks, and C^{14} dates. By integrating the several climatic indicators and other data the following conclusions were reached: (1) The core probably penetrated sediments deposited during the Wisconsin, Sangamon, Illinoian, Yarmouth, Kansan, and part of the Aftonian ages of the Pleistocene. The several times of soil formation represent hiatuses in the sedimentary record, but they were probably short. (2) The Pleistocene is calculated from the Saltair core to be about 800,000 years long, whereas the deep-sea cores, according to Emiliani, indicate a length of 300,000 years. The rhythms of solar radiation, according to Milankovitch and Zeuner, indicate a length of 600,000 years. (3) No relation of the pluvial stages of the core to the Lake Bonneville beaches could be established. (4) Little firm evidence correlates the pluvial stages of the core with Rocky Mountain glacial stages. (5) The Pearlette tuff at 548 feet is a significant time marker and according to the succession of lakes recognized in the core is early Kansan. And (6) five strong pluvial cycles are recognized, and these correlate well with the Lower Mississippi Valley chronology.

U. Utah, Salt Lake City, Utah.

White, E. M., and Bonestell, R. G. SOME GILGAIED SOILS IN SOUTH DAKOTA. Soil Sci. Soc. Amer. Proc. 24: 305-309. 1960.

The addition of material to the lower part of the solum by the swelling of clay down into desiccation voids seems to be the first step in the genesis of South Dakota gilgai. The microridges of wavy gilgai are formed by: (1) The cyclic movement of microvalley subsoil material along oblique cleavage planes into the microridge; (2) a slower downslope soil creep of microridges than of microvalleys; and (3) the upward extrusion of material from a compacted microridge subsoil as it is moistened and clays swell. Normal gilgai are formed by extrusion. Gilgaied areas have soils similar to Chestnuts, Solodized-Solonetz, Solonchaks, or complexes of these soils.

S. Dak. State Col., Brookings, S. Dak.

Robinson, G. H., and Rich, C. I. CHARACTERISTICS OF THE MULTIPLE YELLOWISH-RED BANDS COMMON TO CERTAIN SOILS IN THE SOUTHEASTERN UNITED STATES. Soil Sci. Soc. Amer. Proc. 24: 226-230. 1960.

Multiple bands or strata of soil materials, which are finer textured and browner or redder colored than the material above or below, have been studied. These bands are common in unconsolidated sandy Coastal Plain and glacial deposits. In Virginia, North Carolina, and South Carolina they are found to lie nearly horizontally, are much deeper where the present soil is nearly level than on sloping soil areas, and the soils in which they occur contain "clay balls" and band segments above the continuous bands. Stratification within the bands, charcoal fragments deposited with the sand, and bands showing scour and fill characteristics were observed in the field. In no instance were yellowish-red bands found to cross bedding planes but rather the redder color follows the texture of the strata.

Chemical analyses show that these bands, where continuous, contain more organic matter, and have a slightly lower pH and higher cation-exchange capacity than the interbands. Percentage free iron in the clay fraction, and clay mineral analyses show no significant differences between the bands and interbands.

Attempts to develop clay-iron oxide strata in the laboratory by leaching unstratified soil materials were unsuccessful. However, some were developed in stratified materials when leached with a complexing or reducing agent. These experiments produced evidence that clay movement in a sandy medium is similar under some conditions to clay movement in a finer textured medium and give support to the conclusion that the bands studied are primarily the result of geologic deposition.

Based upon this conslusion, it is proposed that the part of the profile containing such bands be considered as the C horizon of the soil above. The small residual "clay balls" or segments of bands remaining in the B horizon (often a color B) would be considered as fragments of parent material and comparable to partially weathered rock fragments in the lower B of a residual soil.

SCS, USDA, Blacksburg, Va.

McKenzie, L. J., Whiteside, E. P., and Erickson, A. E. OXIDATION-REDUCTION STUDIES ON THE MECHANISM OF B HORIZON FORMATION IN PODZOLS. Soil Sci. Soc. Amer. Proc. 24: 300-305. 1960.

Oxidation-reduction studies have been carried out in a hydrosequence of sandy soils in the Podzol region of Michigan with variations in time and space. The soils studied were well-drained Kalkaska s, imperfectly drained Saugatuck s and poorly drained Roscommon s. Redox potentials were observed to vary with time, temperature, moisture, and horizons. Moisture variations were caused by variations in rainfall, drainage, and biological utilization of water. Residual redox variations not associated with differences in soil moisture were caused by variations in temperature and indirectly by the activity of microorganisms and by leaf fall. Variations in redox potentials with depth could be related to character of the soil horizon and variations of the above variables with depth in the profile. Two possible mechanisms of mobilization of iron oxides in the A horizons and their

precipitation in the B horizons of Podzols are discussed. These results seem to indicate that mobilization of iron oxides could occur by the formation of complexes with dicarboxylic and tricarboxylic acids present in the water-soluble fraction of freshly deposited organic material. These complex compounds serve as a source of energy for microorganisms and the complexes are decomposed releasing iron in the ferrous form as it is carried to the region of the B_{ir} horizon. The ferrous iron may be oxidized in the B_{ir} horizon by iron-oxidizing organisms or by the process of valence induction.

J. article 2224, Mich. State U., Agr. Expt. Sta., East Lansing, Mich.

Sawhney, B. L. WEATHERING AND ALUMINUM INTERLAYERS IN A SOIL CATENA: HOLLIS - CHARLTON - SUTTON - LEICESTER. Soil Sci. Soc. Amer. Proc. 24: 221-226. 1960.

Large amounts of a mineral with a stable 14Å. spacing are present in clay fractions of the Hollis-Charlton-Sutton-Leicester catena. When subjected to the usual procedures for the characterization of clay minerals, this mineral exhibited a behavior between that of vermiculite and chlorite. It was identified as vermiculite after interlayer aluminum was removed. Mild acid conditions and abundant illite and vermiculite in the parent micaceous schist are significant factors in forming these aluminum interlayers. The stability of aluminum interlayers both to sodium citrate and heat treatments increased with proximity to the surface. In Charlton fine sandy loam, 6 to 9 hours extraction with N sodium citrate were required to remove interlayers in the A_1 horizon, whereas only 3 and 6 hours sufficed for the C and B_{22}, respectively. The aluminum interlayers in well-developed and well-drained Charlton and Sutton soils are more stable to heat treatments than the material in poorly drained Leicester and shallow Hollis soils.

The cation-exchange capacity increased as much as 30 to 40% after the removal of aluminum interlayers; the increase was greater in more stable samples. Aluminum interlayers produced experimentally in vermiculite and montmorillonite resulted in stable 14Å. spacing and lowered the cation-exchange capacity of the original minerals considerably.

Conn. Agr. Expt. Sta., New Haven, Conn.

Classification and Land Use

Soil Survey Staff. SOIL CLASSIFICATION: A COMPREHENSIVE SYSTEM 7th APPROXIMATION. U.S.D.A., S.C.S. 265 pp. 1960.

The present status of a comprehensive system of soil classification being developed by the Soil Survey staff is presented. The Soil Survey uses a classification to see relations among soils and between soils and their natural and cultural environment. Predictions are made about soil behavior from the relations of soils for which we lack experience to soils on which we have conducted research or have experience. Thus, classification is a basic tool used in our research, extension, and technical assistance.

This is not a book for beginning students of soil classification. It is written to introduce the new system to people who are familiar with the present system. It assumes knowledge of the Soil Survey Manual terminology for describing soils.

SCS, USDA, Inform. Div., Washington 25, D.C.

Mapping and Interpretation

Soil Conservation Service. SOIL SURVEY:*

* DALE COUNTY, ALABAMA.	U.S.D.A., S.C.S.	54 pp.	May 1960.
* ESCAMBIA COUNTY, FLORIDA.	U.S.D.A., S.C.S.	87 pp.	June 1960.
* FORSYTHE COUNTY, GEORGIA.	U.S.D.A., S.C.S.	47 pp.	Feb. 1960.
* JEFFERSON COUNTY, IOWA.	U.S.D.A., S.C.S.	62 pp.	Mar. 1960.
* LUCAS COUNTY, IOWA.	U.S.D.A., S.C.S.	29 pp.	Feb. 1960.
* MONONA COUNTY, IOWA.	U.S.D.A., S.C.S.	41 pp.	Jan. 1960.

* POLK COUNTY, IOWA.	U.S.D.A., S.C.S.	96 pp.	June	1960.
* GEARY COUNTY, KANSAS.	U.S.D.A., S.C.S.	35 pp.	Feb.	1960.
* TERREBONNE PARISH, LOUISIANA.	U.S.D.A., S.C.S.	43 pp.	Feb.	1960.
* MONTCALM COUNTY, MICHIGAN.	U.S.D.A., S.C.S.	40 pp.	Mar.	1960.
* NEWTON COUNTY, MISSISSIPPI.	U.S.D.A., S.C.S.	60 pp.	Feb.	1960.
* DAWSON COUNTY, NEBRASKA.	U.S.D.A., S.C.S.	52 pp.	Aug.	1960.
* NANCE COUNTY, NEBRASKA.	U.S.D.A., S.C.S.	44 pp.	July	1960.
* SOUTHWEST QUAY AREA, NEW MEXICO.	U.S.D.A., S.C.S.	58 pp.	May	1960.
* LEWIS COUNTY, NEW YORK.	U.S.D.A., S.C.S.	107 pp.	May	1960.
* ALAMANCE COUNTY, NORTH CAROLINA.	U.S.D.A., S.C.S.	87 pp.	Apr.	1960.
* FAIRFIELD COUNTY, OHIO.	U.S.D.A., S.C.S.	77 pp.	Mar.	1960.
* CIMARRON COUNTY, OKLAHOMA	U.S.D.A., S.C.S.	53 pp.	June	1960.
* HARPER COUNTY, OKLAHOMA.	U.S.D.A., S.C.S.	59 pp.	June	1960.
* LOGAN COUNTY, OKLAHOMA.	U.S.D.A., S.C.S.	60 pp.	June	1960.
* NEWBERRY COUNTY, SOUTH CAROLINA.	U.S.D.A., S.C.S.	62 pp.	May	1960.
* HENDERSON COUNTY, TENNESSEE.	U.S.D.A., S.C.S.	76 pp.	Apr.	1960.
* DAWSON COUNTY, TEXAS	U.S.D.A., S.C.S.	58 pp.	Aug.	1960.
* FORT BEND COUNTY, TEXAS.	U.S.D.A., S.C.S.	53 pp.	Feb.	1960.
* HANSFORD COUNTY, TEXAS.	U.S.D.A., S.C.S.	41 pp.	June	1960.
* MARSHALL COUNTY, WEST VIRGINIA.	U.S.D.A., S.C.S.	50 pp.	May	1960.
* SKAGITT COUNTY, WASHINGTON.	U.S.D.A., S.C.S.	91 pp.	Jan.	1960.
* LA CROSS COUNTY, WASHINGTON.	U.S.D.A., S.C.S.	93 pp.	Apr.	1960.

These Soil Surveys are all published by the United States Department of Agriculture - Soil Conservation Service in cooperation with the local state agriculture and/or other cooperating agencies. All contain maps in addition to the written text.

SCS, USDA, Inform. Div., Washington 25, D. C.

Gliddens, J., Perkins, H. F., and Carter, R. L. SOILS OF GEORGIA. Soil Sci. 89: 229-238. 1960.

Parent materials and topography have been largely responsible for the numerous soils occurring in Georgia. Red-yellow podzolic soils predominate because of the warm, humid climate. Some gray-brown podzolic soils occur in the mountains at high elevations. Widely scattered areas of reddish brown lateritic soils are found in most of the state.

Poorly drained soils occur widely in the seaward portion of the Coastal Plain.

The soils are highly weathered and low in organic matter. Fertility is a major problem, especially in the case of nitrogen. While kaolinitic clays predominate in the well-drained soils, the poorly drained soils are often high in montmorillonitic clays. Those soils containing montmorillonitic clays offer serious problems in tillage.

U. Ga., Athens, Ga.

Technical Committee on Soil Survey. SOILS OF THE NORTH CENTRAL REGION OF THE UNITED STATES: THEIR CHARACTERISTICS, CLASSIFICATION, DISTRIBUTION, AND RELATED MANAGEMENT PROBLEMS. Wisc. Agr. Expt. Sta. B. 544 (N. Cent. Reg. P. 76) 192 pp. and maps. 1960.

Information on the soils of the twelve North Central States of the United States, designated herein as the North Central Region is given. The information presented is based on Soil Surveys made by state and federal agencies during the past 60 years. These surveys, usually by counties, consisted of identifying the different kinds of soils, describing the characteristics of each, showing their location on maps, observing their uses, and classifying them into small and large groups for various purposes, according to their similarities or differences.

It is a general summary of the soil resources of the North Central Region of the United States. The tabular "keys" or charts indicate general relationships between all the active established soil series in the region. The information on soil distribution, soil properties, kinds of experiment field data available on various soils, and suggestions of gaps in our information will be useful to those who plan or conduct research, and apply the findings to the land. Agronomists, research and extension workers, land appraisers,

farm managers, and representatives of fertilizer, seed, and machinery companies who work with farmers over wide areas will often wish to secure and utilize such information.

SCS, USDA, Coop. States and Agr. Expt. Sta., U. Wisc., Madison, Wisc.

Hill, D. E., and Shearin, A. E. SOILS AND URBAN DEVELOPMENT IN HARTFORD COUNTY. New Haven, Conn. Agr. Expt. Sta. Cir. 209, 8 pp. 1960.

When colonies or suburbs begin to appear around cities, with homes and other buildings where none stood before, communities frequently undertake planning and zoning of land use. One primary determinant of land use is the nature of the soil.

Soil characteristics for the various soils in the county are described and a table is presented showing the site ratings and limitations of soil series as possible sites for urban development.

Conn. Agr. Expt. Sta., New Haven, Conn.

Shrader, W. D., Schaller, F. W., Pesek, J. T., Slusher, D. F., and Riecken, F. F. ESTIMATED CROP YIELDS ON IOWA SOILS. Iowa Agr. and Home Econ. Expt. Sta. Sp. Rpt. 25, 21 pp. 1960.

Detailed crop yield estimates developed for 67 Iowa soil types and phases are presented. The yield estimates represent long-time average yields of corn, soybeans, oats, and hay believed obtainable under two different levels of management. The Management levels include: (1) A low level which should result in yields near the low side now experienced by many farmers; and (2) a high level which should result in yields near the maximum that most farmers could produce profitably.

For soil types not included in the list of 67 soil types, a general evaluation of productive capacity is presented. In this presentation each soil type is placed in a yield group at only the high level of management.

Average crop yields in Iowa vary widely among soil types. Highest yields are believed obtainable on Muscatine soils. Average yields per acre on Muscatine sil soil under the high level of management are estimated to be 90 bushels for corn, 32 bushels for soybeans, 56 bushels for oats, and 3.6 tons for hay. Clarinda sicl is one of the lowest-yielding soils, and average yields per acre at the high management level are estimated to be 20 bushels for corn, 15 bushels for oats, and 0.8 ton for hay. The average yields per acre on a large group of Iowa soils are estimated to range as follows: corn, 65 to 80 bushels; soy beans, 20 to 30 bushels; oats, 35 to 55 bushels; and hay, 2 to 3 tons.

There are many factors which influence crop yields, such as soil type, slope, erosion, cropping system, fertility, crop varieties, planting rates, and timeliness of operation. These factors are evaluated as specifically as possible to show their yield effect of the contribution which they make to the total crop yield. With this information, the yield estimates presented, which are based on rather specific conditions, can be adjusted to fit other soil and crop conditions or management assumptions. Furthermore, a method is presented for developing estimated yields for a particular field or farm, based on information in this report plus other available information.

SCS, USDA, and Agr. and Home Econ. Expt. Sta. and Tech., Ames, Iowa.

Hole, F. D., and Hironaka, M. AN EXPERIMENT IN ORDINATION OF SOME SOIL PROFILES. Soil Sci. Soc. Amer. Proc. 24: 309-312. 1960.

Data concerning three groups of soil profiles were treated separately in order to show the degrees of similarity and dissimilarity between the profiles. Soils of the Miami family and catena were examined in this manner twice, once on the basis of laboratory data and a second time on the basis of current detailed soil profile descriptions. The two treatments gave some strikingly similar results. The third group of soils consisted of 25 soil profiles considered to be representative of as many great soil groups of the world. A three-dimensional model showing relationships between these profiles illustrates the possibilities of this kind of analysis.

Soil Survey Div., Wis. Geol. and Nat. Hist. Sur., U. Wis., Madison, Wis.

Plant Pest Control Division. INFORMATION REGARDING INTERSTATE MOVEMENT OF SOIL SAMPLES. U.S.D.A., A.R.S., P.P.C.D. Irr. pp. 1960.

The instructions regarding the movement of soil samples have been prepared to furnish general information to those concerned. The treatments for soil samples are approved as a basis of certification for interstate movement. These treatments are in addition to those included in the regular program Regulatory Manuals.

Material included is intended for placing in the looseleaf binder designed for 6" x 9" sheets. From time to time revised copies of the maps and revised or amended copies of the Administrative Instructions Designating Regulated Areas will be issued. These will then replace the old copies in the binder.

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