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# ABSTRACTS

of recent published material on  
Soil and Water Conservation

Number 29

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UNITED STATES DEPARTMENT OF AGRICULTURE

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

The ABSTRACTS are issued at irregular intervals. Their purpose is to bring together a summary of current published information about 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 are appended.

The classification of articles follows the table of contents used for the "Soil and Water Conservation Research Needs" of the Soil Conservation Service. 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 the 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 follow 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, Md.

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# WATERSHED ENGINEERING

## Watershed Development

Arnold, A. F., and Back, W. B. POTENTIAL INCREASES IN FARM INCOME FROM UPSTREAM WATERSHED DEVELOPMENT: A CASE STUDY OF BOGGY CREEK WATERSHED IN WASHITA COUNTY, OKLAHOMA. Okla. State U. Expt. Sta. B. 598, 31 pp. 1962.

Boggy Creek watershed in western Oklahoma was studied to estimate potential economic effects of different levels of flood control and irrigation in watershed development. The study was designed to include four levels of flood protection and four levels of irrigation on individual farms. The analysis was made by linear programming procedures for four "typical" farm resource situations in the watershed.

The major factors determining the amount of change in intensity of flood plain land use profitable for farmers to make following flood protection were: (1) The intensity of cropland use prior to protection; (2) the total acres of cropland per farm; and (3) the distribution of total cropland acreage between upland and bottomland. Cotton, wheat, and alfalfa were the major programmed uses of bottomland for the four farms at all levels of flood protection, but cotton was programmed on flood plain land only when protected from flooding. Farms with both relatively large acreages of bottomland and relatively small cotton allotments had little or no programmed changes in intensity of flood plain land with increases in levels of flood protection. On the other hand, farms with more limited bottomland acreages and relatively large cotton and wheat allotments in relation to total acres of cropland had programmed changes in flood plain land use with increases in flood protection. Shifts in land uses within farms with flood protection support a "whole-farm-approach," rather than an analysis of flood plain land only.

Little or no change in numbers of livestock on the farms was programmed as flood protection increased. Also, labor and capital requirements did not change significantly for the farms with changes in flood protection.

Reduction in floodwater damage to crops was the major component of the programmed increments (90 percent) in net farm incomes with increase in flood protection. Shifts in land use accounted for the other 10 percent. For each of the four farms, the income increments decreased with each successive increase in levels of protection beyond 10 structures.

Generally, patterns of land use did not change significantly on the farms with changes in irrigation levels. Only cotton was irrigated with the first increments of water. Combinations of wheat and alfalfa were irrigated with the second and third water increments for irrigation on the farms.

Although livestock numbers changed insignificantly with changes in levels of irrigation for the farms, there were increases in labor and capital requirements, and in gross and net farm incomes, with increases in irrigation.

Water returns ranged from about \$32 to \$40 per acre foot for irrigating cotton with the first increments of water, and from about \$8 to \$10 per acre foot for irrigating wheat and alfalfa. The estimated cost to farmers for developing irrigation water was \$6.28 per acre foot. At this cost of water, the third increments of water for irrigation would be unprofitable except for the farm with a limited amount of both upland and bottomland usable as cropland.

The water available for irrigation in the sediment pools of the floodwater retarding structures would irrigate less than half of the allotted cotton acreage in the watershed. The water storage for 10 of the 36 planned structures could be increased to provide water for irrigating nearly half of the farms in the watershed to their economic potential. Estimates

indicate that irrigation as a major purpose in upstream watershed development would be economically feasible for Boggy Creek and perhaps for many watersheds in Oklahoma.

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

## Hydrology

Cooperative Research Project. HYDROLOGY OF SMALL WATERSHEDS IN RELATION TO VARIOUS CROP COVERS AND SOIL CHARACTERISTICS--A PICTORIAL BROCHURE. TVA in coop. with N.C. State Col. Agr. and Engin., 24 pp. 1962.

A project was established to evaluate the effects of management and principal agricultural land covers on the hydrologic characteristics of important soils of the western North Carolina area. Small watersheds planted to one cover at a time are being used.

The major objectives of the project are: (1) Obtain hydrologic information under five major plant covers on principal soils of western North Carolina; (2) obtain information on changes in physical characteristics of these soils under different land practices; (3) correlate hydrologic and soils information, and develop methods of measuring and separating the effects of numerous variables; and (4) develop a program of land use which will protect the watersheds and provide maximum utilization of water resources in farming systems.

Five small agricultural watersheds, 3 to 6 acres in size, located on soils and slopes representative of the region, are used in measuring the effects of types of plant cover upon soil moisture, evapotranspiration, runoff, and ground water levels. Major lands covers being studied are: (1) Improved clover-grass pasture; (2) overgrazed, heavily trampled, improved clover-grass pasture; (3) wheat with lespedeza summer cover; (4) corn; and (5) alfalfa.

The data being obtained are prerequisite to the development of a program of land use which will provide maximum utilization of the water resources of this area while protecting valuable farm land from damage by surface runoff and erosion. The principal findings to date were given.

N.C. State Col. Agr. and Engin., Raleigh, N.C.

Hardaway, G. D., and Thompson, J. R. A STUDY OF WATER YIELD FROM THE SANTA FE RIVER WATERSHED. Rocky Mountain Forest and Range Expt. Sta., Sta. Paper 70, 18 pp. 1962.

The Santa Fe River watershed has a history of heavy use, followed by an extended period of nonuse. Whether this drastic change in land use affected water yield was studied, and the basic precipitation-runoff relationships for that watershed were determined.

The Santa Fe River watershed is located within the Santa Fe National Forest, New Mexico, in the Sangre de Cristo Mountains. The present gaging station is located at the lower edge of the ponderosa pine type. The area above the station comprises 18.2 square miles of steep and rough terrain, 90 percent of which is covered with conifers. At its headwaters near Lake Peak, the stream is fed by Santa Fe Lake. From that point, at an elevation of 11,500 feet, the stream travels 9.2 miles to the gaging station, with a drop in elevation of 3,800 feet. Flow at the stream gage is regulated by McClure Reservoir.

The stream-gaging records date from April 1913. There has been three different gaging sites.

Average precipitation for the Las Vegas and Santa Fe weather stations was used in the analyses. Both weather stations are about 20 miles from the watershed.

Highly significant correlation was found to exist between annual amounts of streamflow and the Las Vegas-Santa Fe precipitation index. Summer rainfall was a relatively important source of streamflow in the Santa Fe watershed.

A decline in water yield between the period 1914-25, when the Santa Fe watershed had considerable unmanaged use, and the period 1932-57, when the watershed was closed to use, seems to be attributable to a decline in precipitation.

Differences in water yield, caused by changes in land use, could not be segregated from other differences with the type of data available.

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

Marston, R. B. INFLUENCE OF VEGETATION COVER ON SOIL MOISTURE IN SOUTHEASTERN OHIO. *Soil Sci. Soc. Amer. Proc.* 26: 605-608. 1962.

To obtain information of the effect of forest watershed vegetation on the amount of water available for streamflow, soil moisture to a depth of 36 inches was studied for 22 months in southeastern Ohio on oak, pine, broomsedge, brush, and cleared plots. Moisture content near the end of the dormant season was used as a measure of field capacity. It varied from 11.49 inches of water on the pine plots to 13.12 inches of water on the broomsedge plots. Generally, soil moisture declined throughout the summer and increased during the winter, but occasionally summer rainstorms were large enough to rewet the soil to field capacity. Late-summer soil moisture deficits were greatest under oak and least under cleared, whether calculated on the basis of measured field depths or on the basis of equal volumes of soil. Water used in a 6-month growing season ranged from 21 inches under cleared to 25 inches under pine. Additional water was withdrawn during the dormant season. The 2-year average amount of precipitation required to refill the soil was 6.5 inches greater under pine than under broomsedge--broomsedge being the minimum cover practical here. Good opportunities exist in Ohio to affect streamflow and flood control through the manipulation of the forest cover.

Central States Forest Expt. Sta., FS, USDA, Columbus, Ohio.

Willis, W. O., and Carlson, C. W. CONSERVATION OF WINTER PRECIPITATION IN THE NORTHERN PLAINS. *J. Soil and Water Conserv.* 17: 122-123. 1962.

Soil moisture conditions in the fall and general weather conditions during the winter governs depth of freezing, spring runoff, and moisture retention by the soil. Even though there was less runoff from a plot that was dry in the fall, the gain in soil moisture was not of sufficient magnitude to bring the moisture level of the dry plot up to the moisture level of the wet plot. Attempts to increase storage of winter precipitation by maintaining the soil in a dry condition in the fall, through use of a practice such as fall cropping, may not be advantageous. The amount of runoff and erosion in the spring may be reduced by using such a practice; however, the quantity of soil moisture available to the succeeding crops under dryland conditions may also be reduced.

After the soil began to thaw in the spring, the period required for complete thawing was found to be rather short. However, it was during this period of a few days that a large part of the winter precipitation was lost. Almost any means of holding the snowmelt in place until it infiltrated the soil was advantageous in retaining soil moisture. The level or conservation bench terrace was valuable in this respect.

SWCRD, ARS, USDA, Mandan, N. Dak. 58554.

## Geology

Cooperative Report. THE VIRGINIA TIDAL RIVERBANK EROSION SURVEY. Va. Agr. Expt. Sta. Res. Rpt. 65, 15 pp. 1962.

A study of shoreline erosion along both banks of the Rappahannock and a 51.4-mile section of the south bank of the Potomac in Tidewater Virginia, together with their tidal tributaries was made. As a whole, the average rate of bank recession along these rivers and tributaries was not too alarming. The fact that the rate varies from site to site and from year to year adds to the seriousness of the problem. So often the most desirable locations for homes and other developments are the most vulnerable sites. There was a large population increase along the tidal rivers in recent years, and a real population explosion is predicted for the area in the future. The value of waterfront property is increasing at a very rapid rate and the trend is expected to continue.

The shore erosion problem is becoming increasingly important to both the landowner and the public. While the landowner suffers the direct loss of property, the deposition of eroded materials often blocks or impairs the use of navigable streams. In both cases, remedial measures are costly and technically complicated. It will be necessary to develop a comprehensive shore erosion control program, which will meet the needs of both the private landowner and the public, in order to cope successfully with the problem.

The very foundation of the program must be firm community organization and effort, so that corrective measures incorporating the most advanced technical knowledge can be applied to natural physiographic units of shoreline rather than to short reaches defined by individual property lines.

The erosion-causing forces of waves, winds, and tides are so enormous and act in such a wide range of complex combinations that even the best designed control measures utilizing the latest scientific knowledge sometimes fail. Any structure less carefully designed can be expected to fail; and poor designs often actually aggravate the problem.

Research both in this country and abroad is continually supplying new technical knowledge and advancing the overall science of shore erosion control. Much valuable information, both positive and negative, is being obtained from the efforts of landowners to solve their bank erosion problems on these rivers.

Many states have already adopted various programs and policies for dealing with the shore erosion problem. Others are in the process of formulating policies and procedures. Virginia has assisted several municipalities on shore erosion control but has not formulated a definite policy or action program to combat the problem.

Virginia State Soil Conserv. Comt., SCS, USDA, and Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

## Engineering Design

Coleman, N. L. OBSERVATIONS OF RESISTANCE COEFFICIENTS IN A NATURAL CHANNEL. International Assoc. Sci. Hydrol., Comn. Land Erosion 59: 336-352. 1962.

Observations were made of the instantaneous Darcy-Weisbach resistance coefficients in a natural channel during short discrete periods of flow. The results show that the channel resistance coefficient changed considerably as a runoff event progressed. The shape of the time-resistance graph was apparently related to the intensity and duration of the flow. The variation of resistance was believed to be due to changes in the effective channel roughness



that were caused by modification of the channel bed configuration and by differing degrees of bank submergence as the runoff event progressed.

SWCRD, ARS, USDA, Oxford, Miss. 38655.

Anderson, H. W. WATER MANAGEMENT FORESTRY--A MODEL APPROACH. Fifth World Forestry Congress Proc. 5 pp. 1962.

Forest management for water yield and water control can be guided by the results of analyses using regression equations as models. When these models include physical expressions of the forest rationally related to the water product, it is possible to predict the effect of changes in forest conditions, to design forest conditions, and to estimate their effectiveness. Alternative methods in management may be substituted into an appropriate regression model, expressing the effects of forest condition on total water yield, floods, and sedimentation. From the results, an acceptable or optimum combination of forest management can be selected. Management may be guided toward repair of those forest conditions whose consequences are unacceptable. If the water management aspects of forest management are accurately evaluated, forest management decisions which optimize all forest products--wood, forage, and water--can be improved.

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

## WATER MANAGEMENT

### Irrigation

Verner, L. A NEW KIND OF DENDROMETER. Idaho Agr. Expt. Sta. B. 389, 7 pp. 1962.

A new kind of dendrometer, developed at the University of Idaho, measures the radial growth made by a tree trunk during periods of one or more days. This instrument was used successfully in Idaho for the measurement of growth in fruit trees as a guide to scheduling orchard irrigation and in the growth of various forest-tree species. Unlike dial-gauge dendrometers previously available, the lever dendrometer described provides readings that were not affected by daily trunk shrinkage. The Idaho instrument shows maximum radius attained by the trunk since the last previous reading.

U. Idaho, Col. Agr. Moscow, Idaho.

Verner, L., Kochan, W. J., Ketchie, D. O., Kamal, A., Braun, R. W., Berry, J. W., Jr., and Johnson, M. E. TRUNK GROWTH AS A GUIDE IN ORCHARD IRRIGATION. Idaho Agr. Expt. Sta. Res. B. 52, 32 pp. 1962.

In Idaho orchards, the intervals between irrigations varied from 7 to 28 days. A 14-day interval was the one most widely used.

Experiments in apple and prune orchards, using a system in which the scheduling of irrigations was based on trunk-growth rates, showed that intervals between irrigations may often be extended to 28 to 42 days with no reduction in yields. The possibility of comparable

reductions in the irrigation of peach orchards was shown. Radial growth of trunks was measured at 1- or 2-day intervals by a new type of dendrometer calibrated in 5,000ths inches.

The Fritts dendrograph showed that the radial thickness of apple tree trunks undergoes almost continuous change, decreasing from early morning to late afternoon and increasing from late afternoon until early morning. Radial changes were influenced both by growth and by degree of hydration of the tissues. Differences in peak radii recorded on successive days primarily represent growth.

Scheduling irrigation by trunk growth requires uniformity in age, vigor, and crop loads of the trees and reasonably uniform soil. A control plot of 10 trees each with a dendrometer attached was irrigated at sufficiently frequent intervals (usually every 14 days) to assure a continuously adequate soil-moisture supply. The rest of the orchard was irrigated whenever average trunk growth of a second lot of 10 trees declined a predetermined amount below that of the control plot.

Trunk growth proved to have several advantages over fruit growth as a guide in scheduling orchard irrigation. Trunk growth was far more sensitive than fruit growth to moisture stress. Trunk growth was much reduced at soil-moisture levels well above the permanent wilting point, but fruit growth was not. In the trunk, radial increments were reduced 51 percent when the top 3 feet of soil still contained from 2.7 to 5.5 percent of moisture above the point of permanent wilting, while the concurrent rate of fruit growth showed a reduction of only 1.5 percent below that of the control plot. In no case was the rate of fruit growth reduced until long after a decline in trunk growth was recorded. Trunk growth can be used as a guide when fruit growth cannot, as in young trees not in bearing, in bearing trees in years of crop failure, and in species with fruit too small to measure easily, such as cherries.

Measurements of fruit circumference always are subject to error because of fruit shrinkage during the intensified transpiration rates that usually characterize the early part of each day. Shrinkage of the trunk also takes place at those times but does not affect readings with the lever dendrometer as that instrument does not respond to trunk shrinkage but always provides a reading of the maximum radius attained during the period under study.

In 12-year-old apple and peach trees, trunk growth continued until harvest or later. In 23-year-old apple trees and 12-year-old prune trees, growth of trunks was much reduced or had ceased by mid-August, making dendrometer readings more difficult to use because small errors became proportionately more important.

Trunk growth was reduced by the presence of a crop in 4-year-old Golden Delicious apple trees. Trunk growth was strongly influenced by weather and soil moisture. Daily radial increments were increased by rain and high humidity and decreased by high temperature and low humidity.

Irrigation usually was followed by an immediate, substantial increase in trunk-growth rate, the magnitude of the increase tending to be greatest in plots that had suffered the greatest moisture deficit. Following irrigation of low-moisture plots, their trunk growth often continued for periods of 2 or more weeks at levels well above those of corresponding control plots.

U. Idaho, Col. Agr. Moscow, Idaho.

Faulkner, M.D., and Miars, R.J. LEVELING RICE LAND IN WATER. La. Agr. 5(4): 3, 16. 1962.

Proper irrigation of rice depends upon how well the depth of the water can be controlled and how uniformly the irrigation water can be applied. Where there is variation in land

elevation, leveling can solve many problems connected with irrigation. Leveling reduces the number of levees needed, cuts levee maintenance, and provides for easier soil preparation, flooding and draining. It makes harvesting easier and helps in the irrigation of crops other than rice that are grown on the land. Leveling reduces the chance of washing levees away and reduces grass infestation that usually spreads from the levees.

Leveling can be made easier and more effective by flooding the land and working the machinery in the water. Because of the plow sole pan found in most rice soils, equipment can be supported under flooded conditions. By using the water as a moving agent, greater amounts of soil can be moved in water than on dry land when the same equipment is used. By leveling in water, levees can be greatly reduced in number or eliminated in small fields.

Two methods are commonly used in water-leveling riceland. One is to build a levee around small land areas and eliminate all other levees within the field. The other, normally used in large fields, is to remove every second levee and level within those remaining.

In using either method, the soil is worked into a loose seedbed and, after being flooded, is moved with a blade and a tractor of 50 horsepower or greater. The blade can be a one-blade land leveler with float removed or any other blade approximately 10 feet wide pulled at a right angle to the direction of travel. Flood only the land that can be leveled in one day, since soil becomes compacted when partially worked and then allowed to remain under water overnight.

Land should always be leveled to within 0.2 foot between levees for good water control. This allows a minimum water depth of 4 inches and a maximum depth of 6.4 inches. Water depths of less than 4 inches are ineffective in controlling grasses, while depths of more than 6.4 inches injure the rice and result in greater pumping costs for the increased volume of water.

Leveling in water normally is difficult where elevation varies more than 0.6 foot. The difficulty is encountered where the water is deepest, since the land to be cut and filled is hard to see.

When leveling in water, the following procedure should be followed: (1) Make a good seedbed the depth of top soil, then smooth; (2) construct levees that are to remain after leveling; (3) flood only the land to be worked in one day; (4) work the soil from the high to the low of the cut; (5) watch or measure the water depth to determine where soil is to be moved; (6) drain field only after water becomes clear to avoid loss of top soil, then allow soil to dry; (7) work the soil into a seedbed; (8) smooth with a land leveler to remove small highs and lows left by equipment; (9) level a small area the first year to determine the effects on the soil; (10) level at least 6 months before planting; and (11) move only small amounts of soil.

La. State U. Rice Expt. Sta., Crowley, La.

Paterson, D. R., and Speights, D. E. SOME EFFECTS OF IRRIGATION AND FERTILIZER ON THREE VARIETIES OF SWEET POTATOES. Tex. Agr. Expt. Sta. Prog. Rpt. 2254, 5 pp. 1962.

Porto Rico, Copperskin Goldrush, and Redgold sweet potato varieties were tested with two irrigation treatments in combination with a 3 X 3 X 3 NPK complete factorial experiment on Izagoria fsl soil at Hern, Tex., in 1959.

Supplemental irrigation decreased the yield of the No. 1 grade Porto Rico roots 4 percent and increased the yield of cull and No. 2 grade sweet potatoes. The Copperskin Goldrush and Redgold varieties responded to irrigation with a 38 and 68 percent increase, respectively, in the yield of the No. 1 grade.

As nitrogen was raised from 0 to 50 and from 50 to 100 pounds per acre, it increased total yield. On the basis of No. 1 grade, the Porto Rico variety responded only to the application of 50 pounds of nitrogen per acre. The Copperskin Goldrush and Redgold varieties showed an increase in yield of the premium grade up to 100 pounds of nitrogen per acre. There was no yield response to either applied phosphorus or potassium.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Staff writer. IRRIGATION RESEARCH SHOWS HIGH SOIL MOISTURE BEST FOR INCREASED BEAN YIELD. Idaho Agr. Sci. 47(4): 8. 1962.

Proper irrigation throughout the snap bean growing season speeded maturity and increased yields. High soil moisture levels early in the growing season caused bean plants to mature early and usually increased yield of seed. Conversely, low soil moisture levels late in the season tended to force the plants to maturity resulting in decreased seed yield. A low soil moisture level early in the season and a high soil moisture level late in the season resulted in larger seed. Germination was highest and slight to moderate injury lowest in seed grown under a high soil moisture level for the entire growing season.

In dry years, bean growers are interested in saving water. Although the amount of water the plant uses decreases as the number of irrigations decrease, saving water by reducing the number of irrigations is not advisable. A better practice is to apply water more often and more efficiently to reduce surface runoff and deep percolation. Plants require a certain amount of easily available water for good seed production, and moisture stress reduces yield out of proportion to the amount of water saved.

The 8-day period of field curing resulted in more seedlings with slight to moderate injury than the 4-day curing.

No address given.

Wight, J. R., Lingle, J. C., Flocker, W. J., and Leonard, S. J. THE EFFECTS OF IRRIGATION AND NITROGEN FERTILIZATION TREATMENTS ON THE YIELD, MATURATION, AND QUALITY OF CANNING TOMATOES. Amer. Soc. Hort. Sci. Proc. 81: 451-457. 1962.

The effects of 3 irrigation treatments on yield and quality of canning tomatoes were studied. These treatments represented moisture ranges of near optimum, excessively wet, and excessively dry. Control was obtained by using soil moisture blocks and tensiometers to indicate when to irrigate. Excessive irrigation decreased yield and percent well-colored fruit, delayed maturity, lowered percent soluble solids of raw fruit, and tended to increase percent wholeness and percent retention of the canned fruit. Excessive dryness increased percent soluble solids and percent well-colored fruit; it hastened maturity, but decreased yields and tended to decrease percent wholeness, percent retention, and pH of the canned fruit.

Three levels of N fertilization were studied--20, 80, and 200 pounds N/A. of which two and possibly all three were in excess of the amount needed for maximum yield. Excessive N had no effect on yield, rate of maturity, or any of the quality factors measured.

U. Calif., Davis, Calif.

Moomaw, J. C. IRRIGATED FORAGE AND GRAIN SORGHUM TRIALS AT KEKAHA, KAUAI. Hawaii Agr. Expt. Sta. Tech. Prog. Rpt. 134, 15 pp. 1962.

Results of trials of irrigated, winter-grown grain and forage crops were reported from Kekaha, Kauai, Hawaii. Sorghum, corn, and soybeans were planted in a randomized block, split-plot design with four replications. The plantings were made in mid-October in one of the warmest, driest environments in the Islands.

Applications of 350 pounds of 11-13-10 fertilizer were made to all plots at planting time with an additional 300 pounds of the same material being applied to one-half of each plot after 4 weeks. No improvement in grain or forage yield was derived from the application of additional fertilizer on any variety.

High yields of grain were obtained from sorghum varieties 37-X (3929 lbs. per acre), 46-X (2467 lbs. per acre), Sart (1890 lbs. per acre), C44a (1854 lbs. per acre), and 400-C (1759 lbs. per acre). Corn varieties were not sufficiently mature at harvest to assess potential yield of grain.

Yields of green forage from SX-11 (26.0 tons per acre), Mayorbello corn (22.7 tons per acre), Hawaiian yellow corn (18.7 tons per acre), and 37-X (18.5 tons per acre) were adequate.

Damage from the sorghum midge, corn earworm, or birds was low on all varieties. Salt damage from the 80-grain irrigation water was low.

Yield of pol (sugar content of the cane juice determined in a polarimeter) in SX-11 was high (0.4 ton per acre-month) when harvested before maturity of the grain.

HCN content of the forage of sorghums was well below toxic levels.

Hawaii Agr. Expt. Sta., U. Hawaii, Honolulu, Hawaii.

McMaster, G., Walker, J. G., and Owens, E. W. IRRIGATION AND FERTILIZATION OF FIELD CORN GROWN FOR SILAGE IN SOUTHEASTERN IDAHO. Idaho Agr. Expt. Sta. B. 392, 15 pp. 1962.

A project initiated in 1957 was conducted for 4 years to test the effect of soil moisture level and fertility on the yield, moisture content, and quality of corn silage. For the first 2 years, 3 soil moisture levels were maintained by varying the irrigation frequency. Twelve fertilizer treatments were used--combinations of three rates of nitrogen, two rates of phosphate, and two rates of potash. After 2 complete years, different irrigation treatments were selected to maintain a high and low soil moisture level from the time the crop was planted until tasseling occurred and a high low soil moisture level from tasselling to harvest. The number of fertilizer treatments was reduced to 6-3 rates of nitrogen and 2 rates of phosphate.

The soil moisture level maintained in the root zone throughout the entire growing season did not materially affect the total yield of corn although the high soil moisture treatments resulted in a higher silage-moisture content. A low soil moisture level early in the growing season resulted in a greater yield of silage. The number of desirable characteristics such as high ear-weight to total-yield ratio, early silking rate, and mature ears was increased by maintaining a relatively low soil moisture level in the early part of the growing season.

The results were summarized as follows: (1) Consumptive use was increased as the soil moisture level was increased. (2) Maximum total yield was obtained from plants grown under a low soil moisture level from planting until tassels appeared--moisture varying from 100 percent to 40 percent field capacity. (3) Plants grown under low soil moisture

level the second half of the season produced as much silage as those grown under the high moisture levels. (4) The application of nitrogen increased yield most significantly when applied to the high soil moisture level plots. (5) Silage moisture was increased as soil moisture was increased, especially in the last half of the growing season. (6) Nitrogen deficiency caused a great increase in leaf firing. Leaf firing occurred in cases where nitrogen was not applied to the plots or where the amount of available nitrogen was reduced by the application of excess irrigation water. And (7) ear-weight to total-yield ratio was increased as the soil moisture level was decreased in the early part of the growing season.

U. Idaho, Col. Agr. Moscow, Idaho.

Burman, R. D., Painter, L. I., and Partridge, J. R. IRRIGATION AND NITROGEN FERTILIZATION OF FIELD CORN IN NORTHWEST WYOMING. Wyo. Agr. Expt. Sta. B. 389, 15 pp. 1962.

Throughout 3 years of study, 1958-60, nitrogen-fertilizer applications (80, 160, and 240 lbs. of actual nitrogen per acre) always caused significant increases in the yield of field corn over the check plots, harvested for use as either grain or ensilage. This was true for a wide range of soil-moisture regimes.

In two of the years, frequent irrigations, or irrigation at low tension; caused a significant increase in the yield of ensilage.

Irrigation frequency or pre-irrigation tension limits did not cause a significant change in one year in the yield of corn harvested for grain. Severe conditions of drouth were not studied. The range in irrigations was from two to nine per season.

In 1959, there was a significant interaction between pre-irrigation soil-moisture level and nitrogen-fertilization level. The response to high nitrogen (160 lbs. per acre) was much higher under irrigation at 1, 2, and 4 atmospheres of soil-moisture tension than under the high stress condition of irrigation at 8 atmospheres. In 1959, an application of 80 lbs. of actual nitrogen per acre, irrigated from four to nine times, produced nearly the same amount of ensilage and grain as 160 lbs. of nitrogen per acre when irrigated only two times during the season.

There was no consistent change in the number of irrigations required to maintain desired soil-moisture conditions because of nitrogen-fertilization levels.

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

Rumery, M. G. A., and Ramig, R. E. IRRIGATED SUDANGRASS FOR DAIRY COWS. Nebr. Agr. Expt. Sta. B. SB 472, 12 pp. 1962.

Two methods of grazing irrigated sudangrass pasture with Holstein dairy cows were studied for 3 years. These grazing methods were: Strip grazing, which provides fresh pasture each day; and rotational grazing, in which the cows were moved from pasture to pasture as choice forage was depleted. Supplements were fed in each case. Dairy milk production per cow was 30.3 pounds when the cows grazed fresh pasture daily and 30.0 pounds when they rotationally grazed the sudangrass. Average daily body weight gains were 1.23 pounds and 0.95 pounds, respectively.

Cows grazed on fresh pasture daily produced an average of 2,514 pounds of 4 percent FCM (fat-corrected milk) per acre, whereas those on rotational grazing produced 2,487 pounds.

Results indicated no advantage in providing a fresh pasture daily compared to rotational grazing of irrigated sudangrass.

Another 2-year experiment was conducted to test whether or not the dairy cow is an efficient harvesting unit. This experiment compared the results of rotational grazing with the dry-lot feeding of green, chopped sudangrass.

Feeding green, chopped sudangrass produced slightly less milk per cow daily than rotational grazing. The difference in average daily production between 34.0 and 35.4 pounds of 4 percent FCM respectively, was not statistically significant.

Milk production from green, chopped sudangrass with supplemental feed averaged 9,503 pounds of 4 percent FCM per acre, whereas rotational grazing of sudangrass with supplemental feed produced 3,500 pounds. At \$4.30 per hundred pounds, this difference amounted to \$185.00 an acre more return for feeding green, chopped sudangrass than for grazing sudangrass.

No significant differences were observed in estimates of total digestible nutrients required to produce milk when cows were grazed or fed green, chopped sudangrass.

U. Nebr. Col. Agr., The Agr. Expt. Sta., Lincoln, Nebr.

Smith, L. E., Thomas, D. W., and Wiersma, D. AN ECONOMIC ANALYSIS OF WATER, NITROGEN AND SEEDING RATE RELATIONSHIPS IN IRRIGATED CORN PRODUCTION. Purdue U. Agr. Expt. Sta. Res. B. 755, 24 pp. 1962.

Some of the important inter-relationships among water, nitrogen, and seeding rate and the influence of these on an economic optimum were studied.

The relationship between water, nitrogen, seed, and corn yield was complex, in that no one variable by itself had a dominant effect on corn yield. The effect of water on corn yields was influenced by the levels of both nitrogen and seed. Interaction between nitrogen and seeding rate did not exist.

Total and marginal physical products were calculated for various combinations of water, nitrogen, and seeding rate. Isoquants were constructed to determine the amount and type of substitution between any two variables. The total product of water increased at a decreasing rate throughout the range of water inputs used. The total product of water was near linear in form and gave rise to marginal physical products as great as 16.26 bushels per acre.

Estimates of the most profitable level of water, nitrogen, and seeding rates were made, for each single and two variable combination, holding the other variable or variables constant at predetermined levels. These optimal levels were determined for various factor-product and factor-factor price ratios to determine the effect of price changes on the optimal levels of water, nitrogen, and seeding rate in single and two variable combinations.

The optimal level of water and seeding rate was influenced by the nitrogen level, the price of corn, and the variable cost of water and seed corn. The variable cost of water was not fixed by the market structure, but depended on such factors as type of irrigation, size of irrigation operation, and labor efficiency. The optimal levels of water and seed decreased quite rapidly as the price of water was increased. Corn yields also decreased nearly proportionally resulting in a rather constant profit after water and seed cost. The same general relationship was found for the water-nitrogen combination.

The optimal inputs of nitrogen and seeding rate were affected by economic conditions (price of the factors and the market price of corn) and the physical conditions (the amount of substitution between nitrogen and seed). In general, the lower the price of corn relative to the factor cost the lower the optimal corn output will be; and the higher one factor price is relative to another, the less of that factor will be used. However, the physical conditions found in the production process may lessen the effect of these economic forces.

Changes in the price of nitrogen affected the economic optimal combination of nitrogen and seeding rate when the corn yield was allowed to vary. By increasing the variable cost of nitrogen from 2 to 14 cents per pound, a decrease of 67.4 pounds of nitrogen was accompanied by a decrease of 110 kernels of corn per acre. The economic optimal corn yield declined only 3.8 bushels per acre. The factor of maintaining the optimal combination of nitrogen and seeding rate increased as the variable cost of nitrogen increased, total returns remained relatively stable, and gross profit declined.

In determining the proper level of water, nitrogen, and seed to use in corn production one must consider the combined effect of the combination of water, nitrogen, and seed, and their effect on corn yield.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Hughes, W. F., and Magee, A. C. PRODUCTION PRACTICES AND SPECIFIED COSTS OF IRRIGATING ROW CROPS, LOWER COAST PRAIRIE, 1958-60. Tex. Agr. Expt. Sta. MP-616, 8 pp. 1962.

The combination of physical resources and climatic environment of the Coast Prairie contributes to variation in conditions affecting irrigated crop production. Operators of irrigated farms are faced with decisions considerably more complex than those ordinarily encountered in most other irrigated areas.

Irrigation facilities for row crops were developed on the Coast Prairie at an average cost of \$53 per acre irrigated. The annual irrigation operation expenses ranged from \$2.25 to \$4 per acre. Most crop production practices, including crop varieties used, seeding rates, cultural practices, and hoe labor requirements, were similar on irrigated and nonirrigated crops. Irrigation operation required an increased rate of fertilizer use and additional labor for applying the water.

Irrigated cotton, corn, and grain sorghum yields on the Coast Prairie have not measured up to those normally obtained in most other irrigated areas. Part of this may be due to lack of experience with irrigated crop production, but mainly it reflects the yield-reducing effects of excess rainfall at certain times. Cotton, the major irrigated crop, was particularly susceptible to yield reduction from excess moisture during both the growing and harvest seasons.

Avoiding or minimizing weather damage, particularly during harvesting season, was the major problem with irrigated row crop production on the Lower Coast Prairie.

Agr. and Mech. Col. Tex., Agr. Expt. Sta., College Station, Tex.

## Drainage

Agricultural Research Service. UNDERGROUND PRIVATE EYE. Agr. Res. 11(5): 8-9. 1962.

A self-propelled "private eye" can inch its way through an underground drainage line in a farmer's field and record what it sees. The device is a camera with remote control, built as a research tool to locate damaged or clogged tiles.

The camera should prove useful to farmers in finding clogged spots in their drainage systems. With photographs from the self-propelled camera, scientists can inspect a much greater length of drainage line than is possible when a random tile is excavated and examined. They can insert the camera at the drainage outlet or at any point along a line where tile is exposed by excavation.



The experimental device consists of a 35 mm. camera and electronic flash installed in a clear plastic tube about 3 inches in diameter and 16 inches long. The tube is mounted on two wide wheels, one at each end. A small reversible, battery-operated motor geared to the rear wheel moves the unit through the tile line.

Controls for the camera and motor are located in an aboveground unit connected to the tube by a cable. From this light-weight control unit, the cameraman can operate the camera and flash device, advance the film, and move the tube forward or backward in the tile line. Plastic tabs on the control cable indicate the distance the camera tube has moved into the drain, which enables the operator to determine the exact location of clogging.

Pictures taken by the camera can show roots in drainage lines, gravel at the tile joints, and misalignment of individual tiles.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781.

Mackenzie, A. J. CHEMICAL TREATMENT OF MINERAL DEPOSITS IN DRAIN TILE. J. Soil and Water Conserv. 17: 124-125. 1962.

Investigations into the malfunction of tile drainage systems in the Imperial and Coachella Valleys of California revealed the presence of mineral deposits which were affecting the performance of the drain tiles. The inside of the tiles, particularly the joints between the tiles, was found to contain accumulations of insoluble mineral materials that clogged the joints and restricted water entry into the drainage systems. In some cases, drainage lines were affected to such an extent that a water table had developed over the lines and the increased soil salinity had severely inhibited plant growth.

Two types of deposits that cause malfunction of drainage systems were found in tile sections. One was a black material consisting mainly of manganese oxide, the other was a reddish-colored material that resembled ordinary iron rust and was predominately iron oxide. Either one or both of the deposits were found in both concrete and clay tile systems.

The incidence of these mineral deposits in tile lines in the Imperial and Coachella Valley areas followed no distinct pattern in relation to soils, age, and design of the drainage systems, or geographic location.

Some progress in applying remedial measures was made. It was possible to restore the efficiency of affected lines by chemical treatment. Mechanical scrapers and brushes failed to dislodge the deposits from the tile joints where the important sealing action occurred.

A mixture of sulfuric acid and sodium bisulfite readily dissolved both the red and black deposits clogging the tile lines at a cost of \$3 to \$5 per acre for systems having 4- or 5-inch diameter laterals spaced 350 feet apart. The sulfuric-acid sodium-bisulfite solution treatment required considerable labor and careful metering of chemical solutions and farmer interest and acceptance of the treatment lagged.

Sulfur dioxide was found to be equally effective in dissolving the mineral deposits. The sulfur dioxide was obtained as a compressed gas in cylindrical steel tanks. It was injected directly into the drain line under its own pressure. The labor requirements were relatively small and the troublesome jobs of mixing up the noxious sodium bisulfite solution and handling corrosive sulfuric acid were eliminated. The sulfur dioxide gas was injected into the upper end of the drainage system through the same type of riser that was used for the sulfuric-acid sodium-bisulfite solution treatment. The gas was added to the lines at the rate of 1 pound of sulfur dioxide for every cubic foot of tile volume. The outlet end of the drainage system was closed for a 24-hour period after the air in the lines had been displaced by the sulfur dioxide gas. To obtain the desired chemical reaction, it was necessary to have water in the lines along with the sulfur dioxide.

The current price for sulfur dioxide gas brings the cost of this treatment to about the same level as that involved with the sulfuric-acid sodium-bisulfite solution treatment.

SWCRD, ARS, USDA, Brawley, Calif. 92227.

## Evaluation of Flood Water Damage

Rhoades, E. D. GRASSES AND FLOOD SURVIVAL. Agr. Engin. 44: 22-23. 1963.

An important project of the Soil Conservation Service's watershed protection program is the construction of detention reservoirs to temporarily trap water from heavy rains. When not flooded these detention areas furnish grassland for livestock. Prolonged spring rains in past years have killed many acres of native grasses in the detention pool areas of Texas, Oklahoma, and Kansas. Knowledge of the ability of selected grasses to survive temporary submergence would help in selecting grasses for detention pool areas and in establishing criteria upon which to base water-release rates.

Grasses were planted in each basin in rows running parallel with the slope. Depth of flooding varied from a few inches to 6 feet during inundation. Perennial warm-season species commonly found in the Southern Great Plains Region were selected. The flooding schedule duplicated the depth and duration of the usual spring floods.

Grasses of all species inundated during early spring when plants were semidormant survived without appreciable damage other than slight suppression of growth. This damage, although apparently minor, influenced the survival ability during subsequent floodings.

In general, the greater the depth and duration of flooding, the quicker individuals of a given species succumbed. Many grasses survived short durations of shallow flooding, but were largely or completely destroyed by an equivalent duration of deep flooding. Such variation in tolerance suggests the possibility of contour planting of selected species based on the expected duration of inundation of a given level in the detention pool.

Bermudagrass, buffalograss, vine-mesquite, KSU lowland switchgrass No. 2218, and prairie cordgrass withstood mid-spring and late-spring flooding better than Caddo switchgrass, Eastern gamagrass, alkali sacaton, bluestem, and Weeping lovegrass.

SWCRD, ARS, USDA, Chickasha, Okla. 73018.

## Storage and Conveyance

Agricultural Research Service. SELECTIVE APPETITE IS PUT TO WORK AS--SNAILS WEED WATERWAYS. Agr. Res. 11 (3): 8-9. 1962.

The snail (Marisa cornuarietis L.) was tested as a control of several aquatic weeds that impede southern U.S. waterways. The results were encouraging.

The snail made a clean sweep of four weeds--coontail, southern naiad, Illinois pondweed, and salvinia. All are troublesome in canals, ponds, and lakes. The snail inhibited growth and flowering of water-hyacinth and partially controlled alligatorweed--which are among the worst aquatic weeds in the United States. It partially controlled waterlettuce and fed readily on fanwort and filamentous algae.

In limited tests, 3- and 4-week-old rice plants suffered very little damage, even though the snails had no other source of food. But younger transplants and germinating rice seeds did not survive. In previous tests, the snails destroyed rice seedlings grown from direct field planting of seed--commonly used in the United States--but did little damage to older transplants.

Control of aquatic weeds by the Marisa snail might help control disease inexpensively in many parts of the world. Most earlier observations concerning the snail's weed-control potentialities were made in connection with its disease-control effects. Weed control would permit fuller use of waterways for agriculture, transportation, hydroelectric power, fisheries, and recreation.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781.

## BASIC SOIL SCIENCE

### Soil Physics

Harper, H. J., and Brensing, O. H. A PRELIMINARY STUDY OF WATER-STABLE AGGREGATES IN OKLAHOMA SOILS. Okla. Expt. Sta. Processed Ser. P-423, 47 pp. 1962.

Water-stable aggregates were determined in 29 virgin and 29 cultivated soils collected from 11 Oklahoma counties. A higher percentage of coarser water-stable aggregates was obtained in all samples when analyses were made on moist soils soon after they were collected as compared with analyses made on the air dried samples. The disintegration of aggregates in the air-dry soils as a result of rapid wetting did not follow any definite pattern. A higher percentage of the coarser aggregates present in the moist cultivated soils disintegrated into granules finer than 0.053 mm. than in moist virgin soils.

The organic matter content of the water-stable aggregates was quite variable, but in no instance was it below 2 percent in the coarse aggregates of the medium-textured and fine-textured soils. No separation of the aggregated material in the sandy soils was made. However, the organic matter content of the coarsest and the finest aggregates in Pratt s1 and Foard vsl were equal to or higher than the organic content of aggregates in many of the medium-textured and fine-textured soils.

The organic matter content of granules that passed through the openings in an 80-mesh sieve and held on a 270-mesh sieve usually was lower than in finer or coarser fractions obtained from the same sample. Complete reaggregation occurred in some cultivated soils since all aggregate groups separated from the cultivated soils were much lower in organic matter than aggregates of a similar diameter separated from an adjacent virgin soil.

The sand, silt, and clay content of the coarse water-stable soil aggregates was similar to the sand, silt, and clay content of the whole soils. This indicates that water-stable aggregates were formed in place as a result of the cementing effect of organic matter and plastic clay.

Rapid wetting of two air-dry soils and wetting more slowly by capillary action gave very different results in the percentages of coarse water-stable aggregates as compared with data obtained on moist samples collected from the field.

Incubating air-dry soils moistened by capillary action for periods of 3, 6, 9, 12, 18, and 24 days indicated that soil aggregates could be increased or decreased in a short period of time as a result of biological activity. Greater variations were observed in changes in the coarse aggregates in Hollister sil than in the Labette sil.

The length of time that an air-dry soil sample was soaked in water before wet sieving affected the quantity of aggregates remaining on the different sieves. The percentage of coarse aggregates was lower in samples soaked for 4 or 8 hours than in samples soaked for 1 or 2 hours in a virgin and cropped sample of Labette sil.

The rate of water infiltration through each of six soils was not affected appreciably when the percentage of coarse aggregates (2.0 to 0.18 mm. in diameter) was reduced from 50 to 10 percent. However, the infiltration rate between different soils was quite variable. Some water-stable aggregates were more resistant to raindrop impact than others.

Coarse aggregates have a more important influence on soil aeration than on the rate of infiltration of water in medium-textured soils.

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

Sedgley, R. H. EFFECTS OF DISRUPTION AND FLOCCULATION ON PORE-SPACE CHANGES IN BEDS OF CLAY AGGREGATES. *Soil Sci.* 94: 356-365. 1962.

The changes in pore space which occur when air-dry aggregates of clay soil are flooded and then allowed to dry were examined in the laboratory. Oven-dry porosities of beds of aggregates after flooding and drying depended on the initial size of the units composing the beds and the content of electrolyte in the wetting solution. The shape of individual aggregates and structural pore space separating them could be distinguished on polished blocks of flocculated samples. In the controls, the arrangement of aggregates was compact and pore space visible at low magnifications was confined mainly to large cracks formed by shrinkage.

The preparation and rapid wetting of the soil involved processes of disruption which increased the amount of structural pore space present by more than 12 cc. per 100 cc. of soil. The tendency for this structural pore space to be lost by consolidation during drying was opposed by forces associated with flocculation, and, in beds containing aggregates 1 to 2 mm. in diameter which had been flooded with solution containing 5 me. per liter of dissolved salt, only a small proportion of newly created structural pore space was consolidated.

The roles of disruption and compression in producing the pore-space changes described were discussed in relation to conditions in the field.

Commonwealth Sci. and Indus. Res. Organ., Reg. Pastoral Lab., Deniliquin, New South Wales, Australia.

Eagleman, J. R., and Jamison, V. C. SOIL LAYERING AND COMPACTION EFFECTS ON UNSATURATED MOISTURE MOVEMENT. *Soil Sci. Soc. Amer. Proc.* 26: 519-522. 1962.

Measurements of the velocity of flow and hydraulic gradients were obtained in the suction range of 0 to 700 cm. of water across the plane of contact for three different soil textural pairs, two of which were sampled from naturally occurring textural breaks in alluvial soil profiles. The hydraulic conductivity values across the textural breaks indicated that the soil properties were favorable for moisture transfer from large pores to smaller pores, but that a barrier existed for water movement from smaller pores to large pores. The barrier developed as the suction increased in a coarse layer in contact with finer material. With water removal from the larger pores at moderately low suctions, flow from the fine soil layer into the coarse material was reduced. In the naturally occurring breaks in soil texture, it was found that the compaction of the different soil layers determined the degree of expression of the barrier to water movement.

U. Mo., Columbia, Mo.

Wooley, J. T. SOIL-APPLIED HEXADECANOL AS AN EVAPOTRANSPIRATION SUPPRESSANT. *J. Soil and Water Conserv.* 17: 130. 1962.

The straight-chain alcohol, 1-hexadecanol, is known to form a film on a water surface, such as a pond, and to reduce evaporation. Roberts (1961) suggested that hexadecanol might form a similar film on the evaporating water surfaces within a plant or soil and thus decrease evapotranspiration. Experiments were designed to show whether hexadecanol mixed with the soil can reduce evapotranspiration.

Individual corn and bush bean plants were grown in soil with and without hexadecanol in narrow-mouthed bottles in a growth chamber. As soon as the shoots had emerged from the mouths of the bottles the openings were almost completely sealed off with thin plastic film so that evaporation from the soil was prevented.

The results indicate that although hexadecanol reduces soil water evaporation under some conditions, it has no effect on transpiration. Hexadecanol usually has a slight stunting effect on the plants.

SWCRD, ARS, USDA, Urbana, Ill. 61803.

Burman, R. D., and Partridge, J. R. EVAPO-TRANSPIRATION OF WATER BY SMALL GRAINS, CORN, AND BEANS IN NORTHWESTERN WYOMING. *Wyo. Agr. Expt. Sta. Mimeo. C. 174*, 14 pp. 1962.

Evapo-transpiration measurements by gravimetric soil sampling from nine crop years at northwestern Wyoming were presented. The measurements involved beans, barley, and corn from 1956-60.

Seasonal quantities of evapo-transpiration agreed fairly well with estimates made by the empirical Blaney-Criddle and Thornthwaite methods. The daily evapo-transpiration rates calculated from field measurements were much lower than those estimated from the empirical methods in the spring and fall and were much higher in the middle or hot part of the season.

Mean calculated consumptive-use coefficients were presented by standard Weather-Bureau weeks. Estimates using these "K" values for the years having field measurements checked reasonably well with field measurements on a seasonal basis. The peak weekly estimated evapo-transpiration rates were in general somewhat lower than those from equivalent field measurements, but in general, were more reasonable than those resulting from the use of the Blaney-Criddle method using a constant "K" value of 0.75. The mean weekly consumptive-use coefficients form a convenient method of presenting the deviations of the field measurements from estimates by the Blaney-Criddle method using season-long constant consumptive-use coefficients.

Tables and charts.

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

Koo, R. C. J. THE DISTRIBUTION AND UPTAKE OF SOIL MOISTURE IN CITRUS GROVES. *Fla. State Hort. Soc. 1961 Proc.* 74: 86-90. 1962.

Soil moisture distribution in orange and grapefruit groves on Lakeland fs was studied with the Nuclear-Chicago d/M gauge. On a typical Lakeland soil with clay at 8 feet, 90 percent of the soil moisture removed came from the surface 4 to 5 feet. On a deep sand, the

same percent of soil moisture loss was distributed in the surface 8 to 9 feet with two-thirds of it in the 3 to 8 foot zone. Grapefruit trees showed a higher rate of evapotranspiration than oranges of the same age. Soil moisture content beneath grapefruit trees was consistently lower than at the drip. The difference became more pronounced in periods of light rainfall. Similar but much smaller differences were found for orange trees.

Fla. Citrus Expt. Sta., Lake Alfred, Fla.

Fitzsimmons, D. W., and Corey, G. L. A PROCEDURE FOR DETERMINING EQUIVALENT CONDUCTIVITIES OF SOILS FOR ELECTRIC ANALOG SOLUTIONS OF STEADY FLOW PROBLEMS. Idaho Agr. Expt. Sta. Res. B. 58, 11 pp. 1962.

Unsaturated flow is essentially a case of flow in a medium whose conductivity varies throughout the medium with the soil-moisture tension; thus, the conductivity-tension relationship for the soil must be known and used in solving unsaturated flow problems. Since the conductivity-tension relationship for a particular soil is generally rather complex, the solution of unsaturated flow problems with analytical or numerical techniques has proved to be very difficult and little attention has been paid to this type of flow. Recently, relatively rapid solutions of steady two-dimensional irrigation and drainage problems have been obtained with electrical analogs using a numerical technique developed by Bouwer and Little (1959) for expressing the conductivity of the soil between any two adjacent network points in terms of the soil-moisture tensions at the points. Much of the tedious work involved in solving unsaturated flow problems by conventional relaxation procedures can be avoided by using this procedure, for the electrical analog automatically relaxes the system.

While using Bouwer and Little's procedure for studying steady flow from irrigation furrows, it was found that their procedure could be simplified to reduce the number of calculations required to express the conductivity of a soil in terms of tension values. Because researchers are using electrical analogs for studying all types of fluid-flow problems, this article was written to point out how Bouwer and Little's important contribution to this field can be simplified. Much of their work was reproduced and discussed in detail to show the nature of this simplification.

U. Idaho, Col. Agr. Moscow, Idaho.

Wagner, G. H. USE OF POROUS CERAMIC CUPS TO SAMPLE SOIL WATER WITHIN THE PROFILE. Soil Sci. 94: 379-386. 1962.

An apparatus was described for sampling soil water at various depths within the soil profile. It involves the use of porous ceramic cups placed in the soil. By reducing the pressure to a few mm. of mercury within these cups at times when moisture is held in the soil at tensions less than one atmosphere, water moves from the soil into the ceramic cup.

The samples obtained are of sufficient volume so that quantitative analysis of a number of significant nutrient ions is possible. These analyses in combination with soil moisture measurements with the neutron meter at the time of sampling, provide a means of calculating the amount of the various ions in solution on a pounds per acre basis. The apparatus will yield information regarding leaching similar to that obtained by lysimeter studies, but with equipment that may be easily installed in existing field plots.

U. Mo., Columbia, Mo.

Wilcox, J. C. EFFECTS OF WEATHER ON EVAPORATION FROM BELLANI PLATES AND EVAPOTRANSPIRATION FROM LYSIMETERS. *Canad. J. Plant Sci.* 43: 1-11. 1963.

Evaporation and evapotranspiration were measured in 1958-59. Bellani plate evaporimeters proved to be just as reliable as Class A pans and more convenient. Evapotranspiration was determined on alfalfa, ladino clover, and brome grass growing in lysimeters. Temperature, radiation, wind, and dew-point were also determined. On a daily or weekly basis, temperature gave the highest correlations with evapotranspiration, but on a 2-hour basis radiation gave the highest correlations. All four weather elements were found by partial correlation to have highly significant effects on both evaporation and evapotranspiration. Their effects on evaporation were quite similar to their effects on evapotranspiration. It was concluded that, if weather records are used to estimate evapotranspiration, all four of them should be used. By the direct correlations, better estimates of evapotranspiration were obtained using evaporation records than by using any one weather record by itself.

Canada Dept. Agr., Summerland, British Columbia, Canada.

Awada, M. SOIL MOISTURE TENSION IN RELATION TO GROWTH AND YIELD OF PAPAYA (CARICA PAPAYA L.) *Hawaii Agr. Expt. Sta. Tech. B.* 49, 15 pp. 1962.

Papaya plants of the Solo variety were grown in the field at Waimanalo, Honolulu, Hawaii, under three soil moisture tension conditions ranging from 0.22 atmosphere to 6.3 atmospheres, during the summer of 1959. During the summer of 1960, plants were grown under four soil moisture tension levels ranging from 0.27 atmosphere to 7.7 atmospheres. Tensiometers were used for the two "wet" treatments and gypsum blocks for the two "drier" treatments. They were installed at the 18- and 24-inch depths during the experimental periods of 1959 and 1960, respectively.

Correlation coefficients and regression coefficients determined between soil moisture tension and leaf moisture percentages of three leaf tissues, the petiole and the blade of the most recently matured leaf (16th leaf), and the petiole of a young, rapidly expanding leaf (8th leaf) indicated high significance only for the young petiole. It was found that the range in concentration of leaf moisture in this tissue was too small to be useful as a moisture index tissue.

Correlation and regression coefficients between soil moisture tension and dry weights of the 16th leaf, and between soil moisture tension and circumference of the trunk were both significant at the 1 percent level of probability.

Difference in growth response as indicated by the difference in circumference measurements as well as the difference in dry weights of the 16th leaf were indicated between treatments. However, growth rate of the circumference decreased considerably at the onset of fruit production. This fact was attributed to the developing fruits.

Yield response to the various soil moisture tension treatments for plants treated during the summer of 1959 was significant at the 1 percent level only between the plants in the highest soil moisture tension treatment and the lower moisture tension treatments. No significant difference in yield was indicated for plants differentially treated during the summer of 1960.

Difference in yield between treatments for the entire duration of the experiment indicated significance at the 5 percent level of probability between the plants of the two lowest soil moisture tensions and the plants in the highest soil moisture tension.

Hawaii Agr. Expt. Sta., U. Hawaii, Honolulu, Hawaii.

Gardner, W. R., and Hillel, D. I. THE RELATION OF EXTERNAL EVAPORATIVE CONDITIONS TO THE DRYING OF SOILS. *J. Geophysical Res.* 67: 4319-4325. 1962.

Evaporation from laboratory soil columns was studied as a function of potential evaporative conditions. The length of time a given evaporation rate could be maintained by the soil was in good agreement with an approximate solution of the isothermal equation for unsaturated flow. During the falling-rate period of drying, the evaporation rate was found to approach very nearly a function of the water content of the soil and to be nearly independent of the potential evaporation rate. The cumulative evaporation at any time could be calculated from the flow equation. Temporary interruption of the evaporative process had little effect upon the cumulative evaporation over a long period of time.

U.S. Salinity Lab., SWCRD, USDA, Riverside, Calif. 92502.

Hanks, R. J., and Bowers, S. A. NUMERICAL SOLUTION OF THE MOISTURE FLOW EQUATION FOR INFILTRATION INTO LAYERED SOILS. *Soil Sci. Soc. Amer. Proc.* 26: 530-534. 1962.

A numerical solution of the moisture flow equation was devised and programmed for an IBM 650 computer. Solutions obtained for infiltration into a loam over a silt loam and vice versa showed that infiltration was governed by flow through the less permeable soil, provided the wetting front had extended well into the second layer. Solutions were obtained for vertical upward and vertical downward infiltrations and for horizontal infiltration into two soils. The numerical solution was found to give excellent results when compared with the methods of E. J. Scott et al. and J. R. Philip for horizontal infiltration into homogenous soils at a uniform initial water content.

SWCRD, ARS, USDA, Fort Collins, Colo. 80522.

## Soil Chemistry and Mineralogy

McDowell, L. L., and Marshall, C. E. IONIC PROPERTIES OF MICA SURFACES. *Soil Sci. Soc. Amer. Proc.* 26: 547-551. 1962.

Seven micas were studied; muscovite, rose muscovite, phlogopite, margarite, biotite, lepidomelane, and a vermiculite-biotite. Curves connecting selectivity number  $K_s$  with surface cationic composition were obtained for Li-Na, Li-Rb, Li-Cs, Ba-Ca, and Ba-Sr exchange equilibria. The polyfunctional character of the surfaces was well shown in the monovalent series. Cesium was held less firmly than rubidium at biotite, vermiculite-biotite, and lepidomelane surfaces, and more firmly only in the case of phlogopite. Margarite was entirely different from the other micas, in showing a high bonding for lithium, and an order  $NH_4 < Cs < Na < K < Rb$ . Potentiometric results, using clay membrane and silver electrodes, were obtained for  $Na^+$ ,  $Ag^+$ , and  $Ca^{++}$  in 0.5% suspensions of the micas. The bonding energy curves showed the polyfunctional character of the mica surfaces.

SWCRD, ARS, USDA, Columbia, Mo. 65202.



Townsend, L. R., and MacKay, D. C. THE EFFECT OF CROPPING ON SOME CHEMICAL PROPERTIES OF A SPHAGNUM PEAT SOIL. *Canad. J. Soil Sci.* 43: 171-177. 1963.

Chemical analysis, including a conventional scheme of proximate analysis as well as pre-treatment with 0.1N hydrochloric acid, were used to assess changes occurring in the chemical properties of a strongly acid sphagnum peat when it was limed, fertilized, and cropped for 3- and 5-year periods. Pre-treatment was necessary to remove the large quantities of added fertilizer and limestone which were found to neutralize substantial amounts of the hydrochloric acid required for the hydrolysis of hemicellulose.

In comparison with raw peat, the percentages of hemicellulose and cellulose and the carbon-nitrogen ratio decreased in the cropped peat. The situation was reversed in the case of bitumen, the lignin-humic substances complex, and cation-exchange capacity. The results indicated that with cropping the composition of the peat tended towards the composition of an adjacent muck.

Table - Some Chemical Properties of Peat and Muck Soils from Different Areas

(Means of three samples expressed on organic matter basis)

Property	Raw peat	3-year area	5-year area	Muck <sup>1</sup>	L.S.D.
Cation exchange capacity (m.e./100g.)	135.8	150.1	155.8	155.7	1.2**
Carbon (percent)	49.1	50.0	51.0	59.4	-
Hydrogen (percent)	6.32	6.75	6.61	6.13	-
Nitrogen (percent)	0.84	1.26	1.29	1.43	0.24**
C/N ratio	58.3	40.1	39.7	41.7	6.8**
pH	3.39	6.09	6.38	3.68	0.88**

<sup>1</sup>One sample only, not included in statistical analysis.

\*\*Significant differences at P = 0.01.

Canada Dept. Agr., Kenville, Nova Scotia, Canada.

Dilz, K., and Mulder, E. G. THE EFFECT OF SOIL-pH, STABLE MANURE AND FERTILIZER NITROGEN ON THE GROWTH OF RED CLOVER AND OF RED CLOVER ASSOCIATIONS WITH PERENNIAL RYEGRASS. *Netherlands J. Agr. Sci.* 10: 1-22. 1962.

An investigation was made into the effect of soil-pH, fertilizer nitrogen, and stable manure on the growth of red clover and of red clover-perennial ryegrass associations. The experiments with clover-grass mixtures were performed on a series of garden plots of different pH during the years 1957-58. In 1959, red clover and grass were grown separately on these garden plots. In each year, the clover and the grass were sown on part of the plots where no clover had been grown for at least 35 years; the seeds or the soil were not inoculated with *Rhizobium trifolii*. Investigations comparable with those in the field were carried out in a number of pot experiments.

On the garden plots, soil-pH was found to be of major importance in the response of the clover-grass association to fertilizer nitrogen. On acid soil (pH below 5.3) where nodulation, nitrogen fixation, and development of the legumes were poor, the yield of herbage, which consisted mainly of grass, was wholly dependent on fertilizer-nitrogen supply. On slightly acid and neutral soil (pH 6 and higher), the response to added nitrogen was slight, due to the profuse nodulation, nitrogen fixation, and development of the red clover with little or no fertilizer nitrogen. With increasing amounts of fertilizer nitrogen, the amount of grass produced increased considerably but that of clover decreased sharply.

When grown alone, the response of red clover on the acid soils to fertilizer nitrogen was similar to that of the ryegrass, demonstrating that it was competition by the grass which suppressed the clover when grown together with high nitrogen dressings.

Nodulation of the red-clover plants on the uninoculated garden plots was absent or poor at a soil-pH of 5.2 or lower, moderate at pH 5.3 to 5.8, and profuse at higher pH. Inoculation of the soil with an effective strain of *Rhizobium trifolii* gave normal nodulation even at pH 5.0. With increasing supply of nitrogenous fertilizer, nodulation was increasingly delayed. Under certain conditions (pot experiment with inoculated acid soil), this led to nitrogen-deficiency in plants having received fertilizer nitrogen since no effective nodules had formed by the time the fertilizer nitrogen was used up. Control plants without fertilizer nitrogen appeared normal because they had formed effective nodules.

Stable manure, particularly when residual in the soil, promoted nodulation and nitrogen fixation of clover plants on uninoculated acid soil (pH 5.0); on inoculated acid soil this effect was still clearly perceptible, but weaker.

Lab. Microbiology, Agr. U., Wageningen, The Netherlands.

Shacklette, H. T. PROBLEMS OF INTERPRETING ELEMENT CONTENT OF PLANTS IN RELATION TO UNDERLYING DEPOSITS. Proc. Symposium on Detection of Underground Objects, Materials and Properties, March 19-20, 1962, pp. 201-208. 1962.

The U.S. Geological Survey is accumulating a body of data concerning the capabilities of plant species in element absorption. The data will be filed on IBM cards to facilitate their retrieval and sorting by many category classifications.

The particular value of plant analysis as an indication of substratum element content is related to the following functions:

1. Plants often sample the substratum at a deeper level than is practicable in field methods of reconnaissance soil sampling. This is particularly true of trees and shrubs, and is most pronounced with those classed as phreatophytes.
2. The root systems of certain plants may take a composite sample of a rather large area, a plant sample therefore being more representative of the site than a single soil sample.
3. The plant may concentrate in its tissues certain elements which exist in very small amounts in the soil, and therefore the detection and quantitative analysis of these elements are made more accurate.
4. Plants can often be sampled at times when soil or rock sampling is impracticable (when there is a deep snow cover, or over frozen or submerged ground).
5. Plant species are often highly specific in element absorption and follow consistent patterns of accumulation, thus enabling one to select for sampling those species which favor the element in question.
6. The element content of plant tissue may be used to determine the date when a significant change in the chemical environment occurred, and the magnitude of the

change. For example, wood of a certain age as determined by ring count records the chemical environment of the tree at the time in which that particular portion of the tree trunk was formed. This property has potential value in fixing the time when substratum, and perhaps also aerial, contamination occurred, and the nature of this contamination.

These features seem to make plants the preferred sampling media for an appraisal of substrate element content. However, there are certain difficulties in the interpretation of the analyses in a manner that yields significant and practical data. As compared to the sampling of soil and rock, plant sampling (including sample selection, preparation, and analysis) is more difficult and time consuming. The fact that plants have specific reactions to their chemical environment (which is the basis of their value as indicators) complicates the evaluation of their analysis, and the following factors must be considered:

1. The capabilities of a particular plant species in accumulating the element in question.
2. The accumulating ability of plants often varies greatly even between closely related species; therefore the proper identification of the species follows as a requirement of this specificity.
3. The species having been properly identified, we must then consider the fact that the amounts of a particular element may vary within a species according to the following factors: (1) The part of the plant that is sampled (i.e., root, stem, leaf, etc.). (2) The age of the tissue that is sampled. It has been found most accurate in our work to use 2-year-old portions of woody branches. (3) The season of the year when sampled. This is important only with new growth (stems, leaves) of woody plants, and with herbaceous plants. (4) The relation of the part sampled to the direction of root spread. (5) The physiological condition of the plant. The amount of elements absorbed from the substratum is related to the activity of water movement through the plant, and also to its metabolic rate. (6) The genetic nature of the individual (ecologically adapted biotypes, etc.). And (7) the amount and availability of the elements in the substratum.

U.S. Geological Survey, Denver, Colo.

Chao, T. T., Harward, M. E., and Fang, S. C. SOIL CONSTITUENTS AND PROPERTIES IN THE ADSORPTION OF SULFATE IONS. *Soil Sci.* 94: 276-283. 1962.

Sulfate-retentive soils were studied to obtain information on the soil constituents and factors responsible for sulfate adsorption. Treatments for the removal of organic matter, "free" iron, and aluminum oxides all resulted in marked reductions in sulfate retention. The amounts of sulfate retained by reference clays was in the order kaolinite > illite > bentonite. The acid nature of clays was shown to be important in that Al-clays retained more sulfate than H-clays.

Sulfate adsorption was observed to increase, generally, as degree of neutralization and pH of an Al-saturated resin increased. The sulfate adsorption decreased with an increase in pH of Al-saturated bentonite. The data suggest that two factors were operative in these systems; in the resin system the formation of reactive OH anion-exchange sites predominated; and in the clay systems the predominant factor was the effect of pH on the amphoteric properties of reactive groups on the clay.

The author concluded that possible mechanisms of sulfate adsorption by soils are: (1) Anion exchange due to positive charges developed on hydrous iron and/or aluminum oxide or on the crystal edges of clays, especially kaolinite, at low pH's; (2) retention of

sulfate ions by hydroxy-aluminum complexes through coordination; (3) "Salt adsorption" resulting from attraction between the surface of soil colloids and the salt; and (4) amphoteric properties of soil organic matter which develop positive charges under certain specific conditions.

Oreg. State U., Corvallis, Oreg.

Collins, W. B., and Bishop, R. F. THE EFFECT OF VARIOUS ORGANIC AMENDMENTS ON CERTAIN CHEMICAL PROPERTIES OF SOIL, ON PLANT NUTRIENT LEVELS IN STRAWBERRY FOLIAGE AND ON FRUIT YIELDS. *Canad. J. Plant Sci.* 42: 437-444. 1962.

In the field experiment, applications of manure decreased soil acidity but increased total nitrogen, organic matter, and adsorbed plus easily acid-soluble phosphorus. Where either peat moss or sawdust was applied, there was an increase in soil acidity, total nitrogen, and organic matter. The effects of other treatments--hay and hay compost--were less marked.

The phosphorus level in strawberry leaf samples from manured plots reflected the improved phosphorus status of the soil but none of the treatments resulted in significant differences in levels of nitrogen, potassium, or calcium in the leaves.

All treatments gave highly significant increases in yield. The yield with either hay compost or hay was significantly higher than with manure.

Res. Sta., Fredericton, New Brunswick, Canada.

Mandal, L. N. LEVELS OF IRON AND MANGANESE IN SOIL SOLUTION AND THE GROWTH OF RICE IN WATER-LOGGED SOILS IN RELATION TO THE OXYGEN STATUS OF SOIL SOLUTION. *Soil Sci.* 94: 387-391. 1962.

Levels of certain mineral elements (iron and manganese) in the soil solution, and the growth of rice plants in water-logged soils were studied in relation to the oxygen status in the reducing layer of soil. Rice plants were grown in water-logged soils kept in 10-liter aspirator bottles. Concentration of oxygen in the atmosphere above the water surface was maintained throughout the experiment at levels of 0, 10, 20, and 30 percent by volume by aerating the bottles daily for 3 hours with gas mixtures of requisite compositions. Samples of drainage water collected periodically from the bottles were analyzed for dissolved oxygen, manganese, ferrous and ferric iron, and specific conductivity. The supernatant water was analyzed for dissolved oxygen only. The plants were harvested at the end of the experiment, which continued for 55 days after the start of aeration, and their dry weights analyzed for total nitrogen, iron, and manganese. The dry weight of plants and the concentrations of iron and manganese in the drainage water were highest in the soils which were kept under an atmosphere containing 10 percent oxygen. Plants of this treatment absorbed the greatest amounts of iron and manganese. The better growth of plants in this treatment was possibly due to the beneficial effect of iron and manganese.

State Agr. Res. Inst., West Bengal, India.

MacLean, A. J., and Brydon, J. E. RELEASE AND FIXATION OF POTASSIUM IN DIFFERENT SIZE FRACTIONS OF SOME CANADIAN SOILS AS RELATED TO THEIR MINERALOGY. *Canad. J. Soil Sci.* 43: 123-134. 1963.

The average amount of non-exchangeable potassium removed by H-resin and boiling 1 N HNO<sub>3</sub> from the clay in 11 Canadian soils was about twice that in the fine silt, about 4 times that in the medium silt, and about 11 times that in the coarse silt and sand. Continuous leaching with 0.01 N HCl removed 4 times as much potassium from the clay as from the medium silt. The amounts released were usually less from the clay of 4 Podzols than from the clays of a Brown Chernozemic, a Brown Podzolic, a Brown Forest, and 3 Dark Grey Gleysolic soils.

The percentage of total potassium released from K-bearing minerals by the above procedures was usually in the following order: feldspar < illite < muscovite < biotite.

Although fixation of added potassium against extraction with ammonium acetate usually decreased with increasing particle-size, there was considerable fixation in the fine and medium silts. The clays of two Dark Grey Gleysolic and a Brown Forest soil fixed the highest amounts of potassium.

Differences in the release and fixation of potassium were not related to the contents of feldspar, illite, vermiculite, and mixed-layer minerals in the clays, nor to the amounts of feldspar and mica in the non-clay fractions.

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

Smith, C. M., and Pesek, J. T. COMPARING MEASUREMENTS OF THE EFFECT OF RESIDUAL FERTILIZER PHOSPHORUS IN SOME IOWA SOILS. *Soil Sci. Soc. Amer. Proc.* 26: 563-566. 1962.

The accuracy of the chemical soil test (0.03N NH<sub>4</sub>F in 0.025N HCl) for predicting biological response to residual fertilizer P was determined for several Iowa soils. Significant correlations were obtained with various measurements in the field and greenhouse, including grain, total dry matter, yield of P, and radioactively determined A values.

Soil test P was the most highly correlated with greenhouse A values and the relationship was essentially linear over the range of levels of residual P. One regression line described this relationship for all neutral and acid soils tested but was different from that for a calcareous (pH 8.0) soil. The soil test predicted the A values equally well regardless of whether the fertilizer P had been applied 1, 2, or 3 years previously.

Ext. Soil Scientist, Mont. State Col., Bozeman, Mont.

Halstead, R. L., Lapensee, J. M., and Ivarson, K. C. MINERALIZATION OF SOIL ORGANIC PHOSPHORUS WITH PARTICULAR REFERENCE TO THE EFFECT OF LIME. *Canad. J. Soil Sci.* 43: 97-106. 1963.

In a laboratory experiment, liming resulted in an average decline of 3.6 percent in the total organic phosphorus content of incubated surface samples of seven acid soils from eastern Canada. Increases of 2.6 and 5.1 percent in 1N H<sub>2</sub>SO<sub>4</sub>- and 4N HCl-soluble inorganic phosphorus, respectively, and a decrease of 46.4 percent in NaHCO<sub>3</sub>-soluble organic phosphorus (pH 8.5) provided further evidence of mineralization of organic phosphorus following liming. There was some evidence that the differences in NaHCO<sub>3</sub>-soluble organic phosphorus following liming was due only in part to mineralization, since Ca(OH)<sub>2</sub> added

to a soil just prior to extraction with  $\text{NaHCO}_3$  had a repressive effect on the solubility of the organic phosphorus compounds.

Some mineralization of organic phosphorus occurred when unlimed samples were incubated in the laboratory for 9 months.

Marked increases in microbiological activity, as indicated by increased numbers of microorganisms, and increased  $\text{CO}_2$  and  $\text{NO}_3$ -nitrogen production, were associated with lower values for extractable organic phosphorus following liming. Partial sterilization of samples with toluene lowered biological activity in the unlimed and limed samples. Toluene was found to have a positive effect on release of phosphorus from the organic form.

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

Cook, M. G., and Rich, C. I. WEATHERING OF SODIUM-POTASSIUM MICA IN SOILS OF THE VIRGINIA PIEDMONT. Soil Sci. Amer. Proc. 26: 591-595. 1962.

The occurrence of paragonite, the Na-analogue of muscovite, in intimate association with muscovite was observed in two soils of the Nason Series and their parent materials in the Virginia Piedmont. A relatively constant Na/K molar ratio of approximately 1 was maintained in both the parent rocks and soils. This indicated that equal molar quantities of paragonite and muscovite were present and that the weathering rates of the two micas were similar.

Vermiculite and kaolinite were the weathering products formed upon weathering of the mixed Na-K mica. The vermiculite had the same expansion and contraction characteristics as that formed from a predominantly K-mica. Consequently, the kind of weathering of muscovite and paragonite also appeared to be similar.

Paragonite is believed to be of more widespread occurrence than previous work has indicated. Its possible influence on soil genesis, morphology, and classification may be significant.

Va. Polytech. Inst., Blacksburg, Va.

## Soil Biology

Mitchell, R., and Alexander, M. MICROBIOLOGICAL PROCESSES ASSOCIATED WITH THE USE OF CHITIN FOR BIOLOGICAL CONTROL. Soil Sci. Soc. Amer. Proc. 26: 556-558. 1962.

In an investigation of the mechanism of action of chitin in the biological control of Fusarium solani f. phaseoli in soil, statistically significant control of a root rot caused by the fungus was noted when the aminopolysaccharide was added to soil up to 2 weeks prior to planting. No significant suppression by the microflora responding to the amendment was observed in longer periods of preincubation. Saprophytic soil fungi was also inhibited during the first 2 weeks after chitin incorporation. Actinomycetes, chitinase-producing microorganisms, and chitinase activity were markedly stimulated during that period of time, but the population of bacteria was not altered appreciably. Mycolytic activity and toxin production may be implicated in the selective influence of chitin in suppressing certain soil fungi. Acetate effectively controlled disease, but it appears that the mechanisms of action of chitin and acetate are distinct.

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

## Soil-Plant-Animal Relationships

Leach, R. M., JR., Hodgson, J. F., and Allaway, W. H. SOIL MINERAL DEFICIENCIES AND LIVESTOCK. *J. Soil and Water Conserv.* 17: 114-117. 1962.

Close growing forage crops are versatile tools for controlling erosion, but to be of maximum use to the conservationist they must produce farm income competitive with row crops. On many farms, this means a greater intensity of production and a greater intensity of forage crop use than is common today.

The following problems were reviewed: (1) Nitrate accumulation in plants; (2) grass tetany; and (3) molybdenum--copper problems.

No one of these problems is likely to be very widespread, nor does it appear impossible to solve any of them if appropriate research programs are maintained. Some promising directions for research were given.

Plant, Soil, and Nutr. Lab., SWCRD, ARS, USDA, Ithaca, N.Y. 14850.

Spencer, W. F., and Koo, R. C. J. CALCIUM DEFICIENCY IN FIELD-GROWN CITRUS TREES. *Amer. Soc. Hort. Sci. Proc.* 81: 202-208. 1962.

The symptoms of Ca deficiency in field-grown citrus trees were described. Calcium deficient leaves were somewhat smaller and thickened, sometimes distorted with a short midrib and usually developed a chlorosis along the leaf margin and between the veins during the winter months. Severely Ca deficient trees exhibited twig die-back symptoms and a multiple bud growth of new leaves. Misshapen fruit due to shrunken vesicles was more prevalent in Ca deficient trees.

The Ca content of leaves, feeder roots, and peel were closely related to the Ca content of the soil. Calcium deficiency resulted in grapefruit of slightly lower juice content, and higher soluble solids and acids, than fruit from non-deficient trees.

Young orange trees interplanted in the same plots exhibited symptoms of Ca deficiency similar to the grapefruit trees and suffered severely from Ca deficiency.

Citrus Expt. Sta., Lake Alfred, Fla.

Stewart, I. THE EFFECT OF MINOR ELEMENT DEFICIENCIES ON FREE AMINO ACIDS IN CITRUS LEAVES. *Amer. Soc. Hort. Sci. Proc.* 81: 244-249. 1962.

Chromatographic analyses of amino acids in citrus leaves were reported. Leaf samples analyzed from trees having Fe, Zn, Mg, Mn, or Cu deficiencies disclosed that the free amino acids were greatly influenced by these essential elements. Zn deficient leaf samples showing chlorosis contained approximately 50 times more arginine than green leaves from the same trees and over 100 times more than in the control samples. In Mg deficient samples there was a relatively large amount of tryptophane present while in all other samples the amount of this amino acid was too small to determine by the procedures used. The effect of each deficiency on amino acids in the leaves was fairly specific and different from that caused by other deficiencies.

Citrus Expt. Sta., Lake Alfred, Fla.

Wall, J. R., and Andrus, C. F. THE INHERITANCE AND PHYSIOLOGY OF BORON RESPONSE IN THE TOMATO. *Amer. J. Botany* 49: 758-762. 1962.

Brittle stem (btl), an abnormal sublethal phenotype in the tomato caused by boron deficiency, was found to be controlled by a single recessive gene. The threshold of boron concentration for brittle stem expression is not constant but fluctuates and is intimately associated with a number of interrelated environmental factors. Light duration and intensity were especially significant, while temperature and nitrogen, phosphorus, and calcium availability probably contributed to btl expression. It was suggested that when boron supply is limiting, brittle stem (boron deficiency) symptoms were intensified by any environmental factor or factors which enhance plant growth. Plants of btl/btl genotype contained much less boron in their leaves than those of the control variety 'Rutgers'; conversely, these plants contained more boron in their roots when grown in nutrient cultures of high boron content. This finding was discussed in relation to possible modes of gene action.

U.S. Vegetable Lab., CRD, USDA, Charleston, S.C.

Lewis, L. N., and Kenworthy, A. L. NUTRITIONAL BALANCE AS RELATED TO LEAF COMPOSITION AND FIRE BLIGHT SUSCEPTIBILITY IN THE BARTLETT PEAR. *Amer. Soc. Hort. Sci. Proc.* 81: 108-115. 1962.

Various nutritional environments were established to study their effect on the leaf composition and fire blight (Ewinia amylovora) susceptibility of the Bartlett pear tree. The trees were grown in quartz sand and the nutrients were supplied by solutions which were varied to provide low and high levels for each of 11 elements.

A study of leaf composition values showed that variations in the supply of major elements (N, P, K, Ca, and Mg) had a greater effect upon leaf composition than variations in the minor elements (Mn, Fe, Cu, B, Zn, and Mo). Deficiency symptoms were observed for N, P, K, Ca, Fe, and Cu. Symptoms of excess or toxicity either did not develop or were not clearly identifiable.

The susceptibility of Bartlett pear trees to fire blight was influenced by the nutritional environment. Lowest susceptibility was found for trees growing with a high supply of Ca. A low supply of B also appeared to reduce susceptibility. All other treatments except minus P and minus Fe resulted in a slight or significant increase, as compared to the check, in susceptibility. It does not appear that withholding fertilizer applications would increase resistance to fire blight. The relationship of N to the susceptibility of pear trees to fire blight does not appear to be as definite as previously reported.

Michigan State U., East Lansing, Mich.

Ouellette, G. J. EFFECTS OF LIME, NITROGEN AND PHOSPHORUS ON THE RESPONSE OF LADINO CLOVER TO MOLYBDENUM. *Canad. J. Soil Sci.* 43: 117-122. 1963.

A chlorosis of Ladino clover, which was attributed to a shortage of molybdenum on St. Onesimo stony 1, did not appear unless sufficient superphosphate was applied. An excessive amount of superphosphate rendered the chlorosis more acute. The situation was corrected by applying to the soil either 1 pound of sodium molybdate, 100 pounds of ammonium nitrate, or 2 tons of limestone. This tended to prove that the trouble was one



of nitrogen deficiency induced by the lack of molybdenum. Greater yield increases were obtained, however, with additions of nitrogen or limestone than of molybdenum. Tissue content of molybdenum, nitrogen, and phosphorus correlated with growth data.

Laval U., Ste-Foy, Quebec, Canada.

Dunn, L. E. PLANT CHEMICAL COMPOSITION AND SOIL FERTILITY. Nev. Agr. Expt. Sta. Tech. B. 211, 16 pp. + 28 fig. 1961.

The chemical composition of plants is dependent upon the kind of plant and the environmental conditions present for its growth. Climatic and soil conditions are of great importance in influencing the composition and quality of crops. Soils which are low in one or more of the plant nutrient elements are frequently associated with lower crop yields and with crops or crop products which are deficient in elements needed in feeds for livestock or foods for human consumption. Cultural practices may be adjusted to improve the yield, nutrient content, and quality of crops. Fertilizers are commonly used for these purposes.

A number of experiments were conducted with the use of fertilizers on Nevada soils for crops which are most commonly grown in Nevada. Yields and chemical composition were obtained. Nitrogen fertilizers commonly increased the yields and protein content of grains and grasses. High rates of application were either uneconomical or tended to discourage the growth of legumes in pasture or meadow mixtures. Phosphate fertilizers did not have much effect upon yields for the soils and conditions involved. In nearly all cases, phosphate fertilizer increased the phosphorus content of grains, grasses and legumes. In most cases, the increases were such as to materially increase the quality of the crops produced. Potash fertilizers increased the potassium content of the crops. Most Nevada soils are relatively high in potash and the crops produced on untreated soils had adequate amounts of potassium.

Fertilizers should be used on Nevada soils to improve both the yield and quality of crops. Kinds and amounts of fertilizers to use will need to vary appreciably for different soils, crops, and growing conditions.

Agr. Expt. Sta., Max C. Fleischman, Col. Agr., U. Nev., Reno, Nev.

Haworth, F., and Cleaver, T. J. THE EFFECTS OF THE UPTAKE OF DIFFERENT AMOUNTS OF POTASSIUM ON THE RATE OF GROWTH OF CARROT SEEDLINGS. J. Hort. Sci. 38: 40-45. 1963.

Carrot seedlings from FYM-treated plots on the field experiments at Wellesbourne, England, contained more potassium than those from plots which had received only mineral fertilizers including potassium sulphate. The seedlings on the former plots grew more rapidly than those on the latter.

In sand culture in the glasshouse, the dry weight of carrot seedlings, 10 days after the opening of the cotyledons, increased progressively as the amount of potassium in the nutrient medium and in the aerial parts of the plants increased; the rates of growth and of potassium uptake were found to be similar to those recorded for seedlings grown on the FYM-treated soil.

It was concluded that the greater uptake of potassium by seedlings on the FYM-treated plots were largely responsible for their more rapid growth.

Natl. Veg. Res. Sta., Wellesbourne, Warwick, England.

Haworth, F. THE EFFECTS OF DIFFERENT MANURIAL TREATMENTS ON THE YIELD AND MINERAL COMPOSITION OF RUNNER BEANS (PHASEOLUS MULTIFLORUS). J. Hort. Sci. 38: 26-39. 1963.

The effects of farmyard manure (FYM), peat, and mineral fertilizers applied in 1957 on the yield and mineral composition of runner beans grown in 1957 and 1958 were described. The residual effects of the organic matter treatments were compared with the effects of further applications of fertilizers in 1959 and 1960. No fertilizer was applied in 1958. A total of 10 tons of manure were applied per acre for an 360-90-360 application of major nutrients, while the mineral fertilizer applications equaled 150-60-240. Eight tons of peat were applied per acre.

In the year of application, FYM produced more than twice the yield of bean pods than the application of mineral fertilizers, but in succeeding years the difference decreased and had disappeared by 1960. Peat had a much smaller effect on yield than FYM, both in the presence and in the absence of mineral fertilizers, and by 1959 its residual effect was negligible. Possible reasons for the difference between the yield responses to applications of FYM and peat were discussed.

The results of chemical analyses of whole plants (1957) and of leaves (1958-60) did not indicate any major nutrient deficiency in the plants from the fertilizer-only plots, as compared with those from the FYM-treated plots.

The manurial treatments had relatively little differential effect on the nitrogen, phosphorus, and calcium contents of the bean leaves but had a large effect on their potassium and magnesium contents. In the bean pods, only the concentration of potassium was markedly affected by the manurial treatments. While there was a negative K/Mg interaction in the leaves, this was not found in the pods, in which the concentration of magnesium was virtually constant.

Runner bean leaves were found to contain more magnesium than many other vegetable materials, but the amount in the pods was much lower than that in the leaves, with the result that the amount of magnesium removed by this crop was similar to that removed by other vegetables.

Natl. Veg. Res. Sta., Wellesbourne, Warwick, England.

Day, A. D., Tucker, T. C., and Vavich, M. G. EFFECT OF CITY SEWAGE EFFLUENT ON THE YIELD AND QUALITY OF GRAIN FROM BARLEY, OATS, AND WHEAT. Agron. J. 54: 133-135. 1962.

Experiments were conducted over a 2-year period at Cortaro, Ariz., to compare the yield and quality of grain from barley, oats, and wheat irrigated with sewage effluent with the yield and quality of grain produced when the same crops were irrigated with irrigation water from wells and fertilized with different amounts of commercial fertilizer.

Grain yields of 3,032, 2,346, and 2,201 pounds per acre were obtained from barley, oats, and wheat, respectively, when the crops were irrigated with sewage effluent with no additional fertilizer. More grain was produced on plots irrigated with sewage effluent than was obtained on plots that received well water and nitrogen, phosphate, and potash in amounts equivalent to those applied during the growing season in sewage effluent.

Sewage effluent produced very tall, fast-growing plants that tended to lodge at maturity.

The average protein contents of the grain on the plots that received sewage effluent were 13.99, 16.26, and 16.67 percent for barley, oats, and wheat, respectively.

When barley, oats, and wheat were grown with sewage effluent the average percentage of digestible laboratory nutrients (D.L.N.) and the average bushel weight of the grain were similar to the D.L.N. and bushel weight values obtained when the crops were grown with well water and commercial fertilizer.

Ariz. Agr. Expt. Sta., U. Ariz., Tuscon, Ariz.

Thompson, J. W. EFFECTS OF FERTILIZERS AND SOIL AMENDMENTS ON THE MINERAL CONSTITUENTS OF MAIZE. *Soil Sci.* 94: 323-330. 1962.

Leaves of maize plants from a fertilizer experiment in which different amounts of potassium and nitrogen were applied were analyzed. The following general trends were observed: Increased K supply increased the K content of the leaf but reduced the Mg, Mn, and Al contents, while the changes in P, B, and Cu levels were relatively slight. The Ca and Zn contents of the leaves were increased by the application of K, reaching a maximum with 30 pounds per acre of K<sub>2</sub>O, but reduced by larger applications of K. Nitrogen fertilization generally tended to raise the levels of Mg, Ca, Zn, and Mn, but decreased the levels of K and Al.

The effects of phosphate, green manure, and lime applications on the mineral content of maize were determined. There was a large yield response to P and a smaller response to green manure. Except for the effect on K and Mg levels, P produced effects on leaf composition similar to but greater than green manure. Both P and green manure treatments raised the copper levels considerably; P and B levels were raised to a lesser extent, whereas Ca, Zn, and Mn were depressed. K and Mg levels were unaffected by P but were raised by the green manure treatment.

Ministry Agr., Federation of Rhodesia and Nyasaland.

Warder, F. G., Lehane, J. J., Hinman, W. C., and Staple, W. J. THE EFFECT OF FERTILIZER ON GROWTH, NUTRIENT UPTAKE AND MOISTURE USE OF WHEAT ON TWO SOILS IN SOUTHWESTERN SASKATCHEWAN. *Canad. J. Soil Sci.* 43: 107-116. 1963.

The use of NP fertilizer gave consistent increases in yields of wheat on a loam and a clay soil with low NaHCO<sub>3</sub> soluble phosphorus contents. The fertilizer increased crop growth during the early part of the growing season, hastened maturity, and increased the amount of stooling and the number of mature heads at harvestime.

Fertilized crops on both soils used more moisture than unfertilized crops between seeding and the heading stage. For the season as a whole, no difference in total moisture use was recorded on loam soils between fertilized and check crops, but on clay soil some fertilized crops extracted more subsoil moisture than the unfertilized crops.

Under the climatic conditions of these experiments, yield responses obtained from fertilizer application did not appear to be directly related to the amount of available moisture at time of seeding or to the seasonal precipitation. When increased yields were obtained from the use of fertilizer the fertilized crops used moisture more efficiently.

The NP fertilization had little or no effect on the phosphorus content of the grain but did increase the total phosphorus uptake by the crops. The fertilizer treatment increased the protein content of wheat grown on stubble on both the loam and the clay soils and on two of the four crops grown on fallow on the loam soil.

Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

Ohms, R. E. POTATO CULTURAL PRACTICES; ARE YOURS THE RIGHT ONES FOR GROWING BEST QUALITY, HIGHEST YIELDS? Idaho Agr. Sci. 47(4): 4-5. 1962.

In 1961, a survey showed the following cultural practices resulted in highest yield and quality in eastern Idaho potato fields:

1. Higher yields and quality were obtained in fields of over 100 acres.
2. Lower total and U.S. No. 1 yields resulted on land planted in potatoes the previous year.
3. Potatoes produced on medium textured soil had average total yields and higher than average U.S. No. 1 yields. Yield and quality were lower than average on light and heavy textured soils.
4. Fields in which the previous crop residue was returned in the fall had higher than average total and U.S. No. 1 yields. Residues returned in the spring produced average yield and quality. When residues were not returned, below average total and U.S. No. 1 yields resulted.
5. Potatoes produced on ground that had been fall plowed had average total yields, but higher than average quality. Potatoes produced on ground that had been spring plowed had lower yields and quality.
6. Fields not pre-irrigated produced lower than average total and U.S. No. 1 yields.
7. Lower total and U.S. No. 1 yields when planted in compact seedbeds.
8. Lower than average total and U.S. No 1 yields in seedbeds with a lack of moisture.
9. Fields that were planted with 1-1/2 to 2 ounces and over 2 ounces of seed piece had average total and U.S. No. 1 yields.
10. Growers that used seed treatment had average total and U.S. No. 1 yields.
11. The optimum planting date in eastern Idaho for 1961 appeared to be May 1 to 15.
12. Early emergence resulted in higher than average total and U.S. No. 1 yields, whereas later emergence resulted in lower than average.
13. Fields that were planted deep had higher than average total and U.S. No. 1 yields.
14. The fields that had 36 x 9, 36 x 11, 38 x 9 row and drop spacings had higher than average total and U.S. No. 1 yields.
15. Fields with both certified seed and non-certified seed had average yields of potatoes, but fields planted with certified seed had higher than average quality potatoes.
16. Fields with nitrogen applied according to the University of Idaho's recommendations had higher than average total and U.S. No. 1 yields.
17. Fields in which nitrogen was broadcast resulted in average total and U.S. No. 1 yields. Band applications or broadcast plus side-dressed applications of nitrogen gave lower than average results. The broadcast plus side-dress method also produced lower than average specific gravity.
18. There was no increase in yield or quality when phosphate was applied.
19. Sprinkler irrigated fields gave higher than average total and U.S. No. 1 yields. Surface and sub-irrigated fields were lower.
20. Fields in which the soil moisture was used as the guide for irrigating potatoes had higher than average total and U.S. No. 1 yields.
21. Higher than average results were obtained when the potatoes were irrigated within 20 days after planting.
22. Fields irrigated five to eight times had lower than average total and U.S. No. 1 yields. Nine to ten irrigations produced average yields and quality, and fields irrigated eleven to thirteen times had higher than average total and U.S. No. 1 yields.
23. Fields where irrigation was stopped early in the season tended to produce higher total yields and higher specific gravity than those where irrigation was stopped late in the season.

24. The fewer times a potato field was cultivated, the higher the yield of U.S. No. 1's.
25. Potatoes produced under broad flat hills had average total and U.S. No. 1 yields. Potatoes produced under rounded type hills had below average yields and quality.
26. Loose soil in the hill resulted in average yields and quality, whereas firm soil in the hill gave below average results.
27. When the seed piece was below the level of the irrigation furrow, higher than average total and U.S. No. 1 yields were obtained.
28. If vines were killed between the middle of August and the middle of September, total and U.S. No. 1 yields were higher than average.

Ext. Potato Spec., U. Idaho, Moscow, Idaho.

Jackson, T. L., Foote, W. H., and Dickason, E. A. EFFECT OF FERTILIZER TREATMENTS AND PLANTING DATES ON YIELD AND QUALITY OF BARLEY. Oreg. Agr. Expt. Sta. Tech. B. 65, 20 pp. 1962.

Six experiments were established during 1960 and 1961 to evaluate the effect of planting dates and fertilizer treatments on yield, test weight, kernel size, and protein content of Hannchen barley in the presence of yellow dwarf virus disease.

Aphids that transmit the yellow dwarf virus to spring-planted cereal crops did not appear until very late during 1960 and some plots had no yellow dwarf symptoms while others had a light infestation. There was an early infestation with aphids during 1961 which resulted in an extensive and heavy infection with yellow dwarf virus disease. Results from these experiments show that:

1. Planting early in the spring resulted in greater yields, higher test weights, and a lower percentage of thin kernels for both years.
2. Application of nitrogen consistently increased yields. Excessive application of nitrogen decreased test weights and increased the percentage of thin kernels.
3. Banded applications of phosphorus increased yields on the April 30 and May 10 (late) planting dates on the Hyslop farm in 1960.
4. Increases in yield and test weight and decreases in percent of thin kernels were evident from application of both phosphorus and potassium in 1961 when yellow dwarf virus disease was severe. These responses were observed on soils that would normally be considered adequately supplied with both phosphorus and potassium.
5. Banding phosphorus close to the seed at planting time resulted in greater increases in yield than broadcasting it ahead of planting.
6. The combination of NPKS fertilizer at the 40 pounds per-acre rate of nitrogen resulted in a protein content equal to or lower than the check plots in 1961.
7. Plantings later than mid-April in 1961 were not successful.
8. These experiments provide evidence that infection with yellow dwarf virus disease appreciably alters response from phosphorus and potassium.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg.

Vicente-Chandler, J., and Figarella, J. EFFECTS OF FIVE NITROGEN SOURCES ON YIELD AND COMPOSITION OF NAPIER GRASS. J. Agr. U. Puerto Rico 46(2): 102-105. 1962.

The effects of applying 600 pounds of nitrogen per acre yearly from five sources on yield and composition of Napier grass growing on a latosol in the humid Mountain Region of Puerto Rico over a 3-year period were determined.

Dry-matter yields and the calcium, phosphorus, manganese, and potassium content of the forage were unaffected by the nitrogen source. However, less protein was produced with urea and ammonium hydroxide than with ammonium sulfate, sodium nitrate, or ammonium nitrate, showing that the former were somewhat less efficient providers of nitrogen.

Forage yields were lower but protein content was higher during the "winter" months of lower rainfall, shorter days, and cooler weather.

TABLE 1.--The effect of 5 sources of nitrogen on yield and composition of well-fertilized Napier grass cut every 60 days over a 3-year period at Orocovis

N source	Yields per acre yearly			Composition on a dry-weight basis			
	Dry forage	Crude Protein	Crude protein (NX 6.25)	Ca	P	K	Mn
	Pounds	Pounds	Percent	Percent	Percent	Percent	P.p.m.
Ammonium sulfate	30,372	2,408	7.9	0.36	0.11	3.67	182
Sodium nitrate	27,185	2,375	8.7	.37	.13	3.63	190
Urea	26,095	2,048	7.8	.35	.13	3.74	185
Ammonium hydroxide	28,135	1,972	7.0	.32	.12	3.80	170
Ammonium nitrate	27,940	2,305	8.2	.35	.12	3.89	161
Average	27,945	2,222	8.0	0.35	0.12	3.71	184
L.S.D. .05 <sup>1</sup>	N.S.	178	0.59	N.S.	N.S.	N.S.	N.S.
0.01	N.S.	250	0.82	N.S.	N.S.	N.S.	N.S.

<sup>1</sup>N.S. -- not significant.

SWCRD, ARS, USDA, and U. Puerto Rico, Rio Predras, Puerto Rico. 00928.

Lutz, J. A., Jr., Obenshain, S. S., and Lillard, J. H. THE INFLUENCE OF FERTILIZATION AND IRRIGATION ON THE QUANTITY AND QUALITY OF PASTURE HERBAGE. Va. Agr. Expt. Sta. B. 543, 20 pp. 1962.

The effects of nitrogen, phosphate, and potash fertilization on the yield, chemical, and botanical composition of a native bluegrass-white clover sod, under irrigated and non-irrigated conditions on Groseclose sil near Blacksburg, Va., were measured from 1949-54. The experiment was revised in 1951 to include ladino clover-orchard grass in addition to bluegrass-white clover. Rates of P<sub>2</sub>O<sub>5</sub> from concentrated superphosphate, which was applied in April 1949, were 0, 100, 200, 400, and 800 lbs. per acre. Some plots received

annual applications of 100 lbs. per acre each of N and K<sub>2</sub>O from NH<sub>4</sub>NO<sub>3</sub> and KCl. The following conclusions were drawn:

1. Bluegrass-white clover yields on plots without irrigation were markedly increased by annual applications of nitrogen but not by annual potash fertilization. Increased yields were obtained with initial increased rates of phosphate fertilization.
2. Irrigation increased bluegrass-white clover yields, from all treatments, by 43 percent.
3. Annual nitrogen fertilization on irrigated plots caused a slight increase in bluegrass-white clover yields during each year of the experiment except the first year. Yields were increased appreciably by each increased rate of initially applied phosphate. Annual potash application did not increase yields.
4. Annual nitrogen fertilization increased ladino clover-orchard grass yields each of the 3 years on irrigated plots but only during the last 2 years on plots without irrigation. Phosphate fertilization increased yields on plots with and without irrigation. Potash fertilization increased yields in 1953 and 1954 on irrigated and on non-irrigated plots.
5. Total ladino clover-orchardgrass yields from 1952 to 1954 were increased 27 percent by irrigation.
6. On plots without irrigation in 1952, 1953, and 1954 ladino clover-orchardgrass yields (total of all treatments) were 14, 29, and 69 percent higher, respectively, than white clover-bluegrass yields. During the same 3 years on irrigated plots, bluegrass-white clover yields (total of all treatments) were 47, -5, and 23 percent higher than ladino clover-orchardgrass yields.
7. Nitrogen and potash fertilization increased the N and K content of bluegrass. Increased rate of phosphate fertilization increased the P, Ca, and Mg content of bluegrass.
8. Nitrogen fertilization did not influence the N content of ladino clover on plots with or without irrigation. Phosphate fertilization increased the P content of ladino clover on plots with and without irrigation. Potash fertilization increased the K content of ladino clover on irrigated plots, but not on plots without irrigation.
9. Nitrogen, phosphate, and potash fertilization increased the N, P, K, content of orchardgrass on plots with and without irrigation.
10. The botanical composition of the white clover-bluegrass pasture was affected more by irrigation than by fertilizing or grazing.
11. Fertility treatments did not appreciably influence the botanical composition of the ladino clover-orchardgrass pasture. The composition was affected by grazing with the influence being less on irrigated than on non-irrigated plots.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

Gossard, A. C., and Hammar, H. E. SOME EFFECTS OF POTASSIUM FERTILIZATION AND SOD CULTURE ON PECAN TREE PERFORMANCE AND NUTRITION. Amer. Soc. Hort. Sci. Proc. 81: 184-193. 1962.

Money maker and Success pecan trees in an acid sandy loam soil deficient in K, with summer cultivation and uniform N fertilization, responded more in growth over a 6-year period, to 600 pounds per acre of fertilizers equivalent to 0-8-24 than did similar trees fertilized with the same amount of 0-8-8. They produced larger yields of nuts per tree, but no more pounds per unit of trunk growth than cultivated trees fertilized with 0-8-8.

Similar trees in Bermudagrass sod, fertilized with 600 pounds per acre of 0-8-8 produced fewer nuts per tree and fewer pounds per unit of growth than cultivated trees with the same fertilization.

Nuts from cultivated trees were generally a little larger than those from trees in sod. Nuts from trees with small crops were a little better filled (higher specific gravity and percentage of kernel) than those from trees with larger crops.

Leaf N was highest in the 0-8-24 cultivated trees, which made the greatest growth, and lowest in the 0-3-3 sod trees, where the grass competed with the trees for moisture and N. Leaf P and Mg were little influenced directly by the fertilizer and culture treatments but were generally higher in years of small crops than in years of large crops. Leaf K was increased by soil applications of K and was reduced by large crops of nuts. Leaf Ca bore a reciprocal relation to leaf K. The Ca + Mg:K ratios in the leaves were the reciprocal of the leaf K percentages, indicating that they were inversely affected by fluctuations in the leaf K.

CRD, ARS, USDA, Meridian, Miss.

Stembridge, G. E., Gambrell, C. E., Sefick, H. J., and Van Bjaricom, L. O. THE EFFECT OF HIGH RATES OF NITROGEN AND POTASSIUM ON THE YIELD, QUALITY, AND FOLIAR MINERAL COMPOSITION OF DIXIGEM PEACHES IN THE SOUTH CAROLINA SANDHILLS. Amer. Soc. Hort. Sci. Proc. 81: 153-161. 1962.

The results of a 3-year study in which the influence of high rates of N and K on yield and quality of Dixigem peaches was evaluated were:

High rates of N and K applied to mature peach trees failed to produce outstanding differences in yield during "heavy" crop years. High rates of N increased yield in the "light" crop year, probably as a result of increased fruit set. Maturity was delayed by N applications.

Potassium applications increased foliar K and decreased foliar Mg. High rates of N resulted in high foliar concentrations of N and low foliar concentrations of K.

Skin and flesh color of fresh fruit was associated with foliar concentrations of N and K. Low foliar N and high foliar K were generally associated with desirable color.

When the fruit was harvested at uniform maturity, canned peaches from high-N plots were ranked superior in texture and inferior in flavor to fruit grown at lower levels of N.

Clemson Col., Clemson, S. C.

Stewart, I., Leonard, C. D., and Wander, I. W. COMPARISON OF NITROGEN RATES AND SOURCES FOR PINEAPPLE ORANGES. Fla. State Hort. Soc. 1961 Proc. 74: 75-79. 1962.

A source and rate of nitrogen experiment with Pineapple oranges growing in a deep Lakeland s was run for 5 years. Ammonium nitrate and sodium nitrate were applied at the annual rates of 50, 100, 200, 350, and 550 pounds of N per acre in three equal applications.

Yield differences between the two sources were not significant at rates up to and including 200 pounds of N per acre. At the two highest rates of N, trees receiving sodium nitrate produced higher yields than those receiving ammonium nitrate.

The highest total soluble solids in the juice were in fruit from trees receiving 350 and 550 pounds of N as ammonium nitrate which was associated with low yields and poor tree condition. At the lower N rates, the total soluble solids in the juice was about the same regardless of the source of N applied to the trees.



The soil pH was influenced by the two nitrogen sources. Ammonium nitrate decreased the soil pH and sodium nitrate increased it.

Leaf analysis showed an excellent correlation between N content of the leaves and N application. Increasing N rates was associated with lower amounts of K in the leaves, with ammonium nitrate having a greater depressing effect on the uptake of K than sodium nitrate.

Fla. Citrus Expt. Sta., Lake Alfred, Fla.

Sites, J. W., Wander, I. W., and Deszyck, E. J. THE RATE AND TIMING OF NITROGEN FOR GRAPEFRUIT ON LAKELAND FINE SAND. Fla. State Hort. Soc. 1961, Proc. 74: 53-57. 1962.

The quality and yield of seedy grapefruit were found to be significantly affected by the time and the rate of the nitrogen application on Lakeland fs.

The linear components of rates of application of nitrogen were significant for four of the six independent variables studied, percent soluble solids, percent citric acid, percent juice, and yield.

Trees receiving split or double applications of nitrogen when compared with those receiving single applications were found to produce significantly higher yields and to produce fruit significantly higher in soluble solids and citric acid content.

Split applications applied spring and fall resulted in significant yield increases when compared to spring and summer and summer and fall time of application.

No advantage in yield was found to result from applying nitrogen in three equal applications, spring, summer, and fall.

A significant negative linear effect of rate of nitrogen on yield of fruit was found when nitrogen rates were varied over a wide range beginning at 0.1 and continuing through 0.2, 0.30, 0.45, 0.60, 0.75, and 1 pound of N per box of anticipated yield per year. Optimum yields were obtained from applications of 230 pounds of nitrogen per acre and applications above this rate resulted in decreased yields and reduced tree vigor.

Fla. Citrus Expt. Sta., Lake Alfred, Fla.

Smith, P. F., and Rasmussen, G. K. EFFECT OF NITROGEN SOURCE, RATE, AND pH ON THE PRODUCTION AND QUALITY OF MARSH GRAPEFRUIT. Fla. State Hort. Soc. 1961, Proc. 74: 32-38. 1962.

A field experiment involving different sources and rates of nitrogen and different pH levels was carried out over an 8-year period in a Marsh grapefruit grove near Groveland, Fla. The trees were about 11 years old at the start, were on rough lemon root stock, and were planted 60 to the acre.

No appreciable difference was found in growth, production, or fruit quality of trees supplied calcium nitrate, ammonium nitrate, or ammonium sulfate as individual sources of nitrogen.

No difference in total production was found when nitrogen rates of 120, 240, and 540 pounds N per acre were compared. When size, color, and juice quality factors were considered as a whole, some advantage in early maturity was found for the lowest rate of N. The differences between 120 and 240 pounds N per acre, however, were slight.

When the topsoil pH was maintained above 6, by the use of dolomitic lime, production during the latter half of the period averaged about one box per tree greater than when the pH was near 5 regardless of N source or rate.

The mineral composition of the leaves was mostly unaffected by N source or pH, but increased N supply increased leaf N and depressed leaf P and K to some extent.

U.S. Hort. Field Sta., Orlando, Fla.

Labanauskas, C. K., Jones, W. W., and Embleton, T. W. EFFECTS OF NITROGEN, PHOSPHORUS, POTASSIUM, LIMESTONE, GYPSUM, AND MANURE SOIL APPLICATIONS ON SOIL pH AND ON MACRO- AND MICRONUTRIENT CONCENTRATIONS IN WASHINGTON NAVEL ORANGE LEAVES. Proc. Amer. Soc. for Hort. Sci. 80: 259-267. 1962.

Soil pH and the concentrations of 12 mineral elements in Washington Navel orange leaves as affected by fertilizers, soil amendments, and cultural practices were studied in a long-term orchard experiment at Riverside, Calif.

The effects of fertilizers on soil pH varied from extreme acidification where  $(\text{NH}_4)_2\text{SO}_4$  was applied to extreme alkalization with  $\text{NaNO}_3$ .

The effects of soil applications N, P, K, manure, limestone, and gypsum on nutrients in leaves were not influenced by changes in soil pH, with the exception of acidification produced by  $(\text{NH}_4)_2\text{SO}_4$ , which resulted in higher Mn concentration in the leaves.

Applications of  $\text{NaNO}_3$  increased the K, Na, and B concentrations in the leaves as compared to  $\text{Ca}(\text{NO}_3)_2$ .

Soil applications of  $(\text{NH}_4)_2\text{SO}_4$  to orange trees increased Mn and Mg in the leaves as compared to analogous leaves of trees treated with  $\text{Ca}(\text{NO}_3)_2$ .

Limestone added to  $(\text{NH}_4)_2\text{SO}_4$  increased soil pH and reduced Mg and Mn in the leaves of trees treated with  $(\text{NH}_4)_2\text{SO}_4$  alone.

Gypsum applied to the orange trees in addition to  $\text{NaNO}_3$  reduced soil pH and the Na concentration in the leaves as compared to the soil and leaves of trees treated with  $\text{NaNO}_3$  alone.

Applications of P in combination with urea to orange trees slightly increased soil acidity and decreased the Cu concentration in the leaves as compared to values from trees treated with urea alone.

Applications of K plus urea to the trees increased K and Cl concentrations in the leaves as compared to leaves of trees treated with urea alone.

Soil applications of manure to Washington Navel orange trees increased the concentration of K and decreased N and Fe in the leaves as compared to values found in the leaves of trees treated with similar quantities of N, P, and K from chemical sources.

Leaves from trees growing under tillage plus covercrop in winter contained higher concentrations of Ca, Mg, Na, and B, and lower P and K than leaves from trees growing under nontillage involving chemical weed control through the year.

U. Calif., Citrus Res. Cent., Riverside, Calif.

Bengston, G. W., and Voigt, G. K. A GREENHOUSE STUDY OF RELATIONS BETWEEN NUTRIENT MOVEMENT AND CONVERSION IN A SANDY SOIL AND THE NUTRITION OF SLASH PINE SEEDLINGS. Soil Sci. Soc. Amer. Proc. 26: 609-612. 1962.

A greenhouse lysimeter study was made of plant-soil-water relations determining the availability of N, P, and K from different fertilizer sources to slash pine seedlings growing in Lakeland fs.

Leachate analyses showed that virtually all  $\text{NH}_4\text{NO}_3$  and  $\text{KCl}$  applied to the surface of the soil in bare lysimeters was leached from the upper 12 inches of the profile within 4 weeks when water was applied at the rate of 4 inches per week. At the same watering rate, urea-formaldehyde and potassium calcium pyrophosphate showed substantially lower leaching losses. No significant leaching of P was observed.

The presence of pine seedlings in the lysimeters prevented or reduced leaching of N and K at low and intermediate watering levels, but at the high level the seedlings were relatively ineffective in reducing nutrient losses.

Chemical analyses of the seedlings showed greater nutrient uptake over a 17-week period from the readily soluble N and K sources at 1 and 2 inches of water per week. At the higher watering rate (4 inches per week), more N and K was taken up from the slowly soluble sources. These differences were reflected in seedling growth.

Fertilized seedlings transpired from 30 to 80 percent more water than the controls, yet their water use per gram of dry matter produced was 25 to 50 percent less than that of control seedlings.

Southeastern Forest Expt. Sta., FS, USDA, Olustee, Fla.

Baumgardt, B. R. and Smith, D. CHANGES IN ESTIMATED NUTRITIVE VALUE OF THE HERBAGE OF ALFALFA, MEDIUM RED CLOVER, LADINO CLOVER, AND BROMEGRASS DUE TO STAGE OF MATURITY AND YEAR. Wis. Agr. Expt. Sta. Res. Rpt. 10, 17 pp. 1962.

Changes in estimated nutritive value and in nutrient yield were investigated with advance in maturity in alfalfa grown alone, an alfalfa-brome-grass mixture, brome-grass grown alone, medium red clover, and ladino clover during the spring and summer growth periods of 1955-56 at Madison, Wis. The cellulose content of the forages increased similar to crude fiber as plants matured. Protein content decreased as plants matured.

Artificial rumen digestion trials produced nutritive value estimates which were presented as estimated digestible dry matter (EDDM), and estimated total digestible nutrients (ETDN). All forage species studied declined in EDDM and ETDN with advance in maturity during the spring and summer growth periods of both years. The actual percent EDDM and ETDN and the rate of decline varied with growth period and year. Summer growth forages (second crop) declined less in nutritive value as they matured than did spring growth (first crop) forages.

Year-to-year variation was marked in nutritive value of spring growth forages. Differing growth characteristics and maturity dates due to temperature and precipitation patterns probably accounted for the nutritive value variation. Unusually warm temperatures coupled with adequate moisture were noted in April and May 1955. Conditions were very near normal in 1956. At a given date (or stage of maturity), the forages grown in the spring of 1955 were lower in nutritive value than those grown in 1956.

Ladino clover was generally highest and most constant in the percentage of EDDM and ETDN at all stages of growth. Alfalfa grown alone and the alfalfa-brome-grass mixture were quite similar in nutritive value at all stages, whereas, the brome-grass grown alone was usually somewhat lower and the red clover somewhat higher than the alfalfa.

Yields of ETDN per acre for all species increased steadily up to stage IV (1/10 bloom of alfalfa) during the spring period (first crop) and stage X (full bloom of alfalfa) during the summer period (second crop). Yields did not change much with the more mature stages. Over all species, approximately 88 percent of the ETDN per acre had been produced by stage IV during the spring and by stage X during the summer growth periods.

The common harvesting schedule for alfalfa and alfalfa grass mixtures throughout Wisconsin has been two cuttings at full-bloom stage in late June and in late August. The recommended schedule now calls for three cuttings, each at approximately 1/10 bloom, before September 1. This requires taking the first cutting in early June to allow time for two additional cuttings before September 1. Using yields from a recent cutting trial for each of the above harvesting systems and using the appropriate ETDN values from this study, the three cutting (early) system produced 20 percent more hay, 46 percent more protein, and 31 percent more ETDN than two cuttings at full bloom.

Tables and Charts.

Agr. Expt. Sta., U. Wis., Madison, Wis.

Trimberger, G. W., Kennedy, W. K., Reid, J. T., Loosli, J. K., Turk, K. L., and Krukovsky, V. N. FEEDING VALUE AND DIGESTIBILITY OF BIRDSFOOT TREFOIL HAY HARVESTED AT DIFFERENT STAGES. Cornell U. Agr. Expt. Sta. B. 974, 36 pp. 1962.

The feeding value of birdsfoot trefoil was compared with a legume-grass hay during a continuous feeding experiment with high-producing Holstein cows for 12 weeks during 2 consecutive years. Comparisons were made between early-cut, first-cutting, barn-dried hay; late-cut, field-cured hay; and second-cutting, barn-dried hay. Digestibility tests for birdsfoot trefoil were made for early, intermediate, and late stages of first-cutting Viking and Empire birdsfoot trefoil. Barn-dried and field-cured hays were compared on the basis of methods of harvesting. Second-cutting hays of 7 and 9 weeks regrowth were compared with first cutting.

During the first year, excessive rainfall of about 4 inches during a 10-day period after the forage for barn-dried hay was cut resulted in a field loss of approximately one-third of the forage. Under near ideal conditions during the second year, for both first and second cutting, the leaf loss was minimized and total field losses were only about half that of the first year. In each case, the field losses for birdsfoot trefoil forage were about 5 percentage units higher than for the control. Leaves shattered easily on birdsfoot trefoil, especially for late-harvested forage, but storing at approximately 35 percent moisture for barn drying prevented this. No varietal differences between Viking and Empire birdsfoot trefoil were shown by leaf loss except for the late-cut, first-cutting, barn-dried hay cut July 7 and 8. For this cutting, the leaves of the Viking shattered more because it was approximately 2 weeks more mature.

Storage losses following unfavorable curing weather during the first year of the experiment were high for both the birdsfoot trefoil and legume-grass hays. There was no difference between forage species and variety. For second-cutting hays and the first-cutting of the second year of the experiment, the forage was stored near optimum moisture levels and storage losses were low with a range from a low 3.2 to a maximum of 6.7 percent.

The 16 cows on the early-harvested, first-cutting, barn-dried Viking birdsfoot trefoil and barn-dried second-cutting hay consumed an average of 38.3 pounds of hay containing 33.2 pounds of dry matter per day. The 16 cows on the control legume-grass hays consumed an average of 38.6 pounds of hay which contained 33.6 pounds of dry matter. The 8 cows on the late-harvested, first-cutting, field-cured, Viking birdsfoot trefoil consumed an average of only 28.8 pounds of hay containing 25.2 pounds of dry matter. The daily averages of 4 percent FCM produced from these hays and a daily average of 14.6 pounds of grain (12.9 pounds dry matter) were 51.2, 50.0, and 47.4 pounds, respectively.

In a comparison between first- and second-cutting hays the 16 cows on each consumed 37.8 and 39.2 pounds of hay containing 33.0 and 33.9 pounds of dry matter and produced 51.4 and 50.0 pounds of 4 percent fat-corrected milk, respectively. Thus, the cows ate 0.9 pounds less dry matter of the first-cutting hay but produced 1.4 pounds more milk which is in accord with approximately 3 percent higher digestibility of the early first-cutting hay as compared with second-cutting hay.

The digestibility trials showed very little difference between Viking and Empire birds-foot trefoil. Rain-damaged forage was lower in digestibility and late-cut birdsfoot trefoil forage was much more susceptible to severe weather damage and leaf loss than the early- and intermediate-cut forages. Field curing of late-cut, first-cutting birdsfoot trefoil forage resulted in a decrease of more than 5 percentage units in digestibility as compared with barn-dried hay. The major portion of this difference was caused by leaf loss.

A postponement in cutting date of birdsfoot trefoil affected palatability and daily consumption to about the same extent as it did other legume and mixed forages. However, the digestibility of the late-cut forage was higher (about 3 to 5 percent) than is usual for forages harvested late in the season. The higher digestibility coefficient over a longer period of time, particularly later in the season, extends the time for harvesting good hay from birdsfoot trefoil forage. However, barn-curing facilities must be available to avoid excessive leaf shattering which decreases the digestibility of the hay.

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

Elliot, J. M., and Mountain, W. B. THE INFLUENCE OF SPRING AND FALL APPLICATION OF NEMATICIDES ON PRATYLENCHUS PENETRANS AND QUALITY OF FLUE CURED TOBACCO GROWN WITH VARIOUS FORMS OF NITROGEN. *Canad. J. Soil Sci.* 43: 18-26. 1963.

Field experiments were conducted to determine the effect of two chlorinated hydrocarbon nematicides on control of the root lesion nematode (Pratylenchus penetrans (Cobb.) and on the yield and quality of flue-cured tobacco. The nematode was effectively controlled with a spring or fall application of either D-D or Telone. Fall application resulted in an increase in total nitrogen and total alkaloids and a decrease in reducing sugars and ethanol extractables in the cured tobacco leaf, effects which were associated with low quality. Fall fumigation inhibited the nitrification of ammonium nitrogen fertilizer applied to the rye straw in the summer preceding the tobacco crop. Excessive amounts of mineral nitrogen became available to the tobacco plant during its growing season. Spring application increased the chlorine content of the leaf but had no other adverse effects on chemical composition.

Tobacco Substation, Res. Br., Agr., Delhi, Ontario, Canada.

Woodbridge, C. G., and Kamal, A. L. THE EFFECT OF 2,4-D ON THE NITROGEN FRACTIONS OF BARTLETT PEAR TISSUES. *Amer. Soc. Hort. Sci. Proc.* 81: 116-122. 1962.

The effects of 2,4-D on the N fractions of Bartlett pear (Pyrus communis) leaf and stem tissues and of some of the morphological changes accompanying them were studied. The authors concluded that:

1. On Bartlett pear trees relatively late applications of 2,4-D (4 p.p.m.) did not effect either morphological or chemical changes in the year of application, but there was an effect the following year.
2. Early applications of 2,4-D (8 and 16 p.p.m.) did effect morphological and chemical changes in the year of application.

3. In general, 2,4-D treatments increased total and protein N contents in leaf tissue but decreased them in stem tissue.
4. No effect of the 2,4-D treatments was found on the amino N fraction of leaf and stem tissues.
5. The treatments had variable effects on the soluble ammonia and amide N contents of both young and old leaves.

Wash. State U., Pullman, Wash.

## Soil Classification

Rhodehamel, E. C., and Carlston, C. W. GEOLOGIC HISTORY OF THE TEAYS VALLEY IN WEST VIRGINIA. *Geol. Soc. Amer. B.* 74: 251-273. 1963.

The segment of the abandoned pre-Pleistocene Teays Valley between Scary and Huntington, W. Va., stands 130-240 feet above the Ohio and Kanawha Rivers, and its bedrock floor slopes westward at about 0.6 foot per mile.

The bedrock floor is overlain by highly weathered gravel in which a soil profile developed; only resistant siliceous materials remain. As much as 100 feet of locally derived sediments overlies the basal gravel. Sand was deposited at each end of the valley but in the east-central part it grades laterally into a laminated silty clay that was deposited during a period of ponding, probably in Kansan time. These deposits are deeply eroded. Probably during Illinoian time, ponding at a lower level resulted in deposition of a younger silty clay in the western part of the valley. This silty clay is weathered to a depth of about 14 feet. During a brief ponding in Wisconsin time, a widely scattered veneer of ice-rafted unweathered pebbles of igneous and metamorphic rocks was deposited. This veneer represents the youngest Pleistocene deposits in the valley and it occurs as much as 110 feet above the present Ohio River.

Depositional, weathering, erosional, and topographic evidence suggests that the teays Valley in West Virginia was abandoned in late Tertiary or early Pleistocene time by normal stream-capture processes and that prolonged weathering followed.

Water Resources Div., U.S. Geol. Survey, Trenton, N.J.

Lessig, H. D. CALCUTTA SILT, A VERY EARLY PLEISTOCENE DEPOSIT, UPPER OHIO VALLEY. *Geol. Soc. Amer. B.* 74 (2): 129-139. 1963.

Unconsolidated, laminated, weathered, silty material, called the Calcutta Silt, and soils formed in it occur in Columbiana County, Ohio. The silt mantles most of the land surface on benches at elevations of 1,080 to 1,180 feet in the unglaciated Allegheny Plateau; it is also buried beneath the gravelly outwash of very early Pleistocene glaciation on a terrace at 970 feet, which is part of the Teays-age level in the region. It does not extend over nearby higher slopes and ridgetops of 1,200 feet and higher.

The Calcutta Silt, apparently a water-laid deposit, is 2 to 10 feet thick and contains thin sandy layers and pebbles from local sedimentary rocks. Cobbles and pebbles of very resistant crystalline rocks occur at places on the surface.

The Calcutta Silt is a remnant of a former lake bed created during very early Pleistocene glacial ponding of the preglacial northward-draining Old Monongahela System.

SCC, USDA, Lisbon, Ohio.

Sawhney, B. L., Frink, C. R., and Hill, D. E. PROFILE DISCONFORMITY AND SOIL FORMATION ON GLACIOLACUSTRINE DEPOSITS. *Soil Sci.* 94: 297-303. 1962.

Physical, chemical, and mineralogical studies were made on the Buxton and Berlin soils formed on the clayey facies of glaciolacustrine deposits in central Connecticut. Both soils have silt loam surface horizons lying disconformably over silty clay loam or silty clay subsoil and substratum layers. The disconformity, although not sharp, occurred in the B horizon of both soils, and was evident in the particle-size distribution, clay mineralogy, and mineralogy of the heavy-fine-sand fraction.

The disconformity in these two soils was evidently related to changes in the environment of deposition. Glacial geologists attribute these surficial disconformities to the lowering of lake levels when new spillways were opened. Thus, the former deep waters, where silt and clay had been accumulating, were shoaled, and subsequent erosion of the exposed coarser sediments onto the silt and clay deposits resulted in these disconforming layers.

Several thousand years of soil profile development, superimposed on this geological sequence, have resulted in two soils with strikingly similar textural distributions and physical characteristics, but these soils are so different chemically and morphologically that they belong to two different great soil groups. The Buxton soils of the grayish glaciolacustrine silts and clays originated from granites, gneisses, and schists of the highland areas surrounding the Connecticut River Valley, while the Berlin soils of the reddish silts and clays originated from local triassic sediments within the Connecticut Valley. The strong influence of these different parent materials was maintained because of restricted drainage, and resulted in the Buxton soil developing as a brown podzolic, while the Berlin soil became a sol brun acide.

Conn. Agr. Expt. Sta., New Haven, Conn.

Sherman, G. D., Schultz, F., and Alway, F. J. DOLOMITIZATION IN SOILS OF THE RED RIVER VALLEY, MINNESOTA. *Soil Sci.* 94: 304-313. 1962.

The occurrence of dolomite in the subsoils of the Red River valley was investigated by field and laboratory methods. The following conclusions were made:

1. The carbonates were converted to dolomite by the action of waters rich in magnesium. The dolomitization was limited to the zone of water fluctuations in the soil profile.
2. Dolomitic soils occurred most frequently in the soils developed on the silt and very fine sand sediments of the glacial lake bed. The soils of the Ulen and Bearden series developed on these sediments.
3. Dolomite was established as the carbonate mineral by effervescence to cold and hot acid, by chemical composition, by differential thermal analysis, and by x-ray diffraction.
4. The data strongly supported the secondary origin of the dolomite. The process of conversion was probably due to a slow conversion of calcite by the action of magnesium salts in the fluctuating water table.
5. The occurrence of dolomite in locations on slopes to micro-depressions suggested a similarity in mode of occurrence to magnesium solonetz on clay sediments.

U. Hawaii, Honolulu, Hawaii.

Edelman, C. H., and Brinkman, R. PHYSIOGRAPHY OF GILGAI SOILS. Soil Sci. 94: 366-369. 1962.

The hypothesis was proposed that the original condition of present gilgai areas was lake, sea, or swamp bottom. The first irreversible desiccation of these very wet deposits, a process called "ripening" by Dutch soil scientists, has a profound influence on the morphology of the later gilgai landscape.

The gilgai microrelief is caused, however, by cyclic swelling and shrinking; reversible processes.

Examples were given of the three physiographic situations: former lake, sea, or swamp bottom. Colluvial transportation, by which process a clay soil reverts to a mud, may, in some cases, pave the way for later gilgai formation.

Agr. U., Wageningen, The Netherlands.

Bartelli, L. J. USE OF SOILS INFORMATION IN URBAN-FRIDGE AREAS. J. Soil and Water Conserv. 17: 99-103. 1962.

The widely varying uses, needs, and requirements for land in the expanding urban-fringe areas of America make it essential that precise soils information be readily available to all people concerned with land use planning and development. These users must have the basic facts that detailed soil surveys provide if they are to use the land within its capabilities and avoid the serious problems inherent in using soils for purposes to which they are not adapted. The ways basic soils information can be helpful in developing a balanced and orderly pattern of land use in close harmony with the dominant nature of the area were given.

SCS, USDA, Knoxville, Tenn.

Haack, P. M. EVALUATING COLOR, INFRARED, AND PANCHROMATIC AERIAL PHOTOS FOR THE FOREST SURVEY OF INTERIOR ALASKA. Photogrammetric Engin. pp. 592-598. Sept. 1962.

Vertical aerial photography at a scale of 1:5,000 using a 12-inch focal-length camera was flown over three sample strips in interior Alaska. Infrared and panchromatic, both with a minus-blue filter, and color film were used. The type of photography best suited for the interpretation of vegetative classes on the proposed Forest Survey was determined.

Four photo interpreters tested the film types on the basis of land-and-forest-class recognition. Another test compared the ability of five interpreters to measure tree heights on panchromatic and infrared film. Empirical estimates indicating the ease of accomplishing the goal also were made.

Interpreter success was analyzed by a technique involving angular transformations of adjusted percents as determined from unequal cell frequencies.

No significant difference between film-types was found. Each film type has certain desirable features. Ground detail, such as down logs and animal trails was best defined on panchromatic. Tonal details were best on color transparencies. The superiority of infrared was shown in differentiating between softwood and hardwood components of mixed stands.

With estimates of commercial forest area and timber volumes as foremost aims of the extensive forest survey of interior Alaska, evidence pointed to infrared film with a minus-blue filter as the type best suited for the inventory.

Northern Forest Expt. Sta., FS, USDA, Juneau, Alaska.



Willson, G. C., Jr., and Brunger, E. H. MACHINE MONOLITHS; EFFECTIVE EDUCATIONAL TOOLS. *J. Soil and Water Conserv.* 17: 126-127. 1962.

A new style soil monolith that has great potential for use in visually demonstrating the basic differences among soils is now being used in Virginia. By using a new kind of soil coring machine, full-scale soil monoliths can be taken in a matter of minutes. The monoliths weigh only an average of 1 pound each and can be displayed simply, quickly, and attractively. Core sizes currently available are 1 and 2 inches in diameter.

After the soil core is taken, it is removed from the coring tube and placed on a previously grooved molding board that has been freshly coated with a vinylite resin solution. (The vinylite resin solution is 59 percent acetone, 11 percent vinylite resin (VYHH), and 30 percent methyl isobutyl ketone.) The monoliths are properly positioned on the boards, saturated with vinylite resin solution, and then allowed to dry for 30 minutes. After they are dry, a small, sharp instrument is used to pick down the sides of the monolith until they are flush with the sides of the molding board. This exposes the natural colors and helps to show clearly the horizons and structure of the profile. The monoliths are then allowed to dry for 1 to 2 weeks and again treated with the vinylite resin before they are placed in a vertical position.

SCS, USDA, Richmond, Va.

## EROSION CONTROL

### Erosion Equation

Wischmeier, W. H., and Smith, D. D. SOIL-LOSS ESTIMATION AS A TOOL IN SOIL AND WATER MANAGEMENT PLANNING. *Internatl. Assoc. Sci. Hydrol. Comn. Land Erosion. Proc.* 59: 148-159. 1962.

An improved soil-loss equation recently developed by the Agricultural Research Service enables mathematical selection of optimum erosion-control practices for any specific farm.

Factors influencing field soil loss were evaluated in regression analyses of more than 10,000 plot-years of basic runoff and erosion data assembled from 45 research stations. The results were combined in an equation,  $A = R K L S C P$ , which expresses average annual soil loss (A) as a function of: erosive potential of locality rainfall (R); erodibility of specific soil (K); slope length (L); degree of slope (S); cover, crop sequence, productivity level, residue management and tillage (C); and conservation practices (P).

The erosive potential of rainfall (R) in each locality was evaluated by rainfall-erosion index which describes the interaction effect of rainfall energy and maximum 30-minute intensity of each storm. Iso-erodent maps were developed showing values of R throughout the U.S.

"K" is the average soil loss per unit of R from continuous fallow when other factors are at predetermined unity values. Factors L, S, C, and P are dimensionless.

Cover and management effects were evaluated from the data for each of five growth-stage periods of a crop year. Rotation C values are derived by combining these evaluations with data on expected seasonal distribution of erosive rainstorms. Pertinent values of L, S, and P in the equation are available from graphs developed for that purpose.

Any combination of cropping system and conservation practices for which C times P is less than T/RKLS will hold long-time erosion losses below an average of T tons per year. For a fixed cropping system, limiting slopes and practices are similarly defined by the equation.

SWCRD, ARS, USDA, Lafayette, Ind. 47907.

Chepil, W. S., Siddoway, F. H., and Armbrust, D. V. CLIMATIC FACTOR FOR ESTIMATING WIND ERODIBILITY OF FARM FIELDS. J. Soil and Water Conserv. 17: 162-165. 1962.

Results of a continuation of a research project to evaluate major soil and surface conditions that influence wind erodibility of farm fields were given. Seven types of conditions were evaluated: Soil clodiness; clod stability against abrasion from wind erosion; vegetative residues above the ground surface; surface roughness; wind barriers; width of field; and wind direction in relation to field orientation. All were evaluated for climatic conditions existing in the vicinity of Garden City, Kans., for the period 1954-1956. Alignment charts and tables indicated the approximate wind erodibility of any farm field under the climatic conditions considered.

The charts and tables can be used in reverse to determine the field conditions needed to reduce the field erodibility to an insignificant quantity under these particular climatic conditions. The field conditions required in one region are expected to be different from those required in another, because the general level of wind velocity, the quantity and frequency of rainfall, and the rate of drying of the soil surface differ from one region to another. The problem has been to determine how much the wind velocity-surface soil moisture factor (wind erosion climatic factor) of the different regions directly influences the average rate of wind erosion; and conversely, to what degree controllable field conditions must be modified in different regions to reduce wind erosion to an insignificant quantity.

The solution of this problem (shown by map) pertaining to the relative climatic influence on field erodibility in different regions was drawn from reasoning based on known relationships between wind velocity, surface soil moisture, and rate of soil movement by wind.

F. H. Siddoway, SWCRD, ARS, USDA, Sidney, Mont. 592700.

## Wind and Water Erosion

Agricultural Engineering Branch, Land and Water Development Division. SOIL EROSION BY WIND AND MEASURES FOR ITS CONTROL ON AGRICULTURAL LANDS. Food and Agr. Organ. United Nations FAO Agr. Development Paper 71, 88 pp. \$1.00. 1960.

Basic information available on wind erosion and practices for its control, including some interpretation and application of existing knowledge to conditions in less developed countries, was summarized.

The basic cause of serious wind erosion is the depletion or destruction of vegetative cover, either by man or through natural events. Wind erosion is most commonly a problem in dry, windy regions, for it is here that the re-establishment or maintenance of a vegetative cover is most difficult.

The most serious consequence of wind erosion is the sorting action involved in the continued removal of finer soil fractions. This can reduce productivity and increase erosiveness to a point where the land cannot be successfully cultivated. If not stabilized with permanent vegetation, such land can ultimately revert to a condition of active dune formation. Other consequences include the discomfort and physical injury to human beings and livestock and the damage to crops and capital improvements, both public and private.

A thorough understanding of the mechanisms and processes in wind erosion phenomena is basic to the development of control methods. The principles apply everywhere, but local conditions dictate which possible control procedure will be most effective in any specific instance. Usually a combination of practices is most effective.

Sandy soils and granular clays are usually most susceptible to erosion. The state and stability of consolidation are other soil properties of importance. Land surface conditions of importance are the degree of surface roughness and the presence of vegetation or vegetative residues. Wind barriers are also a significant factor in relation to control.

The following four principles of wind erosion control are evident from the analysis of wind erosion phenomena: (1) Produce, or bring to the soil surface, aggregates or clods which are large enough to resist the wind force; (2) roughen the land surface to reduce wind velocity and trap drifting soils; (3) establish wind barriers or trap strips at intervals to reduce wind velocity and soil avalanching; and (4) establish and maintain vegetation or vegetative residues to protect the soil.

The following general recommendations can be used to combat wind erosion on cultivated lands:

1. Keep land vegetated as much of the time as possible.
2. When not in a growing crop, maintain as much crop residue as possible on the soil surface or incorporated in the immediate surface layers.
3. Avoid excessive grazing.
4. Use cover crops on more susceptible areas or for added grazing where climatic conditions permit.
5. Strip cropping combined with proper residue management is beneficial and requires no basic change in tillage or cropping practices.
6. Rotations that provide high soil productivity, substantial soil cover, and favorable soil tilth should be used.
7. Windbreaks and shelterbelts are helpful. Wind barriers are especially beneficial in protection of animals, high value crops, buildings, as well as for controlling erosion on highly susceptible localized areas.
8. Tillage and planting equipment should preserve vegetative residue on the surface and leave the surface cloddy and rough. For emergency tillage where residues are lacking, reliance must be placed on roughening the surface.
9. Sandy lands on which erosion cannot generally be controlled should be permanently revegetated with grass, trees, or shrubs.
10. Do not attempt the cultivation of lands where either rainfall or soil condition so severely limits growth that crop failure is very frequent.

Columbia U. Press, International Doc. Serv. 2960 Broadway, New York, N.Y.

Rich, L. R. EROSION AND SEDIMENT MOVEMENT FOLLOWING A WILDFIRE IN A PONDEROSA PINE FOREST OF CENTRAL ARIZONA. Rocky Mountain Forest and Range Expt. Sta., Res. Note 76, 12 pp. 1962.

A hot wildfire burned 60 acres in the upper part of South Fork of Workman Creek in Arizona. The fire destroyed 74 percent of the basal area of trees in the burn. The first storm after the fire was one of the most intense measured to date.

During the first summer, under nearly average total rainfall, approximately 1 acre-foot of sediment (an average depth of 0.016 foot) was eroded from the burn. Sediment was deposited immediately below the burn in unburned forest vegetation, in the stream channel, and in the weir pond. Only 2 percent was trapped in the weir pond, but even this was much more than before the fire. Summer storm peaks were higher than before the fire, but these higher peaks did not result in increased annual streamflow.

The burn was immediately and successfully seeded to perennial grass. The seeded grass, sprouting locust, oak, and bracken are effectively stabilizing the area, as indicated by decreased sediment in the weir basin since the fire.

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

The control of soil erosion on the many farms where it is still a problem would not be difficult if it required only an understanding of the critical physical relationships between climate, topography, plant cover, water, and soil as well as an ability to prescribe the proper engineering and agronomic measures for each situation. An understanding of the reasons that farmers choose the methods of farming which expose their soil to the hazard of heavy erosion losses is essential.

Although alternatives are limited, landowners and farm operators have some leeway in selecting between those farming methods which tend to increase the loss of soil and those which tend to reduce it. Their choices are restricted by the physical environment, economic considerations, and the customs and legal arrangements associated with the use and ownership of property.

The decisions of farmers reflect their personal goals, values, and beliefs, the amounts and kind of information available to them, opinions of friends and neighbors, and the resources available. An understanding of the environment in which decisions are made is necessary if farmers are to be encouraged to make the choices that are more conducive to erosion control and if the obstacles which prevent farmers from making such choices are to be overcome.

The task of soil erosion control is a continuing job on the part of all individuals and governmental agencies sharing these responsibilities.

If the erosion-control objective is to be reached with the limited funds available for the job, efforts must start with the individual farmer and landowner. He must be informed and motivated to accomplish those measures that are profitable for him. The public must be ready to help remove the obstacles that the individual cannot overcome alone. Beyond the level of what is profitable to the farm operator are measures that can be accomplished only by two or more farm operators working together. Public responsibility for more direct assistance in financing the required changes begins at the point where the groups of farmers can do no more.

If the gap between present erosion losses and the public soil loss goal is to be eliminated, it will come about through the use of various tools and techniques used in different combinations to meet the problems that arise. An effective erosion-control program cannot be built around the use of a single technique. Problems not only are different from farm to farm but are different on the same farm over a period of time.

Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa.

## Terraces

Schaller, F., Jacobson, P., Hull, D. O., and Willrich, T. GRASSED WATERWAYS AND TERRACE OUTLETS. Iowa State U. Sci. and Tech., Coop. Ext. Serv. Pamphlet 166 (Rev.). 8 pp. 1962.

Almost every sloping field has natural draws or waterway channels where water concentrates and runs off the field. When these waterway channels are not protected by grass, they often become small gullies in a short time. "Plowing in" of these small gullies so they can be crossed without seeding may actually speed up gully formation. As these gullies or ditches grow larger, they often divide the field into two or even three or more patches. They are a serious problem, not only because of the soil lost, but also because of the inconvenience they cause in farming operations.

A good grassed (regular type) watercourse allows excess water to move off the field with only a small amount of soil loss. A good grass sod in a waterway ties down the soil and slows down the speed of moving water. In addition, it permits the farmer to cross the waterway with his farm machinery.

Although grassed waterways represent one of the most necessary supporting erosion control practices, they will not do all of the soil saving job. Contour farming, strip cropping, and terracing are other practices that can and should be used to help save soil.

Grassed waterways work best when other good soil management practices are followed in the fields. A good crop rotation and the use of lime, fertilizers, and manure all contribute to the job.

An illustrated and descriptive guide on the making and maintenance of grass waterways was presented.

Iowa State U. Sci. and Tech., Coop. Ext. Serv., Ames, Iowa.

Stoekeler, J. H. ANGLE DOZER USED FOR TREE PLANTING. J. Soil and Water Conserv. 17: 178-179. 1962.

In the spring of 1961, an angle dozer was used to prepare ground for an experimental tree planting in hilly terrain. The study area was the Coulee Experimental Forest, a tract of state-owned land in the unglaciated part of southwestern Wisconsin. High initial survivals were achieved with this method of ground preparation.

A 6-foot-wide, adjustable angle dozer blade mounted on a light crawler tractor was used to make a series of level bench terraces on the contour. These terraces, 16 to 20 inches wide, were subsequently hand planted to a variety of tree species of different age classes. A total of 30.5 miles of bench terrace was constructed.

Slopes ranged from 10 to 32 percent; many sites had slopes over 20 percent. The soils were sandy loams and silt loams. All sites were an open land and were usually devoid of trees.

Terrace construction costs on six separate experimental plots ranged from \$6.50 to \$22.05 per mile. With an 8-foot interval between terraces, the weighted average cost was \$12.20 per mile or \$12.57 per acre. Most terraces were 330 to 660 feet long.

The first-year rate of survival (fall of 1961) was 90 percent for 25,000 trees of 11 different species and age classes. For the better age classes, involving mostly transplant stock, the rate of survival was around 95 percent. Level bench terraces had the following advantages:

1. Not only are they an economical method of ground preparation, but narrow bench terraces also appear to hold some runoff.
2. The terracing process removed or buried dry grass and weeds present on the plots and eliminated the hazard of grass wildfires during the first spring after planting.
3. The terraces furnished a convenient place on which to plant trees; trees were planted considerably faster on them than in scalps.
4. The level portion of the narrow bench terrace remained rather free of competing grass and weeds. Where the former cover was bluegrass or mown hay fields, no followup hand weeding was necessary.

Div. Watershed Mangt., Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

## Critical Areas

Miller, C. R., Woodburn, R., and Turner, H. R. UPLAND GULLY SEDIMENT PRODUCTION. International Assoc. Sci. Hydrol. Commission of Land Erosion. 59: 83-104. 1962.

The gullying process and the sediment production from it results in the loss of valuable farm lands, interrupts effective agricultural operations, and causes downvalley reservoir storage losses and channel damages. The comprehensive sedimentation research program at the USDA Sedimentation Laboratory helps provide additional information on this problem.

Studies on several treated and untreated gully systems in the loessial hills area of Mississippi were carried out over a 5-year period utilizing detailed field surveys, analyses of in situ and deposited gully materials, and evaluations of photographic records. Direct sediment production from untreated gullies ranged from 1.45 to 6.77 inches per year per acre of exposed gully surface. The lower production rate was associated with an average 20-foot vertical exposure and a low percentage of uncemented sand formation in the exposure. The higher production rate was associated with an average 40-foot vertical exposure and a high percentage of uncemented sand formation in the exposure face. Treating gullies with mulch, grasses, trees, brush dams, and combinations thereof, effectively reduced sediment production up to 80 percent for the best established cover conditions. A lasting stand of sediment-screening tree growth was established in some of the experimental gully areas.

Although the sediment production within the immediate gullied area was significant, the projection of these quantities indicated decreasing significance in terms of total sediment yielded from progressively larger agricultural areas. In one instance the sediment production rate from the exposed gully surface area was 2.90 inches per year, but the production rate for a 300-acre area encompassing this gully was only 0.10 inch per year per acre.

SWCRD, ARS, USDA, Oxford, Miss. 38655.

Thames, J. L. LOBLOLLY BEST BUT SEED SOURCE IMPORTANT IN EROSION-CONTROL PLANTINGS IN NORTH MISSISSIPPI. Tree Planters' Notes. 55: 21-22. 1962.

Growth of loblolly pine (Pinus taeda L.) from four seed sources differed markedly in 5-year-old erosion-control plantings in north Mississippi. Differences among sources were consistent on two major soils in this area--deep droughty sands and eroded Coastal Plain subsoils. The poorest loblolly pine source outperformed shortleaf pine (P. echinata Mill.) from two sources and Virginia and sand pine (P. virginiana Mill. and P. clausa (Chapm.) Vasey) from single sources.) Fast growth is necessary in erosion-control planting to quickly stabilize surface soil.

Among the four loblolly seed sources, trees from seed collected on one of the Lost Pine islands in Caldwell County, Tex., grew tallest; trees from Crossett seed grew least. Differences between the Lost Pines and the average of the other sources were significant at the 1-percent level. Trees from sources in northwest Georgia and east Texas grew about the same, and their average height growth was significantly better (at the 5-percent level) than that of the Crossett trees. Survival was uniformly high among the four loblolly sources, and superior at the 5-percent level of significance to the average of the other three species.

Height growth of all species averaged 3.5 feet less on subsoils than on sands.

TABLE 1.--Survival and height growth after five growing seasons

Species or source	Survival		Height growth	
	Sandy sites	Eroded sites	Sandy sites	Eroded sites
	Percent	Percent	Feet	Feet
Loblolly:				
Lost Pines . . . . .	97	82	12.0	8.1
East Texas . . . . .	95	80	10.6	6.2
Northwest Georgia . .	92	87	10.0	6.4
Crossett . . . . .	93	71	9.0	5.7
Sand pine . . . . .	70	75	8.7	4.5
Virginia pine . . . . .	87	84	7.4	4.8
Shortleaf:				
Oklahoma . . . . .	89	76	6.3	3.8
Local . . . . .	84	80	6.9	3.5

Southern Forest Expt. Sta., FS, USDA, Oxford, Miss.

Brown, G. W. PIPING EROSION IN COLORADO. J. Soil and Water Conserv. 17: 220-222. 1962.

In an effort to relate physical and chemical soil properties to piping erosion, soil samples from three areas exhibiting this type of soil movement were analyzed. All three of the areas studied were characterized by: (1) Sparse vegetation; (2) a past history of heavy grazing on the piped areas and on adjacent uplands; (3) a summer precipitation pattern involving long dry periods with occasional heavy thunderstorms; and (4) a major gully system adjacent to the sites on which piping occurred.

The textural class of the soils on the piped areas ranged from silt loam to clay and the average bulk densities ranged from 1.2 to 1.7 g. cm.<sup>3</sup> All soil samples showed a high degree of instability when subjected to Middleton's dispersion test. The results of these tests thus place the soils in the highly erosive to extremely erosive categories. As a result of their fine texture, the soil samples exhibited shrinkage values ranging from 20 to 40 percent.

The chemical analyses revealed that cation exchange capacities of the soils on the piped areas ranged from 23 to 35 milliequivalents per 100 grams of soil and total exchangeable ion contents ranged from 51 to 86 milliequivalents per 100 grams of soil. The calcium, sodium, magnesium, and potassium contents of the soils were measured. The concentration of soluble salts in these soils, expressed as milliequivalents of calcium sulfate per liter of water, ranged from 4 to 90 milliequivalents per liter.

Analysis of variance showed that the soils studied, especially those at Bayfield and Silt, Colo., were similar in most respects. The differences between the soils at Nunn and those on the other two sites were not of practical significance in most cases.

Based on these chemical and physical analyses, an hypothesis on the sequence of events involved in pipe formation was formulated.

The properties of the soils studied might contribute to the formation of soil pipes through the following sequence of events:

1. A steep hydraulic gradient is created by the formation of a large gully in the valley bottom.
2. The litter and vegetative cover on the adjacent uplands is seriously depleted through adverse land use.
3. Drying during the summer months causes the exposed soils to crack.
4. Wetting from occasional thunderstorms affords an opportunity for the extension of these cracks through the profile.
5. Excessive salt contents produce a highly aggregated, granular soil structure.
6. The highly aggregated soil particles react much like sand when subjected to sub-surface flow toward the gully. Granules from the walls of the gully wash away, thus creating a depression which progressively deepens and widens.
7. Continued washing of the soil adjacent to the cracks and soil pipes leaches the excess salts, especially calcium, from the profile. The remaining sodium salts then disperse the aggregates, initiating an even more accelerated rate of erosion.

No address given.

Brown, J. H. SUCCESS OF TREE PLANTING ON STRIP-MINED AREAS IN WEST VIRGINIA. W. Va. Agr. Expt. Sta. B. 473, 35 pp. 1962.

Surface mining of coal has directly affected nearly 70,000 areas of land in 36 of West Virginia's 55 counties. Revegetation offers the most practical means of stabilizing these areas and returning them to a productive condition.

A survey of tree plantings established on spoil areas throughout the State revealed the following:

1. Successful stands of trees were established on nearly 75 percent of the spoil bank area planted in the State, while partially successful stands resulted on approximately 20 percent of the area planted.
2. Although spoil and site conditions varied considerably throughout West Virginia, conditions within limited areas were often quite similar. The spoil bank planting sites in the State were broken down into eight districts, each having certain combinations of spoil or site conditions. Results of evaluations in each of these districts are presented in Table form.
3. Ten different species were planted on the areas evaluated.
4. Survivals of the different species planted were generally quite good, with averages ranging from 48.7 to 80.3 percent. In most instances, low survivals could be attributed to areas of excessive acidity or extreme exposure.
5. Black locust was particularly outstanding in providing stabilization and cover on spoil bank areas. The average survival for locust plantings was 68.7 percent, with many of the stands established on the more adverse portions of individual spoil areas. Of the black locust stands 80 percent were rated as successful, while only 6.4 percent of the stands were rated as failures.
6. Of the conifers planted on spoils, the performances of Scotch pine, red pine, and white pine were particularly good. Nearly 68 percent of the conifer stands were rated as successful, while approximately 20 percent were rated as partially successful.



7. Survival of plantings were found to be closely correlated with precipitation during certain periods of the first growing season.
8. A definite correlation between slope and growth and survival of black locust plantings was noted. Survival was found to decline in direct relationship to increases in slopes percent. Growth was quite uniform on slopes up to 40 percent and then declined as slopes increased above this point.
9. Changes in elevation were found to affect the growth and survival of black locust plantings. Growth of black locust declined in direct relationship to increases in elevation, while survival was nearly constant at the lower elevations and then declined as elevation increased above 2,300 feet. Growth or survival of red and Scotch pines were not affected by changes in elevation.
10. Grading and its resulting compactions was found to affect the growth of plantings adversely but had little or no effect on survival.
11. Acidity of spoil material had a pronounced effect on the survival of plantings. On those areas having over one-half of their spoil material classified as toxic (pH less than 4.0), survival averaged less than 35 percent; on sites with 25 to 50 percent of their spoil material in the toxic class, survival averaged nearly 60 percent; and on sites with less than one-fourth of their area in toxic class, survivals averaged better than 75 percent.
12. Poor planting was observed to be a major cause of mortality and poor growth on many spoils, with numerous instances of "shovel root," planting too shallow, and planting too deep noted.

W. Va. U. Agr. Expt. Sta., Morgantown, W. Va.

## SOIL MANAGEMENT

### Cropping Practices

Jeter, B. E., Smith, J. C., and Whitely, E. L. INFLUENCE OF CROPPING SYSTEMS ON COTTON AND CORN YIELDS ON THE GULF COAST PRAIRIE. Tex. Agr. Expt. Sta. B. B-993, 23 pp. 1962.

The following experiments were conducted on the Gulf Coast Prairie in Texas during 1953-58: (1) The influence of cropping systems on crop yields, soil improvement, and conservation; (2) the influence of nitrogen fertilizer on crop yields; and (3) fertilizer tests on continuous and rotated cotton.

Cropping systems producing the highest forage yields, with and without nitrogen fertilizer, were those which contained a legume.

A 2-year system of first-year--oats and Sudangrass and second-year--cotton produced the lowest forage yield of any system tested and showed little effect on soil improvement.

High forage yields were obtained from all cropping systems containing Hubam. A 3-year system of first-year--oats, Hubam, and Sudan, second-year--Hubam and Sudan, and third-year--cotton provided forage over a long period of time.

Cropping systems containing Dallisgrass and White clover rated highest. These forage crops furnished year-round grazing and required only one planting operation per cycle of the cropping system.

Dallisgrass and White clover produced higher forage yields and were better able to use nitrogen fertilizer following cotton than when following corn.

Fescuegrass, in a 5-year cropping system of 3 years fescuegrass and 2 years cotton, produced winter and spring grazing, high forage yields the first year in the system when treated with nitrogen fertilizer, and required only one planting operation. This system was the most unsatisfactory system tested, because it was difficult to maintain a good stand of fescuegrass.

Statistical analysis showed that there were no significant differences in cotton yields because of the treatments in 1953. In 1954, nitrogen fertilizer produced a highly significant difference in the increase in yields and in 1955 a significant difference was caused by the interaction of nitrogen and crop rotation. In 1956, the effects of cropping systems became apparent in increased yields. In 1956-57, there was a highly significant increase in yields because of crop rotation, and in 1957, a highly significant increase in yields because of nitrogen fertilizer.

The three cropping systems recommended for the Gulf Coast Prairie were: (1) A 5-year system of 3 years Dallisgrass-White clover and 2 years cotton; (2) a 3-year system of first year--oats, Hubam, and Sudan, second year--Hubam and Sudan, and third year--cotton; and (3) a 2-year system of first year--Hubam and Sudan and second year--cotton.

Applications of 60 pounds of nitrogen per acre per year produced an average increase in cotton yields in all systems tested.

In comparing the fertilizer tests on continuous cotton and cotton rotated with Dallisgrass and White clover, the nonfertilized, rotated cotton produced an average yield increase of 550 pounds of seed cotton per acre per year more than the nonfertilized continuous cotton.

In the fertilizer test on continuous cotton, the highest average increase in yields were produced by the 90-30-60 treatment (380 pounds of seed cotton per acre more than the nonfertilized cotton) and the 45-0-0 treatment (190 pounds of seed cotton per acre).

In the fertilizer tests, there was a larger increase in yield of rotated cotton with fertilizer than in the continuous cotton. In the fertilizer test on rotated cotton, nitrogen was the most effective element and phosphorus the next in increasing cotton yields. Fertilizer applications of 90-30-0 and 45-30-0 produced the highest yields with an average of 1,430 and 1,390 pounds of seed cotton per acre per year, respectively.

A 5-year system of 3 years Dallisgrass and White clover and 2 years corn increased first and second year corn yields 42 and 56 percent more than the continuous corn. When nitrogen fertilizer was applied, there was an increase in yields of 21 and 12 percent more than the fertilized, continuous corn. The application of 60 pounds of nitrogen increased continuous corn yields 60 percent. Combinations of crop rotation and nitrogen increased first and second year corn yields 96 and 88 percent more than the nonfertilized corn.

Cropping systems of Dallisgrass and White clover were recommended as soil improvement crops for corn as well as cotton.

A deficiency of soil moisture was a major limiting factor in cotton and corn yields.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Bevan, R., Pawson, W. W., and Brough, O. L., Jr. A COMPARISON OF CROPPING SYSTEMS FOR THE WASHINGTON-IDAHO PALOUSE AREA. Idaho Agr. Expt. Sta. B. 390, 22 pp. 1962.

Net returns from seven different crop rotations in the Washington-Idaho Palouse area were compared for a representative Palouse farm with 520 acres of cropland. Three of these rotations were without hay or green-manure crops; four included alfalfa grown for hay or green manure.

With present wheat acreage allotments, returns to the farmers capital and management from the seven rotations varied from \$9,289 to \$11,714. These returns gave the farmer

\$2,000 for his management activities plus from 4.9 to 6.5 percent return on the capital investment. Of the seven rotations, the most profitable were the wheat-pea rotation and the 12-year alfalfa-hay rotation with wheat and peas. Least profitable were the wheat-fallow and the re-cropped wheat rotation. Green manure rotations were intermediate in return.

Changes in the price of wheat did not affect the ranking of the rotations, but changes in the price of peas, barley, and hay altered the order of profitability. On land previously in grain, dry peas were more profitable than barley unless a ton of barley was worth more than 1,300 to 1,500 pounds of peas.

If wheat allotments were eliminated, and if prices remained as originally assumed, the returns from the selected rotations would be quite different. In that situation, the recropped wheat rotation would become the most profitable, and the wheat-pea rotation would be second in returns. With one exception, the rotations would rank in the same order as the percentage of land in wheat. Thus cropping systems with the least wheat would have smallest returns.

Soil losses and organic matter depletion were greatest with the wheat-fallow rotation; the wheat-pea system was second in this respect. The least loss of soil, coupled with actual increases in organic matter content, occurred with the green-manure and hay rotations. New knowledge regarding fertilizer use and weed control practices now make it possible to farm continuous wheat with relatively light soil losses and with no decrease in organic-matter content.

U. Idaho, Col. Agr. Moscow, Idaho.

Luebs, R. E. INVESTIGATIONS OF CROPPING SYSTEMS, TILLAGE METHODS, AND CULTURAL PRACTICES FOR DRYLAND FARMING AT THE FORT HAYS (KANSAS) BRANCH EXPERIMENT STATION. Kans. Agr. Expt. Sta. B. 449, 114 pp. 1962.

Results of over 50 years of experimental work with cropping systems, tillage methods, and cultural practices at the Fort Hays (Kansas) Branch Experiment Station were reported.

The soil is a deep, silty clay loam of relatively high fertility on slopes of 1 to 3 percent. There is a claypan-like layer about 20 inches deep that is an upper layer of free lime accumulation. Internal drainage is slow but external drainage is generally good.

Average annual precipitation at Hays, Kans., over the 91-year period 1868-1958, was 22.90 inches. Over three-fourths of this precipitation was received from April 1 to October 1.

Winter wheat and grain sorghum were the major crops, with more acreage in wheat. Data from over 30 different cropping systems indicated that their effect on average winter wheat yield was largely that of the previous year's crop or land use. An exception was the lower average yield of continuous wheat when compared with wheat after wheat in systems including fallow or other crops. Weed control was a problem with continuous small grain crops. Available stored soil moisture was important in determining wheat yields. Within limits, an increase in time between crops increased yields.

Green manure crops did not benefit winter wheat production. Any value they might have had was overshadowed by their use of soil moisture.

As much wheat was produced with 1 year of fallow in 4 as with continuous cropping. Fallowing for winter wheat gave generally higher yields and fewer crop failures. Because of the variable rainfall, a flexible cropping system was preferable to a set, rigid system.

Yields of milo after fallow were nearly twice those of milo after milo.

On a pound basis, barley yielded more than oats or spring wheat. Spring wheat produced about one-half as much grain as winter wheat. Yield increases of spring crops after fallow were not enough to justify fallowing.

Forage sorghum grown for hay consistently outproduced sudangrass. Alfalfa failed often and its yields were low. Attempts to grow bromegrass were largely unsuccessful.

Highest yields of continuous and second-year wheat were obtained when the initial tillage operation was not later than July. In fallowing for winter wheat, tillage in May resulted in yields about the same or slightly better than on land tilled the previous fall. When considerable weed growth occurred in the fall after wheat harvest, a shallow tillage operation was desirable. Delaying fallow tillage until July of the fallow year lowered yields.

Shallow cultivation, with a one-way disk plow or subsurface tillage equipment, was as satisfactory for wheat production as deeper tillage with a moldboard plow or lister. Using a basin lister did not increase wheat yield.

Fall was somewhat superior to spring tillage for preparing spring crop seedbeds. A fairly deep spring tillage operation for sorghum seedbed preparation increased yields.

Average yields of several crops grown continuously or the second year after fallow were increased by subsoiling.

Stubble burning did not increase average wheat yields; tillage was necessary for satisfactory yields whether or not stubble was burned. Wind erosion was a hazard following stubble burning. Removal of crop residues by burning reduced water infiltration.

Manure was of negligible value for winter wheat and sorghum in a fallow-wheat-sorghum rotation. With continuous cropping and adequate surface soil and subsoil moisture, profitable increases in winter wheat yields were obtained by applying 30 pounds of nitrogen per acre at drilling. Diking around cropped areas on nearly level land increased crop yields by conserving moisture. Contouring increased yields in a rotation of wheat, wheat, grain sorghum, and barley.

#### Tables.

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

Gerard, C. J., Burleson, C. A., Cowley, W. R., Bloodworth, M. E., and Khan, S. H.

EFFECT OF SELECTED CROPPING SYSTEMS ON COTTON PRODUCTION AND THE PHYSICOCHEMICAL PROPERTIES OF A COARSE-TEXTURED SOIL. Tex. Agr. Expt. Sta. MP-624, 12 pp. 1962.

The influence of rotations on root rot was evaluated. Rotation 7 (cotton-Madrid sweet-clover-cotton-tomatoes) produced about 0.5 bale per acre more than rotations having cotton every year. Root-rot infestations progressively increased to a plateau, regardless of the rotations evaluated. However, root-rot infestations were slower building up to a plateau on rotations having cotton once every 2 years as compared with rotations having cotton every year.

Organic matter and total nitrogen percentage of the Willacy s1 were low. Rotation 5 (continuous cotton) was lowest in organic matter and low in total nitrogen; rotation 2 (tomatoes and red top cane) also was low in organic matter and total nitrogen. The exchangeable sodium concentrations were influenced by rotation treatment; the highest exchangeable sodium occurred under an intensive farming practice of cotton which was followed by a vegetable every year.

The influence of rotations on several soil physical properties was evaluated. This particular coarse-textured soil was found to contain large quantities of fine sand and, consequently, very little aggregation. Lack of aggregation caused the coarse-textured soils to develop into problem soils with respect to physical properties. Vegetable production contributed to soil compaction and reduced greatly the hydraulic conductivity of the upper soil profile. A cotton-Hubam rotation (rotation 3) created favorable soil physical properties. Continuous cotton was not particularly detrimental according to soil physical properties measured.

Measurement of hydraulic conductivity and penetrometer analyses were the most sensitive indices of differences in soil physical properties; bulk density and aggregate stability measurements appeared to be the least sensitive indices of soil physical properties.

The Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Ferguson, W. S. EFFECT OF INTENSITY OF CROPPING ON THE EFFICIENCY OF WATER USE. *Canad. J. Soil Sci.* 43: 156-165. 1963.

An experiment conducted at Brandon, Manitoba, during the years 1955-1959, inclusive, indicated that the proportion of the total rainfall lost to the atmosphere from plant and soil surfaces on cropped land during the growing season (evapotranspiration) was highly dependent on the intensity of cropping. Evapotranspiration accounted for only 38.3 percent of the total rainfall in a wheat-summer fallow rotation. The remaining 61.7 percent was lost by percolation, run-off, and/or evaporation during the non-crop period of the rotation. Decreasing the frequency of summer fallow in the rotation increased the percentage of the total rainfall used by evapotranspiration. This percentage increased to 78.5 when wheat was grown continuously. Evapotranspiration accounted for 90.8 percent of total rainfall with alfalfa. Evapotranspiration by wheat grown on summer fallow tended to decrease when fertilizer was used and increased when third crop wheat was fertilized. The changes resulting from fertilizer were small, relative to the changes resulting from the intensity of cropping. The use of fertilizer increased the number of bushels of wheat produced per inch of evapotranspiration. Summer fallow was not necessary to conserve moisture for wheat production during the experimental period.

Canada Dept. Agr., Res. Br., Expt. Farm, Brandon, Manitoba, Canada.

Harper, H. J. EFFECT OF SUMMER FALLOW, LESPEDEZA AND SWEETCLOVER ON GRAIN YIELD AND FORAGE PRODUCTION. *Okla. Expt. Sta. Processed Ser. P-427*, 13 pp. 1962.

Wheat, rye, and barley were fall-planted every year on the same plots in 7-inch and in 14-inch rows on summer-fallowed land or following Korean lepedeza. Spring oats were planted in a similar manner following summer fallow, Korean lepedeza, and trailing wild beans. Wheat and oats also were planted in various row spacings with biennial sweetclover to compare the effect of this cropping system with yields where small grains were planted every year. Plantings were on Norge 1, a moderately permeable reddish prairie soil.

The average yields of wheat, barley, and oats were slightly higher when planted in 7-inch rows. Rye production was not affected appreciably by row spacing. Average grain yields of wheat, barley, and rye where Korean lepedeza was grown with the small grain were lower than yields following a summer fallow.

Oat yields were slightly higher where lepedeza grew during the summer as compared with plowing the land as soon as possible after an oat crop was harvested.

Trailing wild beans were not as effective in producing good yields of spring oats as Korean lepedeza.

Winter forage production was highest where fall-planted small grain was planted on summer-fallowed land as compared with small grain following Korean lepedeza. No nitrogen was applied when the small grains were planted.

Korean lepedeza produced sufficient forage to provide good summer grazing during 11 of the 14 years.

Sweetclover residues increased wheat yields more than oat yields. Three crops of wheat following sweetclover were more profitable than four crops of wheat following summer fallow, or following Korean lespedeza. Sweetclover and Korean lespedeza failed from 1954 to 1956 because of severe summer drought.

Barley and spring oats harvested for grain were not profitable during a majority of the seasons.

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

Alley, H. P., and Chamberlain, E. W. SUMMARY REPORT OF CHEMICAL FALLOW STUDIES. Wyo. Agr. Expt. Sta. Mimeo. C. 166, 33 pp. 1962.

Studies to evaluate herbicides for use in chemical fallow were conducted by several stations in the Western United States. Most stations reported that satisfactory control of broadleaved weeds was obtained, but that grass weed control was not satisfactory.

New herbicides now being evaluated have given complete season-long control of both grass and broadleaved weeds. In many cases, especially on clay soils, the residual effect of the chemicals has caused considerable damage to winter wheat.

Wind and water erosion have been reduced by chemical-fallow methods. Wheat yields have equaled or outyielded conventional fallowed land in areas where sandy soils persist.

Chemicals are now available which can be used under certain soil and climatic conditions. Until the residual effect of the chemical, its persistence, and wheat-variety tolerance studies are completely understood under a greater set of conditions, recommendations for commercial use should not be made. The authors concluded that:

1. Atrazine controlled both grass and broadleaved weeds for a complete summer-fallow period.
2. The residual effect of atrazine is not completely understood when subjected to different soil and climatic conditions.
3. New compounds and analogues of existing compounds, with more solubility and selectiveness, may hold more promise for this area.
4. Yields of winter wheat, in many cases were equal to, or in excess of, those from mechanically fallowed lands.
5. The residual effect of atrazine persisted for a longer period of time in clay soils than in sandy soils.
6. Reduction in wheat yield resulted only on the clay soils. Wheat has tolerated rates of 2 and 4 lbs./A. of atrazine on sandy soils.
7. There is a need and a definite potential for the chemical-fallow program.

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

Isely, D., and Bragonier, W. H. SEEDS OF IOWA NOXIOUS AND COMMON WEEDS. Iowa Agr. Expt. Sta. B. P-131, 24 pp. 1962.

Weeds are one of the most serious problems faced by the American farmer. Losses due to weeds are estimated at 3 billion dollars annually in the United States.

The best way to control weeds is to stop them before they reach the farm. It is much easier and cheaper to prevent these pests from establishing themselves than to eradicate them. The seeds of a few kinds of weeds can be carried long distances by natural means.

The seeds of most weeds are spread by man, most commonly planted with crop seed.

Many individuals can recognize our worst weeds by appearance. If these weeds show up in fields, their presence is soon noted and control measures can be taken. But control can often begin a step earlier if weed seeds are recognized when found in other seed.

The identification of weed seeds is more difficult than knowing the plants. It is primarily the responsibility of seed specialists. Nonetheless, many farmers and agricultural leaders recognize some seeds and wonder about others.

Illustrations and descriptions of the noxious weed seed and some of the more common weed seeds in Iowa were given.

Iowa State U. Sci. and Tech., Agr. Home Expt. Sta., Ames, Iowa.

## Crop Residue Management

Parker, D. T. DECOMPOSITION IN THE FIELD OF BURIED AND SURFACE-APPLIED CORNSTALK RESIDUE. *Soil Sci. Soc. Amer. Proc.* 26: 559-562. 1962.

The decomposition of cornstalk residue placed on the surface of soil or buried in soil in the field was followed during a corn crop-growing season by removing from the soil at various times subsamples of decomposing residue contained in glass-cloth bags. Decomposition during the season (20 weeks) amounted to 50 percent of the surface residue and 65 percent of the buried residue. Half of this decomposition occurred in 8 weeks and in 5 weeks for surface and for buried residue, respectively.

There was little change in the total N content of surface residue throughout the season. Nitrogen was not immobilized. However, the C/N ratio declined from 57 to approximately 30.

A maximum of 12 pounds of N per 3 tons of residue per acre was immobilized by buried residue after 3 weeks incubation. Thereafter, total N content of the residue declined. A net loss of N occurred after 5 weeks with no N fertilization and after 15 weeks' with N fertilization. The C/N ratio declined from 57 to 22. The decline in C/N ratio, both with surface and with buried residue, was caused by loss of carbon from the residue rather than an increase in total N.

Early season growth of corn plants was retarded by surface residue, but the retardation was not a consequence of N immobilization. A slight retardation of growth with buried residue might, in part, have been caused by immobilization of N.

SWCRD, ARS, USDA, Ames, Iowa. 50010.

Parr, J. F., and Reuszer, H. W. ORGANIC MATTER DECOMPOSITION AS INFLUENCED BY OXYGEN LEVEL AND FLOW RATE OF GASES IN THE CONSTANT AERATION METHOD. *Soil Sci. Soc. Amer. Proc.* 26: 552-556. 1962.

Laboratory experiments were conducted to determine the rate of decomposition of wheat straw added to soil when continuous aeration was conducted with N<sub>2</sub>-O<sub>2</sub> gas mixtures containing 0, 0.5, 1.0, 2.5, 5.0, and 21 percent oxygen at flow rates of 1/8, 1/4, 1/2, 1, and 2 liters per hour. Rates of decomposition and total decomposition were followed by determination of wheat straw carbon evolved as CO<sub>2</sub>.

Total decomposition at all oxygen levels varied directly with aeration flow rate, except for the 0 percent level where an inverse relationship was observed.

Microbial activity at the 21 percent oxygen level was greatly stimulated as flow rate increased from 1/8 through 2 liters per hour.

A rapid increase in microbial activity occurred for the 0.5, 1.0, 2.5, and 5.0 percent oxygen levels as flow rate increased from 1/8 through 1/2 liters per hour, however, little increase in CO<sub>2</sub> production was observed at higher flow rates.

Plant Nutr. Lab., U. Mich., Ann Arbor, Mich.

Heavy straw presented a problem hampering the use of stubble mulch as an erosion control measure in the Pacific Northwest. In the Walla Walla County, Washington, area farmers have developed the necessary know-how and ability to handle heavy straw as mulch. The practices and records of seven of these farmers were studied. Each has worked out a method or sequence of tillage to suit his land, using the tillage and seeding equipment available to him.

The experience of these operators shows that many kinds of equipment can be used to do good mulch fallow. The large amount of straw and stubble present on the land after harvest is no reason extra fall tillage need be used to start decomposition. Instead, standing stubble should remain so that better water intake will occur during the winter prior to starting mulch fallow. Methods or tillage sequence can be varied from year to year to meet different seasonal weather conditions and help control cheatgrass. If cheatgrass is a problem, a degree of control can be achieved by disking in the late fall after it has sprouted.

The kind of grain drill or seeding equipment needed to seed stubble mulch fallow is not a problem if mulch preparation is pointed toward the kind of seeding equipment available or the skew treader is used immediately after seeding to plant any seed that was not properly placed through the straw mulch by the drill.

The skew treader is about the only piece of equipment that needs to be purchased by farmers who are planning to start a mulch fallow program. And one operator has found even this machine is not necessary. He has successfully used a combination of fall and winter pasturing of cattle on grain stubble and two diskings, at 5- and 3-inch depths, respectively, the following spring to reduce straw to the desired condition for tillage and seeding.

TABLE 1.--Soil, Rainfall and Management Data Relating to the Practice of Stubble Mulching on Seven Farms in Walla Walla County, Washington.

Name	Kind of Soil	Average Annual Rainfall per Crop Year	Years Mulch Used	Amount and Length of Straw Per Acre	Yield Before Mulch	Tillage Sequence	Kind and Amount of Fertilizer Used	Amount and Length of Straw Per Acre <sup>a</sup>	Method of Seeding	Wheat Yield After Mulch
		(inches)			(bu./ac.)		(pounds)			(bu./ac.)
Robert Stevens <sup>b</sup>	Walla Walla, Ritzville, Transition	14	8	3-4 tons 2-3 feet	45	30 in. sweep 5-6 in. deep or disc 4-5 in. deep, skew tread, 2-3 rod weeding	N 50	600-800 lbs. 3-8 inches	10 in. spacing with Belke drill shoe or 7 in. double disc	45-60
Walter Brothers <sup>b</sup>	Ellisforde	12	20	2-3 tons 2-3 feet	44	Skew tread, 5-6 in. deep with 30 in. sweep, skew tread, 2 rod weeding	N 55	600-800 lbs. 3-6 inches	14 in. spacing, 6 in. shovel, deep furrow	46
John Nordheim <sup>c</sup>	Walla Walla	15	20	3-4 tons 2-3 feet	45-50	Disc 4-5 in. deep, Disc 2-3 in. deep, 2 rod weeding	N 50	800-1000 lbs. 4-6 inches	7 in. spacing double disc	50-55
Lee Mantz <sup>c</sup>	Walla Walla, Athena, Transition	18	2	4-5 tons 3-4 feet	56-60	Jeffroy Chisel Plow 5-6 in. deep, 4 skew treading	N 60	1000 lbs. (40 percent soil showing) 4-6 inches	6 in spacing double disc	56
Mike Thomas <sup>hc</sup>	(Middle) Walla Walla	17	8	2-3 tons 2-3 feet	40-45	Disc 4-5 in. deep, skew tread, 2 rod weeding, skew tread	N 50 S 10	600-800 lbs. 8-12 inches	7 in. spacing double disc	45-50
Andy Hermanns <sup>bc</sup>	(Middle) Walla Walla	17	7	2-3 tons 2-3 feet	48	30 in. sweep 5-6 in. deep, skew tread, 3 rod weeding	N 50-60 S 10	700-800 lbs. 3-6 inches	7 in. spacing double disc	50
Harry Morse <sup>b</sup>	Walla Walla, Athena, Transition	18	7	3-4 tons 3-4 feet	54-60	Disc 4-5 in. deep, skew tread, 2-3 rod weeding	N 60-70	800-1000 lbs. 3-6 inches	7 in. spacing single disc	54-60

<sup>a</sup> On surface at time of seeding. <sup>b</sup> Used hydraulic controlled compensating hitches on all equipment except disc and sweep. <sup>c</sup> Stubble used as winter pasture for beef.



Stubble mulching has been established as a sound wind erosion control practice by more than 20 years of successful use. In the Great Plains, however, this practice has not materially improved soil moisture storage. Research and widespread experience have shown that stubble-mulch farming can be done satisfactorily. Used in combination with a complete soil and water conservation program it provides protection essential to the continued productivity of the basic natural resource, the soil. A number of soil fertility, microbiological, weed, and tillage problems associated with mulch farming on specific soils need to be solved. The following summary of the comparison of stubble mulching with plant residue incorporation was given:

Stubble Mulching Compared With Plant Residue Incorporation--  
Effects on Soil Properties and Plant Growth

Type of Determination	Mulched Surface Compared With Bare Soil
<b>Physical</b>	
Erosion control-- wind and water	Far superior
Infiltration	Improved, but depends on soil.
Soil temperature	Cooler in summer--warmer in winter.
Soil moisture storage	Majority of information from the Great Plains shows that mulches either slightly increase or have little effect on moisture storage. Amount of water stored during fallow depends upon climate, rainfall pattern, and soil.
Aeration and bulk density	No difference--tillage pans may form on some soils even with sweep equipment.
Aggregation wet sieve	Greater in surface inch.
dry sieve	No difference at greater depths.
<b>Chemical--Soil</b>	
Ammonia loss	Slightly higher with legume residues.
Nitrites	No difference.
Nitrates	About 5 to 10 percent less.
Amino acids	Slightly higher in 0- to 3-inch depth; no difference in 3- to 6-inch depth.
Nitrogen, carbon, organic matter, pH, HCl soluble and adsorbed phosphorus	Slightly higher in surface inch of soil; in 1- to 6-inch depth, no difference.
<b>Chemical--Plants:</b>	
Oats, Wheat, Corn )	
Nitrogen and protein contents, grain and straw	Slightly less.

Stubble Mulching Compared With Plant Residue Incorporation--  
Effects on Soil Properties and Plant Growth--Continued

Type of Determination	Mulched Surface Compared With Bare Soil
<b>Chemical--Plants--Continued</b>	
Phosphorus, potassium, calcium, and magnesium	No marked differences.
Manganese	Lowered.
<b>Biological</b>	
Crop yields, grain and straw	Variable--may be higher in dry years and lower in wet years.
Straw/grain ratio	Lower.
Bacteria, Actinomycetes, fungi, denitrifiers, earthworms, and Nematodes	Greater number in surface inch.
Azotobacter, legume bacteria	No difference in numbers or effect on nodulation.
<b>Decomposition of Residues</b>	
Fungi decomposing straw residue	<u>Penicillium</u> , <u>Fusarium</u> , <u>Alternaria</u> , <u>Hormodendrum</u> , <u>Trichoderma</u> , and <u>Chaetomium</u> as a group decom- posed more rapidly than <u>Aspergillus</u> , <u>Rhizopus</u> , and some species of <u>Trichoderma</u> . All bring about decomposition in well aerated soil--sweep tilled or plowed.
<b>Plant Growth Inhibitors</b>	
	Present in crop residues and soil and produced by some microorganisms associated with stubble mulching--seem to be more severe with stubble- mulch tillage.
<b>Insects and Plant Diseases</b>	
	No differences observed--root rot of wheat may be increased.
<b>Weed Control</b>	
Machinery and chemicals	Cheatgrass and other weeds more difficult to control-- a combination of sweep tillage plus chemical weed control appears promising.
<b>Machinery Requirements</b>	
Seedbed preparation, seeding, and cultivation of row crops	Conventional equipment can be used but sweep cul- tivators are usually needed. Power requirements are usually less for sweep implements. Conventional semi-deep or deep shovel drills are satisfactory if residues are not excessive.

SWCRD, ARS, USDA, Lincoln, Nebr. 68503.

## Tillage

Baughman, N. M., and Olsen, F. WHEEL-TRACK PLANTING OF CORN. W. Va. Coop. Ext. Serv. Misc. P. 110, 5 pp. 1962.

Cooperative tillage trials were conducted for corn production. Wheel-track planting, a method of minimum tillage, was shown to have considerable merit when compared to other methods, including the conventional method of plowing, disking, dragging, and harrowing prior to planting corn.

Wheel track planting removed much of the erosion hazard in corn production, helped maintain favorable structural conditions in the soil, and reduced costs of production by decreasing time and labor needed in preparation of soil for planting and that needed for weed control.

Corn in West Virginia is used primarily as feed for livestock--either as grain or ensilage--on farms where it is grown, and does not contribute materially to surplus. In terms of nutrient production per acre, corn cannot be excelled by any other commonly grown grain or forage crop.

By the adoption of wheel-track planting, many of the dangers of erosion were minimized, costs of production were reduced, and use of manures were made more efficient. Yields were equal to or greater than yields from conventionally tilled crops. The net advantages are such that few farmers can afford to ignore this practice.

Coop. Ext. Serv., W. Va. U., Morgantown, W. Va.

Siddoway, F. H., and McKay, H. C. TILLAGE OF SWEETCLOVER UNDER DRYLAND CONDITIONS. Idaho Agr. Ext. Serv. B. 388, 12 pp. 1962.

Several methods of initially tilling a sweetclover green manure crop under a dryland summer fallow system of farming were investigated in Idaho.

The number of plants that survived the initial summer fallow tillage was consistently highest for the one-way disk treatment. When the soil was dry to tillage depth, sweep tillage resulted in the most complete kill. The moldboard was superior in this respect when the soil was moist within the tillage zone.

The amount of original residue maintained on the surface for two seasonal extremes ranged from about 10 to 65 percent, 5 to 30 percent, and 1 to 6 percent for the sweep, one-way disk, and moldboard treatments, respectively. Weeding operations with the rodweeder were not seriously destructive to surface residue.

Nitrates in the surface foot varied more by season and year than among initial treatments. There was an indication, based on protein content of wheat, that nitrogen availability was positively correlated with the quantity of residue on the surface.

Differences in wheat yields attributable to the placement of sweetclover residues and methods of tillage were small.

The results apply to spring grain areas of high elevation with 14 or more inches of annual precipitation and to nitrogen deficient winter wheat areas where sweetclover can be tilled before surface moisture is depleted.

U. Idaho, Col. Agr., Idaho Agr. Ext. Serv., Moscow, Idaho.

Lessard, J. R., Bourget, S. J., Hamilton, H. A., and Levesque, M. INFLUENCE OF DIFFERENT DEPTHS OF PLOWING ON THE PHYSICAL PROPERTIES OF A CLAY SOIL AT GUYENNE, QUEBEC. *Canad. J. Soil Sci.* 43: 178-185. 1963.

An experiment was initiated in 1955 to study the effect of plowing to depths of 6, 12, and 24 inches on the physical properties of a Guyenne C soil. A 4-year crop rotation was established. Soil core samples were taken in 1957, 1959, and 1960 and determinations of bulk density and porosities were made. The soil particle-size distribution was determined for all tillage treatments in 1960.

Plowing to a depth of 24 inches resulted in higher bulk density and lower non-capillary porosity values in the surface 6-inch soil layer of soil than the 6- and 12-inch plowing. The 18- to 24-inch soil layer was less packed than the corresponding undisturbed layers at the same depth, as a result of deep tillage. The clay content of the 0- to 6-inch layer of soil was also increased by 24-inch plowing. Year-to-year data showed the importance of seasonal climatic conditions on the soil physical properties.

Kapuskasing Expt. Farm, Kapuskasing, Ontario, Canada.

Wind, G. P., and Hidding, A. P. THE SOIL-PHYSICAL BASIS OF THE IMPROVEMENT OF CLAY COVER-SOILS. *Netherlands J. Agr. Sci.* 9: 281-292, 1961

Clay cover-soils (a shallow clay layer upon a sandy subsoil) are very susceptible to drought. This occurs because no roots penetrate into the sand. The crop can use only the moisture of the shallow clay cover and some moisture that can flow capillary out of the sand to the root zone. Methods for improving these soils are: (1) Sub-irrigation in spring with saline water; and (2) deep-plowing by which clay and sand are mixed.

The amounts of available moisture were computed for different depths of the spring groundwater table. The amounts in the root zone were computed with the aid of pF-curves and those in the capillary zone with a formula for the relation between capillary conductivity and pF. From potential evapotranspiration and rainfall data, the mean actual evapotranspiration in the growing season was calculated for different amounts of available moisture. Under the assumption that there is a rectangular relation between yield and actual evapotranspiration, the agricultural production capacities were calculated.

It was concluded that a groundwater table 100 cm. below the soil surface gives a sufficient moisture supply for deep-plowed cover-soils and that cover-soils that are not deep-plowed will not reach a high productivity.

Inst. for Land and Water Mangt. Res., Wageningen, The Netherlands.

## Fertility Requirements for Conservation Farming

Gorodniy, N. G. INFLUENCE OF PROLONGED, SYSTEMATIC APPLICATION OF FERTILIZERS ON HUMUS ACCUMULATION IN SOIL, AND THE AGRICULTURAL CROP YIELDS. *Soviet Soil Sci.* 2: 190-197. Feb. 1961.

The influence of organic and mineral fertilizers and their mixtures, depending on the duration of application, on soil humus under permanent hemp and a rotation with row crops, clover, perennial legume-grass mixtures, and pure fallow was studied. The studies were made on dark-gray, slightly podzolized clay loam in the fields of Russia.

The amount of soil humus under hemp left unfertilized for 27 years did not change during this period, while in the area where manure was applied at a rate of 40 metric tons/ha., (17 tons/ac.) the humus content increased by 1.39 percent, and when NPK was applied at a rate equivalent to 40 metric tons of manure, it increased by 0.09 percent.

The author concluded:

1. The prolonged and systematic application of manure, as well as the seeding of perennial legume-grass mixtures increased the humus content in the soil. The highest accumulation of humus occurred in the plowed layer, and in the lower layers of the soil under the prolonged application of high amounts of manure.
2. The amount of organic matter in manure changed into humus varied from 14 to 30 percent. The mineralization of organic substances added to the soil under hemp increased with increasing amounts of manure and reached a maximum (86 percent) with annual rates of manure of 80 metric tons/ha. (34 tons/ac.).
3. When manure and mineral fertilizers were applied together, the amount of humus in the soil did not decrease as compared to that when the same amount of mineral fertilizer was applied singly.
4. The simultaneous application of manure and lime promoted the accumulation of humus in the soil, while the application of lime against a background of mineral fertilizers intensified the mineralization of organic matter.
5. When fertilizers were systematically applied to the soil, the content of mobile humus increased. The amount of water-soluble humus in the soil to which mineral fertilizers were applied was higher than when manure was used.
6. Mineral fertilizers, equivalent to 40 metric tons/ha. of manure (17 tons per ac.), gave higher yields of hemp and certain other agricultural crops in the first year than did the manure, but later their negative influence on the fertility of soil becomes felt, and the yield of hemp, potatoes, spring wheat, barley, and clover after manure exceeded that after mineral fertilizers.
7. Under the prolonged application of fertilizers, the stem length and yield of fiber, and the count and strength of long fiber were higher after manure than after mineral fertilizers, independent of the crop preceding hemp and the amount of fertilizer used.

Scripta Technica Inc., 1000 Vermont Ave., N.W. Washington, D.C. 20005.

Ahrens, C. L., and Swanson, E. R. CHOOSING THE MOST PROFITABLE FERTILIZER PROGRAM. Ill. Col. Agr. C. 855, 16 pp. 1962.

A procedure was described for using money spent on fertilizer most effectively in terms of increasing farm profit. The procedure is intended to be used by persons who have the responsibility of making recommendations to farmers concerning the use of fertilizer. It may be used directly during consultation. Although the procedure is principally a tool meant for agricultural consultants, many farmers may, without assistance, find the procedure useful in analyzing their own fertilizer programs.

U. Ill., Col. Agr., Ext. Serv. Agr. and Home Econ., Urbana, Ill.

Williams, B. C. RATES OF FERTILIZER FOR FORAGE CROPS. N. Mex. Agr. Expt. Sta. Res. Rpt. 71, 14 pp. 1962.

Common Sweet Sudangrass and Sumax 1712 forage sorghum were fertilized at four rates with nitrogen and at three rates each with phosphorus and potassium.

Although studies of 1 year duration may not be conclusive, the results help confirm certain points with respect to fertilization of forage crops produced under irrigation in southern New Mexico.

Nitrogen and phosphorus were both required to produce high yields. These data indicate that rates of nitrogen, for good production, were 160 and 200 pounds per acre for forage

sorghum and sudangrass, respectively. The rates of available phosphorus were 80 pounds for forage sorghum and 50 pounds for sudangrass.

The possibility of need for potassium was shown. The need for this element will become more acute as the yields of forage are increased by fertilization with nitrogen and phosphorus.

The fact that fertilization increases water-use efficiency was shown. Nitrogen content of the forage was increased by the application of fertilizers. This did not result in an increase in the total digestible nutrients found in the crop; however, it did increase the total amount of digestible nutrients harvested per acre. This latter result was caused by the effect of fertilizers increasing the yield of forage per acre.

TABLE 1. Common Sweet Sudangrass yield increases and increases in gross profit, by fertilizer treatment

Treatment N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O	Increase in Yield per Acre	Cost of Fertilizer per Acre <sup>1</sup>	Value of Change in Acre Yield	Gross Profit per Acre <sup>1</sup>
lbs./A	Tons	Dollars	Dollars	Dollars
0- 0- 0	--	--	--	--
100- 0- 0	11.4	14.00	74.10	60.10
200- 0- 0	14.7	28.00	95.55	67.55
300- 0- 0	11.6	42.00	75.40	33.40
0- 50- 0	6.2	4.50	40.30	35.80
100- 50- 0	3.4	18.50	22.10	3.60
200- 50- 0	16.5	32.50	107.25	74.75
300- 50- 0	10.8	46.50	70.20	23.70
0-100- 0	4.3	9.00	27.95	18.95
100-100- 0	11.8	23.00	76.70	53.70
200-100- 0	11.5	37.00	74.75	37.75
300-100- 0	14.6	51.00	94.90	43.90
0- 0-50	8.6	3.00	55.90	52.90
100- 0-50	9.8	17.00	63.70	46.70
200- 0-50	12.8	31.00	83.20	52.20
300- 0-50	15.4	45.00	100.10	55.10
0- 50-50	7.3	7.50	47.45	39.95
100- 50-50	11.1	21.50	72.15	50.65
200- 50-50	14.5	35.50	94.25	58.75
300- 50-50	14.7	49.50	95.55	46.05
0-100-50	8.8	12.00	57.20	45.20
100-100-50	14.0	26.00	91.00	65.00
200-100-50	10.5	40.00	68.25	28.25
300-100-50	9.8	54.00	63.70	9.70

<sup>1</sup> In calculating the columns above, the following values were used:

Nitrogen @ 14¢/lb.; P<sub>2</sub>O<sub>5</sub> @ 9¢/lb.; K<sub>2</sub>O @ 6¢/lb.; and Sudan silage @ \$6.50/ton

Note-(The 0-0-0 treatment yielded 39.9 tons of silage in three cuttings).

Hughes, R. H., Jackson, J. E. FERTILIZATION OF YOUNG SLASH PINE IN A CULTIVATED PLANTATION. Southeastern Forest Expt. Sta., Sta. Paper 148, 14 pp. 1962.

Forty-two fertilizer treatments were replicated three times in a cultivated slash pine plantation (*Pinus elliottii* Engelm. var. *elliottii*) established in 1957 on Lynchburg ls in southern Georgia. Seedlings were fertilized in 1957 and 1958. Average height of four trees in each replication was taken as the unit of observation.

Seedlings in check plots not fertilized reached a height of 60.8 inches in two growing seasons. In a 3 x 3 x 3 factorial experiment, where mixed fertilizers containing phosphorus were broadcast around trees at a rate of 50 pounds of P<sub>2</sub>O<sub>5</sub> per acre, trees attained a height of 68.6 inches. Nitrogen and potash (K<sub>2</sub>O), each at a 100 pounds per acre rate mixed with 0-, 50-, and 100-pound levels of phosphate, in most cases gave good response, but addition of potash without nitrogen or nitrogen without potash retarded growth. Phosphate alone at the 50-pound rate was the most efficient fertilizer tested; trees thus fertilized measured 28.7, 72.7, and 120.6 inches high 1, 2, and 3 years from planting. Nitrogen at the 200-pound rate, alone or in mixtures, retarded tree growth.

Additional tests involving: (1) N-P-K with minor elements and lime; (2) split application of nutrients involving widely varying rates of N, P, and K; and (3) subsurface application of fertilizer did not reveal significant increases in growth when compared with single annual surface application of mixed fertilizers. Subsurface applications had the advantage of preventing excessive growth of weeds.

Rapid growth stimulated by cultivation and fertilization apparently increased the susceptibility of plantation trees to attacks by insects and diseases.

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

Brinkman, K. A. FERTILIZERS INCREASE SEED PRODUCTION OF SHORTLEAF PINE IN MISSOURI. Tree Planters' Notes. 53: 18-19. 1962.

A 4-acre block of shortleaf pine was thinned in 1958 to create a seed-production stand with a basal area of about 45 square feet per acre. The best potential seed trees were left, those with good crowns and some indication of past seed production. Form, vigor, spacing, and apparent root-firmness also were considered in selecting the seed trees. The hardwood understory was controlled by cutting and/or spraying with 2,4,5-T.

The block was divided into four 1-acre plots. Each of three plots was given a standard dosage of all three nutrients (nitrogen, phosphorus, and potassium) plus an additional amount of one of the nutrients (see table). The fourth plot was not fertilized. Half the total amount of fertilizer was applied in April of 1958 and half in 1959.

TABLE.--Fertilizer treatments and seed produced in 1960

Treatment	Total fertilizer applied per acre in 2 years				Seed produced per acre 1960 <sup>1</sup>
	N	P	K	Total	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Phosphorus	120	180	84	384	54.0
Potassium	120	60	252	432	45.6
Nitrogen	360	60	84	504	33.7
Check	0	0	0	0	24.8

<sup>1</sup> Assuming 40,000 seeds per pound.

Heavy stands of grasses and herbs developed on all fertilized areas and competed with the seed trees for soil moisture and nutrients. The harmful effects of grasses and herbs, if not controlled, may more than offset the beneficial effects of fertilizers on seed production.

Expt. Sta., FS, USDA, U. Mo., Columbia, Mo.

Bagley, W. T. TREE RESPONSE TO FERTILIZER APPLIED AT PLANTING. *J. Soil and Water Conserv.* 17: 117-119. 1962.

Chemical fertilizers containing N, P, K, NP, and NPK were applied at planting time on 13 tree windbreak plantings in nine counties of northeast and north central Nebraska. Small differences in survival were noted. The greatest benefits accrued to Siberian elm and green ash where NPK was added. Height response to added nutrients was small. Nitrogen was responsible for the most increase in growth in all species except ponderosa pine. Siberian elm and honey locust showed the most growth increase. Weed growth stimulation by fertilizers was not apparent. Nutrients are not likely to be as limiting to tree seedling survival and growth as other factors on most Nebraska sites.

If soil or foliage analyses indicate low nutrient availability, and if soil moisture shortages can be minimized, it is likely that proper application of fertilizers will increase vigor and growth of many tree species in Nebraska plantations.

U. Nebr., Lincoln, Nebr.

Rasmussen, G. K., and Smith, P. F. EVALUATION OF FERTILIZER PRACTICES FOR YOUNG ORANGE TREES. *Fla. State Hort. Soc.* 1961 Proc. 74: 90-95. 1962

Several young orange tree fertilizer experiments were started in new groves on Lakewood soil in Lake County between 1956-60. Approximately 30 combinations of rate and timing of a complete mixed inorganic fertilizer, several rates of Uramite as a source of nitrogen, moisture-holding materials, and other miscellaneous treatments were used in each experiment.

On Lakewood soil, 1 pound the first year, 2 pounds the second, and 4.5 pounds the third year of an inorganic 8-2-8 mixed fertilizer were adequate for good tree growth. The number of applications was not critical. Just as good growth resulted from 3 applications the first 2 years and 2 the third year as from 5 the first year and 3 the second and third years. Fertilizing once in the spring with a complete fertilizer of Uramite as the nitrogen source was satisfactory.

On Lakeland soil, Valencia and Hamlin orange tree growth was very good when about 1, 2, and 4 pounds of 8-2-8 inorganic fertilizer was applied in the first, second, and third seasons, respectively. Timing of applications of fertilizer also was not critical for young Valencia or Hamlin orange trees. No advantage in using more than 3 applications in any year was found. Two applications were satisfactory after the first year. Uramite was a satisfactory source of nitrogen when used in a single application of a complete 8-2-8 fertilizer, but the trees became temporarily pale green in late summer.

Moisture holding materials used at plantingtime were of questionable value since their effect disappeared by the third year.

Nutritional sprays containing Cu, Zn, and Mn were of no additional benefit in promoting growth when these elements were included in the fertilizer. Foliage sprays of NPK were of no benefit when applied to trees which received soil application of a complete fertilizer. Dolomite used as a filler in the fertilizer mix was adequate for pH control and additional dolomite was of no benefit in producing growth.



During the fourth year, 1 application of 4 pounds of inorganic-mixed fertilizer gave as good growth as 3 applications or 1 application of complete fertilizer containing Uramite as the source of N.

U.S. Hort. Field Sta., Orlando, Fla.

Longstaff, W. H. SOIL FERTILITY MANAGEMENT OF COASTAL BERMUDA GRASS IN THE BLACKLANDS ON SHALLOW AUSTIN CLAY. Hoblitzelle Agr. Lab., Tex. Res. Found. B. 13, 19 pp. 1962.

Results of soil fertility management studies of Coastal Bermuda-grass on shallow Austin clay soil indicated that:

1. Each additional increment of nitrogen fertilizer applied to Coastal Bermudagrass produced an additional increase in hay yield.
2. Essentially the same total hay yields were obtained whether nitrogen was applied as a single spring treatment or as a split application.
3. The application of a phosphatic fertilizer greatly increased the forage yield of a Button Clover crop overseeded in a Coastal Bermuda pasture. It also increased the forage yield of a pure stand of Coastal Bermuda.
4. The average return per dollar invested in fertilizer ranged from \$3.00 to \$4.00 depending upon the rate of applied nitrogen. Only in two instances during this 4-year period was the return less than \$2.00.
5. The net profit, after all the various production costs were deducted, increased with each increment of nitrogen fertilizer. At the highest rate of 148 pounds of nitrogen, applied in split applications, the net profit per acre was essentially doubled.
6. A dense stand of Coastal Bermudagrass more efficiently used applied fertilizer; which produced more efficient use of the available soil moisture.

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

Carter, L. P., and Scholl, J. M. EFFECTIVENESS OF INORGANIC NITROGEN AS A REPLACEMENT FOR LEGUMES GROWN IN ASSOCIATION WITH FORAGE GRASSES: I. DRY MATTER PRODUCTION AND BOTANICAL COMPOSITION. Agron. J. 54: 161-163. 1962.

Studies to evaluate the effect of nitrogen, supplied by ammonium nitrate, on the yield of orchardgrass and bromegrass and on yield and botanical composition of grass-legume mixtures were conducted during the period 1957-1959. These grasses were grown with 0, 30, 60, 120, and 240 pounds of elemental nitrogen and in association with red clover and alfalfa, without and with 60 pounds of N, and all were compared on the basis of dry matter production. Seasonal distribution of growth and contributions made by each component of the mixtures were determined.

Nitrogen fertilization increased the dry matter yield of pure grass stands. Orchard grass tended to produce less than bromegrass at low rates of nitrogen and more than bromegrass at higher rates of nitrogen. The dry matter yields showed a typical diminishing returns response to increasing rates of N on the pure grass stands. The response did not appear to have reached its maximum.

When a split application of 120 pounds of N (two 60-pound increments) was applied and compared to a single 120-pound application, increased yield of herbage resulted in the

second and third harvests. This gave more favorable distribution of the forage and greater over-all dry matter yields, except with bromegrass in 1959, where there was little difference between the two treatments.

The application of N to four grass-legume mixtures resulted in increased yield of dry matter. This was due to increased growth of the grass component. The increased growth of grass resulted in a corresponding decrease in legume growth in most cases.

The management of grass-legume mixtures to maintain a desirable balance of components is difficult. The manager must attempt to balance the factors favoring growth of grass with those favoring the legume. Allowing the balance to shift in either direction may result in loss or serious reduction in one or another of the components.

There was little difference between the yields of the grasses receiving 240 pounds of N and the unfertilized grass-legume mixtures.

It took about 240 pounds of N on the pure grasses to produce as much dry matter as was produced by grass-alfalfa mixtures without added N. The yields of the legumes in pure stand were comparable to the yield of the grass-legume associations.

Mont. State Col., Bozeman, Mont.

Everett, P. H. THE EFFECT OF SUPERPHOSPHATES ON WATERMELON YIELDS. Fla. State Hort. Soc. 1961. Proc. 74: 158-161. 1962.

In a field experiment on virgin soil, the effects on watermelon yield of three levels of  $P_2O_5$  from two sources were measured. The three levels were 0, 100, and 200 pounds  $P_2O_5$  per acre and the two sources were ordinary 20 percent superphosphate and concentrated 46 percent superphosphate.

There was a definite linear trend toward higher yields with increased levels of  $P_2O_5$  when ordinary superphosphate was the source. However, the only significant increase in yield was between the 0 level and the 200 pounds  $P_2O_5$  per acre level. When concentrated superphosphate was the phosphorus source the yield response was essentially opposite and with a much smaller magnitude than the response with ordinary superphosphate. The trend was a reduction in yield and fruit size with increased amounts of concentrated superphosphate.

Chemical analyses of soil and foliar samples revealed that there was an increase in soil phosphorus at the 100- to 200-pound levels when compared to the 0 level, but this increase was not reflected in the tissue phosphorus. As the addition of the superphosphates increased so did the soil and tissue calcium. The magnitude of the increase was greater with ordinary than with concentrated superphosphate.

Although it is impossible to eliminate other factors completely, the data indicate that the positive response to increased amounts of ordinary superphosphate was closely associated with the additional calcium contained in this material.

South Fla. Field Sta., Immokalee, Fla.

Williams, R. R. THE EFFECT OF NITROGEN ON THE SELF-FRUITFULNESS OF CERTAIN VARIETIES OF CIDER APPLES. J. Hort. Sci. 38: 52-60. 1962.

Certain varieties of cider apple, vary from apparent self-sterility to self-fruitfulness.

This behavior is probably due to the influence of the nitrogen status of the tree. Under conditions of nitrogen supply which are suboptimal, the time of fertilizer application has a

considerable bearing on the response of the tree. The use of summer nitrogen immediately after extension growth had ceased was shown to promote fruit-bud production and to increase self-fruitfulness.

The variation in response to selfing in the variety Michelin was examined and found to depend on two factors, the longevity of the embryo-sac and the rate of pollentube growth. Both have been increased by boosting available summer nitrogen. In flowers from trees low in nitrogen, the short-lived embryo-sacs were usually disorganized before pollentubes resulting from self-pollination at anthesis had reached the nucellus.

The relationship between fruit-bud production and flower behavior was discussed, together with the advantages of summer applications of nitrogen in improving cider apple crops and grass management.

Res. Sta., Long Ashton, Bristol, England.

Leonard, C. D., Stewart, I., and Wander, I. W. . A COMPARISON OF TEN NITROGEN SOURCES FOR VALENCIA ORANGES. Fla. State Hort. Soc. 1961 Proc. 74: 79-86. 1962.

Ten different nitrogen sources were compared in a field experiment with Valencia orange trees growing on Lakeland fs. The sources were ammonium sulfate, sodium nitrate, calcium ammonium nitrate, ammonium nitrate, calcium nitrate, an ammonium nitrate urea solution, an ammonium nitrate solution, ammoniated superphosphate, a mixture of sodium nitrate and ammonium nitrate containing 75 percent nitrate and 25 percent ammonium nitrogen, and urea applied as a spray: The 5-year average yields showed no significant differences due to sources of nitrogen. A few significant differences were found in fruit quality measurements. Ammoniated superphosphate resulted in extractable soil calcium significantly higher than that of any other nitrogen source. Calcium nitrate resulted in leaf calcium significantly higher than any other source except ammoniated superphosphate. During the 5-year period of the experiment, no dolomite was required for plots receiving either sodium nitrate or calcium nitrate; all other plots were given dolomite.

Fla. Citrus Expt. Sta., Lake Alfred, Fla.

Lombard, P. B., Cahoon, G. A., Jones, W. W., and Garber, M. J. THE EFFECT OF NITROGEN FERTILIZATION AND CULTURAL TREATMENTS ON SOIL MOISTURE RELATIONSHIPS OF MATURE WASHINGTON NAVEL ORANGE TREES. Amer. Soc. Hort. Sci. Proc. 81: 209-217. 1962.

A long-term fertilizer experiment was conducted on Washington Navel orange trees in California. Six fertilizer treatments from 5 N sources imposed on 2 methods of weed control were studied as to their influence on the soil moisture regime and moisture stress of the orange trees.

Tillage used for weed control decreased the rate of water intake from each irrigation, and was directly related to the size of the soil moisture reservoir as indicated by tensiometers. Rate of moisture depletion was greater under tillage than under nontillage. The first 3 feet of soil was the principal region in which the tillage plots showed greater depletion. Increased moisture stress of the trees under tillage, compared with the nontillage plots, was indicated by the higher average leaf moisture deficit measured during 3 irrigation cycles.

Moisture stress of the trees, as measured by leaf moisture deficit, was greatest under  $\text{NaNO}_3$  when compared with other fertilizer treatments. The no N treatment exhibited the lowest moisture stress of the fertilizer treatments. Trees of both of these fertilizer treatments were the lowest in yield. Previous studies have found high soil salinity in the  $\text{NaNO}_3$  treatment, and low N nutrition in the no N treatment. These two factors were predominant in affecting the tree response under these 2 treatments.

The leaf moisture deficit was indicative of greater moisture stress in the tillage treatments of  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NaNO}_3$ , urea, and  $\text{Ca}(\text{NO}_3)_2$  than in the nontillage counterparts.

An adverse relationship was found between the average leaf moisture deficit and the average tree yield within fertilizer and cultural treatments, but to a smaller degree for  $\text{NaNO}_3$  and no N. This relationship indicated that moisture stress between irrigations strongly influenced tree response as measured by productivity. Measurements of the soil moisture regime supported this evidence.

U. Calif., Citrus Res. Cent., Riverside, Calif.

Hageman, R. H. HOW CORN USES NITROGEN. Ill. Res. 4(3): 8-9. 1962.

Greater use of nitrogen fertilizers has played a big part in the increased corn yields of the last decade.

Nitrogen is essential for a plant's growth and development. Plants combine reduced nitrogen, or the ammonium ion, with keto acids (partially oxidized glucose) to form amino acids, needed for protein synthesis. Animals and humans cannot fabricate the essential amino acids and most get them from plants.

Most of the nitrogen absorbed by the corn plant is in the oxidized (nitrate) form. Actually, corn can absorb and assimilate the reduced (ammonium) form of nitrogen just as easily as nitrate. But when ammonium fertilizer is applied, nitrifying organisms in the soil quickly convert it to nitrate.

On a fertile soil, plants grown at a rate of 28,000 an acre had more nitrate than plants grown at a rate of 4,000 an acre.

Planting rate did not significantly affect carbohydrate content, although mean values tended to be lower in plants grown at the thicker rate. Citric acid, a precursor of a critical keto acid needed to form amino acids, was slightly higher in the shaded plants.

Evidence with both artificial and competitive shading suggests that nitrogen metabolism is more sensitive to decreased light intensity than is photosynthetic fixation of carbon dioxide.

Subsequent experiments demonstrated that reduction in light intensity inactivated an enzyme, nitrate reductase, which is necessary for nitrogen metabolism. Corn plants lost 90 percent of their nitrate reductase activity when placed in complete darkness for 48 hours. The activity returned rapidly when the plants were re-exposed to light.

Nitrate reductase activity was related to the amount of nitrate supplied. Nitrate reductase activity virtually disappears when environmental conditions caused plants to wilt or roll their leaves.

To produce amino acids, the plant first has to reduce nitrate to the ammonium ion. The following sequence for the reduction of nitrogen by the plant has been proposed but has not been completely established: nitrate  $\longrightarrow$  nitrite  $\longrightarrow$  hyponitrous acid  $\longrightarrow$  hydroxylamine  $\longrightarrow$  ammonium ion.

Although the plant can accumulate relatively high levels of nitrate, presumably without toxicity, the other four intermediates are considered to be toxic and are never found in high accumulations in healthy corn tissue. Once the reduction process is started, it carries to completion and the ammonium ion is combined with a keto acid to produce an amino acid.

Each of the four steps in the pathway from nitrate to ammonium is catalyzed by an enzyme or enzyme system. Although much is known about nitrate reductase, which carries out the first step, relatively little is known about the others. An enzyme system was extracted from corn plants that reduces nitrate and hydroxylamine to the ammonium ion.

Corn plants in nutrient culture have grown better under most conditions when supplied with nitrate rather than ammonium salts. The reduction of nitrate in the plant may be useful in oxidation-reduction reactions, thereby maintaining a more balanced metabolism. Even if ways would be found to supply only the ammonical form of nitrogen to the plant, optimal growth and yield might not result.

Adding small amounts of ammonium to the plant, thereby supplementing the available nitrate in the soil, might be the best way to by-pass a lagging nitrate reductase system, and increase growth and yield.

U. Ill., Agr. Expt. Sta., Urbana, Ill.

Nelson, C. E., Roberts, S. and Nelson, G. D. YIELDS AND PLANT RESPONSES OF SIX SOYBEAN VARIETIES TO NITROGEN AND ZINC FERTILIZATION. Wash. Agr. Expt. Sta. B. 642, 12 pp. 1962.

Six soybean varieties were grown under irrigation with and without zinc fertilization at five nitrogen levels on low-nitrogen soil.

The application of 10 pounds of Zn per acre increased yields 10.3 bushels per acre over the check treatment.

Nitrogen fertilizer application at the rates of 40, 80, 120, and 240 lbs. N/A. with 10 lbs. Zn/A. did not increase yields.

Nitrogen fertilization without zinc increased yields. The curvilinear regression of yield on nitrogen fertilization indicated a maximum yield at 160 lbs. N/A. This confirms work with other crops that nitrogen application generally increases the uptake of indigenous zinc, the effect depending on the change in pH by the nitrogen carrier.

Zinc fertilization alone produced a higher yield than the nitrogen treatments without zinc.

In the 1961 experiment, the acidifying effect of ammonium nitrate even at the 240-lb. nitrogen level apparently was insufficient to release sufficient indigenous soil zinc for the plants to produce a yield comparable with that from the zinc treatment.

On this nitrogen deficient soil, it was apparent that the soybean plant was capable of obtaining sufficient nitrogen by symbiosis with adequate zinc in the soil. The application of nitrogen fertilizer was detrimental in that it increased plant height and lodging, and made harvesting more difficult because more leaves were retained as the nitrogen level rose.

Tables and charts.

Wash. Agr. Expt. Sta., Inst. Agr. Sci. Wash. State U., Pullman, Wash.

Wells, J. P. SOURCES OF NITROGEN FOR RICE. Ark. Agr. Expt. Sta. Rpt. Series 115, 10 pp. 1962.

Various sources of nitrogen were compared on Nato rice at the Rice Branch Experiment Station in 1959-60. Nitrogen was applied in split applications made 45 and 75 days after planting. The 1959 test showed a yield increase due to 32 percent nitrogen solution, but no

increase with 32 percent nitrogen solution resulted in 1960. The increase in 1959 was explained as resulting from the plot layout of the test.

Other sources of nitrogen such as urea, ammonium nitrate, ammonium sulfate, ammonium chloride, and 32 percent solid nitrogen (made up of  $\text{NH}_4\text{NO}_3$  and urea) did not differ in their influence on yield of rice grain. There was no yield advantage or disadvantage from using the same source of nitrogen at first and second application or from combining any of the above-named sources.

The following tables show the results of the two tests:

TABLE.--Nato Rice Yields as Influenced by Rates and Sources of Nitrogen, Rice Branch Experiment Station, 1959

Source of nitrogen <sup>1</sup>	Pounds nitrogen per acre			Average <sup>2</sup>
	60	100	140	
	Yield in bushels per acre			
32% N solution	136.3	147.9	163.4	149.2 a
Urea	122.8	140.6	152.0	138.5 b
Ammonium sulfate	127.7	135.4	142.7	135.3 b
Ammonium nitrate	124.7	133.7	143.1	133.8 b
Ammonium chloride	123.6	134.6	138.7	132.3 b
Average <sup>2</sup>	126.9 a	138.4 b	148.0 c	----

<sup>1</sup> All nitrogen sources were applied in split applications with half applied at 45 days and half at 75 days.

<sup>2</sup> In any column or row, those means that are followed by the same letter or letters are not significantly different, while those means followed by different letters are significantly different at the 1% level.

#### SOURCES OF NITROGEN FOR RICE

TABLE.--Yield and Lodging of Nato Rice as Influenced by Rates and Sources of Nitrogen, Rice Branch Experiment Station, 1960

Nitrogen source at 1st and 2nd application <sup>1</sup>	Pounds nitrogen per acre			Average <sup>2</sup>
	0	80	120	
	Yield in bushels per acre			
Check, none	50.7	----	----	----
Ammonium nitrate, ammonium nitrate	----	89.7	87.8	88.8
Urea, urea	----	83.0	90.5	86.8
32% N solution, 32% N solution	----	75.6	88.4	82.0
32% N solid, 32% N solid	----	87.9	88.8	88.4
Ammonium nitrate, urea	----	80.8	87.8	84.3
Urea, ammonium nitrate	----	82.7	89.6	86.2
Average <sup>2</sup>	50.7 a	83.3 b	88.8 b	----

See footnotes on next page.

SOURCES OF NITROGEN FOR RICE

TABLE.--Yield and Lodging of Nato Rice as Influenced by Rates and Sources of Nitrogen, Rice Branch Experiment Station, 1960--Cont.

Nitrogen source at 1st and 2nd application	Pounds nitrogen per acre			Average <sup>2</sup>
	0	80	120	
		Percent lodging		
Check, none	0	----	----	----
Ammonium nitrate, ammonium nitrate	----	60	53	56
Urea, urea	----	43	51	47
32% N solution, 32% N solution	----	29	54	42
32% N solid, 32 N% solid	----	48	65	56
Ammonium nitrate, urea	----	48	74	61
Urea, ammonium nitrate	----	56	73	65
Average <sup>2</sup>	0 a	47 b	62 c	----

<sup>1</sup> Applied in split applications at 45 days and 75 days after seeding.

<sup>2</sup> In column or row, those means that are followed by the same letter or no letters are not significantly different, while those means followed by different letters are significantly different at the 1% level.

U. Ark., Agr. Expt. Sta. Fayetteville, Ark.

Smith, D. R., and Lang, R. L. NITROGEN FERTILIZATION OF UPLAND RANGE IN THE BIG HORN MOUNTAINS. Wyo. Agr. Expt. Sta. B. 388, 10 pp. 1962.

The effects of nitrogen fertilization upon forage production, utilization, and chemical composition were studied over a 5-year period in the Big Horn Mountains.

Nitrogen fertilization of native range resulted in significant increases of production of grasses only in 1960, when trials were located on Burgess fgrl. The relationship between rate of application and production of grasses was non-linear. Maximum increments led to decreased yields. With optimum application rate, the increased yield was estimated at about 150 lbs. of oven-dry forage per acre. Although statistically significant, the increase did not approach economic feasibility.

Maximum response (grass production) was obtained when fertilization was combined with control of broad-leaved plants. The expense did not appear justified however.

There was some indication that heavy applications of nitrogen to soil of the Owen Creek sil series resulted in decreased yield of forbs.

Crude-protein content of Idaho fescue was increased by nitrogen fertilizer. The maximum rate of increase was obtained with application of 25 lbs. of nitrogen per acre. With higher levels, crude-protein content averaged about 5 percent greater than plants growing on unfertilized range.

Forage palatability was increased by fertilization. Maximum success was achieved by complete coverage of problem areas, with 25 lbs. of nitrogen per acre. Soils of granitic origin were expected to give maximum response.

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

Kresge, C. B., and Younts, S. E. EFFECT OF NITROGEN SOURCE ON YIELD AND NITROGEN CONTENT OF BLUEGRASS FORAGE. *Agron. J.* 54: 149-152. 1962.

Urea-formaldehyde + urea, urea,  $(\text{NH}_4)_2\text{SO}_4$ , and  $\text{NH}_4\text{NO}_3$  were topdressed at various rates for 2 years to an established bluegrass pasture. Residual effects of these nitrogen carriers were evaluated in the third year. Yields were measured and total nitrogen was determined on plant samples from all plots. Response to fertilizers was evaluated on the basis of total yield, seasonal distribution of yield, percent nitrogen, and percent nitrogen recovery of the forage.

No differences in total yields (3 years) existed among nitrogen sources applied at rates of 80, 80+80, and 160 pounds of nitrogen per acre. At the 160+160-pound rate, total yields of plots receiving  $\text{NH}_4\text{NO}_3$  were greater than those topdressed with the other sources. Split applications of the more available nitrogen sources were favorable in a "wet" year but not in a "dry" year. Urea-formaldehyde, supplemented with urea, produced the most uniform seasonal distribution of growth and its residual effect continued throughout the third year. Residual effects of urea,  $(\text{NH}_4)_2\text{SO}_4$ , and  $\text{NH}_4\text{NO}_3$  were largely restricted to the first one-third of the third growing season.

The percent nitrogen of urea-formaldehyde-fertilized grass was only slightly less than that of bluegrass topdressed with other sources. Urea and  $\text{NO}_4\text{NO}_3$  performed best in respect to nitrogen recovery, while use of urea-formaldehyde resulted in the lowest recovery.

At rates of nitrogen currently in use, urea-formaldehyde, urea,  $(\text{NH}_4)_2\text{SO}_4$ , and  $\text{NH}_4\text{NO}_3$  can be used with equally satisfactory results, with two compensating qualifications: (1) That urea-formaldehyde need be supplied only once each year as compared to twice or more for more available sources; and (2) that the urea-formaldehyde to be supplemented with about 25 percent of the nitrogen from a more available source. Although inferior in terms of quickly recoverable nitrogen, urea-formaldehyde has a uniform nitrogen release and a long-lived residual effect. The main drawback in the use of urea-formaldehyde in a long-range grass pasture program is its cost.

U. Md., College Park, Md.

Olson, R. A., Dreier, A. F., Hoover, C. A., and Rhoades, H. F. FACTORS RESPONSIBLE FOR POOR RESPONSE OF CORN AND GRAIN SORGHUM TO PHOSPHORUS FERTILIZATION: I. SOIL PHOSPHORUS LEVEL AND CLIMATIC FACTORS. *Soil Sci. Soc. Amer. Proc.* 26: 571-574. 1962.

Data in Nebraska suggested that it was hazardous to apply starter fertilizer containing P for corn and grain sorghum to soils inherently high in P-supplying power. Yield increases under these circumstances were not likely; in fact, decreases frequently were measured.

Compared with small grains, corn and sorghum were efficient in the utilization of soil P. They made optimum yields on soils of substantially lower soil P supply than was possible with small grains. Deep subsoil P levels contributed substantially to the crops' nutrition when surface soil P level was low.

In the case of drought year and moisture stress in the crop, planting time P application caused overstimulation. This resulted in excessive vegetative growth and moisture use in early growth at the expense of final yield.

Optimum planting date for corn was established without the benefit of starter fertilizer. This optimum time undoubtedly was associated particularly with weather conditions at mid-season when tasseling and silking occurred. Hastening development by starter P altered this situation and forced the plant into its reproductive stage several days earlier thus upsetting the above-established time schedule.

Disturbed trace element utilization appeared to be the cause for poor results in some cases as evidenced by chlorotic symptoms in the plant induced by starter P.

U. Nebr., Lincoln, Nebr.



Langin, E. J., Ward, R. C., Olson, R. A., and Rhoades, H. F. FACTORS RESPONSIBLE FOR POOR RESPONSE OF CORN AND GRAIN SORGHUM TO PHOSPHORUS FERTILIZATION: II. LIME AND P PLACEMENT EFFECTS ON P-Zn RELATIONS. Soil Sci. Soc. Amer. Proc. 26: 574-578. 1962.

Greenhouse and laboratory studies showed that Zn concentrations in corn were often markedly reduced by P applications, to the extent that levels critical for growth were reached. The results indicated that the field problem with Zn deficiency was likely to be aggravated by modest row applications or heavier mixed applications of readily available P fertilizer. The problem can be expected to be of greatest magnitude with soils that are inherently calcareous where Zn solubility is restricted due to the high pH and that are initially high in available P. The more effectively the applied P is utilized by the crop, the more severe will be the curtailment of Zn uptake.

It was concluded that the damaging effect of P on Zn utilization is physiological within the plant, perhaps in plant root cells, and is not a simple chemical precipitation of Zn phosphate external to the roots. Since applied Zn counteracts the harmful P effect, this would appear to be an absorption phenomenon in root cells, increasing levels of P blocking the absorption of Zn and vice versa. Very possibly some Zn activated enzyme involved in growth is associated; however, its effect would seem secondary to the absorption concept.

U. Calif., Los Angeles, Calif.

Locascio, S. J., Nettles, V. F., and Neller, J. R. THE EFFECT OF SAWDUST INCORPORATION IN A SOIL ON GROWTH OF IRISH POTATOES AND SWEET CORN. Fla. State Hort. Soc. 1961 Proc. 74: 197-201. 1962.

Permanent field plots were established to study the effect of soil incorporation of sawdust on the yield of Irish potatoes and sweet corn. Rates of sawdust from 0 to 25 tons and nitrogen from 0 to 150 pounds per acre had no significant effect on the marketable yield of two crops of Irish potatoes in 1957 and 1958. But, the first year after sawdust application, the yield tended to decrease as the sawdust level was increased.

Additional sawdust was added to the plots in 1959. This brought the sawdust rate from 0 to 55 tons per acre. In the 1959 and 1961 seasons, sweet corn yield was not influenced by sawdust or nitrogen levels. In the 1960 season, significantly higher yield of marketable sweet corn was produced by the incorporation of 55 tons per acre of sawdust as compared to the 0 sawdust treatment.

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

Zhukov, M. D., and Yukhimchuk, F. F. IMPORTANCE OF PEAT IN THE CULTIVATED SANDY SOILS. Soviet Soil Sci. 7: 744-748. July 1961.

The results of experiments on various methods of adding peat as a fertilizer showed that peat was a very important factor in cultivation and increased the total and effective productivity of coarse sandy soils.

The addition of peat, especially in conjunction with manure or with green manure of lupine improved the water properties of sandy soils, increased their water capacity, and decreased their water permeability. This provided a greater accumulation of moisture in the root zone of the soil and better utilization by plants.

A single application of 130-195 metric tons/ha. (55 to 81 tons/A.) of peat ensured a considerable, long-term increase in the yield of all green manure crops. The greatest effect

from increased amounts of peat was obtained when it was added in the form of a continuous layer at a depth of 25 to 30 cm. (10 to 12 in.) without being mixed with the plowed horizon.

The simultaneous application of peat with manure or lupine to sandy soil enhanced the effectiveness of the mixture considerably, since the decomposition of the organic matter in manure and lupine was slower with peat and the nutrients, which were released during the process, were more fully utilized by plants.

Scripta Technica Inc., 1000 Vermont Ave., N.W., Washington, D.C. 20005

During, C., and McNaught, K. J. EFFECTS OF COW URINE ON GROWTH OF PASTURE AND UPTAKE OF NUTRIENTS. *New Zealand J. Agr. Res.* 4: 591-605. 1961.

A field trial was conducted on permanent pasture on Marton 1 with cow urine and a nearly equivalent rate of KCl to: (1) Determine the apparent recovery of applied nitrogen and potassium; and (2) evaluate the effect of these treatments on the magnesium and calcium in pasture and soil.

The apparent recovery of applied nitrogen in the herbage was only 10 percent of that applied in urine. The apparent recovery of potassium in the herbage was 20 to 23 percent of that applied in urine or KCl. No difference was observed in the action of potassium whether applied as urine or as KCl.

The effect of urine nitrogen on yields and on N concentration in the pasture lasted only about 2 months. The effect of applied potassium on yields and K concentration in the pasture was significant for 2 years.

Urine and KCl depressed the concentration but not the uptake of Mg and P in the herbage and slightly lowered the level of exchangeable magnesium in the soil.

Considerable losses of N and K and some losses of Mg and Ca are likely to occur under urine spots.

Farm Advisory Div., Dept. Agr., Wellington, New Zealand.

Oertli, J. J., and Lunt, O. R. CONTROLLED RELEASE OF FERTILIZER MINERALS BY INCAPSULATING MEMBRANES; I. FACTORS INFLUENCING THE RATE OF RELEASE. *Soil Sci. Soc. Amer. Proc.* 26: 579-583. 1962.

The availability of nutrients from inorganic fertilizer salts was regulated through coating such materials. The release rate was investigated in several elution and leaching experiments. The release approached linearity for a considerable period; thereafter the rate dropped off. The release rate was largely independent of the pH of the elutant and of the soil pH. An increase in temperature from 10° to 20° C. almost doubled the initial release rate. The release was regulated very efficiently through the coating thickness. There was an effect of ionic species, nitrate and ammonia had given off more rapidly than potassium or phosphates. The release was only slightly reduced under sterile conditions. It was concluded that diffusion is the most likely release mechanism and proposed that discrepancies such as the high  $Q_{10}$  value could be explained through possible changes in membrane properties. Coated fertilizers thus possess the properties required for regulation of the availability of nutrients: they may reduce leaching losses and provide a steady prolonged nutrient supply to plants.

U. Calif., Los Angeles, Calif.

Lunt, O. R., and Oertli, J. J. CONTROLLED RELEASE OF FERTILIZER MINERALS BY INCAPSULATING MEMBRANES; II. EFFICIENCY OF RECOVERY, INFLUENCE OF SOIL MOISTURE, MODE OF APPLICATION, AND OTHER CONSIDERATIONS RELATED TO USE. *Soil Sci. Amer. Proc.* 26: 584-587. 1962.

An experiment using membrane-coated granular fertilizer, in which the membrane constituted 11 or 12.5 percent of the weight of the granules revealed that: (1) Moisture levels, exceeding the range of permanent wilting percentage to field capacity in a loam soil, did not appreciably affect the rate of transfer of minerals through the membrane of coated fertilizer mixed in the soil; (2) the time for transfer of a given fraction of fertilizer through membranes was substantially extended if the fertilizer was topdressed on a soil as compared to incorporated (presumably due to intermittent drying between leachings); and (3) an efficiency of recovery ranging from about 25 to 45 percent was obtained from a single application, incorporated in the sand, of coated ammonium nitrate by corn during a 3-month growing period. In the latter study, a sand was used containing < 1 percent of clay and as much as 7 feet of water passed through the root zone during the period of the study. Implications of the coating technique for controlling fertilizer availability were briefly considered.

U. Calif., Los Angeles, Calif.

Jackson, W. A., Heinly, N. A., and Caro, J. H. SOLUBILITY STATUS OF ZINC CARRIERS INTERMIXED WITH N-P-K FERTILIZERS. *Agr. and Food Chem.* 105: 361-364. 1962.

The degree of water solubility of zinc, added to mixed fertilizers as basic zinc sulfate or zinc sulfate monohydrate, depended chiefly upon the pH of the fertilizer system. Ammoniated mixed fertilizers having a pH range of 4.6 to 6.1 showed a larger capacity for fixing zinc than nonammoniated fertilizers having a pH range of 3.6 to 4.2. Water-soluble zinc recovery was greater at pH 6.1 to 6.6 than at the intermediate pH levels, indicating the formation of soluble zincates. The results show that chelated zinc remains water soluble in N-P-K fertilizers which otherwise have a large capacity to immobilize free zinc ions.

SWCRD, ARS, USDA, Beltsville, Md. 20705.

Neller, J. R. EFFECT ON PLANT GROWTH OF PARTICLE SIZE AND DEGREE OF SOLUBILITY OF PHOSPHORUS LABELED IN 12-12-12 FERTILIZER. *Soil Sci.* 94: 413-417. 1962.

Phosphorus labeled 12-12-12 fertilizers of two mesh sizes and three degrees of water solubility of the phosphorous were used in a greenhouse experiment with Leon fs, representing soils of low capacity for fixing phosphorus, and Red Bay fsl, representing soils of strong fixing capacity. Treatments were in triplicate with two levels of liming. Statistical evaluations were given on the effects of mesh size and phosphorus water solubility on growth, phosphorus content, and uptake of labeled fertilizer phosphorus for two cuttings of oats that were combined as one sample. Oats were replanted the following year for determination of the residual effects of the fertilizers. Fertilizer phosphorus was available to a far greater degree in Leon than in the Red Bay soils. There were lesser effects of particle size and degree of solubility of the phosphates.

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

## Salinity and Alkali Problems

Graveland, D. M., and Toogood, J. A. GYPSUM AS AN AMELIORATING AGENT FOR SOLONETZIC SOILS IN ALBERTA. *Canad. J. Soil Sci.* 43: 1-6. 1963.

The application of gypsum to a number of Alberta solonetzic soils in laboratory studies resulted in significant physical and chemical improvements in all soils except those with very high exchangeable sodium percentages. Data obtained in threshold concentration studies indicate that gypsum was effective as an amendment for the amelioration of solonetzic soils only if the exchangeable sodium did not exceed 20 to 25 percent of the total exchange capacity, assuming that the effective solubility of gypsum in the field is about one-half that of its saturated concentration.

Dept. Soil Sci., U. Alberta, Edmonston, Alberta, Canada.

Sims, J. R., and Dregne, H. E. FERTILIZER RESPONSE ON A SODIUM SOIL. *N. Mex. Agr. Expt. Sta. Res. Rpt.* 63, 6 pp. 1962.

A fertilizer experiment was conducted on a calcareous sodium soil, using different sources of nitrogen, phosphorus, and potassium in several different combinations, with and without added calcium. There was no response to nitrogen or calcium but there were significant responses to the nitrogen - phosphorus and nitrogen - phosphorus - potassium combination. The combination of potassium and phosphorus in potassium dihydrogen phosphate was much more effective than when superphosphate and two common forms of potash fertilizer were applied together. Muriate of potash produced higher yields than did the sulfate of potash.

Explanations for the results obtained are based upon the nitrogen-fixing capabilities of blue-green algae and upon the concept of ion antagonism.

Agr. Expt. Sta., N. Mex. State U., University Park, N. Mex.

Reed, L. W. A STUDY OF SALINE-ALKALI SOILS IN OKLAHOMA. *Okla. State U. Expt. Sta. Processed Ser.* P-430, 37 pp. 1962.

Saline and alkali soils occur in many parts of Oklahoma. The chemical characteristics of these soils can be correlated with their morphological properties. The growth of plants on saline-alkali soils is usually impaired by soluble salts and high exchangeable sodium. Reclamation of saline and alkali soils regardless of source of the salines may be accomplished by: (1) Drainage; (2) an abundant supply of high quality irrigation water or rainfall for leaching; (3) adequate cultural practices such as leveling, ponding, and strict adherence to a plan of operation; and (4) soil treatment sufficient to replace soil sorbed sodium with calcium.

The extent and relative severity of saline and alkali soils in Oklahoma, and the origin of the salts and sodium saturated clays were indicated. The effect of saline irrigation water on soil properties and plant growth was reported, and techniques for reclamation of soils damaged by saline irrigation water were suggested.

The table presents the effects of leaching with saline water and surface application of gypsum on exchange properties of the topsoil and subsoil of a Tipton sl soil.

TABLE . Effect of Leaching with Saline Water and Surface Application of Gypsum on Exchange Properties of a Tipton Sandy Loam Soil, McElroy Farm, Tillman County, 1959.

Treatment	Exchangeable Cations m.e./100 grams of Soil								ESP	
	Sodium		Calcium		Magnesium		Potassium			
	Top	Sub	Top	Sub	Top	Sub	Top	Sub	Top	Sub
Original Soil	0.52	0.37	2.65	3.00	2.91	2.58	0.20	0.33	8.28	5.90
No Gypsum	.14	.11	3.35	3.35	2.25	2.88	0.21	0.24	3.27	2.04
1 Ton Gypsum	.12	.15	3.40	3.50	2.02	2.88	0.19	0.26	2.50	2.87
3 Tons Gypsum	.09	.13	3.80	3.52	2.00	2.29	0.20	0.23	1.89	2.50
5 Tons Gypsum	.14	.13	4.27	3.36	1.55	2.38	0.19	0.25	2.78	2.42
7 Tons Gypsum	.10	.12	4.66	3.56	1.42	2.12	0.19	0.23	2.11	2.35
9 Tons Gypsum	.06	.12	4.00	3.60	1.09	2.42	0.17	0.23	1.54	2.13

Tables and graphs.

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

Bower, C. A., Haise, H. R., Legg, J., Reeve, R. C., Carlson, R., Dregne, H. E., and Whitney, R. S. SOIL SALINITY AND IRRIGATION IN THE SOVIET UNION: REPORT OF A TECHNICAL STUDY GROUP. U. S. Dept. Agr. Agr. Res. Serv. Rpt. Tech. Study Group (Unnumbered) 41 pp. 1962.

Under an exchange agreement, a technical study group, consisting of specialists in soil salinity, irrigation, drainage, agronomy, and agricultural economics, visited the Soviet Union during the period June 27 to July 29, 1960. The primary purpose of the visit was to study soil salinity in the U.S.S.R, but opportunity was also afforded to study irrigation agriculture in general because of its close relation to soil salinity. The information was obtained by direct measurements, observations, and from discussions with Soviet scientists.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781.

### Climatic Influence

Thompson, L. M. EVALUATION OF WEATHER FACTORS IN THE PRODUCTION OF WHEAT. J. Soil and Water Conserv. 17: 149-156. 1962.

A multiple regression analysis was made to differentiate between the influence of weather and technology in the production of wheat in five states (North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma). The time period 1935-61 was studied. From the standpoint of wheat production, there were two favorable weather cycles since 1935; one reached a peak in 1942 and the other was at its peak in 1958. Except for 1952, which was a reasonably good year, an unfavorable cycle occurred in the early fifties.

During the 4-year period 1958-61, the five Great Plains states produced an extra 269 million bushels of wheat because of better than average weather in 1958 and 1960.

The multiple regression equations used for explaining yield variations included the weather variables in quadratic form. The weather variables included pre-season precipitation (total precipitation from August through March) and rainfall and temperature for May through July.

The weather variables and the time trend factor (for technology) accounted for 82 percent or more of the yield variation in each State.

The average rate of increase in yield of wheat was one-half bushel per acre per year since 1935 in the three winter wheat States, Nebraska, Kansas, and Oklahoma. The average rate of increase in yield of wheat during the same period in the spring wheat States, North Dakota and South Dakota, was about one-fourth of a bushel per acre per year.

Iowa State U., Ames, Iowa.

McWhorter, J. C. CLIMATIC PATTERNS OF MISSISSIPPI. Miss. Agr. Expt. Sta. B. 650, 24 pp. 1962.

Moisture, temperature, soils, and vegetation are intimate factors influencing the cultural and economic development of society. In agriculture, certain areas are especially suited by both climate and soil to the crops they produce. If climate is not adequately considered, crops, soils, and man may fail. Today agriculture and industry must thoughtfully evaluate the influence of day-to-day weather and climatic characteristics in developing plans and operations.

Climate is the average condition of the weather at a place over a period of years as shown by temperature, precipitation, wind, sunshine, and other weather occurrences.

Data accumulated over a long period of years defined certain climatic characteristics of the state.

Tables and maps.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Murphy, H. J., and Goven, M. J. THE EFFECT OF SIMULATED HAIL DAMAGE ON YIELD AND QUALITY OF POTATOES IN MAINE. Maine Agr. Expt. Sta. B. 607, 33 pp. 1962.

Hail storm damage to potatoes or any other field crop is one of the natural hazards of crop production. Damage to potato plants because of defoliation or stem injury can result in losses of yield, quality, and market value of resultant potato tubers. Annual losses caused by hail damage can run into millions of dollars. In Maine during the period of 1951 to 1960, \$23,600,335 of hail insurance was written with losses paid to the extent of \$218,686.

Because of the difficulties in making equitable settlements for hail damage losses on potatoes, the Hail Insurance Adjustment Association contracted with the Maine Agricultural Experiment Station to study the effect of simulated hail damage on the yield, and size distribution of potatoes grown in Aroostook County, Maine.

The authors concluded that:

1. The general trend for the effect of simulated hail damage on yield of the Katahdin and Kennebec varieties was for yield to be decreased as the degree of damage applied to the foliage was increased.
2. The greatest loss in yield of both the Katahdin and Kennebec varieties by simulated hail damage occurred at the full-bloom stage of vegetative growth.
3. Specific gravity of the potato tubers was not reduced excessively by simulated hail applied to the foliage except where complete removal of the vines was accomplished.

4. Market grade sizes of tubers were reduced as degree of simulated hail was increased and most drastically at the full-bloom stage.
5. As the degree of damage from simulated hail was increased, a higher percentage of smaller sized tubers was produced resulting in a lower tuber index rating.
6. Simulated hail applied at the full-bloom stage caused the greatest reduction in tuber size and the lowest tuber index rating.
7. The same trends for all factors affected by simulated hail were found in the Katahdin and Kennebec varieties although because of the larger plant size, earlier maturity, and more succulent foliage the Kennebec variety was damaged to a greater extent than the Katahdin for any given degree of damage and at any stage of plant growth.
8. Damage to vascular tissues in the stems seemed to cause more damage to yields, quality, and tuber size than a large amount of leaf removal.
9. In a few cases, simulated hail applied when the plants were 8 to 10 inches in height produced slight increases in yield and quality.

U. Maine, Maine Agr. Expt. Sta., Orono, Maine.

Harms, W. R. SPACING-ENVIRONMENTAL RELATIONSHIPS IN A SLASH PINE PLANTATION. Southeastern Forest Expt. Sta., Sta. Paper 150, 16 pp. 1962.

Multiple regression methods were used to study the influence of plantation spacing on the relationships between certain environmental factors and the diameter growth of young slash pine in the middle coastal plain of Georgia.

The study was made during the sixth and seventh growing seasons in a plantation planted at spacings of 6 x 6, 8 x 8, and 15 x 15 feet. Diameter growth was measured weekly and soil moisture at 2- to 3-day intervals. Soil and air temperature, relative humidity, evaporation, wind, and rainfall measurements were made at a weather station installed near the plantation.

Significant correlations were found between diameter growth and available soil moisture, maximum air temperature, evaporation, and elapsed days from January 1. None of these factors explained the differences in diameter growth between spacings. Differences were attributed to the interaction of light and photosynthetic surface. Photosynthetic surface of the trees, as measured by crown ratio, increased with spacing; under the same light conditions individual trees on the wide spacing produced more food for growth than those on the close spacing.

Competition for light began in the close spacing during the fifth year. Root competition, and therefore competition for soil moisture, was not yet apparent during the sixth and seventh years in the close spacing. The rate of change of diameter growth with change in soil moisture was uniform for all spacings.

The growing season moisture regime of the middle coastal plain of Georgia is such that soil moisture probably is not a very serious limiting factor in plantations at this age even at close spacings, though it may become important as the stand develops.

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

### Mulching

Button, E. F., and Potharst, K. COMPARISON OF MULCH MATERIALS FOR TURF ESTABLISHMENT. *J. Soil and Water Conserv.* 17: 166-169. 1962.

The application of a mulch to control erosion, hold available moisture near the surface of the soil, and prevent movement of the seed by wind and water during the establishment of vegetative cover of highway rights-of-way and other areas is a widely used practice.

Usually, hay or straw is applied as a mulch and in some manner is held on the soil surface after the seed is in place.

The elimination of a separate mulching operation through the use of a mulching material that could be applied in one operation with the seed and fertilizer would be advantageous from the standpoint of time and labor saved and would reduce the amount of necessary equipment.

Cellulose fiber and bran inoculated with a fungus were compared with a standard hay mulch in a random-block test. A site on long, steep, coarse sand fill slopes was used in order to impose severe conditions encountered in turf establishment.

Under weather conditions extremely unfavorable for turf establishment, it was found that adequate available soil moisture for germination and seedling survival of the temporary and fast germinating species was dependent upon the amount of exterior shade cast on the seeded areas by trees or by the slope itself during the latter half of the day. Type and amount of mulch material had no significant effect upon germination or seedling survival, especially during the first 40 days after seeding.

As effective mulch materials, the cellulose and bran were equal to hay--all provided adequate erosion control. Combinations of cellulose fiber and bran treated with a fungus seemed to be superior to all other mulches with regard to resistance to crackling, blowing-off, peeling, and deterioration on areas devoid of growth 90 days after application.

Highway Testing Lab., Portland, Conn.

## PLANT MANAGEMENT

### Pasture and Haylands

McCormick, W. C., Beardsley, D. W., and Southwell, B. L. SYSTEMS OF UTILIZING SMALL GRAIN PASTURES IN FATTENING BEEF STEERS. Ga. Agr. Expt. Sta. C. N.S. 31, 14 pp. 1962.

Grazing small grain pastures for part of all of the fattening period is one of the most effective and economical methods of finishing steers in Georgia. Cost of gains is reasonable and steers make good rates of gain.

In two series of feeding trials utilizing small grain pastures in fattening beef steers in Georgia, the following conclusions were made:

1. Yearling steers fed to maintain body weight for a short period and then fattened on a combination of small grain pasture and dry-lot feeding made faster and cheaper gains than those fattened in dry lot.
2. Yearling steers fed in dry lot for short periods and then transferred to small grain pasture for the remainder of the feeding period gained faster and more economically than those fed in dry lot.
3. Yearling steers fattened on a combination of oats pasture and dry-lot feeding made cheaper gains than those fattened on a combination of rye pasture and dry-lot feeding.
4. Transferring either yearling steers or calves, which had been fed in dry lot for short periods, to small grain pastures did not cause a reduction in gains.
5. When calves that were just weaned were fattened for 196 days, first in dry lot and then on small grain pasture and then returned to dry lot, they performed similarly to those fattened entirely in dry lot for 196 days.
6. For an entire steer calf crop, the lighter calves (weighed about 100 pounds less) gained as rapidly and somewhat more efficiently than the heavier calves.
7. Feeding an entire steer calf crop, beginning at weaning, for 196 days resulted in animals that had a carcass weight of around 500 pounds.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Tifton, Ga.



Gangstad, E. O. WINTER GRAZING OF SMALL GRAINS IN NORTH CENTRAL TEXAS. Hoblitzelle Agr. Lab., Tex. Res. Found. B. 11, 19 pp. 1962.

Wheat, barley and rye, a combination of oats and button clover, and a cool season perennial, Hardinggrass, were grazed for total yields of beef and the relative distribution of these yields during the year. Potential yields of forage and grain of commercial varieties of small grains were also studied.

A combination of oats and button clover gave a total yield of 139 steer grazing days, 2.21 pounds average daily gain, and 309 pounds of beef per acre for a 4-year grazing period. An average yield of 25, 49, 74, 76, 72, and 16 pounds of beef per month was obtained for January, February, March, April, May, and June, respectively.

Partial grazing reduced the yield of grain about one-half from March 10 to April 16 but the value of the additional beef produced was greater than the value of the reduced grain yield. The gross return per acre was highest with continued grazing.

Winter grazing, from the 20 percent probable frost date in the fall (October 30) to the 20 percent probable frost date in the spring (March 30) was highest with wheat and lowest with Hardinggrass. Wheat, oats, barley and oats, and Hardinggrass gave an average yield of 135, 119, 103, and 105 pounds of beef per acre, respectively.

Winter grazing yields for the 1960-61 season from Elbon rye, Mustang oats, and Bronco oats were 190, 166, and 110 pounds of beef per acre, respectively.

Mustang, Fulwin, and Arkwin oats were observed to be relatively winter hardy and were good forage oats. Bronco did not produce as much early fall growth but was very winter hardy, produced well later in the season and was free of leaf and stem diseases.

Knox, Quanah, and Frisco wheat were relatively cold hardy, produced satisfactory early forage, and had a fairly high total forage yield. They were satisfactory for winter grazing and more winter hardy than oats but somewhat less palatable.

Cordova, Rogers, and Hudson barley were winter hardy in this area, produced good fall and early spring growth but were somewhat lower in total yield of forage and did not graze well in the late spring.

Summer perennial pastures were not very productive until mid-April so small grains must be grazed beyond the March 10 deadline for grain production, or a period of supplemental feeding or a low stocking rate was necessary to meet the forage requirement for this program of management.

Summer annual pastures are not very productive until mid-June so late grazing of small grain, a period of supplemental feeding, or use of summer perennial pasture was necessary to meet the forage requirement for this program of management.

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

Kinch, D. M., and Ripperton, J. C. KOA HAOLE PRODUCTION AND PROCESSING. Hawaii Agr. Expt. Sta. B. 129, 58 pp. 1962.

Research on how koa haole (Leucaena glauca) responds when placed under cultivation and treated as a high-quality forage crop was presented. The crop was grown, harvested, dehydrated, and fed to dairy cattle as a means of assaying its value as a substitute for alfalfa, a crop little grown in Hawaii.

The crop was planted in rows in 21-inch spacing, and cultivated, irrigated, and harvested as a row crop. It yielded about 32 tons of green forage per acre per year when harvested at a height of 4½ feet.

The procedures for dehydrating koa haole were similar to those for alfalfa, except that additional provision for removal of coarse stems and ratoon stumps was desirable. Dehydration reduced the weight of the chopped material in the ratio to 3.6:1, when it was dried to

about 10 percent moisture, wet basis. A dehydrator rated at 4,000 pounds of water removal per hour produced about 1,500 pounds of dried feed per hour.

The production cost of bringing a koa haole stand from initial land preparation to a well-established stand, through its second cutting at about 6 months, was about \$162 per acre, excluding land costs and based on a 200-acre crop. The harvesting cost, including labor, was \$1.27 per ton of green forage or \$4.58 per ton of dried feed. The dehydrating cost was \$19.89 per ton of dried feed.

The protein in dehydrated koa haole was about the same as in alfalfa, but the carotene content was 50-100 percent greater. Its mimosine content, about 30 milligrams per gram, apparently has no detrimental effect on its usefulness as a cattle and dairy feed, but it may produce some unwanted side-effects as a swine feed.

In general, koa haole was produced and processed as a dairy feed easier and cheaper than alfalfa; and its feed quality was superior.

Hawaii Agr. Expt. Sta., U. Hawaii, Honolulu, Hawaii.

Phillips, R. A., and Elliott, K. C. USING FLAIL FORAGE HARVESTERS. West Va. Agr. Expt. Sta. B. 474, 16 pp. 1962.

The effectiveness of flail forage harvesters was studied for the following: (1) Chopping forage for direct feeding; (2) mowing forage for hay; (3) removing hay from the swath; (4) removing hay from the windrow; (5) making silage; (6) pasture trimming; and (7) brush cutting. The proficiency with which representative machines performed each of these tasks was determined along with the desirable and undesirable features of such machines. Two different type machines, were selected for the tests.

The horizontal rotating flail harvester was satisfactory for removing standing crops not over 12 to 15 inches in height. The vertical rotating flail harvester removed any standing hay crop satisfactorily and removed corn with minor losses. Cutting for direct feeding was satisfactory. The length of cut was longer than that considered desirable for silage. Forage cut for hay cured at an increased rate if it was turned and weather conditions were favorable. This method of haymaking was not desirable for general conditions. The flailed material could be removed from the field with a rake and baler. The rotary flail choppers were not satisfactory for pickup of cured hay because of excessive losses. Each machine was satisfactory for pasture clipping.

W. Va. U. Agr. Expt. Sta. Morgantown, W. Va.

\*. ALFALFA CUTTING PRACTICES. \*\*. Wis. Agr. Expt. Sta. Res. Rpt. 11, 15 pp. 1962.

\* Smith, D. \*\* PART I. INFLUENCE OF CUTTING SCHEDULE, SOIL FERTILITY, AND INSECT CONTROL ON YIELD AND PERSISTENCE OF VERNAL AND NARRAGANSETT ALFALFA.

\* Smith, D., Groskopp, M. D., Johannes, R. F., Schmidt, D. R., Strommen, A. M., and Tepas, G. H. \*\*. PART II. YIELDS OF VERNAL WITH TWO AND THREE CUTTINGS AT SIX LOCATIONS IN WISCONSIN.

PART I--The productivity and persistence of Vernal, a winter hardy and wilt resistant alfalfa variety, and of Narragansett, a winter hardy but wilt susceptible alfalfa variety, were studied at Madison, Wis. during 1953-57, under several cutting schedules with two soil fertility levels and with and without insect control. Yields of hay and protein were obtained during 1954-56. Plant counts and residual hay yields harvested in the spring of 1957 indicated the cumulative influence of treatments.

No practical differences in yield were apparent between the two varieties during the 3 harvest years. However, wilt thinned stands reduced yields of Narragansett rapidly in the fourth harvest year.

The highest yields of hay and protein per acre for the 3 harvest years were obtained from 3 cuttings at near 1/10 bloom before September 1 and the extension of this schedule to 4 cuttings with the fourth cutting in early October. Extending the 3 cuttings to 4 cuttings gained very little in hay or protein yield, but it opened the stands to possible winter damage since the fourth cutting was taken during the critical fall period.

The schedule of 3 cuttings at 1/10 bloom before early September appeared to be the most practical system for obtaining high yields of quality forage. Hay yields were 22 percent higher and protein yields were 49 percent higher than for the conventional 2 cuttings at near full bloom.

Residual yields and final stands were highest with cutting schedules which had no fall cutting. They were influenced more by fall cutting than by the number of harvests per season.

Soil fertility level did not influence yields until the third harvest when yields were significantly higher with high soil fertility. Even though infected with bacterial wilt, Narragansett plants were more vigorous with high soil fertility. Conditions that weaken plants, such as low soil fertility, seemed to increase the speed with which wilt thinned the susceptible variety.

Leafhoppers significantly reduced yields each year by damaging the second and/or third hay crops. Insects reduced yields more with low than with high soil fertility.

PART II--Cutting trials at six locations in Wisconsin compared the production from two and three harvests per season of Vernal alfalfa. At all locations, except Ashland in the north, the highest yields of quality hay measured in terms of protein per acre were obtained from three cuttings at early stages of growth--one harvest near June 1 and two harvests at 1/10 bloom--before September 1, the beginning of the critical autumn period. Yields of hay from three cuttings early were not greatly different from the conventional two cuttings per season, but yields of protein, and thus of quality, were greatly increased.

Three cuttings before September 1 can probably be harvested in all of the southern two-thirds of Wisconsin and thereby greatly improve hay quality. Most of the alfalfa acreage is in this part of the State. In the northern one-third of the State, two cuttings may still be the best management practice. The season is quite short and little time is available for three cuttings before September 1. Cutting after this date opens the plants to winterkilling.

Tables and charts.

Agr. Expt. Sta., U. Wis., Madison, Wis.

Byers, G. L., and Lucey, R. F. LEGUME DAMAGE BY TRACTORS. N. H. Agr. Expt. Sta., Sta. B. 473, 11 pp. 1962.

A study was made to evaluate the effect of tractor traffic on yields of alfalfa and red clover. Eight basic treatments were applied by using two tractors, one with new tires and one with smooth tires.

The tests were conducted on a Paxton 1 soil. Plots were seeded in August of 1959 and 1960. The following spring the first crop was harvested by hand. The traffic treatments were applied to the second growth when the plants were approximately 4 inches high. The area between the tractor tracks was kept cleanly mown, consequently, only those plants that had been run over by the tractor were allowed to grow.

The author concluded that: (1) Significant damage was inflicted on alfalfa and red clover plants when they were subjected to tractor traffic; (2) increasing the area of tire contact, increased the number of plants damaged; (3) slippage of the drive wheel was not as important a factor as weight; (4) minimum pressures to eliminate damage were well below average tractor tire contact pressures; (5) damaged plants continued to grow, but at a slow rate and yielded much lower than undamaged plants; (6) plant crowns were severely damaged and were more susceptible to disease; and (7) field traffic, where plants will be damaged, should be reduced to a minimum.

Agr. Expt. Sta., U. N. H., Durham, N.H.

Sprague, M. A., Ilnicki, R. D., Aldrich, R. J., Kates, A. H., Evrard, T. O., and Chase, R. W. PASTURE IMPROVEMENT AND SEEDBED PREPARATION WITH HERBICIDES. N. J. Agr. Expt. Sta. B. 803, 68 pp. 1962.

Seedbed preparation with herbicides and minimum tillage was tested extensively with most perennial forage crops, winter small grains, and sudangrass in New Jersey from 1949-60. The authors concluded that:

1. Usually modern pasture improvement is a step-by-step procedure involving clipping; use of herbicides; fertilizing, liming, and seeding with or without surface tillage; and grazing management.
2. Surface tillage left a mulch that deterred erosion and aided pasture establishment.
3. TCA (trichloroacetic acid) was used to demonstrate the principle of pasture seedbed preparation with herbicides, but its cost, corrosive characteristics, and the residue left in the soil made it impractical for farm use.
4. Sodium arsenite applied at the rate of 25 pounds per acre gave immediate top kill of all plants in a sod, but regrowth from rhizomes of bluegrass was rapid except on areas that were heavily disked.
5. Dalapon at 8 pounds per acre reduced a live bluegrass sod to a dead mulch during the growing season. Dalapon often left troublesome broad-leaved weeds unkilld in most pastures when used alone.
6. The residue left in the soil when TCA, dalapon, or 2,4-D were used at adequate rates necessitated a long delay between spraying and seeding.
7. A mixture of dalapon (4 pounds) and amitrole (1 pound) killed most pasture sods, and a delay of 2 weeks plus some rainfall were required before grass-legume mixtures were safely seeded.
8. A mixture of 4 pounds of dalapon and 2 pounds of cacodylic acid killed most pasture sods, and seedings were safely made 2 weeks after treatment.
9. Cacodylic acid, at rates of up to 12 pounds per acre, was safely applied within 1 hour without affecting the new seeding. Split applications reduced the amount of chemical required.
10. Amitrole applied at the rate of 4 pounds per acre killed all plants in pasture sods. Both sudan grass and winter small grains were safely seeded 3 weeks after such treatment.
11. Orchard grass in pastures, compared with other grasses, had more tolerance for cacodylic acid than it had for other herbicides tested.
12. Grazing old pastures as closely as possible before treatment enhanced the effectiveness of the herbicides and made tillage easier.
13. Date of planting determined when herbicides should be applied, whereas choice of of chemical was based on the season and the condition of the weedy plants to be killed.

14. Band placement of large-seeded species, such as small grains and sudangrass, was successful in dead sods without any tillage other than that of the furrow openers on the seed drill.
15. During the winter there was less erosion on a dead mulch seedbed than on one that has been plowed. Broadcast seedings of small-seeded legumes on dead sod in late winter become much better established than similar seedings on fall-plowed ground.
16. About 90 percent of a bluegrass sod had to be killed to permit normal growth of sudan grass and small grains.
17. Perennial forages lasted several years longer when their seedbeds were prepared with herbicides rather than plows.
18. The physical characteristics of a grass sod killed with herbicides offered an effective deterrent to erosion on a very steep slope. Decaying plant parts caused the soil surface to become slightly spongy, and the rate of water absorption was increased considerably.

N. J. Agr. Expt. Sta., Col. Agr., Rutgers--The State U., New Brunswick, N.J.

Heagler, A. M., Crowe, G. B., and Cooke, F. T., Jr. THE ECONOMICS OF PASTURE YIELDS IN BEEF CATTLE PRODUCTION, YAZOO-MISSISSIPPI DELTA. Miss. Agr. Expt. Sta., B. 649, 10 pp. 1962.

Tests conducted on Delta plantations indicated that calf weight gains per acre ranged from a low of 0.45 hundredweight on Johnsongrass to a high of 3.61 hundredweight on Coastal Bermuda. There was little difference in the level of calf weight gains per acre obtained from common Bermuda and Dallisgrass. The practice of winter feeding the breeding herd on common Bermuda, Johnsongrass, and Dallisgrass resulted in damage to the turf from excessive trampling and reduced the output potential of these pasture crops.

Although calf weight gains obtained from oats and ryegrass and fescue were almost identical, the seasons in which they were usually grazed were different. Fescue provided grazing in fall and winter and oats in late winter and spring.

The relatively low calf weight gains associated with crop residue grazing should not restrict its use as a partial substitute for either fescue or oats and ryegrass in any grazing system because it represents a cheap source of forage.

Evaluation of pasture output measured in ETDN (effective total digestive nutrient) utilization per acre indicates that although large variations existed in the level of ETDN utilization per acre among both permanent and temporary pasture crops, there was little difference in the percentage of ETDN required for maintenance or used for gain. The low level of ETDN utilization per acre obtained from crop residue and the high percentage required for maintenance reflects the effect of a short grazing period in conjunction with the provision of a minimum maintenance ration and weight losses associated with calving.

Pasture cost per hundredweight of calf weight gain ranged from a low of \$2.15 on crop residue to a high of \$18.34 on oats and ryegrass. Coastal Bermuda cost was \$3.21 and Johnsongrass and fescue slightly more than \$9.00 per hundredweight. Carrying capacity, grazing period length, and ETDN utilization per acre were of major importance when one pasture crop was being considered as a partial or complete substitute for another in a grazing system.

Sound judgment and experience are necessary when making pasture adjustments. Complete dependence on crop residues for grazing during the fall to spring periods would prove disastrous during periods of high rainfall or ground-covering snow. A small amount of fescue or oats and ryegrass (1/8-1/4 acre per brood cow) should be maintained as an inclement weather safety factor.

Miss. State U., Agr. Expt. Sta., State College, Miss.

Schneider, V. E., and Korzan, G. E. AN ECONOMIC ANALYSIS OF RYEGRASS SEED: PRICES, PRODUCTION, AND MOVEMENT. Oreg. Agr. Expt. Sta., Sta. B. 585, 15 pp. 1962

Movement of both common and perennial ryegrass seed was highly seasonal. Peak movement of common ryegrass at the first-handler (valley-dealer) level is during July, when 25 percent occurs, followed by August with 20 percent, and September with 18 percent. Peak movement of perennial ryegrass is also during July when about 17 percent occurs.

Over a period of 13 years, average prices of common ryegrass at the first-handler level have shown little variation from month to month, ranging from an average high in January of \$7.86 to an average low in June of \$7.43. During the same period, average monthly prices of perennial ryegrass ranged from an average high in November of \$12.21 to an average low in May of \$10.59.

Weighed season-average prices received by producers and for the first handler for common and perennial ryegrass seed were highly related; that is, they moved up and down together.

A comparison between price received by growers and price received by the first handler shows a high correlation of price movement. Between 1947 and 1959, average price received by producers for common ryegrass was \$6.96, as compared to \$7.53 at the first-handler level. Average price received by growers for perennial ryegrass for the 13-year period was \$10.29, as compared to \$11.48 received by the first handler.

The two most important factors influencing price received by growers for ryegrass are carryover from previous years and current year's production. About 83 percent of variation in price of common ryegrass seed (grower level) was explained by these two factors.

Production of common ryegrass (supply) in the current year is a response to price received by growers the previous years.

Use of fertilizer has played an important role in the shift of the supply curve to the right and the highly responsive nature of common ryegrass seed production. Average yield from 1939 to 1949 was 409 pounds per acre; 1950 to 1954, 734 pounds per acre; and 1955 to 1960, 970 pounds per acre.

Extreme price fluctuations (up and down) can be expected because a small change in price usually is accompanied by a large production response; but this large increase in supply is difficult to sell even at drastically lower prices.

Through group action, ryegrass seed producers can increase their bargaining power to some extent by: (1) Expanding total market demand; (2) controlling production response through quantity and quality controls; and (3) sound management of an association of ryegrass seed growers.

Tables and charts.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg.

## Rangelands

Conrad, C. E., and Reed, M. J. AUTOMATIC DATA PROCESSING OF RANGE VEGETATION INFORMATION. Pacific Southwest Forest and Range Expt. Sta. Res. Note 201, 5 pp. 1962.

More than 2-1/4 man-months of laboratory and field time were saved by using automatic data processing in a large-scale continuing study of vegetation characteristics. A

high-speed computer solved 57 separate problems in less than an hour, enabling researchers to determine sampling requirements for 19 species or specie groups in three range sites.

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

Beetle, A. A. RANGE SURVEY IN TETON COUNTY, WYO. II, UTILIZATION AND CONDITION CLASSES. Wyo. Agr. Expt. Sta. B. 400, 35 pp. 1962.

Grazing pressures by game and livestock in the Teton County of Wyoming have brought about the following: (1) Changes in plant composition; (2) increase of sagebrush seedlings; (3) browse lines on woody species; (4) high lines on aspen; (5) trailing; (6) presence of certain individual species such as the common dandelion and cheatgrass brome; and (7) disturbance patterns.

The large number of dominants involving shrubs, forbs, and grasses of all types on varied areas has ruled out dominants as good general indicators of range-condition class. The general absence of invaders (except on the floor of the Hole and the Elk Refuge) rules them out as general indicators, except where loss of percentage composition of decreasers can be demonstrated. This leaves only the general class of increasers as a possible key to range condition. One of the most promising indicators is Sandberg bluegrass, which cuts across soil types as well as vegetation types, over a broad zone of elevation, and invariably increases in abundance as the habitat becomes disturbed. This disturbance may be by cattle, sheep, big game, or gophers. In the same manner, two forb genera (pussytoes and sandworts) seem to have significance over about the same area as Sandberg bluegrass.

The most evident changes in vegetation patterns in Teton County were related to the geologic youthfulness of the area. Game animals have severely altered the vegetation. The pattern of change caused by livestock was less easy to detect and less obviously associated with their distribution.

Winter feeding by eliminating the winter range as a factor in elk-herd size releases the population for additional growth in numbers until a new limiting factor asserts itself. This new factor has proved, for the elk, to be the summer range. The survey points conclusively to the elk as a major cause of disturbance of vegetation in Teton County and warns of further damage to the Snake River watershed, and the elk herd itself.

Where the shrub layer was severely browsed on the south slopes and Agropyron spicatum remains the dominant grass, all range damage, trailing erosion, and shrub pruning were attributed to game alone.

Under ideal circumstances, it is possible to graze more than one kind of animal without competition. In all cases, overused ranges lead to competition for the few remaining plants.

The problems of range management in Jackson Hole are apparently not primarily concerned with the competition between domestic stock and big game, although there are points of conflict. The primary concern is that big game compete among themselves for food.

Overgrazing patterns in Teton County were attributed largely to elk. On the winter range, the damage was confined largely to high ridges and browse and was accentuated by competition from deer. On the summer ranges, the damage was on high parks where there was no grazing by domestic livestock.

The most pressing problem appears to be reduction of the elk herd within the carrying capacity of the summer range. This involves: (1) Recognition of the limited nature of the summer range; (2) an estimate of the carrying capacity of that range; and (3) a mechanism in the winter to accomplish herd reduction.

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

Ecology of the range plants, grazing capacity of the forage resource, and techniques of management most suited to black grama and tobosa grasslands and associated shrub ranges of the Southwest were interpreted from records of vegetation, climate, and livestock on the Jornada Experimental Range.

1. Annual rainfall at the Jornada Experimental Range headquarters from 1916-53 averaged 9.02 inches; more than 50 percent of this amount was received in July, August, and September. Precipitation records showed alternate periods of generally higher or lower rainfall at intervals of approximately 20 years.
2. Vegetation types on the experimental area include black grama, tobosa, mesquite sandhills, creosotebush, tarbush. Perennial grasses furnish the bulk of the forage in all types except the mesquite sandhills, where grasses are sparse and palatable, browse plants yield more forage. Most forage growth is made from July through September. Growth characteristics and maintenance of black grama and tobosa are given primary consideration in the management of the experimental area.
3. The basal area of grasses on meter-square quadrats charted yearly from 1916-53 was found to fluctuate with precipitation received in a 15-month period, which includes the previous grazing year (July-June 30) plus the current growing season (July, August, and September). The basal area of black grama was closely related to this 15-month precipitation under conservative grazing.
4. Herbage production of perennial grasses varied widely from year to year in response to fluctuations in precipitation during the growing season. In dry years, production was reduced to approximately 100 pounds an acre, air-dry. In favorable years herbage production in the black grama type averaged 500 pounds to the acre. Production of tobosa averaged 1,000 to 1,900 pounds of herbage an acre.
5. Shrubs became more numerous on many areas in the black grama and tobosa types during the period of record and the grasses and grazing capacity were materially reduced.
6. On three experimental pastures, which were predominantly covered by shrub types, grazing capacity averaged 4.8 animal units per section in contrast to 10.9 animal units on 3 pastures that were mostly grass.
7. For best use and maintenance, tobosa range should be grazed during the growing season and black grama areas should be reserved for fall-winter-spring use.
8. Other features of management included constant improvement of the herd through careful culling, selection of good-quality cows, the use of bulls either registered or eligible for registration, the use of numerous inexpensive water developments in the tobosa areas, salting away from water on black grama range, and fencing to obtain better distribution of the cattle.
9. Because of the wide fluctuations in forage production, it was advantageous to maintain the number of breeding cows at approximately 60 percent of the entire herd.
10. The cow-yearling herd arrangement increased beef production per animal unit grazed, and increased the value of the beef produced. During the period 1927-34 when the herd was managed as a cow-calf operation, 377 pounds of beef were sold per animal unit grazed with an average annual value of \$23.21. When the cow-yearling herd was maintained from 1940-51, 495 pounds of beef per animal unit were sold with an annual average value of \$64.51.



11. Despite application of the best known techniques of range management, ranchers and land administrators of semidesert grass-shrub range areas often face periods of low forage production when stocking must be reduced.

FS, USDA, Inform. Div., Washington D.C. 20250.

Schutz, W. D., Baker, J. L., and Vanvig, A. RANCHING ALTERNATIVES ON THE WIND RIVER RESERVATION. Wyo. Agr. Expt. Sta. B. 401, 56 pp. 1962.

An economic analysis of ranching alternatives on the Wind River Reservation of Wyoming was presented to determine what results can be expected from alternate types and sizes of ranches.

Items of income and expense were budgeted. Estimates of income and expense were made on the basis of data and assumptions regarding livestock and crop-production rates, prices, labor requirements, and land requirements.

Three types of ranch organizations--livestock on permit range, livestock on irrigated pasture, and cash crop with and without livestock--were selected for analysis. By use of the budgets a residual return to labor, management, and 80 acres of allotted land was estimated for the respective types and sizes of ranches, 23 in all. A summary of important data from these budgets was given in table form.

Though a cash crop-feeder operation showed the highest net return, the livestock alternatives were favored by the Indian operators.

Cash crop beets with feeder steers provided the highest net returns followed by the cow/yearling operation (175 cows), utilizing both irrigated pasture and permit-range and then the 175 cow/calf, permit-range operation.

Cropland yields used in the budget analysis presumed good management and the assumption that no serious obstacle to irrigated-crop production existed. Presently, serious obstacles or problems respecting irrigation apparently do exist. About one-quarter of the assessable irrigable acreage is idle. An even larger amount is classified as temporarily non-irrigable, non-assessable.

With the soil survey now being completed, it should be possible to better identify problem soils and to appraise the feasibility of their reclamation.

It appears that the range offers fewer serious problems in utilization than the irrigable acreage. Some range-improvement measures would undoubtedly prove economical such as stockwater development, additional fencing, and spraying of sagebrush on parts of the Reservation.

An appraisal of changes in investment, costs, and returns in enlarging ranch operations was made. An additional \$14,716 investment was the estimated requirement in expanding from 24 cows up to 80 cows. Also, additional operating capital was required. With all returns over operating expenses used to amortize the loan, it could be paid off in about 12 years. Increasing the cow herd from 50 cows up to 125 cows required an estimated \$19,285 more investment, additional operating funds, and about 8 years for repayment.

Approximately \$600,000 of additional credit would be required if half of the ranches with 20 to 50 head of cattle, and all ranches with more than 50 head of cattle, were to attain the 80 cow/calf herd size.

In all of the budgets, the assumed production rates were somewhat higher than those presently being achieved by the Indian operators.

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

Mueggler, W. F. RANGE RESOURCES AND MANAGEMENT PROBLEMS IN NORTHERN IDAHO AND NORTHEASTERN WASHINGTON. Intermountain Forest Range Expt. Sta. Res. Paper 68, 31 pp. 1962.

Range resources and management problems in 6 counties of northeastern Washington and 10 counties of northern Idaho were studied. Approximately 70 percent is covered by forest and wood processing is a major industry.

The area supports more than 350,000 cattle and 65,000 sheep. Estimated valuation of all livestock in 1954 was 38 1/4 million dollars. Big-game animals contribute much more to the economy here than in many other areas in the West. Approximately 23,000 deer and 7,000 elk are harvested annually. Both livestock numbers and big-game harvest have varied considerably. The trend appears to be upward, and the demand upon the forage resource is likely to increase. This appears especially true for big game because of increased recreational pressures.

The contribution of livestock and big game to the economy of northern Idaho and northeastern Washington has entailed certain costs. Both livestock and big-game range have suffered varying degrees of depletion, primarily because many livestock operators and big-game managers do not thoroughly understand relations between animals and vegetation. They did not recognize the limited grazing capacity of the range, and grazing management systems for sustained forage production were practically nonexistent. Large areas of formerly productive bunchgrass range have undergone type conversion to low-producing annuals and many once luxuriant subalpine herblands are now actively eroding.

Despite the present impoverishment of large portions of the area's rangelands, there is still a potential for substantial livestock and big game production. A large livestock industry can be maintained by a combination of range improvement and development of grazing on forested lands. Values of the big-game resource are just beginning to be realized. The great potential for big-game production on a sustained yield basis can be achieved by development of methods for habitat manipulation and for control of animal distributions.

Production of livestock and big game in northern Idaho and northeastern Washington depends upon highly diverse grazing lands. These vary from open low-elevation grasslands to both permanent and transitory forest ranges, to mountain meadows, and to subalpine herblands. Each of these broad types presents peculiar problems in grazing management. Most involve serious multiple-use considerations. All demand attention if their full grazing potential is to be achieved.

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

Rauzi, F., Lang, R. L., and Becker, C. F. MECHANICAL TREATMENTS ON SHORTGRASS RANGELAND. Wyo. Agr. Expt. Sta. B. 396, 16 pp. 1962.

In the spring of 1955, replicated native pastures at the Archer Substation near Cheyenne, Wyo., were mechanically treated with a sod drill, a range pitter, and a range seeder. Standard crested wheatgrass, alfalfa, and ammonium nitrate, at different rates, were applied to the native pastures by use of the sod drill and the Wyoming range seeder. There was no seeding or fertilization on the pastures treated with the range pitter at the time of pitting. The grazing results of this 5-year study show:

1. An average of 71.5 sheep days of grazing per acre was obtained from the pastures treated with the Wyoming range seeder. This was 17 and 12.6 days more grazing than was obtained from the pastures treated with the sod drill and the range pitter, respectively, and 29.2 days more than from the moderately grazed pastures.

2. Differences in lamb gain per head between treatments were negligible, but differences in lamb gain per head between years were significant.
3. The pastures treated with the Wyoming range seeder produced an average of 9.2 and 10.8 more lbs. of lamb gain per acre than did the pastures treated with the range pitter and the sod drill, respectively. The pastures treated with the Wyoming range seeder produced 16.6 more lbs. of lamb gain than did the moderately grazed check pastures.
4. An average of 1,049 lbs. of herbage per acre was obtained from the pastures treated with the Wyoming range seeder, and 634, 703, and 414 lbs. per acre, respectively, for the pastures treated with the range pitter, the sod drill, and the moderately grazed check.
5. Good stands of crested wheatgrass and alfalfa were present on the pastures treated with the Wyoming range seeder, but the alfalfa started thinning out the third year and by 1961 was almost nonexistent in the pasture. Fair stands of crested wheatgrass were present in areas of depression where additional runoff water was caught on the pastures treated with the sod drill.
6. The pits on the south-facing slopes have completely weathered, and the water-holding capacity of the pits on the upland and bottom areas of the pastures was materially reduced by the filling in and revegetation of the pits.
7. After the third year, the pastures treated with the sod drill had lost the effect of both renovation and fertilization and were comparable to the check pastures. The renovation, plus the 60 lbs. of nitrogen, stimulated the production on the pastures treated with the sod drill for the first 3 years of the study. The pastures treated with the Wyoming range seeder and with the range pitter were still producing more sheep days of grazing, lamb gain per acre, and herbage than the moderately grazed pastures.
8. The major changes in plant composition of the native pastures were reduction of blue grama and increase in the cool-season species. Annual grasses increased, especially on the slope and bottom sites of the pastures.
9. During the second 30-minute period of a 1-hour test, the test plots on the pitted pastures absorbed almost twice as much water as the test plots on the pastures treated with the Wyoming range seeder, and almost four times as much as the pastures moderately grazed or as those treated with the sod drill.

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

Hilmon, J. B., and Lewis, C. E. EFFECT OF BURNING ON SOUTH FLORIDA RANGE. Southeastern Forest Expt. Sta., Paper 146, 12 pp. 1962.

Livestock ranges in south Florida are burned during the winter season every 2 or 3 years to remove old growth and provide cattle with readily available new growth. A study on the Caloosa Experimental Range, Charlotte County, Fla., measured yield, composition, and chemical content of herbage from ungrazed native range during a 2-year period following burning on February 14, 1957.

Production of herbage increased rapidly following burning. Yields were 66 pounds per acre at 3 weeks and 2,200 pounds per acre at 9 months. The highest accumulative production, approximately 3,500 pounds per acre, was attained in November of the second year. Shrubs were relatively unimportant on the study area.

Pineland three-awn was the principal plant in the herbaceous understory. It comprised 95 percent of the total herbage 3 weeks after burning and thereafter averaged 75 to 80 percent. A variety of other grasses, grass-likes, and forbs contributed to total herbage. Sawpalmetto was the principal shrub and comprised 90 percent or more of browse volume.

Nutrient levels of herbage were generally highest in the young growth immediately after burning. Crude protein in pineland three-awn and other herbage decreased rapidly to amounts inadequate for cattle; calcium and phosphorus were always inadequate. Mineral supplement affords an effective means of offsetting nutrient decline and enables ranchers to make use of the large volumes of feed produced on native ranges.

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

Lindenmuth, A. W., Jr., and Glendening, G. E. CONTROLLED BURNING OF ARIZONA CHAPARRAL: A 1962 PROGRESS REPORT. Proc. 6th Annual Watershed Symposium, Sept. 18, 1962. pp. 23-24. 1962.

Land managers must control fire if intentional burning is to find a place as a recognized tool for managing chaparral lands in Arizona. The burning period and fire behavior must be in accord with a preconceived plan. A progress report describing a test of a model for prescribed fire in Arizona chaparral was given. The authors concluded that: (1) The treated strips burned as planned, without spread to adjacent untreated areas; (2) the combination of spraying and burning produced a 93 percent reduction in live brush cover; (3) organic litter on the ground was reduced 29 percent; (4) soil movement during a winter of normal precipitation was not increased; (5) Wright silttassel, Emory oak, and shrub live oak appeared to be flammable, while mountain mahogany and the manzanitas appeared to be less flammable; and (6) the initial burning was a success and provided justification for continuing the investigation of fire as a tool in managing Arizona chaparral.

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

Johnson, W. M. VEGETATION OF HIGH-ALTITUDE RANGES IN WYOMING AS RELATED TO USE BY GAME AND DOMESTIC SHEEP. Wyo. Agr. Expt. Sta. B. 387, 31 pp. 1962.

During the summer of 1959, an extensive survey was made of the high-altitude sheep ranges of Wyoming. Information was obtained on vegetation types, vegetative composition, herbage production, and herbage utilization.

Soils from three distinct parent materials were identified in this high elevation country. The most extensive and probably the least productive were soils derived from granites. Soils on redeposited volcanic material were the next most extensive and appeared to be productive. The soils were deeper than those from granites, and less bare rock was exposed. Soils from sedimentary rocks were most extensive in the Big Horn Mountains and supported a different vegetation than the other soil groups.

Interpretation of the data obtained suggests seven major vegetation types making up the high-altitude sheep ranges:

1. The fescue/primrose/marigold community was believed to be a pioneer stage of succession on soils derived from granite. It was not extensive in area, contained little forage, and was extremely sensitive to wind and water erosion.
2. The dwarf-willow community was a good forage type for both livestock and game but was not extensive in area. It was found on all of the mountain ranges studied and on all three soil types.
3. The sedge/hairgrass community was the most important alpine community. It covered the greatest area and produced the largest amount of highly palatable forage for both livestock and game. It was found on the granitic and redeposited volcanic soils.

4. The sedge/hairgrass community in the subalpine zone was the next most important vegetative type. Its vegetative composition was very similar to the same community in the alpine areas.
5. Wet meadows were common throughout the subalpine zone but were of little value for sheep. Usually they were too wet to be grazed by sheep, but game made extensive use of such areas.
6. The fescue/bluegrass community occupied the open slopes, the ridges, and the drier sites of the subalpine zone. The vegetation was dominated by Idaho fescue, bluegrass, and timber danthonia. This type produced large amounts of herbage, but much of it was not palatable to sheep. It was most typical on soils from sedimentary rocks in the Big Horn Mountains.
7. The timber types of the subalpine zone were not considered as major forage types.

Variations were observed in the vegetation of the major grazing communities. Some of this variation was undoubtedly related to past grazing use by livestock and game.

Hairgrass was a key representative of the desirable grass group and was used as an indicator of the response of this group to grazing. Pale agoseris occupied a similar role among the desirable forbs.

Mat and cushion plants showed negative association with the desirable grasses and desirable forbs. Where desirable grasses and forbs were abundant, the mat and cushion plants were relatively less abundant.

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

Sperry, O. E., Ryerson, D. E., and Pearson, H. A. DISTRIBUTION AND CHEMICAL CONTROL OF COYOTILLO--A RANGE SHRUB POISONOUS TO LIVESTOCK. Tex. Agr. Expt. Sta. MP-594, 10 pp. 1962.

Coyotillo is a poisonous range plant which grows in more than 30 counties of South and Southwest Texas. Livestock losses from this shrub frequently are high. Livestock management and control measures are of prime importance to operators in the areas of its occurrence.

Experimental control studies over a 5-year period show that coyotillo was difficult to kill with herbicides. The following three control methods met with various degrees of success and were recommended where applicable:

1. Treatment of plants with a soil injector was effective on deep soil sites. Solutions of low volatile esters of either 2,4-D, 2,4,5-T, or equal parts of 2,4-D and 2,4,5-T gave a high percentage of kill when injected into the soil around the base of the plant. Two percent solutions of these chemicals in diesel oil injected into the soil to a depth of 4 inches at the rate of 2 ounces of solution per foot of crown diameter gave the most consistent kills.
2. Fenuron pellets gave a high rate of kill when applied to the soil at the base of the plant before the summer rains. Best results were obtained from the application of 2 heaping teaspoons (approximately one-half ounce) of pellets per foot of crown diameter.
3. Selective herbicides obtained reasonably good kill when sprayed on the lower portion of the stems when the plants were in lush condition after spring or early summer rains. Ester formulations of 2,4,5-T, Silvex, and equal parts 2,4-D and 2,4,5-T gave the best results of the chemicals tested over the 5-year period. Although the results were not consistent from year to year, 1,2,3 and 4 percent concentrations gave good

kills in some of the tests. Treatment with a 3 or 4 percent level appeared most practical. A second year's application to the remaining live plants was necessary to obtain high levels of control.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Krenz, R. D. COSTS AND RETURNS FROM SPRAYING SAGEBRUSH WITH 2,4,-D. Wyo. Agr. Expt. Sta. B. 390, 31 pp. 1962.

The economic returns from chemical control of sagebrush were measured. Discounting procedures were used to determine annual rates of return for four site conditions. Attempts were made to determine the effect of the original density of sagebrush on rates of return from spraying. Other problems such as reinvasion of sagebrush and deferred grazing were discussed.

Spraying of sagebrush was profitable on the types of rangeland currently being sprayed. The main problem was obtaining a good kill. To get good control one must: (1) Use recommended materials; (2) spray when the sagebrush is actively growing; and (3) do a good job of applying the material. Ranchers should take care in selecting a good operator if custom spraying is used. Good aerial operators guarantee results.

Respraying every 7 or 8 years will maximize returns in areas of 8 to 13 inches of precipitation. With better control methods, the range will not become reinfested as rapidly.

Deferment of use of the range immediately after spraying may prolong the life of the spraying operation but does not necessarily maximize returns. Where a rancher needs immediate increase in grass, it may pay him not to defer grazing, then respray after a few years.

Comparisons of spraying with buying additional grazing land indicate that spraying was a much cheaper way to gain more forage. With grazing land worth \$10.00 per acre, one must buy an additional 1.35 acres of unsprayed land to give the same amount of grass gained by spraying one acre. One can spray 2.75 acres for what it costs to own an additional acre of unsprayed land.

Spraying sagebrush is an operation which will bring a return for many years, if the job is done right.

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

## Plant Materials

- \*. ALFALFA SEED PRODUCTION STUDIES. \*\*. Utah Agr. Expt. Sta. B. 436, 22 pp. 1962.
- \*. Pedersen, M. W. \*\*. PART I. ALFALFA SEED PRODUCTION AS INFLUENCED BY THREE VARIETIES, SIX CULTURAL TREATMENTS, AND FOUR GROWING SEASONS.
- \*. Pedersen, M. W., and Nye, W. P. \*\*. PART II. ADDITIONAL FACTORS ASSOCIATED WITH SEED YIELDS.

PART I--The following conclusions in an experiment using three alfalfa varieties (Ranger, Lahontan, and Uinta) were given for an experiment involving 6 cultural treatments over a 4-year period (1957-60) at Logan, Utah.

1. Differences among varieties, cultural treatments, and interactions were highly significant.
2. Uinta alfalfa averaged 859 pounds of seed per acre, followed by Ranger with 510 pounds, and Lahontan with 380 pounds.

3. Satisfactory management practices for growing alfalfa seed included planting in 24-inch rows at a rate of about 1.5 pounds of seed per acre. After the second year, the stand was thinned by cutting out about every other foot in the row.
4. Additional thinning after the third year appeared to stimulate seed yield.
5. Ranger and Lahontan alfalfa varieties responded more to thinning and row stands than Uinta.
6. In 1959 the seed yield of Lahontan was affected less by the unfavorable conditions than either Ranger or Uinta.
7. Ranger and Lahontan alfalfa varieties responded more to different cultural treatments than Uinta, but the response varied from year to year.
8. Satisfactory seed yields were produced by Uinta alfalfa from either hay or seed stands.
9. No definite conclusions about the practical use of interplanting was reached.

PART II--When measurements of ecological, disease, insect, biological, and yield factors associated with alfalfa seed yields were made in a 4 year study it was concluded that:

1. The 1959 season had higher than average rainfall, lower than average temperatures, and excessive irrigation. These conditions brought about low seed yields, low nectar secretion, and low honey bee populations.
2. Soil moisture, light penetration, and relative humidity were discussed in relation to the different cultural practices.
3. The cultural practices were not considered to have affected susceptibility to insect damage.
4. Uinta was the most resistant to yellow leaf blotch and downy mildew of the varieties studied.
5. Uinta alfalfa was high in chaff production as well as seed.
6. Cultural practices did not significantly affect the number of racemes or flowers per acre.
7. Uinta alfalfa had 8.0 pods per raceme, Ranger had 7.4, and Lahontan had 6.7.
8. Uinta alfalfa had 4.1 seeds per pod, Ranger had 4.0, and Lahontan had 3.6.
9. A reduction in both the number of seeds per pod and in seed weight appeared to be associated with the increasing age of the stand.
10. Uinta alfalfa flowered a few days earlier than the other varieties. Row stands and thinning also promoted earlier flowering.
11. In the number of flowers per raceme, Ranger was high with 19.2 followed by Uinta with 16.6 and Lahontan with 16.0.
12. A low value for nectar sugar concentration for Uinta alfalfa was interpreted as indicating greater attractiveness to honey bees.
13. Uinta alfalfa averaged 1.10 tripped flowers per raceme followed by Lahontan with 0.89 and Ranger with 0.86.
14. Low bee populations were found on Lahontan alfalfa and on the hay stand of all three varieties.
15. The treatments did not affect cross fertility, but Lahontan showed low self fertility.

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

Bohart, G. E. HOW TO MANAGE THE ALFALFA LEAF-CUTTING BEE (MEGACHILE RONDATA FABR.) FOR ALFALFA POLLINATION. Utah Agr. Expt. Sta. C, 144, 7 pp. 1962.

An illustrated "culture and care" publication on the life history and management of the alfalfa leaf-cutting bee for alfalfa pollination was given.

The farming areas of Utah seem to be favorable for the alfalfa leaf-cutting bee for several reasons: (1) There are many acres of alfalfa, much of which is left for seed; (2) the old wooden outbuildings and dead and dying cottonwoods provide good nesting places; (3) no serious parasites or diseases have appeared, although minor ones take a light toll; and (4) the bee likes bright sunshine and warm, but not excessively hot, temperatures.

The worst dangers to this bee in this area are: (1) Insecticides (it seems to be more susceptible than the honey bee); (2) heat (the eggs and young larvae die when the cell temperature gets much above 100° F.; and (3) birds (shelters may have to be protected with chicken wire).

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

## Woodlands

Hebb, E. A. RELATION OF TREE GROWTH TO SITE FACTORS. Tenn. Agr. Expt. Sta. B. 349, 18 pp. 1962.

The productivity of hardwood forest lands on sites in West Tennessee on soils derived from loess overlying coarse Coastal Plain sediments was evaluated. The species studied were red oak (Quercus falcata Michx.), white oak (Q. alba L.), tulip poplar (Liriodendron tulipifera L.), sweet gum (Liquidambar styraciflua L.), and cherrybark oak (Q. falcata var. pagodaefolia Ell.). The trees grow in all-aged stands, so conventional site index methods based on stand averages could not be used.

Growth curves were constructed for individual trees using cores extracted at 4 or 5 well-spaced locations along the stem. From these curves an index of productivity--height at 50 years--was determined for each site. The following measurable factors considered to affect the site complex were recorded: topographic position, exposure, drainage, slope length, basal area, competition, depth to mottling, soil aeration porosity, and percent silt. Using an electronic computer, the regression of the productivity index on all possible combinations of these factors was determined for each species.

Considering all species, topographic position was the variable most consistently correlated with site index and apparent surface drainage was the next important.

Soil series was not a very promising variable but in sweet gum it did show some general relation to productivity indexes. Upland soils such as Memphis, Lexington, and Ruston were associated with lower site indexes than bottom land soils such as Ina and Beechy. Productivity indexes had wide ranges within the soil series, so no strict relationship for prediction appeared possible.

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

Cooley, J. H. SITE REQUIREMENTS AND YIELD OF PAPER BIRCH IN NORTHERN WISCONSIN. Lake State Expt. Sta., Sta. Paper 105, 11 pp. 1962.

Paper birch in northern Wisconsin was studied to provide forest managers in the area with information on yield and site requirements. Site characteristics and the age and total height of dominant and codominant trees were recorded on 103 plots. Stand tallies were made on 71 plots, 54 of which were fully stocked with paper birch.

Terrain was one of the principal determinants of site quality of paper birch in the area. The silt-plus-clay content in the first 6 inches of soil and surface drainage also had a major influence on paper birch growth. On sites with less than 10-percent slope or where steeper



slopes did not result in elevation changes of more than 15 feet, the best soils were those that had mottling in the first 48 inches. Where the terrain was broken up by steep slopes that resulted in ridges or knolls more than 15 feet high, site index was related to slope percent and position in relation to breaks in the topography. The presence of bedrock within 12 inches of the surface had a detrimental effect on site quality in this kind of terrain.

The predictions of volume yield in pure stands were limited because the pure birch stands that were sampled did not represent the entire age and site index range for the species. The average size of dominant and codominant paper birch in mixed and pure stands on good sites was calculated from sample tree data.

Preliminary suggestions for the management of paper birch stands were based on subjective observations made. Most of the existing stands in the area apparently were the result of fire, and it is unlikely that the type will be perpetuated on any extensive areas. Many paper birch stands are converting naturally to some other species, and others are being converted by artificial means.

On the poorest sites paper birch should be clear cut for pulpwood when it is 60 years old or before. There was no justification for intermediate cuts in these stands. On some of the medium quality sites, there was an opportunity to extend the rotation to approximately 70 years and harvest some small bolts for specialty products along with pulpwood. On the best sites, many trees reached saw log and veneer bolt size in an 80-year rotation. Intermediate cuts can be made to salvage less vigorous trees as pulpwood and increase the growth rate of residual trees. It is essential to maintain a fairly tight crown canopy for the best development of the paper birch.

In most paper birch stands that are converting naturally to northern hardwoods, the birch can be removed in a series of light partial cuts based on the condition of the individual trees. The understory trees will close any gaps created in the crown canopy quite rapidly so that the residual birch will not be drastically exposed. The most vigorous trees can be retained in the stand until they reach 20 inches d.b.h.

Lake State Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Curtis, R. O., and Post, B. W. SITE-INDEX CURVES FOR EVEN-AGED NORTHERN HARDWOODS IN THE GREEN MOUNTAINS OF VERMONT. Vt. Agr. Expt. Sta. B. 629, 11 pp. 1962.

A system of site-index curves for even-aged northern hardwoods in the Green Mountains of Vermont was developed in a cooperative research project. The forest manager can use this system as a guide in estimating tree growth of the northern hardwoods--sugar maple, yellow birch, white ash, and white birch.

Site productivity was expressed as a function of height over age (site index). The site curves were prepared using tree-stem analyses. It was considered that the resulting curves more closely fit the true tree-growth pattern than previous curves.

Only the general method of developing the curves--and the curves themselves were presented.

Map and charts.

Vt. Agr. Expt. Sta., U. Vt., Burlington, Vt.

Young loblolly pine trees were grown from seed in large containers for 5 years. Two contrasting soil moisture regimes were maintained for the final years: (wet) soil maintained near field capacity throughout growing season; and (dry) simulated summer drought.

Stems of trees were analyzed by internodes and annual rings for certain gross characteristics. The important results were:

1. The spring terminal flush was nearly equal for both treatments, but wet trees produced four internodes of growth annually while dry trees produced two.
2. Gross radial growth was more than twice as great in wet as in dry trees, but the net latewood band was equal in both treatments; thus percentage of latewood was much greater in dry trees, particularly in the basal one-half of the stem.
3. A correlation was noted between continued shoot elongation and continued earlywood production by the wet trees, and cessation of shoot elongation and early inception of latewood in dry trees. Such a pattern of cambial behavior is in agreement with current theories of a terminal shoot-mediated control of tracheid diameter.
4. No difference due to moisture treatment was found between the specific gravities of the earlywood portion of the annual ring. The dry treatment produced somewhat more dense latewood than the wet.

U. Mich., Ann Arbor, Mich.

Thomson, G. W., and McComb, A. L. GROWTH OF PLANTATION BLACK WALNUT IN RELATION TO pH AND CERTAIN CHEMICAL FACTORS OF THE SOIL. *Forest Sci.* 8: 322-333. 1962.

Of the physical soil characteristics measured, only depth of soil above an impervious layer and the 10 YR Munsell color "values" for dry, surface soil were significantly correlated with site index. No significant relationship was found between site index and topographic position, aspect, soil texture, volume height, pore volume, specific gravity, field moisture capacity, and degree or color of subsoil mottling.

Site index was found to vary directly, ( $p = 0.01$ ), with both surface and subsurface soil pH. It was subsequently established that these correlations existed because of other factors of the base exchange complex.

Total exchangeable bases and percent of base saturation of the surface soil were directly correlated linearly with site index, ( $p = 0.01$ ). Total base exchange capacity of the surface soil was not statistically correlated with site index.

The regressions of site index on nitrifiable nitrogen, exchangeable potassium, and exchangeable calcium in the surface soil were found to be linear, direct, and highly significant.

Site index decreased significantly with increasing amounts of soluble iron, ( $p = 0.05$ ), and soluble aluminum, ( $p = 0.01$ ). Soluble iron and aluminum increased as pH decreased.

The amounts of calcium and potassium in walnut leaves were significantly correlated with the amounts of exchangeable calcium and potassium found in the surface soil. Foliar nitrogen was not statistically significantly correlated with the nitrifiable nitrogen in the surface soil.

Site index was found to be significantly correlated with foliar calcium, magnesium, potassium ( $p = 0.01$ ) and nitrogen ( $p = 0.05$ ) in a positive and linear manner. The negative linear regression of site index on foliar phosphorus was just short of statistical significance.

Partial regression coefficients strongly suggested that potassium and, to a lesser degree, calcium were the nutrient elements most limiting to good walnut growth on the soils studied.

Results from the addition of potassium and calcium to black walnut saplings in the field were not conclusive at the end of one, two, and three growing seasons, although there appeared to be a positive response to the addition of potassium.

A number of interrelated factors appears to limit the growth of black walnut. The majority of the results points to a limiting supply of potassium and/or calcium as the most important factors associated with poor walnut growth.

Iowa State U., Ames, Iowa.

Lindenmuth, A. W., Jr. EFFECTS ON FUELS AND TREES OF A LARGE INTENTIONAL BURN IN PONDEROSA PINE. *J. Forestry* 60: 804-810. 1962.

A systematic survey of fire effects was made on two geographic units of ponderosa pine timberlands totaling approximately 27,000 acres that were intentionally burned in November and December 1956 by experienced men during conditions and by methods they considered favorable for success of such burning.

The major objective was fuel reduction with silvicultural and other effects as secondary objectives. The results were from a single application of fire with a minimum of controls under near minimum conditions for spread of fire.

Data taken at 6,666 observation points systematically distributed over the entire area lead to the following conclusions concerning fire effects on fuels and trees:

1. This fire was predominantly a low intensity or "cool" fire.
2. Of the burnable area, 22 percent did not burn. An additional 55 percent burned by light surface fire that produced small benefits.
3. Major changes in fuels and understory were found only on the 23 percent of the total area that burned by hot surface or crown fire.
4. Despite the low level of fire danger under which the fire burned, more than half the area that had a potential for crown fire actually crowned.
5. Fuel consumed, potential crop trees released, and fire intensity were directly correlated--the higher the intensity the greater the percentage of trees released.
6. The burning released 4 percent of the total number of potential crop trees, or 24 percent of the number of potential crop trees needing release.
7. For every potential crop tree released an average of nearly 6 potential crop trees needed to utilize growing space were either damaged or killed.
8. Before the fire, 15 percent of the area was unstocked with either sawlog trees or potential crop trees; after the fire, 19 percent.
9. Intentional burning of ponderosa pine timberlands to treat fuels and timber stands presents many unsolved complex problems.

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

Mosher, M. M., and Lunnun, K. TREES OF WASHINGTON. Wash. Ext. Serv. Ext. B. 440, 41 pp. Rev. 1962.

An illustrated and descriptive guide of 327 of the principal trees grown in Washington was presented.

Ext. Serv., Wash. State U. Inst. Agr. Sci., Pullman, Wash.

Several major plant communities can be identified in Arizona by dominant species, including: spruce-fir-aspen, pine-fir, ponderosa pine, pinyon-juniper, chaparral, oakwoodland, shortgrass, desert grass, sagebrush, desert shrub, and creosotebush-saltbush.

Major non-agricultural uses of these communities are production of: timber, livestock, game and fish, water, and recreation. The ponderosa pine community ranks high as to multiplicity of uses. It ranks first for timber, water, and recreation, and is of intermediate importance for livestock, range, and game habitat.

Disturbance or reduction of dominants in any major plant community, with the exception of desert shrub and creosotebush-saltbush where dominants replace themselves, favors plants of lower stature in the community. The general trend of retrogression passes through the following stages of dominants: climax trees, subclimax trees, shrubs, tall perennial grasses, short perennial grasses, half-shrubs, weeds, and annual grasses. Under progressive succession the trend is reversed.

In communities where a woody plant overstory (coniferous forest, pinyon-juniper, chaparral, or oak-woodland) is understoried by grassland, an inverse, but not necessarily direct relation, exists between abundance of wood plants and grasses.

The primary objective of timber harvesting and improvement practices is to provide for a continuous crop of high-quality wood products. When these practices reduce the overstory, understory plants are favored.

Woody plant reduction, where former grasslands have been invaded, can increase grazing capacity severalfold. When clearing programs are not too extensive, most wildfire species should be benefitted. A variety and interspersions of plants seems to favor wildlife populations.

Too heavy or otherwise improper grazing produces retrogression in a grassland community. Game should be benefitted by grazing management practices that favor forage plant interspersions and variety.

Much remains to be learned about making full use of plant communities for a variety of uses. In some cases, uses are complementary; in other cases, they may be competitive. The job ahead is that of determining how various structures, compositions and arrangements of vegetation contribute to individual land uses. Uses for a given community can then be allocated on a priority basis. Where compromises among uses are necessary, decisions can be guided by the objective of obtaining the highest yields possible from a combination of products.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Tempe, Ariz.

Ashman, R. I. ESTABLISHMENT AND DEVELOPMENT OF FOREST PLANTATIONS IN MAINE. *Maine Agr. Expt. Sta. B.* 601, 56 pp. 1962.

Forest planting in Maine started early in the century and continued on a small scale until World War II.

During the past few years, largely because of incentive payments by the Federal Government, the acreage planted annually has increased manyfold.

Four species have shown their adaptability to Maine climate and soil and have been planted widely. These species are white pine, red pine, white spruce, and Norway spruce.

Earlier planting and much of that carried on in recent years has been with stock from any source available. The same has been true of seed. Survival of stock properly packed, shipped, and planted has been good, except on light soils in drought years and where brush competition was severe.

All species are subject to attack by insects and disease and, like any planted crop, need care. Without proper care we shall have thousands of acres of poor quality timber; with proper care we shall have a valuable resource for the future.

A "culture and care" publication on forest planting and development was presented.

U. Maine, Maine Agr. Expt. Sta., Orono, Maine.

Hodges, J. D., and Scheer, R. L. SOIL COVER AIDS GERMINATION OF PINE SEED ON SANDY SITES. *Tree Planters' Notes* 54: 1-3. 1962.

In the sandhills of west Florida, pine seeds covered with a thin layer of soil germinated better than those lying on the surface. Direct-seeding tests near Clarksville indicated that sowing depths up to three-fourths of an inch were best for slash and sand pine. For longleaf, depths should not be greater than one-half inch.

The west Florida soils, about 95 percent sand, were nearly sterile. For pine to become established and grow well, the competing wiregrass and scrub oak usually must be eliminated. Heavy brush choppers accomplished this purpose, but the bared soil dried rapidly and crusted over after rains. Surface-sown seeds often germinated but died because their radicles could not penetrate the crust. Heavy rains caused washing even on slight slopes, thus displacing large numbers of seed.

TABLE 1.--Germination of three species of pine at various depths of soil cover

Species and depth of sowing <sup>1</sup> (inches)	1959		1960, field	1961, field	
	Laboratory	Field		February sowing	March sowing
	Percent	Percent	Percent	Percent	Percent
<b>Longleaf:</b>					
0.0.....	84	--	25	82	30
0.25 or 0.3.....	76	84	85	80	82
0.5 or 0.6.....	74	62	73	82	82
0.75.....	--	--	37	57	52
1.0 or 1.2.....	0	0	--	6	16
<b>Sand:</b>					
0.0.....	95	--	2	3	--
0.25 or 0.3.....	90	84	85	66	--
0.5 or 0.6.....	74	45	83	62	--
0.75.....	--	--	82	36	--
1.0 or 1.2.....	10	4	--	20	--
<b>Slash:</b>					
0.0.....	97	--	1	36	--
0.25 or 0.3.....	87	34	44	52	--
0.5 or 0.6.....	70	36	52	45	--
0.75.....	--	--	48	48	--
1.0 or 1.2.....	36	4	--	38	--

<sup>1</sup>The 0.3-, 0.6-, and 1.2-inch depths were tested in 1959 only.

During a dry spring and summer season in east Texas, pine seedlings planted in furrows survived and grew better than those in sod. Mulching the seedlings with sawdust was not helpful, either in the furrows or on sod.

Loblolly (*Pinus taeda* L.) seedlings were planted in 14-inch-wide furrows and natural sod, with and without sawdust mulch. The planting site, an open field with Cahaba soils, was burned in December 1959. The furrows, about 3 inches deep, were plowed shortly before the pines were planted in late January of 1960. Pine sawdust was spread 2 inches thick in a 14-inch-wide strip over the planting row. Seedlings were 4 feet apart in the row, with rows spaced on 6-foot centers.

March and April were drier than normal, though 2 inches of rain fell at the end of April. June had better than average rainfall, but May, July, August, and September were below average. From October on rainfall was adequate.

Seedling mortality attributable to drought was noted on all plots by late April, but survival on the mulched rows was still as good as on unmulched. The greatest seedling losses, particularly on the mulched plots, occurred between June and September.

Average survivals and heights at the end of the first growing season were analyzed statistically. In the following tabulation any two means not connected by the same line differ at the 0.05 level of significance:

<u>Treatment</u>	<u>Survival</u> (percent)	<u>Height</u> (feet)
Furrow	94	1.44
Furrow and Mulch	80	1.42
Sod	65	1.29
Sod and mulch	57	1.28

Survival and growth was better in furrows than in sod. Apparently furrowing conserved soil moisture by reducing competition.

Southern Forest Expt. Sta., FS, USDA, Nacogdoches, Tex.

Buckman, R. E. GROWTH AND YIELD OF RED PINE IN MINNESOTA. U.S. Dept. Agr., Forest Serv. Tech. B. 1272, 50 pp. 1962.

A method of predicting the growth and yield of red pine in Minnesota was presented. Growth was considered synonymous with net periodic annual increment. Yield was the summation of any number of these annual increments.

Some 324 growth periods were available from 235 individual plots contained in 14 sets of permanent sample plots. Measurement intervals varied from 3 to 12 years.

Net periodic annual basal area increment was predicted from the independent variables of age, site index, and stand density. Intensity of cutting, number of trees per acre, cutting method, and variability of tree diameter were also considered. None of these appeared to add to the prediction of basal area growth after the effects of age, site index, and stand density were removed. While not important for the prediction of basal area growth, several of these rejected variables were of great importance in the control of size and quality of red pine trees.

Basal area growth tables were constructed by 10-year intervals for ages 30 to 160; for stand densities of 60, 90, 120, 150, and 180 square feet of basal area per acre; and for site indexes of 45, 50, 55, and 60. Total cubic-foot, cordwood, and board-foot growth tables were also prepared for the same range of ages, stand densities, and site indexes, except that board-foot growth figures were omitted at early ages.

Maximum basal area growth occurred at about 126 square feet of basal area per acre for the sites and ages studied.

Yield tables were constructed for thinning schedules in which the stand was cut back to densities of 90, 120, or 150 square feet of basal area each 10 years (except 5 years for young stands with the 150-square-foot density). The 120-square-foot schedule approximates present-day thinning practice in Minnesota. Differences in yields between the three thinning schedules were not great; the major advantage of one over the other was in the control of size and radial growth rate of trees. Methods used to prepare the growth and yield tables were presented.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

Haney, G. P. A REVISED SHORTLEAF PINE BIBLIOGRAPHY. Southeastern Forest Expt. Sta., Sta. Paper 155, 74 pp. 1962.

Shortleaf pine (*Pinus echinata*, Mill.) is one of the four pine species commonly referred to as southern yellow pine. It comprises about one-fourth of the total volume of pine timber in the South. Its botanical range extends from New Jersey to Texas, occurring in some 22 States.

An earlier bibliography was prepared covering the literature pertaining to this species from about 1900 to June 1954. This revised edition brings the bibliography up to December 1960 and includes a few references omitted from the earlier publication. Unpublished theses were grouped and listed alphabetically by author as a final section to the bibliography.

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

Cline, C. E. PULPWOOD DEMAND SPURS REFORESTATION PROJECTS. Land and Water Contract. 4(10): 4-5, 10. 1962.

A timberman is interested in a tree that will grow to a height of 41 feet in three growing seasons and one having the capability of yielding 45 cords of merchantable pulpwood per acre, in just 15 years.

Foresters heading up projects in the Mississippi River delta and certain riverbottoms in east Texas believe cottonwood to be such a tree.

Cottonwood grows best on well-drained, loose, fine textured alluvial soils, found principally along major stream courses and their tributaries.

Wild land in this classification is invariably covered with a dense stand of native hardwood and brush. Heavy landclearing techniques are required to condition it for regeneration. Even lands that have been improved for pasture or agricultural uses, require some preparation before cottonwood may be planted successfully.

Since cottonwood has excellent pulping qualities, an awareness of its phenomenal growth potential might cause owners of industrial timberlands to take a closer look at management practices on their well-drained bottomlands.

Already engaged in large-scale reforestation projects are three large paper companies.

Cuttings are prepared from 1-year-old "switches" taken from wild or nursery-grown root stock during the dormant season. Cuttings are pushed into the furrow cut by the sub-soiler.

Cottonwood cutting survival has varied from a low of approximately 50 percent on poor sites to almost 100 percent on the best sites. Overall, the survival rate is estimated to be approximately 85 percent.

Cottonwood is one of the most intolerant of tree species. Because of this it is necessary to cultivate the young trees to prevent their being over-topped by grasses and weeds. At least two cultivations are required the first season and one early in the second season.

No address given.

Holland, I. I. TIMBER PRODUCTS MARKETING IN THE CLAYPAN REGION OF ILLINOIS. Ill. Agr. Expt. Sta. B. 689, 40 pp. 1962.

The marketing of timber products in the claypan region of Illinois is not a highly organized and developed system for a number of reasons. While the claypan region occupies one-fifth of the total area of the State, and contains one-third of the State's forest land, the forested property is largely in the hands of owners whose primary concern is not with the development of this property, and whose income is derived chiefly from other sources. Of the total volume of sawlogs received at sawmills in the claypan region, 61 percent was obtained from independent producers (mostly farmers), 36 percent was produced by mill labor on other private woodland, and 3 percent was produced by mill labor on mill-owned land.

Because of this pattern of forest ownership and lumber production (the figures on raw material receipts for processors of other than lumber wood products are very similar to those mentioned above), the initiative in the marketing process is largely in the hands of the producers and mill operators. Many owners are poorly informed of marketing opportunities, prices, and the availability of marketing assistance. Some owners ignore their woodlands altogether because of nonforest interests which take up most of their time.

Timber owners in areas like the claypan region need to be informed of logging procedures, and should be taught to insist on adherence to provisions for protecting the stand. Extension efforts also need to be directed toward assisting and educating log producers and small primary processors, especially sawmillers. Production and marketing practices need to be improved if the forested land of the claypan region is to be profitably used in the future.

U. Ill., Agr. Expt. Sta., Urbana, Ill.

Tryon, E. H., and Woodrum, H. G. GROWING CHRISTMAS TREES FROM SEED. W. Va. Agr. Expt. Sta. B. 472, 21 pp. 1962.

Pines, spruces, and firs which are suitable for Christmas trees may be raised from seed by the Christmas tree grower. The home production of trees from seed requires a great deal more work and time than ordering and handling seedlings from a state or commercial nursery. Certain preferred Christmas tree species, not always readily available from nurseries, may be produced in these seedbeds and home production assures the grower that his trees will be available for planting at his convenience.



Tree seedlings can be raised from seed by methods quite like those used in gardening. The selection of the seedbed site where the Christmas tree seedlings are to be grown is the first step and one of the most important.

A "culture and care" publication on raising Christmas trees for planting in a home nursery was presented.

W. Va. U. Agr. Expt. Sta., Morgantown, W. Va.

Janes, R. L., Butcher, J. W., and Morofsky, W. F. CHRISTMAS TREE INSECT CONTROL. Mich. Coop. Ext. Serv. Ext. B. 353, Rev. 1962.

Commercial Christmas tree growing has become an important Michigan enterprise. Along with planting, shearing, and harvesting, insects must be controlled to give a high percentage of marketable trees. Insects hinder normal growth and damage tree quality. Numerous insects damage Christmas trees; all parts of the plant (roots, trunk, branches, twigs, and needles) can be affected at one time or another.

This publication has the following four sections: (1) Outline of a spray program; (2) an illustrative and descriptive guide to help identify the different insects; (3) a brief discussion about the different insecticides and their use; and (4) the equipment used in a spray program.

Mich. State U., Coop. Ext. Serv., East Lansing, Mich.

Brandt, W. H. DECAY RESISTANCE OF WOOD FROM SOME WILT-INFECTED SPECIES OF OAK. Forest Sci. 8: 334-335. 1962.

The decay resistance of increment borings from 25 trees of the red oak group which had oak wilt was fully as great as that of similar samples from 25 comparable healthy looking trees. The average weight loss of the two groups differed by only 0.1 percent after a 4 month exposure to 3 species of wood-rotting fungi.

Oreg. State U., Corvallis, Oreg.

Graham, D. P., and Frazier, W. E. DWARFMISTLETOE SURVEY IN NORTHEASTERN WASHINGTON. Intermountain Forest & Range Expt. Sta. Res. Note 103, 8 pp. 1962.

Distribution and abundance of dwarfmistletoe in northeastern Washington were determined from two separate surveys. Dwarfmistletoes were widespread in three tree species: Douglas-fir, western larch, and ponderosa pine. Much of the lodgepole pine, especially in the north, was infected. Dwarfmistletoe attacked several other tree species but was generally only a minor problem in them.

Surveys showed that an infected overstory markedly affected the amount of infection in the understory. Dwarfmistletoe in Douglas-fir and larch overstory of merchantable stands was six to seven times more prevalent than in sapling and pole stands with no overstory.

A plot survey in infected Douglas-fir and larch stands on National Forest land showed 80 percent of the Douglas-fir board-foot volume and 92 percent of the larch board-foot volume were in infected trees. Merchantable trees killed by dwarfmistletoe accounted for 7 and 14 percent of the total volumes in Douglas-fir and larch, respectively. In nonmerchantable trees on these plots, 41 percent of the Douglas-fir, and 62 percent of the larch trees were infected.

A survey on private lands within and south of the Colville National Forest, including both infected and non-infected stands, showed that 45 percent of the total board-foot volume was in infected trees. By species, infected trees accounted for 15 percent of the ponderosa pine, 85 percent of the western larch, and 60 percent of the Douglas-fir board-foot volumes. Amount of infection based on basal area and cubic-foot volume also was determined. The positive correlation between tree mortality and infection suggests that dwarfmistletoe contributed to mortality.

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

Froiland, S. G. THE GENUS SALIX (WILLOWS) IN THE BLACK HILLS OF SOUTH DAKOTA. U.S. Dept. Agr., Forest Serv. Tech. B. 1269, 75 pp. Illus. 1962.

Willow mortality is common in some parts of the Black Hills area and has caused speculation and concern. Because willow identification was difficult, little if any attempt was made to relate species and mortality. A study was conducted to: (1) Determine the number of willow species present in the Black Hills area and the taxonomic characteristics of each species; (2) determine the geographical distribution of the willow, by species for the area; (3) determine the general site requirements for each species; (4) determine the general health and vigor of the species in the area; and (5) examine all willow species with respect to their North American distribution.

Multiple collections were made at 33 major stations and numerous satellite stations. These were complete collections of flowers, fruits, and leaves from the same plant at different times. Details were taken on the topography, plant associations, moisture conditions, species of willows believed present, general vigor of each species, and apparent site requirements. Detailed notes were taken for each collection. Over 2,100 collections were made from 750 individual plants, and complete herbarium collections were deposited at several herbaria.

These collections and notes were used to develop a vegetative key to the willows of the the Black Hills. Taxonomic descriptions, maps of the North American and Black Hills distributions, and photographs of each species were included along with notes on field identifications, site requirements, general vigor and abundance.

Twenty species and varieties were identified from the collections, of which eight are rare in the Black Hills, three moderately abundant, and nine abundant and widely distributed.

There were species differences as to distributions, densities, and vigor in the Black Hills. The rare species and those present in moderate quantity, except for an isolated situation, were in good to excellent conditions. Among the species present in quantity, Salix scouleriana Barratt and S. bebbiana Sarg. were the only species that were generally in poor condition. S. bebbiana was obviously the species referred to when the overall willow mortality was considered. At one time S. bebbiana was a very vigorous willow, the most abundant in the area. At the present time, however, it is in serious trouble.

FS, USDA, Inform. Div., Washington, D.C. 20250.

Tigner, J. R., and Besser, J. F. REPELLENTS FOR PROTECTION OF YOUNG FOREST TREES FROM RABBIT AND RODENT DAMAGE. Tree Planters' Notes 51: 1-3. 1962.

Four commercial repellents, the active ingredients of which are trinitrobenzeneaniline (TNB-A), tetramethyl thiuram disulfide (TMTD), and zinc dimethyldithiocarbamate cyclohexylamine complex (ZAC) are available for protecting young forest trees from rabbit and rodent damage. The repellent films may remain effective for a year or longer.

Seedlings can be treated economically by spraying while still in the nursery beds or by dipping while in bundles. Through such treatments, Douglas-fir seedlings were protected from rabbit damage for less than one dollar per thousand. Trees in plantations may be protected by individual spraying, but the cost will be higher, primarily for labor.

Bur. Sport Fisheries and Wildlife, U.S. Dept. Int., Denver, Colo.

Van Deusen, J. L., and Myers, C. A. PORCUPINE DAMAGE IN IMMATURE STANDS OF PONDEROSA PINE IN THE BLACK HILLS. *J. Forestry* 60: 811-813. 1962.

Fifty-six sample plots were examined for porcupine damage throughout the Black Hills and Bear Lodge Mountains. Nearly 10 percent of the 7,364 trees observed had been damaged by porcupines.

The thriftiest trees, dominants and codominants, were most heavily attacked, accounting for 86 percent of the trees damaged. Trees from 6.0 to 7.9 inches d.b.h. were most commonly injured.

Damage was permanent to 75 percent of the trees attacked. Average stand diameter, basal area per acre, and site index could not be correlated with amount of damage.

The most common bole damage was spike-top; crown scars and crook were also important. Almost 80 percent of the observed damage was in these three categories.

Porcupines were most active within 2 chains of openings one acre or larger. They attacked a higher percentage of trees on lower and upper slopes than on bottoms, mid-slopes, or ridgetops.

Porcupine damage in immature ponderosa pine stands was great enough to warrant the attention of land managers in the Black Hills and Bear Lodge Mountains. As the area of thinned stands increases, more stands that contain trees apparently preferred by porcupines will be created. Since thinning produces desired stocking, permanent damage to reserve trees will reduce growing stock. Problem areas should be delineated so time and money can be spent where they will provide the most protection for timber crops.

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

## Windbreaks

Stoekeler, J. H. SHELTERBELT INFLUENCE ON GREAT PLAINS FIELD ENVIRONMENT AND CROPS. U.S. Dept. Agr., Forest Serv. Prod. Res. Rpt. 62, 26 pp. 1962.

During 1935-41, crop-yield data were gathered from 286 fields adjacent to shelterbelts in the Great Plains. Corn, small grains, and cotton were sampled within the growth range of each from North Dakota to Texas and between the 98th and 100th meridians of longitude. Observations showed both favorable and unfavorable effects, depending on the type of crop, geographic location, and orientation of the tree plantings.

Fields of small grains in the Dakotas benefited substantially when protected, regardless of whether the belts ran east to west or north to south. In Nebraska and Kansas, only those fields on the south and east of shelterbelts showed substantial benefit. In the Dakotas, there were greater responses to protection from fields of lower inherent productivity. For the gross area of farmland protected by shelterbelts in the Dakotas (including the space occupied by the trees) the average annual gain in wheat yield was estimated at about 1 bushel per acre over the entire lifespan of the belts. On sandy erodible soils it was expected to be more.

Ear corn in the Dakotas showed substantial gains only on fields south of shelterbelts. In Nebraska and Kansas, response was greatest to the east but only slightly less to the north and south. The crop response in Nebraska was much greater in fields protected by dense shelterbelts than in those protected by shelterbelts of low density.

Cotton was sampled on 8 fields in Oklahoma and Texas, 7 of them north of the shelterbelt. Yields increased substantially to about 20 tree heights.

The zone in which crops showed a large response was considerably narrower than the zone in which wind velocity or evaporation was reduced appreciably. Substantial wind reduction was observed over a distance of 25 or 30 tree heights to leeward and 5 tree heights to windward. Reduction of water loss from evaporimeters extended a similar distance. Corp effects usually extended about half that distance.

Close to the windbreaks there was a marked depression of crop growth due to the sapping and shading effect of the trees. The sapping effect was reduced by root pruning to a depth of 2 feet or more.

The effect of shelterbelts was particularly important in the northern half of the Great Plains where there was considerable snowfall. The additional snow trapped on the fields added soil moisture for subsequent crop growth and was a prime factor in increasing crop yields near the shelterbelts. Properly located belts reduced the amount of snow drifting onto roads and thus reduced highway maintenance costs.

In general, Great Plains shelterbelts oriented east and west were more effective than those oriented north and south. However, the geographic location of a field and type of crop to be grown on it were primary considerations.

Net gain from shelterbelt protection was directly related to the width of the strip in trees. Shelterbelt continuity and density improved with increasing width, but net benefits decreased if the belts were too wide. A narrow shelterbelt, preferably under 50 feet in width, and good continuity and density was ideal for crop protection.

Lake States Forest Expt. Sta., FS, USDA, St. Paul, Minn.

## Management of Coffee Plantings

Hurt, L. C. COFFEE SITUATION, PROGRAMS, AND POLICIES IN PRODUCING COUNTRIES. U.S. Dept. Agr., Foreign Agr. Serv. FAS-M-148, 19 pp. 1963.

The coffee situation, programs, and policies in the coffee producing countries were given.

FAS, USDA, Information Service Branch, Washington, D.C. 20250.

## Fruit and Nut Crops

Vicente-Chandler, J., and Figarella, J. EXPERIMENTS ON PLANTAIN PRODUCTION WITH CONSERVATION IN THE MOUNTAIN REGION OF PUERTO RICO. *J. Agr. U. Puerto Rico* 46(3): 226-238. 1962.

The same high yields and quality of plantains, a cooking banana widely used throughout the Tropics, were produced by planting directly in the sod, followed by strip cultivation for erosion control, as after complete land preparation and clean cultivation on a typical latosol in the Humid Mountain Region of Puerto Rico.

The effects of plant population and fertilization with sod-planting and strip cultivation were studied.

Increasing the number of trees from 500, which is standard practice, to 800 per acre increased yields by 4 tons of fruit. No further increase resulted from increasing the population to 1,300 trees per acre.

Plantains responded strongly in yield to applications of 200 pounds each of nitrogen and of phosphoric acid per acre on this soil, which contained 0.20 percent of nitrogen and less than 40 pounds of dilute acid-soluble phosphorus per acre. No response to lime, magnesium, or potassium was evident.

The nitrogen, phosphorus, and potassium contents of the plantain leaves increased with applications of these nutrients as fertilizer, but applications of magnesium and calcium did not affect the content of these nutrients in the leaves. Leaf contents of 2.8 percent of nitrogen, or 0.13 percent of phosphorus, indicated a deficiency of these nutrients, while a calcium content of 0.60, a magnesium content of 0.24, and a potassium content of 2.8 percent indicated a sufficiency.

The experiments showed that 8 tons of plantains yielding 5 tons of edible pulp comparable in feeding value to potatoes, or 2 tons of dry matter with a caloric content similar to that of corn, could be produced per acre with excellent erosion control on steep lands in the Humid Mountain Region of Puerto Rico.

SWCRD, ARS, USDA, and U. Puerto Rico, Rio Piedras, Puerto Rico. 00928.

Kretchman, D. W., and Krezdorn, A. H. RECENT DEVELOPMENTS IN PRUNING CITRUS. Fla. State Hort. Soc. 1961 Proc. 74: 67-74. 1962.

Several methods of pruning for rejuvenating crowded and canopied citrus groves are under investigation. The most promising treatments appear to be hedging on two or four sides plus topping, and skeletonizing. Observations and limited data indicate that tree responses were favorable, and yields from these treatments, although reduced the first year after pruning compared well with unpruned and hedged trees by the second year.

Hedging appears to be a beneficial practice to facilitate grove operations.

Severe hedging to form a tree 6 feet wide and 15 feet tall offers considerable promise for producing a tree that can be easily harvested and one that will produce a good crop of fruit. The possibility exists that by closer spacing, increased yields per acre might occur.

Data indicated that as tree size increases the proportion of fruiting wood to supporting structure or non-fruiting wood becomes smaller.

Fla. Citrus Expt. Sta., Lake Alfred, Fla.

Gardner, F. E., and Horanic, G. E. A COMPARATIVE EVALUATION OF ROOTSTOCKS FOR VALENCIA AND PARSON BROWN ORANGES ON LAKELAND FINE SAND. Fla. State Hort. Soc. 1961 Proc. 74: 123-127. 1962.

Old-line Parson Brown and Valencia sweet orange varieties were planted in 1942 on 7 rootstocks in a well-replicated plot design on a fairly good grade of Lakeland near Tavares, Fla. The 7 rootstocks were sour orange (2 selections), Rough lemon, Duncan grapefruit, Cleopatra mandarin, Rusk citrange, and sweet orange (Parson Brown variety). In the portion of the experiment in which Parson Brown was the scion variety, unbudded seedlings of this variety were included for comparison with the old-line strain budded on its seedlings.

Measurements throughout the first 17 years of the experiment included tree growth, fruit yields, and various fruit-quality factors namely fruit size and weight, percent juice, and total soluble solids, acid, and vitamin C content of the expressed juice. Pounds of solids per box of fruit and per tree were calculated and presented for each of the rootstocks used.

On the Lakeland fs, Parson Brown variety made the largest trees on Duncan grapefruit and Cleopatra rootstocks, followed in descending order by Rough lemon, sweet orange, sour orange, and Rusk citrange. The unbudded Parson Brown seedlings greatly exceeded all budded trees in size. With Valencia as the scion variety, there were no significant size differences between Rough lemon, Cleopatra mandarin, Duncan grapefruit, and sweet orange rootstocks. The 2 sour orange selections were intermediate in size and Rusk citrange the smallest.

Up to 13 years of age, Rough lemon greatly exceeded all other rootstocks in production. Subsequently, Duncan grapefruit, Cleopatra mandarin, and sweet orange rootstocks caught up with Rough lemon when Parson Brown was the scion variety and when Valencia was the scion variety they approached Rough Lemon. Rusk citrange, although it resulted in smaller trees, produced about the same amount of fruit as the sour orange rootstocks.

On the pound-solids basis, Rough lemon outyielded the other rootstocks in both scion varieties during the first 13 years of age. Thereafter, the Cleopatra mandarin, Duncan grapefruit, and sweet orange rootstocks equalled the Rough lemon when Parson Brown was the scion variety and these 3 rootstocks surpassed Rough lemon when Valencia was the scion variety.

The data on pound-solids, particularly for the Valencia variety, raised a question whether the heavy trend of planting Valencia on Rough lemon rootstock is justified on fairly good soils. The long productive life of a citrus orchard should lead one to weigh the distinct advantage of Rough lemon in the early years against the higher returns shown by Cleopatra mandarin, sweet orange, and Duncan grapefruit rootstocks in the later years.

CRD, ARS, USDA, Orlando, Fla.

## Field Crops

Hoyert, J. H., McKee, C. G., and Street, O. E. EFFECT OF PLASTICS IN MODIFYING THE ENVIRONMENT OF MARYLAND TOBACCO PLANT BEDS. Md. Agr. Expt. Sta. Misc. P. 473, 6 pp. 1962.

Tests were conducted in 1961-62 to compare the effect of polyethylene plastic films in modifying the environment of Maryland tobacco plant beds. Plastic films of 3-, 4-, and 6-mil thicknesses were studied along with transparent and translucent plastics. Methods of supporting the plastic materials were investigated. These included wooden frames which positioned the plastic above the soil in a tent style and the use of crushed corn cobs to support the plastic flat on the soil.

The results obtained showed striking increases in soil and air temperature, faster emergence, and a more rapid rate of growth under the various plastic covers than under tobacco bed cotton.

Average soil temperature increases under the plastic for the 4-week period of March 28 - April 28, 1962 ranged from 5° F. at night to 33° F. at midday when compared to the cotton covers. During this period, the average soil temperature under plastic was 64.5° F., and 51.5° F. under the cotton cover. Maximum soil temperatures at midday were in the range of 15° F. higher under the plastic supported by the tent frame than the plastic supported by crushed cob.

Plants emerged 8 days earlier under the plastic than under the tobacco bed cottons and grew from emergence to the 4-leaf stage 6 days earlier. A total of 74 days was required from seeding to first pulling under the cotton cover and only 62 days under the plastic cover sealed flat on the soil.

There didn't appear to be any significant differences among the 3-, 4-, or 6-mil thicknesses of plastic film nor was there any apparent difference between the transparent and translucent plastic covers in either soil temperatures or plant growth rate.

There were differences in plant stand due to soil moisture variations. Although the plastic covers reduced evaporation and moisture loss, irrigation was advisable for optimum soil moisture conditions under the plastics which were not sealed. More severe moisture deficiencies were encountered under the tent frame and the plastic held by bricks than under the plastic sealed flat over the soil. Although the moisture under the sealed plastic was adequate, it was not entirely optimum.

The number of good plants pulled for transplanting were not significantly changed by any of the treatments. There were no detrimental effects on the quality of plants grown under the plastic covers when temperatures were not allowed to exceed 100° F. by adequate ventilation. Improper ventilation resulted in excessive heat under the plastics and caused distorted and abnormal tobacco plants.

Plastic materials offered a relatively inexpensive and readily available method for growers to modify the tobacco bed environment to produce earlier transplants. Careful attention should be given to adequate ventilation to prevent temperatures under the plastic from exceeding 100° F. Sufficient soil moisture should be ensured with the use of plastic covers.

Agr. Expt. Sta., U. Md., College Park, Md.

Krenz, R. D., and Miller, T. A. WHEAT FARMING IN WYOMING: I. CHARACTERISTICS AND CLASSIFICATION OF WHEAT FARMS. Wyo. Agr. Expt. Sta. B. 391, 15 pp. 1962.

The table presents a grouping of all wheat farms in the State of Wyoming by size of allotment. Although there are nearly 4,000 farms in the State which have produced wheat, the bulk of the production comes from a relatively small portion of these farms (874 farms, 22 percent of the total, held 72 percent of the State allotment).

Seventy-five percent of the large allotment farms are located in the southeast area, 20 percent in the northeast area, and only 5 percent in the western counties. Of the smallest allotment group (0.1-15 acres), two-thirds are from the western counties.

Changes in government programs may well lead to further concentration of the allotment acres on fewer and larger farms. Farms with large acreages enjoy considerable cost advantages. In the future, the large farms will probably increase in numbers and in average size of operation, causing further reduction in the importance of the small allotment groups. The number of commercial farms and ranches in Wyoming decreased from 10,527 in 1949 to 8,084 in 1959.

TABLE 14.--Grouping of all Wheat Farms in Wyoming by Size of Wheat Allotment

Allotment size	Average size allotment	No. of farms	Percent of farms	Total allotment	Percent of total allotment
	(acres)				
0	0	444	11	0	0
0.1-15.0	7	971	25	6,881	2
15.1-59.9	34	1,123	30	37,600	13
60.0-99.9	79	485	12	38,368	13
100.0-199.9	142	519	13	73,702	26
200.0 and over	365	355	9	129,578	46
Total		3,897	100	286,129	100

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

Krenz, R. D., and Miller, T. A. WHEAT FARMING IN WYOMING; II. PROFIT-MAXIMIZING PLANS FOR SPECIALIZED WHEAT FARMS IN SOUTHEAST WYOMING. Wyo. Agr. Expt. Sta. B. 392, 36 pp. 1962.

Wyoming's wheat farmers are faced with the need for downward adjustments in wheat acreage. The problems accompanying such adjustments are: (1) Utilizing resources diverted from wheat production so as to maintain farm incomes; and (2) changing the present farm organization to adjust to changes in government wheat programs.

The six counties in southeastern Wyoming that held almost 63 percent of Wyoming's wheat allotments were studied. Optimal farm plans for each of six sizes of farms were determined for a variety of wheat programs. The optimal combination of enterprises was determined for each farm for each wheat program, including a land-retirement option and without this option.

These plans describe the long-run adjustments to the various wheat programs. Land was assumed to be the only fixed resource. Sufficient capital was assumed to be available as long as it could return costs of 7 percent.

Most of the farm plans call for growing the full wheat allotment, regardless of the type of plan. Even at prices as low as \$1.22 per bushel, production on the larger farms remained at relatively high levels. On the smaller farms, \$1.22 per bushel was low enough to discourage wheat production.

Second to wheat on the basis of returns per acre was placing the land under a 10-year Conservation Reserve contract. The average rate of payments under the contract for land that had formerly been planted to the soil-bank base crops of wheat, barley, oats, corn, and sorghum was \$8.75 per acre.

Since wheat production and the Conservation Reserve are both limited by controls, other alternatives were needed to utilize the remaining cropland. Usually the most profitable alternative use of such land was feed production for cattle feeding. This feed consisted of alfalfa/crested wheatgrass for hay and pasture, and sometimes corn for silage.

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

Krenz, R. D. WHEAT FARMING IN WYOMING; III. WHEAT ON EASTERN WYOMING GRAIN/LIVESTOCK FARMS. Wyo. Agr. Expt. Sta. B. 397, 31 pp. 1962.

An analysis of wheat production on wheat/livestock farms was given. A variety of possible government wheat programs were analyzed. In general, the best use of cropland was in the production of wheat or hay for livestock run on the available rangeland. On farms with small amounts of cropland in proportion to the whole farm, the best cropland use was usually in hay production. On other farms that have proportionately more cropland, or with the wheat programs which include higher price supports, wheat was the best possible use. The balance between wheat or hay production depended upon: (1) The size of the operation; and (2) the support price of wheat.

Some wheat programs included land-retirement options such as the soilbank plan. Optimal farm plans call for maximum use of these alternatives at diversion rates on small farms and on larger farms with lower priced wheat supports. Farms that need hay for livestock would profit from growing the hay on cropland rather than putting land in the soilbank at non-diversion rates. The diversion rate gave better returns than barley production except on farms with 2,000 acres or more of cropland.

Where land-retirement options were not offered, the best use of any additional acreage was in forage production for feeder cattle. The plans indicated that pasture was a better source of income than growing barley. If barley is needed for livestock feeding, it should be



purchased. Exceptions to this can be found only on farms where labor supplies limit the size of livestock enterprises or on farms with extremely large proportions of cropland.

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

Pratt, A. D., and Triplett, G. B., Jr. HIGH POPULATION CORN PRODUCED POOR QUALITY, BLACKENED SILAGE. Ohio Farm and Home Res. 47(4): 54-55. 1962.

Corn drilled on May 1 in 7 inch rows with a population of 200,000 plants to the acre was cut for ensiling on July 10 when from 3 to 4 feet high.

Immature corn cut when it contained only 13.3 percent dry matter made a poor quality of silage as judged by its blackened color and bad odor, whether treated with bacitracin or untreated. Treatment with bacitracin reduced deamination (or ammonia formation) only when the excess moisture was drained from the silo.

The quality of these silages indicated that immature corn, when available, should be used in some other way than for silage.

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

Kjelgaard, W. L., and Olver, E. F. BIN AND WAGON DRYING OF SHELLED CORN. Pa. Agr. Expt. Sta. B. 699, 23 pp. 1962.

A 2-row picker-sheller harvesting corn at 25 to 30 percent moisture accumulates water at the rate of 800 to 1,000 pounds per working hour. The 24-hour capacity of the drying equipment should exceed the daily water output of the field machine to prevent carryover and water-load build-up.

Corn drying tests were conducted with bin and wagon drying systems over 1952-61. Unheated air trials in bin drying failed to give satisfactory results. Heated air trials showed much improvement with some pockets of mold resulting from either trash accumulation or other air distribution problems. Use of coal or Lp burners added 20 to 40 degrees to temperatures of drying air, which largely accounted for the success of the bin drying system.

Wagon drying is a batch-drying method. Batch quantity depends on size and number of wagons used. Systems may range from two to several wagons depending upon crop production and anticipated harvesting rate. Loads averaging 16 inches in depth on wagon beds roughly 8 by 16 feet yielded about 125 bushels each of dry corn following an overnight drying period of 14 to 17 hours. Drying air temperatures did not exceed 150° F. and air flow per wagon averaged about 5,000 cubic feet per minute.

In other trials, wagons yielding 100 bushels of dry corn required 4 hours drying time at air temperatures around 287° F. and air flow of approximately 7,000 c.f.m. per wagon. Corn depth was 17 inches and initial moisture content was 30 percent.

One gallon of fuel oil indirectly fired produced the same drying effect as 1.18 gallons of Lp gas directly fired. If combustion, stack, heat exchanger, and other losses were ignored, the average thermal efficiencies for shelled corn drying systems with indirect fired oil burners and direct fired Lp gas burners were 32.3 and 41.3 percent, respectively. Direct firing without stack or heat exchanger increased thermal efficiency about 10 percent in comparison with indirect firing. Housing of wagons in a drying building and air recirculation added 10 percent to heat efficiency over an unsheltered wagon system. Where air flow and initial moisture content were relatively stable, the drying time requirement was linear with temperatures over the range from 160° to 287° F.

Overdrying of wagon loads was controlled by shutting down the drying system when the corn surface at the point of air exhaust reached about 18 percent. Mixing during unloading distributed the remaining wet corn with dry, thus reducing the effect of overdrying.

Pa. State U., Col. Agr., Agr. Expt. Sta., University Park, Pa.

Hunt, R. A., Bennett, R. R., Van Arsdall, J. W., Rhodes, G. N., and Mathews, G. R. PREPARING BURLEY TOBACCO FOR MARKET. W. Va. Coop. Ext. Serv. C. 387, 24 pp. 1961.

Proper stripping and sorting of burley tobacco are important to get the highest price for the crop.

Stripping and sorting the crop into grades according to group, quality, and color enables the manufacturer and leaf buyers to obtain their specific needs. When offered for sale, leaf poorly stripped and sorted may not meet the needs of specific manufacturers or leaf buyers. Tobacco is still being bought, to a large extent, on its looks and uniformity. Burley tobacco properly stripped, sorted, tied, and attractively displayed will usually sell for the highest current price on the market.

Preparing the burley tobacco for market involves a number of steps. All are important. Detailed information on each phase of preparation were given.

W. Va. U. Coop. Ext. Serv. Morgantown, W. Va.

Kaufmann, M. L., and McFadden, A. D. THE INFLUENCE OF SEED SIZE ON RESULTS OF BARLEY YIELD TRIALS. *Canad. J. Plant Sci.* 43: 51-58. 1963.

Two series of tests were conducted to determine the influence of seed size on barley yield trials. In the first series, four varieties and four seed categories were studied in seven tests over a period of 3 years. Large seed produced more tillers and greater yields on the average than small, medium, or bulk seed. The yield ranking of varieties depended on the size of seed used. The large seed of Olli, a low-yielding variety, outyielded the small seed of Husky, a highly productive variety. Only in one of the seven tests was emergence reduced by use of small seed.

Yields from large seed were compared with those from a combination of large and medium-sized kernels in the second series. In 20 tests with four varieties, over a 2-year period, large seed was more productive on the average than the combination. Striking differences were obtained in some tests. These results serve to emphasize the necessity of using seed of comparable quality in yield trials.

Canada Dept. Agr., Lacombe, Alberta, Canada.

Holekamp, E. R., Hudspeth, E. B., Colwick, R. F., and Ray, L. L. PLANTING EQUIPMENT AND PRACTICES FOR COTTON ON THE HIGH PLAINS. *Tex. Agr. Expt. Sta. B. B-992*, 13 pp. 1962.

Equipment development and planting practice tests for cotton were conducted on the High Plains over a 13-year period. Equipment studied included the planting row profile, seed-furrow openers, seed-firming wheel, and covering devices. Planting practices, such as depth of lister furrow, depth of covering over seed, time of planting, rate of seed, and

type of seed, were studied. Studies were conducted on fine sandy loam soils at Lubbock, Tex., loamy fine sand in Terry County, and on clay loam soils in Swisher and Hale Counties.

The planting furrow or lister furrow should be deep enough to reach moisture adequate to germinate seed and insure seedling emergence. Deep-furrow plantings slowed emergence and frequently resulted in thinner stands when precipitation occurred before and during the emergence period. The plateau-planter profile prevented the silting-over of the seed row by heavy washing rains which was experienced frequently with lister-planter profiles. The use of the plateau planter reduced the necessity for replantings and gave the highest seedling emergence and best stands. Planting high on the bed gave the second highest emergence and stands.

A 3/4 inch wide chisel-furrow opener that was shielded adequately and shaped to drop the seed to the bottom of the seed furrow gave excellent results on the three soil types. A modified stub runner worked equally well on clay loam soil. Poorer emergence was experienced with the conventional stub runner, and the wear on the knife edge was severe in sandy soils. The seed-furrow opener should be set to cut a trench deep enough into the firm soil behind the lister bottom to permit the covering of seed with 2 inches of soil.

The use of a 1- x 10-inch rubber-tired wheel to firm the seed into moist soil at the bottom of the seed furrow resulted in faster emergence and better stands under drying conditions. Small scrapers attached to the sides of the seed-firming wheel eliminated excessive buildup of sticky soil on the side of the wheel.

Covering devices that place a 2-inch deep loose soil cover over the seed were recommended. Short fishtail drags attached at the seed-firming wheel axle were satisfactory in friable soils. A harrow-type device covered well, but caught crop residue, which interfered with proper covering.

Soil covering the seed should not be pressed on the surface in loamy fine sand and fine sandy loam soils. Surface pressing on clay loam soils resulted in faster emergence and better stands. The rubber-flap press wheel mounted on a planter did not build up with sticky soil when used for pressing simultaneously with planting. Seed should be covered to a depth of 1 1/2 to 2 inches.

Delinted cotton seed produced earlier emergence and better stands. Delinted seeds were easier to handle and meter, and caused fewer stoppages in the seed tube and the narrow seed-furrow openers.

Seeding rates of 20 pounds of chemically delinted seed per acre were adequate to give good emergence and stands for top yields, high harvesting efficiency, and good weed control. A population of less than 20,000 plants per acre reduced yields and harvesting efficiencies. Yields decreased progressively as populations increased over 50,000 plants per acre.

Cotton was planted successfully after the minimum soil temperature at an 8-inch depth averaged 60° F., or above for the 10 days preceding planting. Plantings after this temperature occurred had higher emergence percentage and a shorter emergence period. This guide permitted plantings when favorable weather prevails earlier than was normally recommended by date alone.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Goddard, R. J. WEEDING COTTON WITH GEESE ON AMES PLANTATION. Tenn. Farm and Home Sci. Prog. Rpt. 44: 23-24. 1962.

Geese on the Ames Plantation controlled grass in cotton when they were protected from predators, supplied with adequate water, properly fenced, and fed a small amount of grain.

Goslings were used more than older geese. Adult geese did an excellent job early in the season, but were not as efficient in extremely hot weather. Adult geese ate more Johnson-grass roots turned up during seedbed preparation or tillage. Adult geese were more difficult to restrain from crossing barriers. With goslings, it was found necessary to use 18- or 24-inch poultry wire in addition to the regular hog-wire fence.

The number of geese needed per acre depended on the amount of grass in the field-- 1 to 2 geese per acre for reasonably clean fields, 2 to 3 geese per acre for average conditions, and 3 to 4 where Johnsongrass was abundant. No more than 4 geese per acre were needed, provided 6-week-old goslings or older geese were put in the fields as soon as first grass appeared in the spring. They may be put in the fields before planting time, provided they are removed temporarily when the cotton is emerging.

Comparison of Costs and Returns Per Acre in Producing Cotton using Dalapon, the Hoe and Weeder Geese for Control of Weeds, Ames Plantation, 1960-62.

Item	Method of controlling weeds		
	Dalapon	Hoe	Weeder geese
	<u>Per acre</u>	<u>Per acre</u>	<u>Per acre</u>
Cost:			
Seedbed preparation, seed, and Fertilizer	\$26.53	\$26.53	\$26.06
Weed control and cultivation	41.00	32.10 <sup>1</sup>	19.82
Insect control	15.35	13.15	10.88
Harvesting costs	35.80	52.25 <sup>2</sup>	40.81
Total cost	\$118.68	\$124.03	\$97.57
Income:			
Gross income	226.00	230.00	240.00
Net income	\$107.00	\$106.00	\$143.00

<sup>1</sup>This field was cultivated 7 times; other fields were cultivated 6 times.

<sup>2</sup>Cotton hand-picked; on other fields, cotton was picked mechanically.

Geese must have access to the cotton fields both early and late in the day for most favorable working conditions. Predator control is always important. Geese are very vulnerable to all kinds of insecticides and must be kept out of fields from 24 to 48 hours after spraying or dusting.

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

Skoog, H. A. CHEMICAL CONTROL OF WEEDS IN BURLEY TOBACCO PLANT BEDS. Tenn. Agr. Expt. Sta. B. 346, 23 pp. 1962.

The effect of chemicals at different rates, methods, and times of application on weed control and the production of burley tobacco plants suitable for transplanting to the field were presented. The experiments were conducted during 1956-60 at Greenville, Tenn.

Chemicals evaluated were methyl bromide; sodium-N-methyl dithiocarbamate (SMDC); a mixture of allyl alcohol and ethylene dibromide; calcium cyanamide with and without 20% superphosphate added; 3, 5-dimethyltetrahydro-1, 3, 5, 2H-thiadiazine-2-thione (DMTT); a liquid form of cyanamide; and an experimental product containing a mixture of propargyl alcohol and 1, 2-dibromoethane.

Excellent weed control and plant production were obtained with methyl bromide. 41 percent SMDC at the minimum rate of 8 quarts per 100 square yards gave good weed control and plant production. When this chemical was confined with gasproof covers, 4 quarts per 100 square yards performed well. DMTT performed similarly to the regular SMDC treatment. SMDC and DMTT gave more erratic results and were slightly inferior to methyl bromide. They were superior to calcium cyanamide and allyl alcohol-ethylene dibromide applications.

A liquid form of cyanamide was not promising as a late-winter treatment because rates that controlled the weeds were toxic to tobacco. Calcium cyanamide was toxic to tobacco plants in one of the 2 years tested. Adding 2 pounds of 20 percent superphosphate per square yard to 1 1/2 pounds of cyanamide per square yard decreased, but did not eliminate, the toxic effects of the latter in the year this comparison was made. Better control of grass weeds was obtained by adding the superphosphate.

Allyl alcohol-ethylene dibromide and propargyl alcohol-1, 2-dibromoethane materials at the rates used were inferior to methyl bromide in the production of early plants and slightly below it in weed control.

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

Davis, R. L., and Nichols, B. C. EFFECTS OF TIME OF FUMIGATION AND SOURCES OF NITROGEN ON BURLEY TOBACCO PLANT PRODUCTION. Tenn. Agr. Expt. Sta. B. 340, 19 pp. 1962.

Different times of soil fumigation and sources of nitrogen in burley tobacco plant production were studied at the Tobacco Experiment Station, Greeneville, Tenn., during 1958-61. Fall fumigation of the soil with methyl bromide was compared with fumigating before seeding in the spring. Nitrogen sources compared were nitrate of soda, ammonium sulfate, urea, and a mixture of the three. A check, or no-nitrogen treatment, was also included. The authors concluded that: (1) Response to nitrogen was obtained with both times of fumigation. (2) On fall-fumigated beds, ammonium sulfate, urea, and a mixture of nitrogen sources were about equally satisfactory for producing tobacco plants. Nitrate of soda was somewhat less effective. (3) On the spring-fumigated areas, nitrate of soda was much superior to the other sources of nitrogen for producing early plants. Relatively few early plants were obtained with ammonium sulfate or urea on spring-fumigated beds. And (4) overall, plant production was more satisfactory when methyl bromide was applied in the fall. This was especially true when the nitrogen used was not in the nitrate form. On the average, the first pulling of usable plants was made about 10 days earlier and the total number of plants obtained was about 60 more per square yard on fall- than on spring-fumigated beds.

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

Exconde, O. R., and Hansing, E. D. EFFECT OF CAPTAN AND CAPTAN-DIELDRLIN SEED TREATMENTS ON GERMINATION AND YIELD OF EIGHT VARIETIES OF WINTER WHEAT. *Kans. Tech. B.* 125, 8 pp. 1962.

Captan and captan-dieldrin were tested on 8 varieties of winter wheat with 4 ranges of germination to determine their value as disinfectants against fungi and bacteria associated with the seed and as protectants against soil-borne fungi, such as species of Pythium and Fusarium, and soil insects, such as wireworms and cutworms, that occurred naturally in soil. All experiments were conducted in the field at Kansas State University, Manhattan, from 1958-60. Emergence and yield data showed that captan and captan-dieldrin were significantly better than no treatment in 1958 and 1959, but not in 1960. Comparing the 2 treatments, captan-dieldrin was superior to captan in 1958. In both emergence and yield, no statistically significant interactions were obtained between varieties and treatments, indicating that different varieties responded to the treatments the same way. Treatments with captan and captan-dieldrin with different germination percentages gave considerably greater increase in emergence and yield in the low germination range than in the other three. During the 3 years, no significant interactions were obtained between treatments and ranges. Correlation analyses between emergence and yield showed that out of 87 comparisons 70 gave positive correlations with 14 of them statistically significant at the 5-percent level.

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

Brazzel, J. R. A COTTON INSECT CONTROL PROGRAM BASED ON FALL DESTRUCTION OF THE BOLL WEEVIL. *Tex. Agr. Expt. Sta. Prog. Rpt.* 2250, 6 pp. 1962.

Large-scale experiments were conducted in Brazoria and Maverick Counties in Texas to test the feasibility of incorporating a diapause boll weevil control program during the harvest period into a complete cotton insect control program. The basis for the experiments was to destroy sufficient weevils in the fall to eliminate the necessity for insecticidal control during the following growing period. This would enable better use of natural control factors such as predators and parasites on such mid- and late-season pests as aphids, spider mites, and bollworms.

The diapause boll weevil control program consisted of chemical control practices employed prior to and during harvest to destroy the diapause boll weevils before they leave the cotton fields for overwintering quarters. The cultural practice of stalk destruction follows harvest and completes the program. The cultural control practices utilized in this work were used for several years with excellent results for control of the pink bollworm. Since many boll weevils diapause and leave the fields before harvest is complete, chemical control measures were required to destroy the overwintering weevils.

In the Brazoria County experiment, the diapause weevil control program in the fall of 1961 and a systemic insecticide treatment in the spring of 1962 were used. Approximately 900 of the 1,050 acres of cotton in the test produced an excellent crop without mid- or late-season insecticide treatments. Insect control requirements on the remaining 150 acres were greatly reduced.

In Maverick County, 1,650 acres were treated one to three times at a cost of \$1 to \$3 per acre in the fall of 1961 to destroy diapause boll weevils. During 1962, only 650 acres of this cotton received the recommended practices. Early-season insects were not a problem. Approximately 425 acres of this cotton were produced without insecticide treatment in 1962. The insect control costs were greatly reduced on the remaining 230 acres.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

A 1959 study of crop expenses for 60 northwestern Ohio farms that ranged in size from 165 to 275 acres and averaged 220 showed the following average costs per acre: corn, \$58; soybeans, \$46; oats, \$42; and wheat, \$47. The average cost of producing an acre of hay on 73 farms ranging in size from 100 to 560 acres and averaging 230 was as follows: one cutting, \$37; two cuttings, \$50; and three cuttings, \$57.

These costs for producing grain and hay included a land charge of \$18 an acre and a payment of \$1.50 an hour for all labor used.

Costs of producing an acre of corn, soybeans, and small grain declined as size of farm increased. However, most of this cost reduction occurred before size of farm reached 300 crop acres. An increase in rotated crops from 110 to 440 acres reduced the cost of producing an acre of corn and soybeans about \$7 and an acre of oats \$3.50. About two-thirds of these reductions in cost were due to lower tractor and machinery charges and the remaining one-third resulted from using less labor.

Labor costs for corn, soybeans, oats, and wheat declined substantially as size of farm increased because larger tractors and machinery reduced the amount of time required to perform a specific job. Tractor costs declined as size of farm increased because of more intensive use and larger size tractors. Machinery costs declined as size of farm increased because of a more intensive use of equipment.

On many farms, corn pickers and combines accounted for more than one-half of the total machinery charges for corn, soybeans, and small grain. However, operators of small farms can compete with operators of large tracts of land on a unit cost basis if they: (1) Hire crops harvested; (2) own harvesting equipment and do enough custom work on other farms to use the machine 100 or more hours a year; or (3) purchase second-hand harvesting equipment when a new machine would become obsolete before it wears out.

Profits from an acre of the various crops grown on a 220-acre farm were as follows: corn, \$16 for a 75 bushel yield; soybeans, \$14 for a 30 bushel yield; wheat, \$9 for a 32 bushel yield; two cuttings of hay, \$4 for a 2.7 ton yield; and three cuttings of hay, \$7 for a 3.2 ton yield. These profits were left after paying all costs including charges for labor and the use of the land. This same method of figuring showed a loss of \$3 for each acre of oats produced and a \$5 loss for an acre of hay when only one cutting was made and no pasturing was done the remainder of the season.

A good crop farmer usually had high crop costs on an acre basis because of heavy expenditures for fertilizer, manure, and lime. However, if he produced high yields, he had low costs per bushel of grain or ton of hay produced and high profits per acre.

The amount of time used to perform the various jobs needed to produce crops varied considerably because of differences in the rate of travel at which machines were operated, frequency of equipment breakdowns, amount of time needed to move machines to and from fields, weather, yields, and size of fields.

Tables.

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

## Vegetable Crops

Hutchinson, F. E., and Murphy, H. J. TEN YEARS OF SNAP BEAN STUDIES IN MAINE.  
Maine Agr. Expt. Sta. B. 609, 15 pp. 1962.

Field experiments to evaluate rate, placement, and source of fertilizer materials, plant spacing, yield versus maturity, growth regulators, and maximum yield for snap beans were conducted in Maine over the 10-year period, 1951-1960.

Band placement of fertilizer in combination with broadcast, plowed-down, or down-the-spout methods was equally as effective as band placement alone. A nitrogen rate of 50 pounds per acre at planting time was most desirable. Rates in excess of this amount were not beneficial. In general, a yield response to applied phosphorus was obtained in each of nine experiments, with the optimum rate ranging from 150 to 200 pounds per acre of available phosphorus pentoxide. Response was greatest on soils with a low level of residual phosphorus.

For two seasons out of four, beans spaced at 1 inch in the row yielded significantly more than beans spaced at 2, 3, and 4 inches. For the remaining 2 years all spacing were about equal to yield.

Yield versus maturity evaluations for five snap bean varieties indicated a negative relationship for quality and yield of bean pods. During the time required for the amount of No. 1 pods to decrease from 100 to 50 percent, the yield of Tendercrop variety increased 5,800 pounds, Harvester increased 5,100 pounds, Kinghorn and Slender-green increased 5,000, and Tenderlong increased 3,500 pounds per acre.

As growth regulators, 2, 4, 5-T acid at 100 p.p.m., p-chlorophenoxyacetic acid at 500 p.p.m., a-naphthalenacetic acid at 25 p.p.m., and Duraset 20-W at one-half pound per acre were effective in significantly increasing yield, pod set, and small pod size in beans.

One acre maximum yields for Slendergreen grown in 1958 and Harvester grown in 1959 were 6,426 pounds and 7,065 pounds, respectively.

U. Maine, Maine Agr. Expt. Sta., Orono, Maine.

Foley, R. F., and Woodbury, G. W. ASPARAGUS STUDIES IN SOUTHWESTERN IDAHO.  
Idaho Agr. Expt. Sta. B. 383, 8 pp. 1962.

Eight years of cultural studies in southwestern Idaho on asparagus varieties and best planting depths for asparagus crowns yielded the following information: (1) Quality of the asparagus grown on the experimental plots was completely satisfactory for either fresh use or for processing; (2) California "500" proved to be superior to the Mary Washington variety in yielding ability, but there was no difference in their qualities; (3) the yield of these varieties were described as average; and (4) the best yield of asparagus spears came from crowns planted at the shallowest depth or 6 inches below the soil surface.

U. Idaho, Col. Agr., Moscow, Idaho.



Massey, P. H., Jr., Eheart, J. G., Young, R. W., and Mattus, G. E. THE EFFECT OF SOIL MOISTURE, PLANT SPACING, AND LEAF PRUNING ON THE YIELD AND QUALITY OF BROCCOLI. Amer. Soc. Hort. Sci. Proc. 81: 316-323. 1962.

A 5-year study was initiated in 1956 to determine the effects of soil moisture, plant spacing, and leaf pruning on the yield and quality of broccoli. The significant results obtained were summarized as follows:

1. The plants receiving the high-moisture treatment yielded about twice as much edible plant material as the plants not irrigated. The yield of lateral inflorescence was greatly increased by irrigation. In some years, irrigation tripled the yield of lateral inflorescence over that obtained from the unirrigated plots. Higher quality broccoli was produced on the high moisture plots than on low moisture plots. Organoleptic and chemical composition studies indicated that irrigation increased the succulency and decreased the percent dry matter of the broccoli plant parts.
2. One-foot spacing between plants in rows 3 feet apart significantly increased the yield of central and lateral inflorescences, leaves, and total edible material over that obtained from the 1.5-foot spacing. The chemical composition of the plants was not significantly influenced by the spacing tested.
3. The removal of 10 leaves per plant increased the yield of edible plant material by 39 percent over the standard commercial practice of harvesting only the inflorescence. Yields of inflorescences were slightly reduced by pruning.
4. The yield and quality of broccoli was found to vary from year to year. Broccoli plant parts high in percent crude fiber and percent dry matter tended to be low in ascorbic acid and carotene.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

Singh, K., and Nettles, V. F. EFFECT OF DEFLOURATION, DEFRUITING, NITROGEN AND CALCIUM ON THE GROWTH AND FRUITING RESPONSES OF BELL PEPPERS (CAP-SICUM ANNUM L.) Fla. State Hort. Soc. 1961 Proc. 74: 204-209. 1962.

Experiments were conducted in 1960-61 to test various defloration or defruiting treatments, levels of nitrogen, and levels of calcium on the growth and fruiting responses of Bell peppers. Highly significant differences were obtained in the height of plants as well as in total marketable yield of peppers due to removal of flower buds before anthesis, removal of flowers after anthesis but before gametic union, and removal of young developing fruits as compared with control or no blossom removal. In 1960, increase in the rate of application of nitrogen from 100 to 200 pounds per acre resulted in no significant increase in plant height, and a linear reduction in the total marketable yield of peppers. In 1961, a linear increase in height and yield was obtained by increasing the rate of nitrogen application from 50 to 150 pounds per acre. Increasing the levels of calcium from 0 to 1,000 pounds per acre had a significant effect on increasing the height of plants but a depressing effect on the yield. An increase in the rate of nitrogen application resulted in an increased number of blossom-end rot fruits and a reduced number of sunburned fruits. Increasing the rate of calcium had a significant effect in decreasing the incidence of blossom-end rot.

U. Fla., Gainesville, Fla.

Comes, R. D., Timmons, F. L., and Weldon, L. W. CHEMICAL CONTROL OF ANNUAL WEEDS IN PINTO AND GREAT NORTHERN FIELD BEANS. Wyo. Agr. Expt. Sta. B. 393, 15 pp. 1962.

More than 40 chemicals were evaluated as pre-emergent or post-emergent treatments for the control of annual weeds in Great Northern and Pinto field beans at widely separated locations in Wyoming. None of the post-emergent treatments evaluated showed promise, and only two of the chemicals applied as pre-emergent treatments (EPTC and CDEC) were considered satisfactory.

The most effective and consistent chemical studied was EPTC. This chemical, applied at the rate of 3 to 4.5 lb. /A., gave excellent control of all annual weeds encountered over a 3-year period without injuring the bean crops (4 lb. /A. is the heaviest rate of EPTC registered for use in field beans). The 3-lb. /A. rate of EPTC was recommended for use on coarse-textured soils, where rainfall is usually received during the bean-planting season and the 4-lb. /A. rate was recommended for use on fine textured soils and in arid areas.

CDEC at 6 lb. /A. the heaviest rate registered for use in field beans, gave rather erratic results during the 6 years it was tested. Higher degrees of weed control, and more consistent results were obtained with CDEC at 8 and 10 lb. /A., but these rates cannot be recommended because of restriction of label registration.

Better weed control was obtained with EPTC and CDEC when the chemicals were mechanically incorporated into the surface 1 1/2 in. of soil than when they were not incorporated. When 0.25 in. or more precipitation was received immediately after chemical application on sandy loam, the effects of mechanical incorporation were obscured. Both EPTC and CDEC should be mechanically incorporated into the soil surface immediately after chemical application. A fingerweeder, rotary hoe, and rototiller were all effective incorporation devices.

Eight-inch band treatments were as effective as broadcast treatments, and chemical costs were reduced approximately 66 percent by their use.

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

Harris, M. R., and Brannon, D. H. DISEASES AND INSECT PESTS OF POTATOES. Wash. State Ext. Serv. Ext. B. 553, 30 pp. 1962.

Descriptions, color photographs, and recommended control of the important diseases and insect pests of potatoes in Washington were given.

Ext. Serv., Wash. State U. Inst. Agr. Sci., Pullman, Wash.

Suter, R. C., and Wilson, D. E. TOMATOES; COSTS AND RETURNS. Purdue Agr. Expt. Sta. Res. B. 750, 19 pp. 1962.

Dollar costs and returns, both per acre and per hour, were summarized for set tomatoes in North Central Indiana (29 farms), for seeded tomatoes in North Central Indiana (18 farms), for set tomatoes in South Central Indiana (14 farms), and for seeded tomatoes in South Central Indiana (16 farms).

The cost did not vary particularly between areas; however, less fertilizer was used in the South Central area. Neither did total costs vary particularly between set and seeded acreages. Plants cost more than seed, yet set tomatoes required less labor. Other differences in cost were due mainly to differences in yields and in the amounts of harvesting labor.

Returns per acre were largely a function of the variation in yields, and with one exception (seeded tomatoes in South Central Indiana) 1958 yields were below those reported as typical.

In a typical year, growers in North Central Indiana obtained a per-acre return of \$378 (14 tons at \$27); in South Central Indiana they obtained \$270 per acre (10 tons at \$27).

Tables.

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

## ECONOMIC AND SOCIAL ASPECTS OF SOIL AND WATER CONSERVATION

### Costs and Returns

St. Clergy, C. J., and Corty, F. L. ADJUSTMENTS FOR HIGHER FARM INCOMES IN THE HILL AREA OF NORTH LOUISIANA. La. Agr. Expt. Sta. B. 560, 56 pp. 1962.

From 1954-59, the total number of farms in the hill farm area of North Louisiana decreased by 43 percent. The allocation of resources, or better proportioning of factors of production needed to have profitable open land farming in the hill farm areas of Louisiana was studied. The combination of resources necessary to provide the hill farmer a return of \$3,000, or \$5,000, for his labor and investment in four major farm types, i.e., beef, dairy, cotton, and general farming were determined.

The analysis was based on data collected from 24 better-than-average resident farmers who obtained not less than 75 percent of gross income from the farm unit.

Beef--Many beef enterprises survived because they were not burdened by real estate debt. Both sample farms and the model farms indicated that large acreages were needed to obtain an adequate income from a specialized beef cattle operation. Sample farms averaged 440 acres. The model farm at the \$3,000 income level, using intensive practices, required slightly more than 230 acres and fixed capital investment in excess of \$60,000; and at the \$5,000 income level, required more than 365 acres and fixed capital investment in excess of \$90,000.

Dairy--The dairy enterprise is a relatively profitable enterprise at prevailing prices. The farms in the survey sample were conducting dairy operations in an extensive manner. Comparison of the extensive model dairy farms with the intensive models indicated that the dairy enterprise is well adapted to intensive operation. The extensive models required more land, capital, and labor to obtain the same level of income of the intensive model. The extensive model at the \$3,000 income level required 78 acres of land and a fixed capital investment of \$26,952, while at the \$5,000 income level, 119 acres of land and a fixed capital investment of \$34,356 were needed. The intensive model at the \$3,000 income level required on 46 acres of land and a capital investment of \$25,345, but to obtain \$5,000 required 74 acres of land and a fixed capital investment of \$31,776.

Cotton--The cotton enterprise supplemented by other enterprises was profitable at current support prices. Most farmers in the survey sample had not adjusted the farm unit

to the reduction in cotton acreage, and much of the land area was not being efficiently utilized. The model cotton farm designed to return \$3,000 to operator labor and investment required 188 acres of land and a fixed capital investment of \$29,208. The farm model designed to return \$5,000 to operator labor and investment required 288 acres and a capital investment of \$40,317.

General or Diversified Farms--The general farm enterprises yielding the largest returns per acre, in order of importance, were: cotton, hogs, corn, beef, and timber. Net returns per acre were highest for the dairy enterprise, followed by cotton, general farms, and beef.

The principal factors contributing to the success of the sample farms were: (1) Good management ability; and (2) debt-free ownership of a large land area.

The need for a large land area was primarily due to the topography and fertility level of the soil. For each acre of crop land suitable for intensive farming there were approximately 4 acres of land suitable only for pasture, timber, or other extensive use.

Census data indicate that more than 60 percent of the farms in the area are less than 100 acres in size. The many small farm units must be consolidated if open land farming is to continue.

Although open land farming was considerably curtailed in the North Central Louisiana area, the many dairy farms in existence can operate profitably as long as milk prices retain their present relationship to costs. On the same basis, farms with large cotton allotments will continue to be successful. Large general farms offer the best possibilities for continued successful farming in the area. Diversified farm units can withstand economic adversity much better than farm units with a single enterprise. Many small, isolated farm units will become idle, or revert to timber. Others must be consolidated into economical units.

Tables.

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

Magee, A. C., Baird, R. W., and Pope, J. B. CONSERVATION PAYS IN THE BLACKLANDS. Tex. Agr. Expt. Sta. MP-602, 11 pp. 1962.

One phase of the research program at the Blacklands Experimental Watershed, Riesel, Texas, was to observe and record crop yields and other results obtained with and without conservation measures on an area of typical Blackland soils.

Conservation measures used included terracing, contour farming, sodding permanent waterways, and a land-use pattern and cropping system based on land capabilities. Some land previously used for cultivated crops was shifted to permanent grass under conservation program. Sweetclover was seeded with oats, and fertilizer was used with the oats-sweet clover crop. Chemical weed control was used on permanent pasture when needed.

The ordinary system of farming included a cropping plan consisting of 50 percent of the land in cotton, 25 percent in corn or grain sorghum, and 25 percent in oats. When cotton allotments became effective, the cropping system was adjusted to approximately 30 percent in cotton, 45 percent in corn or grain sorghum, and 25 percent in oats. Fertilizer was not used and no other conservation measures were practiced with this plan.

A study was made to determine the cost of installing measures on a conservation model farm that was typical of the Blacklands, and farm budgets were prepared to determine the effect of conservation measures on farm earnings. Results indicate that a farmer who

adopts conservation measures for the first time can expect to wait 3 or 4 years before the benefits of the program are reflected to any great extent by improved production and increased earnings. A wait of several years also can be expected before conservation exerts its full influence on farm income.

Using 1960 price relationships, accumulative returns were calculated for the ordinary farm without conservation and compared with the 12-year returns of conservation. The benefits of these practices, as applied experimentally, would be sufficient to pay all costs of establishing the program, repay all temporary losses of income incurred while the system was being put into effect, and also pay interest on an amount equal to installation costs plus the temporary loss of income during the adjustment period.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Ault, W. C., Riemenschneider, R. W., and Saunders, D. H. UTILIZATION OF FATS IN POULTRY AND OTHER LIVESTOCK FEEDS: TECHNOLOGY AND FEEDING PRACTICES. U.S. Dept. Agr., Agr. Res. Serv. Utilization Res. Rpt. 2, 41 pp. 1960.

Numerous changes in agricultural economy and scientific knowledge of feedstuffs have led to an enormous increase in the use of added fats in feeds since 1954. Fats are known to be essential components of animal feeds, and currently more than 500 million pounds of added fats are used annually.

With this vast expansion in use, important problems have arisen, such as specification for fats suitable for feed use, effectiveness of and methods for incorporating suitable antioxidants, storage and handling of fats, and mixing of fats into finished feeds. Many studies were made that relate the use of fat to the nutritional requirements of our various domestic animals and serve to delineate the most favorable conditions for adding fats to their respective rations.

Results of the studies pertinent to the use of fats in feeds have been published in a wide variety of journals and trade magazines. This report brings together in one place a comprehensive review of available information in this field.

Tables, charts, and bibliography.

ARS, USDA, Inform. Div., Room 645A, FCB, Hyattsville, Md. 20781.

Stevens, D. M., and Agee, D. MOUNTAIN-VALLEY CATTLE RANCHING IN WYOMING: INVESTMENTS COSTS, EARNINGS, AND MANAGEMENT PRACTICES. Wyo. Agr. Expt. Sta. B. 386, 56 pp. 1962.

Economic information to aid ranchers in making decisions was given for 1959. Cattle prices were favorable in 1959 compared with the past 10-year period. During the entire marketing period of 1959, however, the price trend was noticeably downward.

Thirty-five ranches were studied. Every one of the operators made good earnings--the rate of return earned on total investment ranged from 2.8 to 13.4 percent with an average of 5.7 percent. The rate earned on capital was in addition to a fair wage for the operator's labor.

In studying why some ranchers had higher earnings than others, the 35 ranches were sorted and analyzed on the basis of several criteria: (1) Size of business; (2) type of operation; (3) rate of production (4) efficiency of production; and (5) management success.

The following table summarizes most of the results obtained in the study:

<u>Item</u>	<u>Small</u>	<u>Medium</u>	<u>Large</u>
Cattle units per ranch .....	193	406	847
Investment per ranch .....	\$130,314	\$252,729	\$499,950
Investment per cattle unit .....	664.00	625.00	593.00
Operating costs per cattle unit.....	37.20	40.24	33.63
Total cost of production per cattle unit.....	99.33	90.42	75.93
Total income per cattle unit .....	98.20	95.68	84.59
Profit or loss per cattle unit.....	-1.13	5.26	8.66
Percentage of return to capital .....	4.9	5.8	6.5
Pounds of beef produced per cattle unit .....	380	372	326
Cost per cwt. of beef produced.....	26.23	24.46	23.36
Price per cwt. of feed sold.....	25.43	24.96	24.46
Man equivalent.....	1.5	3.0	4.8
Cattle units per man.....	128	143	186
Invest. in depreciable assets per cattle unit ...	137.00	108.00	69.00
Cost of producing hay (per ton).....	19.36	16.78	15.42

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

Wallace, J. D., Raleigh, R. J., Hubbert, F., JR., and Sawyer, W. A. WINTER FEEDING AND MANAGEMENT OF RANGE CALVES. Oreg. Agr. Expt. Sta., Sta. B. 584, 22 pp. 1962.

Experimental studies were carried on at Squaw Butte Experimental Station at Burns, Oreg. from 1951-61 to investigate feeding and management practices that would lead to improved winter performance of weaner calves. This locality is similar to large areas in the intermountain west where ranchers rely on native flood meadows for winter hay supplies and on sagebrush-bunchgrass ranges for summer grazing. The authors concluded that:

1. Feeding phosphorus-fertilized hay as opposed to unfertilized hay resulted in increased calf performance.
2. A protein supplement combined with a meadow hay wintering ration brought about marked increase in calf gains.
3. No advantage was obtained by feeding higher levels of phosphorus than calves normally consume from a salt-bonemeal mix.
4. When calves were fed rations containing 5.5, 6, 9, and 12 percent protein, gains increased with each additional level of protein.
5. Cottonseed meal was superior to either urea or a cottonseed meal-urea combination as a protein source for calves.
6. Calves fed pelleted hay gained at a faster rate than similar calves fed chopped or wafered hay.
7. Transportation costs and processing costs involved in pelleting roughages tended to offset advantages derived from feeding meadow hay as pellets or wafers.
8. Gains made by yearling animals on spring and summer range were not materially reduced by previous winter gains until winter gains exceeded 1.6 pounds per day.
9. Return (gain value minus winter feed cost) was considerably lower for calves wintered on meadow hay alone than for those wintered on meadow hay plus supplements.

10. Calves weaned in mid-September gained at a higher rate during winter than similar calves weaned approximately a month later.
11. Feeding an antibiotic supplement resulted in increased calf performance, especially during the first few weeks following weaning.
12. Feeding either a yeast additive, a flavoring material, or an arsenical compound with a meadow hay ration did not materially influence calf performance.
13. Copper supplementation was needed with a meadow hay ration for calves.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg.

Suter, R. C., and Washburn, S. H. FEEDER CATTLE SYSTEMS OF MANAGEMENT, BUDGETED COSTS AND RETURNS. Purdue Agr. Expt. Sta. Res. B. 744, 40 pp. 1962.

Comparison of feeder cattle systems is difficult because of the many different kinds of cattle that can be fed and the many alternative methods of feeding and fattening them.

A condensation of the data from each system was presented in Table form. The basic data, such as feed, labor, and capital requirements, along with the prices paid and the prices received determine the dollar costs and returns and the returns to labor and management. Cattle prices were based on one complete cattle cycle; however, adjusted to \$1.10 corn using a shorter more realistic price period. Feed costs were based on--\$1.10 corn, \$85.00 supplement, \$20.00 hay, \$7.20 corn silage and \$8.00 pasture.

When per-hour returns to labor and management were used, the more profitable conventional systems of management were the high quality steer calves, the high quality yearling steers, choice cattle finishing, and the medium quality yearling steers.

The reason for the high returns differs with the kind of cattle. With steer calves and high quality yearling steers more profit was obtained in the feedlot than in the market. With choice cattle and the medium quality yearling steers most of the profit was obtained in the market. Two-year-old cattle also obtained a high return per hour of labor. With these cattle systems labor requirements appear low and price risks are high.

The following observations were made:

1. The kind of cattle fed--calves or yearlings, steers or heifers, high, medium or low quality--should depend on the kinds and amounts of feed available. The younger, lighter weight cattle and higher quality cattle consume more concentrates and should consume more of the higher quality roughages.
2. The ratio of concentrates to roughage fed depends on the kind of cattle fed. The younger, lighter weight, and higher quality cattle require feeds with the higher ratio of concentrates to roughage.
3. The amount of feed fed per hundredweight gain varies with the kind of cattle (particularly age) and degree of finish desired. The younger and lighter weight cattle require less feed per hundredweight gain. The higher the degree of finish the more feed required per hundredweight gain.
4. The period of ownership or length of the feeding period depends on the kind of cattle fed and the type of feed fed. Younger, lighter weight cattle tend to be fed longer than the older, heavier cattle, even though they put on their gains faster. Cattle that are full-fed (in drylot or on pasture) require less time than cattle that are grazed and put on full feed later.
5. The price per hundredweight that can be paid for feeder cattle depends on class or age of cattle, weight of the cattle, present-day corn and other feed costs, and future fat cattle price expectations.

6. The necessary selling price, price spread or margin (difference between purchase price and selling price) necessary for profit is a function of class or age and weight. The older and heavier cattle require a wider price margin than the younger, lighter weight cattle.
7. The seasonal price variation helps determine when different classes of cattle should be bought and sold. Feeder cattle prices are most generally low during September, October, November, and December. Fat cattle prices for the higher quality cattle are most generally high during September, October, November, and December. August should be included for choice cattle; while January should be included for prime cattle.
8. The year-to-year price variation for any one month for both feeder and fat cattle is several times larger than the average month-to-month seasonal change. By purchasing cattle in-the-big-run, some cattle feeders obtain their cattle for as much as 8 percent below the average price for the month. By selling cattle in-the-holes some cattle feeders sell their cattle for as much as 2 or 3 percent above the average price for the month.
9. Veterinary costs and death loss together will usually average 2 to 6 percent. The death loss is much higher for calves (3.0) than for yearlings (1.5) or 2-year-olds (1.0).

Purdue U., Agr. Expt. Sta., Lafayette, Ind.

Thacker, D. L., and Ross, R. H. RATIONS FOR VEAL CALVES. Idaho Agr. Expt. Sta. B. 398, 7 pp. 1962.

Southern Idaho farmers using commercial milk replacers for feeding the large number of calves produced in that area were unable to show a profit because of the high feed cost. A study was initiated to develop rations for raising this veal on an economic basis. The results of two feeding trials using male Holstein calves were reported.

The following conclusions were made; (1) To raise a veal on any ration, the rate of feeding must be higher than for normal calf raising. (2) A calf must be fat and weigh 200 to 225 lbs. at 6 to 8 weeks of age to sell as veal. (3) To grow a veal of this size 125 to 200 lbs. of dry mild replacer was required. (4) During the first 2 weeks on feed the calf should receive at least 1 lb. dry milk replacer per day. (5) The milk replacer should be reconstituted at the rate of 1 lb. replacer to 6 lbs. water. (6) The amount of reconstituted milk replacer fed the calf should be increased 6 lbs. per week. At the end of 6 weeks the calf should be receiving 35 lbs. of reconstituted milk daily. (7) Steam-rolled barley should be before the calves at all times. And (8) Holstein calves can be vealed in less than 8 weeks by using milk replacers.

Management suggestions for veal production are; (1) Small individual pens free from drafts should be used for housing. (2) Three times as much bedding were required as in normal calf raising. (3) Diluting the ration 1 lb. replacer to 8 lbs. water aids in bringing the calf back to normal when scouring. And (4) corn wheat, or other high-energy grains may be substituted for barley. Dried beet pulp was helpful in getting the calf started eating grain but did not constitute more than one-third of the grain mixture.

The following information may be used to determine the profit on veal production: (1) Total cost will be the original cost of the day-old calf, 150 lbs. milk replacer, 10 lbs. grain and \$1.00 for drugs; and (2) the income will be 200 to 225 lbs. of veal at the current market price.

U. Idaho, Col. Agr. Moscow, Idaho.



Hoglund, C. R. ECONOMICS OF DAIRYING NEAR METROPOLITAN AREAS. Mich. Agr. Expt. Sta. Q. B. 232, 16 pp. 1962.

Current trends toward higher land values and tax rates near metropolitan areas will continue. As urban and suburban areas expand outward from metropolitan centers, additional farmers will be subjected to higher land assessments and tax rates. Real estate taxes on a per acre basis will be doubled or tripled on some farms.

Dairy farmers near metropolitan areas can minimize some of the costs and maximize the gains associated with urban development by keeping informed about developments in their areas. Both short run and long run effects of urban infringement need to be studied.

Dairymen need to examine the consequences of adopting alternative solutions to high land assessments and tax rates if they are to stay competitive. This will require carefully prepared budgets showing expected changes in investments, receipts, and expenses if they change the land area operated or sell their farm and move to a new location.

With a level of production costs similar to those in 1961, milk sales of 10,000 to 12,000 pounds per cow, and milk prices of \$4.00 to \$4.25 per cwt. net at the farm, many dairymen would be better off financially to continue operating present acreages until real estate tax rates were at least \$5 to \$6 per acre.

When farm land can be sold for as much as \$1,200 per acre and real estate taxes are as high as \$10 to \$12 per acre, most farmers can no longer afford to produce most of the feed needs of the dairy herd. Many of them will profit most by selling their farm and relocating in a more rural area. Others may select the alternative of selling most of the farm land and buying feed.

Farmers need to consider the consequences of taxes paid on capital gains in the event they sell their farms at a high price. Savings in taxes paid on capital gains are considerable when no more than 30 percent of the selling price is received at time of sale with the balance collected over a period of 5 to 10 years.

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

Chambliss, R. I., Jr. LABOR AND CAPITAL REQUIREMENTS IN HERRINGBONE AND OTHER ELEVATED-STALL MILKING PARLORS. Va. Agr. Expt. Sta. B. 539, 46 pp. 1962.

The chore labor requirements and capital requirements for facilities in elevated-stall milking parlors in Virginia were determined to help dairymen choose the most efficient and economical system for milking and other related chores.

During the summer of 1960, 25 herringbone milking parlors and 25 other elevated-stall milking parlors in Virginia were visited to obtain data on chore time and capital investment. The number of cows milked varied from less than 20 to more than 200. On the 25 farms with herringbone parlors, 42 men were milking 1,801 cows (43 cows per man), while on the other 25 farms, 42 men were milking 1,387 cows (33 cows per man). Each man in the herringbone parlors operated an average of 3.3 milking machines, while in the other parlors, each operated an average of 2.5 machines.

Capital investment in installed equipment (not including the bulk milk tank) and in the parlor building (not including milk room or feed bin) averaged \$99 per cow in the herringbone parlors and \$89 in the other parlors. Capital investment in the building alone averaged about \$5.25 per square foot in both types of parlors. Investment in facilities per cow declined as the number of cows in the herds increased.

Daily time requirements for chores per cow milked averaged 7.5 man-minutes in the herringbone parlors and 8.6 man-minutes in the other parlors. Practically all of the difference in chore time was in milking, which required 5.4 man-minutes in the herringbone

parlors and 6.3 man-minutes in the other parlors. Time requirements for the other tasks were almost identical in both types of parlors--cleaning the parlor: 1 man-minute per day per cow milked; preparing and cleaning equipment: 1.1 man-minute; and preparing grain: 0.2 man-minute in the non-herringbone parlors which did not have automatic grain feeding systems.

Milking machines were on the cows for an average of 6.5 minutes in the herringbone parlors and for 5.7 minutes in the other parlors. Machines were on the cows for the recommended maximum time of 4 minutes or less on only 16 percent of the cows in herringbone parlors and on only 23 percent of the cows in other parlors. About 7 percent of the cows had milking machines on them for 10 minutes or more.

Cows seemed to have ample time to eat their grain ration in herringbone parlors, but whether the time was adequate in other parlors was questionable. The average time in the stall of the cows observed was 14.6 minutes in the herringbones, but only 7 minutes in the other parlors.

By use of a statistical model known as differential contrast, the following relationships were revealed: (1) Investment in equipment and building was \$36.32 higher per cow in the herd in herringbone than in other parlors; (2) this investment was \$24.93 lower per cow in parlors with stalls on both sides of the pit than in those with stalls on only one side of the pit (most herringbones were two-sided whereas most of the other parlors were one-sided); (3) an increase of 1 cow in the number of cows in the herd decreased investment per cow by 38¢; (4) an increase from 1 to 2 men employed increased total daily chore time by 3.63 man-minutes per cow; (5) an increase of 1 cow in the number of cows milked reduced total daily chore time by 0.04 man-minutes per cow; (6) having cows on both sides rather than on 1 side of the pit reduced total daily chore time by 1.65 man-minutes per cow; (7) use of high-pressure rather than regular-pressure water reduced the daily time required to clean the parlor by 0.82 man-minutes per cow; (8) an increase of 1 stall in cow capacity of the parlor reduced daily time in milking by 0.43 man-minutes per cow; and (9) a mechanical grain feeding system reduced daily labor requirements in preparing grain for feeding by 0.16 man-minutes per cow.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va.

### Institutional, Educational, and Social Factors Affecting Conservation Application

Crosswhite, W. M. and Vaughn, G. F. LAND USE IN THE RURAL-URBAN FRINGE: A CASE STUDY OF NEW CASTLE COUNTY, DELAWARE, Del. Agr. Expt. Sta. B. 340, 28 pp. 1962.

Land use in northern New Castle County, Del., is becoming increasingly urban. Careful planning for the future becomes mandatory as urban demand for land increases and the availability of open land decreases.

Using a land use classification system designed specifically for the "rural-urban fringe," an inventory was conducted of existing land use and related factors. Information was obtained on all ownership units of 10 or more acres lying outside subdivisions and incorporated municipalities.

There were 1,260 separate ownership units of 10 or more acres lying outside subdivisions and incorporated municipalities in northern New Castle County in 1960. They contained 109,969 acres of land or 68 percent of all land in New Castle County north of the Chesapeake and Delaware Canal.

Nearly half of the individuals owning tracts of 10 or more acres were 60 years old or older; one-third were between 40 and 59 years old. Thirty percent of these owners were retired. Owners engaged in business industry and agriculture owned, respectively 15, 12, and 9 percent of the tracts.

In 1960, individuals owned 74 percent of the tracts of 10 or more acres. Commercial and industrial firms held title to 13 percent. Government, civic groups, and other noncommercial groups owned 10 percent. Trusts and estates owned the remaining 3 percent. Eighty-eight percent of the individual owners resided in New Castle County.

Prior to 1950, land values advanced slowly in northern New Castle County. Urbanization has since brought land prices in rural districts to the approximate level that exists close to cities. Property taxes levied against land and improvements are low in comparison with those of other suburban areas in the Northeastern United States. Taxes levied on farm real estate in New Castle County in 1960 averaged \$1.54 per acre. More than 12 percent of the acreage under study was tax exempt.

Agr. Expt. Sta., U. Del., Newark, Del.

Nunns, F. K. HAWAII PIONEERS WITH A NEW ZONING LAW. J. Soil and Water Conserv. 17: 104-107. 1962.

"The General Plan of the State of Hawaii, 1960-1980," includes maps that delineate Hawaii's lands into urban, agricultural, and conservation districts on a generalized, tentative basis. Special attention was given to the preservation of prime tillable lands when the plan's agricultural districts were delineated. The boundaries for the plan's urban districts were drawn with reference to anticipated urban development and population growth as well as maximum use of marginal farm lands that are physically suited and satisfactorily located for urban uses. The conservation districts of the plan incorporated the current forest and water reserve areas, which contain numerous historic sites and potential recreational areas. The benefits and opportunities are:

1. Farmers will have some assurance that certain lands will remain agricultural and be taxed at purely agricultural rates.
2. Urban districts will be a protective influence for developers and investors because scattered "mushrooming developments" cannot rise purely at will in raw rural areas.
3. By requiring that agricultural districts reserve prime farmlands for agricultural uses, some of the urban pressures will be diverted to other lands.
4. Real property taxation should become simpler and more equitable. Tax assessors will know where to add and where to refrain from adding increments of urban value to their land valuations.
5. Land values should assume a more realistic and orderly pattern. Land sale and lease prices within an agricultural district should assume agricultural levels because speculative urban development is prohibited. Longterm leases should be more readily given and obtained.
6. By outlining permissible urban development areas in logical locations, community services should be obtainable earlier and at lower cost.

Land Study Bureau, U. Hawaii, Honolulu, Hawaii.

Botts, R. R. FARMERS' HANDBOOK OF FINANCIAL CALCULATIONS AND PHYSICAL MEASUREMENTS. U.S. Dept. Agr., Econ. Res. Serv., Agr. Hbk. 230, 53 pp. 1962.

Modern American farming is a complex business operation. As farms get bigger and investments higher, more and more figuring is required for determining the costs and

returns of the farm business and for such things as depreciation, Social Security, credit, life insurance, retirement, and estate planning.

Today's farmer needs to be able to figure the interest rates charged by competing sellers and creditors, the size of installment required to pay off a debt at a specified interest rate over a given term, survivorship benefits payable to dependents under Social Security, if he dies before retirement, and his own retirement income, if he lives. He needs to be able to convert life insurance proceeds into installment income for dependents in order to know whether Social Security and present life insurance will provide adequate incomes for them. And because financial computations are based on physical measurements, he needs to know such things as how to estimate acreages, yields in the field, and bushels in the bin.

This report is an attempt to make these and many other calculations easier. The material is presented in question form with detailed solutions, so that the reader may solve similar problems with the help of the tables included in the report.

Tables and graphs.

MOD, USDA, Inform. Div., Washington, D.C. 20250.

Stanberry, C. O., and Anderson, D. M. A CONVENIENT PUNCHED-CARD FILING SYSTEM. Soil Sci. 94: 397-403. 1962.

A simple filing system was described for a 5- x 8-inch edge-punched-card which offers much flexibility in operation. The desired information may be written or typed on cards, or clippings may be attached. Recovery of information files was rapid. Expansion into more and varied subjects does not necessitate abandoning one system and creating another. The orthographic system described is consistent with normal thought processes and does not require any involved index, special care, or knowledge. The alphabetical filing of authors names also is simple and does not require an index. Costs for cards and basic requisite operating equipment are nominal.

The punched-card filing system may be maintained readily available for an individual. Subjects for a given abstract, listing author, title, and publication, are cross-indexed on one card. Since, after use, cards are "thrown" into convenient boxes or drawers, no filing labor is involved. It is not necessary to keep cards in any given order, since "needling them out" provides any information recorded on the cards. About a thousand descriptors were selected for a soils index to develop consistent term usage and to simplify punched-card filing.

SWCRD, ARS, USDA, Tuscon, Ariz. 85717.

Hannah, H. W., and Krausz, N. G. P. LAW FOR THE ILLINOIS FARMER. U. Ill. C. 860, 85 pp. 1963.

A discussion of some of the Illinois laws that concern farm people and those in related businesses was given.

The information will not enable anyone to act as his own lawyer. The purpose of the circular is rather to give its readers two kinds of help: (1) Information concerning their rights and responsibilities; and (2) a better realization of situations that may contain legal dangers. Knowing when a situation is dangerous or likely to become so will enable a farmer to consult a lawyer in time to settle issues that could lead to costly and long-drawn out disputes.

U. Ill., Col. Agr., Urbana, Ill.

# BIOLOGY

## Fish

Eipper, A. W., and Regier, H. A. FISH MANAGEMENT IN NEW YORK FARM PONDS. N.Y. State Col. Agr. Cornell Ext. B. 1089, 40 pp. 1962.

There are more than 18,000 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 because it provides recreation for the whole family, and the fish caught are a valuable addition to any meal.

This publication discusses: (1) Factors to consider in deciding which fish species to stock; (2) design and construction features particularly important in fish ponds; (3) where and how to obtain fish for a farm pond; (4) growth, survival, reproduction, and yield that can be expected from a farm fish pond in New York; and (5) management practices for obtaining satisfactory fishing from a pond.

The information was based largely on results of 12 years' work on more than 150 ponds in Central New York State. The recommendations apply to farm ponds throughout New York that have surface areas up to 2 acres and maximum depths of 7 to 15 feet.

N.Y. State Col. Agr., Cornell Ext. Serv., Ithaca, N.Y.

Shetter, D. S. RECOVERIES BY ANGLERS OF LEGAL-SIZED TROUT STOCKED DURING DIFFERENT SEASONS OF THE YEAR IN MICHIGAN STREAMS. Trans. Amer. Fisheries Soc. 91: 145-150. 1962.

Four experiments with marked, legal-sized, hatchery-reared, brown and rainbow trout were conducted on portions of five Michigan trout streams to determine which season of release yielded the greatest return to the angler. Equal numbers of tagged or fin-clipped fish were planted in the fall after the close of the trout season and in the spring before the trout season opened. In two experiments, larger numbers of fish were also released during the fishing season--May, June, and July. In three of the experiments, angler returns were obtained by voluntary reports and by partial creel census conducted during the first season that marked fish were present. In the fourth experiment, all recoveries were reported voluntarily. Almost 63,000 fish were planted, and recaptures of 1,173 brown trout and 2,307 rainbow trout were reported. In six tests with rainbow trout and four tests with brown trout, spring planting yielded significantly higher returns than fall planting. In two tests with brown trout, spring planting yielded higher returns, but its superiority over fall planting was not statistically significant.

Inst. Fisheries Res., Mich. Dept. Conserv., Lewiston, Mich.

Kramer, R. H., and Smith, L. L., Jr. FORMATION OF YEAR CLASSES IN LARGEMOUTH BASS. Trans. Amer. Fisheries Soc. 91: 29-41. 1962.

Early life history of largemouth bass (Micropterus salmoides) at Lake George and adjoining sloughs, Anoka County, Minn., was described. Bass spawning first occurred 2 to 5 days after mean daily water temperature exceeded 60° F. Two-hundred and sixty-six nests were found on needlerush, waterlily roots, humps of fibrous material, aquatic vegetation,

and sand in 10 to 62 inches of water. Egg survival at time of hatching varied from 0 to 94 percent. Percentage of successful nests from a single spawning period varied from 0 to 100. Number of fingerlings per brood 2 weeks after rising from the nest varied from 500 to 12,715 fish with mean brood size of 5,600 in 1956 and 1957 and 3,600 in 1958. Analyses of bag-seine catches showed 1.0, 5.5, 10.0, and 1.3 fingerlings per 1,000 square feet in 1955, 1956, 1957, and 1958, respectively. Number of yearlings in the 4-year classes at the beginning of the second summer of life were 0.05, 0.42, 0.93, and <0.05 per 1,000 square feet. Year classes were weak in 1955 and 1958 and strong in 1956 and 1957. Year-class strength was set after egg disposition and before fingerlings were 2 weeks old. Water temperature was directly related to egg survival and nest success. Wind was the most important single factor in year-class formation in Lake George. Egg survival was highest on needlerush and lowest on sand. Two-thirds of all successful nests were in water deeper than the median depth. Illumination, dissolved oxygen, total alkalinity, hydrogen-ion concentration, cannibalism, predation, food habits, growth rate, and condition were not factors in determining year-class strength.

Dept. Ent. and Econ. Zool., U. Minn., St. Paul, Minn.

Maloney, J. E., Schupp, D. R., and Scidmore, W. J. LARGEMOUTH BASS POPULATION AND HARVEST, GLADSTONE LAKE, CROW WING COUNTY, MINNESOTA. Trans. Amer. Fisheries Soc. 91: 42-52. 1962.

Sport-fishing catch from Gladstone Lake, a 481-acre hard-water bass-panfish lake in north-central Minnesota, averaged 24.3 pounds (about 65 fish) per acre over a 7-year period (1952-58). Of the weight of fish taken 25.4 percent was larger predaceous fishes, including 13.4 percent (3.2 pounds per acre) of largemouth bass (*Micropterus salmoides*). Panfishes, especially bluegill (*Lepomis macrochirus*), made up the bulk of the catch. Average summer fishing pressure over the 6 years was 37 hours per acre and of the same magnitude as that for other bass-panfish lakes in this area.

The fish population was sampled by seining in 1957 and 1958 and size of the bass population estimated by marking and recovery methods. In 1957 there were estimated to be 11,000 bass 6 inches or longer (23 per acre); in 1958, 5,500 (12 per acre). The exploitation rate was 14.6 percent in 1957 (3.5 bass per acre) and 15.6 percent in 1958 (1.8 per acre). Total fishing pressure was 29.9 hours per acre in 1957 and 27.3 in 1958. Fishing mortality of age-IV and older bass was 15 percent during the 2 years, and estimated natural mortality, 47. Age-groups IV and younger were taken incidentally to panfish angling. Larger bass were caught mostly by anglers fishing specifically for them. During the 2 years, 30 percent of the total fishing pressure was directed at largemouth bass and 50 percent at panfishes. The population of larger bass declined 30 percent from 1957 to 1958, but the catch declined 48 percent and fishing pressure for larger fish declined 55 percent. The catch of smaller bass declined 35 percent and the population declined about 55 percent. Age-groups V-VIII (1 to 3 pounds) were taken in both years in greater proportion to their numbers than ages IX and older (3.5 to 5.0 pounds).

Angling habits and success of panfish anglers had considerable influence on the bass catch. Opening the bass season 2 weeks earlier in 1957 and 1958 than in the preceding years had little influence on the catch and about half the fish were taken during the first month in both instances.

Minn. Dept. Conserv., St. Paul, Minn.

Schwartz, F. J. FOOD, AGE, GROWTH, AND MORPHOLOGY OF THE BLACKBANDED SUNFISH, (ENNEACANTHUS C. CHAETODON), IN SMITHVILLE POND, MARYLAND. Chesapeake Sci. 2: 82-88. 1961.

Following standard methods of counts and measurements, body proportions of the specimens from Smithville Pond were found to approach those noted for the recently described southern subspecies Enneacanthus c. elizabethae. Maryland specimens of E. c. chaetodon were found to grow to a length of between 43 to 53 mm. standard length in 4 years. None were found to live longer than 4 years although aquarium specimens have been known to live to 6 years. No morphological or growth differences could be found to delineate males from females in either sample. The food of E. c. chaetodon in July was primarily the chironomid larvae of Pseudochironomus and Tendipes. Caddis fly larvae were the most frequent November food. The blackbanded sunfish, by food preference, seems to prefer weedy situations where it feeds on bottom and plant foods, perhaps at night.

Maryland Dept. Res. & Education, Solomons, Md.

Collins, G. B., Gauley, J. R., and Elling, C. H. ABILITY OF SALMONIDS TO ASCEND HIGH FISHWAYS. Trans. Amer. Fisheries Soc. 91: 1-7. 1962.

The ability and persistence of salmonids in ascending pool-and-overfall fishways was measured in experimental "endless" fishway structures in which fishways of any height could be simulated. Six chinook salmon (Oncorhynchus tshawytscha), four sockeye salmon (O. nerka), and four steelhead trout (Salmo gairdneri) were permitted to ascend 1,000 in the experimental fishways. One sockeye salmon was allowed to ascend an endless fishway for over 5 days, climbing 6,648 feet, a vertical ascent of more than a mile, before the test was discontinued. Rate of ascent of all fish tested increased following an initial period of experience in the fishway. The level of blood lactate in the exercised fish showed no evidence of fatigue. Practical significance of the data in relation to fishway design was discussed.

U.S. Bur. Com. Fisheries, Seattle, Wash.

Lawrence, J. M. AQUATIC HERBICIDE DATA. U.S. Dept. Agr., Agr. Res. Serv. Agr. Hbk. 231, 131 pp. 1962.

Since 1946, the use of chemicals for controlling all types of aquatic plant growths has been greatly expanded. The information on such research and results of field trials is widely scattered in various publications and is not readily available to the technician in the field. This handbook was compiled to bring this information together and to summarize it.

The first section of this handbook is a listing of the chemicals for which data are available. Next is a plant index, which includes listings of all genera and species of higher plants on which screening tests and field chemical-control data has been recorded. The listing of higher plants is divided into groups of submerged, emergent, marginal, floating, and miscellaneous weeds.

The last section of the handbook is the bibliography in two parts. The first part contains references on the toxicity of aquatic herbicides and related compounds to fish and other aquatic animals. The second part contains references on chemical control of aquatic weeds.

Tables.

Inform. Div., ARS, USDA, Room 645A, FCB, Hyattsville, Md. 20781.

Pickering, Q. H., Henderson, C., and Lemke, A. E. THE TOXICITY OF ORGANIC PHOSPHORUS INSECTICIDES TO DIFFERENT SPECIES OF WARMWATER FISHES. Trans. Amer. Fisheries Soc. 91: 175-184. 1962.

Bioassays were conducted with thirteen organic phosphorus insecticides to determine their relative toxicity to four species of fish. An extremely wide range in toxicity was found with 96-hour TLM (median tolerance limit) values ranging from 0.0052 to 610 p.p.m. Bluegills were generally the most sensitive fish, followed by guppies, fathead minnows, and then goldfish. The maximum sensitivity of the different species to particular compounds ranged from 4 to as high 900 times the minimum. Additional experiments were conducted with some of the compounds. Larger bluegills (10 grams) were slightly more tolerant than smaller bluegills (2 grams) to Delnav, parathion, and malathion; green sunfish of similar size and largemouth bass (5 grams) were not greatly different in sensitivity from the larger bluegills. Tests of five compounds revealed that the toxicity of emulsible concentrates or wettable powders was similar to that of the technical grade material. Fathead minnow fry from 2 to 30 days old were about ten times as sensitive to Delnav as adults. However, when exposed for 15 days the toxic effect of Delnav increased about fivefold over that shown in 96 hours, but there was no additional fish mortality between 15 and 30 days.

U.S. Dept. Health, Ed. and Welfare, Public Health Serv., R. A. Taft Sanitary Engin. Cent., Cincinnati, Ohio.

Grizzell, R. A., Jr., and Neeley, W. W. BIOLOGICAL CONTROLS FOR WATERWEEDS. 27th North Amer. Wildlife and Natl. Resources Conf. Trans.: 107-113. 1962.

Two genera of algae often are serious problems in Southeastern ponds. Pithophora grows in freshwater fish ponds, and Cladophora in brackish-water duck ponds. No suitable chemical has been found to control either one.

Field trials in Georgia and Arkansas confirm research at Auburn, Ala., that it was practical to establish effective biological reduction of Pithophora in bass-bluegill ponds by using 50 Israeli carp per acre. It was necessary to stock with 5- to 6-inch fish, rather than smaller fingerlings, to prevent largemouth bass from depleting the stocking.

Field trials in coastal South Carolina proved that Cladophora was effectively controlled in widgeongrass duck ponds when mullet was introduced. Stocking was accomplished by opening the control gates to take water into the ponds on high tides, when schools of fingerling mullet were observed in adjacent creeks. The fingerling mullet thus come in with the water. The rate of stocking was not known.

Duckweeds occur in farm ponds that are protected too well from wind and wave action. Chemical and mechanical control measures were but temporarily effective. It was found that six or more Muscovy ducks per acre controlled duckweeds in ponds. A method of protecting these ducks from predation was described.

Adequate winter and summer fertilization controlled submersed waterweeds in ponds not having extensive shallow edges.

SCS, USDA, Little Rock, Ark.

## Upland Wildlife

Reynolds, H. G. EFFECT OF LOGGING ON UNDERSTORY VEGETATION AND DEER USE IN A PONDEROSA PINE FORREST OF ARIZONA. Rocky Mountain Forest and Range Expt. Sta., Res. Note 80, 7 pp. 1962.

Logging activities in ponderosa pine forests on the North Kaibab Plateau, Ariz., influence understory vegetation. During the first year after logging, perennial grasses and



sedges were reduced and forbs and aspen sprouts were increased slightly. Understory vegetation reached peak production about 6 years after logging, and continued higher than on unlogged areas for 11 to 15 years. Ridgetop aspects and dense pole-size stands of timber produced the least understory vegetation.

Deer use, as measured by accumulated pellet groups, was lower on logged than on unlogged areas for the first 2 years after logging. Between 3 and 11 years after logging, deer use was several times higher on logged areas. Deer use was found to be comparatively low in pole-size timber, on ridgetops, and where perennial grasses and sedges dominated the understory.

Implications for improving deer habitat on the North Kaibab by adjusting timber harvest include: (1) Shifting areas of logging to benefit deer populations; (2) shortening timber cutting cycles to keep forage production high; (3) thinning of pole-size stands to increase herbaceous understory; and (4) reducing density of timber on north aspects.

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

Reynolds, H. G. USE OF NATURAL OPENINGS IN A PONDEROSA PINE FOREST OF ARIZONA BY DEER, ELK, AND CATTLE. Rocky Mountain Forest and Range Expt. Sta. Res. Note 78, 4 pp. 1962.

Game abundance is favored by diversity and interspersion of vegetation types. Accordingly, natural openings scattered throughout ponderosa pine forests of Arizona and New Mexico should favor game use of the forest habitat. How some of these forest openings were used by deer, elk, and cattle in relation to adjacent forests was determined.

The study area was in a logged-over ponderosa pine forest on the Apache National Forest near Buffalo Crossing, Ariz. Logging was completed during the past 5 to 15 years under an improvement-selection method for sustained yield. The forest contained numerous natural openings, had a fairly high population of deer and elk, and was of fairly level and uniform topography.

It was concluded that: (1) Natural forest openings in selectively cutover ponderosa pine forests of Arizona were used by both elk and deer; (2) natural openings, as a part of habitat requirements, were more important to elk than to deer; (3) seeding or planting of natural openings improved elk habitat, and should benefit cattle range; and (4) clear cutting small patches or groups of trees improved habitat for elk, and range conditions for cattle.

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

Duvendek, J. P. THE VALUE OF ACORNS IN THE DIET OF MICHIGAN DEER. J. Wildlife Mangt. 26: 371-379. 1962.

A study of the value of acorns as a winter food for deer was conducted over a 3-year period at the Houghton Lake Wildlife Experiment Station in Michigan by controlled feeding of penned deer. The daily food intake of deer receiving diet of good food was approximately 4 lb. fresh weight per hundredweight. Deer ate approximately 1.5 lb. of acorns per day per hundredweight, when they were available. Of deer fed a basic starvation ration of jack pine and oak browse, or balsam plus a small amount of cedar, only those given a 0.5 lb. supplement of acorns per hundredweight would have had a chance of surviving a 90-day winter period with a weight loss less than the critical 30 percent. White oak acorns were apparently more palatable than red oak acorns, but weight loss was not significantly different between two groups of deer, one receiving white oak acorns, the other red oak acorns, as

a supplement to a poor food browse diet. Deer entering a winter in excellent condition may be better able to resist a critical winter weight loss than animals that are in poorer, lighter condition.

Game Div., Mich. Dept. Conserv., East Lansing, Mich.

Dietz, D. R., Udall, R. H., and Yeager, L. E. DIFFERENTIAL DIGESTIBILITY OF NUTRIENTS IN BITTERBRUSH, MOUNTAINMAHOGANY, AND BIG SAGEBRUSH BY DEER. First Natl. White Deer Disease Symposium Athens, Georgia, Feb. 13-15, 1962. Proc. pp. 29-36, 39-50, 1962.

Two methods of determining digestibility of three staple deer browses in north-central Colorado were compared. Big sagebrush, bitterbrush, and mountainmahogany were fed to four mule deer fawns both single and in combination with alfalfa pellets.

Digestion coefficients of bitterbrush and mountainmahogany were obtained for crude protein, crude fat, crude fiber, and nitrogen-free extract by both the single-feed method and by difference with alfalfa pellets. The deer refused to eat sagebrush alone and only the difference method was employed to obtain these values. Total digestible nutrients (TDN) and nutritive ratios were determined for all digestibility trials.

Alfalfa pellets were a good source of digestible protein and had the best nutritive ratio. Sagebrush had higher percentages of digestible protein, fat, and fiber, and more TDN with a better NR than the deciduous shrubs. Mountainmahogany had higher digestion coefficients than bitterbrush for protein, fat, fiber; lower for NFE; and equal in TDN, but with a slightly better NR.

Bitterbrush and alfalfa were considerably more palatable to the deer than either mountainmahogany or sagebrush. The deer either gained or maintained their weight on all feeding combinations except that with sagebrush.

Differences between the mean digestion coefficients determined by the two feeding methods indicated that the addition of alfalfa to a browse ration inhibited the digestibility of individual nutrients and lowered the total digestible nutrients. This inhibition of digestibility was significant in bitterbrush for protein, fat, fiber, and TDN but not nitrogen-free extract. In mountainmahogany, digestibility of protein and fat were not significantly inhibited, but fiber, NFE, and TDN were.

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

Dietz, D. R., Udall, R. H., and Yeager, L. E. CHEMICAL COMPOSITION AND DIGESTIBILITY BY MULE DEER OF SELECTED FORAGE SPECIES, CACHE LA POUUDRE RANGE, COLORADO. Colo. Game and Fish Tech. P. 14, 89 pp. 1962.

Mule deer occupying Cache la Poudre range in Colorado, spend the summers in the upper transition and on the true summer ranges (alpine and sub-alpine zones), and the winters on ridges and in canyons, mainly below the 8,500-foot elevation.

On the summer range, aspen, willow, blueberry, and tufted hairgrass were collected in the late spring and early fall, representing early- and late-season use. The constituents analyzed were crude protein, crude fat (either extract), crude fiber, nitrogen-free extract, ash, calcium, phosphorus, and moisture, and in some cases carotene.

Aspen and willow were the best sources of protein, fat, nitrogen-free extract, ash, calcium, and phosphorus. Aspen contained significantly more fat and calcium than willow,

but less protein and phosphorus. Tufted hairgrass was significantly higher in fiber and ash, but lower in the other nutrients than the shrub and tree species. Blueberry was higher than aspen and willow only in fiber content.

The various nutrients contained in summer-range species were affected either highly significantly or significantly by the season collected. Protein, ash, and phosphorus percentages were highest in the late spring, while fat, fiber, nitrogen-free extract, and calcium percentages were highest in the fall.

On the summer range, interactions between species and seasons were highly significant for calcium and phosphorus; significant for protein, fat, and nitrogen-free extract; and non-significant for crude fiber and ash.

The species of winter-range plants analyzed had a highly significant effect on all of the chemical constituents tested. The mean of juniper, sage, and rabbit-brush was higher in protein, fat, ash, calcium, and phosphorus and lower in fiber and nitrogen-free extract than the mean of bitterbrush and mahogany.

The effect of different seasonal-use periods on the chemical content of winter-range shrubs was highly significant for all chemical constituents except nitrogen-free extract. The browses were higher during the summer-use period than during the three winter-use periods in protein, ash, calcium, and phosphorus; lower in fiber; and equal in fat and nitrogen-free extract.

First-order interactions between seasons and species on the winter range were highly significant for protein, fiber, nitrogen-free extract, ash, and phosphorus; significant for calcium; and non-significant for fat.

Forage species from summer range were closer to the desired 2:1 ratio in calcium and phosphorus than winter-range forage species during the summer-use period.

Immature cheatgrass (*Bromus tectorum*) collected during the late winter-use period was a very good source of protein and phosphorus. The low nutrient content of browse at this time emphasizes the importance of early emergent grasses on winter range during the critical late-winter period.

The three most important browse species on the Cache la Poudre winter deer range--big sage, bitterbrush, and mountain mahogany--were fed to captive mule deer in order to determine their nutritive value.

Mule deer during the first-year trials refused to eat big sagebrush when fed alone. The addition of alfalfa pellets improved the palatability of sage to where the deer would consume about 200 to 300 grams per day, along with about 227 grams (one-half pound) of alfalfa pellets. Palatability ratings based on feed-consumption data would result in the following ranking: (1) Alfalfa; (2) bitter-brush; (3) mountain mahogany; and (4) big sagebrush.

The experimental deer lost weight on the alfalfa-sagebrush diet, gained weight on the alfalfa, alfalfa-mahogany, and bitterbrush diets, and did not change weight on the mahogany and alfalfa-bitterbrush diets.

Dept. Game and Fish, Denver, Colo.

Vohs, P., Jr., and Birkenholz, D. E. RESPONSE OF BOBWHITE QUAIL TO MANAGEMENT ON SOME ILLINOIS STRIP-MINED LANDS. Ill. State Acad. Sci. Trans. 55(1): 12-19. 1962.

Responses of bobwhite quail to management practices applied on 920 acres of strip-mined land in southern Illinois were studied from 1954-61. Practices employed included road construction, grading of spoils and widening of spoil valleys, manipulation of cover, and introducing plant species which produce food for quail. An increase of bobwhites from 46, prior to incorporation of management, to 279 in 1959-60 was recorded. An analysis of the crops of 49 quail obtained in 1959-60 indicated a dependence of the birds on plant species introduced through management.

Huntable populations of quail on naturally revegetated spoilbanks depended largely on the establishment of a suitable food supply and to a lesser extent upon altering the vegetative pattern to provide diversity. Large tracts with extremely homogeneous vegetative cover were detrimental to quail populations as were farmlands where cover was wanting. Efforts should be directed toward retarding or disrupting the natural plant establishment by bulldozing, burning, or application of herbicides. The selection of specific spoilbanks to manage depends upon the topography and the accessibility for hunting. Less expense was incurred when management practices were initiated as soon after mining as possible.

Iowa State U., Ames, Iowa.

Madson, J. THE COTTONTAIL RABBIT. Olin Mathieson Chem. Corp. Conserv. Dept. (Unnumbered) 56 pp. 1959.

A game management publication on the cottontail rabbit was presented.

The following general chapters were given: (1) Life history; (2) parasites and diseases; (3) conservation and management; (4) rabbit hunting; and (5) bibliography.

Conserv. Dept., Olin Mathieson Chem. Corp. East Alton, Ill.

Madson, J. THE WHITE-TAILED DEER. Olin Mathieson Chem. Corp. Conserv. Dept. (Unnumbered) 108 pp. 1961.

A game management publication on the white-tailed deer was presented.

The following general chapters were given: (1) Life history; (2) management and conservation; (3) hunting; (4) tomorrow's white-tails; and (5) bibliography.

Conserv. Dept., Olin Mathieson Chem. Corp., East Alton, Ill.

## Wetland Wildlife

Stotts, V. D., and Davis, D. E. THE BLACK DUCK IN THE CHESAPEAKE BAY OF MARYLAND: BREEDING BEHAVIOR AND BIOLOGY. Chesapeake Sci. 1: 127-154. 1960.

The breeding behavior and biology of black ducks, *Anas rubripes*, were observed from 1953-1958 on the upper Eastern Shore of Chesapeake Bay in Maryland. Ducks were trapped, banded, and marked during the study in an essentially estuarine habitat, which was frostfree from mid-April to early November. The general habitat adjoining the Bay consisted of cultivated fields, pine woods with dense underbrush, extensive marshes in some areas, and duck blinds.

Resident black ducks began to pair in the late summer and reached a peak in early April just before the height of the breeding season. Few, if any, young were observed to pair in the early fall. In the spring, the male defended a territory for each clutch, generally using some promontory along the shore. The male remained nearby while the female built her nest, gradually deserting his mate during incubation. Eventually the pairing bond disappeared, although some males probably paired again with reneesting hens.

Females reneested one or more times when the eggs were destroyed or even when the ducklings disappeared on the first day after hatching. Eight out of 51 marked ducks were known to have reneested.

The dates of first laying varied from March 9 to March 27. The nesting peaks occurred about April 20. The first hatching occurred in early April; the last in early August. The date by which 50 percent of the nests were started was significantly earlier in 1953 than in 1957 or 1958 but no other differences were significant. Comparison of the peaks of hatching and of laying showed that in 1958 a loss of early clutches occurred.

Nests were built most extensively in woods, less so in fields and marshes, and markedly on duck blinds. They were constructed from adjacent material (leaves, grass, twigs, pine needles) in shallow basins, which were occasionally used by renesting females. Usually the nest site was covered by honeysuckle, poison ivy, brush, or grasses. Spacing between nests was determined by available cover; sometimes they were placed within a few feet of each other. The density varied from 0.6 to 15.2 nests per acre.

The average number of eggs in a clutch declined from 10.9 to 7.5 during the season (360 clutches). Young females laid smaller average clutches (9.2) than adults (9.7). Primary clutches were larger (9.1) than secondary clutches (8.1) for the same females. The incubation period averaged 26.2 days (51 clutches). Neither size of clutch nor season had a significant effect on incubation period. About 5.6 percent of the eggs did not hatch.

The fate of nesting was determined for 574 nests. During the 6 years, 38.0 percent hatched at least one egg, 11.5 percent were abandoned, and 50.0 percent were destroyed (34.0 percent by crows). Although complete and incomplete clutches were equally susceptible to predation; over half (51.8 percent) of the destruction of complete clutches occurred in the first week of incubation. An average of 9.6 percent of eggs in successful clutches was taken by crows.

Estimations of production indicated that 100 females would raise 510 young to flying age and that the population in the area would decline if the mortality rate of females from flying age to breeding exceeded 78 percent.

Maryland Game and Inland Fish Comn., Annapolis, Md.

Madson, J. THE MALLARD. Olin Mathieson Chem. Corp. Conserv. Div. (Unnumbered) 80 pp. 1960.

A game management publication on the mallard was given.

The following general chapters were presented: (1) Life history; (2) parasites and diseases; (3) management; (4) hunting; (5) man and the mallard; and (6) bibliography.

Conserv. Dept., Olin Mathieson Chem. Corp., East Alton, Ill.

## SUPPLEMENT

### Problems Indirectly Affecting the Application of Soil and Water Conservation Practices

Daniels, N. E. INSECTICIDAL CONTROL OF THE GREENBUG. Tex. Agr. Expt. Sta. Prog. Rpt. 2247, 4 pp. 1962.

Five experiments were conducted for chemical control of the greenbug during 1961. Satisfactory control was obtained with parathion, methyl parathion, phosphamidon, and dimethoate. Granulated Di-Syston was not as effective as the other materials. The insecticides used in the first four experiments demonstrated exceptionally long residual periods. Parathion and methyl parathion were effective when applied at a time when the temperature was low. Parathion used in combination with 2,4-D gave satisfactory greenbug control. The residual action of the parathion was not as good in this experiment as in the four previous tests.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Trevett, M. G., and Murphy, H. J. A GUIDE FOR THE USE OF CHEMICAL WEED KILLERS IN 1963: WEED CONTROL IN VEGETABLES, SMALL FRUITS, FIELD CROPS, AND TURF. Maine Agr. Expt. Sta. and Maine Coop. Ext. Serv. Misc. P. 656, 46 pp. 1963.

The successful use of chemical weed killers requires close attention to details. The aim of any chemical weed control program should be to apply the smallest possible amount of herbicide at a time when it will destroy the most weeds and injure the crop least. The small amount of crop injury that may follow the use of chemical herbicides normally will be rapidly outgrown and will not have a depressing effect on yield.

Pre-emergence treatments tend to give best weed control if they are deferred until about 2 days prior to crop emergence.

In general, post-emergence treatments on the best results if made when both weed and crop plants were small.

The chemicals suggested for use in vegetables or field crops under favorable conditions gave good control of the common annual broadleaved weeds, but generally only fair control of grasses.

Herbicides did not eliminate the need for cultivation, but under favorable conditions reduced the number of cultivations required. Cultivating immediately after the herbicide was applied reduced the effectiveness of the treatment. Postpone cultivation until the effect of the herbicide has disappeared.

A weed killer should be used only at the rates recommended and only on the crops recommended by the manufacturers on the container label. The manufacturer of the chemical has the responsibility of labeling the chemical so that excessive residues will not be found on the crop, IF LABEL DIRECTIONS ARE FOLLOWED.

U. Maine, Maine Agr. Expt. Sta., and Maine Coop. Ext. Serv., Orono, Maine.

Carpenter, S. E. EFFECTS OF ADDING RICE OIL TO DAIRY RATIONS. Tex. Agr. Expt. Sta. Prog. Rpt. 2249, 3 pp. 1962.

A feeding trial to determine the effect of adding 1-percent rice oil (a by product of the rice industry) to the grain ration of dairy cows was conducted at Substation No. 2, Tyler, Tex., during May-August 1962.

Twelve Jersey cows in production, paired according to milk yield, body weight, and stage of lactation, were used.

The ration containing 1 percent rice oil improved the palatability of the feed and yielded 0.9 pound more milk per cow per day. On the average, \$1.00 spent for rice oil returned \$3.53 through increased milk yield. No significant difference was found in body weight or percentage of fat or solids-not-fat.

Agr. and Mech. Col. Tex., Tex. Agr. Expt. Sta., College Station, Tex.

Krista, L. M., Carlson, C. W., and Olson, O. E. WATER FOR POULTRY: THE EFFECTS OF SALINE WATER ON SOUTH DAKOTA CHICKENS, DUCKS, AND TURKEYS. S. Dak. Farm and Home Res. 8(4):15-17. 1962.

Many livestock losses have been traced to the use of high mineral (saline) waters. To avoid such losses, South Dakota farmers and ranchers can have analyses made of suspected water supplies and get an evaluation of their suitability for animals.

Experiments were run using young chicks, laying hens, turkey poults, and ducklings. Waters of varying salinity were prepared by adding different amounts of the appropriate salt to Brookings tap water. While some work was done using magnesium sulfate (Glauber's salt), most experiments were run using sodium chloride (common salt), since experience has shown it to be particularly troublesome in poultry. All salts used are commonly found in South Dakota waters. Effects on mortality, growth, feed consumption, feces condition and various physiological symptoms of toxicity were observed in the several experiments.

TABLE.--Effect of Salt Content of Poultry Drinking Water, Based on Conductivity Tests

Conductivity (micromhos cm)	Evaluation
0 to 999	Excellent for all poultry.
1,000 to 2,999	Satisfactory for all poultry. At the higher levels within this classification watery feces may occur, but there should be no increased mortality nor any decrease in production or growth.
3,000 to 4,500	This is a poor water for poultry. It will often cause watery feces, and it may cause increased mortality and decreased growth, especially in turkey poults.
Over 4,500	This water is considered unfit for poultry. It will almost always cause some type of problem, and the probability that it will reduce growth or production, increase mortality, or cause other symptoms of toxicity is fairly high and increases with increasing conductivity.

TABLE.--The Effect of Sodium Chloride Content of Drinking Water on Poultry

Sodium chloride content (p.p.m.)	Chicks	Laying hens	Turkey poults	Ducklings
4,000	Watery feces. Some loss of appetite. Some increase in water consumption.	Watery feces.	Watery feces. Some loss of appetite Some increase in water consumption. Some inactivity and somnolence. Some decrease in growth. Slightly increased mortality.	Watery feces. Some increase in billing of feed. Some decrease in growth.

TABLE.--The Effect of Sodium Chloride Content of Drinking Water on Poultry--Continued

Sodium chloride content (p.p.m.)	Chicks	Laying hens	Turkey poults	Ducklings
7,000	Watery feces. Decreased growth and appetite. Increased mortality. Increased water consumption. Some inactivity.	Watery feces. Increased water consumption.	Watery feces. Decreased growth and appetite. Increased mortality. Increased water consumption. Some inactivity and somnolence.	Watery feces. Some increase in billing of feed. Decreased growth and appetite.
10,000	Watery feces. Greatly decreased growth and appetite. Greatly increased mortality. Billing of feed. Several other symptoms of toxicity, such as dehydration, labored breathing and edema.	Watery feces. Decreased egg production. Greatly increased water consumption.	High mortality (all dead at two weeks).	Watery feces. Billing of feed. Loss of appetite and reduced growth. Some inactivity. Increased mortality.

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

Hill, R. D., Schwab, G. O., Malaney, G. W., and Weiser, H. H. QUALITY OF WATER IN OHIO FARM PONDS. Ohio Agr. Expt. Sta. Res. B. 922, 66 pp. 1962.

Water from 14 farm ponds in 8 Ohio counties was sampled to determine the physical, bacterial, and chemical characteristics of the water for the period May 1958 through August 1961. The major conclusions were:

1. Turbidity ranged between 1 and 155 units with a mean of 30 units. Maximum turbidities occurred during March and appeared to be associated with high runoff.
2. Apparent color ranged between 0 and 800 units with an average of 60 units. Turbidity was the major cause of color.
3. Odor was found in 4.8 percent of the samples taken near the water surface and in 21.2 percent of the samples taken near the bottom. Maximum odor occurred during the summer months. Maximum threshold odor was 64.
4. As depth of water increased, turbidity, color, and odor increased. The greatest increase occurred in the lowest 2-foot layer.
5. All pond waters contained coliform bacteria, but the degree of contamination was slight. The waters were of good sanitary quality. Highest coliform populations occurred during the summer months.



6. The populations of thermophilic, thermoduric, and psychrophilic bacteria, as well as counts of enterococci and total bacteria were relatively low, indicating a generally low level of microbial contamination.
7. Chemical quality of pond water was good except for hardness, which averaged 100 p.p.m. Fifty percent of the ponds had hard water which might have to be softened for domestic use.
8. Pond water treated with sodium arsenite for weed control had dangerous arsenic levels for human consumption as long as 16 months after treatment.

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

## Radioactive Fallout

Rasmusson, D. C., Smith, L. H., and Myers, W. M. PLANT SCIENTISTS MAY HOLD THE KEY TO REDUCING RADIOACTIVE CONTENT OF FOOD. *Minn. Farm and Home Sci.* 20(1): 16. 1962.

A way of reducing radionucleid contamination of the food chain was studied. Basic contributions to the knowledge of the physiological processes by which plants take up and transport ions, and how genes control these processes were obtained.

Plants were grown in the greenhouse in soil to which Sr-89 was added prior to planting. The plants were harvested at maturity, and Sr-89 content of the seed was determined by measuring the amount of radioactivity in each sample. The radioactivity was measured as disintegrations per second per gram (dis./sec./g.) of dry matter.

TABLE 1.--Sr-89 content (dis./sec./g. dry matter) in seed of soybeans, barley and wheat.

Crop	Number of Varieties	Average	Low	High
Soybeans.....	50	224	105	370
Barley.....	48	61	33	100
Wheat.....	50	47	18	82

Varieties within each species differed in the content of Sr-89 in the grain (table 1). For all three crops the variety with the highest content of Sr-89 in the seed contained more than three times as much as the variety with the lowest. The most variation was found among wheats. The variety Kenya 117A had 4.5 times as much Sr-89 in the seed as did the variety Great Northern. In barley, the variety Regal was the highest accumulator while Tregal was the lowest.

Sr-89 deposition in grain, stems, and leaves of six barley and wheat varieties was determined.

TABLE 2.--Average Sr-89 content (dis./sec./g. dry matter) in plant parts of barley and wheat

Crop	Number of varieties	Grain	Stems	Leaves
Wheat.....	6	74	563	2,410
Barley.....	6	84	524	2,784

Maximum accumulation always occurred in the leaves (table 2). The stems were intermediate in Sr-89 content, and the grain contained the smallest amounts. Grain contained only about 3 percent as much Sr-89 as the leaves on a per gram dry matter basis. Within each crop, the varieties differed significantly not only in Sr-89 content of grain but also in Sr-89 content of stems and leaves.

Results indicated that the hazard associated with the radiostrontium in the soil can be reduced. The plant breeder could make available existing varieties that accumulate lower than normal amounts of Sr-89 and Sr-90 or breed new varieties which would contain even lower amounts of strontium. Since plant parts differ in content of Sr-89, it would be possible to specify the plant parts that are most hazardous and thereby avoid their use.

Minn. Agr. Expt. Sta., St. Paul, Minn.

Graham, E. R., and Killion, D. D. SOIL COLLOIDS AS A FACTOR IN THE UPTAKE OF COBALT, CESIUM, AND STRONTIUM BY PLANTS. *Soil Sci. Soc. Amer. Proc.* 26: 545-547. 1962.

A study of the uptake of Co, Cs, and Sr by rye, garden peas, and soybeans showed that the amount of these elements harvested, as well as the concentration in the plants, varied with the nature of the soil colloid on which they were grown.

Illite, kaolinite, montmorillonite, peat (fibrous), peat (sedimentary), and Putnam c were Ca-saturated, mixed with nutrients and sand; and treated with known amounts of radioactive Co-60, Cs-137, and Sr-85. Cultures of rye, peas, and soybeans were started in sand-nutrient solution mixtures, then transferred to the radioactive colloid-sand-nutrient mixture. After a period of growth, the plants were harvested, weighed, and assayed for their content of radioactivity. A study of the adsorption of the nuclides by the colloids was made.

The order of uptake of Co by the rye plants was highest on illite followed in order by kaolinite, Putnam c, peat (sedimentary), montmorillonite, and peat (fibrous). The uptake of Cs by the rye plants was highest in the plants grown on (fibrous) peat (10.59 percent harvested), and lowest for the plants grown on Putnam c (0.36 percent harvested). The uptake of Sr by the rye plants was highest for the plants grown on montmorillonite (2.08 percent harvested). The uptake of the nuclides by peas and soybeans followed closely that of rye.

The distribution coefficient studies of the elements for the exchangers after equilibration in 0.01M CaCl<sub>2</sub> solution revealed that more Co was adsorbed by the peats than by the clays; a higher adsorption of Cs by illite and Putnam c; and smaller differences with Sr with exchangers other than kaolin. The adsorption of the three elements was lower for kaolin than for the other cation-exchangers. The percentage of Co and Cs harvested by the plants was correlated with the reciprocal of the distribution coefficient.

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

Woodwell, G. M. THE ECOLOGICAL EFFECTS OF RADIATION. *Sci. Amer.* 208(6): 40-47.  
June 1963.

Changes that ionizing radiation produced in several terrestrial ecosystems were described. Recent experiments showed that typical North American forests were damaged by exposures in the same range as those that approach lethal exposures in human beings. Pine trees were particularly sensitive. In irradiated forest, ecosystems pines were killed by 6 months' exposure to 20 or 30 roentgens per day, and deleterious effects were produced by exposures of only one or two roentgens per day. (A roentgen is a unit of radiation dosage, an amount of energy deposited in a region through which ionizing radiation has passed. A typical dental X-ray delivers a local dose of 1 to 5 roentgens; a whole-body dose of 500 to 1,000 roentgens is generally fatal to man.) In contrast to forests, fields of weeds are remarkably resistant, surviving exposures of 100 to 200 roentgens per day without major short-term damage. It was apparent that there are patterns of radiation sensitivity among major ecosystems, forests being among the most sensitive and tundra and grassland among the most resistant.

No address given.

