agricultural research

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A Winter Tapestry

The cold, harsh beauty of winter is here. Winter is Nature's resting period. If the cadence of life slows in the autumn, it comes nearly to a halt now.

Winter subdues plant growth. Trees become dormant—physiologically inactive. The liquid phase of the tree—its sap—becomes more concentrated and moves into a subterranean area where it doesn't, or can't, freeze.

During winter, plants and trees organize their cellular structures to form gels, instead of crystals. We know that fruit trees are damaged by winter's cold when the water in the spaces between the cells freezes. If the weather is cold enough, the cells too freeze and die.

Winter wheat can survive temperatures as low as −20°F because it makes its own antifreeze. The sugars, lipids, and water status change to keep the plant alive. A snow cover protects and insulates the wheat from dessication and freezing. Last winter, wheat in the Great Plains was damaged because there was little or no snow cover.

Cold is but one form of plant stress—drought is another. Cold stress may, in fact, be a drought phenomenon. Many trees were damaged last winter because of the combination of cold and drought. Because the ground froze so deeply, water was unavailable to the roots, while the exposed tree continued to lose water to the atmosphere.

Biochemically and physiologically, dormancy is one of the most exciting research areas in agriculture. Although we are beginning to learn many secrets of plant physiology, we have only begun. There are still enormous voids in our basic knowledge. What, for example, is it in the cellular structure, tissues, or molecules of plants that lets them survive winter?

Historically, plant breeders have had only one way to select for cold hardy plants—they collected the survivors of a freeze. Today, we need new options, and these new options can come only from research.

New knowledge from studies at the molecular and membrane level might lead to the identification of a natural or a synthetic substance that would render crops resistant to cold and heat stress. This potential is not impossible. The challenge awaits our response.

Basic plant stress research is meaningless, however, unless it can be fitted into a master research plan. We can no longer be content with having only individual pieces of the puzzle. Our research must fit together in a pattern that will sustain plant life amidst the elegant tapestry of winter.—*M.M.M.*

Editor: *H. G. Hass*

Assistant Editor: *R. W. Deimel*

Contributors to this issue:

R. C. Bjork, F. W. Brouard, B. D. Carriere, R. H. Fones, P. L. Goodin, E. Likums, M. M. Memolo, S. C. Miller, R. G. Pierce, D. H. Senft, L. C. Yarris

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COVER: ARS scientists at the University of Minnesota are field testing experimental strains of alfalfa bred for nitrogen fixation characteristics. Test plots containing precise amounts of a radioactive nitrogen isotope enable the scientists to trace and measure the nitrogen in each plant (0877W875–30). Story begins on page 3.

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Bob Bergland, Secretary
U.S. Department of Agriculture

Talcott W. Edminster, Administrator
Agricultural Research Service

Nodulation and root types on two different strains of alfalfa are examined by Dr. Barnes (0777W876–27).

Nitrogen Fixation--An Inherited Trait?

PRESENTLY USED ALFALFA varieties can fix 250 to 530 pounds of nitrogen per acre per year, depending on weather and the nutrients available in the soil. "If we can increase that by only 50 pounds per acre, it would be worth nearly $2 billion a year to the Nation in increased forage production and fertilizer nitrogen," said geneticist Donald K. Barnes, Plant Science Research Unit, St. Paul, Minn.

"Virtually no research has been conducted in this country on improving the nitrogen-fixing ability of forage legumes. Some work has been done in an effort to improve *Rhizobium* strains, but little has been done to improve the plant's ability to fix nitrogen," Dr. Barnes continues.

Dr. Barnes and his Agricultural Research Service colleagues began their effort in 1974 by analyzing more than 2,000 plants for nodulation, root type, and the ability to reduce acetylene to ethylene. All three traits are associated with nitrogen-fixation.

"We found those plants with high acetylene reduction ability had a more fibrous root system and more nodules than did the low acetylene reduction plants," he said. "Our main objective was to find out whether the nitrogen fixing ability of alfalfa, as measured by acetylene reduction, was an inherited characteristic."

The researchers crossed plants having high rates of acetylene reduction with each other and with plants having low acetylene reduction rates. Crosses were also made between plants with high and low reduction rates.

Seedlings for all of the crosses were grown in the greenhouse. The rate of acetylene reduction for the crosses among high reducing plants was twice the rate of plants from crosses of low reduction parents. Crosses of high and low plants produced plants with me-

Extremes of fiberous root traits are graphically demonstrated in this photograph of two experimental lines of alfalfa. The plant with the highly developed fiberous root structure (right) offers far more potential for root nodulation—and thereby nitrogen fixation (0777W877–14A).

Donald Viands, a graduate student in plant breeding at the University of Minnesota, removes alfalfa plants from a sand bench to prepare them for acetylene reduction analyses. Sand was used as a growth medium because it contains no nitrogen (0777W878–5).

dium acetylene reduction ability.

"If we assume that differences in acetylene reduction rates indicate differences in nitrogen fixation, then our results strongly indicate that nitrogen fixation is an inherited characteristic that we should be able to improve by breeding," Dr. Barnes said. "Cooperative field studies with plant physiologists are underway. Testing procedures to accurately measure nitrogen production under field conditions are necessary to properly evaluate the greenhouse results."

Research leader Gordon C. Marten emphasizes the multidisciplinary approach of the alfalfa project. Working with Dr. Barnes are plant pathologist Fred I. Frosheiser and plant physiologists Gary H. Heichel and Carroll P. Vance.

Dr. Frosheiser concentrates on selecting plants for disease resistance and determines if various types of disease resistance are related to nodulation and acetylene reduction. It will be necessary to breed for both high nitrogen fixation and pest resistance if new varieties are to be successful, Frosheiser said.

Dr. Heichel, who joined the ARS unit in August 1976, is establishing a new growth chamber facility to carry on whole-plant studies that simultaneously relate the photosynthetic capacity of alfalfa plants to their nitrogen fixation capacity. Concurrent measurements of photosynthetic CO_2 exchange and nitrogen fixation using the acetylene reduction assay and tracer analysis with nitrogen-15 are planned. This will permit precise measurements of the nitrogen actually taken out of the atmosphere, used by the plant, or converted to organic forms and deposited in the root system. Dr. Heichel said, "With this whole-plant equipment, we will be able to evaluate the actual relationship of nitrogen fixation to photosynthetic capacity, something that is not possible with the acetylene reduction assay."

Dr. Vance, who joined the ARS unit in September 1976, is evaluating the infection process of nitrogen-fixing bacteria in an effort to find better strains and to gain a better knowledge of how bacteria and alfalfa interact to convert atmospheric nitrogen to a plant soluble form. This work includes the identification of chemical compounds that may be responsible for the host plant recognizing the bacterium. He says a better understanding of how the process works will help the team select and breed plants with the most efficient nitrogen fixing capacity.

Dr. Barnes' address is: Plant Science Research Unit, University of Minnesota, Agronomy Building, Room 402, St. Paul, MN 55108.—*R. G. P.*

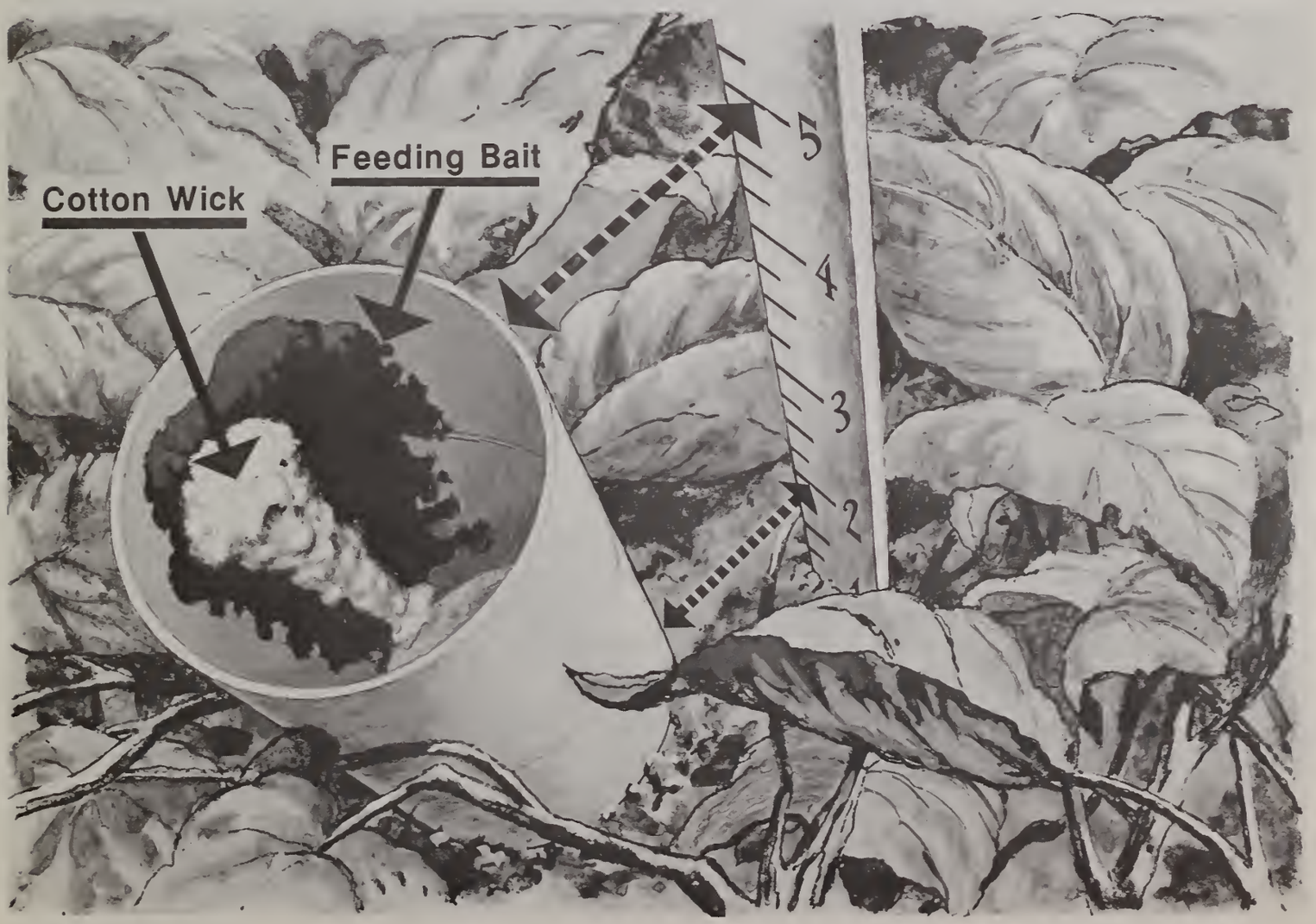
Screwworm Flies, Take Warning

If you're a screwworm fly you would do well to watch out for "screwworm fly killer," a new biodegradable weapon in the ceaseless war against this pest of cattle and other animals. Researchers J. R. Coppedge, M. M. Crystal, J. L. Godenough, working with research leader, J. W. Snow, of the Screwworm Research Laboratory, Mission, Tex., and A. B. Broce of Texas A&M University Agricultural Experiment Station reveal that the new trap promises effective population suppression of screwworm flies.

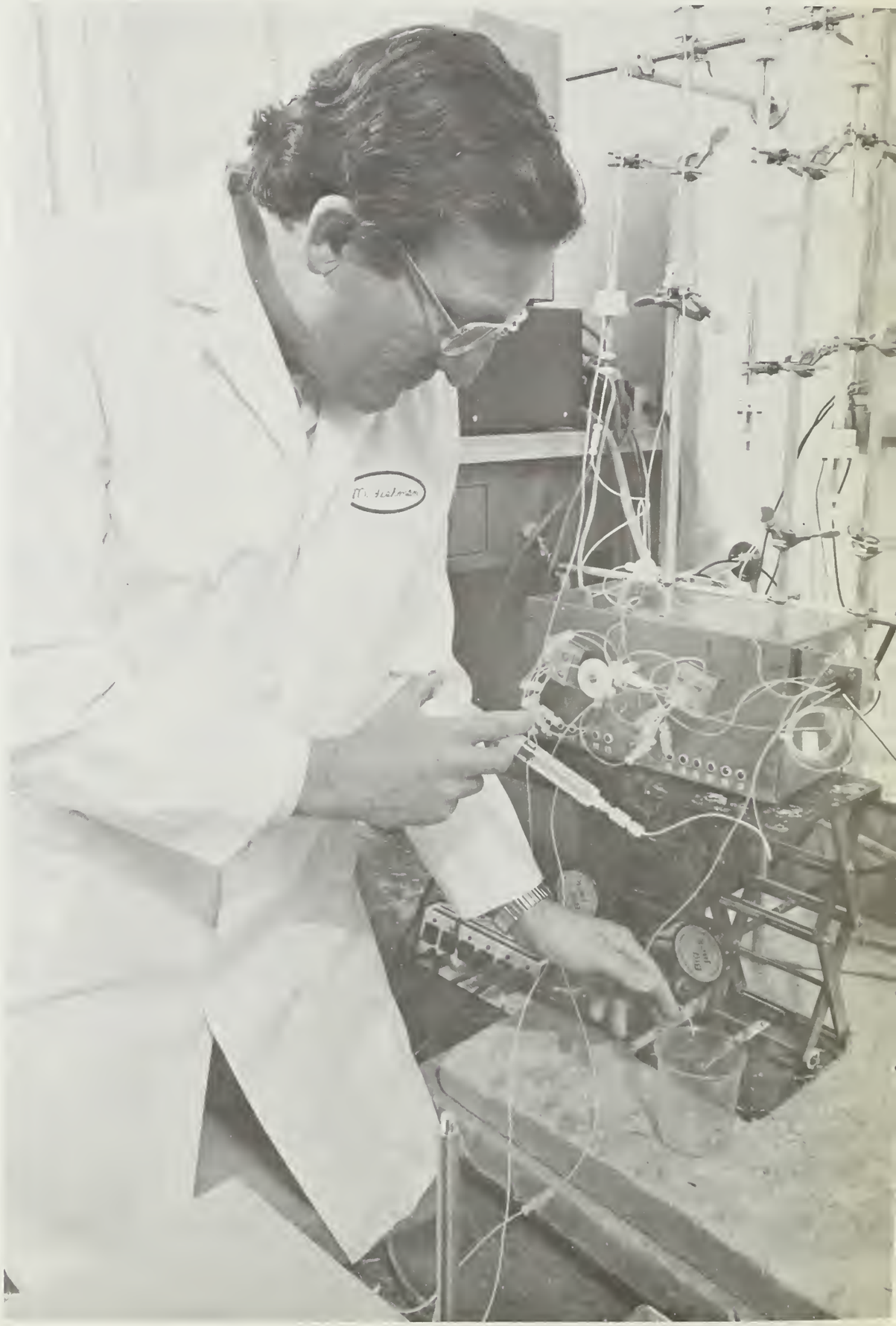
The weapon, a 2- by 3-inch paper cylinder, contains an attractant, bait, and a minute amount of a nonpersistent insecticide. The attractant is called Swormlure-2, and simulates a festering flesh wound. Attracted flies are further lured by a few grams of dried blood and sugar bait, only to be killed by the insecticide added to the bait. The cylinders are dropped from aircraft at the rate of about 20 per square mile.

The major role of the "screwworm fly killer" is to reduce the native screwworm population to levels where artificially sterilized males from mass rearing facilities in Mission, Tex., and Tuxtla Gutiérrez, Mexico, will be more effective in eradicating natural populations.

Favorable tests conducted on the island of Curaçao in the Caribbean have spurred further onsite evaluations in Mexico in the coming year. The address of the Screwworm Research Laboratory is P.O. Box 986, Mission, TX 78572.—*E.A.L.*



Evaluation of Protein from



Dr. Fishman injects a sample of grass protein into an automated gel filtration chromatograph that has specially packed columns (0277X161–14).

Forage

WITH THE AID of a new scientific instrument called an automated gel filtration chromatograph, ARS scientists have obtained and evaluated three grades of protein from coastal bermudagrass (CBG).

The new instrument can be used to evaluate a broad spectrum of legumes and grasses, such as alfalfa, ryegrass, and fescue. It can also be used to evaluate the proteins and polypeptides in ensiled grasses and the commercially prepared soluble protein from forages.

"Just as the horse was found to be an inefficient source of power compared to the internal [combustion] engine, cattle are a potentially inefficient power source for conversion to food protein compared to mechanical or chemical processing of grass as food."

The statement comes from research chemist Marshall L. Fishman, at the Field Crops Utilization and Marketing Research Laboratory. He is referring to the power required to supply protein to a hungry world. While "grass steaks" are clearly not in the cards, products made from processed grasses can and do feed some segments of the human population. In Pakistan, for example, people eat a gruel made from grasses in preference to beef.

Also, grasses are used as animal feed, thus making grains available for human diets.

Up to 27 percent of the crude protein in CBG, a 10-million acre crop in the Southeastern United States, may have potential as human food. At least 53 percent could be made available for single stomach animals and the remainder for ruminants. At present, CBG (grazed or baled as hay) is suitable only for sheep and cattle. But protein extraction is difficult in CBG because of the chemical complexity of the grass. An instrument was needed for rapidly measuring the quality of extracted proteins.

Gel filtration, a form of chromatography using porous gels packed in columns, has been a useful tool for characterizing biological molecules for many years, but analysis has been slow due to instability of the gel packings.

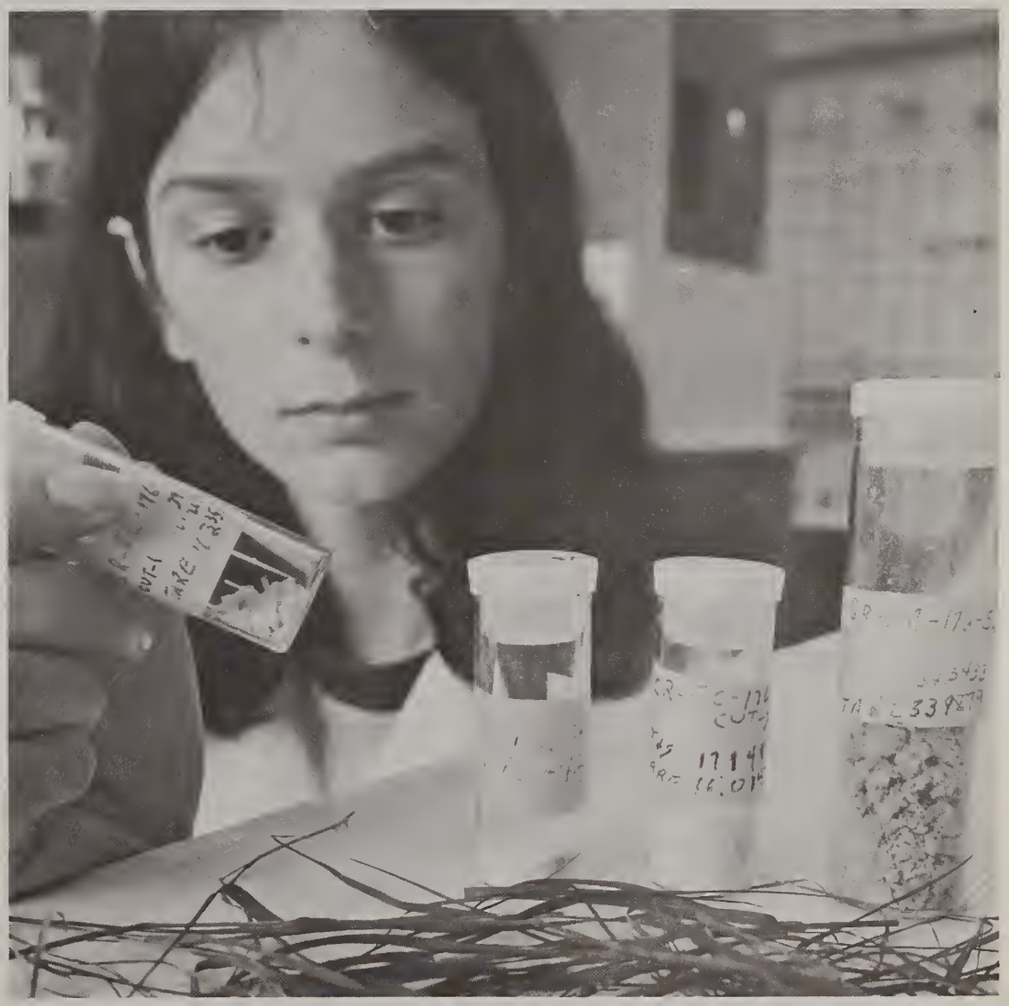
Dr. Fishman's new technique packs these gels into columns so that they remain stable to compression indefinitely, incorporating the columns along with other components into a gel chromatograph which analyzes up to five samples automatically. The chromatograph analyzes the samples unattended in 16 hours or less, with one initial loading.

By appropriate selection of gel columns and chemical detection devices, the chromatograph is able to measure change in solubility, contamination by various organic compounds, and degradation of protein.

In addition to its usefulness in protein extraction in CBG, the chromatograph can be used to analyze molecular weight distributions, solubilities, and changes in chemical structure for complex mixtures of biological molecules.

Presently, and in the future, applications of the new technique include chemical and molecular weight characterization of macromolecules in plant extracts or single cell microbes. The chromatograph also will facilitate study of biodegradation processes in silage, waste effluents from tanneries, and studies on ruminant digestion.

Dr. Fishman is at the Field Crops Utilization and Marketing Research Laboratory, Russell Research Center, P.O. Box 5677, Athens, GA 30604.—*P.L.G.*



Physical science aide Beth McDonough checks different protein "fractions"—i.e., freeze-dried isolates obtained from aqueous buffer—extracted from coastal bermudagrass. The fractions will be redissolved in sodium chloride solution for injection into the automated gel filtration chromatograph. In the foreground is fresh frozen coastal bermudagrass (0677B809–31).

This ladybug is getting its wings clipped before being set free on soybean plants. Ladybugs represent one of the three groups of beneficial predators and parasites (the wasp and the spined soldier bug represent the other two) being tested as "wingless" biological control agents (0877B1064–36).

A Remedy for Flighty

FARMERS AND HOME GARDENERS would get more help from several kinds of insects that parasitize and prey on harmful insects if the beneficial insects were not flighty. ARS scientists contrived a way to stifle insects' waywardness—clip their wings!

That idea may seem a little absurd, but entomologist Carlo M. Ignoffo of the Biological Control of Insects Research Unit says that an operation to remove insect wings really serves as a research technique. He and his colleagues released beneficial species of dewinged insects on soybean plants in greenhouse and field studies.

The scientists reasoned that if partially immobilizing beneficial insects increased the insects' effectiveness, then practical application of the knowledge might follow. Perhaps chemicals that inhibit wing development could be found and wingless beneficial insects could then be mass produced and released to control harmful insects. Inducing genetic mutations of winglessness or selecting mutants that are naturally wingless might even be a more feasible step toward mass production, the researchers suggested.

"Our field study with *Podisus maculiventris*, which prey on cabbage looper larvae, showed that 84 percent of the dewinged predators remained at least 3 days in small soybean plots where they were placed," said Dr. Ignoffo.

In other plots where winged *P. maculiventris* were released, only 12 percent remained. In addition, the dewinged beneficial predators laid about nine times more eggs than the winged predators. Eggs from both winged and dewinged eventually hatch into normal wingless young predators which do not develop wings until they become adults, yet prey upon insect pests during their entire lives.

In other soybean plots, the scientists released dewinged *Hippodamia convergens*—commonly known as ladybugs, which feed upon eggs of the soybean podworm. Soybean podworms, also known as corn earworms and cotton bollworms, are serious pests of soybeans. About half of the dewinged ladybugs remained in the plots for at least 1 day and virtually none of the winged ladybugs remained. Feeding by the dewinged ladybugs reduced the egg population about fourfold.

In a laboratory study, the scientists placed young larvae of soybean loopers on potted soybean plants. Then, as the larvae fed on leaves, they were exposed to groups of dewinged, beneficial, wasp-like parasites (*Campoletis flavicincta*). These dewinged wasp-like parasites killed about 85 percent of the soybean loopers, said Dr. Ignoffo. In contrast, winged *C. flavicincta* parasitized about 7 percent of the larvae.

y Insects

The experiments were part of a larger study on new management systems for controlling insect pests of soybeans. Dr. Ignoffo says that presently, in Missouri and much of the Midwest, where agricultural pesticides are used with moderation, naturally occurring parasites, predators, and insect diseases usually hold soybean pests in check. But scientists are seeking new knowledge to help farmers deal with insect infestations.

"We want to develop controls that are compatible with beneficial insects and that don't hamper progress of future agricultural technology," says Dr. Ignoffo. "If we judiciously select our insect control agents and use them properly, we may never experience the problems that have developed in other crop ecosystems."

Carlo M. Ignoffo's address is: Biological Control of Insects Research Unit, Research Park, P.O. Box A, Columbia, MO 65201.—*G.B.H.*

Top and center: *Dewinged but hardly disarmed: although neither the adult spined soldier bug (top, 0877B1065–19) nor the adult ladybug (center, 0877B1065–34A) were able to fly, they both kept their appetites. Here, the soldier bug preys on a caterpillar pest which tries to "curl away" in self-defense, while the ladybug prepares to eat a caterpillar egg.*

Bottom: *Unable to fly to another field, these dewinged beneficial predators will seek out and eat every caterpillar pest they can find—but they won't damage the soybean leaves, no matter how hungry they become (0877B1068–5).*

Right: Soil scientist William E. Larson checks the spray pattern of sludge shot from a "traveling gun irrigator" designed to handle agricultural wastes containing up to 10 percent solid matter. A half-inch layer of sludge will be applied, after which scientists will trace its heavy metal, nitrogen, and phosphorous components (0777W871–16A).

Below: From atop a raft, a "lagoon sludge dredger" agitates sludge settled at the bottom of an artificial pond. The loose solid matter is drawn by an irrigation pump to testing grounds about 100 yards away. At present, storage of sludge in artificial ponds is almost exclusively an urban strategy. But increased recycling of sludge into fertilizer could eventually make "sludge lagoons" a familiar sight on farmlands (0777W869–29A).

No Metal Uptake by Corn or Grass

CORN AND REED CANARYGRASS yielded well on land treated with sewage sludge without picking up heavy metals on an experimental watershed at Rosemount, Minn.

Dr. Edward Clapp, ARS soil biochemist at St. Paul, said applications of 4 tons of liquid digested sewage sludge per acre applied each year for 2 years produced an average of 4.4 tons of reed canarygrass, dry matter basis, per year. A conventionally fertilized control area without sludge application produced an annual average of 3.5 tons per acre.

Three years of 4.5-ton applications of sludge per year produced average yields of 108 bushels of corn and 6.5 tons of fodder per acre. The commercially fertilized area produced 102 bushels of corn and 6.1 tons of fodder.

Dr. Clapp is conducting tests on a 40-acre research watershed at Rosemount. "We had 10 experimental areas for this project: 5 planted in corn and 5 in reed canarygrass. One area of each crop received a normal application of commercial fertilizer, the other eight received sludge," he said.

"The objectives of the project are to develop safe, efficient, and practical methods for the application of sewage sludge to land for agricultural purposes and, also, to collect information on specific practices so that we can develop safe management guidelines for land application of sewage sludge," he said.

"The main problems we are studying are heavy metal pickup by plants and losses in runoff or ground water of heavy metals or the plant nutrients, nitrogen and phosphorus."

"Analyses showed there was no difference in the heavy metal content of the corn grain or leaf tissue from the sludge areas as compared with corn from the fertilized area," Dr. Clapp continued.

The sewage sludge contained several metals, including chromium, 25 parts per million (ppm); zinc, 900 ppm; copper, 600 ppm; lead, 300 ppm; nickel, 20 ppm; and cadmium, 7 ppm.

"Reed canarygrass tissue analyses were normal for good quality grass and again showed no significant differences between sludge and control areas," said Dr. Clapp.

Surface water samples were collected during runoff and soil water samples were taken at depths of 2 feet and 5 feet. Samples from wells and from other sources outside the treatment area were also collected and analyzed for heavy metal concentrations and plant nutrients.

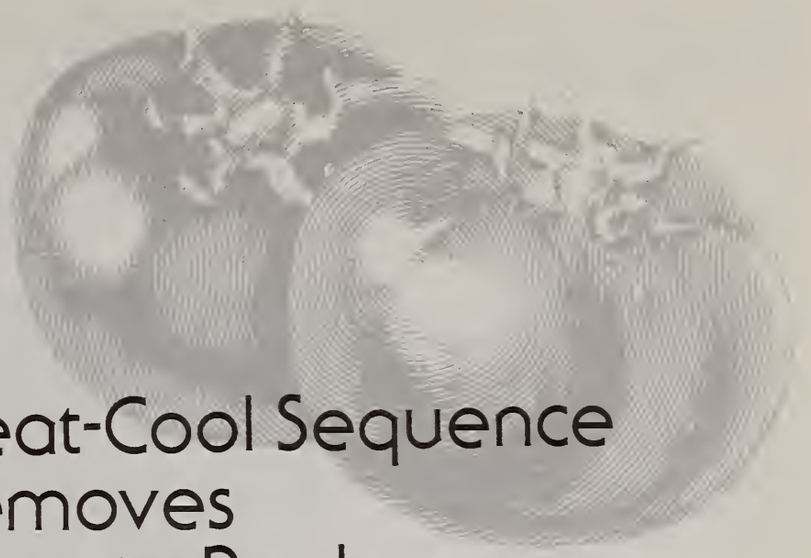
"The concentration of heavy metals in soil water was not increased by sludge application, and analyses of surface and subsurface water showed no movement of potentially polluting materials out of the watershed," Dr. Clapp said. "There was some movement of plant nutrients in surface water on the sludge-treated land within the plot area during snowmelt, early spring runoff, and high rainfall periods."

The watershed is terraced and designed to keep runoff on the treatment area.

"Results so far indicate that this type of sludge may be used safely for agricultural purposes if the land is properly terraced for control of runoff," Dr. Clapp said.

Other members of the ARS research team include soil scientists William E. Larson, Robert H. Dowdy, and Dennis R. Linden; agricultural engineer Russell E. Larson, and research technician Daniel R. Duncomb. The project is in cooperation with the University of Minnesota's Department of Soil Science, USDA's Soil Conservation Service, the St. Paul-Minneapolis Metropolitan Waste Control Commission, and the U.S. Environmental Protection Agency.

Dr. Edward Clapp is at the Soil Science Building, University of Minnesota, St. Paul, MN 55108.—*R.G.P.*



Heat-Cool Sequence Removes Tomato Peels

A NEW PROCESS for commercial tomato peeling uses only heat and water, both of which may be recycled to conserve our natural resources. Conventional peeling processes use large amounts of heated caustic (lye). Caustic is expensive and requires large amounts of energy for its production. Peels removed by caustic are difficult to dispose of and can pollute our environment if not properly handled.

The new process, developed by ARS scientists, involves heating tomatoes with steam at approximately 315° C (600° F) then cooling them in a water bath or spray. Each step requires approximately 10 seconds and the heat-cool sequence is usually conducted three times for a total of 60 seconds. Peels can then be removed mechanically.

"In the present commercial tomato peeling process, caustic is required to remove the tougher peels of tomatoes destined for processing," said agricultural engineer Charles C. Huxsoll, Berkeley, Calif. "These tougher skinned tomatoes were bred to withstand the rougher handling inherent in mechanical harvesting. But these skins are more difficult to remove than skins on garden varieties. Further development of the 'heat-cool' process could provide a means for removing the tough skins without the need for caustic," he continued.

Plant physiologist Merle L. Weaver said "The process is similar to that used by housewives who remove skins from their garden-grown tomatoes by first dipping them in boiling water to loosen the peels. Because this simple technique does not work with tougher-skinned processing tomatoes, we had to develop a method so that heat only penetrated and loosened skins and not the pulp or interior. If tomato interiors are heated, some of the pulp is removed along with the skins, making recovery of this edible portion difficult."

"Tomatoes peeled in the laboratory by the ARS process have a high quality and a very attractive appearance. Also less pulp is removed with skins," said food technologist Keng Ng.

Pilot scale testing of this process will continue this year. Equipment manufacturers and processors have shown considerable interest in the project.

Drs. Huxsoll, Ng, and Weaver are at the Western Regional Research Center, 800 Buchanan Street, Berkeley, CA 94710.—*D.H.S.*

New Directions for Virus Control

This 4-week-old chicken is being vaccinated with Newcastle disease virus. Newcastle vaccination by the eyedrop method is a common commercial practice, although in the United States vaccination through spray or drinking water is more often used. For experimental and regulatory purposes, however, the eyedrop method is generally preferred (0677B811–7).

A WIDELY ACCEPTED antioxidant used to delay degradation in food for humans as well as feed for animals has recently been reported to protect chickens from Newcastle disease virus (NDV).

"To consider immediate clinical use of butylated hydroxytoluene—BHT—for control of virulent NDV is premature, even though the chemoprophylactic effect is evident in our experiments with chickens fed 100 to 200 parts per million of BHT in the total diet," says veterinary medical officer Max Brugh, Jr., Southeast Poultry Research Laboratory.

NDV, which is highly contagious and produces a sometimes devastating disease, is controlled primarily through immunization with live virus vaccines of avirulent NDV strains. Yet, for diverse and often unexplained reasons, says Dr. Brugh, these vaccines sometimes fail to immunize the birds that receive them. Because BHT protects chickens exposed to either vaccine or virulent strains of NDV, this commonly used feed additive may actually interfere with effective Newcastle disease vaccination.

In his studies, Dr. Brugh found that *in vitro* (outside the body of the chicken) inactivation of NDV by BHT is dependent on concentration of the chemical, exposure time and temperature, and strain of virus tested.

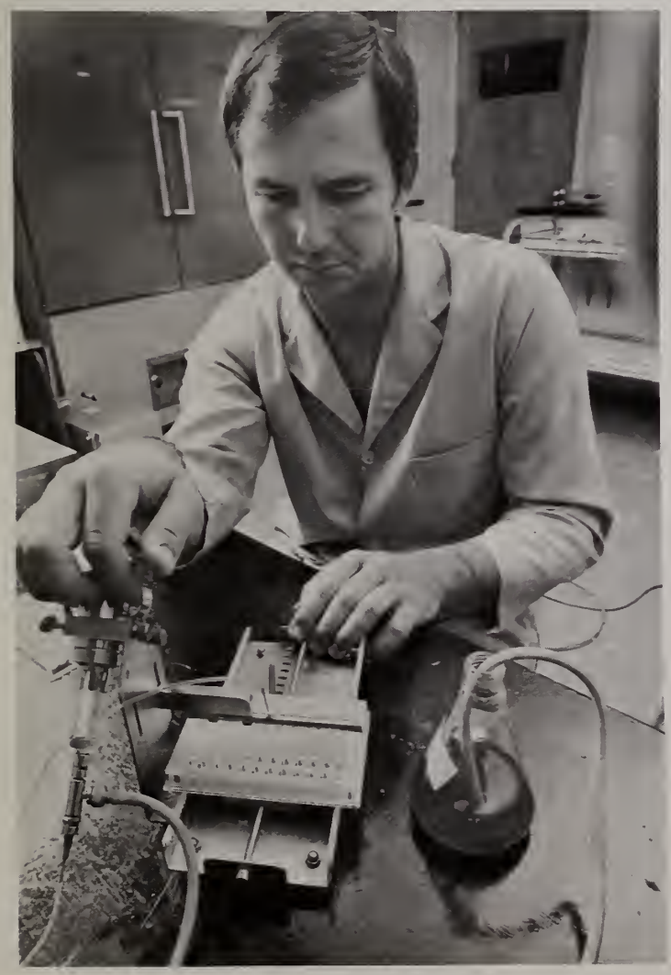
Exposure of NDV to low concentrations of BHT for 30 minutes at 37° C (98° F) causes a marked reduction in viral infectivity, more pronounced with avirulent NDV LaSota than with virulent NDV Texas–GB. The inactivation of these two viruses by BHT was essentially complete after 10 to 15 minutes at 37° C or after 30 minutes at 25° C (77° F).

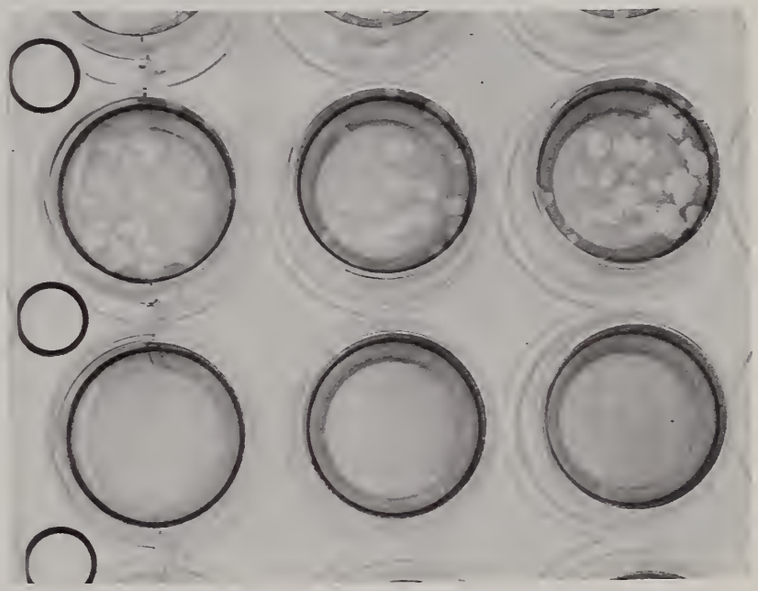
In tests to assess the *in vivo* (inside the body of the chicken) effects of BHT on NDV, immature susceptible chickens were fed nutritionally adequate diets containing various levels of BHT—up to 2,000 parts per million—and were then exposed to several different concentrations of virus.

Infection rate and mortality were maximum in untreated controls, and survival of BHT-treated chickens was generally in proportion to BHT concentration. The mortality differences were most apparent when the virus dose was minimal.

In addition to providing a possible explanation for the vaccination failure encountered with NDV vaccines, Dr. Brugh suggests that the study may point to a new direction in the development of antiviral agents. "Now we need to define the mechanism of the apparent antiviral action of BHT and to study other viruses using both BHT and related compounds," he said.

Dr. Max Brugh, Jr. is with the Southeast Poultry Research Laboratory, P.O. Box 5819, 934 College Station Rd., Athens, GA 30604.—*P.L.G.*





Above: *The inhibiting effect of BHT on Newcastle disease virus can be seen in this plaque assay done with cultures prepared from normal chicken tissues. Cultures along the bottom were innoculated with NDV treated with BHT. The top row was innoculated with untreated NDV. Samples along the top reveal the presence of infectious NDV, while the cultures innoculated with BHT-treated viruses show no signs of infection (0677B811–29).*

Left: *Biological laboratory technician William J. Wilkes dispenses an erythrocyte suspension into a microplate containing chicken serum previously incubated with Newcastle disease virus. Settling patterns of erythrocytes in the microplate indicate whether the serum-donating chicken was infected with NDV (0677B812–13A).*

Mr. Shackelford compares opening of top door on old style or conventional poultry coop with the larger opening of a coop designed for the new poultry unloading system (0277X164–4).

Dumping Birds, But Gently

HANDLING CHICKENS when they arrive at the processing plant is a dirty job. It may be as rough on the handler as it is on the chicken.

All this is being changed by a new automated coop handling system that marks the first major change in live handling of broilers in the past decade.

Two broiler processing plants—one in Georgia and one in Arkansas—are currently using the system and four companies are manufacturing and selling the new coop.

Basically, the system dumps broilers from the coop and transports them loose on a belt conveyor to the hanging cage.

The new coop has a very large top door mounted lengthwise. When the door is opened, approximately one-half of the top area is readily accessible for loading and unloading birds.

A powered lift truck transports 44 coops per trip from the live haul trucks. A powered feed conveyor provides temporary storage for 6 stacks of 11 coops each and loads them, 1 stack at a time, onto the tilting frame conveyor. The tilting frame rotates the stack and deposits the coops onto an inclined conveyor.

The rotation of two powered wheels at the end of the inclined conveyor forces the coop to tip over; as the coop is being rotated, the weight of the broilers opens the door.

The broilers slide out of the coop, down a chute, and onto a belt conveyor which transports the live birds into the hanging cage. In a conventional plant, the live birds must be removed from the coop by hand, a laborious and sometimes rough procedure. With the new system, workers easily pick them up from the belt and hang them in shackles.

Empty coops are returned to a restack station where one worker stacks them on a powered conveyor for automatic removal to a storage conveyor. The storage conveyor accumulates stacks of coops and provides rows of coops ready for the powered lift truck to transport back to the truck for return to the growing house.

Eleven coops are emptied every 45 seconds or approximately 7,200 birds per hour.

Two coop unloaders can handle 100,000 birds a day, and the system

now costs approximately $45,000 to install.

Processing plants expect to save about 30 percent in labor on the bird receiving dock.

The coop is an outgrowth of an experimental coop unloading machine (*Ag. Res.*, Feb. '75, Unstacking Boiler Problems) designed by Agricultural engineer A. Don Shackelford and John Holladay at Russell Research Center.

Mr. Holladay said "The chickens are not handled nearly as much—it's a gentler process. As a result, there is less downgrading of birds and more profit. Another money saver is that the coops last longer."

Mr. Shackelford also emphasized the improved working conditions. "Workers in processing plants are hard to keep," he said. "The two men required to handle this system efficiently now contend with fewer feathers and less dust."

Important to the processing industry is the potential 30 percent overall savings in labor as well as a better product for market.

Mr. Shackelford and Mr. Holladay are at Russell Research Center, Box 5677, Athens, GA 30604.—*P.L.G.*

Mr. Holladay checks the dumping action of coops being transported by conveyor chain on the live-bird receiving dock of a commercial processing plant. Once emptied, crops are restacked and conveyed back to the live poultry haul trucks (0277X165–29).

AGRISEARCH NOTES

New Yearbook—Gardening for Food and Fun

"GARDENING for Food and Fun," the 1977 Yearbook of Agriculture, features gardening tips and advise for a diverse range of gardeners—from novice to experienced.

Secretary of Agriculture Bob Bergland described it as a practical book for gardeners of all types—from the beginner to the proficient, from young people to retired persons.

"Gardening is one of America's most popular activities," Secretary Bergland said. "A USDA study last year found that nearly half the households surveyed either had a garden or intended to have one."

The new Yearbook, which has nearly 400 pages of text, 74 color photos, and 171 black and white photos, is organized into 4 sections. The sections cover an introduction to gardening, vegetables, fruits and nuts, and a final section on how to preserve and store garden products.

Specialists in a wide variety of fields have written this guide for successful home gardening. Gardeners will have a chance to study the book and benefit from its tips well in advance of next year's planting.

Copies of "Gardening for Food and Fun," the 78th Yearbook of Agriculture, may be purchased for $6.50 each from government bookstores, or by sending a check or money order to: Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Order by stock number 001–000–03679–3. Members of Congress have a limited number of copies for free distribution to constituents.—*M.M.M.*

Muscular Dystrophy in Minks

A NEW MINK disease has been identified as a form of muscular dystrophy. Studying mink afflicted with this disease could provide better understanding and possibly treatment of the disease in humans.

ARS veterinarian John R. Gorham, working with veterinarians of Washington State University, identified the mink disease as a hereditary disorder affecting skeletal muscles throughout the body. The mink disorder strongly resembles human muscular dystrophy.

Muscular dystrophy is a disease which progressively wastes muscles in the body, impairing muscle strength. The disease affects over 250,000 persons in the United States. Though it has been recognized, little is understood about the treatment for muscular dystrophy.

Using an animal as a genetic model of a human disease provides medical researchers much greater opportunities to study the disease and to experiment with treatments than they would have by using only human patients.

Dr. Gorham's address is Wegner Hall, Washington State University, Pullman, WA 99164.—*L.C.Y.*

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Mechanically Harvestable Strawberries Possible

UNIFORM RIPENING and higher yields than present-day, hand-harvested strawberries, make a new strawberry—Linn—a prime candidate to be the first mechanically harvested commercial strawberry in the Pacific Northwest.

Developed by ARS horticulturist Francis J. Lawrence, Corvallis, Oreg.; Linn is uniquely adapted to mechanical harvesting. Nearly 85 percent of the fruit matures uniformly yielding a 75 to 85 percent machine harvested usable fruit. Test yields over a 4-year period averaged 5 tons per acre using a mechanical harvester. This yield is slightly higher than the average yield of hand-harvested berries and much better than any previous mechanically harvested strawberry.

Named for Linn County in Oregon, the Linn strawberry plant grows semi-erect with a concentrated crop and the fruit is almost completely exposed for easy machine harvest. Though Lawrence would like a tougher skin to better protect the fruit from bruising. Linn berries are firm and when ripe, feature a prominent stem that can easily be removed by mechanical means.

The flavor and color of Linn berries are so good that once processed, it is impossible to distinguish mechanically harvested Linn berries from hand-harvested fruit. Linn berries show good tolerance to red stele root disease and good mildew resistance, the two major strawberry diseases in the Northwest, but its tolerance to virus is not completely known. Working in this area is ARS plant pathologist Richard H. Converse, also of Corvallis.

Labor shortages and recently enacted child labor laws make hand-harvesting of strawberries economically unsound in the Northwest. Mechanically harvesting Linn strawberries could reduce needed hand labor for harvesting by at least 75 percent.

Dr. Lawrence's address is Agricultural Hall, Room 1036, Oregon State University, Corvallis, OR 97331.—*L.C.Y.*

Solar Powered Insect Traps

SCIENTISTS WITH ARS and two other Government agencies have combined efforts in a pioneering experiment to use solar energy to operate insect survey traps. These traps determine population patterns of harmful insects. Then, effective insect control programs can be started to reduce crop damage.

The other agencies involved with ARS are the National Aeronautics and Space Administration (NASA) and the Energy Research and Development Administration (ERDA).

The traps were designed and built by a team of scientists headed by agricultural engineer J. P. Hollingsworth, Cotton Pest Control Equipment and Methods Research Unit. The team also operates the traps which are charged by photovoltaic (solar cell) power systems designed by NASA. The solar cells store energy during the day to power the traps at night.

One of the traps used for the experiment attracts insects by a fluorescent blacklight. The other kills the insects on an electric grid after they have been attracted by a synthetic pheromone (sex attractant).

The data gathered on insects collected by these traps go into computer programs which will enable scientists to predict future insect populations.

The advantage of the solar-powered traps is that they may be placed wherever desired, however remote. Since sunlight reaches to distant fields where powerlines do not, scientists are no longer constrained in the conduct of long-term studies by a lack of power availability, as has been the case in the past.

Solar cells were developed originally to power satellites in outer space and are now being used for a variety of applications on earth.

Mr. Hollingsworth's address is: Cotton Pest Control and Methods Research Unit, Room 231, Agricultural Engineering Bldg., Texas A&M University, College Station, TX 77843.—*B.D.C.*