

spray material. The same necessity exists for caution in the timing and clean-up after the use of aerosols to remove dead insects as with other space sprays. Insects that fall into containers after the use of an aerosol are just as objectionable as any other dead insects.

Where insecticides are permissible, residual-type sprays have come into use. They are usually more economical in first cost and cost of application and in frequency of use. Residual-type sprays are designed for application only to the places where insects go to rest or roost or hide, of which usually there are relatively few in a processing plant. When the places have been covered with a residue of the insecticide, insects that go to them are killed if the spray material was well selected. The residues often continue to kill for months. They are usually quite effective in preventing insects from breeding. They kill constantly, and insects are not allowed to build up to objectionable numbers. More than any other material in recent years, the residual insecticides have improved sanitation in and about processing plants where food for man or animals or clothing are handled.

Because many insecticides and fumigants are poisonous to humans as well as to insects and because insecticides, like any other material not necessary in the production of food, would be adulterants if permitted to fall into food, only workers trained for the purpose should use insecticides about food-processing plants.

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## Extension Work in Entomology

M. P. Jones

Extension entomology developed from a need to have technically trained entomologists in the State extension services to conduct educational programs in insect control and beekeeping.

The extension entomologist brings to the public useful and practical information and encourages the adoption of recommended practices. The information derives from experiments conducted by the State experiment stations and the United States Department of Agriculture.

Extension entomology grew out of the demands of the public for help in fighting an increasing number of insect pests, the lag between the research worker's discoveries and their application by farmers, and the inability of other organizations to supply the needed help.

The beginning was in 1913. By that year the alfalfa weevil, first noticed in the United States near Salt Lake City in 1904, had spread over Utah and into points in Idaho. Growers of alfalfa knew its destructiveness but were confused as to the character of injury it caused. Hay growers in Idaho were worried about quarantine laws enacted by California and Montana and the threat to their most profitable crop and livestock feed. The University of Idaho decided on a new approach. On April 1, 1913, the State extension service there hired T. H. Parks to devote his full time to extension entomology. The appointment was about a year ahead of the Smith-Lever Act, which created the Federal-State Cooperative Extension Service. Later that year the extension service in New York employed C. R. Crosby as extension entomologist to help combat the insect

pests attacking the fruit orchards. The number of such specialists increased gradually between 1913 and 1922 and since 1933. In 1952, 65 extension entomologists were employed in 42 States.

Nine States employed extension specialists in beekeeping in 1952. In most States extension work in beekeeping is handled by the extension entomologists, who also do the extension work in the control of pestiferous spiders, snails, slugs, rats, mice, gophers, birds, and like animals. Their first responsibility is to fortify the 9,000 county agricultural, home demonstration, and 4-H Club agents with current information and why and how it should be put into practice.

The extension entomologist's most effective method of operation is to develop his program in advance of the time when the insects are present and causing damage. Then he can help set up demonstrations of methods, plan for farm tours, and prepare informational materials—exhibits, models and mounted specimens, motion pictures, lantern slides, chalk talks, reports on local conditions, and such. The county agent learns most about the insect and its control from the specialist's visit during an outbreak of insects.

Because too few extension entomologists are employed to serve the agents by visits to the counties, the entomologists have had to rely on such measures as annual refresher courses, which bring together the county agents in a State or district. Because the situation regarding pests and pesticides has been changing rapidly, some extension entomologists issue weekly service letters in which they report on the occurrence, abundance, and development of pests, give information about control measures, and summarize results of experiments by State and Federal research workers.

Pest control now has so many aspects that the specialists and county workers cannot do the job only through direct work with farmers. More and more they work with insecticide and equipment manufacturers, distributors, re-

tailers, commodity production associations, lending agencies, milling and meat-packing industries, canning companies, cotton ginners, oil crushers, other processors of crops and livestock, farm organizations, agricultural consultants, field agents of milk companies, and similar groups.

The groups receive the entomologists' bulletins on pest control and beekeeping and often reprint them in their house organs and periodicals. Specialists appear on their programs and thus project farther the information and recommendations they have. Entomologists in many States arrange conferences with sellers of insecticides. They review the recommendations for the State and discuss the insecticides for which the dealers likely will have a demand. Similar conferences are held with pest-control operators and the operators of aerial and ground equipment who apply insecticides.

SOMETIMES A CRITICAL SITUATION requires concerted action—the sudden outbreak of a pest like grasshoppers and chinch bugs in a region of several States, for example, or the need to warn people of the dangers of careless use of an insecticide or the need (as in 1951) of greater care of stored grain and hence the need for greater efforts against insects in farm grain bins. We call them drives or campaigns, for want of better terms. They are conducted on a regional or State basis. Usually the interested groups in States or counties are organized to share responsibility. An example of such action, which includes extension entomologists and other Government agencies, is the grasshopper control program.

EVER SINCE THE FIRST SETTLERS inhabited the Plains States, grasshoppers have threatened crops there. Farmers and ranchers applied the known measures for control with varying results. Later the State colleges and experiment stations offered help. Mechanical devices for destroying the grasshoppers were developed. Some were used ex-

tensively, but all turned out to be inadequate. The use of paris green and wheat bran was a long step forward. Many State agencies used the bait in well-organized control programs. But the problem burst beyond State lines. More attention had to be paid to the breeding places of the migratory forms of grasshoppers which began to damage crops far beyond the place where they hatched. As a result, requests were made for Federal help. The early help consisted of providing poison bait to farmers and ranchers, who scattered it on their farms and adjoining property.

The participation of the Federal Government necessitated the establishment of standard procedure in working with the States. Memoranda of understanding therefore were drawn up by State officials and the Bureau of Entomology and Plant Quarantine. The responsibility of each agency was outlined. In each State where grasshoppers were a major problem one person was designated as State leader of grasshopper control—usually the extension entomologist but sometimes the State regulatory official or the head of the entomology department in the State agricultural college. The county agent was in charge of efforts in his county.

A division of grasshopper control was established in the Bureau of Entomology and Plant Quarantine to administer the program. Its headquarters are in Denver, Colo., which is near the center of the "grasshopper country." Another division of the Bureau and State experiment stations have conducted research on grasshopper control and methods of surveys of grasshopper populations. It is possible now to map the grasshopper-infested areas and indicate the relative abundance of the pests in the different areas. State extension services and other agencies have made annual grasshopper surveys. New chemicals were tested against grasshoppers. Some are as effective as poison baits and more practical to use.

As State leader, the extension entomologist has coordinated the efforts

of the division of grasshopper control and the county agents. He has assisted in the procurement and distribution of baits to counties. When farmers apply their own baits or insecticides, he and the county agents help farmers to decide on the need for control measures and, by means of farm visits, meetings, demonstrations, publicity, and special service letters, help farmers to decide on the need for control measures and to determine what insecticides to use.

ONE OF THE OLDEST and most highly developed extension programs relating to insects is the spray service for orchardists, especially growers of apples, pears, prunes, and cherries. The type of spray service and its extent depend somewhat on the relative importance of fruit growing in the State or county. Research and extension men from the States and the Department of Agriculture give advice at the meetings on the preparation of bulletins that carry recommendations for the control of fruit insects. Federal employees usually participate only when they are located in the State that has the spray service. Extension specialists in entomology and plant pathology usually publish the recommendations and do most of the field work of the spray service. Sometimes the extension horticulturists or other related specialists cooperate.

The service in a number of States has developed somewhat like this: The extension and research specialists hold a meeting to review the results of experiments and extension experience on pest control. They draft tentative recommendations for control of the various pests. At a later meeting the specialists meet with the county agents to perfect the recommendations. They consider the use of insecticides and fungicides on a farm basis according to the experience of the county agents. The recommendations for a given State are often adjusted to agree with those of adjoining States. In some States the specialists go over the recommendations with representatives of insecticide

manufacturers and distributors, who thus get a chance to learn the recommendations first-hand.

Information about the insects, the insecticides to use, and the timing of the applications is then published in bulletins and distributed to fruit growers. During the critical part of the spraying season, the extension entomologist spends much of his time with the county agents and orchardists. The county agents make frequent visits to key orchards to determine the progress in development of the fruit trees and of the insects. The information is relayed to all fruit growers by postal card and radio. In urgent situations, the county agent telephones the information to several orchardists, who in turn telephone their neighboring fruit growers.

Timeliness of applications is important. Proper timing and proper insecticides can reduce greatly the number of applications in a season. The United States Weather Bureau provides special weather reports to aid in the spray programs.

Each week the county agents send to their State extension entomologists a report of the observations in the field. The information from the agents is compiled and distributed to the agents as a weekly news letter, in which the entomologist directs attention to any changes in recommendations, reports on new insecticides, and mentions other matters of timely interest. The county agents and specialists continue to observe spray operations and note the effectiveness of the spray materials. They also hold meetings and arrange tours for fruit growers at various times. Sometimes the fruit is examined to determine the percentage of insect damage.

EXTENSION ENTOMOLOGISTS participate in other work of many types.

When the need for beef and leather became critical during the Second World War, several States were completing campaigns to control cattle grubs. In some of them the extension

entomologist, animal husbandman, dairyman, and veterinarian together organized the project and carried it out. Several months before the season began for treating cattle for grubs, they worked with county agents, farm groups, and commercial representatives to explain the damage the grubs cause, control methods, and materials to use. They prepared news articles and bulletins. As the time for treating the cattle approached they assisted the county agents in demonstrations to show the methods for mixing and applying the insecticides. Sometimes they used grubby carcasses to show the losses caused by the grubs. The work gained momentum throughout the war. As power sprayers became available, more and more cattle were treated for external parasites—in 1949 about 4 million head in the 29 States that submitted reports. The estimated saving to farmers was almost 14 million dollars.

Another program related to the use of DDT against house flies. Many of the States participated. The work in Iowa is typical. The extension entomologist suggested a State meeting be held. The Governor called the meeting and invited organized groups to send delegates. At the meeting procedure was outlined and discussed. The delegates brought the problem to the attention of the county leaders of their organizations and asked their support. The extension entomologist and others of the extension staff prepared, printed, and distributed suggestions for setting up county, community, and town organizations, recommendations for control, posters and stickers, mats for newspaper articles, and news articles giving information on the progress of the campaign. The county extension agents participated actively in the program, but public-spirited citizens did most of the work and deserved credit for its success.

A drive to reduce losses from pests in cotton was another program.

The efforts in South Carolina illustrate the procedure adopted in several

States. Early in 1950 the chairman of the State agricultural committee called a meeting that about 175 representatives of State and Federal agencies, farm organizations, and commercial and trade groups attended. An outgrowth was the organization of a State cotton committee, of which the director of the State extension service was elected chairman. A committee of extension specialists was formed to give technical guidance. Each county in the State organized cotton committees to handle its insect-control program. The State and county committees held meetings, training schools, demonstrations, and tours, and gave reports by radio and newspapers. The results were considered outstanding, as shown by surveys, but nevertheless some farmers failed to apply the recommended measures. Those who did not apply poison averaged about 90 pounds of lint cotton per acre; farmers who poisoned 10 times or more picked about 460 pounds.

The foregoing are but a few of the problems upon which the public requests the help of the extension entomologist. Others include the many additional pests affecting livestock, field crops, fruit crops, the health of man, vegetables, greenhouse crops, home gardens, shade trees and ornamentals, grain and other products in storage, wood structures, household furnishings, clothing, and pets.

AN IMPORTANT PHASE of extension entomology is the work with young people, particularly 4-H Club members. Many State extension services have issued bulletins, circulars, lesson leaflets, project outlines, and activity manuals on the subject of entomology for the use of 4-H Club members. A Department pamphlet, *Miscellaneous Publication No. 318, 4-H Club Insect Manual*, is used widely. Nature study often is conducted at 4-H Club camps. An insect-collecting project has been in operation in Indiana since 1925. About 20,000 persons have participated in it.

Other projects have dealt with the life histories of insects, complete control programs for pests, surveys of the abundance of insects, demonstrations of methods and results, and insect collections. Sometimes the activities are part of a broader project having to do with gardens, cotton, corn, clothing, raising pigs, and so on. Some form of work with insects is being carried on by 4-H Club members in nearly every State.

In some States teams of 4-H Club members are trained to give demonstrations about insect pests and their control. Club members learn to recognize the pest, assess its economic importance, and apply control measures. In Texas, club members learn a certain number of insects; community teams are selected to compete on a county basis, and the county teams compete in a State contest. The teams are judged on oral tests that cover insects found in the contestant's community—the identity of insects, hosts, control methods, and the application of insecticides.

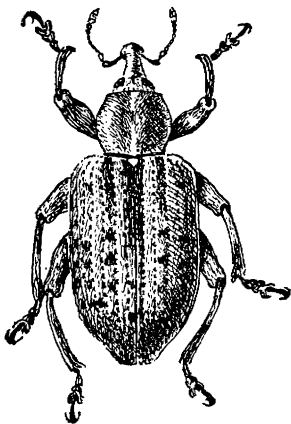
Entomology work with 4-H Club members has developed to the extent that some phase of it is suitable for every club member.

As an added incentive to 4-H work in entomology there has been established a National 4-H Entomology Award. The rewards are medals for the county winners, prizes for State winners, trips to the National 4-H Club Congress for sectional winners, and scholarships for national winners. The rewards recognize excellence in all phases of work relating to insect pests and their control—making collections, conducting life-history studies, carrying out insect-control practices, giving demonstrations relating to entomology, and participating in community-wide control programs.

EXTENSION WORK in apiculture is as old as the extension service itself. Much of the work now is through county and State beekeepers' associations. The usual extension teaching

methods are employed to show the beekeepers how to transfer bees, detect and control bee diseases, and manage the colony for maximum honey production. Management of the colony includes requeening, brood rearing, feeding of bees, swarm control, placement of supers, removal of honey, and provisions of winter stores of food for the bees. Bee management has taken into account the use of bees for pollination—the procurement of bees, the number of colonies needed, and the location of bees in orchards or seed-producing fields. Many thousands of 4-H Club members keep bees as a project. It provides a small enterprise for members who like bees and cannot have livestock or crop projects. John D. Haynie, extension apiculturist in Florida, introduces beekeeping and a taste for honey to 4-H Club members by operating a 4-H Club apiary at one of their camps. The honey produced is distributed to three other 4-H Camps in the State. He uses the apiary to instruct club members in beekeeping practices.

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Alfalfa weevil.

## Entomologists in Washington

*Helen Sollers*

One hundred years ago a man by the name of Townend Glover was so fascinated by insects that he made colored plates of every specimen he could get. He spent years making etchings on stone and copper. He also wrote about the insects he saw. He had a dream of a great book which would illustrate all the common insects of North America and help the farmer to identify any pest he found.

He had a counterinterest that interfered with his dream, however. He made almost perfect models of fruits, which he exhibited at State fairs. He displayed the collection also in Washington, hoping that the Government would buy it. While he was in Washington, the Bureau of Agriculture was established in the Patent Office, and Glover was appointed in 1854 to collect information on insects, seeds, and fruits.

Things moved along in the next 8 years. The Department of Agriculture was established, and Glover was appointed the first entomologist in it. He wrote about the destruction of fruit and vegetable crops by insects. He had time to enlarge his agricultural museum. Congress appropriated \$10,000 to buy the Glover Museum, which comprised insects, birds, and fruit models. He became curator of the museum.

Glover's heart and time went into the museum, which attracted crowds of people. But what was happening to his dream—his "Illustrations of North American Entomology"? He toiled on plates and his notes in every spare hour. His friends pleaded with him to publish the work. Finally at various times in 6 years he put out four volumes in which he pictured and described grass-