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RESEARCH ACTIVITIES AT THE STORED-PRODUCT INSECTS RESEARCH BRANCH

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Dried Fruit and Tree Nut Insects Investigations

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Before I tell you about the Fresno laboratory, I want to discuss briefly the activities of other stored-product insects laboratories across the United States.

The Stored-Product Insects Research Branch of the Market Quality Research Division, Agricultural Research Service, United States Department of Agriculture, conducts research on the protection of harvested agricultural crops against insect infestation and contamination. This includes: (1) Development of preventive and control measures for insects that infest harvested agricultural products and the facilities where food, feed, seed, and fiber are handled, stored, processed, packaged, and transported; (2) development of analytical methods and the determination of insecticide residues from postharvest treatments; and (3) obtaining information on the fate of insecticide residues and the effects they may have on the chemical composition and quality factors of treated commodities and the products derived from these commodities.

Headquarters of the Stored-Product Insects Research Branch are located in Hyattsville, Maryland. The research is conducted at seven locations in the United States. Information is available at any one of these laboratories and may be obtained upon request.

The largest station is at Savannah, Georgia, where research is conducted on such basic aspects as biology, ecology, physiology, toxicology, and nutrition of insects. Applied research projects include evaluation, formulation, and methods of application of insecticides and fumigants. Insect-resistant packages such as multiwall paper bag, and more recently a cotton bag, have been developed for overseas shipment of grain products. The bags are treated with a pyrethrins-piperonyl butoxide mixture, and have heat-sealed paper tape over all stitched seams, or have completely heat-sealed closures. The cotton bag has a waxed paper liner. Controlled atmospheres of carbon dioxide and nitrogen are being studied for control of insects in grain and peanut storages. Protection of packaged foods and bulk grain by irradiation treatments is now under study. Some of these approaches to insect prevention and control may someday play a part in the dried-fruit and tree-nut industries even though most of the present research deals with grain and grain insects.

A station at Tifton, Georgia, works specifically with the insects and control measures involved in corn and peanut storage and processing.

The station at Manhattan, Kansas, works with insects infesting various grains after harvest and several methods of controlling grain insects. Most of their work is with wheat, corn, and grain sorghum.

Insects and control measures concerned with stored and manufactured tobacco are studied at Richmond, Virginia.

Research at the Madison, Wisconsin laboratory is concerned with the insects and mites that attack cheese and non-fat dry milk. Sex attractants produced by female black carpet beetles and various Trogoderma species are being looked at as possible aids in controlling and sampling insect populations.

A station at Beaumont, Texas, is being equipped and staffed to study the insects and control methods involved in keeping rice free of infestation during storage and processing.

The station at Fresno, California, researches the insects and control methods involved in the storage, processing, and transportation of dried fruits and tree nuts.

Mr. Howard Nelson, Investigations Leader at our laboratory, has been directing research on malathion-treated paper raisin drying trays for the past few years. These trays were first made available to the industry in 1966. About 15 million were used in 1967, with promising results. At present, Mr. Nelson is working on development of fumigation methods for applying aluminum phosphide to stored dried fruit, as he has just discussed with you.

Mr. Garth Spitler has been working to develop protective treatments for dried fruits and tree nuts. Most of the research has been on the use of low-toxicity chemicals, especially various levels of malathion, applied to several types of dried fruits, inshell almonds and meats, and inshell walnuts. Commodities so treated are then subjected to heavy infestations of insects for one year to show the effectiveness of the various application rates of the malathion. Concentrations of 3, 8, 12, and 16 p.p.m. on almond meats protected the nuts for 9 months, and the last 3 dosages protected the nuts for a full year. Taste panel tests showed no off flavors. Residue information has been collected along with all these studies. We are now awaiting USDA and FDA approvals for an experimental tolerance for the use of malathion as a protectant on inshell almonds. This will allow further research to be conducted on an industrial scale.

Mr. Al Yerington is working to develop space treatments for insects in storage and processing areas and to develop insect-resistant packages. A vapor generator has been used to apply dichlorvos in wine cellars for vinegar fly and dried-fruit beetle control. Tests in a large raisin processing area have also been conducted. Present activities are concentrated on the use of a thermal aerosol machine to apply pyrethrins for dried-fruit beetle and vinegar fly control. Problems of insect control in prune dehydraters will be studied in the near future. Mr. Yerington has tested the insect resistance of various cartons and visipacks. None of the packages used by the dried-fruit industry were found to be very resistant to insects. A plastic cup with heavy polyethylene cover, not now used in the industry, was the only type of package tested that showed no infestation after 6 months' exposure to intense insect pressures. A carton made of paper laminated on each side with polyethylene shows promise for industry use, but a suitable seal has not yet been developed. Two rooms for testing packages are now being used. One exposes the packages to penetrating insects -- those that can chew into most materials. A second room exposes them to invading insects -- those that must find some existing opening, such as a faulty seal, to enter.

Some of the research such as biology, ecology, and pathology studies are of a rather basic nature at present, but most activities will sooner or later be directed toward the immediate development and improvement of chemical, physical, and biological methods of preventing and controlling insect infestations.

Dr. William Kellen, Dr. Douglas Hunter, and Mr. James Lindegren form the pathology section at our laboratory. They are now working on the microbial parasites attacking the insects of dried fruit and tree nuts. These are the protozoa, bacteria, viruses, and nematodes that infect insects. Several species of protozoan pathogens in the genera Nosema and Mattesia have been found in the dried-fruit beetle and other nitidulid beetles, the red flour beetle, various Trogoderma species, and various moths including the Indian-meal moth and raisin moth. A bacterial pathogen, Bacillus thuringiensis, and a granulosis virus have been isolated from various Indian-meal moth populations. Dr. Hunter will be conducting most of the studies of virus pathogens of insects. He is presently working with one virus attacking the Indian-meal moth and another attacking the almond moth. An electron microscope is being acquired, which will greatly facilitate work with virus organisms. The pathologists have studied some of the pathogens mentioned to work out their morphology, developmental cycles, and lethal concentrations required to kill insects. The pathogens are all specific to insects, and many of them will attack only one species of insect.

These insect diseases may be especially useful to control insects in their breeding areas in the field before they are attracted to dehydraters and processing and packaging plants. Before these pathogens will be available for industrial use, problems of mass producing them, problems of application to an area or commodity, and problems of USDA and FDA approval have to be surmounted.

Dr. Edward Soderstrom studies the effects of pesticides and fumigants on insect behavior and biology and also how the behavior of the insects influences the effectiveness of insecticidal treatments. You already have some insight into this line of research from his talk today.

My own research is concerned with the biology, ecology, and behavior of dried-fruit and tree-nut insects. The research is directed toward development of biological and physical controls in storage and processing areas. It will also provide basic information for the other projects being conducted at our laboratory. We are rearing the saw-toothed beetle, merchant beetle, and Indian-meal moth in controlled environment rooms at constant temperature and humidity to establish the duration of various stages in the life cycles, oviposition rates, and other biological data. We use raisins, prunes, and almond meats as food media. Threshold temperatures and humidities for activity and reproduction are being established so that refrigeration temperatures required to keep insects from developing in a commodity may be determined. Present storage conditions used by the industry are being studied by taking temperature and humidity records in raisin, prune, and almond storage areas. New equipment has been obtained to record temperature and humidity conditions within a mass of commodity. All these records can be used to duplicate actual storage conditions in controlled environment rooms at our laboratory to study the effects of fluctuating conditions on the biology, ecology, and behavior of the insect species involved in dried-fruit and tree-nut storage.

Our analytical laboratory, headed by Mr. Preston Hartsell, has several gas chromatographs and other analytical equipment for determining insecticide residues. Residue studies of dichlorvos and malathion have been made in this laboratory. Mr. Hartsell is now developing techniques to determine oxygen, carbon dioxide, and relative humidity by gas chromatography. These will be useful in the research on pathology and ecology.

In addition to all of these activities, our station and other stations in the Stored-Product Insects Research Branch participate in extramural research with several governmental and university groups and private industry. One such program involves George Okumura of the Bureau of Entomology of the California State Department of Agriculture at Sacramento. He is preparing descriptive material for easier identification of the several larval instars of economically important nitidulid beetles, of which the dried-fruit beetle is a representative.