granules in pesticide-fertilizer mixtures is growing. The reduced load factor and drift factor offer advantages to airplane applications. For many reasons the immediate future looks interesting for granulated insecticides.

Insect Control in Food Packages

Synergized pyrethrum is effective but costs bar wider use in food industry

INSECT DAMAGE is a problem in food production that begins on the farm and in the orchard and extends right through to the final stage of packaging. Prevention of damage and infestation in this last phase is probably the most difficult because of toxicity hazards and limitations placed upon the chemicals and quantities that can be utilized.

Only one compound, Pyrenone, has found acceptance in coating paper bags and cartons against the inroads of boring beetles and other pests. It is a synergized form of pyrethrum, and may consist of one part pyrethrum combined with 10 parts of piperonyl butoxide, the latter acting as both stabilizer and activator.

Knockdown and kill with pyrenone-treated bags is quite high for the first few months. The repellency of the compound, however, has been shown in storage tests to continue for as much as nine months or more, indicating the line of research taken recently. In this work allethrin, lindane, and methoxychlor have shown encouraging results but these materials also have their drawbacks. They are among the insecticides which "migrate" into the inner plies of multiwall paper bags.

Results of this research were described earlier this year before a meeting of the Technical Association of the Pulp and Paper Industry in New York by Hamilton Laudani and Dean F. Davis, Marketing Research Division, USDA. The work has been conducted jointly by the Stored-Product Insects Laboratory and the Quartermaster Corps.

Extended Protection Obtained

An important finding was that treatment of the just outer ply of multiwall paper bags with synergized pyrethrum would give protection for up to 12 months. Bags made of textile materials will require more effective treatment, and a suitable compound has yet to be found for rendering paper shipping boxes insect-repellent.

On the other hand, investigation conducted by Robert Gair Co. researchers has indicated that infestation of stored products is reduced through the use of a pyrenone-treated, clay-coated folding carton. Richard I. Rice, technical director of its American Coating Mills at Elkhart, Ind., contends that most folding cartons are entered through their closures and not through the boxboard.

From the West Coast comes the objection that pyrenone treatment for food containers is costly, and the same criticism is voiced elsewhere in the industry. Production of flour bags involves a manufacturing cost of from 9 to 12 cents per bag, depending on size and type according to a container interest in California. Treatment of these bags with pyrenone will cost an additional 2 to 4 cents per bag. At the TAPPI meeting, Rice declared that cost has been a deterrent to widespread use of the insect-resistant carton. Synergized pyrethrins, he said, cost 0.7 mill per sq. foot of boxboard. Others make it one tenth of a cent.

This brings the outlay for treatment of cartons close to $2.00 per 1000 cartons, and for a company employing up to 20 million cartons a year the added cost would be in the neighborhood of $40,000. The point made is that the cost of infestation would be less in this instance. In most branches of the food industry, certainly in production, processing, and packaging, manufacturers are dealing with very small profit margins necessitating large volume for profitable business.

The use of insecticides therefore in insect-repellent packages will have to be confined to specialized uses. The procedure is being followed on packages intended for export, and some use of it is being made also in drugs and pharmaceuticals, where the profits per package justify the added expenditure. The treated area in this case amounts to only a few square inches.

Pyrenone is a product developed by the Fairfield Division, Food Machinery & Chemical Corp., which recently has located its activities in Baltimore. The company designates the product as an insecticide, although its outstanding characteristics are its repellency to insects and its lack of toxicity to humans in packaging applications. It is used by the Quartermaster Corps, and as a contact insecticide government specifications call for its surface application.

Toughies of the Insect World

The insects which attack food packages are mostly bettles and borers although moths and caterpillars can also ruin food supplies. The confused flour beetle thrives on cereal products. The cadelle is a very tough boring insect who prefers flour, and the saw-tooth grain beetle is only less menacing than the cadelle.

The particular problem in the West appears to be the Khapra bettle against which nothing has been effective in the past except methyl bromide fumigation. More recently paper manufacturers there have been running tests against the Khapra with Pyrenone-treated bags.

Some package experts contend that there is no defense against these pests other than a well designed and constructed package. But this view is not fully shared in the paper and container industries. Besides, some beetles have shown that they can bore through almost any type of paper carton regardless of its construction.

Pyrethrum Progress

Special characteristics and improvement by synergists are pushing up use and encouraging production

PYRETHRUM demand is steadily increasing. This year, U. S. usage of pyrethrins (the general name for the active ingredients in pyrethrum) is expected to reach about 100,000 pounds, as compared to about 80,000 pounds in 1950. U. S. consumption estimates are about 120,000 pounds in 1956 and 200,000 by 1960.

There are a number of reasons, in addition to the general increase in pesticide use for pyrethrum's rise. New government regulations and increasing sensitivity to safety are focussing attention on

Demand for pyrethrum flowers rising

its freedom from toxicity to humans and warm-blooded animals. It is enjoying a rising demand for use in stored grain protection and for insect-repellent packages (see page 991) for cereals and premixed foods. And it is used on some crops such as spinach, cauliflower, broccoli, and sugar beets. Cost and deterioration by sunlight usually discourage its application on crops, but the gradual decomposition is an asset at times.

But by far the biggest use of pyrethrum is in outdoor and household sprays and aerosols for the control of flies, mosquitoes, and roaches. There it is especially effective against insects that have developed resistance to DDT, chlordan, or other standard insecticides.

The increase in demand is encouraging efforts to step up production of the basic raw material in Kenya and the Belgian Congo, where most of the world's pyrethrum flowers are grown. Output of dried flowers, which contain about 1 to 1.6% by weight of active insecticide, is expected to reach 6.7 million pounds in Kenya and more than 4.5 million in Belgian Congo this year. Combined production in those countries is expected to reach about 16 million pounds within two or three years.

Growth Limited by Economics

Pyrethrum flowers can be grown in many parts of the world, but economic production requires high annual yield at low cost. Generally, this means cultivation near the equator at high altitude and where labor is plentiful and costs are low. Picking requires selection on the basis of maturity and machines are not successful. Kenya, which straddles the equator, has roughly 20,000 acres of pyrethrum under cultivation at an altitude of about 7000 to 9000 feet. Belgian Congo has approximately 8000 acres under cultivation at about the same altitude.

Although some distance north of the equator, Japan also produces pyrethrum. Japanese exports of the dried flowers totaled about 1 million pounds in 1954, a large share of which went to Argentina and other South American countries. This year, Japan has exported very little if any pyrethrum and, in fact, is currently considering the importation of African material.

Continuing efforts are being made to grow pyrethrum in South America. Obviously, U. S. companies, which traditionally prefer not to depend exclusively on a single source of supply of any material, don't want to be caught empty handed in the unlikely, but not impossible, event that the African supply is curtailed by a war or a crop failure.

During World War II, concerted efforts were made to encourage pyrethrum growing in Brazil, where, in one wartime year, output reached about 2.5 million pounds, principally for export to the U. S. Since the war Brazilian production has dropped below local demands.

Pyrethrum growing is today a much more active operation in Ecuador, primarily at the urging of U. S. companies. Ecuador began commercial production in 1951 and is expected to turn out about 450,000 pounds of dried flowers in 1955, with 560,000–670,000 pounds next year.

The high cost of harvesting is one reason why pyrethrum growing in the U. S. has never been a real success. As another key factor, the flowering season in the U. S. lasts only about 2 months, as compared to 8 to 10 months in Africa. Some years ago, an attempt was made to grow pyrethrum commercially in Colorado, but was eventually abandoned.

Extract Production Rising

In the past, most pyrethrum has been shipped as flowers in highly compressed bales. But the extract, which has lower shipping cost and better stability of active ingredients, is getting attention in Africa. In late 1953, Kenya made its first large shipment of extract to the U. S. —some 40,000 pounds of material containing 25% pyrethrins. Belgian Congo expects to have its first extraction plant in operation within a month.

As another noteworthy development, the Pyrethrum Board of Kenya recently completed its new chemical and biological laboratory for research on improved strains of pyrethrum flowers and better methods of crop management. The growing of pyrethrum is being rotated with the growing of wheat, corn, and other crops to maintain soil fertility.

The price of pyrethrum has remained relatively steady for the past year and a half and is expected to stay that way for at least another year. The present level is about 45 cents a pound in the U. S. for dried flowers.

Largest single U. S. processor of pyrethrum is Fairfield Chemical Division of Food Machinery, which takes about half of pyrethrum imports. Other major processors are McLaughlin Gormley King, Prentiss Drug & Chemical, Olin Mathieson, and S. B. Penick. Among the largest American producers of finished pyrethrum insecticides is Gulf Oil.

Today, compounds are available that are outstandingly effective in increasing the insect killing power of pyrethrum. Because these synergists also appreciably lower the cost of pyrethrum application, very little pyrethrum is actually used without such an additive. Fairfield's piperonyl butoxide, introduced in 1946, is widely used domestically and abroad. Other available synergists include Penick's sulfoxide and McLaughlin Gromley King's MGK 264.

Researchers are also working on new synthetic compounds resembling pyrethrum chemically and in insect killing properties. The most commercially successful of these has been allethrin. Other synthetic pyrethrum-like compounds such as cyclethrin and Furethrin have also been developed, but suffer from the major drawback that they cannot be synergized as effectively as pyrethrum.

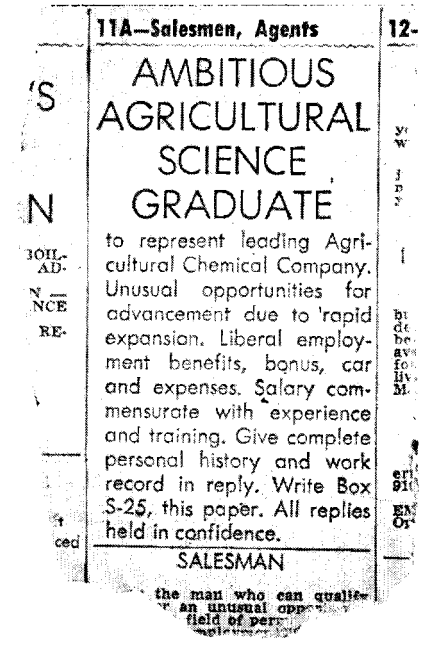
One industry spokesman predicts that world consumption of pyrethrum may double in the next five years. The most rapid growth, he says, will be in areas such as India and the Middle East, where insect problems are especially severe. Indications are that, if the demand existed, Kenya and Belgian Congo could double their pyrethrum production—and, in not too many years, may very well be doing just that.

Agriculturists for Chemical Industry

Shortage of trained specialists in agricultural sciences will soon affect the chemical industry

THE CHEMICAL INDUSTRY not only takes many of our graduates, but this year it also took four of our staff members." This statement from an agricultural college dean was not a com-

Help-wanted ad from newspaper is typical of offers from chemical industry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