lows: Panelwood 37.5%, standard Pressdwood 71.9%, tempered Pressdwood 60.6%, and tempered Duolux 77.5%. Even though the painted Panelwood retained the least gas there was enough methyl bromide in the box to kill any test insects associated with raisins.

The cheapest satisfactory material (unless prices have changed substantially) is Masonite Panelwood or its equivalent with one or even two coats of an asphalt-aluminum emulsion. Unpainted Panelwood or its equal is not satisfactory because it retains little or no methyl bromide during 24-hour fumigations.

Experiments to Exclude *Drosophila* from Dried Fruit[1]

PEREZ SIMMONS, *Stored-Product Insects Laboratory, Agricultural Marketing Service, U.S.D.A., Fresno, California*

This report brings together (1) the results of work done by Dwight F. Barnes (deceased), Erwin F. Sawall, Jr., and George W. Reilly in 1955 on the use of fans at dehydrators to protect fresh grapes from *Drosophila* spp., and (2) tests of open-weave fabrics for the same purpose by Lee A. Wood, Jr., and the writer in 1954. The participants not listed as authors are no longer stationed at the Fresno Laboratory, but credit for most of the work belongs to them.

Most raisins made in California are sun-dried but a small percentage of the 200,000-ton crop is dehydrated to make golden-bleached raisins. Although raisin grapes on the vines in the San Joaquin Valley may become infested by *Drosophila* spp., chiefly *D. melanogaster* Meigen, swarming of adults occurs chiefly on grapes stacked in picking boxes in vineyards or on or near loading docks at dehydration plants. In order to avoid infestation handlers need improved means for protecting the fruit before it is processed into golden-bleached raisins, which includes dipping in water containing lye, washing, sulfuring, and dehydrating. Evidence of infestation on the finished golden raisins has received increasing attention from food inspectors in recent years. Pileup of freshly harvested grapes, either in vineyards or at dehydrators, should be avoided, but even with good planning a supply of fruit must be held overnight in order to get the plant started in the morning before new deliveries begin to arrive from the vineyards.

Two three-box stacks of cull grapes containing crushed, rotten, and moldy berries were set up on a loading dock for each test. One stack was left as a check; the other was air-washed by means of electric fans according to different schedules. The bunches of grapes to be used in the tests were selected before the flies had a chance to settle on them or were freed of most of the insects by holding each bunch in front of a fan. The fans were three-bladed, 17-inch fans having a capacity of 4,500 cubic feet per minute 7 inches in front of the blades. Hand anemometers were used to measure air movements. Some flies reached the grapes when a single fan was directed against a stack from a distance of 12 feet, but the reduction compared with the check stack population was 89%. Reduction was 97% when two fans were used to air-wash a stack on all sides, the air being directed diagonally against corners of the stack so that each fan air-washed one side and one end of the boxes. Speed of the air was from 3 to 6 or 8 miles per hour. Exposure periods were 20 hours or more, beginning in midafternoon.

The reduction in flies was ascertained by the following method. Flies on the grapes were immobilized by spraying the fruit in the treated and untreated stacks of boxes with pyrethrum spray. The grapes were then immersed in water and the flies that floated were recorded. When a single fan was used the average populations of flies per 50-pound box were: air-washed 142; untreated 1,258. Two fans gave the following protection: air-washed 33 flies per box; untreated 1,327.

The experiment with closely woven fabric as protection for fresh fruit was done in heavy paperboard drums, laid on their side and open at both ends except for a covering of 40-mesh cheesecloth. Placed in the shade out-of-doors, these rearing chambers satisfied the requirements of the flies for reduced light, moderate air movement, and favorably cool morning and evening temperatures. There was no activity at night. A large population of flies, in this case *Drosophila simulans* Sturtevant, a species close to *D. melanogaster*, was reared on crushed grapes or canned pumpkin.

Uninfested dishes of attractive food were introduced into the chambers. Each dish was covered with a piece of fabric to be tested; either tobacco shade cloth, 10 threads per inch, or 40-mesh cheesecloth. The tobacco shade cloth was tested plain (single and double thickness) and also after the pieces were dipped in pyrethrum or methoxychlor formulations. The pyrethrum stock emulsion contained 1.18% pyrethrins, 11.84% piperonyl butoxide, 14.81% emulsifier, and 72.17% deodorized kerosene. This stock was used in water at 5% strength. The methoxychlor emulsion contained 24% technical methoxychlor, 63% methylated naphthalenes, 10% dimethyl phthalate, and 3% inert ingredients. Two strengths, 5% and 2%, were used in making the dips.

All treated and untreated shade-cloth barriers, whether in one or two layers, permitted flies to enter within 24 hours and large numbers gained entrance within 48 hours. No *Drosophila* entered dishes of food protected by 40-mesh cheesecloth and no larvae developed in the food.

[1] Accepted for publication May 25, 1960.

Malathion Sprays for Reducing Dried-Fruit Packing House Infestations[1]

PEREZ SIMMONS[2]

Areas in dried-fruit packing plants where cases of packed goods are stacked while awaiting shipment usually are kept clean. However, these areas may be close to storage places for unprocessed dried fruits, some of which may be newly received and not yet fumigated. Such a situation may be an infestation hazard to commodities stored on shipping floors. With this hazard in mind a survey was made extending through parts of three seasons, 1955 to 1957.

Traps devised by Mr. George Riley were distributed. They were made of two 7-inch paper pie plates, with the concave sides facing, joined together at a point where the rims touched with a single staple. Four holes were punched in the side of the lower plate, near the bottom, to serve as entrances for crawling insects. A handful of raisins was the bait used in all the traps except one, in which dried peaches were tried. Collections were made twice weekly as a rule. Captured insects were separated from the baits by sifting, and the baits were then replaced in the trap.

A survey made in eight plants in 1955, using 43 traps, showed that there was a control problem in four of them. In plant 1 the lower 4 feet of wall and a 2-foot strip of adjacent floor was sprayed with a formulation containing malathion at a concentration of 5 pounds in 100 gallons of water. This and subsequent spray formulations were prepared from a 25% malathion wettable powder. When dry the spray left a visible deposit. A second application was made on October 11. The insect counts, although never high, dropped abruptly after the sprays were applied.

Infestations were measured in 1956 by trapping in eight plants in the San Joaquin Valley and San Jose areas of California. Seventy traps were put out on shipping floors. In plant 8 all open spaces on the shipping floor were sprayed on September 14

[1] Accepted for publication May 26, 1960.

[2] The tests reported in this note were conducted by Dwight F. Barnes (deceased), Samuel B. Stagg (resigned June 1958), Erwin Sawall (resigned January 1956), and George W. Riley, associate technical director of Dried Fruit Association of California at the time tests were made.

with a formulation containing 3 pounds of malathion in 100 gallons. A sharp reduction in the insect population followed.

Plant 9 was sprayed on August 17 with a formulation containing 5 pounds of malathion per 100 gallons. The sprayed area was 8 feet wide (4 feet around the perimeter of the floor and 4 feet up the walls) and totaled 2,880 square feet. Three and three-quarters gallons of spray were applied, producing a calculated deposit of 29.7 milligrams of malathion per square foot. The same areas were sprayed again on September 4 and on October 2. Trapping indicated marked improvement in the insect situation after the first spraying, but there was an invasion of larvae of the raisin moth, *Ephestia figulilella* Greg., during the week following the last spraying.

The shipping floor of plant 10 was sprayed on September 14 and again on November 9 with a formulation containing 3 pounds of malathion in 100 gallons of water. Comparatively large catches of insects were taken in the shipping area early in September. This part of the plant was near the raisin stemmer and there was no barrier between. A total of 127 saw-toothed grain beetles, *Oryzaephilus surinamensis* (L.), were collected on September 11 and 79 on September 14. The first collection after spraying (September 18) totaled 18 beetles.

Trapping in 1957 was confined to 14 traps on the shipping floor of plant 15. The owner sprayed four times at monthly intervals. Insect catches for 5 months, from July 5 to December 16, totaled only 96 insects. Catches included the dominant *Oryzaephilus surinamensis*, *Carpophilus* spp., *Drosophila* sp., dermestids, *Tribolium* spp., *Ephestia figulilella*, *Blapstinus* sp., psocids, silverfish, *Cephalonomia* sp., and ants.

A New Technique for Shipment of Natural Enemies of Insects[1]

JOHN LANDI and PAUL DEBACH, *Department of Biological Control, University of California Citrus Experiment Station, Riverside*

In foreign exploration work the biggest problem confronting the entomologist is likely to be the satisfactory survival of parasites or predators en route home. This has been greatly alleviated by the development of air transport; still, certain species, which for one reason or another are preferably shipped as active adults, have exhibited high mortalities during transit. Often adult parasites or predators are more easily obtained by the collector than are the immature forms. Of course, other species, which can be shipped as larvae or pupae inside the host insect and which do not emerge en route, do not present as great a problem. Quarantine restrictions often preclude the inclusion of host-plant material in shipments, and in the case of external parasites this means increased exposure during transit. Such exposure is particularly adverse to small external parasites of diaspine scale insects such as *Aphytis* and *Thysanus*. The junior author had particularly poor results with shipments of both adult and immature *Aphytis* spp. from the Orient to California, especially when parasitized scales on the host plant could not be included.

There are two main problems during air shipment—one is to provide food for the adult parasites or predators which are included or which emerge en route; the other is to minimize exposure to extremes of temperature and humidity which may be encountered. With many parasites and predators, honey applied in thin streaks is a standard adult food. However, its use under shipment conditions is impractical with small parasites which easily become mired in the honey, or in cases where debris or host material is included which sticks in the honey and makes it inaccessible as food. Hence, attempts to devise better techniques for shipment of beneficial insects were carried out, and although these have resulted in an improved method, various ramifications need further work. It seems advisable, however, to review the results obtained thus far because they may be of immediate value to other investigators engaged in similar work.

FOOD SUPPLEMENTS.—Preliminary studies utilizing adult parasites of the genus *Aphytis* as test organisms indicated that a solid or semisolid material having a high moisture content would be a more suitable form of nutrient during transport than pure bee honey, the food supplement generally employed, particularly in cases where large numbers of parasites are to be confined in comparatively small, sealed containers.

The use of pure honey as a food medium has several disadvantages. Inasmuch as honey tends to absorb moisture under certain conditions, its consistency may change from a thick syrup to a thin adhesive film which in transit may spread over large areas of the shipping container, thereby ensnaring the parasites. Honey is also subject to spoilage when exposed to hot, humid conditions.

Earlier trials in which small amounts of honey were covered with thin films of various waxes (in order to prevent small parasites from becoming stuck) were found to be satisfactory for laboratory use but were deemed inadequate for shipment, inasmuch as the honey flowed and the wax films tended to rupture when subjected to sudden movement or prolonged periods in an inverted position.

Several media, including honey-agar mixtures and various dextrose agars, were considered by the authors and temporarily rejected because of the complexity of formulation, procedures involved, and other reasons.

The medium finally selected for further trial consisted of a gel composed of 125 ml. of orange juice, 63 ml. of pectin (MCP brand), and 250 ml. of granulated cane sugar, prepared in a manner similar to that employed in making household jelly, according to the instructions furnished by the processors of the pectin. (Water or other liquids may be substituted for the orange juice in this mixture, and the authors contemplate the use of several supplements in future formulations.) Early trials utilizing this medium indicated that adult *Aphytis* spp. could be held, in the absence of host material, for periods of time equaling or surpassing that of honey-fed parasites. Sometimes the surface of this gel will tend to be slightly sticky, so in order to preclude the possibility of parasites becoming stuck, a thin wax film of the type already tried with honey was used. This is applied as a wax in solution[2] which evaporates out to leave a thin, dry, firm film over the gel through which the parasites readily feed.

SHIPPING CONTAINERS.—With the knowledge from experience that parasites in transit may be subjected to low and sometimes lethal temperatures such as occur in high altitude flights in unheated cargo planes, and conversely to extremely high temperatures which may occur when cargo is temporarily stored or held on the air-strip in transfer operations, a compact, well-insulated shipping container was required that would afford protection against adverse climatic conditions for a period of time. Small commercial vacuum bottles of the type used for cold or hot drinks came to mind as a logical choice for trial. The ones selected for use in the first shipping tests were one-pint vacuum bottle fillers of the type commonly used in thermos bottles, measuring approximately $2\frac{3}{4}\times 8$ inches and weighing 6 ounces (including the cork stopper). Preliminary tests showed that *Aphytis* adults, when packaged in these vacuum bottles, could withstand outside temperatures of −4° F. (−20° C.) for up to 4 hours' duration, and sublethal outside temperatures (near or below freezing) for 8 hours or longer with no ill effects. Shipping tests were then arranged.

Several days prior to the intended shipping date, a fresh mixture of the food supplement was prepared and used to coat the

[1] Accepted for publication June 13, 1960.

[2] Acknowledgment is made to Dr. A. F. Kalmar, Chief Chemist of the Research Division of the Food Machinery and Chemical Corporation Packing Equipment Division at Riverside, for his advice and for making available several types of solvent waxes for these experiments. The wax used in this instance is a Food Machinery Corporation product known as "Flavorseal," which is usually used as a protective film over fruits.