H.A.E.S. Ent. Dept.

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine
Division of Fruit Insect Investigations

University of California — Hawaii Agricultural Experiment Station

Territorial Board of Agriculture and Forestry

Pineapple Research Institute — Hawaiian Sugar Planters' Association Experiment Station.

INVESTIGATIONS OF FRUIT FLIES IN HAWAII
(Formerly Oriental Fruit Fly Investigations.)

QUARTERLY REPORT

July 1 - September 30, 1952.

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INVESTIGATIONS OF FRUIT FLIES IN HAWAII

COOPERATIVE QUARTERLY REPORT

JULY 1 THROUGH SEPTEMBER 30, 1952

With the transfer of Dr. C . C. Roan to another Bureau assignment in Beltsville, Maryland, in September, the studies concerned with the development of fruit fly resistance to insecticides were transferred to the Chemical Control Project. Miss Sue Maeda will have the responsibility for these and the remaining physiological studies, under Mr. Steiner's general supervision. The production of experimental flies, with Miss Dorothy Niimoto in charge, was assigned to the Biology-Ecology Project at the same time. Frank S. Morishita, who has assisted in the insecticide investigations, left the project late in the quarter to join the staff of the University of California at Los Angeles.

We were pleased to have Dr. F. P. Cullivan, Assistant Chief, Bureau of Plant Industry, Soils and Agricultural Engineering visit our laboratories late in September.

The following summaries of progress have been prepared from the reports of the cooperating agencies:

Current Oriental Fruit Fly Situation.--Hawaii - Fruit fly infestations on Hawaii remained at comparatively high levels during the third quarter of 1952. A total of 8,143 puparia were reared from 4,535 fruits for an infestation index of 31.7 per pound. Rose apple was most heavily infested, averaging 149 puparia per pound of fruit. Indices of infestation for other fruits were guava, 45.3 per pound; mango 19.7 per pound; strawberry guava, 94.1 per pound; mountain apple 39.9 per pound; papaya, 1.6 per pound; and lime (only 17 fruits), 28.3 per pound. Individual fruit studies indicated that from 10 to 100 per cent of the various kinds of fruits contained fruit fly infestations, with most having infestations higher than 50 per cent. With the exception of 12 Mediterranean fruit flies reared from mango, all flies emerging from 275 pounds of fruit collected at lower elevations on Hawaii, were oriental fruit flies. Nearly all fruit flies reared from approximately 5 pounds of Jerusalem cherry collected at 4250 and 4600 feet elevations on Mauna Loa Truck Trail were Mediterranean fruit flies.

Maui - The average infestation index was somewhat higher on Maui than on Hawaii. From approximately 280 pounds of fruit consisting of 100 different collections 11,407 fruit fly pupae were reared for an infestation index of 44 per pound. The ratio of emergence from puparia was about one and one-third oriental fruit flies to one Mediterranean fruit fly. Most of the Mediterranean fruit flies were reared from peach collected in the cool Kula section of Maui at elevations from 2500 to 3000 feet, but some were also reared from a few mango collections made at Lahaina, Wailuku, and Kihei--low elevation locations. In one kamani collection made at sea level in Lahaina, the Mediterranean fruit fly was the predominant species in a moderately high mixed infestation of both fruit fly species. Heaviest infestations on Maui were in peach, caused principally by the Mediterranean fruit fly, and the oriental fruit fly infestations in rose apple and mango. Substantial oriental fruit fly infestations also occurred in guava, mountain apple, sapote and fig. The presence of a few scattered infestations of the Mediterranean fruit fly in low altitude areas in which oriental fruit fly is abundant and presumably still capable of exerting a competitive influence, is an unusual development.

Oahu - Samples of guava from Waimanalo had a mean index of 93.8 oriental fruit fly larvae per pound. Mean infestation in ten different guava plots in Brodie gulch was 21.3 fruit fly larvae per pound 42 days after last spray application. Ratio of emergence from puparia reared from guava from Brodie gulch was two oriental fruit flies to one Mediterranean fruit fly. Rose apples in one sample from Honolulu were 100 per cent infested, producing 234 fruit fly puparia per pound, and from 1 to 31 per fruit. Papayas at Waimanalo averaged 4.9 fruit fly puparia per pound on trees cleaned of all ripe fruits 5 days earlier. Previously the infestation had been 15.5 per pound; 86 per cent oriental fruit flies, 14 per cent melon flies (Dacus cucurbitae). Mangoes also had substantial fruit fly infestations.

University of Hawaii records showed that 59 per cent of the guavas collected on Oahu during the third quarter were infested by the oriental fruit fly, an increase from 41.7 per cent during the previous quarter. The average number of larvae per infested guava also increased significantly.

Trapping results for September revealed that adult oriental fruit fly populations were approaching or had exceeded previous peak densities attained during periods of from 18 to 33 months at all trapping sites on Maui and in the Kupaahu area of Hawaii. An abundant mango crop plus other favorable host conditions were responsible for the increase in population densities. On Oahu, University of Hawaii trap catches were higher than the preceding quarter but failed to show any pronounced trends.

Biology-Ecology.--Only winter conditions were simulated in the bioclimatic cabinets during the quarter. The comparatively brief periods of cold weather encountered in the Orlando, Florida, and Houma, Louisiana, cabinets retarded the development of the immature stages but they were not sufficiently severe or prolonged to interrupt the recovery of melon fly, oriental fruit fly, or Mediterranean fruit fly progeny.

In the El Centro, California, cabinet, the production of all three flies ceased by the middle of December and there was no further activity until the end of February. Fruit fly activity and production was at an end by early November in the Auburn and San Jose, California, cabinets. Subsequent conditions precluded the possibility of any further activity until March. The results of all cabinet studies indicated that the Mediterranean fruit fly is capable of more rapid development than the oriental fruit fly but the latter can build up to greater densities in a shorter period of time, under cabinet conditions. The melon fly and Mediterranean fruit fly were able to develop under somewhat cooler temperature conditions than the oriental fruit fly.

Biological Control.—The parasite propagation and release activities of the Territorial Board of Agriculture and Forestry were continued, but at a somewhat reduced level of operations. In all, seven parasites were reared in the insectary and there were sufficient numbers to allow for regular liberations on all the islands. Six shipments of oriental fruit fly parasites were made to Oregon and Idaho, for release as possible parasites of the cherry fruit flies.

University of Hawaii evaluation studies showed that the proportion of oriental fruit fly larvae parasitized thus far in 1952 has been generally lower than in a comparable period in 1951. A total of 33 New Caledonia Opius No. 2 were recovered from fruits collected on Oahu during the third quarter of 1952, in comparison with 7 during the first quarter and 1 during the second quarter. Parasites other than Opius oophilus were encountered too infrequently to detect any changes in their relative abundance. New Caledonia Opius #2 was found for the first time on the Island of Kauai.

Chemical Control.—In screening tests, Geigy 22870 was more effective than G-22008 as a residual oriental fruit fly toxicant. Neither material was as effective against the Mediterranean fruit fly as against the oriental fruit fly. Residues of DDT on field-sprayed guava foliage were more toxic to the oriental fruit fly than to either the melon or Mediterranean fruit flies; with the latter in an intermediate position. Fungicides commonly used on the mainland had no effect on the residual effectiveness of parathion or DDT when combinations of the materials were applied to guava foliage. Bordeaux mixture in combination with DDT had no adverse effect for 6 days but thereafter it greatly reduced the effectiveness of the spray. In the laboratory the fumigant action of aldrin was much greater than that of dieldrin and the action of parathion was the lowest of these three materials. Under field conditions, parathion has demonstrated the best fumigant action. In other tests with sprays, Systox, a systemic insecticide, was less effective than parathion.

In replicated field tests in approximately 45 acres of mango orchard on Maui, a protein hydrolysate-sugar-parathion bait spray, the latter applied at the rate of only 4 pounds of 25 per cent wettable powder per acre, gave 97 per cent control. Parathion alone at the rate of 10 pounds of 25 per cent wettable powder gave 95 per cent, a Dilan-Malathon combination 93 per cent, and a DDT-EPN combination 92 per cent. The sprays, which were applied with a mist blower, greatly reduced fly activity in adjacent unsprayed check plots. The bait spray had no depressive effect on the total parasitization. On Molokai, in similar large plot mango tests, a bait spray containing 8 pounds of 25 per cent parathion wettable powder per acre, gave 96 to 99 per cent control of a somewhat heavier initial oriental fruit fly infestation.

The large scale experiment on the Hamakua coast of Hawaii continues to indicate that the annihilation of the oriental fruit fly male population by means of poisoned methyl eugenol feeding stations will greatly reduce fruit infestations if a large enough area is treated. The reductions were especially good at sampling stations at locations from 700 to 1500 feet elevations where the reductions ranged from 61 to 100 per cent in the latest guava crop. The promising results obtained with this unique method of control have suggested the need for a test in a location where the entire infested area can be treated with the poisoned feeding stations, and other tests where the effect of male annihilation is supplemented with the use of female lures or spot applications of a bait spray to remove at least a part of the female population. Under these conditions, it is possible that entirely satisfactory reductions in oriental fruit fly infestations can be achieved.

A 75 per cent DDT wettable powder retained its residual effectiveness on various screens and surfaces for 6 months. Tests were made with a number of different insecticides to find the most effective material for treating the walls of packing rooms where fruit is packed for shipment to the mainland after fumigation.

A rapid spot method of testing potential fruit fly attractants in the olfactometer has been developed. Among 320 compounds and essential oils screened by this method, 32 were attractive to the oriental fruit fly, and 12 were attractive to the Mediterranean fruit fly. Further study of these materials is needed before the limits of their possible usefulness can be established.

Commodity Treatments.--In screening tests of fumigants, normal hexyl, heptyl and octyl iodides killed 95 per cent of both eggs and larvae of the oriental fruit fly at dosages of 3 milligrams per liter. Ethyl chloroformate killed 95% of the eggs at a dosage of 7.3 milligrams per liter but it was ineffective against the larvae.

There was little or no post-fumigation effect of ethylene dibromide when subsequent conditions were favorable for the development of larvae hatching from fumigated eggs. However, the somewhat greater mortality of larvae hatching from fumigated eggs when subsequent developmental conditions were not favorable indicated that they may be somewhat less vigorous than those coming from untreated eggs.

In small chamber studies with papayas wrapped and packed for shipment and then sealed in cardboard cartons before fumigation with ethylene dibromide, the last survivors were recorded at a dosage of 7/16 pound per 1000 cubic feet for 2 hours at 70° F. In two large chamber tests at a dosage of 3/4 pound of ethylene dibromide per 1000 cubic feet for 3 hours at 70° F. there were no survivors in 4480 papayas containing approximately 20,017 immature fruit flies. Analyses indicated that about 90 per cent of the gas was lost through sorption in the large chamber tests. Recoveries of only 0.8 to 1.4 milligrams of ethylene dibromide per liter inside the cartons after 3 hours indicated that comparatively low concentrations will produce complete kill.

In tests with the Mediterranean fruit fly in papayas, survivors were recorded only at dosages of 1 to 4 milligrams per liter. Results of ethylene chlorobromide fumigation tests on naked fruits infested by the oriental fruit fly were about the same as those obtained with ethylene dibromide.

L. D. Christenson, Entomologist in Charge
Investigations of Fruit Flies in Hawaii

PERSONNEL CHART
INVESTIGATIONS OF FRUIT FLIES IN HAWAII
SEPTEMBER 30, 1952
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