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

April 1 - June 30, 1952.

oOo

WORK PROJECT I-c-3 - Chemical Control - Loren F. Steiner, Project Leader

## SUMMARY

Line Project I-c-3-1. Residual and topical screening tests were conducted with 29 coded compounds at concentrations of 255 mmg./cm.$^2$ or 10 mmg./fly. Compounds 4119 and 4120 were as effective as 1/10 as much DDT in residual tests while compound 4133 was twice as effective. Compounds 4134 and 4138 gave 90 to 98 per cent kills compared to 27 for 1/10 as much DDT in topical tests. Repellency was indicated for compounds 4134 and 4138 and attraction or stomach poison action for 4133.

As a topical treatment, Du Pont's NPD compound was comparable to DDT in solution form. As a residual in wettable powder form, it was inferior to DDT.

Residual deposits from malathon emulsifiable were substantially less toxic than those from the wettable powder.

In preliminary tests, the addition of Fullers earth to Compound 708 emulsifiable improved the toxicity of residual deposits as compared to the emulsifiable alone.

Media made from the inside pulp of guavas sprayed 10 days earlier with Systox at 2 lbs. per acre permitted 90 per cent survival of 3rd-instar dorsalis and 76 per cent of 3rd-instar capitata left in the media for 24 hours. Only 0.4 per cent survival of 2nd-instar capitata occurred in a 3-day exposure period compared to 70 per cent in media from unsprayed guavas.

An improved bio-assay method utilizing guava twigs having about 200 leaves for each efficiency test was developed and used in comparing the residual efficiency of field spray treatments. At 20 lbs. toxicant per acre, methoxychlor proved as good a residual as 10 lbs. of DDT up to 19 days after the application. Parathion was not improved by the addition of "National Sticker." At 5 lbs. per acre its residues 12 days after the applications gave 86-87 per cent mortalities of dorsalis during 24-hour exposure periods. Compound 711 was as effective as dieldrin but neither at 2.5 lbs. per acre equaled parathion at 5 lbs. until after 12 days of weather. Malathon at 5 pounds was about equal to parathion at 2 lbs., neither being effective after 7 days. Systox at 2 lbs. per acre produced 75 per cent mortality 24 hours after spraying but had very little residual toxicity left after 4 days weathering.

In screen cage tests sodium fluoride when combined with the water supply was highly effective as a stomach poison but it was of very low toxicity in topical and residual treatments. Coded compounds 3790 and 3792 produced 80 and 100 per cent mortalities in 24 hours when flies were given access to a 1% solution in their water supply.

Line Project I-c-3-2. In carefully controlled fruit-sampling studies firm green guava starting to break color produced 9.1 larvae per fruit compared to from 5.4 to 6.4 in fruit representing 3 riper stages picked concurrently

from the same guava. Sampling for infestation indices may therefore include mature guavas in all stages of ripeness but there is strong evidence that attempted oviposition at old oviposition sites as the fruit ripens may result in enough egg and larval mortality at the site to reduce the final larval population in the fruit.

Soil insecticide tests indicated that the aldrin aerial spray program on Lanai did not leave enough residue in the soil to depress fruit flies pupating therein one year later.

In bait spray tests on bananas in which 4 sprays at 2-week intervals were applied to the foliage and unsprayed caged fruit was used to measure control, the sprays depressed trap catches in untreated checks half as much during the first 24 hours as in treated. The rate of build-up after that was greater in the sprayed than unsprayed. The bait sprays which included parathion, dieldrin, or G22008 as toxicants with sugar and protein hydrolysate failed to improve on parathion alone probably because of fly movement and the urge to oviposit in the sample fruit before feeding. Mean infestations in 5 replicated treatments ranged from 18.0 larvae per pound for G22008 or parathion 25 WP bait spray to 25.6 for the unsprayed. During the period of its use dieldrin appeared to be a more effective toxicant for the bait spray than parathion when each was used at 1 lb. per acre.

Six acres of guava in each of 2 portions of a gulch were sprayed 3 times at 2-week intervals from the rim with bait sprays containing 0.5 lb. yeast hydrolysate, 2.5 lbs. raw sugar and 1 lb. of either 25% lindane or parathion in 4 gals. water per acre. During the 3 weeks immediately following the sprays infestation indices averaged 3.2, 9.1, and 20.0 larvae per pound for parathion, lindane, and control plots. After 1 to 2 weeks of weathering the respective indices were 7.7, 23.0 and 20.6, demonstrating that parathion was considerably superior to lindane for bait spray use. A bait spray of parathion 0.5 lbs., yeast hydrolysate 0.5 lb., and sugar 2.5 lb. in 6 gals. water was applied to 2 acres of guava in 3 separate gulches and paired with similar areas receiving 1 lb. parathion (toxicant) alone in 3 sprays at 2-week intervals. It gave 97 and 95 per cent control during the first and second weeks after the sprays. The parathion alone gave mean reductions of 92 and 73 per cent. The percentage parasitization was not affected by the sprays.

When 10 spray treatments were replicated 4 times and applied 3 times at 2-week intervals to non-contiguous 50 ft. diameter guava plots in a solid guava stand on the floor of a gulch, 100 per cent control developed in all plots, sprayed and unsprayed, within 13 days after the first spray. The infestation was thereafter negligible until 3 weeks after the last spray at which time sharp increases occurred in some plots. Concentrations of materials used ranged from 2 lbs. Systox, or 5 lbs. dieldrin, parathion, or malathon to 10 lbs. DDT or 20 lbs. methoxychlor per acre. To develop treatments suitable for back-yard plantings test materials must be applied to more widely scattered plots than those used in these tests where about 1/3 of the acreage was sprayed.

Field tests are now under way on Maui and Molokai where the largest crop of mangoes produced in at least 3 years is anticipated. Four spray programs are being compared on 36 acres (3 replicates of 3 acres each) on Maui where the pre-spray infestation in 45 samples of mature picked fruit averaged 4.4 larvae per pound. Two bait spray formulas are being applied to 7 acres each on Molokai where pre-spray infestations averaged 5.1, 5.5, and 9.9 larvae per pound for the 3 varieties involved.

After 28 months' operation the large-scale methyl eugenol-poison bait test at Opaeula gulch was terminated. Guava infestations within the gulch protected by the traps averaged 4.0 larvae per pound as determined by weekly samples taken from Feb. 12 to May 12. Those in 5 or more surrounding untreated gulches averaged 16.4 during the same period. This apparent reduction of 76 per cent is of about the same order as occurred in other prior crops produced in Opaeula since early 1950.

On Hawaii, male flies coming to traps in the 6-square mile test on the Hamakua coast have dropped to such a low level as to suggest almost complete extermination yet infestations are higher than early in 1950. Fertile female movement into the area is indicated. Some control is believed to be developing at the 700, 1100, and 1500 ft. elevations but not at 300 or 1900 feet. Along with a retarded trend in increasing infestations in the treated area a sharp upturn in the Medfly infestation there has occurred at elevations as low as 700 and 1100 ft. where in January, February and March capitata was almost completely absent. Removal of dorsalis competition is the most probable reason for the increase which is very unusual at such a low elevation. In May, capitata was 2 to 8 times as abundant as dorsalis in guava at 700 to 1500' elevations and was infesting an estimated 25 per cent of the guavas.

In the Kilauea experiment 6,100 flies have appeared since February 1 in a single trap on the rim of currently active Kilauea volcano in desert-like terrain. In other traps 0.5 mile or more from the nearest dorsalis hosts, up to 54,000 flies have been taken in single traps indicating extensive fly movement. Infestations in guava in the small treated but semi-isolated area averaged 5.4 larvae per pound during the first month (Jan. 25-Feb. 20) and 15.4 thereafter until production terminated about May 22. In the 4 control areas the mean infestations during comparable periods were 6.7 and 35.0 for an increase of 5.2 times compared to 2.9 for the treated area.

Line Project I-c-3-4. In residual tests with insecticides applied to inside packing house surfaces DDT-75 WP at 0.5 lb. toxicant per gallon of water was still giving essentially 100 per cent control 98 days after treatment. DDT emulsion which never gave 100 per cent kill on all surfaces was 57 per cent effective after 98 days. Dilan EC-30 as an emulsion was 28 per cent effective.

During the period from 55 to 83 days after the applications, emulsions of lindane (0.03 lb. per gal.) and Dilan (0.5 lb.) were still 64-69 per cent effective on unpainted plywood and along with chlordane (0.16 lb. per gal.) were still moderately effective on canec. On non-absorbent surfaces (metal, glass, screening, and painted plywood) these materials were of little or no value after 3 weeks. DDT emulsifiable most closely approached DDT wettable in effectiveness when applied to aluminum sheeting. This was followed in relative effectiveness by deposits on galvanized iron, glass, and painted canec.

Line Project I-c-3-5. Strains bred for tests of resistance were taken over by the Physiology Project in the 15th generation. In residual tests the DDT-residual strain was significantly more tolerant of DDT residues than the NI (no insecticide) strains, but the LD-50 for the latter still remained about half that of the former. The SI (sexually immature when exposed) strain 2 generations after splitting off from the NI strains was showing a tolerance intermediate between the other 2 strains but significantly greater than that of the NI strain.

Line Project I-c-3-6 and 7: Field experiments with lures have been resumed in a new location. Screening traps with 1/4-inch mesh hardware cloth to exclude blow flies did not result in complete exclusion of blow flies but did result in significantly lowering the catch of fruit flies by 25 to 30%. The proteinaceous soy meal lure averaged from 1 3/4 to 3 1/4 times as good as the fermenting lure and gave good performance for as long as three weeks without renewal. Preculturing the soy meal lure with bacterium No. 14 for 1 week was found to be not significantly different than preculturing for two weeks both as to initial attractiveness and lasting qualities of the lure. Freezing the soy meal lure to permit storage depressed its attractiveness. An olfactometer test indicated that prefermentation of the soy meal by yeast 15-2 prior to culture with bacterium No. 14 may improve the attractiveness of the proteinaceous lure.

In olfactometer tests of aromatics 83 materials were screened for D. dorsalis, 37 for C. capitata, and 9 for D. cucurbitae. Some attraction for dorsalis was shown by 21, for capitata by 10, and for cucurbitae by 2. Six showed some repellent action, xylene being one of the most effective dorsalis repellent. Among dorsalis attractants, castoreum, diethyl phthalate, and ethyl oxalate were promising for both sexes while turpentine was attractive to males. Diethyl ketone in water was attractive to cucurbitae males. P-methyl tetrahydroquinoline was slightly attractive to capitata males.

In further tests of methods of utilizing methyl eugenol with poisons on cane squares the fully exposed square again gave better results than that protected from rain. Parathion wettable applied to the cane before application of methyl eugenol again gave better results than use of a single solution of methyl eugenol + G22008 but requires much more labor in maintenance. Use of the methyl eugenol-G22008 formula in larger amounts results in proportionately larger catches. Malathon (technical) proved an effective substitute for G22008 in the formula except during the first 4 days when it appeared to be repellent.

I-o-3-1. Preliminary Laboratory Testing of Insecticides (Keiser, Holloway, Steiner)

Tests with Coded Compounds (by I. Keiser)

During this quarter, 29 compounds submitted by the Division of Insecticide Investigations were tested residually and topically. All of the coded compounds were liquid, except No. 4139, a gray-white amorphoric solid. Table 1 presents the data from the residual tests. Two milliliters of appropriate xylene solutions of these compounds were pipetted into a 100 ml. Petri dish, and allowed to dry for 24 hours, leaving a deposit of 255 micrograms insecticide per square centimeter of glass surface, or approximately 24 pounds per acre of plane surface.

Table 1. Comparative effectiveness of DDT and coded compounds against D. dorsalis adults, when tested as a residual treatment.

| "E" compound | Per cent mortality after specified numbers of hours | | | | "E" compound | Per cent mortality after specified numbers of hours | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 24 | 48 | 72 | 96 | | 24 | 48 | 72 | 96 |
| 4112 | 0 | 0 | 0 | 0 | 4128 | 0 | 1 | 1 | 1 |
| 4113* | 0 | 5 | 5 | 5 | 4129 | 0 | 0 | 0 | 0 |
| 4114* | 0 | 1 | 1 | 3 | 4130 | 0 | 0 | 0 | 0 |
| 4115* | 3 | 17 | 21 | 21 | 4131 | 0 | 1 | 1 | 1 |
| 4116* | 1 | 5 | 8 | 9 | 4132 | 0 | 0 | 1 | 1 |
| 4117 | 1 | 1 | 1 | 2 | 4133 | 43 | 58 | 62 | 63 |
| 4118* | 0 | 0 | 0 | 0 | 4134* | 1 | 8 | 9 | 10 |
| 4119* | 5 | 29 | 49 | 59 | 4135 | 1 | 1 | 1 | 1 |
| 4120* | 15 | 26 | 29 | 34 | 4136* | 0 | 0 | 1 | 5 |
| 4121* | 1 | 3 | 4 | 4 | 4137* | 4 | 7 | 10 | 14 |
| 4122 | 0 | 0 | 0 | 0 | 4138* | 6 | 15 | 23 | 26 |
| 4123 | 0 | 0 | 1 | 1 | 4139* | 0 | 0 | 0 | 0 |
| 4124 | 0 | 0 | 0 | 1 | 4140 | 0 | 0 | 1 | 4 |
| 4125 | 0 | 1 | 1 | 2 | 4141* | 0 | 0 | 1 | 1 |
| 4127 | 1 | 1 | 2 | 2 | DDT 1/ | 18 | 25 | 46 | 55 |

* Apparently repellent to some extent, as noted by infrequency of flies on treated glass surfaces. Only qualitative observations made.

1/ Residual application at the rate of 13 micrograms DDT per square centimeter of glass surface. The coded compounds--255 micrograms insecticide. All mortalities are averages of 2 cages--50 flies per cage. Check mortalities (also based on 100 flies) were 1 per cent after 48, 72 and 96 hours.

It may be noted from table 1 that compounds 4119 and 4120 were somewhat effective when compared with the others, even though repellent in action, and compound 4133 was the best of the 29 tested. However, none was as good as some of the new and promising insecticides tested and reported the previous quarter.

These coded compounds were also tested topically. One microliter of appropriate acetone solution of each compound was applied to the thorax of the adult fly, at a concentration of 10 micrograms insecticide per fly. The results are shown in table 2, where it may be noted that compounds 4134 and 4138 were highly effective. These two compounds were not satisfactory as residual treatments (table 1), very probably due to the repellent action involved. From a field standpoint, however, repellency may not be an important factor if a comparatively large acreage is treated, as the flies might have no alternative but to alight somewhere in the area. Of course, this type of material would not be suitable in bait sprays.

Table 2. Comparative effectiveness of DDT and coded compounds of the Division of Insecticide Investigations against D. hominis when applied as a topical treatment to the adult fly.

| "E" Compound | Per cent mortality after 48 hours 1/ | "E" Compound | Per cent mortality after 48 hours 1/ |
|---|---|---|---|
| 4112 | 0 | 4128 | 8 |
| 4113 | 0 | 4129 | 6 |
| 4114 | 2 | 4130 | 10 |
| 4115 | 18 | 4131 | 0 |
| 4116 | 16 | 4132 | 4 |
| 4117 | 0 | 4133 | 2 |
| 4118 | 2 | 4134 | 90 |
| 4119 | 4 | 4135 | 0 |
| 4120 | 22 | 4136 | 20 |
| 4121 | 14 | 4137 | 22 |
| 4122 | 0 | 4138 | 98 |
| 4123 | 0 | 4139 | 2 |
| 4124 | 0 | 4140 | 0 |
| 4125 | 0 | 4141 | 20 |
| 4127 | 8 | DDT 2/ | 27 |

1/ Coded compounds--average of 50 flies. DDT--average of 100 flies. Seventy-five flies used for check--zero mortality.

2/ Topical applications at concentration of one microgram DDT per fly. All others, 10 micrograms insecticide per fly.

## Tests with Proprietary Formulations (Keiser and Hollowsy)

DuPont product "NFD" was tested against D. dorsalis, and table 3 presents the data from topical tests at various concentrations. One microliter of solution was applied to the thorax of each fly.

Table 3. Comparative effectiveness of DDT and DuPont "NFD" when applied at different dilutions in acetone solution, as a topical treatment to adult D. dorsalis.

| Dosage | | Per cent mortality after 24 hours[1] | |
|---|---|---|---|
| Micrograms insecticide per fly | Micrograms insecticide per gram of fly | NFD[2] | DDT[3] |
| 0.7 | 45 | 60 | 55 |
| 0.9 | 58 | 65 | 85 |
| 2.0 | 130 | 95 | 95 |
| 4.0 | 260 | 100 | 95 |
| 6.0 | 390 | 100 | 95 |
| 8.0 | 519 | 100 | 100 |
| MEAN | | 83 | 84 |

1/ Twenty flies treated with each insecticide at each dosage level.
2/ Eighty-five per cent emulsion concentrate diluted with acetone.
3/ One hundred per cent technical material dissolved in acetone.

As a topical treatment, the NFD solution was strikingly similar to DDT. When wettable powders were tested residually, however, DDT was superior (table 4).

Table 4. Comparative effectiveness against adult D. dorsalis of DDT and NFD when applied as a residual suspension spray.

| Micrograms insecticide per square centimeter of glass surface | Per cent mortality after 48 hours[1] | |
|---|---|---|
| | NFD[2] | DDT[3] |
| 0.36 | 4 | - |
| 0.43 | 0 | - |
| 0.50 | 1 | 3 |
| 0.65 | 4 | 7 |
| 0.93 | 2 | 12 |
| 1.3 | 1 | 20 |
| 2.8 | 23 | 81 |

1/ Two cages (50 flies per cage) were used for each insecticide at each dosage level.
2/ Twenty-five per cent wettable powder.
3/ Fifty per cent wettable powder.

As noted in table 4, NPD was comparatively ineffectual as a residual suspension treatment. Whether or not that was due to repellent action remains to be determined. A solution of this insecticide was also tested residually, using the emulsion concentrate employed in the topical tests described above. There was no residual action at the concentrations tested. This study will be continued.

Studies with emulsifiable American Cyanamid 4049 (Malathon) were made in the previous quarter, and described in the January-March, 1952, quarterly report (pp. 113-116). During this quarter, malathon emulsions and suspensions were compared at different concentrations, under laboratory conditions, and the results are shown in table 5.

Table 5. Comparative effectiveness of malathon emulsion and suspension sprays against adult D. dorsalis when applied as a laboratory residual treatment. Deposits on Petri dishes 24 hours old before introduction of flies.

| Micrograms malathon per square centimeter of glass surface | Per cent mortality after 48 hours 1/ | |
|---|---|---|
| | Emulsion 2/ | Suspension 3/ |
| 0.26 | 30 | 20 |
| 0.43 | 16 | 29 |
| 0.50 | 29 | 39 |
| 0.65 | 28 | 63 |
| 0.93 | 53 | 100 |
| 1.3 | 91 | 93 |
| 3.0 | 96 | 95 |
| MEAN | 48 | 62 |

1/ Two cages (50 flies per cage) used for each type of spray at each dosage level.
2/ 50 per cent emulsifiable material used.
3/ 25 per cent wettable powder used.

The suspensions appeared to give significantly higher mortalities in the middle range of dosage concentrations tested, and approximately the same as emulsions at the higher and lower ranges.

An exploratory experiment (by Holloway) was conducted to determine if emulsions of Dilan prepared from liquid concentrate (50 per cent) would leave more toxic residues if supplemented with wettable powders. Previous work had shown that most wettable powders leave residues more toxic to dorsalis than do emulsifiable formulations regardless of the insecticide involved.

Dilan LC-50 with polyethylene glycol 400 mono laurate as an emulsifier was supplemented with 1/2 as much wettable powder as toxicant and emulsions were pipetted into Petri dishes leaving deposits at 5 levels from 0.51 to 2.5 mmg/cm$^2$. At deposit levels of 0.85 mmg/cm$^2$ and lower no significant toxicity was shown in 48 hours by residues from the emulsion alone or with talc, but when supplemented with Fullers earth the 48-hour kill amounted to 31 per cent. At 1.3 mmg/cm$^2$ this combination produced 48 per cent mortality, more than twice that effected by the other formulas. At 2.5 mmg/cm$^2$ mortalities ranged from 76 to 87 per cent, the differences being non significant.

Testing Guavas Sprayed with Systox for Systemic Action (by Holloway)

The systemic insecticide manufactured under the trade name "Systox" has, in sprays applied at various times during this past year, given excellent control. Since, after three or four days all residual effectiveness is lost, the control may be a result of systemic action or absorption but the possibility also exists that the residues repelled ovipositing flies. In previous tests with media made of systemic treated fruits, eggs just ready to hatch were used and the results were read three days after the hatching date with larval activity or none being the criteria of the effectiveness of the poison. However, the guava media from the sprayed plots was invariably covered with mold at the end of the three-day period and it was not determined whether the molds caused the larval mortality or developed because of the absence of live larvae.

Fifty guavas were picked from sprayed and unsprayed areas in the Brodie plot tests (see Line Project I-c-3-2). They were carefully broken open and the inside meat scooped out and blended into a media. Even though the guavas were gathered 10 days after the spray was applied and 6 days after all residual effectiveness was lost, as indicated by Mr. Keiser's bioassay tests, great care was taken to insure that none of the outside of the guavas got into the media. Samples of the media were then poured into two separate sets of six small, clean ice-box dishes. In two dishes of each set were placed 1,000 third-instar Dacus dorsalis larvae, 500 to a dish, ready to be washed out after 24 hours by which time they would be mature. In two more dishes of each set were placed 1,000 Ceratitis capitata, also third instar and ready to be washed out in 24 hours. In the remaining two dishes of each set were placed 1,000 C. capitata larvae, 3 days old, scheduled to reach maturity in 4 days. Thus there were six replicates of each media, treated and untreated, and two replicates for each type of larvae and each age group.

During the first 24 hours the treated media had no apparent effect on the larvae of either species. At the end of 48 hours the activity of the 2nd-instar larvae in the treated media seemed to stop altogether. At the end of 96 hours these larvae were washed out. Excellent recovery was made from the 1,000 larvae placed in the check dishes, while only 4 survived in the treated dishes. At no time during this test did mold form on the treated dishes. Recovery data are given in table 6.

Table 6.--Per cent recovery of mature live larvae from 1000 second and third instar larvae introduced 1 to 5 days earlier in media made from systemic-treated and untreated guava.

| Treatment | 1000 Larvae exposed | Per cent recovered alive | Per cent fly emergence |
|---|---|---|---|
| Systox 2 pts./acre 10 days before fruit was picked | 3rd instar dorsalis | 90 | 86 |
| | 3rd instar capitata | 76 | 42 |
| | 2nd instar capitata | 0.4 | 50 |
| Unsprayed | 3rd instar dorsalis | 76 | 89 |
| | 3rd instar capitata | 76 | 54 |
| | 2nd instar capitata | 70 | 76 |

The results indicate that little or no toxic action remained 10 days after the spray for nearly mature larvae, but immature (2nd instar) capitata were very susceptible to either absorbed or translocated Systox. Tests are being arranged to yield more complete information on the duration of effectiveness against fruit flies of Systox residues in guava fruit.

Effectiveness of Field Deposits (Keiser and Prange)

A special apparatus was constructed for use in evaluating the effectiveness of insecticidal residues on foliage gathered from guava trees treated with different insecticidal formulations under field conditions, and subject to natural weathering. Four twigs were gathered from each replicated plot in the Brodie guava experiments (L.P. I-c-3-2) and placed in florist tubes to prevent wilting until they were transferred to the laboratory. Each twig contained about 12-13 leaves, so that approximately 50 leaves were used from each replicated plot, or 200 from the four replicates of a particular treatment. Four twigs are placed beneath a 9 by 12 inch cage and kept fresh by having the stems in water beneath the canec board on which the cage rests. The stems lead through a modified florist tube, to the water below, and the rubber cap with a hole takes stems of various thicknesses without affording an opportunity for fly escape. Fifty flies were placed in each cage and fed sugar water on a cotton pad for the 24-hour exposure period. This is a considerable improvement over the masked leaf technique previously employed. It is less time-consuming, keeps the foliage in better condition, utilizes far more foliage thus insuring more reliable sampling, and provides the flies with a somewhat more natural environment. (Figs. 1A and 1B)

The method became available for use near the end of the current series of small plot field tests on guava and was utilized late in the season to provide information on the comparative residual effectiveness of the test treatments. The results are summarized in table 7.

Table 7.--Comparative effectiveness of insecticidal residues on guava foliage gathered from field-sprayed plots[1].

| Treatment | | Per cent mortality after 24 hours laboratory exposure | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ingredients | Pounds toxicant per acre | Days after 2nd treatment | | Days after 3rd treatment | | | | | | | | |
| | | 7 | 13 | 1 | 4 | 7 | 12 | 15 | 19 | 25 | 32 | 39 |
| DDT-50% WP | 10 | 98 | 74 | 92 | 95 | 87 | 61 | 77 | 80 | 23 | 51 | 44 |
| Methoxychlor 50% WP | 20 | 98 | 81 | 96 | 94 | 76 | 94 | 65 | 76 | 6 | 45 | 58 |
| Dieldrin | 2.5 | 71 | 20 | 100 | 99 | 77 | 40 | 14 | 14 | 3 | -- | -- |
| JH-711 - 50% WP | 2.5 | 100 | 13 | 93 | 94 | 68 | 58 | 61 | 24 | 5 | -- | -- |
| Parathion 25% WP+raw sugar, yeast hydrolysate | 2 | 31 | 0 | 100 | 88 | 27 | 6 | 5 | -- | -- | -- | -- |
| Parathion 25% WP | 5 | 72 | 32 | 100 | 99 | 89 | 86 | 21 | 27 | 3 | -- | -- |
| Parathion 25% WP National Sticker | 5 | 96 | 22 | 100 | 99 | 92 | 87 | 35 | 15 | 3 | -- | -- |
| Malathion 25% WP | 5 | 2 | 0 | 99 | 63 | 37 | 2 | 1 | -- | -- | -- | -- |
| Systox | 2 | 0 | 0 | 75 | 18 | 4 | 5 | 2 | -- | -- | -- | -- |

1/ Sprays applied May 28, June 11, and June 26, 1952, from underneath the tall guava trees.

Figure 1A.--The residual action of spray deposits is evaluated by exposing 50 or more fruit flies for 24 hours in cages, each of which contains 4 fresh guava twigs taken at intervals after spraying.

Figure 1B.--Guava foliage sampled from field plots is kept fresh during the fly exposure period by inserting cut ends through a rubber dam, and florist tube open at both ends, into a water bottle below the fly cage.

These results show a surprisingly high residual effectiveness for methoxychlor wettable when it was used at twice the concentration of DDT and 4 times that of most of the other materials. At the concentrations used, DDT and methoxychlor were each highly effective for up to 19 days. Dieldrin and JH-711 were about equal to each other and to parathion. The latter was not improved when supplemented with a new so-called adhesive. The residual effectiveness of malathon at 5 lbs. toxicant per acre was no greater than that of parathion at 2 lbs. in a bait spray. Since sugar water was available to all flies these tests prove nothing with regard to the bait spray except perhaps that in such tests the effect measured is probably largely residual, the same as for parathion alone at the higher concentration. As previously indicated, Systox surface residues are comparatively non-toxic after 4 days. The amount of this material used was less than that of the wettable powders (except the bait spray) but because the formulation is 2/3 emulsifier the use of greater concentrations would have resulted in little, if any, greater deposit.

The composite effect of the residual action shown in table 7 was nearly 100 per cent fly control in both sprayed and adjacent unsprayed guavas in Brodie gulch.

Studies of Laboratory Screening Methods. (Keiser)

Comparative studies were commenced with the topical and residual methods used in bio-assay studies, in order to learn why results are sometimes so dissimilar. A few compounds may be effective residually and not topically and visa versa. In one test sodium fluoride (1% solution) was applied topically to 40 flies with no subsequent evidence of any toxicity. In another test a set of 4 cages (50 flies per cage) Petri dishes treated with 2 milliliter 1% solution of sodium fluoride and cotton dental rolls treated with sugar water were used. In a second set of 4 cages (again 50 flies per cage) untreated Petri dishes and cotton rolls saturated with one per cent sodium fluoride in sugar water were used. Mortalities were zero during the first 24 hours for those flies on Petri dishes treated with NaF and with cotton rolls having only sugar water present and only 20 per cent after 48 hours. Mortalities were 100 per cent after 48 hours (72 per cent after 24 hours) for those flies subjected to clean Petri dishes, but with cotton rolls impregnated with both sugar and NaF. Sodium fluoride had very little residual effectiveness against D. dorsalis, but its stomach poison qualities were readily apparent when the fluoride was incorporated in the cotton rolls which provided a source of food. Within 24 hours the deposits on the Petri dishes became hygroscopic and apparently more toxic. It is understood that a sodium fluosilicate and sugar solution is being used in Australia as a C. capitata bait spray.

In another test, flies were treated topically--once at 0.9 microgram DDT per fly, twice at that dosage, and once at 1.8 micrograms DDT per fly. Approximately 50 flies were treated topically in each series. DDT is evidently cumulative when applied topically, as the 0.9 microgram dosage applied once showed 25 per cent mortality after 24 hours; the 0.9 dosage applied twice, 75 per cent mortality; and the 1.8 micrograms DDT per fly applied once, 68 per cent mortality.

Compounds 3790 and 3792 from the Division of Insecticide Investigations showed definite stomach poisoning qualities in tests arranged to verify previous conclusions. A 1 per cent solution in water was prepared of each material and 2 ml. placed on cotton plugs in "residual" cages. There was no deposit on the Petri dish, and no sugar was included. After 24 hours there were 80 and 100 per cent mortalities noted for E-3790 and E-3792, respectively. (After 48 hours, E-3790 showed 84 per cent mortality.) As previously reported (page 128, October to December 1951 report), these materials, when applied topically to adult *dorsalis*, were non-effective at rates up to 9 mmg. per fly.

Line Project I-o-3-2. Field Testing of Insecticides. (Steiner, Morishita and Lee.

Fruit Sampling Studies (Steiner)

In connection with the large-scale test of methyl eugenol on Hawaii, inadequate guava production in three of the untreated guava sample areas in the Half Way House set-up resulted in a tendency toward the picking of less mature fruit than would have been the case if ripe fruit were abundant. Since the results of this sampling indicated that these three areas contained lower infestations than where more ripe fruit was available a study was started to determine at what stage of ripeness the most larvae would be produced and if the tendency to sample less mature fruit could account for the lower infestation indices recorded in the three areas in question.

A total of 144 guavas of uniform size, averaging 10 per pound and ranging from mature green with only a slight color break to dead ripe, were picked from a single small clump of trees in sample area 8. These were handled carefully to avoid bruising. They were subdivided into 4 lots of 36 fruits each, representing mature green, dead ripe and 2 intermediate degrees of maturity. Each guava was held over sand in an individual quart jar until emergence was complete. The results are given in table 8.

Table 8. Degree of ripeness in relation to fly infestation indices in guava.

| | Sub-sample number | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Maturity - Color - | Breaking | Light Green to Yellow | Yellow | Deep Yellow |
| Firmness | Very firm | Moderately firm | Sl.soft | Soft |
| Infested fruit - per cent | 97.2 | 94.4 | 83.3 | 91.7 |
| Larvae per fruit- | | | | |
| Maximum | 26 | 35 | 17 | 24 |
| Mean | 9.1 | 6.4 | 5.4 | 6.1 |
| Emergence - Per cent | 95.6 | 92.2 | 94.3 | 91.3 |
| % parasites | 62.2 | 74.8 | 65.0 | 68.8 |
| % capitata | 0.3 | 2.9 | 0 | 2.7 |
| LSD (5%) mean number larvae per fruit = 3.0 | | | | |

The results indicate that for sampling purposes where the fruit is to be held over sand and indices are based on numbers of larvae reared, guavas just breaking color may be selected as reliably as ripe fruit. The significantly greater larval production from mature green fruit than from that considered to be ripe was surprising. Consideration should be given to the following points in further studies:

1. Egg and larval mortality may be less in fruit picked green than ripe, possibly because fruit decomposition is less advanced in the early stages of larval development.

2. Repeated oviposition at old oviposition sites as the fruit ripens may result in enough egg and larval mortality at the site to reduce the final larval population within the fruit. This is at variance with the theory sometimes advanced, that D. dorsalis' reproductive capacity tends to increase as the population and fruit attack increases.

3. Dorsalis like C. capitata may oviposit readily in firm green fruit at the first indication of (or possibly even prior to) any color break.

4. Weather conditions or population abundance may have been such that oviposition in the riper subsamples on the days they broke color was at a comparatively low level yet may have been especially favorable at the time the maximum attraction occurred in sub-sample No. 1. For this reason in particular this study needs repeating. However, infestations in the regular 50-fruit samples of ripe fruit from this area averaged 82 larvae per pound March 24, 50.5 on March 31 and 54.4 on April 10. The 3 ripest samples referred to in table 8 averaged 59.0 larvae per pound. They were collected April 4.

5. Opius oophilus, the sole parasite reared from the collections, was about as effective on the most immature fruit as on the ripest.

On the basis of this study picked fruit samples of guava are now drawn from fruit in all stages of maturity subsequent to the first color break.

Soil Insecticide Tests (Steiner, Holloway)

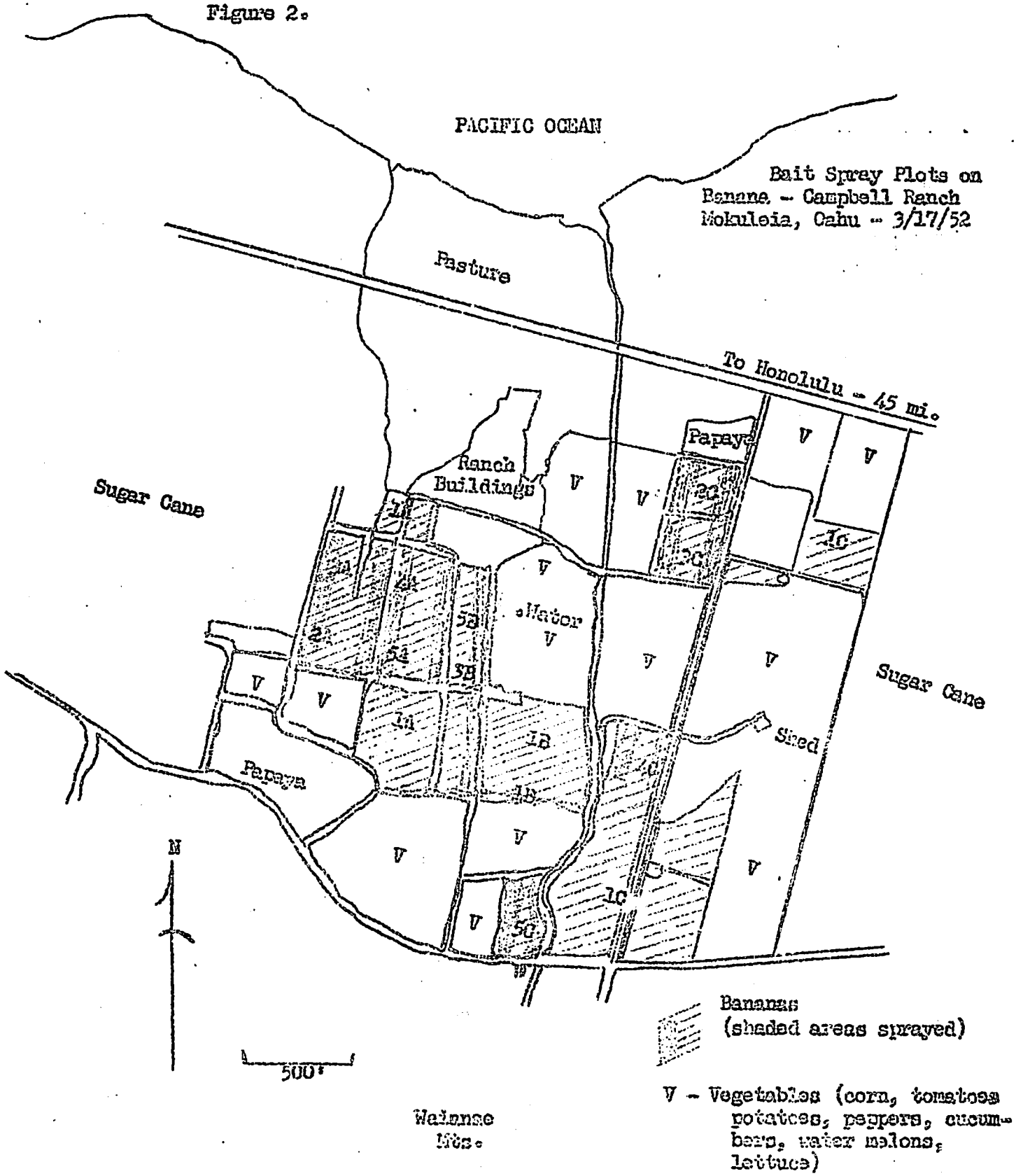
A series of soil toxicant tests including soil from the area control aldrin plot on Lanai and 3 types of Oahu soils was raided by a powerful colony of Argentine ants during the emergence period despite a DDT barrier. Most of the results are of questionable value since the ants destroyed unknown numbers of flies in the plots before they were themselves killed by the various soil toxicants. The number of emerged dorsalis and capitata taken from the Lanai soil slightly exceeded that from the untreated and it may be concluded that by one year after completion of the aldrin aerial spray program the soil no longer contained residues effective against pupating larvae.

Larvae totalling 15,000 dorsalis and 15,000 capitata were supplied for these tests by the fly rearing section.

Bait Spray Tests on Bananas (Steiner, Morishita, Keiser, Kinoshita)

As reported last quarter the Cavendish banana planting at Mokuleia was divided into 5 plots, each replicated 3 times (see figure 2). Each replicate averaged about 1 acre within reach of the spray discharge from the Lawrence Aeromist operated from 2 (opposite) sides of the plot (except the B replicates).

Figure 2.


PACIFIC OCEAN
Bait Spray Plots on
Banana - Campbell Ranch
Mokuleia, Oahu - 3/17/52
Pasture
To Honolulu - 45 mi.
Ranch
Buildings
Sugar Cane
Papaya
Water
Shed
Sugar Cane
Papaya
N
500'
Waianae
Mts.
Bananas
(shaded areas sprayed)
V - Vegetables (corn, tomatoes
potatoes, peppers, cucum-
bers, water melons,
lettuce)

The unsprayed portion also averaged about 1 acre per replicate. Bananas (10 per 1/2 inch mesh cage) in 4 cages per replicate were exposed half within the sprayed portion and half in the unsprayed control area. The fruit, of uniform ripeness, was left for 5 days during two 5-day periods after each spray (2 to 6 days and 8 to 13 days). It was not in place at time of spraying and flies never contacted original spray deposits while attempting to oviposit. Sprays were applied 4 times at 2-week intervals. Changes in formula were made as the experiment progressed and in method of application after the second spray. The test was designed to help evaluate the various components in the bait sprays.

The spray formulas, dates and methods of application are given in table 9 and the infestation indices in table 10.

As evident from the mean infestation indices the infestations in the sprayed as compared to unsprayed portions of each plot were most uniform in plots 2 and 3 which received all three bait spray components (toxicant, sugar, and protein). In plots 4 and 5 where parathion was used alone or with protein, fruit exposed in the unsprayed portion was the most heavily infested suggesting that these sprays leveled the population less than those used in plots 2 and 3. In table 11 the mean differences in infestation between treated and control plots are shown for the 3 periods during which different combinations of formulas were used. The results were inconclusive, except that they demonstrated the difficulty of obtaining effective fly control with the concentrations tested when the sprays are applied to the host foliage but excluded from the fruit surface contacted during oviposition. As in the previous Tifa-fog tests in this same banana planting, flies were undoubtedly continually arriving from adjacent guava areas and spreading over all plots alike, many going directly to the sample fruit for oviposition before feeding and contacting the toxicants. The need for substantial residual effectiveness in the spray deposits is clearly indicated.

There was some indication that dieldrin as used on plot 3 in the fourth spray (May 7) was more effective than the parathion formulas but this requires further study.

As previously reported, the fumigating effect from some of these sprays was sufficient to kill practically all flies present during the first night after each application, an indication that the heavy infestation resulted largely from newly arriving females.

During the 8 days prior to the first spray, female catches in 18 standard fermenting lure traps averaged 10 and 9 per trap day in control and treated plots respectively. During the first 24 hours after each spray the mean catch as compared to that for the preceding 24 hours declined 46 per cent in the control plots and 85 per cent in the treated. From 2 to 5 days after each of the 4 sprays the mean reductions in catches of females compared to those of the 24-hour periods preceding the sprays were 62 and 73 per cent respectively. These data support other evidence that the population in the unsprayed plots was depressed about half as much as in those sprayed during the first 24 hours with a further decline there during the next 4 days while that in the sprayed plots was increasing. The tendency of the population to level off between sprayed and unsprayed plots as a result of interplot movement plus the migration into all plots from outside areas largely nullifies the value of the control plots as the basis for estimating infestation reductions particularly where bait sprays are involved.

Table 9. Spray formulas applied to banana plots[1/]. Mokuleia, Oahu, 1952.

| Date and spray no. | | Pounds formulation per acre in 8 gallons water as mist concentrate | | | |
|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 |
| 3/26 | (1) | G-22008 0.5 lb.<br>Xylene 1.0 "<br>B-1956 0.025 lb.<br>Prot. hydrol. 1.0 lb.<br>Raw sugar 5.0 lb. | Parathion 25 Em. 1 qt.<br>Prot. hydrol. 1 lb.<br>Raw sugar 5 lb. | Parathion 25 Em. 1 qt.<br>Prot. hydrol. 1 lb. | Parathion 25 Em. 1 qt. |
| 4/9 | (2) | do. | do. | do. | do. |
| | | Sprays 3 and 4 applied as coarse spray with 50 gallons per acre at 600 lb. pressure. | | | |
| 4/23 | (3) | Parathion 25 WP 2 lb.<br>Prot. hydrol. 1 lb.<br>Raw sugar 5 lb. | do. | Parathion 25 WP 2 lb.<br>Prot. hydrol. 1 lb. | Parathion 25 WP 2 lb. |
| 5/7 | (4) | Parathion 25 WP 4 lb.<br>Prot. hydrol. 1 lb.<br>Raw sugar 5 lb. | Dieldrin 25 WP 4 lb.<br>Prot. hydrol. 1 lb.<br>Raw sugar 5 lb. | Parathion 25 WP 4 lb.<br>Prot. hydrol. 1 lb. | Parathion 25 WP 4 lb. |

1/ Application made along 2 opposite borders, spraying in 50 to 100 feet depending upon wind. Area, calculated on mean 75 ft. swath, averaged 0.8 acre per replicate. Each plot replicate enclosed or bordered an unsprayed inaccessible strip of about 1 acre. Two banana samples of 10 fruits each were placed in the unsprayed middle and 2 in portions sprayed and left 5 days. Banana fruit carried no spray residue.

Table 10. Number larvae per pound ripe bananas exposed at 4 locations in each of the 3 replicates per treatment. From 540 samples of 10 fruits each.

| Period | Plot | | | | | |
|---|---|---|---|---|---|---|
| | 1 | | 2 | 3 | 4 | 5 |
| Pre-Spray Mar. 20-25 | 59.7 | O[1] | 68.8 | 30.5 | 54.0 | 47.0 |
| | | I | 47.0 | 67.6 | 52.5 | 39.9 |
| | | M | 57.9 | 49.0 | 53.2 | 43.4 |
| Spray 1 (3/26) Mar. 27-Apr. 1 | 42.2 | O | 33.6 | 43.0 | 68.4 | 43.9 |
| | | I | 33.0 | 45.1 | 61.9 | 62.9 |
| | | M | 33.3 | 44.0 | 65.2 | 53.4 |
| Apr. 3 - 8 | 24.5 | O | 28.5 | 39.6 | 8.5 | 16.6 |
| | | I | 44.4 | 37.3 | 17.0 | 35.7 |
| | | M | 36.4 | 38.4 | 12.8 | 26.1 |
| Spray 2 (4/9) Apr. 10-15 | 43.2 | O | 20.4 | 23.3 | 2.0 | 45.5 |
| | | I | 22.7 | 22.0 | 34.8 | 40.6 |
| | | M | 21.6 | 22.6 | 18.3 | 43.0 |
| Apr. 17 - 22 | 37.7 | O | 25.6 | 37.7 | 12.1 | 14.5 |
| | | I | 19.1 | 38.6 | 33.2 | 27.3 |
| | | M | 22.4 | 38.2 | 22.6 | 20.9 |
| Spray 3 (4/23) Apr. 24-29 | 22.8 | O | 2.2 | 11.2 | 4.8 | 19.1 |
| | | I | 6.3 | 5.6 | 12.1 | 16.9 |
| | | M | 4.2 | 8.4 | 8.4 | 18.0 |
| May 1 - 6 | 8.3 | O | 2.9 | 11.2 | 4.0 | 7.5 |
| | | I | 8.8 | 11.8 | 6.4 | 11.8 |
| | | M | 5.8 | 11.5 | 5.2 | 9.6 |
| Spray 4 (5/7) May 8 - 13 | 19.1 | O | 12.1 | 6.6 | 9.7 | 12.2 |
| | | I | 12.6 | 11.6 | 9.4 | 18.1 |
| | | M | 12.4 | 9.1 | 9.6 | 15.2 |
| May 15 - 20 | 7.3 | O | 4.7 | 4.1 | 15.3 | 8.8 |
| | | I | 12.3 | 3.8 | 8.9 | 16.0 |
| | | M | 8.5 | 3.9 | 12.1 | 12.4 |
| March 27 - May 20 | | | | | | |
| Mean - Outer | | | 16.2 | 22.1 | 15.6 | 21.0 |
| Mean - Inner | | | 19.9 | 22.1 | 23.0 | 28.7 |
| Averaged[2] | 25.6 | | 18.0 | 22.1 | 19.3 | 24.8 |

1/ Symbols refer to locations of exposed bananas in plots: O=outer, I=inner, and M=mean.

2/ Each average represents 96 holding-box samples.

Table 11. Per cent control indicated in treated banana plots when compared with replicated check (inner and outer areas combined).

| Period | Plot | 1-6 days | | 8-13 days | | Mean post spray | Per cent indicated |
|---|---|---|---|---|---|---|---|
| | | Index 1/ | % change | Index 1/ | % change | Index | control |
| 3/27-4/22 | 1 | 42.7 | - | 31.1 | - | 36.9 | - |
| | 2 | 27.4 | -36 | 29.4 | -5 | 28.4 | 23 |
| | 3 | 33.3 | -22 | 38.3 | +23 | 35.8 | 3 |
| | 4 | 41.8 | -2 | 17.7 | -43 | 28.8 | 22 |
| | 5 | 48.2 | +13 | 23.5 | -24 | 35.8 | 3 |
| 4/24 - 5/6 | 1 | 22.8 | - | 8.3 | - | 15.6 | - |
| | 2 | 4.2 | -82 | 5.8 | -30 | 5.0 | 68 |
| | 3 | 8.4 | -63 | 11.5 | +39 | 10.0 | 36 |
| | 4 | 8.4 | -63 | 5.2 | -37 | 6.8 | 56 |
| | 5 | 18.0 | -21 | 9.6 | +16 | 13.8 | 12 |
| 5/8 - 5/20 | 1 | 19.1 | - | 7.3 | - | 13.2 | - |
| | 2 | 12.4 | -35 | 8.5 | +16 | 10.4 | 21 |
| | 3 | 9.1 | -52 | 3.9 | -47 | 6.5 | 51 |
| | 4 | 9.6 | -50 | 12.1 | +66 | 10.8 | 18 |
| | 5 | 15.2 | -20 | 12.4 | +70 | 13.8 | 0 |

1/ Number larvae per pound. Mean of 16 samples.

Parasitization prior to the first spray averaged 43 per cent and was 99.9 per cent O. cophilus. During the 2-week periods following the first 3 sprays parasitization averaged 50, 50, 37, 41, and 54 per cent in the five plots (1 to 5 respectively). After the last spray it averaged 30, 3, 5, 16, and 21 per cent respectively but the decline could not be definitely attributed to the insecticides used. Cophilus is believed to have been accompanying dorsalis adult movement from the outside guava areas into the banana acreage.

Bait Spray Tests in Guava Gulches (Steiner, Morishita, Keiser)

Parathion vs. Lindane: The experiment, started last quarter, to compare wettable powder formulations of lindane and parathion as bait spray toxicants has been completed and the infestation data are given in table 12. As previously described (p. 129, Quarterly Report, Jan.-Mar. 1952), 12 acres of guava in a shallow gulch 1/2 mile long were divided into 2 plots and sprayed with a mist concentrate of 0.5 lb. yeast hydrolysate, 2.5 lbs. raw sugar and 1 pound of 25 per cent wettable powder formulation in 4 gallons water per acre. This was half the application rate used in the banana experiments described above and was intended to give less than complete control so that the two insecticides could be better evaluated. The gulches used as controls were distributed in the vicinity and most have been sampled for infestation indices since early 1950. The sprays were applied with the Laurence Aeromist under generally unfavorable weather, usually under windy conditions and during intermittent light showers blown from the nearby mountains.

Mean infestations (larvae per pound) summarized from table 12 were as follows:

| | Pre-Spray | 1st week | 2nd week | Post spray |
|---|---|---|---|---|
| Parathion | 11.5 | 3.2 | 7.7 | 6.5 |
| Lindane | 2.0 | 9.1 | 23.0 | 27.0 |
| Untreated | 6.0 | 20.0 | 20.6 | 12.8 |

The fluctuating infestations typical of many guava areas, especially when small and surrounded by pineapple fields, make any accurate estimation of control impossible in the absence of adequate replication, but the data strongly indicate that lindane was much less effective during the first week after spraying than parathion and was completely non-effective at the dosage used, during the second week after the application. Even at only 4 oz. toxicant per acre, parathion appeared moderately effective during the second week.

The average percentages of parasitization in the various gulches were as follows:

| | 2/18-3/10 Pre-spray | 3/11-4/2 During sprays | 4/22-5/12 Post-Spray |
|---|---|---|---|
| Parathion bait spray | 72 | 73 | 64 |
| Lindane " " | 71 | 63 | 75 |
| Untreated | 71 | 77 | 77 |

During the first week after the three spray applications parasitization ranged from 41 to 89 per cent in the parathion plot and 27 to 68 where lindane was used. During the second week the respective ranges were 85 to 88 and 20 to 83 per cent. The mean of 53 per cent in the lindane plot suggests some adverse effect on the parasites but the evidence is inconclusive. Opius conbilus again constituted more than 99 per cent of the parasite emergence.

Table 12.---Larvae per pound picked guava fruit in Opaeula Gulch (sprayed) and comparable untreated gulches in vicinity.

( --- No ripe fruit)

| Gulch No. | Sample areas | Pre-spray period | | | | Spray 1(3/11) | | Spray 2(3/25) | | Spray 3 (4/8) | | Post-spray period | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2/18 | 2/25 | 3/3 | 3/10 | 3/17 | 3/24 | 3/31 | 4/7 | 4/14 | 4/21 | 4/28 | 5/5 | 5/12 |
| 6 | 19-21 Parathion | 18.1 | 11.9 | 11.2 | 5.6 | 3.0 | 5.6 | 4.6 | 1.6 | 2.0 | 15.8 | 3.4 | 4.8 | 11.3 |
| 8 | 22-24 Lindane | 3.5 | 0 | 4.5 | 0.2 | 1.6 | 14.5 | 11.0 | 14.4 | 14.6 | 40.0 | 31.5 | 22.5 | --- |
| | Mean Untreated | 6.3 | 5.7 | 9.2 | 2.6 | 5.2 | 10.2 | 27.9 | 30.2 | 26.9 | 29.8 | 20.6 | 9.4 | 8.4 |
| 2 | 25-27 " | 0 | 2.8 | 6.6 | 1.3 | 2.0 | 8.5 | 27.4 | 31.1 | 47.0 | --- | --- | 3.2 | 4.0 |
| 3 | 28-30 " | 12.6 | 10.6 | 5.9 | 3.8 | 2.8 | --- | 23.0 | --- | 10.0 | 58.2 | 1.6 | 7.4 | 8.6 |
| 4 | 36-38 " | 6.2 | 9.3 | 7.7 | 1.7 | 3.6 | 3.7 | 3.9 | 14.4 | 4.7 | 8.4 | 6.6 | 19.8 | 12.7 |
| 5 | 45-47 " | no record | | | 5.0 | 4.1 | 9.8 | 7.7 | 21.4 | 15.7 | 12.1 | 36.4 | 5.5 | 9.8 |
| 1 | Brodie " | --- | 0 | 16.4 | 1.2 | 13.4 | 18.6 | 77.7 | 53.8 | 57.1 | 40.6 | 37.6 | 11.0 | 7.0 |

Note: The absence of ripe fruit is indicated by a dash whereas a zero indicates a clean fruit sample. In areas 25-27 for example, the crop on certain trees came to an end about April 14, but that on adjacent trees began ripening 2 weeks later.

In the control gulches the means of the weekly infestation indices and the means of the weekly per cent parasitization were associated as follows: 12.2 larvae per pound with 79 per cent parasitization, 13.1 with 86 per cent, 7.9 with 78 per cent, 12.8 with 64 per cent and 27.5 with 68 per cent. Parasitization by oophilus has undoubtedly reached a point of stabilization in these guava-producing areas with 45 to 75 per cent of the fruit still being infested and without any detectable correlation between percent parasitization and the infestation index.

Parathion alone and with attractants: Guava production in several other Wahiawa gulches came on later than the main spring crop. These gulches were utilized in a replicated test of parathion alone and in a bait spray at a concentration thought to be near the minimum for nearly perfect control. In previous tests of this type, concentrations were kept low enough to show treatment differences.

The tip of Brodie gulch was divided into 2 plots, each about 1/8 mile long. The middle of this gulch was used in small plot tests to be reported later. Unsprayed samples were taken below the small plot tests. Helemano laterals A and B, each 1/4 mile long and 1/3 mile apart and emptying into the large Helemano gulch, were also divided into 2 plots 1/8 mile long. The check plots for these consisted of 2 sample areas in the bottom of Helemano and 1 on the rim opposite the mouths of the 2 treated gulches. The Helemano gulches had produced no guava for several months and the fly population appeared very low. For this reason an attempt was made to stock them with dorsalis and capitata starting April 17 and ending May 13. Containers holding pupae in sand, protected from ants, were suspended at 2 points in each Helemano plot. Helemano A was given only dorsalis, 2000-3000 per week for 4 weeks. Helemano B was given only capitata, 2000 per week during the same period. Helemano Main was given 2000 capitata and 2000-3000 dorsalis each week. Emergence varied but averaged about 50 per cent for the Medflies and 80 per cent for dorsalis. The first fruit began ripening in early April and because of its scarcity was rather heavily infested indicating that dorsalis was present in larger numbers before the releases than anticipated. Beginning early in April single samples of up to 50 guavas were taken from each plot replicate. After May 12 full 50-fruit samples when available were taken from 2 marked areas within each plot replicate. Capitata was recovered only occasionally. Only 18 adults emerged from the samples collected in the Helemano gulches. These were all from fruit collected between May 12 and June 18. The failure of the Medfly to establish itself is difficult to explain since in some of the early samples there was no competition from dorsalis. Sprays were applied May 29, June 12 and 25 with the Lawrance Aeromist. The bait spray was applied at a per acre rate of 0.5 lb. yeast hydrolysate, 2.5 lb. raw sugar, and 2 lb. parathion 25 WP plus water to make 6 gals. The parathion spray consisted of parathion 25 WP, 4 lbs. in 6 gallons water per acre.

Infestation data are summarized in table 13.

The decline in infestation that occurred in Brodie areas 5 and 6 was undoubtedly effected by the spray program on nearby small plot tests which practically annihilated the population in the lower end of the gulch and rendered these areas unfit for controls. As usual, some infestation was already present in fruit on the trees in sprayed plots at the time of the first spray, however, the degree of control obtained was estimated by comparing the mean infestation on

Table 13.--Mean number larvae per pound picked guavas in treated and untreated gulches.

| Gulch and sample area treatment | 4/7 | 4/14 | 4/21 | 4/28 | 5/5 | 5/12 | Pre-spray 5/19 | Pre-spray 5/26 | Spray 1 (5/29) 6/4 | Spray 1 (5/29) 6/11 | Spray 2 (6/12) 6/18 | Spray 2 (6/12) 6/24 | Spray 3 (6/25) 7/1 | Spray 3 (6/25) 7/8 | Mean % change from pre-spray level 7 day | Mean % change from pre-spray level 13 day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brodie | | | | | | | | | | | | | | | | |
| 5-6 Untreated | -- | -- | 40.8 | 37.6 | 11.0 | 6.7 | 15.0 | 11.3 | 0.80 | 1.28 | 0.46 | 0.13 | 1.12 | 0.82 | -94 | -94 |
| 1-2 Bait spray | -- | 7.5 | 40.8 | 37.6 | 11.0 | 5.5 | 18.4 | 13.7 | 0.40 | 0 | 0 | 0 | 0 | 5.36 | -99 | -89 |
| 3-4 Parathion | -- | 7.5 | 40.8 | 37.6 | 11.0 | 8.9 | 3.8 | 3.0 | 1.30 | 0.15 | 0 | 0 | 0.18 | 3.61 | -86 | -63 |
| Holemano A | | | | | | | | | | | | | | | | |
| 16, 17, 18 Untreated | -- | 57.1 | -- | 23.8 | 19.8 | 9.8 | 4.5 | 7.7 | 4.80 | 3.69 | 3.63 | 11.78 | 9.08 | 10.89 | -4 | +14 |
| 10-10A Bait spray | -- | -- | 32.2 | 38.8 | 13.0 | 31.2 | 17.4 | 15.9 | 0.40 | 0 | 0 | 0 | 0.15 | 0.27 | -99 | -99 |
| 12-12A Parathion | -- | -- | -- | -- | -- | 2.9 | 3.9 | 4.1 | 0.20 | 0.08 | 0 | 0.15 | 0.84 | 4.86 | -91 | -58 |
| Holemano B | | | | | | | | | | | | | | | | |
| 16, 17, 18 Untreated | -- | 57.1 | -- | 23.8 | 19.8 | 9.8 | 4.5 | 7.7 | 4.80 | 3.69 | 3.63 | 11.78 | 9.08 | 10.89 | -4 | +14 |
| 15-15A Bait spray | 52.5 | -- | -- | -- | -- | 10.6 | -- | 2.4 | 0 | 0 | 0.37 | 0 | 0.08 | 0.24 | -94 | -97 |
| 13-13A Parathion | 52.5 | -- | -- | -- | -- | 6.4 | 16.6 | 9.9 | 0 | 0 | 0 | 0.06 | 0 | 0.24 | -100 | -99 |
| | Composite samples not restricted to specific areas within plots. | | | | | | Samples of 50 picked fruits from each marked area (2 or 3 per replicate). | | | | | | | | | |

May 19 and 26 with that on the 3 one- and two-week after-spray dates. On this basis the bait spray with 0.5 lb. actual parathion per acre effected mean reductions of 97 per cent in the 3 gulches up to 7 days after the sprays compared to 92 per cent for 1 lb. parathion used alone. Reductions during the second week after spraying were 95 per cent for the bait spray and 73 for parathion alone. After July 8 infestations appeared to be increasing rapidly in all plots. These results confirm previous unreplicated experiments indicating the superiority of the parathion bait spray to twice as much parathion alone. In the currently used formula the concentration of sugar was reduced well below that previously used. The 1:5:1 ratio of protein hydrolysate, raw sugar, toxicant appears entirely satisfactory.

Parasitization averaged about 70 per cent during May. There was no evidence among the low infestations following the spray treatments that the percentage was depressed by either treatment.

Small Plot Tests on Guava in Brodie Gulch (Steiner, Morishita, Holloway, Keiser)

One portion of Brodie gulch widens to about 200 yards, is about 40 feet deep, and has a moderately level floor. This area contains about 8 acres of a dense stand of tall guava trees. Permission was obtained from Hawaiian Pineapple Company to open a jeep trail down into and through the gulch by cutting out guava trees wherever necessary. This trail meandered through the gulch for a distance of about 300 yards. On either side of the trail at distances up to 100 feet, circular plots 50 feet in diameter were set up by blazing the trunks of the border guava with yellow paint. Forty such plots were marked and allotted in a restricted randomization to 10 treatments. After the fruit began ripening pre-spray samples of ripe picked guava were taken on May 19 and 27 from within the marked circular plots. Sprays were applied with a Bean 4 gpm. sprayer at 300 lbs. pressure on May 28, June 11, and 26. Samples (40 guavas each) were taken from each replicate at 4 to 5-day intervals after each spray (3 per inter-spray interval).

Because this was intended as a drastic test of the relative efficiency of various insecticides in preventing oviposition on small areas simulating backyard plantings, the spray concentrations were greater than previously employed where larger areas were uniformly sprayed. For these tests the sprayman regulated the amount applied by timing the application and generally spraying around the circular plot from near the center. Because of the great height of the guava trees most spray was applied to lower leaf surfaces instead of upper as was true of most previous tests. This should increase effectiveness by reducing weathering and placing the spray where the flies spend most of their time. At 200 gallons per acre as used there was very little run-off.

Formulas and results are given in table 14.

Fruit sampled June 2 and some of that on June 6 was mature enough on May 27 to attract ovipositing females; hence, the infestation was not cut off sharply and the full effects of the first spray was not evident until June 10. Apparently fly movement was great enough so that the population in the unsprayed portions of the gulch including the replicates of Plot 1 became exposed and succumbed to the spray deposits, or to fumigating action, about as rapidly as those initially present within the small plots.

Table 14.--Infestation indices before and after applying insecticides to non-contiguous small guava plots.

| Plot | Treatment | Quantity1/ formulation per acre | Mean number larvae per pound | | | | | | | | | | | | Indicated per cent control 6/6-7/10 2/ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pre-spray period | | After 1st spray (5/25) | | | After 2nd spray (6/11) | | | After 3rd spray (6/26) | | | Post-spray 7/16 | |
| | | | 5/19 | 5/27 | 6/2 | 6/6 | 6/10 | 6/16 | 6/20 | 6/25 | 6/30 | 7/3 | 7/10 | | |
| 1 | Unsprayed | | 11.4 | 13.6 | 2.56 | 0.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.7 | 99.1 |
| 2 | DDT-50 WP | 20 lb. | 10.5 | 7.0 | 0.59 | 0.08 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.3 | 99.8 |
| 3 | Methoxychlor 50 WP | 40 lb. | 1.8 | 3.2 | 0.50 | 0.47 | 0 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0 | 98.9 |
| 4 | Dieldrin 25 WP | 10 lb. | 3.4 | 5.3 | 0.68 | 0 | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 | 14.6 | 99.9 |
| 5 | J. H. 711 25 WP | 10 lb. | 2.2 | 6.2 | 0.80 | 0.04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.5 | 99.9 |
| 6 | Parathion 25 WP<br>Prot. hydrol.<br>Raw sugar | 8 lb.)<br>2 lb.)<br>20 lb.) | 6.2 | 4.6 | 0.13 | 0.11 | 0 | 0 | 0 | 0.05 | 0 | 0 | 0.06 | 4.9 | 99.6 |
| 7 | Parathion 25 WP | 20 lb. | 4.9 | 4.5 | 0.03 | 0 | 0 | 0 | 0 | 0.06 | 0 | 0 | 0.71 | 0 | 98.2 |
| 8 | Parathion 25 WP<br>Nutional Sticker | 20 lb.)<br>2 qt.) | 3.4 | 3.2 | 0 | 0.04 | 0 | 0 | 0.04 | 0 | 0 | 0 | 0.06 | 6.0 | 99.6 |
| 9 | Malathon 25 WP | 20 lb. | 5.4 | 4.1 | 0.16 | 0 | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 | 1.8 | 99.9 |
| 10 | Systox (31.5%) | 6 pt. | 1.4 | 8.6 | 0.35 | 0.48 | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 | 0.4 | 98.9 |
| | MEAN | | 5.1 | 6.0 | 0.58 | 0.16 | 0 | 0 | 0.02 | 0.01 | 0 | 0 | 0.09 | 3.5 | |

1/ In 200 gal. water.
2/ Per cent reduction from the pre-spray mean of 5.55 larvae per pound for all plots.

The mean infestation (unsprayed plot included) declined 90 per cent in the second series of samples and 100 per cent in the third (13 days after the spray). No difference between spray treatments could be determined with any reliability. It would be highly inaccurate to assume that none existed. The low population in the checks is proof that effective treatments aided the ineffective ones. The general increase in infestation during the third week after the last spray to nearly 60 per cent of the pre-spray level may have reflected a heavier than normal movement of flies into the gulch. It is believed, however, that a weakening of the general residual effectiveness occurred, and the low infestation from June 6 to July 10 was effected entirely by the spray program. It is obvious that any attempt to evaluate insecticides for use on single trees or small backyard plantings must be set up on a much more widely dispersed basis among unsprayed hosts, probably with a very limited number of treatments and larger number of replicates.

These results were not available in time to set up such a test in one of the larger mango orchards.

Field Tests on Mango (Steiner, Morishita, Kinoshita)

Field tests on 3 varieties of mangoes in the H.S.P.A. planting on Molokai were started late in June. Two bait-spray treatments utilizing parathion at 0.5 and 2.5 lbs. toxicant per acre are being applied to single plots of about 7 acres each.

On Maui the two largest commercial mango orchards in the Islands are both being used in tests of 4 spray programs. Here the treatments plus an unsprayed control are set up with three 3-acre replicates on the Haden variety. At Molokai fruit samples of about 10 lbs. each are collected weekly from 21 sample areas and airfreighted to Honolulu for holding. On Maui composite samples of similar size are taken 3 times weekly from 3 points in each replicate and held for fly emergence there.

The pre-spray infestations on Molokai averaged 5.1 larvae per pound for 9 samples of the Mapelehu variety, 5.5 for 9 samples of Haden and 9.9 for 6 of the Pirie variety. Individual samples ranged up to 15.9 larvae per pound in Mapelehu, 15.7 in Haden and 25.5 in Pirie.

On Maui the mean pre-spray infestation in 45 samples from the replicated plots was 4.4 larvae per pound with individual samples ranging up to 30.

Crops at both locations will be heavier than any produced since 1949. The current retail price is as high as 60 cents per pound.

Large-Scale Tests of Methyl Eugenol-Poison Bait Stations for Control of Dacus dorsalis. (Steiner, Lee, Pagay, Kinoshita)

Ornesula 55-Trap Test

This experiment, started in January 1950, was terminated except for post-treatment observations, with the removal of all traps on May 15. Guava production had about ceased after 14 weeks. Although the infestation data for the first portion of this crop was reported last quarter, the early results have been included in table 15 in order to show the full effects on the 1952 spring crop. Some of the control gulches stopped producing early or started late; hence, replacements were included in an effort to make available at least 5 bearing gulches for comparison.

Table 15.--Mean fruit infestations, Opaeula methyl eugenol experiment.

| Date | Mean number larvae per pound guava fruit | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Control gulches 1/ | | | | | | | Mean | Opaeula treated 2/ | Indicated % reduction | Ripe fruit abundance in Opaeula 3/ |
| | 1 | 2 | 3 | 4 | 5 | 6,7 | 8,9 | | | | |
| 2/11 | - | - | 7.0 | 18.5 | - | 54.6 | - | 26.7 | 5.0 | 81 | 1 |
| 2/18 | - | 0 | 12.6 | 6.2 | - | 18.1 | 3.5 | 8.1 | 4.3 | 47 | 2 |
| 2/25 | - | 2.8 | 10.6 | 9.3 | - | 11.9 | 0 | 6.9 | 4.6 | 33 | 4 |
| 3/3 | 16.4 | 6.6 | 5.9 | 7.7 | - | 11.2 | 4.5 | 8.7 | 3.2 | 63 | 6 |
| 3/10 | 1.2 | 1.3 | 3.8 | 1.7 | 5.0 | 5.6 | 0.2 | 2.7 | 2.1 | 22 | 6 |
| 3/17 | 13.4 | 2.0 | 2.8 | 3.6 | 4.1 | Diverted for insecticide tests | | 5.2 | 3.5 | 33 | 4 |
| 3/24 | 18.6 | 8.5 | - | 3.7 | 9.8 | | | 10.2 | 6.1 | 40 | 1 |
| 3/31 | 77.7 | 27.4 | 23.0 | 3.9 | 7.7 | Other gulches substituted | | 27.9 | 4.2 | 85 | 2 |
| 4/7 | 53.8 | 31.1 | - | 14.4 | 21.4 | - | 52.5 | 34.6 | 6.3 | 82 | 3 |
| 4/14 | 57.3 | 47.0 | 10.0 | 4.7 | 15.7 | - | - | 26.9 | 3.6 | 87 | 2 |
| 4/21 | 40.6 | - | 58.2 | 8.4 | 12.1 | - | 32.2 | 30.3 | 1.6 | 95 | 1 |
| 4/28 | 37.6 | - | 1.6 | 6.6 | 36.4 | 20.8 | 31.3 | 22.4 | 7.7 | 66 | 1 |
| 5/5 | 11.0 | 3.2 | 7.4 | 19.8 | 5.5 | 24.6 | - | 11.9 | 4.0 | 66 | 1 |
| 5/12 | 7.0 | 4.0 | 8.6 | 12.7 | 9.8 | 2.8 | - | 7.5 | 0 | 100 | 1 |
| MEAN | 30.4 | 12.2 | 12.6 | 8.7 | 12.6 | 18.7 | 17.7 | 16.4 | 4.0 | 64 (76) | 1 |

1/ When available, separate 40-50 fruit samples of picked ripe fruit were obtained from 3 marked areas in each gulch. A dash (-) indicates non-availability of ripe fruit.

2/ Separate samples were obtained from 5 marked areas, but all 5 were rarely in production at the same time. These data generally represent at least 3 of the areas.

3/ Scale of fruit abundance ranges from 0 to 8. No. 1 indicates that considerable searching is needed to find ripe fruit, while 8 indicates abundant ripe fruit in all fruit sampling areas.

The results show that infestation indices obtained from the central 1/3 mile section of the quarter-mile wide Opaeula gulch ranged from 22 to 100 per cent less than the means of the control gulches. The per cent indicated control for the entire crop was 64 if taken as the mean of the weekly differences or 76 if calculated from the seasonal mean infestations. The apparent reduction is about the same as previously reported for the guava crops produced there in 1950 and 1951.

Control gulch 1 was Brodie, 2 miles south; No. 2 was a Helemano lateral 1/2 mile southeast; Nos. 3 and 7 were short laterals of Opaeula emptying near the west end of the treated portion; No. 4 was 1 mile north; No. 5, 1 mile east in Helemano; Nos. 6 and 8 were 1/2 mile east and were diverted for use in insecticide tests as was No. 9 located 1 mile south. Most of the control gulches lost males in varying degrees to the methyl eugenol traps. The 55 traps which captured 55,260 male flies in January, 43,980 in February, and 15,270 in March took 20,750 in April, and 14,350 during the first 2 weeks in May.

During the fruit ripening period from February 11 to May 12, 5 standard glass traps containing the fermenting sugar-yeast-vinegar bait (changed weekly) captured only 13 males and 99 females.

The 55 box traps were each treated twice monthly with 5 ml. of methyl eugenol containing 2% G22008. This was usually applied as a spray after adding an emulsifier (B-1956) and reducing the methyl eugenol concentration to 50 per cent with water. As previously reported, these traps were located at 1/10 mile intervals along opposite sides of Opaeula gulch for a distance of nearly 2 miles with 5 outpost traps 1/4 mile southwest and 1 mile northeast (upwind) of the sampled portion of Opaeula gulch.

Ookala, Hawaii (Hamakua Coast)

This experiment was described in detail in the last quarterly report (Jan.-Mar. 1952, pp. 132-138). It was initiated in January and is expected to run for a year.

One hundred and seventy-five 10"x10"x3/4" cane feeding stations treated monthly with 25 to 30 ml. of methyl eugenol containing 3% G-22008 are in operation along the windward rim of all gulches in a 6 square mile segment of the Hamakua coast. These gulches are separated largely by cane fields. The experiment centers around the town of Ookala and Kaula gulch, and extends from the ocean up to the forest line at 2100 feet, about 3 miles inland. Adjacent treated gulches to about 1 mile north and 1 1/2 mile south of Kaula are intended to help intercept male flies and hold the male population in Kaula to a minimum. Infestation indices are obtained at 5 elevations plus or minus 150 feet in Kaula and also in gulches 2 to 3 miles northwest and the same southeast of the treated area. The elevations of 300, 700, 1100, 1500, and 1900 feet are each represented by two 50- (when available) fruit samples of picked ripe guava taken from rim and bottom when possible or from adjacent gulches or laterals in each of the 3 sample areas, Kaula, northwest and southeast.

Thirty-seven of the cane feeding stations were equipped with collecting funnels underneath for record purposes but wind, lizards, and sometimes ants, removed an unknown portion of the catch and no accurate estimate of the total number of males destroyed could be obtained.

On the basis of flies actually caught the total kill by all feeding stations was slightly less than 34,000 compared to 186,000 for the preceding quarter.

By early June the mean catch per trap-day declined to less than 1 fly per trap. During the April, May, June and July bait renewals more than 5,000 ml. of methyl eugenol was dispensed along about 18 miles of gulch rim in about 30 working hours at each renewal. Not a single live male fly was seen within the treated area, yet they appeared within a few minutes when methyl eugenol was exposed to the north or south of the area, and a rather heavy infestation persisted in guavas within Kaula gulch at the 300 ft. elevation. See table 16. (Host fruits other than guava were present but not distributed adequately for use in estimating control.)

Table 16.--Mean number D. dorsalis and C. capitata larvae per pound guava fruit. Hamakua Coast, Island of Hawaii.

| Area | Month | Elevation and larvae per pound (D=dorsalis; C=capitata) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 300' | | 700' | | 1100' | | 1500' | | 1900' | | Mean | |
| | | D. | C. | D. | C. | D. | C. | D. | C. | D. | C. | D. | C. |
| Kaula | January | 35.3 | 0.1 | 7.4 | 0 | 6.0 | 0 | - | - | 0 | 0 | 12.2 | 0 |
| | February | 35.9 | 0.1 | 1.1 | 0 | 3.0 | 0 | 0.3 | 0 | 0.8 | 0 | 6.2 | 0.3 |
| | March | 8.1 | 0.1 | 1.8 | 0.4 | 0 | 0 | 0 | - | 0.2 | 0 | 2.0 | 0.1 |
| | April | 34.4 | 1.2 | 12.0 | 0.4 | 3.8 | 0.7 | 0.5 | 0.1 | 2.7 | 0.7 | 10.7 | 0.6 |
| | May | 81.8 | 0.3 | 3.7 | 3.3 | 1.4 | 8.0 | 0.8 | 7.6 | 0.4 | 9.1 | 17.6 | 6.7 |
| N.W. | January | 15.6 | 0 | 22.3 | 0.2 | 6.2 | 4.4 | 4.9 | 0.1 | 1.3 | 0 | 10.1 | 0.9 |
| | February | 6.1 | 0.6 | 6.7 | 0.9 | 1.0 | 0.1 | 2.4 | 0 | 1.9 | 0.1 | 3.6 | 0.3 |
| | March | 2.5 | 0.6 | 4.2 | 0.2 | 3.0 | 0.2 | 1.4 | 0 | 1.4 | 0 | 2.5 | 0.2 |
| | April | 16.1 | 0 | 15.0 | 0 | 3.5 | 0.6 | 1.7 | 0 | 0.5 | 0.3 | 7.4 | 0.2 |
| | May | 14.2 | 3.2 | 36.6 | 1.9 | 3.3 | 2.5 | 0.3 | 0 | 0 | 0.6 | 10.9 | 1.6 |
| S.E. | January | 4.2 | 0.1 | 5.8 | 1.9 | 2.0 | 0.4 | 0 | 0 | 2.1 | 0.3 | 2.8 | 0.6 |
| | February | 18.6 | 0.1 | 6.8 | 0.4 | 2.1 | 0 | 0.6 | 0 | 1.0 | 0.3 | 5.8 | 0.2 |
| | March | 2.8 | 1.2 | 13.0 | 2.8 | 1.1 | 0.3 | 4.0 | 0 | 5.7 | 0.1 | 5.3 | 0.9 |
| | April | 61.6 | 0 | 15.8 | 0.8 | 6.0 | 0.3 | 0.7 | 0 | 2.9 | 0.2 | 17.6 | 0.3 |
| | May | 54.4 | 0 | 22.9 | 1.4 | 5.7 | 0.2 | 1.6 | 5.9 | 0.3 | 0 | 16.9 | 1.6 |

Since most females present at the start of the experiment were doubtless fertile and many could live for 3 months no control was expected to appear until the male population had been suppressed for at least one or two generations.

During the 5-month period the mean infestations in Kaula were not substantially different from those in the two control areas. Infestations at the mouth of Kaula remained unusually high for reasons as yet unknown. One factor thought responsible was the impossibility of blanketing the coastal area with methyl eugenol odors because of the strong almost constant onshore winds. There was also little evidence of control at 1900' where the record areas were within 1/4 mile of

untrapped host vegetation. At 700, 1100, and 1500' in April and May there seemed to be a greater trend toward increasing infestations in both the control areas than in the treated. One change, which may be significant, was the change in the dorsalis-capitata relationship. Capitata was less abundant in Kaula during the first quarter than in the control areas and was not recovered there above 700'. In April it was more abundant in Kaula than in the NW control at every elevation. At 3 elevations it was more abundant in Kaula than in the SE area. In May it surpassed dorsalis at every elevation above 300' in Kaula but only at 1900' in the NW area and at 1500' in the SE area. Although the capitata infestation was low in April, it was twice as great in Kaula as in the control areas. In May it was 4 times as great, and at 6.7 capitata per pound had developed into an infestation that was affecting at least 25 per cent of the guava crop. The greatest increase took place in the last of the spring guava crop late in May.

Present indications are that suppression of dorsalis in Kaula above 300', by annihilation of the male population with methyl eugenol-poison baits, allowed capitata to become dominant there in May despite its scarcity in January, February and March.

As indicated above, male catches during the first quarter were about 5 1/2 times as great as during the second. However, infestations in Kaula on a per pound basis were only half as great during the first as compared to the second quarter. Some allowance must be made for the older males present when the experiment started which always results in comparatively heavy catches wherever methyl eugenol is first exposed. Another factor was the difference in fruit abundance, there being somewhat more guava in the first quarter. There is a strong indication, however, that fertile females may be moving across the area possibly as infertile females move on out and that the beneficial effects of the male annihilation are scattered, largely by female fly movement.

It is obvious that we still do not have enough information about the extent of fly movement and the factors that influence it.

Kilauea Experiments at Half-Way House

The small second field test of methyl eugenol-222008 on Hawaii was described on page 136 of the Jan.-Mar. 1952 report.

Guava production in the treated area fell to too low a level for reliable sampling by June 10 after coming to an end in most of the control areas late in May.

Male catches in various locations are given in table 17 which includes, for comparison, those for the first 3 months of the experiment.

Infestation and mean sample size data are given in table 18 with the most distant check area (8) tabulated separately, as well as being represented in the mean for all 4 control areas. Sample area 8 is the only one of the 4 (Nos. 5, 6, 7, 8) in which there are massed guava approaching the treated area in size. The other 3 control areas contain only widely scattered plants and therefore may not hold fly populations during periods when fruit ripens slowly or is widely scattered. During such periods their infestations dropped below that in the treated area. Areas 5 and 6 may also have been under the influence

Table 17.--Male D. dorsalis in Half-Way House representing various locations[1/].

| Trap No. | Location | Flies per trap day | | | | | | Total flies per trap | |
|---|---|---|---|---|---|---|---|---|---|
| | | Jan. | Feb. | Mar. | Apr. | May | June | Jan.-Mar. | Apr.-June |
| 1-12[2/] | In or near guava-treated area. | 37 | 39 | 9 | 4 | 22 | 26 | 2,182 | 1,807 |
| 13-14[2/] | 0.5 mile south of treated area. | 164 | 123 | 74 | 57 | 139 | 153 | 9,617 | 10,814 |
| 15-16[2/] | 0.5 mile north of treated area. (non-host area) | 227 | 156 | 21 | 26 | 103 | 111 | 10,077 | 8,061 |
| 54[3/] | 2 mile north of 15-16 (ohia on lave--non-host area 0.5 mile from Ohaikea Valley. | 912 | 700 | 238 | 67 | 261 | 208 | 36,238 | 17,912 |
| 55[3/] | 4 mile north of 15-16 (ohia on lave--non-host area 1 mile from Ohaikea Valley. | 536 | 69 | 1 | 2 | 102 | 235 | 9,259 | 11,658 |
| 52[4/] | On south rim of Kilauea caldera in Kau desert. No vegetation near. 3 miles from Ohaikea Valley. | -- | 164 | 41 | 0.1 | 24 | 6 | 5,132 | 1,004 |
| 52A[5/] | NE rim of Kilauea caldera | -- | -- | -- | 0.6 | 15 | 2 | -- | 598 |

1/ See map, page 139, Quarterly Report, Jan.-Mar. 1952.
2/ Installed January 7.
3/ " January 17.
4/ " January 31.
5/ " March 31.

Table 18.--Fly infestations in the Kilauea methyl eugenol experiment.

| Date | Treated area Means of 4 samples | | | | Control area Means of 4 samples | | | | Control area #8 Single sample | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | dorsalis | | capitata | | dorsalis | | capitata | | dorsalis | | capitata |
| | No. fruit | Lve./lb. | % para. | Per cent | No. fruit | Lve./lb. | % para | Per cent | No. fruit | Lve./lb. | % para. | Per cent |
| 1952 | | | | | | | | | | | | |
| 1/25 | 43 | 4.3 | 20 | 6 | 50 | 0.7 | 18 | 46 | 50 | 2.4 | 54 | 38 |
| 1/31 | 48 | 4.8 | 44 | 0 | 50 | 2.5 | 35 | 0 | 50 | 5.6 | 33 | 0 |
| 2/7 | 38 | 7.5 | 51 | 8 | 50 | 5.6 | 60 | 2 | 50 | 13.1 | 82 | 9 |
| 2/13 | 50 | 5.3 | 64 | 6 | 43 | 16.6 | 80 | 4 | 23 | 50.1 | 86 | 4 |
| 2/20 | 50 | 5.2 | 54 | 8 | 50 | 7.9 | 60 | 1 | 50 | 21.4 | 87 | 1 |
| 2/25 | 50 | 6.9 | 59 | 15 | 50 | 12.3 | 56 | 1 | 50 | 42.4 | 66 | 3 |
| 3/4 | 50 | 3.9 | 55 | 9 | 50 | 7.1 | 40 | 2 | 50 | 13.3 | 30 | 0 |
| 3/14 | 50 | 6.4 | 50 | 12 | 50 | 7.2 | 46 | 6 | 50 | 20.2 | 48 | 0 |
| 3/24 | 50 | 15.8 | 66 | 2 | 30 | 25.7 | 26 | 1 | 50 | 80.5 | 18 | 1 |
| 3/31 | 50 | 15.4 | 74 | 2 | 46 | 15.5 | 15 | 2 | 50 | 49.8 | 41 | 1 |
| 4/10 | 50 | 6.3 | 56 | 0 | 44 | 16.2 | 61 | 0 | 50 | 54.4 | 72 | 0 |
| 4/21 | 50 | 17.0 | 66 | 2 | 35 | 17.0 | 45 | 9 | 50 | 51.5 | 60 | 0 |
| 4/30 | 50 | 33.6 | 77 | 1 | 21 | 63.8 | 50 | 0 | 50 | 164.1 | 53 | 0 |
| 5/9 | 50 | 40.6 | 71 | 2 | 10 | 131.7 | 37 | 0 | 17 | 236.0 | 55 | 0 |
| 5/22 | 39 | 7.8 | 81 | 1 | 16 | 53.6 | 30 | 6 | 21 | 68.6 | 81 | 0 |
| 6/2 | 30 | 14.8 | 84 | 0 | 4 | 15.6 | 50 | 0 | 0 | - | - | - |
| 6/11 | 19 | 19.1 | 88 | 5 | 1 | 20.0 | - | 0 | 0 | - | - | - |

of methyl eugenol since they are located from 0.5 to 1.5 miles from the nearest traps. Traps 13 and 14 indicated that large fly populations may have been moving up from the control areas to the treated in May and June. This movement coincided with the final disappearance of ripe guava in the areas to the south and adds evidence to that already obtained that emerging flies vacate guava areas in which they are reared if they emerge when fruit production is at a low level. The comparatively heavy catches in traps 54 and 55 in May and June came at a time when there were few guava left anywhere in the Kilauea area and may have resulted from a movement of flies from the heavily infested Kalapana area on the Puna coast 10-15 miles east where production was also declining.

The trap on the NE rim of Kilauea is in an ohia-fern forest where rains and overcast skies are frequent. That on the south rim 2 miles away and 1/2 mile from the current eruption (it caught several handfuls of pumice) is generally in sunlight but is more exposed to winds and is far from vegetation. Its catches strongly indicate that flies are either attracted 3 miles from Ohaikea Valley or that some fly movement across the Kau desert, perhaps from the Puna coast to the slopes of Mauna Loa, is quite general during certain periods.

In the treated area 12 traps caught only a few more flies than the two pairs 1/2 mile north and south. This strongly indicates that 1 or 2 traps in place of the 12 might also have captured the entire male population, though not as soon after emergence. It also indicates almost complete annihilation of the males in and near the treated area.

Figure 3 illustrates the dorsalis infestation data of table 18. It indicates that 3 periods of more than normal fly hatch occurred in mid-February, late March and early May, coinciding quite likely with successive brood development on which was superimposed the progeny of immigrating flies.

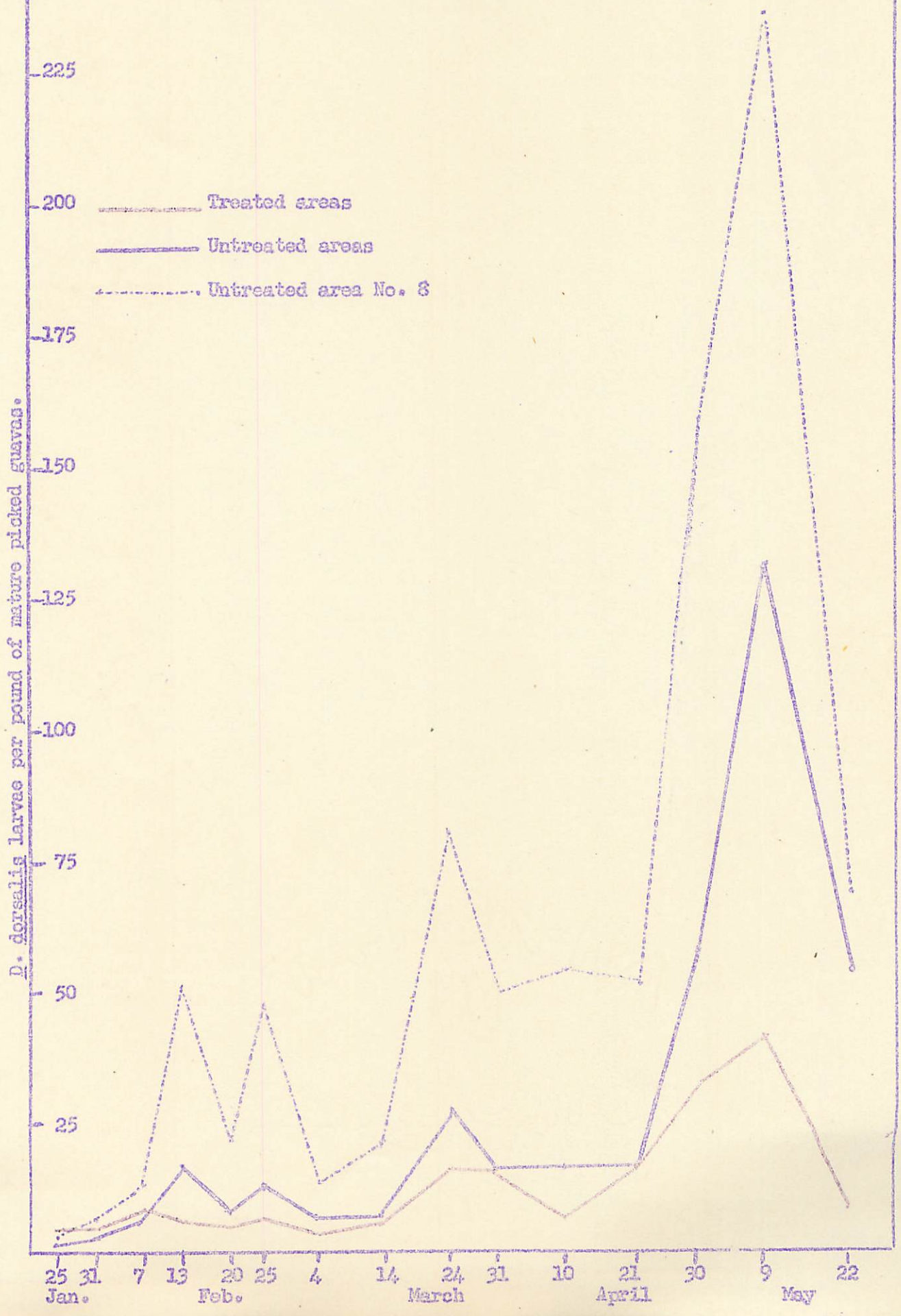
Infestations when the methyl eugenol stations were first installed were low and quite similar. By the third week substantial differences were developing between the treated area and area 8 which is included in the mean for the 4 untreated areas. Area 8 contains massed guava stands and is the control block most similar to the treated area.

The first month can be considered indicative of pre-treatment infestations since it took that long to substantially reduce the male population and longer than that to exhaust fertile females present before the full effect of the treatment was developed.

Mean infestations during the first month were 5.4, 6.7 and 18.5 for the treated, control, and No. 8 areas, respectively. From February 25 to May 22 the respective means were 15.4, 35.0 and 78.1. Thus while the infestation in the treated area increased 2.9 times with successive generations, that in the control areas increased 5.2 times which is taken as an indication of a substantial control effect.

In this experiment capitata disappeared from Area 8 as the infestation increased but remained fairly constant at a low level in the treated area. Mean per cent parasitization from January 25 to May 22 in the treated area was 59;

Figure 3. Oriental fruit fly indices in guava. Kilauea Experiment.



in Area 8, 58, and in all the untreated areas, 44. The parasites recovered were identified either by Mr. Q. C. Chock, Territorial Board of Agriculture and Forestry, or by Dr. Dresner (Ecology-Biology project), and found to be 88 to 100 per cent Opius oophilus with O. vandenboschi the only other species represented.

The next guava crop in the Kilauea area is not expected to begin ripening before mid-August.

Line Project I-c-3-3. INACTIVE

Line Project I-c-3-4. Development or Improvement of Treatments to Control Fruit Flies in Aircraft and Maritime Vessels. (Keiser, Holloway, Steiner)

Treatments for use or for specification by Quarantine Agencies which in addition to the above may include residual treatments of docks, airport facilities, or fruit packing house interiors are covered by this project. The work described below was set up to provide information requested by the Division of Plant Quarantines and resulted in a substantial change in recommendations even before the experiment was terminated.

Indoor Residual Tests (by I. Keiser)

A special study was initiated during the last quarter for determining the comparative effectiveness of different insecticides and formulations against D. dorsalis when applied as a residual treatment to indoor building surfaces and allowed to weather indoors. Pages 147 through 150 of the January-March, 1952, Quarterly Report contain the data already gathered. It was noted that DDT suspension was not only the best of the 6 formulations tested, but was still giving 100 per cent kill 29 days after treatment. Table 19 presents the data through 98 days of indoor exposure. As in previous tests, the disks composed of different indoor building surfaces are removed from the exposure racks, 30 flies introduced per cage of which the disk is the top, and mortalities noted after 24 hours. (See Figure 10.) The mortalities listed in table 19 are averages of 9 different surfaces.

As reported in the previous quarter, DDT suspension was most effective, followed by DDT emulsion and Dilan emulsion. Although the three less satisfactory insecticides (chlordane, lindane, and methoxychlor) were discontinued by the seventy-sixth day of exposure, the porous surfaces (plywood unpainted, canec painted and unpainted) were still studied for chlordane and lindane. The long residual action of these on only porous surfaces may have resulted from heavier initial deposits or from fumigating action.

As mentioned in the previous quarterly report, five holding boards were prepared, each containing one replicate for indoor exposure. This replicate consists of nine different surfaces for each of the six treatments or a total of 54 disks per board. After different time intervals, successive replicates of the first four are used. (The fifth replicate has not been tested to date.)

Table 20 presents the data for the first four exposures or the average results of the first four replicates tested 1 to 12 days after treatment.

Figure 10.--Surfaces to be tested are placed under the Petri dish tops of the exposure cages. Fruit flies are introduced, given access to sugar water apart from the insecticide coated surface, and held 48 hours for observation. The above illustrates one series of replicates which includes 9 surfaces and 6 insecticides plus the controls.

Table 19.--Comparative effectiveness against adult D. dorsalis of residues from various insecticides deposited on representative indoor building surfaces and allowed to weather indoors.

| Insecticide | | Per cent mortality after different number of days' exposure | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Name | Dosage[1/] | 34 | 41 | 48 | 55 | 69 | 76 | 83 | 91 | 98 |
| DDT suspension 75% WP | 50 | 100 | 99[4/] | 100 | 100 | 100 | 100 | 99[4/] | 100 | 100 |
| DDT emulsion[2/] | 50 | 90 | 52 | 77 | 60 | 53 | 51 | 58 | 57 | 57 |
| Methoxychlor 50 emulsion | 50 | 11 | 2 | 6 | 2 | 2 | - | - | - | - |
| Chlordane 40 emulsion | 16 | 20 | 16 | 6 | 23 | 3 | - | - | - | - |
| Lindane 20 emulsion | 8 | 25 | 27 | 7 | 23 | 17 | - | - | - | - |
| Dilan 80 emulsion[3/] | 50 | 53 | 41 | 45 | 29 | 17 | 23 | 36 | 29 | 28 |

1/ Number of pounds active ingredients per 100 gallons total spray liquid.
2/ DDT one pound per quart xylene and one per cent E-1956.
3/ The Dilan liquid concentrate 80% solution was made emulsifiable by the addition of 1.3 per cent E-1956.
4/ One live fly on plastic screen. Only live fly of 270 exposed on all 9 surfaces. Actually, mortality is 99.6 per cent.

Table 20.--Comparative effectiveness against adult D. dorsalis of residues from various insecticides deposited on representative indoor building surfaces and allowed to weather indoors, 1 to 12 days after spraying.

| Surface | Per cent mortality after 24 hours 1/ | | | | | |
|---|---|---|---|---|---|---|
| | DDT Suspension | DDT Emulsion | Methoxychlor Emulsion | Chlordane Emulsion | Lindane Emulsion | Dilan Emulsion |
| Galvanized iron sheet | 100 | 99 | 33 | 58 | 37 | 73 |
| Aluminum sheet | 100 | 99 | 28 | 74 | 28 | 68 |
| Plywood - painted | 100 | 95 | 16 | 90 | 75 | 38 |
| Plywood - unpainted | 100 | 86 | 46 | 99 | 100 | 81 |
| Canec - painted | 100 | 88 | 24 | 98 | 98 | 82 |
| Canec - unpainted | 100 | 91 | 32 | 100 | 99 | 75 |
| Galvanized iron window screening | 100 | 66 | 2 | 73 | 63 | 73 |
| Plastic window screening | 100 | 48 | 18 | 57 | 56 | 68 |
| Glass | 100 | 98 | 62 | 89 | 77 | 88 |
| Mean | 100 | 86 | 29 | 82 | 70 | 72 |

1/ Average results of four tests comprising completion of first round of 4 replicates--1-, 5-, 8-, and 12-day indoor exposure series.

During the first 12 days DDT suspension was completely effective on all surfaces, DDT emulsion better on the solid surfaces than the screening, chlordane best on porous surfaces, lindane best on porous surfaces and unsatisfactory on metals (either solid or screening), and Dilan more or less uniformly satisfactory on all surfaces except painted plywood.

Table 21 presents the data for the second four exposures made 15 to 26 days after treatment.

Table 21.--Comparative effectiveness against adult D. dorsalis of residues from various insecticides deposited under laboratory conditions, on representative indoor building surfaces, and allowed to weather indoors, 15 to 26 days after spraying.

| Surface | Per cent mortality after 24 hours 1/ | | | | | |
|---|---|---|---|---|---|---|
| | DDT Suspension | DDT Emulsion | Methoxy-chlor Emulsion | Chlordane Emulsion | Lindane Emulsion | Dilan Emulsion |
| Galvanized iron sheet | 100 | 99 | 42 | 3 | 4 | 55 |
| Aluminum sheet | 100 | 100 | 43 | 2 | 1 | 58 |
| Plywood - painted | 100 | 84 | 1 | 22 | 30 | 12 |
| Plywood - unpainted | 100 | 88 | 13 | 80 | 96 | 72 |
| Canec - painted | 100 | 88 | 14 | 91 | 84 | 62 |
| Canec - unpainted | 100 | 61 | 12 | 92 | 88 | 45 |
| Galvanized iron window screening | 100 | 57 | 1 | 5 | 3 | 26 |
| Plastic window screening | 100 | 29 | 1 | 3 | 0 | 60 |
| Glass | 100 | 100 | 7 | 22 | 42 | 81 |
| Mean | 100 | 79 | 15 | 35 | 39 | 52 |

1/ Average results of four tests comprising completion of second round of 4 replicates 15-, 19-, 22-, and 26-day exposure series.

It may be noted from table 21 that for the 15-26 days' exposure series DDT suspension was still completely effective; DDT emulsion unsatisfactory on the screening and unpainted canec; methoxychlor unsatisfactory on all surfaces although better on the metal sheetings; chlordane and lindane unsatisfactory on all surfaces except these porous--plywood unpainted, canec painted and unpainted. The almost zero mortalities on metal surfaces (galvanized iron and aluminum sheeting, galvanized iron window screening) treated with chlordane and lindane suggest a chemical breakdown of these insecticides on these surfaces or a very low initial deposit. Dilan emulsion was again the third most satisfactory insecticidal formulation tested, but residual deposits on none of the surfaces could be considered very satisfactory in this second series.

Table 22 presents the data for the third 4 exposures. DDT suspension was 100 per cent effective up to 48 days except for 1 fly out of 1,080 alive after 24 hours; DDT emulsion was highly effective only on the metal sheetings and painted canec; methoxychlor was not effective on any surface; and chlordane and lindane again showed mortalities on the porous surfaces. Dilan was effective to some degree on all surfaces except painted plywood and galvanized iron window screening. The mean mortalities are again in the same order---DDT suspension, DDT emulsion and Dilan as the upper three.

Table 22.---Comparative effectiveness against adult D. dorsalis of residues from various insecticides deposited on representative indoor building surfaces and allowed to weather indoors, 29 to 48 days after spraying.

| Surface | Per cent mortality after 24 hours 1/ | | | | | |
|---|---|---|---|---|---|---|
| | DDT Suspension | DDT Emulsion | Methoxy-chlor Emulsion | Chlordane Emulsion | Lindane Emulsion | Dilan Emulsion |
| Galvanized iron sheet | 100 | 93 | 9 | 1 | 0 | 49 |
| Aluminum sheet | 100 | 100 | 8 | 3 | 2 | 47 |
| Plywood - painted | 100 | 70 | 4 | 9 | 11 | 5 |
| Plywood - unpainted | 100 | 70 | 24 | 37 | 76 | 72 |
| Canec - painted | 100 | 98 | 2 | 58 | 52 | 63 |
| Canec - unpainted | 100 | 46 | 8 | 66 | 67 | 49 |
| Galvanized iron window screening | 100 | 53 | 0 | 2 | 2 | 22 |
| Plastic window screening | 99+ 2/ | 43 | 2 | 1 | 2 | 62 |
| Glass | 100 | 77 | 0 | 1 | 20 | 67 |
| Mean | 99+ 3/ | 77 | 6 | 20 | 35 | 48 |

1/ Average results of four tests comprising completion of third round of 4 replicates---29, 34, 41, and 48 days' indoor exposure series.
2/ One fly of 120 (30 flies in each of 4 replicates) alive after 24 hours.
3/ One fly of 1,080 alive after 24 hours. This was on plastic screen. Actual mortality 99.91 per cent.

Table 23 presents the data listing the mean mortalities of the fourth series of 4 replicates. Only DDT suspension is highly effective at the end of 83 days' exposure.

Table 23.--Comparative effectiveness against adult D. dorsalis of residues from various insecticides deposited on representative indoor building surfaces and allowed to weather indoors, 55 to 83 days after spraying.

| Surface | Per cent mortality after 24 hours[1/] | | | | | |
|---|---|---|---|---|---|---|
| | DDT Suspension | DDT Emulsion | Methoxy-chlor Emulsion | Chlordane Emulsion | Lindane Emulsion | Dilan Emulsion |
| Galvanized iron sheet | 100 | 86 | 2 | 1 | 0 | 20 |
| Aluminum sheet | 100 | 98 | 3 | 0 | 0 | 7 |
| Plywood - painted | 100 | 33 | 1 | 1 | 0 | 0 |
| Plywood - unpainted | 100 | 64 | 3 | 11 | 69 | 64 |
| Canec - painted | 100 | 83 | 0 | 33 | 14 | 32 |
| Canec - unpainted | 100 | 14 | 0 | 35 | 53 | 24 |
| Galvanized iron window screening | 100 | 19 | 0 | 0 | 0 | 7 |
| Plastic window screening | 99[2/] | 18 | 0 | 0 | 0 | 44 |
| Glass | 100 | 87 | 0 | 0 | 0 | 39 |
| Mean | 99+[3/] | 56 | 1 | 9 | 15 | 26 |

1/ Average results of 4 tests comprising completion of fourth round of 4 replicates--55, 69, 76, and 83 days' indoor exposure series.
2/ One fly of 120 (30 flies in each of 4 replicates) alive after 24 hours.
3/ One fly of 1,080 alive after 24 hours. This was on plastic screen. In the 4 series of 4 replicates each, 4,320 adult D. dorsalis were exposed to the 9 surfaces of DDT suspension. Only 2 of the 4,320 flies were alive after 24 hours, on plastic screen, or a mortality of 99.95 per cent.

It is of extreme interest to note that DDT suspension is so much more highly effective than the emulsion under the indoor weathering conditions of this test, even though the same dosage (50 pounds actual insecticide per 100 gallons total spray) was used. It is planned to repeat this test with lower dosages of DDT suspension, to determine the most feasible concentrations based on 30 or 60 days' retreatment schedules and to include wettable powder formulations of Dilan, lindane, and methoxychlor.

Line Project I-o-3-5. Studies to Determine if the Development or Segregation of Strains of Fruit Flies Resistant to Insecticides is Likely to Occur. (Keiser, Holloway, and Steiner) by Keiser

During this quarter the fourteenth and fifteenth generations of the DDT-residual strains were tested along with the second and third generations of the residual strains involving sexually immature adults. The survivors were then turned over to the Physiology Project where these studies will be continued.

The fourteenth generation of the DDT-residual strain was tested on April 23, and the results are shown in table 24. There were 50-53 flies per cage, and three cages were used for each strain at each dosage level.

Table 24.--Comparative toxicity of DDT suspension spray as a residual laboratory treatment against fourteenth-generation DDT-residual strain of adult D. dorsalis.

| Micrograms insecticide per square centimeter of glass surface. | Per cent mortality after 48 hours | |
|---|---|---|
| | Residual-DDT strain | No-insecticide strain |
| 2.8 | 26.8 | 88.3 |
| 3.7 | 67.6 | 99.0 |
| 5.6 | 91.9 | 100.0 |
| 7.1 | 99.3 | 100.0 |
| 9.3 | 99.3 | 100.0 |
| Mean | 77.0 | 97.5 |

The DDT residual strain showed a significant quantity of resistance at the lower dosages tested. However, any resistance developed after fourteen generations of exposure to DDT residues would apparently not be of any great economic importance, since only a slight increase in dosage level would be necessary to nullify this phenomenon.

The second generation of the sexually immature strain of D. dorsalis adults exposed to DDT residues was also tested on April 23. These flies were 16 to 18 days old. However, they were produced from adults which were 3 to 5 days old when exposed to DDT residues, and therefore contain any inherited resistance from both parents. The results are shown in table 25. Three cages, each with 48 to 53 flies were used for each strain at each dosage level.

Here, too, any resistance developed in 2 generations appeared manifested at the two lower dosages and is not of economic importance as yet. It is apparent, however, that some tolerance has developed in only 2 generations.

Table 25.--Comparative toxicity of DDT suspension spray as a laboratory residual treatment against second generation sexually-immature DDT-residual strain of adult D. dorsalis.

| Micrograms insecticide per square centimeter of glass surface. | Per cent mortality after 48 hours | |
|---|---|---|
| | SI Strain 1/ | NI Strain |
| 2.8 | 59.3 | 86.3 |
| 3.7 | 76.1 | 99.0 |
| 5.6 | 96.0 | 100.0 |
| 7.1 | 100.0 | 100.0 |
| 9.3 | 100.0 | 100.0 |
| Mean | 86.3 | 97.5 |

1/ Split off from NI strain.

The fifteenth generation of the DDT-residual strain was tested on June 10 along with the third generation of the sexually-immature strain. The results are shown in table 26. The flies tested were 11 to 16 days old, 3 cages were used for each strain at each dosage level, and 50 flies were contained in each cage.

Table 26.--Comparative toxicity of DDT suspension spray as a laboratory residual treatment against fifteenth-generation residual, and third generation of sexually-immature adult D. dorsalis.

| Micrograms insecticide per square centimeter of glass surface. | Per cent mortality after 48 hours | | |
|---|---|---|---|
| | Residual strain | SI strain | NI strain |
| 2.8 | -- | 18.7 | 63.0 |
| 3.7 | 25.3 | 40.7 | 82.0 |
| 5.6 | 58.7 | 68.0 | 100.0 |
| 7.1 | 72.7 | 90.0 | 100.0 |
| 9.3 | 88.7 | 96.7 | 100.0 |
| Mean | -- | 63.2 | 89.0 |

It may be noted from table 26 that the residual strain showed significantly lower mortalities, after 15 generations, for all dosage levels tested. Whether or not this is the beginning of a sharp increase in noticeable resistance, or merely variations noted in one particular generation will be determined by the Physiology Project under whose jurisdiction these studies will be continued.

Line Project I-o-3-6 and I-c-3-7. Development of Fermenting and Non-Fermenting Lures and Development of Chemical Repellents or Barriers. (Gow and Steiner)

## Comparative Field Tests of Lures (Gow and Hayashi)

The Aiea field experimental layout consisting of 12 rotating trap suspensions was completely reconditioned and set up in the Bingham Tract in Honolulu. This move was made as a result of higher fly catches found in Honolulu and reported in the last quarterly report. The 12 trap suspensions comprising the Maunawili experiment have been brought in for reconditioning and will be stored for the time being since insufficient help is available at present to run two experiments simultaneously.

Field Experiment 65 was designed to compare the red soy meal lure with the standard fermenting lure and to test the effect of screening traps with 1/4-inch hardware cloth in an attempt to exclude blow flies to which the proteinaceous baits are highly attractive. To determine day to day fluctuations in the performance of the soy meal lure, traps were tended daily for the first ten days and on the 14th day. The standard lure was replaced with fresh standard lure on the 7th day, while the soy meal lure only received additions of water each day to make up for evaporation.

### Experiment 65

Results expressed as per cent of standard mean catch or per cent of unscreened traps mean catch.

| Treatment | Description |
|---|---|
| $L_1$ | Standard fermenting lure renewed on 7th day. |
| $L_2$ | 1% soy meal cultured at 10% with bacterium No. 14 for 1 week. |
| $S_1$ | Traps unscreened. |
| $S_2$ | Traps screened with 1/4-inch hardware cloth. |

| Treatment | DAYS | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1-7 |
| $L_1$ | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| $L_2$ | 307.9 | 420.9 | 257.9 | 228.5 | 333.3 | 360.1 | 432.2 | 327.1 |
| LSD 5% | 82.0 | 124.0 | 103.7 | 49.6 | 68.4 | 128.8 | 113.1 | 74.7 |
| $S_1$ | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| $S_2$ | 53.7 | 48.4 | 57.1 | 61.8 | 53.4 | 72.4 | 91.4 | 66.6 |
| LSD 5% | 30.9 | 35.3 | 45.6 | 24.5 | 24.2 | 48.3 | 40.7 | 29.1 |
| Total catch | 604 | 245 | 322 | 759 | 494 | 805 | 1064 | 4293 |

| Treatment | DAYS | | | | | |
|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11-14 | 8-14 | 1-14 |
| $L_1$ | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| $L_2$ | 207.8 | 142.7 | 162.5 | 317.9 | 232.6 | 278.2 |
| LSD 5% | 33.9 | 35.3 | 46.8 | 62.2 | 37.5 | 50.5 |
| $S_1$ | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| $S_2$ | 91.8 | 80.0 | 85.2 | 89.5 | 88.4 | 75.9 |
| LSD 5% | 21.1 | 26.2 | 33.0 | 28.3 | 21.2 | 23.5 |
| Total catch | 1099 | 522 | 252 | 1709 | 3582 | 7875 |

It is evident that, while the comparative performance of the standard and the soy meal lures fluctuated over a considerable range, there was no indication that the soy meal lure had become poorer during two weeks of exposure. The soy meal lure was in every case significantly better than the fermenting lure by a considerable amount.

It is evident that screening the traps reduced the catch from 51.6% on the second day to 10.5% during the 11 to 14-day period. Why this effect was greater during the first week is not clear. The effect of the screens on the blow fly catch was noticeable but they did not serve to eliminate blow flies, but only to decrease the catch. In view of the effect of the screens on the oriental fruit fly catch it was fortunate that the blow fly population in the new location was so low as not to interfere at all with the oriental fruit fly catch.

Field Experiment 66 was designed to determine the effect of time of preculture and also of freezing with subsequent storage on the soy meal lure.

## Experiment 66

Results are expressed as per cent of standard lure mean catch.

| Lure | Description |
|---|---|
| A | Standard fermenting lure renewed on the 8th and 14th days. |
| B | 1% soy meal precultured with bacterium No. 14 at 10% for 2 weeks. |
| C | 1% " " " " " " 14 " 10% " 1 week. |
| D | 1% " " " " " " 14 for 2 weeks and then quick frozen at 10% and stored for 3 weeks. |

| Lure | DAYS | | | | |
|---|---|---|---|---|---|
| | 1-2 | 3-4 | 5-6 | 7-8 | 1-8 |
| A | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| B | 200.6 | 206.5 | 245.8 | 383.9 | 244.6 |
| C | 131.4 | 204.2 | 301.5 | 477.4 | 248.4 |
| D | 80.6 | 90.6 | 140.1 | 193.5 | 114.9 |
| LSD 5% | 37.5 | 51.1 | 76.7 | 86.2 | 42.9 |
| Mean catch std. | 12.5 | 14.1 | 5.8 | 7.8 | 40.2 |

| Lure | DAYS | | | |
|---|---|---|---|---|
| | 1-10 | 11-12 | 13-14 | 9-14 |
| A | 100.0 | 100.0 | 100.0 | 100.0 |
| B | 125.2 | 174.8 | 201.2 | 165.9 |
| C | 177.5 | 156.3 | 205.4 | 179.0 |
| D | 54.1 | 47.4 | 58.9 | 53.5 |
| LSD 5% | 49.7 | 67.5 | 89.6 | 64.2 |
| Mean catch std. | 9.3 | 12.3 | 6.6 | 27.2 |

| Lure | DAYS | | | |
|---|---|---|---|---|
| | 15-17 | 18-21 | 15-21 | 1-21 |
| A | 100.0 | 100.0 | 100.0 | 100.0 |
| B | 127.5 | 88.7 | 113.1 | 174.2 |
| C | 134.1 | 110.8 | 125.5 | 184.0 |
| D | 61.9 | 43.5 | 55.1 | 78.3 |
| LSD 5% | 50.1 | 54.6 | 48.6 | 47.4 |
| Mean catch std. | 27.5 | 16.1 | 43.6 | 105.4 |

During the first two days of exposure the 2-week culture was significantly better than the 1-week culture, but by the end of the first 8 days the 1-week culture had caught up, and thereafter there were no significant differences between these two lures. These two lures were better in comparison with the standard during the first week than during the second and third week, but were considerably better than the standard throughout the three-week period, in spite of the fact that the standard lure was renewed each week while the original soy meal lures were used throughout the entire period.

The freezing and storage had the effect on the soy meal lure of depressing the catch until it was no better than the standard fermenting lure, so this method of preservation of the lure is evidently not satisfactory.

The per cent females taken in experiments 65 and 66 are given below:

Per cent Females in Field Experiments 65 and 66 Taken Over the Entire Period of the Experiments.

Experiment 65

| Treatment | Per cent females in 2 weeks' catch |
|---|---|
| Standard lure | 59.4 |
| Soy meal lure | 65.0 |
| Unscreened traps | 62.0 |
| Screened traps | 62.4 |
| LSD 5% | 3.9 |
| LSD 1% | 5.2 |

Experiment 66

| Lure | Per cent females in 3 weeks' catch |
|---|---|
| Standard | 56.0 |
| Soy meal - 2-week culture | 62.5 |
| Soy meal - 1-week culture | 64.2 |
| Soy meal - frozen and stored | 56.7 |
| LSD 1% | 6.3 |

The fresh soy meal lure in each experiment caught a considerably greater proportion of females than did the standard lure, the differences in each case being highly significant. The frozen and stored soy meal lure caught approximately the same proportion of females as did the standard lure, while screening had no effect on the percentage of females.

Olfactometer Screening Tests (Gow and Hayashi)

Eighty-three materials were screened for the oriental fruit fly, thirty-seven for the Mediterranean fruit fly, and nine for the melon fly. The results may be summarized as follows:

| | D. dorsalis | C. capitata | D. cucurbitae |
|---|---|---|---|
| Attractants | 21 | 10 | 2 |
| Enhancers | 7 | 0 | 0 |
| Repellents | 6 | 4 | 0 |
| Obscurants | 35 | 12 | 3 |
| No effect | 14 | 13 | 4 |
| Materials screened | 83 | 37 | 9 |

Results for the various materials tested are presented in table 27. The indices show the catches for each material as compared with the catches in water and in the standard fermenting lure. Thus an index of more than one indicates attraction and of less than one indicates repellence. Where no index is given differences, if they occurred, were not significant. The mean catch in water and the mean catch in the standard lure for both sexes are shown. Tests with C. capitata and D. cucurbitae could only be made when a large enough population of these flies was present in the cage to give significant results.

Of the materials tested with D. dorsalis only castoreum and diethyl phthalate showed much promise as attractants. Combining castoreum and diethyl phthalate did not give significantly better results than using castoreum alone. None of the enhancers were very effective. Methyl benzoate and perhaps methyl acetophenone showed promise as repellents. Xylene at a concentration of 5% was the strongest repellent we have found for D. dorsalis.

No very good attractant was found for C. capitata. On our first test p-Methyl tetrahydroquinoline seemed to be a fairly strong male attractant but subsequent tests showed this material to be considerably poorer than was first indicated. No highly repellent material emerged for this fly.

Diethyl ketone appeared to be a fairly good male attractant for D. cucurbitae. We have only had three tests in which enough melon fly showed up to give results with any significance and even in these tests the numbers caught were quite low, so we do not yet know whether this fly will behave in a satisfactory manner in the olfactometer.

Table 27.--Olfactometer Screening Tests.

Dacus dorsalis

| MATERIAL | Conc. % | Water Indices Female | Water Indices Both sexes | Water Mean water catch | Standard Indices Female | Standard Indices Both sexes | Standard Mean Stand. catch |
|---|---|---|---|---|---|---|---|
| | | Attractants | | | | | |
| Carbon tetrachloride | 5.0 | 2.1 | 1.3 | 7.7 | --- | --- | 250.3 |
| Castoreum | 0.1 | 8.1 | 11.6 | 8.3 | 1.7 | 1.7 | 370.0 |
| | | 14.5 | 18.8 | 5.3 | 2.3 | 2.5 | 318.0 |
| | | 4.3 | 8.9 | 7.7 | 1.4 | 1.6 | 175.3 |
| Diethyl acetic acid | 0.1 | 2.1 | 2.3 | 6.7 | --- | --- | 89.3 |
| Diethyl malonate | 0.1 | 5.3 | 5.6 | 9.0 | 1.9 | 1.9 | 354.0 |
| Diethyl phthalate | 0.1 | 6.4 | 6.7 | 9.0 | 2.8 | 2.7 | 354.0 |
| | | 7.0 | 7.1 | 16.0 | 1.9 | 1.9 | 262.0 |
| Dimethyl anthranilate | 0.1 | 3.1 | 3.6 | 9.0 | --- | --- | 321.3 |
| Ethanol amine | 0.1 | 2.4 | 2.3 | 27.3 | 0.8 | 0.8 | 260.7 |
| Ethyl anisate | 0.1 | 2.3 | 2.4 | 20.7 | --- | --- | 282.7 |
| Ethyl cinnamate | 0.1 | 3.8 | 3.9 | 7.0 | --- | --- | 128.7 |
| Ethyl decylate | 0.1 | 5.9 | 4.8 | 7.0 | --- | --- | 128.7 |
| Ethyl lactate | 0.1 | 9.2 | 5.8 | 12.0 | --- | --- | 225.3 |
| Ethyl oxalate | 0.1 | 12.2 | 8.7 | 12.0 | --- | --- | 225.3 |
| Guiac wood acetate | 0.1 | 2.1 | 2.4 | 36.7 | --- | --- | 379.0 |
| Linalyl butyrate | 0.1 | 2.4 | --- | 5.3 | --- | --- | 122.3 |
| Meta homo methyl salicylate | 0.1 | 3.9 | 3.5 | 9.3 | 1.3 | 1.3 | 245.3 |
| Methyl anisate | 0.1 | --- | 2.9 | 9.3 | --- | 1.3 | 245.3 |
| Musk ambrette | 0.1 | 5.9 | 7.8 | 4.0 | --- | --- | 70.3 |
| Musk ketone | 0.1 | 4.6 | 5.1 | 4.0 | --- | --- | 70.3 |
| Musk xylol | 0.1 | 6.6 | 7.7 | 4.0 | --- | --- | 70.3 |
| Triacetin | 5.0 | 3.0 | 1.8 | 3.7 | 0.6 | 0.6 | 127.3 |
| Turpentine | 5.0 | --- | 33.8 | 1.3 | 0.02 | 1.5 | 80.7 |
| Castoreum+Diethyl phthalate | 0.1<br>0.1 | 9.1 | 4.8 | 7.7 | 1.5 | 1.6 | 175.3 |
| | | Inhibitors | | | | | |
| Cholesterol | 0.01 | --- | --- | 1.0 | --- | 1.4 | 161.0 |
| Ethyl butyl malonate | 0.1 | --- | --- | 0.7 | --- | 1.4 | 203.3 |
| Ethyl succinate | 0.1 | --- | --- | 6.0 | 1.4 | 1.5 | 310.0 |
| Hydroxy acetal | 0.1 | --- | --- | 6.3 | 1.5 | 1.7 | 204.0 |
| Hydroxy citronellal | 0.1 | --- | --- | 6.3 | 1.4 | 1.6 | 204.0 |
| Hydroxy citronellal dimethyl acetal | 0.1 | --- | --- | 6.3 | 1.4 | 1.5 | 204.0 |
| Neroline | 0.1 | --- | --- | 6.0 | 1.3 | 1.2 | 133.3 |

Table 27, cont'd — Dacus dorsalis (cont'd)

| | Conc. % | Water Indices: Female | Water Indices: Both sexes | Water: Mean water catch | Standard Indices: Female | Standard Indices: Both sexes | Standard: Mean Stand. catch |
|---|---|---|---|---|---|---|---|
| **Repellents** | | | | | | | |
| Methyl acetophenone | 0.1 | --- | --- | 9.3 | 0.2 | 0.2 | 245.3 |
| Methyl anthranilate | 0.1 | 0.3 | 0.3 | 22.3 | 0.7 | 0.7 | 202.0 |
| Methyl benzoate | 0.1 | 0.1 | 0.1 | 22.3 | 0.1 | 0.1 | 202.0 |
| Methyl p-cresol | 0.1 | 0.2 | 0.2 | 22.3 | 0.3 | 0.3 | 202.0 |
| p-Methyl tetrahydroquinoline | 0.1 | 0.2 | 0.3 | 10.7 | 0.6 | 0.5 | 352.7 |
| Xylene | 5.0 | 0.0 | 0.01 | 3.7 | 0.01 | 0.01 | 127.3 |
| **Observants** | | | | | | | |
| Baseoil C. | 5.0 | --- | --- | 3.7 | 0.2 | 0.2 | 127.3 |
| Benzene | 5.0 | --- | --- | 1.3 | 0.3 | 0.4 | 80.7 |
| Corn oil | 5.0 | --- | --- | 8.0 | 0.6 | 0.7 | 188.7 |
| Cottonseed oil | 5.0 | --- | --- | 8.0 | 0.3 | 0.3 | 188.7 |
| Cyclonol | 0.1 | --- | --- | 9.0 | 0.3 | 0.3 | 354.0 |
| Diethyl amine | 0.1 | --- | --- | 6.7 | 0.6 | 0.6 | 89.3 |
| Diethyl ketone | 0.1 | --- | --- | 6.7 | 0.8 | 0.8 | 89.3 |
| Dimethyl benzyl carbinyl acetate | 0.1 | --- | --- | 9.0 | 0.4 | 0.4 | 321.3 |
| Dimethyl hydroquinone | 0.1 | --- | --- | 20.7 | 0.2 | 0.2 | 282.7 |
| Ethanol amine | 0.1 | 2.4 | 2.3 | 27.3 | 0.8 | 0.8 | 260.7 |
| Ethyl anthranilate | 0.1 | --- | --- | 0.7 | 0.7 | 0.7 | 203.3 |
| Ethyl caproate | 0.1 | --- | --- | 0.7 | 0.6 | 0.6 | 203.3 |
| Ethyl heptylate | 0.1 | --- | --- | 12.0 | 0.6 | 0.7 | 225.3 |
| Ethyl pelargonate | 0.1 | --- | --- | 11.3 | 0.5 | 0.4 | 198.0 |
| Ethyl phenyl acetate | 0.1 | --- | --- | 11.3 | 0.7 | 0.7 | 198.0 |
| Geranyl acetate | 0.1 | --- | --- | 1.7 | 0.4 | 0.5 | 137.7 |
| Geranyl butyrate | 0.1 | --- | --- | 1.7 | 0.5 | 0.5 | 137.7 |
| Geranyl phenylacetate | 0.1 | --- | --- | 13.0 | 0.8 | 0.7 | 146.7 |
| Geranyl propionate | 0.1 | --- | --- | 13.0 | 0.6 | 0.5 | 146.7 |
| Hexane | 5.0 | --- | --- | 1.3 | 0.6 | 0.5 | 80.7 |
| Hydrolene | 0.1 | --- | --- | 36.7 | 0.6 | 0.6 | 379.0 |
| Ionone | 0.1 | --- | --- | 8.0 | 0.7 | 0.5 | 238.3 |
| Iso-Jasmone | 0.1 | --- | --- | 8.0 | 0.4 | 0.6 | 238.3 |
| Lauryl formate | 0.1 | --- | --- | 8.0 | 0.8 | 0.7 | 134.0 |
| Linalyl benzoate | 0.1 | --- | --- | 5.3 | 0.5 | 0.5 | 122.3 |
| Linalyl cinnamate | 0.1 | --- | --- | 5.0 | 0.6 | 0.6 | 142.7 |
| Linalyl propionate | 0.1 | --- | --- | 5.0 | 0.6 | 0.7 | 142.7 |
| Menthol | 0.1 | --- | --- | 5.0 | 0.6 | 0.7 | 142.7 |
| Methyl heptine carbonate | 0.1 | --- | --- | 5.3 | 0.2 | 0.3 | 94.7 |
| Methyl novoviol | 0.1 | --- | --- | 5.3 | 0.7 | 0.7 | 94.7 |
| Methyl octine carbonate | 0.1 | --- | --- | 3.0 | 0.6 | 0.7 | 83.0 |
| Methyl phenyl acetate | 0.1 | --- | --- | 3.0 | 0.5 | 0.7 | 83.0 |
| Mineral oil | 5.0 | --- | --- | 8.0 | 0.1 | 0.1 | 188.7 |
| Nerol | 0.1 | --- | --- | 6.0 | 0.3 | 0.4 | 133.3 |
| Petroleum ether | 5.0 | --- | --- | 7.7 | 0.8 | 0.8 | 250.3 |

Table 27$_8$ cont'd — Dacus dorsalis (cont'd)

| MATERIAL | Conc. % | Water Indices: Female | Water Indices: Both sexes | Mean water catch | Standard Indices: Female | Standard Indices: Both sexes | Mean Stand. catch |
|---|---|---|---|---|---|---|---|
| **No effect** | | | | | | | |
| Citronellyl formate | 0.1 | --- | --- | 27.3 | --- | --- | 260.7 |
| Dimethyl benzyl carbinol | 0.1 | --- | --- | 9.0 | --- | --- | 321.3 |
| Dioxane | 0.1 | --- | --- | 27.3 | --- | --- | 260.7 |
| Diphenyl methane | 0.1 | --- | --- | 20.7 | --- | --- | 282.7 |
| Ethyl caprylate | 0.1 | --- | --- | 7.0 | --- | --- | 128.7 |
| Ethyl ether | 5.0 | --- | --- | 7.7 | --- | --- | 250.3 |
| Ethyl phenyl glycidate | 0.1 | --- | --- | 11.3 | --- | --- | 198.0 |
| Ethyl salicylate | 0.1 | --- | --- | 6.0 | --- | --- | 310.0 |
| Ethyl sebacate | 0.1 | --- | --- | 6.0 | --- | --- | 310.0 |
| Ethyl tartrate | 0.1 | --- | --- | 1.7 | --- | --- | 137.7 |
| Geranyl valerate | 0.1 | --- | --- | 13.0 | --- | --- | 146.7 |
| Heliotropin | 0.1 | --- | --- | 36.7 | --- | --- | 379.0 |
| Linalyl iso-butyrate | 0.1 | --- | --- | 5.3 | --- | --- | 122.3 |
| Methyl ionone | 0.1 | --- | --- | 5.3 | --- | --- | 94.7 |
| **Dacus cucurbitae:** | | | | | | | |
| **Attractants** | | | | | | | |
| Diethyl ketone | 0.1 | --- | 19.0 | 0.3 | --- | --- | 12.0 |
| Musk ambrette | 0.1 | 4.0 | 3.4 | 1.7 | 2.1 | 1.7 | 13.3 |
| **Deterrents** | | | | | | | |
| None | | | | | | | |
| **Emollients** | | | | | | | |
| None | | | | | | | |
| **Ovicidants** | | | | | | | |
| Nerol | --- | --- | --- | --- | 0.2 | 0.3 | 34.7 |
| Neroline | --- | --- | --- | --- | 0.5 | 0.5 | 34.7 |
| Neryl acetate | --- | --- | --- | --- | 0.4 | 0.4 | 34.7 |
| **No effect** | | | | | | | |
| Diethyl acetic acid | 0.1 | --- | --- | 0.3 | --- | --- | 12.0 |
| Diethyl amine | 0.1 | --- | --- | 0.3 | --- | --- | 12.0 |
| Musk ketone | 0.1 | --- | --- | 1.7 | --- | --- | 13.3 |
| Musk xylol | 0.1 | --- | --- | 1.7 | --- | --- | 13.3 |

Table 27, Cont'd — Ceratitis capitata

| MATERIAL | Conc. % | Water Indices: Female | Water Indices: Both sexes | Water: Mean water catch | Standard Indices: female | Standard Indices: Both sexes | Standard: Mean Stand. catch |
|---|---|---|---|---|---|---|---|
| | | Attractants | | | | | |
| Castoreum | 0.1 | 3.6 | 5.5 | 23.7 | 1.5 | 1.4 | 196.7 |
| | 0.1 | 2.1 | 2.9 | 7.0 | --- | --- | 47.3 |
| Diethylacetic acid | 0.1 | --- | 2.4 | 22.7 | 2.2 | 1.8 | 106.7 |
| Diethyl malonate | 0.1 | 1.9 | 1.7 | 26.0 | 0.7 | 0.8 | 293.3 |
| Diethyl phthalate | 1.0 | --- | --- | 12.0 | 0.3 | 0.6 | 116.7 |
| | 0.1 | 2.3 | 2.6 | 12.0 | 0.6 | --- | 116.7 |
| | 0.01 | --- | --- | 12.0 | --- | --- | 116.7 |
| Dimethyl benzyl carbinyl acetate | 0.1 | --- | 7.0 | 6.3 | --- | 1.5 | 92.0 |
| Dioxane | 0.1 | 5.3 | 3.5 | 3.7 | --- | --- | 17.3 |
| Diphenyl methane | 0.1 | 1.4 | 2.0 | 19.0 | --- | --- | 226.7 |
| Ethyl caprylate | 0.1 | --- | 6.2 | 3.7 | --- | --- | 40.3 |
| Methyl phenyl acetate | 0.1 | --- | 3.6 | 11.0 | --- | 1.5 | 112.7 |
| p-Methyl tetrahydroquinoline | 0.1 | 0.0 | 13.8 | 11.0 | --- | --- | 112.7 |
| | 0.1 | 0.1 | 2.0 | 31.0 | 0.5 | --- | 218.0 |
| | 0.05 | 0.1 | 1.7 | 19.7 | 0.6 | --- | 76.7 |
| | | Enhancers | | | | | |
| None | | | | | | | |
| | | Inhibitors | | | | | |
| Dimethyl hydroquinone | 0.1 | 0.1 | 0.1 | 19.0 | 0.3 | 0.4 | 226.7 |
| Methyl heptine carbonate | 0.1 | 0.2 | 0.1 | 19.0 | 0.3 | 0.3 | 37.3 |
| Methyl ionone | 0.1 | 0.2 | 0.2 | 19.0 | 0.3 | 0.3 | 37.3 |
| Methyl novoviol | 0.1 | 0.3 | 0.3 | 19.0 | 0.4 | 0.4 | 37.3 |
| | | Observants | | | | | |
| Citronellyl formate | 0.1 | --- | --- | 3.7 | 0.1 | 0.5 | 17.3 |
| Cyclonol | 0.1 | --- | --- | 26.0 | 0.5 | 0.4 | 293.3 |
| Diethyl malonate | 0.1 | 1.7 | --- | 26.0 | 0.7 | --- | 293.3 |
| Diethyl phthalate | 1.0 | --- | --- | 12.0 | 0.3 | 0.6 | 116.7 |
| | 0.1 | 2.3 | 2.6 | 12.0 | 0.6 | --- | 116.7 |
| | 0.01 | --- | --- | 12.0 | --- | --- | 116.7 |
| Dimethyl anthranilate | 0.1 | --- | --- | 6.3 | 0.6 | 0.6 | 92.0 |
| Ethyl anisate | 0.1 | --- | --- | 19.0 | 0.7 | 0.7 | 226.7 |
| Ethyl heptylate | 0.1 | --- | --- | 1.7 | 0.2 | 0.4 | 39.7 |
| Ethyl lactate | 0.1 | --- | --- | 1.7 | 0.5 | 0.7 | 39.7 |
| Ethyl oxylate | 0.1 | --- | --- | 1.7 | 0.4 | 0.5 | 39.7 |
| Nerol | 0.1 | --- | --- | 3.3 | 0.2 | 0.3 | 74.3 |
| Neroline | 0.1 | --- | --- | 3.3 | 0.4 | 0.5 | 74.3 |
| Neryl acetate | 0.1 | --- | --- | 3.3 | 0.5 | 0.5 | 74.3 |

Table 27, Cont'd — *Ceratitis capitata* (cont'd)

| | Conc. % | Water Indices Female | Water Indices Both sexes | Water Mean water catch | Standard Indices Female | Standard Indices Both sexes | Standard Mean Stand. catch |
|---|---|---|---|---|---|---|---|
| | | No Effect | | | | | |
| Diethyl amine | 0.1 | --- | --- | 22.7 | --- | --- | 106.7 |
| Diethyl ketone | 0.1 | --- | --- | 22.7 | --- | --- | 106.7 |
| Dimethyl benzyl carbinol | 0.1 | --- | --- | 6.3 | --- | --- | 92.0 |
| Ethanol amine | 0.1 | --- | --- | 3.7 | --- | --- | 17.3 |
| Ethyl anthranilate | 0.1 | --- | --- | 7.7 | --- | --- | 64.7 |
| Ethyl butyl malonate | 0.1 | --- | --- | 7.7 | --- | --- | 64.7 |
| Ethyl caproate | 0.1 | --- | --- | 7.7 | --- | --- | 64.7 |
| Ethyl cinnamate | 0.1 | --- | --- | 3.7 | --- | --- | 40.3 |
| Ethyl decylate | 0.1 | --- | --- | 3.7 | --- | --- | 40.3 |
| Methyl octine carbonate | 0.1 | --- | --- | 11.0 | --- | --- | 112.7 |
| Musk ambrette | 0.1 | --- | --- | 9.0 | --- | --- | 51.0 |
| Musk ketone | 0.1 | --- | --- | 9.0 | --- | --- | 51.0 |
| Musk xylol | 0.1 | --- | --- | 9.0 | --- | --- | 51.0 |

Miscellaneous Olfactometer Tests (Gow and Hayashi)

A test was made with the soy meal lure cultured with bacterium No. 14 in which the effect of prefermentation with yeast No. 15-2 was studied. The prefermentation was to remove carbohydrates which amount to about 20% of the soy meal. Tests which were reported earlier failed to show increased catches resulting from prefermentation and indicated that the diastase used to hydrolyze the starch acted as a repellant. It was observed that yeast No. 15-2 was able to carry on an active fermentation in the 10% soy meal mash in the absence of added diastase, so this test was carried out without diastase. The soy meal was sterilized and inoculated with the yeast and then allowed to ferment for 4 days. One batch was then resterilized to kill the yeast and inoculated without resterilizing. Culture with bacterium No. 14 was continued for 14 days. The results of this test follow:

Olfactometer test on soy meal prefermented with yeast No. 15-2.

| Lure | Description |
|---|---|
| A | Standard fermenting lure. |
| B | Soy meal cultured with bacterium #14. |
| C | Soy meal prefermented with yeast #15-2, resterilized and cultured with bacterium #14. |
| D | Soy meal prefermented with yeast #15-2, and cultured with bacterium #14 without resterilization. |

All soy meal lures were cultured at 10% and diluted to 1% before exposure.

| Lure | Per cent of Standard Mean Catch | |
|---|---|---|
| | Females | Both Sexes |
| A | 100.0 | 100.0 |
| B | 87.1 | 99.7 |
| C | 61.6 | 70.7 |
| D | 137.0 | 157.9 |
| LSD 5% | 16.5 | 18.8 |
| Standard lure mean catch | 162.3 | 305.7 |

Unfortunately as occasionally occurs the response to the soy meal lure was no better than to the fermenting lure. However, the test does indicate that prefermentation without resterilization may improve the soy meal lure.

An olfactometer test was made with the lures used in Field Experiment 66. These lures had been diluted and allowed to stand under non-sterile conditions for 2 days. The results were as follows:

Olfactometer test with lures used in field experiment No. 66.

| Lure | Description |
|---|---|
| A | Standard fermenting lure. |
| B | Soy meal - 2-week culture with bacterium #14. |
| C | Soy meal - 1-week culture with bacterium #14. |
| D | Soy meal - 2-week culture with bacterium #14 quick frozen and stored. |

| Lure | Per cent of Standard Mean Catch | |
|---|---|---|
| | Females | Both Sexes |
| A | 100.0 | 100.0 |
| B | 253.7 | 269.8 |
| C | 267.6 | 306.0 |
| D | 237.0 | 296.3 |
| LSD 5% | 78.6 | 80.6 |
| Standard lure mean catch | 36.0 | 71.7 |

These results compare favorably with the results from the field experiment except that the quick-frozen lure was considerably better in the olfactometer. It is possible that the failure of the frozen lure to perform well in the field was due to the fact that most of the bacteria in this lure were killed by the freezing and so were unable to protect the lure against subsequent infection in the field with undesirable microorganisms, while the lure retained for olfactometer testing was not exposed to this subsequent infection.

## Canec Squares Vs. Box-Type Poison-Bait Stations
(Steiner and Morishita)

The experiments reported in table 36, page 177, of the January-March report were continued after retreating all bait stations (located at 4 points on Oahu) with the original formulas except No. 5. The purpose of this test was to compare formulas and methods of using methyl eugenol so that those used in the Hawaii control experiments could be modified if the results warranted it.

Eight treatments with 4 replicates of each were exposed from April 24 to May 21 with the results as given in Table 28.

Table 28.--Comparative performance of methyl eugenol-poison bait formulas (Third Series).

| Treatment (Period April 24-May 21) | No. flies caught (4 replicates) |
|---|---|
| 1. Standard box trap, parathion 25 WP base + 5 ml. ME applied 4 times. | 3,677 |
| 2. Canec (10" x 10" x 3/4") covered with rain guard. 50 ml. ME + 1.5 gm. G22008. | 3,581 |
| 3. Canec, without rain guard, 50 ml. ME + 1.5 gm. G22008 | 5,403 |
| 4. Canec, without rain guard, 50 ml. ME + 1.5 gm. G22008 plus 3 ml. isopropyl alcohol. | 5,748 |
| 5. Canec, without rain guard, 25 ml. ME + 0.75 gm. G22008 and 1.5 ml. isopropyl alcohol. | 2,082 |
| 6. Canec, without rain guard, 25 ml. ME + 0.25 gm. G22008 and 0.5 ml. isopropyl alcohol. | 2,096 |
| 7. Canec, without rain guard, painted with parathion slurry + 25 ml. ME. | 2,869 |
| 8. Canec, without rain guard, 25 ml. ME + 0.75 gm. malathon tech. | 2,236 |
| TOTAL | 27,692 |

The results of this test largely confirm earlier tests indicating that the box trap (1) is a more efficient method of using methyl eugenol than the canec square (7) if fly catches alone are considered, but that the use of more methyl eugenol (3) at less frequent intervals on the squares (monthly instead of weekly) will result in greater catches and save more than enough labor to offset the increased cost of materials. The use of a rainguard (2) for the third time in this type of comparison resulted in lower catches than when omitted (3). Apparently entrance of rain into the vertically hanging canec forces methyl eugenol to the surface or in some other way keeps the surface in a more attractive condition. Rainfall was very heavy in the Ookala, Hawaii, area.

Parathion painted as a slurry on the canec square and made attractive by the addition of pure methyl eugenol (7) was again more effective than application of the methyl eugenol-G22008 solution (5). With the parathion formula more labor is involved in maintaining the poison stations and the catches made by 25 ml. ME can be doubled by using 50 ml. of methyl eugenol (4 vs. 5). Again no advantage accrued from use of isopropyl alcohol to dissolve the G22008 before addition to the methyl eugenol. (The latter at 3% will dissolve completely in methyl eugenol within a few hours.)

In this experiment malathon (unlike technical parathion and G23611 in previous tests) was an effective substitute for G22008 over the 4-week period; however, it appeared to kill flies less rapidly and was only half as effective as G22008 during the first 4 days which suggests some repellent action when fresh.