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

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

University of California — Hawaii Agricultural Experiment Station

Territorial Board of Agriculture and Forestry

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

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

QUARTERLY REPORT

July 1 - September 30, 1952.

ooo

WORK PROJECT I-o-1. Biology and Ecology of the Oriental Fruit Fly.
N. E. Flitters, Project Leader.

Line Project I-o-1-1. The Effect of Temperature and Humidity on the Oriental Fruit Fly Under Controlled Conditions. (N. E. Flitters, Bureau of Entomology and Plant Quarantine, F. S. Messenger, University of California Agricultural Experiment Station, E. Dresner, B.E.P.Q.)

SUMMARY

During the quarter the simulated climates in all cases were winter condi
In two test sites, Orlando and Houma, the short duration of cold weather resu
in retarded developmental rates of immature stages, but these cold periods were not sufficiently severe to interrupt progeny recovery. However, progeny returns were reduced considerably below the rates obtained in the previous quarter when the simulated conditions were much more favorable.

In the El Centro study, fruit fly development and production ceased by mid-December (simulated time). No further activity had occurred up to the end of February of the following year. In this test, only the F-1 generation was obtained before the onset of winter.

In the remaining two California studies, Auburn and San Jose, winter severity brought fruit fly activity and production to a halt by early November (simulated time). Since past experience had indicated that no possible resumption in fly production could occur before the spring months, the months of December, January, and February were omitted from these studies, and simulation was resumed in March of the following year. By the end of the quarter no results for the new season had been obtained.

In the two Gulf coast cabinets, Houma and Orlando, development and progeny returns were obtained throughout the winter season. The oriental fruit fly in the Houma cabinet was only able to develop pupae of an F-2 generation, but the Mediterranean fruit fly was able to build up to an F-3 adult generation. In the Orlando cabinet both species developed F-3 adult generations. The melon fly, which was introduced into the cabinets later than the other two species, was able to develop an F-2 generation in the Orlando cabinet.

Comparisons between species indicate that, although the Mediterranean fruit fly is capable of faster development and the attainment of new generations sooner than the oriental fruit fly, the latter can build up to greater numbers in shorter periods of time. This is probably due to the fact that the adult longevity of the Mediterranean fruit fly under caged conditions is much shorter than that of the oriental fruit fly. The melon fly and the Mediterranean fruit fly were able to develop under cooler temperatures than the oriental fruit fly.

Cabinet operations during the quarter were satisfactory. No interruptions of importance were encountered. With the elimination of the barren winter months in two of the studies, at least two new climate studies can be initiated late in the forthcoming quarter.

Line Project I-o-l-l. The Effect of Temperature and Humidity on the Oriental Fruit Fly Under Controlled Conditions. (M. E. Flitters, B.E.P.Q., P. S. Messenger, U. of Calif. Agr. Expt. Station.)

Cabinet No. 1 - El Centro, California. (Dec. 1950, Jan.-Feb. 1951)

With the onset of winter, the conditions at this site became increasingly less tolerable for all three species of fruit flies under study. Temperatures began falling very early in December, and on occasion, night temperatures fell to freezing values, with daily thermal peaks for the most part bordering 60° F. However, towards the end of the month a slight increase was experienced but neither the amplitude nor duration of the rise were sufficient to influence any insect development.

Progeny were recovered from fruits infested during exposure to the flies in the preceding quarter. The pre-imaginal developmental period, however, was quite extended. Both oriental and melon fly pupae yielded adults during the week of December 19 to 24th. Pupae amounting to 958 were recovered from the oriental fruit fly which yielded 79 adults. Recovery from the melon fly amounted to 938 pupae which in turn produced 168 flies. The Medfly pupal recovery was but 525 from which 65 adults were recovered. The average pre-imaginal developmental time for the oriental fruit fly was 55 days, Medfly 72 days, and the melon fly 43 days. The percentage of emergence was very low-- the melon fly had 18% followed by the Medfly with 12%, and then by the oriental fruit fly with 8%.

Relative humidities were for the most part low but characterised by wide diurnal fluctuation. Throughout the month there were no periods of sustained high humidity but short periods of 80 to 90 per cent were experienced at night followed by a sharp decline during the day, often down to 10%.

Climatological conditions throughout January and February were such that fruit fly development was completely inhibited, and adult mortalities in all cages (parent and progeny) and in all three fruit fly species were quite high. Progeny populations were wiped out by mid-January.

Cabinet No. 2 - Auburn, California. (Nov.-Dec. 1951 and Mar. 1952)

Conditions within the cabinet simulating this climate became increasingly worse as the days advanced. There were a few days in the early part of November that were conducive to fruit fly development and during that period a few progeny flies were recovered from each of the three species, but for the most part the average temperatures were below the threshold of fruit fly development. Pupal recoveries were made during the quarter from fruits that had been infested during the preceding months. However, some idea of the arresting influence of the low temperatures can be readily attested by reviewing the rate of pre-imaginal development. In the previous quarter (Aug.-Sept.-Oct.) this developmental period was in the region of 28 days, approximately the same for both the oriental and Medflies. However, progeny recovered from these two species during this quarter required an average of 55 days for pre-imaginal development. The melon fly, which has a more accelerated rate of development, required 49 days.

Temperature peaks, which had reached 75° F. for short periods on occasional days during the early part of November, dropped to 50° before the end of the month but the minimum temperatures never fell below 35° F. and for the most part varied around 40° F. However, December provided a month of constant low temperatures. At no time did the thermal peaks reach 60° F. and ofttimes the minimum night temperature dropped to sub-freezing values. A study of the chronological records of climate progression through the rest of the severe winter months (Jan.-Feb. and the first 2 weeks of March) revealed that, from previous established biological findings, fruit flies could not survive. Therefore, the studies in this cabinet were discontinued on Dec. 10 (simulation date) at which time complete adult mortality was recorded.

After a delay of about 10 days, while the cabinet was prepared for the simulation of the early spring months of the year 1952, the cages were restocked with parent stocks of oriental, Mediterranean, and melon flies. Operations were again commenced on March 17 at which time climatological conditions were considered just marginal for the establishment of each of the three species.

A summary of total progeny returns from this cabinet for the period simulated before discontinuance of the climate cycle is appended.

Total progeny recovered from the oriental fruit flies amounted to only 47 flies; no F_2 population for this species was established. The Medfly produced 187 progeny from the parent stock, and 650 flies were recovered from an F_1 generation making a total of 837 flies, which included the initial returns that represented the establishment of an F_2 generation. Pupal recoveries amounted to 2819 for the oriental fruit fly, 4687 for the Medfly and 599 for the melon fly. The above data illustrate the enormous pupal mortality that occurred during the quarter.

Cabinet No. 3 - Houma, Louisiana. (Nov.-Dec. 1948, Jan.-Feb. 1949)

The decrease in temperature experienced late in November continued during December. Minimum temperatures fell below 40° F. on several occasions and the thermal peaks rarely exceeded 70° F. However, the temperature range during the entire month was such that some insect development was possible even though it was greatly retarded.

The latter part of November provided us with some emergence from the pupae of all three species of fruit flies. The parent stock of the oriental fruit fly produced a total of 116 adults from a total of over 2000 pupae; the F_1 population produced no adults from 258 puparia. The elapsed pre-imaginal developmental period averaged about 51 days. The Medfly during this same period produced many more adults but these were recovered from the F_1 population. The parent stock yielded 49 adults from a total of 577 pupae, the developmental period having taken 59 days. Progeny from the F_1 generation of this fly produced adults just in excess of 600 from a total of 1529 pupae. Pre-imaginal development ranged from 53 to 66 days. The melon fly was able to produce the initial progeny representing its F_1 generation near the end of November. From 731 puparia 85 adults were recovered which had a pre-imaginal development of 48 days.

During the entire month of December no progeny were recovered from the parent oriental fruit flies but the F_1 population yielded 49 adults. Pupae were recovered from fruits previously infested by both groups, 148 from the parent stock and 397 from the progeny F_1 group. Pre-imaginal development had taken 75 days in one instance and 62 in another. Recoveries from both the parent and progeny Medflies were made during December. The former produced 79 adults from a total of 242 pupae, and the F_1 generation produced 119 adults from a total of 288 pupae. Pre-imaginal development averaged a little in excess of 60 days. Progeny were recovered in December from the melon fly adults in the amount of 118 from a total of 491 pupae. The rate of pre-imaginal development for this species was considerably less than for the oriental or Medfly, the average being 50 days. However, the retarding effect of low temperatures on pre-imaginal development was clearly illustrated in the returns from each species.

A marked improvement in climate was evidenced in January. The temperature climbed to 80° during certain days and was for the most part in excess of 70° F. during the peak of the day. On two occasions minimum temperatures dropped to the low 40's ° F. but the average minimum temperature was in excess of 60° F. Relative humidity remained low for the month usually ranging between 40 and 70%. Greater fly activity and accelerated pre-imaginal development were the result of these much improved conditions. While no appreciable improvement in progeny returns were anticipated, the recoveries illustrated the shorter pupal duration brought about by the higher average temperature. Both Medfly and melon fly were capable of producing some adults but only negative returns were obtained from the oriental fruit fly. These findings support previous reports that showed the oriental fruit fly to have a higher average temperature requirement than either of the other two species. Adult recovery from the parent Medflies amounted to 72 and from the F_1 generation 107 flies were recovered. The former represented the recovery from 160 pupae, while the latter returns were from a total of 189 puparia. The pre-imaginal developmental period was approximately 50 days. The parent melon flies produced 175 progeny from a total of 509 puparia, the pre-imaginal development time fell from 48 early in the month to about 32 days as the month advanced. Pupae in the amount of 49 were recovered from fruits infested by the F_1 population but no emergence took place.

February provided much variance in temperature, beginning with a more or less uniform thermal pattern ranging from 68° to 80° F. the first few days of the month to be followed sharply by a drop to 30° F. Cool weather (much of the time below 60° F.) continued for three days but was immediately followed by a week of weather which provided temperatures often in excess of 70° F. and never lower than 60° F. This desirable climate was again followed by two weeks when the average temperature was below the threshold for insect activity much of the time and sufficiently low to appreciably retard development. Temperatures frequently dropped to or near 40° F. and the daily peaks rarely reached 70° F. The pattern of relative humidity differed little from that experienced in previous months. Progeny were recovered from all three species of fruit flies, from the parent oriental fruit flies 677 flies were recovered from a total of 1737 pupae; from the F_1 population 25 pupae failed to produce any adults. From 462 Medfly pupae 173 adults were realized, but no recovery of any kind was obtained from the progeny stock of this species. The parent melon flies produced 3000 pupae which in turn yielded 642 adults. Again recoveries from the progeny were negative. Of interest is the fact that pre-imaginal developmental period for the three species of fruit flies had been reduced to the following: oriental fruit fly, 34 days; Medfly, 39 days; and melon fly, 25 days.

During the quarter Medfly alone was successful in producing an F_3 generation but the complete totals of both pupae and progeny recoveries are interesting. The parent stock of oriental fruit fly produced a total of 4272 pupae which yielded 792 adults. This represents 19% emergence. The F_1 generation of this species produced 681 pupae, from which 49 adults were recovered. Recovery from the parent stock of Medflies totaling 1441 pupae was 371 flies or an emergence of 26%. The F_1 generation produced 2006 pupae, which produced 839 adults, or 42% emergence. The F_2 generation produced 728 pupae, which yielded 320 adults.

The parent stock of melon flies produced 4726 pupae from which 1020 adults representing 22% emergence were recovered. The F_1 generation produced 49 pupae with no emergence. (The actual number of fruits exposed in comparison with the number positively infested is quite interesting.) The oriental fruit fly was able to infest successfully 56 of the 73 fruits exposed, the Medfly 60 of 81 fruits, and the melon fly 40 of 71.

Cabinet No. 5 - San Jose, California. (Dec. 1951 and Mar.-Apr. 1952)

Climatological conditions experienced during the month of December grew continuously worse. The temperature on occasions exceeded 60° F. at the very beginning of the month but from then on the daily thermal peaks very rarely reached 60° F. and the nightly minima very frequently fell below freezing. Relative humidity followed a sharp diurnal pattern ranging from about 24 to 95% but for the most part conditions were fairly dry.

With no fruit infestation having occurred for several weeks, and from a careful study of the climatological conditions to be simulated for the following three months, it became obvious that fruit fly development would definitely be inhibited by the winter conditions of January and February. Consequently the operation of this cabinet was discontinued on December 24. After the necessary removal of fruit, isolation containers, and fly cages, the cabinet was cleaned, restocked with all three species of caged fruit flies and climate simulation again begun on March 15. By that time conditions had improved sufficiently to suggest that it might be possible for the fly to re-establish itself.

The recovery of progeny during December was actually quite low but the true significance of the influence of the cold weather on insect development can best be adjudged by a study of the rate of pre-imaginal development during the months previously simulated. All progeny recoveries during December were from fruits infested in October and early November; however, some fruits were infested later but only pupal recoveries were made from them.

From a total of 3667 oriental fruit fly pupae, only 177 adults were recovered during which time the pre-imaginal developmental period averaged 58 days. The Medfly parents produced a greater number of pupae, 3115, from which 551 flies emerged, the average period of pre-imaginal development being 61 days; the F_1 generation produced 3 pupae but no emergence took place.

With the climate simulation advanced to the month of March the flies were introduced into conditions that were for the most part below those desired for their normal development. Temperatures during the entire month were for the most part under 60° F., but only one two occasions did they reach freezing. However, there were six days when the daily thermal peaks exceeded 70° F. and during these periods the temperature remained above 60° F. for the greater part of the day. During these temperature peaks the fruit flies were observed ovipositing in the fruits exposed to them in each cage.

The month of April provided slightly improved climatological conditions--minimum temperatures seldom fell lower than 40° F. and daily thermal peaks of 70° were frequent. However, average conditions were such that pre-imaginal development of all three species of fruit flies was retarded to the extent that no emergence was possible during this or the preceding month although oviposition did take place and the fruits presumably became infested.

Cabinet No. 6 - Orlando, Florida. (Dec.-Jan.-Feb.-Mar. 1929-1930)

Climatological conditions in the Orlando cabinet were such that uninterrupted recovery of progeny was experienced throughout the quarter, but the low temperatures experienced in December and January materially retarded the rate of pre-imaginal development.

Two successive nights of freezing temperatures were experienced in mid-December and for two weeks the daily peak temperature seldom reached 70° F. However, a steady increase in temperature was evidenced during the latter few days of the month.

The tremendous population build-up of the oriental fruit fly necessitated the discontinuance of the original parent stock in order to provide sufficient space for the cages of progeny flies. This is the first instance in which we have had a climate that has provided conditions so favorable to the oriental fruit fly that it could maintain itself in entirety in the cabinets under winter conditions. During the month 2180 puparia were recovered from the parent stock, which in turn yielded 1426 adult flies. The F_1 generation produced 642 puparia from which 490 adults emerged, and the F_2 population produced 799 puparia which provided 118 adults. During this period the Med-flies' parent stock produced 239 puparia from which 121 adults emerged and the progeny or F_1 generation provided 486 puparia which yielded 221 adults. The parent stock of melon flies were responsible for contributing 671 progeny from a total of 2251 puparia.

Climatological conditions during January were for the most part suitable for continued fruit fly development, but the cold periods that occurred midway and the latter part of the month had a retarding effect on both pre-imaginal development and fly activity. There were several days during which the daily thermal peaks barely reached 60° F. and the minimum temperatures fell to 40° F. but both preceding and following these cold periods were days of continued near-optimal temperatures.

During the month fly emergence from the three species of flies dropped appreciably and the developmental period for those that emerged had risen from around 30 days in the previous month to over 40 in the case of Mediterranean and oriental fruit flies, and from 26 days for the melon fly to 36.

The oriental fruit fly produced progeny from both the F_1 and F_2 generations, a total of 594; however, the number of puparia from which these flies emerged (2045) indicates the deleterious effect of cold on the percentage of emergence, from pupae exposed to such a condition. From the Medflies a slightly higher total of flies was recovered--602--and the per cent emergence was higher than the oriental fruit fly for the recovery was from a total of 1439 puparia. These figures represent the recoveries of flies from the parent stock and both the F_1 and F_2 generations. Melon fly production was quite low--only 397 flies were recovered from a total of 1249 puparia.

February provided much improved climatological conditions. Daily thermal peaks usually ranged as high as 80° F. and minimum night temperatures were generally above 50° F. Relative humidities during the month followed a more or less usual pattern, usually falling to about 50% during the day and climbing into the high 90's at night, there being few extremes. However, fly emergence during the month, although plentiful, reflected the cool conditions experienced earlier, the rate of development having been just over 40 days for both the oriental fruit fly and Medfly, and from about 38 days for melon fly during the early part of the month down to 30 days at the latter part of the month.

Progeny were recovered from both the F_1 and F_2 generation of oriental fruit flies and from both the parent and F_2 generation of Medflies and from parent and F_1 populations of melon flies. The reason for no progeny being recovered from the F_1 generation of Medflies was due to the fact that this population was so slow in its initial build-up, and consequently did not reproduce at a high rate, that this coupled with high mortalities accounted for the non-recovery of progeny during the month. However, during the coldest or most severe months of this simulated climate all three species have been able to reproduce and maintain a strong fly population, indicating that with the improved climatological conditions that will be experienced in the next few months uninterrupted population build-up and extended generations can be anticipated.

The following figures represent the total progeny of flies recovered during February: Oriental fruit fly F_1=4 flies; F_2=923 flies. Medflies, parent stock=169; F_2=382. Melon fly, 267 from parent stock; 90 from F_1 generation.

Since but a few days of the simulated month of March have been in progress this quarter, the climatological conditions encountered, and their effect on the biological returns will be dealt with in full in the next report.

Line Project I-c-1-5. Population Trends

OAHU - Kipapa Gulch (N. E. Flitters)

Fly movement in and around Kipapa Gulch during the quarter has been particularly light, this in spite of the fact that guava fruits were abundant. From samples of fruit collected from the gulch infestation was found to be practically non-existent, which substantiates the evidence of very limited amounts of flies visiting the gulch as reflected in the trap catches. To determine whether flies were being collected in scattered amounts or on certain days when conditions were conducive for fly movement, a daily check was made of the traps for a period of 1 week. Since normal fly movement could be expected to take place during the dry daylight hours, the survey was conducted at approximately 3:30 each p.m. at which time maximum trap catches were presumed to have taken place. The study, while of too short a duration to be conclusive, indicated that only on those days when gentle prevailing winds and bright sunny skies free from rain (or man-made hazards) were evidenced did we recover any flies and in every case the collections were very low, well scattered and confined exclusively to the traps situated on the rim of the gulch. It was of particular interest to note on what could be considered an ideal day for fly movement an airplane was conducting spraying operations some distance south of the gulch, and on this and the following day no flies were recovered in the traps; while these conditions could have been coincidental, the possibility of their influence cannot be ignored especially in view of the findings on previous occasions. The total flies collected during the quarter amounted to 83 flies. The following table gives a comprehensive breakdown of the total trapping operation for the months of July-August-September.

Flies recovered				Number of	Flies per	Actual exposure	Flies per Trap	Flies per trap	No.
July	Aug.	Sept.	Total	collections	collection	period	tran days	day	traps
33	24	26	83	18	4.6	65	1.84	3625	0.0217	45

MAUI - (R. Miyabara and T. Yamada)

The work at the Maui ecological station was carried out with greater concentration on oriental fruit fly population studies in the field. Ten methyl eugenol traps established at different localities in connection with this study produced very interesting results. Fruit collections were made at these ten trapping sites in order to correlate the fly abundance with the degree of fruit infestation. Pineapple collections were made to determine the degree of infestation of Dacus dorsalis in these fruits and to determine whether fruit fly larvae could successfully develop if an infestation was positive.

Line Project I-c-1-2. Effect of Climate on the Oriental Fruit Fly Under Field Conditions.

Meteorological Data for Maui Stations

Station		July	August	September	
Haleakala	7030'	77	76	71	Absolute max.
		67	67	62	Max. mean
		44	43	40	Min. mean
		36	36	36	Absolute min.
		2.40	.37	.75	Ppt.
Haleakala	5500'	71	70	68	Absolute max.
		65	66	62	Max. mean
		50	48	47	Min. mean
		44	46	44	Absolute min.
		1.43	.32	.99	Ppt.
Kula	3750'	74	76	73	Absolute max.
		71	71	69	Max. mean
		53	53	52	Min. mean
		49	50	48	Absolute min.
		1.84	.11	.93	Ppt.
Kahului Naska	50'	-	-	95	Absolute max.
		-	-	88	Max. mean
		-	-	71	Min. mean
		-	-	64	Absolute min.
		-	-	-	Ppt.
Haiku	550'	4.29	3.32	3.02	Ppt.
Pauwela	500'	4.02	2.98	2.44	Ppt.
Iao Valley	290-420'	3.95	1.15	2.18	Ppt.
Wailuku	200'	1.12	.22	.15	Ppt.

Pupal Studies.--Experiments carried out to determine pupal duration at three different elevations during the summer months were successfully concluded. At the Kula (3750') station the pupal duration was from 24 to 28 days; at Haleakala (5500') station, 41 to 49 days; and at the highest station on Haleakala, 34 to 47 days.

The results obtained from the pupal experiments were as follows:

Dacus dorsalis:

Expt.	Date pupated	Date emerged	Duration	% emerged
		HALEAKALA 7030'		
2878	6/19/52	negative	-	-
2884	7/ 1/52	8/ 4/52	34 days	50
2890 ground	7/ 9/52	negative	-	-
2896	7/ 9/52	8/18/52	42 days	32
2902 ground	7/17/52	negative	-	-
2908	7/17/52	9/ 2/52	47 days	28
2914	8/ 2/52	negative	-	-
2920	8/ 7/52	negative	-	-
		HALEAKALA 5500'		
2880	6/19/52	negative	-	-
2886	7/ 1/52	8/11/52	41 days	20
2892 ground	7/ 9/52	negative	-	-
2898	7/ 9/52	8/18/52	42 days	56
2904 ground	7/17/52	negative	-	-
2910	7/17/52	9/ 1/52	46 days	32
2922	8/ 7/52	negative	-	-
2928 ground	8/ 7/52	9/25/52	49 days	4
		KULA 3750'		
2888	7/ 1/52	7/26/52	27 days	95
2894 ground	7/ 9/52	8/ 2/52	24 days	36
2900	7/ 9/52	8/ 5/52	27 days	96
2906 ground	7/17/52	negative	-	-
2912	7/17/52	8/12/52	26 days	44
2918	8/ 2/52	8/29/52	27 days	24
2924	8/ 7/52	9/ 3/52	28 days	64
2930 ground	8/ 7/52	9/ 1/52	26 days	60
2936	8/29/52	9/25/52	27 days	44
2946	9/ 2/52	9/29/52	27 days	80

Longevity Studies.--Three cages of second generation melon flies are still under study from last October. In Expt. 2598 there is one female melon fly still alive; in Expt. 2626 there are two females alive; and in Expt. 2628 there is one male alive. These three cages are the last of the longevity studies.

The results of the longevity studies are tabulated below:

Expt.	Date emerged	No. days alive
2598	10/ 8/51	364
2626	10/25/51	338
2628	10/25/51	338

Mating Studies.--The cage of forty gravid female melon flies, continued from March 28 to determine the duration of fertility after mating, still produce fertile eggs in cucumber slices after 6 months of segregation.

Population Studies. - Citronella Lure

Fly catches gradually increased in the last three months. Several areas yielded the highest fly recoveries of the year during the month of September. Some areas increased three times as much as September, 1951.

Population Studies. - Methyl Eugenol Lure

Ten different localities, chosen because of their variability of elevation, climate, hosts, and ecological conditions, were selected as follows: Waihee Valley, elevation 150', a large valley with plentiful hosts such as guava, mountain apple, lemon guava, and mangoes with over average rainfall; Lahaina, elevation 50', is a very dry area, the principal host being mangoes with enough other hosts to maintain the flies throughout the year; Honokahua Valley, elevation 50', a very large valley with many imported fruit trees and other local hosts such as guava, mangoes, and coffee; Kihei, elevation 25', a very dry area near sea level with mangoes and papaya; Makaalae, elevation 100', very close to the sea with mainly kamani and few other hosts; Nahiku, elevation 100', mainly guava with few mountain apples and rose apples; Kailua, elevation 500', mainly rose apple and guava; Olinda, elevation 2100', mainly guavas; and Paia, elevation 750', mainly citrus with other hosts such as avocado, mangoes, guava, and peach.

Fly catches reflect the difference in host abundant areas as compared to areas with few hosts. Fly recoveries per trap day is as high as 6602 flies in favorable host areas and as low as 15 flies in fair host areas.

Line Project I-c-1-4. Hosts of the Oriental Fruit Fly.

Fruit Collections.--Fruits collected this quarter were mostly mangoes. The infestation indices in mangoes in most areas were as high as 100 to 300 pupae per 1000 grams of fruits. In Kihei we made a fruit collection and recovered only 26 pupae from 3 infested lots out of a total of 20 lots of mangoes. From these 26 pupae, 20 flies emerged, all were Medflies. From kamani nuts collected in Lahaina at sea level 86 pupae were recovered from which emerged 29 dorsalis, 39 Medfly, and 11 cophilus. In another collection we recovered 163 pupae which yielded 47 dorsalis, 96 Medfly, and 2 cophilus. This was the first time we have recorded Medfly predominance at a low elevation.

Fruit collected on Maui from June to August, 1952, is summarized as follows:

Total lots:	100
Total fruit:	1734
Total weight:	128,553 in grams
Total pupae:	11,407
Index:	88 per 1000 gram fruit

From the 11,407 pupae emerged 49.8% dorsalis, 32.4% Medfly, .81% O. longicaudatus, .48% O. vandenhoschi, and 16.3% O. cophilus.

Pineapple Collection.--Total pineapples collected amounted to 150 lots which included 422 fruits weighing 1275 pounds; no infestation (eggs or larvae) was discovered in any of the fruits. The pineapples were collected from six different localities--Kuiaha, elevation 250' to 500'; Haiku, 550'; Honolua, 750' to 1000'; Piholo, 2000'; and Pauwela, 450'. These localities were selected because ecological studies had previously been conducted in adjacent areas, and the trapping records indicated that oriental fruit flies were abundant in the area.

FRUIT COLLECTED ON MAUI FROM JUNE TO AUGUST, 1952

Date	Lot	Locality		Fruit	Wt.	No. Fruit	Fungs	Dor.	Med.	Lon.	Van.	Oop.	Index
6/17	5310	Kula	2850'	Peach	849	20	354	63	253	0	0	15	417
"	5311	"	2900'	"	1480	30	159	7	87	0	0	9	107
"	5312	Iao V.	550'	L. guava	332	34	6	4	0	0	0	0	18
"	5313	Wailuku	200'	Mango	863	8	5	3	0	0	0	0	6
"	5314	Haiku	760'	Guava	764	13	57	12	0	0	0	43	75
"	5315	Iao V.	500'	"	1309	19	0	0	0	0	0	0	0
6/19	5316	Kula	2900'	Peach	735	20	317	4	265	0	0	0	431
"	5317	"	"	"	820	25	558	0	423	1	0	0	680
6/20	5318	Olinda	3000'	"	1446	28	12	0	7	0	0	0	8
6/23	5319	Kuiaha	500'	Pineapple	6817	3	0	0	0	0	0	0	0
"	5320	"	"	"	5101	3	0	0	0	0	0	0	0
"	5321	"	"	"	5430	3	0	0	0	0	0	0	0
"	5322	"	"	"	5266	3	0	0	0	0	0	0	0
"	5323	"	"	"	3567	3	0	0	0	0	0	0	0
"	5324	"	"	"	4130	3	0	0	0	0	0	0	0
"	5325	"	"	"	3657	3	0	0	0	0	0	0	0
"	5326	"	"	"	4792	3	0	0	0	0	0	0	0
"	5327	"	"	"	4153	3	0	0	0	0	0	0	0
"	5328	"	"	"	3643	3	0	0	0	0	0	0	0
6/24	5329	Iao V.	550'	L. guava	511	45	11	1	0	0	0	8	22
"	5330	"	500'	Guava	978	17	2	2	0	0	0	0	2
"	5331	"	"	"	892	13	2	0	0	0	0	2	2
"	5332	Wailuku	200'	Mango	2111	22	267	151	0	0	0	15	126
"	5333	"	"	"	1616	16	318	96	0	0	4	39	197
"	5334	Haiku	550'	"	1361	20	365	246	0	5	0	62	268
"	5335	Kula	2850'	Peach	627	19	290	11	202	0	0	7	351
6/25	5336	Honolua	800'	Guava	1474	20	75	2	2	0	0	33	51
"	5337	"	"	"	1446	20	185	23	0	0	0	97	128
"	5338	Honokahua		Mango	3457	30	9	3	0	0	1	1	3
"	5339	L. luna	500'	"	1671	20	97	59	0	0	0	10	58
"	5340	Lahaina	50'	"	2853	30	135	62	0	0	0	3	47
6/26	5341	Kula	1700'	Peach	495	32	119	13	45	0	0	0	240
"	5342	"	2200'	"	708	25	204	11	101	0	0	11	259
"	5343	"	"	"	778	25	100	8	45	0	0	1	129
"	5344	Kihei	20'	Mango	3066	30	213	180	4	0	0	3	69
"	5345	Paia	750'	"	2833	15	247	119	0	0	0	24	88
"	5346	Makawao	100'	"	1956	17	201	65	0	0	0	17	103
"	5347	Kailua	650'	Pineapple	453	15	135	102	0	0	0	1	298
"	5348	Kahiku	250'	"	676	29	232	137	0	0	21	25	343
"	5349	Kailua	650'	"	465	16	192	155	0	0	0	2	413
7/1	5350	Wailuku	200'	Mango	1885	18	49	2	11	0	0	2	26
"	5351	Kula	2900'	Peach	935	15	122	6	74	0	0	8	130
7/2	5352	Honolua	750'	Pineapple	4409	3	0	0	0	0	0	0	0
"	5353	"	"	"	2806	3	0	0	0	0	0	0	0
"	5354	"	"	"	3714	3	0	0	0	0	0	0	0
"	5355	"	"	"	4252	3	0	0	0	0	0	0	0
"	5356	"	"	"	3260	3	0	0	0	0	0	0	0
"	5357	"	"	"	2565	3	0	0	0	0	0	0	0
"	5358	"	"	"	3387	3	0	0	0	0	0	0	0
"	5359	"	"	"	3060	3	0	0	0	0	0	0	0
"	5360	"	"	"	2932	2	0	0	0	0	0	0	0
"	5361	"	"	"	2735	3	0	0	0	0	0	0	0

MAUI FRUIT COLLECTION (cont'd)

Date	Lot	Locality		Fruit	Ht.	No. fruit	Papac	Dor.	Mad.	Lon.	Van.	Cop.	Index
7/8	5362	Pauwela	500'	Mango	1545	6	382	121	0	13	0	35	247
"	5363	Wailuku	200'	"	2260	18	97	34	6	4	0	22	43
"	5364	Kula	2850'	Peach	1146	27	454	91	263	0	0	23	396
7/9	5365	Lahaina	50'	Mango	1700	15	103	93	0	0	0	0	61
"	5366	"		"	1665	15	69	49	0	0	0	0	41
"	5367	Honokahua	50'	"	1624	15	8	1	0	0	0	5	5
"	5368	"		"	1799	15	18	7	0	3	0	3	15
"	5369	Kihei	25'	"	2565	20	53	14	0	0	0	0	21
"	5370	"		"	230	1	0	0	0	0	0	0	0
"	5371	"		"	107	1	0	0	0	0	0	0	0
"	5372	"		"	141	1	0	0	0	0	0	0	0
"	5373	"		"	127	1	0	0	0	0	0	0	0
"	5374	"		"	104	1	0	0	0	0	0	0	0
"	5375	"		"	138	1	23	0	19	0	0	0	167
"	5376	"		"	132	1	0	0	0	0	0	0	0
"	5377	"		"	127	1	0	0	0	0	0	0	0
"	5378	"		"	154	1	0	0	0	0	0	0	0
"	5379	"		"	132	1	0	0	0	0	0	0	0
"	5380	"		"	174	1	0	0	0	0	0	0	0
"	5381	"		"	127	1	0	0	0	0	0	0	0
"	5382	"		"	113	1	1	0	1	0	0	0	9
"	5383	"		"	102	1	0	0	0	0	0	0	0
"	5384	"		"	147	1	0	0	0	0	0	0	0
"	5385	"		"	130	1	0	0	0	0	0	0	0
"	5386	"		"	106	1	0	0	0	0	0	0	0
"	5387	"		"	145	1	2	0	0	0	0	0	14
"	5388	"		"	92	1	0	0	0	0	0	0	0
"	5389	"		"	113	1	0	0	0	0	0	0	0
7/16	5390	Kuiaha	500'	Pineapple	3914	3	0	0	0	0	0	0	0
"	5391	"		"	4167	3	0	0	0	0	0	0	0
"	5392	"		"	4365	3	0	0	0	0	0	0	0
"	5393	"		"	6428	3	0	0	0	0	0	0	0
"	5394	"		"	3425	3	0	0	0	0	0	0	0
"	5395	"		"	3515	3	0	0	0	0	0	0	0
"	5396	"		"	4521	3	0	0	0	0	0	0	0
"	5397	"		"	3687	3	0	0	0.	0	0	0	0
"	5398	"		"	3790	3	0	0	0	0	0	0	0
"	5399	"		"	3740	3	0	0	0	0	0	0	0
"	5400	Wailuku	200'	Mango	2823	20	189	74	12	4	0	59	81
"	5401	Pauwela	500'	"	1782	8	178	89	0	0	0	48	100
7/22	5402	Haiku	550'	"	1062	5	161	65	0	1	3	51	151
"	5403	Iao V.	420'	"	1215	13	193	82	0	0	0	46	159
"	5404	Wailuku	200'	"	2360	20	24	12	0	0	0	1	10
"	5405	Pauwela	500'	"	4351	16	437	56	0	9	0	14	100
"	5406	Olinda	3000'	Peach	1993	52	149	0	62	10	0	42	75
7/23	5407	Lahaina	50'	Mango	2083	20	60	29	14	0	0	5	29
"	5408	"		"	2353	20	51	19	11	0	0	4	22
"	5409	L. Luna	500'	"	1775	22	66	20	1	0	0	16	37
"	5410	"		"	1822	20	46	27	0	0	0	15	26
"	5411	Kihei	50'	"	2358	18	25	19	2	0	0	2	11
"	5412	Lahaina	10'	Kamani	1570	75	86	29	39	0	0	11	56
"	5413	"		"	1330	74	163	47	96	0	0	2	123

MAUI FRUIT COLLECTION (concluded)

Date	Lot	Locality		Fruit	Wt.	No. fruit	Pmne	Dor.	Med.	Lon.	Van.	Con.	Index
7/24	5414	Kaupo	350'	Mango	2069	24	649	220	0	0	0	36	314
8/5	5415	Haiku	550'	Mt. Apple	995	58	1	0	0	0	0	0	1
"	5416	"		Fig	806	10	13	4	0	0	0	0	16
"	5417	Pauwela	500'	Mango	664	9	211	79	0	0	0	12	318
8/11	5418	Iao V.	500'	Guava	1245	25	11	1	0	0	0	1	9
"	5419	"		"	2055	22	14	0	0	0	0	0	7
"	5420	Haiku	550'	Mango	1417	9	58	25	0	0	0	6	41
"	5421	"		Fig	870	10	24	8	0	0	0	0	28
"	5422	"		Mt. Apple	1238	40	141	17	1	0	0	46	114
"	5423	Iao V.	420'	Mango	2245	20	13	8	0	0	0	0	6
"	5424	"		Mt. Apple	735	50	29	0	0	0	0	11	39
"	5425	Wailuku	200'	Mango	2253	20	67	21	0	0	0	3	30
"	5426	Pauwela	500'	"	3477	11	229	7	0	1	0	8	66
"	5427	"		"	3338	8	112	1	0	0	0	4	34
"	5428	Iao V.	290'	Avocado	1756	17	690	282	0	0	2	13	393
8/18	5429	"	700'	Guava	949	20	39	1	0	0	0	15	41
"	5430	"		"	707	20	20	3	0	0	0	10	28
"	5431	"	500'	"	849	20	0	0	0	0	0	0	0
"	5432	"	450'	"	1245	20	63	5	0	0	0	12	51
"	5433	"		"	1062	20	24	1	0	0	0	2	23
"	5434	"	420'	Mango	1202	15	81	24	0	0	0	2	67
"	5435	"		"	1630	15	162	16	0	0	0	3	99
"	5436	Pauwela	500'	"	2806	11	164	3	0	0	0	0	58
"	5437	"		"	2537	8	198	3	0	0	0	0	78
"	5438	Haiku	550'	"	2139	14	251	1	0	0	0	0	117
"	5439	"		Sapote	806	8	65	5	0	1	0	13	81

POPULATION TRENDS, MAUI

Citronella Lure
Flies per trap day

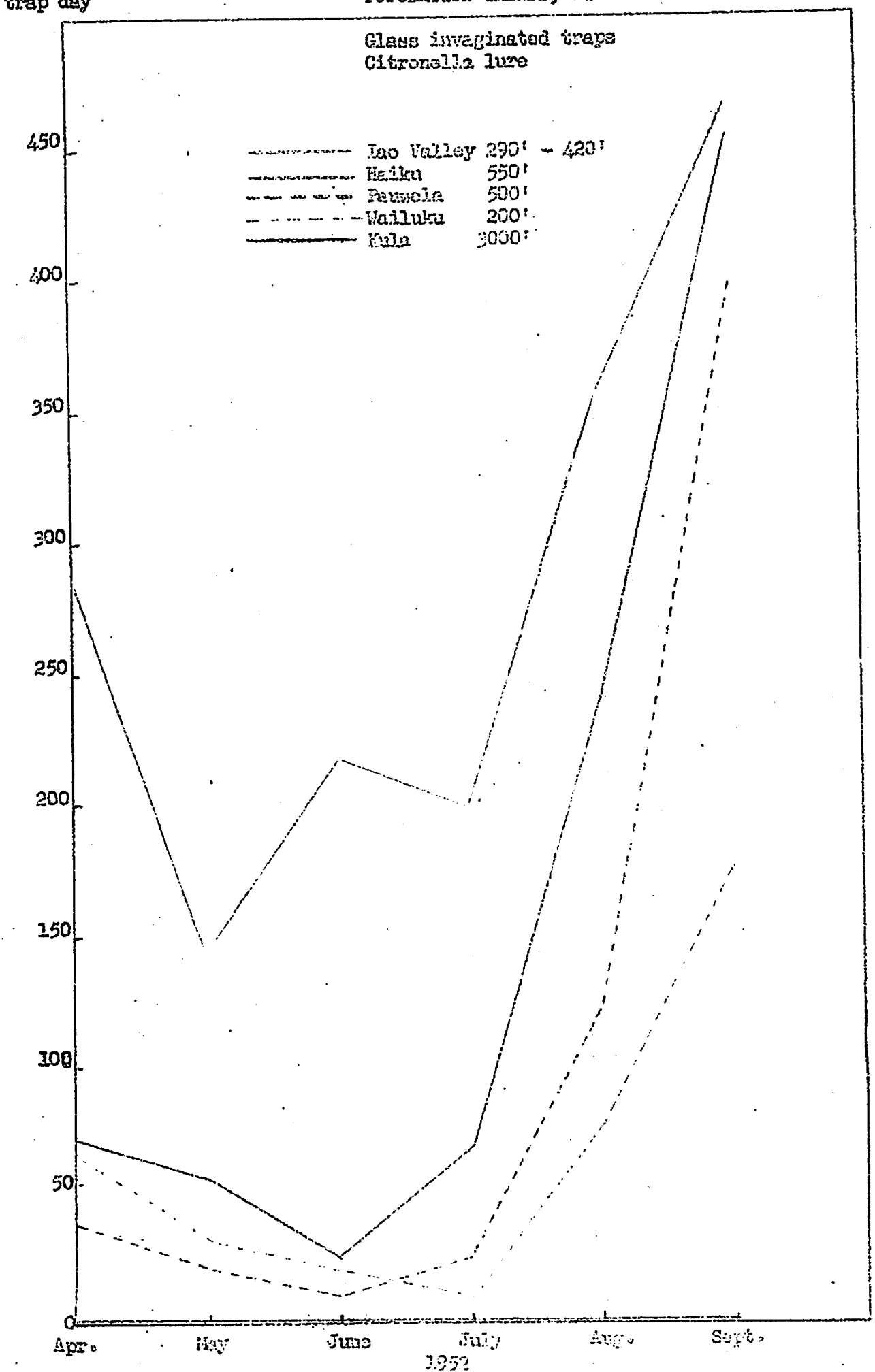
Year	Month	Wailuku 200'	Iao Valley 290'-420'	Paunela 500'	Haiku 550'	Kula 3000'
1950	Jan.		109	94	245	2.1
	Feb.		81	65	199	3.7
	Mar.		202	271	423	11.9
	Apr.		144	232	290	5.8
	May		157	188	284	2.5
	June		323	285	614	3.1
	July		637	291	623	4.4
	Aug.		520	242	541	2.9
	Sept.		616	168	666	3.9
	Oct.		326	141	617	3.1
	Nov.		109	132	270	2.9
	Dec.		45	39	81	.33
1951	Jan.		167	44	140	.23
	Feb.		320	67	240	1.1
	Mar.		222	30	116	1.1
	Apr.	153	451	67	159	.41
	May	213	1313*	170	261	.36
	June	81	521	49	123	.20
	July	67	506	89	224	.43
	Aug.	75	524	175	202	.36
	Sept.	30	312	112	188	.28
	Oct.	19	191	50	168	.14
	Nov.	46	113	36	93	.11
	Dec.	35	84	18	61	.18
1952	Jan.	27	56	12	26	.53
	Feb.	75	132	38	63	.97
	Mar.	139	102	26	58	.71
	Apr.	65	284	39	72	.71
	May	33	144	22	56	.92
	June	21	217	12	26	1.3
	July	11	199	25	68	1.3
	Aug.	76	356	121	239	1.5
	Sept.	175	466	396	454	1.5

Methyl Eugenol Lure
Flies per trap day

1952	Olinda 2100'	Waihee 150'	Lahaina 50'	Honokahua 50'	Kihei 25'	Kaupo 350'	Makaalae 100'	Nahiku 100'	Kailua 500'	Pain 750'
June	91	511	1147	56	481	3844	710	15	26	690
July	32	1669	1492	629	299	5823	787	35	853	845
Aug.	70	1393	1746	1193	156	5439	1152	127	879	894
Sept.	120	1030	1222	1155	91	6602*	998	312	492	789

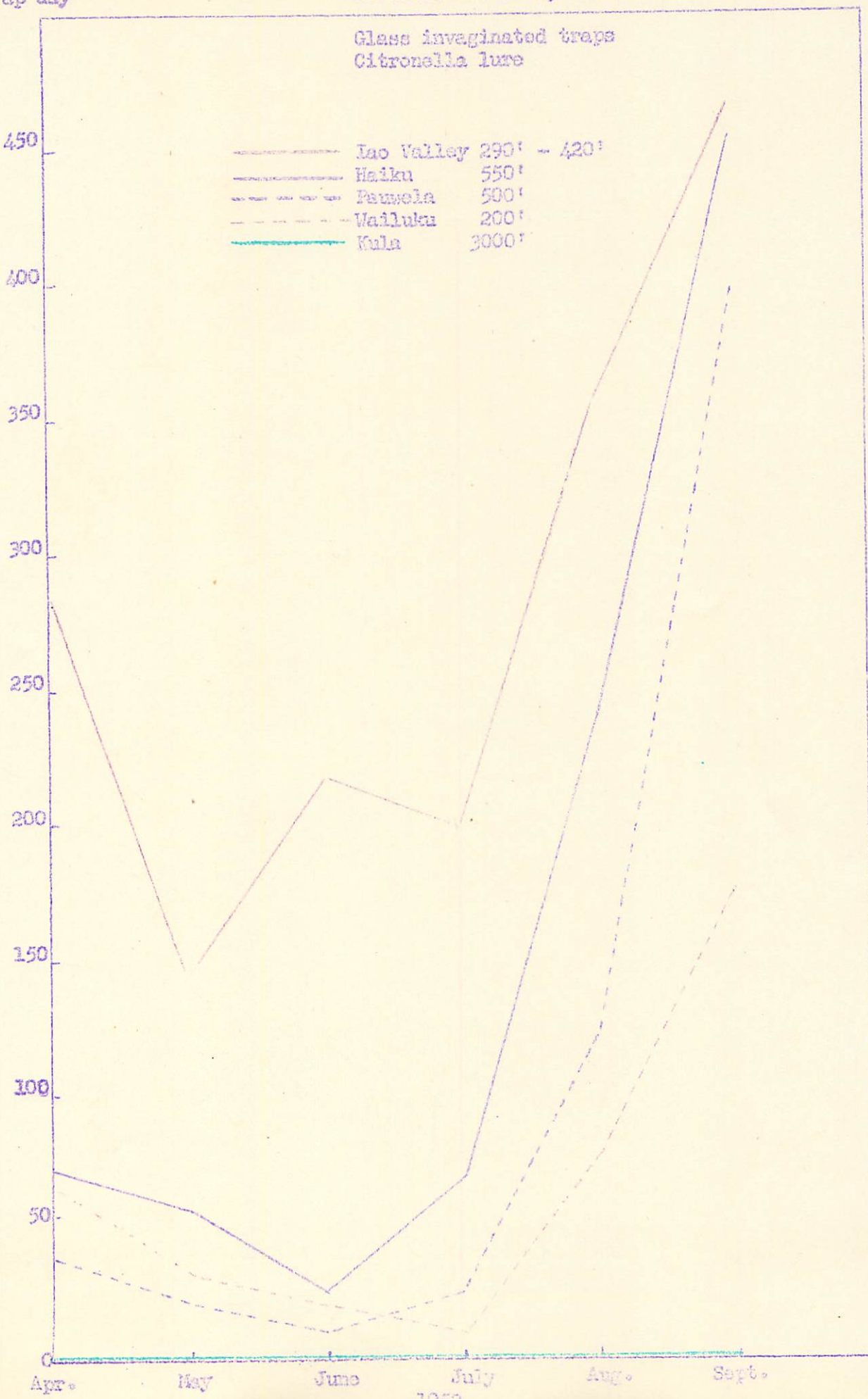
Flies per trap day

POPULATION TRENDS, Maui

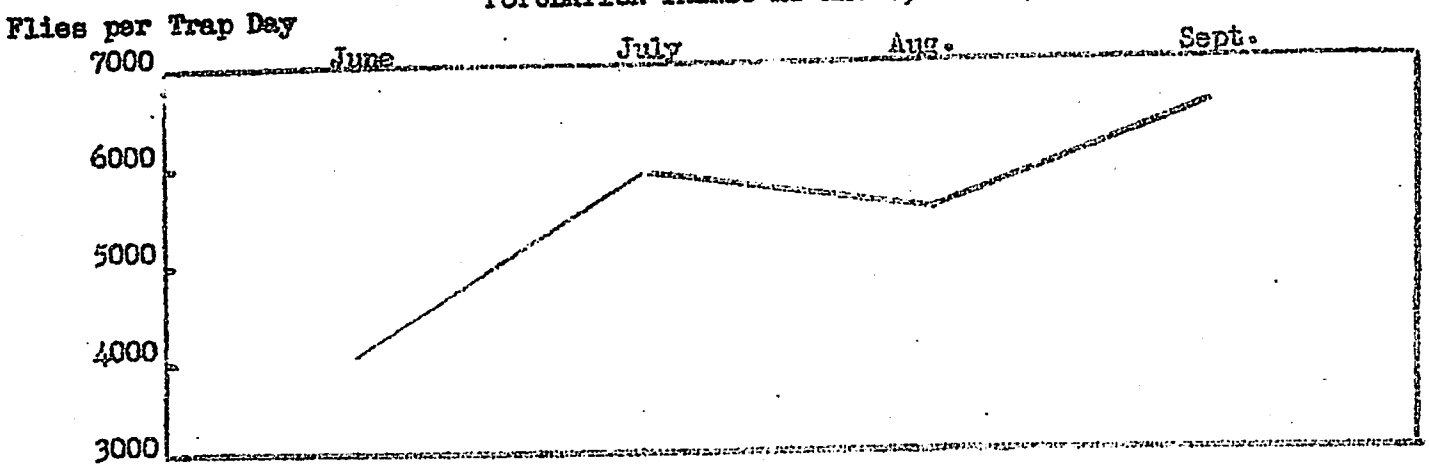


Flies per trap day

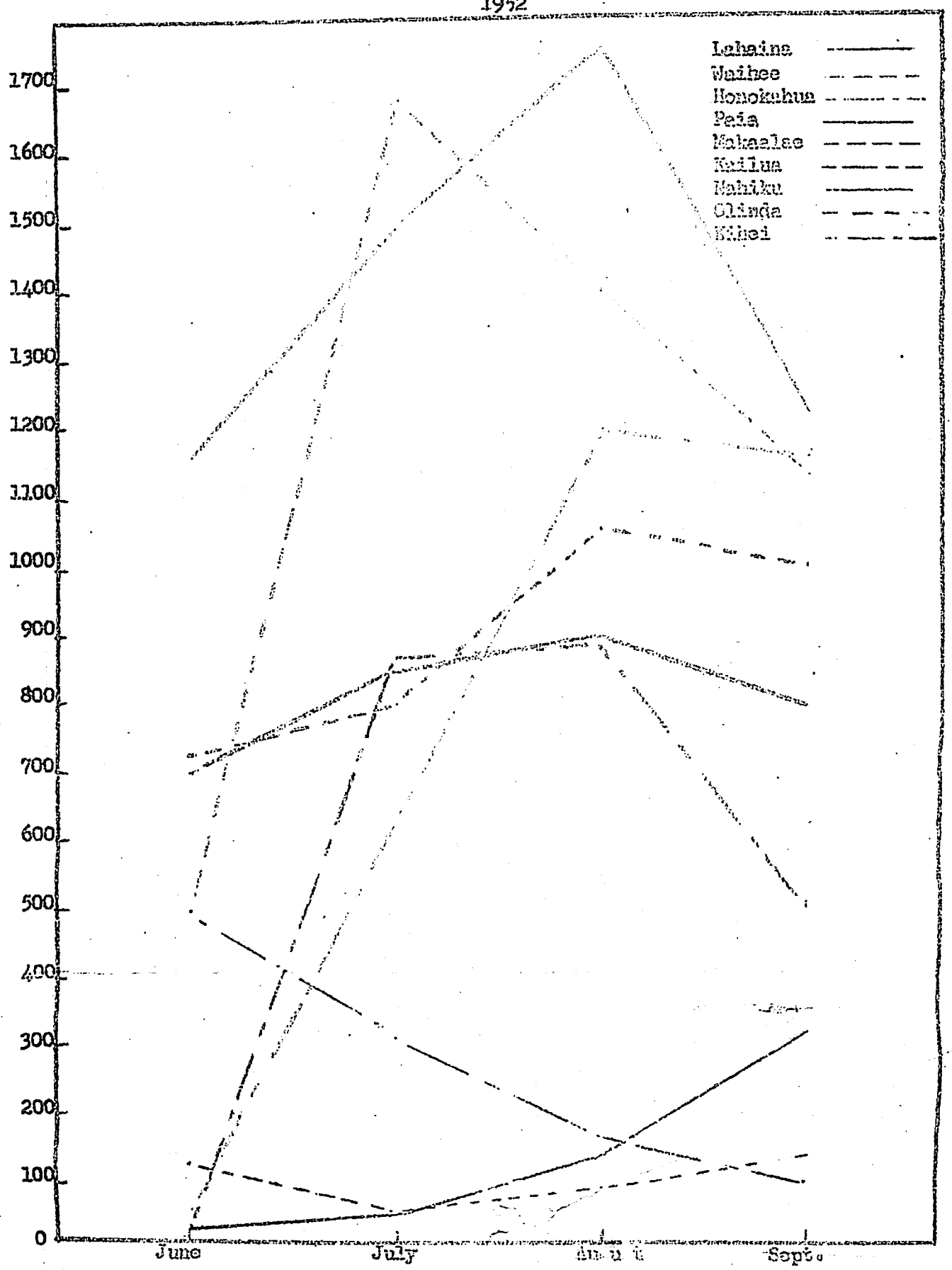
POPULATION TRENDS, Maui



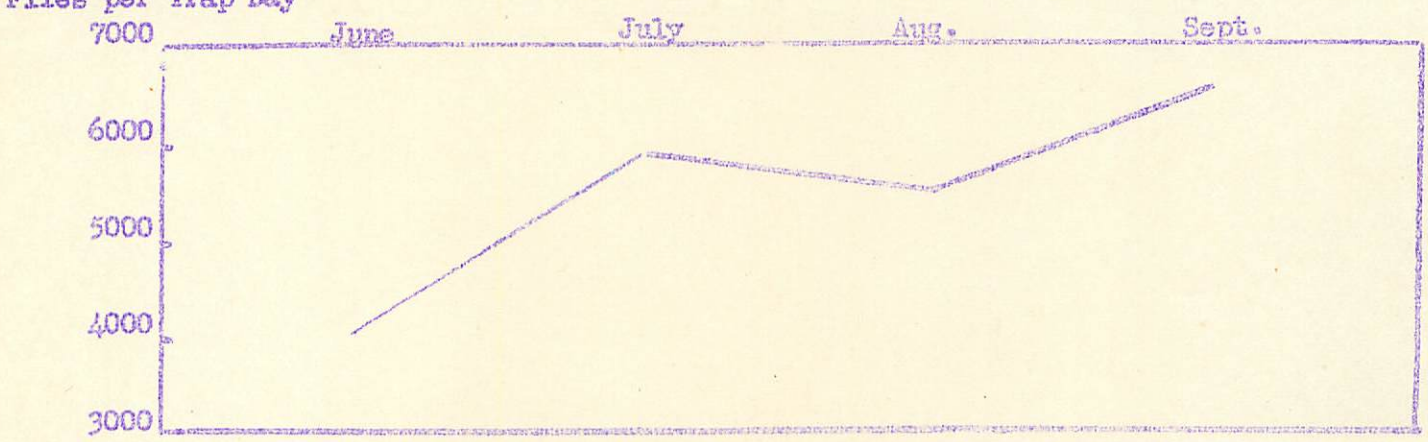
POPULATION TRENDS AT KAUPO, MAUI (1952)



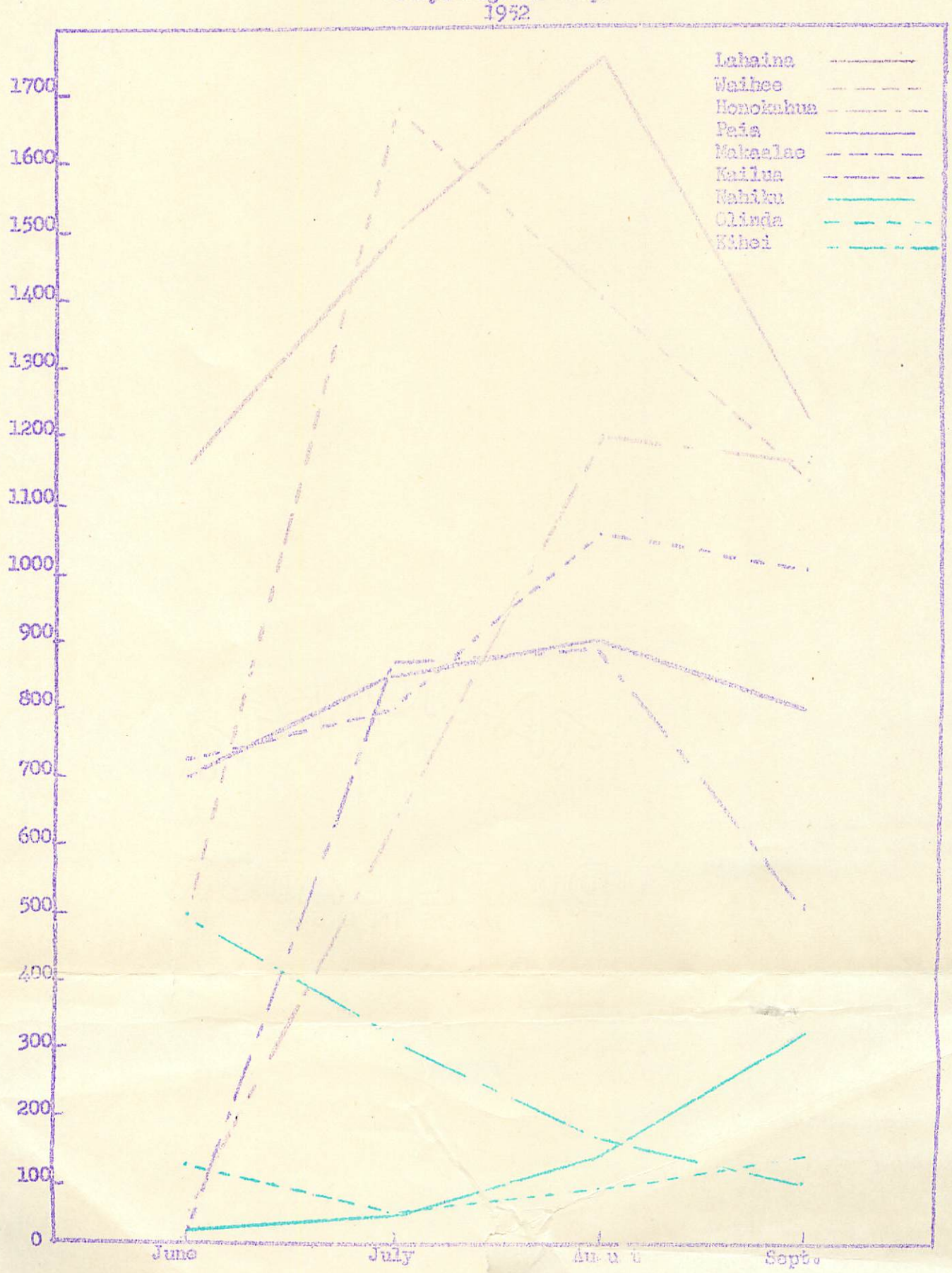
POPULATION TRENDS, MAUI
Methyl Eugenol Traps
1952

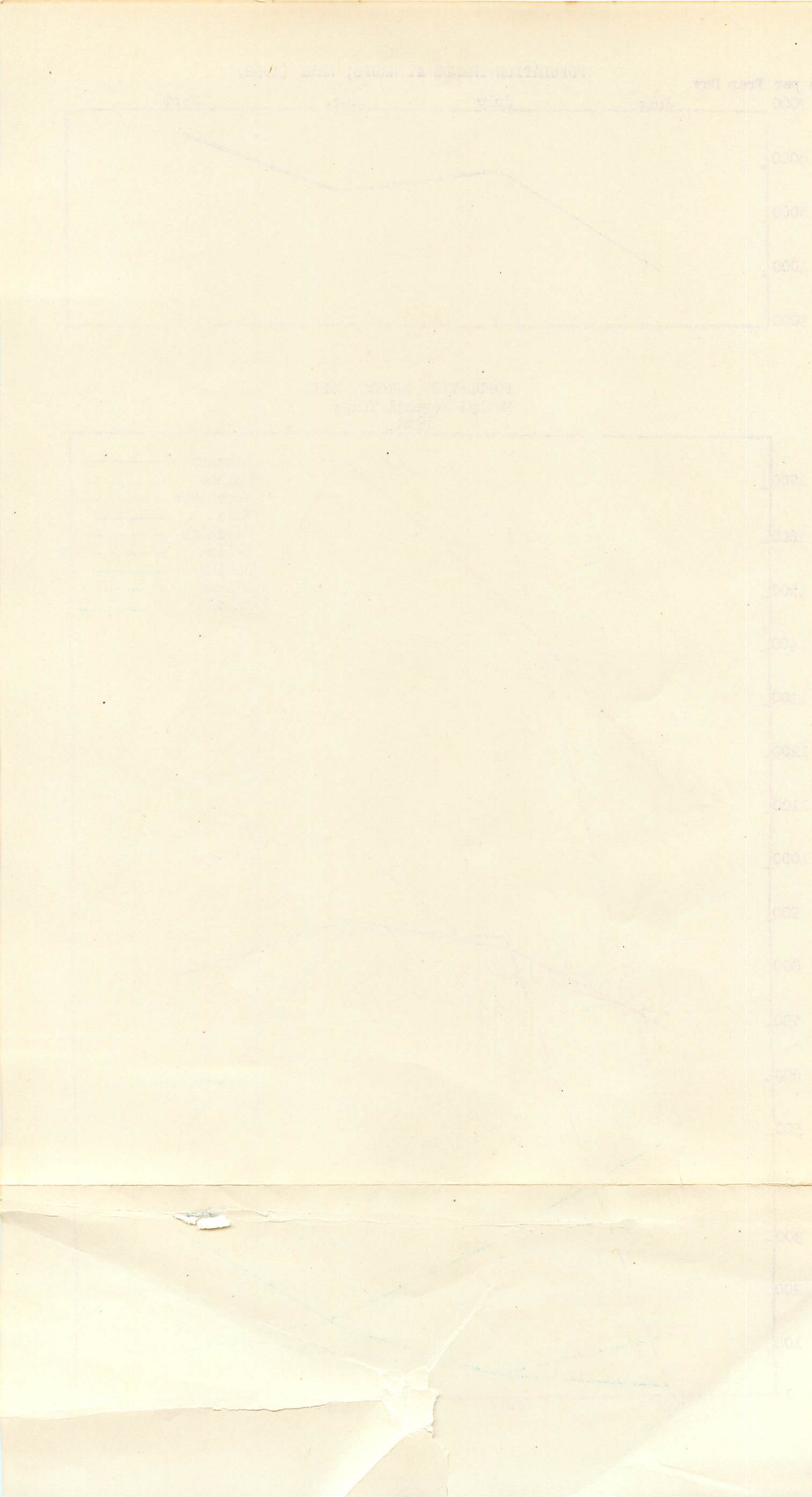


POPULATION TRENDS AT KAUPO, MAUI (1952)



POPULATION TRENDS, MAUI
Methyl Eugenol Traps
1952





HAWAII -(S. Nakagawa and G. Farias)

Line Project I-o-1-2. Effect of Climate on the Oriental Fruit Fly Under Field Conditions.

Meteorological Data.--The weather of the past quarter was very favorable to the oriental fruit fly. High average maximum temperatures at most of the Hawaii stations from sea level to 6700' were favorable for the developmental stages and the activities of adult flies. Kupaahu had the highest maximum temperature, 87° F. recorded on August 16, and also the highest average maximum, 82.9° F. The lowest temperature, 33° F., was recorded at 5900' and 6900' on the Mauna Loa Truck Trail. Total precipitation for the past three months was generally less than for the same comparable period of 1951.

Meteorological data for the Hawaii stations are summarized in table 1.

Pupal Study.--In pupal studies, emergences occurred regularly at all ecological stations. The optimum summer conditions hastened the rate of pupal development and resulted in a considerably shortened pupal period. The results of the comparative pupal studies are summaried below and in tables 2 to 7 inclusive.

Station	Elevation	Pupal duration March to May	Pupal duration June to August
Hilo	75'	13 to 17 days	11 to 14 days
Mauna Loa Truck Trail	4000'	31 to 33 days	19 to 28 days
" " " "	4250'	29 to 34 days	20 to 28 days
" " " "	5100'	33 to 37 days	23 to 32 days
" " " "	5900'	31 to 36 days	23 to 37 days
" " " "	6700'	36 to 43 days	29 to 46 days

Line Project I-o-1-4.--Hosts of the Oriental Fruit Fly.

Fruit Collections.--Fruit collections on Hawaii during the past quarter totaled 132 lots, excluding the pineapple samples. A total of 8,143 puparia were recovered from 4,535 fruits weighing 117,384 grams. This gave an overall index of 69 larvae per 1000 grams of fruit, or 31.7 per pound.

The large fruit fly populations of Dacus dorsalis and Ceratitis capitata along the Mauna Loa Truck Trail a couple of years ago evidently have diminished in numbers. Fly trappings and fruit collections showed a definite drop in flies and fruit infestations. Jerusalem cherry collections this summer had less infestation than in the past, although the infestation index is still considerably high. The highest index of 843 larvae per 1000 grams of fruit was recorded at 4600'. Only 3 dorsalis were recovered from 2,215 cherries and 20 presumably Medfly parasites.

Table 1.--Meteorological Data for Hawaii Stations 1952

STATION	JULY	AUGUST	SEPTEMBER	TEMPERATURE
HILO INSECTARY	85	83	83	Abs. Max.
	78.0	78.9	79.2	Max. Mean
75'	68.7	68.8	68.0	Min. Mean
	65	66	64	Abs. Min.
	8.73	7.25	8.62	Ppt.
KUPAAHU	86	87	86	Abs. Max.
	81.4	82.9	81.5	Max. Mean
100'	68.3	68.9	67.6	Min. Mean
	66	67	64	Abs. Min.
	1.55	1.34	3.27	Ppt.
M. L. T. T.	84	80	80	Abs. Max.
	78.0	75.2	74.4	Max. Mean
4000'	53.3	53.4	52.8	Min. Mean
	48	50	49	Abs. Min.
	2.44	0.35	0.77	Ppt.
M. L. T. T.	82	79	76	Abs. Max.
	74.7	73.5	71.9	Max. Mean
4250'	53.0	53.5	52.5	Min. Mean
	46	49	47	Abs. Min.
M. L. T. T.	76	79	74	Abs. Max.
	70.5	70.3	68.4	Max. Mean
5100'	46.4	45.5	45.7	Min. Mean
	38	38	36	Abs. Min.
M. L. T. T.	81	80	75	Abs. Max.
	71.8	71.0	68.7	Max. Mean
5900'	47.2	42.8	41.1	Min. Mean
	38	36	33	Abs. Min.
M. L. T. T.	75	75	76	Abs. Max.
	68.2	68.6	66.6	Max. Mean
6700'	42.1	40.6	39.8	Min. Mean
	35	35	33	Abs. Min.
KONA	85	85	83	Abs. Max.
	81.4	79.9	79.4	Max. Mean
1700'	61.7	62.9	62.8	Min. Mean
	58	60	61	Abs. Min.
	6.31	3.47	8.24	Ppt.

SUMMATION OF PUPAL STUDIES ON HAWAII

Hilo 75'

Table 2

Dacus dorsalis

Experiment	Date pupated	Date emerged	Pupae	Age	Emergence	Pupal duration
2947	6-3-52	6-16-52	25	1	28%	13 days
2959	6-10-52	6-23-52	25	1	64%	13 days
2973	6-17-52	6-29-52	25	1	48%	12 days
2985	6-24-52	7-7-52	25	1	16%	13 days
2997	6-29-52	7-11-52	25	1	60%	12 days
3009	7-8-52	7-19-52	25	1	44%	11 days
3023	7-14-52	7-28-52	25	1	72%	14 days
3035	7-22-52	8-4-52	25	1	40%	13 days
3049	7-26-52	8-7-52	25	1	68%	12 days
3063	8-4-52	8-17-52	25	1	88%	13 days
3077	8-9-52	8-21-52	25	1	60%	12 days

Mauna Loa Truck Trail 4000'

Table 3

Dacus dorsalis

Experiment	Date pupated	Date emerged	Pupae	Age	Emergence	Pupal duration
2949	6-3-52	7-1-52	25	1	56%	28 days
2961	6-10-52	7-6-52	25	1	56%	26 days
2975	6-17-52	7-11-52	25	1	68%	24 days
2987	6-24-52	7-16-52	25	1	8%	22 days
2999	6-29-52	7-18-52	25	3	64%	19 days
3011	7-8-52	7-30-52	25	1	24%	22 days
3025	7-14-52	8-9-52	25	1	20%	26 days
3037	7-22-52	8-15-52	25	1	16%	24 days
3051	7-26-52	8-16-52	25	4	48%	21 days
3065	8-4-52	8-28-52	25	2	32%	24 days
3079	8-9-52	8-31-52	25	4	48%	22 days

Mauna Loa Truck Trail 4250'

Table 4

Dacus dorsalis

Experiment	Date pupated	Date emerged	Pupae	Age	Emergence	Pupal duration
2951	6-3-52	7-1-52	25	1	20%	28 days
2963	6-10-52	7-9-52	25	1	32%	28 days
2977	6-17-52	7-11-52	25	1	48%	24 days
2989	6-24-52	7-16-52	25	1	28%	22 days
3001	6-29-52	7-19-52	25	3	36%	20 days
3013	7-8-52	8-1-52	25	1	12%	24 days
3027	7-14-52	8-9-52	25	2	36%	26 days
3039	7-22-52	8-14-52	25	1	16%	23 days
3053	7-26-52	8-15-52	25	4	44%	20 days
3067	8-4-52	8-29-52	25	2	36%	25 days
3081	8-9-52	8-30-52	25	4	60%	21 days

Mauna Loa Truck Trail 5100'

Table 5

Dacus dorsalis

Experiment	Date pupated	Date emerged	Pupae	Age	Emergence	Pupal duration
2953	6-3-52	7-4-52	25	1	24%	32 days
2965	6-10-52	7-9-52	25	1	8%	29 days
2979	6-17-52	7-16-52	25	1	24%	29 days
2991	6-24-52	7-18-52	25	1	8%	24 days
3003	6-29-52	7-22-52	25	3	20%	23 days
3015	7-8-52	Negative	25	1	-	-
3029	7-14-52	8-15-52	25	2	12%	32 days
3041	7-22-52	Negative	25	1	-	-
3055	7-26-52	8-18-52	25	4	40%	23 days
3069	8-4-52	9-1-52	25	2	12%	28 days
3083	8-9-52	9-1-52	25	4	44%	23 days

Mauna Loa Truck Trail 5900'

Table 6

Dacus dorsalis

Experiment	Date Pupated	Date emerged	Pupae	Age	Emergence	Pupal duration
2955	6-3-52	7-4-52	25	1	4%	31 days
2967	6-10-52	7-9-52	25	1	24%	29 days
2981	6-17-52	7-12-52	25	1	4%	25 days
2993	6-24-52	7-17-52	25	1	8%	23 days
3005	6-29-52	7-23-52	25	3	40%	24 days
3017	7-8-52	8-2-52	25	1	24%	25 days
3031	7-14-52	8-20-52	25	2	8%	37 days
3043	7-22-52	Negative	25	1	0	-
3057	7-26-52	8-21-52	25	4	28%	26 days
3071	8-4-52	9-7-52	25	2	8%	34 days
3085	8-9-52	9-4-52	25	4	40%	26 days

Mauna Loa Truck Trail 6700'

Table 7

Dacus dorsalis

Experiment	Date pupated	Date emerged	Pupae	Age	% Emergence	Pupal duration
2957	6-3-52	7-10-52	25	1	4%	37 days
2969	6-10-52	Negative	25	1	-	-
2983	6-17-52	7-22-52	25	1	24%	35 days
2995	6-24-52	7-26-52	25	1	4%	32 days
3007	6-29-52	7-28-52	25	3	4%	29 days
3019	7-8-52	8-13-52	25	1	32%	46 days
3033	7-14-52	8-20-52	25	2	28%	37 days
3045	7-22-52	Negative	25	1	-	-
3059	7-26-52	8-24-52	25	4	32%	29 days
3073	8-4-52	Negative	25	2	-	-
3087	8-9-52	9-9-52	25	4	12%	31 days

Line Project I-o-1-4.--Hosts of the Oriental Fruit Fly. (cont'd)

The summation of the Jerusalem cherry collections are as follows:

Locality	Lots	Weight	No.fruit	Pupae	Dor	Med	Lon	M.P.	VanB	Oop	Index
M.L.T.T.											
4000'	3	189	175	2	1	-	-	1	-	-	11
4250'	12	1237	1200	344	1	281	-	7	-	1	283
4600'	8	714	640	602	1	560	-	12	-	-	843
5100'	2	224	200	0	-	-	-	-	-	-	0

The mangoes collected from Kawaihae had the highest index of 434 larvae per 1000 grams of fruit, but the most highly infested hosts of the oriental fruit fly were the rose apples. However, the 50 rose apples collected at Kalaoa, Kona (1700') in June did not yield a single fruit fly puparia. It was one of the rare situations where one of the best hosts of dorsalis was found to be uninfested. The summary of the fruit infestations and the individual screenings of fruit fly hosts are shown in tables 8 and 9.

Pineapple collections were started on June 30, 1952, to determine the status of commercial pineapples as hosts of the oriental fruit fly and Mediterranean fruit fly. The work here was devoted largely to making pineapple fruit collections in close proximity of the gulches at Hawi, Kohala (650') and to fly trapping with McPhail traps. To date we have collected a total of 421 pineapples weighing 1,359 pounds of the ripe and over-ripe stages.

Large fly populations have been caught along gulches of the pineapple fields, but no flies were observed on the fruit. As yet, no fruit fly recoveries have been made from the pineapples collected.

SUMMATION OF FRUIT COLLECTIONS AND FLY EMERGENCE

Table 8

Key: A lot of fruit may include from a few to several hundred depending upon availability, size, etc.
Dor: Dacus dorsalis
Med: Ceratitis capitata
Lon: Opius longicaudatus
M.P.: Medfly parasites
Van: Opius vandenboschi
Oop: Opius oophilus
Index: puparia per 1000 grams of fruit

Locality	No. lots	Weight	No. fruit	Pupae	Dor	Med	Lon	M.P.	Van	Oop	Index
ROSE APPLES											
Olaa	4	1545	63	454	223	-	-	-	12	29	293
Keau	1	312	14	133	34	-	-	-	-	67	427
Pahoa	5	3214	150	1366	761	-	11	-	28	138	425
Mt. View	1	364	20	63	56	-	-	-	-	-	173
Kalaoa, Kona	2	1246	50	0	-	-	-	-	-	-	0
Hilo	5	2233	120	905	241	-	30	-	74	313	405
GUAVA											
M.L.T.T.	2	336	42	11	5	-	-	-	2	-	36
Kukuihaele	1	894	12	107	51	-	-	-	30	-	120
Pahoa	5	5208	89	733	303	-	-	-	103	203	141
Honaunau	1	644	5	0	-	-	-	-	-	-	0
Waiohinu	2	396	18	40	19	-	-	-	2	13	101
Kalapana	1	924	8	194	21	-	-	-	22	81	210
Hakalau	3	2537	22	75	16	-	-	-	-	36	7
Hilo	1	896	12	16	6	-	-	-	3	4	20
MANGO											
Kailua, Kona	4	7050	60	218	79	1	8	-	28	10	30
Honaunau	2	4214	40	191	32	11	-	-	43	62	45
Kupeahu	16	28606	245	927	604	-	-	-	34	20	32
Kawaihae	1	952	12	413	282	-	6	-	11	27	434
Kalapana	3	1960	24	109	49	-	2	-	1	15	56

cont'd

Table 8 cont'd

Locality	No. lots	Weight	No. fruit	Purse	Dor	Med	Lon	M.P.	Van	Oop	Index
STRAWBERRY GUAVA											
Pahoa	2	758	100	198	51	-	9	-	18	69	261
Kalapana	2	252	50	11	3	-	-	-	3	2	44
MT. APPLE											
Hilo	3	3762	54	450	239	-	1	-	55	101	120
Kona	1	1428	20	3	1	-	-	-	2	-	4
PAPAYA											
Hilo	11	24199	53	47	41	-	-	-	-	-	2
Kailua	1	2128	5	48	19	-	-	-	-	-	23
LIME											
Kawaihae	1	77	9	16	12	-	-	-	-	-	208
Waiohinu	1	196	7	1	1	-	-	-	-	-	5
HAWAIIAN ORANGE											
Waiohinu	1	1428	7	9	-	-	-	-	-	7	6
LEMON											
Mt. View	1	560	12	31	26	-	-	-	-	-	55
WILSON SAFOTA											
Hilo	2	2333	23	263	168	-	-	-	13	2	115
STAR APPLE											
Hilo	3	6193	54	22	12	-	-	-	3	-	4
COFFEE											
Kona, Kainoa	2	246	150	5	-	-	-	-	1	1	20
ZANZIBAR DATE											
Kawaihae	3	1676	230	33	26	-	-	-	-	1	20

INDIVIDUAL SCREENINGS OF FRUIT FLY HOSTS

Table 9

FRUIT	LOCALITY	NO. FRUIT	WEIGHT	TOTAL PUPAE	INDEX	AM'T. INFEST.	% INFEST.
Guava	Kupaahu	20	1352	133	98	16	80
Guava	Kupaahu	20	1334	27	20	10	50
Guava	Kupaahu	20	1368	521	381	20	100
Guava	Kupaahu	20	1513	294	194	20	100
Rose Apple	Hilo	20	495	254	513	18	90
Rose Apple	Hilo	20	410	240	585	18	90
Mt. Apple	Hilo	20	1486	202	136	18	90
Mt. Apple	Hilo	20	1380	153	111	17	85
Star Apple	Hilo	20	2404	4	2	2	10
Star Apple	Hilo	20	2445	2	2	2	10
Mango	Kupaahu	20	2131	73	34	5	25
Mango	Kupaahu	20	2255	45	20	5	25
Jer. Cherry	M.L.T.T.	20	37	36	973	17	85
Jer. Cherry	M.L.T.T.	20	35	35	1000	19	95

Line Project I-c-1-5.---Population Trends of Dacus dorsalis Hendel.

CITRONELLA TRAPS

Fly catches from citronella baited McPhail traps on the Big Island remained at a low level at Hilo, Kona and Mauna Loa Truck Trail during the past quarter. The average flies per trap day count for the past nine months of this year at these three stations have been below that for 1951. However, at Kurtahu large numbers of flies continued to occur. The large reservoir of good hosts and ideal weather conditions have been responsible for the rather high fly populations throughout the period since the McPhail traps were established in September of 1950.

Last month (September), Kurtahu had the second highest index recorded (497 flies per trap day) during twenty-four months of trapping activity. The highest index of 696 flies per trap day was recorded last October. Guavas are the most important hosts in this heavily populated area and, together with the mangoes, they are responsible for the tremendous fly populations during the fall months.

The trap catch results are shown in tables 10 to 14 inclusive.

METHYL EUGENOL TRAPS

The population studies with the 30-day methyl eugenol traps installed the latter part of June, 1952, have progressed smoothly during the past quarter.

The most striking increase in population density occurred at Kalaoa, Kona, (1700') from 3 in June to 109 flies per trap day in August. This marked increase in fly activity may be attributed to the ripening of coffee and sporadic fruiting of guavas and mangoes. The Kona areas in general, do not appear to have the large fruit fly populations expected.

Fly densities at Kalapana remained at high levels despite fluctuations in the weekly collections. This is the only district where the supposedly 30-day methyl eugenol trap is serviced weekly due to the tremendous numbers of flies that are caught. At times the flies were so numerous that they covered the entire trap.

The results of the methyl eugenol trap catches are shown in table 15.

Table 10

POPULATION TRENDS, WAIAKEA, HILO (100')

1950

MONTH	PPT.	TRAP DAYS	FLY COUNT	INDEX
September	6.30	112	2,352	21
October	8.45	140	5,951	42
November	10.67	112	3,944	35
December	15.55	112	1,956	17
TOTAL	40.97	476	14,203	Av. 30

1951

January	9.28	140	7,360	53
February	27.78	112	15,919	142
March	18.39	112	9,962	89
April	6.48	112	4,462	40
May	3.46	140	5,916	42
June	6.01	112	3,103	28
July	14.45	140	2,835	20
August	11.09	112	2,279	20
September	3.10	112	3,112	28
October	27.02	140	9,235	66
November	17.67	112	5,392	48
December	20.31	136	3,671	27
TOTAL	166.24	1,480	73,246	Av.49

1952

January	20.43	116	2,337	20
February	9.04	112	5,075	45
March	26.28	112	2,094	19
April	11.60	140	1,859	13
May	8.10	112	887	8
June	9.93	112	1,060	9
July	8.73	140	1,569	11
August	7.25	112	471	4
September	8.62	140	1,410	10
TOTAL	109.98	1,096	16,756	Av.15

Index: Flies per trap day

Table 11

POPULATION TRENDS, KUPAAHU, PUNA (100')

MONTH	PPT.	TRAP DAYS	FLY COUNT	INDEX
1950				
September	-	140	33,099	236
October	-	35	4,865	140
December	-	150	16,462	110
TOTAL	-	325	54,446	Av.168
1951				
January	16.11	160	23,894	149
February	12.62	140	63,291	452
March	20.67	140	56,792	406
April	2.91	161	62,475	388
May	3.62	140	51,566	368
June	2.36	145	44,861	309
July	2.74	175	62,880	359
August	1.65	140	28,390	203
September	2.00	140	53,513	382
October	16.24	175	121,876	696
November	7.81	140	45,475	325
December	5.83	170	20,885	123
TOTAL	94.56	1,926	635,898	Av.348
1952				
January	27.15	143	17,541	121
February	2.58	140	63,191	451
March	12.60	140	43,271	309
April	1.32	175	66,310	379
May	.97	140	49,887	356
June	3.30	140	38,625	276
July	1.55	161	40,581	252
August	1.34	126	27,432	218
September	3.27	175	86,977	497
TOTAL	54.08	1,342	433,815	Av. 323

Table 12

POPULATION TRENDS ON MAUNA LOA TRUCK TRAIL (4000-5100')

1950

MONTH	PPT.	TRAP DAYS	FLY COUNT	INDEX
January	10.00	196	26,127	133
February	10.96	231	62,069	269
March	2.56	196	39,850	203
April	9.34	196	29,344	150
May	1.56	245	15,736	64
June	.27	196	4,615	24
July	7.50	245	28,083	115
August	3.04	196	14,537	74
September	1.85	196	9,564	49
October	3.44	245	5,051	21
November	9.80	196	1,625	8
December	1.23	217	1,447	7
TOTAL	61.51	2,555	238,046	Av.93

1951

January	8.41	203	2,677	13
February	22.37	112	9,411	84
March	25.72	112	1,496	13
April	2.10	140	378	3
May	2.00	112	456	4
June	2.99	112	3,740	33
July	1.51	140	2,492	18
August	9.43	112	1,086	10
September	1.32	112	742	7
October	15.02	140	2,233	16
November	5.77	112	972	9
December	2.18	120	1,202	10
TOTAL	98.82	1,527	26,885	Av. 18

1952

January	17.64	140	715	5
February	3.54	112	2,807	25
March	9.77	112	251	2
April	3.87	140	324	2
May	4.01	112	164	1
June	.52	112	204	2
July	2.44	140	1,790	13
August	.35	112	461	4
September	.77	112	251	2
TOTAL	42.91	1,092	6,967	Av. 6

Table 13

POPULATION TRENDS, HILO CITRUS ORCHARD (75')

1950

MONTH	PPT.	TRAP DAYS	FLY COUNT	INDEX
March	9.04	115	2,779	24
April	33.45	140	2,796	20
May	21.04	175	1,455	8
June	6.27	140	698	5
July	9.83	140	251	2
August	5.63	175	176	1
September	6.30	140	955	7
October	8.45	170	1,899	11
November	10.67	140	1,947	14
December	15.55	140	1,344	10
TOTAL	126.28	1,475	14,300	Av.10

1951

January	9.28	175	2,718	16
February	27.78	140	5,436	39
March	18.39	140	5,336	38
April	6.48	140	2,324	17
May	3.46	175	3,693	21
June	6.01	140	1,149	8
July	14.45	175	1,062	6
August	11.09	110	1,257	10
September	3.10	140	1,761	13
October	27.02	175	5,015	29
November	17.87	140	2,647	19
December	20.31	170	1,479	9
TOTAL	165.24	1,629	24,766	Av. 14

1952

January	20.43	145	1,197	8
February	9.04	140	2,458	18
March	26.28	140	1,546	11
April	11.60	175	1,877	11
May	8.10	140	883	6
June	9.93	140	839	6
July	8.73	175	493	3
August	7.25	140	190	1
September	8.62	175	714	4
TOTAL	109.98	1,370	10,197	Av. 7

Table 14

POPULATION TRENDS, KAINALIU, KONA (1700')

1950

MONTH	PPT.	TRAP DAYS	FLY COUNT	INDEX
August	2.45	56	820	15
September	6.34	112	880	8
October	4.45	140	2,469	18
November	11.84	112	5,397	48
December	3.34	112	7,662	68
TOTAL	28.42	532	17,228	Av.32

1951

January	4.27	140	15,244	109
February	5.71	112	19,920	178
March	12.50	116	12,045	104
April	6.97	136	3,991	29
May	7.24	112	1,302	12
June	14.72	112	1,159	10
July	8.89	140	1,509	10
August	8.75	112	573	5
September	7.37	112	473	4
October	10.51	140	414	3
November	5.48	112	576	5
December	2.85	140	1,539	11
TOTAL	95.26	1,464	58,745	Av. 40

1952

January	8.55	112	1,610	14
February	3.89	112	1,421	13
March	4.49	140	692	6
April	5.28	112	119	1
May	6.51	112	128	1
June	8.14	140	81	.5
July	6.31	112	172	2
August	3.47	112	411	4
September	8.24	140	351	3
TOTAL	54.88	1,092	4,985	Av. 5

Table 15

METHYL EUGENOL TRAPPING DATA

JUNE--1952

STATION	EL.	TOTAL TRAP DAYS	NO. cc	CC/DAY	TOTAL FLIES	INDEX
Hilo	100'	10	240	24	5,400	540
Hakalau	30'	11	10	.9	227	21
Kukuihaele	790'	11	39	3.5	979	89
Puako	20'	13	10	.8	213	16
Kalaoa	1750'	13	-	-	44	3
Kailua	60'	13	37	2.8	722	56
Honaunau	40'	13	183	14.1	4,337	334
Waiohinu	950'	13	60	4.6	1,242	96
Pahoa	600'	10	30	3.0	681	68
Kalapana	50'	10	960	96	21,868	2189
JULY						
Hilo	100'	30	720	24	15,336	511
Hakalau	30'	34	60	1.8	1,254	37
Kukuihaele	790'	34	75	2.2	1,335	39
Puako	20'	35	14	.4	287	8
Kalaoa	1750'	32	12	.4	251	8
Kailua	60'	32	70	2.2	1,155	36
Honaunau	40'	32	175	5.5	3,517	110
Waiohinu	950'	32	370	11.5	7,176	224
Pahoa	600'	21	160	7.6	3,360	160
Kalapana	50'	35	2351	67.2	46,295	1323
AUGUST						
Hilo	100'	25	131	5.2	2,751	110
Hakalau	30'	15	22	1.5	590	39
Kukuihaele	790'	15	10	.7	244	16
Puako	20'	15	6	.4	132	9
Kalaoa	1750'	18	75	4.2	1,965	109
Kailua	60'	17	34	2.0	822	48
Honaunau	40'	17	20	1.2	508	30
Waiohinu	950'	17	210	12.4	4,284	252
Pahoa	600'	34	585	17.2	13,923	410
Kalapana	50'	20	757	37.9	16,957	848
SEPTEMBER						
Hilo	100'	28	105	3.7	2,331	83
Hakalau	30'	31	88	2.8	1,883	61
Kukuihaele	790'	31	29	0.9	603	19
Puako	20'	31	-	-	42	1
Kalaoa	1750'	32	120	3.8	2,808	88
Kailua	60'	33	64	1.9	1,459	44
Honaunau	40'	33	33	1.0	673	20
Waiohinu	950'	33	445	13.5	9,968	302
Pahoa	600'	30	70	2.3	1,610	54
Kalapana	50'	30	2430	81.0	52,974	1766

UNIVERSITY OF HAWAII AGRICULTURAL EXPERIMENT STATION

Project No. 960.1 Taxonomy and geographic distribution of the fruit flies of the sub-family Dacinae, with special emphasis upon those regions where parasite exploration work is being carried on.

Personnel: D. Elmo Hardy, Marian Adachi

A study of the Dacus (Neodacus) Perkins of the world has been completed and will be submitted for publication to either the Annals of the Entomological Society of America or the Trans. of the Washington Entomological Society. This study brings together all of the known information concerning the taxonomy of this subgenus. Two species from India are described as new and the diagnostic details and a key to all of the known species are given.

This is the first monographic study of this group of fruit flies. They have been poorly known in the past and several of the species have not been recognizable from the original descriptions.

The species of Neodacus are among the largest of the fruit flies; they infest a variety of fruits. The subgenus is apparently restricted to the Pacific and oriental regions.

Project No. 960.3. The Biology and Ecology of Fruit Flies

Subproject title: "Competition" between D. dorsalis and C. capitata.

Personnel: H. A. Bess, Frank Haramoto

The regular monthly collections of coffee cherries were continued for Kona during the quarter. The number of dorsalis and capitata reared from the collections from the three elevations are shown in table 1.

Table 1. Number of dorsalis and capitata reared from coffee cherries (300) collected at different elevations in Kona, Hawaii

Locality and date	Number of flies emerged		Percent capitata
	dorsalis	capitata	
Napoopoo (700')			
7-9-52	none available		
8-5-52	9	6	40
9-3-52	1	0	0
Kona Expt. Sta. (1200')			
7-9-52 1/	0	4	100
8-5-52	0	18	100
9-3-52	4	1	20
Captain Cook (2500')			
7-9-52 2/	0	3	100
8-5-52	0	11	100
9-3-52	0	5	100

1/Only 150 cherries.
2/450 cherries.

The continued scarcity of dorsalis in coffee cherries at the 2500' elevations at Captain Cook and scarcity of capitata at the 700' elevation at Napoopoo are significant. As shown in our previous report parasitization is quite high at all three elevations and the greater part of the parasitization is by Opius oophilus Fullaway.

On August 20 two collections of Jerusalem cherries were made along the Mauna Loa Truck Trail in the Volcano area on Hawaii. From the collection made at the highest elevation (5000') 192 capitata, 2 Opius tryoni, and no dorsalis were reared. The collection made at the lowest elevation (4700'), 607 capitata emerged but no parasites or dorsalis. The absence of dorsalis and oophilus are of interest when contrasted to the above data from coffee cherries collected in Kona at much lower elevations. However, parasitization has never been especially/in Jerusalem cherries.

Subproject title: Field ecology of the melon fly.

Personnel: T. Mishida

Much of the field work on this project has been brought to close. The work during this quarter consisted largely of analyzing data obtained during the past two years. Time was also devoted to bringing the bibliographical work up to date.

In addition to the above work a field trip was made with Dr. H. A. Bess to Molokai, Maui, Lanai, and Hawaii during September 23 to October 3. Information was obtained on distribution, habitat and numerical status of the melon fly on the various islands. Special emphasis was given to those areas where commercial plantings of its host were present.

Project No. 960.5 Establishment and spread of parasites, predators and diseases introduced into Hawaii, and their importance in reducing the abundance of and damage by fruit flies

Personnel: I. M. Newell, F. Haramoto

3. Measurement of changes in population of Dacus dorsalis by trapping.

The trap catches showed no pronounced trends during the quarter, although remaining consistently above those of the preceding quarter. The average catch per day for the three month period was about one-fourth higher than for the corresponding period of last year. It seems apparent from this, and from the fruit infestation studies, that Dacus dorsalis has reached about as low a level on Oahu as it ever will, barring any unexpected major change in the factors influencing fly abundance. In fact it is undergoing a slight increase at the present time.

The index of fruit abundance indicates that peak fly catch for this guava crop will be reached in October or November. In 1951, peak fruit abundance was observed in September, followed by maximum trap catches in October and November.

The individual trap records for the quarter are given in table 1, and a 27-month record in table 2.

6. Studies on egg mortality in the field.

Experimental studies on this have been resumed, but there are no results to report on at this time. Data on this phase of fruit fly biology have been gathered in conjunction with other studies, but have not been analyzed as yet.

7. Fruit infestation and incidence of parasitism on Oahu.

Fruit collections made at the regular collecting sites showed a marked increase in infestation over the previous quarter, averaging about 6.4 larvae per fruit. For the preceding three months, the corresponding figure was about 3.1 larvae per fruit. For the third quarter of last year, the infestation was 3.8 larvae per fruit, and the overall figures for the first nine months of 1952 show the average infestation running somewhat higher this year than last.

The proportion of larvae parasitized has been lower this year than in 1951, April and July being the only exceptions. It is felt that this reflects a lowered parasite abundance relative to the fly population, with a corresponding lowering of egg mortality. However, further observations will be required before this explanation can be either accepted or not.

A total of 33 New Caledonia Opius #2, were recovered from the fruits this quarter, compared with seven the first quarter of 1952 and one the second quarter. The parasites other than Opius ochilus show up too infrequently to detect any changes in their relative abundance. The same is also true of Ceratitis capitata.

8. Establishment and s[illegible] of parasites on outside islands (Bess and Haramoto).

During the quarter, [illegible] were made on the islands of Hawaii and Kauai (table 4). The inf[illegible]he 19 collections from Hawaii averaged 2.6 larvae per fruit, which [illegible] the figure of 12.5 larvae per fruit for the same time a year ago. O[illegible] of the larvae were parasitized, and 75 per cent of the parasi[illegible]ophilus (table 4).

The Kauai collecti[illegible]ruits in three samples, so few conclusions can be draw[illegible] #2 showed up for the first time there, one of the 85 pa[illegible] this species. Six of the parasites were O. vandenboschi, an[illegible]ere O. oophilus.

Table 1. Record of [illegible] in 30-day traps, June-September, 1952, Oahu.

Trap	Location		No. Days	Catch (cc.)	Catch/ Day	Lure (cc.)	Fruit Abund.	Rain (in.)	Notes
	[illegible]ane Val[illegible]		31	260	8.4	6	1	1.9	
			29	240	8.3	6	1	1.3	
			1	115	3.7	7.5	0	0.3	
	[illegible] Valley			105	3.4	7	[illegible]	19.2	a
	[illegible] Station			160	5.5	7.5	[illegible]	8.2	a
				180	5.8	6.5		6.4	a
	[illegible]u Valley			580	16.6	3	[illegible]	13.2	
	[illegible] Reserve)			650	23.2	3	[illegible]	6.5	
			[illegible]	700	20.6	3	6	8.4	
4	Waimalu Valley (John Holt)	J[illegible] [illegible]7	28	498	17.8	5	0	1.6	
		Ju[illegible] [illegible]g. 21	35	1070	30.6	5.5	C	1.2	
		Aug. [illegible]ept. 18	28	425	15.2	5	1	1.2	
5	Waianae Mts. (Puu Kaua)	June [illegible] July 17	28	360	12.9	2.5	1	1.1	
		July [illegible] Aug. 21	35	152	4.3	4	1	0.3	
		Aug. [illegible] Sept. 18	28	30	1.1	3.5	4	1.1	
6	Waianae Mts. (Kolekole Pass)	June [illegible] - July 17	28	130	4.6	4	1	0.8	
		July 17 - Aug. 21	35	102	2.9	4	1	0.8	
		Aug. 21 - Sept.18	28	40	1.4	3	5	1.4	
7	Helemano Gulch	June 26 - July 24	28	375	13.4	2	1	3.5	
		July 24 - Aug. 28	35	355	10.1	3.5	1	3.4	
		Aug. 28 - Sept.25	28	132	4.7	2.5	3	2.0	
8	Waimea Valley	June [illegible] - July 24	28	505	18.0	2.5	X	3.9	
		July [illegible] - Aug. 28	35	635	18.1	2	X	2.6	
		Aug. [illegible] - Sept.25	28	385	13.8	1	X	1.7	
9	Kahana Valley	June 24 - July 29	35	30	0.9	8	1	7.7	
		July 29 - Aug. 26	28	65	2.3	7	3	4.3	
		Aug. 26 - Sept.23	28	142	5.1	7	5	3.4	
10	Kahaluu Valley	June 24 - July 29	35	1385	39.6	2	1	5.1	
		July 29 - Aug. 26	28	875	31.3	2	2	2.8	
		Aug. 26 - Sept. 23	28	1150	41.1	2	5	2.0	
11	Kailua Valley	June 17 - July 22	35	2745	78.4	2.5	0	4.2	
		July 22 - Aug. 19	28	3725	133.0	3	1	1.4	
		Aug. 19 - Sept.16	28	2200	78.6	2.5	2	2.0	

a. The rainfall records for the Manoa Valley Station were obtained from the files of the Hawaiian Sugar Planters' Association. These records are not precisely applicable to the trapping period, but very nearly so.

Table 2. Total catch [illegible] eugenol traps, Oahu, 1950-51-52.

Period	Total catch	Catch per day (cc.)	Fruit index	Average rainfall (in.)
June-July, 1950	[illegible]	778		
July-August	[illegible]	1,640		
August-September	[illegible]	1,540		
September-October	[illegible]	1,297	17	
October-November	[illegible]50	745	34	
November-December	[illegible],700	269	22	
December-January, 1951	10,950	313	4	
January-February	8,975	261	28	
February-March	4,725	164	34	
March-April	3,525	130	29	
April-May	8,400	334	9	
May-June	7,400	245	10	
June-July	5,700	162	18	
July-August	4,160	148	35	
August-September	6,630	216	45	
September-October	13,170	395	34	4.6+
October-November	9,645	327	25	7.4+
November-December	6,012	196	6	8.0
December-January, 1952	4,280	143	6	10.6+
January-February	3,959	130	28	5.8
February-March	2,687	93	29	7.4
March-April	5,514	186	23	4.4+
April-May	5,721	202	15	4.2
May-June	5,388	167	12	4.4
June-July	6,973	214	7	5.7
July-August	8,029	270	16	3.0
August-September	5,499	191	35	2.7

Table 1. Record of catches in 30-day traps, June-September, 1952, Oahu.

Trap No.	Location	Interval	No. Days	Catch (cc.)	Catch/ Day	Lure (cc.)	Fruit Abund.	Rain (in.)	Notes
1	Kahaleone Valley	June 30 - July 31	31	260	8.4	6	1	1.9	
		July 31 - Aug. 29	29	240	8.3	6	1	1.3	
		Aug. 29 - Sept. 30	31	115	3.7	7.5	0	0.3	
2	Manoa Valley (HSPA Station)	June 30 - July 31	31	105	3.4	7	1	19.2	a
		July 31 - Aug. 29	29	160	5.5	7.5	4	8.2	a
		Aug. 29 - Sept. 29	31	180	5.8	6.5	4	6.4	a
3	Nuuanu Valley (water Reserve)	June 17 - July 22	35	580	16.6	3	0	13.2	
		July 22 - Aug. 19	28	650	23.2	3	2	6.5	
		Aug. 19 - Sept. 22	34	700	20.6	3	6	8.4	
4	Waimalu Valley (John Holt)	June 19 - July 17	28	498	17.8	5	0	1.6	
		July 17 - Aug. 21	35	1070	30.6	5.5	C	1.2	
		Aug. 21 - Sept. 18	28	425	15.2	5	1	1.2	
5	Waianae Mts. (Puu Kaua)	June 19 - July 17	28	360	12.9	2.5	1	1.1	
		July 17 - Aug. 21	35	152	4.3	4	1	0.3	
		Aug. 21 - Sept. 18	28	30	1.1	3.5	4	1.1	
6	Waianae Mts. (Kolekole Pass)	June 19 - July 17	28	130	4.6	4	1	0.8	
		July 17 - Aug. 21	35	102	2.9	4	1	0.8	
		Aug. 21 - Sept.18	28	40	1.4	3	5	1.4	
7	Helemano Gulch	June 26 - July 24	28	375	13.4	2	1	3.5	
		July 24 - Aug. 28	35	355	10.1	3.5	1	3.4	
		Aug. 28 - Sept.25	28	132	4.7	2.5	3	2.0	
8	Waimea Valley	June 26 - July 24	28	505	18.0	2.5	X	3.9	
		July 24 - Aug. 28	35	635	18.1	2	X	2.6	
		Aug. 28 - Sept.25	28	385	13.8	1	X	1.7	
9	Kahana Valley	June 24 - July 29	35	30	0.9	8	1	7.7	
		July 29 - Aug. 26	28	65	2.3	7	3	4.3	
		Aug. 26 - Sept.23	28	142	5.1	7	5	3.4	
10	Kahaluu Valley	June 24 - July 29	35	1385	39.6	2	1	5.1	
		July 29 - Aug. 26	28	875	31.3	2	2	2.8	
		Aug. 26 -Sept. 23	28	1150	41.1	2	5	2.0	
11	Kailua Valley	June 17 - July 22	35	2745	78.4	2.5	0	4.2	
		July 22 - Aug. 19	28	3725	133.0	3	1	1.4	
		Aug. 19 - Sept.16	28	2200	78.6	2.5	2	2.0	

a. The rainfall records for the Manoa Valley Station were obtained from the files of the Hawaiian Sugar Planters' Association. These records are not precisely applicable to the trapping period, but very nearly so.

Table 2. Total catch in all methyl eugenol traps, Oahu, 1950-51-52.

Period	Total catch co.	Catch per day (co.)	Fruit index	Average rainfall (in.)
June-July, 1950	[illegible]	778		
July-August	[illegible]	1,640		
August-September	[illegible]	1,540		
September-October	[illegible]	1,297	17	
October-November	[illegible]	745	34	
November-December	7,700	269	22	
December-January, 1951	10,950	313	4	
January-February	8,975	261	28	
February-March	4,725	164	34	
March-April	3,525	130	29	
April-May	8,400	334	9	
May-June	7,400	245	10	
June-July	5,700	162	18	
July-August	4,160	148	35	
August-September	6,630	216	45	
September-October	13,170	395	34	4.6+
October-November	9,645	327	25	7.4+
November-December	6,012	196	6	8.0
December-January, 1952	4,280	143	6	10.6+
January-February	3,959	130	28	5.8
February-March	2,687	93	29	7.4
March-April	5,514	186	23	4.4+
April-May	5,721	202	15	4.2
May-June	5,388	167	12	4.4
June-July	6,973	214	7	5.7
July-August	8,029	270	16	3.0
August-September	5,499	191	35	2.7

Table 3. Data on the parasitization of oriental fruit fly larvae in guava fruits collected at permanent stations on Oahu. July, August, September, 1952.

Locality	Lot No.	Collection date	Number Fruits Infested	Number Fruits Clean	Larvae per fruit	Index Fruit Abund.	Number Emerged: Dacus dors.	Opius longi.	Opius oophilus	Others	Number Unemerged: Empty	Dacus	Opius	% Emergence	% Parasitized
#1 Woodlawn	A-305	July 8	4	14	1.1	1	0	0	20	0	1	0	0	95.2	100
" "	A-343	Aug. 6	16	4	4.9	2	18	0	43	2 Opius #2	0	1	3	94.0	71.6
" "	A-381	Sept. 8	20	0	12.7	3	39	0	65	6 O. incisi	22	2	22	70.5	69.4
#2 Woodlawn	A-306	July 8	5	15	1.2	2	0	0	18	0	0	1	1	90.0	95.0
" "	A-344	Aug. 6	12	8	6.4	3	20	0	84	0	2	0	2	96.3	85.0
" "	A-382	Sept. 8	16	4	10.3	4	29	0	117	0	33	4	15	74.1	80.5
#3 Woodlawn	A-307	July 8	6	10	1.6	1	1	0	2		1	0	1	91.3	95.5
" "	A-345	Aug. 6	18	2	7.4	2	14	0	63		6	1	17	76.2	84.2
" "	A-383	Sept. 8	20	0	18.2	3	49	9	189	1 O. incisi	8	5	23	87.3	80.4
#1 Manoa	A-308	July 8	0	4	0.0	1	--	--	--	--	--	--	--	--	--
" "	A-346	Aug. 6	1	2	4.0	1	0	0	12	0	0	0	0	100	100
" "	A-384	Sept. 8	5	15	1.0	6	2	0	18	0	0	0	0	100	90.0
#2 Manoa	A-309	July 8	5	1	3.2	1	1	0	14	0	0	0	0	100	93.3
" "	A-347	Aug. 6	20	0	12.8	2	25	0	155	10 Opius #2 1 O. incisi	6	1	6	93.6	86.9
" "	A-385	Sept. 8	19	1	25.8	5	196	0	132	5 Opius #2	11	8	18	90.0	43.2
#3 Manoa	A-310	July 8	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-348	Aug. 6	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-386	Sept. 8	0	0	--	0	--	--	--	--	--	--	--	--	--
Waikakalaua	A-311	July 10	4	1	19.2	1	25	1	20	0	7	0	13	69.7	57.6
"	A-349	Aug. 7	19	1	16.9	3	51	0	135	0	13	1	11	88.2	73.7
"	A-387	Sept. 11	7	13	1.4	6	4	0	9	0	0	0	0	100	69.2

Table 3 cont'd.

Locality	Lot No.	Collection date	Number Fruits Infested	Number Fruits Clean	Larvae per fruit	Index Fruit Abund.	Number Emerged Dacus dore.	Opius longi.	Opius oophilus	Others	Number Unemerged Empty	Dacus	Opius	% Emergence	% Parasitized
Kipapa	A-312	July 10	5	6	4.7	1	9	0	28	0	0	1	4	88.1	76.2
"	A-350	Aug. 7	8	0	13.8	1	38	0	45	6 Opius #2	2	0	0	97.8	57.3
"	A-388	Sept. 11	0	5	0.0	1	--	--	--	--	--	--	--	--	--
Waipio	A-313	July 10	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-351	Aug. 7	0	0	--	0	--	--	--					--	--
"	A-389	Sept. 11	8	12	1.2	2	4	0	12						72.2
Halawa	A-314	July 10	1	1	6.0	1	0	0	6						100
"	A-352	Aug. 7	5	1	9.0	1	3	0	40						93.3
"	A-390	Sept. 11	19	1	11.3	3	43	0	60					61.8	61.7
#1 Schofield	A-315	July 17	6	4	2.6	1	5	0	11				4	80.0	75.0
" "	A-364	Aug. 21	0	0	--	0	--	--	--				--	--	--
" "	A-399	Sept. 18	0	0	--	0	--	--	--	--		--	--	--	--
#2 Schofield	A-316	July 17	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-365	Aug. 21	2	8	1.6	1	0	0	9	1 C.cap.	0	0	2	83.3	91.7
" "	A-400	Sept. 18	3	17	0.2	5	0	0	3	0	0	0	0	100	100
#3 Schofield	A-317	July 17	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-366	Aug. 21	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-401	Sept. 18	0	20	0.0	3	--	--	--	--	--	--	--	--	--
#1 Kunia	A-318	July 17	3	0	8.3	1	2	0	18	0	0	0	3	87.0	91.3
" "	A-367	Aug. 21	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-402	Sept. 18	4	16	0.3	4	2	0	1	0	0	0	0	100	33.3
#2 Kunia	A-319	July 17	2	3	6.4	1	2	0	24	0	0	1	1	92.9	89.3
" "	A-368	Aug. 21	0	20	0.0	3	--	--	--	--	--	--	--	--	--
" "	A-403	Sept. 18	1	19	0.1	7	0	0	1	0	0	0	0	100	100

Table 3 cont'd.

Locality	Lot No.	Collection date	Number Fruits		Larvae per fruit	Index Fruit Abund.	Number Emerged				Number Unemerged			% Emergence	% Parasitized
			Infested	Clean			Dacus dors.	Opius longi.	Opius oophilus	Others	Empty	Dacus	Opius		
#1 Tantalus	A-320	July 21	9	11	1.1	2	1	0	14	0	0	0	3	83.3	94.4
" "	A-353	Aug. 13	18	2	4.6	2	5	0	41	0	10	2	20	59.0	89.7
" "	A-391	Sept. 15	15	5	5.9	3	37	0	40	0	3	1	2	92.7	52.5
#2 Tantalus	A-321	July 21	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-354	Aug. 13	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-392	Sept. 15	7	13	1.7	3	4	0	18	0	2	0	0	91.7	81.8
#3 Tantalus	A-322	July 21	1	19	0.1	1	0	0	1	0	0	0	0	100	100
#" "	A-355	Aug. 13	1	9	0.1	1	1	0	0	0			0	100	0.0
" "	A-393	Sept. 15	0	20	0.0	2	--	--	--	--				--	--
#4 Tantalus	A--323	July 21	1	6	0.1	1	1	0	0						0.0
" "	A-356	Aug. 13	11	2	5.6	1	11	1	69						86.7
" "	A-394	Sept. 15	4	16	0.6	3	2	1	7						80.0
#1 Burma Rd.	A-331	July 24	11	9	1.7	2	1	0	15	0			2	81.8	85.0
" "	A-374	Aug. 28	13	7	3.5	5	15	0	19	0			3	89.5	59.5
" "	A-412	Sept. 25	7	13	1.1	5	0	0	15	0		0	0	100	100
#2 Burma Rd.	A-332	July 24	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-375	Aug. 28	11	0	9.7	1	8	0	65	0	1	1	2	94.8	88.2
" "	A-413	Sept. 25	4	16	0.4	6	3	0	5	0	0	0	0	100	62.5
#3 Burma Rd.	A-333	July 24	6	1	8.0	1	11	0	28	0	1	1	7	81.3	74.5
" "	A-376	Aug. 28	12	8	3.4	2	6	0	31	0	2	1	6	80.4	84.1
" "	A-414	Sept. 25	7	13	0.7	4	1	0	11	0	0	0	0	100	91.7
#4 Burma Rd.	A-334	July 24	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-377	Aug. 28	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-415	Sept. 25	0	0	--	0	--	--	--	--	--	--	--	---	--
Waimea	A-335	July 24	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-378	Aug. 28	0	0	---	0	--	--	--	--	--	--	--	---	--
"	A-416	Sept. 25	3	17	0.2	3	0	0	4	0	0	0	0	100	100

Table 3 cont'd.

Locality	Lot No.	Collection date	Number Fruits Infested	Number Fruits Clean	Larvae per fruit	Index Fruit Abund.	Number Emberged Dacus dors.	Opius longi.	Opius oophilus	Others	Number Unemerged Empty	Dacus	Opius	% Emergence	% Parasitized
Kahaluu	A-336	July 29	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-369	Aug. 26	20	0	28.0	2	153	0	103	7 Opius #2	6	18	28	83.5	44.7
"	A-407	Sept. 23	18	2	7.5	4	25	0	26	1 Opius incisi	8	5	13	66.7	57.1
#1 Waimanalo	A-324	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-357	Aug. 19	20	0	14.2	2	14	3	145	0	[illegible]	[illegible]	[illegible]	80.2	91.8
" "	A-395	Sept. 16	19	1	9.2	6	14	6	74	[illegible]	[illegible]	[illegible]	[illegible]	80.3	81.0
#2 Waimanalo	A-325	July 22	0	0	--	0	--	--	--						--
" "	A-358	Aug. 19	0	0	--	0	--	--	--						--
" "	A-396	Sept. 16	0	0	--	0	--	--	--						--
#1 Kailua	A-326	July 22	0	0	--	0	--	--	--	--			--	--	--
" "	A-359	Aug. 19	5	0	17.6	1	20	0	30	0			2	94.3	62.5
" "	A-397	Sept. 16	2	0	7.0	1	3	4	7	0		0	0	100	78.6
#2 Kailua	A-327	July 22	5	2	6.4	1	3	2	13	0		0	3	75.0	85.7
" "	A-360	Aug. 19	20	0	11.1	2	29	2	87	5 O. incisi	6	1	10	87.9	77.6
" "	A-398	Sept. 16	13	7	2.9	5	8	4	16	2 O. incisi	1	0	2	90.9	75.0
#1 Nuuanu	A-328	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-361	Aug. 19	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-404	Sept. 22	0	20	0.0	5	--	--	--	--	--	--	--	--	--
#2 Nuuanu	A-329	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-362	Aug. 19	19	1	23.5	2	253	0	103	0	8	9	15	91.8	31.1
" "	A-405	Sept. 22	6	14	0.7	7	3	0	10	0	0	0	0	100	76.9
#3 Nuuanu	A-330	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-363	Aug. 19	9	1	9.4	1	8	0	71	0	7	0	0	91.9	89.9
" "	A-406	Sept. 22	12	8	1.2	6	5	0	10	0	2	0	1	83.3	68.8
Waikane	A-337	July 29	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-370	Aug. 26	19	1	30.2	2	57	1	124	0	33	1	20	77.1	71.8
"	A-408	Sept. 23	18	2	15.3	5	29	8	117	1 O. incisi	11	2	30	78.3	83.4

Table 3 cont'd.

Locality	Lot No.	Collection date	Number Fruits Infested	Number Fruits Clean	Larvae per fruit	Index Fruit Abund.	Number Emerged: Dacus dors.	Opius longi.	Opius oophilus	Others	Number Unemerged: Empty	Dacus	Opius	% Emergence	% Parasitized
Kahana	A-338	July 29	17	3	6.7	3	12	0	78	0	2	0	11	87.4	88.1
"	A-371	Aug. 26	15	5	5.9	5	8	0	17	0	13	5	22	38.5	75.0
"	A-409	Sept. 23	10	10	1.6	6	9	0	14	0	1	1	2	85.2	61.5
#1 Makaua	A-339	July 29	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-372	Aug. 26	19	1	13.9	2	31	0	73	0	29	4	6	72.7	69.3
" "	A-410	Sept. 23	20	0	6.2	5	9	0	49	1 O. incisi	4	0	6	85.5	86.2
#2 Makaua	A-340	July 29	0	3	0.0	1	--	--	--	--	-		--	--	--
" "	A-373	Aug. 26	15	5	6.0	3	4	0	51	0					90.8
" "	A-411	Sept. 23	13	7	2.0	5	6	0	22	0					80.0
#1 Kalihi	A-341	July 31	4	1	12.6	1	6	0	33	1 Opius #2					87.0
" "	A-379	Aug. 29	18	2	11.2	4	26	0	89	0	7		17	80.4	77.9
" "	A-417	Sept. 29	9	11	1.5	6	2	0	21	1 O. incisi	0	0	2	92.3	92.3
#2 Kalihi	A-342	July 31	15	3	7.6	2	17	0	83	0	2	0	2	96.2	83.3
" "	A-380	Aug. 29	18	22	7.3	2	28	0	31	0	9	3	16	67.8	60.3
" "	A-418	Sept. 29	2	18	0.1	6	0	0	1	0	0	0	0	100	100
Total Oahu	A-305 to A-342	July	110	117	4.7	0.7	97	3	444	1 Opius #2	20	6	61	86.2	83.2
	A-343 to A-380	Aug.	364	92	10.1	1.6	846	7	1735	25 Opius #2 7 O. incisi 1 C. cap	176	57	249	84.5	69.1
	A-381 to A-418	Sept.	311	336	4.4	3.9	528	32	1074	7 Opius #2 1 Opius incisi	144	45	173	82.0	69.4

Dacus dor. = Dacus dorsalis Hendel , Opius longi. = Opius longicaudatus (Ashmead),
O. vdb. = Opius vandenboschi Fullaway, C. cap = Ceratitis capitata Wied.

Table 4. Data on the parasitization of fruit fly larvae in guava fruits collected on Hawaii, August-September 1952.

Locality	Lot No.	Collection date	Number fruits		Larvae per fruit	Number Emerged					Number Unemerged			% emergence	% parasitized
			Infested	Clean		Dacus dors.	Opius longi.	Opius vand.	Opius oophilus	Others	Empty	Dacus	Opius		
South Volcano area	H-23	Aug. 25	18	2	5.6	56	0	0	3	3 C.cap	1	7	0	88.6	4.3
Honaunau	H-24	Aug. 25	6	14	1.2	0	0	0	13	0	0	0	0	92.9	100
South Kona	H-25	Aug. 25	0	20	0.0	--	--	--	--	--	--	--	--	--	--
So. Kona-So.point	H-26	Aug. 25	0	20	0.0	--	--	--	--	--	--	--	--	--	--
Kona(Opp. Kialoa)	H-27	Aug. 26	0	20	0.0	--	--	--	--	--	--	--	--	--	--
Honokaa	H-28	Aug. 26	11	9	2.1	0	0	0	23	0	0	0	4	85.2	100
Ninole	H-29	Aug. 26	17	3	6.1	41	0	10	37	0	1	4	3	91.7	52.6
Laupahoehoe	H-30	Aug. 26	0	20	0.0	--	--	--	--	--	--	--	--	--	--
Papaikou	H-31	Aug. 26	5	15	0.3	0	0	0	4				1	80.0	100
Paauilo	H-32	Aug. 26	3	17	0.6	0	0	0	7				2	[illegible]	100
Paauilo-Hilo	H-33	Aug. 26	6	14	0.5	0	0	0	2					[illegible] 7	42.9
Olaa	H-34	Sept. 2	14	6	3.9	9	0	0	15					[illegible] 7	68.6
Pahoa	H-35	Sept. 2	17	3	2.3	20	0	4	0					[illegible] 3	23.1
Queen's bath tub	H-36	Sept. 2	17	3	4.5	11	0	3	15					72.5	65.7
Kalapana	H-37	Sept. 2	18	2	9.3	8	0	1	15					31.2	60.7
Mt. View	H-38	Sept. 2	2	18	0.4	0	0	0	1				0	100	100
Olaa-Pahoa	H-39	Sept. 2	0	20	0.0	--	--	--	--	--	--	--	--	--	--
Kopcho-Warm Spring	H-40	Sept. 2	19	1	7.9	13	0	15	1	0	12	3	7	47.5	46.9
Kalapana-Kopoho	H-41	Sept. 2	14	6	4.2	17	0	5	0	0	4	5	2	66.7	24.1
TOTAL HAWAII	H-23 to H-41	Aug.-Sept.	167	213	2.6	175	0	38	136	7 C.cap	45	35	50	73.3	50.8

Table 5. Data on the parasitization of fruit fly larvae in guava fruits collected on Kauai, June 1952.

Locality	Lot No.	Collection date	Number fruits		Larvae per fruit	Number Emerged					Number Unemerged			% emergence	% parasitized
			Infested	Clean		Dacus dors.	Opius longi	Opius vand.	Opius oophilus	Others	Empty	Dacus	Opius		
Waimea-Kokee	K-1	June 22	0	14	0.0	--	--	--	--	--	--	--	--	--	--
Puhi	K-2	June 22	17	3	7.8	53	0	0	50	--	4	1	5	91.2	50.5
Moloaa	K-3	June 22	14	0	8.1	18	0	6	28	1 Opius #2	2	[illegible]	[illegible]	[illegible]	68.4
TOTAL Kauai	K-1 to K-3	June	31	17	5.3	71	0	6	78	1 Opius #2	[illegible]			[illegible]	[illegible]

Project No. 961.1

Subproject title: Toxicity of insecticides to the larvae of the oriental fruit fly and its internal parasites.

Personnel: M. Tamashiro

The oriental fruit fly [illegible] from the action of contact insecticides during most of its la[illegible]ment, since it is within the fruit. However, it leaves the [illegible] third instar and enters the ground to pupate. In any inte[illegible] a residue of insecticide may be built up in the soil due to [illegible]. Therefore, it is possible for the larva to be exposed to l[illegible] doses of insecticide when it enters the soil to pupate. Not [illegible] occur with such stable insecticides as DDT and dieldrin but with the [illegible] volatile or unstable insecticides if the larva leaves the fruit a short time after spray application.

With the present high parasitization of the oriental fruit fly many of the larvae that drop to the ground contain parasites. Previous workers have studied the effect of insecticides on the adult flies and parasites but little is known abo the effect of contact insecticides on the larva of the fruit fly and its internal parasites.

Therefore, this study is being initiated to determine the toxicity of insecticides to fruit fly and parasite larvae.

Project No. 961.2 Chemical control of fruit flies in Hawaii. Field studies.

Subproject title: Chemical control of C. capitata on persimmons.

Personnel: H. A. [illegible]

In September of [illegible] spray tests were made against C.capitata on persimmons on Maui. DDT applied [illegible] power sprayer gave such excellent control that further tests seemed [illegible]. However, it was decided that a check would be made of the results obtained in 1952 by orchardists who followed the recommendations based [illegible] tests. Consequently, in September of 1952 persimmon orchards [illegible] Nishida and the writer and also some information obtained [illegible] effectiveness of the DDT sprays against capitata on loquats. Persimmon [illegible] were examined in two sprayed and one unsprayed orchard. The data obtained are shown in table 1.

Table 1. Number of stung fruits per 50 fruits in sprayed and unsprayed persimmon orchards at Kula, Maui, 9-25-52.

Sample No.	S. Haramoto orchard (unsprayed)		J. Hashimoto orchard (sprayed)	K. Hashimoto orchard (sprayed)
	Mature unripe fruits	Ripe fruits	Mature unripe fruits	Mature unripe fruits
1	23	49	1	0
2	19	--	1	0
3	27	--	0	0
4	--	--	0	1

Each sample was composed of 50 unripe mature fruits (yellowish green in color) except for one sample of 50 ripe fruits examined in the Haramoto orchard. There were no ripe fruits in the other two orchards since the fruits were being harvested before they were ripe. Since the flesh immediately around the stings becomes darkened the stung fruits can be readily detected.

It can be seen that close to 50 percent of the mature unripe fruits in the unsprayed orchard were stung and 49 of the 50 ripe fruits examined were stung. However, only around 1 percent of the mature unripe fruits in the sprayed orchards were stung. Therefore, the spray program appears to be effective and both orchardists are highly pleased with the results.

Mr. K. Hashimoto advised us that the same spray program had given excellent control of C. capitata on his loquat crop harvested earlier in the season. He stated that in former years when he was using handsprayers, often 50 percent of his loquats were stung.

Table 3 cont'd.

Locality	Lot No.	Collection date	Number Fruits Infested	Number Fruits Clean	Larvae per fruit	Index Fruit Abund.	Number Emerged Dacus dorsalis	Opius longicaudatus	Opius oophilus	Others	Number Unemerged Empty	Dacus	Opius	% Emergence	% Parasitized
Kipapa	A-312	July 10	5	6	4.7	1	9	0	28	0	0	1	4	88.1	76.2
"	A-350	Aug. 7	8	0	13.8	1	38	0	45	6 Opius #2	2	0	0	97.8	57.3
"	A-388	Sept. 11	0	5	0.0	1	--	--	--	--	--	--	--	--	--
Waipio	A-313	July 10	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-351	Aug. 7	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-389	Sept. 11	8	12	1.2	2	4	0	12	0	0	1	1	88.9	72.2
Halawa	A-314	July 10	1	1	6.0	1	0	0	6	0	0	0	0	100	100
"	A-352	Aug. 7	5	1	9.0	1	3	0	40	1 C. capitata	0	0	1	97.8	93.3
"	A-390	Sept. 11	19	1	11.3	3	43	0	60	2 Opius #2	37	8	20	61.8	61.7
#1 Schofield	A-315	July 17	6	4	2.6	1	5	0	11	0	0	0	4	80.0	75.0
" "	A-364	Aug. 21	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-399	Sept. 18	0	0	--	0	--	--	--	--	--	--	--	--	--
#2 Schofield	A-316	July 17	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-365	Aug. 21	2	8	1.6	1	0	0	9	1 C. cap.	0	0	2	83.3	91.7
" "	A-400	Sept. 18	3	17	0.2	5	0	0	3	0	0	0	0	100	100
#3 Schofield	A-317	July 17	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-366	Aug. 21	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-401	Sept. 18	0	20	0.0	3	--	--	--	--	--	--	--	--	--
#1 Kunia	A-318	July 17	3	0	8.3	1	2	0	18	0	0	0	3	87.0	91.3
" "	A-367	Aug. 21	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-402	Sept. 18	4	16	0.3	4	2	0	1	0	0	0	0	100	33.3
#2 Kunia	A-319	July 17	2	3	6.4	1	2	0	24	0	0	1	1	92.9	89.3
" "	A-368	Aug. 21	0	20	0.0	3	--	--	--	--	--	--	--	--	--
" "	A-403	Sept. 18	1	19	0.1	7	0	0	1	0	0	0	0	100	100

Table 3 cont'd.

Locality	Lot No.	Collection date	Number Fruits		Larvae per fruit	Index Fruit Abund.	Number Emerged				Number Unemerged			% Emergence	% Parasitized
			Infested	Clean			Dacus dors.	Opius longi	Opius oopidus	Others	Empty	Dacus	Opius		
#1 Tantalus	A-320	July 21	9	11	1.1	2	1	0	14	0	0	0	3	83.3	94.4
" "	A-353	Aug. 13	18	2	4.6	2	5	0	41	0	10	2	20	59.0	89.7
" "	A-391	Sept. 15	15	5	5.9	3	37	0	40	0	3	1	2	92.7	52.5
#2 Tantalus	A-321	July 21	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-354	Aug. 13	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-392	Sept. 15	7	13	1.7	3	4	0	18	0	2	0	0	91.7	81.8
#3 Tantalus	A-322	July 21	1	19	0.1	1	0	0	1	0	0	0	0	100	100
#" "	A-355	Aug. 13	1	9	0.1	1	1	0	0	0	0	0	0	100	0.0
" "	A-393	Sept. 15	0	20	0.0	2	--	--	--	--	--	--	--	--	--
#4 Tantalus	A--323	July 21	1	6	0.1	1	1	0	0	0	0	0	0	100	0.0
" "	A-356	Aug. 13	11	2	5.6	1	11	1	69	0	4	0	2	93.1	86.7
" "	A-394	Sept. 15	4	16	0.6	3	2	1	7	0	0	0	0	100	80.0
#1 Burma Rd.	A-331	July 24	11	9	1.7	2	1	0	15	0	2	2	2	81.8	85.0
" "	A-374	Aug. 28	13	7	3.5	5	15	0	19	0	1	0	3	89.5	59.5
" "	A-412	Sept. 25	7	13	1.1	5	0	0	15	0	0	0	0	100	100
#2 Burma Rd.	A-332	July 24	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-375	Aug. 28	11	0	9.7	1	8	0	65	0	1	1	2	94.8	88.2
" "	A-413	Sept. 25	4	16	0.4	6	3	0	5	0	0	0	0	100	62.5
#3 Burma Rd.	A-333	July 24	6	1	8.0	1	11	0	28	0	1	1	7	81.3	74.5
" "	A-376	Aug. 28	12	8	3.4	2	6	0	31	0	2	1	6	80.4	84.1
" "	A-414	Sept. 25	7	13	0.7	4	1	0	11	0	0	0	0	100	91.7
#4 Burma Rd.	A-334	July 24	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-377	Aug. 28	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-415	Sept. 25	0	0	--	0	--	--	--	--	--	--	--	---	--
Waimea	A-335	July 24	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-378	Aug. 28	0	0	--	0	--	--	--	--	--	--	--	---	--
"	A-416	Sept. 25	3	17	0.2	3	0	0	4	0	0	0	0	100	100

Table 3 cont'd.

Locality	Lot No.	Collection date	Number Fruits Infested	Number Fruits Clean	Larvae per fruit	Index Fruit Abund.	Number Emberged Dacus dors.	Opius longi	Opius oophilus	Others	Number Unemerged Empty	Dacus	Opius	% Emergence	% Parasitized
Kahaluu	A-336	July 29	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-369	Aug. 26	20	0	28.0	2	153	0	103	7 Opius #2	6	18	28	83.5	44.7
"	A-407	Sept. 23	18	2	7.5	4	25	0	26	1 Opius incisi	8	5	13	66.7	57.1
#1 Waimanalo	A-324	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-357	Aug. 19	20	0	14.2	2	14	3	145	0	0	8	30	80.2	91.8
" "	A-395	Sept. 16	19	1	9.2	6	14	6	74	0	1	8	24	80.3	81.0
#2 Waimanalo	A-325	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-358	Aug. 19	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-396	Sept. 16	0	0	--	0	--	--	--	--	--	--	--	--	--
#1 Kailua	A-326	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-359	Aug. 19	5	0	17.6	1	20	0	30	0	1	9	2	94.3	62.5
" "	A-397	Sept. 16	2	0	7.0	1	3	4	7	0	0	0	0	100	78.6
#2 Kailua	A-327	July 22	5	2	6.4	1	3	2	13	0	3	0	3	75.0	85.7
" "	A-360	Aug. 19	20	0	11.1	2	29	2	87	5 O. incisi	6	1	10	87.9	77.6
" "	A-398	Sept. 16	13	7	2.9	5	8	4	16	2 O. incisi	1	0	2	90.9	75.0
#1 Nuuanu	A-328	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-361	Aug. 19	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-404	Sept. 22	0	20	0.0	5	--	--	--	--	--	--	--	--	--
#2 Nuuanu	A-329	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-362	Aug. 19	19	1	23.5	2	253	0	103	0	8	9	15	91.8	31.1
" "	A-405	Sept. 22	6	14	0.7	7	3	0	10	0	0	0	0	100	76.9
#3 Nuuanu	A-330	July 22	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-363	Aug. 19	9	1	9.4	1	8	0	71	0	7	0	0	91.9	89.9
" "	A-406	Sept. 22	12	8	1.2	6	5	0	10	0	2	0	1	83.3	68.8
Waikane	A-337	July 29	0	0	--	0	--	--	--	--	--	--	--	--	--
"	A-370	Aug. 26	19	1	30.2	2	57	1	124	0	33	1	20	77.1	71.8
"	A-408	Sept. 23	18	2	15.3	5	29	8	117	1 O. incisi	11	2	30	78.3	83.4

Table 3 cont'd.

Locality	Lot No.	Collection date	Number Fruits Infested	Number Fruits Clean	Larvae per fruit	Index Fruit Abund.	Number Emerged: Dacus dors.	Opius longi.	Opius oophilus	Others	Number Unemerged: Empty	Dacus	Opius	% Emergence	% Parasitized
Kahana	A-338	July 29	17	3	6.7	3	12	0	78	0	2	0	11	87.4	88.1
"	A-371	Aug. 26	15	5	5.9	5	8	0	17	0	13	5	22	38.5	75.0
"	A-409	Sept. 23	10	10	1.6	6	9	0	14	0	1	1	2	85.2	61.5
#1 Makaua	A-339	July 29	0	0	--	0	--	--	--	--	--	--	--	--	--
" "	A-372	Aug. 26	19	1	13.9	2	31	0	73	0	29	4	6	72.7	69.3
" "	A-410	Sept. 23	20	0	6.2	5	9	0	49	1 O. incisi	4	0	6	85.5	86.2
#2 Makaua	A-340	July 29	0	3	0.0	1	--	--	--	--	--	--	--	--	--
" "	A-373	Aug. 26	15	5	6.0	3	4	0	51	0	2	2	0	82.1	90.8
" "	A-411	Sept. 23	13	7	2.0	5	6	0	22	0	0	0	2	92.3	80.0
#1 Kalihi	A-341	July 31	4	1	12.6	1	6	0	33	1 Opius #2	1	0	6	85.1	87.0
" "	A-379	Aug. 29	18	2	11.2	4	26	0	89	0	7	4	17	80.4	77.9
" "	A-417	Sept. 29	9	11	1.5	6	2	0	21	1 O. incisi	0	0	2	92.3	92.3
#2 Kalihi	A-342	July 31	15	3	7.6	2	17	0	83	0	2	0	2	96.2	83.3
" "	A-380	Aug. 29	18	22	7.3	2	28	0	31	0	9	3	16	67.8	60.3
" "	A-418	Sept. 29	2	18	0.1	6	0	0	1	0	0	0	0	100	100
Total Oahu	A-305 to A-342	July	110	117	4.7	0.7	97	3	444	1 Opius #2	20	6	61	86.2	83.2
	A-343 to A-380	Aug.	364	92	10.1	1.6	846	7	1735	25 Opius #2 7 O. incisi 1 C. cap	176	57	249	84.5	69.1
	A-381 to A-418	Sept.	311	336	4.4	3.9	528	32	1074	7 Opius #2 1 Opius incisi	144	45	173	82.0	69.4

Dacus dor. = Dacus dorsalis Hendel , Opius longi. = Opius longicaudatus (Ashmead),
O. vdb. = Opius vandenboschi Fullaway, C. cap = Ceratitis capitata Wied.

Table 4. Data on the parasitization of fruit fly larvae in guava fruits collected on Hawaii, August-September 1952.

Locality	Lot No.	Collection date	Number fruits		Larvae per fruit	Number Emerged					Number Unemerged			% emergence	% parasitized
			Infested	Clean		Dacus dors.	Opius longi.	Opius vand.	Opius oophilus	Others	Empty	Dacus	Opius		
South Volcano area	H-23	Aug. 25	18	2	5.6	56	0	0	3	3 C.cap	1	7	0	88.6	4.3
Honaunau	H-24	Aug. 25	6	14	1.2	0	0	0	13	0	0	0	0	92.9	100
South Kona	H-25	Aug. 25	0	20	0.0	--	--	--	--	--	--	--	--	--	--
So. Kona-So.point	H-26	Aug. 25	0	20	0.0	--	--	--	--	--	--	--	--	--	--
Kona(Opp. Kialoa)	H-27	Aug. 26	0	20	0.0	--	--	--	--	--	--	--	--	--	--
Honokea	H-28	Aug. 26	11	9	2.1	0	0	0	23	0	0	0	4	85.2	100
Ninole	H-29	Aug. 26	17	3	6.1	41	0	10	37	0	1	4	3	91.7	52.6
Laupahoehoe	H-30	Aug. 26	0	20	0.0	--	--	--	--	--	--	--	--	--	--
Papaikou	H-31	Aug. 26	5	15	0.3	0	0	0	4	0	0	0	1	80.0	100
Paauilo	H-32	Aug. 26	3	17	0.6	0	0	0	7	0	0	0	0	100	100
Paauilo-Hilo	H-33	Aug. 26	6	14	0.5	0	0	0	2	4 C.cap	0	0	1	85.7	42.9
Olaa	H-34	Sept. 2	14	6	3.9	9	0	0	15	0	1	1	7	72.7	68.6
Pahoa	H-35	Sept. 2	17	3	2.3	20	0	4	0	0	0	0	2	92.3	23.1
Queen's bath tub	H-36	Sept. 2	17	3	4.5	11	0	3	15	0	0	1	5	72.5	65.7
Kalapana	H-37	Sept. 2	18	2	9.3	8	0	1	15	0	21	14	18	31.2	60.7
Mt. View	H-38	Sept. 2	2	18	0.4	0	0	0	1	0	0	0	0	100	100
Olaa-Pahoa	H-39	Sept. 2	0	20	0.0	--	--	--	--	--	--	--	--	--	--
Kopoho-Warm Spring	H-40	Sept. 2	19	1	7.9	13	0	15	1	0	12	3	7	47.5	46.9
Kalapana-Kopoho	H-41	Sept. 2	14	6	4.2	17	0	5	0	0	4	5	2	66.7	24.1
TOTAL HAWAII	H-23 to H-41	Aug.-Sept.	167	213	2.6	175	0	38	136	7 C.cap	45	35	50	73.3	50.8

Table 5. Data on the parasitization of fruit fly larvae in guava fruits collected on Kauai, June 1952.

Locality	Lot No.	Collection date	Number fruits		Larvae per fruit	Number Emerged					Number Unemerged			% emergence	% parasitized
			Infested	Clean		Dacus dors.	Opius longi.	Opius vand.	Opius oophilus	Others	Empty	Dacus	Opius		
Waimea-Kokee	K-1	June 22	0	14	0.0	--	--	--	--	--	--	--	--	--	--
Puhi	K-2	June 22	17	3	7.8	53	0	0	50	--	4	1	5	91.2	50.5
Moloaa	K-3	June 22	14	0	8.1	18	0	6	28	1 Opius #2	2	0	4	89.8	68.4
TOTAL Kauai	K-1 to K-3	June	31	17	5.3	71	0	6	78	1 Opius #2	6	1	9	90.7	86.6

Project No. 961.1

Subproject title: Toxicity of insecticides to the larvae of the oriental fruit fly and its internal parasites.

Personnel: M. Tamashiro

The oriental fruit fly is protected from the action of contact insecticides during most of its larval stages of development, since it is within the fruit. However, it leaves the fruit during the late third instar and enters the ground to pupate. In any intensive spray program a residue of insecticide may be built up in the soil due to drift and run off. Therefore, it is possible for the larva to be exposed to lethal or sublethal doses of insecticide when it enters the soil to pupate. Not only can this occur with such stable insecticides as DDT and dieldrin but with the more volatile or unstable insecticides if the larva leaves the fruit a short time after spray application.

With the present high parasitization of the oriental fruit fly many of the larvae that drop to the ground contain parasites. Previous workers have studied the effect of insecticides on the adult flies and parasites but little is known abo the effect of contact insecticides on the larva of the fruit fly and its internal parasites.

Therefore, this study is being initiated to determine the toxicity of insecticides to fruit fly and parasite larvae.

Project No. 961.2 Chemical control of fruit flies in Hawaii. Field studies.

Subproject title: Chemical control of C. capitata on persimmons.

Personnel: H. A. Bess

In September of 1951 spray tests were made against C.capitata on persimmons on Maui. DDT applied with a power sprayer gave such excellent control that further tests seemed unnecessary. However, it was decided that a check would be made of the results obtained in 1952 by orchardists who followed the recommendations based on the 1951 tests. Consequently, in September of 1952 persimmon orchards were checked by S. Nishida and the writer and also some information obtained on the effectiveness of the DDT sprays against capitata on loquats. Persimmon fruits were examined in two sprayed and one unsprayed orchard. The data obtained are shown in table 1.

Table 1. Number of stung fruits per 50 fruits in sprayed and unsprayed persimmon orchards at Kula, Maul, 9-25-52.

Sample No.	S. Haramoto orchard (unsprayed)		J. Hashimoto orchard (sprayed)	K. Hashimoto orchard (sprayed)
	Mature unripe fruits	Ripe fruits	Mature unripe fruits	Mature unripe fruits
1	23	49	1	0
2	19	--	1	0
3	27	--	0	0
4	--	--	0	1

Each sample was composed of 50 unripe mature fruits (yellowish green in color) except for one sample of 50 ripe fruits examined in the Haramoto orchard. There were no ripe fruits in the other two orchards since the fruits were being harvested before they were ripe. Since the flesh immediately around the stings becomes darkened the stung fruits can be readily detected.

It can be seen that close to 50 percent of the mature unripe fruits in the unsprayed orchard were stung and 49 of the 50 ripe fruits examined were stung. However, only around 1 percent of the mature unripe fruits in the sprayed orchards were stung. Therefore, the spray program appears to be effective and both orchardists are highly pleased with the results.

Mr. K. Hashimoto advised us that the same spray program had given excellent control of C. capitata on his loquat crop harvested earlier in the season. He stated that in former years when he was using handsprayers, often 50 percent of his loquats were stung.