

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine

ORIENTAL FRUIT FLY INVESTIGATIONS

QUARTERLY REPORT

July 1 - September 30, 1949

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This, the first quarterly report of the Oriental Fruit Fly Investigations, necessarily covers a period of organization and the coordination of activities of all agencies engaged in work on the oriental fruit fly. The foundation for this latter has been laid through the medium of a Memorandum of Understanding among the following agencies:

The Hawaii Agricultural Experiment Station
The Regents of the University of California and the
California Agricultural Experiment Station
The Board of Commissioners of Agriculture and Forestry, T. H.
The Pineapple Research Institute of Hawaii
The Experiment Station of the Hawaiian Sugar Planters' Ass'n.
The Bureau of Entomology and Plant Quarantine, Agricultural Research
Administration, United States Department of Agriculture.

The Project has been singularly fortunate in these cooperative arrangements, which have already demonstrated their value and which will, without a doubt, continue to do so in an increasing measure.

The cooperation of the Washington Bureau must also be recorded at this time, because it is only through this that the gathering of a competent staff in such a short time has been achieved.

The problem of space was an acute one but this has been greatly relieved through the cooperation of the Administration of the University of Hawaii in purchasing a large surplus building and moving it to an appropriate site near the established fruit fly laboratory.

The Project has also had the advantage of taking over a small but well trained staff from the Division of Fruit Fly Investigations, so that actually three of the projects of the Investigations, namely Commodity Treatments, Biological Control and Chemical Control, were taken over as going concerns. All of these projects have been considerably strengthened and their facilities increased. The two newest projects, namely Area Control and Ecology-Biology, are necessarily in an early stage of organization, but even with these two projects considerable progress has been made in establishing fundamental concepts and the accumulation of essential preliminary data.

The Personnel Chart as of September 30, 1949, which is attached herewith, illustrates the present organization of the investigations into five major projects. The Ecology-Biology Project is in two divisions necessitated by the physical separation of the synecological work on the islands of Maui and Hawaii. For all but the last named, line projects are available and are reported on by the division leaders on the pages that follow. The synecological work had not been organized to the point where formal division into line projects was feasible by September 30, and in this case the report is made on the basis of the working outline which heads the project leader's report.

These reports follow in the order given below:

Commodity Treatments

Biological Control

Chemical Control

Area Control

Ecology-Biology

CHEMICAL CONTROL, Work Project I-o-3 - Loren F. Steiner, Project Leader

I-o-3 Chemical Control of the Oriental Fruit Fly.

The writer arrived in Honolulu August 13. The latter part of August was spent in studying the fruit fly problem in the field as well as from available reports and discussions with workers already on the job, particularly Messrs. Flitters, Mashler, Balock, Clancy, Henderson and Hinman.

Because of the lack of sufficient motor equipment in August no survey of the island could be made, however, several trips were made with different members of the staff and with Dr. Schmidt of PRI to observe infestations on different hosts in the field. In general, the fly population is said to be lighter than in 1948 and some difficulty has been experienced in obtaining adequate collections of flies for laboratory tests and of sufficient infestations in the field for small-plot field tests.

The ILWU strike here has been a serious handicap in getting field work on this project inaugurated since many necessary supplies and materials were obtainable only after long delays. Much is still to be obtained. The staff could not be enlarged to handle some phases of the work until space became available and considerable time has been required to get the work of the various line projects underway. Holding boxes, necessary for field tests, could not be obtained until late September. Until the quonset hut assigned to this project is in place, adequate space for the holding boxes will not be available. It did not appear advisable to order more suitable spray equipment until that on hand was found to be inadequate. Spray equipment on hand included 2 Jeep-mounted mist blowers, 1 portable mist blower and 1 Bean dilute-type high pressure sprayer (max. cap. 4 g.p.m. at 400 p.s.i.). It has now become evident that conventional type high pressure equipment similar to that in use by commercial growers on the mainland is needed.

According to the Agricultural Extension Service of the University of Hawaii, the commercial acreage of various crops in the Hawaiian Islands is as follows:

	<u>Oahu</u>	<u>Maui</u>	<u>Hawaii</u>	<u>Kauai</u>	<u>Molokai</u>
Avocados	60	18	<u>139</u>	2	2
Mangoes	27	<u>126</u>	5	1	80
Papayas	<u>453</u>	18	40	8	2
Bananas	<u>875</u>	57	44	13	2
Oranges	0	0	<u>24</u>	0	0
Tangerines	0	0	<u>22</u>	0	0

Because of the mixtures of varieties (especially avocados and mangoes), irrigated terrain or close planting (bananas), low fly infestations and danger of contaminating water supplies with poisonous materials among other reasons, much of this acreage is unusable for spray-plot work.

Oahu is unquestionably the best location for field tests on papayas and bananas but Maui and Hawaii may prove superior for tests with mangoes and avocados respectively during the next crop season. The fruit fly is not readily attracted to papayas and bananas until they have ripened beyond the stage at which they are usually picked, hence fruit in test plots must be allowed to ripen past the marketable stage. Mangoes and avocados may be attacked by the fly well in advance of harvest.

The frequency with which eggs could be found in scattered overripe pineapples in August, especially in part of the PRI experiment station at Wahiawa, and the availability of part of a field which began to ripen in September, led to the use of this host for the first series of field tests.

Guavas, though heavily infested, are located on such rough terrain that the use of this host for tests was delayed until the entire island can be more thoroughly surveyed for accessible areas that might be used when the winter crop develops. Furthermore, the current crop season reached its peak early in September before equipment, supplies and adequate space were available.

For reasons given above few results can be reported at this time except for the first line project.

Line Project I-c-3-1: Preliminary Laboratory Testing of Insecticides. (Hinman and Steiner)

The technique developed by Mr. Hinman for the preliminary screening of insecticides was followed in most tests. Deposits of insecticide per square centimeter of treated surface were calculated from the dilution used and represent the initial amount. Since the volume of material used was twice that which could be made to adhere to a plant surface, the equivalent field concentration would be double the amounts used for the laboratory tests. The excess of liquid was an aid in insuring uniformity of deposit before evaporation of the water or solvent from the Petri dish.

Mr. Hinman's summarization of results follows:

Twelve laboratory insecticide tests were made during the quarter. Each material to be tested was suspended or dissolved in water or xylene and 2 cc. were pipetted into each of two Petri dishes, where the liquid was allowed to evaporate overnight. The time from application to the Petri dish until the flies were caged was approximately 17 hours. The Petri dish then formed the top of a cage about 6 inches high with a cardboard base and wire screen sides. Approximately 30 laboratory-reared flies, half males and half females were put in each cage. The ages of the flies varied from 7 to 28 days in different tests. Food and water were provided by cotton dental rolls inserted through a hole in the screen and soaked at intervals with sugar water. The numbers of dead and paralyzed flies were counted at intervals throughout the first 24 hours and on each day following-- usually for 7 days.

The tests completed during the quarter are summarized in the tables following. All dilutions given are for the active ingredient.

Flies to be tested in the laboratory were counted out in the cold room where they were inactive. An experiment was run to test the effect of such exposure on mortality. (Table 1.)

TABLE 1.

Lab. Expt. #23. Effect of exposure to 40-43° F.
Treatment: DDT 1 gram to 40,000 cc. water. (0.7 mg.DDT per cm²)

Hours exposure to 40-43° F.	Flies	Mortality (Percent) at:			
		24 hrs.	48 hrs.	4 days	7 days
0	66	3	8	14	26
2	43	12	19	27	55
4	46	4	17	26	44
6	60	2	5	13	42
Check: No treatment	52	4	4	6	21

No difference was evident between flies not exposed in the cold room and flies exposed for 6 hours. Exposures of 2 and 4 hours may have increased mortalities. Further tests are needed.

TABLE 2.

Lab. Expt. #24. Effect of DDT and 5 other materials at a dilution of 1 gram to 10,000 cc. of water. (2.8 mmg. per cm²).

Materials	Flies	Mortality (Percent) at:			
		24 hrs.	48 hrs.	4 days	7 days
DDT	57	89	96	100	
Toxaphene	56	89	98	100	
Lindane	60	97	98	98	98
118	56	21	48	63	70
Methoxychlor	59	20	36	54	71
Rothane (TDE)	60	12	20	33	72
Check: No treatment	58	0	2	5	17

Mortalities with DDT and toxaphene were complete within 3 days. Lindane killed all but one fly in 3 days; this fly was still alive at the end of the experiment.

TABLE 3.

Lab. Expt. #25. Test of several materials at different dilutions in water.

Materials	Dilution ingredient	Mmg. per cm. ²	Flies	Mortality (Percent) at:			
				24 hrs.	48 hrs.	4 days	6 days
DDT WP.	1 gr: 20,000cc.	1.4	46	45	52	62	62
Toxaphene WP.	1 gr: 20,000cc.	1.4	60	42	68	85	88
118	1 gr: 5,000cc.	5.6	60	100			
118 emulsion	1 cc: 5,000cc.	5.6	54	100			
497	1 gr: 50,000cc.	0.56	60	65	98	98	98
497 emulsion	1 cc: 50,000cc.	0.56	54	74	100		
EPN Miticide	1 gr: 1,000cc.	28.0	66	100			
Check: No treatment			60	0	3	12	25

118 and EPN Miticide killed all the flies tested within 20 hours. 497 killed 59 of 60 flies in 30-48 hours time.

Sweetened poison baits have been used for the control of other fruit flies. Laboratory experiments 26, 27 and 22 test toxaphene, tetraethyl pyrophosphate, parathion, chlordan, benzene hexachloride, lindane and Blackleaf 40 in water dilutions with the addition of sugar. DDT, methoxychlor, lead arsenate, tartar emetic and cryolite had previously been tested with sugar water. The sugar apparently increased the toxicity of tartar emetic but did not increase the action of lead arsenate or cryolite, and considerably reduced the effectiveness of DDT and methoxychlor.

TABLE 4.

Lab. Expt. #26. Tests of toxaphene, tetraethyl pyrophosphate (NIFOS-T), and parathion in water, with and without the addition of sugar to the mixture.

Material and dilution	Mg. per cm. 2	Flies	Mortality (Percent) at:		
			24 hours	48 hours	3 days
Toxaphene, 1 gr:10,000	2.8	58	83	90	98
Toxaphene, 1 gr:10,000+4% sugar	2.8	59	58	90	100
Tetraethyl pyrophosphate 40% 1:2,500 (1 cc.NIFOS-T to 1000 cc. water)	28.0	59	90	98	100
Tetraethyl pyrophosphate 1:2,500+4% sugar		62	95	100	
Parathion 1 gr:50,000	0.56	60	100		
Parathion 1 gr:50,000+4% sugar	0.56	57	100		
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Check - 4% sugar in water		51	4	10	10
Check - no treatment		57	0	2	5

TABLE 5.

Lab. Expt. #27. Comparison of chlordan, benzene hexachloride and lindane at dilution of 1:20,000 in water (1.4 mg. per cm²), with and without the addition of sugar.

Material & dilution	Flies	Mortality (Percent) at:			
		24 hrs.	48 hrs.	4 days	7 days
Chlordan	62	13	24	55	86
Chlordan + 4% sugar	62	36	86	97	100
BHC 6% gamma, 44% other isomers	62	95	100		
BHC 6% gamma, 44% other isomers + 4% sugar	80	68	96	100	
Lindane	62	97	97	98	98
Lindane + 4% sugar	61	69	95	98	100
Check - No treatment	57	5	7	18	54

TABLE 6.

Lab. Expt. #22. Tests of Black leaf 40 (40% nicotine), with and without the addition of sugar, lindane and benzene hexachloride, all diluted with water.

Material and dilution	Mg. per cm ²	Flies	Mortality (Percent) at:			
			24 hrs.	48 hrs.	4 days	7 days
Black leaf 40 diluted to 1% nicotine in water	280.0	60	53	90	98	100
Blackleaf 40 diluted to 1% nicotine+6% sugar	280.00	53	25	43	77	94
Blackleaf 40 diluted to 1% nicotine+25% sugar	280.0	65	26	69	88	97
Lindane - 1 gr. gamma: 40,000 cc.	0.7	60	58	62	62	67
BHC (6% gamma, 44% other isomers), 1 gr. gamma: 40,000 cc.	0.7	25	56	68	68	84
DDT, 1 gr.:10,000 cc.	2.8	61	61	68	81	85
Check - no treatment		47	0	0	0	26

Sugar increased the kill of chlordan but delayed the action of benzene hexachloride and lindane and delayed the action of Blackleaf 40. Sugar apparently had little effect on the mortalities obtained with toxaphene, tetraethyl pyrophosphate and parathion. Mortalities with lindane and with benzene hexachloride at the same gamma concentration were approximately the same.

TABLE 7.

Lab. Expt. #22. Comparison of acid lead arsenate and basic lead arsenate, DDT paste and DDT Wettable Powder, EPN Miticide and parathion diluted in water.

Material & dilution	Mg. per cm ²	Flies	Mortality (percent.) at:			
			24 hrs.	48 hrs.	4 days	7 days
Acid lead arsenate 1 gr:400 cc.	70.0	51	77	98	100	
Basic lead arsenate 1 gr:400cc.	70.0	69	1	19	91	100
DDT paste (Stauffer) 1 gr.:20,000 cc.	1.4	65	97	98	100	
DDT Wettable powder 1 gr.:20,000 cc.	1.4	68	84	93	94	94
Parathion 1:100,000 cc.	0.28	68	87	91	94	96
EPN Miticide 1:100,000 cc.	0.28	69	100			
Check - no treatment		62	0	3	16	45

The effect of basic lead arsenate was much slower than that of acid lead arsenate. DDT paste appeared to be at least as effective as DDT wettable powder. EPN Miticide was more rapidly effective than parathion at a 1:100,000 dilution.

TABLE 8.

Lab. Expt. #29 and 30. Comparisons of DDT and DFDT (2,2,5-fluorophenyl 1,1,1-trichloroethane) at different dilutions in xylene.

Material	Dilution	Mmg. per cu. ²	Flies	Mortality (percent.) at:			
				24 hrs.	48 hrs.	4 days	7 days
DFDT	1 gr:2,000 cc.	14.0	49	78	88	98	98
DDT	1 gr:2,000 cc.	14.0	54	94	96	100	
DFDT	1 gr:4,000 cc.	7.0	59	29	46	64	75
DDT	1 gr:4,000 cc.	7.0	60	53	87	93	97
DFDT	1 gr:8,000 cc.	3.5	56	9	16	34	57
DDT	1 gr:8,000 cc.	3.5	60	48	78	92	98
Check:	no treatment		60	3	3	20	58
DFDT	1 gr:10,000 cc.	2.8	60	2	8	27	68
DDT	1 gr:10,000 cc.	2.8	62	35	50	73	82
DFDT	1 gr:20,000 cc.	1.4	56	9	18	45	79
DDT	1 gr:20,000 cc.	1.4	60	15	27	47	62
DFDT	1 gr:40,000 cc.	0.7	30	0	3	23	63
DDT	1 gr:20,000 cc.	0.7	64	16	31	45	73
Check:	no treatment		50	2	4	20	58

DDT was more effective than DFDT at all dilutions, from 1:2,000 to 1:40,000.

TABLE 9.

Lab. Expts. 31, 32 and 33. Effect of DDT when applied to different leaf surfaces. DDT 1 gram:10,000 cc. water (2.8 mg. per cm.²) applied to leaves fastened to the Petri dish cage top by paraffin.

Applied to:	Surface	Flies	Mortalities (percent) at:			
			24 hrs.	48 hrs.	4 days	7 days
Panex leaves	upper	63	94	98	98	98
	under	58	93	95	97	97
Kamani leaves	upper	59	88	93	98	98
	under	57	46	79	88	90
Petri dish cage top		60	98	98	100	
Check - no treatment		60	3	3	20	58

TABLE 9 (cont'd)

Applied to:	Surface	Flies	Mortalities (percent.) at:			
			24 hrs.	48 hrs.	4 days	7 days
Guava leaves	upper	60	57	75	83	90
	under	63	52	73	78	83
Banana leaves	upper	67	88	94	94	94
	under	63	43	59	60	75

Petri dish cage top		64	100			
Check - no treatment		61	7	10	11	31

Mango leaves	upper	65	67	77	84	88
	under	62	53	73	79	84
Papaya leaves	upper	58	33	44	53	72
	under	60	53	65	72	85

Petri dish cage top		62	77	85	90	94
Check - no treatment		61	0	8	15	43

DDT was considerably more toxic on the upper surfaces of Kamani, banana and avocado leaves than on the under surfaces. Mortalities on mango, guava and Panex leaves were very nearly the same on both surfaces. On papaya leaves DDT was most effective on the under surface.

These differences may be due to differences in the structure of the leaves. The under sides of most leaves are rougher than the upper surfaces and more absorptive. The avocado leaf has numerous small hairs on the under surface which may prevent the fly from contacting part of the leaf area. Mortalities were greater when the flies were exposed to the DDT-coated Petri dish than when they were caged under any of the leaves. The phototropic flies probably contacted the glass surface more frequently than the darker leaf surfaces and came in contact with more DDT on a smooth surface than on a rough leaf surface.

Because the flies spend much time on the under surfaces of leaves, the practical importance of differences in the effectiveness of DDT on different leaves and on the two surfaces is evident.

Laboratory Tests of Quassia and Parathion in Lures.

At the suggestion of Dr. Carter, Quassia and parathion were tested as lures for dorsalis. Quassia chips--10 grams to 100 cc. of water, were boiled for an hour and left for a day before the liquid was poured off for use in the tests. Parathion, 25% wettable powder, was diluted to one gram actual parathion to 4,000 cc. of water.

The materials to be tested were poured into Syracuse watch glasses with absorbent cotton in the center, and set in foot-square screen fly cages. In some cages a drop of citronella was added to the liquid in the watch glass. A piece of papaya and sugar were put in each cage.

The cages were examined daily and the dead flies were removed. The results are shown in Table #10.

TABLE 10.

Effect of Quassia and parathion on field collected male dorsalis in cages.

Material	Flies	Mortality (Percent)						
		Days after treatment						
		1	2	3	4	5	6	7
<u>TEST I.</u>								
Quassia	385	3	6	10	13	15	17	20
Quassia+citronella	477	5	9	13	17	20	21	30
Quassia+citronella	442	8	12	18	21	24	28	36
Water	362	1	5	6	11	12	13	14
Water+citronella	330	3	4	6	9	13	14	15
Water+citronella	321	4	8	10	13	16	19	22

<u>TEST II.</u>								
Water	415	3	6	9	12			
Water+citronella	304	5	9	12	15			
Parathion 1:4,000+ citronella	354	69	95	98	99			

The Quassia proved relatively ineffective. The parathion killed 95% in two days and 99% in 4 days.

Laboratory-reared flies, approximately half males and half females, were tested with Quassia and with parathion in combination with yeast-sugar-pyridine lure. The lure and the Quassia and parathion 1:4,000 were mixed half-and-half. The test materials were poured into Syracuse watch glasses in screen fly cages and examined daily as before. Table #11 shows the results.

TABLE 11.

Effect of Quassia and parathion in combination with yeast-sugar-pyridine lure upon dorsalis in cages.

Material	Flies	Mortality (Percent)						
		Days after treatment						
		1	2	3	4	5	6	7
Quassia+yeast-sugar-pyridine 1:1 mix	77	5	9	18	22	23	26	30
Quassia+yeast-sugar-pyridine 1:1 mix	77	1	8	17	18	22	22	22
Yeast-sugar-pyridine	75	1	4	5	9	12	15	17
Yeast-sugar-pyridine	74	0	0	0	5	7	8	9
Water	74	0	3	4	7	8	10	11

Water	317	2	2	3	4		5	7
Parathion 1:8,000	199	41	81	90	94		98	98
Parathion 1:4,000+yeast-sugar- pyridine lure, 1:1 mix		62	84	93	96		98	99

The Quassia was ineffective. Parathion was as effective in combination with water as in combination with lure. Although 62% were killed by parathion+lure during the first day, 3 of 230 flies were still alive after 7 days.

Tests of Eight Insecticides Against dorsalis Larvae in Fruits.

To determine the effect of various insecticides upon dorsalis larvae in sprayed fruits, several tests were made in which kamani nuts and guavas were dipped in water solutions or suspensions, taken out immediately, dried in air for several days and then put in holding boxes on screens above sand in order to collect the emerging pupae. The pupae were sifted from the sand at intervals and the flies developing from them were recorded. In a preliminary test made with kamani nuts, the nuts were dried out so thoroughly after treatment that no larvae developed. In the first test using guavas it is believed some of the larvae were killed when the fruits were exposed to direct sunlight for several hours.

The results of the treatments of guavas are shown in Table #12. In Test I, the treated fruits were set in screen trays on a frame above the floor of the open insectory for 5 days before being put in holding boxes. In Test II, the guavas were similarly aerated for 4 days and in Test III for 3 days.

The results indicate that chlordan, Rhothane and toxaphene in sprays or dips would have little effect on larvae within fruits, but that lindane, EPN-Miticide, parathion, 497 and 118 might be expected to kill some of the larvae in sprayed fruits. These materials should be tested further.

No flies emerged from the two pupae obtained from guavas dipped in lindane. Although 117 and 123 pupae came out of guavas dipped in 118 and 497 respectively, no flies emerged from the 497 treated fruits and only 1 fly from the 118 treatment.

TABLE 12.

Effect of 8 different insecticides on dorsalis larvae in dipped guava fruits.

Materials and dilutions	Test I.				Test II.			
	Pupae		Flies Emerged		Pupae		Flies Emerged	
	Lots		Lots		Lots		Lots	
	I	II	I	II	I	II	I	II
Chlordan 4 gr:100 cc.	2	34	1	10	76	66	13	18
Lindane 4 gr:100 cc.	0	0	0	0	2	0	0	0
EPN-Miticide 1 gr:EPN:100 cc.	0	0	0	0	2	5	0	2
Parathion 1 gr:100 cc.	0	0	0	0	0	25	0	1
Water - Check	5	0	4	0	53	109	23	46
	Test III.							
Rhothane 4 gr:100 cc.	73	60	13	33				
Toxaphene 4 gr:100 cc.	49	71	35	14				
497 - 4 gr:100 cc.	37	36	0	0				
118 - 4 gr:100 cc.	34	83	0	1				
Water - Check	185	189	34	50				

Mortalities of oriental fruit flies caged over guava branches sprayed with DDT in xylene.

In conjunction with Mr. Henderson's airplane spraying of guava gulches with DDT-xylene, it was thought desirable to obtain some information on the residual effect of these operations by caging flies at intervals over sprayed branches.

The first two spray applications were made 12 days apart. Branches were collected 6 days after the first application, just before and just after the second application, and seven days after the second spraying. It is proposed to collect branches just before and just after each spraying and as nearly as possible at the midpoint between sprayings.

Six branches are obtained each time from an area treated with 2 pounds of DDT per acre. These are picked from near the top and from near the base of bushes at three marked locations, each some distance apart in the treated area. Two branches are collected each time from an unsprayed area as checks.

Each branch is set in a large flask of water and covered with a cheesecloth bag. The mouth of the bag is tied around the neck of the flask. Thirty flies, 15 males and 15 females, all of the same approximate age, are put in with each bagged branch. A piece of cotton soaked with water, a piece of papaya, and a sugar cube are added to each cage. The following day and each day for 5 days the dead flies are counted and removed and fresh papaya added.

The mortalities of the flies caged 1, 3 and 5 days on the four sets of branches are shown in Table #14. The data indicate nearly the same mortalities 7 and 12 days after the first spraying. Mortalities on the first day after caging were greater on guavas collected on the 12th day than on those collected on the 7th day. This difference is believed to be due in part to weather conditions affecting the movement of flies in the cages. Flies caged over the earlier collected branches were subjected to a continuous breeze in the open insectory for the first two days; flies were caged 6 days later during a warm, almost windless period.

The second spraying speeded up the kill and increased the mortality of the flies. The effects of the second spraying apparently were not lost 7 days later when flies were again caged over sprayed branches.

The differences between the kills of flies on top and bottom branches were not significant, apparently, although the mortalities after 5 days averaged a little greater on the top branches in each of the four collections. The guava bushes in this area had an open, uncompact growth, so that differences between top and bottom would not be expected to be as pronounced as on leafy, densely-growing plants where upper branches might screen lower branches.

TABLE 14.

Mortalities of Oriental Fruit Flies caged over guava branches sprayed by airplane with 2 pounds of DDT in xylene per acre. Mortalities based on 26-33 flies.

Time of collection of branches	Length of Expos. (Days)	DEAD FLIES (Percent.)							
		Locations							
		I		II		III		Unsprayed area Check	
		Top	Base	Top	Base	Top	Base	Top	Base
Sept. 14 6 days after 1st spray	1	23	29*	7	11	17	25	0	0
	3	100	83*	83	48	66	61	19	3
	5		96*	90	89	86	86	42	7
Sept. 19 12 days after 1st spray	1	37	43	57	63	37	34	0	7
	3	63	90	89	80	77	84	18	14
	5	73	97	100	87	93	88	30	28
Sept. 20 Several hrs. after 2nd spray	1	70	73	87	100	56	31	0	7
	3	97	100	100		91	75	13	21
	5	100				97	84	20	28
Sept. 27 7 days after 2nd spray	1	69	39	52	37	90	53	27	0
	2	100	93	100	93	100	100	33	3
	3		96		100			40	3

*Mortalities based on 24 flies only

A recapitulation of Mr. Hinman's tests with different insecticides is given in Table #15 for the 24 and 48 hour mortalities. This interval generally preceded any serious mortality among the controls. Many additional tests of various dilutions are still to be made with the majority of the chemicals listed.

TABLE 15.

Comparative performance of different insecticides after 24 and 48 hr. exposure periods with differences in controls disregarded.

Formulation	Deposit mg/cm ²	Percent. Mortality	
		24 hrs.	48 hrs.
DDT - wettable	1.4	84	93
	1.4	45	52
	2.8	89	96
	2.8	61	68
DDT - paste	1.4	97	98
DDT-xylene	0.7	16	31
	1.4	15	27
	2.8	35	50
	3.5	48	78
	7.0	53	87
	14.0	94	96

TABLE 15 cont'd

Formulation	Deposit mg/cm ²	Percent. Mortality	
		24 hrs.	48 hrs.
DFDT	0.7	0	3
	1.4	9	18
	2.8	2	8
	3.5	9	16
	7.0	29	46
	14.0	73	89
TDE - wettable	2.8	12	20
Methoxychlor	2.8	20	36
Chlordane	1.4	13	24
J. H. 118 wettable	2.8	21	48
	5.6	100	
J.H. 118 emulsion	5.6	100	
J. H. 497 wettable	0.56	65	98
J. H. 497 emulsion	0.56	74	100
EPN - wettable	0.28	100	
Parathion - wettable	0.28	87	91
	0.56	100	
BHC - 6% gamma	0.7	56	68
	1.4	95	100
Lindane - wettable	0.7	58	62
	1.4	97	97
	2.8	97	98
Toxaphene - wettable	1.4	42	66
	2.8	83	98
	2.8	83	90
TEPP	28.0	90	98
Blackleaf 40	280.0	53	90
Acid lead arsenate	70.0	77	98
Basic lead arsenate	70.0	1	19

Line Project I-o-3-2: Field Testing of Insecticides (Steiner and Tanada)

Pineapple: Small plot tests were set up on 30x30 ft. replicates, 3 per treatment at the P.R.I. Experiment Station at Wahiawa in a corner of the field about 150 yards from where fruits ripening early in September were heavily infested. Except for 2 rows per replicate harvested by P.R.I., all fruit was allowed to mature.

The first of 2 sprays was applied September 28 with the Bean sprayer at 500 gal. per acre, 1.5 to 3.5 gpa. and 200 to 375 lbs. pressure per sq. inch (variation due to mechanical difficulties). The first spray was applied about when the first fruit began to ripen. Since the fly eggs hatch in 24 to 48 hours, fruits were taken from each replicate September 27, 30 and at 6 or 7 day intervals thereafter but very little overripe fruit was found before October 6 and no pupae have been obtained to date from holding boxes. Since D. dorsalis cannot ordinarily survive in whole fruit but can if the fruit is halved, quartered or skinned, only the skins of the fruit were held. Any infestation subsequently found will represent oviposition in the fruit during the 48-hour period preceding the time of sample preparation.

A list of treatments with amounts used per 100 gals. follows:

1. Untreated
2. Stauffer's DDT-paste 50%, 2 lb.
3. DDT tech, 1 lb., xylene 1 qt. B-1956 1 oz.
4. Monsanto DDT: 50% wettable, 2 lb.
5. Chlordane 50%, wettable, 2 lb.
6. Julius Hymen 49%, 25%, 2 lb.
7. California Spray Chem. Lindane 75%, 2/3 lb. (1st cover)
Isotox 25%, 2 lb. (2nd cover)
8. Toxaphene 40%, 2.5 lb.
9. Methoxychlor 50%, 2 lb.
10. DuPont's EPN 31.5%, 1.6 lb.
11. Parathion 25%, 2 lb.
12. Parathion 25%, 1 lb. plus light brown sugar 2 lb.

Bananas: Field tests on Cavendish bananas were set up at the Campbell ranch near Hukuleia. This is the only large planting of this low-growing variety on the island. Because bananas ripen throughout the year, and because the fruit fly survives only in fruit after it begins to turn color, it was necessary to use replicates with a road or trail frontage of 75-100 feet in order to have at least 2 bunches near the picking stage. These were marked to be left by the pickers. The first spray application was delayed until after September 30.

Line Project I-o-3-5. Studies to Determine if the Development or Segregation of strains of Fruit Flies Resistant to Insecticides is Likely to Occur. (Steiner, Hinman, Stout).

Both Mr. Hinman and Mr. Stout have reported that certain active flies occasionally survive treatment long after all others have died. No work on this project has been done to date but in future tests flies which apparently show unusual resistance will be allowed to reproduce and their progeny compared with that from non-segregated populations.

Line Project I-o-3-6. Development of Fermenting or Non-Fermenting Lures or Attractants (Gow and Steiner).

Before his assignment to this project Mr. Gow had developed a revolving trap suspension on which 4 traps could be suspended. The object was to insure a more or less continuous slow-rotation to eliminate the variation in trap catches attributable to positional differences. The suspension is essentially a crossarm arrangement of 2 two-foot 1"x2" wooden arms, a central 1/2" pipe upright about 12" long to prevent tipping, a ball-bearing swivel and on each arm a counter-balanced wind cup which is adjusted after the suspension is in place to spill excess air and prevent too rapid revolution of the traps. The latter are about 2 feet apart and it is recognized that there will be some interference of odors and some flies may be attracted by one lure from distances beyond the range of others yet may be caught by the latter.

Twenty-five of the suspensions have been made and uniformity trials are now getting under way as fast as the suspensions are installed. It is planned to replicate each test lure 12 times, 6 on the windward and 6 on the Honolulu side of the island. Thus 2 sets of tests involving 7 different baits with a common check will be operated for at least 2 weeks per experiment.

Because of the wide variation in internal dimension of the glass McPhail traps, the maximum amount of bait held, internal opening diameter and height were measured and traps comparable in these dimensions will be used on individual suspensions. Extremes encountered in the 3 dimensions measured were as follows: 318 to 662 ml. in volume, 65 to 88 mm. in diameter of internal opening, and 51 to 58 mm. in height of internal opening.

SUMMARY

CHEMICAL CONTROL - WORK PROJECT I-o-3

The necessity for first studying the problem, acquiring personnel, equipment, supplies and space limited investigational work largely to the preliminary laboratory testing of insecticides.

I-o-3-1: The most toxic materials found in preliminary laboratory tests in which adult flies were exposed to deposits on glass surfaces include DDT-paste, Julius Hyman 497, parathion, DuPont's EPN, Lindane and BHC.

At 1 gram to 10,000 ml. water DDT (wettable), toxaphene and lindane were considerably more effective than J. H. 118, methoxychlor and TDE. Parathion at 1 gram to 50,000 ml. water and EPN 1 gm. to 100,000 ml. water gave complete kills within 24 hours. Sugar increased the toxicity of chlordane but not any of the other insecticides tested. Acid lead arsenate at a high concentration produced 100 percent mortality in 4 days being much more toxic than the basic form. DDT-paste was slightly superior to DDT-wettable powder and greatly superior to deposits from DDT in xylene. DFDT was roughly half as toxic as DDT.

The toxicity of DDT deposited on the upper and lower surfaces of Panax leaves, and the upper surfaces of Kamani nut, banana, and mango was only slightly less than similar deposits on glass. The toxicity, however, was greatly reduced on the lower surfaces of Kamani, banana and mango and both surfaces of papaya and guava leaves. Leaf structure, pubescence or absorptive properties may account for the differences.

Quassia in combination with lures was ineffective, whereas parathion 1:8,000 in water alone was a highly effective combination food and contact poison.

In preliminary tests ripe guavas were dipped in suspensions of various insecticides. Chlordane, TDE and toxaphene at 4 percent strength were of little value in killing eggs or larvae in the fruit, whereas lindane, EPN, parathion, J. H. 118 and 497 at one to four percent were highly effective.

The residual toxicity of water suspensions of DDT, J. H. 497, BHC and methoxychlor at 0.25 percent strength applied to papaya seedlings was negligible four or more days after spraying although when flies were exposed to 1-day residues the mortalities ranged from 57 percent (chlordane) to 100 percent (DDT and J. H. 497).

Four collections of guava branches from gulches sprayed by air with DDT at 2 lb. per acre (Work Project I-o-4) were exposed in the laboratory to flies. Fresh residues were highly effective while 6 and 12 day old residues gave very good control particularly after the second spray application.

I-o-3-2: Small plot tests of 11 to 13 insecticides were set up and replicated three times late in September on pineapples and bananas. No results are available.

I-o-3-6: Tests of lures were delayed until after Mr. Gow's appointment September 26. A revolving suspension holding 4 traps developed by him is now being used in uniformity trials prior to starting comparative tests of lures. Because of apparent differences in volume along with diameter and height of inside opening of the McPhail traps, a large number of traps were measured so that uniform dimensions could be matched on the suspensions. The range in trap capacity was from 318 to 662 ml., in diameter of internal opening 65 to 88 mm., and an height opening 51 to 58 ml.

WORK PROJECT I-o-3

- Line Project I-o-3-1. Preliminary Laboratory Testing of Insecticides (Hinman and Steiner).
2. Field Testing of Insecticides (Steiner and Tanada).
3. Determination of Poison Spray Residues In and On Fruit at Harvest (Tanada and Steiner).
4. Development or Improvement of Chemical Treatments to Control Adult Oriental Fruit Flies in Aircraft and Maritime Vessels (Stout and Steiner).
5. Studies to Determine if the Development or Segregation of Strains of Fruit Flies Resistant to Insecticides is Likely to Occur. (Steiner, Hinman and Stout).
6. Development of Fermenting or Non-Fermenting Lures or Attractants. (Gow and Steiner).
7. Development of Chemical Repellents or Barriers. (Steiner and Gow).