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Trials in the Control of the Mediterranean Fruit Fly (Ceratitis capitata Wied.). with Organophosphorus Insecticides 1

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Abstract

In field tests with six insecticides, the best results were obtained with Fenthion: all the fruit was clear of fruit fly larvae for a period of 13-15 days after treatment in guavas and peaches, and after 18 days in apricots. Fenthion was also the most effective material in preventing the fruit from being stung. Phosphamidon , Rogor and Dipterex gave 100% protection to peaches for 8 days after treatment.

In laboratory tests, Fenthion, Rogor, and Phosphamidon were active in killing larvae in the fruit for a period of 16-17 days, Dipterex for 10-14 dayr', and Ronnel for 6-11 days.

The highest adult mortality through contact with sprayed fruit was recorded in the Ronnel and Fenthion treatments.

DDVP - Nuvan was active in the laboratory for a very brief period of 2-3 days.

The efficacy of low volume spraying as compared with high volume spraying was tested on peaches using two insecticides, Diptagan (Dipterex), water soluble, 80%; and Rogor, wettable powder, 20%.

Laboratory checks on field-treated fruit showed no significant differences either in the adult fly mortality through contact, or in the larval mortality caused by penetration. However, there were marked differences in fruit infestation in the orchard, and the low volume spray treatment was superior to the high volume.

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Introduction

Studies and publications abroad have shown that several of the new organic phosphorus compounds are effective against the Mediterranean fruit fly as well as against the olive fly and other trypetids, killing larvae in the fruit by "depth action" and adult flies through contact (4, 6, 10, 13).

In order to study the properties and the practical value of such insecticides under local conditions, including efficacy against adult flies, penetration capacity into the fruit, persistence, effect, etc., a series of trials was conducted during 1962-63. The trials were carried out both in the laboratory and in the orchards: three in 1962, on apricots, peaches and guavas; and two in 1963, on peaches and guavas. Various formulations of six organophosphorus insecticides were tested and, in addition, in one of the trials low volume spraying was compared with high volume spraying.

Materials and Methods

Various formulations of the following compounds were used:

a) Fenthion - 0,0 dimethyl 0 4-(methyltio)m-tolyl phosphorothioate
Lebaycid formulations of W.P. 25% a.i. and E.C. 50% a.i.

b) Dimethoate - 0,0 dimethyl s N-methyl-carbamoil methyl phosphorothioate -
Rogor formulations of W.P.20% a.i.and E.C.40% a.i.

c) Phosphamidon - 2, chloro - 2 - diethyl-carbamoil -1-methyl - vinyl
dimethyl phosphate - formulations of W.P. 50% a.i.and
W.S.50% a.i.

d) Trichlorophos - dimethyl (2, 2, 2 thrichloro -1- hydroxyethyl)
phosphonate, formulations of W.S.- 80% a.i.and W.P.- 50%
a.i.(Dipterex, Diptagan, Danex).

e) Ronnel - 0,0 dimethyl 0- (2, 4, 5 thrichlorophenyl) phosphorothioate
Nankor - formulation E.C.44% a.i.

f) Dichlorovos - 2,2 dichlorovinyl dimethyl phosphate formulation of
DDVP-Nuvan E.C.50% a.i.

Table 1 gives a description of the trials, including crop, locality, dates of spraying and fruit examinations, formulations, concentrations, etc.

In 1962, the replicated plots were sprayed as planned. Sprayed fruit from every plot was picked and brought to the laboratory for further study. Fruits were placed in screened cages, and ten gravid, laboratory-bred Med-fly females were put into each cage for 24 hours and then removed. As the upper part was covered by black cloth, the flies in the cage were concentrated on the lower, lighted parts of the cage, and contact with the sprayed fruit was enforced. Adult mortality was checked 24 hours after the introduction of the flies. The fruit was transferred to other cages, at 24-27°C, for further study.

The procedure was repeated several times at intervals of 2-4 days until the normal harvest date of the fruit.

In the orchard, all fruit in the experimental area was left on the trees for maximum ripening and then harvested. At harvest time this fruit was examined, and that which was uninjured except for stings, was transferred to a temperature-controlled oven to await the hatching of the larvae.

In the 1963 trials, one large, heavy-yielding peach tree was chosen for examination. On this tree 24 fruit-bearing branches were marked and divided at random into six groups which served as plots replicated four times for five different treatments and one control.

Early in the season, while the fruit was still green and not ripe for attack by the Med-fly, each branch was covered with a cylindrical sleeve of polyvinyl, provided with small holes in order to prevent water accumulation from transpiration and guttation. When the fruit colored and matured, the sleeves were removed in order to spray the branches, after which they were replaced.

24 hours after spraying, 10 gravid, laboratory-bred female Med-flies were placed in each sleeve, and after 24 hours the flies, both dead and alive, were removed. One week after spraying, the fruit was picked and examined. This procedure was repeated two and three weeks after spraying.

In addition, collections were made of the unprotected fruit on the tree and also that which had dropped on the ground, for examination in the laboratory.

The experiment on the guava tree was done on a small scale. On one tree, seven branches, each of which bore 30-40 fruits, were chosen and marked. Just prior to spraying each fruit was examined, and those with stings or any other injury were removed. Six branches were sprayed, each with a

different compound; one branch was left unsprayed as a control. Five, 13 and 20 days after the treatment the fruits on each branch were examined, and a count was made of fruit with stings and live larvae. Table 2 summarizes the results.

Results & Discussion

Of these six materials tested, Fenthion (Lebaycid) at a concentration of 0.05% a.i. gave the best results in killing adult flies (90-100% mortality, 11 days after spraying apricots) and in killing larvae in the fruit (100% mortality, 16-17 days after spraying apricots, peaches and guavas). In the field, 18 days after spraying apricots with Fenthion and 13-15 days after spraying guavas and peaches the fruit picked was 100% clear of larval infestation.

Of the other compounds tested, Rogor (0.04%) and Phosphamidon (0.05%) were less effective than Fenthion in killing adult flies through contact. However, their efficacy against larvae in the fruit equalled hat of Fenthion. In the field, Rogor- and Phosphamidon-sprayed fruit were 100% clear of larvae up to 8 days after spraying. The percentage of fruit injured only by stings was considerably higher.

Ronnel and, in some cases, Dipterex were equal to Lebaycid in killing adult flies through contact, but their lasting effect for killing larvae in the fruit was 10-14 days for Dipterex and 6-11 days for Ronnel. In the orchard, Dipterex gave about the same protection as did Rogor and Phosphamidon.

DDVP-Nuvan was was active in killing adult flies and larvae for only 2-3 days.

The trial to compare the efficacy of low volume versus high volume spraying was carried out with Rogor and Dipterex in a peach orchard. Both low and high volume spraying gave about the same results in killing adult flies by contact and in killing larvae inside the fruit. In the field, the low volume spray showed better results than the high volume in protecting the fruit (see Table 3).

While studying the data obtained from these trials it is clear that comparisons regarding efficacy of the various compounds can be drawn separately only within each trial; Table 2 was laid out accordingly. Some inaccuracies in the data are quite obvious and must be considered in the light of additional factors beyond our control: activity and behavior of the laboratory-bred Med-flies, which differ from the "wild" flies; mass migration of wild flies in the orchard towards ripening fruit (12); and the drop of infested mature fruit.

It was previously believed that some of the insecticides used by us, especially Rogor and Lebaycid, had a longer-lasting effect against Med-fly than was found in these experiments. This belief was based on the results of experiments in Europe and South Africa (5, 8, 9, 11). It seems, however, that the climatic conditions in Israel during the summer have a considerable influence in speeding up the breakdown of these insecticides. Consideration should also be given to the fact that during our experiments we were confronted with large natural populations of Med-fly which stung fruit without depositing eggs, as can be seen from the 1963 data. Of all the compounds tested, only the Lebaycid was able to prevent those stings for a period of one-two weeks after spraying. All the other insecticides prevented such stings for a very brief period of only 3-5 days. From the practical point of view, however, stung fruit is marketable and can be allowed to ripen on the tree without fear of drop.

With regard to actual fruit infestation by live larvae, the Lebaycid gave best results compared with the other compounds tested. Complete protection of the fruit was obtained in the Lebaycid-treated plots for up to two weeks and even more after spraying. The other insecticides gave 100% protection to fruit for a period of about 8 days, with the exception of DDVP-Nuvan, which gave a very short protection of only 2-3 days.

There were no marked differences between the different formulations, but it was noted in the apricot experiment that the water-soluble formulation of Dipterex was somewhat more efficient than the wettable powder. The emulsion concentrate formulation of Rogor caused leaf injury to apricots, and therefore the wettable powder form of Rogor is preferred in order to prevent phytotoxicity.

Of interest to the fruit grower is that the first treatment against the Med-fly can be given three weeks before the estimated harvest, instead of 4-6 weeks as practiced with Methoxychlor or bait sprays (1, 3). This practice will reduce the number of treatments against Med-fly to 2-3, instead of the 4-5 used in previous years.

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TABLE 1

OUTLINE OF EXPERIMENTS

Number of exper. & year	Crop "variety" and Location	Number of trees	Number of replicates	Number of plots	Formulations of insecticides used	Concentration, a.i.	Method of application	Number and dates of treatments	Dates of fruit examinations in the laboratory	Dates of fruit examinations in the field
1	apricot	192	4	12	1. Dipterex W.P. 50%	0.15	high	2		
1962	"Ra'anana"				2. Diptagan W.S. 80%	0.16%	volume	6/5; 23/5	25/5; 27/5	10/6
	Bareket				3. Danex W.S. 80%	0.16%	"		30/5; 3/6	
					4. Rogor E.C. 40%	0,04%	"		6/6	
					5. Lebaycid W.P. 25%	0,05%	"			
					6. Lebaycid E.C. 50%	0,05%	"			
					7. Phosphamidon W.P. 50%	0,05%	"			
					8. Phosphamidon Sol. 50%	0,05%	"			
					9. Nankor (Ronnel) E.C. 44%	0,05%	"			
					10. Nuvan (D.D.V.P.) E.C. 50%	0,05%	"			
					11. Methoxychlor W.P. 50%	0,25%	"			
					12. Control	--				
2								3		
1962	peach	72	4	9	1. Diptagen W.S. 80%	0,16%	high	14/6; 29/6,	16/7; 19/7	22/7; 29/7
	"Bonita"				2. Rogor W.P. 20%	0,04%	volume	13/7	22/7; 25/7	
	Miqveh				3. Lebaycid E.C. 50%	0,05%	"			
	Israel				4. Phosphamidon W.P. 50%	0,05%	"			
					5. Nankor (Ronnel) E.C. 44%	0,05%	"			
					6. Nuven (D.D.V.P.) E.C. 50%	0,05%	"			
					7. Control	--				
					8. Diptagon W.S. 80%	9.6gr.	Low Vol.			
					9. Rogor W.P. 20%	3.1 "	"			
								2		
3										
1962	Guave	6	-	6	1. Diptagon W.S. 80%	32 gr.	"	28/9; 5/10	18/10; 22/10	29/10
	"Ben Dor"				2. Rogor W.P. 20%	8 "	"		29/10	
					3. Lebayecid E.C. 50%	10 "	"			
					4. Phosphamidon Solub. 50%	10 "	"			
					5. Nankor (Ronnel) E.C. 44%	10 "	"			
					6. Control --	--				

4 1963	peach "Smith" Kfar Shmaryahu	24 bran- ches	4	6	1. Rogor E.C. 40% 2. Lebaycid E.C.50% 3. Phosphamidon W.P.50% 4. Dipterex W.S. 80% 5. Nuven(D.D.V.P.)W.C. 50% 6. Control	0.04% 0,05% 0,05% 0,16% 0,05% -	High Volume " " " 	1 1/7	3/7; 8/7; 15/) 22/7	22/7
5 1963	guava "Ben Dor" Kfar Shmaryahu	7 bran- ches	-	7	1. Rogor E.C.40% 2. Phosphamidon W.P. 50% 3. Dipterex W.S.80% 4. Lebaycid E.C.50% 5. Nankor(Ronnel)E.C.44% 6. Control 7. Nuvan(D.D.V.P.)E.C. 50%	0,04% 0,05% 0,16% 0,05% 0,05" -- 0,05%	High volume " " " - "	1 25/9		1/10; 8/10; 15/10

TABLE II. SUMMARY

Insecticide formulation	Concentration % a.i.	% Mortality of adult flies after contact in days												Duration for 100% kill of larvae		
		apricots 1962 days			peaches 1962 days			peaches 1963 days			guavas 1962 days			apricots 1962	peaches 1962	guavas 1962
		7	11	14	6	9	12	8	15	22	3	7	14		days	
Lebaycid E.C.	0.05	100	90	20	100	90	60	100	60	47.5	100	80	60	17	17	16
Rogor W.P.	0.04	-	-	-	70	80	30	-	-	-	100	80	30	-	17	16
Diptagan W.S.	0.16	60	10	20	100	100	100	92.	55	30	100	70	30	14	11	10
Phosphamidon W.P.	0.05	100	0	0	20	30	60	85	22.5	13.5	-	-	-	17	17	-
Ronnell E.C. (Nankor)	0.05	100	60	10	100	100	90	-	-	-	100	100	60	11	7	6
Nuven E.C. (DDVP)	0.05	10	50	60	30	20	40	35	17.5	7.5	-	-	-	3	2	-
Rogor E.C.	0.04	60	50	10	-	-	-	95	40	25	-	-	-	14	-	-
Phosphamidon W.S.	0.05	20	30	30	-	-	-	-	-	-	100	70	30	17	-	16
Dipterex W.P.	0.15	90	10	10	-	-	-	-	-	-	-	-	-	11	-	-
Methoxychlor W.P.	0.25	80	40	70	-	-	-	-	-	-	-	-	-	-	-	-
Control	-	-	-	-	-	-	-	5	0	2.5		-	-	-	-	-

OF RESULTS

% Infested fruit during picking time (-)% fruit with stings										
apricots 1962	peaches 1962		peaches 1963			guavas 1962			guavas 1963	
	No. of days after last treatment									
18	9	16	2	8	15	22	13	5	13	20
0	0.3	2.4	0(0)	0(3)	0(13)	12(50)	4	0(2)	0(4)	9(9)
-	3.1	7.8	0(3)	0(14)	3(28)	18(72)	4	-	-	-
9	3.0	13.6	0(3)	0(15.5)	9(33)	22(72)	9	0(8)	16(27)	47(70)
2	2.7	13.4	0(3)	0(16)	6(42)	22(87)	-	0(4.3)	7(22.7)	40(61)
27	5.1	25.5	-	-	-	-	1.5	0(11)	12.5(17)	40(50)
12	8.6	11.6	0(0)	3(30)	15(54.5)	42(90)	-	2(8.7)	16.2(21.4)	39(50
7.5	-	-	-	-	-	-	-	0(6)	3(20)	24(36)
2.9	-	-	-	-	-	-	2.1	-	-	-
11.5	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-
17	14.3	40.5	9(32)	45(60)	72(100	-	25.2	15.8	54.80	100(100)

TABLE 3

COMPARISON OF LOW AND HIGH VOLUME SPRAYS

Insecticide formulation	Volume	concentr. a/i %	grams per tree	% Mortality of adult flies after contact (days)				Duration for 100% kill of larvae-	% of infested fruit during picking time (days)	
				3	6	9	12	days	9	16
Diptagan W/S 50%	high	0,16%	-	100	100	100	100	11	3	13,6
	low	-	9.6	100	100	100	30	11	2.9	3.0
Rogor W/P 20%	high	0.4%	-	40	70	80	30	17	3.1	7.8
	low	-	2.4	70	70	90	70	17	0	3.0