

LABORATORY TESTS
ON THE EFFECT OF CHLORINATED HYDROCARBON COMPOUNDS
ON THE MEDITERRANEAN FRUIT FLY¹⁾

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The need for insecticides effective against the Mediterranean fruit fly has been felt in Israel for a long time. For a number of years field experiments were conducted with DDT and Methoxychlor²⁾ on plums, apricots and some subtropical fruits. Provided the dusting and spraying operations were carried out at relatively short intervals, the results were mostly satisfactory. Recently, the experiments have been extended to include the new compound Dieldrin³⁾ which was reported a greater residual effect and thus necessitating less frequent applications.

In the summer of 1951 experiments were undertaken to determine the toxicity of all the three chlorinated hydrocarbon compounds. A laboratory method was devised to simplify and expedite the experimental procedure. Seedlings and branches of trees were sprayed with the insecticides at various concentrations, the spray being thoroughly applied to both sides of the leaves. 6 to 16 flies, depending on the number of laboratory-bred flies available on the day of the experiment, were placed inside glass tubes (20 mm internal diameter) which were plugged at both ends with cottonwool. After introducing a sprayed leaf into the poison-tube, the plugs were pushed inwards and the tubes were shaken from time to time so as to bring the flies into close contact with the leaf. After ten minutes the flies were transferred to 500 ml recovering-jars covered with muslin and after the lapse of two hours they were given food in the form of cottonwool soaked in sugared water or slices of fruit. In the first series of tests the room temperature was 27—31° C, in the second — 25—30° C.

The condition of the flies was generally recorded at the end of 10, 20 and 30 minutes and then at the end of every hour, up to 7 hours from the beginning of the test. At each observation the number of knocked-down and active flies were recorded. The condition of knock-down was taken as an indication of lethal effect, since flies observed in such a state invariably died within a few hours. On rare occasions, where high mortality occurred during the test period in the breeding-jars, the related records were discarded.

In the various tests described below, the mortality rate of the flies often increased considerably during the 24 hours following the test. It has been assumed, however, that a knock-down effect which does not manifest itself within three hours following contact with the sprayed leaf, provides no practical indication of the efficacy of the insecticide.

The test were repeated at various intervals from the time of spraying, over a period of 50 days or even longer.

1) Abridged translation from Hebrew.

2) Methoxychlor — 1, 1, 1 — trichloro — 2, 2 bis (p — methoxyphenyl) — ethane.

3) Dieldrin — 1, 2, 3, 4, 10, 10, — hexachloro — 6, 7 — epoxy — 1, 4, 4a, 5, 6, 7, 8, 8a — octahydro — 1, 4, 5, 8, — dimethanonaphthalene.

The following compounds were examined: Dieldrin wettable powder, J. Hyman and Company, U.S.A., containing 25 per cent of the active ingredient; DDT and Methoxychlor wettable powders, Geigy Company, U.S.A., each containing 50 per cent active ingredient¹⁾).

The ten-minute duration of the treatment was determined by the results of preliminary tests. By maintaining the flies in contact with sprayed leaves for different lengths of time (Table 1, p. 192),²⁾ it was ascertained that 10 minutes is a long enough period to ensure a maximum knock-down and that the percentage of knock-down as recorded at the end of a three-hour test gives a reliable indication as to the toxicity of the compounds. It is noteworthy that in certain instances an unusually high percentage of knock-down resulted from a relatively brief contact with the sprayed leaf. It is also surprising that the percentage of knock-down increased occasionally with the lengthening of the interval between the spraying and the test. It is likely that differences in the amount of spray residue on individual leaves account for these irregularities.

FIRST SERIES: TEST WITH APPLE LEAVES

Leaves of apple seedlings were sprayed between 2nd and 6th of July. Each test was repeated several times at intervals. The percentages of knock-down as recorded 3 hours after the beginning of the test are given in Table 2 (p. 193). Since there was some divergence between the spraying dates, whereas all the tests were performed on the same day, there is no uniformity in the intervals between spraying and testing in respect of the different compounds.

The results indicate that the toxicity of DDT is low in both concentrations used, while the knock-down effect of Methoxychlor and Dieldrin is weak in concentrations lower than 1 per cent. The action of 1 per cent Methoxychlor was very satisfactory during the first 2—3 weeks, but afterwards the percentage of knock-down decreased considerably. The higher concentrations of Dieldrin effected a 100 per cent knock-down during the first two weeks and retained a somewhat reduced insecticidal power for about another 5 weeks.

The percentages of knock-down produced by 1 per cent preparations (corresponding in each case to 0.5 per cent of the active ingredient) as recorded in Figure 1 (p. 194), indicate clearly the greater effectiveness of Dieldrin and Methoxychlor as compared with DDT.

In connection with this series of tests, an investigation was carried out on the egg-laying capacity of female which had been in contact with sprayed leaves. Immediately upon transfer into the recovering-jars, the female flies were supplied with ripe, thin-skinned fruits (mostly pitanga). In observations which took place 2, 7 and 12 days after spraying, oviposition was noted only in the case of flies treated with 1 per cent Methoxychlor and with Dieldrin at the concentrations of 0.2, 0.5 and 1 per cent. Eggs were generally laid in small numbers and not on the fruits but close to them or on the walls of the jars. It can thus be concluded that flies brought into contact with sprayed leaves (at least up to a fortnight from the date of the spray application) lose their capacity for normal oviposition.

1) All further references to percentage of toxic ingredient in the sprays apply to the commercial products. Dieldrin was kindly supplied by the Shell Chemicals Distributing Company (Middle East) Ltd.; DDT and Methoxychlor by I. Green and Company, both of Tel-Aviv.

2) Page numbers in parentheses refer to the Hebrew text.

SECOND SERIES: TESTS WITH ORANGE LEAVES

In this series the sprays were applied first to the lower branches of the trees. Six to seven days after spraying low sprinkler irrigation was applied in the experimental orchard at the rate of 40 to 50 m³ per dunam and, in consequence, the lower branches of the trees were wetted. Leaves from these branches produced very little or no knock-down in the first 3 hours. Contact with leaves sprayed with 1 per cent Methoxychlor and 2 per cent Dieldrin resulted in high knock-down figures (90—100%) only after some 7 to 8 hours from the beginning of the tests. It follows from these results that sprinkler irrigation or rainfall of 40—50mm are capable of washing the spray residues from the leaves to the extent of completely neutralizing the toxic effect of poison sprays. In view of these facts the sprays were applied again to loftier branches which were outside the range of the sprinklers and the results reported in Table 3 refer only to tests with leaves picked from these branches.

The sprays were applied on 21st August. The leaf-tests were carried out 10 times at intervals of several days (Table 3, p. 195).

The toxic effect of all the compounds was found to be more powerful and of greater persistence than on apple leaves. DDT at 0.5 per cent never achieved a 100 per cent knock-down and its effectiveness declined rather rapidly. At 1 per cent it maintained a 100 per cent knock-down for about three weeks and afterwards it gradually became less effective. Methoxychlor at the concentration of 0.5 per cent retained maximum toxicity for about a fortnight, while at 1 per cent it resulted in a 100 per cent knock-down for more than 6 weeks. 0.5 per cent Dieldrin produced satisfactory results for about a fortnight, whereupon its effectiveness declined sharply. At higher concentrations it retained high toxicity for about six weeks. The unexpectedly low knock-down figures associated with 2 per cent Dieldrin in the tests performed 38 and 43 days after spraying seem to represent freak occurrences, considering that at 1.5 per cent a high level of knock-down was achieved on those occasions.

Figure 2 (p. 195) which represents diagrammatically the effects of the three compounds at 0.5 per cent active ingredient, suggests the existence of a time lag before DDT and Methoxychlor become fully effective. The rapid decline in the toxicity of DDT is borne out by practical experience. Methoxychlor, on the other hand, is distinguished by the persistence of its toxic properties. The toxic action of 2 per cent Dieldrin parallels that of Methoxychlor at 1 per cent.

COMMERCIAL SPRAYING EXPERIMENT IN AN ORANGE GROVE

Blocks of 30 Shamuti orange trees were sprayed by means of a power-sprayer, as practised in commercial pest control. A shower (3 mm) which occurred between the first and the second test had no effect on the toxicity of the different compounds.

Random branches from the sprayed trees supplied leaf material for the toxicity tests (Table 4, p. 196). DDT and Methoxychlor at the concentration of 1 per cent effected a 100 per cent knock-down throughout the experimental period which lasted some four weeks from the time of spraying. 0.5 per cent Dieldrin achieved a knock-down of all the flies up to a fortnight after spraying, but subsequently its toxic effect wore off rapidly. The effectiveness of Dieldrin at higher concentrations remained at a fairly high level throughout the experimental period, but after the first fortnight it fell below the 100 per cent killing power retained by the two other preparations. These tests had to be discontinued owing to the inadequate supply of live flies.

SUMMARY

1. Mediterranean fruit flies were bought into contact for ten minutes with leaves sprayed with DDT, Methoxychlor and Dieldrin of various concentrations. The percentage of knock-down recorded 3 hours from the beginning of the test was taken as a measure of toxicity. The tests were carried out at intervals during a period of about 7 weeks from the date of spray application.
2. DDT has been shown to be inferior in its direct and residual toxicity to Methoxychlor and Dieldrin at equivalent concentrations of active ingredient.
3. The toxicity of all the three chlorinated hydrocarbons is more persistent on orange leaves than on apple leaves. The percentage of knock-down resulting from contact with sprayed orange leaves is initially very high, and in the case of Methoxychlor and Dieldrin (50% active ingredient) the knock-down is maintained at a fairly high level for about six weeks.
4. Wetting of the foliage with water equivalent to 40—50 mm of rain a week after spraying practically eliminates the toxic effect of the compounds tested.
5. Flies which have come into contact with sprayed leaves within two weeks following the spray applications, appear to be incapable of normal oviposition.