the Okanagan Valley was affected. Injury varied from 0 to 2% in orchards which were sprayed with diazinon at petal fall for control of fruittree leafroller. Diazinon, 2 quarts 50% E.C. per acre applied on June 29 gave 100% reduction of adult and late instar larvae.

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EROSION OF AZINPHOSMETHYL FROM APPLE LEAVES BY RAIN AND OVERTREE IRRIGATION[1]

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ABSTRACT

Three sprays of azinphosmethyl wettable powder were applied for seasonal control of the codling moth, **Laspeyresia pomonella** (l.), in a semi-dwarf apple orchard. A rain of 1.75 cm, occurring 6 hours after a spray application, removed 41% of the deposit from the leaves; a rain of 1.00 cm, occurring 16 days after an application, did not remove any residue. Residues in the treetops were eroded more rapidly in blocks with overtree irrigation than in those with undertree irrigation. But there was no difference in the erosion rate in the overtree-irrigated orchard whether 5.1 cm of water was applied biweekly or 2.5 cm was applied weekly. There was a trend to poorer control of the codling moth with overtree irrigation.

INTRODUCTION

There has been concern for many years that overtree irrigation of apple trees may remove pesticides and thus reduce control of the codling moth, *Laspeyresia pomonella* (L.). In a small-scale experiment in 1961 with Golden Delicious trees, Williams showed that 1 overtree sprinkling, applied 5 days after a spray of azinphosmethyl, removed a large amount of the residue and that a rain of 0.33 cm that fell 2 days after spraying removed an even larger amount. A number of workers have investigated the influence of rain, or simulated rain, on the removal of other pesticides. Much of this work is summarized by Ebeling (1963) and Linskens, Heinen, and Stoffers (1965). Our experiment, conducted throughout the 1971 growing season, was designed to measure the effects of overtree irrigation on the erosion of azinphosmethyl residues from apple leaves and on the control of the codling moth. The amounts of residue removed by rain were also measured whenever possible.

[1] Contribution No. 342 of the Research Station.

MATERIALS AND METHODS

The experiment was conducted in 3 adjacent blocks (I, II, III) of semi-dwarf apple trees on M.VII rootstocks. There were 8 varieties in each block, planted randomly. Each block consisted of 7 rows with 12 to 15 trees per row. The rows were spaced 4.6 m apart and the trees 2.3 m apart. Height of the trees was about 3.7 m.

Each block was divided into 4 plots of 3 rows each; the 7th row served as a buffer between the sprayed plots. Three sprays of 50% azinphosmethyl wettable powder were applied for codling moth control on 2 June, 23 June, and 28 July, at the currently recommended rate of 0.23 kg / ha in plot 1, and at rates of 0.17 and 0.11 kg / ha in plots 2 and 3 respectively. Plot 4 was sprayed with water only: it served as a check on codling moth infestation at harvest and as a blank for residue analysis. No other pesticides were applied during the season. The sprays were applied with an experimental, low-volume, airblast sprayer using 55 l of water per ha.

The blocks were irrigated from May to September. Block I received 5.1 cm of water every 2 weeks by undertree sprinkling. Blocks II and III were irrigated by overtree sprinkling: block II received 2.5 cm every week and block III 5.1 cm every two weeks. No irrigation was applied until at least 1 week after a spray application.

The following rains occurred during the experiment: 1.75 cm accompanied by strong winds on 2 June, starting 6 hr after the spray had dried; 0.89 cm on 8 June; 1.19 cm on 13 June; 0.15 cm on 22 June; 0.30 cm on 23 June, starting 5 hr after the spray had dried; 0.46 cm on 25 June; and 1.00 cm during 9-10 July.

Leaves for analysis of azinphosmethyl residues were sampled 20 times during the season: before and after each spray application, before and after each irrigation, and following periods of rain. A sample consisted of a total of 25 leaves picked from 4 trees in the centre row of each plot at each of 3 levels: 1.2, 2.3 and 3.4 m above the ground. Azinphosmethyl was determined by the Miles method (1964).

The codling moth infestation at harvest was determined by examining all the fruit on the trees and on the ground for stings and entries. Unfortunately, the crop was light and variable, ranging from 0 to 500 apples per tree.

RESULTS AND DISCUSSION

The initial deposits of azinphosmethyl on the leaves varied widely between blocks, indicating that large differences would be required to show the effects of sprinkling on the erosion of spray deposits. The greatest variation was at the 3.4-m level where the range of spray deposits (ug / cm²) on the 3 spray dates for the 3 application rates was:

Application rates, kg/ha	2 June		23 June		28 July	
	Range	Average	Range	Average	Range	Average
0.23	1.0-1.6	1.3	0.7-1.8	1.2	1.0-2.1	1.4
0.17	1.1-1.6	1.4	1.1-1.7	1.4	1.2-1.5	1.4
0.11	0.7-0.9	0.8	0.8-0.9	0.8	0.9-1.3	1.1

Figure 1A shows the average residues of azinphosmethyl on the leaves on sampling dates throughout the summer, where blocks were irrigated by undertree and overtree sprinklers. Overtree sprinkling weekly with 2.5 cm of water did not remove any more residue than overtree sprinkling biweekly with 5.1 cm. The residues eroded more rapidly in the overtree-irrigated blocks than in the undertree-irrigated block, but the differences were barely significant (P = 0.05) only at the 3.4-m level.

The following table shows the per cent of the original deposits left on the leaves at the different levels 3 weeks after the spray of 23 June.

There was no significant difference (P = 0.05) between blocks with different irrigation treatments in the percentage of original deposits still remaining at the 1.2 and 2.3-m levels. Evidently the insecticide eroded

Irrigation method	Level in tree (m)	Initial deposit (µg/cm²)	Residue on leaves after 3 weeks (µg/cm²)	% of original deposits remaining on leaves after 3 weeks
Overtree, weekly	3.4	1.21	0.49	40
	2.3	1.45	0.70	48
	1.2	1.19	0.73	61
Overtree, biweekly	3.4	0.87	0.41	47
	2.3	1.39	0.78	56
	1.2	1.02	0.71	70
Undertree	3.4	1.31	0.77	59
	2.3	1.57	0.91	58
	1.2	1.13	0.83	73

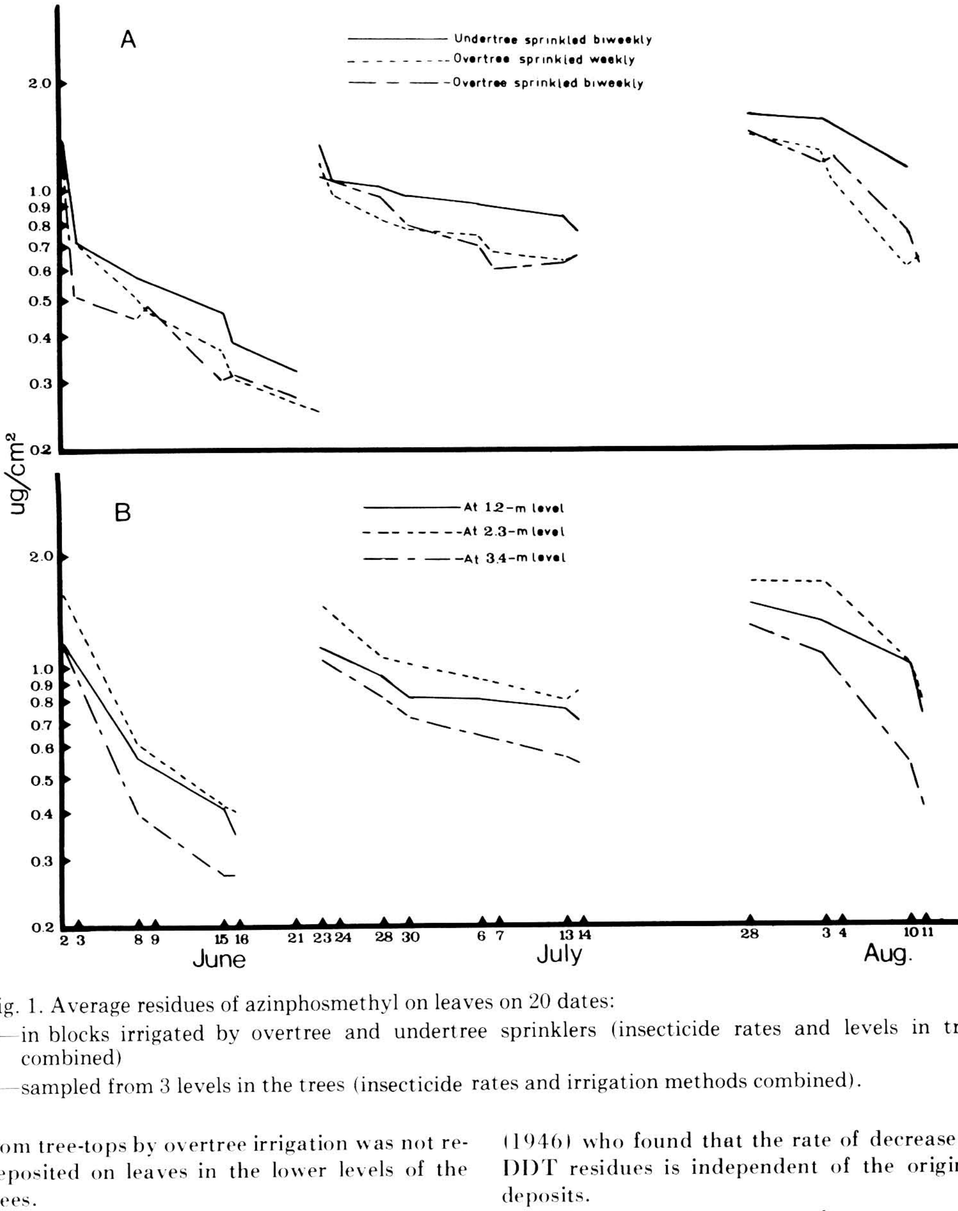

Fig. 1. Average residues of azinphosmethyl on leaves on 20 dates:
A—in blocks irrigated by overtree and undertree sprinklers (insecticide rates and levels in trees combined)
B—sampled from 3 levels in the trees (insecticide rates and irrigation methods combined).

from tree-tops by overtree irrigation was not redeposited on leaves in the lower levels of the trees.

Figure 1B shows the average residues of azinphosmethyl on leaves sampled at 3 levels in the trees throughout the summer. Though residues were highest at the 2.3-m level and lowest at the 3.4-m level, the only instance where the initial deposits at these 2 levels differed significantly ($P = 0.05$) was on 2 June. Regardless of the magnitude of the initial deposits, the residues eroded at approximately the same rate at each of the 3 sampling levels. This agrees with the work of Gunther *et al.* (1946) who found that the rate of decrease of DDT residues is independent of the original deposits.

Rains occurring soon after spray application removed large amounts of insecticide. For example, the 1.75 cm that fell 2 June starting 6 hr after the spray had dried, and lasting for 10 hr, removed 41% of the initial deposit; the much lighter rainfall of 0.30 cm on 23 June, starting 5 hr after spray application, and lasting for 3.5 hr, removed 12% of the inital deposit. When dry weather followed a spray application the erosion rate was much slower. For example, during the dry

1-week period following the spray of 28 July the initial deposit eroded only 7%.

Residues that had been on the leaves for long periods were not eroded as readily as freshly-applied sprays. For example, the average residue on leaves in all plots on 7 July, 14 days after spray application, was 0.65 $\mu g/cm^2$. Though a rain of 1.0 cm fell during 19 hr on 9-10 July the average residue on 12 July was still 0.64 $\mu g/cm^2$. No irrigation was applied between 7 and 12 July.

Overtree sprinkling is likely to have an effect similar to rain on the removal of residue and therefore we believe that overtree irrigation should be delayed as long as possible after spray application. Further work is required to determine how soon overtree irrigation can be applied after spraying without causing serious erosion of spray deposits.

It is interesting to note that azinphosmethyl residues declined more rapidly, and to lower levels, in the wet weather of June than in the drier periods of July and August. Cool temperatures usually occur with the wet weather of June and this extends the period of codling moth emergence. These 2 factors, rapid residue decline and cool wet weather, may explain why good control of first-brood codling moth is not readily obtained in some years.

Because the crop was so light and variable no definite conclusions could be drawn from the codling moth counts. However, there appeared to be no difference in the control achieved with 0.23 and 0.17 kg / ha of azinphosmethyl. Control appeared poorer with 0.11 kg / ha. Percentage codling moth infestation for the 3 rates of azinphosmethyl was 5, 5, and 8, respectively; infestation in the check was 43%. The effect of irrigation method on codling moth control appeared more pronounced; there was a trend to poorer control with overtree irrigation. The infestation in the block sprinkled undertree averaged 2%; in the block sprinkled overtree weekly, 6%; and in the block sprinkled overtree biweekly, 12%. Respective percentages in the checks were 39, 42 and 45.

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