5-1957

Insect pests and their control - Tobacco pests - Experiments in their control in Western Australia

B.A. B. Edwards

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Experiments In Their Control In Western Australia

Experiments have been conducted at Manjimup, Western Australia, for the control of insects attacking tobacco. The insects concerned include the leaf miner, stem borer, cutworms, looper caterpillars and grass hoppers.* The insecticides used were lead arsenate, DDT, dieldrin, aldrin and endrin. As applied, i.e., at equal intervals during the growing season and at the strengths used, DDT proved superior to all other treatments.

Of the insects which attack tobacco after planting out, the present article deals with two particular types, the leaf miner and leaf chewing insects. The latter includes cutworms, looper caterpillars and, to a lesser degree, grasshoppers.

Until the advent of DDT, control measures were carried out with arsenical dusts and baits (Newman 1931) but in recent years DDT has been found more effective either as a spray or as a dust (Cannon, 1946). Interest also arose in the chlorinated hydrocarbons, aldrin, dieldrin, and endrin, for tobacco pest control.

I. Treatments.
The following treatments were decided on after a survey of the literature:

(i) Control—no treatment.
(ii) 50 per cent. lead arsenate dust—5 applications.
(iii) 50 per cent. lead arsenate dust—3 applications.
(iv) 2 per cent. DDT dust—5 applications.
(v) 2 per cent. DDT dust—3 applications.
(vi) 0.1 per cent. DDT spray—5 applications.
(vii) 0.1 per cent. DDT spray—3 applications.

II. Site.
The site selected was on the Department of Agriculture’s Tobacco Research Station located six miles west of Manjimup, Western Australia.

* The scientific names of pests are listed at the end of the paper.
III. Design.

A randomised block design with five replications of the seven treatments was used. Each plot consisted of five rows of tobacco plants each one chain long and containing approximately 33 plants in every row.

The variety used in all experiments in the present paper was Hickory.

IV. Application.

The seedlings were planted out on November 4, 1952, and the interval between this date and the end of February, 1953 (approximately the end of harvesting) was divided into five or three periods as required for each treatment.

Dusts were applied by means of a hand rotary duster and sprays with a knapsack spray pump.

The amounts of both dusts and sprays used varied considerably, according to the age of the plants. The amounts of 50 per cent. lead arsenate dust varied between $\frac{1}{2}$ to 2 lb. per treatment, 2 per cent. DDT dust from $\frac{1}{2}$ to 3$\frac{1}{2}$ lb. per treatment and 0.1 per cent. DDT spray from 3 to 5 gals. per treatment.

V. Sampling.

This was carried out by examining all the leaves picked from the middle 20 plants of the middle row in each plot. Leaf miner damage was assessed by counting the number of leaf mines in each leaf. At the same time, chewing damage was estimated by placing the leaf into one of two classes—undamaged or slightly damaged and badly damaged.

VI. Results.

(1) Leaf miner damage (Table I).

The tabulated figures are the total number of leaf mines found in all the leaves from the 20 plants in each plot.

An analysis of variance was performed on the data. Since different numbers of leaves were taken from each plot, the variate used was the number of mines per leaf on a plot basis.

Examination of the results allows the following conclusions:

(a) All the treatments were significantly better than the control.

(b) Treatment 4 (five applications of 2 per cent. DDT dust) was significantly better than both Treatments 2 and 3 (three and five applications of 50 per cent. lead arsenate dust), but Treatment 5 (three applications of 2 per cent. DDT dust) did not show significance from these treatments.

(c) Treatments 6 and 7 (0.1 per cent. DDT spray) were significantly better than Treatments 2 and 3 (lead arsenate dusts).

<table>
<thead>
<tr>
<th>TABLE I.—LEAF MINES.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments.</td>
</tr>
<tr>
<td>1. Control.</td>
</tr>
<tr>
<td>Block A</td>
</tr>
<tr>
<td>Block B</td>
</tr>
<tr>
<td>Block C</td>
</tr>
<tr>
<td>Block D</td>
</tr>
<tr>
<td>Block E</td>
</tr>
<tr>
<td>Total all Blocks</td>
</tr>
<tr>
<td>Leaf mines per leaf</td>
</tr>
<tr>
<td>Treatment Totals Leaf mines/leaf</td>
</tr>
</tbody>
</table>

Least significant differences between 2 treatment totals.

At 5% level—2.9056
1% level—3.9494
0-1% level—5.2894
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(d) Treatment 6 (five applications of 0.1 per cent. DDT spray) was significantly better than Treatment 5 (three applications of 2 per cent. DDT dust). No significant difference was shown between the other DDT treatments.

(ii) Chewing damage (Table II).

These results give the percentage of undamaged or slightly damaged leaves for each treatment. The treatments are tabulated in order of merit.

TABLE II.—CHEWING DAMAGE.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total Number of Leaves</th>
<th>Undamaged or Slightly Damaged</th>
<th>Per cent. Undamaged or Slightly Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1,638</td>
<td>1,542</td>
<td>94-1</td>
</tr>
<tr>
<td>4</td>
<td>1,433</td>
<td>1,323</td>
<td>92-3</td>
</tr>
<tr>
<td>7</td>
<td>1,430</td>
<td>1,290</td>
<td>90-2</td>
</tr>
<tr>
<td>5</td>
<td>1,236</td>
<td>1,085</td>
<td>87-8</td>
</tr>
<tr>
<td>2</td>
<td>1,027</td>
<td>867</td>
<td>84-4</td>
</tr>
<tr>
<td>3</td>
<td>1,151</td>
<td>943</td>
<td>81-9</td>
</tr>
<tr>
<td>1</td>
<td>1,032</td>
<td>766</td>
<td>74-2</td>
</tr>
</tbody>
</table>

The differences in these percentages were tested firstly as a whole and then as individual comparisons using a chi-square analysis. The separate comparisons revealed a marked heterogeneity (see significant levels given in Table III).

The following conclusions can be made from the analysis:

(a) All treatments were significantly better than the control.

(b) The DDT treatments (Treatments 4, 5, 6, and 7) were all significantly better than the lead arsenate treatments (Treatments 2 and 3).

(c) Treatment 6 (five applications of 0.1 per cent. DDT spray) was the best treatment followed by Treatment 4 (five applications of 2 per cent. DDT dust).

TABLE III.—CHEWING DAMAGE.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>1</th>
<th>3</th>
<th>2</th>
<th>5</th>
<th>7</th>
<th>4</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>n.s.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

n.s. = no significance.

x = significant at 5% level.

xxx = significant at 0.1% level.

VII. Discussion.

(i) Leaf miner damage.

From the results of this experiment, it can be seen that damage due to the leaf miner can be best controlled by the use of DDT either as a 2 per cent. dust or as a 0.1 per cent. spray. In all cases, DDT proved superior to the old method of control, namely the use of lead arsenate dust.
(ii) Chewing damage.

DDT was also proved to be superior for the control of chewing insects on tobacco in this experiment. The larger number of applications (5) of either DDT dust or 0.1 per cent. DDT spray was superior to the applications in each case.

(iii) The experiment as a whole.

The results from this experiment indicate that at the concentrations used, DDT either as a spray or as a dust is superior to lead arsenate dust to control insects damaging tobacco leaves in the field.

Thorough application of all treatments is most important and 3 to 5 gals. of spray were used to cover approximately 650 plants (19-32 gals./acre). With dusts, $\frac{1}{2}$ to 3½ lb. were used (3-22 lb./acre), the amounts with either formulation varying with the size and development of the plants in each individual treatment.

EXPERIMENT 1953-54

Due to reports of the effectiveness of dieldrin against looper caterpillars on tobacco (Smith, 1953), and its known toxicity to grasshoppers, an experiment was begun during this season to compare dieldrin and the related compound aldrin with DDT. All three compounds were used in the form of sprays. Unfortunately, half way through the season, the site was converted to a dam and the experiment was abandoned.

EXPERIMENT 1954-55

The preceding season's experiment was repeated and, in addition, the promising new insecticide, endrin, was used. This material had been reported as effective against most tobacco pests (Smith, 1954). All three insecticides were compared with DDT against both the leaf miner and against leaf chewing insects.

I. Treatments.

From a survey of the literature, the following treatments were decided upon:

(i) Control—no treatment.
(ii) 0.1 per cent. DDT.
(iii) 0.5 per cent. aldrin.
(iv) 0.1 per cent. aldrin.
(v) 0.05 per cent. dieldrin.
(vi) 0.1 per cent. dieldrin.
(vii) 0.05 per cent. endrin.
(viii) 0.1 per cent. endrin.

Experimental samples of aldrin, dieldrin and endrin were obtained from Shell Chemicals (Aust.).

All treatments were applied four times during the growing season—the first a week after planting out and the remainder at approximately monthly intervals.

II. Site.

As in the previous experiments, the site was at the Tobacco Research Station, Manjimup.

III. Design.

A randomised block design with four replications of eight treatments was used with plot sizes similar to those used in previous work.

IV. Application.

All treatments were applied with a knapsack spray pump. The amount of spray used varied from 2 to 4 gals. per treatment (16 to 48 gals. per acre).
TABLE IV.—LEAF MINES.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>(0.1%) DDT</th>
<th>(0.05%) Aldrin</th>
<th>(0.1%) Dieldrin</th>
<th>(0.05%) Endrin</th>
<th>(0.1%) Dieldrin</th>
<th>(0.05%) Aldrin</th>
<th>(0.1%) Endrin</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. 0.1% DDT</td>
<td>323 622 301 134</td>
<td>318 180 251 159</td>
<td>294 171 255 157</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
</tr>
<tr>
<td>3. 0.05% Aldrin</td>
<td>182 478 333 83</td>
<td>232 136 237 106</td>
<td>255 165 235 125</td>
<td>242 109 221 120</td>
<td>242 109 221 120</td>
<td>242 109 221 120</td>
<td>242 109 221 120</td>
</tr>
<tr>
<td>4. 0.1% Dieldrin</td>
<td>228 253 230 255</td>
<td>224 358 234 186</td>
<td>228 453 221 120</td>
<td>228 453 221 120</td>
<td>228 453 221 120</td>
<td>228 453 221 120</td>
<td>228 453 221 120</td>
</tr>
<tr>
<td>5. 0.05% Dieldrin</td>
<td>300 114 301 134</td>
<td>318 180 251 159</td>
<td>294 171 255 165</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
</tr>
<tr>
<td>6. 0.1% Dieldrin</td>
<td>300 114 301 134</td>
<td>318 180 251 159</td>
<td>294 171 255 157</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
<td>227 120 206 120</td>
</tr>
<tr>
<td>7. 0.05% Aldrin</td>
<td>163 404 153 212</td>
<td>228 294 273 173</td>
<td>273 173 161 137</td>
<td>231 101 198 198</td>
<td>231 101 198 198</td>
<td>231 101 198 198</td>
<td>231 101 198 198</td>
</tr>
<tr>
<td>8. 0.1% Endrin</td>
<td>967 176 1000 1083</td>
<td>967 176 1000 1083</td>
<td>1000 1083 161 137</td>
<td>198 198 198 198</td>
<td>198 198 198 198</td>
<td>198 198 198 198</td>
<td>198 198 198 198</td>
</tr>
</tbody>
</table>

V. Sampling.

Sampling and the assessment of results were carried out in a similar manner to the previous experiments.

VI. Results.

(i) Leaf miner damage—Table IV.

While all treatments were significantly better than the control, there was no significant difference between individual treatments.

(ii) Chewing damage—Table V.

The results of individual comparisons between the treatments using a chi-square analysis are shown in Table VI.

TABLE V.—CHEWING DAMAGE.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total Number of Leaves</th>
<th>Undamaged or Slightly Damaged</th>
<th>Per cent. Undamaged or Slightly Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,194</td>
<td>1,076</td>
<td>90.4</td>
</tr>
<tr>
<td>2</td>
<td>967</td>
<td>819</td>
<td>84.9</td>
</tr>
<tr>
<td>3</td>
<td>875</td>
<td>676</td>
<td>77.4</td>
</tr>
<tr>
<td>4</td>
<td>1,000</td>
<td>771</td>
<td>77.2</td>
</tr>
<tr>
<td>5</td>
<td>814</td>
<td>629</td>
<td>77.0</td>
</tr>
<tr>
<td>6</td>
<td>937</td>
<td>705</td>
<td>75.6</td>
</tr>
<tr>
<td>7</td>
<td>902</td>
<td>638</td>
<td>70.2</td>
</tr>
<tr>
<td>8</td>
<td>920</td>
<td>369</td>
<td>39.1</td>
</tr>
</tbody>
</table>

The following conclusions can be made from the analysis:

(a) All treatments were significantly better than the control.

(b) The best treatment was 0.1 per cent. DDT (treatment 2).

(c) 0.1 per cent. dieldrin (treatment 6) was superior to every treatment except DDT.

(d) Treatments 4 (0.1 per cent. aldrin), 5 (0.05 per cent. dieldrin), 8 (0.1 per cent. endrin) and 3 (0.05 per cent. aldrin) were not significantly different from one another.

TABLE VI.—CHEWING DAMAGE.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1</th>
<th>7</th>
<th>3</th>
<th>8</th>
<th>5</th>
<th>4</th>
<th>6</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>2</td>
<td>x</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
<td>xx</td>
</tr>
<tr>
<td>3</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
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<tr>
<td>4</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
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<tr>
<td>5</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
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<tr>
<td>6</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
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<tr>
<td>7</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

VII. Discussion.

The experiment has indicated clearly that good control of tobacco leaf miner in the field in Western Australia can be obtained with aldrin, dieldrin, endrin and DDT.
Further, they all gave effective control of the chewing insects which damage tobacco at Manimup, Western Australia, but DDT spray at 0.1 per cent. strength and four applications throughout the growing season was the best treatment.

Endrin did not prove to be superior to DDT in Western Australia.

The relative importance of the chewing insects listed as attacking tobacco was not ascertained, but all were present at some stage of the experiment.

SCIENTIFIC NAMES

Leaf miner—Gnorimoschema operculella (Zell).
Cutworm, Budworm—Heliothis punctigera Wallengr.
Looper caterpillars—Plusia spp.
Grasshoppers—Phaulacridium vittatum (Sjost.). Gastrimargus musicus (F.). Austroicetes vulgaris (Sjost.).

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The author wishes to thank the Government Entomologist (Mr. C. F. H. Jenkins) for his interest and suggestions while this work was being carried out.

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Explanatory Diagrams only — NOT illustrative of Microfine* particles

<table>
<thead>
<tr>
<th></th>
<th>Poor</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured in number</td>
<td>10%</td>
<td>90%</td>
</tr>
<tr>
<td>Correct</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Measured in weight</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Correct</td>
<td>90%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Microfine* Microphene drench is guaranteed to have as much as 99% of its weight ground to the recommended fineness, and Liquaphene 97%.

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