A SURVEY OF APPLE LEAFCURLING MIDGE *(DASYNEURA MALI)* MANAGEMENT IN WAIKATO ORCHARDS

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SUMMARY

A survey of 30 Waikato and one Bay of Plenty apple (cv. "Braeburn") blocks found that 27% of survey trees had 100% shoot damage and up to 41% of leaves on individual trees were damaged. Of the blocks surveyed, 74% had been treated with one or more applications of diazinon and/or dimethoate. Blocks treated with soil or foliar applications of diazinon had less leaf damage than blocks which had not been treated with diazinon. These differences were not significant. Leaf damage was not lower in blocks treated with dimethoate. Blocks treated with fewer insecticides suffered more leaf damage. Spray volume did not affect infestations.

Keywords: apple, apple leafcurling midge, *Dasyneura mali*, diazinon, dimethoate, water volume

INTRODUCTION

Apple leafcurling midge (*Dasyneura mali*) larvae may damage the leaves, flowers and developing fruitlets of apple trees. Larvae mostly feed inside leaf rolls formed when emerging leaves fail to unfold due to midge infestation. Damage may cause affected leaves to drop prematurely and can stunt shoot growth, especially on young trees. Fruit may be contaminated by pupal cocoons when mature larvae exiting leaf rolls are caught in the stalk end of fruit, as they try to reach the soil to pupate (Lowe 1993). In the past, apple leafcurling midge was regarded as a secondary pest mainly controlled by insecticides applied against key pests such as leafroller and codling moth. However, in recent years orchardists have reported increasing difficulties trying to control this pest and the problem appears to be increasing (Wilton 1994). In the absence of any trial data, growers have had to experiment with changes to their spray programmes. This has generally involved additional applications of diazinon and/or dimethoate.

This paper reports on a survey conducted to determine the current pest status of apple leafcurling midge in the Waikato and Bay of Plenty and the level of control being achieved by insecticide practices.

METHODS

Thirty blocks in the Waikato and one in the Bay of Plenty were chosen for surveying according to their usage of diazinon or dimethoate. Blocks were grouped depending on the number of applications of these two insecticides made up to 28 February 1994. Five groups were initially designated but later reorganised into seven groups (Table 1) when some sites were treated with later applications of one or both insecticides. Diazinon was applied to the trees or soil beneath them.

The survey was conducted by walking diagonally through each block and randomly selecting 10 trees from which 10 shoots (1 year old wood) and 20 fruit per tree were examined. The numbers of apple leafcurling midge pupal cocoons per fruit and whether pupae were still present was recorded. Shoots were chosen randomly with no regard to length. For each shoot, the total number of leaves and number of damaged leaves were recorded. Blocks were visited between 8 April and 5 May 1994.

Proc. 47th N.Z. Plant Protection Conf. 1994: 346-349

For the purposes of analysis, blocks were sorted according to their diazinon and dimethoate usage (Table 2), seasonal frequency of application of all insecticides (Table 3) and the water volume used to apply insecticides (Table 4). Total insecticide use and water volume were analysed because all of the insecticides used may have affected apple leafcurling midge and higher water volumes might provide better coverage of larvae inside leaf rolls. Data on the proportions of shoots and leaves damaged and the total (empty + full) cocoons per fruit were analysed by ANOVA untransformed and after square root transformation. Only untransformed analyses are presented in these tables. Individual trees were treated as plots.

RESULTS

Of the 76 spray programmes from Waikato or Bay of Plenty blocks examined during selection of the survey orchards by late February, 57% included diazinon. Over the entire season, 74% of the survey blocks had been treated with one or both of these insecticides. Of the diazinon applications, 18% were soil-applied before or after flowering.

The group of blocks treated with diazinon and dimethoate were the most intensively sprayed, followed by the group treated with >4 applications of diazinon (Table 1). When diazinon was applied more than once, the first application was often to the soil. A small proportion (7%) of survey blocks were treated with diazinon in September, with most (71%) receiving December and January applications, although it was sometimes applied until March. Dimethoate was used from December until February inclusively. Between February and harvest, 10% of blocks were treated with 1-3 applications of carbaryl.

TABLE 1: Orchard spray programmes: mean number of applications of different insecticides and total number of all applications.

	diazinon[1]	dimethoate[2]	oil	carbaryl	azinphos -methyl	chlorpyrifos	Total
No diazinon or dimethoate:	0	0	1.1	0	5.3	4.5	10.9
1X diazinon:	1.0	0	1.2	0.8	5.2	3.3	12.2
2X diazinon:	2.0	0	1.0	0	3.5	3.0	9.5
3X diazinon:	3.0	0	1.0	0.2	3.1	3.0	10.3
>4X diazinon:	5.0	0	1.0	0	3.5	3.5	13.0
dimethoate:	0	1.0	1.0	0.5	3.0	5.0	10.5
dimethoate and diazinon:	1.6	1.4	1.0	0.8	4.6	4.4	13.8

[1] diazinon as Basudin 50WP at 50 or 100 g or Diazinon 50W at 40-100 g or Diazinon 800 at 32 or 80 g/100 litres.
[2] dimethoate as Rogor 20W at 16-50 g/100 litres or Rogor E at 20 g/100 litres.

Large variations were found between blocks in shoot (23-100%) and leaf damage (2-30%) and cocoons per fruit (0-0.115, equivalent to 0-11.5% of fruit infested). All shoots were damaged on 27% of survey trees, with up to 41% of the leaves on individual trees affected. Most (98%) of the fruit which was contaminated by pupal cocoons only had a single cocoon, although up to three cocoons per fruit were found. Of 102 pupal cocoons found on fruit, 63% contained no pupae, indicating these insects had completed pupation before fruit were harvested.

The lowest levels of shoot and leaf damage and fruit contamination were found in blocks treated with one or more applications of diazinon (Table 2). In contrast, the highest levels of damage and contamination were found in two blocks treated only with dimethoate. These differences were not significant.

TABLE 2: Mean percentage of shoots and leaves damaged by apple leafcurling midge larvae and numbers of pupal cocoons (with or without pupae) per fruit on apple cv. "Braeburn" trees treated with varying numbers of applications of diazinon and/or dimethoate during 1993/94.

Insecticide use	No. of blocks	% shoot damage	% leaf damage	No. of cocoons /fruit
No diazinon or dimethoate	8	80.1	14.6	0.018
1 diazinon	6	64.2	10.9	0.012
2 diazinon	2	65.5	17.3	0.020
3 diazinon	6	67.0	12.2	0.008
>4 diazinon	2	64.0	10.1	0.003
dimethoate only	2	93.0	23.2	0.045
dimethoate + diazinon	5	77.0	15.7	0.023
SED		19.24	6.42	0.0220

The number of insecticide sprays per annum ranged from 6-18 between survey blocks with an average of 11.4. Tree damage and fruit contamination were highest in the blocks treated with the lowest frequency of insecticide application (Table 3).

TABLE 3: Mean percentage of shoots and leaves damaged by apple leafcurling midge larvae and numbers of pupal cocoons (with or without pupae) per fruit on apple cv. "Braeburn" trees treated with varying numbers of insecticide applications during 1993/94.

Applications /season	No. of blocks	% shoot damage	% leaf damage	No. of cocoons /fruit
6-9	9	85.1	19.0	0.027
10-13	15	66.5	11.8	0.016
14-18	7	70.1	12.5	0.011
SED		10.08	3.34	0.0119

TABLE 4: Mean percentage of shoots and leaves damaged by apple leafcurling midge larvae and numbers of pupal cocoons (with or without pupae) per fruit on apple cv. "Braeburn" trees treated with insecticides applied using different water volumes during 1993/94.

Spray volume	No. of blocks	% shoot damage	% leaf damage	No. of cocoons /fruit
low (460-1000 litres/ha)	5	72.6	12.4	0.016
medium (1200-1500 litres/ha)	4	56.8	8.0	0.012
high (1700+ litres/ha)	22	75.8	15.3	0.019
SED		12.67	4.16	0.0147

The water volume used during spraying varied between blocks from 456-2000 litres/ha. Most (71%) of the blocks surveyed were usually treated using high volume spraying (Table 4). Blocks treated with the medium water volume had the lowest level of tree damage. However, one of the blocks treated with medium volume spraying was the site in the Bay of Plenty which had very low levels of tree infestation ie. 23% of shoots damaged.

DISCUSSION

In the past, only a low proportion of shoots on apple trees treated with export spray programmes were damaged by apple leafcurling midge. eg. 14% of watersprouts examined in mid-February from apple trees cv. Cox's Orange Pippin treated with azinphos-methyl full season (Penman and Chapman 1980). This survey has confirmed orchardist observations that the incidence of apple leafcurling midge in the Waikato has increased substantially in some export apple blocks. Similar increases have been reported from Nelson and Hawkes Bay orchardists. The low incidence of apple leafcurling midge found in the single Bay of Plenty block, has been observed in other orchards in this area. This may be due to the relative isolation and low number of pipfruit orchards in the Bay of Plenty.

This trend for increasing damage by apple leafcurling midge must be countered. A recent survey of three Nelson orchards experiencing control problems, found no indication of resistance (Anon. 1994). However, the presence of large populations of apple leafcurling midge in orchards coupled with the protected nature of their larval feeding sites which may result in sublethal exposure to insecticides, could lead to resistance. Improved methods of managing this pest are also required to halt increases in the frequency of insecticide application.

For the present, at least, apple leafcurling midge management in export apple orchards will depend on improving insecticidal control. Although this survey showed that blocks treated with one or more applications of diazinon had lower damage levels, a moderately high level of shoot damage still occurred. In addition, some caution may need to be exercised about increasing the frequency of applying diazinon as it is less effective at controlling leafrollers than azinphos-methyl or chlorpyrifos (Woon and Haydon 1973). It may be necessary to investigate alternative insecticides.

The frequency of application of all insecticides over the entire season affected apple leafcurling midge. This may be due to more applications coinciding, by chance, with as yet unidentified key periods for control. There was no evidence to indicate that higher water volumes gave better apple leafcurling midge control. Visual changes in leaf damage may help to track apple leafcurling midge phenology (Lowe 1993) and at least one survey orchardist had attempted to time sprays. However, our future studies aim to develop a better system of spray timing to enable insecticides to be applied before larvae hatch and become protected inside rolled leaves. The effects of the levels of leaf damage on tree cropping will also be determined to enable development of spray decision thresholds.

ACKNOWLEDGEMENTS

NZAPMB provided funding for this survey; the orchard managers for their willingness to allow orchard inspections; Ms. B. Dow for statistical analysis.

REFERENCES

Anonymous, 1994. Update on research into control of apple leafcurling midge. Pipmark Technical Bulletin, N.Z. Apple & Pear Marketing Board.

Lowe, S., 1993. Apple leafcurling midge. Pipmark Technical Bulletin, N.Z. Apple & Pear Marketing Board. 5p.

Penman, D.R. and Chapman, R.B., 1980. Woolly apple aphid outbreak following use of fenvalerate in apples in Canterbury, New Zealand. *J. Econ. Ent 73*: 49-51.

Wilton, J., 1994. Reviewing this season's harvest and crop performances. *N.Z. Orchardist 67*: 15-16.

Woon, G.W. and A.A. Haydon., 1973. Broad spectrum control of insect pests in pipfruit with chlorpyrifos. *Proc. 26th N.Z. Weed and Pest Control Conf.*: 178-181.