PEAR SLUG AND APPLE LEAF CURLING MIDGE: OBSERVATIONS ON THEIR BIOLOGY AND CONTROL IN AN ORGANIC ORCHARD

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Insect pests were monitored in a small apple and nashi orchard at the Levin Horticultural Research Centre in 1989/90. This was the first season in the transition between the use of conventional spray programmes and becoming an approved organic orchard. Two pests that are uncommon under conventional spray programmes increased; these were the pear slug (*Caliroa cerasi*) and the apple leaf curling midge (*Dasineura mali*). Pear slug attacks the leaves of a variety of trees including nashi, pears and cherries and can cause severe defoliation. Apple leaf curling midge occurs only on apples, and is known to increase dramatically once a full spray programme is stopped (van Epenhuijsen unpub.; van Frankenhuyzen, 1979).

This paper reports biological observations on the two pests and describes attempts to control them. The compounds used are allowed under the NZ Biological Producers Council Standards for organic production (NZBPC 1988) or have been reported to be useful (Yepsen 1984).

The orchard consisted of 200 4-year-old apple trees of the varieties 'Red Delicious', 'Cox's Orange', 'Fuji' and 'Granny Smith' and 110 trees of nashi cvs 'Hosui' and 'Kosui' planted with the pollinator 'Nijisseiki'.

Apple leaf curling midge

Trees were monitored by checking 100 shoots of each variety of apple every fortnight for curled leaves. At the same time 25 tips of each variety were examined with a hand lens (10x) for the presence of eggs. On 29 November 1989 10 shoots which had midge eggs or young larvae, were sprayed to run off with: water, Thuricide HP 0.7%, Naturoil 1%, Defender 1%, Defender 1% + Naturoil 1%; or liquid derris 0.5%. The numbers of curled leaves on these shoots were counted on 20 December 1989.

Defender is a saponified fatty acid insecticide, Naturoil is a vegetable oil based insecticide, Thuricide H.P. is a *Bacillus thuringiensis* preparation and liquid derris 0.5% has 30 g/litre rotenone, 3.7 g/litre natural pyrethrins and 15.1 g/litre piperonyl butoxide.

None of these insecticides gave adequate control of the pest on the test shoots. One peak infestation of both eggs and larvae occurred on the trees in mid December but the main peak (46.7% of tips infested) occurred on 7 February (Figure 1). These infestation levels occurred even though there were very few tips damaged by apple leaf curling midge in the previous year.

Pear slug

Two experiments with a similar range of insecticides were carried out for pear slug control. Materials are listed in Tables 1 and 2. The trial design was randomised blocks of four replicates of three trees each. Only the centre tree was used for insect assessment. The number of slugs on 10 shoots with 10 leaves were counted. Each tree received 2.5 litres of spray from a hand operated knapsack sprayer on 29/11/89 for Experiment 1 and on 22/02/90 for Experiment 2. The diatomaceous earth was applied with a Kyoritsu handduster at a rate of 140 g/tree. Prior to treatment the evenness of distribution of pear slugs was assessed.

Liquid derris significantly reduced pear slug numbers below levels in all the other treatments, including that of Defender after 6 days in Experiment 1 (Table 1). In Experiment 2, on the second generation of pear slug in February, liquid derris and natural pyrethrins in paraffinic solvent significantly reduced insect numbers (Table 2).

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Fig. 1: Percentage of apple shoots with curled leaves or eggs (mean of four cultivars) at H.R.C. 1989-90.

TABLE 1: Effect of four insecticides applied in November 1989 on first generation of pear slug in Experiment 1 compared to an untreated control.

Treatment/Solution	Mean no. of slugs/100 leaves ($\pm$ SE)	
	1 day after spraying	6 days after spraying
1. Control	14.88 a* $\pm$ 2.23	10.25 a $\pm$ 1.53
2. Defender 2%	10.63 ab $\pm$ 2.96	6.0 b $\pm$ 1.2
3. Defender 1% + Naturoil 1%	16.38 a $\pm$ 2.60	11.63 a $\pm$ 1.58
4. Thuricide HP 0.7% + Naturoil 1%	16.5 a $\pm$ 3.30	10.13 a $\pm$ 1.16
5. Liquid Derris 0.5%	3.88 b $\pm$ 0.97	2.13 c $\pm$ 0.44
	LSD 6.84	LSD 3.08

* Means followed by the same letter are not significantly different at the 5% level.

TABLE 2: Effect of five insecticides in Experiment 2 on second generation of pear slug, February 1990.

Treatment/Solution	Mean no. of slugs/100 leaves ($\pm$ SE)	
	1 day after spraying	4 days after spraying
1. Naturoil 2%	25.5 a* $\pm$ 4.97	36.88 a $\pm$ 4.06
2. Liquid Derris 0.5%	6.75 b $\pm$ 2.14	8.63 b $\pm$ 1.76
3. Sunspray 1%**	28.5 a $\pm$ 3.94	30.63 a $\pm$ 4.84
4. Diatomaceous earth	30.5 a $\pm$ 5.07	27.38 a $\pm$ 3.35
5. Natural pyrethrins 50% in paraffinic solvent 1%	2.88 b $\pm$ 0.69	3.63 b $\pm$ 1.25
	LSD 14.76	LSD 11.3

* Means followed by the same letter are not significantly different at the 5% level.

** All purpose mineral oil.

TABLE 3: Mean number of pear slugs per 100 leaves ($\pm$ SE) on east and west sides of nashi trees (all treatments combined).

	Days after treatment	November 1989	February 1990
East	1	9.25 $\pm$ 1.73	16.55 $\pm$ 3.38
	6-4	6.25 $\pm$ 0.97	20.75 $\pm$ 3.59
West	1	15.65 $\pm$ 1.76	21.10 $\pm$ 3.57
	6-4	9.80 $\pm$ 1.08	22.10 $\pm$ 3.60

Pear slugs were significantly more common on the north west (and warmest) side of the trees for the first generation, but this difference disappeared in the second generation (Table 3). In Europe sticky traps for the cherry fruitfly are hung on the south (and warmest) side of the trees as more of the insects are found on the warmer aspect (Remund and Boller 1978).

Throughout the season pear slug eggs and larvae were monitored fortnightly in the orchard. The attractiveness of various colours to adult pear slugs was tested with flat vertical boards (105 x 260 mm) each painted on both sides with one of 13 different colours; another board was covered with aluminium foil and one was made of transparent perspex. Each type was replicated twice. From 10 January 1990 to 20 February 1990 the boards were placed 1.7 m above the ground. From 20 February to 18 March half the boards were moved to 2.6 m above the ground. The trees were about 4.2 m high. Tanglefoot was spread on transparent acetate sheets and these were clipped to both sides of the boards. The sheets were changed weekly but the traps were not randomised during the experiment.

A total of 229 adult pear slugs were caught on the 30 traps over the trapping period. The most effective colours for attracting adult pear slug were (figures % of total catch): fluorescent dazzle yellow 19% (yellow green 154B*); transparent perspex 11%; Sun 11% (orange 23A); canary yellow 8% (yellow 5A); highball 7% (yellow green 146D); guardsman red 7% (red 43A) and fern 6% (green 135B). Very few adults were caught on black, blue, brown, grey, zinc white, emulsion white, red oxide and aluminium foil. The pear and plum sawfly (*Hoplocampa* spp.) is attracted to non UV-reflecting white (zinc white) as they search for blossom (Owens and Prokopy 1978; Wildbolz and Staub 1984). Pear slug adults oviposit on leaves so it had been assumed that green tones would be most attractive, yet in practice 41% were caught with only three of the trap colours — yellow green, yellow and transparent. Yellow tones are attractive to many insect species e.g. carrot rust fly (Judd *et al* 1985). After the traps were shifted so that half were higher in the tree, 62.5% to the total catch were caught on the high traps, showing that the traps were more effective when they were higher. This matches observations of the adults of the pear slug which are most often seen resting near the tops of host trees.

Despite using only two traps of each colour, this test demonstrated that pear slug adults can be effectively trapped. The most effective colours now need more detailed evaluation to see which is best for monitoring and to see if it is possible to suppress pear slug damage by trapping the adults.

Nashi were defoliated by hand in March 1989 and 47% less flowers were produced in spring that year (Kingston *et al* 1990) demonstrating the impact of late season defoliation on subsequent crop size.

The work described in this paper has shown that these two secondary pests of pipfruit can be monitored effectively. Monitoring can provide the basis for developing spray thresholds.

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*Colours are defined by RHS Colour cards (1966).

REFERENCES

- Judd, G.J.R., Vernon, R.S. and Borden, J.H., 1985. Commercial implementation of a monitoring program for *Psila rosae* (F.) (Diptera: Psilidae) in South western British Columbia. *J. Econ. Entomol.* 78: 477-481.
- Kingston, C.M., Klinac, D.J., van Epenhuijsen, C.W., 1990. Floral bud disorders of Nashi (*Pyrus serotina*) grown in New Zealand. *N.Z. J. Crop and Hort. Sci.* (In press).
- N.Z. Biological Producers Council, 1988. Production Standards for Organic Foods. NZBPC Auckland. 24 pp.
- Owens, E.D. and Prokopy, J., 1978. Visual monitoring trap for European apple sawfly. *J. Econ. Entomol.* 71: 576-578.
- Remund, V. and Boller, E., 1978. Kirschenfliegenfallen für Prognosewesen und biotechnische Bekämpfung in Vormarsch. *Schweizerische Zeitschrift für Obst-und Weinbau.* 120: 228-232.
- Royal Horticultural Society, 1966 RHS Colour charts. RHS London.
- van Frankenhuyzen, A., 1979. Bestrijding van de appelbladgalmug. *Fruitteelt*, 7: 246-247.
- Wildbolz, Th. and Staub, A., 1984. Überwachung der Sage wespen mit Eiablage kontrollen Befallskontrollen und weissen Fallen. *Schweizerische Zeitschrift für Obst-und Weinbau.* 120: 228-232.
- Yepsen, R.B., 1984. The Encyclopedia of Natural Insect and Disease Control. Rodale press, Emmaus, Pennsylvania: 132-133.