EMERGENCE OF APPLE LEAFCURLING MIDGE (*DASINEURA MALI*) AND ITS PARASITOID (*PLATYGASTER DEMADES*)

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ABSTRACT

Apple leafcurling midge (*Dasineura mali*) (ALCM) can seriously damage apple tree leaves. Insecticides may be applied to the soil in spring to kill ALCM emerging from overwintering sites. ALCM emergence was studied in the Waikato, Hawke's Bay, Nelson, Canterbury and Central Otago over two seasons (1998/99 and 1999/2000) using cages placed over the soil beneath apple trees. ALCM and its egg parasitoid (*Platygaster demades*) emerged over a similar period of time. Emergence in southern districts began later and over a shorter period. A single soil treatment with diazinon, reduced the numbers of ALCM emerging from treated soil, but also very few *P. demades* emerged.

Keywords: apple, *Dasineura mali*, *Platygaster demades*, emergence, diazinon.

INTRODUCTION

Apple leafcurling midge (*Dasineura mali* Kieffer) (ALCM) was accidentally introduced into New Zealand in 1950 (Todd 1956) and became a secondary pest primarily controlled by the broad-spectrum insecticides applied against key pests. In the mid 1980s, ALCM populations and their damage increased considerably (Tomkins *et al.* 1994). The actual cause(s) of this change in pest status is not clear. Control measures are used to prevent serious leaf damage (Tomkins *et al.* 1994), fruit contamination by pupal cocoons and because larval feeding damage can act as an entry point for plant pathogens (Gouk and Boyd 1999). ALCM is currently managed with sprays of diazinon applied to the soil and/or foliage of apple trees in spring (Burnip *et al.* 1998), with further applications only made when a threshold based on the level of shoot infestation by eggs is reached (Anon. 1998). The soil application of diazinon in spring is intended to kill ALCM as they emerge from overwintering in the soil. The optimum timing of these treatments may differ between apple growing districts in response to regional differences in ALCM phenology as the number of generations per annum varies from 2-7 between districts. Whilst treatments with diazinon can be very effective (Burnip *et al.* 1998), there is the possibility that they may also adversely interfere with the biological control of ALCM.

ALCM is attacked by a range of natural enemies, including the egg parasitoid *Platygaster demades* (Walker). This parasitoid was introduced into New Zealand in the 1920s to help manage the pear leafcurling midge (*Dasineura pyri* Kieffer) (Muggeridge 1929), but also began attacking ALCM shortly after its arrival (Todd 1956). *P. demades* parasitises ALCM eggs, with a single parasitoid usually emerging just prior to pupation, even though the host may have suffered multiple parasitism (Dumbleton 1934). In Europe *P. demades* has been observed to play a significant role

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in reducing ALCM populations (Carl 1980; Trapman 1988), although very little is known about pest/parasitoid interaction. However, past observations in New Zealand have shown considerable variation in the level of parasitism between and within seasons (Dumbleton 1935; Todd 1959). A better understanding of the relationship between ALCM and *P. demades* might enable the development of a programme where insecticidal intervention was only required when the parasitoid was less effective. This paper reports on some initial results of studies with ALCM and *P. demades*.

METHODS

ALCM emergence was monitored in five apple growing regions (Hamilton, Havelock North, Riwaka, Lincoln and Clyde) over two seasons (1998/99 and 1999/2000). Eight emergence traps were used at each site except in 1999/2000 season when 16 traps were used at some sites. Each trap consisted of a 10 litre bucket with a 50 mm hole cut in the top. White buckets were used in order to reflect heat, with the inside painted black to encourage emerging insects to move to the hole in the top. An inverted Petri dish coated with Tac Trap was fastened over the top of each hole. The sticky Petri dishes were changed two-three times per week from late August until early/late December. In the laboratory, the numbers of male and female ALCM and their parasitoid *P. demades* per trap were determined.

In the 1998/99 season, each trap was placed over a 30 litre planter bag containing a 3-year old apple cv. Royal Gala tree which had been growing in Hamilton. These trees had been unsprayed for two seasons and were heavily infested with ALCM, some of which had dropped off the trees to overwinter in the planter bag soil. In early August 1998, each tree was cut off near ground level and the planter bags were then placed in a coolstore at 4°C for 7 days to provide some chilling since ALCM may undergo diapause like some other *Dasineura* species (Axelsen *et al.* 1997). After chilling, the soil surface of each bag was covered to prevent soil being lost during transit and the bags were then sent by courier to each monitoring site. On arrival at each site, the bags

FIGURE 1: Cumulative emergence (%) of apple leafcurling midge (male and female) adults from soil beneath apple trees in 1998/99.

FIGURE 2: Cumulative emergence (%) of *Platygaster demades* (male and female) adults from soil beneath apple trees in 1998/99.

were buried in soil up to the junction between the planter bag and the bucket, usually within a row between apple trees in a block of trees which were unsprayed or not treated with broad-spectrum insecticides.

In the 1999/2000 season, the traps were placed over the soil between apple trees in blocks under ENZA IFP or organic (Hamilton only) programmes. The blocks were chosen for a previous history of moderate to high ALCM infestation in the previous season. The soil beneath the traps was not treated with insecticides except at the Hamilton and Clyde sites where 8 traps were each placed over soil which was either untreated or treated with diazinon. The diazinon was applied at 48 g/100 litres on 20 September (Hamilton) or 1 October (Clyde) 1999 using a knapsack sprayer and at Hamilton was then flushed into the soil with 500 ml water per trap after spray application.

The numbers of ALCM and *P. demades* caught over the entire trapping period under the different spray regimes was analysed by ANOVA after square root transformation of the data.

RESULTS AND DISCUSSION

Apple leafcurling midge

ALCM were caught from 14 September until 15 December 1998 (Fig. 1) and from 14 September until 17 December 1999 (Fig. 3). Data from Lincoln in 1999/2000 are not presented as insufficient insects were trapped. The numbers of days ALCM were trapped varied from 41 to 84 at different sites over the two seasons. In both seasons, emergence at Lincoln and particularly at Clyde began relatively later than in districts further north. The use of potted trees from Hamilton in the 1998/99 season, provided a source of relatively large numbers of ALCM and *P. demades* at all sites to enable some preliminary comparison of regional differences in their phenology. However, when only natural populations of insects were trapped in the 1999/2000 season, it was apparent that the first season's results were different. In particular, ALCM from Clyde and Riwaka were trapped relatively earlier in the second season.

Platygaster demades

P. demades were first found in emergence cages on 2 September 1998 (Riwaka) (Fig. 2) and 31 August 1999 (Hamilton) (Fig. 4). This is earlier than had been recorded

FIGURE 3: Cumulative emergence (%) of apple leafcurling midge (male and female) adults from soil beneath apple trees in 1999/2000.

previously by Todd (1959) and Dumbleton (1935) who did not observe any emergence until mid-October and early December in orchards in Palmerston North and Auckland respectively.

In the 1998/99 season, *P. demades* began emerging before ALCM at all of the sites except Clyde (Fig. 2). However, this may have been due them originating from Hamilton, where in the following season, *P. demades* began emerging much earlier than ALCM (37 days) than in other districts (3-12 days) (Fig. 4). Previously, *P. demades* has been observed to begin emerging 2-3 days after ALCM (Todd 1959) and three weeks after *D. pyri* (Dumbleton 1935). These differences between sites may reflect regional differences or simply be due to the relative size of the *P. demades* population.

P. demades emergence has similar trends to those observed for ALCM, beginning relatively later in Clyde and occurring over a relatively shorter period in southern districts. This may be due to cooler air temperatures during spring delaying emergence until warmer conditions occur in southern districts or may indicate that *P. demades* undergoes diapause which is more effectively terminated by more chilling in Clyde. This may, at least partially, explain why *P. demades* emergence occurred over a longer period (94 days) at Hamilton compared with other sites (31-39 days).

As only one *P. demades* emerges from each parasitised ALCM, this means that 83% of the ALCM overwintering on the potted trees used in the 1998/99 study ($n=1884$, for sum of ALCM plus *P. demades* trapped) were parasitised. A similar level of parasitism (85%, $n=173$) was found in the Hamilton population in the 1999/2000 season, much higher than the level found at the other sites (21-43%) although the latter were based on fewer insects ($n=13-33$ per site). This may be due to differences in orchard practices between sites or regional differences in the level of parasitism.

At present, ALCM is managed by targeting insecticide applications against the first and second generations because they are better synchronized. Diazinon may be applied directly to apple trees to prevent infestation or to the soil beneath them to kill emerging ALCM. A soil drench in early spring has been shown to provide effective ALCM control (Smith *et al.* 1998) and not adversely affect some beneficial insects (Burnip *et al.* 1998). In Nelson, Smith *et al.* (1998) have shown that by delaying the

FIGURE 4: Cumulative emergence (%) of *Platygaster demades* (male and female) adults from soil beneath apple trees in 1999/2000.

application of diazinon, the second generation can also be partially controlled in addition to the first generation. However, our studies show that a single application of diazinon to the soil will considerably reduce, but not completely prevent, ALCM emerging even in the same generation (Table 1). This situation is exacerbated by the more prolonged period over which ALCM emergence occurs in more northern districts and by the effect of the treatment on emerging *P. demades*. The significance of reducing *P. demades* populations in spring will depend on the parasitoid's contribution to ALCM control and its ability to recover. A soil application of diazinon is therefore likely to have a greater effect on *P. demades* in Waikato orchards. If *P. demades* has limited dispersal abilities, then leaving some parts of orchards untreated may help the parasitoid to recover more quickly. Alternatively, diazinon could be used against later generations of ALCM or diazinon replaced with an insecticide which has no or minimal toxicity to *P. demades*.

TABLE 1: Mean number of apple leafcurling midge and *Platygaster demades* adults caught per trap throughout the entire trapping period over soil beneath apple trees with or without a soil drench of diazinon. Data presented are the values obtained after square root transformation.

District	Apple leafcurling midge		<i>Platygaster demades</i>	
	untreated	Diazinon	Untreated	Diazinon
Clyde	0.91	0.39	1.09	0.00
Hamilton	1.67	0.30	4.22	0.74
SED			0.38	

CONCLUSIONS

ALCM and *P. demades* emerge over a similar period which begins relatively later in southern districts. In the Waikato, a large proportion of overwintering ALCM may

be parasitised by *P. demades*. A soil application of diazinon in spring can substantially reduce the numbers of ALCM emerging but may also seriously affect overwintering *P. demades* populations. The benefits of controlling ALCM with soil-applied diazinon should therefore be weighed against the potential adverse effects on *P. demades* and in some situations an alternative approach to managing ALCM with insecticides, when required, should be developed and adopted.

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