COMPARISON BETWEEN EMERGENCE AND EGG LAYING IN APPLE LEAFCURLING MIDGE (*DASYNEURA MALI*)

JASON T. SMITH and R. BRUCE CHAPMAN

Department of Entomology and Animal Ecology, Lincoln University, Canterbury

ABSTRACT

Two trap designs were placed in three orchards on the Waimea Plains, Nelson, during October 1995 and April 1996, to evaluate their potential to monitor soil emergence of adult apple leafcurling midge (ALM) (*Dasyneura mali* Diptera:Cecidomyiidae). No correlation between the percentage of apple shoots infested with ALM eggs compared to the number of ALM adults caught in emergence traps was shown. A significantly greater number of ALM were captured on one orchard with 2.2 ALM per ten traps per week compared to 0.5 for each of the other orchards. The apple cultivars 'Royal Gala' and 'Braeburn' showed no significant difference in the number of adult ALM captured or egg infestation levels. The implications of these findings for future monitoring and study of ALM is discussed briefly.

Keywords: apple leafcurling midge, *Dasyneura mali*, emergence trap, egg laying

INTRODUCTION

Apple leafcurling midge (*Dasyneura mali* Kieffer) (ALM) is now a serious pest of apples in most regions of New Zealand. Recent surveys of orchards in the Waikato (Tomkins *et al.* 1994) and Nelson (Smith and Chapman 1995a) districts have shown that many trees in these areas have had greater than 50% of their shoots damaged by ALM. The concern shown by growers and the apple industry as a whole towards ALM also clearly reflects the importance of this insect (Anonymous 1994; June 1994; Smith and Chapman 1995a).

The establishment of an effective monitoring method for ALM is important, not only as an aid for timing specific insecticides to control this pest, but also for studying the biology of this insect. Smith and Chapman (1995b) found shoots actively growing and vertical in orientation were more likely to be colonised by ALM than shoots without these characteristics. The present system for ALM monitoring in commercial orchards involves the examination of 50 shoot tips for the presence of ALM eggs (Walker *et al.* 1995; Anonymous 1995). However, other methods involving coloured sticky traps, pheromones and emergence traps are currently being developed and evaluated.

This paper reports on a study investigating the use of emergence traps and shoot tip sampling for monitoring ALM populations in the Nelson district.

METHODS

Three conventionally-managed orchards situated on the Waimea Plains, Nelson, were used for the investigation from October 1995 to April 1996. From each orchard, one block of 'Braeburn' and one block of 'Royal Gala' cultivar trees were selected. Each block consisted of approximately 750 trees.

Shoot Tip Sampling/Egg laying

Each week 50 apple shoot tips, which were actively growing and approximately vertical in orientation, were haphazardly sampled from each block. Each tip was examined using a hand lens for the presence or absence of freshly laid ALM eggs.

Emergence Traps

Two trap designs were evaluated for their effectiveness at monitoring the emergence of ALM adults from the soil. The two trap designs are described below.

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Design 1: Consisted of a black 10-litre plastic bucket (ø285 mm x 240 mm high) to the outside base of which was glued the base of a standard ø90 mm petri dish. A hole (ø80 mm) was cut through the petri dish base and the bottom of the bucket. The lid of the petri dish, coated with an insect trap adhesive (Davis Gelatine, Christchurch) was then placed on its corresponding base. The whole bucket was upturned and anchored to the soil by three 100 mm long nails driven through the rim of the bucket. Each week a freshly coated sticky petri dish lid was placed on the trap.

Design 2: Consisted of a black 10-litre plastic bucket (ø285 mm x 240 mm high) with a hole (150 mm) cut in the bottom. A 175 mm plastic funnel was glued to the outside of the bottom of the bucket. A 60 ml plastic specimen container with a 17 mm hole in the cap was pushed onto the narrow end of the funnel until a tight fit occurred. The whole bucket was upturned and anchored to the soil by three 100 mm long nails driven through the rim of the bucket. Each week the specimen container was replaced and a few ml of 70 % alcohol was placed in each removed container to preserve any insects.

For each apple cultivar block, five of each of the two emergence trap designs were randomly placed under orchard trees no more than 1300 mm from the nearest tree trunk. Each week the catching device of each trap was removed and examined under a binocular microscope. The number of ALM adults captured was recorded. The emergence traps were shifted several times during the season to capture emerging adults from each ALM generation. This was necessary as the traps prevented mature larvae from pupating in the soil beneath the trap; therefore the next generation would not be captured.

Data on the number of ALM captured and levels of shoot tip infestation between orchards and cultivars were analysed by ANOVA with the significance, correlation and standard error of the mean calculated and presented.

RESULTS

The mean percentage of shoot tips infested with eggs fluctuated over time with several peaks and troughs (Fig. 1). Estimated values were used when data were unable to be collected for a particular week. ALM eggs were recorded on leaf tips from 22 November 1995 until 17 April 1996. The only time during the thirty week sampling

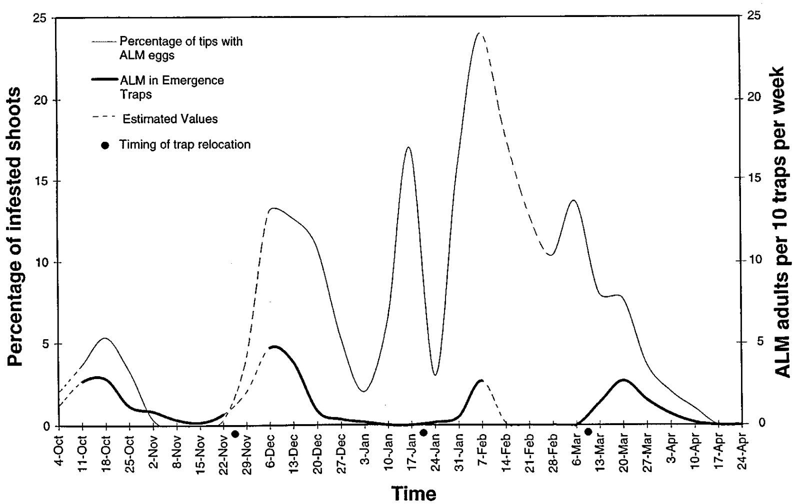

FIGURE 1: The mean percentage of shoot tips with ALM eggs per week and the mean number of ALM adults captured per 10 emergence traps per week between 4 October 1995 and 24 April 1996.

period in which no eggs were found on shoot tips was between 2 November 1995 and 22 November 1995 (Fig. 1). The highest percentage of shoot tips with freshly laid eggs was 24%, which was recorded for the week preceding 7 February 1996.

The average weekly number of ALM captured per ten traps per week fluctuated over time in a manner similar to the percentage of shoot tips infested with eggs (Fig. 1). The correlation between trap capture and the percentage of egg-infested shoots was not significant (P=0.063) with a correlation coefficient of 0.377.

The Design 1 traps caught significantly more ALM than those of Design 2 (0.90 compared to 0.19 ALM per five traps per week, P<0.01, SE mean 0.16). The number of ALM captured in emergence traps was significantly different between orchards, with traps in orchard 2 catching 2.2 ALM per 10 traps per week compared to only 0.5 ALM per ten traps per week for each of the other two orchards (Table 1). No significant difference between orchards in the percentage of shoots tips infested with eggs was detected.

TABLE 1: Apple leafcurling midge captured in emergence traps and percentage of shoot tip infested with eggs for each orchard and apple cultivars.

	ALM Captured (mean no./10 traps/week)	Percentage of shoot tips with eggs (mean no./week)
Orchard 1	0.5	5.6
2	2.2	6.1
3	0.5	8.6
Significance[1]	**	NS
SE mean	0.3	1.2
Cultivar 'Braeburn'	1.1	5.8
'Royal Gala'	1.1	7.7
Significance[1]	NS	NS
SE mean	0.2	1.0

[1] Significance: NS P>0.05, ** P<0.01

Similar numbers of ALM were captured in 'Braeburn' and 'Royal Gala' blocks, averaging 1.1 ALM per ten traps per week being captured (Table 1). Similarly, no significant difference in the percentage of shoot tips infested with eggs occurred between cultivars. Only 5.8% of shoot tips examined for 'Braeburn' and 7.7% of the shoot tips examined for 'Royal Gala' were infested with eggs.

DISCUSSION

The series of peaks observed in the percentage of shoot tips infested with eggs in this investigation suggests that five generations of ALM occurred in the Nelson district during the 1995/96 season (Fig. 1). Walker *et al*. (1995), using a similar sampling technique, found four generations of ALM occurred in Nelson in the 1994/95 season. The timing of the peak egg laying for the first three generations were almost identical in both studies (mid October, early December and mid January). The most likely reason for the extra generation of ALM in the current season would be variations in the weather conditions.

The number of ALM adults captured in emergence traps followed a similar trend to that shown for percentage of tips infested with ALM eggs; however the low correlation coefficient suggests that no significant relationship exists. The low correlation could be attributed to two main factors. Firstly, the relocation of emergence traps is necessary to capture each new generation of ALM. Unfortunately, the timing of the second relocation of emergence traps was too late (19 January) to capture adults of the third generation. Secondly, relatively low numbers of ALM were captured in the emergence traps, with most of those being captured by trap Design 1. Walker *et al*. (1995) found a similar problem when investigating the use of emergence traps for monitoring adult ALM flights. Their traps caught a wide range of insects, relatively few ALM and they abandoned trapping in favour of shoot tip examination for eggs.

Despite these drawbacks, the trend between trap catches and percentage of tips infested confirms that egg laying on shoot tips occurs almost as soon as the adult ALM emerge from their soil pupation sites. This knowledge is of practical value as once ALM adults are observed in an orchard block, most egg laying for that generation commences within the week, and control measures implemented if needed.

Several potential reasons may account for Design 1 traps capturing approximately five times more ALM adults than Design 2 traps. With Design 2, insects were initially captured alive (i.e., no sticky mechanism to immobilise insects as in Design 1). Several spiders and other predatory species were also captured and may have preyed on and consumed the ALM adults. The funnel of Design 2, and the large number of slugs often observed in the spout of the funnel, could have further limited the numbers of ALM caught.

The significantly higher number of ALM captured at orchard 2 compared to orchards 1 and 3 may have been related to the fact that these later orchards applied diazinon in September before the investigation commenced. However, such an application would probably only had an effect on the first two generations of ALM. Despite this early soil insecticide, no statistically significant difference between orchards occurred in the percentage of tips infested with eggs. This may be due to the effect of the foliar insecticide programmes which were similar in each orchard.

In this investigation both 'Braeburn' and 'Royal Gala' apple cultivars were similarly susceptible to ALM infestation as measured by the percentage of shoot tips infested with eggs. Todd (1959) found none of the 12 cultivars that he studied were more or less prone to ALM attack, although this did not include 'Braeburn' or 'Royal Gala'.

The regular use of emergence traps, like those used in this study, as devices to monitor ALM in commercial apple properties is unlikely. This is because low numbers of ALM adults were captured per trap. The need to relocate traps at the correct time during the season, to achieve effective monitoring of the next generation, is also difficult and requires regular sampling of other ALM life stages (e.g., larvae). Examination of captured insects under the microscope was often needed to accurately confirm the presence of ALM adults. Even so, with modifications, such emergence traps could potentially be used in ecological and phenological studies of ALM.

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