DAILY PERFORMANCE OF ORCHARD PHEROMONE TRAPS

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SUMMARY

In a Canterbury apple orchard, pheromone traps attractive to four tortricid species were checked daily between September and December for 3 consecutive years. Flight threshold temperatures for leafrollers were generally exceeded, suggesting that variability in catch was not primarily due to temperature. Wind speed, rainfall, barometric pressure, and phase of the moon had no major effect on catch. Flight activity on single nights reached 2-3 times the weekly mean catch per trap.day. Recapture rates for marked *Epiphyas postvittana* males varied from 0-30%, averaging 4.85%, 3.47% and 0.50% from 1989-1991, respectively. The average ratio of recapture rates of *E. postvittana*, *Ctenopseustis herana*, and *Planotortrix octo* in 1991 were 1.0 : 0.63 : 0.50.

Keywords: pheromone trapping, tortricids, *Epiphyas postvittana*, *Planotortrix octo*, *Ctenopseustis herana*, flight threshold

INTRODUCTION

Pheromone trapping of leafrollers is now used as the basis for pest management decisions on apple orchards (Suckling *et al* 1990a), but important questions on interpretation of trap catch remain. For example, Suckling and Shaw (1992) found no relationship between the catch of *E. postvittana* in pheromone traps and fruit damage incurred on orchard boundaries 50 m away. This suggested limited prospects for the use of spray thresholds. Meteorological factors are known to affect pheromone trap catch of orchard pests (Reidl *et al* 1986). Flight temperature thresholds of 12°C and 8-11°C have been reported for *Cydia pomonella* (Pitcairn *et al* 1990) and *E. postvittana* (Danthanarayana 1976a) respectively, but thresholds for the New Zealand native leafrollers are unknown.

This study used daily trap recording to investigate the effect of meteorological factors on pheromone trap catch in spring at a Canterbury orchard. There is evidence that pheromone trap efficiency differs between leafroller species (Suckling *et al* 1990c). Such variations are partly due to behavioural differences in trap approach and landing (Foster *et al* 1991). Releases of *Ctenopseustis herana*, *Planotortrix octo*, and *E. postvittana* permitted comparisons of trap efficiency between species.

METHODS

Stafford Orchard, a well-established non-export pip and stone fruit orchard (10 ha) in Prebbleton (near Christchurch) was chosen for the study. Eight delta traps for *C. herana*, *P. octo*, *C. pomonella*, and *E. postvittana* were baited as described by Suckling and Shaw (1990) and placed on the orchard boundaries (n=4) and centre (n=4) of a 1.5 ha trial block. These traps were checked daily during the spring of 1989, 1990, and 1991 (daily records only used). At the same time a Campbell CR10 data recorder (Campbell Scientific, Logan, Utah) was used to store hourly temperature and wind speed data, measured at a height of 1.5 m inside the orchard. Dusk temperatures were averaged between 6-8 pm to allow for some variation in flight time (Reidl *et al* 1986). Daily rainfall was recorded by the orchardist.

To gauge trap efficiency, male *E. postvittana* moths were released on 24, 53, and 26 nights in 1989, 1990, and 1991 (Table 2). On several occasions in 1991, releases of *C. herana* and *P. octo* were made simultaneously with those of *E. postvittana* (Table 3). Moths were marked dorsally with different colour codes for each release occasion

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using felt-tip pens (Suckling *et al* 1990b), and liberated before 4 pm in a shelter belt running through the centre of the orchard. This method had previously resulted in recapture rates of up to 30% of laboratory-reared and wild moths, with large numbers of traps (Suckling, unpublished data). Limited numbers of traps were used in this experiment to simulate normal intensity of traps. No insecticides were applied against leafrollers during the course of this investigation.

RESULTS AND DISCUSSION

Epiphyas postvittana were caught on the majority of possible trapping occasions (67%, n=181), but catches of *C. herana* and *P. octo* were limited to only 31% and 13% of the occasions when traps were checked. Consequently, conclusions on the role of meteorological factors in trapping must be limited for these species. There were few occasions when dusk (6-8 pm) temperatures were below 8°C in the spring of 1989, 1990, and 1991. For example, in the 11 weeks from September 3 to November 19, 1991 dusk temperatures dropped to the lower range of the reported threshold for *E. postvittana* of 8°C on only 8% of nights. Flight activity of all three leafrollers species was apparent near the lowest temperatures recorded (Figs. 1a and 1b). From the limited data, a first approximation for flight thresholds for *C. herana* and *P. octo* would be 6 and 7°C, respectively, although flight at even lower temperatures may be possible.

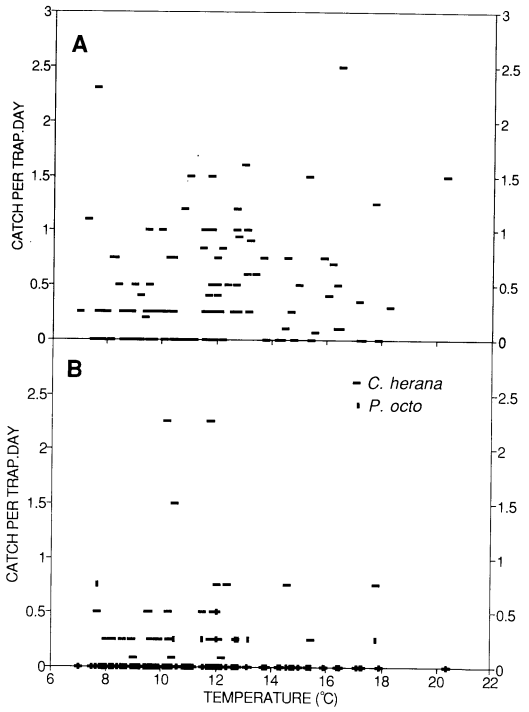

Fig. 1: Effect of daily dusk temperature on catch in pheromone traps of male a) *E. postvittana*, and b) *C. herana* and *P. octo* at Prebbleton, Canterbury from September 3-December 12, 1989, 1990, and 1991.

Daily catches of wild *E. postvittana* were erratic. Occasionally they exceeded the mean by 2-3 fold. For all species, catch from a single night was sometimes equal to the whole catch for a week. Significantly fewer wild *E. postvittana* were caught in internal compared to boundary traps ($P<0.05$, Mann-Whitney U-tests), but this was not so for the other species. *E. postvittana* numbers were lowest in 1991 ($P<0.05$, Table 1).

TABLE 1: Mean moth captures/trap (sd) in boundary traps from 9 September to 12 December for 1989, 1990 and 1991 at Stafford Orchard, Prebbleton.

Species	Catch/trap 1989		1990		1991	
E. postvittana	58.3	(17.3)	94.8	(77.0)	22.0	(18.7)
C. herana	13.5	(6.8)	10.5	(7.0)	15.3	(7.0)
P. octo	8.3	(4.6)	4.5	(3.1)	2.8	(2.8)
C. pomonella	14.0	(7.4)	8.8	(7.4)	0.5	(1.0)

The *C. pomonella* population was low throughout the study (Table 1), and therefore insufficient data were obtained for comparisons with previous studies on this species (e.g. Reidl *et al* 1986; Pitcairn *et al* 1990). The higher flight threshold temperature (12°C) for this species suggests that dusk temperature could have been a limiting factor in up to 60% of nights in spring 1991 at this site.

Rainfall from 10 to 33 mm in a 24 h period did not seem to have an inhibitory effect on trap catch, with catches on nine of the 13 occasions with rainfall in this range. No data were collected on rainfall during dusk.

Barometric pressure showed a narrow range of values over the spring for the 3 years, from 980 mm to 1030 mm, with >2 moths per trap.day only caught between 1000 and 1020 mm, and the distribution of catches centred on 1010 mm.

Examination of the 6-8 pm temperatures recorded between September 1 and November 30, 1991, at Clyde Research Orchard, Central Otago, were lower than those at Stafford Orchard over this period. Trapping has shown a general lack of moth flight activity up to mid-October in Central Otago (McLaren *et al*, in press). Of the period from 15 October - 30 November 1991, when moth flight activity normally commences, only about 5% of the nights at Clyde were below the threshold for *E. postvittana*, compared to about 25% of nights below the codling moth threshold. The potential impact of temperature on leafroller flight activity would appear from this to be fairly limited at Clyde.

A wind speed flight threshold of 2.6-2.7 m/s was reported by Danthanarayana (1976a) for *E. postvittana*. Average wind speed at the lower canopy level inside the orchard was generally much lower than this at dusk. For example, the mean wind speed at dusk was 0.73 m/s (range 0.2-2.0 m/s) over the September-December period in 1991 at Stafford Orchard. Fluctuations in wind speed often permit the insects to fly even on moderately windy nights. There was no evidence that wind affected trap catch at this site, which has 6 m high shelter belts and a sharply defined vertical wind speed profile (unpublished data).

Similarly, phase of the moon did not appear to have any impact on trap catch of *E. postvittana* (Fig. 2), despite evidence for this in Australia (Danthanarayana 1976b). The possible effects of diminution of moonlight from cloud cover was not examined, as catches were evident on nights with <5% moon.

The recapture rate of *E. postvittana* was not different between 1989 and 1990, but declined significantly ($P<0.001$) from 1990 to 1991 (a ratio of 1.0:0.71:0.10, Table 2). Recaptures of *E. postvittana* in 1991 averaged 1.51% for the first six releases from 7-16 October (Table 3), but 18 of 20 releases made after this period returned no moths, resulting in the mean of only 0.50% recapture overall (Table 2). Catches of wild moths of this species in boundary traps from September 3 to December 12 also declined by

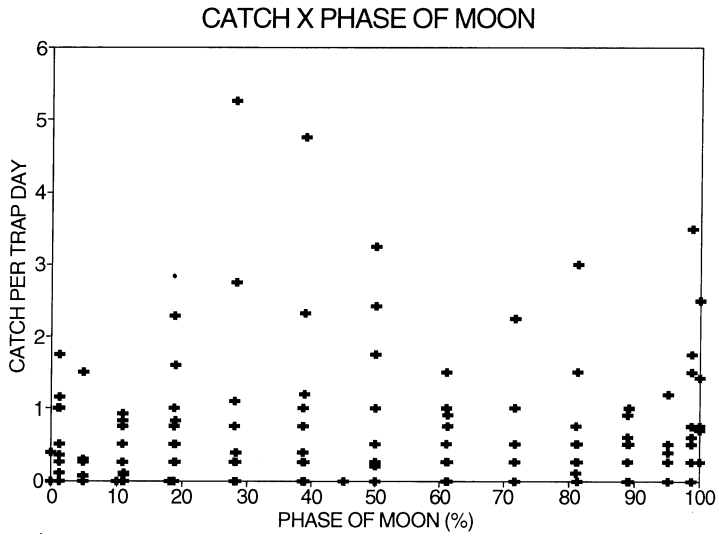

Fig. 2: Trap catch of *E. postvittana* in relation to phase of the moon at Prebbleton, from September 3-December 12, 1989, 1990, and 1991.

four fold from 1990 to 1991 (Table 1) ($P<0.05$), but catches of other species did not decline significantly. No insecticides were applied until mid-December, and the quality of insects released was not noticeably poor in any way. The lack of recaptures after mid-October 1991 could not be readily explained, as standard quality assurance comparisons (with pheromone caps stored frozen since 1990) did not identify a difference in catch between lures from the two years.

TABLE 2: Recapture rates of *E. postvittana* in pheromone traps at Stafford Orchard, Prebbleton after releases over 3 years.

Year	No. releases[a]	% Recaptured (±SE)	Range % recaptured
2/10-24/10/89	24 (1111)	4.85 (1.20)	0-20%
9/9-12/12/90	53 (1569)	3.47 (0.86)	0-30%
7/10-12/12/91	26 (2685)	0.50 (0.18)	0-3.5%

[a] Total number released

Recapture rates indicated approximately three and four fold greater recapture of *E. postvittana*, compared with *C. herana* and *P. octo*, respectively (Table 3). These values might be considered to bear some relation to trap efficiencies under comparative conditions, under the assumption that the laboratory-reared moths were in similar condition to wild moths. Comparison of flight behaviour of *E. postvittana* and *P. octo* in a wind tunnel suggested a tendency for the latter species to land on a delta trap rather than enter it in a cross wind (Foster *et al* 1991).

TABLE 3: Recapture rates at Stafford Orchard, Prebbleton after simultaneous releases of three leafroller species from 7 October to 16 October 1991.

Species	No. releases[a]	% Recaptured	Range % Recaptured
E. postvittana	6 (1828)	1.51% ± (0.44)	0.54-3.5%
C. herana	8 (1675)	0.48% ± (0.17)	0-1.4%
P. octo	7 (1618)	0.37% ± (0.23)	0-1.9%

[a] Total number released

The recapture rate of *E. postvittana* was high enough in 1989 to permit calculation of the daily survivorship of males (Suckling *et al* 1990a). Back-transformation of the slope of regression of log (% available moths) on time gave a daily retention rate of 86% (r^2=42%, P<0.002), which compares favourably with the 74% recorded in Nelson for wild males of this species (Suckling *et al* 1990b). The maximum longevity of *E. postvittana* was recorded in 1989 (27 days), followed by 1990 (25 days), and 1991 (12 days).

CONCLUSION

Temperature did not directly affect leafroller moth flight activity at dusk in Canterbury, on the majority of spring nights examined. Moth flight activity fluctuated nightly. However, weekly recordings of trap catch used by growers adequately reflect trap catch for current pest management purposes, such as insecticide timing. Phase of the moon, rainfall, barometric pressure, and wind speed inside the tree canopy were not factors demonstrably affecting trap catch. Pheromone traps for *E. postvittana* were three and four fold more efficient than traps for *C. herana* and *P. octo*, respectively.

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