THE TIMING OF LEPIDOPTERAN DAMAGE TO KIWIFRUIT

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ABSTRACT

Unsprayed kiwifruit vines were monitored over two growing seasons to determine the timing of lepidopteran damage to fruit. Damage to vines at Kumeu and Te Puke mainly occurred in the first 7-11 weeks after fruit set. At Kumeu, more than half the caterpillars collected from leaves and fruit were brownheaded leafroller (*Ctenopseustis* spp.) although lightbrown apple moth (*Epiphyas postvittana*), black-lyre leafroller (*Cnephasia jactatana*), greenheaded leafroller (*Planotortrix* spp.) and *Stathmopoda* spp. were also recorded. The relative abundance of the different species varied between leaves and fruit, and was not consistent between seasons and sites. Pheromone traps for *E. postvittana*, *C. obliquana* and *C. jactatana* were operated at Kumeu. Traps caught very low numbers of *C. obliquana* and high numbers of the less important *E. postvittana*. A large peak in the numbers of *E. postvittana* in pheromone traps starting in February did not correspond to any subsequent fruit damage. The changing attractiveness of the fruit is possibly a more important factor in determining the timing of damage than the local leafroller flight patterns as reflected by pheromone trap catches.

Keywords: Tortricidae, Oecophoridae, damage, kiwifruit, pheromone trap

INTRODUCTION

Over the last few years, pest management of kiwifruit has undergone significant changes. The widespread adoption by industry of a monitoring system and mineral oil sprays for armoured scale control has resulted in a decrease in the use of broad spectrum insecticides, especially over the last half of the season (Steven *et al.* 1994). This reduction in insecticide use means that other pests which were formerly controlled by the broad spectrum sprays may now need specific control measures.

Apart from the armoured scales, the other most important group of kiwifruit pests are leafrollers [Lepidoptera: Tortricidae], and *Stathmopoda* spp. [Lepidoptera: Oecophoridae]. The leafrollers consist of six species, all but one of which are native to New Zealand. These are the brownheaded leafrollers (BHLR) (*Ctenopseustis obliquana* and *C. herana*), the greenheaded leafrollers (GHLR) (*Planotortrix octo* and *P. excessana*), the black-lyre leafroller (BLLR) (*Cnephasia jactatana*) and the Australian lightbrown apple moth (LBAM) (*Epiphyas postvittana*). The caterpillars feed on both kiwifruit leaves and fruit (Steven 1992). Healed damage on fruit greater than 1 cm² or any fresh damage will cause fruit to be rejected from export. Over the years several methods of assessing lepidopteran pressure in kiwifruit have been used including bait traps, pheromone traps (Tomkins *et al.* 1991), and examining fruit clusters or leaves (Wearing *et al.* 1980). Ferguson (1980) identified the early part of the season as a critical period for caterpillar damage but urged further investigations. D. Steven (unpublished) found in the early 1980s that sprays applied immediately after flowering prevented most damage. The research reported here was carried out to confirm earlier findings about the critical time of leafroller damage, and to determine which species were important and whether there was any relationship between pheromone trap catch and damage.

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METHODS

Individual fruit in two blocks of unsprayed kiwifruit were labelled after fruit set in 1992 and 1993. One block was in the Kumeu area and the other was at Te Puke and both were trained on a T-bar structure. A total of 250 fruit were labelled in December at each site, evenly spread over 10 randomly selected vines. Each fruit was checked fortnightly from December until late May or June and any caterpillars or feeding damage were recorded. Any caterpillars found were left on the fruit. Fruit were divided into two categories depending on the severity of the caterpillar damage at harvest. Any fruit with well healed superficial feeding less than 1 cm² were classed as being lightly damaged, while those with fresh or penetrating damage, or superficial damage covering more than 1 cm² were classed as a reject. The reject fruit would automatically be excluded from export by a commercial packhouse.

At Kumeu only, we maintained pheromone traps for *Ctenopseustis obliquana* (four traps) (pheromone blend was 21 µg Z8-14:OAc and 9 µg Z5-14:OAc), *Epiphyas postvittana* (three traps) (pheromone blend was 100 µg E11-14:OAc and 5 µg E-9,11-14:OAc) and *Cnephasia jactatana* (two traps) (pheromone blend was 100 µg Z11-14:OAc). Traps for *C. herana* were not used as previous work (Steven, unpublished data) had found that this species was not caught at the Kumeu site. The traps were the commercially available standard delta trap with a sticky base and rubber cap loaded with sex pheromone. The pheromone caps and sticky bases were changed every 6–8 weeks. In addition, caterpillars were collected from leaves and fruit at approximately fortnightly intervals to determine which leafroller species were present. The caterpillars were reared on artificial diet (Singh 1983) and the leafroller species was identified after moth emergence.

Data were analysed using the statistics package SAS. The number of kiwifruit damaged by caterpillars was not compared between the two sites as this would constitute pseudoreplication. However means and standard errors are presented. The relative proportions of caterpillar species were analysed using a Chi-squared test of homogeneity.

RESULTS

Timing of leafroller damage

In both seasons considerably more fruit were damaged by caterpillars at Te Puke than at Kumeu (Fig. 1). The percentage of fruit damaged by caterpillars increased rapidly between December and February at both sites. At least 80% of the total damage occurred in the first 7 weeks after fruit set (before 28 January) at the Kumeu site in 1992-93 and in the first 10 weeks in 1993-94 (before 1 March). Similarly, at the Te Puke site 80% of the damage occurred in the first 9 weeks after fruit set in 1992-93 (before 11 February) and 11 weeks in 1993-94 (before 2 March). The levels of caterpillar damage increased more slowly for the remainder of the season.

The percentages of damaged fruit at harvest were higher at the Te Puke site than at the Kumeu site (Table 1). The percentage of damaged fruit classed as reject was very similar between years and sites and most damage was severe enough for the fruit to be excluded from export. At any one site there was little difference in leafroller damage between seasons, but the data indicate the difficulty in generalising from one site to another.

TABLE 1: The percentage of damaged fruit at harvest and the percentage of damaged fruit not suitable for export (mean $\pm$ standard error).

Site	Harvest date	% fruit damaged by caterpillars	% fruit rejected	% damaged fruit in reject class
Kumeu	15 June 1993	14.7 $\pm$ 3.4	8.9 $\pm$ 2.3	61.1 $\pm$ 12.4
Kumeu	24 May 1994	9.4 $\pm$ 2.6	7.8 $\pm$ 2.2	82.6 $\pm$ 6.7
Te Puke	21 May 1993	35.4 $\pm$ 2.5	29.1 $\pm$ 2.7	82.1 $\pm$ 4.2
Te Puke	23 May 1994	31.1 $\pm$ 4.2	22.0 $\pm$ 3.3	70.8 $\pm$ 5.7

FIGURE 1: Percentage of fruit damaged by caterpillars at Kumeu and Te Puke.

Pheromone traps and caterpillar species composition at Kumeu

Catches of *Ctenopseustis obliquana* and *Cnephasia jactatana* were very low over the two seasons (Fig. 2). In both seasons, large catches of *Epiphyas postvittana* occurred between March and June. In contrast the majority of the caterpillars collected from leaves and fruit were BHLR (Table 2), probably *C. obliquana* (D. Steven, unpublished pheromone trap results).

TABLE 2: Percent species composition of leafroller caterpillars collected from leaves and fruit on unsprayed kiwifruit at Kumeu throughout the season.

	Year	Sample size	Lepidoptera species (%)				
			BHLR	LBAM	BLLR	GHLLR	Stath.
Leaves	1992-93	103	65.1	33.0	1.9	0	0
	1993-94	138	76.1	22.5	0	1.4	0
Fruit	1992-93	47	66	15	19	0	0
	1993-94	59	59	29	3	2	7

There was no significant difference between the ratios of caterpillar species on the leaves in each season ($X^2 = 3.5$, $P > 0.05$), but there was a significant difference between seasons in the ratio of species found on the fruit ($X^2 = 12.5$, $P < 0.05$). In both seasons BHLR was the most common species collected from leaves and fruit. However in the 1992-93 season, LBAM was collected from fruit less often than in the 1993-94 season and

FIGURE 2: Pheromone trap catches of three leafroller species, *Ctenopseustis obliquana*, *Cnephasia jactatana* and *Epiphyas postvittana*, at Kumeu.

conversely, BLLR was more commonly collected from fruit in the 1992-93 season. The relative proportions of the caterpillar species feeding on the leaves differed significantly from that on the fruit in both years (1992-93, $\chi^2 = 16.6$, $P < 0.05$ and in 1993-94 $\chi^2 = 13.9$, $P < 0.05$). BHLR was the most important species on the fruit, followed by BLLR or LBAM, depending on the season. *Stathmopoda* spp. was not recovered from leaves.

DISCUSSION

Most damage occurred between fruit set and late February, although the end of this critical damage period varied by about a month between seasons or sites. The rapid increase in the number of fruit damaged by caterpillars at the start of the season highlights the importance of spraying immediately after fruit set. Ferguson (1980) also concluded that there was a critical period for leafroller control in Bay of Plenty kiwifruit and reported

on trials comparing several spray programmes on different kiwifruit cultivars, including 'Hayward' but some of this earlier work was also carried out on 'Bruno' and 'Abbott'. In Ferguson's first assessment of leafroller damage, in mid-late January (approximately 4 - 6 weeks after fruit set), damage levels were already in some cases almost as high as at harvest. The research reported in this paper for kiwifruit grown in the Bay of Plenty and in Auckland confirms and elaborates on these earlier findings. The methodology used of following the same fruit through the season has allowed the timing of damage to be elucidated more accurately.

At Kumeu, BHLR was the main caterpillar collected from leaves and fruit. As stated in the introduction, BHLR actually consists of two species, *C. obliquana* and *C. herana*, but the caterpillars cannot easily be distinguished. Although *C. herana* has never been caught in pheromone traps at the Kumeu site it has been recorded from pheromone traps in other kiwifruit orchards (D. Steven and P. Stevens, unpublished data). In situations with both species present it would be useful to determine the relative importance of each. Very low numbers of *C. obliquana* are caught in the pheromone traps so it is very difficult to relate trap catches and damage periods. Foster *et al.* (in press) reports that the delta trap was inefficient in terms of the number of *C. obliquana* moths actually entering and being caught. A change in trap design and in the type of glue used could increase catches to a level where the data may be more useful. In both seasons large numbers of LBAM were caught in traps between March and June, but there was no corresponding increase in fruit damage levels. At this stage pheromone traps are not a suitable tool for monitoring leafrollers in kiwifruit orchards.

Steven (1992) assessed the importance of the lepidoptera damaging kiwifruit as BHLR > BLLR > *Stathmopoda* spp. >>> LBAM >>> GHLR. The results from Kumeu confirm the primary importance of BHLR, but indicate that LBAM can still be important. Steven (1992) recorded that at Kumeu in 1991 58% of the caterpillars found on fruit were BHLR and 31% BLLR. Thus there is some constancy in the dominant species, but variability among other species. At Te Puke C. McKenna (pers. comm.) rarely finds LBAM on fruit.

The relative abundance of some of the lepidoptera species depended on whether the samples were collected from the leaves or the fruit. The BLLR in particular was found more commonly on the fruit than on the leaves. When considering species importance it is obviously important to define the part of the plant (ie. leaves or fruit) which is relevant.

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