A COMPARISON OF LEPIDOPTERAN DAMAGE TO 'HORT16A' AND 'HAYWARD' KIWIFRUIT

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ABSTRACT

The timing and incidence of lepidopteran damage to two kiwifruit cultivars, Hort16A and Hayward, were compared by monitoring tagged fruit bunches on unsprayed vines over two seasons. In both seasons, the percentage of fruit with caterpillar damage increased rapidly during the 8 weeks immediately after fruit set. No new damage was found on Hort16A fruit after this time, but Hayward fruit continued to be damaged from February until May. Only 7.4% (both seasons) of Hort16A fruit incurred severe damage (non-export) compared with 11.7% (1997) or 18.4% (1998) of Hayward fruit. Damage to Hort16A fruit was generally to the sepal area or side of fruit, whereas the side of fruit or stamen end were the most common feeding sites on Hayward. *Ctenopseustis obliquana* and *Stathmopoda* spp. caterpillars were the predominant species found on Hort16A fruit, while *C. obliquana* and *Cnephasia jactatana* were the most common species found on Hayward fruit.

Keywords: kiwifruit, Hort16A (*Actinidia chinensis*), Hayward (*Actinidia deliciosa*), lepidopteran damage.

INTRODUCTION

At least six leafroller (Lepidoptera: Tortricidae) species have been recorded on Hayward kiwifruit (*Actinidia deliciosa* (A. Chev.) C.F. Liang et A.R. Ferguson), including the brownheaded leafrollers, *Ctenopseustis obliquana* (Walker) and *C. herana* (Felder and Rogenhofer); the greenheaded leafrollers, *Planotortrix excessana* (Walker) and *P. octo* Dugdale; the black-lyre leafroller, *Cnephasia jactatana* (Walker); and the lightbrown apple moth, *Epiphyas postvittana* (Walker) (Steven 1991). *Stathmopoda* spp. (Lepidoptera: Oecophoridae) caterpillars have also occasionally been found on Hayward kiwifruit; they are usually associated with dead plant parts such as the sepals or stamens on kiwifruit, and any damage caused by their feeding tends to be minor or superficial (Steven 1990).

All of the leafroller species listed above are considered to be horticultural pests of a range of crops. This reflects their broad host range, their distribution throughout much of New Zealand, and their ability to colonise suitable host plants rapidly (Suckling et al. 1998). Despite the broad host range of leafrollers, there is evidence of a degree of selectivity in their larval feeding sites. For example, while all species feed on kiwifruit leaves, there are differences in their contribution to fruit damage. Brownheaded leafroller and black-lyre leafroller are the predominant species found feeding on Hayward fruit (Stevens et al. 1995). Their feeding typically results in superficial scarring to the fruit skin, but can occasionally result in gross distortion of the fruit.

Partly as a result of the broad host range and abundance of suitable host plants within kiwifruit growing regions, pheromone traps have not proven to be a useful tool for predicting the timing of control measures to prevent damage to kiwifruit crops (Tomkins et al. 1991). However, knowledge of the timing of damage in association with targeted pest scouting has proven to be a successful approach to minimising leafroller

damage to Hayward kiwifruit. For example, Stevens et al. (1995) determined that most leafroller damage to Hayward fruit occurs in the 8 weeks immediately after fruit set (December–January), and that the species largely responsible for the damage is the brownheaded leafroller. Crop protection measures are therefore critical over this period, and the current recommendations are for two to three sprays at approximately 21-day intervals at this time. After January the incidence of new caterpillar damage declines markedly, but infestations of the black-lyre leafroller sometimes occur. Control measures for these late-season infestations of black-lyre leafroller are applied on the basis of crop monitoring. The lack of late season damage is not reflected in a decline in pheromone trap catches in the local environment (Tomkins et al. 1991), which suggests that the suitability of kiwifruit as a leafroller host relative to other plants declines through the season.

A new kiwifruit cultivar, *Actinidia chinensis* Planch Hort16A, was released to the New Zealand kiwifruit industry for commercial production in 1997. Plantings of Hort16A are generally within existing Hayward kiwifruit orchards. Bud-burst and fruit set occur approximately one month earlier on Hort16A than on Hayward vines, so the young rapidly growing fruit, which appear to be the most suitable hosts for leafroller larvae, are available at a different time of the year than those of Hayward. The aim of this study was to determine the risk of lepidopteran damage to Hort16A, and how this differs from that for Hayward, so that preliminary recommendations could be made on the number and timing of spray applications, and the need for crop monitoring.

METHODS

Site

Two neighbouring blocks of kiwifruit located at the Te Puke HortResearch Centre were used for this study. One block contained 88 female Hort16A vines, stump-grafted onto *A. deliciosa* vines in 1993, and the other block contained 95 female Hayward vines, planted in 1976. Both blocks were bordered on one side by a gully containing a mix of native and exotic plant species, whilst other kiwifruit blocks bordered the remaining sides. Vines were trained on a T-bar structure and received standard vine husbandry except that no budburst enhancers or pesticide sprays were applied throughout the course of the study.

Timing and incidence of leafroller damage

In each block, 25 fruit on each of 10 randomly selected vines were tagged immediately after fruit set in 1996 and 1997. Tagging dates were 14 November 1996 and 11 November 1997 for Hort16A, and 11 December 1996 and 9 December 1997 for Hayward.

Tagged fruit was checked for live caterpillars and feeding damage at 2-weekly intervals from fruit set to February, and thereafter every 3 (1996-97) or 2 weeks (1997-98) until harvest in May. Any caterpillar damage found was recorded as fresh or old, and categorised as light (superficial damage <1 cm^2) or severe (superficial damage >1 cm^2, and any penetrating damage). Fruit with severe damage are not acceptable for export. At harvest on 2 May 1997 or 4 May 1998, 100 untagged fruit were picked without conscious bias from each of the tagged vines, and examined in the laboratory for light or severe caterpillar damage. The position of the damage on the fruit was also recorded as the sepal area, side of fruit or stamen area.

Results are presented as the mean (± standard error) percentages of Hort16A and Hayward fruit with lepidopteran damage at each check date. Student's t-test was used to compare the numbers of Hort16A versus Hayward fruit with severe damage at harvest in May. Statistical significance is given at the 5% level.

Leafroller species composition

In 1995-96 and 1997-98 caterpillars were collected from the fruit in the two blocks. In the first season, five 'timed' searches were completed at monthly intervals on Hort16A and Hayward fruit, commencing in mid December. In the second season 11 searches were completed at fortnightly intervals on Hort16A fruit, commencing 11 November 1997, and 9 searches were completed on Hayward fruit, commencing 11 December 1997.

A standard search pattern was followed, which involved searches of fruit on vines in both outside rows of the block and both diagonals of the block. All caterpillars found on the fruit within a 45-minute period were placed in plastic tubes containing artificial diet (Singh 1983), and reared in the laboratory at ambient temperature. Tentative field identifications were confirmed after moth emergence using adult morphological characters.

RESULTS

Timing and incidence of caterpillar damage

The numbers of fruit damaged by caterpillars and the seasonal patterns of damage occurrence were similar on the two kiwifruit cultivars (Fig. 1). In both seasons the percentage of fruit with caterpillar damage increased rapidly during the 8 weeks immediately after fruit set. No new damage was found on Hort16A fruit after this time, but a further 8% (1997) or 10% (1998) of Hayward fruit were damaged during February until harvest in May.

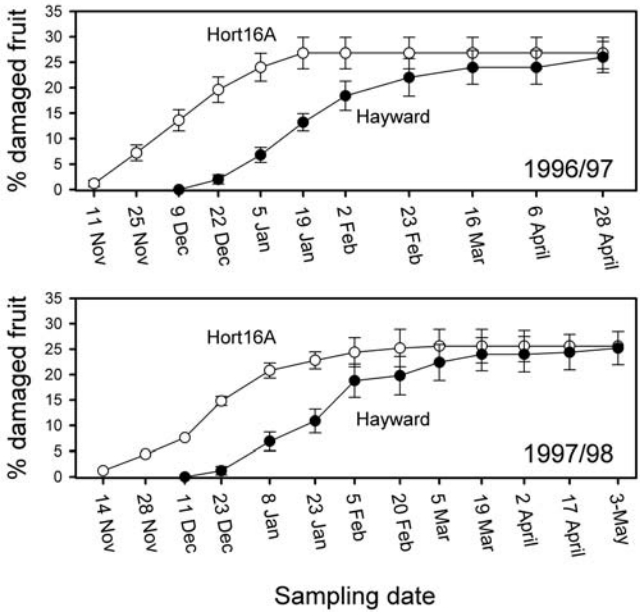

FIGURE 1: The percentage of Hort16A and Hayward fruit damaged by caterpillars during the 1996-97 and 1997-98 growing seasons (error bars are SEM).

In both seasons, similar numbers of Hort16A and Hayward fruit had caterpillar damage at harvest in May (Table 1). There was also no difference in the numbers of Hort16A or Hayward fruit with severe damage in 1997, but the following year significantly more Hayward fruit had severe damage than Hort16A fruit (P=0.001). The majority of damage to Hort16A fruit was to the sepal area (55.1%) or side of fruit (43.6%). Only 1.3% of the fruit had damage to the stamen area. The most common damage sites on Hayward were the side of fruit (41.3%) and, in contrast to Hort16A, the stamen area (40%), with damage to the sepal area accounting for 18.7% only.

TABLE 1: The percentage of unsprayed Hort16A and Hayward kiwifruit with caterpillar damage on 7 May 1997 and 4 May 1998 (mean ± SEM).

	1997		1998	
	% fruit damaged	% fruit with severe damage	% fruit damaged	% fruit with severe damage
Hort16A	17.9 ± 2.1	7.4 ± 1.8	29.4 ± 3.0	7.4 ± 1.5
Hayward	21.2 ± 2.7	11.7 ± 2.0	33.4 ± 2.0	18.4 ± 2.4

Leafroller species composition

Considerably more caterpillars were found feeding on Hayward fruit than on Hort16A fruit (Table 2). Caterpillars were found on Hayward fruit throughout the growing season, whereas on Hort16A fruit no caterpillars were found after January.

In both seasons, brownheaded leafroller and *Stathmopoda* spp. were the dominant caterpillars collected from Hort16A fruit (Table 2). In contrast, brownheaded leafroller and black-lyre leafroller were the most common species collected from Hayward fruit, accounting for 80% or more of the total caterpillars found in a season. Brownheaded leafroller was the dominant species in December and January (60–100% of caterpillars), while black-lyre leafroller was found in increasing numbers from February and dominated collections in March (90% of caterpillars) and April (100% of caterpillars).

TABLE 2: The number of caterpillars found (mean ± sem) per 45 minute search of Hort16A and Hayward fruit during the 1995-96 and 1997-98 seasons, and the percent species composition.

		No. of larvae	Lepidopteran species (%)[1]				
	Season	per search	BHLR	BLLR	GHLR	LBAM	Stath
Hort16A	1995-96	3.8 ± 2.0	37.0	5.0	0	0	58.0
	1997-98	5.8 ± 1.9	41.8	20.9	0	0	37.3
Hayward	1995-96	15.0 ± 3.5	37.0	47.0	0	0	16.0
	1997-98	13.9 ± 2.3	38.4	40.0	11.2	8.8	1.6

[1]BHLR=brownheaded leafroller, BLLR=black-lyre leafroller, GHLR=greenheaded leafroller, LBAM=lightbrown apple moth, Stath=*Stathmopoda* spp.

DISCUSSION

The abundance of leafrollers and the dominant species found on Hort16A fruit differed from that on Hayward, especially in the later stages of fruit development. As the two blocks of kiwifruit were directly opposite each other, differences in local leafroller populations cannot account for these observations.

Despite the differences in the timing of flowering and fruit set, accumulation of damage to both types of kiwifruit occurred in the first 8 weeks of fruit development. This has been well documented for Hayward (e.g. Stevens et al. 1995; McKenna 1998) and this study shows that Hort16A is similarly most at risk from leafrollers in this period. Fewer Hort16A fruit incurred severe feeding damage (non-export) than Hayward fruit, particularly in year two of the study, indicating that the potential for early-season fruit losses due to leafrollers may not be as great for Hort16A crops. However, damage levels were high enough to have economic impact and the damage period in terms of crop phenology was the same as that for Hayward, leading us to conclude that the early-season control recommendations for use on Hayward crops will also be applicable to Hort16A.

It must be noted that the date of fruit set for Hort16A is about 4 weeks earlier than that for Hayward and it is important that actual spray application dates reflect this.

No new damage was recorded on Hort16A fruit subsequent to the 8 weeks after fruit set (i.e. from February to harvest in May), nor were any caterpillars found on the fruit during this period. This suggests that leafrollers are unlikely to be a significant pest of Hort16A beyond January. However, it is recommended that Hort16A crops still be monitored for caterpillar infestations at least twice; once in late January to ensure that the grower's post-blossom spray programme was effective, and again in the month before harvest as a safeguard against problems during packing.

Brownheaded leafroller and *Stathmopoda* spp. were the most common species found on Hort16A during the 8-week damage period, but of the two, brownheaded leafroller is likely to be the key damaging species. *Stathmopoda* spp. tends to feed predominantly on dead and decaying plant material (Steven 1990), and is not considered a key damaging pest of Hayward. All of the *Stathmopoda* spp. found on Hort16A were located under the sepals and there was little or no damage associated with their presence, which further indicates brownheaded leafroller is the key pest species. The absence of caterpillars on Hort16A from February to May could indicate that Hort16A may not be a preferred host at this time, particularly for the black-lyre leafroller. Black-lyre leafrollers tend to feed at the stamen end of Hayward fruit, using the decaying stamens as shelter. Hort16A does not have obvious stamens and tends to have a 'clean' protruding beak, and it may be that Hort16A fruit does not provide the physical habitat preferred by black-lyre leafroller.

Since the completion of this study the numbers of Hort16A plantings have increased markedly. Packhouse records from the previous 5 years confirm that caterpillars or fresh feeding damage are rarely found on Hort16A during crop monitoring from February to April, and caterpillars have not been found during packing in May (P. Allison, pers. comm.). These observations thus provide further evidence that leafrollers are not a key pest of Hort16A during the later half of the growing season.

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REFERENCES

McKenna CE 1998. The effectiveness of different insecticide programmes for kiwifruit. Proceedings of the 51st New Zealand Plant Protection Conference: 184-188.

Steven D 1990. Entomology in kiwifruit. In: Warrington IJ, Weston GC ed. Kiwifruit Science and Management. Ray Richards Publisher in association with the N.Z. Society for Horticultural Science, Auckland, New Zealand. Pp. 362-412

Steven D 1991. Pest Lepidoptera of kiwifruit in New Zealand. Acta Horticulturae 297: 531-536.

Stevens PS, McKenna CE, Steven D 1995. The timing of lepidopteran damage to kiwifruit. Proceedings of the 48th New Zealand Plant Protection Conference: 130-134.

Singh P 1983. A general purpose laboratory diet mixture for rearing insects. Insect Science Application 4: 357-362.

Suckling DM, Burnip GM, Walker JTS, Shaw PW, McLaren GF, Howard CR, Lo P, White V, Fraser 1998. Abundance of leafrollers and their parasitoids on selected host plants in New Zealand. New Zealand Journal of Crop and Horticultural Science 26: 193-203.

Tomkins AR, Steven D, McKenna C, Lees N, Sale P 1991. Monitoring leafroller moths in Bay of Plenty kiwifruit orchards. Proceedings of the 44th New Zealand Weed and Pest Control Conference: 52-57.