Cultural control of redlegged earth mite, blue oat mite and lucerne flea in canola

Eve Merton[A], **Garrick McDonald**[B] and **Ary Hoffmann**[A]
[A] School of Genetics and Human Variation, La Trobe University, Bundoora, Victoria 3083, Australia.
[B] Plant Sciences and Biotechnology, Agriculture Victoria, La Trobe University, Bundoora, Victoria 3083, Australia.

Summary

Field trials were undertaken to assess the merit of various cultural techniques in the control of redlegged earth mite (*Halotydeus destructor*), a primary pest of many broad-leaf crops and pastures in Victoria. The effects of these techniques on other pests such as blue oat mite (*Penthaleus major*) and lucerne flea (*Sminthurus viridis*) were also assessed. An experiment using wheat borders on the edge of a canola crop did not prevent *H. destructor* from entering the crop and causing damage. Both *S. viridis* and *P. major* were only present in low numbers on canola even though these pests occurred in high numbers in adjacent pasture. In a tillage experiment, involving lupins in 1993, cultivation was associated with higher numbers of *H. destructor* compared to direct drilling, but this was probably an indirect consequence of clover, a favoured host, being more abundant in the cultivated plots. In 1994, when wheat was sown, cultivation caused a significant decline in *H. destructor* compared to direct drilling, and in this case broad-leaf weeds were controlled by spraying. Both lupins and wheat appear to be unsuitable hosts for *H. destructor*, probably preventing population growth over the full season, and may therefore be useful in crop rotations with canola.

Introduction

Cultural control techniques can reduce overall pest infestation levels to below economic damage thresholds, particularly when employed in conjunction with other means of pest control. The aims of cultural control include reduced pest colonization, reduced reproduction and survival, an increase in pest dispersal from the system, or a combination of these (Dent 1991). Various methods, such as crop rotation, tillage practices and mixed cropping, may be used to create an inimical environment for the pest.

This paper arises from current studies on the management options for establishment pests of canola, principally earth mites and lucerne flea. Canola is highly vulnerable to attack by establishment pests, and it is probable that cultural practices can play a significant role in reducing their impact.

It is commonly observed by farmers and advisers that redlegged earth mite (*Halotydeus destructor*) and other pests follow particular patterns when they move into crops from adjacent pasture or weedy edges. A conventional control method based on these observations is a border spray of miticide. A secondary crop species might function as an alternative to a border spray, if it is grown between a primary crop and a pest source area. The border species would necessarily need to be repellent or distasteful, or else nutritionally inadequate for the pest. Anecdotal evidence from the field, and laboratory screening of plant species for resistance to *H. destructor*, both suggest that survival of the pest is low when feeding on cereals (McDonald *et al.* 1995). A border trial was therefore established in 1994 to examine how a wheat border between a canola crop and adjacent pasture might influence pest numbers and movement.

Tillage practices can have an indirect effect on pest survival by changing the soil environment, and a direct effect by physical damage to the pest itself. Direct drill techniques, with minimal soil disturbance, and the retention of some crop residue, are likely to result in an increase in pest numbers in comparison with cultivation. *H. destructor* sampling in an ongoing trial comparing the effects of direct drilling and cultivation was used to compare these tillage regimes.

Table 1. Relative densities of *Halotydeus destructor, Penthaleus major* and *Sminthurus viridis* in the pasture border and main crop areas, as proportions of the total per transect, and absolute numbers averaged across transects for each treatment.

	Date	Transect through pasture/canola				Transect through pasture/wheat			
		pasture	border	crop	no. m^{-2}	pasture	border	crop	no. m^{-2}
RLEM	13/6	0.77	0.04	0.19	500	0.74	0.12	0.14	506
	23/6	0.87	0.08	0.05	1588	0.82	0.15	0.03	1149
	4/7	0.94	0.04	0.02	1619	0.88	0.09	0.03	1020
	14/7	0.88	0.05	0.07	3653	0.88	0.06	0.06	2355
BOM	13/6	0.91	0.09	0.00	288	0.92	0.08	0.00	150
	23/6	0.88	0.11	0.01	424	0.52	0.39	0.13	261
	4/7	0.79	0.20	0.01	321	0.86	0.14	0.00	233
	14/7	0.78	0.21	0.01	426	0.74	0.15	0.11	461
LF	13/6	0.89	0.07	0.04	698	0.81	0.08	0.11	542
	23/6	0.77	0.21	0.02	1129	0.81	0.15	0.04	636
	4/7	0.79	0.19	0.02	869	0.86	0.12	0.02	416
	14/7	0.96	0.03	0.01	937	0.88	0.09	0.03	420

Methods

Macro-invertebrates on the soil surface at all field sites were collected by suction, using a machine with a 137 mm^2 diameter nozzle. The samples were stored in 70% alcohol, in 30 mL plastic vials, for later examination. The contents of the vials were examined under a binocular microscope. Invertebrates were identified to species level where possible.

Wheat border trial

The trial aim was to determine whether a border planting of wheat would prevent mite invasion of a canola crop. In June 1994, shortly after >20 mm rainfall, wheat was planted as a 5 m wide border along one fenceline in a canola crop at Rupanyup in west-central Victoria. The border consisted of 50–60 m long alternate strips of wheat and canola (three of canola and four of wheat). Transects were taken through the middle of each strip, running from the adjacent pasture paddock, through the border strip, and into the main crop of canola. Eleven samples were taken along each transect, one at the fenceline, and at 2 m, 3 m, 4 m, 8 m and 13 m into both the pasture and the crop areas. The transects were sampled twice a week for five weeks, then at weekly intervals for another two weeks.

Tillage trial

At Dookie, in north-eastern Victoria, eight 20 × 50 m plots with two treatments, arranged in a complete randomized design, were established in an old pasture paddock. The treatments were two contrasting tillage methods—direct drill and conventional cultivation. The cultivation treatment consisted of at least four disk/scarifier workings. In 1993, the plots were planted with lupins and were not subsequently sprayed to remove volunteer sub-clover and other weeds. In 1994, the experimental design and treatments were maintained except the plots were planted with wheat, and sprayed to remove all broad-leaf plants including clover. Five random samples were taken in each plot approximately once a week during the *H. destructor* season.

Results and discussion

Wheat border trial

On the first sampling occasion, *H. destructor* were recorded in a relatively higher frequency in the crop area than on the following sample dates (Table 1). Subsequently, numbers of *H. destructor* were relatively low in the border and the crop areas compared to the adjacent pasture. This suggests that both canola and border plants were not supporting the same increases in numbers that were observed in the pasture area. There were no significant differences between the numbers of *H. destructor* in the border-crop area of the wheat and canola treatments. Although wheat is a poor host for *H. destructor* (McDonald *et al.* 1995) mite densities did not decline appreciably, as was expected, in the wheat border over the five week study. This suggests that wheat does not actively repel *H. destructor*; in contrast, the mites either consistently moved into the 5 m strip of wheat from the neighbouring pasture, or they were able to survive using weeds and/or other non-vascular flora as hosts. Similarly, even though canola is also a poor host, *H. destructor* numbers persisted in the canola borders, albeit in much lower numbers than the pasture.

Some economic damage to the canola crop was caused by *H. destructor* beyond 13 m from the fenceline between 14–21 July. This necessitated re-sowing of the damaged patches by the farmer. It is not clear whether *H. destructor* did move into the crop from the adjacent pasture. It is probable that many of the mites arose from egg hatches within the crop itself and occurred in sufficient numbers to cause the economic damage. This damage was not confined to either of the treatment areas.

Both *Penthaleus major* and *Sminthurus viridis* were present in very low numbers in the border-crop region compared to the pasture region (Table 1). This suggests that canola and wheat are not attractive hosts for *S. viridis*. Considering recent evidence for the parthenogenicity of *P. major* and evidence for discrete morphological types (Weeks *et al.* 1995), a broad statement on host suitability for this species seems inappropriate at this stage. However canola and wheat do not appear suitable hosts for the clones of *P. major* present at this site.

Tillage trial

In 1993, there were large differences in the numbers of *H. destructor* in the direct drilled and the cultivated plots (Table 2). *H. destructor* densities were similar in June and July under both treatments, but in the direct drilled plots they began to decrease sharply from mid July while increasing rapidly in the cultivated plots. It is likely that the differences in numbers of *H. destructor* are not a direct result of cultivation but of the associated crop plants. Cultivation encouraged the growth and persistence of heavy under-canopy of crop weeds such as subclover, which is an acceptable host for *H. destructor*, in terms of adult and juvenile survival (McDonald *et al.* 1995). In contrast, the direct drill plots contained only lupins while clover was rare. Like wheat, lupins are an inferior host and so it was not surprising that only very low populations persisted into spring on the direct drill plots.

In 1994, after initial rain on May 15th, there were less *H. destructor* present in any of the plots than there was at the start of the previous season (Table 2). The cultivated plots, in which the *H. destructor* densities had been very high in spring 1993, were re-cultivated in 1994. The repeated cultivations appeared to decimate the diapausing egg populations as the 1994 *H. destructor* numbers were very low. The densities in the direct drill plots, which were relatively low, remained stable throughout the winter and early spring (Table 2). The large reduction in *H. destructor* numbers in August 1994 was possibly due to two days of severe frost (-4°C) that occurred in this region.

Although the two years are not directly comparable, this experiment provided evidence to confirm our laboratory observations (McDonald *et al.* 1995) that both wheat and lupins are inadequate hosts which lead to poor adult/juvenile survival and restricted or no oviposition.

Conclusions

The results indicate that the use of wheat as a border crop as an alternative to a border spray may not be an effective barrier to *H. destructor* movement to a crop. Using such species may be more effective in rotations, where there is an effect on the whole paddock environment and where *H. destructor* may not be able to persist for a whole season. Lupins are an even more promising rotation crop for canola because of their nitrogen fixing capability. However, the effectiveness of either crop in reducing the mite load of a paddock for the following season may depend on the cultivation technique employed, and on the presence of weeds.

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Table 2. Mean *Halotydeus destructor* population densities (mites m^{-2}) and standard errors (in brackets) in 1993 and 1994 at Dookie, Victoria.

	May	June	July	Aug	Sept	Oct	Nov
1993 (lupins)							
direct drill	0	6288 (988)	936 (216)	81 (41)	65 (44)	92 (15)	413 (283)
cultivated	0	5892 (465)	1590 (335)	1160 (282)	7210 (940)	16438 (4502)	12613 (4760)
1994							
direct drill	334 (122)	445 (130)	705 (140)	147 (40)	162 (94)	na	na
cultivated	0	10 (7)	211 (91)	11 (4)	70 (55)	na	na

na = not available.