SUSCEPTIBILITY OF LEGUME AND *HIERACIUM* SPP. SEEDLINGS TO FEEDING BY NATIVE BROAD-NOSED WEEVILS (COLEOPTERA: CURCULIONIDAE)

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SUMMARY

Glasshouse screening trials compared the relative susceptibility of cotyledon seedlings of exotic hawkweed species, *Hieracium pilosella* and *H. praealtum,* and three introduced legumes, white clover, Caucasian clover, and lucerne, to two native broad-nosed weevil species, *Nicaeana cervinata* and *N. cinerea*, common in the Strath Taieri and East Otago Plateau areas, respectively. Both weevils fed on and destroyed *Hieracium* seedlings but *N. cervinata* was the more damaging, destroying up to 54% of *H. pilosella* seedlings. *N. cinerea* selected legume seedlings over *Hieracium* seedlings. The possible role of native weevils in establishment of *Hieracium* in the field is discussed.

Keywords: broad-nosed weevils, *Hieracium* spp., cotyledon defoliation, legume spp., *Nicaeana* spp.

INTRODUCTION

Hieracium spp. (hawkweeds) are invasive weeds causing increasing concern in South Island hill and high country east of the main divide (McMillan 1991; Floate 1993). Due to their prostrate growth habit they are unavailable to stock and displace and exclude native and beneficial introduced plant species (Scott 1985; Treskonova 1991). They are roughly estimated to dominate the vegetation over 508,000 ha of pastoral and other land in the South Island (Hunter 1991; McMillian 1991). The two most common species are *H. pilosella* (mouse-eared hawkweed) and *H. praealtum* (king devil hawkweed).

Native broad-nosed weevils (Curculionidae : Brachycerinae), indigenous to extensive dryland and high country areas, damage and destroy seedlings of legumes introduced as part of agricultural development (Barratt *et al.* 1993; Ferguson and Evans 1994). However these weevils are cosmopolitan feeders (Bremner 1988) and may also be significant herbivores of other plant seedlings, such as *Hieracium* species. Broad-nosed weevils, *Irenimus* spp. and *Nicaeana cinerea* (Broun), known to feed on seedlings of introduced legumes, have been observed feeding on mature *H. pilosella* when white clover (*Trifolium repens* L.) was also present (Bremner 1988). Weevil damage to white clover seedlings has been shown to reduce plant survival and vigour, and reduce subsequent production for several years (Barratt *et al.* 1992). Ferguson and Evans (1994) have reported similar results for Caucasian clover (*T. ambigium* L.) and birdsfoot trefoil (*Lotus corniculatus* L.). It is possible that similar damage to *Hieracium* spp. seedlings may reduce establishment and therefore slow the spread of these weeds.

An initial investigation (Evans A.A., unpublished) indicated that *H. praealtum* seedlings were fed on by *N. cervinata* in preference to white clover seedlings. This paper reports on the relative susceptibility of seedlings of three legume and two *Hieracium* species, to feeding by two broad-nosed weevil species in the glasshouse.

METHODS

Two experiments were conducted during January-April 1994 in an unheated glasshouse.

Experiment 1

'Grasslands Huia' white clover, 'Grasslands Wairau' lucerne (*Medicago sativa*), 'Challenge seeds KZ1' Caucasian clover, *Hieracium pilosella*, and *H. praealtum* seed was sown in commercial seed raising mix (Yates Black Magic) and grown to the early cotyledon stage. *Hieracium* spp. seed was soaked in water for 1 hour prior to sowing to improve germination, and sowing times for various species were staggered where germination times differed, so that all seedlings used were at the same stage of development. One-day-old seedlings were transplanted in a grid pattern at 40 mm spacings into sterilised soil in trays 350 x 520 x 65 mm deep. Each of 10 rows of seedlings per tray contained one seedling of each species, positioned at random. There were 15 trays, each covered by a perspex cage 300 mm high with a nylon gauze top. The seedlings were lightly watered and left overnight before weevils were introduced.

Fifty *N. cervinata*, collected from pasture near Sutton (altitude 198 m a.s.l) in the Strath Taieri, were added to each of 10 trays (replicates). The remaining five replicates served as controls, to measure seedling survival and growth in the absence of weevils.

After 3 and 9 days, seedlings were visually assessed to determine the amount of cotyledon leaf consumed by weevils (Barratt *et. al* 1993). Loss of 10-90% of cotyledon area was classed as sub-lethal damage. At day 9 the seedlings were cut at soil level, the 10 seedlings of each species bulked per tray, and oven dried overnight to determine dry-matter yields.

Experiment 2

The same procedure as for Experiment 1 was repeated using *N. cinerea* and *N. cervinata,* with five replicate trays of each weevil species, and eight rows of seedlings per tray. Weevil species were tested in separate trays. Because low numbers of *N. cinerea* were collected only 31 weevils of each species were introduced into respective trays. *N. cinerea* were collected from the road summit of the Rock and Pillar range (1040 m), and *N. cervinata* were collected from near Sutton as above.

Damage and yield assessments were as in Experiment 1.

Statistical methods

The percentage of seedlings in each damage class (none, sublethal, destroyed) from trays exposed to weevils, was analysed as a binomial generalised linear model (McCullagh and Nelder 1989), fitting terms for tray, and seedling species (Experiment 1) or weevil species, seedling species and their interaction (Experiment 2). Dry matter yields were analysed by analysis of variance with trays as the block structure, and weevil treatment, seedling species and their interaction as the treatment structure. Effective SEDs were calculated and are presented in the tables.

RESULTS

Experiment 1

At day 3 significantly more *H. pilosella* seedings had been destroyed than for all other species ($P<0.01$), and more *H. praealtum* had been destroyed than any of the legume species ($P<0.05$) (Table 1). Of the surviving seedlings, fewer *H. pilosella* seedlings remained undamaged and more were sub-lethally damaged, than for all other species ($P<0.01$) (Table 1). Significantly more *H. pilosella* than *H. praealtum* seedlings were destroyed ($P<0.05$) (Table 1).

Weevil damage to the *Hieracium* species after 9 days was greater than recorded for the legume species ($P<0.01$) (Table 1). The three legume species sustained feeding damage and some seedling mortality but this did not differ significantly between species (Table 1).

When assessed after 9 days the yield of both *Hieracium* species was significantly lower for weevil feeding than the control ($P<0.01$) (Table 1). None of the legumes showed any significant decrease in yield associated with weevil feeding.

Experiment 2

N. cervinata feeding produced similar results in Experiment 2 to those in Experiment 1, although the lower weevil density used in this experiment resulted in lower seedling mortality, especially of legume species. *H. pilosella* sustained less damage from *N. cervinata* than *H. praealtum* at day 3, but there was no significant difference in damage between the *Hieracium* spp. at day 9 (Table 2). Both *Hieracium* species were preferred over the legume seedlings.

TABLE 1: Effect of *N. cervinata* feeding on seedling damage, survival and yield (mg dry matter per seedling) (Experiment 1).

Seedling species	Treatment	% of seedlings in each damage category Day 3			Day 9			Mean yield
		None	Sub-lethal	Destroyed	None	Sub-lethal	Destroyed	
white clover	+weevils	98	2	0	83	10	7	0.92
	-weevils							0.98
lucerne	+weevils	97	3	0	82	12	6	3.50
	-weevils							3.76
Caucasian	+weevils	98	2	0	92	8	0	2.70
clover	-weevils							2.89
Hieracium	+ weevils	68	16	16	41	5	54	0.42
pilosella	- weevils							1.04
Hieracium	+weevils	91	3	6	57	7	36	0.47
praealtum	-weevils							1.05
SED		5.2	3.7	2.6	9.2	11.5	8.8	0.19

TABLE 2: Comparison of effects of *N. cervinata* and *N. cinerea* feeding on seedling damage, survival and yield (mg dry matter per seedling) (Experiment 2).

Seedling species	Treatment	% of seedlings in each damage category Day 3			Day 9			Mean yield
		None	Sub-lethal	Destroyed	None	Sub-lethal	Destroyed	
white	cin†	97	3	0	72	25	3	1.33
clover	cer–	100	0	0	85	15	0	1.66
	no weevils							1.87
lucerne	cin	97	3	0	72	28	0	3.80
	cer	90	10	0	60	40	0	4.50
	no weevils							4.94
Caucasian	cin	95	5	0	78	22	0	3.62
clover	cer	100	0	0	95	5	0	3.66
	no weevils							3.89
Hieracium	cin	100	0	0	93	0	7	0.88
pilosella	cer	83	8	9	64	1	25	0.70
	no weevils							1.01
Hieracium	cin	100	0	0	90	0	10	0.86
praealtum	cer	78	7	15	70	7	23	0.54
	no weevils							0.94
SED		5.6	3.8	2.4	16.5	14.4	4.7	0.16

† *Nicaeana cinerea*
– *Nicaeana cervinata*

N. cinerea appeared to prefer clover seedlings. More clover seedlings were damaged by *N. cinerea* than were damaged by *N. cervinata*. Conversely more *Hieracium* spp. seedlings were destroyed by *N. cervinata* at both day 3 and 9 than were destroyed by *N. cinerea* (Table 2), and no sub-lethal feeding on either *Hieracium* spp. by *N. cinerea* was recorded.

Weevil feeding on *Hieracium* seedlings tended to result in the seedlings being destroyed, where as feeding on legume seedlings was mostly sub-lethal.

N. cinerea feeding was associated with reduced yields of both white clover and lucerne ($P<0.01$) (Table 2), while *N. cervinata* feeding reduced lucerne and *H. praealtum* yields significantly.

DISCUSSION

Different feeding preferences of the two broad-nosed weevil species were apparent, and although both weevil species fed on both *Hieracium* species only *N. cervinata* preferred *Hieracium* spp. over legume seedlings. *Hieracium* seedlings were more vulnerable to broad-nosed weevils than the legumes tested, as they were often totally destroyed by weevil feeding whereas white clover, lucerne, and Caucasian clover, suffered mostly sub-lethal damage.

N. cervinata and *N. cinerea* damage levels to legumes were similar to the results of Barratt *et al.* (1993), who found that a complex of broad-nosed weevil species, comprised of *Irenimus* spp. and *Nicaeana* spp. from the East Otago Plateau, exposed to a range of legumes, readily defoliated white clover and lucerne.

Populations of broad-nosed weevils may have an influence on the success of *Hieracium* seedling establishment in the field and may therefore reduce the rate at which *Hieracium* could become dominant in grasslands. Further work will concentrate on matching historical vegetation composition and weevil density records from an East Otago Plateau study site to look at the interaction between broad-nosed weevil densities and *Hieracium* invasion patterns. The nature and effect of broad-nosed weevil feeding on the longer term growth of *Hieracium* spp. seedlings will also be investigated.

ACKNOWLEDGEMENTS

We would like to thank Roger Littlejohn for the statistical analysis, and Lynley Evans, Jackie Shand and Ann Cresswell for technical assistance.

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