LABORATORY STUDIES OF *TRIFOLIUM UNIFLORUM* ROOT CONSUMPTION BY GRASS GRUB (*COSTELYTRA ZEALANDICA*)

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Grass grub (*Costelytra zealandica*) (White) is a serious pest of pasture throughout New Zealand and legumes are a preferred host. Many *Trifolium* species have been screened for grass grub resistance (Farrell and Sweney 1972, 1974; Dymock *et al* in press) but reduction in larval weight gains comparable with those recorded for *Lotus pedunculatus* have only been found for *T. uniflorum* (Dymock *et al* in press). *T. uniflorum* has a large woody taproot and can be hybridised with white clover (*T. repens*) (Pandey 1957; Pandey and Patterson 1978). The aim of this study was to determine whether grass grub consumption of *T. uniflorum* root differed from that of white clover and *L. pedunculatus* as susceptible and resistant controls respectively, and whether root thickness affected the amount consumed.

Experiment 1

Roots of six-month old plants of *L. pedunculatus*, white clover and *T. uniflorum* grown in the glasshouse were washed, cut into 150 mm lengths and weighed after the removal of excess water. Approximately 300 mg of root and a single third instar grass grub (collected from Manawatu hill country and starved for 24 hours before the experiment) were placed individually in ice-cube compartments 20 mm in diameter. Forty larvae were tested with each legume species. Each tray was wrapped in damp tissue paper and held at 18°C in darkness. After 5 days the remaining root was freeze dried and weighed. More weighed fresh root was then added to the compartments and the dry weight of the root remaining determined after a further 3 days.

Consumption was measured as both fresh weight and the proportion of root dry weight eaten by the larvae over each interval. The initial dry weight of the root material was obtained using a mean fresh weight/dry weight ratio determined for each species by washing and weighing 35 replicates of 300 mg of fresh root material. These were freeze dried and then reweighed.

Larvae consumed less root of *L. pedunculatus* than of white clover or *T. uniflorum* (Table 1) demonstrating that grass grub larvae are deterred from feeding on *L. pedunculatus* whole root. This is consistent with results from root extract bioassays conducted by Hutchins *et al* (1984).

TABLE 1: Consumption of root of three legume species by third instar grass grub larvae.

	21/5-26/5/87		26/5-29/5/87	
	Mean fresh root $\pm$ SE (mg)	Mean dry root $\pm$ SE (%)	Mean fresh root $\pm$ SE (mg)	Mean dry root $\pm$ SE (%)
<i>L. pedunculatus</i>	6.5 $\pm$ 18.2	2.7 $\pm$ 5.2a	-8.9 $\pm$ 21.5	3.1 $\pm$ 4.3a
white clover	78.5 $\pm$ 10.9	26.1 $\pm$ 6.6b	72.3 $\pm$ 13.7	25.8 $\pm$ 5.8b
<i>T. uniflorum</i>	109.4 $\pm$ 19.0	37.0 $\pm$ 6.3b	83.3 $\pm$ 10.9	28.5 $\pm$ 4.9b

Means followed by the same letter are not significantly different at the 5% level.

Experiment 2

A further experiment using the same method was conducted using root material from five white clover and *T. uniflorum* plants. Roots were divided into two size classes, <2 mm and >2 mm in diameter. Root >2 mm in diameter was not necessarily taproot which is defined as the vertically penetrating primary root. Root consumption was measured as the fresh weight and percentage of dry weight consumed over 7 days.

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TABLE 2: Effect of plant species and root size on consumption of root by third instar grass grub larvae.

Species	Root diameter	N	3/6 - 10/6/87	
			Mean fresh weight root consumed (mg) ± SE	Mean % dry weight root consumed ± SE
white clover	>2mm	18	107.0 ± 8.8	38.1 ± 2.7
white clover	<2mm	30	183.6 ± 6.2	60.8 ± 2.0
<i>T. uniflorum</i>	>2mm	28	-11.1 ± 9.2	-4.0 ± 3.1
<i>T. uniflorum</i>	<2mm	20	172.7 ± 23.9	57.6 ± 7.8

There was a significant effect of root size on consumption ($P < 0.001$) for both *Trifolium* species (Table 2). Grass grub larvae consumed comparatively less of the larger diameter root of both *T. uniflorum* and white clover than the smaller root. The effect was much greater for *T. uniflorum* roots, which overall were probably thicker than for white clover in the > 2mm size class, but this was not measured.

Because larvae fed equally on the small roots of both white clover and *T. uniflorum* the question remains as to whether there would be sufficient small roots of *T. uniflorum* to support grass grub growth in the field. In the first experiment where all roots were included there was no difference in consumption of root between *T. uniflorum* and white clover. Similarly, van den Bosch and Gaynor (1986) found no significant difference in grub weight gains between taprooted and fibrous-rooted lines of potted white clover in a controlled environment room or any effect of taproot size where there was an excess of root material available for a single larva in each pot. With potted *T. uniflorum* plants, Dymock *et al* (in press) recorded significantly lower weight gains of larvae compared with white clover. It is possible there were insufficient small roots of *T. uniflorum* available to support grass grub growth, but this was not measured. Because *T. uniflorum* hybridises with white clover it may be possible to utilise its root size characteristics for grass grub resistance.

This study has shown that root size does affect grass grub consumption but other possible resistance factors such as feeding deterrents and toxins are being investigated. Identification of resistance factors of *T. uniflorum* may enable the selection and introduction of such characteristics into white clover through hybridisation.

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