

Research Note

***Bombus* and other bee pollinators in *Trifolium hybridum* seed fields¹**D.T. Fairey² and L.P. Lefkovitch³

ABSTRACT

Insect pollination is a prerequisite for seed production in alsike clover (*Trifolium hybridum* L.) and the leafcutting bee (*Megachile rotundata* Fab.) is an effective pollinator of this crop. In a previous experiment, seed yield in the vicinity of leafcutting bee shelters was higher (345 kg ha⁻¹) than elsewhere in the field (228 kg ha⁻¹) where leafcutting bees were not provided. Therefore the identity of the other bee pollinators was determined. Observations on the pollination behaviour and samples of the pollinating insects were made at frequent intervals during the growing season. Honey bees, and six species of bumble bees were collected in areas of the field that did not contain leafcutting bee shelters; of the bumble bee species, *Bombus rufocinctus* L. was the most abundant. The mouth parts of these bees were of a size capable of extracting nectar from alsike clover florets.

EXPERIMENTAL AND DISCUSSION

In a previous study, Fairey and Lefkovitch (1993) showed that the leafcutting bee, *Megachile rotundata* Fab., presently used largely for pollinating lucerne, *Medicago* spp., is an effective pollinator of alsike clover (*Trifolium hybridum* L.). The seed fields used in that study had been divided into two rectangular areas of equal size, one for each of two treatments (Trt). In Trt1, leafcutting bees were introduced into the experimental area; leafcutting bees were not provided in Trt2. Other pollinating insects were not excluded; these included honey bees from hives unexpectedly introduced to adjacent areas, and a number of bumble bee species that nested in the surrounding native bush. The activity of the leafcutting bee is usually restricted to the vicinity of its shelter (Fairey, Lefkovitch and Lieverse, 1989); the average seed yield in the vicinity of the leafcutting bees was 345 kg ha⁻¹, but a reasonable yield of 228 kg ha⁻¹ was obtained from the areas in the field where leafcutting bee shelters were absent (Fairey and Lefkovitch, 1993), indicating the presence of other pollinators in these areas. The purpose of the present study is to report the identity of these pollinators.

Observations on the pollinating activity of leafcutting bees and other insects were made at frequent intervals during the growing season, and samples of insects, including leafcutting bees, honey bees and bumble bees, that were pollinating alsike clover in the field, were taken. The mouth parts were dissected, mounted and measured. Bumble bees were collected in the same way for a second year to ascertain whether there were any differences in the relative abundance of the species present. The relationship between the corolla tube length of florets of alsike clover and the mouth parts of the insect pollinators was then examined. Further details on the measurements of insect mouth parts,

the corolla tube of the plant and the other experimental procedures, including the data analyses, are presented in detail elsewhere (Fairey and Lefkovitch, 1993).

The range of the sample of 100 corolla tube lengths was 2.45 - 4.96 mm; the mean was 3.87, standard error 0.11. Analyses of deviance for the length of components of the mouthparts of leafcutting bees, worker honey bees, and queens of the six species of bumble bees present are given in Table 1. These measurements (Table 2) reveal that all can easily reach the nectaries at the base of the corolla tube. This conclusion is in agreement with the association between flower size and tongue length reported for different *Bombus* species (Heinrich, 1979). Note, however, that the mouthparts of the *Bombus* species collected in 1990 were generally smaller than those collected in 1989. Because the difference in mouthpart size between years was not associated with the date of collection, it was attributed to some other unmeasured circumstances which influence the availability of food. In both years, *B. rufocinctus* L. was the most abundant species collected.

It appears that the good seed set obtained in the present study was attributable to the activity of the leafcutting bee in Trt1, and by other pollinators, including honey bees that are recommended for pollination of alsike clover (Crane and Walker, 1984) and bumble bees, in Trt2. It is interesting to note that in Trt 1, honey bees and bumble bees were seldom observed near the leafcutting bee shelters, and that the activity of the leafcutting bees was revealed by concentric 'seed rings' of dark brown seed heads which appeared around the shelters in mid-July; this effect gradually disappeared by mid-August. This delineation of pollination territory is not uncommon, and has been observed in other studies (eg Fairey *et al.*, 1989).

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Table 1. Analyses of deviance for the components of mouthparts in leafcutting bees, honey bee workers and some species of *Bombus*.

(i) Leafcutting bees and honey bees					
	d.f.	mean deviances			
		glossa	prementum	mentum	total
Species	1	12.7202	7.0354	0.1216	8.3911
Sex within leafcutting bees	1	0.0098	0.0137	0.0626	0.0151
Residual	297	0.0042	0.0075	0.0127	0.0018

(ii) Bumble bees				
	d.f.	Mean deviances		
		glossa	prementum	total
Year (Y)	1	2.8975	1.9662	2.6120
Date within year	11	0.0854	0.0538	0.0660
Species (S)	5	0.3667	0.1461	0.2751
Y*S	2	0.0996	0.0815	0.0965
Residual	102	0.0181	0.0117	0.0148

Table 2. Measurements of mouth parts of pollinators. Means (mm) and standard errors in parenthesis.

(i) Leafcutting bees ¹								
	glossa		prementum		mentum		total	
males	2.335 (0.015)*		1.612 (0.014)		0.527 (0.006)		4.481 (0.019)	
females	2.368 (0.015)		1.639 (0.014)		0.546 (0.006)		4.560 (0.019)	

(ii) Honey bees ¹ workers								
	3.608 (0.023)		2.238 (0.019)		0.560 (0.006)		6.406 (0.027)	

(iii) Bumble bees species								
	glossa		prementum		total		number measured	
	1989	1990	1989	1990	1989	1990	1989	1990
<i>B. rufocinctus</i>	5.904 (0.131)	4.143 (0.100)	3.008 (0.054)	2.225 (0.044)	8.911 (0.179)	6.354 (0.139)	85	81
<i>B. nevadensis</i>	8.100 (0.629)	8.125 (0.639)	3.700 (0.231)	3.765 (0.232)	11.800 (0.829)	11.860 (0.835)	7	4
<i>B. borealis</i>	8.027 (0.393)	5.800 (0.780)	3.547 (0.139)	2.600 (0.281)	11.574 (0.511)	8.400 (1.022)	16	4
<i>B. vagans</i>	—	4.774 (0.229)	—	2.416 (0.093)	—	7.190 (0.312)	0	15
<i>B. terricola</i>	5.725 (0.385)	4.771 (0.242)	2.750 (0.148)	2.536 (0.014)	8.475 (0.515)	7.312 (0.336)	7	11
<i>B. californicus</i>	—	7.100 (0.995)	—	2.800 (0.303)	—	8.900 (1.083)	0	2

* standard errors are approximate, since model is not linear

¹ 100 of each were measured

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