ALTERNATIVE FLORAL SOURCES FOR LEAFCUTTING BEES

By

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The leafcutting bee, Megachile rotundata (Fab.) has been observed pollinating a number of different legume species in experimental plots. These observations, made over a 15-year period at various locations in the Peace River region of Alberta and British Columbia, include clovers (Trifolium spp.), birdsfoot trefoil (Lotus corniculatus L.), sainfoin (Onobrychis viciaefolia Scop.) and milk vetch (Astragalus cicer L.). In many instances a preference for some floral sources has been recorded with respect to different cultivars within a species, and also among different species. For example, while there has been an abundance of observed pollinating activity on single-cut diploid red clover, few observations of pollination of tetraploid cultivars have been recorded. Furthermore, from 1985-7, inclusive, the leafcutting bee has been used successfully for pollinating canola (Brassica campestris) in the greenhouse, to obtain early generation seed production in a breeding program.

Based on the above observations, studies on the use of the leafcutting bee for pollination and seed production in a number of legume species are currently underway. In the field studies in progress, bee reproduction, pollinating behaviour and seed set are being documented, while cage studies are being used to demonstrate the relative effects of insect pollination versus the absence of a pollinator. In current greenhouse studies, floret morphology, seed formation and behaviour of the insect are being studied in some detail. In this report, some of the results of a 5-year field study on single-cut diploid red clover, Trifolium pratense L., and a 1-year cage study on diploid alsike clover, Trifolium hybridum L., are presented.

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I. Red Clover

In each year of the 5-year study described here, a single-cut, diploid red clover seed field of about 40 ha was selected. The field was divided into two rectangular areas of equal size, one for each of treatments (Trt) 1 and 2, with an isolation strip of about 300 m between the treatments. In Trt 1, six shelters for leafcutting bees, M. rotundata were provided for pollination. Bees were not provided in the area allocated to Trt 2, but six stakes were positioned in the field in a manner similar to that for the six shelters in Trt 1. It should be noted that other pollinating insects were not excluded in both treatments. Samples of the red clover seed crop were harvested when 80 to 90% of the seed heads were brown. The harvested crop was dried and threshed for seed. Seed samples were then cleaned and weighed.

The culture and management of leafcutting bees and the methods of isolation of shelters from each other in this red clover study, were identical to those described by Fairey and Lieverse (1986)‡ for alfalfa. All bees came from a population maintained since 1966 at the Agriculture Canada, Research Station, Beaverlodge, Alberta. If the leafcutting bee can pollinate red clover successfully, the cell increase of bees on this crop will be compared with that obtained when foraging on alfalfa, the crop for which this bee is the currently recommended pollinator in western Canada. Therefore, in each year of study a cell increase with that on alfalfa was also made. Differences attributable to location are accepted as factors that cannot be altered, while differences attributable to crop irrespective of location effects are deemed to be of interest. For each shelter of red clover and alfalfa, the total yield of viable male and female bees was determined. The ratio of viable cell increase at the end of the season was also calculated.

Seed yield

Since the coefficient of variation appeared to be small, an analysis of variance of the logarithm of the yields, equivalent to a generalized linear model assuming a small, constant coefficient of variation, was performed. The seed yields based on 5-year averages were 410 kg/ha and 291 kg/ha for Trts 1 and 2, respectively (Table 1). Furthermore, in four of the five years of study, significantly greater amounts of seed were obtained with the provision of leafcutting bees for pollination. These yields ranged from 343 to 498 kg/ha for Trt 1 and 240 to 347 kg/ha for Trt 2.

‡ J. Appl. Ent. 102: 148-153, 1986.

Table 1. Seed yield

Year	Treatment		Seed increase with bees %
	With bees	Without bees	
1983	498 a[+]	240 b	208
1984	466 a	256 b	182
1985	343 a	347 a	99
1986	390 a	306 b	127
1987	373 a	320 b	117
Mean	410	291	

[+] Means, within years, followed by the same letter are not significantly different at the 5% level of probability according to an analysis of variance of the logarithm of yield.

Leafcutting bee cell increase

Comparisons of viable cell production, as expressed as a proportion of the total weight of cells produced for red clover and alfalfa were made. There was no significant difference ($P > 5\%$) between crops for both viable cell production and number of female bees. There was a significant crop x year interaction ($P < 2\%$) implying that year/location of fields had a significant effect on bee reproduction. A large proportion of the cells produced were viable. On an average, this was about 96 percent, irrespective of whether the crop being pollinated was alfalfa or red clover. About 32 percent of these cells were female.

Table 2. Ratio of cell increase

Year	Crop	
	Alfalfa	Red clover
1983	2.39 (0.216)[+]	1.50 (0.178)
1984	2.70 (0.106)	1.69 (0.149)
1985	2.16 (0.106)	2.23 (0.160)
1986	2.66 (0.104)	2.59 (0.082)
1987	3.24 (0.088)	2.12 (0.080)
Mean	2.63 (0.081)	2.03 (0.085)

[+] Standard error

The ratio of bee cell increase was influenced by the crop being pollinated. This ratio of increase was usually greater for alfalfa.

Average values of 2.63 and 2.03 were recorded for alfalfa and red clover, respectively. For alfalfa, cell increase ratios ranged from 2.16 to 3.24, the range for red clover was 1.50 to 2.59.

These results show that there was an increase in seed production in red clover associated with the provision of leafcutting bees in four of five years. Since, up to 347 kg/ha of seed was produced in the treatment where these bees were not provided, other pollinating insects were also active in the seed fields studied. However, the results of the present study indicate that the leafcutting bee is a candidate pollinator for red clover that merits further investigation.

II. Alsike Clover

Two cultivars of alsike clover, 'Dawn' and 'Aurora' were used in this study. For each cultivar, 14 screen cages were used, 7 for each of treatments (Trt) 1 and 2. Each cage was 1.2m x 1.2m x 1.2m in size. In Trt 1, 300 leafcutting bees were introduced into the cage at weekly intervals commencing on July 1 at first bloom and continuing until August 20 when the crop was ready for harvest. Leafcutting bees and all other pollinating insects were excluded from Trt 2. The entire crop under each of the cages was harvested on August 20.

Seed yield

The yield data were analysed using a general linear model assuming a constant coefficient of variation, since the latter was relatively large. The significant differences in seed yield observed between cultivars could partly be attributed to the fact that the stand of Aurora appeared to be more uniform and vigorous before the commencement of treatments. There was approximately an eight-fold increase in seed yield with the provision of bees, again emphasizing the importance of insect pollination in this predominantly cross pollinated species.

Table 3. Seed yield in cages

Cultivar	With bees	Without bees
	Yield kg/ha (Standard Error)	
Aurora	270.15 (62.16)	24.86 (5.74)
Dawn	136.57 (31.52)	28.15 (6.41)

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