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## **POLLEN COLLECTION FROM ALSIKE CLOVER BY HIGH AND LOW ALFALFA POLLEN COLLECTING LINES AND BY A COMMERCIAL LINE OF HONEYBEES\***

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### **Summary**

The collection of alsike clover pollen by high alfalfa pollen collecting (APC) and low alfalfa pollen collecting lines of honeybees and by bees from commercial colonies were compared at Donnelly, Idaho, U.S.A., in an area where alsike clover was flowering. All three lines collected an overwhelmingly high percentage of alsike clover pollen (92-99%), and there were no significant differences between them. A limited amount of rape pollen was collected every day by all groups, and also a small amount of dandelion pollen on one or two days. Only one (high APC) colony collected pollen from a small nearby field of alfalfa, and only one (low APC) colony collected pollen from scattered patches of *Senecio* spp.

### **Introduction**

Mackensen and Nye (1966) demonstrated that the tendency to collect pollen of alfalfa (*Medicago sativa*) is inherited in honeybees (*Apis mellifera*): they succeeded in establishing a line which had a high proportion of alfalfa pollen collectors (APC) and a line which had a low proportion of alfalfa pollen collectors. The next question was whether the tendency was specific for alfalfa pollen, or whether it could be extended to pollen from other small-flowered legumes such as clovers. Mackensen and Tucker (1972) therefore tested the two lines at Baton Rouge, Louisiana, where no alfalfa is grown. They found that pollen of white clover (*Trifolium repens*) was collected equally by the two lines, but that two other pollens—poison ivy (*Rhus rodicans*) and wild geranium (*Geranium carolinianum*)—were collected in significantly different quantities: the high APC line collected more geranium pollen, and the low APC line collected more poison ivy pollen. In order to discover whether the two lines would collect different amounts of pollen of alsike clover (*Trifolium hybridum*), a similar test was made in 1969 in an area where alsike clover is grown for seed, at Donnelly in west central Idaho. There was only one small field of alfalfa (2 hectares) being grown for forage, about 1 km to the west of the apiary, and other sources of pollen were limited.

### **Materials and Methods**

Eight colonies in each of the following groups were used in the main part of the test: (1) high APC line, (2) low APC line, (3) a commercial strain. The colonies were placed at random in two semicircles in a field of alsike clover (198 hectares) in full bloom at Donnelly, Idaho. The high and low APC lines were chosen from among eighth-generation colonies developed in a selective breeding programme based

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\* In co-operation with Utah Agricultural Experiment Station

on tests made in alfalfa seed fields in Box Elder County, Utah, and Parma, Idaho (Nye & Mackensen, 1970). In Box Elder County, an average 75% of the pollen collectors in the high APC line collected alfalfa pollen, and an average 5% of the pollen collectors in the low APC line collected alfalfa pollen. The commercial strain was not tested in this locality.

The procedure was similar to that used in previous tests (Nye & Mackensen, 1968). Returning foragers were collected at the hive entrances of all colonies once each day from 8 to 12 July between 14.00 and 16.00 hr (the period of maximum flight activity) with an aspirator made from a small automobile vacuum cleaner. The bees were classified as pollen collectors or as nectar collectors (i.e. foragers returning without pollen). Details of sample sizes are given in Table 1, and weather data in Table 2.

TABLE 1. Numbers of bees collected in samples from each colony during the 5-day observation period.

Group	Minimum sample size	Maximum sample size	Mean sample size	Total no. bees sampled
High APC	44	183	101	504
Low APC	58	175	108	539
Commercial	35	160	87	436

TABLE 2. Weather data 8-12 July, 1969, Donnelly, Idaho.

Date	Maximum temperature °C	Wind, always from S.E. (km/hr)	Sky
8	23.3	4.8-8.0	clear
9	26.7	3.2-8.0	clear
10	28.3	gusty, 8.0-16.1	partly cloudy
11	18.9	12.9-19.3	clear
12	18.9	gusty, 9.6-24.1	partly cloudy

Pollen traps were installed on another four colonies (2 high APC, 1 low APC, 1 commercial) in the same field, and pollen samples were collected from dawn to dusk on each of the 5 days of the test. Pollens from the bees collected in the aspirator and from the traps were identified by microscopical examination.

The sugar concentration in nectar of alsike clover was determined by analysing (with a hand refractometer) the contents of the honey sacs of bees collected from flowers.

## Results and Discussion

Generally, about half the returning foragers collected at the hive entrances were pollen collectors. However, the commercial line had about 1½ times as many pollen collectors as nectar collectors ( $P < 0.05$ ). The means for each group are given in Table 3.

Analysis of variance of the data shows that the low APC line had the greatest number of nectar collectors ( $P < 0.05$ ), but that the three lines did not differ significantly in the total amount of pollen collected, or in the amounts of clover or rape (*Brassica napus*) pollen collected. Differences in the amounts collected on the

TABLE 3. Mean numbers of different types of foragers per colony, sampled on different dates, from the three lines of bees.

Group	Date (July 1969)	Nectar collectors	Pollen collectors	Mean no. pollen collectors with pollen from:				
				Alfalfa	Alsike clover	Dandelion	Rape	Senecio
High APC	8	52.8	56.1	0	55.5	0.25	0.38	0
	9	48.4	54.3	0	52.8	0	1.50	0
	10	60.9	53.9	0	52.8	0	1.10	0
	11	55.3	48.3	0.12	47.4	0	0.75	0
	12	35.1	41.7	0	40.8	0.12	0.75	0
Mean		50.5	50.9	0.02	49.9	0.07	0.90	0
Low APC	8	38.8	53.4	0	52.6	0.12	0.75	0.12
	9	49.2	62.8	0	61.0	0	1.75	0
	10	73.5	44.4	0	43.4	0	1.00	0
	11	75.5	44.2	0	41.9	0	2.25	0
	12	59.2	37.6	0	36.2	0	1.38	0
Mean		59.2	48.5	0	47.0	0.02	1.43	0.02
Commercial	8	23.5	58.3	0	58.2	0	0.12	0
	9	28.2	54.4	0	54.2	0	0.25	0
	10	39.1	58.6	0	57.9	0	0.75	0
	11	43.5	56.8	0	55.6	0	1.25	0
	12	31.6	40.5	0	40.1	0.12	0.25	0
Mean		33.2	53.7	0	53.2	0.02	0.52	0

different dates were highly significant ( $P < 0.01$ ), probably because of the wide range in maximum temperature (18 to 28°C).

Of the pollen taken from the traps, 92–99% was alsike clover pollen; this was also true for pollen taken from bees sampled at the hive entrance. The abundance of clover in the area and its highly concentrated nectar (53% total solids) probably explain its almost exclusive use for forage by all three lines. Rape pollen was collected in limited amounts every day by all groups, and each group collected a little dandelion (*Taraxacum officinale*) pollen on at least one day. Only one high APC colony collected a small amount of alfalfa pollen (the field was just starting to flower, but was cut for forage on 10–11 July). One low APC line colony collected a small quantity of pollen from *Senecio* spp.

The quantity and percentage of pollens collected in the traps were not analysed statistically, because so few traps were used. Generally, the percentages were much the same for the 4 colonies, except that 1 of the 2 high APC colonies collected about twice as much pollen as each of the other 3 colonies with traps. Only this high APC colony collected pollen from alfalfa. All colonies collected carrot (*Daucus*) pollen during the morning when most of the carrot anthers discharged their pollen, but no carrot pollen was obtained from returning foragers in the afternoon when they were sampled at the hive entrances.

It seems clear, from the lack of difference between the amounts of alsike clover pollen collected by the three groups, that the tendency for the high APC line to

collect alfalfa pollen is specific and does not extend to legumes in general, such as clovers. It can also be noted, though without placing undue emphasis on it, that the only two colonies to collect alfalfa pollen both belonged to the high APC line.

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