THE INFLUENCE OF HONEYBEE POLLINATION ON FRUIT SET OF THE LOWBUSH BLUEBERRY[1]

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ABSTRACT

Inconsistent results were obtained when the fruit set was determined in blueberry fields with and without the service of honeybees. Adverse weather conditions curtailed pollinator activity and this was reflected in poor fruit set. The advantage of using honeybees was more evident in the season which had a short period of bloom. No significant increase in percentage fruit set was obtained when the number of colonies of honeybees per acre was increased. There was also no correlation between percentage fruit set and composition of plant stand.

INTRODUCTION

The importance of honeybees as a supplement to native bees in the pollination of lowbush blueberry has not been clearly established. Several workers have observed that native bees are not particularly abundant in blueberry fields during the period of bloom, and have suggested that fruit set may be increased substantially by the use of honeybees. In his work with caged honeybees Lee (4) concluded that the lowbush blueberry is capable of setting and maturing fruit on a high percentage of its flowers, and that the honeybee is an effective pollinator of this plant. Karmo (3) has reported promising results from the use of honeybees in blueberry pollination in Nova Scotia.

Preliminary investigations in New Brunswick showed that blueberry blossoms must be insect pollinated before they can set fruit. In this area pollination is performed almost entirely by bumble bees and solitary bees. While many clones of blueberry have been noted with fruit set in excess of 70 per cent, the average set on a field basis is rarely over 50 per cent and is generally considerably lower. Since populations of native bees may fluctuate considerably from year to year and are never as plentiful as one might desire, the most promising approach towards increasing the percentage fruit set would seem to be in the use of honeybees.

This paper presents the results of studies on blueberry pollination in New Brunswick in 1957, 1958, and 1959. Data are presented on fruit set in fields with and without honeybees, and in fields with honeybees supplied at the rate of one, two, and three colonies per acre. The influence of weather on pollination is discussed briefly.

In New Brunswick there are three recognized lowbush blueberries; *Vaccinium myrtilloides* Michx. is a diploid, and *V. angustifolium* var. *laevifolium* House and *V. angustifolium* var. *nigrum* (Wood) Dole are tetraploids (1). Of these *V. angustifolium* var. *laevifolium* is the predominant species, particularly in stands which have been developed from abandoned hayfields (2). It seemed advantageous to investigate the relation of fruit set to plant stand concurrent with the study of honeybee influence, and the results of this investigation are, therefore, included in this paper.

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MATERIALS AND METHODS

The study was made in the vicinity of Tower Hill, Charlotte County, New Brunswick. First crop fields only were selected. Honeybees were placed in one group of fields when the plants were coming into bloom and the check fields were left to be pollinated by native bees. Honeybees were purposely placed in those fields which had the greater amount of isolation from the bloom of competitive plants and from other blueberry fields, hoping thereby to induce the honeybees to work the blueberries more thoroughly. The fields containing honeybees were also far enough from each other and from the control fields that spill-over of bees from one field to another was negligible. In 1957 and 1958 one, two, and three colonies per acre were used, whereas in 1959 only one colony per acre was used.

The percentage fruit set in each field was obtained from counts of blossoms and berries in 25 one foot-square plots located at random. In the fields with honeybees the plots were contained within a 2-acre area about the hive site. Stand composition in the various fields was determined by recording the species of blueberry occurring at 1-yard intervals on a 100-yard line transect selected at random five times in each field.

RESULTS

Observations on the percentages of fruit set (Table 1) showed that in 1957 and 1958 there was no significant difference in the proportion of flowers which set fruit in the fields with or without honeybees. In 1959, however, the introduction of honeybees more than doubled the proportion of flowers which set fruit, as compared to those which were accessible to native bees only. This difference was highly significant.

There was no significant increase in set when the number of colonies per acre was increased (Table 2). It should be pointed out, however, that the number of colonies used may not be a good criterion for density of bees in a field. In the Tower Hill area most blueberry fields are less than 10 acres in area, and are either contiguous with or very close to other blueberry fields. Under such conditions honeybees rapidly extend their foraging range, and the density of bees in a given field does not increase in proportion to the number of colonies used unless all growers in the immediate area also use honeybees.

TABLE 1.—PERCENTAGES OF FRUIT SET IN BLUEBERRY FIELDS WITH AND WITHOUT THE EMPLOYMENT OF HONEYBEES

Year	Bloom period	Fruit set with honeybees			Fruit set without honeybees			Difference	P
		N	$\bar{X}$	S.E. % $\bar{X}$	N	$\bar{X}$	S.E. % $\bar{X}$		
1957	May 15-June 7	7	37.6	6.7	7	36.1	6.5	+1.5	0.70
1958	May 22-June 6	6	18.1	20.4	10	24.2	5.8	−6.1	0.10
1959	May 22-May 30	5	52.8	5.7	5	23.8	8.4	+19.0	0.001

TABLE 2.—PERCENTAGE OF FRUIT SET IN RELATION TO DENSITY OF HONEYBEES

Year	Density of honeybees (colonies/acre)			F
	1	2	3	
1957	49.6	41.4	32.4	2.13 N.S.
	39.0	31.8	31.1	
	38.2			
1958	18.7	17.4	27.6	3.87 N.S.
	17.2	12.9	20.9	

A survey of all fields in which records on fruit set were taken during the 3-year study on honeybees showed no correlation between fruit set and composition of stand. Forty-two fields were sampled and the coverage by tetraploid species ranged from 97.2 to 4.1 per cent. Most fields contained between 50 and 70 per cent tetraploids. An analysis of covariance was made on fruit set and percentage coverage by *V. angustifolium*, and correlation coefficients of 0.172, 0.132, and 0.208 were obtained for the years 1957, 1958, and 1959 respectively.

DISCUSSION

A precise assessment of the importance that honeybees can assume in the pollination of lowbush blueberry is complicated by several factors. Blueberry is a native fruit and is produced on a commercial basis with a minimum of cultural care. Consequently a typical blueberry field contains a wide range of clonal types with variability in such qualities as age, time of bloom, colour and size of blossoms, and need for cross-pollination. There is wide variation between fields in density of stand and relative coverage by diploid or tetraploid species. Competing bloom is very common within and surrounding the fields, particularly in New Brunswick. Native bee densities vary between fields and between years. A solution to the problems of blueberry pollination, therefore, will in all probability await a detailed study of the influence of these factors. This paper reports on a rather general approach to the problem and the results obtained show the need for a more intensive study.

The data on fruit set in fields with and without the service of honeybees showed that, at least in some years, the set of fruit can be increased by the use of honeybees. The lack of a significant increase in set in 2 years out of 3, however, shows that an increased set cannot be guaranteed by adding honeybees to the pollinating force. It must also be remembered that these results are based on conditions in New Brunswick only, and more favourable results would be possible in other areas.

No counts of native bees were taken in this study because of limitation of time and personnel. It was assumed that, although variations in native bees would occur between fields, these variations would be compensated by the number of fields sampled.

The influence of weather on pollination cannot be overlooked in this study. In 1957 conditions were favourable for pollination. Clear, warm days were experienced during the major part of the blooming period. Rainfall was light and confined to the later hours of the day. Fruit set was considered average.

In 1958 the days were cloudy and cool, and rain was common during the period of bloom. This weather was adverse to bee activity and the set was well below average.

In 1959 the weather was again favourable. However, there was extreme variation in fruit set among fields in the Tower Hill area. This was due to the combined influences of weather and pollinator density. The days during bloom were unusually warm and plant development was rapid. Most of the blossoms opened within a 9-day period as contrasted with 19 and 16 days in 1957 and 1958. With such a short period of bloom a given density of native pollinators could not accomplish as much pollination as when the bloom period lasted twice as long. On the other hand the effect of adding a supply of honeybees would be most apparent in a year with a short bloom period. This is supported by the low set obtained in fields with native bees only, and by the greatly increased set which followed the addition of honeybees. Honeybees tend to expand their foraging range to competing bloom in adjacent fields. This habit takes on increased significance when there is a long period of bloom.

No significant increase in set could be obtained by increasing the number of honeybee colonies per acre. These results add support to the conclusion that increased set cannot be guaranteed by adding honeybees to supplement the native bee population.

An examination of the set obtained in fields with varying types of stand (with respect to coverage by tetraploid or diploid species of blueberry) showed no relationship between composition of stand and percentage fruit set. This lack of correlation rules out the theory that the higher set reported in Nova Scotia might be due to the very high percentage of the tetraploid *V. angustifolium*. New Brunswick fields show a more mixed type of stand.

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