FRUIT SET AND BEE ACTIVITY IN FOUR RABBITEYE BLUEBERRY CULTIVARS

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Abstract. Rabbiteye blueberry (Vaccinium ashei Reade) cultivars grown in North Central Florida have a lower percentage fruit set than Northern highbush cultivars. In 1979, the percentage fruit set 30 days after full bloom was as follows: 'Woodard', 50.7%; 'Bluegem' 31.2%; 'Tifblue' 35.4%; and 'Delite', 51.6%. However, prior to harvest on July 1, excessive fruit drop further reduced the percentage fruit set of 'Tifblue' to as low as 12.8%. Small bumblebees were present in numbers that appeared adequate for cross pollination and were the most prevalent bee species prior to full bloom.

Blueberries have the potential for 100 percent fruit set, provided that they receive adequate cross-pollination with a compatible species (1, 3, 12, 14, 16, 20). Bees are the most effective pollinators, although research workers disagree as to the most effective species. Bumblebees effectively pollinated highbush blueberries (11, 15) but were less effective than honeybees for other species (12, 21). Furthermore, the addition of honey bee hives to blueberry plantings has increased set in some instances (21) and has had no effect on set in others (13). The number of hives recommended for adequate cross-pollination varies from 1 to 5 per acre (4) and the importance of hive number to fruit set is yet unresolved (15).

Rabbiteye blueberries growing in North Central Florida conditions require cross pollination (7). However, little information is available on pollinator species or the average percentage fruit set for the most widely planted rabbiteye cultivars. Percentage fruit set has been used as an indicator of pollination effectiveness (18), thus information of this type would be of importance to growers. The purpose of this study was to determine the patterns of bee movement during flowering and to follow fruit set and fruit drop following the bloom period in 4 commercially important rabbiteye blueberry cultivars.

Materials and Methods

All fruit-set measurements and bee observations were made at the University Horticultural Unit 12 km northwest of Gainesville. This 6-year-old planting was established on poorly drained, acid soils and is similar to commercial planting sites in North Central Florida. Bee counts and observations were made from March 16 to 25, 1979 when bushes ranged from 10 to 60% of full bloom. 'Woodard' and 'Bluegem' bushes were observed for 10-minute intervals during the morning and afternoon throughout the bloom period. Bee species, total bee visits per bush and total flowers visited by each bee were recorded.

Table 1. Observations of bee movement in rabbiteye blueberries.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Full bloom (%)</th>
<th>Bee visits bush/min²</th>
<th>Flowers visited/bee²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HB</td>
<td>BB</td>
<td>LBB</td>
</tr>
<tr>
<td>Woodard</td>
<td>15</td>
<td>0</td>
<td>1.6</td>
</tr>
<tr>
<td>Bluegem</td>
<td>10</td>
<td>3.4</td>
<td>3</td>
</tr>
<tr>
<td>Bluegem</td>
<td>25</td>
<td>5.3</td>
<td>0</td>
</tr>
</tbody>
</table>

*HB = honeybees; BB = small bumblebees; LBB = large bumblebees.

Results and Discussion

Three distinct bee species were present during the bloom period in 1979, honeybees (Apis mellifera); small bumblebees (Bombus spp.); and large bumblebees (Bombus spp.). Small bumblebees were most prevalent pollinators during mid-March, with large bumblebees occasionally visiting flowers (Table 1). Honeybees were absent because of their preference for nearby pine pollen for hive building at that time of year. However, they became the most prevalent species following the placement of a hive in the planting on March 25, 1979.

Three flowering limbs per bush were selected on 'Woodard', 'Tifblue', 'Bluegem' and 'Delite'. Seventy to 100 flowers were counted per limb at 40 to 60% of full bloom on March 28, 1979. Subsequent counts were made when fruit set was completed, April 13 for 'Tifblue' and 'Delite' and May 2 for 'Woodard' and 'Bluegem', and immediately prior to harvest, June 20 for 'Woodard' and 'Bluegem' and June 27 for 'Tifblue' and 'Delite'. Counts were made on 20 bushes each of 'Woodard' and 'Bluegem' and 12 of 'Tifblue' and 'Delite'.

Small bumblebees averaged from 1.6 to 5.3 visits per bush depending on the percent of full bloom, with each bee visiting 5.0 to 14.1 flowers per bush (Table 1). Small bumblebees always collected nectar through the top of the corolla, a practice which guarantees the highest possibility of cross pollination. On the contrary, large bumblebees generally spent more time per flower (15 seconds on the average vs. 3 to 5 seconds for small bees), and collected nectar by slitting the base of the corolla. This practice has also been observed in highbush blueberries (26). Corolla splitting by "robber bees" prevents cross-pollination because the bee never contacts the stigma or the anthers. Furthermore, honeybees have been observed entering through these slits to collect nectar. Baton and Stewart (2) have made similar observations in highbush blueberries. Honeybees also pollinate the corolla, although less frequently than large bumblebees. Helms (9) also observed this practice; however, Baton and Stewart (2) found honeybees did not damage the flowers. Generally, honeybees enter the flower at the top of the corolla in rabbiteye blueberries.

Theoretically, every one of the 12,000 plus flowers on a
6-year-old rabbiteye blueberry bush could be visited at least once by a pollinator in as little as a 5-hour period, given the visiting rate information in Table 1. Consequently, every flower should receive sufficient bee visitations over a 2 to 3 week bloom period potentially to have 100% fruit set. Unfortunately, fruit set on date 1 was only 51.6% at best in 'Delite' and varied among cultivars (Table 2). 'Woodard' and 'Delite' had the highest percentage set and 'Bluegem' and 'Tifblue', the lowest. Rabbiteye blueberry fruit set is considerably lower than the 80 to 90% reported for 'Coville' highbush blueberries (10) but is comparable to that reported for lowbush cultivars (20). Furthermore, there is an additional decrease in fruit set by as much as 22.6 and 26.3% in 'Tifblue' and 'Delite', respectively, when the fruit-set period, March 28 to April 13, was separated from the fruit-drop period, April 14 to harvest. Fruit drop was 5.7% in 'Bluegem' and 10.3% in 'Woodard' which still represents a significant number when considered on a per acre basis.

The same trend of lower fruit set occurs in the field as under controlled conditions with rabbiteye cultivars (8). Observations indicate that poor set in rabbiteyes is probably not due to insufficient numbers of pollinators; nevertheless, many environmental and genetic factors influence fruit set. Incompatible pollen and selfing (8, 13, 19) limit fruit set in highbush and lowbush blueberries. As a result, incompatible pollen may inhibit fertilization even if compatible pollen is present on the stigma (19). Lack of sufficient chilling in Florida particularly, may also result in poor fruit set or, as in the case of 'Tifblue' and 'Delite', weaker flowers and heavy fruit drop. Water stress during fruit development, especially between May 20 and June 20, also increases fruit drop during that period in 'Tifblue' (5). Rabbiteye blueberry yields could be substantially increased by providing more effective cross pollination and increasing fruit set. Extensive interplanting of compatible cultivars which bloom synchronously may be the key to increasing yields.

### Table 2. Percent fruit set in 4 rabbiteye blueberry cultivars.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Fruit Set (%)</th>
<th>Date 1</th>
<th>Date 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodard</td>
<td>50.7</td>
<td>40.4</td>
<td>40.4</td>
</tr>
<tr>
<td>Bluegem</td>
<td>51.2</td>
<td>25.3</td>
<td>25.3</td>
</tr>
<tr>
<td>Tifblue</td>
<td>35.4</td>
<td>12.8</td>
<td>12.8</td>
</tr>
<tr>
<td>Delite</td>
<td>51.6</td>
<td>25.3</td>
<td>25.3</td>
</tr>
</tbody>
</table>

*Mean separation at each date by Duncan's Multiple Range Test, 5% level.*
*Date 1 counts made on May 2 for 'Woodard' and 'Bluegem' and April 13 for 'Tifblue' and 'Delite'.
*Date 2 counts made on June 20 for 'Woodard' and 'Bluegem' and June 27 for 'Tifblue' and 'Delite'.

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### Literature Cited