Flower Morphology Influences Pollinator Community with Implications for Cross-Pollination: Observations in Rabbiteye Blueberry (*Vaccinium ashei* Reade)

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Abstract

The narrow, long corolla of rabbiteye blueberries (*Vaccinium ashei*) can be challenging to foraging pollinators, particularly honey bees (*Apis mellifera*), and variations in this floral morphology appear to alter the species composition of the visiting bee community. The rabbiteye var. 'Premier' exhibits abnormal flower morphology, with shorten and split corollas, and appeared to be visited by a different community of bee pollinators than nearby, simultaneously flowering varieties. We conducted observations to compare bee visitation rates at 'Premier' flowers to other common rabbiteye varieties ('Powderblue' and 'Brightwell') that have more typical flowers. Timed observations were conducted during 2009 and 2010, and significantly more *A. mellifera* and significantly fewer wild bees visited 'Premier' flowers when compared to other rabbiteye cultivars. This apparent resource partitioning may reduce cross-pollination, which is important for successful rabbiteye blueberry production but may also increase *A. mellifera* visitation. A similar visitation rate increase by *A. mellifera* in blueberries has been suggested to occur following nectar robbing by carpenter bees (*Xylocopa* spp.).

Background

1. A complex of native and wild bees pollinate blueberries in North Carolina.
2. Blueberry pollinators vary in their abundance, per-visit efficiency, activity patterns, visitation rate, and interspecific interactions.
3. Rabbiteye blueberry cultivars may vary in flower morphology.
4. Differences in flower morphology may influence bee behavior and activity.

Methods

2009

Timed, 15 min. single plant observations were conducted on var. Premier (15 plants), Powderblue (9), and Brightwell (28) at three sites over the course of a total of 10 days (3-4 visits per site) during blueberry bloom.

2010

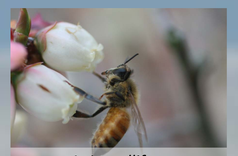
Timed, 15 min. observations of paired plants of var. Premier and Powderblue were conducted at a single location and repeated at four different times on different plants.

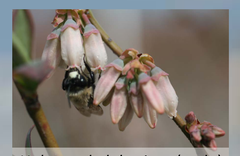
In both years, the number and species group (*Apis mellifera*, *Bombus* spp., *Habropoda laboriosa*, *X. virginica,* or small natives) of all bees visiting the flowers was recorded by a single observer (2009) or two observers (2010).

Statistical analyses

Using a generalized linear mixed model (Proc Mixed, SAS v. 9.2), we compared the effects of variety on the abundance of either wild bees or *A. mellifera* visits to a plant. Count data were log+1 transformed to meet the assumptions of normality, and the Satterwhaite method of estimation was employed for degrees of freedom due to unbalanced sample sizes. Because there was no significant difference in bee visits between varieties with normal flower morphology (Powderblue and Brightwell), these were pooled for all analyses. Site and year were considered random effects.

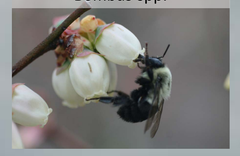
1. Blueberry pollinators


Apis mellifera


Habropoda laboriosa (male)


Andrena bradleyi (most common small native)

Bombus spp.



Xylocopa virginica

Small native bees

2. Relative pollinator efficiency

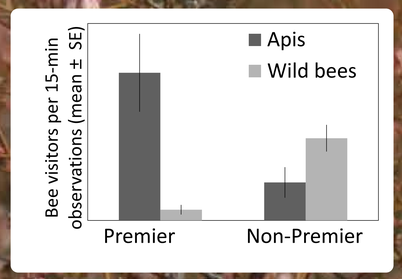
	Abundant?	Per visit Efficient?	Activity limits?	Visitation rate?
Optimal bee	Yes	Yes	No	Faster
Apis mellifera	Yes	No	Yes	Slower
Bombus spp.	No	Yes	No	Faster
Habropoda laboriosa	Sometimes	No	No	Faster
Xylocopa virginica	No	No	Yes	Slower
Small native bees	Sometimes	Yes	No	Slower
Osmia cornifrons	No	Yes	Unknown	Unknown

3. Rabbiteye blueberry flower morphology

a. Powerblue flowers with typical corollas, and b. Premier flowers with shortened corollas.

4. Pollinator community between rabbiteye blueberry varieties

Premier received significantly more visits from *A. mellifera* than wild bees, and non-Premier varieties received more visits from wild bees ($F_{1,113}$ = 64.8; P < 0.0001)



Results

- 'Premier' attracted a pollinator community distinct from other cultivars.
- This difference may be the result abnormal flower morphology found in 'Premier' rather than among-cultivar differences in nectar volume, concentration, or volatile profiles (Rodriguez-Saona et al. 2011).

Interpretation and relationship to previous work

A. mellifera were abundant at 'Premier' flowers due to the ease of access to their nectaries. Wild bees visit blueberry primarily for pollen, not nectar (Dogterom 1999), and may prefer flowers with a complete corolla, enabling more uniform handling. Alternately, wild bees may be avoiding interspecific competition with *A. mellifera* at 'Premier' flowers (Rogers et al. 2013).

These activities may reduce cross-pollination in intercropped plantings: *A. mellifera* may skip over less-attractive 'Brightwell' or 'Powderblue' plants to preferentially forage at 'Premier', and wild bees may do the opposite, avoiding 'Premier'. Despite the potential for reduced cross-pollination, Sampson and Cane (2000) found that *A. mellifera* were efficient pollinators of 'Premier'.

The attraction of *A. mellifera* to abnormal blueberry flowers is also worth considering in relation to the phenomenon of 'nectar-robbing' (Inouye 1980). The carpenter bee, *X. virginica* frequently robs nectar from blueberry flowers by creating a perforation in the base of the corolla. In the presence of these perforations, *A. mellifera* readily switch to nectar-robbing (Cane and Payne 1993) as a more efficient way of extracting nectar from flowers (Dedej and Delaplane 2005). Abnormal 'Premier' flowers are effectively similar to *Xylocopa*-perforated blueberry flowers. Interpreted in this context, our findings suggest that nectar-robbing by *Xylocopa* may actually increase blueberry visitation and enhance pollination by *A. mellifera* if nectar-robbing *A. mellifera* are equally efficient at pollinating blueberry flowers, as suggested by Sampson et al. (2004).

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