Effect of Bee Pollination and GA₃ on Fruit Size and Maturity of Three Rabbiteye Blueberry Cultivars with Similar Fruit Densities

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Abstract. Plants of the rabbiteye blueberry (*Vaccinium ashei* Reade) cultivars **Brightwell**, **Climax**, and **Tifblue** were subjected to pollination with bees or to applications of 250 mg·L⁻¹ of gibberellic acid (GA₃) to examine the influence on fruit size and maturation period. Plants were thinned to a similar fruit density (FD) 4 weeks after anthesis. 'Tifblue' and 'Climax' fruit were smaller on GA₃-treated than on bee-pollinated plants, but no difference was observed for 'Brightwell'. The fruit maturation period for 'Climax' was not affected by treatments, but 'Brightwell' and 'Tifblue' fruit on pollinated plants ripened 2 weeks earlier than fruit on GA₃-treated plants. These data suggest that excess fruit load is not the primary factor responsible for the smaller fruit size and lengthened fruit development period resulting from GA₃ applications to rabbiteye blueberries.

Fruit set of rabbiteye blueberry is often poor, especially when the crop is produced in large fields (Lyrene and Crocker, 1983; Lyrene and Goldy, 1983). Gibberellic acid (GA₃) has been used successfully in the southeastern United States to increase fruit set of several rabbiteye blueberry cultivars (NeSmith and Krewer, 1997b). Activity of the growth regulator depends on dosage and flower bud stage (NeSmith and Krewer, 1992, 1997a), and progress has been made in effectively using GA₃ as a management tool to improve rabbiteye blueberry fruit set under conditions of poor pollination (Williamson et al., 1995).

Fruit set following GA₃ applications is generally much greater than that resulting from pollination, but the resulting fruit are frequently smaller and take longer to ripen (Cano-Medrano and Darnell, 1998; NeSmith et al., 1995; Williamson et al., 1995). A plausible explanation for these observations is that GA₃-treated fruit generally have few or no seeds

(Cano-Medrano and Darnell, 1998; NeSmith et al., 1995). While this probably contributes to the small size, excess fruit load could also affect fruit size and development period. The objective of this research was to examine the effects of GA₃ and pollination on fruit size and development of rabbiteye blueberries having similar fruit density (FD).

Materials and Methods

One-year-old 'Brightwell', 'Climax', and 'Tifblue' blueberry plants grown in pine bark in 3.8-L containers were obtained from a commercial nursery in Dec. 1995. The plants were subjected to 700 h of artificial chilling (<7 °C) in a dark cold-room at the Georgia Station (Griffin, Ga.). After chilling (Jan. 1996), blueberries were moved to a greenhouse (24 °C day/18 °C night) with natural daylength to force budbreak. As flowers began to open, half of the plants of each cultivar were placed in a separate greenhouse (24 °C day/18 °C night) with a colony of commercial bumblebees (*Bombus* sp.) containing ≈50 workers. The other half of the plants remained in a greenhouse without bees, and received two applications of GA₃ (ProGibb 4%; Abbott Laboratories, Chicago) at 250 mg·L⁻¹ containing 0.25% X-77 surfactant. Gibberellic acid was first applied when a majority of flowers were at stage 5 to 6 (opened or nearly opened flowers) of bud development (NeSmith and Krewer, 1992). The second application was made 14 d later. Plants were sprayed to the point of drip. Six single-plant replicates of each cultivar per treatment were placed on greenhouse benches in a randomized complete-block design.

Following 4 weeks in separate greenhouses,

all plants were placed in the same greenhouse for the remainder of the experiment. At that time, total shoot length was measured and berry number was determined for each plant. These values were used to determine initial FD. The lowest FD for each cultivar was used as the target FD for the remaining plants of that cultivar. In order to adjust FD, a calculated number of berries was removed to give the desired density. The resulting FD were 0.3, 0.4, and 0.2 berries per centimeter of shoot for 'Brightwell', 'Climax', and 'Tifblue', respectively. Following fruit thinning, plants remained in the greenhouse until harvest was complete. Harvests were made weekly for all plants. At each harvest, all ripe fruit were removed, counted, and weighed. Means and standard errors were calculated for the number of fruit, and analysis of variance procedures were conducted on fruit size data for each harvest with mean separation by least significant difference tests.

Results and Discussion

Cumulative fruit number per 'Climax' plant over the course of the fruit-ripening period was not affected by treatment (Fig. 1). However, 'Brightwell' and 'Tifblue' cumulative fruit number was greater for the bee-pollinated plants at all weekly harvests except the

Fig. 1. Effects of pollination by bees vs. GA₃ treatment on cumulative fruit number harvested for 'Brightwell', 'Tifblue', and 'Climax' rabbiteye blueberries following thinning to equal fruit density (FD). Error bars represent standard errors for n = 6.

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final one. GA₃ delayed ripening of 'Brightwell' and 'Tifblue' fruit ≈2 weeks. This delay in ripening agrees with the recent findings of Cano-Medrano and Darnell (1998), who reported a 10- to 15-d delay in the ripening of 'Beckyblue' rabbiteye blueberry when GA₃ was applied. Our results with 'Climax' were less dramatic; however, even in 'Climax' a trend toward delayed ripening of the berries on GA₃-treated plants was evident.

Fruit weight was much greater for bee-pollinated than for GA₃-treated fruit of 'Climax' and 'Tifblue' plants for all harvests except the final one (Fig. 2). However, weights of 'Brightwell' fruit differed only for one harvest (week 3). All cultivars showed a typical decline in average fruit weight during the harvest period, regardless of treatment. Cano-Medrano and Darnell (1998) reported GA₃-treated fruit were consistently smaller than hand-pollinated fruit of 'Beckyblue', although FD was not uniform among treatments. NeSmith et al. (1995) reported that bee-pollinated fruit of 'Brightwell' and 'Tifblue' were larger than GA₃-treated fruit, but again, no attempt was made to equalize FD.

Our results suggest that the response of smaller, later-maturing fruit of GA₃-treated rabbiteye blueberries is probably a result of reduced seed numbers rather than increased fruit loads. Seed number was not measured, but pollinated fruit of all cultivars appeared to have more seeds than did GA₃-treated fruit. The effect of reduced seed number on size of GA₃-treated blueberry fruit has been well documented by others (Cano-Medrano and Darnell, 1998; NeSmith et al., 1995). The similarity in weights of 'Brightwell' fruit from plants with similar fruit loads in this experiment may indicate that cultivars differ in their ability to size fruit following GA₃ treatment when fruit loads are lessened. However, maturity of the GA₃-treated 'Brightwell' fruit was delayed in comparison with pollinated fruit even though FD was similar. Although we did not have a

Fig. 2. Effects of pollination by bees vs. GA₃ treatment on average weight per fruit for 'Brightwell', 'Tifblue', and 'Climax' rabbiteye blueberries following thinning to equal fruit density (FD). Mean separation within cultivars and weeks of harvest by least significant difference, $P \leq 0.05$.

nonthinned GA₃ control in this experiment, previous work has clearly shown that a heavy fruit set resulting from GA₃ application to 'Brightwell' results in small, late-maturing berries (NeSmith et al., 1995).

While these results support other findings that show GA₃-treated rabbiteye blueberry fruit are generally smaller and later maturing than

pollinated fruit, even with similar FD, this should not discourage use of the growth regulator. The increased fruit set following GA₃ applications should translate into increased total fruit yields even with smaller individual fruit size (NeSmith and Krewer, 1997; Williamson et al., 1995). Also, GA₃ can induce fruit set of freeze-damaged blueberries when pollination would otherwise fail (NeSmith et al., 1995). Growers should be aware of the influences described here, and use this information to determine if GA₃ would benefit their production.

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