SOUTHERN REGION SMALL FRUIT CONSORTIUM RESEARCH PROJECT
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TITLE Evaluation of Fruit Cracking and Berry Firmness in Rabbiteye Blueberry Germplasm

INVESTIGATOR

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OBJECTIVE

To evaluate existing rabbiteye blueberry cultivars and new selections for fruit cracking and berry firmness differences

JUSTIFICATION

Rabbiteye blueberries (*Vaccinium ashei* Reade) are well suited for conditions in the Southeast, since these grow well on most acid soils, including those with low organic matter, and because they generally are more tolerant to diseases (Krewer and NeSmith, 2000). However, problems of fruit cracking or splitting in response to excess rainfall during harvest often occur, rendering fresh fruit potential poor, especially for those cultivars harvested later in the season when rainfall is more frequent. Also, rabbiteye berry firmness is an important parameter related to post-harvest quality of fresh fruit, especially for long distant shipping.

Fruit cracking has been studied rather extensively in cherries, grapes, and tomatoes, but the problem in blueberry has received little attention (Marshall et al., 2002). Fruit splitting has been correlated to soil water content, water uptake and berry osmotic potential in cherries (Anderson, 1982; Sekse, 1995 and 1998), however, recent research with blueberries indicated little correlation with various fruit physiological parameters and incidence of fruit cracking (Marshall et al., 2002). Apparently, fruit cracking in rabbiteye blueberry is cultivar specific, and the incidence of splitting needs to be determined for current cultivars and germplasm being used to advance breeding (Marshall et al., 2002). A project funded by the SRSFC in 2005 began to examine rabbiteye germplasm for fruit cracking responses. Differences were noted among cultivars and selections (see SRSFC 2005 Research Report), but additional data are needed. Therefore, one objective of this research is to continue to survey current rabbiteye cultivars along with selections in the University of Georgia Blueberry Breeding Program for incidence of fruit cracking in response to a standard screening protocol.

Berry firmness has been recently evaluated for some rabbiteye blueberry cultivars at different storage temperatures (NeSmith et al., 2005). The initial experiment indicated cultivars do differ in firmness losses, especially at elevated temperatures. Additional research is needed to evaluate post-harvest firmness of current rabbiteye cultivars and existing germplasm to determine suitability for fresh market usage and long distant shipping. Therefore, the additional objective of this research will be to survey rabbiteye blueberry fruit firmness, and attempts will be made to determine if fruit cracking and firmness are correlated.

METHODS

The UGA Blueberry Breeding Program has numerous standard rabbiteye cultivars readily growing, along with a number of selections at locations in south and middle Georgia (NeSmith, 2006). Thus, germplasm for this study was readily available. In order to assess variation in fruit cracking, the method designated by Marshall et al. (2002) was employed. Briefly, berries from each blueberry line of interest were harvested at commercial maturity and were submerged in distilled tap water overnight (12 to 14 hours). The following day, individual berries were examined from each line, and the number of splits was recorded. A scale reflecting the severity of fruit cracking was developed as follows: (A) no visible cracking; (B) 1 or more, small hair-line cracks, (C) more prominent cracks, (D) frequent cracks observed, some leakage present, (E) severe cracks and rupturing of the berry skin observed, with considerable leakage (Fig. 1). Berries having a rating of C, D, or E (moderate to severe cracking) were considered commercially unacceptable. Berries were obtained for each line at multiple harvests.

Fruit firmness was determined using a FirmTech II firmness assessment device (NeSmith et al., 2002; NeSmith et al., 2005; Tetteh et al., 2004). The protocol used measured initial firmness at harvest, followed by firmness measurements after 72 h of storage at room temperature (25 C). Instrument settings were 50 g minimum force and 250 g maximum force. Cultivar standards included Austin, Alapaha, Baldwin, Brightwell, Centurion, Climax, Columbus, Premier, Powderblue, and Ochlockonee. Additional lines included advanced selections from the UGA Breeding Program. Once all data were collected, the correlation of fruit cracking and firmness was assessed.

RESULTS

Fruit cracking data again in 2006 depicted a range of results for various cultivars and selections (Table 1). The standard cultivars with the lowest degree of fruit cracking were Ochlockonee, Premier, and Alapaha. Generally, selections and cultivars ranked similarly to those observations from berries in 2005 with a few exceptions. For example, ‘Tifblue’ cracking percentage in 2005 was very high (45%), whereas in 2006 it was only 19%. In contrast, ‘Vernon’ cracking percentage in 2005 was only 15%, whereas in 2006 it was 39%. Reasons for these different responses for certain cultivars in the two years are not

clear. However, in 2006 we did rate cracking severity, which is likely a better estimate of troublesome cultivars and/or selections. When only those berries that were rated as moderate-to-severe splits were considered, only five selections had a percentage of splits greater than 10%. Hence, in future evaluations, it is recommended to rate fruit cracking severity rather than total number of berries with any visible splits.

In addition to fruit cracking assessment, fruit firmness was determined for the various germplasm in 2006 using a FirmTech II device (Table 1). As with fruit cracking data, the firmness data indicate a range in firmness values for the various selections and cultivars. The selection T-671 had the highest firmness readings and 'Premier' had the lowest. Overall, all rabbiteye material was considered firm, although there were those with a higher degree of firmness. The firmness values should be useful for determining which selections would be suitable for mechanical harvesting for the fresh market and for long distance shipping.

The data in Table 1 suggest a possible correlation between firmness and fruit cracking. That is, those selections that were the most firm tended to be those with higher fruit cracking percentages. In order to examine this relationship further, correlations between the variables were determined (Fig. 2). Using all data points from selections, the data indicated a trend for increased fruit splitting with increased firmness (upper graph Fig. 2) in each of the two years. However, when two "outlier" selections were removed (T-451 and T-675) from the analysis, a strong correlation between fruit firmness and cracking percentage was found (lower graph Fig. 2). Hence, these data suggest that our selecting for the favorable trait of very firm fruit may also be selecting for the negative trait of a tendency for fruit cracking. Additional research in this area is needed to explore this relationship further.

IMPACT

These preliminary findings indicate there are considerable differences in fruit cracking and berry firmness among rabbiteye germplasm. The fruit cracking assay appears to be useful for identifying those selections that may not be suitable for production in areas that receive considerable rainfall during harvest. Also, the fruit firmness measurements should indicate those cultivars and selections that should be considered for mechanical harvesting and long distance shipping. The trend for a correlation between fruit cracking and firmness should be considered in our blueberry breeding efforts.

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Table 1. Fruit cracking and firmness for various rabbiteye blueberry selections during 2006. The category "moderate-to-severe" splits were considered commercially unacceptable berries.

Culitvars and selections	Total splits (%)	Moderate to severe splits (%)	Fruit firmness at harvest (g/mm)
Alapaha	6.0	1.0	219
Austin	14.0	1.0	241
Baldwin	5.0	2.0	197
Brightwell	12.0	4.0	244
Centurion	8.0	6.0	219
Climax	10.0	2.0	227
Columbus	19.0	9.0	197
Ochlockonee	1.0	0.0	208
Powderblue	16.0	1.0	207
Premier	4.0	1.0	194
Tifblue	19.0	8.0	241
Vernon	39.0	10.0	234
T-451	57.0	39.0	214
T-516	6.0	1.0	212
T-619	7.0	2.0	263
T-655	24.0	6.0	252
T-670	12.0	3.0	229
T-671	51.0	22.0	305
T-672	21.0	9.0	211
T-674	25.0	3.0	256
T-675	44.0	22.0	241
T-676	35.0	18.0	208
T-743	53.0	27.0	238
T-760	14.0	9.0	268
$LSD_{0.05}$	**12.9**	**8.3**	**14.7**

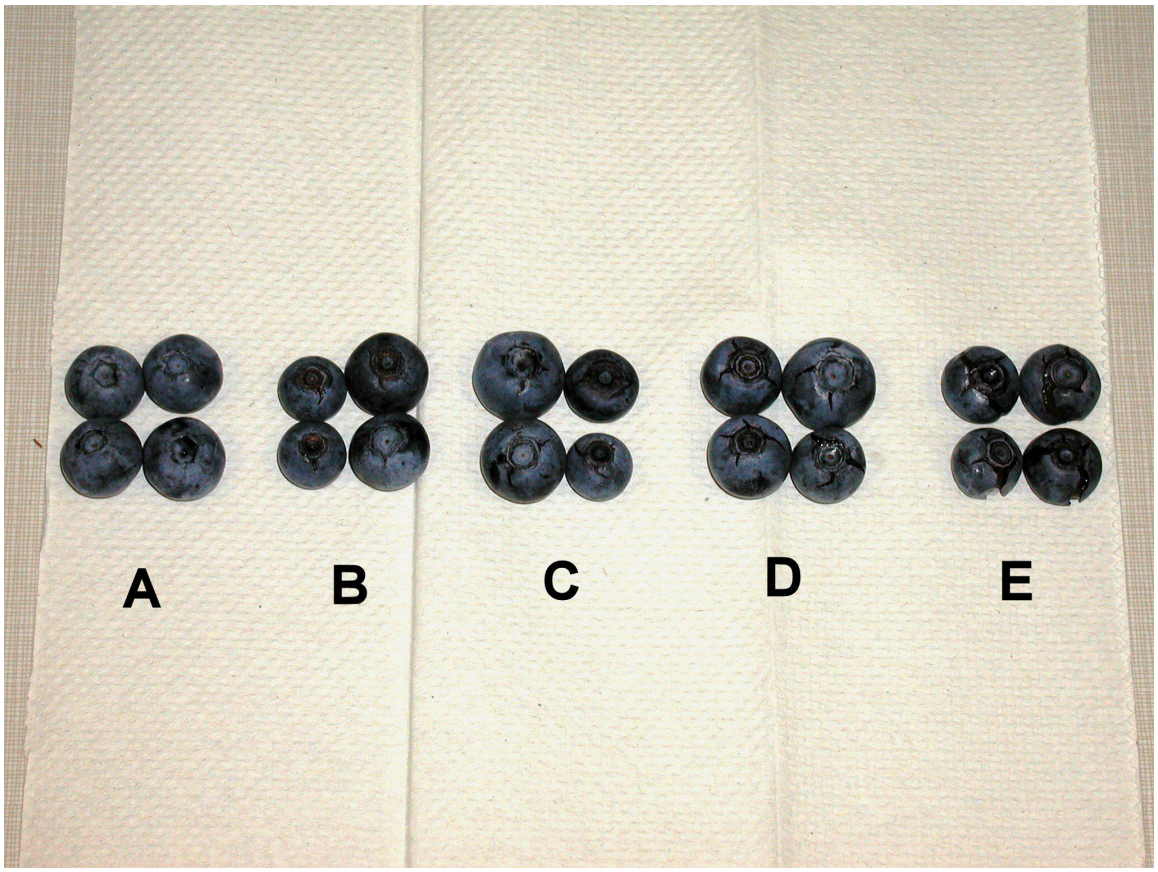
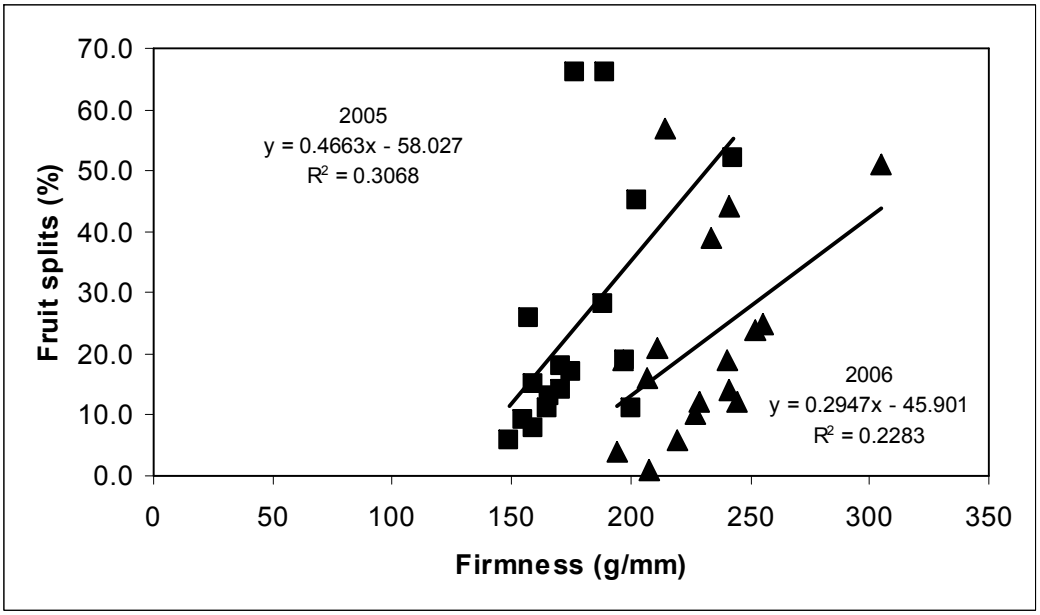


Figure 1. Range in cracking severity in response to soaking treatment. (A) no visible cracking, (B) 1 or more small hair-line cracks, (C) more prominent cracks, (D) frequent cracks observed, some leakage present, (E) severe cracks and rupturing of the berry skin observed, with considerable leakage.



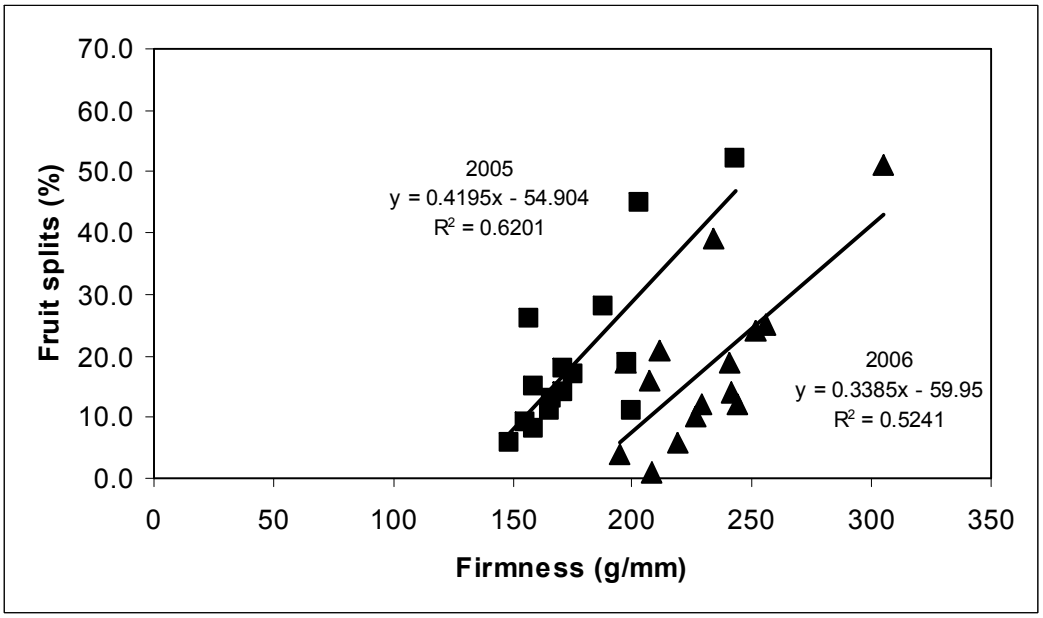


Figure 2. Correlations between firmness readings and fruit cracking percentage for various rabbiteye selections during 2005 and 2006. The upper graph includes all selections, and the lower graph was adjusted by removing two selections considered "outliers" (i.e., those having a high degree of fruit cracking and only moderate firmness).