New Banana Cultivars Trial in the Coastal Plain of South Georgia

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Scientists at the University of Georgia have been conducting research on the potential of banana production at the Bamboo Farm and Coastal Gardens, Savannah, since 2003. Banana research has now been extended and for the first time is being carried out at the University of Georgia, College of Agricultural and Environmental Sciences, Tifton Campus, located in the south-central part of the state in a more temperate climatic zone. The State of Georgia produces many fruits such as apples, blueberries, strawberries, blackberries, grapes and peaches, but banana has never been considered an economic crop due to unfavorable weather conditions, which has rendered the U.S. a net importer of this nutritionally important crop. In Tifton, 63 different cultivars obtained from three different sources—Belgium, Puerto Rico, and Florida—were planted in an experiment using a randomized complete block design. The principal objective is to evaluate which of these cultivars will be suitable for fruit production under Tifton weather conditions. All aspects of agricultural production will be investigated and good agricultural practices (GAP) will be developed to facilitate production of this important fruit crop.

Bananas *(Musa spp.)* are "monocotyledon, herbaceous and evergreen perennials" (Robinson 1996; Fonsah and Chidebelu 1995). The importance of the crop in terms of food security, therapeutic, nutritional and medicinal purposes is well documented (Fonsah and Chidebelu 1995; Fonsah, Krewer, et al. 2007; Krewer et al. 2008). Several studies have shown that banana can be utilized in different ways. The leaves, pseudo stems, roots, and fruits have added value (Fonsah and Chidebelu 1995). For instance, beer can be produced from bananas. Children utilize the leaves as umbrella during rainfall and adults utilize the leaves as wrappers for special dishes and eco-friendly plates in Africa (Fonsah and Chidebelu 1995; Fonsah, Krewer, et al. 2007; Krewer et al. 2008; Wallace, Krewer, and Fonsah 2007a). In Central America, researchers have successfully produced paper using banana fibers extracted from banana pseudo stems collected from corporate plantations after harvesting in place of conventional wood fiber. These leftover wastes were sources of "constant environmental contamination and destruction as they polluted the nearby rivers, affecting the flora and fauna thus hazardous to the communities living around the banana plantations" (E.A.R.T.H. 1998). The fruits are eaten as desert and some cultivars are cooked green (Fonsah and Chidebelu 1995; Waddick and Stokes 2000; Fonsah, Krewer, et al, 2007; Krewer et al. 2008).

Due to the beautiful color of the leaves and pseudo stems, banana plants can also be used as ornamentals and for landscaping. The cultivar variations, taxonomic classifications, and different morphological characteristics render banana plants appealing to landscapers (Fonsah, Krewer, and Rieger 2003, 2005; Fonsah, Krewer, and Wallace 2006; Fonsah, Adamu, et al. 2007; Waddick and Stokes 2000; Krewer et al. 2007). The objective of this study is to determine whether bananas can be successfully grown in the Coastal Plain climatic zone 8A.

Material and Methods

Tissue Culture (TC) banana plantlets from Puerto Rico and Belgium arrived January 16, 2009 and February 11, 2009, respectively, and were repotted into three-liter containers with Fafard 3-B potting mix and kept in the greenhouse at the University

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of Georgia, Coastal Experimental Station, Tifton Campus for post in-vitro processing. Land preparation started January 22 and continued through May 11, 2009. During this time various land-prep operations such as drainage tile installation, land tillage, S-tine installation, soil sampling and lime application were undertaken. Beds and drainage system were constructed after lime application. We transplanted 63 cultivars from three different sources: Belgium, Puerto Rico, and Florida. The plants from Florida were mostly replants extracted from the University of Georgia Bamboo Farm and Coastal Gardens Banana Research plot. Actual planting took place on May 11, 2009 in a randomized complete block design. Spacing was 8ft x 8 ft equidistant triangular with a population density of 800 plants/acre. Preplant fertilizer was applied at a rate of nine ounces per plant of 10-10-10. Thereafter we applied 8.7 oz of KCL/ mat and 4.3 oz of Urea CO $(NH_2)_2$ per plant/month, alternated with nine ounces of 10-10-10 every other month. For weed control we alternated a mixture of Paraquat 40 oz with 16 oz of a non-ionic surfactant /acre and glyphosate (Glyphos-Xtra) 114 oz + 16 oz of non-ionic surfactant per acre. Deleafing (removal of any broken leaves and any leaves touching the bunch) was conducted every month and sucker pruning was conducted every two months. Solid set irrigation was installed before planting, and water was applied for 15 minutes every two hours to keep the leaves moist and protect against extreme heat for the first week of planting. Thereafter we applied about two inches of water every week in three applications except when it rained.

Data Collection

We were interested in morphological, pomological, and phenological data. We kept records on total number of suckers per plant, leaf width, leaf length, pseudo stem circumference, plant height, number of leaves per plant, bunch weight, and number of fingers per bunch. We also documented the time from planting to shooting, from shooting to bagging, and from bagging to harvesting (Fonsah and Chidebelu 1995; Robinson 1996; Stover and Simmonds 1997).

Results and Discussion

Climatic Conditions

The Coastal Plain of Georgia experienced unusual weather conditions in 2009, especially from January to June. Heavy rainfalls of up to about 17 inches were observed. Serious flooding occurred on the research plot and rendered land preparation and other activities impossible. Since excessive water is harmful to banana plants, we were obliged to install drainage, systems in the plot. Due to wet soil, no heavy equipment like tractors could be used. Consequently, by the time every necessary operation such as liming, tilling, sub-soiling, drainage and irrigation installations was completed, it was late for planting, especially since one of our objectives was to evaluate short-cycle cultivars in our study.

Plant Growth Rate and Performance

There were variations in plant characteristics before and during planting. For instance, there were differences in plant heights, age, type, and sources. Although some of the plants were the same cultivar, they came from different sources. For instance, we had Veinte Cohol plants from three different sources: Belgium, Puerto Rico, and Florida. They all arrived at different times and were different ages and sizes. Also, some of the plants in the study were tissue culture, others were suckers extracted from original tissue culture parent plants, and some were propagated peepers. Despite these variations, all plants performed well and had excellent growth rates. By the third and fourth months after planting it was difficult to determine the age differences. During weed control, two of the five Novaria were killed by herbicides.

Flowering and Fruiting

Although we were almost two months late in planting due to the weather, 32 of 63 plants (roughly 51 percent) produced fruits/bunches in the experiment. Table 1 shows all the plants that produced fruits/bunches in the experiment. They were Novaria, Blue Torres Island, Cacambou, Dwf Nino, Gold Finger, Veinte Cohol, Grand Nain, Gypumgusi, and Chinese Cavendish. Amongst the plants that produced fruits, Novaria, Blue Torres Island, Cacambou, Pisang Awak, and Gypumgusi are new to us (Table 1).

Table 1. Banana Cultivars that Produced Fruits/Bunches before December 15, 2009.

1. Veinte Cohol	12. Kandarian	23. Chinese Cavendish[a]	34. B. Torres Island[a]	45. Pisang Awak[a]	56. Veinte Cohol[a]
2. Pisang Awak	13. Cacambou[a]	24. Pisang Awak	35. Gold Finger[a]	46. Gypungusi	57. Veinte Cohol[a]
3. Novaria[a]	14. Gypungusi	25. Novaria	36. Veinte Cohol[a]	47. B. l. Torres[a]	58. B. I. Torres
4. Blue Torres Island	15. Dwf Nino[a]	26. Gold Finger[a]	37. B. I. Torres[a]	48. C. Cavendish	59. Manzano
5. Novaria	16. Cacambou	27. Veinte Cohol[a]	38. B. I. Torres	49. Dwf. Nino	60. Ice Cream
6. Cacambou[a]	17. Cacambou	28. Gold Finger	39. Gypungusi	50. Cacambou	61. Dwf. Namwah
7. Cacambou[a]	18. Manzano	29. Veinte Cohol[a]	40. Grand Nain[a]	51. Veinte Cohol[a]	62. Saba
8. Chinese Cavendish	19. Pisang Awak	30. Dwf. Orinoco	41. Veinte Cohol[a]	52. Gypumgusi[a]	63. Raja Puri
9. Cacambou[a]	20. Novaria[a]	31. Veinte Cohol	42. Dwf. Nino	53. Grand Nain[a]	
10. Chinese Cavendish[a]	21. Cacambou[a]	32. Cacambou[a]	43. Dwf. Namwah	54. Veinte Cohol[a]	
11. Blue Torres Island[a]	22. Novaria	33. Dwf. Namwah	44. Veinte Cohol[a]	55. Gypumgusi	

[a]Cultivars that produced bunches in the research.

Characteristics of Fruited Plants

Novaria Cultivar

Out of a total of three Novaria that were planted, two (67 percent) produced bunches/fruits. This cultivar was imported from the International Network of the Improvement of Banana and Plantain (INIBAP) Germplasm in Belgium. Five TC plants arrived February 2009; two were killed during weed control with Glyphos-Xtra (Roundup) run-off (Table 2). Therefore these plants are very susceptible to chemicals. They showed some potential characteristics of being classified short-cycle, but further research is needed to confirm this hypothesis.

Blue Torres Island Cultivar

Blue Torres Island plants were obtained from Puerto Rico in two different TC consignments, the first in April, 2008 and the other January 2009. Two of the January 2009 consignment died during post in-vitro process and one of the two that were transplanted produced a bunch. On the other hand, all four of the April 2008 consignment survived and all produced huge bunches. It is interesting to mention that although the April 2008 consignment was almost 13 months old whereas the January consignment was only four months old during transplanting, both consignments produced fruits/bunches at the same time. Therefore the age of the plants did not affect their ability to produce fruits. However, the fruit emergence was not early enough to mature before the winter (Table 2).

Cacambou Cultivar

Similar results were observed with Cacambou plants. Both consignments came from Puerto Rico, one in April 2008 and the other in January 2009

Table 2. Performance and Sources of the Banana Cultivars that Produced Fruit in the Coastal Plain Research Plot, Tifton, Georgia, 2009.

Cultivars	# of plants	# of short	% of short plants	Source of plant	Type of plant
1. Novaria	3	2	67	Belgium	TC/02/09[1]
2. Blue Torres Island	2	1	50	Puerto Rico	TC/01/09[2]
3. Blue Torres Island	4	4	100	Puerto Rico	TC/04/08[3]
4. Cacambou	5	3	60	Puerto Rico	TC/01/09[2]
5. Cacambou	4	3	75	Puerto Rico	TC/04/08[3]
6. Chinese Cavendish	4	2	50	Belgium	TC/02/09[1]
7. Gold Finger	3	3	100	Florida	S/08/08[4]
8. Veinte Cohol	5	5	100	Florida	P/S/08/08[5]
9. Veinte Cohol	3	3	100	Belgium	TC/02/09[1]
10. Veinte Cohol	2	2	100	Puerto Rico	TC/01/09[2]
11. Grand Nain	2	2	100	Florida	R/TC/08/08[6]
12. Pisang Awak	3	1	33	Puerto Rico	TC/04/08[3]
13. Gypumgusi	5	1	20	Puerto Rico	TC/04/08[3]

[1]Tissue culture plants received February 2009, potted and hardened in greenhouse until transplant in May 2009.
[2]Tissue culture plants received January 2009, potted and hardened in greenhouse until transplanted in May 2009.
[3]Tissue culture plants received April 2008, potted and hardened in greenhouse until transplanted in May 2009.
[4]Sucker extracted in August 2008, potted and nursed in the greenhouse until transplanted in May 2009
[5]Peeper extracted in August 2008, potted and nursed in the greenhouse until transplanted in May 2009.
[6]Ratoon from tissue culture plants extracted in August 2008, potted and nursed in greenhouse until transplanted in May 2009.

(Table 2). Seventy-five percent of the April 2008 consignment produced healthy fruits, compared to 60 percent of the January 2009 consignment. Because we were almost six weeks late in planting, the bunch emergence was also not early enough to reach maturity prior to the arrival of winter.

Chinese Cavendish Cultivar

This cultivar was supposed to be short-cycle, although we have yet to see any published literature confirming this. Out of the five we received from INIBAP germplasm in Belgium, one died during post in-vitro and four were transplanted in May 2009. Two of the four transplanted specimens (fifty percent) produced bunches in seven months. It is worth mentioning here that the weather, especially the night temperature, in the Coastal Plain started getting colder in October 2009, thus slowing the growth process. Although there are not enough data to form a valid scientific conclusion, we believe that if planting had not been delayed this cultivar would have produced fruit/bunch earlier. Further research is needed to determine whether this cultivar is sufficiently short-cycle for our climatic conditions (Table 2).

Veinte Cohol Cultivar

Another interesting result is the Veinte Cohol cultivar, which came from three sources: Florida, Belgium, and Puerto Rico. The Florida consignment consisted of propagated peepers obtained from suckers in August 2008. The second consignment consisted of TC received from INIBAP, Belgium on February 2009 and the third consignment was

obtained from Puerto Rico in January 2009. All the plants from the three sources produced fruits/bunches. All of the bunches from all sources of supply reached maturity and were harvested, packed, and ripened.

Conclusion

Thirty-two of 63 plants actually produced bunches/fruits as early as four months after planting. The 32 plants belonged to nine different cultivars: Novaria, Blue Torres Island, Cacambou, Dwf Nino, Gold Finger, Veinte Cohol, Grand Nain, Gypumgusi, and Chinese Cavendish. Two cultivars, Novaria and Chinese Cavendish, showed potential characteristics of being considered short-cycle plants in our weather conditions, but more research needs to be conducted to support this conclusion. In our study, all ten Veinte Cohol plants not only produced fruits but the fruits actually reached maturity and were harvested before the official winter season, November 15. This finding is consistent with the results of other studies (Wallace, Krewer, and Fonsah 2007b, 2008) that concluded that Veinte Cohol is a short-cycle banana cultivar that can be successfully grown commercially in the Southeast region of the U.S.

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