Banana Cultivar Trials for Fruit Production, Ornamental-Landscape Use, and Ornamental-Nursery Production in South Georgia

Esendugue Greg Fonsah, Gerard Krewer, and Mark Rieger

North America is the largest net importer of bananas on a regional basis. The United States is still the world's number-one importer and consumer of bananas. U.S. companies spend approximately $1.1 billion each year on banana imports, purchasing 31.1% of total world imports (Fonsah 2002; FAO 2001). Bananas and plantains together have been rated the fourth most important crop in the world in terms of food value and food security. This research is aimed at determining the feasibility and suitability of Annual Cropping Production (ACP) for a niche market under Georgia weather conditions and, determining which cultivars have the greatest potential for ornamental-landscape use and ornamental-nursery production. Phenological and pomological sampling and data will be used to analyze the feasibility and suitability of ACP and ornamental use.

Key Words: banana, cultivars, input application, fertility, field operations, production, marketing, quality, landscape, green industry, finger length, calibration, pseudo-stem.

North America (Canada and United States) has been by far the largest importer and consumer of bananas in the world since the early 1990s (Figure 1). The U.S. and Canada imported 34.5% of the world total import volume in 2000. Of this, the U.S. imported 31.1% of the total world volume of 11.7 million tons, or to 3.6 million tons, thus rendering the U.S. the single largest banana-consuming country in the world. Canada only imported 3.4% of the world total (FAO 2001).

For the past several years, the U.S. import value of bananas has stood at about $1.1 billion. The forecast for 2004 banana imports is $1.2 billion, a 9 percent increase from 2003 (Fonsah 2003; Whitton and Carter 2002, 2003). Although U.S. agricultural trade balances have been positive in recent years, the gap between imports and exports is narrowing, reducing the positive trade balance. As a result, the $9.5-billion positive balance of agricultural trade forecasted for 2004 is 10.5% lower than for 2002. At the same time, banana imports alone represent 2.5 percent of total 2004-forecast agricultural imports of $47.5 billion.

Fonsah is assistant professor, Krewer is professor, and Rieger is professor, University of Georgia, Athens, GA.

We are indebted to Randy Strode, Owner of Agri-Starts, Inc, Apopka, Florida, who donated the tissue culture plants used for our research. We are also grateful to Steve Brady, David Linvill, Mindy Linton, Chris Roberts, Frank Williams, and Kathy Deloe for assisting in maintenance and data collection.

Since the U.S. banana market depends almost exclusively on imports from other countries, price fluctuations depend on the quantity supplied. There was a negligible 0.6 percent price decrease in July 2003 from July 2002. An estimated 3 percent increase in price is forecast for August 2004 from August 2003. Prices are less lucrative and sustain a downward slope in the summer season when bananas have to withstand fierce competition from a wide variety of summer fruits and customer substitution effects set in. This price volatility and fierce competition in the summer of 2003 did not deter U.S. banana imports—5.1 billion pounds were imported, a decrease of only 0.1 percent (Perez and Pollack 2003).

Interestingly, studies from FAO (2001) show that even though the U.S. is the largest consumer and importer of banana in the world, they pay the lowest wholesale and retail prices per kilogram in the world (Figure 2). Except in 1998, Germany led other developed nations in wholesale prices per kilogram. It is also interesting to note that source of supply and brand name have an impact on the prices obtained.

Trends in Banana Production and Marketing in the U.S.

Hawaii is the only state in the U.S. that produces Cavendish and apple bananas on a commercial

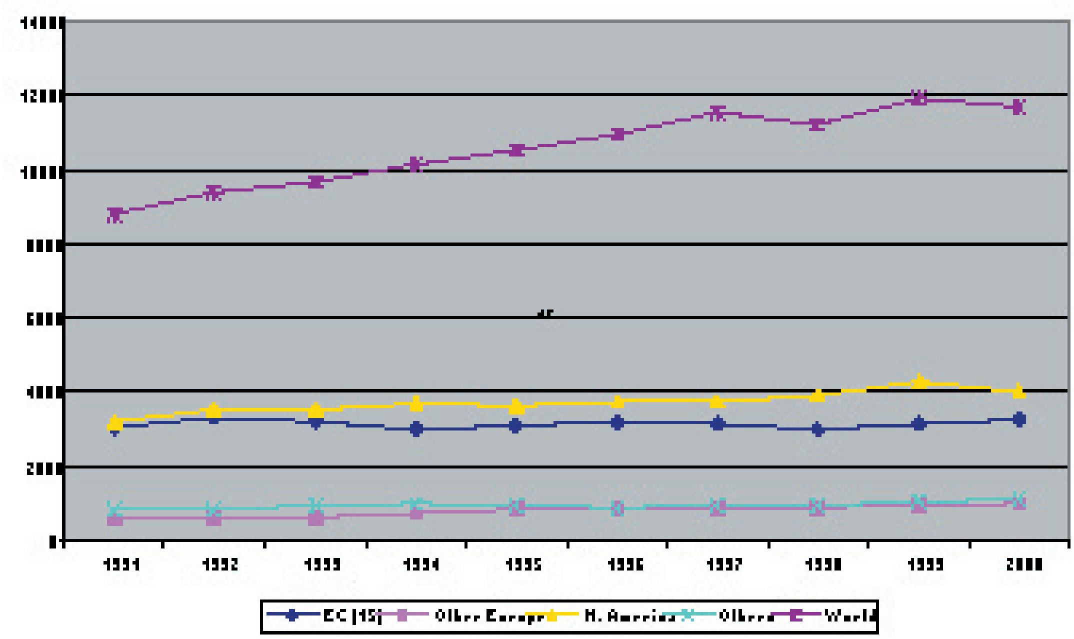

Figure 1. World Banana Import, Selected Major Countries,1991–1999.

Source: FAO (2001).

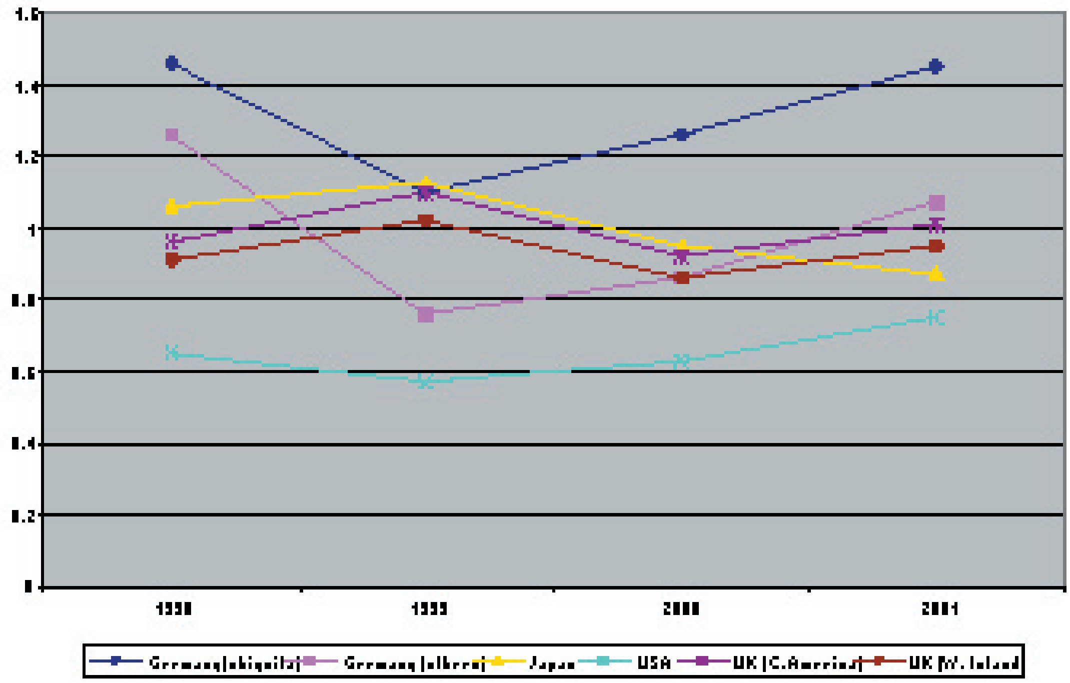

Figure 2. Wholesale Prices in Selected Countries,1998–2001.

Source: FAO (2001).

scale. Total production for 1999, 2000, 2001, and 2002 were 24.5, 29, 28, and 20.6 million pounds (11,136; 13,182; 12,727, and 9,364 metric tons), respectively. The state generated $8.6 million, $10.4 million, and $10.6 million in 1999, 2000 and 2001, respectively (Figure 3). The 26.4% decrease in production from 2001 to 2002 was partially a result of the Banana Bunchy Top virus (BBTV) that infested most of the farms in the Kona area; the Hawaii Department of Agriculture imposed a two-year ban as part of the eradication effort. Lower-yielding Hawaii apple bananas could also be partially blamed for the drop in production.

Plantings totaled 1,760 acres (~704 hectares), 1710 acres (~697.96 hectares),and 1660 acres (677.6 hectares) in 1999, 2000, and 2001, respectively, while average prices fluctuated between 38 cents per pound (83.6 cents per kg) and 42.5 cents per pound (93.5 cents per kg) during the same period (HASS 2001, 2002). Hawaii apple bananas command higher prices than Cavendish bananas (Figure 4). Cavendish prices are usually depressed

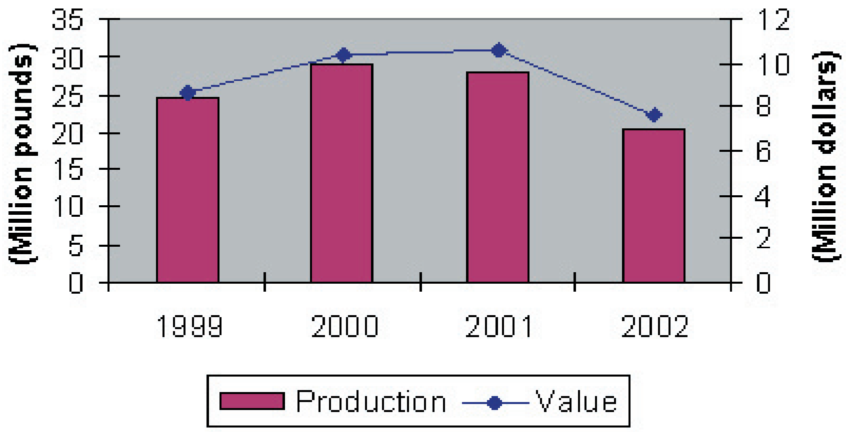

Figure 3. Hawaii Banana Production and Farm Gate Value,1999–2002.

Source: NASS (2002).

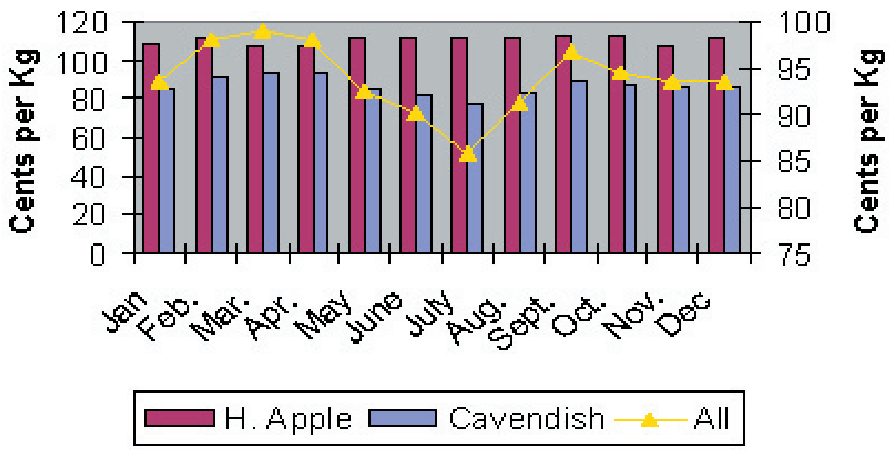

Figure 4. Hawaii Monthly Banana Prices, 2002.

Source: NASS (2002).

by quality requirements, fierce competition, and flooded markets from the export industry in tropical America.

Other studies indicate that non-Cavendish bananas have been a valuable crop in Florida for more than a century (Ploetz et al. 1999; Stambaugh 1952). Because of its subtropical climate, the Florida banana industry has no comparative advantage over the tropical Central American banana-producing countries, so growers have limited themselves to the non-Cavendish cultivars and targeted the ethnic niche market. This market generates about $2.5 million annually (Ploetz et al. 1999; Degner et al. 1997).

Annual Cropping Production (ACP)

The annual cropping production (ACP) is a strategy that alters the natural agricultural-production cycle and practices in order to target a particular market during periods of scarcity and to take advantage of better prices. This strategy also is aimed at developing and penetrating matured markets with a new branded product. The easiest method to penetrate the market at the right time is to plan planting so that that harvesting coincides with periods of fruit scarcity.

The anatomical and morphological characteristics generally change with the agricultural practices adopted and cultivars utilized. In the commercial production system utilizing Cavendish varieties such as “Williams” or “Grand Nain,” planting to shooting takes about 20–22 weeks from and shooting to harvest about 12 weeks. This time can be shortened by about 8 weeks when tissue-culture plants are used (Fonsah and Chidebelu 1995; Robinson 1996; Stover and Simmonds 1987). Furthermore, Robinson (1996) shows that 30 days after emergence of the inflorescence, the pulp/peel ratio is 0.17; this ratio increases to 1.0 after 70 days to and 1.87 at harvest. The growth rate of the finger during the rapid growth stage is 4 mm per day. These characteristics differ from country to country and from cultivar to cultivar, factors the ACP system has to take into consideration.

Georgia-grown bananas would be classified as exotic fruit that appears in the market at a particular time of the year. It could also target ethnic niche markets, depending on which cultivar performs better in Georgia’s climate and meteorological conditions. Furthermore, additional source of income can be generated from the by-products such as the male bud, which currently sells for $1.49 per pound ($3.28/kg) in the Atlanta Farmers Market. The foliage is sold in various ethnic markets (Chinese and African Markets) and in the Farmers Markets. Small bananas are often grown in South Georgia for ornamental purposes. Their tropical foliage is greatly appreciated and often used for landscaping patios, pool areas, and gardens.

Which cultivars can be used for various ornamental purposes under Georgia conditions must be determined. Plant height varies greatly with cultivar, and the selection of the proper height is important for landscape planning. Variations in plant color must also be considered. In order for nurseries to produce their own plants from suckers, data on sucker production is important.

Material and Methods

Environmental Conditions

The experiment was conducted at the University of Georgia Coastal Gardens in Savannah, Georgia, latitude 32.133' N, 81.2' W, elevation 14 meters (45 feet). The average temperature ranges from 76.91^{o}F to 55.72^{o}F, with a daily average of 66^{o}F. Thirty-one different cultivars were donated to by Agri-Starts, Inc. of Apopka, Florida, a biological technology company that produces and sell tissue culture liners. The plants were in 72-cell packs. When they arrived, they already had 4–5 leaves and well developed root system. Two additional cultivars, “Raji Puri” and “Frank Unknown,” were obtained locally as sword suckers. Tissue cultured plants arrived in Savannah on 3 March and were repotted into three-liter containers with Fafard 3-B potting mix. The plants were placed in the greenhouse and fertilized with 15 grams of Osmocote and grown in the greenhouse until 24 April.

Soil Characteristics

The test site was on a Pelham fine loamy sand. Soil pH was adjusted to 6.5 prior to planting with dolomitic limestone. Pre-plant soil-nutrient levels were medium for potassium and high for phosphorus, so no pre-plant fertilizer was applied. The site was subsoiled, and raised beds one meter wide and 25 cm high were constructed. Two lines of drip irrigation tape were used on each bed. About 10 cm of yardwaste mulch was applied to the top of the bed.

Experimental Design

Plants were set in the field on 24 April. Experimental design was a randomized complete block with five single-plant replications. Planting distance was 2.4 x 2.4 meters (8 x 8 ft) equidistant triangular planting pattern with a plant-population density of 1736 plants/hectare. The site was kept relatively weed-free by the use of mulch and contact herbicides. Plants were fertilized with 112 grams per plant of 18-6-12 Osmocote at planting. Plants were re-fertilized with 110 grams per plant of All Purpose 10-10-10 on 4 June 2003. A third fertilization was done on 22 August 2003. Plants in Replications One, Two, and Three were fertilized with 56 grams of potassium nitrate per plant. Plants in Replications Four and Five were fertilized with 110 grams of 10-10-10 per plant. The plants were irrigated 3 to 4 times a week or as needed.

Data Collection

Plant height to the upper leaf axle, pseudo-stem circumference at 0.6 m, and leaf number were measured on 4 September and 14 October. The length and width of the leaf blade on the fifth leaf from the apex were measured on 14 October and a plant description recorded. Data on sucker production was recorded on 4 September and 14 October. Plant growth rate and esthetics were recorded. Other horticultural production data such as weed control and fertilizer application were also recorded.

Data Analysis

Basic descriptive statistical analysis was used. Mean separation by Proc Mixed (SAS 2000) was used for classification of plant heights, pseudo-stem circumference, number of suckers, number of leaves, and length and width of leaves.

Results and Discussion

Plants Characteristics

Plants were divided into three categories based on height. *Tall* was defined as plants from 1.5 meter to 2.0 meters high, *medium* was plants from 1.0 to 1.49 meters high, and *short* was plants less than 1.0 meter high. The best tall plants were Kandarian, Musa 1780, Saba, Ice Cream, and Kummunaba. The best medium height plants were Dwarf Namwah, Pace, Dwarf Orinoco, Super Plantain, and Raja Puri. The best short plants were Grand Nain, Williams Hybrid, Sum X Cross, and Dwarf Nino (Table 1).

Attractive color combinations occurred on the leaves and petioles of a number of cultivars. Sum X Cross had attractive red spots on the upper leaf surface and maroon undersides of the leaves. Raji Puri had brown patches on the bases of the petioles and pink edges on the edge of the petioles. Kummunaba had a pink blush on the mid-rib of the leaf (Waddick and Stokes 2000).

The best nursery-production cultivars were Grand Nain, Williams Hybrid, Musa 1780, Cardaba, and Manzano. These cultivars had 4.6 to 5 suckers per plant.

Disease Infestation

Several plants, including Cardaba, Mysore, and Sikkimmensis, exhibited symptoms of disease infestation. One out of five Sikkimensis died, and the other four exhibited poor plant-growth characteristics. Burmese Blue was more susceptible to desease attack and had the highest death rate, three out of five; the two remaining plants exhibited extremely poor growth performance. Two out of five Cardaba died, but the remainder performed relatively well. One Orinoco out of five died, but the rest performed very well. Two Hua Moa performed well, two showed extensive insect foliar feeding, and one was a mutant. One Dwarf Nino also died. The Dwarf Namwah, Kandarian, Hua Moa, Kalela, and Frank Unknown all showed pronounced potassium deficiency, which contributed to the reduced number of leaves during deleafing operation. All these plants were in Replications Four and Five, where 110 grams of 10-10-10 fertilizer was applied per plant.

Bunch Characteristics

Three plants shot 25 weeks after planting. Two of the three were Kandarian cultivars and the third was Cardaba. These two shot cultivars represent only 6.3% of the total cultivars in the study.

Conclusions

Under Georgia conditions, we found that starting with tissue culture plants in March did not provide adequate time for fruit production during the 2003 season. Banana leaf emergence stops at temperatures below 60.8°F (16°C). Flower emergence was expected about 22 weeks after planting (late September); however, after transfer to the field in Savannah, Georgia there were 21 days when the average minimum temperature was below 60.8°F. Limited flowering did occur on a few plants 25 weeks after planting. From 1 October to 14 November, there were 27 days with average minimum temperatures below 60.8°F (16°C). A frost occurred on 14 November. A combination of low temperatures and less-than-optimum nutrition was probably the cause of the delayed fruiting. Hopefully, earlier fruit production will occur on the ratoon crop next year.

As ornamentals, bananas have tremendous potential in South Georgia. Starting from small plants in April, very large and attractive plants can be obtained by mid-summer and maintained until frost, which normally occurs in mid-November. Many attractive cultivars of various heights and colors were identified in this study.

It appears that a number of cultivars will be excellent for nursery production to supply local and export demand. Several cultivars average five or more suckers for nursery production. These have a potential retail value of $50 or more per mother plant. For optimum results, the best time to start with tissue culture plants is from mid-November to mid-December. The ratoon plants, however, may perform differently.

References

FAO. 2001. *Banana Statistics*. Committee on Commodity Problems, CCP: BA/TF01/2(Rev.1). Intergovernmental Group on Bananas and Tropical Fruits, Second Session, San Jose, Costa Rica. 4–8 December.

Table 1. Classification of Banana Cultivars by Height 18 Weeks After Planting.

Tall	Medium	Short
1. Kandarian	1. Hua Moa	1. Grand Nain
2. Musa 1780	2. Dwf. Namwah	2. Williams Hybrid
3. Saba	3. Pace	3. Sum X Cross
4. Ice Cream	4. Dwf. Orinoco	4. Kru
5. Kummunaba	5. Mysore	5. Dwf. Nino
6. Belle	6. Pisang Ceylon	6. Sikkimensis
7. Manzano	7. Kalela	
8. Kofi	8. FHIA 18	
	9. FHIA 17	
	10. FHIA 1Goldfinger	
	11. FHIA 3 Sweet Heart	
	12. Super Plantain	
	13. Cardaba	
	14. Ele Ele	
	15 FHIA 23	
	16 Brazilian	
	17 Raja Puri	
	18 Burmese Blue	

Fonsah, E. G. 2003. "Integrated Quality Control Management Strategies in Banana Production, Packaging and Marketing." *Journal of Food Distribution Research* 34(1):100–101.

Fonsah, E. G. 2002. "Global Sustainable Banana Production, Marketing and Trade Implications". Published Abstract: Global Conference on Banana and Plantain, Organized by *AIPUB,* FAO, INIBAP and Ministry of Agriculture, Banglore, India. October 27–31.

Fonsah, E. G. and A. S. N. Chidebelu 1995. *Economics of Banana Production and Marketing in the Tropics*. Minerva Press, London

Degner R. L., S. D. Moss, and M. D. Mulkey. 1997. "Economic impact of agriculture and agribusiness in Dade County, Florida." FAMRC Industry Report, 97.1. Florida Agricultural Market Research Center, University of Florida, IFAS, Gainesville, FL.

Hawaii Agricultural Statistics Service (HASS). 2002. "Hawaii Fruits Annual Summary." August 29. Hawaii Agricultural Statistics Service, U.S. Department of Agriculture.

Hawaii Agricultural Statistics Service (HASS) 2001. "Hawaii Fruits Annual Summary." August 15. Hawaii Agricultural Statistics Service, U.S. Department of Agriculture.

Perez, A. and S. Pollack 2003. "Fruit and Tree Nuts Outlook." Electronic Outlook Report from the Economic Research Service and Foreign Agricultural Service, FTS-306, September 24.

Ploetz, R. C., J. L. Haynes, and A. Vasquez. 1999. "Evaluation of bananas for niche markets in subtropical Florida." *INFOMUSA* 8(2):15–18.

Robinson, J. C. 1996. *Bananas and Plantains.* CAB International, University Press, Cambridge.

Stambaugh, S. U. 1952. *Bananas in Florida.* Florida Department of Agriculture, Tallahassee, FL.

Stover, R. H. and N. W. Simmonds. 1987. *Bananas: Tropical Agriculture Series*, 3rd ed.: Longman Scientific & Technical, New York.

Waddick, W. J. and G. M. Stokes. 2000. "Bananas You Can Grow." *Tropical Plants you can Grow* vol. 1. Stokes Tropicals Publishing Co., Ontario.

Whitton, C. and E. Carter. 2003 "Outlook for U.S. Agricultural Trade." Electronic Outlook Report from the Economic Research Service and Foreign Agricultural Service, AES-39. August.

Whitton, C and E. Carter. 2002. "Outlook for U.S. Agricultural Trade." USDA, Economic Research Service, AES-35/29. August.