BRAZILIAN BANANA CROP: CURRENT SITUATION AND RESEARCH CHALLENGES

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SUMMARY

Brazil is the world's fifth largest producer of bananas, with 7.3 million Mg, 503 thousand ha and average yield of 14.6 Mg ha^{-1}. The country also holds an important market with unique characteristics. In the Northern and Northeastern regions, AAB varieties such as 'Pacovan', 'Dwarf Prata' and 'Terra' dominate. In the Southeastern region, AAB 'Prata', 'Dwarf Prata' and 'Maçã' and AAA Cavendish type, in that order. In the Southern region, Cavendish varieties and the Prata type, and, in the Midwest, Prata type and 'Maçã'. In the main banana producing centers of the country, in general, the climatic conditions are suitable, except for water limitation in the North of Minas Gerais, Medium and Submedium São Francisco in Bahia, Submedium São Francisco at Pernambuco, Jaguaribe-Apodi in Ceará and Mossoró/Açú in Rio Grande do Norte, overcome with the use of irrigation; and low temperatures in São Paulo and in the South. Research with the crop began in 1925 in São Paulo, and became more consistent after the 1970s. The Brazilian system of agricultural research is constituted by the Brazilian Agricultural Research Company, state research companies, federal and state universities and other research, teaching and extension institutions. More than a fifth of the 453 articles published in leading scientific journals in Brazil, in the last 20 years, developed the theme improved genotypes. The Brazilian Banana Breeding Program, coordinated by Embrapa Cassava and Fruits, began in 1983 and made available to farmers several genotypes, since 1995. In the North of the country, where black Sigatoka is present and there are climatic conditions favorable to the pathogen, there was greater adoption the new genotypes. The banana crop in Brazil has evolved greatly in recent decades, due to the generation, adaptation and diffusion of technology, but also the organization of banana growers. Some highly technified production centers emerged, especially in irrigated areas, disseminating information and functioning as showcases positive for producers.

Key words: Bananas, Brazil, Prata, AAB genotypes, market, studies.

INTRODUÇÃO

Brazil is the fifth largest country in area, with 8,547,403 km^2. Of the countries of South America, it only does not border with Chile and Ecuador, being bordered by the Atlantic Ocean to the east. According to FAO (2011A), when considering the statistics of bananas, not including plantains, Brazil is the fourth largest producer, with 7,33 thousand Mg produced in 503 thousand ha, resulting in average yield of 14.6 Mg ha^{-1}. Data from the Brazilian Institute of Geography and Statistics (IBGE, 2011) confirm the FAO data.

In addition to being a great producer, Brazil has an important market. The per capita consumption of 29.1 kg yr^{-1} (FAO 2009B - apparent consumption, as there is uncertainty about the losses, although estimated at 40%) at first seems low, compared to other countries that have much higher consumption. However, as the country has 170 million inhabitants, with true consumption since this is a fruit that is part of their food culture, the result is a large and stable demand. Nevertheless, studies of the National Confederation of Agriculture - CNA (Agência Brasil, 2011) show that less than 20% of Brazilians consume fruits. So if Brazil can now absorb almost all banana producing, there is great potential for increased consumption, also favored by the reduction of poverty reported nationwide in recent years, the result of assistance programs promoted by the government, with increased consumption, especially for basic items like food. According to the Consumer Expenditure Survey conducted by the IBGE (2008-2009), as well as with fruits in general, as family income increases, also increases the resource used to buy bananas by the Brazilians (Figure 1). Additionally, there is a trend of an aging population, which certainly will require campaigns to improve nutrition, including increased consumption of fruits, to maintain quality of life of this long-lived population.

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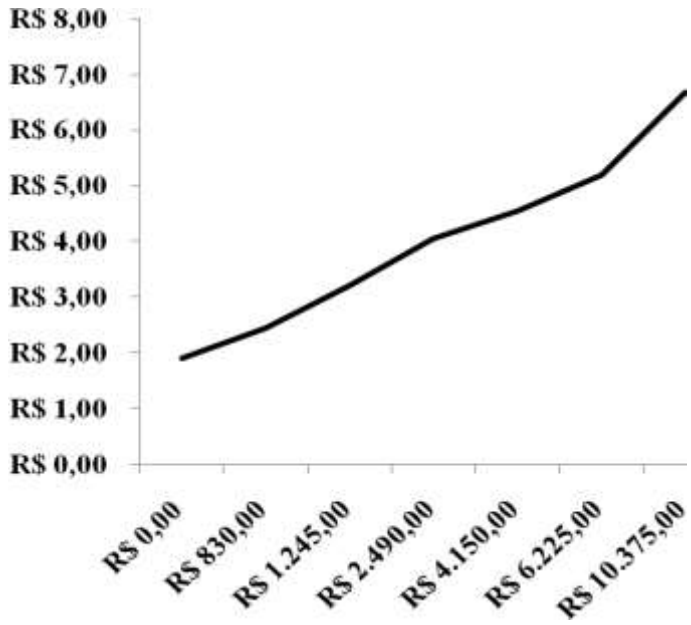

Figure 1. Amount spent by households in Brazil, in reais (R$), in the acquisition of bananas, according to family income (R$) per month.

Brazilian market is quite unique regarding the consumption of dessert varieties. In the North and Northeast, AAB varieties predominate, as 'Pacovan', 'Dwarf Prata' and 'Terra', which is a plantain. The Southeastern region has a preference for AAB varieties 'Prata', 'Dwarf Prata' and 'Maçã' and AAA from the Cavendish subgroup, in that order. In the South, the main varieties are the Cavendish and Prata type, in this order, and in the Midwest, Prata type and 'Maçã'.

The evolution of production, planted area and productivity of banana plantations in Brazil in the last decade are shown in Figure 2. It is observed that productivity has increased in recent years, about 2.6 Mg ha^{-1}, with the lowest and highest yields recorded in 2001 (12 Mg ha^{-1}) and 2011 (14.6 Mg ha^{-1}), corresponding to the extremes of the analyzed period. The planted area was higher in 2008 (around 523,000 ha) and lowest in 2009 (483,000 ha), while the lowest production was observed in 2001 (6.2 million Mg) and higher in 2011 (7.3 million Mg).

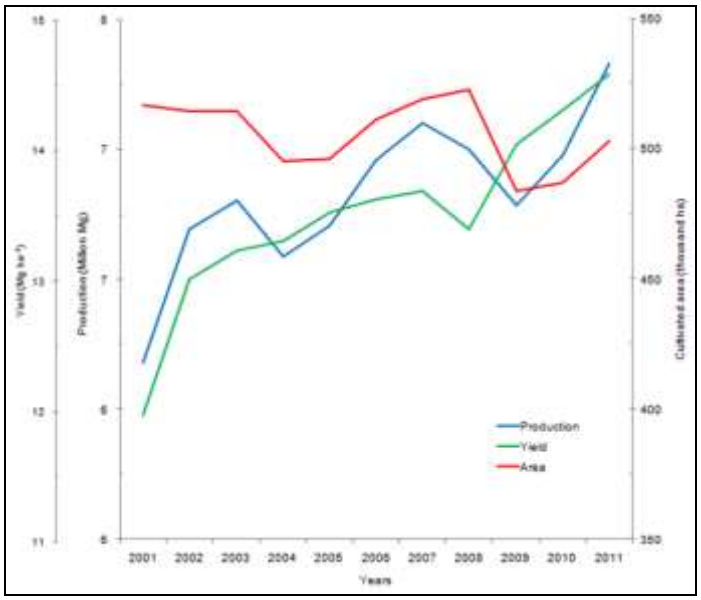

Figure 2. Evolution of production, cultivated area and yield of banana in Brazil (IBGE, 2011).

There is banana production in all units of the federation, but the five main producers are: Sao Paulo, Bahia, Minas Gerais, Santa Catarina, e Pernambuco, with production of 1,354; 1,240; 654; 650 e 546 mil Mg, and yield de 22.9; 16.5; 15.8; 21.4; 10.7 Mg ha^{-1}, respectively. The Northeast region accounts for the largest banana production, followed by the Southeast (Figure 3). Just as between regions, there is great difference in banana yield between states, resulting from the varieties used and the level of technology adopted, with extremes of 6.6 Mg ha^{-1} (Rio de Janeiro) to 25.8 Mg ha^{-1} (Rio Grande do Norte).

Regions	Thousand Mg	Thousand ha	Mg ha^{-1}
Northeast	2,863	212.7	13.5
Southeast	2,379	144.5	16.5
South	984	53.3	18.4
North	850	71.7	11.9
Midwest	254	21.1	12.0

● Main production centers in rainfed or supplementary irrigation.
● Main production centers obligatory irrigated

Figure 3. Map of Brazil (Brazil Republic, 2011) and banana production data by region (IBGE, 2011).

CHARACTERISTICS OF THE MAIN PRODUCING REGIONS

For being present throughout the country and by its large territorial extension, banana occurs in various conditions of climate, soil, altitude, near the coast or in the center of the continent. In addition, each site has a prevalence of various pests and diseases, sometimes even preventing the exchange of plant material between regions within the country. All this diversity requires production technologies adjusted to meet the particularities of each site.

The main banana producing centers of the country have different climatic conditions and cultivate different varieties (Tables 1 and 2): Northern Minas Gerais: Public Irrigated Perimeters (Jaíba, GorutubaLagoa Grande and Pirapora) and private areas; Middle São Francisco, Bahia: Public Irrigated Perimeters (Formoso, Ceraíma, Miroros, Estreito); Middle São Francisco, Bahia: private areas, outside the public irrigated perimeters; Recôncavo and southern Bahia; Siriji Valley, Pernambuco (São Vicente Férrer, Timbaúba, Limoeiro, Machados and Vicência); Submedium São Francisco: Pernambuco (Petrolina, Orocó, Santa Maria da Boa Vista and Petrolândia) and Bahia (Juazeiro); Irrigated Perimeter, Ceará: Jaguaribe / Apodi (Limoeiro do Norte); North and Oriental Coast of Rio Grande do Norte, Mossoró Production Center / Açú in Rio Grande do Norte; South Coast of São Paulo; North Coast and Itajai Valley, Santa Catarina; South Coast of Santa Catarina and northern Rio Grande do Sul.

Table 1. Characteristics of the main banana production centers in Brazil: altitude (ALT), relative humidity (RH), minimum temperature (MIN), average (AVG) and maximum (MAX), precipitation (PREC), climate according to Köppen's classification, relief, production system under irrigation (I) or under rainfed conditions (S).

Centers	ALT (m)	UR (%)	Temperature (°c)			PREC (mm)	Climate	Relief	System
			MIN	MED	MAX				
Northern Minas Gerais	452 to 515	64.3	19.1	25.1	31.6	800	AW	Flat or low slope	I
[1]Medium São Francisco: Public Perimeters–Bahia	500 to 2000	64.0	21	25	30	600 to 900	AW and BShw variation	Flat or low slope	I

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Table 1. Characteristics of the main banana production centers in Brazil: altitude (ALT), relative humidity (RH), minimum temperature (MIN), average (AVG) and maximum (MAX), precipitation (PREC), climate according to Köppen's classification, relief, production system under irrigation (I) or under rainfed conditions (S).

Centers	ALT (m)	UR (%)	Temperature (°c)			PREC (mm)	Climate	Relief	System
[1]Medium São Francisco: Private areas - Bahia	200 to 800	61.5	23.4	26	28.3	695	BShw	Flat or low slope	I
Recôncavo and South – Bahia	25 to 50	5 a 85	16 a 20.8	21.0 a 25.0	26.1 a 33	2.199	Aw, Am and Am	Heavily rugged	S
[3]Siriji Valley – Pernambuco	119 to 419	>70	17.3	25.0	30.7	1055	As	Smooth uneven to uneven	S
[3]Submedium São Francisco – Pernambuco/Bahia	282 to 376	66.8	21.1	25.7	32.9	569	BShw	Flat	I
[2]Jaguaribe/Apodi Irrigated Perimeter– Ceará	10 to 250	2	22	28.5	5	772	BShw	Flat	I
[4]Norte and Oriental Coast – Rio Grande do Norte	2	70 a 80	20	24	31.5	1100	Csa	Flat and low slope	S
[4] Mossoró/Açú Productive Center – Rio Grande do Norte	107	60 a 70	22	26.5	33	620	BSh	Flat	I
[2 e 5] South Coast – São Paulo	25 to 50	84	12.9	21.2	27.8	1500	Cfa	Flat areas (wetlands) and slopes	S
North Coast – Santa Catarina	9 to 108	76.4	17.1	21.6	25.4	2222	Cfa	Mostly slopes	S
Itajaí Valley– Santa Catarina	12 to 88	83.7	17.1	21.2	24.8	1707	Cfa	Mostly slopes	S
South Coast Santa Catarina and Northeast Rio Grande do Sul	15 to 180	79.8	15.7	18.6	22.3	1359	Cfa	Slopes	S

INFORMATIONS: [1, 2, 3, 4 e 5] – at the bottom of Table 2.

Table 2 . Characteristics of banana production of the main Brazilian technified centers.

Centers	Production (thousand Mg)	Area (ha)	Yield (Mg ha^{-1})	Cultivars
Northern Minas Gerais	312.4	13.7	22.8	Basically Dwarf Prata cultivated under irrigation
[1]Medium São Francisco: Public Perimeters–Bahia	150.1	5.9	25.4	Basically Dwarf Prata and Nanica
[1]Medium São Francisco: Private areas – Bahia	11.8	0.6	20.8	Basically Dwarf Prata and Nanica
Recôncavo and South – Bahia	428.8	29.1	14.7	Dwarf Prata and Terra
[3]Siriji Valley – Pernambuco	115.6	13.1	8.8	80% common Prata and 20% Pacovan and others
[3]Submedium São Francisco – Pernambuco/Bahia	141.8	7.9	18.7	92% Pacovan , 5,45% Cavendish and 2,55% Dwarf Prata
[2]Jaguaribe/Apodi Irrigated Perimeter– Ceará	43.7	1.9	23.0	Pacovan, Dwarf Prata and Grand Naine
[4]North and Oriental Coast – Rio Grande do Norte	46.3	2.6	17.5	Pacovan and Maçã

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Table 2 . Characteristics of banana production of the main Brazilian technified centers.

Centers	Production (thousand Mg)	Area (ha)	Yield (Mg ha^{-1})	Cultivars
[4] Mossoró/Açú Productive Center – Rio Grande do Norte	85.2	2.4	35.5	Pacovan (domestic market) and Grand Naine (export)
[2 e 5] South Coast – São Paulo	919.0	38.5	23.8	60% Cavendish (Nanicão, Grand Naine and Williams) and 40% Dwarf Prata and FHIA-18
North Coast – Santa Catarina	335.2	14.4	23.3	90% Cavendish (Nanicão, Grand Naine) and 10% Prata (Dwarf Prata and Branca)
Itajaí Valley– Santa Catarina	203.3	8.4	24.3	Mostly Cavendish (Nanicão, Grande Naine) and Dwarf Prata
South Coast Santa Catarina and Northeast Rio Grande do Sul	192.2	18.1	10.6	90% Dwarf Prata and 10% others (Nanicão and Branca)

INFORMATIONS:
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In general, the climatic conditions are suitable for the cultivation of banana in all production centers in Brazil, except for limited water producing areas of northern Minas Gerais, Medium and Submedium São Francisco in Bahia, Submedium San Francisco in Pernambuco, Jaguaribe-Apodi in Ceará and Mossoró-Açu in Rio Grande do Norte, overcome with the use of irrigation; and low temperatures in São Paulo and in the South. In São Paulo the limitations are low temperatures, but only in some years. In Santa Catarina, the minimum temperature may reach 0 °C in some years, and every year there are temperatures below 12 °C (which causes the darkening of the peel of the varieties from the Cavendish subgroup), and in almost every year there are temperatures below 8 °C (causing the same problem in the Prata subgroup varieties) (Lichtemberg et al., 2001). Edaphic characteristics are also specific and highly variable, and should be evaluated by each property.

Brazilian subtropical environments occupy 23.4% of the area under bananas in Brazil and are responsible for 32.5% of domestic production of bananas. Despite the climatic restrictions, productivity in these environments has been above the national average due to the improved level of technology used and the predominance of cultivars more productive than the national average. In these areas, predominates the cultivation of the Cavendish banana subgroup, with the exception of Southern Minas Gerais, where it is grown almost exclusively the 'Common Prata', and Southern Santa Catarina and Northeastern Rio Grande do Sul, which produce the 'Dwarf Prata'in these regions, known as 'grafting'. In subtropical regions, the duration of the crop cycle is longer, sometimes up to twice that observed in the tropics. In the North Coast of Santa Catarina, for example, the development period of the bunch of Cavendish bananas launched in the second half of the spring may be three months, while for the bunches released in the fall it can reach seven months (Lichtemberg et al., 2011) .

The cultivation in tropical climate extends from the North of Minas Gerais throughout the Northeast, Midwest and North of the country. In this area, there is a great diversity of levels of technology used, and the AAB cultivars dominate. In tropical areas, the cycle of the 'Dwarf Prata' grown under irrigation is quite fast, with the first bloom at 8 to 10 months, harvesting the first cycle with 12 months, and the second and third cycles in the second year. When well-conducted, this banana field presents production cycle (time between the harvest of two bunches of the same family) of nine months for several consecutive years. Stressful temperatures above 35 °C can occur in some periods of the year, such as between September and February for the semi-arid in Bahia and northern Minas Gerais. This factor is even more critical in October, when temperatures can exceed 38 °C, and are accompanied by excessive radiation, low relative humidity and absence or low rainfall. These conditions hinder the cooling of the banana tree, causing strong decrease in stomata opening and damaging transpiration, which can raise the temperature of the plant to values close to the point of thermal damage. Under these conditions, the plants decrease the flush of leaves, the number of bunches on young plants and fruit growth and, consequently, there is a drop in production about four months later, because the period for development of the bunch in 'Prata' bananas, varies from four months to bunches launched in the spring-summer and five months for bunches launched in the autumn-winter (Donato et al., 2006, 2009).

STRUCTURE, MAIN RESEARCH RESULTS AND CHALLENGES

Brazilian research with the banana crop began with the installation of the first experiments in 1925, in Sao Paulo, but only after the 1970s it became more consistent (Lichtemberg and Lichtemberg, 2011). Today, the Brazilian agricultural research system consists of several institutions distributed throughout the country, mostly public, as the Brazilian Agricultural Research Corporation (Embrapa), state research companies , federal and state universities and other research , education and extension institutes. In a survey of 453 articles published on the crop in Brazil (Table 3), the first authors were affiliated with universities (52.5%), federal research institutions (29.5%), state research institutions (16.1%), federal institutes of education (2%) and only 0.2% of private companies. Funding is also essentially public, such as the National Council for Scientific and Technological Development (CNPq), state foundations for research support such as FAPESP (São Paulo), FAPEMIG (Minas Gerais), FAPESB (Bahia), banks that finance the cultivation and others.

Table 3. Number of articles involving banana published in the main Brasilian scientific journals between 1991 and 2013.

Journal	Survey period of each journal, in years	Number of articles
Bragantia	21	173
Magistra	21	50
Pesquisa Agropecuária Brasileira	10	38
Revista Brasileira de Ciência do Solo	11	26
Revista Brasileira de Fruticultura	21	20
Revista Ceres	6	19
Scientia Agrícola	20	18
Brazilian Journal of Plant Physiology	12	17
Cência e Tecnologia de Alimentos	14	16
Anais da Academia Brasileira de Ciências	21	15
Ciência Rural	12	15
Revista Brasileira de Engenharia Agrícola e Ambiental	21	14
Tropical Plant Pathology	8	8
Acta Amazônica	21	6
Ciência e Agrotecnologia	16	5
Engenharia Agrícola	9	5
Summa Phytopathologica	3	5
Crop Breeding and Applied Biotechnology	12	3
Total		**453**

The works developed by this research structure reflect the demands of the entire chain. In a survey carried out in 18 leading Brazilian scientific journals ,in the last 20 years, 453 published articles based on national researches were found (Table 3).

More than a fifth of these studies (Table 4) developed as a theme the varieties and improved genotypes. According to Amorim et al. (2011), the Brazilian Banana Breeding Program is coordinated by Embrapa Cassava & Fruits, which has a Germplasm Active Bank (GAB) with 274 accesses, and more than three decades of work on improvement of diploids and obtaining triploids and tetraploids from traditional varieties.

Table 4. Main themes aborded by research with the banana crop in Brasil.

Theme	Number of articles	%
Varieties and improved genotypes	100	22.1
Propagation	91	20.1
Fruits, post-harvest, packs and market	66	14.6
Phytosanity	51	11.3
Management of soil fertility and mineral nutrition of plants	41	9.1
Irrigation, fertigation and salinity	34	7.5
Area choosing, planting and cultural practices	27	6.0
Fruits processing	22	4.9
Breeding	8	1.8
Statistics and mathematical models	7	1.5
Physiology	4	0.9
Use of residues	2	0.4
Total	**453**	**100.0**

The maintenance of the GAB, as well as obtaining and/or introducing improved genotypes, are made by Embrapa Cassava & Fruits, located in Cruz das Almas, Bahia, in the Recôncavo region, where the cultivation of Terra bananas (Plantain) dominates, and banana production is not very significant. Once these genotypes are obtained by hybridization or by selection, and show to be promising (at least resistant to the main phytosanitary problems), they are taken to the production areas, where they are evaluated for agronomic performance, post-harvest characteristics, acceptance by the productive sector and, in a second moment, by consumers. These assessments are essential to recommending new cultivars for use by farmers. Such studies in Brazil began with Alves et al. (1984) and Moreira and Saes (1984), and coincided with the implementation of the Brazilian Banana Breeding Program in 1983, being intensified after 1997 with testing of new genotypes generated and released by Embrapa (Donato et al. 2009). These evaluations in various regions and conditions are possible due to a structure of network research collaboration, with the various institutions distributed throughout the country. Only after this work of developing genotypes by regions, with selection of the promising candidates, and validation with the productive sector, the recommendation is made with greater security for the cultivation of a given genotype. Since 1995, several genotypes obtained by hybridization, selected and/or entered, evaluated in the country, resistant to at least one of the major diseases of the crop (Panama disease, yellow and black Sigatoka), with different characteristics in terms of yield and quality of fruits, were made available for cultivation in farmers' production systems (Table 5). There are also presented five genotypes more provided by the program coordinated by Embrapa.

In the Northern region, where the level of technology adopted in the fields is low, there are some communities dependent on the banana as food (not just dessert), the black Sigatoka is present and there are weather conditions very favorable for the pathogen, it was observed the adoption of resistant genotypes in the whole region. In the other regions, none of these varieties has been adopted by the producers for planting on a large scale so far, but many experiments show great potential for some.

The preference for type ‘Prata’ fruits (pome), which work well as parental female (produce seeds when pollinated), increase the probability of obtaining a variety with desirable agronomic traits and that pleases the consumer. As the Brazilian consumer has the habit of consuming more than one variety, there may be more flexibility to accept new genotypes, however these have to show characteristics very similar to those presented by the variety that he is used to consuming.

Table 5. [1]Varieties available by Brazilian Banana Breeding Program and other initiatives.

Varieties (code)	Type	Genomic group	Genealogy (origin)	Resistanced	Recommendation
'Pioneira' (PA12-03)	Pome (Prata)	AAAB	'Prata-Anã' ('Lady Finger' or 'Dwarf Pome' x 'Lidi' (Embrapa)	Yellow Sigatoka	Embrapa Cassava & Fruits
'BRS FHIA-18' (FHIA-18)	Pome (Prata)	AAAB	'Prata-Anã' x SH-3142 (FHIA)	Black Sigatoka, moderate resistance for Yellow Sigatoka	Embrapa Cassava & Fruits
BRS Maravilha (FHIA-01; Gold Finger)	Pome (Prata)	AAAB	'Prata-Anã' x SH-3142 (FHIA)	Black Sigatoka e mal-do-Panamá, moderate resistance for Yellow Sigatoka	Embrapa Cassava & Fruits
'Prata-Graúda' (SH36-40)	Pome (Prata)	AAAB	'Prata-Anã' x SH-3393 (FHIA)	Panama disease	Embrapa Cassava & Fruits; Epamig Sul de Minas
'BRS Platina'[2] (PA-42-44)	Pome (Prata)	AAAB	'Prata-Anã' x M53 (Embrapa)	Yellow Sigatoka e mal-do-Panamá	Embrapa Cassava & Fruits; IF Baiano - Campus Guanambi; Epamig Norte de Minas
'Caprichosa' (PC42-01)	Pome (Prata)	AAAB	'Prata-Comum' x M53 (Embrapa)	Black and yellow Sigatoka and Panama disease	Embrapa Amazônia Ocidental
'Garantida' (ST42-08)	Pome (Prata)	AAAB	'Prata São Tomé' x M53 (Embrapa)	Black Sigatoka e amarela e mal-do-Panamá Black and yellow Sigatoka and Panama disease	Embrapa Amazônia Ocidental

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Table 5. [1]Varieties available by Brazilian Banana Breeding Program and other initiatives.

Varieties (code)	Type	Genomic group	Genealogy (origin)	Resistanced	Recommendation
'Pacovan-Ken' (PV42-68)	Prata	AAAB	'Pacovan' x M53 (Embrapa)	Black and yellow Sigatoka and Panama disease	Embrapa Cassava & Fruits
'Preciosa' (PV42-85)	Pome (Prata)	AAAB	'Pacovan' x M53 (Embrapa)	Black and yellow Sigatoka and Panama disease	Embrapa Cassava & Fruits
'Vitória' (PV42-81)	Pome (Prata)	AAAB	'Pacovan' x M53 (Embrapa)	Black and yellow Sigatoka and Panama disease	Embrapa Cassava & Fruits; INCAPER, ES
'Japira' (PV42-142	Pome (Prata)	AAAB	'Pacovan' x M53 (Embrapa)	Black and yellow Sigatoka and Panama disease	Embrapa Cassava & Fruits
'Nam' ('Prata Baby')	Fruits type baby	AAA	Introduced from Tailândia	Yellow Sigatoka and Panama disease	Embrapa Cassava & Fruits; EPAGRI
'Caipira' (Yangambi km 5)	Sugrupo Ibota, with Fruits type baby	AAA	Introduced from África Ocidental	Black and yellow Sigatoka and Panama disease	Embrapa Cassava & Fruits
'Tropical' (YB42-21)	Fruits type Maçã	AAAB	Yangambi nº 2 x M53 (Embrapa)	Yellow Sigatoka and tolerance for Panama disease	Embrapa Cassava & Fruits
'Princesa' (YB42-07)	Fruits type Maçã	AAAB	Yangambi nº 2 x M53 (Embrapa)	Yellow Sigatoka e tolerance for Panama disease	Embrapa Cassava & Fruits; Tabuleiros Costeiros
'Thap-Maeo'	Fruits type baby	AAB	Introduced from Tailândia, 'Mysore' mutation	Black and yellow Sigatoka and Panama disease	Embrapa Cassava & Fruits
'BRS Conquista'	Fingers type baby	AAB	'Thap Mae' mutation (Embrapa)	Black and yellow Sigatoka and Panama disease	Embrapa Amazônia Ocidental
'FHIA-21'	Plátano tipo francês (*French Plantain*)	AAAB	AVP67 (French Plantain) x SH3142 (FHIA)	Black and yellow Sigatoka and Panama disease	Embrapa Cassava & Fruits
'NanicãoCorupá' (SCS452 Corupá)[4]	Cavendish	AAA	Cavendish clone Nanicão	Panama diseasee	EPAGRI
'IAC Nanicão 2001'[3]	Cavendish	AAA	Cavendish clone 'Nanicão' (IAC)	Yellow Sigatoka	IAC
SCS451 Catarina[4]	Pome (Prata)	AAB	'Branca' clone (EPAGRI)	Higher tolerance for Panama disease compared to progenitor	EPAGRI
'Prata Gorutuba'[5]	Pome (Prata)	AAB	'Prata-Anã' clone (Technical of Norte de Minas Gerais)	Higher tolerance for Panama disease compared to progenitor	Technical of Norte de Minas Gerais
Galil-18[6] (FHIA-18)	Pome (Prata)	AAAB	'Prata-Anã' hybrids (FHIA)	Black Sigatoka and Panama disease, moderate resistance for Yellow Sigatoka	Galil

[1, 2]Embrapa Cassava & Fruits e Amazônia Ocidental e instituições parceiras do Brazilian banana Breeding Program
[3]Instituto Agronômico de Campinas, IAC;
[4]Empresa de Pesquisa Agropecuária de Santa Catarina, EPAGRI;
[5]Clone selected by technicals and farmers in northern Minas Gerais; [6]Inicialmente marketed in Brazil by Galil.

Over 40 disease-resistant genotypes were evaluated by the research collaboration network in the country, with promising results, and some attempts at cultivation and marketing of these are in progress, being necessary to work the market before planting in scale. On the other hand, several clones of 'Dwarf Prata' have been selected by

producers and technicians in areas with high infestation of fusarium wilt (Panama disease), in the North of Minas Gerais, with less manifestation of symptoms. These materials have yet to be subjected to more research, but are considered promising by the productive sector (Rodrigues et al., 2011).

Another major concern, presented as the second most discussed topic (20.1%) in the scientific articles published in Brazilian journals was the propagation (Table 4). This is directly related to the first, since the best genotypes need to be multiplied. In addition, the sanity of the seedlings and the efficiency in their production, facilitating access to the producer, are among the first items considered when it comes to technified production.

The cares with the fruits and postharvest were also important for research, since 14.6% of articles have dealt with this issue. Works with plant health, management of the area since its choice until fertilization and irrigation, totaled 27.8% of the articles (Table 4). These themes include the major components of the production cost, as well as the quality of the final product which will be sold. The search results cannot be extrapolated to any situation, requiring, at least, adjustments.

There was a great development of banana plantations in Brazil in recent decades, due to the generation, adaptation and diffusion of technology, but also the organization of banana planters (Lichtemberg and Lichtemberg, 2011). Some highly technified production centers have emerged, especially in irrigated areas, bringing information and working as a positive showroom for producers who did not bet in the use of technology. In addition, these technified poles attract public investment to the regions, such as improvement of roads to the flow of products, lines of credit, improved education and health facilities for the local population many times multiplied by the immigration of workers from other regions.

However, much remains to be done, both in the generation of information and technology, as well as in the diffusion and adoption of these. In surveys of demand made by the research system, it was observed that the producers and technicians who work in the more technified regions show demands for information still under development, for example, increasing the shelf life of AAB varieties, especially the 'Dwarf Prata' , and fine-tuning of plant nutrition. However, most of the demands for information presented by the producers that operate in less technified regions already exist, and what is still lacking is the arrival of this information to the productive sector. In the irrigated centers, where highly technified business production goes along with family production usually done by settlers, often with low education, the two types of demand (generation and diffusion of information and technology) are observed.

Considering that the banana generates 0.7 direct job and two indirect jobs per cultivated hectare (Moreira and Rebello, 2008), it is estimated that the Brazilian banana plantations provide the generation of 1,305,450 jobs, which evidences its socioeconomic importance. As the main production centers are located in less developed regions of the country, some of the main ones in the semi-arid region, with few employment options, many municipalities have the banana crop as one the pillars of its economy.

PERSPECTIVES FOR BRAZILIAN RESEARCH

In most of its time and actions, the Brazilian Banana Breeding Program coordinated by Embrapa has adopted as its main strategy for obtaining banana hybrids resistant to major diseases and pests, as well as improvement of diploids, hybridization involving improved diploids as male parents and triploids as female parents. More recently, and as a main strategy for future action, hybrid tetraploid are used as female parents and improved diploids as male parents (Amorim et al., 2011). There is also need to direct research on breeding for selection of the triploid clones most widely accepted by producers and the market today.

Another perspective that is being discussed in the research media is the use of banana for many other purposes besides the traditional dessert fruit or for cooking: the use of the pseudostem fibers in the paper and textile industries; fruit peels in dyeing, and as raw material for ethanol production, biogas production and extraction of pectin; the flowers and the central portion of the buttons as cooked food; roots, flowers, stems and leaves in the pharmaceutical industry, as well as other alternative use as ornamental plants. (Santos-Serejo et al., 2011a). In the latter case, there is an ongoing and designing as a new perspective for the genetic improvement of banana in Brazil the development of cultivars with high potential for ornamental use, such as potted plants, cut flowers and production of mini fruit (Santos-Serejo et al., 2011b).

Referring to the producers and technicians who work directly in the producing areas, they should be aware of the research to meet specific demands of the country, still under development, for example, increased shelf life of AAB varieties, especially the 'Dwarf Prata', and fine-tuning in plant nutrition (Lichtemberg and Lichtemberg, 2011), to suit certain combinations of varieties and environments, particularly for each producing region. Another demand for research still unexplored in the country and crucial for the development of the banana crop in the face of current and future scenarios is the interaction between crop physiology, cultural practices and climate change. It also assumes significance the selection of genotypes adapted to abiotic stress conditions prevailing in different banana production centers.

A theme that permeates current discussions of banana producers and traders in Brazil is the need to standardize the commercialization of fruit in the domestic market, per unit mass, kg, and the certification of production. This is a banner held by producers by means of the CONABAN, National Confederation of Banana Planters, an organization that brings together the main banana production centers in the country and requires the end of the commercialization of bananas per box, model that currently dominates the trade of bananas. This particular model is highly damaging to producers in Brazil because there is a huge variety of boxes, with much variable mass capacity.

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