Musa clones in Peru: classification, uses, production potential and constraints

Ulrike Krauss, Raúl Figueroa, Andrea Johanson, Enrique Arévalo, Raúl Anguiz, Oscar Cabezas and Luis García

Peru, in contrast to its neighbours, Brazil, Colombia and Ecuador (Figure 1), is not an important exporter of bananas and plantains. As a result, Peruvian *Musa* clones have received little attention internationally and their names are often different from those of the same clones in other countries. Indeed, the same clones frequently have different names and uses within Peru. However, like in many parts of Africa, Asia and the Americas, *Musa* plays an important role both in rural alimentation and as a cash crop for internal markets. Rengifo and Fasanando (1994) counted 37 *Musa* clones in agricultural fairs in the central Mayo valley (Figure 2). This number was exceeded only by the genus *Capsicum* (42) and by bean varieties (52) of different genera.

With the exception of the coastal region of Grau (Departments of Tumbes and Piura), the majority of *Musa* is produced and consumed in the eastern, tropical parts of the country (Figure 1), notably the Amazon, Apurímac, Ene, Huallaga, Marañon, Ucayali and Urubamba valleys and their lower tributaries (Figure 2). These areas also produce *Musa* for metropolitan markets where especially dessert-type bananas are highly valued by the middle class. This trade brings important income to the eastern valleys where illicit coca production is only gradually being replaced by cocoa, coffee, *Musa* and other tropical fruit crops.

Because of the importance of banana and plantain for sustainable development in many areas, the objective of this paper is to present and analyse information available on the classification, uses, production potential and constraints of common clones in Peru.

Musa clones

Local names of Peruvian clones along with regional and internationally recognised synonyms according to the classification by Stover and Simmonds (1987) are presented in Table 1. The most widely used Peruvian name is listed under “clone” and “Peruvian synonyms” are presented in alphabetical order. *M. textilis* is grown sporadically and possibly two different varieties exist which are collectively known as ‘Semeníferos’. This term is probably also applied to other seed-forming hybrids of *M. acuminata* and/or *M. balbisiana* origin which were not identified. On experimental stations, the diploid Lady’s Finger and Vietnam Occidental (Ney poovan?) (both AB clones) and the tetraploid IC2 and SH3436 (AAAA) can be found (Astocaza 1996). The FHIA-23 (=FHIA-1-1) (AAAA), the FHIA-01, FHIA-02 and FHIA-18 (all AAAB) and the FHIA-03 (AABB) hybrids are now being evaluated in farmers’ fields (Anguiz 1998, Krauss, unpublished).

Peruvian publications on *Musa* germplasm should be interpreted with caution. Cuadrado, Datíl, Filipino, Guayaquil, Guineo, Indio, Lady’s Finger, Manzano and Morado are used by growers and authors for several different clones in different areas. The terms Guineo and Morado can refer to any variety with a dark pigmentation on the fruit or pseudostem. Suffixes further specify differences in colour and/or size. These subdivisions are beyond the scope of this article. Names of Cavendish clones are used as synonyms and do not necessarily match the international equivalent or even the same subgroup. Similarly, Seda and Guayaquil (=Seda Guayaquil), both members of the Gros Michel subgroup, have been mistakenly assigned to the Cavendish subgroup by some authors and used as synonyms for any yellow, AAA-type banana. In San Martín, local names are often Quechua descriptions of fruit and plant characteristics, which the authors could not match with familiar varieties. Thus, the following clones may or may not be identical to those listed in Table 1 and/or to each other:

AAA group: Alquizar, Canchaque, Datíl, Flauta, Inmune, Montero, Ovilla Guineo and Seda Sharapino.

French plantain group (AAB): All-paplátano, Balsino, Brashico, Ca-

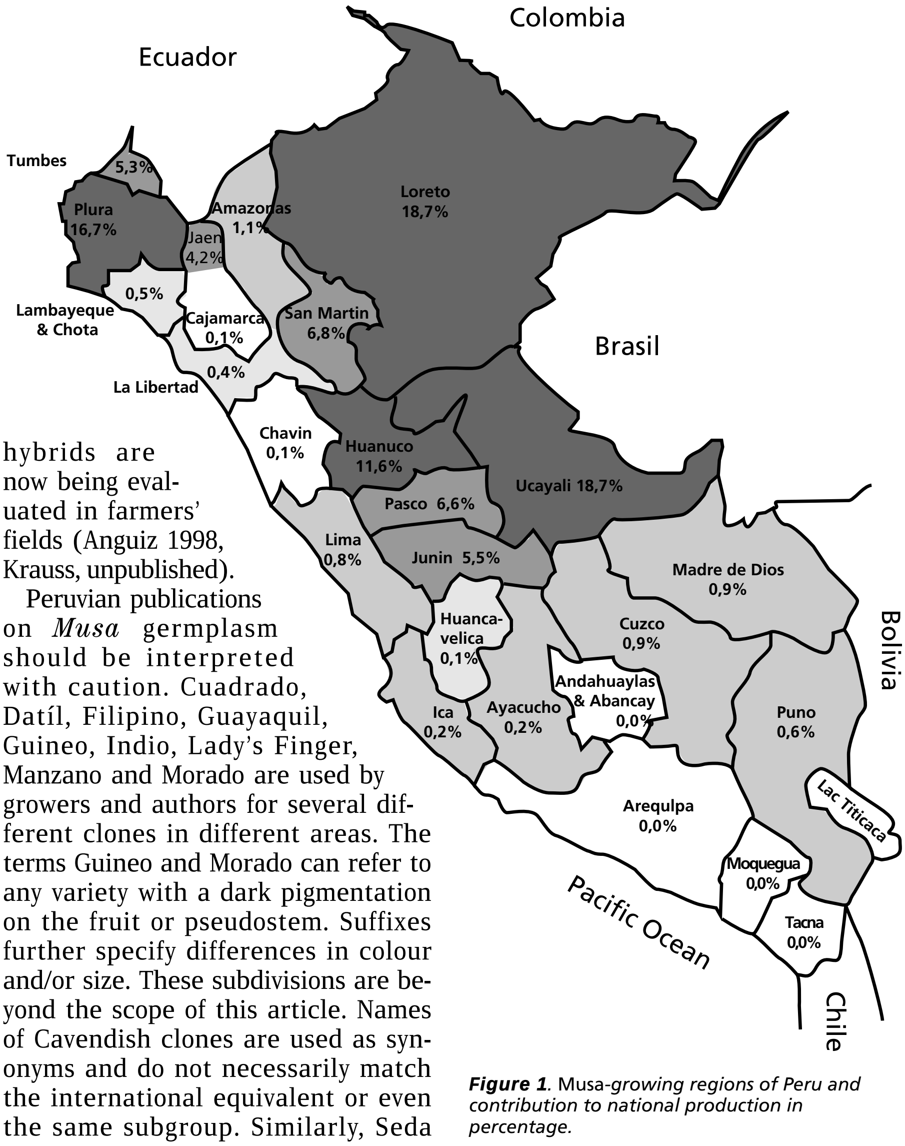

***Figure 1**. Musa-growing regions of Peru and contribution to national production in percentage.*

Table 1. Peruvian *Musa* clones, local synonyms, genomic classifications and international equivalents (in accordance with Stover and Simmonds 1987).

Clone	Peruvian synonyms	International synonym (description)
AA types		
Moquicho	Azucarado, Bizcocho, Bocadillo, Canelita, Ciento en Boca, Datíl, Guineo, Guineo Mequiche, Lady's Finger, Limenillo, Orito, Oro, Ouro, Perita, Platanito de Oro	Sucrier
AAA types		
Gros Michel subgroup		
Seda		Gros Michel
Guayaquil	Seda Guayaquil	Guayaquil (Colombie), Seda Guayaquil (Equateur)
Cavendish subgroup		
Filipino	Congo, Nanicao, Poyo, Robusta, Valery	Giant Cavendish
Indio	Enano del País, Viejilla	Dwarf Cavendish
Montecristo	Lacatán	Lacatán
Gran Enano		Grand Nain
Green-red subgroup		
Morado Claro	Guineo Colorado	Green-red
Red subgroup		
Morado	Guineo, Guineo Rojo, Indio, Morado Oscuro, Rojo	Red
Lujugira subgroup		
Lujugira		Lujugira [1, 2]
Unidentified		
Tosquino		nk [3]
AAB types		
Plantain subgroup		
Inguiri	Asapa Plátano, Arcanchaco, Común, Delgado, Dominico, Largo, Hembra, Paisano, Plátano Bueno, Plátano de Freir, Sancochado	Green French Plantain
Provinciano	Manzano, Tosco Pupusapa	French Plantain (Fewer hands than Inguiri, with shorter, fuller fruit)
Bellaco	Barraganete, Cuerno, Hartón, Macho	Hartón (5-7 hands)
Bellaco Plátano	Bellaco Plantano, Cuerno	Plantain corne (usually 7 hands)
Mameluco	Mamaluca, Mameluca, Bellaco Cachaco	Plantain corne (usually 2 hands with long fruit)
Mysore subgroup		
Mysore		Mysore [2]
Maia Maoli subgroup		
Palillo	Canela, Capirona, Guayabo, Guayaquil, Maqueño, Rey, Vaporino	Ecuadorian Maqueño ?
Silk subgroup		
Manzano	Apple, Guineo Manzano, Mansanita, Maca	Manzano
Pome subgroup		
Prato de Brazil	Pacovan, Pome	Pome
ABB types		
Bluggoe subgroup		
Huaybino Cenizo	Sapino Verde Cenizo	Silver Bluggoe
Pelipita	Colombiano, Filipino	Pelipita
Sapo	Balsino, Burro, Chato, Cuadrado, Huaybino, Sapino, Sapote, Sapucho	Bluggoe
Sapo Plátano	Cotoplátano	(Wrinkly fruit with black lines)
Trujilliano	Morocho	Bluggoe
Pisang awak subgroup		
Isla	Cuadrado, Manzano	nk (various clones, see Table 3)

[1] This clone is suggested to have been brought to Peru from East Africa by the Portuguese via Brazil (Astocaza 1996).

[2] Only in border region with Brazil?

[3] nk = not know

ballero, Maquisapa, Yanaplátano, Omegon (=Omecon), Rompe Pedro Casanova and Santa Rosa Amarillo.

Horn plantain group: Bellaco Mellizo, Garaffon (=Garajon), Huacra Bellaco, Huaira Bellaco, Tosco Bellaco and Warmi Bellaco.

Several clones could not be assigned to any group with certainty. Tosquino is a popular multipurpose clone which has been placed into both the AAA and AAB groups (French plantain, Silk, Pome and Maia Maoli) by different authors. It has some AAA characteristics but also resembles Silk and Pome. Tosquino is resistant to Panama disease and moderately resistant to yellow Sigatoka (Table 2), so it is not Silk. The possibility that it is AB (Ney Poovan) or related to the Pisang kelat/Pisang raja subgroup has not been discarded. Tosquino reaches a height of 3.8 m and produces an average of 98 fingers per bunch with an average weight of 185g per finger. Fruit are curved, somewhat angular and possess two regular rows of ovules in each loculus. The male flowers are yellow; their bracts are lanceolate, relatively persistent and do not curl (Figueroa and Wilson 1992). Bigas Plátano, Dos Racimos (a mutant which produces two bunches), Guinea Viejilla Moquillo (AAA?), Manzano Sapino (Ney Poovan?), Moquillo, Omeley Plátato, Omeley Yana, Picuro Plátano, Puca Guineo, Pucaquiro, Quillo Guinea, Sara Guinea Plátano, Shacapa, all of which are cultivated in San Martín, could not

Table 2. Disease resistance and susceptibility[1] of common *Musa* clones in Peru (data collected and interpreted from personal observation including PCR analysis, Astocaza 1996, Figueroa 1992, MINAG *et al*. 1997, Munive 1985, Ostmark 1997, SENASA and FAO 1997, Pérez and Anguiz 1998).

Clone	Leaf diseases				Soil-borne pests and diseases	
	Black Sigatoka	Yellow Sigatoka	*Cordana* leafspot	*Cladosporium* sp.	Panama disease	Nematodes
AA types						
Moquicho	HS-R [1] (**MS**)	HS-R	S	S	S-R (**response varies**)	nd [3]
AAA types						
Seda	HS	HS	S	S	S	S
Sous-groupe Cavendish	TS	HS	S	S	R	S
Morado	HS	HS-R (**MR**)	nd	nd	MR	nd
Non identifiée						
Tosquino	S	S-R (**MR**)	S	S	R	S
AAB types						
Inguiri	S	S-R (**MR**)	S	S	R	S
Bellaco	S	S-R (**MR**)	S	S	R	S
Palillo	MS	S-R (**MR**)	S	S	S	nd
Manzano	S	S-HR (**R**)	S	S	R-HS (S)	S
ABB types						
Pelipita	R	R-HR	nd	nd	R	nd
Sapo	MS	R	nd	nd	S [2]	nd
Isla	S-HR (**MR**)	S-HR (**R**)	S	S	S [2]-R (**MS**)	S

[1] HS = highly susceptible, S = susceptible, MS = moderately susceptible, MR = moderately resistant, R = resistant, HR = highly resistant. Serious contentions are indicated as range of opinions, e.g. S-R, and discussed in the text. The score in bold represents our conclusion.

[2] Race 2 only

[3] nd, no data

be identified. Common, unidentified clones should be characterised using IPGRI descriptors and molecular techniques.

Within Isla (Pisang Awak subgroup), at least five, but possibly up to seven clones are distinguished: Isla del Alto Huallaga, Isla Guayaquil, Isla Maleño, Isla Nacional, Isla de Tingo María, Isla Vaporino (=Isla Baporino) and Isleño (Astocaza 1996, Figueroa and Wilson 1992, MINAG, INIA and CONFRUTA 1997, Rengifo and Fasanando 1994, SENASA and FAO 1997, Pérez and Anguiz 1998). Because of the importance of Isla (multipurpose) in Peru and its peculiar features, the main clones are compared in Table 3. Isla Maleño is grown in the coastal region of Tumbes whereas, the others are of wider distribution with predominance in the eastern valleys. The most remarkable characteristic of Isla is a pink hue of the pseudostem, leaves and fruit pulp. In the field, this can best be seen when leaves are viewed against the light. It covers the entire leaf surface apart from a 2-inch strip on the left margin. Isla is believed to have been introduced from Asia via the Canary Islands (hence the name) by the Spanish. It does not seem to have spread into neighbouring countries to any significant extent, and no clone in the Colombian Collection of Musaceae (Belalcázar, undated) corresponds to Isla.

Musa production in Peru

In this decade, the area under *Musa* has risen consistently in Peru (Table 4), which indicates a willingness of farmers to produce this crop. However, due to mediocre yields caused by poor agronomic practices and almost complete lack of disease control (Cavalié *et al.*, Chingay and Molero, Figueroa, Perco *et al.*, Tanchiva and Charpentier, Rivas and Palomino *et al.* 1986), an increase in productivity has been less pronounced (Table 4). In 1996, production reached over 1.3 million metric tons. The largest producers were the Departments of Ucayali (251,969 t), Loreto (251,943 t), Piura (225,091 t), Huánuco (156,008 t), Pasco (88,365 t), Junín (73,662 t) and Tumbes (71,887 t) (Fujimori *et al.* 1997) (Figure 1). National production shows relatively little fluctuation throughout the year (Figure 3). Although most of the production is consumed locally, sales in Lima's largest fruit market (Figure 3) provide a steady income to growers (Figure 4).

Between Jaén and San Ignacio on the Ecuadorian border (Figure 1), a

Table 3. Characteristics of main Isla clones (Pisang Awak subgroup) in Peru.

Clone	Pseudostem		Male flower	Fruit characteristics		
	Diameter (cm)	Blotched	Colour	Fingers per bunch	Fruit weight (g)	Finger shape
Isla del Alto Huallaga	16	-	yellow	110	140	typical
Isla Guayaquil	26	+	whitish	63	170	large
Isla Maleño	16	-	cream	120	105	flatter
Isla Nacional	16	-	cream	45	120	typical
Isla de Tingo María	16	-	yellow	nd [1]	nd	shorter, riged, tip more pronounced

[1] nd = no data; similar to Isla del Alto Huallaga.

Table 4. *Musa* production in Peru from 1990 to 1996 (after Webb and Fernández 1997).

Year	Area under *Musa* (ha)	Production (metric tons)	Yield (t/year/ha)	Farm-gate price (US$/t)
1990	57 888	702 418	12.13	nd[1]
1991	62 443	809 404	12.96	nd
1992	66 404	698 976	10.53	nd
1993	66 470	710 237	10.69	130.00
1994	69 401	845 403	12.18	132.42
1995	83 551	1 065 988	12.76	133.93
1996	114 126	1 347 959	11.81	116.67

[1] nd = no data.

small percentage (4%) of *Musa* is grown under irrigation. Seda and Manzano are the most popular; whereas, Isla and Palillo are more rare (Díaz 1986). In San Martín, Inguiri prevails (Yengle 1986) although this ethnically mixed Department exhibits a tremendous diversity of *Musa* germplasm (Rengifo and Fasanando 1994). The same applies to Loreto. Inguiri with *ca* 80% of production used to be of greater importance than Bellaco (Tanchiva and Charpentier 1986). Owing to black Sigatoka, both clones have largely been replaced by Pelipita. Among fruit types, Seda, Manzano and Moquicho predominate. Mameluca, Maquisapa and Tosquino for cooking, and Isla and Prato for fruit are mostly back-yard crops in Loreto (Tanchiva and Charpentier 1986). The leading clones in the Huallaga valley are Inguiri, Palillo, Isla and Seda, followed by Morado, Manzano and Moquicho (Cavalié *et al.* 1986). The main clones in the Selva Central are Isla, Seda, Inguiri and Bellaco, followed by Manzano and Morado (Parco *et al.* 1986). In Ucayali, Inguiri, Bellaco and Sapo are favoured cooking types; Isla de Tingo María, Seda, Moquicho and Manzano the preferred fruit types; and Palillo and other Isla clones are multi-purpose (Rivas and Palomino 1986). In Mardre de Dios, Inguiri, Bellaco, Seda, Manzano, Moquicho and Morado predominate (Chingay and Molero 1986).

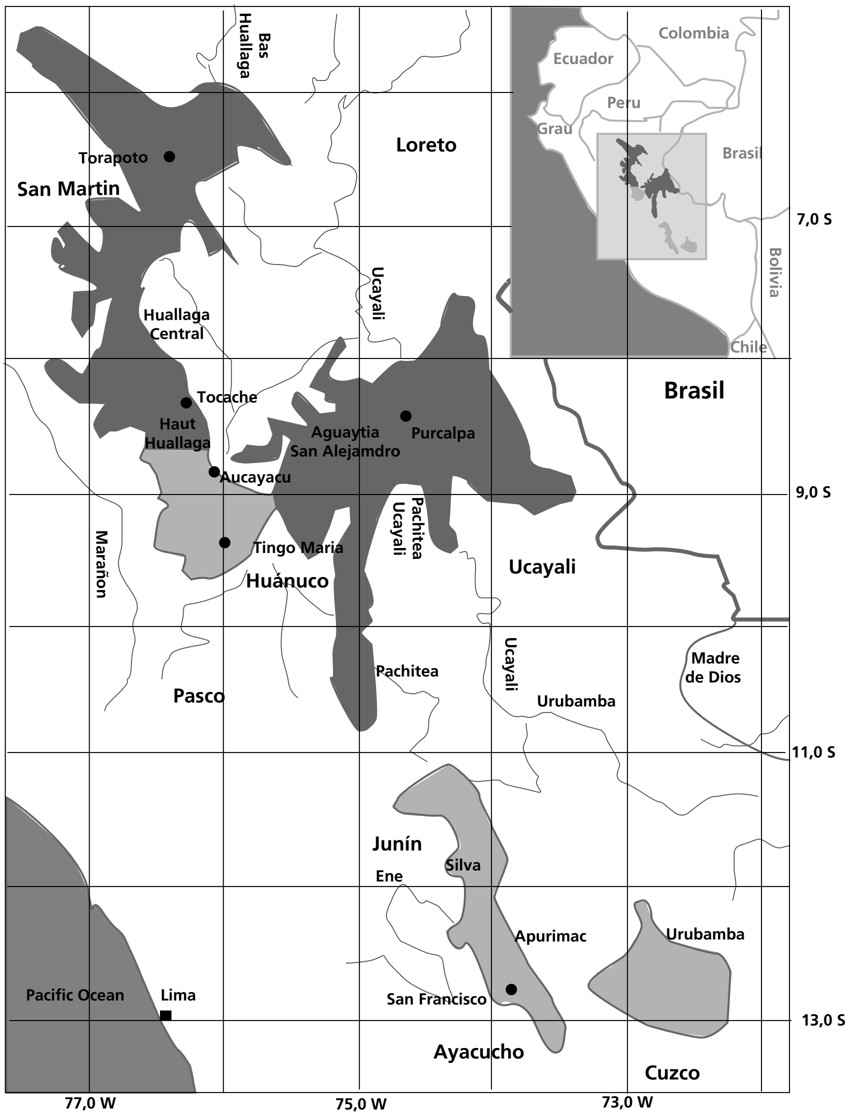

***Figure 2**. Musa-growing regions of eastern Peru covered by the disease survey (shaded). Dark shading indicates the presence of black Sigatoka, light shading its absence.*

Uses of *Musa* in Peru

Dessert-type fruit are more appreciated in the coastal regions and cooking-types in the tropical East. Among dessert-types, which are consumed as fruit or drink, Cavendish clones are the least popular. Seda is highly favoured, but the spread of Fusarium wilt (Table 5) is increasingly limiting production. Moquicho is rising in popularity, rapidly filling the gap. Some lines are reported not only to be resistant to Fusarium wilt, but also to be tolerant to the nutrient-exploited, acidic, former coca soils which are often unsuitable for the production of other crops. Ripe Moquicho is enjoyed as fresh fruit or deep-fried in a batter and green fruit is boiled whole, without peeling. This clone is the only one

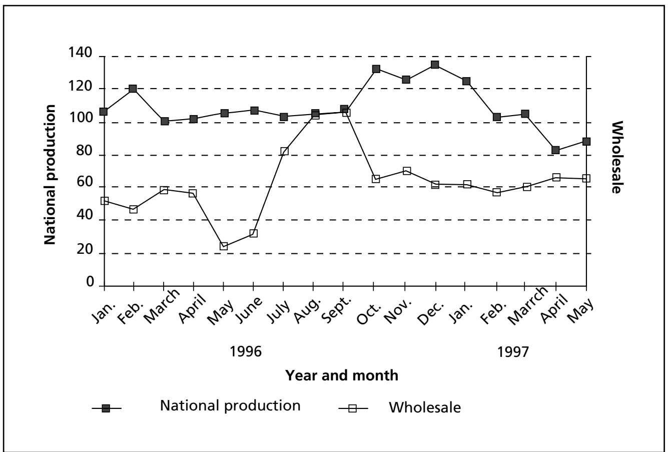

***Figure 3**. National* Musa *production and wholesale volumes on Lima's largest fruit market (x1000 t) throughout the year (adapted after Webb and Fernández 1997).*

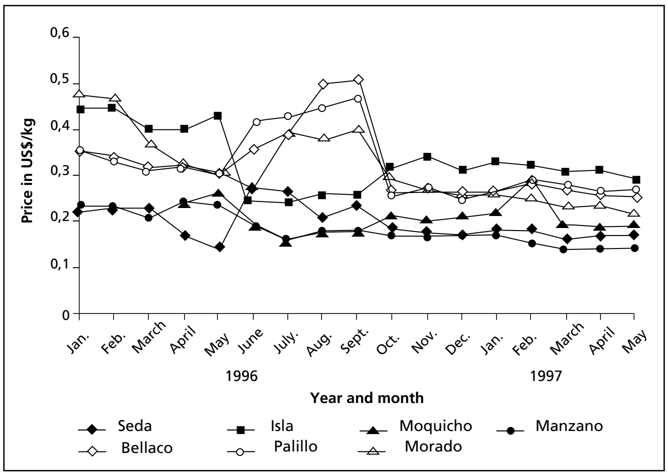

***Figure 4.** Wholesale prices of popular clones in Lima in $US/kg (after Webb and Fernández 1997).*

Table 5. Disease incidence (% of surveyed plants infested) in *Musa* in valleys of eastern Peru in 1998.

	River Valley								
	Huallaga			Ucayali		Urubamba	Apurimac		
Disease	Lower	Central	Upper	Aguaytía-San Alejandro	Pachitea Ucayali	Upper	San Francisco-Sivia	Weighted average	Change from 1997
Yellow Sigatoka	100.0	95.0	97.6	88.9	60.0	77.8	47.1	85.1	+ 1.9
Cordana leafspot	36.4	25.0	54.8	22.2	20.0	33.3	23.5	35.8	+ 10.8
Nematodes	40.9	45.0	57.1	33.3	20.0	0.0	0.0	35.8	+ 13.3
Fusarium wilt	0.0	0.0	50.0	11.1	26.7	0.0	0.0	19.4	+ 22.8
Black Sigatoka	0.0	45.0	19.0	55.6	20.0	0.0	0.0	18.7	+ 46.1
Finger tip rot	18.2	20.0	14.3	0.0	6.7	22.2	5.9	13.4	nd [1]
Moko	4.5	0.0	4.8	0.0	13.3	0.0	0.0	3.7	nd

[1] nd = no data.

transported to markets in wooden crates. All others are loaded onto trucks as whole bunches with little or no padding.

All plantain-types are boiled or fried, both green and ripe. Plantain flour and starch are produced in cottage industries in the eastern valleys. “Tacacho”, a popular dish in the eastern valleys is prepared from mature but green, boiled, mashed plantains which are then fried with lard. “Patacones” are prepared by smashing parboiled or lightly fried plantain slices and refrying them in hot oil. Horn plantains are preferred for patacones. “Chifles”, thin, deep-fried and crisp slices of green fruit, are occasionally prepared from plantain, but Manzano (Silk-subgroup) and Tosquino are preferred for making these chips on the coast. As the market potential of the delicate Manzano (the peel of ripe fruit tends to split) is recognised, padding using palm leaves is gradually being adopted to protect this clone against mechanical damage and chilling injury during the Andean crossing. This process is slow since most people of the tropical east do not appreciate Manzano and feed it to pigs. But, in some areas, fruit of both the Silk and the Pome subgroup are eaten as fresh fruit when ripe. Manzano is not consumed by inhabitants of the high Andes because they report an adverse reaction to this clone. Palillo (Maia Maoli subgroup) is boiled (green or ripe) or fried ripe on the coast. In the tropical east, the main use of Palillo is for the preparation of fresh (“chapo”) or fermented (“chicha de plátano”) drinks from the raw, ripe fruit.

Bluggoe is eaten mostly as boiled, ripe fruit. It is not popular and is found only as a back-yard crop. Sapo Plátano is the only clone in the Bluggoe subgroup, which is also eaten raw. In contrast, Isla is enjoyed in any possible form throughout the country. It is one of the most popular *Musa* subgroups in Peru.

Musa trade

In contrast to most countries, farm gate prices in Peru are not determined by fruit weight but by number of pairs of fruits (fingers) in two quality categories. In 1997, the 1000-finger price ranged from \$33.00 for Bellaco and Palillo, \$28.00 for Isla, to \$15.00 for Manzano and Moquicho in Class 1 which accounts for ca 80% of production. The price of Class 2 (20%) is half that of Class 1. For comparison, Class 1 farm-gate prices are equivalent to an average of US\$ 120-140 t^{-1}. Given this unusual remuneration system, agronomic recommendations should focus on the very early stages of inflorescence differentiation which takes place before emergence. At this time, the maximum number of hands and fingers are being determined (Stover and Simmonds 1987). After emergence, only fruit filling takes place and good crop husbandry then will be less profitable than at an earlier stage. This is a difficult task for extensionists because growers are more likely to take care of a visible bunch after flowering than a plant before emergence.

A further problem of the pricing system is that only pairs of fingers on the two whorls of a hand are counted. The number of fingers on an odd-numbered hand is rounded down. Thus, farmers lose approximately 10% of their income while traders win because retail prices in Peru are based on weight like elsewhere. Farmers do not remove odd fruits for home consumption. The removal of these fingers at early stages of bunch development could accelerate the development of the remainder of the bunch. Waste would be reduced and gross income increased. However, Peru is a long way from using such sophisticated bunch care techniques.

In the wholesale market in Lima, there are significant variations in prices during the year and among clones (Figure 4). High prices (average for 1996 in parentheses) were obtained for Bellaco, Palillo, Morado (US\$ 0.35 kg^{-1}) and Isla (US\$ 0.34 kg^{-1}); whereas, Seda, Moquicho (US\$ 0.21 kg^{-1}) and Manzano (US\$ 0.20 kg^{-1}) were lower-priced. Dessert-types are consumed throughout the year and prices are relatively stable. In contrast, Bellaco and Palillo, two varieties which, in Lima, are consumed only cooked, are most popular in the colder winter month. This is reflected in a seasonal price increase between June and September (Figure 4).

As mentioned above, Peru exports only small amounts of banana/plantain. Chile is the main destination with 700-1000 t/year^{-1}. In 1994, Ecuador, Italy and the Netherlands also imported Peruvian fruit (Fijimori *et al.* 1996). Insignificant amounts are imported from Ecuador when national supplies are insufficient in border regions.

Pests and diseases

The most problematic diseases in Peru are black and yellow Sigatoka and *Cordana* leafspot (Tables 5 and 6) (Anguiz and Nicolas 1998, Arévalo *et al.* 1998). Yellow Sigatoka, *Cordana* leafspot and the relatively harmless *Cladosporium* leafspot are ubiquitous; whereas, the more aggressive black Sigatoka, which reached Peru (Ucayali) in 1994, is still absent from Apurímac, Madre de Dios and Urubamba (Anguiz and Nicolas 1998, Arévalo *et al.* 1998) (Figure 2). Black Sigatoka is seriously affecting production in Loreto, San Martín and the Ucayali valley and exhibits the fastest expansion rate of all diseases (Table 5). It is now spreading upstream in the upper Huallaga valley. By late 1997, it had reached between Tocache and Aucayacu (Table 6, Figure 2). Fusarium wilt (races 1 and 2) is serious in some locations and expanding (Table 5). Moko is serious in Loreto (Pérez and Anguiz 1998, Tanchiva and Charpentier 1986). It also occurs in Patchitea-Ucayali but only sporadically in the Huallaga valley (Table 5) where *Erwinia* sp. is also present. The present distribution of Moko should be validated by modern diagnostic techniques. Banana streak virus and cucumber mosaic virus have been reported in Ucayali (Pérez and Anguiz 1998). Nematodes (*Meloidogyne* spp., *Pratylenchus* spp. and *Radopholus similis*) are widespread (Table 5). *Cosmopolites sordidus* and *Metamasmius hemipterus* are serious pests (Diaz 1986, Rivas and Palomino 1986, Viera 1986). *Castina licus* and *C. daedalus* have been reported from Loreto (Tanchiva and Charpentier 1986). No fungicides are used for disease control. Cultural control, especially phytosanitation, is the recommended control method (Pérez and Anguiz 1998). The lack of drainage, weeds and excessive sucker populations often negate such control efforts. As a result, farmers do not see the benefit of sanitation and often do not practice it diligently.

Plantain and Bluggoe are regarded as resistant to yellow Sigatoka and most ABB-types are tolerant or resistant to black Sigatoka (Stover and Simmonds 1987). However, under poor disease management, serious infections occur in Peru. In a survey in 1997, yellow Sigatoka was found affecting Inguiri, Bellaco, Palillo, Manzano and Isla (Table 6). These results were confirmed by microscopy and PCR (according to Johanson and Jeger 1992). Stover and Simmonds (1987) reported that yellow Sigatoka resistance does not hold in the highlands of Colombia, and Munive (1985) confirmed that, under bad conditions, these clones can be seriously affected in Peru. Yellow Sigatoka is better adapted to high altitudes than black Sigatoka. However, the altitudes recorded in this survey (220-780 masl) were not correlated with disease incidence. Instead, a displacement of yellow Sigatoka by the more aggressive black Sigatoka was observed in the Ucayali where it has been present longest (Table 6). It was concluded that plantains and Palillo are moderately resistant to yellow Sigatoka in Peru, and Manzano and Isla are resistant but can be attacked under severe conditions. On the other hand, Moquicho is highly susceptible to yellow Sigatoka (Figueroa and Wilson 1992, Munive 1985, Stover and Simmonds 1987), but only moderately so to black Sigatoka (Stover and Simmonds 1987). The frequently suggested high susceptibility of Moquicho to black Sigatoka in Peru may be a result of misidentification of the pathogen. Field symptoms under local conditions are indistinguishable from those of black Sigatoka and atypical for yellow Sigatoka. However, PCR analyses, in most cases, confirmed the identity of the pathogen as *Mycosphaerella musicola* (Table 6). The reaction of Moquicho to Panama disease is also disputed (Table 2). It is possible that the synonyms listed in Table 1 represent different mutants. Datíl has been reported as resistant and Moquicho as susceptible (SENASA and FAO 1997). Alternatively, pathogenic races of *Fusarium oxysporum* f. sp. *cubense* could have evolved on stressed root systems. The shortcomings in crop and disease management mentioned above, especially periodically flooded soils, also contribute to poor root health and concomitant soil-borne pest and disease damage. Panama disease may be reduced by inundation. It is surprising that bacterial wilts are only of localised importance outside Loreto. However, nematodes and banana borers destroy many plants. The causal agents and mecha-

Table 6. Distribution of foliar diseases in eastern Peru in October 1997.

Geographic information				Disease diagnosis			
Area	Site	Altitude (m)	Cultivar	Black Sigatoka	Yellow Sigatoka	*Cordana* Leafspot	*Cladosporium* sp.
Apurímac Valley							
San Francisco	San Francisco	780	Palillo	-	+	+	nd [1]
		780	Palillo	-	+	+	nd
Huallaga Valley							
Tingo María	Tingo María	660	Isla	-	+	+	+
	Afilador	660	Moquicho	-	+	+	+
	Marona Baja	670	Moquicho	-	+	nd	nd
		670	Isla	-	+	+	nd
Aucayacu	Aucayacu	720	Isla	-	+	+	+
Tocache	Huayranga	515	Bellaco	++	+	+	+
		515	Palillo	++	+	+	+
	Bambamarca	558	Inguiri	+	+	+	+
		392	Palillo	+	+	+	+
		392	Palillo	-	+	+	-
	Bajo Almendra	463	Bellaco	++	+	+	+
		463	Inguiri	++	+	+	-
		392	Palillo	++	+	+	+
Juanjuí	Costa Rica	360	Inguiri	-	+	+	+
	Huicungo	500	Inguiri	++	+	+	+
	Montevideo	500	Inguiri	+	+	+	-
	Pachiza	500	Inguiri	++	+	+	+
	Piscuyaco	510	Inguiri	+	+	+	-
	Saposoa	560	Inguiri	-	+	nd	nd
Ucayali Valley							
Boquerón	La Divisoria	700	Guayaquil	+	-	-	nd
"	Boquerón	500	Moquicho	+	-	-	nd
Aguaytía	Hauipoca	360	Seda	+	-	+	nd
"	San Juan	256	Manzano	++	-	+	nd
San Alejandro	San Alejandro	295	Seda	-	+	-	nd
Pucallpa	km 50	228	Morado	+	-	-	nd
"	Campo Verde	220	nd	+	-	+	nd

[1] nd = no data

nisms of infestation and dissemination are often not known to farmers.

Future prospects and constraints

Pests and diseases are the most limiting factors for *Musa* production in Peru. The recently started evaluation of resistant germplasm under Peruvian conditions is an important step in addressing these problems. Disease-resistant FHIA varieties have been introduced to Peru. It remains to be seen how they perform in comparison with popular and robust local varieties such as Isla. Resistant varieties alone, however, will not solve all the problems since hardy, local varieties succumb to infection at present. Extension to improve crop husbandry must go hand in hand with the planting of suitable varieties to ensure sustainable production in the future. A top priority should be drainage. However, any suggestion to drain soils is refuted by the observation that plantations suffer seasonally from drought. Farmers intuitively believe drought damage would be more severe in drained soils. Extension services will have to employ practical methods, such as demonstration plots and farmer field schools, to prove that less drought stress is experienced in drained soils due to improved root health. Additional technology transfer is needed to introduce modern techniques which are widely practised in neighbouring countries, i.e. selection of planting material, planting density, sucker management, weed control and phytosanitary pruning. The economics of cultural practices are underinvestigated and most likely underestimated in Peru. The benefit/cost ratio of fertilisation during early bunch differentiation on marketable yields should be determined.

Marketing is limited by substantial quality losses in transit to metropolitan markets. Some transandean roads are in mediocre conditions and can be closed for days in the rainy season. However, poor post-harvest practices also contribute to losses. Harvesting techniques and packaging for transport should be priorities. Communication between customers and growers leaves room for improvement. Manzano enjoys a promising market potential in Lima. However, due to its unpopularity in the east where it is produced, this is not yet realised by growers. Ripe fruit can drop off the bunch and/or its peel splits open. One way to reduce this problem would be by sequential partial harvesting from hanging bunches, i.e., by harvesting the proximal hands earlier than the distal ones. The high-priced Isla is a robust variety with high disease tolerance. It also produces a fruit with a unique flavour and texture which may not be easily replaced. Isla clones should thus be included in any comparison of improved germplasm in Peru.

Acknowledgements

This paper was prepared during a diversification project funded by the Ministry of Agriculture of Peru, the Food Agriculture Organisation (FAO) and the United States Department of Agriculture - Agricultural Research Service (USDA-ARS). During the resident starting period, additional funds were received from the Organisation of American States (CICAD/OAS). The project was managed by CABI Bioscience and the *Convenio UNAS-ARS-NAS*. The Natural Resources Institute facilitated Sigatoka diagnostics. The disease survey was assisted by the following field officers: Esteban Altamirano, David Arévalo, Jefferson Cárdenas, Julio Flores, Tomás Malgarejo, Alejandro Pimentel, Manuel Piña, Tulio Pisco, Walter Rategui and Romulo Rodríguez. The authors also wish to thank colleagues of numerous institutions (FAO, INIA, UNAS, UNSM, UN La Molina) for helpful comments and discussion. We are particularly grateful to Phil Rowe who provided germplasm and reviewed this manuscript. ■

References

Anguiz R. 1998. Evaluación de variedades introducidas y locales de plátano a la Sigatoka Negra en condiciones de Ucayali. Paper presented at the XV Congreso Peruano de Fitopatología, Pucallpa, Peru, 27 September - 02 October, 1998.

Anguiz R. & Z. Nicolas. 1998. Mapeo fitopatológico e incidencia de la Sigatoka negra del plátano en el Perú. Paper presented at the XV Congreso Peruano de Fitopatología, Pucallpa, Peru, 27 September - 02 October, 1998.

Arévalo E., Ríos R., Cabezas O. & L. Zuñiga. 1998. Distribución de enfermedades en los principales cultivos alternativos en las zonas cocaleras del Perú. Paper presented at the XV Congreso Peruano de Fitopatología, Pucallpa, Peru, 27 September - 02 October, 1998.

Astocaza E. 1996. Programa Nacional de Prevención y Control de la Sigatoka Negra del Plátano. Ministerio de Agricultura, Servicio Nacional de Sanidad Agraria, Ucayali, Pucallpa, Peru.

Belalcázar S. 1991. El Cultivo del Plátano en el Trópico. ICA-IDRC-CDCQ-INIBAP. Manuál de Asistencia Técnica Nº 50.

Cavalié J. M., C. R. Coz, J. A. Estela, J. W. Panduro & J.A. Benito. 1986. Diagnóstico del cultivo de plátano en el ámbito del Alto Huallaga. Pp. 21-24 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds). IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

Chingay J.L. & R.R. Molero. 1986. Diagnóstico del cultivo de plátano en el Departamento de Madre de Dios. Pp. 41-45 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds). IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

Díaz C.J. 1986. Diagnóstico del cultivo de plátano en Jaén-San Ignacio. P 20 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds). IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

Figueroa R. 1986. Prácticas culturales en la producción del plátano. Pp 78-88 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds). IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

Figueroa R. & G. Wilson. 1992. El Cultivo de Plátano en el Perú. (Roque Otárola, ed.). Fundación para el Desarrollo del Agro (FUNDEAGRO), Lima, Peru.

Fujimori A., R. Muñante, R. Masuda & S. Maza y Silupu. 1996. Comercio Exterior Agrario 1993-1996 (A Junio). Ministerio de Agricultura, Oficina de Información Agraria, Lima, Peru.

Fujimori A., R. Muñante, R. Masuda & S. Maza y Silupu. 1997. Producción Agricola de Principales Cultivos, 1996. Ministerio de Agricultura, Oficina de Información Agraria, Lima, Peru.

Johanson A. & M. J. Jeger. 1992. Use of PCR for detection of *Mycosphaerella fijiensis* and *M. musicola*, the causal agents of Sigatoka leaf spots of banana and plantain. Mycological Research 97: 670-674.

Ministerio de Agricultura (MINAG), Instituto Nacional de Investigación Agraria (INIA) & Comisión Nacional de Fruticultura (CONFRUTA) 1997. El Cultivo de Plátano. Boletín Técnico No. 8, Lima, Peru.

Munive J. 1985. El Plátano y la Sigatoka. Pura Selva, June 1985.

Ostmark E. H. 1997. An Assessment of Production of Bananas/Plantains in the Tingo María Area of Peru. Consultancy report prepared for ACDI/VOCA, 50 F St NW Suite 1100, Washington DC 20001, USA, August 1997.

Parco M., A. B. Lermo & R. Cayllaha. 1986. Diagnóstico del cultivo de plátano en la Selva Central. Pp. 25-26 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds). IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

Pérez L. 1997. Manual para el Manejo Agronómico del Cultivo del Plátano en Parcelas Demonstrativas del Proyecto FAO TCP/PER/6611. FAO, Lima, Peru.

Pérez L. & R. Anguiz. 1998. Manual para el Manejo Integrado del Cultivo del Plátano. Proyecto TCP/PER/6611, Asistencia al Plan de Emergenmcia para el Control de la Sigatoka Negra, Lima, Peru.

Rengifo G. & J. Fasanando. 1994. Crianza Campesina de Semillas en el Mayo Central - San Martín. Centro de Desarrollo e Investigación de la Selva Alta (CEDISA), Tarapoto, San Martín, Peru.

Rivas R & J.C. Palomino. 1986. Diagnóstico del cultivo de plátano en el Departamento de Ucayali. Pp 35-41 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds). IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

Servicio Nacional de Sanidad Agraria (SENASA) & Food and Agriculture Organisation (FAO) (1997). Manual para el Manejo Integrado de la Sigatoka Negra (*Mycosphaerella fijiensis* Morelet) del Plátano. Project TCP/PER/6611, Lima, Peru.

Stover R.H. & N.W. Simmonds. 1987. Bananas (3rd edition), Longman, London, United Kingdom.

Tanchiva E & A. Charpentier. 1986. Diagnóstico del cultivo de plátano en el Departamento de Loreto. Pp. 26-35 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds). IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

Viera M. 1986. Manejo de insectos en el cultivo de plátano. Pp. 112-116 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds.) IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

Webb R. & G. Fernández. 1997. Perú en Números 1997. Cuanto S. A., Lima, Peru.

Yengle V.E. Cervantes, C. Egoavil & J. W. Alvarado. 1986. Diagnóstico del cultivo de plátano en el Departamento de San Martín. Pp. 20-21 *in* Seminario Taller sobre Producción de Plátano en la Selva Peruana (A. M. Pimchinat, R. Figueroa & L. Ramírez, eds). IICA & INIPA, Serie Ponencias, Resultados y Recomendaciones de Eventos Técnicos Nº A3/PE-86-001, ISSN-0253-4746, Lima, Peru.

U. Krauss is Assistant Professor at CATIE, 7170 Turrialba, Costa Rica, e-mail ukrauss@catie.ac.cr, Fax (506) 556 0606. **R. Figueroa Z**. holds the position of the Executive Coordinator of the *Comisión Nacional de Fruticultura* (CONFRUT), Pasaje Zela s/n piso 9, Espalda Edificio Ministerio de Trabajo, Jesus María, Lima, Peru, Tel/Fax (51) - 1 4327999. **A. Johanson** is Assistant Director of the Agricultural Biotechnology Support Project (ABSP), 414 Plant & Soil Building, Michigan State University, East Lansing, NI 48824, USA, e-mail andreaj@pilot.msu.edu, Fax (1) 517 43221982. **E. Arévalo** is Professor of Plant Pathology at UNAS, based at Taropoto, Jirón Tarapoto 247, Banda del Shilcayo, Tarapoto, San Martín, Tel/Fax (51) - 94 - 526815, e-mail unasars@computextos.pe. **R. Anguiz** is a Consultant for FAO in Peru and is in charge of the evaluation of FHIA germplasm in Ucayali; c/o FAO, Manuel Almenara 328, Urb, Aurora, Miraflores, Apdo 14-0016, Lima 14, Fax (51) 1 4472640, e-mail: ranguiz@hotmail.com. **O. Cabezas** in Professor for Plant Pathology at UNAS based in Tingo María, e-mail ocabhu@telematic.com.pe. **L. García** is Head of the Department of Agricultural Sciences of UNAS.

Country report Focus on...

Highland bananas in Colombia

Nigel S. Price

Musa in Colombia

Colombia is one of the world's major growers of *Musa*. Data recently assembled by Thierry Lescot of CIRAD show that the country ranks fifth globally in terms of overall *Musa* production and is the worlds third biggest exporter of "Cavendish" bananas (Lescot 1998).

Domestic consumption of *Musa* by Colombia's 36 million people is largely of AAB plantains and at 3 million tonnes Colombia is the world's biggest producer (for which there is also a very small export trade) (Table 1). In addition both "Cavendish" and "Gros Michel" bananas are significant components of this domestic consumption.

Whereas "Cavendish" bananas are generally grown in the lowland coastal regions of Colombia, both AAB Plantains and "Gros Michel" bananas occur mainly in the more central highland regions, often in association with coffee. Articles on the growing in Colombia of both these *Musa* types have appeared in previous issues of INFO*MUSA* (Lescot 1993, Grisales and Lescot 1993, Grisales 1996).

Highland bananas

Less well known is the small, but locally significant, growing of East African Highland banana (AAA-EA) in Colombia. In Africa in the Highlands bounding Lake Victoria (their presumed centre of diversity, if not origin, Simmonds 1966) these bananas are of great agricultural importance. In Uganda and her neighbours they constitute a major starchy staple, and as banana beer have a particular cultural significance (Champion 1970). The botanical and geographic origins and development of this *Musa* group are of interest not only to agriculturists but also to anthropologists and historians (Simmonds 1966, Davies 1995).

During a recent visit to the central Andean region of the Department of Antioquia in Colombia, East African Highland banana (AAA-EA) was frequently observed growing in association with coffee. Subsequent to this visit, and with the assistance of Colombian colleagues, further details on the growing of this particular *Musa* type, so far from its known region of origin, has been assembled.

Antioquia (see Figure 1) with its capital Medellin is, at 63,612 Km^{-2}, one of the largest of the 32 Departments that make up the Republic of Colombia. Stretching from the Caribbean coast up to 4000 masl in the major part of the department (Figure 1) it is also one of the most important economically being a major producer of electricity and possessing substantial industry. Agriculturally, "Cavendish' bananas are important in the coastal North of the department whereas the Andean uplands of the southern part of Antioquia form a major coffee producing area with over 300,000 hectares being grown. Commonly grown in association with this coffee are AAB plantains (mainly the False Horn variety "Dominico Harton"), dessert bananas (in particular "Gros Michel") and to a lesser extent, East African Highland banana (AAA-EA), known as "Guineo" (see photograph) which generally occurs between 1500 and 2000 masl.

Table 1. Relative production of major *Musa* types in Colombia. (Data compiled by T. Lescot 1998).

Musa type	Domestic consumption		Exports		Total production	
	Tons (1000)	%	Tons (1000)	%	Tons (1000)	%
AAB Plantains	2 970	96	120	4	3 090	55
Cavendish	524	26	1 476	74	2 000	35
Gros Michel	500	100	Ins	Ins	500	9
Highland/cooking bananas[1]	42	100	Ins	Ins	42	1

[1] As well as East African Highland banana (AAA-EA) this category also includes other cooking types such as Bluggoe.

Ins = Insignificant or unknown.