

SHORT COMMUNICATION

Introduction, Evaluation and Adoption of an Exotic Banana (*Musa* AAB cv 'Popoulu') (EC320555) to Kerala, India

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Introduction, characterization and evaluation of exotic *Musa* germplasm has been undertaken at the Banana Research Station (BRS), Kannara, Kerala since 1994, under the aegis of All India Coordinated Research Project (AICRP) on Tropical Fruits, with the view to widen genetic base of this important crop. An exotic cultivar 'Popoulu' belonging to the Maia Maoli/Popoulu group of the AAB genomic group was characterized and evaluated under Kerala growing conditions. Results revealed that 'Popoulu' is a potential dessert and cooking exotic banana cultivar, highly suited for preparation of chips with a recovery of 33%, similar to 'Nendran'. The higher bunch weight of 'Popoulu' contributes to higher yield of chips. 'Popoulu' has great potential for popularization amongst farmers of Kerala, as a profitable cultivar to complement 'Nendran' ecotypes.

Key Words: Banana subgroup, Characterization, Introduction, 'Maoli', 'Popoulu'

Banana is the most widely cultivated and consumed fruit cum vegetable species in the southern Indian state of Kerala. Various cultivars of banana are consumed at the green or half-ripe stage as a cooked starchy vegetable or ripe as a fruit. Edible forms of banana have been selected by farmers from the progeny of either one or two wild seeded diploid parent species, *Musa acuminata* Colla (A genome) and *M. balbisiana* Colla (B genome) with a wide diversity of diploid, triploid and tetraploid hybrids with widely differing properties and composition. More than 1,000 recognizable *Musa* cultivars distributed pantropically have been identified by taxonomists (IPGRI, 2006). Fifty per cent of the banana production in Kerala is confined to homesteads where a wide range of cultivars are accommodated in different cropping systems. While the French plantain (AAB) cultivar 'Nendran' is grown on a commercial scale in Kerala, the other cultivars viz. 'Palayamkodan' (Mysore), 'Rasthali', 'Njalipoovan' and 'Kadali' are integrated in the polyclonal system unique to Kerala. In the highly variable genomic group AAB, Plantain, Mysore, Silk and Padathi are the major subgroups, with 'Nendran', 'Palayamkodan', 'Poovan' and 'Nendrapadathy', the popular cultivars, respectively (Menon, 2000).

The center of origin of the banana is South-east Asia and the Pacific Islands extending from India to Papua New Guinea and including Malaysia and Indonesia (Marin *et al.*, 1998). A diverse selection of cultivars of *Musa* is thought to have arisen in South-east Asia along with the earliest development of agriculture many thousands of years ago (Sharrock *et al.*, 2001). It is thought that the subsequent dispersal of edible bananas outside Asia was brought about solely by humans (Simmonds, 1962). This early dispersal of banana cultivars resulted in the development of distinct sub-groups of varieties in different geographic locations. Secondary diversification within the major groups of cultivated bananas is thought to have been the result of somatic mutations rather than sexual reproduction (Valmayour *et al.*, 2002). Mutations affecting traits of economic or horticultural interest have been selected by farmers over the years and multiplied by vegetative propagation to produce morphotypes. Movement eastwards resulted in the development of a distinct group of AAB bananas cultivated throughout the Pacific Islands (Sharrock *et al.*, 2001; Valmayour *et al.*, 2002). These are known as the Maia Maoli/Popoulu group, and the progenitors of these bananas are thought to have been carried eastwards by proto-Polynesians from an area in or near the Philippines more than 4,000

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years ago (De Langhe, 1996). Today, amongst the several exotic groups of bananas occurring worldwide, the cultivated bananas in the Pacific Islands are unique in their high-level diversity (Daniells 1995; Kennedy, 2008). The Maia Maoli/Popoulu group are named after the 'Maoli' and 'Popoulu' bananas and 'Maia' being the Hawaiian term for bananas (Ploetz *et al.*, 2007; Kepler and Rust, 2011). The Popoulu bananas domesticated in the Pacific region, comprise traditional cooking cultivars and are often referred to as 'Pacific plantains' because of their relationship with African plantains, which also belong to the AAB genome group. The cultivars in the Maoli-Popoulu are typically recognized by their plump, sausage-shape fruits that are either straight or slightly curved with rounded tips. They are also known as 'Hawaiian banana Popoulu', 'Plantain Popoulou', 'Banane à chair rouge', 'Banane de Nouvelle Calédonie'. The fruit has a salmon pink flesh, with smooth texture, no fibers and with a slightly acidic apple-like flavor that can be cooked or eaten fresh when it is ripe (Englberger *et al.*, 2003a). Some types of 'Popoulu' are in danger of extinction (Sharrock *et al.*, 2001).

Introduction, characterization and evaluation of exotic *Musa* germplasm has been undertaken at the Banana Research Station (BRS), Kannara, Kerala since 1994, under the aegis of All India Coordinated Research Project (AICRP) on Tropical Fruits (Menon *et al.*, 2005). The goal is to finally make available suitable selected material to the farming community, to widen its genetic basket of cultivars. Amongst one of the earliest exotic introductions, 'Popoulu' (accession EC320555) was obtained from the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, for its characterization and evaluation. The germplasm was acquired by NBPGR during 1991 from the erstwhile International Network for Improvement of Banana and Plantain (INIBAP), now known as the *Musa* International Transit Centre (ITC), Leuven, Belgium (accession ITC1135). There were no previous records of its cultivation in any part of India, and evaluation was initiated at BRS for the first time. Preliminary evaluation indicated its acceptability in terms of yield and quality, combined with resistance to Sigatoka (*Mycosphaerella* sp.), in India (Menon, 2000). The present work was undertaken to systematically characterize growth and yield traits of 'Popoulu' in the field at BRS, Kannara, and to carry out multi-location evaluation for its agronomic performance and assessment of farmers' acceptability.

In vitro rooted plantlets of 'Popoulu' obtained from NBPGR were hardened and multiplied in the field at BRS, Kannara. Standard agronomic practices were followed for raising the crop (KAU, 2011). During 1997-2000, morphological characterization was undertaken using standard descriptors for banana (IPGRI-INIBAP/CIRAD, 1996). Subsequently in three growing seasons (2003-2006), experiments were conducted in a randomized block design to evaluate 'Popoulu', with four local check cultivars of various AAB subgroups, namely, 'Nendran', 'Palayamkodan', 'Poovan' and 'Nendrapadathy'. Three growth parameters [pseudostem height (cm), pseudostem girth (cm), number of leaves] at bunch emergence, and three yield parameters [bunch weight (kg), number of hands/bunch, number of fruits/hand] at harvest and crop duration were recorded. During 2009-10 and 2010-11, detailed evaluation was carried out to compare yield traits [bunch weight (kg), number of hands/bunch, number of fruits/hand, fruit length (cm), fruit girth (cm), fruit weight (g), pulp-peel ratio] along with recovery of chips (%) of 'Popoulu' with 'Nendran'. Data were also recorded on incidence of Sigatoka leaf spot and rhizome root rot under prevailing conditions of Kannara. All growth and yield data were analyzed statistically and t-test was performed to test the significance. Micropropagation protocol was applied for the large scale multiplication of 'Popoulu' using to facilitate field evaluation at large scale.

Under Kannara conditions, 'Popoulu' plants exhibited robust and luxuriant growth and some selected descriptor states recorded are shown in Table 1. Amongst the morphological characters (Table 2), pseudostem height was tall (mean 295.6 cm) and girth was recorded as medium (mean 51.6 cm). Pseudostem was typically medium green in colour, with small blotches. Red pigmentation was observed only on the outer leaf sheaths. Leaves had intermediate habit, with a length to width ratio of 2.8. The petiole canal of the third leaf was open with erect margins, and red coloration was observed on petiole margins. The bunch hangs vertically and had a compact appearance (Fig. 1). Peduncle was glabrous. The rachis was pendulous, with a lanceolate male bud degenerating at harvest. Bracts were dark purple brown outside and orange red inside. Bracts were revolute and left a prominent scar on the peduncle upon falling. 'Popoulu' had light yellow compound tepal in contrast to the yellow-orange compound tepal of plantains.

Table 1. Salient descriptor states of 'Popoulu' (AAB) (EC320555)

Descriptor	Descriptor state
Pseudostem	tall
Pseudostem color	medium green
Pseudostem appearance	shiny
Presence of blotches	small blotches
Leaf orientation	normal
Petiole canal leaf III	straight with erect margins
Colour of leaves	medium green
Position of suckers	close to parent (vertical growth)
Inflorescence	falling vertically
Male bud type	normal, degenerating at harvest
Bunch	compact
Fruits	straight with blunt apex
Transverse section of fruits	rounded, slightly ridged
Immature peel colour	medium green
Mature peel colour	bright yellow
Remains of flower relicts at fruit apex	persistent style
Flesh texture	firm
Flesh colour	orange yellow
Fruit fall	persistent
Taste	sweet and starchy

Ripe fruit pulp had a striking resemblance to that of French plantain cv 'Nendran'. The cross section of fruits of 'Popoulu' was slightly angular, with blunt apex bearing flower relicts in the form of persistent style. The peel was thick and medium green in young fruits and turned bright yellow when ripe. The pulp colour was light pink when raw and orange yellow when mature, with a firm texture. The fruits were not palatable when raw, and become sweet/starchy at maturity. Seeds were absent in the fruit. Studies have shown that yellow or orange coloration of the edible flesh is a good indication of high carotenoid content in bananas; high carotenoid types help protect against vitamin A deficiency, anaemia, diabetes, heart disease, and certain cancers (Englberger *et al.*, 2003 a, b, 2006).

Table 2 gives the comparison of mean values of growth and yield traits between 'Popoulu' and four local

**Fig. 1. Bunch of 'Popoulu' banana at the time of harvest**

AAB checks. Plant height was significantly lower in 'Popoulu' (295.6 cm) as compared to 'Poovan' (331.0 cm) and 'Nendrapadathy' (272.6 cm) but comparable to 'Nendran' and 'Palayamkodan'. In terms of pseudostem girth, again 'Popoulu' was comparable to 'Nendran'. However, number of leaves were significantly higher in 'Popoulu' as compared to 'Nendran' as well as 'Poovan' (Table 2). Importantly, crop duration of 'Popoulu' (298 days) was the shortest and significantly less compared to all the tested checks, which ranged from an average of 311 to 358 days. Also bunch weight (17.5 kg) recorded in 'Popoulu' was significantly higher than that in other local AAB cultivars, ranging from 10.4 to 13.7 kg (Table 2). Number of hands/bunch was comparable to 'Poovan' and 'Nendrapadathy', but significantly higher than 'Nendran'. 'Popoulu' bunch bore more number of fruits/bunch than 'Nendran', but registering fewer fruits than other checks.

Table 2. Preliminary evaluation of 'Popoulu' (EC320555) in comparison to popular AAB cultivars

Variety	Plant height (cm)	Pseudostem girth (cm)	No. of leaves	Crop duration (days)	Bunch weight (kg)	No. of hands/ bunch	No. of fruits/ bunch
'Popoulu'	295.6 ^c	51.6 ^c	12.4 ^a	298.0 ^d	17.5 ^a	7.2 ^c	76.8 ^d
'Nendran'	301.0 ^c	50.6 ^c	9.8 ^b	311.0 ^c	10.7 ^c	5.4 ^b	56.0 ^e
'Palayamkodan'	305.0 ^c	59.0 ^b	12.8 ^a	313.6 ^c	13.7 ^b	9.8 ^a	168.0 ^a
'Poovan'	331.0 ^a	64.6 ^a	9.6 ^b	358.6 ^a	10.6 ^c	7.4 ^c	115.6 ^b
'Nendrapadathy'	272.6 ^b	58.8 ^b	13.0 ^a	322.4 ^b	10.4 ^c	6.6 ^c	102.0 ^c
CV	7.17	10.29	14.63	7.21	23.96	21.54	37.81

Values in a column followed by the same letter are not significantly different ($P < 0.05$)

Table 3. Performance of ‘Popoulu’ (EC320555) in comparison to ‘Nendran’ (2009-11)

Parameters	‘Popoulu’	‘Nendran’
Growth characteristics		
Plant height (cm)*	299.8 ^b	311.5 ^a
Pseudostem girth (cm)*	51.6 ^a	50.7 ^a
No. of leaves*	12.2 ^a	10.7 ^b
Days to flowering*	227.2 ^a	220.1 ^b
Crop cycle (days)*	301.0 ^b	310.2 ^a
Yield characteristics		
Bunch weight (kg)*	19.45 ^a	11.21 ^b
Number of hands*	7.60 ^a	5.40 ^b
Number of fruits*	79.20 ^a	57.00 ^b
Fruit length(cm)*	15.60 ^b	24.00 ^a
Fruit girth (cm)*	20.50 ^a	13.50 ^b
Fruit weight (g)*	267.90 ^a	190.10 ^b
Pulp peel ratio	3.30	3.10
Recovery of chips (%)	33.0	32.0

* t value=2.101

Values in a row followed by the same letter are not significantly different ($P < 0.05$)

Data on comparative traits between ‘Popoulu’ and ‘Nendran’ showed significant variation during detailed evaluation (Table 3). In general, ‘Popoulu’ appeared short statured than ‘Nendran’ with a shorter crop cycle. Bunch weight recorded in ‘Popoulu’ was superior to ‘Nendran’. Thus, fruit yield of ‘Popoulu’ was significantly higher as compared to ‘Nendran’ (10.68 kg and 56 fruits/bunch). Though ‘Popoulu’ fruits were shorter than ‘Nendran’, fruit girth and weight were significantly more. The variety also accounted for higher pulp to peel ratio and recovery of chips (33%, Fig. 2). While ‘Popoulu’ displayed slight tolerance to Sigatoka leaf spot in comparison to Nendran, susceptibility to rhizome rot was high. Since the intensity of rhizome rot is high during monsoon, planting during August conferred some protection, as the harvest could be done before the onset of rains. It also displayed susceptibility to stem borer which could be managed by prophylactic sprays. Unlike ‘Nendran’ it is not vulnerable to wind damage and no staking is required.

Micropropagation technique was successfully applied for large scale multiplication of ‘Popoulu’ plants resulting in the production of over 5,000 plants. The variety now under multi-locational testing in 10 locations, is being deployed as a dessert and cooking cultivar highly suited for preparation of chips. It is also useful for the preparation of a variety of snack items as that of ‘Nendran’.

To conclude, ‘Popoulu’ is a potential dessert and cooking exotic banana cultivar, highly suited for

**Fig. 2.** Banana chips made from ‘Popoulu’

preparation of chips with a recovery of 33%, similar to ‘Nendran’. The higher bunch weight of ‘Popoulu’ contributes to higher yield of chips. Since the crop cycle is completed within one year, it can be accommodated in the annual cropping pattern preferred for banana in Kerala. Propping is not needed which would account for reduced cultivation costs. Thus, ‘Popoulu’ needs to be popularized amongst farmers of Kerala as a profitable cultivar to complement ‘Nendran’ ecotypes.

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