



P-ISSN: 2349-8528
 E-ISSN: 2321-4902
www.chemijournal.com
 IJCS 2020; 8(3): 1091-1097
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 Received: 19-03-2020
 Accepted: 21-04-2020

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Evaluation of new banana (*Musa* spp.) genotypes under Odisha conditions

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i3n.9345>

Abstract

The present study was undertaken to evaluate five cultivars of banana (*Musa* sp.) belonging to different genomic groups (AAB and ABB) for growth, yield and quality attributes. From the evaluation of the data for growth, yield and quality parameters, it was evident that among all the genotypes, the maximum pseudostem height (352.3 cm) was recorded in Budubale, whereas, NRCB Selection-10 recorded the highest pseudostem girth (69.4 cm), number of suckers (8.6), and number of functional leaves (14.6) at shooting stage. The earliest shooting and fruit maturity (216.1 and 297.4 days respectively) were observed in BRS Selection Popoulu, whereas, late shooting and fruit maturity (289.6 and 390.1 days respectively) were recorded in Budubale. Regarding yield attributes, the maximum bunch weight (20.4 Kg), bunch length (66.6 cm), number of hands per bunch (12.1), number of fingers per bunch (171.2) and yield per hectare (51 tonnes) were recorded in genotype NRCB Selection-10. However, bunch girth (160.1 cm), finger girth (20.0 cm) and weight of finger (264.6 g) were highest in BRS Selection Popoulu. In the AAB genomic group, Popoulu and Manjeri Nendran registered 62.13% and 34.45% yield increase over the check Nendran respectively. In the ABB genomic group, NRCB Selection-10 recorded 40.68% yield increase over the check Budubale. With respect to the quality parameters like TSS, reducing sugar and total sugar content, the genotype, Manjeri Nendran was found to be superior among all the genotypes. On the basis of results obtained in the present investigation, NRCB Selection-10 recorded the highest yield which was at par with BRS Selection Popoulu. The maximum net return of Rs. 392000/ha and B:C ratio of 2.78 was recorded in NRCB Selection-10 against the B:C ratio of 1.89 in BRS Selection Popoulu.

Keywords: Banana, randomized block design, yield attributing characters

Introduction

Banana (*Musa* spp.) is a herbaceous perennial monocotyledonous plant which belongs to the family Musaceae of order Scitamineae. It is the largest produced and consumed amongst all fruits cultivated in India. It is a crop of subsistence being cultivated from prehistoric time in India with great socio-economic significance and is grown in all tropical regions. It provides well balanced diet to millions of people around the globe and also contributes to livelihood through crop production, processing (Singh, 2002)^[30] and thus, plays a key role in the economy of many developing countries.

The term "banana" was introduced from the Guinea coast of West Africa by the Portuguese, while the term "plantain" (cooking bananas) was derived from "plantano" of the Spaniards (Purseglove, 1975)^[21]. Usually, banana is used as a dessert fruit. Plantains are much starchier and generally used for culinary purpose. Plantain and cooking bananas are staple food of people of many countries of Central and West Africa, the Caribbean Islands and Latin America. Ripe bananas are easily digestible food with high nutritive value. There are probably over 30 well known species and more than 700 varieties within the genus *Musa*. Simmonds (1962)^[29] concluded that almost all modern edible parthenocarpic banana cultivars were evolved by hybridization of two ancestral parents, *Musa acuminata* and *Musa balbisiana*, which are considered as the main contributors of A and B genomes respectively. All cultivars are classified into various genomic groups such as AA, AAA, AB, AAB, ABB, AAAA, AAAB, ABAB etc. based on morphological scoring (Stover and Simmonds, 1987)^[31]. Banana is originated from South East Asia, a region considered as the primary centre of diversification of the crop, where early domestication has occurred (Simmonds, 1962)^[29].

In India, banana is appropriately referred as 'Kalpatharu', a plant of all virtues as each and every part of the plant is used for specific purposes. Apart from its use as a dessert fruit and for culinary purposes, the banana plant has multifaceted uses: the leaf is commonly used as a hygienic dining plate and has gained popularity in south India, where varieties are grown commercially for leaves; the male flower is a favourite vegetable; the inner core of the pseudostem is a popular vegetable with many therapeutic uses; the sap is used as an indelible ink in industry etc. Increase in banana cultivation results in abundance of waste materials. These contain cellulose, hemicellulose and lignin which support the growth of edible fungi. Biotransformation of pseudostem and leaves into protein using edible fungi such as *Pleurotus sajor-caju* for obtaining a protein rich animal feed has been reported. Besides being suitable for composting, banana pseudostem is a suitable raw material for biogas production than cow dung. Banana pseudostem is a good source of fibre with numerous uses including manufacture of ropes, recycled paper, fabric and a variety of handicrafts.

In India, banana is well adopted in the regions varying from humid tropics to humid sub-tropics and semi-arid sub-tropics, and up to 2,000 m above mean sea level. Among horticultural crops, contribution of banana to agricultural Gross Domestic Product (GDP) is the highest (1.99%). Interesting feature observed in the country is that commercial banana production is largely concentrated along the rivers. In Bihar, it is grown in Gangetic plains, while in Tamil Nadu; major concentration is in Cauvery basin. In Andhra Pradesh, concentration of production is around the Godavari. In Maharashtra, it is more concentrated around the Tapi River. This phenomenon is attributed to soil and availability of water. However, its cultivation has also been extended to areas where water sources have been created. Banana has assumed more significance now-a-days, as it is the source of regular income for small and marginal farmers, and responds very well to crop management system.

Banana is considered as the most auspicious plant and the fruits are used for offering to Hindu Deities. From the nutritional point of view, banana has a calorific value ranging from 67 to 137 calories per 100 g and is closely comparable with potatoes but digested more easily. It is relatively cheap. According to Gopalan *et al.* (1980), the average composition of banana fruit is moisture-70%, protein-1.2%, carbohydrate-27.0%, crude fibre-0.5%, fat-0.3%, ash-0.9%, phosphorus-290.0 ppm, calcium-80.0 ppm, iron-6.0 ppm, carotene-0.5 ppm, riboflavin-0.5 ppm, niacin-7 ppm, ascorbic acid-120 ppm. There are traces of potassium, copper, iodine, manganese, magnesium, sodium, zinc and cobalt as well.

India is the largest producer of banana contributing 27% of world production (FAO, 2009) ^[7]. In India, the total area under banana cultivation is 0.85mha with the production of 30 MT and productivity is about 34.0 MT/ha (NHB, 2016-17) ^[19]. In Odisha, the total area under banana cultivation is about 24490 ha with the production of around 0.466 MT and productivity is about 19.05 MT/ha (NHB, 2016-17) ^[19].

The banana cultivars like BRS Selection Popoulu, Nendran and Manjeri Nendran which belong to the genomic group AAB and NRCB Selection-10, Budubale which belong to the genomic group ABB are all used for dessert purpose. Besides, BRS Selection Popoulu, Nendran and Manjeri Nendran are good source for making chips and very popular in the district of Kerala.

Materials and methods

The present investigation was carried out at AICRP on Fruits (Banana) located in Horticultural Research Station, OUAT, Bhubaneswar during 2017-18. In the field experiment, five banana genotypes belonging to AAB and ABB genomic groups were evaluated. In AAB group, BRS Selection Popoulu and Manjeri Nendran were evaluated against the check Nendran and in ABB group, NRCB Selection-10 was evaluated against the check Budubale. The experiment was conducted in randomized block design with four replications. The plants were spaced at 2 × 2m and data on growth, duration, yield and quality attributes were recorded and statistically analyzed.

Results and Discussions

Banana is one of the most important fruit crops of India as well as Odisha. It could be considered as poor man's apple and it is the cheapest among all other fruits in the country. The present investigation was undertaken to evaluate the new banana genotypes belonging to AAB Plantain type and ABB Karpuravalli type. In AAB plantain type BRS Selection Popoulu, Manjeri Nendran were evaluated against the check Nendran and in ABB Karpuravalli group, NRCB Selection-10 was evaluated against the check Budubale. Their performances were evaluated under the coastal plain zone of Odisha in respect of growth, yield and yield attributing characters and quality parameters. The objective is to select the elite genotypes so that the genotypes could be commercially grown in the farmer's field. The results obtained in the present investigation were discussed under appropriate headings.

Growth attributes

Significant variation was observed among the five banana genotypes with respect to growth characters. It is evident from the data (table 1) that the maximum pseudostem height was observed in Budubale (352.30 cm) and the minimum height was recorded in NRCB Selection-10 (210.30 cm). NRCB Selection-10 recorded maximum pseudostem girth (69.4 cm), whereas, minimum girth was observed in Nendran (50.50 cm). The number of functional leaves at shooting stage was highest in NRCB Selection-10 (14.6) followed by BRS Selection Popoulu (12.7) and Manjeri Nendran (12.1), whereas, lowest in Nendran (9.9). The differences in the plant height stem girth and number of leaves of the plants at the time of shooting has been reported earlier by different workers. It may be attributed to the genetic potential of the plants and environmental factors such as climate and nutrient availability. Kavitha *et al.* (2009) ^[10] studied 12 Nendran ecotypes of banana and recorded the range of the plant height from 264.1-387.0 cm. Singh (2010) observed plant height (2.16 m) in banana cv. Nendran. Menon *et al.* (2014) ^[17] recorded pseudostem height of 295.6 cm in Popoulu and 301.0 cm in Nendran. They also observed pseudostem girth of 51.6 cm in Popoulu and 50.6 cm in Nendran. The number of leaves was significantly higher in BRS Selection Popoulu (12.4) as compared to Nendran (9.8). Present findings are also in conformity with the results obtained by Deo *et al.* (1999) ^[5], Suvittawat *et al.* (2014) ^[32], Biswal *et al.* (2004) ^[2], Sarkar *et al.* (2005) ^[27], Uazire *et al.* (2008) ^[34] and Kumar *et al.* (2012). With respect to phyllochron, the highest reading was observed in Nendran followed by BRS Selection Popoulu, Manjeri Nendran and Budubale and minimum in NRCB Selection-10. Among all the treatments, the maximum leaf length was reported in BRS Selection Popoulu (148.00 cm).

NRCB Selection-10 (65.00 cm) recorded significantly higher leaf width as compared to rest of the genotypes. The leaf area was found to be highest in NRCB Selection-10 (0.70 m²) and least area was found in Manjeri Nendran (0.49 m²). Karuna and Rao (2016) [9] reported similar findings in most of the genotypes. NRCB Selection-10 recorded the maximum number of suckers (8.6), whereas, BRS Selection Popoulu recorded minimum number of suckers (3.4). The number of suckers varied among all the genotypes. The variation in production of sucker was due to varietal characters and production of more suckers absorbs a lot of nutrients from the soil which affects the productivity of the plant. Variability in sucker production among different culinary cultivars was also reported by Biswal *et al.* (2004) [2] and Blomme *et al.* (2000) [3].

Days to shooting and harvesting:

In crop duration of different banana genotypes (presented in Fig. 1), early shooting was observed in BRS Selection Popoulu (216.1 days), whereas, late shooting was recorded in Budubale (289.6 days). The same trend was also observed in days taken to harvest. Von Loesecke (1950), Simmonds (1959) [28] and Sanchez (1971) [26] reported the influence of varietal characters and growing conditions on the time taken for flowering in banana. Similar variations were also reported by Ram *et al.* (1989) [24], Medhi (1994) [16], Deshmukh *et al.* (2004) [6], Delvadia *et al.* (2008) [4], Kumar *et al.* (2012) [12] and Suvittawat *et al.* (2014) [32].

Table 1: Performance of banana genotypes w.r.t growth attributes

Treatments	Pseudostem height at shooting (cm)	Pseudostem girth at shooting (cm)	Number of suckers at shooting	Number of functional leaves at shooting	Phyllochron (in days)	Length of leaves at shooting (cm)	Width of leaves at shooting (cm)	Leaf area at shooting (m ²)
AAB (Plantain group)								
T ₁ - BRS Selection Popoulu	260.6	53.5	3.4	12.7	8.1	148.00	57.60	0.68
T ₂ - Manjeri Nendran	305.4	57.5	4.2	12.1	7.5	116.65	51.59	0.49
T ₃ - Nendran (Check)	297.4	50.5	6.6	9.9	8.2	144.00	54.30	0.62
ABB (Pisang Awak/Karpuravalli group)								
T ₄ - NRCB Selection-10	210.3	69.4	8.6	14.6	7.2	135.00	65.00	0.70
T ₅ - Budubale (Check)	352.3	64.3	5.4	11.2	7.8	123.00	51.00	0.50
SE(m)±	5.33	2.48	0.48	0.96	0.15	3.99	2.29	0.02
C.D. at 5%	16.41	7.63	1.48	2.96	0.47	12.28	7.07	0.07
CV (%)	7.33	8.39	17.09	15.88	3.92	5.98	8.20	7.96

Table 2: Performance of banana genotypes w.r.t yield attributes

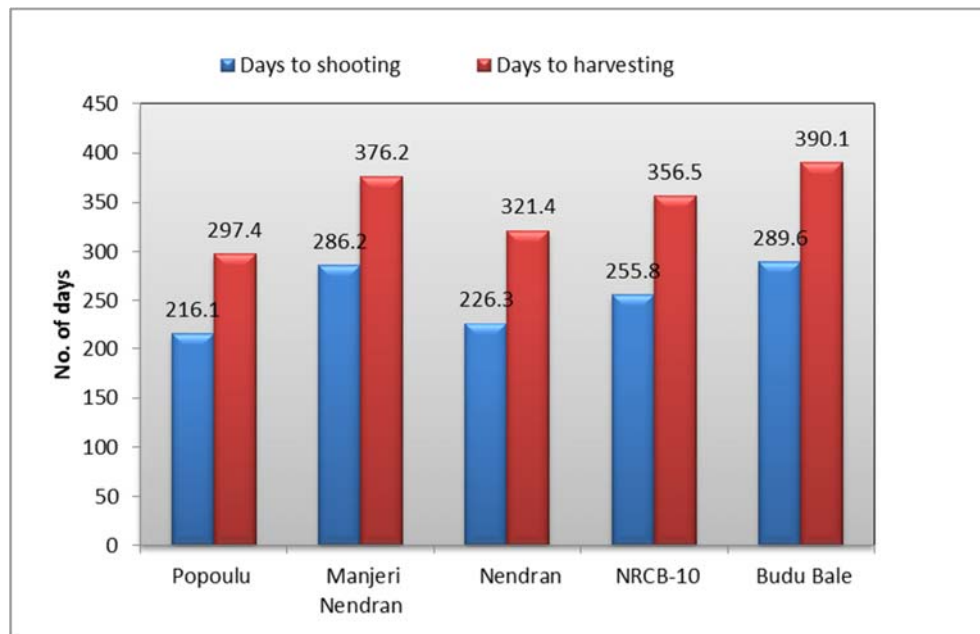
Treatments	Bunch weight (kg)	Bunch length (cm)	Bunch girth (cm)	Numbers of hands per bunch	Number of fingers per bunch	Yield (t/ha)	Finger weight (g)	Finger length (cm)	Finger girth (cm)
AAB (Plantain group)									
T ₁ - BRS Selection Popoulu	16.7	52.7	160.1	7.5	67.4	41.75	264.6	18.2	20.0
T ₂ - Manjeri Nendran	13.6	50.7	128.3	6.4	63.3	34.00	210.4	24.1	14.5
T ₃ - Nendran (Check)	10.3	40.1	101.4	5.7	55.2	25.75	190.2	22.3	13.4
ABB (Pisang Awak/Karpuravalli group)									
T ₄ - NRCB Selection-10	20.4	66.6	99.5	12.1	171.2	51.00	119.2	16.1	13.6
T ₅ - Budubale (Check)	14.5	60.1	98.4	11.4	152.6	36.25	95.2	15.4	12.7
SE(m)±	1.48	3.17	3.56	0.37	3.09	3.69	3.24	1.01	0.47
C.D. at 5%	4.55	9.77	10.98	1.14	9.53	11.38	9.99	3.10	1.45
CV (%)	19.57	11.74	6.06	8.60	6.07	19.57	9.63	10.48	6.33

Table 3: Performance of banana genotypes w.r.t quality attributes

Treatments	Pulp weight (g)	Peel weight (g)	Pulp to peel ratio	Days taken from harvesting to complete yellowing	Shelf life (in days)	TSS (°brix)	Acidity (%)	Reducing sugar (%)	Total sugar (%)
AAB (Plantain group)									
T ₁ - BRS Selection Popoulu	238	26.6	8.95	18.6	4.4	23.52	0.76	9.36	14.33
T ₂ - Manjeri Nendran	167.3	43.1	3.88	6.2	3.0	26.74	0.18	17.15	20.31
T ₃ - Nendran (Check)	148.8	41.4	3.59	10.8	6.4	25.13	0.34	11.51	15.82
ABB (Pisang Awak/Karpuravalli group)									
T ₄ - NRCB Selection-10	99.1	20.1	4.9	3.0	3.2	20.73	0.14	14.07	17.25
T ₅ - Budubale (Check)	76.8	18.4	4.17	5.0	3.1	20.42	0.16	13.08	16.35
SE(m)±	4.44	1.16	0.46	0.47	0.15	0.24	0.02	0.23	0.23
C.D. at 5%	13.68	3.56	1.43	1.44	0.46	0.73	0.06	0.71	0.72
CV (%)	6.08	7.73	18.17	10.72	7.36	2.04	2.61	3.52	2.79

Table 4: Economics of different genotypes of banana

Treatments	Yield (t/ha)	Cost of cultivation (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	B:C ratio
AAB (Plantain group)					
T ₁ - BRS Selection Popoulu	41.75	220000	417500	197500	1.89
T ₂ - Manjeri Nendran	34.00	220000	340000	120000	1.54
T ₃ - Nendran (check)	25.75	220000	257500	37500	1.17
ABB (Pisang Awak/Karpuravalli group)					
T ₄ - NRCB Selection-10	51.00	220000	612000	392000	2.78
T ₅ - Budubale (check)	36.25	220000	362500	142500	1.64

**Fig 1:** Crop cycle of different genotypes of banana

Yield attributing characters

It is evident from the data (table 3) that among all the genotypes, the bunch weight was highest in NRCB Selection-10 (20.4 Kg) which was at par with BRS Selection Popoulu (16.7 Kg). The maximum bunch length was recorded in NRCB Selection-10 (66.6 cm), whereas, BRS Selection Popoulu recorded the highest bunch girth of 160.1 cm. The new introduction NRCB Selection-10 (ABB) had the highest number of hands and fingers per bunch i.e. 12.1 and 171.2, respectively. NRCB Selection-10 (51.00 t/ha) has superseded to all other genotypes with respect to yield followed by BRS Selection Popoulu (41.75 t/ha) which were statistically at par with each other. Manjeri Nendran recorded the highest finger length of 24.1 cm. However, the maximum finger girth (20.0 cm) and finger weight (264.6 g) were registered in BRS Selection Popoulu. The pseudostem girth, number of leaf retention and leaf area at shooting are important components for final yield. During the course of investigation, the result revealed that NRCB Selection-10 recorded highest number of hands and fingers which ultimately lead to highest bunch weight and yield among all the genotypes. Similarly, higher number of functional leaves and more leaf area at shooting might have contributed positively to higher yield in NRCB Selection-10. The highest finger weight (264.6 g) as well as girth (20.0 cm) in BRS Selection Popoulu makes it at par with NRCB Selection-10 with respect to bunch weight and yield in spite of the fact that BRS Selection Popoulu had lesser leaf area, number of hands and fingers than NRCB Selection-10. However, the differences in the genotypes with respect to yield attributing characters were controlled by genetic makeup of the

genotypes. The results obtained in the present study with respect to yield and yield attributes corroborate with the results of Medhi (1994)^[16], Simal and Mishra (1989)^[33], Deo *et al.* (1999)^[5], Kumar (2000)^[13], Biswal *et al.* (2004)^[2], Deshmukh *et al.* (2004)^[6], Baruah *et al.* (2007)^[1], Njuguna *et al.* (2008)^[20], Kumar and Panday (2010)^[11], Rajmanickam and Rajmohan (2010)^[22], Suvittawat *et al.* (2014)^[32] and Menon *et al.* (2014)^[17]. Kurian *et al.* (1985)^[14] reported strong positive correlation of fruit yield with number of hands, number of fingers, number of functional leaves per plant, girth of pseudostem.

Quality parameters

The data regarding quality parameters has been projected in Table 3. The values for pulp weight ranged between 76.8 g to 238.0 g and peel weight 18.4 g to 43.1 g among the different genotypes. Pulp to peel ratio ranged from 3.59 in Nendran to 8.95 in BRS Selection Popoulu. Higher pulp weight (238 g) and low peel weight (26.6 g) are desirable attributes for processing, which were observed in BRS Selection Popoulu. Peel weight was lower in the genotypes NRCB Selection-10 and Budubale. Higher pulp to peel ratio (8.95) was observed in AAB genome group cv. BRS Selection Popoulu indicating the pulp recovery would be high and is highly suited for preparation of chips. This is in line with the studies of Baruah *et al.* (2007)^[1], Ravi and Mustafa (2013)^[25] and Menon *et al.* (2014)^[17]. The total soluble solids (TSS) content of the screen genotypes showed significant differences. The maximum value for TSS (26.74 °brix) was observed in the AAB group Manjeri Nendran and minimum value for TSS (20.42 °brix) was observed in the ABB group Budubale. The

genotype Manjeri Nendran recorded maximum reducing and total sugar of 17.15% and 20.31% respectively, whereas, minimum reducing (9.36%) and total sugar (14.33%) were observed in BRS Selection Popoulu. Stover and Simmonds (1987) reported that increase of TSS is an important trait of hydrolysis of starch into soluble sugars such as glucose, sucrose and fructose. Marriott (1980) [15] indicated that a progressive increase in total sugar content and decrease in starch content was observed during ripening. This could be due to the hydrolysis of starch into sugar during ripening. These results are also in confirmation with the findings reported by Upadhyay and Tripathi (1985) [36], Kanagaratnam and Theivendirarajah (1990) [8], Rajamony *et al.* (1994) [23] and Sarkar *et al.* (2005) [27]. A range of 3.0 to 6.4 days with respect to shelf life was recorded. Nendran (6.4 days) and

BRS Selection Popoulu (4.4 days) had better shelf life as compared to others. Intermediate values were recorded by Manjeri Nendran (3.0 days), Budubale (3.1 days) and NRCB Selection-10 (3.2 days) which were at par with 60 each other. Similar variations were also reported by Sarkar *et al.* (2005) [27] and Uma *et al.* (2006) [35].

Economics

Among all the genotypes, NRCB Selection-10 (ABB) recorded the highest benefit cost ratio of 2.78 followed by BRS Selection Popoulu of 1.89 (AAB) (Table 4). Delvadia *et al.* (2008) [4] reported the highest benefit cost ratio of 2.77:1 in Gandevi Selection whereas lowest in Basrai (1.71:1). The present investigation is in similar trend with that of Delvadia *et al.* (2008) [4].



BRS Selection Popoulu



Nendran



Manjeri Nendran

Bunches of AAB group genotypes



NRCB Selection-10



Budubale

Bunches of ABB group genotypes

Conclusion

The present investigation entitled "Evaluation of New Banana (*Musa spp.*) genotypes" generated useful information for selecting genotype suitable for Odisha conditions. The result indicated that among all the genotypes studied, NRCB Selection-10 proved its superiority in terms of yield and yield attributing characters with maximum net return. The above

genotype also performed well recording the highest number of hands as well as fingers per bunch which was found in compliance with higher number of functional leaves as well as more leaf area. Fingers of this potential genotype showed ashy yellow coloured peel which resembles to Cheeni champa cultivar of Odisha. It has the potential to escape the damage due to heavy wind which can be attributed to its short stature

and thicker stem girth. Keeping the above points in view, the genotype, NRCB Selection-10 may be recommended for commercial cultivation by the farmers. However, the traits like finger weight, finger girth and pulp to peel ratio was found to be highest in BRS Selection Popoulu which makes it at par with NRCB Selection-10 with respect to bunch weight and yield. Hence, it may be tried by the processing industry for preparation of chips.

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