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Ex-situ conservation and performance of genetic resources of banana in New Alluvial Zone of West Bengal

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ABSTRACT

Ex-situ conservation and performance of Genetic Resources of banana were conducted to characterize the growth, yield, quality and biotic stresses during 2002-2016 in the experimental field of AICRP on Tropical Fruits and after merging AICRP on Fruits, Mondouri of Bidhan Chandra Krishi Viswavidyalaya under the new alluvial zone of West Bengal. In present study 143 genotypes of different genomic groups as per Simmonds and Shepherd's scoring system (1955) based on 15 characters (Pseudostem colour, Petiole canal, Peduncle, Pedicels, Ovules, Bract shoulder, Bract curling, Bract shape, Bract apex, Bract colour, Colour fading, Bract scars, Free tepal of male flower, Male flower colour & Stigma colour) that were chosen because they are different in Musa acuminata and Musa balbisiana comprising of elite clones, land races, primitive and reference cultivars viz. 6 of AA genomic group, 3 of AB, 11 of BB, 29 of AAA, 44 of AAB, 20 of ABB (Dessert type), 26 of ABB (Cooking type), 2 of AAAA and 1 each of AAAB and AABB were evaluated as per descriptor developed by Bioversity International for two successive planting as Plant Crop (PC) and first Ratoon Crop (RC-I). In genomic groups of AA and AB plant growth and yield were observed to be minimum compared to all other groups. Among the BB genomic group, maximum plant height (5.8m) in Bhimkol. Maximmum crop duration (721.5days), bunch weight (47.8kg) and TSS content (26.7°Brix) were noted in Bechakala-III (seeded banana). BB genotypes also recorded maximum tolerance to major pest and diseases. Under AAA genomic group, maximum bunch weight (26.7kg) was found in Dwarf Cavendish followed by Barjahaji (23.2kg) and maximum TSS (25.8°Brix) was recorded in Red Banana. In AAB genomic group Dudhsagar-I produced maximum bunch weight of 23.2kg followed by Dudhsagar-II (22.4kg) while minimum bunch weight (7.2kg) was recorded in Hill Banana. The TSS content in the dessert type of ABB group was noted higher ranging from 18.1° Brix (Kothia) to 26.5° Brix (Kanthali). Kanthali Clone –I produced maximum bunch weight (25.4kg) followed by Bagda (25.3kg). ABB (Dessert type) is very famous because of its use in different festivals and rituals in Bengal. Cooking-I under ABB (Cooking type) genomic group showed minimum crop duration (315days) and Baish Chhara recorded maximum bunch weight (23.6kg), yield (47.2t ha^{-1}), hands (15.9) and fingers (224). Baish Chhara is suitable for kitchen garden as the hands can be harvested in staggered manner from top to bottom. Behula recorded maximum finger weight (222 g). FHIA-17 and 23 under AAAA, FHIA-01 (Gold finger) under AAAB and FHIA-03 (Sweet heart) under AABB genomic group were performed well and FHIA-03 (Cooking type) is gaining popularity as the pulp do not develops blackish colour in the curry. Incidence/ Severity of Insect Pests & Diseases of genetic resources of banana were also screened

***Keywords*:** Biotic stress, cooking banana, dessert banana, FHIA, genomic group, qualitative traits

Banana and plantains are important dessert and food crop throughout the tropical and subtropical region of the world. Presently banana and plantains are third world's most important starchy stapple food after cassava and sweet potato and fourth most important food crop after rice, wheat and Maize. Moreover compared with other stapple foods, these are most economic source of carbohydrate in term of production cost, both per hectare and per tone. As a diet, banana is filling, easy to digest, nearly fat free, rich source of carbohydrate with calorific value of 90 calories/100g but no cholesterol and is free from sodium.

India bestowed with rich biodiversity of banana and plantains, is the globally largest producer and consumer. About 28 per cent of world's banana is produced in the country. The contribution of banana to GDP of agriculture in India is 2.8 per cent. Banana is the largest fruit crop in India forming nearly 38.3 % of total fruit production. In India the area under banana cultivation is nearly 0.803 million ha with a total production of 27.72 million tones and productivity 37.0 t h^{-1} during 2013-14 (NHB Database, 2015/ *Indian Hort. Database*, 2014). The major banana growing states in India are Maharashtra, Gujarat, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa, Assam, Bihar and West Bengal with highest productivity in Maharashtra and lowest in North Eastern region. West Bengal is one of leading producer of banana accounting 1097.50 thousand MT production under area of 45.50 thousand ha & productivity is 24.1 tones during 2013-14 (NHB Database, 2015/ *Indian Hort. Database*, 2014). There has been appreciable increase in area (127.69%), production (146.67%) and productivity (36.90%) in the state during last 14 years from 1999-2000 to 2013-14.

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Table 1: Growth characters of AA and AB Genomic Group of banana in new alluvial zone of West Bengal

Genotypes	Height at	Girth at shooting (m)	Leaves plant^{-1} shooting (cm)	Days to at shooting	Days to bunch shooting	Crop duration harvest (days)
Genomic Group AA						
1.Matti	2.85	51.9	12.1	299.0	105.0	404.0
2. Sannachenkadali	2.56	44.3	11.6	249.2	98.2	347.4
3. Pisang Lilin	2.89	45.3	10.2	251.6	95.6	347.2
4. Calcutta-4	2.15	33.3	8.8	240.3	101.7	342.0
5. Pisang Berlin	2.55	37.5	11.6	270.5	98.4	368.9
6. Cv. Rose	2.15	35.0	8.7	259.1	78.9	338.0
Genomic Group AB						
1. Raskadali	2.11	55.7	9.9	280.0	114.0	394.0
2. Tatilla Kunnan	2.96	61.9	10.8	242.0	96.0	338.0
3. Ney Poovan	2.69	56.8	11.1	247.0	92.0	339.0
LSD(0.05)	**0.25**	**3.29**	**1.15**	**20.21**	**11.06**	**21.41**

Table 2: Yield and its attributes of AA and AB Genomic group of banana in new alluvial zone of West Bengal

Genotypes	Bunch weight(Kg)	Yield (t ha^{-1})	Hands bunch^{-1}	Finger bunch^{-1}	Finger wt. (g)	T.S.S (°Brix)
Genomic Group AA						
1.Matti	9.2	18.4	9.5	138.0	61.6	25.9
2. Sannachenkadali	9.7	19.4	10.2	107.3	65.4	19.2
3. Pisang Lilin	4.2	8.4	5.4	65.4	21.3	18.7
4. Calcutta-4	3.39	7.78	5.9	75.1	17.9	19.2
5. Pisang Berlin	12.2	24.4	7.7	92.4	107.5	18.3
6. Cv. Rose	4.35	9.70	7.6	125.3	44.7	19.9
Genomic Group AB						
1. Raskadali	8.7	17.4	8.8	120.0	66.6	28.1
2. Tatilla Kunnan	11.3	22.6	6.1	70.2	140.5	23.4
3. Ney Poovan	10.7	21.4	5.7	73.4	134.8	24.1
LSD(0.05)	**1.01**	**-**	**1.23**	**8.2**	**17.41**	**1.22**

Table 3: Growth characters of BB Genomic group of banana in new alluvial zone of West Bengal

Genotypes	Height at shooting(m)	Girth at shooting(cm)	Leaves plant^{-1} at shooting	Days to shooting	Days to bunch harvest	Crop duration (days)
1. Kechazepa	2.40	53.2	9.5	361.7	111.6	473.3
2. Manguthang	3.21	71.3	11.2	362.3	123.2	485.5
3. Attia Kole	3.25	84.2	9.4	370.1	107.7	477.8
4. Bhimkol	5.8	101.2	14.1	530.1	88.1	618.2
5. Ahtia-II	5.7	83.4	13.8	523.3	90.3	613.6
6. Bechakala (Seeded)-I	4.37	85.5	12.9	490.6	128.2	618.8
7. Bechakala (Seeded)-II	4.49	90.5	9.5	554.7	134.4	689.1
8. Bechakala (Seeded)-III	5.50	109.3	11.4	575.3	146.2	721.5
9. Bechakala (Seeded)-IV	4.10	88.9	9.2	515.5	125.6	641.1
10. Seeded-V	3.97	74.2	12.4	450.2	120.7	570.9
11. Seeded-VI	3.1	60.3	12.4	278.3	75.2	353.5
LSD(0.05)	**0.29**	**5.32**	**1.07**	**37.20**	**9.11**	**47.15**

Table 4: Yield and its attributes of BB Genomic group of banana in new alluvial zone of West Bengal

Genotypes	Bunch wt. (Kg)	Yield (t ha^{-1})	Hands bunch^{-1}	Fingers bunch^{-1}	Finger wt. (g)	T.S.S (°Brix)
1. Kechazepa	12.8	25.6	5.4	53.1	**215.6**	22.1
2. Manguthang	15.4	30.8	9.2	111.3	125.7	22.1
3. Attia Kole	9.8	19.6	9.9	135.2	62.8	20.1
4. Bhimkol	26.4	66.0	9.2	115.4	09.4	22.7
5. Ahtia-II	17.5	43.75	8.7	97.3	153.2	23.1
6. Bechakala (Seeded)-I	22.7	56.7	9.5	103.7	125.6	23.8
7. Bechakala (Seeded)-II	30.2	60.4	11.1	186.1	150.5	25.1
8. Bechakala (Seeded)-III	**47.8**	**95.6**	**14.2**	**254.7**	168.8	**26.7**
9. Bechakala (Seeded)-IV	13.4	26.8	9.2	89.2	129.4	24.5
10. Seeded-V	16.7	33.4	10.3	125.2	121.4	24.3
11. Seeded-VI	14.2	28.4	9.9	123.5	119.2	23.6
LSD(0.05)	**4.45**	**-**	**2.11**	**43.22**	**47.29**	**1.01**

Table 5: Growth characters of AAA Genomic group of banana in new alluvial zone of West Bengal

Genotypes	Height at shooting(m)	Girthat shooting(cm)	Leaves plant^{-1} at shooting	Days to shooting	Days to bunch harvest	Crop duration (days)
1. Kabuli	1.41	51.9	10.2	301.0	77.0	378.0
2. Basrai	1.36	53.2	11.1	266.0	111.0	377.0
3. Gross Michel	2.83	71.4	10.5	395.2	91.4	486.6
4. Dwarf Cavendish	1.91	65.3	12.0	310.0	93.0	403.0
5. Jahaji - 1	2.20	63.1	11.3	330.0	101.0	431.0
6. Jahaji - 2	2.01	62.9	10.4	301.0	92.0	393.0
7. Robusta	1.84	58.6	13.2	215.3	130.2	345.5
8. Robusta Clone-A	2.11	46.2	9.7	290.0	94.0	384.0
9. Robusta Clone-B	1.99	55.8	10.5	263.0	103.0	366.0
10. Giant Governor	2.01	56.6	11.2	277.0	105.0	382.0
11. Barjahaji	1.78	59.2	10.3	279.0	91.0	370.0
12. Lacaton	2.82	63.7	13.1	316.0	96.0	412.0
13. Grand Nain	1.83	53.7	12.1	299.0	89.0	388.0
14. Amrit Sagar	2.25	51.4	9.8	315.0	98.0	413.0
15. Red Banana	3.37	69.5	8.4	460.0	108.0	568.0
16. Agni Sagar	2.95	67.6	9.7	315.0	102.0	417.0
17. Agniswar	2.90	56.9	10.2	320.0	108.0	428.0
18. Arunachal (collection)	3.11	62.0	11.7	311.0	117.0	428.0
19. Poyo	2.65	58.4	12.1	385.4	99.2	484.6
20. Sinduri Harichal	1.99	63.6	11.3	373.5	101.3	474.8
21. Padalse Hanuman	2.63	62.8	10.4	356.3	104.2	469.5
22. Gandevi Selection	2.72	61.7	13.1	277.4	90.6	368.0
23. Mahalaxmi	2.25	62.4	12.5	316.2	99.5	415.7
24. Srimanti	2.01	61.3	10.9	285.6	100.2	385.8
25. Rang Kala	1.89	63.9	13.3	266.2	95.3	361.5
26.Budu Bale	3.10	54.3	12.8	290.7	90.7	381.4
27. KBS-08	2.3	62.7	13.9	283.7	92.3	376.0
28.YKM-5	3.4	57.5	13.4	289.4	87.4	376.8
29.Digjowa	3.2	56.7	13.6	270.2	88.1	358.3
LSD(0.05)	**0.39**	**0.52**	**0.69**	**31.21**	**27.34**	**38.14**

The main growing areas are concentrated in the districts of Hooghly, Howrah, Nadia, Midnapore, Murshidabad, 24-Paraganas, Jalpaiguri, Coochbehar, Burdwan and North Dinajpur. The two distinct areas of banana production are Gangetic plains of South Bengal and Terai Zones of North Bengal. The varieties grown are Giant Governor (AAA) popularly known as Singapuri in West Bengal, Grand Nain (AAA), Martaman(AAB), Kanthali (ABB), Champa (AAB). Besides Amritsagar (AAA), Robusta (AAA) and Kanchkela (ABB) are also cultivated. Recently two selection from Kanthali viz. Bagda and Baisha, Martaman's strain (AAB) and tissue culture plants of Grand Nain (AAA) are replacing the traditional cultivars in West Bengal. Therefore a new thrust is emerging to identify the varieties from the gene bank for growth, yield, quality and susceptibility to diseases and pests. In this context the present experiment was under taken with the following objectives: to study the morphological characters in banana cultivars, to select the best cultivars based on yield, quality, abiotic and biotic stresses and to conserve the bio-diversity of 143 banana varieties belonging to 6 of AA genomic group, 6 of AA genomic group, 3 of AB, 11 of BB, 29 of AAA, 44 of AAB, 20 of ABB (Dessert type), 26 of ABB (Cooking type), 2 of AAAA and 1 each of AAAB and AABB were evaluated for two successive planting as Plant Crop (PC) and first Ratoon Crop (RC-I) under agro climatic condition of Gangetic West Bengal.

MATERIAL AND METHODS

The study was conducted at the experimental field of All India Co-ordinated Research Project (AICRP) on Tropical Fruits and after merging AICRP on Fruits, Mohanpur Centre. The varieties of different genomic groups as elite clones, land races, primitive and reference cultivars viz. 6 (Matti, Sanachenkadali, Pisang Lilin'

Table 6: Yield and its attributes of AAA Genomic group of banana in new alluvial zone of West Bengal

Genotypes	Bunch weight (Kg)	Yield (t ha^{-1})	Hands bunch^{-1}	Fingers bunch^{-1}	Finger wt. (g)	T.S.S (°Brix)
1. Kabuli	18.3	36.6	9.1	125.0	136.0	20.9
2. Basrai	18.8	37.6	9.9	117.2	149.3	21.4
3. Gross Michel	17.5	35.0	8.4	116.2	143.7	23.2
4. Dwarf Cavendish	26.7	53.4	11.2	147.3	173.1	22.1
5. Jahaji - 1	20.3	40.6	8.9	138.4	139.4	19.9
6. Jahaji - 2	22.1	44.2	10.7	148.7	141.2	20.4
7. Robusta	16.3	32.6	7.7	115.2	130.2	24.8
8. Robusta Clone-A	17.7	35.4	8.2	99.9	165.1	21.4
9. Robusta Clone-B	20.5	41.0	9.8	152.1	126.8	23.1
10. Giant Governor	17.5	35.0	11.9	144.5	110.7	20.5
11. Barjahaji	23.2	46.4	9.3	129.3	170.0	20.7
12. Lacaton	18.9	47.2	7.6	122.3	144.7	19.8
13. Grand Nain	16.5	33.0	9.2	120.2	124.7	21.8
14. Amrit Sagar	13.3	26.6	8.5	75.6	158.7	24.3
15. Red Banana	10.1	20.2	7.1	90.5	100.0	25.8
16. Agni Sagar	12.0	24.0	8.1	89.4	123.0	22.3
17. Agniswar	10.5	21.0	7.2	98.7	91.1	21.7
18. Arunachal (collection)	14.7	29.4	6.3	75.3	172.6	22.8
19. Poyo	18.5	37.0	8.5	115.6	147.5	19.3
20. Sinduri Harichal	16.3	32.6	7.7	104.8	143.2	21.1
21. Padalse Hanuman	18.2	34.4	8.6	118.2	143.8	21.4
22. Gandevi Selection	20.2	40.4	9.5	149.3	123.6	19.6
23. Mahalaxmi	16.3	33.6	9.1	125.2	112.5	21.9
24. Srimanti	17.4	34.8	9.2	141.4	98.2	22.2
25. Rang Kala	22.2	44.4	9.7	133.7	123.8	22.5
26. Budu Bale	7.8	19.5	5.0	60.4	2.2	20.2
27. KBS-08	21.7	54.25	8.9	111.3	125.0	21.4
28. YKM-5	11.1	27.75	7.9	121.7	72.5	20.5
29. Digjowa	11.4	28.50	7.4	98.7	100.4	21.1
LSD(0.05)	**2.45**	**-**	**1.33**	**7.88**	**6.02**	**0.12**

Table 7: Growth and characters of AAB Genomic group of banana in new alluvial zone of West Bengal

Genotypes	Height at shooting(m)	Girthat shooting(cm)	Leaves plant^{-1} at shooting	Days to shooting	Days to bunch harvest	Crop duration (days)
1. Dudhsagar-I	2.88	69.9	11.9	270.0	96.0	366.0
2. Dudhsagar-II	3.12	72.3	12.4	275.3	99.6	374.9
3. Martaman	2.75	67.2	13.5	285.0	92.0	377.0
4. Martaman-I	3.11	63.5	13.7	315.8	98.8	414.6
5. Martaman-II	3.15	67.2	11.1	388.8	107.4	496.2
6. Martaman-III	3.27	76.6	14.8	229.7	93.4	323.1
7. Rasthali	2.94	66.8	14.2	280.0	90.0	370.0
8. Malbhog	3.01	70.2	12.4	260.0	98.0	358.0
9. Sabri	2.70	61.5	11.7	255.0	89.0	344.0
10. Amrit Pani	2.66	58.2	14.5	315.0	84.0	399.0
11. Co. -1	2.71	64.2	11.2	351.0	107.0	458.0
12. Champa	2.40	56.3	11.8	301.0	91.0	392.0
13. Champa –I	2.84	57.3	10.7	295.4	99.4	394.8
14. Champa –II	2.97	71.2	10.4	274.9	90.1	365.0
15. Champa –III	2.69	57.4	10.3	276.4	101.7	378.1
16. Champa –IV	2.62	62.7	9.4	317.0	99.4	416.4
17. Champa -V	2.56	56.7	10.2	328.6	99.5	428.1
18. Champa –VI	2.75	58.9	11.4	325.4	98.7	424.1
19. Champa –VII	2.99	55.9	9.9	304.4	96.4	400.6
20. Patakapura	3.11	61.8	12.3	266.7	90.4	357.1
21. Poovan	2.73	66.6	13.5	255.0	100.0	355.0
22. Krishna Vazai	2.55	60.4	14.3	270.0	85.0	355.0
23. Kanai Banshi	2.72	62.7	11.4	301.0	120.0	421.0
24. Kalibow	2.45	58.8	10.8	309.0	115.0	424.0
25. Kalibhog	3.11	69.9	12.1	333.0	112.0	445.0
26. Manohar	2.59	71.9	14.2	333.0	118.0	451.0
27. Nendran	2.50	59.2	9.6	403.2	96.2	499.4
28. Deshi Malbhog	2.89	61.8	9.2	301.3	93.7	395.0
29. Chang Monoa	3.25	73.2	11.3	345.0	109.3	454.3
30. Alapan	3.11	84.1	11.7	349.2	100.1	449.3
31. Mizoram Collection	3.35	66.6	12.2	338.1	97.1	435.2
32. Bamandeshi	3.12	64.9	13.4	356.5	102.4	458.9
33. Madhubansh	3.31	61.7	12.1	346.7	98.7	445.4
34. Hill banana	2.95	51.5	13.3	213.2	105.2	318.4
35. Matta Poovan	2.89	54.3	12.6	227.3	103.1	330.4
36. Alpan (Mahnar)	3.04	74.2	11.8	345.9	93.6	439.5
37. Madhuranga Bale	2.54	62.5	12.7	299.0	114.0	413.0
38. Rajapuri	1.98	56.5	12.1	235.8	100.8	336.6
39. Karpurachakkarkeli	2.73	56.6	12.4	296.6	105.4	402.0
40. Manjeri Nendran	2.75	59.9	11.2	269.0	105.0	374.0
41. Manjeri Nendran-II	3.50	50.4	11.3	297.2	94.7	391.9
42. Krishnasagar	3.30	56.4	13.1	273.2	98.3	371.5
43. Lady's Finger	3.30	69.2	12.0	239.1	96.1	335.2
44. Pisang Nagma	2.96	66.2	10.3	261.1	101.10	362.2
LSD(0.05)	**0.21**	**6.23**	**1.13**	**26.21**	**6.12**	**24.25**

Table 8: Yield and its attributes of AAB Genomic group of banana in new alluvial zone of West Bengal

Genotypes	Bunch weight (Kg)	Yield (t ha^{-1})	Hands bunch^{-1}	Fingers bunch^{-1}	Finger wt. (g)	T.S.S (°Brix)
1. Dudhsagar-I	23.2	46.4	10.1	133.1	164.9	21.1
2. Dudhsagar-II	22.4	44.8	9.9	128.9	255.8	22.3
3. Martaman	15.3	30.6	8.7	128.1	109.2	24.1
4. Martaman-I	15.2	30.4	9.4	121.5	115.2	23.4
5. Martaman-II	17.7	35.4	9.4	125.5	1.99	24.3
6. Martaman-III	22.2	44.4	9.7	137.6	2.23	24.4
7. Rasthali	13.9	27.8	9.3	124.9	104.0	24.6
8. Malbhog	14.4	28.8	9.3	111.5	121.1	23.2
9. Sabri	14.7	29.4	9.4	113.2	122.7	24.9
10. Amrit pani	12.8	24.6	8.2	108.7	110.4	20.1
11. Co. -1	11.3	22.6	8.1	99.5	103.5	23.9
12. Champa	13.1	26.2	16.3	228.2	52.5	24.3
13. Champa –I	12.3	24.6	12.7	115.2	2.11	21.2
14. Champa –II	12.2	24.4	11.4	147.3	2.09	22.7
15. Champa –III	13.4	26.8	12.5	136.7	2.47	22.5
16. Champa –IV	11.4	22.4	13.6	213.4	57.5	21.4
17. Champa -V	12.6	25.2	9.9	165.1	67.8	22.3
18. Champa –VI	13.2	26.4	11.2	145.6	65.9	21.8
19. Champa –VII	14.1	28.2	9.0	124.2	79.4	22.2
20. Patakapura	15.2	30.4	8.6	120.4	90.1	23.8
21. Poovan	16.3	32.6	14.1	200.3	74.8	22.8
22. Krishna Vazai	15.9	31.8	8.3	87.2	165.1	22.9
23. Kanai Banshi	9.8	19.6	7.5	97.3	92.5	20.3
24. Kalibow	10.1	20.2	7.0	101.2	188.9	23.7
25. Kalibhog	13.6	27.2	9.2	96.3	127.0	22.1
26. Manohar	18.5	39.0	10.7	131.5	130.7	20.9
27. Nendran	7.7	15.4	7.8	52.7	115.3	21.4
28. Deshi Malbhog	12.9	25.8	7.8	88.1	128.4	23.3
29. Chang Monoa	15.7	31.4	11.5	75.3	169.9	22.2
30. Alapan	14.5	29.0	12.1	199.7	72.2	18.1
31. Mizoram Collection	13.6	27.2	8.8	85.4	125.7	19.1
32. Bamandeshi	14.7	29.4	9.9	129.5	100.4	20.5
33. Madhubansh	13.6	27.2	10.7	115.2	104.3	19.2
34. Hill banana	7.2	14.4	8.1	93.1	57.1	23.3
35. Matta Poovan	15.4	30.8	13.2	215.3	65.0	22.1
36. Alpan (Mahnar)	19.4	39.8	10.3	145.7	123.5	22.7
37. Madhuranga Bale	11.3	22.6	7.7	74.7	160.6	22.2
38.Rajapuri	16.7	33.4	8.8	118.4	119.1	23.3
39. Karpurachakkarkeli	15.1	30.2	9.2	138.5	86.7	22.8
40. Manjeri Nendran	8.6	21.5	6.5	63.3	1.8	24.6
41. Manjeri Nendran-II	7.3	18.25	3.9	71.4	71.8	21.8
42. Krishnasagar	14.7	36.75	7.2	97.2	121.7	21.7
43. Lady's Finger	5.88	14.70	6.4	102.3	41.22	22.1
44.Pisang Nagma	12.1	30.25	6.9	79.0	123.4	23.3
LSD (0.05)	**2.45**	**-**	**3.34**	**29.2**	**23.16**	**0.19**

Table 9: Growth characters of ABB Genomic group (Dessert type) of banana in new alluvial zone of West Bengal

Genotypes	Height at shooting (m)	Girth at shooting (cm)	Leavesplant^{-1} at shooting	Days to shooting	Days to bunch harvest	Crop duration (days)
1. Simolu	3.25	87.4	14.4	331.0	120.0	451.0
2. Baisha	3.31	82.1	14.7	400.0	99.0	499.0
3.Bagda	3.35	83.2	13.1	407.0	105.0	512.0
4.Karpooravalli	3.11	75.5	12.3	309.0	104.0	413.0
5.Hanumanjatta	2.84	66.7	13.5	336.0	110.0	446.0
6. Jurmuney Kanthali	3.94	90.8	10.9	414.0	99.1	513.1
7. Kanthali	2.90	88.6	11.7	325.0	100.2	425.2
8. Deshi Kanthali	2.99	64.3	12.4	316.2	107.0	423.2
9. Kanthali Clone-I	3.30	89.1	15.9	350.0	115.0	465.0
10. Kanthali Clone-III	3.21	78.8	13.8	349.0	84.0	433.0
11. Thonte	3.15	80.5	14.3	344.0	90.0	434.0
12. Pisang Awak	3.11	80.4	11.7	345.6	115.3	460.9
13. Onchini	3.14	69.2	13.5	327.8	105.2	433.0
14. Chinua	2.99	65.4	12.9	319.6	103.8	423.4
15. Simolumanohar	4.11	84.7	13.3	390.2	125.4	515.6
16. Kothia	3.10	93.2	12.2	375.3	96.3	471.6
17. Tulsimonohar	3.40	67.8	13.5	299.9	99.7	399.6
18. Bogimonohar	3.60	63.9	13.9	295.2	101.3	396.5
19. NRCB-01	3.30	65.2	13.1	253.5	101.2	354.7
20.Kanthali(salt tolerant)	3.45	49.7	10.4	335.2	96.8	432.0
LSD(0.05)	**0.23**	**6.9**	**0.23**	**31.14**	**8.16**	**37.11**

Table 10: Yield its attributes of ABB Genomic group (Dessert type) of banana in new alluvial zone of West Bengal

Genotypes	Bunch weight (Kg)	Yield (tha^{-1})	Hands bunch^{-1}	Fingers bunch^{-1}	Finger wt. (g)	T.S.S (°Brix)
1. Simolu	23.1	46.2	15.1	175.6	125.2	24.3
2. Baisha	24.5	29.0	14.9	223.1	103.0	25.1
3.Bagda	25.3	50.6	13.2	210.3	114.1	24.3
4.Karpooravalli	17.7	35.4	13.2	202.0	81.0	26.3
5.Hanumanjatta	14.5	29.0	8.9	120.5	107.8	24.9
6. Jurmuney Kanthali	23.3	46.6	13.2	165.6	132.8	22.4
7. Kanthali	12.5	25.0	10.3	180.5	64.2	26.5
8. Deshi Kanthali	11.5	23.0	7.3	194.2	56.7	25.1
9. Kanthali Clone-I	25.4	50.8	12.2	146.7	166.3	24.2
10. Kanthali Clone-III	13.1	26.2	10.3	152.2	79.5	24.3
11. Thonte	16.2	32.4	12.4	170.7	88.0	23.9
12. Pisang Awak	15.3	30.6	8.2	125.4	112.7	20.4
13. Onchini	13.3	26.6	9.4	111.2	107.9	24.7
14. Chinua	11.9	23.8	8.8	104.7	99.3	24.1
15. Simolumanohar	15.8	31.6	9.9	117.2	121.2	23.3
16. Kothia	17.6	35.2	9.7	156.3	103.6	18.1
17. Tulsimonohar	13.4	33.50	5.5	88.3	114.1	22.9
18. Bogimonohar	12.9	32.29	7.0	90.2	121.4	24.3
19. NRCB-01	17.4	43.50	9.7	99.8	144.3	23.2
20.Kanthali(salt tolerant)	11.4	28.50	6.4	72.3	73.3	22.3
LSD(0.05)	**2.13**	**-**	**2.3**	**22.6**	**28.3**	**0.78**

Table 11: Growth characters of ABB Genomic group (Cooking type) of banana in new alluvial zone of West Bengal

Genotypes	Height at shooting (m)	Girth at shooting (cm)	Leavesplant^{-1} at shooting	Days to shooting	Days to bunch harvest	Crop duration (days)
1. Jorhat Collection	2.99	67.2	15.2	304.0	79.0	383.0
2. Baish Chhara	2.84	67.7	14.1	300.0	70.0	370.0
3. Behula	2.91	68.2	11.2	265.0	65.0	330.0
4. Purulia Collection	2.54	55.5	12.3	245.0	80.0	325.0
5. Pantharaj	3.44	75.3	11.1	261.0	88.0	349.0
6. Green Bombay	2.77	70.1	12.3	277.0	70.0	347.0
7. Salt Tolerant type	2.87	53.7	12.7	300.0	77.0	377.0
8.Kanchkel (Jorhat)	2.70	69.5	10.9	315.0	75.0	390.0
9.SABA	3.00	70.7	11.3	250.0	70.0	320.0
10. Bluggoe	2.86	72.1	9.3	260.0	71.0	331.0
11. Bara Beglo	3.11	70.3	11.0	275.0	76.0	351.0
12.Cooking -I	3.22	53.9	10.8	260.0	55.0	315.0
13. Cooking –II	2.72	60.8	13.7	269.0	66.0	335.0
14. Cooking –III	3.15	60.3	14.4	285.0	62.0	347.0
15. Cooking -IV	2.85	65.7	7.7	311.5	86.2	397.7
16. Cooking – V	3.11	56.6	11.	268.4	67.1	335.5
17.Pacha Bontha Bathesa	3.00	55.6	14.8	270.0	71.0	341.0
18.Bothisa Bontha Bothisa	3.15	51.3	12.7	236.3	88.2	324.5
19.CUBA-03	2.98	63.2	10.1	345.4	83.7	429.1
20. Banthal	3.23	57.7	11.2	263.4	88.3	315.7
21. Pausia Banthal	3.36	62.2	9.5	250.1	80.5	330.6
22. NRCB-07	3.90	63.2	13.2	249.4	78.2	327.6
23. NRCB-08	3.50	61.3	13.9	246.3	77.4	323.7
24. Cooking-VI	3.20	57.5	12.7	241.7	64.4	306.1
25. Kovvur Bontha	3.30	63.7	13.5	246.5	69.2	315.7
26.Cooking-VII	3.11	45.2	9.3	265.0	75.3	340.3
LSD(0.05)	**0.21**	**6.23**	**1.13**	**26.21**	**6.12**	**23.60**

Calcutta-4, Pisang Berlin and Cv. Rose) of AA genomic group, 3 (Raskadali, Tatilla Kunnan and Ney Poovan) of AB, 11 [Manguthang, Attia Kole, Kechazepa, Bhimkol, Athia-II, Bechakala (Seeded)-I, II, III, IV, V and VI] of BB, 29 (Kabuli, Basrai, Gross Michel, Dwarf Cavendish, Jahaji-1, Jahaji-2, Robusta, Robusta Clone-A, Robusta Clone-B, Giant Governor, Barjahaji, Lacaton, Grand Nain, Amrit Sagar, Red Banana, Agni Sagar, Agniswar, Arunachal Collection, Poyo, Sinduri Harichal, Padalse Hanuman, Gandevi Selection, Mahalaxmi, Srimanti, Rang Kala, Budu Bale, KBS-08,YKM-5 and Digjowa) of AAA, 44 (Dudhsagar-I & II, Rasthali, Martaman, Martaman –I, II & III, Malbhog, Sabri, Amritpani, Krishna Vazai, Kanai Banshi, Kalibow, Kalibhog, Manohar, Nendran, CO-1, Poovan, Champa, Champa- I, II, III, IV, V, VI and VII, Patakapura, Deshi Malbhog, Chang Monoa, Alapan, Mizoram Collection, Bamandeshi, Madhubansh, Hill Banana, Matta Poovan, Alpan-Mahnar, Madhuranga Bale, Rajapuri, Karpurachakkarkeli, Manjeri Nendran, Manjeri Nendran-II, Krishnasagar, Lady's Finger and Pisang Nagma) of AAB, 20 (Simolu, Baisha, Bagda, Karpooravalli, Hanumanjatta, Jurmuney Kanthali, Kanthali, Deshi Kanthali, Kanthali Clone-I, Kanthali Clone-III, Thonte, Pisang Awak, Onchini, Chinua, Simolumanohar, Kothia, Tulsimonohar, Bogimonohar, NRCB-01 and Kanthali-salt tolerant) of ABB (Dessert type), 26 (Jorhat Collection, Baish Chhara, Behula, Purulia Collection, Pantharaj, Green Bombay, Salt Tolerant type, Kanchkel(Jorhat), SABA, Bluggoe, Bara Beglo, Cooking-I, II, III, IV, V, VI and VII, Pacha Bontha Bathesa, Bothisa Bontha Bothisa, CUBA-03, Banthal, Pausia Banthal, NRCB-07, NRCB-08 and Kovvur Bontha) of ABB (Cooking type), 2 (FHIA-17, FHIA-23) of AAAA and 1 each of AAAB (FHIA-01) and AABB (FHIA-03) collected from different institute and farmers' field were evaluated as per descriptor developed by Bioversity International for two successive planting as Plant Crop (PC) and first Ratoon Crop (RC-I). Similar works has also been done by Ortiz, (1997) in

Table 12: Yield and its attributes of ABB Genomic group (Cooking type) of banana in new lluvial zone of West Bengal

Genotypes	Bunch weight (Kg)	Yield (tha^{-1})	Hands $bunch^{-1}$	Fingers $bunch^{-1}$	Finger wt. (g)	T.S.S (°Brix)
1. Jorhat Collection	19.5	39.0	11.8	133.5	134.8	-
2. Baish Chhara	23.6	47.2	15.9	224.0	100.4	-
3. Behula	16.3	32.6	8.1	68.9	222.0	-
4. Purulia Collection	14.5	29.3	11.0	115.2	117.2	-
5. Pantharaj	19.9	39.8	8.5	128.9	143.5	-
6. Green Bombay	17.6	35.2	9.6	133.6	123.5	-
7. Salt Tolerant type	9.9	19.8	7.2	65.8	136.7	-
8.Kanchkel (Jorhat)	12.2	24.4	7.0	72.4	151.9	-
9.SABA	22.5	45.0	6.9	135.3	156.7	-
10. Bluggoe	16.3	32.6	6.3	74.5	201.3	-
11. Bara Beglo	10.4	20.8	6.1	66.7	139.4	-
12.Cooking -I	12.0	24.0	8.4	128.8	85.6	-
13. Cooking –II	9.1	18.2	7.3	80.5	99.3	-
14. Cooking –III	10.5	21.0	6.1	75.4	125.9	-
15. Cooking -IV	12.6	25.2	6.8	98.7	112.7	-
16. Cooking – V	10.3	20.6	6.6	72.1	124.8	-
17.Pacha Bontha Bathesa	12.4	24.8	6.3	64.2	171.4	-
18.Bothisa Bontha Bothisa	9.9	19.8	6.6	89.3	94.06	-
19.CUBA-03	13.4	26.8	6.5	63.3	189.5	-
20. Banthal	11.9	23.8	5.8	57.2	92.4	-
21. Pausia Banthal	14.1	28.2	6.5	71.8	98.3	-
22. NRCB-07	15.7	39.29	7.4	84.4	135.4	-
23. NRCB-08	15.8	39.50	7.6	92.5	133.7	-
24. Cooking-VI	14.7	36.75	5.9	88.8	156.1	-
25. Kovvur Bontha	15.1	37.75	6.8	70.1	170.4	-
26.Cooking-VII	10.35	25.88	6.7	78.2	75.4	-
LSD(0.05)	**3.45**	**-**	**0.34**	**39.20**	**23.16**	**-**

International Institute of Tropical Agriculture in southeastern Nigeria. The suckers of different cultivars were planted on March 2002 in row with twelve plants each spaced at 2.5 x 2.0m. Out of 12 plants three plants were treated as one replication. Hence the experiment was having four replications. All the plants under investigation were subjected to uniform cultural practices. 10kg FYM and full of phosphate were applied as basal in the pit. The fertilizer dose was NPK @ 300:50:350g $plant^{-1}$. Ridge and furrow method of irrigation was applied. Weeding, earthing up and plant protection measures were taken as per recommendations of BCKV. Observation were recorded on growth, crop duration, yield and quality characters under twelve parameters like height, girth, leaves/plant at shooting, days to shooting and bunch harvest, crop duration, bunch weight, yield, hands/bunch, fingers/bunch, finger weight and TSS were estimated. Incidence/ Severity of Insect Pests & Diseases of genetic resources of banana were also screened. Data were analyzed following the standard procedure.

RESULTS AND DISCUSSION

Diploid cultivars of AA and AB genomic groups are low yielder with high TSS content. Matti recorded maximum crop duration (404days) followed by Raskadali (394 days) while cv. Rose & Tatilla Kunnan showed minimum crop duration (338days). Maximum bunch weight (12.2kg) recorded in Pisang Berlin followed by Tatill Kunnan (11.3 kg). Highest TSS content in Raskadali (28.1°Brix) was observed followed by Matti (25.9°Brix). Similar observations were also noticed by Bauri, *et al.* (2010).

Cultivars of BB genomic group *i.e.* mainly seeded banana recorded height, crop duration, bunch weight, TSS ranging from 2.4 to 5.5m, 473.3 to 721.5days, 9.8

Table13: Growth characters of FHIA hybrids in new alluvial zone of West Bengal

Genotypes	Height at shooting (m)	Girthat shooting (cm)	Leaves plant^{-1} at shooting	Days to shooting	Days to bunch harvest	Crop duration (days)
			Genomic Group AAAA			
1.FHAI -17	2.80	73.4	12.8	370.0	112.4	482.4
2.FHAI -23	3.05	78.5	11.6	387.4	105.7	493.1
			Genomic Group AAAB			
1.FHAI -01(Gold Finger)	2.45	56.6	14.5	277.0	85.0	362.0
			Genomic Group AABB			
1.FHAI - 03(Sweet Heart)	2.66	61.1	13.9	250.0	80.0	330.0
LSD(0.05)	**0.27**	**3.33**	**0.61**	**22.10**	**7.8**	**27.30**

Table 14: Yield and its attributes of FHIA hybrids in new alluvial zone of West Bengal

Genotypes	Bunch weight (Kg)	Yield (t ha^{-1})	Hands Bunch^{-1}	Fingers bunch^{-1}	Finger wt. (g)	T.S.S (°Brix)
			Genomic Group AAAA			
1.FHAI -17	19.3	38.6	8.9	137.6	125.8	20.7
2.FHAI -23	18.7	37.4	8.4	126.2	128.4	21.1
			Genomic Group AAAB			
1.FHAI -01 (Gold Finger)	17.7	35.4	10.4	139.1	118.6	22.2
			Genomic Group AABB			
1.FHAI – 03 (Sweet Heart)	14.8	29.6	7.1	94.2	142.2	-
LSD(0.05)	**1.23**	**-**	**1.02**	**11.3**	**6.9**	**NS**

Table-15: Incidence/ severity of insect pests and diseases of different genomic group of banana in germplasm field (Mohanpur centre)

Genomic group	Sigatoka (PDI)	Panama wilt (% plant infested)	BBTV (% plant infested)	Scarring beetle (% leaf	Pseudostem weevil (% plan infested	Aphid (No. per leaf)
1. AA	14-18	0	0	0-2	1-2	2-5
2. AB	16-24	0	0	0-1.5	2-6	2-9
3. BB	0	0	0	0	0	0
4. AAA	36-45	0	2-2.5	9-15	5-9	5-15
5. AAB	32-37	5.5	1-2	7-14	3-7	5-12
6. ABB (Dessert)	16-20	1.5-2.0	1-1.5	2-5	0-2	1-4
7. ABB (Cooking)	16-20	1.0-2.5	1	1-3	2-5	2-6
8. AAAA	14-19	0	0	0-2	0	1-5
9. AAAB	16-24	0	0	0-3	1-3	0-3
10. AABB	15-22	0	0	1-5	0	0-4

***Data recorded at bearing stage of the crop (Plant crop and ratoon crop)**

to 47.8kg and 20.1 to 26.7°Brix. Maximum height (5.8m) recorded in Bhimkol. Maximum crop duration (721.5 days), bunch weight (47.8kg) and TSS (26.7°Brix) content was recorded by Bechakala (Seeded-III) and minimum in Attia Kole (bunch weight 9.8kg and TSS 20.1°Brix). The triploid cultivars under AAA genomic group is the main commercial and export cultivars in the worlds as reported by Ferreira, *et. al.*(2002). Maximum plant height (3.37m) and crop duration (568 days) was recorded in Red Banana while Basrai attained minimum height (1.36m). Maximum bunch weight (26.7kg) was produced by Dwarf Cavendish followed by Barjahaji (23.2kg) and minimum bunch weight (7.8kg) was observed by Budu Bale, but Red Banana recorded maximum TSS (25.8°Brix). Sarkar, *et al.* (2005) recorded maximum bunch weight and yield in Dwarf Cavendish in West Bengal and Kulapati, *et al.* (1999) in Bhadra Command area.

In AAB genomic group, maximum plant height (3.50m) was recorded in Manjeri Nendran-II and maximum crop duration (499.4days) was observed in Nendran. Dudhsagar-I produced maximum bunch weight of 23.2kg followed by Dudhsagar-II (22.4kg) while minimum bunch weight (7.2kg) was recorded in Hill Banana. Sarkar, *et.al.* (2005) and Bauri, *et al.* (2010) also observed maximum bunch weight in cv. Dudhsagar-I. Among the 20 cultivars of ABB genomic group (Dessert type), maximum plant height (4.11m) and crop duration (515.6days) was found in Simolumanohar while minimum crop duration (354.7days) was observed in NRCB-01.Annon. 2015-16 also reported minimum crop duration in NRCB -01. Kanthali Clone-I produced maximum bunch weight (25.4kg) followed by Bagda (25.3kg). Uthaiah *et al.* (1992) reported similar findings of crop duration in most of the cultivars. TSS content in this group is high ranging from 18.1 to 26.5 °Brix and it was maximum in Kanthali (26.5 °Brix). Sarkar, *et al.* (2005) recorded higher bunch weight in the same selection. Similar results was also reported by Syamal and Mishra (1989).

The observation was made of 26 cooking type of ABB genomic group. NRCB-07 showed maximum height (3.90cm). Maximum crop duration (429.1days) was observed in CUBA-03 while minimum in Cooking-I (315 days). Baish Chhara recorded maximum bunch weight (23.6kg), yield (47.2 t ha^{-1}), hands per bunch (15.9) and fingers per bunch (224) followed by SABA which gave the bunch weight 22.5 kg and yield (45.0 t/ha). Sarkar, *et al.* (2005) similarly recorded maximum number of fingers (305) in Baish Chhara and Rodriguez, *et al.* (1996) also showed higher bunch weight (17.6kg) in SABA. Maximum finger weight (222g) was found in Behula. Highest finger weight in Beula was also recorded by Ram Kumar (2000). In AAAA genomic group, two hybrids were evaluated *i.e.* FHIA-17 and FHIA-23. Maximum plant height (3.05m) and crop duration (493.1days) was recorded in FHIA-23, but maximum bunch weight (19.3kg) was observed in FHIA-17. In AAAB genomic group i.e. FHIA-01 and in AABB genomic group *i.e.* FHIA-03 was evaluated and FHIA-01 recorded maximum hands per bunch (10.4), fingers per bunch (139.1) and TSS (22.2°Brix). Gonzalez *et al.* (2003) recorded the growth characters and production of FHIA hybrids in a region of Colombia found same results where they observed earliest harvest in FHIA-03 and most delayed in FHIA-23. TSS content of FHIA hybrids is generally low.

In present study the cultivars belonging to different genomic group [AA, AB, BB, AAA, AAB, ABB (Dessert type), ABB (Cooking type), AAAA, AAAB and AABB] differed in most of the characters. In cultivars of AA and AB group maximum bunch weight (11.3kg) found in Tatilla Kunnan and highest TSS in Raskadali (28.1°Brix). Bechakala(Seeded-III) selection of BB groups recorded significantly highest growth, yield (95.6 t ha^{-1}) and TSS (26.7°Brix) content. Dwarf Cavendish (AAA) performed better with respect to maximum bunch weight (26.7kg), yield (53.4t/h) and finger weight (173.1g). Dudhsagar is another commercial triploid (AAB) cultivars performed well in the alluvial zone with maximum bunch weight (23.2kg), yield (46.4 t ha^{-1}) and maximum finger number (228.2g) in Champa. Cultivars of ABB (Dessert type) is also popular in West Bengal and one selection of Kanthali *i.e.* Kanthali Clone-I gave the best performance in respect of yield (50.8 th^{-1}) and Kanthali recorded maximum TSS (26.5°Brix) content. Cooking banana of ABB group is very common in this state and Behula is famous for finger weight (222g) while Baish Chhara is famous for yield (47.2 t ha^{-1}), number of hands (15.9) and number of fingers (224). Baish Chhara is also suitable for kitchen garden due to its staggered harvesting of hands from top to bottom.

Among the FHIA hybrids, FHIA-03(AABB) gaining popularity as cooking banana and FHIA-01(AAAB) as dessert one though FHIA-17(AAAA) gave the highest yield (38.6t h^{-1}) in this zone.

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