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Assessment of genetic variability, heritability and genetic advance for yield components in some cooking banana genotypes (*Musa* Spp.)

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Abstract
The present investigation consists of 13 cooking banana genotypes and the experiment was conducted during 2014-2015 in Randomize Block Design with 5 replications at All India Coordinated Research Project (Banana), Horticultural Research Station, Bhubaneswar, Odisha. The data were recorded for 11 quantitative characters to study genetic variability, heritability, genetic advance, correlation coefficient analysis and path analysis. On the basis of mean performance, Plant morphology and quantitative yield parameters were recorded maximum pseudostem girth, total number of leaves, average number of hands, fingers and bunch weight was recorded in Bantala Sambalpuri (Patiapalli). Least pseudostem height, girth, bunch weight were recorded in Dakhinisagar. Analysis of variance among 13 genotypes showed significant difference for all characters studied. Highest genotypic coefficient of variation (GCV) & phenotypic coefficient variation (PCV) was observed for number of fingers per bunch, number of hands per bunch, and bunch weight indicating selection for such characters would be more reliable to be used as selection for crop improvement High degree of heritability estimates were obtained in case of length and breadth of leaf, number of fingers per bunch. High genetic advance were observed for no of fingers per bunch and pseudostem height indicating predominance of additive gene effects and possibilities of effective selection for the improvement of these characters.

Keywords: Cooking banana, odisha, genetic variability, heritability and genetic advance.

Introduction
Banana and plantain (*Musa* spp.) is one of the most popular fruit crops of world in terms of production per capita consumption. It is the 4th important global agricultural commodity after rice, wheat and maize in terms of gross value of production. Its culture in India is as old as Indian civilization and is one of the earliest fruit crops grown by mankind at the dawn of civilization. Banana could be considered as poor man's fruit and it is the cheapest among all other fruits in the country. Banana is a cheap source of energy like vitamins A, C, B_6 and other minerals with traces of fat. At present, banana production in India is 29.0 million tonnes from an area of 8.3 lakh ha and the productivity is 34.4 tonnes. Half of the bananas of the World are eaten as cooked vegetable. Bantala is the major culinary variety under cultivation in Odisha (Pillay and Tripathi, 2007) [6]. The sub clones of Bantala were identified, grouped and locally named. Plantains are mostly ABB group and mostly originated in India, particularly in south India through somatic mutation. The fruits have flesh which is starchy and acid at maturity and are usually unpalatable unless cooked. Varieties of plantain subgroup are characterized by long, curved, very starchy bananas. Odisha harbor more diversity in cooking banana varieties but proper varietal identification and characterization of the varieties is essential for proper maintenance and breeding purposes. Approximately 18 number of culinary bantal varieties available namely Gaja Bantala, Mendhi Bantala, Saja Bantala, kuji Bantala, Gendamundia Bantala, Bada Bantala, Paunsia Bantala, Batisia Bantala, Chepta Bantala, BS-1, Manji Bantala, bantala-1, Bantala-2, Dakhinisagar, Singa Bantala etc. they comprise 21% of annual *Musa* production worldwide. Because of its high sterility (i.e., seedlessness) and polyploidy of edible varieties (Stover and Simmonds, 1987) [7], classical breeding is difficult (Ganry, 1990) [3] and have resulted in increasing efforts to genetically improve the crop. Classical approaches for identification and analysis of genetic variability in fruit crops are based on morphological, physiological and agronomic traits. The success of breeding program depends upon the quantum of genetic variability available for exploitation and the extent to which the desirable characters are heritable (Tiwari *et al.*, 2011) [8]. Variability refers to the presence of differences among the individuals of plant population. Variation results due to difference either in genetic constitution of the individual of a plant population or in environment, they have grown. The existence of variability is essential for improvement of genetic material. Selection is also

effective when there is significant amount of genetic variability among the individuals in breeding materials.

Materials and Method

For the present investigation disease free sword suckers (3 months old) of 13 genotypes of cooking bananas were collected from different places of Odisha (Table 1) with an average weight of 1kg. The roots were trimmed and the suckers were treated with furadon at the rate of 3 g / sucker at the time of planting. These were grown in Randomized block design with five replications at All India Coordinated Research Project (Banana), Horticultural Research Station, Odisha during the year 2012-13. Different agro technological practices starting from field preparation to harvest along with various intercultural operations were carried out as per the recommendation. Five representative plants for each genotype in each replication were randomly selected to record observations on no of days to shooting (days), plant height (cm), girth of pseudostem (cm), no of leaves per plant, leaf length (m), leaf breadth (m), leaf area (m^2), no of hands per bunch, no of fingers per bunch, no of suckers per bunch, bunch weight (Kg) were computed on plot basis and data were subjected to statistical analysis. The variability was estimated as per procedure for analysis of variance suggested by Panse and Sukhatme (1967) [5], PCV and GCV were calculated by the formula given by Burton (1952) [2], heritability in broad sense (h2) by Burton and De Vane (1953) [1] and genetic advance i.e. the expected genetic gain were calculated by using the procedure given by Johnson *et al*. (1955) [4].

Table 1: Thirteen culinary banana varieties and their place of procurement:

	Locally named culinary banana	Place of Collection
T1	Gaja Bantala	Pipili, Dist. Puri
T2	Bantala-1	Balikuda, Dist. Jagatsingpur
T3	Bantala-2	Balikuda, Dist. Jagatsingpur
T4	Batisha Bantala	Balikuda, Dist. Jagatsingpur
T5	Dakhinisagar	Balikuda, Dist. Jagatsingpur
T6	Paunsia Bantala	Pipili, Dist. Puri
T7	Bantala Sambalpuri	Budhapalli, Dist. Sambalpur
T8	Bantal Sambalpuri	Patiapalli, Dist. Sambalpur
T9	Banua Bantala	Balikuda, Dist. Jagatsingpur
T10	Manji Bantala	Balikuda, Dist. Jagatsingpur
T11	Paunsia Bantala	Balikuda, Dist. Jagatsingpur
T12	Bantala Selection -1 (BS-1)	Balikuda, Dist. Jagatsingpur
T13	Mendhi Bantala	Balikuda, Dist. Jagatsingpur

Result and Discussion

On the basis of mean performance (Table 2 & 3), Plant morphology and quantitative yield parameters were recorded maximum pseudostem girth, total number of leaves, average number of hands, fingers and bunch weight was recorded in Bantala Sambalpuri (Patiapalli). Least pseudostem height, girth, bunch weight were recorded in Dakhinisagar.

Genetic variability in any crop is pre-requisite for selection of superior genotypes over the existing cultivars. The genetic variability in respect of a trait is the direct measure as to how far the character could be manipulated in a desired direction. The analysis of variance for different characters indicated the existence of highly significant differences for all 11 characters under study at 1% level of significance suggesting each and every genotype are genetically divergent from each other and there is ample scope for selection of characters from these diverse sources for yield and its components (Table 4).

A wide range of variance was observed for all the characters. Coefficients of variation studies indicated that the estimates of PCV were slightly higher than the corresponding GCV (Table 5) among the all traits number of fingers per bunch (56.27, 52.94) exhibited high estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) followed by Number of hands per bunch(39.51, 33.08),bunch weight (35.63, 29.34), high values of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for these traits suggested the possibility of yield improvement through selection of these traits. Close relationship between GCV and PCV was found in all the characters and PCV values were slightly greater than GCV, revealing very little influence of environment for their expression.

The amount of genetic variation considered alone will not be of much use to the breeder unless supplemented with the information on heritability estimate, which gives a measure of the heritable portion of the total variation. It has been suggested by Burton and Devane (1953) that the GCV along with heritability estimate could provide a better picture of the amount of advance to be expected by phenotypic selection. Since genetic advance is dependent on phenotypic variability and heritability in addition to selection intensity, the heritability estimates in conjunction with genetic advance will be more effective and reliable in predicting the response to selection (Johnson *et al*., 1955) [4]. Heritability in broad sense includes both additive and non-additive gene effects. While, narrow sense heritability includes only additive components (Johnson *et al*., 1955) [4]. In the present study, heritability in broad sense was estimated. Highest broad sense heritability was recorded in case of leaf breadth (92.50), leaf length (90.06), no of fingers per bunch (88.51). Maximum genetic advance was recorded for no of fingers per bunch (104.255) followed by pseudostem height of plant (75.026). In general heritability along with genetic advance can be useful in selection programmes. No of fingers per bunch and no of hands per bunch have shown high genetic advance as percent of mean along with high heritability. High heritability with high genetic advance as percent of mean indicates that these characters are largely controlled by additive gene action, which indicates that improvement in these characters is possible through mass selection and progeny selection.

Table 2: Statement showing the comparative vegetative character of culinary banana

Bantala genotypes	Number of days to Shooting	Pseudostem height (cm)	Pseudostem girth at shooting time(cm)	No of leaves at time of harvest	Leaf length (m)	Leaf breadth (m)	Leaf area (m^2)
Gaja Bantala	283.60	274.00	56.60	7.00	2.50	0.60	1.00
Bantala1	308.00	296.00	60.00	9.00	3.11	0.56	1.39
Bantala 2	344.00	260.00	68.40	10.0	2.50	0.56	1.11
Batisha Bantala	309.00	294.00	66.00	8.40	2.50	0.61	1.24
Dakhinisagar	299.00	151.00	48.60	6.60	2.50	0.55	1.11
Paunsia batisha Bantala	288.80	292.00	61.40	6.80	2.50	0.61	1.22
Bantala Sambalpuri (Budhapalli)	328.00	295.00	70.80	10.00	2.40	0.51	1.01

Bantala ambalpuri (patiapalli)	307.00	292.00	70.60	9.60	2.50	0.61	1.22
Banua Bantala	252.40	219.00	47.00	7.60	3.00	0.48	1.14
Manji Bantala	303.00	286.00	63.00	10.40	3.70	0.52	1.55
Paunsia Bantala	274.00	276.00	64.00	7.00	3.00	0.53	1.30
BS-1	281.60	353.00	63.60	7.80	2.50	0.55	1.11
Mendhi Bantala	349.00	270.00	62.80	6.60	3.20	0.47	1.20
GM	302.108	273.692	61.754	8.215	2.766	0.554	1.204
CD (0.5)	16.157	25.30	6.104	2.320	0.167	0.018	0.171

Table 3: Statement Showing the Comparative Yield Attributing Characters of Banana

Bantala genotype	No of hands Per Bunch	No of fingers per bunch	No of suckers per plant	Bunch wt. (kg)
Gaja Bantala	5.40	52.00	7.00	9.00
Bantala1	6.80	82.40	7.60	16.80
Bantala 2	7.20	72.20	6.20	11.40
Batisha Bantala	11.00	186.00	8.00	13.60
Dakhinisagar	5.60	48.20	5.60	7.40
Paunsia batisha Bantala	11.20	215.00	7.40	10.00
Bantala Sambalpuri (Budhapalli)	10.40	210.00	9.60	18.40
Bantala Sambalpuri (Patiapalli)	11.80	198.00	10.20	18.60
Banua Bantala	8.80	86.40	8.60	10.20
Manji Bantala	6.80	157.00	7.80	8.40
Paunsia Bantala	6.80	68.20	4.40	9.40
BS-1	6.60	75.60	7.80	13.80
Mendhi Bantala	15.60	95.00	7.80	14.40
GM	8.769	118.923	7.538	12.415
CD(0.5)	2.419	28.976	1.123	3.205

Table 4: Analysis of variance (mean squares) for eleven characters in culinary banana

Characters	d.f.	No .of days to shooting	Pseudostem height (cm)	Pseudostem Girth at shooting time (cm)	No of leaves at harvest	Leaf length (m)
Sources						
Blocks	4	659.596**	339.038	26.285	4.592	0.016
Genotype	12	3725.783**	11136.170**	272.439**	10.182**	0.795**
Error	48	159.963	392.163	22.826	3.301	0.017

Characters	d.f.	Leaf breadth (m)	Leaf area (m^2)	No of hands/bunch	No of fingers/bunch	No of suckers per plant	Bunch wt. (kg)
Sources							
Blocks	4	0.001	0.012	2.346	39.079	2.538	4.485
Blocks	4	0.001	0.012	2.346	39.079	2.538	4.485
Error	48	0.001	0.018	3.588	514.452	0.772	6.293

* Significant at 5% level **Significant at 1% level

Table 5: PCV, GCV, h^2 and GA estimates for various characters for 13 culinary banana genotypes.

S. No.	Characters	PCV	GCV	h^2	GA (10%)	GA % over mean
1.	Number of days to shooting	9.78	8.84	81.63	42.478	14.06
2.	Pseudostem height(cm)	18.42	16.94	84.57	75.026	27.41
3.	Pseudostem girth at shooting (cm)	13.81	11.44	68.62	10.301	16.68
4.	Number of leaves at harvest	26.32	14.28	29.43	1.120	13.63
5.	Leaf Length (m)	15.03	14.26	90.06	0.659	23.82
6.	Leaf Breadth (m)	8.92	8.57	92.50	0.080	14.51
7.	Leaf Area (m^2)	15.97	11.46	51.47	0.174	14.47
8.	Number of hands per bunch	39.51	33.08	70.11	4.275	48.75
9.	Number of fingers per bunch	56.27	52.94	88.51	104.255	87.67
10.	Number of suckers per plant	22.98	19.80	74.27	2.264	30.03
11.	Bunch weight (kg)	35.63	29.34	67.83	5.281	42.53

Conclusion

In the present investigation which included 13 genotypes of cooking bananas was included in order to study the nature and amount of genetic variability, heritability, genetic advance, correlation coefficient analysis and path analysis of 11 qualitative and quantitative characters. On the basis of mean performance, Plant morphology and quantitative yield parameters were recorded maximum pseudostem girth, total number of leaves, average number of hands, fingers and bunch weight was recorded in Bantala Sambalpuri (Patiapalli). Least pseudo stem height, girth, bunch weight were recorded in Dakhinisagar. Analysis of variance among 13 genotypes showed significant difference for all characters studied. Highest genotypic coefficient of variation (GCV) & phenotypic coefficient variation (PCV) was observed for number of fingers per bunch, number of hands per bunch, and bunch weight indicating selection for such characters would be more reliable to be used as selection for crop improvement High degree of heritability estimates were obtained in case of length and breadth of leaf, number of fingers per bunch. High

genetic advance were observed for no of fingers per bunch and pseudostem height indicating predominance of additive gene effects and possibilities of effective selection for the improvement of these characters.

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