J. Hortl. Sci.
Vol. 5 (2): 109-113, 2010

Variability studies in Palayankodan ecotypes (AAB genomic group) of banana (*Musa* spp.)

C. Rajamanickam and K. Rajmohan[1]
Department of Fruit Crops
Horticultural College and Research Institute
Tamil Nadu Agricultural University
Periyakulam East – 625 604, India
E-mail: manickshorti@yahoo.co.in

ABSTRACT

Six Palayankodan ecotypes of banana belonging to AAB genomic group were evaluated for genetic variability among quantitative traits. Genetic and phenotypic coefficient of variation, heritability and genetic advance were estimated for eighteen traits that included plant height, pseudostem girth, number of leaves per plant, leaf width, number of suckers per plant, days taken from planting to shooting, total crop duration; length, girth, weight and volume of finger; hand weight, bunch weight, number of fingers per bunch, number of fingers per hand, ripe-fruit weight, sugar/acid ratio and pulp weight. Remarkable variability was observed among the collections for these characters. Bunch weight, number of fingers per bunch and number of suckers per plant with very high value of PCV, GCV, heritability and genetic advance makes it prime traits for direct selection. Plant height, pseudostem girth, total crop duration, sugar:acid ratio, finger length and days taken from planting to shooting with high value of heritability and moderate value of genetic advance. PCV are other important traits which need to be considered for selection. The volume of finger with low values for GCV, PCV, heritability and genetic advance as per cent of mean implies that it is highly influenced by environment and should not be taken as a criterion for selection. Plant height, total crop duration, sugar:acid ratio, finger length, pseudostem girth, number of fingers per bunch and days taken from planting to shooting showed high genetic advance and heritability and important characters to be considered for selection of ecotypes.

Key words: Banana, Palayankodan, ecotypes, heritability, genetic advance, PCV, GCV

INTRODUCTION

The primary objective of a crop improvement programme is to assess genetic variability existing in that particular crop the extent to which the character to be improved is heritable. Critical estimation of variability existing in the base population is a prerequisite for successful crop improvement through various plant breeding methods. Burton (1952) pointed out that calculating Genetic Coefficient of Variation (GCV) along with heritability could assess the best picture of amount of advancement to be expected by selection. Ramanujan and Thirumalachar (1967) suggested that heritability estimate in the broad sense is reliable if accompanied by high genetic advance. Johnson *et al* (1955) and Swarup and Chaugle (1967) also considered that heritability estimates along with genetic gain were useful and more reliable than heritability estimates alone in predicting selection response. Effectiveness of selection based on phenotypic performance can be more useful and reliable only when selection is based on heritability estimates combined with genetic gain. Above all these, knowledge of the extent of variability in germplasm is an essential prerequisite in any breeding programme. Banana (*Musa* spp.) is the most important fruit crop grown in the tropical and subtropical regions of India. Clones of 'AAB' genomic group occupy major banana growing area in India. This group comprises several popular desert types, of which, Palayankodan (syn. Mysore Poovan) is the most widely cultivated single clone because of its drought tolerance and suitability for ratooning (Rajeevan and Geetha, 1982). The vast difference in agroclimatic conditions under which the clone is grown in India, is likely to generate numerous mutants of the clone. However, only one mutant, namely 'Mottapoovan', has been reported so far. Progress of a breeding programme depends upon the extent to which desirable traits are heritable. High heritability estimate is

1 Department of Pomology and Floricluture, College of Agriculture, Vellayani - 695 522, Kerala

used to predict the usefulness of traits in a selection programme. Hence, the present investigation was undertaken to study genetic variability, heritability and genetic advance in eighteen morphological traits of six Palayankodan banana ecotypes.

MATERIAL AND METHODS

The present experiment was carried out in the Department of Pomology and Floriculture, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala. A total of six Palayankodan ecotypes procured from Banana Research Station, Kannara, Thrissur and College of Agriculture, Vellayani, Thiruvananthapuram, were planted and maintained at the College Orchard, College of Agriculture, Vellayani. Six ecotypes of Palayankodan banana were raised in Completely Randomized Block design (CRD) with five replications as per Panse and Sukhatme (1985). Cultural practices as per the Package of Practice Recommendations were followed (KAU, 1996). The six ecotypes of Palayankodan banana (all dessert type, having 3x ploidy and AAB genomic composition) are as follows: Palode Palayankodan, PKNNR, Chandra Bale, Pisang Ceylon, Mottapoovan Vellapalayankodan.

The genetic and phenotypic coefficient of variation, heritability and genetic advance were estimated for eighteen characters which included plant height, pseudostem girth, number of leaves per plant, leaf width, number of suckers per plant, days taken from planting to shooting, total crop duration, bunch weight, number of fingers per hand, number of fingers per bunch, hand weight; length, girth, weight and volume of finger, ripe fruit weight, pulp weight and sugar:acid ratio. Biometric data were collected and statistically analyzed following Fischer (1960). From the analysis of variance, genetic parameters like phenotypic and genotypic coefficient of variation (PCV and GCV) (Burton, 1952), habitability estimates (Burton and de Vane, 1953) and genetic advance (Allard, 1960) were calculated.

RESULTS AND DISCUSSION

Phenotypic and genotypic coefficients of variation for eighteen morphological characters of six Palayankodan ecotypes were studied. PCV were higher than their respective GCV for all the characters, which reflects influence of environment on phenotypic expression of these characters. Significant difference was recorded among ecotypes of banana for various plant parameters studied. Results presented in Table 1 indicate the range and general mean for each character studied. The highest range of variation was recorded for plant height, total crop duration, days taken from planting to shooting and number of fingers per bunch. The lowest range of variation was recorded for the number of suckers per plant, number of leaves per plant, number of fingers per hand, hand weight, bunch weight, finger length and girth of finger.

Table 1. Mean, range and coefficient of variation (CV) for eighteen traits in Palayankodan ecotypes of banana

Trait	Mean ± S.E.	Range	CV (%)
Plant height (cm)	311.03 ± 23.3	417.2 – 264.20	17.6
Pseudostem girth (cm)	65.80 ± 6.3	96.06 – 56.46	23.5
Number of leaves per plant	8.53 ± 0.7	11.20 – 6.80	20.3
Leaf width (cm)	78.98 ± 2.1	87.64 – 72.92	6.6
Number of suckers per plant	9.4 ± 1.5	15.80 – 6.20	39.0
Days taken from planting to shooting	227.87 ± 15.6	300.0 – 188.80	16.8
Total crop duration (days)	323.87 ± 17.3	407.0 – 286.80	13.1
Bunch weight (kg)	16.19 ± 1.9	23.04 – 10.60	28.8
Number of fingers per hand	16.90 ± 0.9	18.93 – 14.30	12.2
Number of fingers per bunch	189.73 ± 15.2	254.20 – 72.20	19.6
Hand weight (kg)	2.03 ± 0.2	2.80 – 1.50	22.0
Length of finger (cm)	11.09 ± 0.8	13.60 – 8.36	17.6
Girth of finger (cm)	9.76 ± 0.5	10.52 – 8.14	12.3
Finger weight (g)	99.38 ± 3.0	109.22 – 90.08	7.4
Volume of finger (cc)	92.49 ± 2.8	101.74 – 82.54	7.3
Ripe fruit weight (g)	82.80 ± 2.5	88.78 – 72.74	7.4
Pulp weight (g)	63.66 ± 2.6	68.30 – 52.32	9.9
Sugar:acid ratio	48.01 ± 4.3	68.53 – 37.53	22.2

Phenotypic and genotypic coefficients of variation, heritability and genetic advance are presented in Table 2. Highest PCV was observed for bunch weight (42.07%), followed by the number of suckers per plant (31.99%), hand weight (24.84%) and pseudostem girth (23.62%). Lowest PCV value was seen for leaf width (7.18%), followed by ripe fruit weight (7.78%). GCV ranged from 38.14 per cent for bunch weight to 6.27 per cent for volume of finger. Highest GCV was recorded for bunch weight (38.13%), followed by number of suckers per plant (27.94%), hand weight (21.18%) and sugar:acid ratio (22.03%). Work of Rajeevan and Geetha (1982) and Valsalakumari and Nair (1986) also supported this, with high estimates for GCV.

Table 2. Phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), environment coefficient of variation (ECV), heritability (broad sense) and genetic advance (GA) as percentage of mean for eighteen traits of Palayankodan ecotypes of banana

Trait	GCV (%)	PCV (%)	ECV (%)	Heritability (Broad sense) %	GA as % of mean
Plant height (cm)	17.58	17.68	1.86	98.90	36.02
Pseudostem girth (cm)	23.42	23.62	3.09	98.29	47.83
Number of leaves per plant	19.69	23.36	10.59	77.56	35.72
Leaf width (cm)	6.47	7.18	3.11	81.26	12.02
Number of suckers per plant	27.94	32.00	15.59	82.16	38.68
Days taken from planting to shooting	16.73	16.97	2.78	76.25	34.01
Total crop duration (days)	13.09	13.19	1.58	98.57	26.77
Bunch weight (kg)	38.13	42.07	17.77	97.31	71.21
Number of fingers per hand	9.77	10.58	4.01	85.38	18.60
Number of fingers per bunch	19.48	20.23	5.42	92.81	50.26
Hand weight (kg)	21.18	24.84	12.97	72.73	37.21
Length of finger (cm)	17.41	18.46	6.12	89.02	33.84
Girth of finger (cm)	11.84	14.01	7.47	71.53	20.63
Finger weight (g)	7.24	8.16	3.75	78.88	13.26
Volume of finger (cc)	6.27	10.42	8.32	36.20	7.77
Ripe fruit weight (g)	7.30	7.78	2.69	88.07	14.11
Pulp weight (g)	9.73	1.34	3.48	88.63	18.87
Sugar:acid ratio	22.03	22.73	5.74	93.63	43.91

Lowest GCV value was observed for volume of finger (6.27%), followed by leaf width (6.47%). Rajeevan and Geetha (1982) observed high PCV and GCV values for bunch weight, number of fingers per bunch and weight of finger for 40 banana cultivars. Valsalakumari and Nair (1986) reported highest PCV and GCV for bunch weight, hand weight, number of fingers per bunch, pseudostem girth and finger weight. The vast difference in PCV and GCV and very low estimates for GCV indicate an immense influence of environment on manifestation of this character. Similar findings were also made by Sreerangaswamy *et al* (1980) in banana. Significant difference between phenotypic and genotypic coefficients of variation for number of leaves per plant, number of suckers per plant, number of fingers per bunch, bunch weight, finger weight and volume of finger suggests that these characters were not influenced by environment. The estimates of heritability separate genetic variability from phenotypic variability and indicate possibility and the extent to which improvement can be brought about through proper selection. Moderate phenotypic and genotypic coefficients of variation were registered for plant height (17.68% and 17.58%), total crop duration (13.19% and 13.10%), number of fingers per bunch (20.22% and 19.49%), finger length (18.46% and 17.41%), finger girth (14% and 11.84%) and sugar:acid ratio (22.76% and 22.02%), respectively. These characters offer much scope for improvement by selection and hybridization. Heritability, in a broad sense, gives the amount of heritable portion of a character. Environmental coefficient of variation was high in bunch weight (17.78%) and the lowest in total crop duration (1.58%).

Characters possessing high heritability can be improved directly through selection, as, these are relatively less affected by environment. The magnitude of heritability indicates effectiveness of selection based on phenotypic performance (Johnson *et al*, 1955). In the present study, all traits exhibited high heritability. This ranged from 72.53% for leaves per plant, to 98.90% for plant height. Characters like plant height (98.90%), total crop- duration (98.57%), pseudostem girth (98.29%), bunch weight (97.31 %), number of fingers per bunch (92.81%), sugar:acid ratio (93.63%) and length of finger (89.02%) show high heritability. Relatively higher values of heritability for these characters imply that a large proportion of phenotypic coefficient of variance (PCV) was attributable to the genotypic coefficient variance (GCV). High heritability values for number of fingers per bunch, plant height, days taken from planting to shooting and number of fingers per bunch obtained in the present study are in agreement with findings of Sreerangaswamy *et al* (1980) in banana. High heritability has also been reported for pulp weight and length of finger (Singh and Sharma, 1997), pseudostem girth, bunch weight, finger length and number of fingers per bunch (Rajeevan and Geetha, 1982), plant height, days taken from planting to flowering, finger length, sugar:acid ratio, bunch weight and pesudostem girth (Valsalakumari and Nair, 1986), crop duration (Rosamma and Namboodiri, 1990) and bunch weight, plant height and crop duration (Uma *et al*, 2000). Katiyar *et al* (1974) demonstrated that heritability values alone are inadequate to cannot be taken as a tool to calculate the amount of genetic progress achieved by selecting the best individual. Ramanujam and Thirumalachar (1967) opined that heritability estimates could be reliable if accompanied by a high genetic advance.

In the present investigation, there was wide variation among characters for genetic advance. Genetic advance as per cent of mean, varied from 7.77% for volume of finger to 71.21% for bunch weight. Characters like bunch weight (71.21%), plant height (36.02%), pseudostem girth (47.83%), days taken from planting to shooting (34.01%), number of fingers per bunch (50.26%), sugar:acid ratio (43.91%), hand weight (37.21%), number of suckers per plant (38.68%) and finger length (33.84%) showed higher genetic advance, along with high heritability. This clearly suggests that these characters are mainly of the additive type as reported by Johnson *et al* (1955). Lowest genetic advance was obtained for volume of finger (7.77%), leaf width (12.02%), ripe fruit weight (14.11%), number of fingers per hand (18.61%) and pulp weight (18.87%). Number of suckers per plant and bunch weight with high value for PCV, GCV and heritability, coupled with genetic advance, indicate that the character is predominantly controlled by additive gene action. This is supported by the hypothesis proposed by Panse (1957) suggesting that characters exhibiting high heritability and GA were governed by additive gene effects. Similar results were reported by Rosamma (1982) and Uma *et al* (2000). This implies that selection of bunch weight, number of fingers per bunch and number of suckers per plant can bring about effective improvement, and may be exploited in breeding programmes. High heritability does not necessarily mean a high genetic advance for a particular character (Allard, 1960). Heritability, along with genetic advance, is more useful than heritability alone in predicting the result and effect of selecting the best individuals (Johnson *et al*, 1955). Uma *et al* (2000) reported plant height, with very high value of heritability and moderate value of genetic advance, revealed relatively low influence of environment on the trait for silk ecotypes of banana. In a study with 48 banana varieties, falling under different genomic group traits such as weight of finger, number of fingers per bunch and bunch weight, recorded a high estimate of heritability along with high genotypic gain in the crop (Rosamma, 1982). In the present study, plant height, with high value of heritability (98.92%) and moderate value of genetic advance (36.02%) revealed relatively low influence of environment on this trait. A study by Uma *et al* (2000) also revealed that plant height had high value of heritability (91.11%) and moderate genetic advance (27.54%). Sugar:acid ratio, pseudostem girth, days taken from planting to shooting, number of fruits per bunch and finger length showed high values of heritability, coupled with moderately high genetic advance, indicative the influence of environment on expression of these characters to some extent and, that, rigid selection might bring about improvement in these traits. Though ripe fruit weight, number of fingers per hand, leaf width, finger width and finger weight showed moderate estimate of heritability, lower value of genetic advance reflected favourable influence of environment rather than that of the genotype, and simple selection may not be rewarding. Thus it may be suggested that improvement is likely to be very effective for these characters in banana.

ACKNOWLEDGEMENT

The authors gratefully acknowledge Kerala Agricultural University, Thrissur, Kerala, India, for providing funds and facilities to carry out the research work.

REFERENCES

Allard, R.W. 1960. Principles of Plant Breeding. John Wiley & Sons, Inc., New York,USA

Burton, C.W. 1952. Quantitative inheritance in grasses. *Procs. 6th Int'l. Grassland Congr.*, **1**:277-283

Burton, G.W. and de Vane, E.H. 1953. Estimating heritability in tall fescue (*Festuca arundinace*a) from replicated clonal material. *Agron. J*., **45**:478-481

Fischer, R.A. 1960. The design of experiments. Heffner Publishing Co., Inc., New York,USA

Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soya beans. *Agron. J*., **47**:314-318

Katiyar, R.P., Mishra, B., Singh, S.N. and Chauhan, Y.S. 1974. Genetic variability, heritability and genetic advance of yield and its components in Indian mustard. *Ind. J. Agril. Sci*., **44:**291-293

KAU. 1996. Package of Practices Recommendation, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala, India

Panse, V.G. 1957. Genetics of quantitative characters in relation to plant breeding. *Ind. J. Genet.*, **17**:18-27

Panse, V.G. and Sukhatme, P.V. 1985. Statistical methods for agricultural workers, 2nd edition. ICAR, New Delhi, p 108

Rajeevan, P.K. and Geetha, C.K. 1982. Variability studies in banana. *South Ind. Hort*., **34**:197-200

Ramanujam, S. and Thirumalachar, D.K. 1967. Genetic variability of certain characters in red pepper (*Capsicum annuum* L.). *Mysore J. Agri*., **1**:30-36

Rosamma, C.A. 1982. Biometrical studies in banana. M.Sc. (Ag) thesis, Kerala Agricultural University, Thrissur, Kerala,India

Rosamma, C.A. and Namboodiri, K.M.N. 1990. Genetic

analysis of yield in banana, *Agril. Res. J. Kerala*, **28**:1-8

Singh, D.B. and Sharma, T.V.R.S. 1997. Genetic variability in banana. *Ind. J. Hort.*, **54:**124-127

Sreerangaswamy, S.R., Sambandamurthy, S. and Murugan, M. 1980. Genetic analysis in banana. In: National Seminar on Banana Production Technology, TNAU, Coimbatore, C.R. Muthukrishnana and J.B.M. Abdulkhader (eds.)

Swarup, V. and Chaugle, D.S. 1967. Studies on genetic variability in sorgham. 1. Phenotypic variations and its heritable components in some quantitative characters contributing towards yield. *Ind. J. Genet*., **22**:31-36

Uma, S., Dayarani, M., Singh, H.P., Shyam, B. and Sathiamoorthy, S. 2000. Studies on genetic variability in banana silk sub group (AAB). *Ind. J. Hort*., **57:**106-109

Valsalakumari, P.K. and Nair, P.C.S. 1986. Genetic variability in banana. *Agril. Res. J. Kerala*, **24**:66-72

(MS Received 4 May 2009, Revised 21 June 2010)