I J T A
© Serials Publications
National Academy of Agricultural Science (NAAS) Rating : 3.03

Effect of spacing and variety on growth and yield of banana cv. Grand Naine and Bantala

Swarnasarika Behera*, A. K. Das* and P. K. Panda**

Abstract: *A field experiment was carried out at Horticultural Research Station, Orissa University of Agriculture and Technology, Bhubaneswar during 2013-14 to study ''Effect of spacing and variety on growth and yield of banana cv. Grand Naine and Bantala''. Vegetative parameters like plant height and number of leaves were recorded highest in variety Bantala with spacing 2m×3m. Earliest shooting and harvesting observed in variety Grand Naine with spacing 1.8m×1.8m .The yield of banana was recorded highest in variety Grand Naine with spacing 2m×3m followed by variety Grand Naine with 1.8m×3.6m spacing and the least was in variety Bantala with normal spacing of 1.8m×1.8m. There was 4.37% higher yield with spacing of 2mx3m over 1.8mx3.6m spacing.*

Keywords: *Banana, growth, spacing, variety, yield*

INTRODUCTION

Banana (*Musa spp*) is one of the oldest tropical fruit cultivated by man from prehistoric time in India with a great socio-economic significance, interwoven in the cultural heritage of the country. It is also fourth important food crop in terms of gross value after paddy, wheat, and milk products. It is also a dessert fruit for millions apart from a staple food owing to its rich and easily digestible carbohydrates with 67 to 137calories/100 gm fruit. Banana ranks first in production and second in area among the fruit crops grown in India accounting for an area of 776 thousand hectare and total production of around 26509 thousand MT and the total productivity is around 34.2 MT/ha . In Odisha, the area under banana cultivation is around 27.49 thousand hectare and total production is around 521.31 thousand MT and productivity is around 19.00 MT/ha (NHB 2013). High density planting (HDP) as an intensive system of cultivation in banana not only provides high production and net returns but also facilitates efficient utilization of solar energy, nutrients and water (Apshara and Sathiamoorthy, 2003) and was proven successful in increasing productivity. Besides higher yield, HDP also helps to reduce labour cost and increase the efficiency of input utilization. Planting of three suckers per pit under high density planting consumed less water than normal planting of one sucker per pit, thus enhanced the water productivity in banana cultivation.

Thus, present investigation was aimed to accesses effect of spacing and variety on banana in terms of growth and yield and yield attributing characters.

MATERIALS AND METHODS

The experiment was carried out at Horticultural Research Station, Orissa University of Agriculture and Technology (O.U.A.T.), Bhubaneswar, Odisha during the year 2013-14. The Horticulture Research Station (HRS) is situated about 7km away from the university and located at the latitude of $20^0$15′ N and longitude of $85^0$52′E. It is about 60km away from Bay of Bengal having an altitude of 25.5m above mean sea level. Maximum rainfall during the cropping period was about 720.1mm which was received in October 2013. The maximum temperature observed during the cropping period was 39.8^0C (2013-2014).

The experiment was conducted on sandy clay loam soil with pH 4.57. The experiment consisting of six treatments was laid in Randomized Block Design

* Department of Fruit Science and Horticulture Technology, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar-751003, Odisha, India

** AICRP on Cashew, OUAT, Bhubaneswar, *E-mail: pkpandaouat@gmail.com*

with four replications in plot size 2430 square feet. The treatments included T_1- variety Bantala with spacing 2m×3m (5000 plants/ha), T_2- variety Bantala with spacing 1.8m×3.6m (4629plants/ha), T_3- variety Bantala with spacing 1.8m×1.8m (3086plants/ha) (Normal spacing or control), T_4- variety Grand Naine with spacing 2m×3m, T_5- variety Grand Naine with spacing 1.8m×3.6m, T_6- variety Grand Naine with spacing 1.8m×1.8m (Normal spacing or control). All cultural operations were followed which were necessary for good crop.

Observations on vegetative parameters like plant height, pseudo-stem girth and number of leaves and yield parameters like bunch weight, number of fingers, finger size, bunch size etc. were recorded in each replication of all the treatments. Economics of the treatments were calculated as per prevailing market price.

RESULTS AND DISCUSSION

Vegetative parameters

The pseudo-stem height recorded at harvesting time was statistically analysed. From the data, it was revealed that pseudo-stem height showed significant difference among the treatments. The variety Bantala showed significantly higher plant height as compared to the variety Grand Naine. Banana under treatment with 2mX3m recorded the highest height in both varieties i.e. Bantala (273.27 cm) and Grand Naine (184.10cm). They differed significantly from each other. Similar trend was recorded for the other two spacing and varieties. However there was no significant difference noticed under different spacing within the variety. The lowest plant height was recorded under the treatment T_6 (178.79cm).The Grand Naine recorded lower value under all spacing as compared to Bantala. Observations on pseudo-stem girth recorded at harvesting time were statistically analysed. From the Table 1, it was revealed that significant differences existed among the treatments. The treatment T_3 (V_1P_3) recorded highest pseudo-stem girth (69.11cm) followed by the treatment T_2 (V_1P_2) (67.57cm) and they remained at par. The lowest plant girth was recorded in T_4 (V_2P_1) (58.78cm). It varied significantly from the T_1 and T_2.As far as the varieties were concerned, Bantala showed higher pseudo-stem girth compared to Grand Naine. In both the cases, due to placement of three plants per pit the competition for space and light might have made the plants taller and lanky as a result of which the plant height recorded was more and girth was the least under the spacing accommodating highest number of plants/ha. Similar result were reported by Badgujar and Gawade (2007) and Kumar and Kumar (2011) whose findings collaborates with the present work. The number of leaves per plant was also found to be more under the high density planting (T_4) with 14.22 number of functional leaves and the lowest was 11.69 under the treatment (T_3). In both the varieties, the plants with higher spacing with three plants per pit gave the highest number of leaves where as under wider spacing of 1.8m×1.8m with one plant per pit, the number of leaves was less. This work is in confirmation with the works reported by Nalina *et al.* (2000).

Table 1
Effect of variety and spacing on vegetative character of banana

Treatments	*Plant height (cm)*	*Pseudo-stem girth (cm)*	*Number of leaves*
T1-V_1P_1	273.27	66.83	13.60
T2-V_1P_2	264.55	67.57	12.24
T3-V_1P_3	264.2	69.11	11.69
T4-V_2P_1	184.10	58.78	14.22
T5-V_2P_2	182.11	60.51	13.98
T6-V_2P_3	178.79	63.83	13.18
SEm(±)	7.84	2.27	0.55
CD at 5%	23.63	6.85	1.68

Shooting and harvesting

Shooting and harvesting are the most important stages of banana production. Both shooting and harvesting to be synchronized a number of factors are to be favourable such as variety, age and quality of the suckers/tissue culture plants, environmental conditions prevailing, soil micro-climate, irrigation availability, incidence of pests and diseases, nutrient management etc.

In the present investigation, the shooting and harvesting duration did not show significant differences (Table 2). However, early shooting was observed under the treatment with closer spacing (1.8m×1.8m) with single plant per pit in Grand Naine and also in Bantala. It may be due to wider leaf spread and receipt of more sunlight under 1.8m×1.8m spacing more food materials were produced and supplied to the plant as a result of which the plant's physiological process could be maintained properly and timely shooting could take place. Under the high density planting i.e. in the treatments T_1, T_2, T_3, T_4 and T_5, the number of leaves were more as compared to 1.8m×1.8m spacing and shading effect might have caused some hindrances in the reduction of photosynthetic activities, but owing to more number, might have resulted in production of food materials and supply to the plants to enable to complete its

physiological activities. As a result of this, the shooting and harvesting although have been delayed by a short period but have remained at par with the treatment producing earliest shooting and harvesting.

Table 2
Effect of spacing and variety on days taken for shooting and harvesting

Treatments	*Days taken for shooting*	*Days taken for harvesting*
T_1-V_1P_1	252.53	363.5
T_2-V_1P_2	250.31	360.21
T_3-V_1P_3	249.27	358.33
T_4-V_2P_1	249.35	360.12
T_5-V_2P_2	243.56	356.66
T_6-V_3P_3	242.12	351.56
SEm(±)	7.47	8.98401
CD at 5%	22.52	27.0709

Yield attributing characters

Bunch weight (kg)

Taking the plant population and bunch weight in account, it was observed that the yield (t/ha) varied significantly (Table 3). The variety Grand Naine recorded highest yield (t/ha) as compared to Bantala and varied significantly from it. The highest yield was recorded under the treatment with 1.8m X 3.6m spacing with three plants per pit accommodating 5001 plants in both the varieties i.e. in Bantala (T_1- 63.4t/ha) and in Grand Naine (T_4 - 87.8 t/ha). However, the yield of both the varieties varied significantly. Grand Naine under this treatment recorded 38.48% increase in yield over Bantala. It recorded 100.2 % and 38.48% increase in yield over T_3 and T_6. This was followed by the treatments having a spacing of 2m X 3m accommodating 4629 plants / ha i.e. in Bantala (T_2), yield of 60.68 was recorded while in Grand Naine (T_5), an yield of 83.83t/ha was obtained. Although the single plant per pit at 1.8m x 1.8m spacing recorded the highest bunch weight, the highest yield was recorded under 2m x 3m with three plants per pit.

Ahmed and Mannan (1970) reported that close spacing plants produced more yield per unit area but wider spacing produced heavier bunches. Flowering and fruit maturity were delayed in close spacing which is in agreement with the present findings. Similar results were also reported by Das and Maharana (1995), Ray *et al*. (2001), Thippesha *et al*. (2007) and Pujari *et al*. (2010).

Bunch length (cm)

It was revealed from the results (Table 3) that the bunch length was highest under T_6 (102.05cm) followed by T_3 (99.12cm) which were under Grand Naine and Bantala varieties with wider spacing (1.8m×1.8m) respectively. The lowest bunch length were recorded under T_1 (92.51cm) i.e. Bantala variety followed by T_4 (93.5cm) i.e. Grand Naine both having similar spacing i.e. 2m×3m with three plants/pit. Over all, it was observed that with increase in the spacing and planting three plants/pit, there was increase in total number of plants/ha but bunch length were reduced as compared to 1.8m×1.8m spacing with single plant per pit. However the treatments did not differ significantly from each other. The length of bunch under T_6 recorded 10.22% increase in bunch length over T_1 i.e. between the highest and lowest bunch length.

Bunch girth (cm)

The results on bunch girth (Table 3) revealed non-significant effects among the treatments. Similar trend as in case of bunch length was observed under the bunch girth too. The highest bunch girth was recorded under the treatment T_6 (99.85cm) followed by T_3 (95.34cm), T_5 (93.67cm), T_2 (91.67cm), T_1 (90.53cm) and T_4 (90.12cm). The plants under 1.8m x 1.8m spacing recorded higher plant girth as compared to the treatments with increased plant densities. However the T_6 recorded 10.29% higher bunch girth as compared to T_1.

Number of hands per bunch

The result on number of hands per bunch (Table 3) revealed non- significant effects among the treatments. The highest hand per bunch was observed under the treatment T_6 (7.95) followed by T_5 (7.07), T_4 (7.01), T_3 (6.33). T_2 (5.98) and T_1 (5.67). However from the data, it was recorded that Grand Naine variety produced higher number of hands per bunch than Bantala variety. Normal spacing (1.8m×1.8m) with one plant per pit showed more number of hands per bunch as compared to high density planting i.e. in

Table 3
Effect of spacing and variety on bunch character of banana

Treatments	*Bunch weight (kg/plant)*	*Bunch length (cm)*	*Bunch girth (cm)*	*Number of hands/ bunch*	*Yield (t/ha)*
T_1-V_1P_1	12.68	92.51	90.53	5.67	63.4
T_2-V_1P_2	13.11	94.33	91.67	5.98	60.68
T_3-V_1P_3	14.21	99.12	95.34	6.33	43.85
T_4-V_2P_1	17.56	93.5	90.12	7.01	87.8
T_5-V_2P_2	18.11	95.11	93.67	7.07	83.83
T_6-V_2P_3	20.50	102.05	99.85	7.95	63.26
SEm(±)	1.86	3.86	3.34	0.51288	2.04219
CD at 5%	5.61	11.65	10.08	1.54542	6.15361

spacing 2m×3m (5001plants/ha) and 1.8m×3.6m (4629 plants/ha).

Number of finger per bunch

It was revealed from the experimental data (Table 4) that the number of fingers per bunch varied significantly. The treatment T_6 (120.51) recorded the highest number of fingers and was followed by T_5 (117.33), T_4 (115.57), T_3 (64.5%), T_2 (61.78) and T_1 (60.56). It was observed that the variety Grand Naine recorded significantly higher values for finger number as compared to the Bantala variety for all corresponding spacing tested. In both the varieties, the spacing 1.8m x 1.8m recorded higher number of fingers as compared to wider spacing with three plants per pit. T_6 recorded 4.27% higher than T_4 (V_2P_1).

Finger Length (cm)

The data on the length of the fingers (Table 4) revealed that the treatments did not vary significantly and were at par with each other. However, the treatment T_3 (21.33 cm) recorded the highest length of the fingers followed by T_6 (21.23 cm). The treatments under the closer spacing (1.8mx1.8 m) with single plant per pit recorded higher values for the finger length as compared to the higher spacing with three plants per pit, i.e. 2m x3m and 1.8m x 3.6m.

Finger Girth (cm)

The results of the experiment on the effect of spacing and variety on finger girth (Table 4) showed that all the treatments remained at par with each other. The highest girth of the finger was recorded under the treatment T_3 (17.2 cm) i.e. in Bantala variety with 1.8m x1.8m spacing followed by T_6 (14.23cm) i.e. Grand Naine under 1.8m x1.8m spacing with single plant per pit. The lowest girth was obtained under the treatment T_4 (13.21cm) i.e. Grand Naine variety under 2m x 3m spacing with three plants per pit. The girth of the plants in both the varieties maintained the same sequence that with the increase in the plant density there was decrease in the girth of the plants.

Finger Weight (gm)

It was revealed from the result (Table 4) on the weight of the finger that the treatments displayed significant effects in it. The highest finger weight was recorded under the treatment T_3 (197.3g) followed by T_2 (194.5g) and T_1 (191.23g) which were under the variety Bantala in which T_3 varied significantly from T_1 and remained at par with T_2. The treatments under the variety Grand Naine recorded lower values for the fruit weight as compared to the Bantala and varied significantly from all the treatments of Bantala for all the spacing. T_3 recorded 35.41% higher weight than the T_6 and 45.65% higher weight than the T_4 which recorded the lowest weight of fingers. Among the spacing under Grand Naine the fingers under T_6 varied significantly from T_4 and remained at par with T_5.

Table 4
Effect of spacing and variety on no. of finger, finger length, girth and finger weight

Treatments	*No. of fingers/ bunch*	*Finger length (cm)*	*Finger girth (cm)*	*Finger weight (g)*
T_1-V_1P_1	60.56	18.11	15.51	191.500
T_2-V_1P_2	61.78	18.55	16.1	194.230
T_3-V_1P_3	64.5	21.33	17.2	197.300
T_4-V_2P_1	115.57	18.88	13.21	135.460
T_5-V_2P_2	117.33	19.36	13.56	137.520
T_6-V_2P_3	120.51	21.23	14.23	145.700
SEm(±)	2.74	1.03	1.19	4.892
CD at 5%	8.27	3.12	3.61	14.742

Economics of production

The data (Table 5) obtained revealed that variety Grand Naine was more suitable for high density planting compared to variety Bantala as it resulted maximum net return as well as benefit cost ratio irrespective of spacing. Total return was maximum in the treatment T_4 (V_2P_1) i.e., 14,92,600 followed by T_5 (V_2P_2) 14,25,110 and T_1 (12,68,000) and maximum net return was also obtained in the treatment T_4 (.8,92,600/-) followed by T_5 (.8,58,110) and T_6 (.7,08,420). Cost benefit was maximum in the

Table 5
Economics of production per hectare for banana as influenced by spacing and variety

Treatments	*Variety*	*Spacing*	*Cost of cultivation (₹Rs)*	*Total return (₹Rs)*	*Net Return (Rs)*	*Benefit : cost ratio*
T_1-V_1P_1	V_1 - Bantala	P_1 - 2m x 2m	6,00,000	12,68,000	6,68,000	1.11
T_2-V_1P_2		P_2 - 1.8m x 3.6m	5,67,000	12,13,600	6,46,600	1.14
T_3-V_1P_3		P_3 - 1.8m x 1.8m	3,67,000	8,77,000	5,10,000	1.38
T_4-V_2P_1	V_2 – Grand Naine	P_1 - 2m x 2m	6,00,000	14,92,600	8,92,600	1.48
T_5-V_2P_2		P_2 - 1.8m x 3.6m	5,67,000	14,25,110	8,58,110	1.51
T_6-V_2P_3		P_3 - 1.8m x 1.8m	3,67,000	10,75,420	7,08,420	1.93

treatment (T_6) (1.93) followed by T_5 (1.51) and T_4 (1.48) and lowest was in T_1 (1.11). However, variety Bantala recorded lowest net return as well as cost benefit ratio compared to variety Grand Naine.

REFERENCES

Ahmed, K. and Mannan, A. (1970). Effect of size of pit and spacing on the performance of Amritsagar banana. *Punjab Journal* **110**(32): 7-13.

Apshara, E.S. and Sathiamoorthy. S. (2003). Effect of planting more than one sucker per pit on growth and yield of Banana cv. Nendran (AAB). *Indian J. Hort.* **60**(4): 339-342.

Badgujar, C.D. and Gawade, M.H. (2007). Effect of planting density on growth duration and yield of Barsai banana (*Musa cavendish*). *The Orissa J. Hort*.. **35**(1): 24-28.

Das, A.K. and Maharana, T. (1995). Effect of spacing and intercrop on the bunch characters of banana cv. Robusta. *The Orissa J. Hort.* **23**(1-2): 13-17.

Kumar.S. and Kumar, A. (2011). Effect of High density planting on performance of banana. *Bihar J. Hort*. **1**: 54-56.

Nalina, L., Kumar, N., and Sathiamoorthy, S. (2000). Studies on high density planting in banana cv. Robusta (AAA). Influence on vegetative characters. *Indian J. Hort*. **57** (3): 190-195.

National Horticulture Board (2013). Indian Horticulture database *http://nhb.gov.in/statistics/area- production-statistics.html.*

Pujari, C. V., Pawar, R. D, Marbhal, S.K. and Badgujar, C.D. (2010). Studies on bunch characters and yield of banana as influenced by planting systems and density. *Asian J. Hort.* **5**(2): 479-482.

Ray, P.K., Kumar, R. and Singh, A.K. (2001). Effect of plant on plant characteristic and yield of Basrai banana in north Bihar. *RAU J. Res* **(1-2):** 18-22.

Thippesha, D., Srinivas, V., Mahanthesh, B. and Janardhan, G. Vishnuvardhana. (2007). Effect of different planting systems on flowering and crop duration with different levels of nutrition and spacing in banana cv. Robusta (AAA). *Asian J. Hort.* **2**(2): 280-284.