HIGH DENSITY PLANTING EFFECT ON BANANA (*MUSA SAPIENTUM*) YIELD

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ABSTRACT

A study was conducted at Utholi, Shibganj, Bogra, Bangladesh during October, 2004 to November, 2005 to find out high density plantation effect on banana yield versus recommended spacing. Two plant spacings viz. 1.5 m x 1.5 m (SP_1) and 2m x 2m (SP_2) were tried. Banana fruit characters were higher in SP_2. But higher number of bunches per hectare (3966) was observed in SP_1. against SP_2 (2269). SP_1 gave higher yield due to higher number of plant population than SP_2. Similarly higher gross margin (Tk. 2,54,622.00) and benefit cost ratio (BCR) (3.95) were observed in SP_1 and the lowest gross margin (Tk. 1,58,099.00) and BCR (3.79) in SP_2. Farmers of Shibganj should cultivate banana by using spacing 1.5 m x 1.5 m instead of spacing 2m x 2m due to higher yield as well as gross margin.

KEYWORDS: ***Musa sapientum;*** **spacing; agronomic characters; cost benefit analysis; Bangladesh.**

INTRODUCTION

Banana (*Musa sapientum*) is vigorously growing, monocotyledonous herbaceous plant. The banana plant, often erroneously referred to as a "tree", is a large herb, with succulent and very juicy stem (properly "pseudostem"). This plant is a cylinder of leaf-petiole sheaths, reaching a height of 20 to 25 ft (6-7.5 m) and arising from a fleshy rhizome or corm (9). Edible bananas originated in the Indo-Malaysian region reaching to northern Australia. Bananas and plantains are grown in every humid tropical region. It is cultivated more or less in whole areas of Bangladesh. It is a nutritious fruit and a good source of ascorbic acid (vitamin C), vitamin B_6, and potassium (5).

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Commercial cultivation of banana is generally done at 2 m x 2 m spacing (7) which is a wider spacing. However, in case of varieties and location, now-a-days, many growers cultivate banana at closer spacing. According to them, total yield becomes higher with closer spacing. Besides, banana is a botanically taller crop and duration is also longer (10-14 months). Closer spacing may help prevent natural hazards especially speedy wind and storm. It is to be estimated whether wider or closer spacing gives higher yield of banana.

Present study was undertaken to compare high density plantation at 1.5 m x 1.5 m with recommended spacing (2m x 2m) for optimum plant growth, yield and yield components of banana.

MATERIALS AND METHODS

This study was conducted at Utholi, Shibganj, Bogra, Bangladesh during October, 2004 to November, 2005. Two plant spacings viz. 1.5 m x 1.5 m (SP_1) and 2.0 m x 2.0 m (SP_2) were tried in randomized complete block design with five dispersed replications. Banana suckers (cv. Rangin Mehersagor) were planted during October, 2004. Total dose of fertilizers and manures comprised; cowdung @ 15 kg per plant, urea 600 g per plant, TSP 300 g per plant and MOP 300 g per plant. Total cowdung, TSP and half of MOP were applied during pit preparation, one fourth urea was applied at 3 months after planting and remaining two third urea and half of MOP were applied at 6 months after planting. Irrigation and intercultural operations were done as per needs. Fungicide viz. Tilt 250 EC (0.05%) was sprayed for controlling sigatoka or leaf spot disease and Sevin 85 SP was sprayed against banana leaf and fruit beetle. Banana fruit was harvested during October-November, 2005. Data were recorded on number of green leaves per plant, circumference of basegirth per plant, plant height, bunch length, bunch weight with peduncle, peduncle weight, number of hands per bunch, weight of hands per bunch, weight per hand, number of fingers per bunch, number of fingers per hand, finger length, finger circumference and number of bunches per hectare. The data were analyzed statistically and treatment effect was compared by employing Duncan's new multiple range test (DMRT) following Gomez and Gomez (6). Gross return, total variable cost, gross margin and BCR (benefit cost ratio) were also analyzed. BCR was calculated from Table 5 using following formula:

$$BCR = \frac{\textit{Gross return}}{\textit{Total variable cost}}$$

RESULTS AND DISCUSSION

The data (Table 1) regarding number of green leaves per plant taken at 2 MAP (months after planting) to 8 MAP indicated that spacing did not show any significant effect. Average number of green leaves of banana was more or less same for SP_1 and SP_2 at 2 MAP, 4 MAP, 6 MAP and 8 MAP.

Table 1. Effect of spacings on number of green leaves of banana plant

Plant spacings	Average number of green leaves per plant			
	2 MAP	4 MAP	6 MAP	8 MAP
SP_1 (1.5 x 1.5 m)	8.04	10.9	12.06	10.62
SP_2 (2 x 2 m)	8.38	9.76	12.44	11.30
F-test	NS	NS	NS	NS

NS = Non-significant at 5% level

The results regarding circumference of basegirth per plant (Table 2) also revealed non-significant effect of spacing on this parameter. Maximum circumference of basegirth of pseudostem was recorded in SP_2 at 8 MAP (71.06 cm) and minimum in SP_1 (68.38 cm). Value of this parameter increased with increase in plant age. Apshara and Sathiamoorthy (2) observed that increase in planting density significantly reduced pseudostem girth in all spacings. Nalina *et al.* (10) also found that high density planting reduced pseudostem girth.

Table 2. Effect of spacings on circumference of basegirth of banana plant.

Plant spacings	Average circumference of basegirth per plant (cm)			
	2 MAP	4 MAP	6 MAP	8 MAP
SP_1 (1.5 x 1.5 m)	16.18	23.77	59.68	68.38
SP_2 (2 x 2 m)	16.72	24.44	62.04	71.06
F-test	NS	NS	NS	NS

NS = Non-significant at 5% level

The results further showed that spacing significantly affected plant height of banana (Table 3). It was maximum (465.91 cm) in SP_2 and minimum (304.36 cm) in SP_1 at 8 MAP. Plant height increased with the increase of plant age.

The data of fruit characteristics (Table 4) revealed that length per bunch, weight per bunch with peduncle, weight of hands per bunch, fingers per bunch, length per finger and number of bunch per hectare were significantly affected by spacings. Peduncle weight, number of hands per bunch, hand weight, number of fingers per hand and circumference of finger were not

Table 3. Effect of spacings on plant height of banana plant.

Plant spacings	Average plant height per plant			
	2 MAP	4 MAP	6 MAP	8 MAP
SP_1 (1.5 x 1.5 m)	88.10	127.54	296.25	304.36 a
SP_2 (1.5 x 2.0 m)	88.64	128.02	302.09	365.91 b
F-test ($p \geq 0.05$)	NS	NS	NS	*

In a column figures with different letter(s) differ significantly at 5% level of DMRT.
*Significant, NS = Non-significant (P = 0.05)

Table 4. Effect of spacings on yield and banana fruit characteristics.

Plant spacings	**Length/ bunch (cm)**	**Weight/ bunch with peduncle (kg)**	**Weight/ peduncle (kg)**	**No. of hands/ bunch**	**Weight of hands/ bunch (kg)**	**Weight/ hand (kg)**
SP_1(1.5 x 1.5 m)	**76.20 a**	**20.49 a**	**1.45**	**9.00**	**19.04 a**	**2.12**
SP_2 (2 x 2 m)	**87.90 b**	**25.81 b**	**1.83**	**9.00**	**23.98 b**	**2.67**
F-test ($p \geq 0.05$)	*	*	**NS**	**NS**	*	**NS**
	No. of fingers/ bunch	**No. of fingers/ hand**	**Finger length (cm)**	**Finger circumference (cm)**	**No. of bunches/ ha**	
SP_1(1.5 x 1.5 m)	**140.20 a**	**15.58**	**15.77 a**	**13.29**	**3966 b**	
SP_2 (2 x 2 m)	**158.20 b**	**17.58**	**19.98 b**	**15.85**	**2259 a**	
F-test ($p \geq 0.05$)	*	**NS**	*	**NS**	*	

In a column, figures with different letter(s) differ significantly at 5% level of DMRT
*Significant, NS = Non-significant (P = 0.05).

statistically significant. Higher length per bunch (87.90 cm), weight per bunch with peduncle (25.81 kg), weight per peduncle (1.83 kg), weight of hands per bunch (23.98 kg), weight per hand (2.67 kg), fingers per bunch (158.20), fingers per hand (17.58), length per finger (19.98 cm) and circumference of finger (15.85 cm) were recorded in SP_2. Pereira *et al.* (11) observed that average plantation produced 17.7 kg weight, 9.1 hands and 134 fingers per bunch. Morton (9) also stated that a well-filled bunch (cv. Dwarf Cavendish) produced 150 to 200 fruits. Higher number of bunches per hectare (3966) was observed in SP_1 against SP_2 (2259). SP_1 gave higher yield due to higher number of plant population. Crane and Balerdi (5) found that closer spacings produced higher yields and less weeds and reduced bunch weight. Mandal and Sharma (8) observed that fruit yield significantly increased with increase in crop density. They also found that high density decreased number of fruits, number of hands per bunch, fruit weight and bunch weight. Apshara and Sathiamoorthy (2) found that total yield increased with increasing plant

density in all spacings. Athani and Hulamani (3) achieved higher yield (28.00 t/ha) in closer density (1.0 x 1.2 x 2.0 m) against minimum (11.67 t/ha) in wider spacing (2.4 m x 2.4 m). They also recorded higher yield per plot and per hectare in closer spacing (1.2 m x 2.0 m) than wider spacing (2.4 m x 2.4 m).

Cost benefit analysis of banana (Table 5) revealed significant effect on gross margin. SP_1 had higher gross margin (Tk. 2,54,622.00) and BCR (3.95) than SP_2 (Tk. 1,58,099.00 grass margin and BCR 3.79). Investment of Tk. 1.00 gave a profit of Tk. 3.95 in case of SP_1 against TK 3.79 in SP_2. SP_1 was found economically profitable due to high density of banana plants.

Table 5. Cost benefit analysis.

Plant spacing	No. of bunches/ ha	Gross return (Tk. /ha)	Total variable cost (Tk. /ha)	Gross margin (Tk. /ha)	BCR
SP_1 (1.5 x 1.5 m)	3966	3,41,076.00	86,454.00	2,54,622.00	3.95
SP_2 (2 x 2 m)	2259	2,14,605.00	56,506.00	1,58,099.00	3.79

	Total cost of inputs/ha of SP_1			Total cost of inputs/ha of SP_2		
Items	Amount	Rate (Tk.)	Total price (Tk.)	Amount	Rate (Tk.)	Total price (Tk.)
Suckers	4000.00	1.50	6000.00	2300.00	1.63	3750.00
Urea	2280.17 kg	6.00	13,681.00	1317.66 kg	6.00	7,906.00
TSP	614.66 kg	35.00	21,513.00	354.97 kg	35.00	12,424.00
MOP	651.00 kg	30.00	19,530.00	376.50 kg	30.00	11,295.00
CD	4780.00 kg	1.50	7,170.00	3333.34	1.50	5,000.00
Ploughing	1.00 ha	3500.00	3,500.00	1.00 ha	3500.00	3,500.00
Pesticides						
(a) Sevin	3.00 kg	583.33	1750.00	2.13 kg	583.33	1241.00
(b) Tilt	0.75 L	3000.00	2250.00	0.60 L	3000.00	1800.00
Labour	110.60	100.00	11,060.00	95.90	100.00	9,590.00
		Total (Tk.)	86,454.00		Total (Tk.)	56,506.00

Output price: Tk. 86.00/bunch of SP_1 and Tk. 95.00/bunch of SP_2, TSP = Triple Super Phosphate, MOP = Muriate of Potash, CD = Cowdung Urea, TSP and MOP are 50 kg per Bag Total number of plants per hectare are 3966 for SP_1 and 2259 for SP_2.

CONCLUSION

It is concluded that spacing of 1.5 x 1.5 meter gave higher total banana yield and economic profit than spacing of 2.0 x 2.0 meter. So, plant spacing of 1.5 x 1.5 meter is recommended for banana farmers of Shibganj, Bogra, Bangladesh.

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