Effect of number of suckers per hill on yield and quality of banana cv. Malbhog (AAB) in ratoon crop

ABSTRACT

An experiment was carried out at instructional cum experimental farm, Department of Horticulture, BNCA, AAU, Biswanath Chariali to study the effect of number of suckers per hill on yield and quality of banana cv. Malbhog (AAB) in ratoon crop by maintaining different numbers of suckers per hill as T_1 (one sucker per hill), T_2 (two suckers per hill), T_3 (three suckers per hill), and T_4 (four suckers per hill). Plants for each treatment were planted in two spacing as S_1 (2.1 m x 2.1 m) and S_2 (2.5 m x 2.5 m). One treatment with recommended package of practices was also included in the experiment as control. The treatment combinations were laid out in factorial RBD with three replications. Finger length (15.22 cm), finger girth (12.05 cm), finger volume (84.44 cc) and finger weight (83.65 g), number of fingers (92.75/bunch), hands (7.27/bunch), bunch weight (9.41 kg/bunch and yield (15.05 t/ha) were highest in S_2T_1 (two suckers per hill in 2.5 m x 2.5 m spacing). Yield of banana was significantly lower in wider spacing of 2.5 m x 2.5 m (S_2) than S_1 (2.1 m x 2.1 m). There was no significant effect of treatments on quality attributing parameters of fingers.

Key word: Malbhog, ratoon crop, suckers, treatment, yield parameter, quality

1. INTRODUCTION:

Banana (*Musa* spp.) is one of the most important staple food and starchy fruit crops of the world and India ranks first in both area and production in world scenario. Though area under banana production has been increasing in India but the total production, productivity and quality of the fruits have been found to be in reducing trend in Assam. This might be due to cultivation of low yielding variety, poor management of suckers, spacing, fertilization, irrigation, pests and diseases. In recent years, more emphasis is being given to higher productivity of banana per unit area with better quality by adopting various means. One of such methods is high density planting which depends on variety, method of cultivation, the height and spread of banana plant. Among the different cultural practices, desuckering is one of the important practices which influence the size of the fingers and bunch weight of banana. The commercial cultivation of banana in Assam has gained momentum since last one decade. The majority of the farmers in Assam allow all the suckers to grow along with the mother plants. If all the suckers which arise from the stool are allowed to grow, bunches become smaller with poor quality and some plants may not bear fruit at all (Seifu, 2003). As per opinion of banana growers of Assam, if desuckering is practiced then the period from harvesting of first crop to harvesting of ratoon crop become longer and it affects the economic condition of the small and marginal growers. Therefore, the growers allow the suckers to grow along with the mother plants to get return earlier from the subsequent ratoon crops.

2. MATERIALS AND METHOD

The experiment was carried out at instructional cum experimental farm, Department of Horticulture, BNCA, AAU, Biswanath Chariali with nine treatment combinations. The treatments were T_1 (one sucker per hill), T_2 (two suckers per hill), T_3 (three suckers per hill), and T_4 (four suckers per hill). There were two spacing - S_1 (2.1 m x 2.1 m) and S_2 (2.5 m x 2.5 m) for all the treatments. One treatment with recommended package of practices (control) was also included in the experiment. Nine treatment combinations were laid out in RBD with three replications. The bunch was weighed along with the peduncle and the yield was calculated out on the basis of number of plants accommodated per hectare as per spacing. The physical parameters of fingers *viz.,* length, girth, volume, weight, number of fingers were recorded after harvesting of the bunch. Total soluble solids (TSS) was determined by Pocket Refractometer PAL-1. Titratable acidity, reducing sugars, total sugars and non-reducing sugars of the first ratoon were estimated by adopting the standard methods of AOAC (1975).

3. RESULT AND DISCUSSION

3.1 Fruit and yield parameters

The longest finger (14.90 cm) and highest girth (11.49 cm) were recorded in T_1 (mother plant + one sucker) followed by 14.46 cm length and 11.24 cm girth in T_2 (mother plant + two suckers) while T_4 (mother plant + four suckers) recorded the shortest finger (13.87 cm) and lowest girth (10.54 cm). Finger girth was found to be significant between the control and other treatments and in it was 12.27 cm control. Volume of fingers differed significantly due to spacing and it was significantly higher (81.16 cc) in S_2 (2.5 m x 2.5 m) as compared to 76.93 cc in S_1 (2.1 m x 2.1 m). Among the treatments, T_1 (mother plant + one sucker) recorded the maximum weight of fingers (82.96 g) and differed significantly from the rest of the treatments. The highest (91.25) number of fingers per bunch was recorded in T_1 (mother plant + one sucker) while it was lowest (84.68) in T_4 (mother plant + four suckers). In the present investigation, the physical parameters of the fruits *i.e.* length, girth and volume of the fingers decreased gradually with the increase in the number of suckers per plant. Longer, heavier, and thicker fingers were borne by the plants in lower plant population (control) compared to higher plant population. It might be due to utilization of available nutrients and moisture by the increasing number of suckers as well as the application of same doses of fertilizers recommended for one plant in Assam. Similar results were also reported by Nalina *et al.* (2003) and remarked that wider spacing recorded higher length, girth and volume of fingers as compared to the closer spacing.

Table 1: Length, girth and volume of banana fingers of first ratoon crop

Treatment	Length of fingers (cm)			Girth of fingers (cm)			Volume of fingers (cc)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	14.58	15.22	14.90	10.92	12.05	11.49	79.19	84.44	81.82
T_2	14.25	14.67	14.46	10.83	11.64	11.24	78.94	82.45	80.69
T_3	14.00	14.19	14.10	10.20	11.07	10.64	75.02	80.83	77.93

T_4	13.81	13.93	13.87	10.12	10.97	10.54	74.58	76.93	75.76
Mean	14.16	14.50	---	10.52	11.43	---	76.93	81.16	---
Control	---	---	15.22	---	---	12.27	---	---	84.16
CD (P=0.05)	T: 0.61 S: NS T x S: NS C vs T: NS			T: 0.51 S: 0.36 T x S: NS C vs T: 0.72			T: NS S: 3.45 T x S: NS C vs T: NS		

Table 2: Weight of fingers, numbers of fingers and hands per bunch of first ratoon crop

Treatment	Weight of fingers (g)			Number of fingers per bunch			Number of hands per bunch		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	82.27	83.65	82.96	89.75	92.75	91.25	7.08	7.27	7.18
T_2	73.91	75.40	74.65	86.74	89.50	88.12	6.61	7.06	6.83
T_3	70.84	74.58	72.71	83.87	87.94	85.91	6.35	6.75	6.55
T_4	69.80	72.13	70.96	82.00	87.36	84.68	6.25	6.67	6.46
Mean	74.21	76.44	---	85.59	89.39	---	6.57	6.94	---
Control	---	---	83.96	---	---	93.72	---	---	7.59
CD (P=0.05)	T: 3.91 S: NS T x S: NS C vs T: NS			T: 3.88 S: 2.74 T x S: NS C vs T: 0.51			T: 0.40 S: 0.28 T x S: NS C vs T: NS		

The significantly heaviest bunch weight (9.41 kg/plant) was recorded in S_2T_1 (wider spacing with one sucker/mother plant) while the lowest (6.16 kg/plant) in S_1T_4 (recommended spacing with four suckers/mother plant) and was at par with S_1T_3 (6.22 kg/plant), S_1T_2 (6.28 kg/plant) and S_2T_4 (6.24 kg/plant) in first ratoon crop. Among the treatments, significantly highest yield was observed in T_1 (one sucker per hill) and the lowest in T_4 (four suckers per hill) in both the first crop and first ratoon crop. However, significantly higher yield was recorded in control under the study. The economic character of a banana plant is the bunch which is influenced by the number of hands and fingers per bunch, weight of fingers, length, girth and volume of fingers. The result of the present study revealed that weight of fingers, number of hands, bunch weight and yield were significantly influenced by the different treatments in first ratoon crop. Among the different treatments, bunch weight per plant and corresponding yield per hectare were highest in plants with retention of only one sucker with mother plant (T_1) and bunch weight and yield gradually decreased with the increase in number of suckers per plant. It could also be associated with the higher number of hands and fingers per bunch, longest fingers, higher girth and volume of fingers as recorded in this treatment. Similar results were also observed by Irizarry *et al.* (1978), Lichtemberg *et al*. (1986) and Martiney (1987) in different varieties and locations. It was interesting to note that though the bunch weight per plant was found to be higher in wider spacing but the total yield per hectare was reduced in wider spacing. It might be due more number of plants accommodated per unit area with closer spacing (S_1). Similar results were also obtained by Kesavan *et al.* (2002); Nalina *et al.* (2003); Abdullah *et al.* (2010); Sarrwy, *et al.* (2012).

The plants cultivated as per recommended package of practices (control) produced the heaviest bunches which might be due to adequate spacing, plant population and nutrient supply resulting higher values of number of fingers, girth of fingers, length of finger, weight of second hand and peduncle.

Table 3: Bunch weight and yield of banana of first ratoon crop

Treatment	Bunch weight (kg/plant)			Yield (t/ha)		
	S_1	S_2	Mean	S_1	S_2	Mean
T_1	8.71	9.41	9.06	19.73	15.05	17.39
T_2	6.28	8.24	7.26	14.67	13.18	13.93
T_3	6.22	7.49	6.85	14.09	11.97	13.03
T_4	6.16	6.33	6.24	14.33	10.12	12.23
Mean	6.84	7.87	---	15.71	12.58	---
Control	---	---	10.08	---	---	22.84
CD (P=0.05)	T: 0.29 S: 0.21 T x S: 0.41 C vs T: 0.35			T: 0.66 S: 0.46 T x S: 0.93 C vs T: 0.71		

3.2 Fruit quality parameters

TSS and titratable acidity did not differ significantly due to treatments, spacing and their interaction effects. Higher TSS (26.28^0Brix) and higher titratable acidity (0.35%) were recorded in T_1 (one sucker per hill) but the fingers produced under control recorded higher TSS of 26.31^0Brix and titratable acidity of 0.38 percent than other treatments. Total sugars, reducing sugars and non- reducing were not influenced by treatments but spacing had a positive influence on sugar contents. Fingers under wider spacing (S_2) recorded higher total sugars (15.03 %), reducing sugars (7.99 %) and non-reducing sugars (7.71 %) than that of 14.27 percent, 7.33 percent and 6.28 percent of total sugars, reducing sugars and non-reducing, respectively in recommended spacing (S_1). Total soluble solids, titratable acidity, sugar contents determine the quality of fruits. In the present investigation, plants under low density exhibited superior fruit quality and they had a tendency to decrease with increase in plant density (Choudhuri and Baruah, 2010). In the present study, the differences in total soluble solids (TSS) and titratable acidity contents in fruits were found to be non-significant due to different treatments and spacing. The gradual decreasing trend of TSS and titratable acidity with the increase in number of suckers per plant might be due to the lesser exposure to the sunlight resulting lesser accumulation of sugars and other soluble components from hydrolysis of protein and oxidation of ascorbic acid (Marriot *et al*., 1981). Similarly, lower total sugars and reducing sugars in high density treatments might be due to less conversion of sugar from starch. The present study gets ample support from the work of Chundawat *et al.* (1983). Chattopadhayay *et al.* (1985) and Reddy (1991) recorded higher total sugar in banana with low plant density.

Table 4: TSS and titratable acidity of banana fruits of first ratoon crop

Treatment	Total soluble solids (^{0}Brix) of fingers	Titratable acidity (%) of fingers

	S_1	S_2	Mean	S_1	S_2	Mean
T_1	26.50	26.05	26.28	0.33	0.37	0.35
T_2	23.80	25.46	24.63	0.38	0.32	0.35
T_3	23.58	24.63	24.11	0.37	0.30	0.34
T_4	21.38	22.22	21.80	0.30	0.31	0.31
Mean	23.82	24.59	---	0.35	0.33	---
Control	---	---	26.32	---	---	0.38
CD (P=0.05)	T: NS T x S: NS	S: NS C vs T: NS		T: NS T x S: NS	S: NS C vs T: NS	

Table 5: Sugar contents of banana fruits of first ratoon crop

Treatment	Reducing sugars (%) of fingers			Total sugars (%) of fingers			Non-reducing sugars (%) of fingers		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1	7.49	8.45	7.97	14.62	15.67	15.14	6.17	8.17	7.17
T_2	7.38	8.22	7.80	14.45	15.23	14.84	6.22	7.86	7.04
T_3	7.22	7.96	7.59	14.23	14.98	14.61	6.27	7.76	7.01
T_4	7.21	7.33	7.27	13.79	14.24	14.02	6.46	7.04	6.75
Mean	7.33	7.99	---	14.27	15.03	---	6.28	7.71	---
Control	---	---	8.99	---	---	15.52	---	---	6.53
CD (P=0.05)	T: NS T x S: NS	S: 0.44 C vs T: NS		T: NS T x S: NS	S: 0.47 C vs T: NS		T: NS T x S :NS	S: 0.74 C vs T: NS	

REFERENCE:

1. A.O.A.C.. Official Methods of Analysis. 2nd Ed. Association of Official Agricultural Chemists, Washington D.C; 1975.
2. Abdallah, B. M., Roshdy, K. A. and El-Shenawi, M. R. Effect of plant density on growth, flowering, fruiting and yield of Grand Naine banana in sandy soil. *Alex. Sci. Exchange. J*. 2010; **31**: 380-385.

3. Chattopadhyayay, P. K., Bhowmick, D. J., Maiti, D. C. and Bose, T. K. Optimum planting density for plant and ratoon crops of 'Giant Governor' Cavendish banana in West Bengal. *Indian J. Agric. Sci.,*1985;**55**:17-21.
4. Chaudhuri, P. and Baruah, K.. Studies on Planting Density in Banana cv. 'Jahaji' (AAA). *Indian Journal of Hill Farming*.2010;**23**(2):31-38.
5. Chundawat, B. S., Dove, S.K. and Putel, N. L.Effect of close planting on the yield and quality of 'Lacatan' bananas. *Indian J. Agric. Sci*., 1983;**53**: 470-472.
6. Irizarry, H. G., Rivera, E., Rodriguez, J. A. and Green, J. J.Effect of planting pattern and population density on yield and quality of the Horn type Maricongo plaintain (*Musa acuminate* x *Musa balbisiana*) (AAB) in North Central Puerto Rico. *J. Agric Univ*., 1978;**62**:214-223.
7. Kesavan, V., Hill, T. and Morris, G.The effect of plant spacing on growth, cycling time and yield of banana in subtropical Western Australia. *Acta Hort*., 2002;575:851-857.
8. Lichtemberg, L. A., Hing, R. H. and Malberg, J. L.Effect of spacing and desuckering on the performance of 'Enxerto' banana (*Musa,* AAB) in Southern Santra Catarina, Brazil, *Proc. Int. American Soc. Trop. Hort*. 1986;**30**:25-33.
9. Marriott, J., Robinson. M. and Karikari, S.K. Starch and sugar transformation during the ripening of plantains and bananas. *Journal of the science of food and agriculture.* 1981;**32**(10):1021-1026.
10. Martiney, G. A. Revista Institute Colombiano. In: Boss, T. K. & Mitra, S. K. (eds.). 1990. Fruit. Tropical and sub tropical, Naja Preolicash Calcutotion, India. *Agro Puvario*. 1987;**19**:357-359.
11. Nalina, L., Kumar, N. and Sathiamoorthy, S. 2003. Studies on high density planting in banana Cv. Rubusta (AAA) II. Influence on bunch and fruit quality traits. *Indian J. Hort.*, **60**(4):307-311.
12. Reddy, B. M. C. Effect of spacing, plant density on growth, yield and quality of 'Dwarf Cavendish' banana. *AICRP(TF) Res. Rep. on Citrus, Pineapple, Papaya and Sapota,* IIHR, Bangalore.1991;103-05.
13. Sarrwy, S. M. A., Mostafa, E. A. M. and Hassan, H. S. A. Growth, Yield and Fruit Quality of Williams Banana as Affected by Different Planting Distances. *Int. J. Agric. Res.*, 2012;**7**:266-275.
14. Seifu, G. Status of Cmmercial Fuit Poduction in Ethiopia. Ethiopia Agricultural Research Organization, Addis Ababa, Ethiopia.2003.