

Effect of High Density Planting and Nutrient Management on Growth and Yield of Banana CV. Jahaji (Musa, AAA)

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Abstract: The present study was conducted at the Experimental Farm, Assam Agricultural University, Jorhat during 2009-10 with an objective to determine the growth, yield and nutrient requirement of banana in high density planting system (HDP). The treatments comprised of T₁, T₂, T₃: 2 suckers/hill at 2m×3m with 100%, 75% , 50% RDF; T₄, T₅, T₆ : 3 suckers/hill at 2m×3m with 100%, 75% , 50% RDF; T₇, T₈, T₉ : 2 sucker at 1.8m×3.6m with 100%, 75% , 50% RDF; T₁₀, T₁₁, T₁₂ : 3 sucker at 1.8m×3.6m with 100%, 75% , 50% RDF and T₁₃: 1sucker at 1.5m×1.5m with 100% RDF. All the High Density Planting registered more height than the control and was maximum at T₄ (184.80cm).The plant girth decreased with increase in number of sucker per hill. It was highest in T₁₃ (74.10cm) and lowest in T₄ (53.30cm).Total number of leaves increased in all the HDP treatments. It was found maximum in T₄ (26.64 no). All the HDP treatment having 2 and 3 sucker per hill, recorded more number of functional leaves than the control. Treatment T₆ recorded the lowest shooting harvest interval. All the HDP treatments recorded reduced bunch weight, number of hands per bunch, number of fingers per hands and finger length but the weight of second hand (2.93kg) and yield (80.23t/ha) was found highest in T₆. An overall assessment revealed that planting of 3 suckers per hill at 2m×3m with 50% RDF (T₆) is the best treatment under agro-climatic condition of Assam.

Keywords: High Density Planting, Banana, Growth and Yield

I. INTRODUCTION

Banana is one of the most important fruit crop of world as well as in India. Banana could be considered as poor man's apple and it is the cheapest among all other fruits in the country. It is the fourth most important fruit crop after paddy, wheat and milk products. Banana is known as wholesome fruit, as it provide a more balance diet than any other fruit, containing sufficient amount of carbohydrates, the source of energy. India is the largest producer of banana in the world producing 19.19 tonnes with productivity of 34 tonnes/hectare, Singh, [12]. In recent years more emphasis is being given to higher production per unit area by adopting various means. The planting distance adopted for banana varies a great deal throughout India and also in other parts of the world. It depends on the variety grown, method of cultivation, the height and spread of banana and the growth it would make in a situation. High Density planting (HDP) is one of the recent and novel concepts of increasing the productivity without affecting the quality of fruits. Like pineapple,

banana is also a short duration fruit crop and provides considerable scope for production per unit area, Randhawa *et al.*, [10]. The HDP has been successfully implicated in many fruit crop including banana.. Several studies have been conducted in banana to elucidate the HDP under different agro climatic regions using different cultivars, Bhan and Majumder, [1]. Hence, this study was under taken to determine the effect of planting 2 and 3 suckers per hill on growth and yield of banana cv. Jahaji under different levels of fertilizers application.

II. MATERIALS AND METHODS

The experiment was conducted in the experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. Banana cv. Jahaji was considered as test crop in a randomised block design with 13 treatments and 4 replications. The treatments include T₁, T₂, T₃: 2 suckers/hill at 2m×3m with 100%, 75% , 50% RDF; T₄, T₅, T₆ : 3 suckers/hill at 2m×3m with 100%, 75% , 50% RDF; T₇, T₈, T₉ : 2 sucker at 1.8m×3.6m with 100%, 75% , 50% RDF; T₁₀, T₁₁, T₁₂ : 3 sucker at 1.8m×3.6m with 100%, 75% , 50% RDF and T₁₃: 1sucker at 1.5m×1.5m with 100% RDF. The fertilizers were applied as N, P₂O₅ and K₂O in three splits viz. Third, fifth and seventh month after planting.

The pits were selected randomly from each plot for observations. Observations were taken at 3rd month, 5th month, and 7th month, shooting and harvesting stage. Pseudostem height was marked with red point at 15 cm above the ground level and height was measured from the red mark to the point of the youngest first and second leaf axis. Finally the 15cm length was added and height was expressed in centimetre (cm). The fully emerged leaves produced by the plant up to shooting were counted and recorded. The number of functional leaves at 5 month, 7 month, shooting and harvesting stages were recorded counting only the green leaves when only three fourth or whole leaf areas of leaves were photosynthetically active. Total number of hands and fingers were counted. Finger length was measured from the base of the pedicel to the tip of the fruit along with the dorsal curve and express in centimetres (cm).Weight of single finger from second hand at harvest was recorded in gram.

Statistical Analysis:

The collected data were statistically analysed by using PASW statistics 18.

III. RESULTS AND DISCUSSION

All the HDP treatments registered more plant height than the control [Table 1]. Among the treatments highest plant population registered highest plant height. This is in

support of the findings of Krishnakumary *et al.* [7]. All the HDP treatments showed decrease in plant girth than the control. The present finding is in the support of Jagirdar *et al.* [6].

Table 1: Pseudostem height (cm) and girth (cm) at different stage of growth of banana

Treatments	3 rd month		5 th month		7 th month		Shooting	
	Height (cm)	Girth (cm)	Height (cm)	Girth (cm)	Height (cm)	Girth (cm)	Height (cm)	Girth (cm)
T ₁	41.03	19.90	83.60	42.17	90.27	54.50	124.63	61.27
T ₂	39.60	23.77	72.00	39.23	87.60	48.27	120.27	58.30
T ₃	36.40	21.13	75.30	44.57	89.63	51.57	119.23	59.40
T ₄	53.10	21.83	87.30	25.53	99.69	39.60	184.80	53.30
T ₅	47.17	23.50	84.17	33.47	94.83	42.37	178.60	55.67
T ₆	33.60	21.63	66.83	34.37	79.03	44.59	142.23	63.50
T ₇	38.93	21.87	73.43	39.53	85.76	50.40	161.43	57.20
T ₈	35.50	23.56	75.63	45.00	88.70	52.73	112.13	63.10
T ₉	45.87	25.13	67.80	37.37	76.90	47.57	109.77	56.10
T ₁₀	42.23	19.73	82.30	31.20	94.63	41.10	131.97	57.53
T ₁₁	37.60	18.33	67.97	40.50	82.47	52.10	142.23	56.10
T ₁₂	37.86	21.10	71.13	39.00	88.07	49.17	139.86	65.10
T ₁₃	26.90	29.50	61.43	49.96	74.57	65.20	104.97	74.10
SEd	0.77	1.36	0.64	0.42	0.61	0.33	0.57	0.65
CD (5%)	1.60	2.82	1.32	0.87	1.26	0.68	1.17	0.42

Table 2: Total number of leaves and functional leaves of banana

Treatments	3 rd month		5 th month		7 th month		Shooting	
	Total no. of leaves	Functional leaves	Total no. of leaves	Functional leaves	Total no. of leaves	Functional leaves	Total no. of leaves	Functional leaves
T ₁	11.3	4.62	16.23	5.52	16.83	11.93	24.65	6.98
T ₂	11.05	4.74	16.07	5.54	17.35	11.83	26.16	5.64
T ₃	10.11	4.53	15.43	5.44	17.33	12.4	24.33	7.05
T ₄	11.94	5.03	16.92	5.21	19.15	11.87	26.64	7.36
T ₅	11.76	3.55	16.64	5	19.04	10.73	25.62	5
T ₆	11.53	4.47	16.33	5.15	18.33	11.83	25.32	5.3
T ₇	10.14	4.57	15.84	5.58	18.65	12.67	23.76	7.65
T ₈	10.34	3.79	15.54	5.56	17.62	15	24.03	5.39
T ₉	10.45	3.98	15.06	5.41	17.53	12.53	23.74	5.93
T ₁₀	11.86	4.11	17.38	5.66	18.45	12.67	26.33	7.16
T ₁₁	11.8	4.85	17.06	5.43	19.12	11.03	26.05	5.96
T ₁₂	11.64	5.04	16.84	5.73	18.38	12.07	26.15	6.67
T ₁₃	9.45	5.83	14.47	6.16	15.84	12.17	21.45	7.71
SEd	0.07	0.13	0.09	0.03	0.12	-	0.53	0.19
CD (5%)	0.14	0.27	0.18	0.06	0.25	NS	1.1	0.38

The results recorded in the [Table 2] the HDP treatments registered higher number of leaves than the control. Between 2 or 3 suckers per hill planting, the latter registered higher number of leaves than the former under both the spacing. This may be due to the prolong vegetative growth phase caused by microclimate with low temperature and more shade. Higher number of functional

leaves was found in the treatment having one sucker per pit. It may be due to less competition for soil moisture nutrient and light intensity. The present finding get ample support from the works of Mandal [8] who found less number of functional leaves in higher plant population as compared to lower plant population.

Table 3. Leaf area (m²) and leaf area index of banana

Treatments	Large stage		Shooting stage		Harvesting stage	
	Leaf area	Leaf area index	Leaf area	Leaf area index	Leaf area	Leaf area index
T ₁	11.20	1.65	15.62	2.60	12.45	2.07
T ₂	10.49	1.67	16.31	2.65	10.21	1.69
T ₃	10.66	1.54	14.64	2.44	10.93	1.82
T ₄	9.90	1.78	16.96	2.83	13.41	2.23
T ₅	10.00	1.75	15.50	2.58	8.75	1.45
T ₆	9.24	1.87	15.94	2.72	8.23	1.35
T ₇	10.14	1.56	15.90	2.45	14.23	2.21
T ₈	8.59	1.32	14.59	2.16	10.54	1.02
T ₉	9.11	1.40	14.89	2.49	12.60	1.94
T ₁₀	9.53	1.46	16.44	2.53	7.86	1.62
T ₁₁	9.10	1.40	17.37	2.65	9.31	1.43
T ₁₂	9.88	1.52	17.60	2.71	9.07	1.40
T ₁₃	8.09	3.44	13.99	6.48	6.63	3.49
SEd	0.59	0.09	0.99	0.22	0.09	0.018
CD (5%)	1.21	0.19	2.04	0.46	0.19	0.038

Leaf area is an important index of vigour that influences the consequential yielding capacity of the cultivar. All the HDP treatments registered more leaf area than the control

[Table 3]. In the lower density due to less competition for light, moisture and nutrient, the rapid production of leaves increase the leaf area index, Singh [13].

Table 4. Number of sucker, days taken to shooting and shooting harvest interval

Treatments	Number of suckers			Days taken for shooting	Shooting harvesting interval
	Large stage	Shooting stage	Harvesting stage		
T ₁	3.67	9.26	7.23	254.67	91.47
T ₂	4.67	10.21	8.23	253.33	89.43
T ₃	4.77	9.63	7.47	252.00	91.53
T ₄	4.17	9.67	7.70	279.67	59.47
T ₅	4.50	9.38	7.47	281.67	65.43
T ₆	4.09	8.63	6.50	284.67	64.57
T ₇	4.33	10.57	8.23	245.00	85.47
T ₈	3.60	7.16	5.13	242.00	82.94
T ₉	3.67	9.36	7.55	240.67	84.00
T ₁₀	4.33	8.47	6.15	270.67	80.40
T ₁₁	3.83	9.30	7.14	272.33	78.63
T ₁₂	4.00	10.62	8.37	269.67	78.93
T ₁₃	4.10	11.12	9.31	230.67	93.47
SEd	NS	0.15	0.21	0.86	0.39
CD (5%)	NS	0.32	0.44	1.77	0.82

The number of sucker found to be significant in the shooting and harvesting stage but found to be non significant in large stage [Table 4]. These results are in conformity with the findings of Chattopadhyay *et. al.* [3]. It was interesting to note that though the crop duration increased with increase planting density, the time taken for

harvesting and shooting-harvest interval was less in all the HDP treatments than the control. This might be due to efficient absorption of water and nutrients by 2 or 3 sucker per hill planting than the one sucker per hill. The same finding was also mentioned by Chundawat *et al.* [4].

Table 5: Yield and yield attributing characters

Treatments	Bunch weight (kg)	Yield (ton/ha)	No. of hands/bunch	No. of fingers/hand	Finger length (cm)	Finger girth (cm)	Finger weight (gm)	Finger volume (cc)	Weight of second hand	Harvest index
T ₁	14.14	47.15	8.31	18.06	20.24	11.75	145.86	140.37	2.13	0.39
T ₂	14.02	46.74	8.00	18.15	20.61	12.32	144.09	140.26	2.48	0.41
T ₃	13.15	43.84	8.21	18.20	20.04	12.42	140.59	141.03	2.17	0.41

T ₄	15.52	77.64	7.52	23.20	18.52	11.62	123.83	120.54	2.30	0.36
T ₅	15.83	78.70	7.42	23.64	19.23	11.91	127.15	122.22	2.57	0.35
T ₆	16.06	80.23	7.81	25.33	19.13	11.87	104.35	100.86	2.93	0.33
T ₇	12.63	38.95	8.43	18.54	19.09	11.87	154.51	155.41	2.26	0.42
T ₈	11.36	35.07	8.63	20.64	20.06	12.39	150.59	160.23	2.62	0.42
T ₉	13.07	40.37	8.83	17.79	20.03	11.68	155.22	150.33	2.33	0.44
T ₁₀	16.52	76.44	7.35	22.64	16.91	10.23	119.78	115.25	2.61	0.32
T ₁₁	16.53	76.67	7.23	22.11	18.68	10.59	112.29	110.18	2.13	0.29
T ₁₂	16.63	76.97	7.63	25.08	19.17	10.04	102.87	90.95	2.40	0.33
T ₁₃	17.17	74.67	9.72	27.11	21.00	13.42	161.84	110.03	1.75	0.45
SEd	0.08	0.057	0.14	0.18	0.65	0.24	NS	NS	0.25	0.47
CD (5%)	0.18	0.12	0.029	0.38	1.34	0.50	-	-	0.51	0.97

Yield is the ultimate aim of cropping. In banana, the number of hands, fingers and total weight of bunch are different factors of yield. All the HDP treatments registered reduction in bunch weight when compared to control [Table 5]. This reduction in bunch weight with increment in plant density may be due to excessive interception of light by the enhanced canopy under HDP, which might have helped to increase the vegetative character but not probably the bunch character (Elain Apshara [5]. In contrast, when there is only one sucker per pit more leaf surface were exposed to sunlight and indirectly greater amount of assimilates accumulated in the various organs of the plant leading to increase bunch weight. Two suckers per hill planting had invariably registered more number of hands per bunch. Number of fingers also differed significantly among the treatments. All the HDP treatments registered less number of fingers than the control. Similar result in banana has been reported by Chattopadhyay *et al.*[3]. Longer and thicker fruits were born by the plant having one sucker per pit with 100% RDF. Similar results on 'Robusta' banana were also reported by Nalina *et al.* [9]. Harvest index (HI) generally serves as a good index for assessing the relative efficiency of different treatments. A close observation of the harvest index revealed that it increases with decreasing the number of sucker per pit. This may be due to efficient supply of water, more number of functional leaves at shooting stage causing early development of bunch primordial and efficient partitioning of the assimilates resulting the development of healthy bunch. However, the lowest HI exhibited by the three suckers per pit and hence inefficient partitioning of the assimilates to the development of its bunch leading to enormously high dry matter accumulation in gigantic pseudostem. This view is in tune with that of Bhattacharyya and Rao [2] who had enunciated that the product of total dry weight at harvest and HI would determine the bunch production in banana.

IV. CONCLUSIONS

From the present investigation, all the HDP treatments resulted in increased vegetative characters such as pseudostem height, number of leaves and leaf area and reduced the pseudostem girth. All the HDP treatments registered a reduction in bunch weight and bunch character and fruit quality. Between two and three sucker

per hill planting, three suckers per hill registered more bunch weight than two suckers per hill. Considering the economic point of view planting of 3 suckers per hill at 2 m x 3 m spacing (5001 plants/ha) with 50% recommended dose was found to be highly remunerative.

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