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Effect of Methods of Planting and Planting Density on Vegetative and Yield Parameters in Banana cv. Williams (Ratoon-I)

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ABSTRACT: The present study was carried out to observe the effect of methods of planting and planting density on growth and yield parameters of banana cv. Williams (Ratoon-I) during 2022-23. The experiment was laid out in the Randomized Complete Block Design with eight treatments which were replicated thrice. A significant difference among the different treatments in growth parameters was observed. The results revealed that, among the various treatments, T_4 (Single row - 2.4×1.8 m), had highest values for pseudostem height (204.53 cm), pseudostem girth (67.73 cm), the number of functional leaves (14.80) and leaf area (18.58 m^2). The yield parameters like bunch weight was highest in T_4 (29.40 kg), bunch weight kg/hill in T_6 (33.37 kg) and yield per hectare in T_8 (91.39 t/ha).

Keywords: Banana, Williams, Method of planting, Planting density, Growth and Yield.

INTRODUCTION

Banana (*Musa* sp.) a perennial herbaceous monocot plant in the Musaceae family. The most significant tropical fruit crop and first crop that man ever domesticated. Banana is known by various synonyms such as "Adam's fig," "Kalpatharu," "Tree of wisdom" and many others (Rao and Chundawat 1998). It has many therapeutic properties and is a great source of vitamins and minerals. The edible banana is originated in hot tropical regions of South-East Asia (Yadold and Kadam 2008). India is the largest producer of banana with an area of 9.59 lakh ha, production of 35.131 million tonnes and productivity of 36.67 tons per hectare (Anon., 2021).

Williams (AAA) is a cultivar of Giant Cavendish type in the Cavendish subgroup. It is medium to tall plant (2.4-3.7 m). The pseudostem of Williams has dark brown with black or red streaks. It has a very larger, cylindrical bunch with 300 evenly sized fruits.

The correct planting density is very important for bridging the gap between the actual yield and potential yield of banana from a unit area. High density planting can significantly increase the yield per unit area compared to traditional planting methods (Chaudhuri and Baruah 2010). It facilitates better utilization of solar radiation and increase the photosynthetic efficiency of the plant. Hence, the investigation was carried out to know the effect of methods of planting and planting density on growth and yield characteristics in banana cv. Williams (Ratoon-I).

MATERIAL AND METHODS

The present investigation for studies was carried out during 2022-23 at ICAR-AICRP on Fruits, Kittur Rani Channamma College of Horticulture, Arabhavi, Gokak (Tq), Belagavi (Dt), Karnataka, to assess various growth and yield parameters of banana. The experiment was laid out in Randomized Complete Block Design with three replications and eight treatments *viz.*

T_1 - Single row system (1.5 × 1.5 m)
T_2 - Single row system (1.8 × 1.8 m)
T_3 - Single row system (2.1 × 1.8 m)
T_4 - Single row system (2.4 × 1.8 m)
T_5 - 2 plants/hill (2.4 × 1.8 × 0.3 m)
T_6 - 3 plants/hill) (2.7 × 1.8 × 0.3 m)
T_7 - Paired row system (2.4 × 1.2 × 1.0 m)
T_8 - Paired row system with Zig - Zag method (2.1 × 1.2 × 1.2 m)

The recommended dose of fertilizer followed in the experiment is 200:100:300 g NPK/plant/year (As per the POP of UHS, Bagalkot, Karnataka) for all the treatments. The plots were kept free from weeds by regular weeding. Irrigation schedule was followed according to the requirements. Earthling up was followed whenever soil became compact. De-suckering

was done regularly till shooting. Along with de-suckering other cleaning activities and plant protection measures were also carried out accordingly. The vegetative parameters were taken at different stages *viz*., 60, 120, 180, 210 Days after planting and at shooting stage.

RESULTS AND DISCUSSION

A. Pseudostem height (cm)

The data on pseudostem height and pseudostem girth was presented in Table 1. The maximum pesudostem height (71.13 and 114.93 cm) was obtained in T_6 (3 plants per hill - 2.7×1.8×0.3 m) and minimum pseudostem height (54.20 and 92.73 cm) was obtained in the T_4 (Single row - 2.4×1.8 m) during 60 DAP and 120 DAP. However, there is gradual increase of pseudostem height of banana from 180 DAP to shooting stage in wider spacing. Among all treatments, T_4 (Single row - 2.4×1.8 m) recorded the maximum pseudostem height (147.13, 179.37 and 204.53 cm, respectively). Whereas, the minimum pseudostem height (135.73, 160.42 and 179.43 cm, respectively) was recorded in T_6 (3 plants per hill - 2.7×1.8×0.3 m) at 150, 180, 210 DAP and at shooting stage respectively. It is due to overcrowding and intermingling of leaves to each other in close spaced planting system. Additionally, Chacko *et al.* (1982) noted that increased plant canopy size and age lead to reduced light intensity at ground level. Wider spacing allows maximum exposure of the plant canopy to sunlight, resulting in increased photosynthesis and metabolic activities within the cells and may be due to genetic characteristics of this cultivar.

B. Pseudostem girth (cm)

The maximum pseudostem girth (21.73, 37.40, 55.66, 57.60 and 67.73 cm, respectively) was achieved in T_4 (Single row - 2.4×1.8 m) which was on par with T_3. Whereas, the minimum pseudostem girth (15.71, 28.88, 39.11, 42.16 and 46.51 cm, respectively) was observed in T_6 (3 plants per hill - 2.7×1.8×0.3 m) at 60, 120, 180, 210 DAP and at shooting stage respectively. Optimal exposure of the plant canopy to sunlight was found to be beneficial for maximum photosynthetic assimilation and improved metabolic activities of the cells, which ultimately resulting in increased stem girth. These findings align with the research conducted by Chaudhuri and Baruah (2010) in banana cv. Jahaji (AAA), Gore (2014) in cv. Ardhapuri.

C. Number of functional leaves

The maximum number of functional leaves (10.60, 12.33, 13.73, 14.13 and 14.80 respectively) was obtained in T_4 (Single row - 2.4×1.8 m) which was on par with T_3. Whereas, the minimum number of functional leaves (9.28, 9.60, 10.46, 10.73 and 11.37 respectively) was occurred in T_6 (3 plants per hill - 2.7×1.8×0.3 m) at 60, 120, 180, 210 DAP and during shooting stage respectively. The increased number of leaves observed in wider spacing can be attributed to the sufficient availability of nutrients, which stimulate the production of more leaves. These findings are consistent with the results reported by Sarrwy *et al*. (2012); Naik *et al*. (2016).

D. Leaf area (m^2)

Treatment T_4 (Single row - 2.4×1.8 m) recorded the highest leaf area (2.23, 7.04, 12.76, 13.81 and 18.58 m^2 respectively) which was on par with T_3. However, the minimum leaf area (1.00, 2.86, 4.83, 5.20 and 6.36 m^2 respectively) was recorded in T_6 (3 plants per hill - 2.7×1.8×0.3 m) at 60, 120, 180, 210 and during shooting stage respectively. This could be attributed to the reduced competition for moisture, nutrients and sunlight experienced by plants in the wider spacing. This outcome is consistent with the results obtained by Chaudhuri and Baruah (2010) in cv. Jahaji (AAA) (Table 2).

E. Bunch weight (kg/plant)

The highest bunch weight (29.40 kg) was observed in T_4 (Single row - 2.4×1.8 m), which was on par with T_3 (25.89 kg) and the lowest bunch weight per plant (11.12 kg) was recorded in T_6 (3 plants per hill - 2.7×1.8×0.3 m). There was a consistent trend of decreasing bunch weight with an increase in planting density. This reduction in bunch weight in cases with a high density planting can be attributed to the crowded canopy and increased competition for nutrients. Similar findings were also reported in other banana varieties, such as in cv. Martaman (Naidu *et al*., 2015), in cv. Grand Naine (Patel *et al*., 2018; Gaonkar, 2019).

Table 1: Effect of methods of planting and planting density on Pseudostem height (cm) and Pseudostem girth (cm) of banana cv. Williams (Ratoon-I).

Treatments	Pseudostem height (cm)					Pseudostem girth (cm)				
	60 DAP	120 DAP	180 DAP	210 DAP	At shooting	60 DAP	120 DAP	180 DAP	210 DAP	At shooting
T_1	64.87	110.93	139.33	169.17	196.60	20.03	32.46	48.06	51.00	61.33
T_2	58.40	99.40	141.87	176.87	199.77	20.47	34.80	50.00	52.67	65.13
T_3	56.27	96.53	144.10	178.13	202.17	20.93	36.33	52.80	56.40	65.60
T_4	54.20	92.73	147.13	179.37	204.53	21.73	37.40	55.66	57.60	67.73
T_5	72.87	112.07	137.13	165.20	187.53	17.37	30.53	47.26	49.57	51.63
T_6	71.13	114.93	135.73	160.42	179.43	15.71	28.88	39.11	42.16	46.51
T_7	70.07	112.03	138.17	163.83	191.77	19.40	31.60	46.73	50.67	59.33
T_8	68.77	111.97	138.33	167.73	194.73	20.13	31.80	47.46	49.47	60.60
S. Em ±	**0.44**	**0.67**	**0.30**	**0.42**	**0.62**	**1.09**	**0.44**	**0.58**	**1.01**	**0.81**
CD @ 5%	**1.35**	**2.03**	**0.92**	**1.27**	**1.88**	**3.32**	**1.34**	**1.76**	**3.07**	**2.52**

Table 2: Effect of methods of planting and planting density on Number of functional leaves, Leaf area (m^2) and yield parameters of banana cv. Williams (Ratoon-I).

Treatments	Number of functional leaves					Leaf area (m^2)					Bunch weight (kg/plant)	Bunch weight (kg/hill)	Yield (t/ha)
	60 DAP	120 DAP	180 DAP	210 DAP	At shooting	60 DAP	120 DAP	180 DAP	210 DAP	At shooting			
T_1	10.13	11.33	12.66	13.06	13.93	1.55	4.86	9.33	10.21	12.48	19.15	19.15	85.10
T_2	10.26	11.73	13.26	13.73	14.53	1.87	5.49	10.16	11.43	15.52	23.98	23.98	74.02
T_3	10.33	12.06	13.40	13.86	14.66	2.13	6.00	11.51	12.75	15.98	25.89	25.89	68.50
T_4	10.60	12.33	13.73	14.13	14.80	2.23	7.04	12.76	13.81	18.58	29.40	29.40	68.05
T_5	9.70	10.86	11.93	12.23	12.80	1.20	3.99	7.33	7.61	8.77	15.08	30.07	59.66
T_6	9.28	9.60	10.46	10.73	11.37	1.00	2.86	4.83	5.20	6.36	11.12	33.37	58.86
T_7	9.86	11.13	12.20	12.33	13.13	1.50	4.71	9.39	9.49	11.44	17.86	17.86	87.57
T_8	9.93	11.26	12.53	12.66	13.53	1.44	4.24	8.78	9.53	11.14	18.10	18.10	91.39
S. Em ±	**0.20**	**0.15**	**0.11**	**0.09**	**0.13**	**0.05**	**0.11**	**0.20**	**0.16**	**0.24**	**0.42**	**0.48**	**1.54**
CD @ 5%	**0.63**	**0.47**	**0.35**	**0.28**	**0.39**	**0.16**	**0.33**	**0.61**	**0.48**	**0.72**	**1.26**	**1.47**	**4.67**

F. Bunch weight (kg/hill)

The highest bunch weight per hill (33.37 kg) was observed in T_6 (3 plants per hill - 2.7×1.8×0.3 m) which was on par (30.07 kg) with T_5 (2 plants per hill - 2.4×1.8×0.3 m) and the lowest bunch weight per hill (17.86 kg) was noted in T_7 (Paired row system - 2.4×1.2×1.0 m). This can be attributed to the fact that high-density planting allows for a greater number of plants per hill compared to other spacing configurations. Similar results were obtained by Chundawat *et al*. (1982) in cv. Basrai and Singh and Kashyap (1992) in cv. Robusta.

G. Yield (t/ha)

The highest yield per hectare (91.39 t/ha) was achieved in T_8 (Paired row with zig-zag - 2.1×1.2×1.2 m) which was on par with T_7. Conversely, the lowest yield per hectare (58.86 t/ha) was observed in T_6 (3 plants per hill - 2.7×1.8×0.3 m). This outcome can be attributed to the closer spacing allowed for a greater number of plants to be accommodated within the same unit area. While, in wider spacing yielded a lower overall yield due to a lower plant population. But in case of 2 and 3 pants per hill there is gradual decrease of individual bunch weight as compared to paired row system. Comparable findings were reported by Chundawat *et al*. (1982) in cv. Basrai and Singh and Kashyap (1992) in cv. Robusta.

CONCLUSIONS

Among different treatments evaluated for growth parameters the treatment T_4 (Single row - 2.4×1.8 m) and T_3 (Single row- 2.1×1.8 m) had highest values for pseudostem height, pseudostem girth, the number of functional leaves and leaf area. For yield parameters, the highest bunch weight per plant was recorded in T_4 (Single row - 2.4×1.8 m) bunch weight per hill in T_6 (3 plants per hill - 2.7×1.8×0.3 m) and yield per hectare was recorded in treatment T_8 (Paired row with zig-zag- 2.1×1.2×1.2 m).

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