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Effect of different levels of beheaded heights and foliar spray of micronutrients on the growth of rejuvenated plants under high-density orchard of mango cv. Amrapali

Amit Raj and Goutam Mandal

Abstract
An investigation was undertaken to find out the effect of different levels of beheaded heights and foliar spray of micronutrients on the growth of rejuvenated plants under high-density orchard of mango cv. Amrapali. Treatment consisted of six different beheaded heights *viz*. T_1- 80cm, T_2-100 cm, T_3-120 cm, T_4-140 cm, T_5-160 cm, and T_6-180 cm with two foliar sprays of micronutrients (just before flowering and fruiting) and replicated thrice in a split-plot design. Plant height, plant spread, canopy volume, shoot length, shoot girth, trunk girth, primary shoot girth, and secondary shoot girth were taken for observation. It was found that plants beheaded at 80 cm from ground level had a maximum percent increase in shoot length (18.13 cm), shoot girth (7.15 cm), trunk girth (0.58 cm), primary shoot girth (0.92 cm), secondary shoot girth (1.64 cm) and plant spread: north–south (6.45 cm).The maximum percent in plant height (9.36 cm) and canopy volume (22.26 cm**)** was recorded in plant beheaded at 180 cm. Foliar spray of 0.4% Zinc sulphate + Copper sulphate (0.2%) + Borax (0.2%) [2 sprays just before flowering and marble stage] exerted a significant effect on the increase in plant height (7.87 cm), plant spread –north-south (6.50 cm), east-west (7.97 cm), canopy volume (20.38 cm), shoot length (16.02 cm), shoot girth (6.38 cm), trunk girth (0.55 cm), primary shoot girth (0.85 cm) and secondary shoot girth (1.49 cm) while the interaction of beheaded height and foliar spray also showed a significant effect on the plant growth. The maximum percent increase in shoot length (19.97 cm), shoot girth (8.23 cm), trunk girth (0.63 cm), primary shoot girth (0.92 cm), secondary shoot girth (1.89 cm) and plant spread: north-south (7.65 cm) was recorded in T_1F_2, while the maximum increase in plant height (10.57 cm) and canopy volume (24.05 cm) was recorded in T_6F_2 and maximum increase in plant spread: east-west was recorded in T_6F_2 (8.81 cm). From the above findings, it can be concluded that plants with shorter height (80 cm) with some modification of micronutrients can result in higher growth of the plant.

Keywords: Beheaded height, growth, mango, micronutrients

1. Introduction
Mango is known as the king of fruits in the world. It originated from Indo-Burma (Myanmar) region (Vavilov, 1926) [29] and belongs to the genus *Mangifera* of the family *Anacardiaceae*. It occupies a prime place in fruit crops and has the largest area under fruit cultivation in India. In India, mango occupies an area of 2.26 million hectares with a production of 196.8 million tonnes which works out to low average productivity of 8.7 metric tons per hectare (Anonymous, 2016) [1]. Mango plants planted under high-density planting show progressive decline after 11-12 years of planting owing to overcrowding/intermingling of branches and poor light penetration. To overcome this problem rejuvenation pruning is generally recommended. Some researchers have done great work on rejuvenation pruning (Rao *et al*., 1976, Schaffer *et al*., 1989, Lal *et al*., 2000, Sharma *et al.*, 2006, Singh *et al.*, 2009, Singh *et al*., 2016) [22, 24, 14, 25, 26] but standardization of beheaded height is yet to be recommended for high-density planting of mango. Though, Kshirsagar *et al.*, 2017 [12] tried to standardize the beheaded height in two mango varieties, Keshar and Vanraj. Aleksandr Gurin *et al.*, 2021 [10] found a significant difference in various growth parameters after beheading the tree at 1m, 1.5 m, and 2 m height in the apple tree. Singh *et al*., 2016 [26] reported that pruning at 180 cm height was effective in Nagpur mandarin. Hackett *et al*., 1985 [11] found that pruning severity increase the vigor of the plant. Ram *et al*., 2005 [20] found rejuvenation of plants at 5 m height had a significant effect on tree height, shoot length, shoot girth, and intermodal length.
But rejuvenation alone cannot improve the growth, yield, and quality of any fruit crops unless the addition or modification of micronutrients is not done.

There are plenty of works that support micronutrients that can be beneficial for plant growth, yield, and quality of fruit crops. Ram *et al*., 2000 [19] reported that sufficient amounts of micronutrients are necessary for better plant growth and yield. Davarpanah *et al*., 2016 [8] found a foliar spray of micronutrients plays an indispensable role in the growth and development of fruit trees. Obreza *et al*., 2010 [18] reported foliar application of fertilizers confers quick response and alleviates the deficiency symptoms leading to fruitful returns. Das *et al*., 1993 [7] reported that the application of micronutrients with a combination of boron, zinc, copper, and manganese, induced marked improvement in leaf area, number of functional leaves, plant height, and girth. Singh *et al*., 1976 [27] reported different levels of ZnSO4 increased the length of terminal shoot and foliar spray of Zinc and Boron had showed a significant effect on trunk girth, plant height, and spread of young plants. Babu *et al*., 2002 [3] found that the foliar application of Zinc (0.6%), Copper (0.3%), and Boron (0.3%) accelerates the growth and vigor of the plant of litchi. Fernandez *et al*., 2013 reported that foliar application of fertilizers is more convenient and effective as compared to soil application as some micronutrients like boron leeches quickly in the soil. Keeping the above point of view this experiment was done to find out the effect of different levels of beheaded heights and foliar spray of micronutrients on the growth of rejuvenated plants under high-density orchard of mango cv. Amrapali

2. Materials and Methods

This experiment was done at the Department of Horticulture and Post harvest Technology, Visva-Bharati, Sriniketan, West Bengal, India during 2019-20 and 2020-21. Six different beheaded heights, T_1-80 cm, T_2-100cm, T_3-120cm, T_4-140cm, T_5-160 cm, and T_6-180 cm, with two foliar applications *viz*. F_1: Foliar spray of 0.2% Zinc Sulphate + 0.1% Copper Sulphate + 0.1% Boric Acid (2 sprays at just before flowering and marble stage), F_2: Foliar spray of 0.4% Zinc Sulphate + Copper Sulphate (0.2%) + Borax (0.2%) [2 sprays at just before flowering and marble stage] were taken as treatment and were replicated thrice in a split-plot design. The data was analyzed by the methods suggested by Rangaswamy, 2010 [21].

2.1 The following observations were recorded

2.1.1 Plant height: Plant height was recorded by measuring tape fastened on a bamboo stick from the root base of the tree to the terminal shoot of the plant at the interval of one year and mentioned as a percent increase.

2.1.2 Plant spread: Plant spread was recorded by measuring tape fastened on a bamboo stick from the root base of the tree in East to West and North to South up to the spreading of vegetative growth of the trunk and mentioned as a percent increase.

2.1.3 Canopy volume: The volume of the canopy was calculated by the formula derived by Samaddar and Chakrabarti (1988) [23] and mentioned as a percent increase.

2.1.4 Shoot length: New vegetative shoots on the individual branch were tagged at each vegetative flush. Data on shoot length was recorded at an interval of six months with help of measuring tape. It is expressed as a percent increase.

2.1.5 Shoot girth: The diameter of the shoot was taken at an interval of six months in both seasons with help of a vernier caliper and mentioned as per percent increase.

2.1.6 Trunk girth: The diameter of the trunk above the ground was taken at an interval of six months in both seasons with help of measuring tape and mentioned as a percent increase.

2.1.7 Primary shoot girth: The diameter of the primary shoot was taken at an interval of six months with help of measuring tape and mentioned as a percent increase.

2.1.8 Secondary shoot girth: The diameter of the primary shoot was taken at an interval of six months with help of measuring tape and mentioned as a percent increase.

3. Results and Findings

3.1 Shoot length (cm): The perusal analysis of pooled data for the years, 2020 and 2021 presented in table-1 showed that different levels of beheaded height and foliar spray of micronutrients had shown significant on shoot length. The maximum percent increase in shoot length (18.35 cm, 17.90 cm, and 18.13 cm) was recorded in plants beheaded at 80 cm from ground level during 2020, 2021, and pooled respectively. Foliar spray, F_2 was found to be highly significant during the investigation period 2020 (15.35 cm), 2021 (16.68 cm), and pooled (16.02 cm) respectively. Interaction of beheaded height and foliar spray showed a significant effect in T_1F_2 (19.41 cm, 20.53 cm, and 19.97 cm) during 2020, 2021, and pooled respectively.

3.2 Shoot girth (cm): The pooled data presented in the table-2 show that different levels of beheaded height and foliar spray of micronutrients had a significant effect on shoot girth. The maximum percent increase in shoot girth (6.44 cm, 7.86 cm, and 7.15 cm) was recorded in T_1 i.e. plant beheaded at 80 cm from ground level during 2020, 2021, and pooled respectively. Foliar spray F2 was found to be highly significant during the investigation period 2020 (5.63 cm), 2021 (7.14 cm), and pooled 6.38 cm). Interaction of beheaded height and foliar spray showed a significant effect in T_1F_2 (7.22 cm, 9.24 cm, and 8.23 cm) during 2020, 2021, and pooled respectively.

3.3 Trunk girth (cm): The pooled analysis of data illustrated in table-3 shows that different levels of beheaded height and foliar spray of micronutrients had a significant effect on trunk girth. The maximum percent increase in trunk girth (0.54 cm, 0.62 cm, and 0.58 cm) was recorded in plants beheaded at 80 cm from ground level during 2020, 2021, and pooled respectively. Foliar spray, F_2 was found to be highly significant during the investigation period 2020 (0.50 cm), 2021 (0.60 cm), and pooled 0.55 cm) respectively. Interaction of different levels of beheaded height and foliar spray of micronutrients showed a significant effect in T_1F_2 (0.58 cm, 0.68 cm, and 0.63 cm) during 2020, 2021, and pooled respectively.

3.4 Primary shoots girth (cm): The pooled data shown in table-4 indicate that different levels of beheaded height and foliar spray of micronutrients had a significant effect on primary shoot girth. The maximum percent increase in primary shoot girth (0.94 cm, 0.91 cm, and 0.92 cm) was recorded in T_1 i.e. plant beheaded at 80 cm from ground level during 2020, 2021, and pooled respectively. Foliar spray, F_2 was found to be highly significant during the investigation period 2020 (0.86 cm), 2021 (0.85cm), and pooled 0.85 cm) respectively. Interaction of different levels of beheaded height and foliar spray of micronutrients showed a significant effect in T_1F_2 (0.94 cm, 0.91 cm, and 0.92 cm) during, 2020, 2021, and pooled respectively.

3.5 Secondary shoots girth (cm): The pooled data illustrated in table-5 clearly shows that different levels of beheaded height and foliar spray of micronutrients had a significant effect on secondary shoot girth. The maximum percent increase in secondary shoot girth (1.65 cm, 1.63 cm, and 1.64 cm) was recorded in plants beheaded at 80 cm from ground level during 2020, 2021, and pooled respectively. Foliar spray, F_2 was found to be highly significant during the investigation period 2020 (1.54 cm), 2021 (1.45 cm), and pooled (1.49 cm) respectively. Interaction of different levels of beheaded height and foliar spray of micronutrients showed a significant effect in T_4F_2 (1.84 cm), T_1F_2 (2.06 cm, and 1.89 cm) during 2020,2021 and pooled respectively.

3.6 Plant height (cm): The pooled analysis of data presented in table-6 clearly shows that different levels of beheaded height and foliar spray of micronutrients had a significant effect on plant height. The maximum percent increase in plant height (8.90 cm, 9.82 cm, and 9.36 cm) was recorded in plant beheaded at 160 cm from ground level during 2020, 2021, and pooled respectively. Foliar spray, F_2 was found to be a significant effect on plant height (7.40 cm, 8.33 cm, and 7.87 cm) during 2020, 2021, and pooled respectively. Interaction of different levels of beheaded height and foliar spray of micronutrients showed a highly significant effect in T_6F_2 (9.82 cm, 11.31 cm, and 10.57 cm) during 2020, 2021, and pooled respectively.

3.7 Plant spread (north-south): The pooled analysis of data illustrated in table-7 clearly shows that different levels of beheaded height and foliar spray of micronutrients had a significant effect on plant spread (north-south). The maximum percent increase in plant spread (north-south) was recorded in T_1 (6.90 cm, 6.01 cm, and 6.45 cm) during 2020, 2021, and pooled respectively. Foliar spray, F_2 (6.65 cm, 6.36 cm, and 6.50 cm) found to be highly significant effect on plant spread (North-south direction). Interaction of different levels of beheaded height and foliar spray of micronutrients also exerted a significant effect on plant spread (north-south). The maximum percent increase was found in T_1F_2 (7.43 cm), and T_4F_2 (7.88 cm, 7.65 cm) during 2020, 2021, and pooled respectively.

3.8 Plant spread (east-west): The pooled data presented in table-8 clearly shows that different levels of beheaded height and foliar spray of micronutrients had a significant effect on plant spread (east-west). The maximum percent increase in plant spread (east-west) was recorded in. in T_4 (8.15 cm) and T_5 (8.40 cm, 8.26 cm) during 2020, 2021, and pooled respectively. Foliar spray, F_2 (7.89 cm, 8.06 cm, 7.97 cm) was found to be a significant effect on plant spread (east-west). Interaction of different levels of beheaded height and foliar spray of micronutrients exerted a significant effect on plant spread (east-west) in T_4F_2 (8.71 cm) and T_6F_2 (8.98 cm and 8.81 cm) during 2020, 2021, and pooled respectively.

3.9 Canopy volume (cm): The pooled data illustrated in table-9 clearly shows that different levels of beheaded height and foliar spray of micronutrients had a significant effect on canopy volume. The maximum percent increase in canopy volume was recorded in T_4 (24.42 cm), T6 (20.59 cm, and 22.26 cm) during 2020, 2021, and pooled respectively. The foliar spray was found to have a non-significant effect on canopy volume but the interaction of different levels of beheaded height and foliar spray of micronutrients resulted in a highly significant effect on canopy volume. The maximum percent increase in canopy volume was recorded in T_6F_2 (25.79 cm, 22.31 cm, and 24.05 cm) during 2020, 2021, and pooled respectively.

4. Discussion

4.1 Effect of different levels of beheaded heights on the growth of plant

Rejuvenation of old orchards has been beneficial for farmers to increase the growth and yield of fruit crops (Lal *et al*., 2007) [13]. Many researchers found a foliar spray of a micronutrient can increase the fruit yield (Ram *et al*., 2000, Babu *et al*., 2002) [19, 4]. In this experiment, we also found similar results; plant beheaded at 80 cm recorded the maximum percent increase in shoot length (18.13 cm), shoot girth (7.15 cm), trunk girth (0.58 cm), primary shoot girth (0.92 cm), secondary shoot girth (1.64 cm) and plant spread-north–south (6.45 cm). This might be due to lower canopy volume which received maximum light penetrance within the canopy (Sharma *et al*., 2006) [25] leading to higher mobilization of nutrients within the canopy (Singh *et al*., 2010, which promoted higher action of auxins and accumulation of gibberellic acid in shoot resulting in the accelerated formation of cambial tissue resulting in higher growth of shoot (Das *et al*., 2012, Mika *et al*., 1986) [6, 16]. Similar results have also been reported by Lal *et al*., 2007, Ram *et al*. 2005 and Hackett *et al*., 1985, Mondal *et al*., 2018 [13, 20, 11, 17].

4.2 Effect of foliar spray of micronutrients (Zn, Cu, and Boron) on the growth of plants

Foliar spray of 0.4% Zinc sulphate + Copper sulphate (0.2%) + Borax (0.2%) [2 sprays at just before flowering and marble stage] exerted a significant effect on the increase in plant height (7.87 cm), plant spread–north-south (6.50 cm), east-west (7.97cm), canopy volume (20.38 cm), shoot length (16.02 cm), shoot girth (6.38 cm), trunk girth (0.55 cm), primary shoot girth (0.85 cm) and secondary shoot girth (1.49 cm). This might be because of the interaction of copper and zinc which resulted in higher nitrogen in plant leaves and higher content of chlorophyll, required for the growth and development of plants (Alhasany *et al*., 2019) [2]. Similarly, Zinc activates many enzymes that have an important role in the production of nuclear acid, which contributes to increasing the absorption of nitrogen from the soil leading to increased nitrogen content in the leaves (Castrup *et al*., 1996) [5]. This finding is also supported by Singh and Rajput (1976) [27], who found a foliar spray of Zinc and Boron promoted vegetative growth in terms of plant height, shoot length, trunk girth, and spread of young plants.

4.3 Interaction of different levels of beheaded height and micronutrients (Zn, Cu, and Boron) on the growth of plants: Interaction of different levels of beheaded height and foliar spray of micronutrients exerted a significant effect on the plant growth. The maximum percent increase in shoot length (19.97 cm), shoot girth (8.23 cm), trunk girth (0.63 cm), primary shoot girth (0.92 cm), secondary shoot girth (1.89 cm), plant spread-north south (7.65 cm) was recorded in T_1F_2. This result agreed with Ram *et al.*, 2000 [19] who observed that the application of micronutrients (copper, zinc, and boron) had a significant effect on plant height, stem girth, and spread of the canopy of mandarin orange. Babu *et al.*, 2002 [4] also reported foliar application of zinc (0.6%), copper (0.3%), and boron (0.3%) promoted the growth and vigor of the litchi plant.

The maximum increase in plant height (10.57 cm), canopy volume (24.05 cm), and plant spread -east-west (8.81 cm) was recorded in T_6F_2. This might be due to the spraying of copper, which contributed to the growth of elongation of roots which promoted maximum water and nutrient uptake from the soil leading to higher growth of the plant (Alhasany *et al*. 2019) [2]. This result is also supported by Meena *et al*., 2014 [15] who found highest plant height increment (0.95 m), canopy spread E-W and N-S increment (0.89 m and 0.86 m), canopy height increment (0.93 m) with the combined spray of 0.6% calcium nitrate + 0.4% borax + 0.8% zinc sulphate followed by 0.3% calcium nitrate + 0.2% borax + 0.4% zinc sulphate treatment in aonla plant.

Table 1: Effect of different level of beheaded heights and foliar spray of micronutrients on shoot length

	Shoot length (cm)								
	2020			2021			Pooled		
Treatments	F1	F2	Mean	F1	F2	Mean	F1	F2	Mean
T1	17.29	19.41	18.35	15.27	20.53	17.90	16.28	19.97	18.13
T2	15.24	15.92	15.58	14.56	16.23	15.40	14.90	16.08	15.49
T3	12.25	14.21	13.23	14.66	15.93	15.30	13.46	15.07	14.26
T4	12.51	13.24	12.88	13.40	15.60	14.50	12.96	14.42	13.69
T5	14.24	13.13	13.68	14.37	16.57	15.47	14.30	14.85	14.58
T6	11.54	16.16	13.85	13.17	15.25	14.21	12.35	15.71	14.03
Mean	13.84	15.35	14.59	14.24	16.68	15.46	14.04	16.02	15.03
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.12	0.37*		0.27	0.78*		1.34	3.94**
T		0.55	1.61**		0.39	1.15*		0.89	3.23*
T at same F		0.77	2.35*		0.55	2.00*		1.26	5.98*
F at same T		0.71	2.18*		0.57	2.07*		1.76	8.37*

CD (*P< 0.05); **(P< 0.01.)

Table 2: Effect of different level of beheaded heights and foliar spray of micronutrients on shoot girth

Treatments	Shoot girth (cm)								
	2020			2021			Pooled		
	F1	F2	Mean	F1	F2	Mean	F1	F2	Mean
T1	5.65	7.22	6.44	6.48	9.24	7.86	6.06	8.23	7.15
T2	4.82	5.85	5.34	6.10	7.95	7.03	5.46	6.90	6.18
T3	5.09	4.81	4.95	4.89	6.14	5.51	4.99	5.47	5.23
T4	4.90	5.37	5.14	5.36	5.43	5.39	5.13	5.40	5.27
T5	4.58	5.57	5.08	4.97	6.87	5.92	4.77	6.22	5.50
T6	3.64	4.95	4.29	4.84	7.20	6.02	4.24	6.07	5.16
Mean	4.78	5.63	5.20	5.44	7.14	6.29	5.11	6.38	5.75
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.10	0.63*		0.12	0.35**		0.64	2.32**
T		0.18	0.52**		0.26	0.77**		0.53	1.51**
T at same F		0.25	0.87*		0.37	1.22*		0.75	3.30*
F at same T		0.25	0.87*		0.36	1.18*		0.93	4.12*

CD (*P< 0.05); **(P< 0.01.)

Table 3: Effect of different level of beheaded heights and foliar spray of micronutrients on trunk girth

Treatments	Trunk girth (cm)								
	2020			2021			Pooled		
	F1	F2	Mean	F1	F2	Mean	F1	F2	Mean
T1	0.50	0.58	0.54	0.56	0.68	0.62	0.53	0.63	0.58
T2	0.48	0.56	0.52	0.52	0.61	0.57	0.50	0.59	0.54
T3	0.46	0.49	0.48	0.55	0.55	0.55	0.50	0.52	0.51
T4	0.50	0.52	0.51	0.55	0.58	0.56	0.53	0.55	0.54
T5	0.47	0.48	0.47	0.50	0.61	0.55	0.48	0.55	0.51
T6	0.41	0.37	0.39	0.53	0.56	0.54	0.47	0.46	0.47
Mean	0.47	0.50	0.48	0.53	0.60	0.57	0.50	0.55	0.53
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.00	0.01*		0.01	0.02*		0.03	0.11*

T	0.01	0.04**		0.01	0.05*		0.03	0.11**
T at same F	0.02	0.04*		0.02	0.04*		0.04	0.09**
F at same T	0.01	0.04*		0.02	0.04*		0.05	0.10**

CD (*P< 0.05); **(P< 0.01.)

Table 4: Effect of different level of beheaded heights and foliar spray of micronutrients on primary shoot girth.

	Primary shoot girth (cm)								
	2020			2021			Pooled		
	F1	F2	Mean	F1	F2	Mean	F1	F2	Mean
T1	0.93	0.94	0.94	0.91	0.91	0.91	0.92	0.92	0.92
T2	0.82	0.90	0.86	0.81	0.85	0.83	0.82	0.87	0.84
T3	0.76	0.80	0.78	0.69	0.74	0.72	0.73	0.77	0.75
T4	0.64	0.88	0.76	0.79	0.88	0.83	0.71	0.88	0.80
T5	0.69	0.85	0.77	0.64	0.89	0.77	0.67	0.87	0.77
T6	0.67	0.80	0.74	0.80	0.82	0.81	0.73	0.81	0.77
Mean	0.75	0.86	0.81	0.77	0.85	0.81	0.76	0.85	0.81
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.01	0.08*		0.01	0.05*		0.05	0.19**
T		0.02	0.06**		0.02	0.07**		0.05	0.03*
T at same F		0.03	0.10*		0.03	0.11*		0.08	0.31*
F at same T		0.03	0.10*		0.03	0.10*		0.09	0.36*

CD (*P< 0.05); **(P< 0.01.)

Table 5: Effect of different level of beheaded heights and foliar spray of micronutrients on secondary shoot girth

Treatments	Secondary shoot girth (cm)								
	2020			2021			Pooled		
	F1	F2	Mean	F1	F2	Mean	F1	F2	Mean
T1	1.59	1.72	1.65	1.21	2.06	1.63	1.40	1.89	1.64
T2	1.33	1.53	1.43	1.30	1.18	1.24	1.32	1.36	1.34
T3	1.38	1.51	1.45	1.31	1.42	1.37	1.35	1.47	1.41
T4	1.40	1.84	1.62	1.40	1.56	1.48	1.40	1.70	1.55
T5	1.61	1.11	1.36	1.49	1.02	1.25	1.55	1.06	1.31
T6	1.27	1.53	1.40	0.84	1.45	1.14	1.06	1.49	1.27
Mean	1.43	1.54	1.49	1.26	1.45	1.35	1.35	1.49	1.42
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.02	0.10*		0.02	0.15*		0.12	0.44**
T		0.06	0.17**		0.05	0.15**		0.25	0.91*
T at same F		0.08	0.17**		0.07	0.17**		0.35	0.73**
F at same T		0.07	0.16**		0.07	0.16**		0.35	0.71**

CD (*P< 0.05); ** (P< 0.01.)

Table 6: Effect of different level of beheaded heights and foliar spray of micronutrients on plant height

	Plant height (cm)								
	2020			2021			Pooled		
	F1	F2	Mean	F1	F2	Mean	F1	F2	Mean
T1	5.77	6.05	5.91	6.38	6.58	6.48	6.08	6.31	6.19
T2	5.78	6.93	6.35	6.94	7.70	7.32	6.36	7.31	6.84
T3	7.03	6.63	6.83	6.85	7.47	7.16	6.94	7.05	7.00
T4	7.38	7.08	7.23	7.13	8.02	7.57	7.26	7.55	7.40
T5	7.41	7.89	7.65	7.48	8.92	8.20	7.45	8.40	7.92
T6	7.98	9.82	8.90	8.32	11.31	9.82	8.15	10.57	9.36
Mean	6.89	7.40	7.15	7.18	8.33	7.76	7.04	7.87	7.45
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.08	0.29*		0.18	0.66*		0.90	3.26*
T		0.23	0.68**		0.25	0.73**		0.61	1.73**
T at same F		0.33	1.03*		0.35	1.30*		0.86	2.64**
F at same T		0.31	0.98*		0.37	1.36*		1.19	3.65**

CD (*P< 0.05); **(P< 0.01.)

Table 7: Effect of different level of beheaded heights and foliar spray of micronutrients on plant spread (north-south).

	Plant Spread -North-South (cm)								
	2020			2021			Pooled		
	F1	F2	Mean	F1	F2	Mean	F1	F2	Mean
T1	6.37	7.43	6.90	5.68	6.33	6.01	6.02	6.88	6.45
T2	5.70	6.38	6.04	5.38	5.75	5.57	5.54	6.07	5.80

T3	6.12	6.19	6.15	5.76	6.73	6.25	5.94	6.46	6.20
T4	6.35	7.42	6.89	4.97	7.88	6.43	5.66	7.65	6.66
T5	6.25	5.44	5.84	6.65	5.16	5.90	6.45	5.30	5.87
T6	5.70	7.05	6.37	5.38	6.30	5.84	5.54	6.68	6.11
Mean	6.08	6.65	6.37	5.64	6.36	6.00	5.86	6.50	6.18
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.09	0.33*		0.10	0.35*		0.27	0.98**
T		0.17	0.50**		0.18	0.67**		0.73	2.08**
T at same F		0.24	0.82**		0.26	0.89**		1.03	3.03**
F at same T		0.24	0.81**		0.26	0.87**		0.98	2.88**

CD (*P< 0.05); **(P< 0.01.)

Table 8: Effect of different level of beheaded heights and foliar spray of micronutrients on plant spread (east-west)

	Plant Spread – East –West (cm)								
	2020			**2021**			**Pooled**		
	F1	**F2**	**Mean**	**F1**	**F2**	**Mean**	**F1**	**F2**	**Mean**
T1	6.90	7.28	7.09	5.68	6.35	6.01	6.29	6.81	6.55
T2	7.52	7.30	7.41	7.59	7.34	7.47	7.55	7.32	7.44
T3	7.03	7.55	7.29	6.75	8.60	7.67	6.89	8.07	7.48
T4	7.59	8.71	8.15	7.29	8.51	7.90	7.44	8.61	8.02
T5	8.40	7.84	8.12	8.19	8.60	8.40	8.30	8.22	8.26
T6	7.03	8.64	7.84	6.79	8.98	7.88	6.91	8.81	7.86
Mean	7.41	7.89	7.65	7.05	8.06	7.56	7.23	7.97	7.60
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.05	0.20*		0.0233	0.08*		0.49	1.79*
T		0.24	0.71**		0.26	0.77**		0.58	1.66**
T at same F		0.34	1.04*		0.37	1.10*		0.82	2.43**
F at same T		0.32	0.96*		0.34	1.01*		0.90	2.66**

CD (*P< 0.05); **(P< 0.01.)

Table 9: Effect of different level of beheaded heights and foliar spray of micronutrients on canopy volume.

	Canopy volume (cm)								
	2020			**2021**			**Pooled**		
Treatments	**F1**	**F2**	**Mean**	**F1**	**F2**	**Mean**	**F1**	**F2**	**Mean**
T1	19.91	20.01	19.96	14.96	14.92	14.94	17.44	17.47	17.45
T2	19.98	20.33	20.16	16.43	17.62	17.03	18.21	18.97	18.59
T3	21.56	20.41	20.98	17.45	18.30	17.87	19.50	19.35	19.43
T4	23.45	25.39	24.42	16.82	20.11	18.47	20.13	22.75	21.44
T5	24.73	22.01	23.37	19.07	17.42	18.24	21.90	19.71	20.81
T6	22.06	25.79	23.93	18.87	22.31	20.59	20.47	24.05	22.26
Mean	21.95	22.32	22.14	17.27	18.45	17.86	19.61	20.38	20.00
		S.Em (±)	CD		S.Em (±)	CD		S.Em (±)	CD
F		0.69	NS		0.43	NS		1.49	NS
T		0.67	1.98**		0.59	1.75**		1.47	4.17**
T at same F		0.95	3.94*		0.84	3.11*		2.07	6.43**
F at same T		1.10	4.60*		0.88	3.26*		2.41	7.47**

CD (*P< 0.05); **(P< 0.01.); NS=Non-significant

4. Conclusions

From the above findings, it can be concluded that plants with shorter height (80 cm) with foliar spray of 0.4% Zinc sulphate + Copper sulphate (0.2%) + Borax (0.2%) [2 spray at just before flowering and marble stage can result in better growth of the plant under high-density planting of mango cv. Amrapali.

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