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Effect of Different Beheading Levels on Growth and Yield of Mango under High Density Planting Cv. Kesar

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A B S T R A C T

The investigation was conducted at Instructional cum Research Farm, Department of Horticulture, MPKV., Rahuri during the year 2015 to 2020 on thirty years old, high density planted (5m x 5m) mango orchard of cv. Kesar in RBD. Three beheading levels (H1-1.0m, H2-1.5m and H3-2.0m) were selected for study. Trees were beheaded during 1st fortnight of December, 2015. The studies on growth and yield after beheading revealed significant difference in various growth parameters. Significantly maximum days for sprouting (47.50) were required in the treatment H1. The pooled data showed that significantly maximum shoot length (2.52m), shoot girth (17.66cm), plant height (4.46m) and canopy volume (76.95 m3) were recorded in trees beheaded at 2.0m height (H3). Maximum number of fruit per plant (90.64) were recorded in treatment H3 which is at par with treatment H2 (89.91). Significantly maximum fruit weigh (265.69 g) was observed in 1.0m beheading height (H1) and maximum fruit yield (22.31 kg/plant, 8.92 t/ha) was recorded in treatment H2. Prior to beheading the average fruit yield was 13.10 kg/plant (100%) which increased to 42.92 kg/plant (327.63%) after five years of beheading in treatment H2 i.e. trees beheaded at 1.5m height. Low incidence (5.13%, 7.81%) of stem borer was noticed in 1.0m (H1) and 1.5m (H2) height beheadings. Highest tree survival after beheading (92.00%), maximum net income (Rs.121386/ha), and highest B:C ratio (1.77) for five was recorded in trees beheaded at 1.5m height (H2). Hence, It is concluded that old, senile, high density (5x5m) planted mango orchard cv. Kesar should be beheaded at 1.5m height from ground level for highest a fruit yield during November December in Maharashtra.

Introduction

Mango (*Mangifera indica* L.) is considered as 'King of fruits'. The cv. Kesar is grown on a significant area in Maharashtra. Kesar is popular export variety suitable for processing having biennial bearing tendency. Mango occupies an area of 1.87 million ha in the country and 0.15 million hectares in Maharashtra with production of 223.7 million

tones and 7.58 million tons, respectively. The productivity of mango in country is 8.4 MT/ha which is very low as compare to other countries. Old senile orchards are one of the reason for lower productivity. Fruit plants decline both in quality and quantity of produce after some period of time. Factors responsible for decline in yield and quality of produce are reduction in the photosynthetic surface area, non availability of productive shoots, increased incidence of insect pests and diseases, less penetration of sunlight due to overcrowding of branches. In high density orchards if regular canopy management not followed then it leads to overcrowding of trees and results in unproductive and uneconomic orchards. Sharma *et al.,* (2006) reported that it is necessary to standardize the beheading height of old mango trees so that shading does not occur in skirts of tree canopy and on adjacent rows and also it helps in re-establishing the canopy at low height. Shorter trees have more accessible canopies and are easier to harvest, prune, spray, require less labour and inputs.

Materials and Methods

The present investigations was carried out at Instructional cum Research Farm, Department of Horticulture, MPKV., Rahuri during the year 2015 to 2020. Thirty years old, high density planted (5m x5m) mango orchard (cv. Kesar) displaying signs of decline in production (13.10 kg/plant) were beheaded at 1m (H1), 1.5m (H2) and 2m (H3) height from the ground level during first fortnight of December 2015 (Jadhav *et al.,* 2015). For heading back of old branches, a sharp slanting cut towards inner side was especially undertaken as to enhance sprouting of apical buds from periphery i.e. outer side of the branch (Lal *et al.,* 2008). A unique package of beheading operation was followed immediately after beheading (Jadhav *et al.,* 2015).The experiment was laid out in RBD with three treatments and seven replications. Observations regarding growth parameters viz. number of shoots, shoot length, shoot diameter, plant height, canopy spread, canopy volume, mortality after beheading and for yield parameters viz. number of fruit, fruit weight, fruit yield, yield efficiency were recorded and also to know the reaction of stem borer after beheading the stem borer incidence is recorded.

Results and Discussion

The data presented in Table 1 revealed that more the pruning intensity more is the pruning weight and thus more pruning weight was recorded in higher intensity i.e. beheading at 1m height (H1). The number of primary and secondary branches remained after beheading, decreased as beheading severity increased. Secondary branches were not retained on 1m height beheaded trees.

Plant growth attributes after beheading.

The data presented in Table 1 revealed that, significantly maximum days for sprouting (47.50) were required in the treatment H1. The beheading intensities have effect on GA level. GA level increases with severity of beheading. GA delays the bud initiation by enhancing or maintaining the synthesis of endogenous auxin. The ratio of cytokinin to auxin i.e. promotive to inhibitors for shoot initiation determines when shoot initiation occurs (Davenport *et al.,* 2000).

The pooled data presented in Table 2 revealed that significantly maximum shoot length and shoot girth (2.52m, 17.66cm) were recorded in 2.0m beheading height(H3) and minimum in H1. Higher shoot length can be attributed to increased biosynthesis of Gibbrellic acid with increased in beheading intensity (Das *et al.,* 2013). Significantly maximum plant height (4.46m) and canopy volume (76.95 m3) was observed in trees beheaded at 2.0m height (H3). Non- significant difference was

observed for canopy spread. The pruned trees become umbrella shaped and receive high photosynthetically active radiation (PAR) and become productive on the third year after pruning (Hasan *et al.*, 2009).

Fruit yield attributes after beheading.

The pooled data indicates that significantly maximum number of fruit per plant 90.64 was recorded in 2.0m beheading height(H3) which is at par with treatment H2 where 89.91 numbers of fruit per plant was observed(Table 3). Favourable effects of pruning intensities on mango has been reported on light interception and chlorophyll content of leaves (Schaffer and Gauye, 1989), growth parameters (Lal *et al.*, 2008) and fruit yield (Lal and Mishra, 2008; Rao and Sanmugavelu, 1976). However significantly maximum fruit weight recorded (265.69 g) in 1.0m beheading height(H1) treatment followed by treatmentH2 (244.25 g) and H3 (237.31 g). Ram *et al* (2012) reported that rejuvenation of Mango results in significantly higher fruit weight.

Pooled data indicates significant difference in fruit yield. Maximum fruit yield (22.31 kg/plant, 8.92 t/ha) was observed in treatment H2 which is at par with treatment H3 (22.21 kg/plant, 8.88 t/ha). Prior to beheading the average fruit yield for cv. Kesar was 13.10 kg/plant (100%) which is increases to 42.92 kg/plant (327.63%) after five years of beheading in treatment H2. In treatment H3 fruit yield increases at lower rate than treatment H2 and H1 this might be due to severe beheading in treatment H3. Lal *et al.*, (2008) reported that after rejuvenation there was a gradual increase in fruit yield for initial 3-4 years.

Table.1 Pruning weight, number of primary and secondary branches remained after beheading and days to sprouting after beheading.

Treatment	Pruning Wt. (kg)	No. of primary branches	No. of Secondary branches	Days to sprouting
H1	340.97	2.56	0.00	47.5
H2	339.72	2.97	1.66	25.6
H3	153.56	3.09	4.06	21.9
SE ±	**18.91**	**0.31**	**0.26**	**0.51**
CD at 5%	**54.47**	**NS**	**0.76**	**1.56**

Table.2 Effect of different beheading levels on shoot length and shoot girth of Mango under high density planting cv. Kesar.

Treatment	Shoot length (m)					Shoot girth (cm)				
	2017	2018	2019	2020	Pooled	2017	2018	2019	2020	Pooled
H1	1.31	2.05	2.78	3.39	2.38	9.41	13.72	17.41	20.90	15.36
H2	1.53	2.20	2.82	3.41	2.49	11.12	14.90	18.21	21.30	16.38
H3	1.62	2.27	2.78	3.42	2.52	12.40	16.49	19.80	21.93	17.66
SE ±	**0.01**	**0.01**	**0.005**	**0.01**	**0.007**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**
CD at 5%	**0.03**	**0.03**	**0.01**	**0.02**	**0.021**	**0.41**	**0.41**	**0.41**	**0.41**	**0.41**

Table.3 Effect of different beheading levels on plant height, canopy spread and canopy volume of Mango under high density planting cv.Kesar.

Treatment	Plant height (m)					Canopy spread (m)					Canopy volume (m3)				
	2017	2018	2019	2020	Pooled	2017	2018	2019	2020	Pooled	2017	2018	2019	2020	Pooled
H1	1.93	2.88	3.64	4.20	3.16	2.73	3.66	4.25	4.84	3.87	14.95	40.12	68.41	102.33	56.45
H2	2.97	3.72	4.39	4.86	3.98	2.74	3.60	4.19	4.68	3.80	23.34	50.53	80.89	112.04	66.70
H3	3.62	4.20	4.66	5.37	4.46	2.87	3.52	4.11	5.00	3.87	31.18	54.32	82.61	139.67	76.95
SE ±	**0.05**	**0.06**	**0.06**	**0.07**	**0.06**	**0.05**	**0.07**	**0.07**	**0.07**	**0.06**	**0.99**	**1.75**	**2.90**	**4.12**	**2.35**
CD at 5%	**0.18**	**0.19**	**0.19**	**0.23**	**0.18**	**NS**	**NS**	**NS**	**0.24**	**NS**	**3.09**	**5.48**	**9.04**	**12.83**	**7.32**

Table.4 Effect of different beheading levels on yield parameters of Mango under high density planting cv. Kesar.

Treatment	Number of fruit per plant					Fruit weight (g)					Fruit yield (kg/plant)				
	2017	2018	2019	2020	Pooled	2017	2018	2019	2020	Pooled	2017	2018	2019	2020	Pooled
H1	15.06	44.68	105.91	150.70	79.09	283.25	274.00	251.00	254.50	265.69	4.90	11.27	27.65	38.34	20.54
H2	23.25	52.63	110.88	172.88	89.91	251.75	241.50	235.50	248.25	244.25	5.91	13.18	27.23	42.92	22.31
H3	38.69	74.31	100.38	149.19	90.64	241.25	239.75	232.50	235.75	237.31	9.46	17.72	26.48	35.19	22.21
SE ±	**1.21**	**1.78**	**1.74**	**1.51**	**1.24**	**4.00**	**2.31**	**3.31**	**2.65**	**2.62**	**0.28**	**0.57**	**0.33**	**0.55**	**0.26**
CD at 5%	**3.79**	**5.54**	**5.43**	**4.71**	**3.86**	**12.47**	**7.20**	**10.35**	**8.25**	**8.16**	**0.88**	**1.76**	**NS**	**1.70**	**0.82**

Table.5 Effect of different beheading levels on yield and yield efficiency of Mango under high density planting cv. Kesar.

Treatment	Fruit yield (t/ha)					Yield efficiency (kg/m3)				
	2017	2018	2019	2020	Pooled	2017	2018	2019	2020	Pooled
H1	1.96	4.51	11.06	15.34	8.22	0.33	0.28	0.40	0.37	0.36
H2	2.36	5.27	10.89	17.17	8.92	0.25	0.26	0.34	0.38	0.33
H3	3.78	7.09	10.59	14.08	8.88	0.30	0.33	0.32	0.25	0.29
SE ±	**1.21**	**1.78**	**1.74**	**1.51**	**1.24**	**0.01**	**0.01**	**0.01**	**0.02**	**0.02**
CD at 5%	**3.79**	**5.54**	**5.43**	**4.71**	**3.86**	**0.04**	**0.02**	**0.03**	**0.05**	**0.01**

Table.6 Effect of different beheading levels on stem borer incidence in Mango under high density planting cv. Kesar.

Treatment		Stem borer incidence (%)			
	2017	2018	2019	2020	Pooled
H1	0.00	4.25L	8.75L	7.50L	5.13L
H2	6.25L	7.25L	10.50L	7.25L	7.81L
H3	12.50L	14.50L	20.51M	18.60M	16.53M
SE ±	0.23	0.21	0.38	0.29	0.16
CD at 5%	0.67	0.62	1.11	0.87	0.50

No incidence (0.0%), L: Low incidence (1-15%), M: Medium incidence (15-30%), H: High incidence (>30%).

Table.7 Mortality of plants after beheading in five years

Treatment	Mortality (%)	Survival (%)
H1	12.00	88.00
H2	8.00	92.00
H3	16.00	84.00

Table.8 B:C ratio for five year study from 2015 to 2020.

Treatment	H1	H2	H3
Average cost of cultivation /ha	201658.09	201963.49	203074.29
Average yield (t/ha)	8.22	8.92	8.88
Average cost (Rs./t)	45000.00	45000.00	45000.00
Average gross income/ha	363497.00	383355.00	365495.00
Average net income/ha	96316.91	121386.51	118825.71
B: C ratio	1.69	1.77	1.73

Sever pruning results in rapid vegetative growth, which leads to faster utilization of food reserves and causes less flowering after 3-4 years of rejuvenation as compared to moderate and light pruning (Burondkar *et al.*, 2000) Similar results of increased fruit yield due to rejuvenation were reported by Reddy and Kurian (2015) in mango cultivar Alphanso. Treatment H1 shows significantly maximum yield efficiency (0.35 kg/m3).Yield efficiency of treatmentH2 (0.31 kg/m3) is at par with treatment H3(0.30 kg/m3).

Reaction to stem borer and survival after beheading

Trees were beheaded in the month of December resulted in less attack of stem borer and helping the trees to rejuvenate with the advantage of natural habit to supply of more food material during January to March (Jadhav *et al.*, 2015). The pooled data presented in Table 6 showed medium incidence (16.53%) of stem borer in treatment H3. Low incidence (5.13%, 7.81%) of stem borer in trees beheaded at 1.0m (H1) and 1.5m (H2) height, respectively.

The data presented in Table7 shows the total mortality for five years. Lowest total mortality percentage 8.00% observed in trees beheaded at 1.5m height (H2).

Lowest total mortality i.e. higher survival in

treatment H2 attributes to low incidence of stem borer as compare to treatment H3 and early as well as high sprouting of trees as compare to treatment H1, where non-sprouting of trees causes mortality during initial months.

Economics of rejuvenation of orchard

The data regarding average B:C ratio of five years study presented in Table 8 revealed that trees beheaded at 1.5m height (H2) have top most average B:C ratio of 1.77 with average net income of Rs.1,21,386.51/ha.

Irrespective of beheading height rejuvenation increases the fruit yield in old, senile, high density planting mango orchard of cv. Kesar. Trees beheaded at 1.5m height recorded higher fruit yield (22.31 kg/plant, 8.92t/ha) also it develops canopy at lower level as compare to trees beheaded at 2.0m height. Lower level canopy facilities easy intercultural operations. Trees beheaded at 1.0m and 1.5m height shows low incidence of stem borer. Survival of plants after beheading was maximum (92.00%) in 1.5m beheading height trees. The highest average net income (Rs.121386/ha) and highest average B:C ratio (1.77) for five years data was observed in trees beheaded at 1.5m height. Hence, It is concluded that old, senile, high density(5x5m) planted mango orchard cv. Kesar should be beheaded at 1.5m height from ground level for higher fruit yield during November December in Maharashtra.

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