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The effect of pruning on growth, yield and quality characteristics of mango cv. Dashehari

SV Singh

Abstract
An experiment was conducted to find out the impact of pruning on growth, yield and quality of mango cv. Dashehari. Total 10 treatments were applied on the trees. The trial was laid out in Randomized block design replicated thrice and single tree served as treatment unit. The 2 years (2020-2022) pooled data, confirmed that the vigorous growth in terms of tree height (4.12 m), trunk circumference (43.06 cm) and tree spread (3.12 m) were observed in the trees under control ($M_0F_0T_0$ without PBZ), whereas annually heading back pruned trees ($M_2F_1T_2$) showed lesser growth in terms of tree height (3.20 m) and spread (2.11 m). The annual pruning of tree by heading back of 10 cm of terminal shoots immediately after fruit harvest along with paclobutrazol application ($M_1F_1T_1$) proved effective for increasing the number of fruits per tree (50.11), yield (8.90 kg/tree and 14.37 t/ha), B: C ratio (4.07), maintaining fruit quality and for having the appropriate dwarfing effect on the tree.

Keywords: Mango, Dashehari, pruning, vegetative growth, yield, fruit quality, paclobutrazole

Introduction
The Mango (*Mangifera indica* L.) is the most important tropical fruits of the world and is commonly known as the 'King of fruits'. Its poor productivity of orchard can be attributed to wide tree spacing, poor canopy management and long juvenile phase. In India, mango occupies 20.7% production share with an area of 2.21 million hectares and annual production of 18.50 million tonnes having productivity of 8.34 metric tonnes per hectare (Anon, 2015) [2]. In concern of higher productivity, the unproductive components should be minimize; without affecting the tree health and fruit's quality. The levels of pruning, frequency and time are the pivotal role for fruit's yield and their quality. The huge and tall plants not yield fruits regularly. There are several reasons for pruning perennial fruit trees and if done drastically may influences several physiological processes directly or indirectly. These effects result from alteration in biochemical system within the tree. It also helps to restore the balance between root system and the above ground parts, followed maintaining height, canopy spread and density required for effective spraying with better fruit yield and quality. The canopy management deals with positioning and maintenance of plant's frame work in relation to optimum productivity and quality fruits (Davenport, 2006) [4]. Presently, the high density planting in mango is gaining momentum wherein, planting at a closer spacing is being adopted, which is capable of enhancing productivity and ensuring continuous cropping of mango trees besides getting good quality mangoes. Thus, keeping in view about importance of pruning and use of paclabutrazol the experiment was undertaken to see its impact on vegetative growth, yield and quality of mango cv. Dashehari.

Material and Methods
The experiment was conducted at the farm of S.D.J.P. G. College, Chandeshwer, Azamgarh during 2020-21 and 2021-22 in Dashehari mango orchard planted at the distance of 3×2 meter. The trial was started in the year 2020 on 10 years old Dashehari mango and continuously conducted for two years and thus at the end of the experimentation the age of the trees were 12 years. In total, 10 treatments consisted of heading back of terminal shoots at two different levels *viz.*, M: 10 cm & M: 20 cm, with two level of frequency i.e., F_1: annually & F_2: biennially and at two different timings i.e., T_1: immediately after fruit harvest (June-July) & T_2: during rest period before the emergence of new growth (floral and vegetative) including control as M F T and M F T without Paclobutazol (PBZ) were applied. The paclobutrazol @ 1.0 ml A.I per meter canopy spread was applied in September through Trunk Soil Line Pour-TSLP method (application of aqueous solution of PBZ in trench near to collar of trunk)

uniformly to all trees under the treatments except absolute control (i.e., M0F0T0 without PBZ). The experiment was laid out in randomized block design, replicated thrice and single tree served as treatment unit. The similar cultural practices were adopted for all the trees of mango under the experimentation. The vegetative performance of trees under different treatments was studied on the basis of tree height, trunk circumference and tree spread. The data on number of fruit per plant and yield were recorded at the time of fruit harvesting. The average fruit weight and fruit size (length and width) were recorded with the help of digital balance and vernier calliper, respectively. The total soluble solids (TSS) of the fruits were measured with hand refractrometer (ERMA) and expressed in degree Brix (0B). The acidity was estimated by the standard method of AOAC, 1980 [1].

Results and Discussion

Vegetative growth and yield

The finding clearly proved positive effect of pruning and paclobutrazol on vegetative growth and yield on mango cv. Dashehari (Table 1). The result of 2 years (2020-2022) pooled data, the minimum tree height was recorded with M2F1T2 (3.37 m), followed by M1F1T2 (3.73 m), M2F1T1 (3.34 m), M1F2T2 (3.52 m), which were found statistically *at par* with each other, whereas, maximum tree height (4.86 m) was observed under the control (M0F0T0 without PBZ). The higher tree periphery was reported with M0F0T0 without PBZ (47 cm) followed by M2F2T1 (45 cm) whereas the lower circumferences was observed in M0F0T0 (34 cm). The tree spread was observed maximum in M0F0T0 without PBZ (3.21 m), M2F2T2 (2.87 m), M1F1T1 (2.86 m) and M1F2T1 (2.94 m) which were statistically at par with each other, whereas it was maximum in M2F1T2 (2.21 m).

Table 1: Effect of pruning on vegetative growth and yield in mango cv. Dashehari (based on 2 years pooled data: 2020-2022)

		Vegetative growth			Yield	
S. No.	**Treatments #**	**Tree height (m)**	**Tree Circumference (m)**	**Tree spread (m)**	**Number of fruits**	**Yield per tree (kg)**
1.	M1F1T1	4.01	0.30	2.86	51.98	9.12
2.	M1F2T1	3.58	0.32	2.81	49.67	7.94
3.	M1F1T2	3.37	0.35	2.40	29.68	4.03
4.	M1F2T2	3.54	0.37	2.66	27.22	4.99
5.	M2F1T1	3.38	0.36	2.48	41.45	6.13
6.	M2F2T1	3.51	0.45	3.02	29.00	5.67
7.	M2F1T2	3.36	0.32	2.14	19.76	3.12
8.	M2F2T2	4.27	0.42	2.87	30.46	6.78
9.	M0F0T0	3.73	0.34	2.76	32.82	6.22
10.	$M_0F_0T_0$(without PBZ)	4.86	0.47	3.21	18.53	3.04
SEM ±		0.94	0.48	0.56	6.46	1.18
C.D (P=	0.05)	0.24	1.42	0.18	18.21	2.67
C.V		6.16	3.02	4.28	47.79	43.01

Method: M1-10 cm heading back of terminal shoots, M2-20 cm heading back of terminal shoots, Frequency: F1- Annually, F2-Biennially, Time: T1-Immediately after fruit harvest (July), T2-During rest period before the emergence of new growth (floral and vegetative) and with standard dose of paclobutrazole.

The treatment M2F1T2 (without PBZ) has showed the maximum height due to uninterrupted growth. As the treatment M2F1T2 with PBZ showed that this was very effective for development of dwarfed tree (3.36 m) but at the same time the yield (5.11 t/ha) was reduced at a greater extent and it is certainly due to more heavy pruning during the rest period. Pruning effect on the tree architecture in the present study is in support with the findings of Ram *et al.*, 1997 [8] in mango. The tree subjected to annual pruning coupled with heading back during rest period with paclobutrazol application had registered lower height which may be due to increased tree structural strength in proportion to the number of terminal shoots tipped during the period of canopy development. These effects are especially relevant to high density orchards. Shading within the canopy reduces photo-saturation of leaves and the conversion of light energy to carbohydrates for growth and cropping. In dense mango canopies many leaves are in total shade and heavy shading eventually results in poor canopy regeneration, lower floral initiation (Dambreville *et al.*, 2013) [3], fruit set and yield (Sharma *et al.*, 2006) [9].

The number of fruits per tree and yield per tree (kg) (Table. 1) were higher with M1F1T1 (51.44 & 9.12), M1F2T1 (49.67 & 7.94), M2F1T1 (41.45 & 6.13)) and M0F0T0 (32.82& 6.22) meanwhile it was minimum in M2F1T2 (19.76 & 3.12), M0F0T0 (18.53 & 3.04) without paclobutrazol. As per finding of results, we can say that overall yield was found comparatively lower under all the treatments which are certainly because of younger age of the trees. The yield parameters have clearly shown that in north India the pruning during rest period has no significance; rather it reduces the yield drastically. So that, the pruning operation in mango must be adopted immediately after the harvesting of the fruits. These results are in confirmatory with the findings of Davenport, 2006 [4] and Uddin *et al.*, 2014 [11], who have reported that pruning stimulates development of more laterals and thus resulted in increased potential for yield in mango. Pruning and thinning operations lead to increase in yield (Ram *et al.*, 1997) [8] because they are effective in diverting nutrients and water taken by the tree to productive branches in mango.

The data given in Table 1 clearly show that the different level of pruning gives the dwarfing effect to the plants. This effect is especially relevant for the trees grown under high density planting system. The tipping and pruning operations have been also recommended in South Africa by Oosthuyse, 1992 [6] for good branching, dwarfing effect and more yields in mango. In the present investigation, the annual pruning by heading back of 10 cm of terminal shoots immediately after fruit harvest with paclobutrazole application has been found appropriate for high density planting.

Impact on quality Characters

The Table 2 depicting that the quality characteristics were also influenced by pruning and use of paclobutrazol. The M0F0T0 resulted higher fruit weight (207.86 g) followed by M2F2T2 (188.87 g), M2F2T1 (187.73 g), M1F1T1 (182.26 g), M0F0T0 (185.71 g) and M1F2T2 (177.15g). The lower fruit weight was noticed with M1F1T2 (110.84 g), M2F1T2 (134.19 g), M2F1T1 (135.22 g) and M1F2T1 (154.28 g), which were found statistically *at par* with each other. The Oosthuyse and Jacobs (1995) [7] had also reported that increase in number of branching points are directly associated with a reduction in the average fruit weight. The maximum fruit length was recorded with M0F0T0 (10.36 cm) followed by M1F1T1 (10.24 cm), M2F2T1 (10.18 cm), M0F0T0 (9.82 cm) while minimum recorded with M1F1T2 (7.86 cm).

In concern of fruit's diameter, the treatments M0F0T0 (5.82), M0F0T0 $^{without\ PBZ}$ (5.49 cm) without PBZ, M1F1T1 (5.42 cm), M1F2T1 (5.39 cm) and M1F2T2 (5.30 cm) and M 2 F 2 T 1 (5. 28 cm), which were found statistically *at par* with each other. The lower fruit diameter was reported in M2F1T1 (4.32 cm) followed by M2F1T2 (4.30 cm) and M1F1T2 (4.26 cm). And increase in fruit size has been also observed by Oosthuyse (1992) [6] and it is possibly relates to a lesser depletion of carbohydrate and other nutrient reserves by less vegetative growth, whose development is suppressed.

Similarly the positive effect of pruning with PBZ was also recorded on pulp weight (Table 2). The greater pulp content was observed in M0F0T0 (147.68 g), M2 F2 T2 (126.21 g), M2F2T1 (120.57 g), M1 F1 T1 (122.78 g), M0F0T0 without PBZ (122.72 g), M1F2T2 (120.21), which were found statistically *at par* with each other, meanwhile the minimum content of pulp with M1 F1 T2 (84.76) followed by M2F1 T1 (86.78 g), M2F1T2 (88.69 g) and M1F2T1 (99.32 g). The higher TSS (°B) was observed in M0F0T0 (19.89), followed by M2F2T1 (19.76), M1F2T2 (19.62), M1F1T1 (19.61), M2F2T2 (18.97), while the lower content in $M_1F_1T_2$ (15.11), M2F2T2 (15.39) and M2F1T1 (15.48) respectively.

Table 2: Effect of pruning on quality characteristics of mango cv. Dashehari (based on 2 years pooled data: 2020-2022)

S. No.	Treatments #	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Pulp weight (g)	T.S.S (°B)	Acidity (%)
1.	M1F1T1	182.26	10.24	5.42	122.78	19.61	0.24
2.	M1F2T1	154.28	9.41	5.39	99.32	18.98	0.29
3.	M1F1T2	110.84	7.86	4.26	84.76	15.11	0.23
4.	M1F2T2	177.15	9.87	5.30	120.21	19.62	0.29
5.	M2F1T1	135.22	8.04	4.32	86.78	15.11	0.24
6.	M2F2T1	187.73	10.18	5.28	120.57	19.76	0.28
7.	M2F1T2	134.19	8.26	4.30	88.69	15.12	0.26
8.	M2F2T2	188.87	10.11	5.60	126.21	15.39	0.28
9.	M0F0T0	207.86	10.36	5.82	147.68	19.89	0.27
10.	$M_0F_0T_0$ (without PBZ)	185.71	9.82	5.49	122.72	17.80	0.29
SEM ±		16.23	16.23	0.82	0.47	11.89	0.29
C.D. (P=0.05)		48.71	48.71	2.42	1.31	32.89	0.86
C.V		24.81	24.81	22.76	21.26	25.67	26.32

Method: M1-10 cm heading back of terminal shoots, M2-20 cm heading back of terminal shoots, Frequency: F1- Annually, F2-Biennially, Time: T1-Immediately after fruit harvest (July), T2-During rest period before the emergence of new growth (floral and vegetative) and with standard dose of paclobutrazole.

The acidity was observed in M1F1T2 (0.23%) and M2F1T1 (0.24%), whereas maximum titratable acidity in M1F2T1, M1F2T2, M0F0T0 without PBZ each 0.28%. The fruit quality improvements with respect to TSS and acidity in response to PBZ treatments can be related to assimilate partitioning of the plant. Higher net return from mango could be assured by increasing the productivity through adoption of appropriate management practices. Paclobutrazol is reported to exert influence on partitioning the photosynthates to the sites of flowering and fruit production, consequent to the reduction of vegetative growth. Kurian *et al*. (2001) [5] reported that the paclobutrazol appeared to favourably alter the source sink relationship of mango to support fruit growth. Thus, finally it can be concluded that the annual pruning of tree by heading back of 10 cm terminal shoots immediately after fruit harvest and with application of paclobutrazol @ 1 ml active ingredient per meter canopy spread may be adopted under high density planting for higher yield with maintained fruit quality in mango cv. Dashehari.

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