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Effect of Heading Back and Pinching on Quality and Yield of Guava (*Psidium guajava* L.) Under High Density Plantation in Semi-Arid Conditions of North Western India

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Abstract A field study to investigate the effect of heading back and pinching on yield and yield parameters of Guava (*Psidium guajava* L.) under High Density Plantation was carried out during the year 2014-15. There were two treatments i.e. heading back and pinching. Heading back at the level of 150, 175 and 200 cm was done in the month of March and compared with control (no heading back). Pinching i.e. no pinching, one pinching (in last week of June), two pinchings (in last week of June and July) and three pinchings (in last week of June, July and August) were done on the headed backed plants. The study revealed that all the treatments were effective in increasing the quality, yield and yield parameters, however, heading back at the level of 200 cm and two pinchings were found most effective in increasing average fruit weight, fruit volume, fruit length, fruit breadth, total sugar, ascorbic acid, pectin content and yield over control and other treatments. Total soluble solids and fruit acidity was not influenced due to different treatments.

Keywords Heading back, Pinching, Yield, High density plantation, Guava.

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Introduction

Fruits have been considered as the most important source of nutrition. Besides better yield, improvements in the quality of fruits are the researchable issues of paramount importance, There is a worldwide trend to plant fruit trees at higher density to maintain desired architecture for better light interception and ease in operations such as pruning, pest control and harvesting. The high density orcharding enhance the production and quality of guava fruits [1, 2]. There are several operations involved in improving the yield and quality of guava fruits. Among them, heading back and pinching are important factors to sustain the yield and quality of fruits in high density planted guava [3]. There are number of horticultural economic and practical reasons for heading back and pinching in guava to obtain productive and efficient trees and orchards. Some of these are to control tree size and shape, renewal of bearing shoots, rejuvenation of older plants especially in high density plantation, fruit thinning to improve fruit size, yield and quality. Pinching of current season's growth is an alternative practice used to control vigor of the plant.

There is little documentation regarding the effect of heading back and pinching on the quality and productivity of guava especially under semi-arid north Indian conditions. Thus, to gather the requisite information on the above mentioned cultural practices, the present investigation was carried out under the agro-climatic conditions of north western India.

Materials and Methods

The study was carried out at experimental orchard,

Table 1. Effect of heading back and pinching on average fruit weight (g) of guava under high density plantation. CD 5%, Heading back (H) – 2.67, Pinching (P) – 2.67 H ×P - NS.

Heading back	Pinching				
	No pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	78.77	81.20	83.30	82.20	81.37
150 cm	81.60	83.93	85.07	84.07	83.67
175 cm	91.57	96.63	104.6	100.20	98.24
200 cm	94.37	99.83	102.3	100.9	99.36
Mean	86.58	90.40	93.81	91.85	

Table 3. Effect of heading back and pinching on fruit length (mm) of guava under high density plantation. CD 5%, Heading back (H) - 0.92, Pinching (P) - 0.92, H × P - 1.84.

Heading back	Pinching				
	No pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	40.0	45.0	49.0	48.3	45.6
150 cm	56.6	56.0	60.0	60.0	58.0
175 cm	58.0	62.0	66.0	64.1	62.5
200 cm	64.0	65.0	67.0	66.5	65.6
Mean	54.5	57.0	60.5	59.7	

Department of Horticulture, CCS Haryana Agricultural University, Hisar during the year 2014-15. The experiment was laid out in factorial randomized block design allocating four levels of heading back i.e. control (no heading back), 150, 175 and 200 cm above ground level and four pinchings i.e. no pinching, one pinching (in last week of June), two pinchings (in last week of June and July) and three pinchings (in last week of June, July and August) with three replications, comprising 16 treatment combinations.

Uniformly grown six year old trees spaced at the distance of 6 × 2 m were selected for the study. They were kept under uniform condition of orchard management during the study period where all the agronomic practices were carried out as per package of practices. The average weight was calculated by dividing the total fruit weight by total number of fruits taken and expressed in gram (g). Fruit volume was estimated by water displacement technique. Fruit length and breadth of ten randomly selected fruits per tree was measured with the help of digital Vernier's Callipers and the average value was calculated and expressed in millimeter (mm). TSS was measured with the help of digital refractometer. Acidity, ascorbic acid were determined by the standard method [4] and total sugars and pectin content were estimated by Hulme and Narain [5] and Ranganna [6], respectively.

Table 2. Effect of heading back and pinching on fruit volume (cm^3) of guava under high density plantation. CD 5% , Heading back (H) – 6.35, Pinching (P) - 6.35, H × P - NS.

Heading back	Pinching				
	No. pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	99.4	96.0	113.7	108.6	104.4
150 cm	95.0	110.5	118.8	111.5	109.0
175 cm	107.7	111.2	116.1	113.1	112.0
200 cm	109.9	106.4	124.2	119.6	115.0
Mean	103.0	106.0	118.2	113.2	

Results and Discussion

Yield parameters

It is appropriate to mention that after heading back of guava plants in March 2014, there was no flowering in the subsequent rainy and winter season except in control plants because the plants entered into juvenile phase. Hence, the results given below are for rainy season crop of 2015.

There was significant increment in fruit weight (Table 1), fruit volume (Table 2), fruit length (Table 3) and fruit breadth (Table 4) with decreasing severity of heading back. Heading back at the level of 200 cm produced maximum fruit weight, fruit volume, fruit length and fruit breadth with the respective values of 99.36 g, 115.0 cm^3, 65.6 mm and 63.3 mm followed by heading back at 175 cm level and minimum in control

Table 4. Effect of heading back and pinching on fruit breadth (mm) of guava under high density plantation. CD 5%, Heading back (H) - 1.11, Pinching (P) - 1.11, H × P -2.23.

Heading back	Pinching				
	No. pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	39.0	42.0	47.0	47.0	43.8
150 cm	54.6	55.1	59.2	59.0	57.0
175 cm	56.0	60.0	64.0	63.0	60.8
200 cm	61.0	64.0	64.0	64.0	63.3
Mean	52.7	55.3	58.6	58.3	

Table 5. Effect of heading back and pinching on TSS (^{0}Brix) of guava under high density plantation. CD 5%, Heading back (H) - NS, Pinching (P) - NS, H × P - NS.

Heading back	Pinching				
	No. pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	9.83	9.90	10.00	9.97	9.93
150 cm	10.10	10.00	10.22	10.17	10.12
175 cm	10.12	10.27	10.33	10.27	10.25
200 cm	10.17	10.50	10.57	10.47	10.45
Mean	10.06	10.17	10.28	10.22	

Table 7. Effect of heading back and pinching on ascorbic acid (%) of guava under high density plantation. CD 5%, Heading back (H) - 6.35, Pinching (P) - NS, H ×P - NS.

Heading back	Pinching				
	No. pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	149.7	150.6	154.2	158.8	153.3
150 cm	156.4	154.1	156.2	153.2	155.0
175 cm	151.1	164.3	165.4	158.9	159.9
200 cm	168.3	165.6	169.5	169.6	168.3
Mean	156.4	158.6	161.3	160.1	

(no heading back). There was significant increase in fruit weight and fruit volume with the heading back up to 150 cm level and up to 200 cm in fruit length and fruit breadth. Pinching done at two times (in June and July) resulted in maximum average fruit weight (93.81 g), fruit volume (118.2 $cm^{3)}$, fruit length (60.5 mm) and fruit breadth (58.6 mm) but significantly at par with three pinchings done at 3 times (in June, July and August). The heading back levels and pinching numbers was significant in influencing fruit length and fruit breadth . The fruit length and fruit breadth was comparatively more in no pinching and one pinching treatments than two or three pinching. The similar trend, although non-significant, was observed in average fruit weight, but the trend was reverse in fruit volume. The increase in all the parameters with the decreasing severity of heading back and the increased number of pinching might be attributed to the increased number of leaves per fruit and more exposure of these leaves to sunlight and better aeration due to canopy management in high density plantation, which in turn diverted more nutrients to the remaining fruits, thereby improving all the yield attributing characters of the fruits. The findings of the present study are in conformity with those of other workers in guava [1, 8, 9], and mango [2].

Quality parameters

Level of heading back and pinching numbers did not influence total soluble solids (TSS) and fruit acidity (Tables 5 and 6). These results regarding TSS are in line with the earlier work in guava [10, 11, 12]. The findings of the present investigation regarding acidity are in consonance with those of Das et al. [12] in guava. However, the results are in contradiction with the earlier work [13, 14].

A significant increase in ascorbic acid, total sugar and pectin content (Tables 7, 8 and 9) of fruits was observed with decreasing severity of heading back. Maximum ascorbic acid content (168.3%) was recorded in fruits harvested from plants headed back at 200 cm and minimum was in control (153.3%). Similar trend was observed in total sugar and pectin content. The corresponding values with respect to these

Table 6. Effect of heading back and pinching on acidity (%) of guava under high density plantation. CD 5%, Heading back (H) - NS, Pinching (P) - NS, H × P - NS.

Heading back	Pinching				
	No. pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	0.49	0.48	0.46	0.47	0.48
150 cm	0.46	0.47	0.45	0.47	0.46
175 cm	0.48	0.46	0.45	0.46	0.46
200 cm	0.45	0.45	0.44	0.46	0.45
Mean	0.47	0.47	0.45	0.47	

Table 8. Effect of heading back and pinching on total sugar (%) of guava under high density plantation. CD 5%, Heading back (H) -0.30, Pinching (P) - 0.30, H × P -0.61.

Heading back	Pinching				
	No.. pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	5.06	5.24	5.78	5.04	5.28
150 cm	4.94	5.54	5.34	5.88	5.43
175 cm	4.90	5.6	6.22	5.84	5.64
200 cm	5.32	5.82	6.44	6.22	5.95
Mean	5.06	5.55	5.95	5.75	

Table 9. Effect of heading back and pinching on pectin content (%) guava under high density plantation. CD 5%, Heading back (H) - 0.01, Pinching (P) - 0.01, H × P - 0.03.

Heading back	Pinching				
	No. pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	0.58	0.61	0.64	0.68	0.13
150 cm	0.72	0.70	0.81	0.79	0.76
175 cm	0.74	0.84	0.86	0.83	0.82
200 cm	0.78	0.85	0.86	0.81	0.83
Mean	0.71	8.75	0.79	0.78	

Table 10. Effect of heading back and pinching on fruit yield (kg/tree) of guava under high density plantation. CD 5%, Heading back (H) - 0.65, Pinching (P) - 0.65, H × P - NS.

Heading back	Pinching				
	No. pinching	One pinching	Two pinchings	Three pinchings	Mean
Control	12.89	14.07	15.86	14.88	14.43
150 cm	13.79	15.26	15.99	15.87	15.23
175 cm	14.55	15.80	16.50	16.54	15.85
200 cm	17.77	19.09	22.16	21.03	20.01
Mean	14.75	16.06	17.63	17.08	

parameters were 5.95 and 0.83%. In case of different numbers of pinching, trees pinched twice (in June and July) produced fruits with maximum ascorbic acid (161.3%), total sugar (5.95%) and pectin content (0.79%) closely followed by those pinched thrice (in June, July and August). The combination of heading back at 200 cm level and two time pinching (in June and July) produced fruits with higher total sugar and pectin content. The interaction of the two factors did not affect ascorbic acid content significantly. The reason behind the improvement in quality parameters with respect to decreased severity of heading back and increased number of pinching could be the increased synthesis and translocation of photosynthates and other metabolites from leaves to the fruits. In unpinched plants with lower level of heading back the quality of fruit was poor might be due to shading effect of leaves in close planting. This discussion can further be strengthened by the fact that variation in chemical constituents was probably due to abundant availability of photosynthates for limited number of fruits. Similar observations on quality parameters were also reported by other workers in guava [3, 14].

Fruit yield

Yield was affected significantly by all the heading back levels as well as by pinching numbers (Table 10). Regarding level of heading back, plants headed back at 200 cm level registered the highest yield. In case of pinching numbers, trees pinched twice (June and July) gave maximum yield. The better effect of heading back on the yield per plant may be ascribed to production of shoots conducive to flowering and fruiting. The yield in severe heading back is lower due to reduced number of fruits. In unpinched plants yield is poor due to shading effect of close planting. A similar observation was also reported by Mehta et al. [3] in guava.

From the experimental results it can be inferred that heading back at the level of 200 cm and two pinchings (in June and July) may be most effective in increasing the yield and quality parameters of guava. These intercultural operations might have helped in controlling and managing the excessive growth and vigor of the plant which ultimately helped in enhancing the productivity and quality of the fruits.

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