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CANOPY STRUCTURE OF INVIGORATED GUAVA PLANTS AT DIFFERENT HEIGHTS OF HEADING BACK AND PRUNING INTENSITIES

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ABSTRACT : Significant reduction in vegetative growth with increased severity of heading back was recorded in all years of observations. Although, the vegetative growth of senile (control) trees was remained highest and almost similar in all years of observations, but, among headed back plants, severely headed back (1.5 m) trees exhibited smaller canopies followed by 2.0 m and 2.5 m, respectively. The intensity of pruning also had significant effect on vegetative growth of trees. During the initial years, the canopy volume was decreased with the severity of pruning with minimum canopy volume in trees pruned at 75 % intensity in all levels of heading back. Un-pruned headed back plants exhibited higher canopy volume. The headed back plants exhibited about 50 per cent, 40 per cent and 30 per cent reduction in tree canopy volume in 1.5 m, 2.0 m and 2.5 m headed back trees as compared to un-headed back (senile trees) up to fifth years of rejuvenation, respectively.

Keywords : *Guava, pruning, heading back, rejuvenation, canopy.*

Guava fruit is often referred to as 'apple of tropics' probably because the nutritive value of guava matches with apple, the main temperate fruit crop. Guava is one of the most common fruit grown commercially in India. It ranks next to mango, banana and citrus fruits in respect of area and production with total area of 2, 68,000 ha and production of 36.68 lac tons (Anon., 1). Guava is also the second most important fruit crop in Punjab with area of 8,205 hectares and production of 1. 81 lac tonnes (Anon., 2). Its average productivity in India is 13.68 tonnes per hectare while, under Punjab conditions is 22.03 tonnes per hectare. However, the productivity of guava is quite less than its productive potential. One of the reasons for the low productivity is a large number of old guava orchards in the age group of 15-20 years and above, have either gone unproductive or showing marked decline in productivity. This is attributed to over crowded and intermingling of large branches and meager foliage, allowing poor light availability to growing shoots within the canopy Singh *et al.* (9). The fruit yield, fruit size and quality become poor; hence the orchards become senile. The canopies of such plants become very large, unmanageable, unproductive and the inner canopy areas of plants become totally barren. This renders them unproductive and uneconomical. Manipulation in tree canopy by means of pruning and training for productivity was not felt necessary orchard management practice. The old and senile orchards are now reverting towards a declining trend of production because of plant age factor, non-compatible varieties and poor canopy management (Baba *et al.,* 3). The fruiting potential of guava trees is governed by its architecture, canopy density and photosynthetic efficiency. However, we can restore the productive potential of such old, unproductive and senile guava orchards by deploying appropriate technology (Singh and Singh, 10 and Kalloo *et al.,* 6). Moreover, this technology also helps in maintaining the manageable plant canopies which facilitates the interception of proper sunlight and air in the orchards. Keeping in view the same, the old and senile guava orchard at Regional Station Bhatinda was subjected to rejuvenation technology to increase the fruit yield and quality along with restoration of manageable canopies.

MATERIALS AND METHODS

The guava orchard planted at Regional Research Station, Bathinda in the year of 1991 was subjected to rejuvenation technology in the year of 2010. The guava cv. 'Allahabad Safeda' plants were headed back at the height of 1.5 m, 2.0 m and 2.5 m keeping the old and senile trees as a control in the month of March. The Bordeaux paste was applied on the cut ends immediately after heading back. These headed back plants were again subjected to pruning intensity of 0%, 25 %, 50 % and 75 % of total length of these newly emerged shoots after 5 months of heading back. The un-pruned headed back plants were treated as control. All the plants were supplemented with well rotten farm yard manure and inorganic fertilizers. The observations of vegetative growth in terms of plant height, plant spread and canopy volume was recorded Height of the

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trees was measured with the help of measuring pole up to the maximum point of height ignoring only the off type shoots. The distance between points to which most of branches of a tree had grown in the North-South and East-West directions were also measured in last week of September. The off type shoots were not considered in the measurement.

The tree canopy was calculated by formula given by Roose *et al.* (7) in m^3.

$$V = \frac{4}{6}\pi h r^2$$

Where,

h = height of tree (m)

$$r = \frac{\text{Sum of E - W and N - S directions (in meters)}}{4}$$

E-W = East-West, N-S = North-South

RESULTS AND DISCUSSION

The intensity of heading back significantly influenced the plant height (Table 1). Among headed back trees maximum height (3.93 m) during first year was recorded in 2.5 m height followed by 2.0 m (3.50 m) and 1.5 m (3.18 m) levels. Similarly, the severity of pruning intensity also resulted decrease in plant height during initial year of observations. The plant height was minimum in severely pruned (50 and 75 %) plants while it was maximum i.e. 3.30 m, 3.70 m and 4.08 m in unpruned headed back plants at 1.5 m, 2.0 and 2.5 m levels, respectively. The pruning intensity did not alter the plant height in all the un-headed back trees. More severity of heading back leads to lesser height of rejuvenated trees. Similar was the case during second year of investigations (Table 2) with maximum height in plants headed back at higher level. Pruning intensity in 2.0 m and 2.5 m height of heading back also significantly altered the plant height. Among trees subjected to pruning, height of 4.59 m was recorded in severely pruned plants (75 %) in 2.0 m level of heading back, but, it was maximum (4.95 m) in unpruned plants of 2.5 m of heading back. The minimum plant height was noted in 25 cm level of pruning in both levels of heading back. Basu *et al.* (4). The height and spread of plants increased significantly after pruning as compared to control.

Among heading back treatments, the trees headed back at 2.5 m, resulted significantly higher mean N-S spread than 1.5 m and 2.0 m level in all years of observations (Table 1 & 2). The 1.5 m headed back plants pruned at all intensity levels exhibited significantly same N-S spread during the first year, while in 2.0 and 2.5 m level of heading back it was significantly less in 75 per cent intensity of pruning. In second year, it was significantly higher (3.90 m) in unpruned plants headed back at 1.5 m level. Likewise, in 2.0 and 2.5 m levels, it was significantly less in 50 and 75 per cent pruning. During third and fourth year the plant spread of 1.5 m headed back plants in N-S direction was highest (4.32 m) in 50 % pruning intensity and 75 % (4.67 m) pruning intensity, respectively. In 2.0 m and 2.5 m level of heading back, N-S plant spread was significantly higher at 25 % (4.77 m) and 75 % (4.78 m) pruning intensity, respectively. Similarly, in fifth year, N-S spread in 1.5 m (4.95 m), 2.0 m (5.18 m) and 2.5 m (5.45 m) was maximum in 75 per cent intensity. In fifth year, maximum tree spread was recorded in 75 per cent pruning intensity in all levels of heading back. This may be due to the fact that severity of pruning results profuse vegetative growth resulting more spread. Un-headed back plants, exhibited non-significant effect on plant spread under all pruning intensities. Basu *et al.* (4) also reported increased plant spread after pruning as compared to control.

Increment in plant canopy was recorded with height of heading back in all years of observations (Table 1 and 2). Among the headed back plants, increasing trend in canopy volume with age of rejuvenation was observed in all heading back levels. During first year, maximum mean canopy volume (27.11 m^3) was recorded in 2.5 m level of heading back followed by 24.69 m^3 and 19.10 m^3 in 2.0 and 1.5 m level. Similarly, during second year it was 35.42 m^3 32.29 m^3 and 23.16 m^3 in 2.5 m, 2.0 m and 1.5 m level of heading back, respectively. Similar trend of increment in canopy volume with height of heading back and age was observed during 3rd and 4th year of investigations. The intensity of pruning also had significant effect on canopy volume. During the initial years the canopy volume was decreased with the severity of pruning. Minimum canopy volume was noted in plants pruned at 75 % intensity at all levels of heading back, while it was maximum in unpruned plants. In first year of rejuvenation there was about 80 %, 73 % and 70 % reduction in tree canopy as compared to senile trees in 1.5 m, 2.0 m and 2.5 m headed back trees, respectively. Consequently, it was about 50 %, 40 % and 30 % up to fifth years of rejuvenation, respectively (Fig. 1). New growth and inducement of bearer shoots are stimulated in the inner canopy in the same way the hedging and topping encourages new growth on the outside of the canopy (Burondkar and Gunjate, 5). By topping and hedging, the tree height was reduced by 34 to 43 per cent over the control trees (Singh *et al.,* 8).

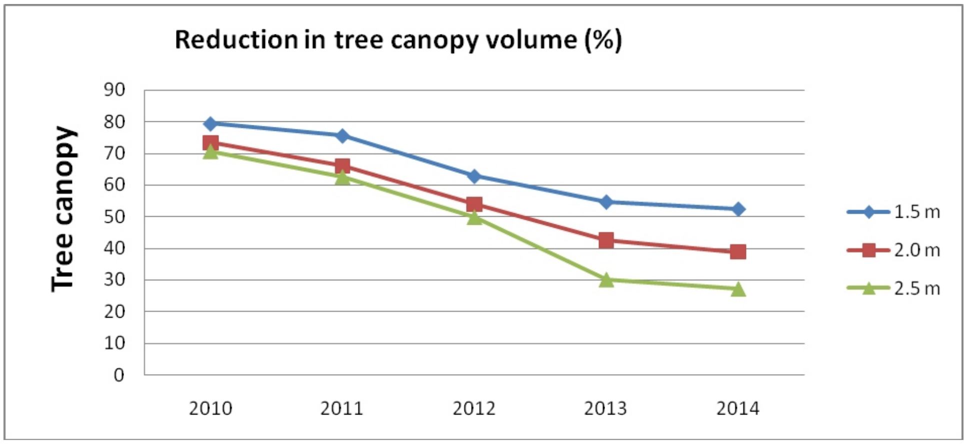

Fig. 1 : Reduction in tree canopy volume as compared senile guava trees.

Table 1 : Vegetative growth of rejuvenated plants under different levels of heading back and pruning intensity during first & second year of rejuvenation.

Heading back from ground level (m) (A)	Pruning intensity (%) (B)	Height (m)	Plant spread (N-S) (m)	Plant spread (E-W) (m)	Canopy volume (m^3)	Height (m)	Plant spread (N-S) (m)	Plant spread (E-W) (m)	Canopy volume (m^3)
		1st year (2010)				2nd year (2011)			
1.5 m	0	3.30	3.50	3.60	21.78	3.50	3.90	3.90	27.88
	25	3.27	3.43	3.57	21.02	3.35	3.62	3.77	24.05
	50	3.07	3.33	3.50	18.70	3.23	3.48	3.78	22.33
	75	3.07	3.40	2.67	14.90	3.25	3.52	3.05	18.37
	Mean	3.18	3.42	3.34	19.10	3.33	3.63	3.63	23.16
2.0 m	0	3.70	3.67	3.87	27.44	4.10	4.00	4.05	34.79
	25	3.68	3.65	3.68	25.95	3.46	4.18	4.20	31.88
	50	3.20	3.90	3.90	25.48	3.80	3.97	4.20	33.20
	75	3.40	3.27	3.40	19.88	3.72	3.77	4.00	29.30
	Mean	3.50	3.62	3.71	24.69	3.77	3.98	4.11	32.29
2.5 m	0	4.08	4.18	3.60	32.40	4.25	4.39	3.91	38.34
	25	4.00	3.90	3.50	28.76	4.17	4.25	3.83	35.65
	50	3.90	3.63	3.43	25.89	4.22	3.96	3.60	31.71
	75	3.75	3.50	3.10	21.39	4.17	4.17	3.95	35.98
	Mean	3.93	3.80	3.41	27.11	4.20	4.19	3.82	35.42
Control (No Heading Back)	0	5.53	5.70	5.80	95.83	5.57	5.77	5.83	98.09
	25	5.50	5.67	5.75	93.89	5.55	5.75	5.75	96.11
	50	5.43	5.62	5.68	90.85	5.48	5.70	5.73	93.87
	75	5.40	5.55	5.67	89.08	5.35	5.63	5.75	90.80
	Mean	5.47	5.64	5.73	92.41	5.49	5.71	5.77	94.72
CD (P=0.05)	A	0.14	0.28	0.20	3.12	0.07	0.25	0.22	3.03
	B	0.11	0.20	0.22	2.53	0.10	0.15	0.16	2.02
	A × B	NS	NS	NS	NS	0.20	NS	0.32	NS

Table 2 : Vegetative growth of rejuvenated plants under different levels of heading back and pruning intensity during third, fourth and fifth year of rejuvenation.

Heading back from ground level (m) (A)	Pruning intensity (%) (B)	Height (m)	Plant spread (N-S) (m)	Plant spread (E-W) (m)	Canopy volume (m^3)	Height (m)	Plant spread (N-S) (m)	Plant spread (E-W) (m)	Canopy volume (m^3)	Height (m)	Plant spread (N-S) (m)	Plant Spread (E-W) (m)	Canopy volume (m^3)
		3rd year (2012)				4th year (2013)				5th year (2014)			
1.5 m	0	3.98	4.20	4.20	36.81	4.10	4.30	4.23	39.10	4.56	4.65	4.45	49.43
	25	3.97	4.03	4.03	33.85	4.02	4.08	4.15	35.68	4.37	4.40	4.46	44.91
	50	3.97	4.32	4.10	36.79	4.10	4.32	4.38	40.66	4.52	4.66	4.62	50.95
	75	4.00	4.18	4.30	37.74	4.52	4.67	4.73	52.26	4.77	4.95	4.94	61.07
	Mean	3.98	4.18	4.16	36.30	4.19	4.34	4.37	41.93	4.56	4.67	4.62	51.59
2.0 m	0	4.20	4.30	4.33	42.60	4.51	4.73	4.67	49.06	4.81	5.02	4.86	61.46
	25	3.92	4.77	4.64	45.43	4.48	4.50	4.75	50.12	4.69	4.83	5.04	59.81
	50	4.46	4.41	4.64	47.68	4.85	4.77	4.85	58.89	5.19	5.17	5.16	72.50
	75	4.59	4.32	4.35	44.32	4.80	4.78	4.80	55.04	5.24	5.18	5.09	72.07
	Mean	4.29	4.45	4.49	45.01	4.66	4.70	4.77	53.28	4.98	5.05	5.04	66.46
2.5 m	0	4.95	5.08	4.42	58.46	5.12	4.84	4.54	58.95	5.48	5.15	4.85	71.74
	25	4.56	4.28	4.02	41.17	5.20	5.03	4.92	67.73	5.57	5.42	5.26	83.17
	50	4.80	4.67	4.22	50.04	4.98	5.02	4.96	65.05	5.28	5.37	5.35	79.43
	75	4.73	4.29	4.33	45.99	5.10	5.00	4.87	66.99	5.38	5.45	5.34	81.99
	Mean	4.76	4.58	4.25	48.92	5.10	4.97	4.82	64.68	5.43	5.35	5.20	79.08
Control (No Heading Back)	0	5.63	5.80	5.87	100.39	5.67	5.72	5.72	96.99	5.94	6.01	6.11	114.22
	25	5.60	5.73	5.75	96.72	5.63	5.68	5.68	95.31	5.87	5.98	5.95	109.36
	50	5.63	5.80	5.87	100.39	5.53	5.58	5.68	91.86	5.86	5.85	5.94	106.63
	75	5.50	5.67	5.68	92.76	5.50	5.55	5.60	86.23	5.77	5.82	5.93	104.28
	Mean	5.59	5.75	5.79	97.57	5.58	5.63	5.67	92.60	5.86	5.915	5.983	108.58
CD (P = 0.05)	A	0.08	0.13	0.06	2.52	0.13	0.12	0.16	3.89	0.06	0.01	0.05	5.27
	B	0.13	0.17	NS	2.89	0.12	NS	NS	2.96	0.07	0.02	0.04	4.52
	A×B	NS	0.27	NS	5.8	0.23	NS	NS	5.92	0.13	0.04	0.08	NS

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