Effect of plant spacing and pruning intensity on yield and fruit quality of guava (*Psidium guajava* L.) cv. Pant Prabhat

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ABSTRACT : The present investigation entitled "Effect of plant spacing and pruning intensity on yield and fruit quality of guava (*Psidium guajava* L.) cv. Pant Prabhat" was conducted at G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand during the year 2011-12 and 2012-13. The treatments were consisted of two plant spacing (i.e. 2.0X1.0 m & 2.0X2.0 m) and three pruning intensities i.e., one fourth, half and three fourth shoot pruning with un-pruned treated as control. The treatment consisted of 2.0X2.0 m plant spacing and three fourth shoot pruning was found superior in this regard, significantly higher fruit set (68.42%) was recorded with treatment combination of 2.0X2.0 m plant spacing and three fourth shoot pruning for winter season crop. Reverse trend was observed in case of per cent flower/fruit drop during both the years. Number of fruits and yield per plant increased with increase in plant spacing. However, yield on the basis of per hectare was found higher with closer spacing (2.0X1.0 m). Treatment combination of 2.0X1.0 m plant spacing and three fourth shoot pruning gave maximum yield (238.75 q/ha) during winter season. Physico-chemical qualities of the fruits were found better at wider spacing (2.0X2.0 m), while, there were affected adversely at closer spacing (2.0X1.0 m). The higher fruit weight, size, T.S.S., ascorbic acid, sugars and pectin content were recorded with treatment combination of 2.0X2.0 m plant spacing and three fourth shoot pruning in winter season crop of guava.

Key words: Guava, high density, shoot pruning, winter season

The guava (*Psidium guajava* L.)**,** known as "The apple of tropics", belongs to family Myrtaceae. Guava is successfully grown in tropical and subtropical region of India and considered**,** nutritionally valuable and remunerative crop. It is one of the referred and legendry fruit due to its hardy and prolific bearing in saline, alkaline and acidic soil. Guava fruits are used for both, fresh consumption and processing (Singh *et al*., 2007). Guava contributes 4.6 % of the total production of fruits in India, which is around 3.99 million tons from an area of 0.246 million hectares and productivity is around 16.21 metric tons per hectare (NHB Data, 2014-15).

Although there was increase in area and production of fruits during last decade in the country, productivity did not show significant increase. Guava is a pruning responsive crop, shoot pruning have been reported to be successful in regulating *bahar* in guava. Shoot pruning is also helpful in reducing the tree size and improving the fruit quality and provide opportunity to increase the number of trees per unit area (Lal *et al*., 2000, Joshi *et al*., 2014). Similarly, the growth of guava plant is also variable under different planting systems (Lal *et al*., 2007).

Generally guava is cultivated through traditional planting system. In which it is very difficult to achieve desirable level of production. Moreover*,* in this system guava tree taken 5-6 years for coming into commercial bearing and thus maximize the overall cost of production per unit area. Therefore, certain strategies have to be identified to intensify the guava production in present per unit area, is the adoption of high density planting or meadow orchards system. This is a superior intensive system and considered as one of the most efficient modern planting system particularly in respect of productivity of the produce. In meadow orchard system 5000 plants (2.0 m x 1.0m) of guava can be accommodated in one hectare area or 2000 plants in one acre area (Singh, 2010). There is also the fact that there are no suitable planting systems being adopted. High density planting gives early economic production, more return per unit area, provides efficient use of natural resources like land, water and light. Hence, there is overriding need to improve the existing planting system. There is currently a worldwide trend to plant fruit trees on permanent high density planting/ meadow orchard and to manipulate tree growth by using canopy management to

control tree growth patterns and tree shape and maintaining high fruit production of desired size and quality. This is a superior intensive system and considered as one of the most efficient modern planting system particularly in respect of productivity of the produce. In this orchard planting system, it is prerequisite to maintain the desired canopy height and spread of this fast growing guava plant.

The available land area for fruit cultivation is shrinking due to rapid urbanization, fragmentation in land holdings and industrialization. Under such circumstances the concept of high density plantation has become extremely significant to increase fruit yield and productivity. The efficient training and pruning can maintain the proper canopy size of the guava tree. Therefore, the present experiment was conducted to estimate the "Effect of plant spacing and pruning intensity on yield and fruit quality of guava (*Psidium guajava* L.) cv. 'Pant Prabhat'

MATERIALS AND METHODS

The study was conducted at Horticulture Research Centre, Patharchatta and Department of Horticulture of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, during the year 2011-12 and 2012-13. Two years old grafted guava plants of cv. Pant Prabhat were planted with two plant spacing (i.e. 2.0X1.0 m(S_1) & 2.0X2.0 m (S_2)) and three pruning intensities i.e., one fourth (P_1), half (P_2) and three fourth shoot pruning (P_3)with un-pruned treated as control (P_0) (Plate 1 to 10). Total 8 treatment combinations with 4 replication with two plants as an experimental unit *viz*. 2mx1m spacing with no pruning (S_1P_0), 2mx1m spacing with top one fourth ($1/4^{th}$) current shoot growth pruned (S_1P_1), 2mx1m spacing with top half (½) current shoot growth pruned (S_1P_2), 2mx1m spacing with top three fourth ($3/4^{th}$) current shoot growth pruned (S_1P_3), 2mx2m spacing with no pruning (S_2P_0), 2mx2m spacing with top one fourth ($1/4^{th}$) current shoot growth pruned (S_2P_1), 2mx2m spacing with top half (1/2) current shoot growth pruned (S_2P_2) and 2mx2m spacing with top three fourth ($3/4^{th}$) current shoot growth pruned (S_2P_3). The experiment was laid out in factorial randomized block design. After one year, all the plants were topped at a uniform height of 60 cm from the ground level for initiation of new growth below cut end. During February, 2011, all the plants were topped to a uniform height of 1.0 m above from the ground level leaving 4-5 small branches for initiation of new growth below the cut ends. After 20-25 days of topping, new shoot emerge. In general 4-5 shoots retained below the cut point of the topping. During the February, 2012 all the plants are topped to a uniform length of 1.25 meter above from the ground level for initiation of new growth. The observations were recorded two year i.e. 2011-12 and 2012-13. Shoot pruning of current season's growth was done as per treatment with the help of secateur in the last week of April during both the years. The data were analyzed according to the procedure of analysis for Factorial Randomized Block Design. The significance of variation among the treatments was observed by applying 'F' test and critical difference at 5 per cent probability was calculated to compare the mean values of treatments for all the characters.

RESULTS AND DISCUSSION

The interaction among plant spacings and shoot pruning intensities gave significant effects on fruit set percentage (Table 1) for both the seasons. Maximum fruit set percentage was found with interaction between 2.0X2.0 m plant spacing and unpruned plants (S_2P_0), while, minimum fruit set percentage was recorded with interaction between 2.0X1.0 m plant spacing and $3/4^{th}$

Table 1: Effect of interaction (spacing x pruning) on per cent fruit set of guava

Treatments	Per cent fruit set							
	2011-12				2012-13			
	Rainy season		Winter season		Rainy season		Winter season	
	2.0 X 1.0 m (S_1)	2.0 X 2.0 m (S_2)	2.0 X 1.0 m (S_1)	2.0 X 2.0 m (S_2)	2.0 X 1.0 m (S_1)	2.0 X 2.0 m (S_2)	2.0 X 1.0 m (S_1)	2.0 X 2.0 m (S_2)
Unpruned control (P_0)	43.15	46.18	41.78	41.61	35.53	37.27	33.83	35.97
$1/4^{th}$ shoot pruning (P_1)	31.00	34.40	47.44	48.02	30.36	35.21	48.17	58.35
½ shoot pruning (P_2)	21.28	21.55	54.20	60.25	23.60	20.59	58.53	71.48
$3/4^{th}$ shoot pruning (P_3)	8.47	9.82	66.85	72.25	8.56	8.58	67.13	74.08
SEm±	2.78		2.61		1.82		6.12	
CD at 5%	8.19		7.68		5.35		18.00	

shoot pruning (S_1P_3) in rainy season during both the years. The lesser number of fruits per plant in closely spaced plants (2.0x1.0 m) might be due to high competition for nutrients, reduced vegetative growth, overlapping of branches and reduced fruiting area. Pruning significantly decreased the fruit set percentage and number of fruits per plant during rainy season and subsequently increased significantly during winter season. It might be due to the fact that the plant accumulates food reserve during rainy season which was diverted for the development of more fruits during winter season (Chandra and Govind, 1995). The number of fruits per plant was found to be increased with decreased plant density in both the seasons during both the years. These results are in agreement with the findings of Chundawat *et al*. (1992), Kalra *et al*. (1994) and Tiwari and Lal (2007). It is also evident that closely spaced plant (2.0X1.0 m) yielded significantly higher yield per unit area than wider spacing (2.0X2.0 m) in both the seasons during both the years. Similar results have also been made by Lal (1992), Mahajan (2004) and Praitbha *et al.* (2013).

The interaction between plant spacing and pruning intensity on yield per plant affected significantly for both the years (Table 02). Maximum yield per plant was obtained with plants spaced at 2.0X2.0 m and unpruned plants (P_0) and minimum yield from the combination of 2.0X1.0 m plant spacing and 3/4th shoot pruning (P_3) during rainy season during both the years. However, during winter season, maximum yield per plant was obtained from treatment combination (S_2P_3) of 2.0X2.0 m plant spacing and 3/4th shoot pruning (P_3) and minimum yield per plant was recorded from the treatment combination (S_2P_0) of 2.0X2.0 m plant spacing and unpruned plants (P_0) during both the years.

Interaction between plant spacing and pruning intensity on total annual yield per plant differed significantly during both the years (Table 03). Maximum total yield per plant per year was obtained with combination (S_2P_0) of 2.0X2.0 m plant spacing and unpruned plants (P_0) and minimum yield per plant per year from the treatment combination (S_1P_2) of 2.0X1.0 m plant spacing and ½ shoot pruning (P_2) during both the years. These results are inconformity with the earlier findings of (Lal *et al*., 2000, Mahajan, 2004 and Pratibha *et al.,* 2013).

Table 2: Effect of interaction (spacing x pruning) yield (kg) per plant of guava Treatments

Treatments	Yield (kg/plant)							
	2011-12				2012-13			
	Rainy season		Winter season		Rainy season		Winter season	
	2.0 X 1.0 m (S_1)	2.0 X 2.0 m (S_2)	2.0 X 1.0 m (S_1)	2.0 X 2.0 m (S_2)	2.0 X 1.0 m (S_1)	2.0 X 2.0 m (S_2)	2.0 X 1.0 m (S_1)	2.0 X 2.0 m (S_2)
Unpruned control (P_0)	3.67	4.61	1.09	1.25	5.11	6.20	1.89	2.39
1/4th shoot pruning (P_1)	2.87	3.73	1.51	1.98	3.55	4.40	2.57	3.47
½ shoot pruning (P_2)	1.92	2.67	2.33	3.02	2.27	2.50	3.34	4.72
3/4th shoot pruning (P_3)	1.43	1.51	3.10	4.25	1.55	1.81	4.78	5.58
SEm±	0.12		0.11		0.15		0.12	
CD at 5%	0.35		0.33		0.43		0.37	

Table 3: Effect of interaction (spacing x pruning) on total yield (kg) per plant of guava

Treatments	Total yield (kg/plant)											
	2011-12						2012-13					
	2.0 X1.0 m (S_1)			2.0 X 2.0 m (S_2)			2.0 X1.0 m (S_1)			2.0 X 2.0 m (S_2)		
	Rainy season	Winter season	Total yield	Rainy season	Winter season	Total yield	Rainy season	Winter season	Total yield	Rainy season	Winter season	Total yield
Unpruned control (P_0)	3.67	1.09	4.76	4.61	1.25	5.86	5.11	1.89	7.00	6.20	2.39	8.59
1/4th shoot pruning (P_1)	2.87	1.51	4.39	3.73	1.98	5.71	3.55	2.57	6.12	4.40	3.47	7.87
½ shoot pruning (P_2)	1.92	2.33	4.24	2.67	3.02	5.69	2.27	3.34	5.61	2.50	4.72	7.21
3/4th shoot pruning (P_3)	1.43	3.10	4.53	1.51	4.25	5.76	1.55	4.78	6.33	1.81	5.58	7.39
SEm±	0.12	0.11	0.18	0.12	0.11	0.18	0.15	0.15	0.15	0.15	0.15	0.15
CD at 5%	0.35	0.33	0.53	0.35	0.33	0.53	0.43	0.37	0.44	0.43	0.37	0.44

Table 4: Effect of interaction (spacing x pruning) on total yield (q/ha) of guava

Treatments	Total yield (q/ha)											
	2011-12						2012-13					
	2.0 X1.0 m (S_1)			2.0 X 2.0 m (S_2)			2.0 X1.0 m (S_1)			2.0 X 2.0 m (S_2)		
	Rainy season	Winter season	Total yield (q/ha)	Rainy season	Winter season	Total yield (q/ha)	Rainy season	Winter season	Total yield (q/ha)	Rainy season	Winter season	Total yield (q/ha)
Unpruned control (P_0)	183.54	54.66	238.19	112.81	31.13	143.94	255.63	94.31	349.94	154.99	59.72	214.71
1/4th shoot pruning (P_1)	143.63	75.66	219.28	93.24	49.45	142.69	177.60	128.63	306.23	110.11	86.69	196.80
½ shoot pruning (P_2)	95.90	116.34	212.24	66.78	75.48	142.27	113.74	167.00	280.74	62.43	117.94	180.36
3/4th shoot pruning (P_3)	71.34	155.02	226.36	40.20	106.28	146.48	77.61	238.75	316.36	45.24	139.47	184.71
SEm±	3.93	4.24	5.73	3.93	4.24	5.73	5.74	5.38	6.10	5.74	5.38	6.10
CD at 5%	11.55	12.47	16.86	11.55	12.47	NS	16.87	15.81	17.92	16.87	15.81	17.92

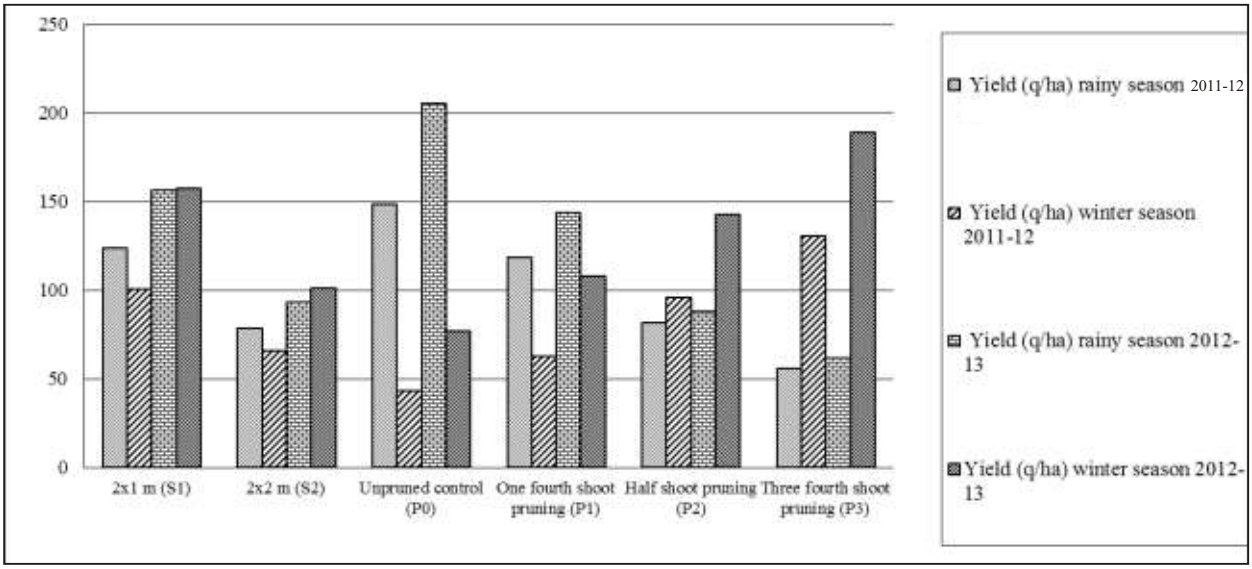

Fig. 1: Effect of different spacing and pruning intensities on yield (q/ha) in guava

Interaction between spacing and pruning intensity on total annual yield per hectare (Table 04 and Fig. 1) differed significantly during both the years. Maximum total yield per hectare was obtained with treatment combination (S_1P_0) of 2.0X1.0 m plant spacing of unpruned plants (P_0), while, minimum yield per hectare per year was recorded with 2.0X2.0 m plant spacing and ½ shoot pruned plants (P_2) during both the years. Several workers also found similar results in different crops and reported that at closer spacing, number of fruits per plant and yield per tree was lesser but yield per hectare was higher (Lal *et al*., 2000 and Pratibha *et al.,* 2013).

Wider spacing (2.0X2.0 m) gave significantly higher T.S.S., total titrable acidity and ascorbic acid content than closer spacing (2.0X1.0 m) and pruning treatments significantly improved the T.S.S., total titrable acidity and ascorbic acid content of the fruits in both the seasons during both the years. Maximum T.S.S. (12.57%) and ascorbic acid content (247.00 mg/100 g pulp) were recorded with treatment combination (S_2P_3) of 2.0X2.0 m plant spacing and 3/4th shoot pruning (P_3) in winter season during the year 2012-13. Plants spaced at 2.0X2.0 m gave higher reducing sugar, non-reducing sugar and total sugar content than plants spaced at 2.0X1.0 m. All the pruning treatments significantly improved the sugar content of fruits. Maximum total sugar content was recorded with treatment combination (S_2P_3) of 2.0X2.0 m plant spacing and 3/4th shoot pruning (P_3) in winter season of the year 2012-13. Pectin content was significantly affected by plant spacings during rainy season but not affected during winter season. Higher pectin content was recorded with wider spacing (2.0X2.0 m) in rainy season during both the years. Pruning treatments significantly improved the pectin content in both the seasons. In general, pectin content was found higher in winter season crop as

compared to rainy season crop during both the years. Wider spacing (2.0X2.0 m) gave higher T.S.S. : acid ratio and sugar : acid ratio than closer spacing (2.0X1.0 m) and pruning treatments significantly improved the T.S.S.: acid ratio and sugar : acid ratio of fruits in both the seasons during both the years. Similar reports have also been made by Pandey *et al*. (1997), Lal *et al*. (2000) and Pratibha *et al.* (2013). The biochemical changes in winter season fruits may be due to low temperature. The decline in temperature not only retarded the excessive loss of respiratory substance but also increased the translocation of photosynthates from leaves to other parts of the plant including fruits. In general, vegetative growth is almost ceased during winter season due to low temperature and this leads to the accumulation of more food reserves within the plants, particularly in the fruits. (Crane, 1969).

CONCLUSION

On the basis of present investigation, it can be concluded that cropping pattern, yield and quality of guava can be influenced by shoot pruning treatments. Yield per hectare increased with increase in plant population per unit area. Physico-chemical qualities of the fruits were found superior at wider spacing (2.0X2.0 m). Maximum fruit yield per hectare during winter season can be obtained at (2.0X1.0 m) plant spacing with three fourth ($3/4^{th}$) shoot pruning during last week of April up to 4^{th} year of planting.

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