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RESEARCH ARTICLE

EFFECT OF PRUNING INTENSITIES AND FRUIT LOAD ON GROWTH, YIELD AND QUALITY OF GUAVA (*Psidium guajava* L.) cv. ALLAHABAD SAFEDA UNDER HIGH DENSITY PLANTING

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ABSTRACT

Pruning of guava cv. Allahabad Safeda under high density planting was done in the third week of June, 2012 with three pruning intensities *i.e*. leaving 10 cm, 20 cm and 30 cm from base of the shoot and retaining 30, 40 and 50 fruits per tree. Ten centimeter (10 cm) pruning intensity has advanced the vegetative bud appearance, recorded maximum cumulative length of new shoots, maximum fruit diameter at harvest, average fruit weight and fruit yield. Pruning intensity of 30 cm has increased the number of vegetative buds per pruned shoot and number new shoots per pruned shoot along with early harvesting at colour turning stage. Thirty (30) fruit load per tree recorded the minimum number of days taken for harvesting at colour turning stage and maximum average fruit weight at harvest. Maximum fruit yield was noticed with 50 fruit load per tree. Pruning intensity of 30 cm with 30 fruit load has advanced the harvesting at colour turning stage but 10 cm pruning intensity with 30 fruit load per tree has recorded the maximum fruit diameter. However, the quality of fruits in control and other treatments was also at par.

INTRODUCTION

Guava (*Psidium guajava* L.) the "poor man's fruit" and "apple of tropics" is a popular fruit tree of tropical and sub tropical climate and is native to the Tropical America stretching from Mexico to Peru. It belongs to the family *Myrtaceae* and has the recognition of being the most widely cultivated species of this family. Guava is considered as one of the exquisite, nutritionally valuable and remunerative fruit crop. It excels most other fruit crops in productivity, hardiness, adaptability and nutritive value. Guava bears on current season's growth and flowers appear in the axils of new leaves, therefore, it responds well to pruning. Pruning of guava is one of the most important practices that influence the vigor, productivity and quality of the fruits (Gadgil and Gadgil, 1933). Large trees take several years before they come into bearing and overall cost of production per unit area is further increased. Hence, there is over riding need to improve the existing planting system and to manipulate tree growth using canopy management to control tree growth patterns, tree shape and maintaining high fruit production of desired size and quality (Gorakh Singh, 2001). Fruit thinning in the early stages of fruit growth increases size of remaining fruits, reduces trunk breakage, and promotes regular bearing. Fruit set, fruit size, fruit weight and organoleptic values were also found improved as compared to control. Flowers and fruits of thinned plants showed less drop than control (Tahir and Kamran Hamid, 2002). The results obtained from the above research work will be highly beneficial to farmers for getting higher yield levels and maintain fruit quality in established high density planting. In the light of the above facts, the present study was taken up with the objective to study the effect of pruning intensities and fruit load on yield and quality of guava under high density planting.

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Brief review of literature

Pruning levels in guava under high density conditions has achieved a great importance, since, pruning is necessary for building strong frame work of the trees in early years and for maintaining vigor, yield, productivity and quality of fruits in the later years. The presence or absence of fruit on guava trees has a major effect on their photosynthetic performance and growth (Flore and Lakso 1989, Forshey and Elfving, 1989; Byers, 2003 and Wünsche and Ferguson, 2005). Effects of time and severity of flower or fruit(let) thinning or crop load adjustment, and concomitant alteration of fruit:leaf ratios, tree and fruit physiology have been extensively studied to determine their effects on fruit size, yield and quality at harvest.

Effect of pruning levels on growth of guava under high density planting

Jadhav *et al.* (2002) noticed that earliest emergence of vegetative bud sprout, shoot length, number of flowers per shoot and number of fruits per shoot, on severely pruned

(60 cm) trees of guava was found to be significantly more than mild pruned (30 cm) trees and control. Sheikh and Rao (2002) found that highest fruit diameter of pomegranate was noticed in severe pruning as compared to mild pruning and control. Jens *et al*. (2005) conducted the experiment on apple crop load and stated that shoot length and shoot cross-sectional area increased with decreasing crop load, consistent with some compensation for the loss of the fruit sink. Suleman Mohammed *et al*. (2006) noticed that guava pruning at 60 cm resulted in minimum number of days for sprouting of new shoots, maximum shoot length and highest number of leaves per shoot during rainy and winter season, respectively. Maximum flowers and fruits per shoot during winter season were recorded in 60 cm pruning treatment. The fruit size and weight were maximum in 60 cm pruning treatment during rainy season and in 30 cm pruning treatment during winter season. 60 cm pruning treatment produced minimum yield in rainy season and subsequently maximum during winter season.

Sharma and Room Singh (2006) stated that highest number of fruited panicles appeared in moderately pruned mango trees (80.3) and the lowest in un-pruned trees (24.6). Panicles developed in higher number even at lower canopy height in severely pruned trees than un-pruned (control) as well as trees that received tipping, light or moderate pruning treatments. Brar *et al.* (2007) observed that the increased pruning intensity in guava increased fruit set and reduced flower drop. The number of fruits reduced significantly with an increase in pruning intensity (30 cm and 45 cm). The increase in number of fruits at light pruning intensity (15 cm) might be due to the optimum balance between the vegetative and reproductive growth of tree. The highest fruit weight was recorded from the trees pruned at 45 cm level. Bhanu Pratap *et al*. (2009) found that the size of mango fruit improved with the severity of pruning treatment under high density planting. The largest fruit size was obtained in light pruned trees followed by severe and moderate pruning intensities. The maximum fruit weight was recorded in severely pruned branches. Pruning treatments slightly improved the fruit quality of cv. Amrapali with respect to TSS, acidity and TSS: acid ratio. Shaban and Haseeb (2009) opined that the length of new shoots of guava on severely pruned shoots was found to be longer than moderate pruning or the control. Moderate pruning produced the highest average number of new shoots in both the seasons. Control tree recorded the lowest average number of new shoots in both the seasons. Severe pruning gave the highest significant average index number of flower bud burst in both the seasons compared with the other treatment. The highest fruit set was recorded with moderate pruning in the first season and severe pruning in the second season. The lowest initial fruit set was recorded with the control in both seasons.

Sanjay Kumar Singh *et al.* (2010) noticed that under high density planting condition, fruit weight of mango was significantly influenced by pruning intensity and was highest in the lightly pruned trees. Average fruit weight decreased in the 'on' year due to increase in the number of fruits per tree. Number of fruits per tree was highest in the moderately pruned trees (Singh, 2007a). Fruit volume increased in the severely pruned trees. Shalini Pilania *et al.* (2010) noticed that 25% pruning of previous season growth in guava gave maximum number of flowers/shoot, maximum fruit diameter under 75% pruning of previous season growth followed by 50% pruning and minimum in control. Singh *et al*. (2010) reported that pruning intensity at moderate level in high density planting of guava took lowest number of days to 50% flowering, had highest number of panicles per branch and longest blooming period. Moderately pruned trees had the highest fruit yield.

Effect of pruning levels on yield of guava under high density planting

Shant-Lal *et al.* (1996) found that unpruned (control) guava trees gave minimum yield per hectare in winter season with 2 x 2 m spacing during both the years. One-leaf pair pruning followed by full shoot pruning gave higher yield per hectare in winter season. Bhanu Pratap *et al*. (2003) noticed that mango fruit yield was highest under moderate pruning (20 cm), followed by severe (30 cm) and light pruning (10 cm) treatments. Minimum yield was under control under high density planting. Shaban and Haseeb (2009) opined that guava moderate pruning gave highest significant increase in the yield for the seasons, Severe pruning and pinching gave a significant intermediate effect between moderate pruning and the control. Gorakh Singh (2011) reported that canopy management under high density planting in guava found highly beneficial towards better tree canopy shape and quality production. Maximum yield of 113.5 and 106.1 kg/plant was recorded as compared to 71.5 and 88.5 kg/plant under unmanaged tree canopy when planted at 3.0 m x 6.0 m and 6.0 m x 6.0 m spacing. Similar trend was also recorded in closer spaced trees. Among different densities, higher yield of 80.76 per cent was obtained under the density of 3.0m x 1.5m. Other densities 3.0m x6.0m, 3.0m x 3.0m and 6.0 x 6.0m also performed well with a increased yield of 58.74 per cent, 45.55 per cent and 19.88 per cent, respectively. Differential light interception within tree canopies as the result of pruning may influence vegetative growth, photosynthetic efficiency, flower initiation, fruit set, fruit colour, fruit size and fruit quality. Sathya Prakash *et al.* (2012) opined that effect of pruning treatments was compared on the per cent increase in winter yield over rainy season. Moderate (33%) pruning resulted in maximum yield of winter crop over rainy season's yield. When compared the cumulative yield of both rainy and winter seasons under different treatments, the trees which received 33% pruning intensity produced the maximum total cumulative yield (57.30 kg/tree) followed by the trees received 50% pruning intensity (53.89 kg/tree).

Effect of pruning levels on fruit quality of guava under high density planting

Gorakh Singh (2011) reported that guava pruning treatment increased the fruit weight, vitamin C and total sugar content of harvested fruit from each density. Trees spaced at 3.0m x 6.0m had heavier fruit closely followed by 6.0m x 6.0m spaced trees. Closely spaced trees had smaller fruits especially in 1.5m x 3.0m spacing. The average total soluble solids were 10.8, 11.6, 12.1 and 11.8 ^{0}Brix in pruned trees from all four densities (3.0m x 1.5m, 3.0m x 3.0m, 3.0m x 6.0m and 6.0m x 6.0m respectively). The average total soluble solids i.e. 10.1, 10.5, 11.3 and 11.2 ^{0}Brix were recorded from unprunned control trees of respective densities. Sathya Prakash *et al.* (2012) opined that the moderately pruned guava trees in winter season produced fruits of largest size and of maximum weight and

such fruits had highest TSS and ascorbic acid content. Smallest size and minimum weight with lowest TSS and ascorbic acid content was recorded in fruits harvested from unpruned control trees.

Effect of fruit load on fruit growth and yield of guava under high density planting

Jens *et al*. (2005) conducted the experiment on apple crop load. Crop loads ranging from zero on non-cropping trees to 100, 225 and 400 fruit per tree on the low, medium and high-cropping trees, respectively. Fruit growth, as indicated by maximum diameter, was significantly and negatively related to crop load from about 60 days after full bloom until fruit harvest when individual fruit mass increased by about 35% with each decrease in cropping density. Differences in yield per tree were large, but reflected crop-load-induced fruit mass responses. Compared with high-cropping trees, fruit from low-cropping trees showed advanced maturity at harvest as indicated by the harvest management criteria of background color and starch/iodine score. Other fruit quality variables at harvest such as soluble solids, flesh firmness and dry matter increased significantly with decreasing crop load. Kann Kartural *et al.* (2006) reported that increase in severity of grape cluster thinning resulted in yield reduction but an increase in TSS in juice. Yield compensation was achieved by an increase in cluster weight of 38% and 25% in response to a reduction of 37% and 23% in cluster numbers. Buler *et al.*(2008) found that manual fruit thinning of pear under high density planting markedly increased mean fruit weight and the percentage of large fruits for the Conference pear grafted on quince S and for the Asian cultivars grafted on common pear seedlings.

Sdoodee *et al.* (2008) reported that moderate crop load of mangosteen trees provided high yield with high percentage of large fruits. Although the highest yield was found in high crop load trees, most of the fruits were small. Yield of large fruits increased with decreasing crop load level. These results suggest that trees should be at the moderate crop load level to optimize crop load with good yield of large fruits. Iwona Szot (2010) reported that apple flower thinning at the pink bud stage and towards the end of flowering had the most beneficial influence on yield of fruit with diameter bigger than 70 mm, and mean fruit mass. The control trees gave the smallest yield of fruit with diameter bigger than 70 mm and control fruits had the lowest mean fruit mass. Fruits from trees where fruitlets were thinned either two week after full bloom or after June drop had a slightly higher mass. Khan *et al.* (2011) reported that Maximum fruit size and weight of guava winter crop was attained at 0% defoliation + 50% deblossoming level followed by the trees subjected to 10% defoliation + 0% deblossoming level as compared to control. Maas and Steeg (2011) noticed that thinning is needed in Pears to realize the target crop load and the desired fruit size. The percentages of fruit having a diameter >65 mm were significantly increased up to 80 to 90% of the yield for those treatments that thinned the trees to the target fruit load of about 110 fruit per tree. Yuri *et al*. (2011) found that mean fruit weight of apple decreased with increasing fruit crop load but the yields of fruit weight were similar in all crop loads. High fruit loads allowed obtaining high fruit yield earlier and of good quality.

Effect of fruit load on fruit quality of guava under high density planting

Sheikh and Rao (2002) found that the highest TSS was recorded with 50 fruit load (15.18 %) in pomegranate. The maximum TSS (15.69 %) was recorded in mild pruning with 40 fruits load. The highest titrable acidity was observed in 50 fruit load. The maximum titrable acidity (0.71) was recorded in mild pruning with 50 fruits load. The highest total sugars were noticed in 30 fruits load (11.55 %). Tahir and Kamran Hamid (2002) conducted the experiment on guava fruit thinning in summer with three treatments viz., control, partial thinning and complete thinning and noticed that completely thinned plants produced highest TSS, total sugars and vitamin-C in their fruits whereas acidity percentage decreased in completely thinned plants. Gurudarshan and Dhaliwal (2004) stated that guava pruning at 30 cm produced the maximum fruit weight and fruit size. The increase in terms of length and breadth may be attributed to the reduction in crop load, which in turn diverted more nutrients to the remaining fruits, thereby improving the size of fruits. Jens *et al*. (2005) conducted the experiment on apple crop load and opined that fruit from light-cropping trees displayed advanced maturity. At harvest, fruit from light-cropping trees were larger, firmer and sweeter than fruit from high-cropping trees. Greater starch conversion and a higher percent of soluble solids compared with fruit on high-cropping trees.

József Racskó (2006) reported that reducing apple crop load has been shown to increase fruit firmness and fruit size at harvest. The greatest increase in fruit firmness at harvest was achieved by thinning during the period from five to fifteen days after full bloom with no increase when thinned at twenty-five days after full bloom for 'Cox's Orange Pippin'. Reducing the number of fruits per tree will inevitably increase the leaf area per fruit. Charles *et al.* (2007) found that excessive apple crop loads have been reported to reduce color, fruit firmness, total acidity, soluble solids and starch. Meland (2009) stated that apple fruit weights and soluble solids contents values were highest with the lowest crop load and decreased with increasing crop load. Trees with the highest crop load had the lowest crop load in the following year. Fruit quality was generally high for all treatments. Abeer and Mohsen (2010) noticed that thinning of peaches decreased the yield as weight and number , advanced the maturity stage and enhanced the fruit quality in terms of weight , diameter, increased total sugars, TSS, TSS/acid ratio while, reduced firmness and acidity. The best result were dedicated to thinning Flordaprince cultiver at full bloom stage and Desert Red cultivar at 20 days after full bloom stage. Einhorn *et al*. (2011) reported that heavy crop loads of unthinned Sweet Cherry trees reduced fruit size by 30 days after full bloom. At harvest, fruit diameter of thinned treatments was increased 22% and 27% compared with unthinned fruit. Fruit quality attributes and greater percentages of large fruit were significantly greater for thinned treatments.
George Ouma (2012) stated that retention of 600 fruits and 800 fruits per citrus tree were found to be at par and these treatments showed significant response in increasing fruit weight over other treatments and control. Minimum number of fruits on the tree i.e. 600 fruits/ tree had minimum peel percentage and maximum juice percentage (50.2%). Increase in TSS and ascorbic acid content with less acidity was noticed in fruit juice of the bigger fruit harvested from trees in hand

thinning. Sathya Prakash *et al.* (2012) opined that guava fruit size has direct correlation with number of fruits borne on the trees. Owing to high leaf to fruit ratio and availability of more photosynthates due to removal of current season's growth, the fruits gained larger size and weight compared to those from unpruned trees. The improvement in chemical composition of fruits obtained from pruned trees might be due to abundant availability of photosynthates for lesser number of fruits.

MATERIALS AND METHODS

The experiment was carried out during the period from June, 2012 to January, 2013 at Fruit Research Station (FRS), Sangareddy, Medak district, Dr.YSRHU, on two and half year old trees of cv. Allahabad Safeda planted at a spacing of 2.5 x 2.5 m under high density planting system. The experiment was laid out in factorial RBD with 19 treatments replicated twice with three trees per replication. The observations recorded are fruit diameter, average fruit weight, fruit yield and fruit quality.

RESULTS AND DISCUSSION

The number of days taken to first vegetative bud appearance of guava cv. Allahabad Safeda was significantly influenced by pruning intensity only. Among the pruning intensities studied, early vegetative bud appearance was observed with 10 cm (4.09 days) followed by 30 cm (4.44 days) and 20 cm (4.71 days) which differed significantly. The earliest vegetative bud emergence in the guava trees which were pruned severely. Similar, results were noticed by Suleman Mohammed (2006), Jadhav *et al.* (2002), Shaik and Hulmani (1993) and Bajpai *et al.* (1973). It might be due to more reserve food materials available to individual vegetative bud (Syamal and Rajput, 1989) and more light interception in trees will induce early sprouting of vegetative buds. According to Mika (1986) the beneficial effect of mango pruning on the bearing is attributed to the removal of apical dominance, release of buds from correlative inhibition and well functioning of the communication system within the trees. It also observed that only the newly developed shoots bear the flowers. Barlow and Hancock (1962) showed that decapitation of growing apple shoot tips or removal of young growing leaves stimulates axillary buds to sprout early. They proposed that growth of axillary meristems is inhibited by the young leaves at the apex of the main axis. When the shoot apex is removed in woody perennials three important results occur (1) Dominant buds are removed, (2) The proportion of buds to the remaining tree parts were changed and (3) The lower buds usually less developed and not predisposed to fast growth become dominant, if the shoot in the apex region are removed early in the season, the lower buds develop into strong laterals and the amount of growth and the number of strong laterals is increased several times (Mika, 1975). All the treatments have recorded the early vegetative bud appearance after pruning compared to control (7.97 days). There was significant difference in the number of days taken to first vegetative bud appearance of pruned shoot was early (58.97 %) under all the pruning levels compared to control. Minimum number of days taken by 10 cm pruning level. Among the pruning intensities studied, maximum number of vegetative buds per pruned shoot (13.21) was recorded with 30 cm pruning intensity followed by 20 cm (10.29) which differed significantly. However, the results are contrary to the findings of Lal singh and Godara (1985) who found that higher number of vegetative bud sprouting was obtained under severe pruning in ber. When compared to control (6.85), various treatment have recorded more number of vegetative buds sprouted per pruned shoot.

Among the three pruning intensities studied, maximum number of new shoots per pruned shoot (6.82) was recorded with 30 cm pruning intensity which was significantly superior to 20 cm (5.65) and 10 cm (4.31). Severely pruned trees there were fewer number of new shoots per pruned shoot. As the number of new shoots per pruned shoot was reduced with increase in the severity in phalsa (Naram naidu, 1987) and in apple (Gardener *et al*.,1922). It might be due to less number of vegetative buds left on the severe pruned shoot. The control recorded the minimum number of new shoot per pruned shoot (2.96) than all other treatments. Among the pruning intensities studied, maximum cumulative length of new shoots (31.77 cm) was recorded with 10 cm pruning intensity which was at par with 20 cm (28.04 cm) followed by 30 cm (25.83 cm). Maximum shoot length was found with severely pruned trees earlier by Shaban and Haseeb (2009) and Jadhav *et al.* (2002) in guava, Jawadgi *et al.* (1996) in ber, Balasubramanyam *et al.* (1997) in pomegranate and Gardner *et al*. (1922) in apple. The increase in shoot length might be attributed to the less number of shoots and more food reserves available to individual shoots, which were left after pruning. These findings are in agreement with the findings of Syamal and Rajput (1989) in ber. The lowest cumulative length of new shoots (17.01 cm) after flowering at 90 DAP was recorded in control. These results are in line with the findings of Kusuma Kumari (2001) in guava.

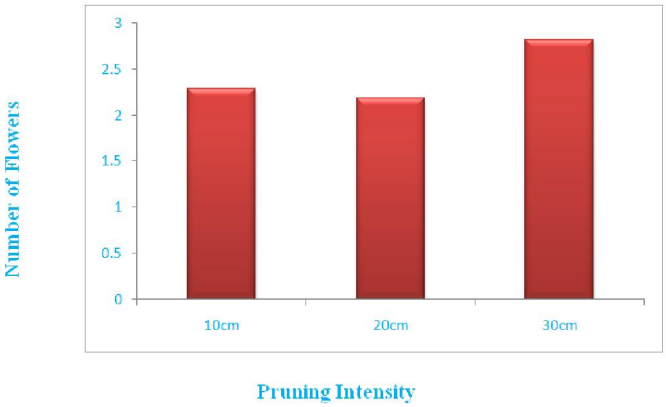

Fig. 1. Effect of pruning intensity on number of flowers at third pair of leaves from base of the shoot of guava cv. Allahabad Safeda

It is evident from the data (Table 1) that there was significant increase in the fruit diameter, average fruit weight at harvest and fruit yield under all pruning treatments as compared to control. Maximum fruit diameter at the time of harvest (7.45 cm) was recorded with 10 cm pruning which was significantly superior to 30 cm pruning (7.19 cm) and 20 cm pruning (7.17 cm). Maximum fruit diameter was noticed with severe pruning. Similar results were noticed earlier by Syamal and Rajput (1989) in ber and Sheikh and Rao (2002) in pomegranate. The combination of 10 cm pruning intensity with 30 fruits pre tree has recorded maximum fruit diameter (7.87 cm) which was significantly superior to all other treatments followed by 20 cm with 40 fruit load (7.30 cm). Sheikh and Rao (2002) found that the highest fruit diameter and fruit weight were noticed with severe pruning and 30 fruit load against mild pruning and 50

Table 1. Effect of pruning intensities and fruit load on growth, yield and quality parameters of guava under high density planting

Treatments		Fruit diameter at the time of harvest	No. of days for colour turning stage	Average fruit weight (g)	yield (kg tree^{-1})	yield (t ha^{-1})	Total soluble solids (°Brix)	Acidity (%)	Total sugars (%)	Ascorbic acid (mg 100g^{-1})
Pruning intensity	Fruit load									
Control	Unpruned trees	6.15	125.88	226.13	6.21	9.93	10.30	0.231	9.04	237.38
10 cm	30 fruit	7.87	116.31	292.24	8.71	14.04	9.97	0.246	8.48	230.45
	40 fruit	7.23	114.20	263.24	10.52	17.01	9.95	0.247	8.45	231.35
	50 fruit	7.26	112.21	255.13	12.76	20.41	10.02	0.244	8.52	232.22
Mean		7.45	114.24	270.26	10.66	17.16	9.98	0.245	8.48	231.34
20 cm	30 fruit	7.09	113.57	221.38	6.63	10.61	10.15	0.238	8.75	231.19
	40 fruit	7.30	117.04	231.69	9.26	14.82	9.90	0.240	8.73	232.02
	50 fruit	7.12	112.15	209.34	10.46	16.74	9.92	0.237	8.95	233.10
Mean		7.17	114.25	220.80	8.78	14.05	9.99	0.238	8.81	232.10
30 cm	30 fruit	7.14	91.21	247.03	7.40	11.84	9.82	0.242	8.73	231.99
	40 fruit	7.26	112.98	239.60	9.58	15.32	10.00	0.239	8.37	234.45
	50 fruit	7.16	109.94	241.12	12.05	19.13	9.95	0.248	8.68	234.16
Mean		7.19	104.71	242.58	9.68	15.43	9.92	0.243	8.73	233.53
Mean	30 fruit	7.36	107.03	253.55	7.58	12.16	9.98	0.239	8.65	231.21
	40 fruit	7.26	114.74	244.84	9.79	15.72	9.95	0.240	8.65	232.60
	50 fruit	7.18	111.43	235.26	11.76	18.76	9.96	0.242	8.71	233.16
S.Em ±	Pruning Intensity (PI)	0.05	0.95	5.58	0.26	0.43	0.05	0.001	0.19	1.68
	Fruit Load (FL)	0.05	0.95	5.58	0.26	0.43	0.05	0.001	0.19	1.68
	PI x FL	0.09	1.65	9.66	0.46	0.74	0.09	0.002	0.33	2.91
CD at 5%	Pruning Intensity (PI)	0.17	2.83	16.57	0.79	1.28	NS	NS	NS	NS
	Fruit Load (FL)	NS	2.83	16.57	0.79	1.28	NS	NS	NS	NS
	PI x FL	0.29	4.90	NS	NS	NS	NS	NS	NS	NS

fruits load in pomegranate. Sathya Prakash *et al.* (2012) opined that guava fruit size has direct correlation with number of fruits borne on the trees. The minimum number of days taken for harvesting at colour turning stage (104.71) was recorded with 30 cm pruning which was significantly superior to 10 cm pruning (114.24 days) and 20 cm pruning level (114.25 days). These results are in agreement with those of Naram Naidu (1987) who has reported that fruit maturity was delayed with increased severity of pruning in phalsa. This may be due to the reason that early flowering in light pruning treatments resulted in early maturity. Minimum number of days taken for harvesting at colour turning stage (107.03) was recorded with 30 fruit load followed by 50 fruit load (111.43 days) which differed significantly. Compared with high crop load trees, fruit from low crop load trees showed advanced maturity at harvest was reported by Jens *et al*. (2005) in apple and Abeer and Mohsen (2010) in peach. The combination of 30 cm pruning intensity with 30 fruit load has recorded minimum number of days taken for harvesting at colour turning stage (91.21) which was significantly superior to 30 cm pruning with 50 fruit load (109.94 days) and 20 cm pruning with 50 fruit load (112.15 days). The maximum average fruit weight at harvest (270.26 g) was recorded with 10 cm pruning followed by 30 cm pruning (242.58 g) which differed significantly. Maximum fruit weight was obtained with severe pruning. Similar, results were noticed earlier by Shaik and Hulmani (1993) in guava, Bhanu Pratap *et al*. (2009) in mango and Syamal and Rajput (1989) in ber.

The increase in weight could be due to utilization of whole food materials among the fewer fruits recorded under sever pruned trees. Similar results are obtained earlier by Bajpai *et al.* (1973) in guava. Maximum average fruit weight at harvest (253.55 g) was recorded with 30 fruit load which was on par with 40 fruits load (244.84 g) followed by 50 fruit load (235.26 g). Sathya Prakash *et al.* (2012) opined that guava fruit size has direct correlation with number of fruits borne on the trees. Owing to high leaf to fruit ratio and availability of more photosynthates due to removal of current season's growth, the fruits gained larger size and weight compared to those from unpruned trees. The maximum fruit yield per tree (10.66 kg) was recorded with 10 cm pruning followed by 30 cm pruning (9.68 kg/tree) which differed significantly. Sathya Prakash *et al.* (2012) noted that highest fruit yield per tree was obtained with severely pruned trees of guava. Chandra and Govind (1995) noticed that pruning intensities in high density plantation of guava, showed that the highest fruit yield was obtained with above 70 per cent pruning intensity but the fruit weight was reduced by pruning intensities above 25 per cent. Rajendra *et al*. (1980) reported that increase in the severity of pruning increased the total yield per tree by way of producing bigger fruits in apple. Gorakh Singh (2011) reported that maximum yield was recorded with pruning under high density planting in guava compared to control trees. It is due to more light interception within tree canopies as a result of pruning. Maximum fruit yield per tree (11.76 kg) was recorded with 50 fruit load followed by 40 fruit load (9.79 kg/tree) and they differed significantly. Sdoodee *et al.* (2008) reported that the highest yield was found in high crop load mangosteen trees. Yuri *et al*. (2011) found that mean fruit weight of apple decreased with increasing fruit crop load. Fruit quality was generally high for all treatments which were on par with control fruits. These findings are in agreement with the findings of Meland (2009) in apple crop load. Fruit number did not affect soluble solid content or acidity of grape (Moon dooYoung and Lee Don Kyun, 1996). But fruit yield was significantly increased without affecting the fruit quality through pruning and fruit load in high density planting of guava.

In context to the high density plantation without employment of pruning technology; Yadav and Kale (1992) reported marked reduction in the biochemical content of the desirable parameters like TSS, sugars, ascorbic acid and increased in acidity with increased density. However, in the present investigation, the fruits from high density planting were satisfactory for fresh consumption. Similar results were also reported by Bal and Dhaliwal (2003), Kundu (2007), Lal *et al*. (2007), Singh *et al*. (2007) and Ravishankar *et al*. (2008). According to them, it was due to crowding of plants. The sunlight competition at the higher plant densities resulted into much taller trees causing shading of the adjacent trees and reduction in the area exposed to the sunlight. Similarly, the dense foliage in high densities resulted in shading its lower canopy thereby affecting the photosynthesis and reduction in carbohydrate production. The observed deteoration in fruit quality in earlier studies of close planting without pruning was attributed to uneven and poor penetration of sunlight, reduction in leaf area and chlorophyll content of leaf. However, the results obtained in present investigation showed that the observed fruit quality from high density plantation was not widely deviating from the control fruit quality and thus, it proved importance of pruning technology in high density planting. Fruit trees will often set more fruit than is needed for a full crop. Excessive fruit set often will result in small fruit with poor quality. Thinning in the early stages of fruit growth increases size of remaining fruits. As a result of fruit load, the fruit quality of the winter crop got improved producing more sugars, TSS and ascorbic acid whereas acidity of the fruit was decreased. Fruit size, fruit weight and organoleptic values were also found improved as compared to control (Tahir and Kamran Hamid, 2002). Thus, in the present investigation, pruning of shoots and fruit thinning were attempeted under high density planting. As a result, high yield was obtained under high density planting without affecting the fruit quality of guava.

Conclusion

From the results, it can be concluded that, pruning of 10cm is suitable for commercial fruit production as the growers are more concerned with early vegetative bud appearance, number of vegetative buds per pruned shoot, cumulative length of new shoots and fruit yield. Pruning intensity of 30 cm can be utilized for maximum number of new shoots per pruned shoot, advancement of flowering and time of harvesting for capturing early market with increased fruit yield. Retaining 50 fruits per tree can result in maximum fruit yield with good quality fruits. However, the quality of fruits in control and other treatments was at par with each other. From the results, it is very clear that the growth, yield and fruit quality of guava for commercial production can be manipulated easily by horticultural practices like pruning and restricted fruit load per tree for good yield depending upon the situation.

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