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Review Article

Influence of Pruning on Yield and Quality of Guava :A Review

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Abstract

The productivity of guava is presently much below the productive potential, due to traditional practices and prevalence of old and unproductive orchards with declining yield efficiency. Moreover, large trees take several years before they come into bearing and overall cost of production per unit area is further increased. The hi-tech and Innovative methods which include high planting density have been identified to increase guava production in India in order to be competitive in world market. The response of guava to training and pruning for canopy modification is well known. It is one of the most suitable for high planting density, as it bears on current season's growth and responds to pruning. Modifications in pruning and training techniques influence plant spacing and production decision. Similarly, unpruned tall and crowded guava trees pose a number of problems while carrying out various cultural operations. Guava has a higher proportion of 'shade' to 'sun' leaves and their leaves are found photo synthetically inactive under deeper shade and act as unproductive sink. Therefore, vegetative growth, fruit yield and quality are functions of light interception and translocation of light energy into chemical energy.

Keywords: Guava; High density planting; Pruning; Productivity; Quality; Yield.

Introduction

Guava (*Psidium guajava* L.) is known as poor man's fruit. It is an important fruit crop in tropical and subtropical regions of the country, due to the hardy nature of its tree and prolific bearing even in marginal lands. Among fruits, guava has a very special place owing to its nutrient contents and is known as "The apple of tropics". The fruit is an excellent source of ascorbic acid, pectin, minerals like phosphorus, iron and calcium etc. as well as vitamins like vitamin A, thiamine, riboflavin, pantothenic acid and niacin (Sharma, 2010). The fruits are in demand in domestic as well as in international market and traded in more than sixty countries. The total production of Guava in India is 3648.2 thousand metric tonnes with an area of 261.7 thousand hectare and productivity is 13.9 metric tons per hectare. In Jammu and Kashmir it is grown in area of 2.46 thousand hectare with a production of 8.65 thousand metric tons (NHB, 2017). At present, guava is cultivated largely through a traditional system, plant takes 5-6 years

for coming into full commercial bearing which increased the cost of cultivation. Land area for fruit cultivation is shrinking due to urbanization and industrialization. Currently, there is a worldwide trend to planting fruit trees at higher density to control tree size and maintain desired architecture for better light interception and ease in operations such as pruning, pest control and harvesting. The system of orcharding having more number of plants per unit area than that is planted under traditional system of planting is called high density orcharding. Increased yield with high density orcharding in guava have been reported by many workers (Bal and Dhaliwal, 2003, Rajput *et al.* 2004). It facilitates to enhance economic production, productivity and quality of fruits and provides efficient use of natural resources. It assures effective use of fertilizers and pesticides as well, which are frequently lost in traditional, wide spaced orchards. Hence, there is overriding need to improve the existing planting system. Therefore, the high density planting system is only one of the ways to increase production and productivity and to minimize the cost of cultivation. The underlying principle of HDP is to make the best use of vertical and horizontal space per unit time and to harness maximum possible return per unit of inputs and natural resources. There are several advantages of high density planting such as early production, high returns per ha, efficient use of fertilizers and irrigation water (Purohit, 1988). The conceptual background of high density planting in fruit growing was pioneered in temperate fruits and first planted at the end of the nineteen sixties, since then there is rise in establishment of commercial high density orchards throughout the world. HDP system is normally understood as a system in which a higher number of plants are accommodated per unit area in comparison to the conventional planting density. However, the exact limit of plant density to be termed as HDP is not yet well defined. It varies with growing region, species, variety, rootstock, agro-techniques adopted for a particular crop and return from the orchard. In India, high density plantings have successfully been demonstrated in guava (Lal *et al.*, 2007). It has been recommended that planting distance for guava should be more in the East-West direction (i.e. between rows) than in the North-South direction (i.e. between plants) as the East-West spread of the trees have a greater bearing (Anon., 1986). Pruning and high density planting in most of the temperate fruit for higher production of quality fruit per unit area has already been taken a lead in major fruit growing areas. However, in tropical and sub tropical fruit the concept of high density planting is gaining a momentum with the introduction of growth retardants, pruning and training techniques. High density planting orchard may be exploited by managing the plant canopies through standardizing the training techniques.

Pruning in guava

Fruit tree pruning is the cutting and removing of selected parts of a fruit tree. It spans a number of horticultural techniques. Pruning often means cutting branches back, sometimes removing smaller limbs entirely. It may also mean removal of young shoots, buds, and leaves. Established orchard practice of both organic and non-organic types typically includes pruning. Pruning can control growth, remove dead or diseased wood, and stimulate the formation of flowers and fruit buds. It is widely stated that careful attention to pruning and training young trees improves their later productivity and longevity, and that good pruning and training can also prevent later injury from weak crotches or forks (where a tree trunk splits into two or more branches) that break from the weight of fruit, snow, or ice on the branches. In guava terminal portion of the shoots up to 20 or 30 cm length should be pruned between 20th to 30th April. Always avoid severe pruning in guava. Pruning the current season's growth of spring flush to avoid the rainy season crop was advocated by Singh (1980). Pruning current season's growth of spring flush to avoid rainy season crop has been advocated in northern parts of the country (Tiwari *et al.*, 1992). The pruning of 25-50% shoots on 20 April, 10 May or 30 May was found to escape flowering in rainy season and encouraged winter season flowering of Sardar guava (Dhaliwal *et al.*, 1998).

Growth Regulators

Plant growth regulators (PGRs) or phytohormones are organic compounds, other than nutrients, that produced naturally in higher plants, controlling growth or other physiological functions at a site remote from its place of production and active in minute amounts, modify plant physiological process. PGRs called biostimulants or bioinhibitors, act inside plant cells to stimulate or inhibit specific enzymes or enzymes systems and help regulate plant metabolism. They normally are active at very low concentrations in plants. Plant growth regulators generally include auxins, gibberellins, cytokinins, ethylene, growth retardants and growth inhibitors. Auxins are the hormones first discovered

in plants and later gibberellins and cytokinins were also discovered. PBRs are used more extensively in tree fruit production than in any other horticultural or agricultural commodity, and they are essential for effective and profitable production. Several commercial uses have been selected to illustrate the evolution of the involvement of PBRs from infancy to the present and progress made in the fundamental understanding of how regulation by PBRs is achieved.

Effect of pruning on vegetative and floral characteristics of Guava

Sheikh and Hulmani (1997) observed that severe pruning (30 cm) produced the little longer shoot length followed by mild pruning (15 cm) and control in the rainy season of guava plants. Dubey *et al.* (2001) in guava reported that 25 percent pruning intensity produced maximum number of sprouts per shoot as compared to control. 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. 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. Brar *et al.* (2007) observed that the increased pruning intensity in guava increased fruit set and reduced flower drop. 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. Kumar and Rattanpal (2010) studied the effect of pruning in guava planted at different spacing under Punjab conditions. The mean tree height was found maximum (5.6 m) in control trees of 6 x 6m spacing and was minimum (4.7 m) in pruning by removal of half the vegetative growth at spacing of 6 x 4 m. 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. Lakhpati *et al*. (2013) reported that Allahabad Safeda under high density planting with three pruning intensities i.e. leaving 10, 20 and 30 cm from base of the shoot and retaining 30, 40 and 50 fruits per tree, resulted in maximum cumulative length of new shoots. Pruning intensity of 30 cm has increased the number of vegetative buds per pruned shoot and number of new shoots per pruned shoot along with early harvesting at color turning stage.

Effect of pruning on quality characteristics of guava

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. Singh *et al.* (2003) suggested canopy modifications by training and pruning and the need for topping and hedging for having a high density planting system. They recommended a density of 3 x 6 m (555 plants/ha) for the cultivar Allahabad Safeda. 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. Gorakh Singh (2011) reported that canopy management under high density planting in guava found highly beneficial towards better tree canopy shape and quality production. 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. Pratibha *et al*. (2013) reported that the plant height was increased in high density planting may be due to unrestricted apical growth. Pankaj *et al*. (2016) studied the effect of pruning severity and plant spacing on yield and fruit quality of guava cv. Pant Prabhat under high density planting and revealed that yield and quality of guava fruits can be influenced by pruning severity. Fruit yield per hectare increased with increase in plant population per unit area. However, chemical qualities of the fruits were found superior at 2.0 x 2.0 m spacing. For obtaining higher winter season crop and enhanced fruit quality under high density

plantation of guava, complete removal of non fruiting shoots followed by one leaf pair shoot pruning of current season growth (i.e. retaining one leaf pair at the base of the newly emerged shoots) should be done during first week of May.

Effect of growth regulators on vegetative and floral characteristics of guava

Singh *et al*. (1990) reported that use of chemicals like NAA, ethephon, MH, KI and urea caused defoliation in guava. Brahmachari *et al*. (1995) studied effect of foliar spray (one before flowering and one a month after fruit set) of NAA, PCPA, 2,4,5-T, GA_3, Kinetin and CCC in 6 years old guava cv. Sardar and found that spray of 250 and 500 ppm CCC has enhanced fruit set as well as improved weight and quality of fruit. Jain and Dashora (2007) studied the effect of various plant growth regulators at different concentrations namely, NAA (100 and 200 ppm), Ethrel (250 and 500 ppm), Paclobutrazol (250 and 500 ppm), CCC (500 and 1000 ppm) and triacontanol (5 and 10 ppm) on growth, flowering, fruiting and yield of winter season crop of guava cv. Sardar and found that 60 days after treatment the mean maximum increase in shoot length (36.25%) was observed in 100 ppm NAA treatment whereas, maximum increase in shoot diameter (34.95%) was recorded in 500 ppm PBZ. However, mean minimum days taken to initiation of flowering (29.0), maximum number of flowers/shoots (7.77 /shoot), maximum fruit set (71.17%), highest fruits retention (73.16%) with minimum days taken to harvesting (115.33) and maximum yield (63.83 kg/plant or 17.74 tonnes/ ha) were recorded in 500 ppm paclobutrazol (PBZ) treatment. Lal *et al*. (2013) studied the effect of plant growth regulators on flowering and fruit growth of Allahabad Safeda guava under Assam condition and recorded maximum number of flowers (16 per shoot), highest fruit set per cent (93.13) and maximum number (6.2) of fruits per shoot at harvest were found with 1000 ppm CCC treatment and minimum fruit drop (38.8%) and maximum yield (37.1 kg/plant) were recorded under 50 ppm GA_3 treatment.

Effect of growth regulators on quality characteristics of guava

Brahmachari *et al*. (1995) reported that application of ethrel at 25 or 50 ppm in guava enhanced fruit set percentage, weight, quality of fruit while, reduced number and weight of seeds thereby increased pulp / seed ratio. Singh and Reddy (1997) reported that all treatments like NAA, ethephon, urea and potassium iodide improved the mean fruit weight of Sardar guava and the maximum fruit weight was observed with 10 per cent urea spray during both rainy and winter season crops. Dubey *et al*. (2002) while studying the effect of various concentrations of NAA (125, 250 and 750 ppm) on quality of guava revealed that treatments, NAA 250 ppm significantly recorded maximum TSS, total sugars and vitamin C contents of winter season guava cv. Allahabad Safeda. Singh and Bal (2006) reported maximum fruit size, TSS and vitamin C content in guava cv. Sardar at wider spacing (6 x 5 m). Fruit weight was maximum in 6x3 m and minimum in 6x4 & 6x2 m spacing. Acidity was minimum in 6 x4 m spacing and maximum in 6x2 m spacing. Pre-harvest foliar application of growth promoters like NAA (100-200 ppm), GA3 (25-75 ppm) and Triacontanol (5-15 ppm) applications were reported to bring improvement in yield and quality of guava fruits and revealed that foliar application of NAA 200 ppm recorded maximum fruit size (53.14 cm^2), fruit weight (138.53 gm), specific gravity (1.17 gm/cm^3) and minimum seed weight (5.19 gm). The quality of fruits in terms of total soluble solids (11.47%), reducing sugar (4.48%), ascorbic acid (239.03 g/100g pulp) and total sugar (7.43%) were also significantly higher with NAA 200 ppm. Datta and Banik (2007) studied the effect of foliar feeding of nutrients and plant growth regulators on physico-chemical quality of Sardar guava and reported that, the maximum length of fruit (6.24 cm), TSS (10.85 °B), total sugars (7.25%) and ascorbic add (135.420 mg/l00g fruit) was obtained with treatment urea + K_2SO_4+ Zinc + NAA. Garasiya *et al*. (2013) studied the effect of various concentrations of GA_3 (50 and 100 ppm), NAA (20 and 40 ppm), 2, 4-D (5 and 10 ppm) and CCC (250 and 500 ppm) on quality of winter season guava cv. L-49 and found that among all the treatments, NAA 40 ppm gave significantly maximum TSS, reducing sugar, non- reducing sugar, total sugars and ascorbic acid contents in guava fruits. Moreover, an application of NAA 200 ppm significantly reduced acidity (0.20%) (Singh *et al*., 2017). Singh and Kaur 2018 revealed that ethephon 750 ppm could be used for enhancing the quality characters of guava fruits cv. Sardar. GA_3 50 ppm proved to be the best in increasing the quality characters like TSS, ascorbic acid and total sugars in both the guava cv. Arka Mirdula and Arka Amulya cultivars (Jayalakshmi and Shakila., 2018).

Effect of pruning and growth regulators on yield characteristics of guava

Jadhav *et al*. (1998) had reported highest fruit yield of guava cv. Sardar with single pruning 60 cm from the tip on 25 April. Growth and yield characters were significantly influenced by planting systems cum densities viz., square system, hedgerow system, double hedgerow system, and paired planting in guava cv. *Sardar* under rainfed conditions and the highest yield was recorded in paired planting. The girth and volume of tree showed decreasing trend with increasing tree density while tree height increased with increasing tree density in Allahabad Safeda guava (Kumar and Singh, 2000). Singh *et al*. (2001) studied the effect of pruning dates on yield of Guava cultivars i.e. Allahabad Safeda and Sardar for five consecutive years. The yield during winter season was increased significantly in May and June on pruned trees than the unpruned trees of both the varieties. Dubey *et al*. (2002) studied the effect of various concentrations of NAA (125, 250 and 750 ppm) on the reproduction of guava and revealed that among all the treatments NAA 250 ppm gave significantly maximum fruit set in winter season of guava cv. Allahabad Safeda. Singh and Bal (2002) reported that, under different spacing viz. 6x4, 6x5 and 6x6 m in guava cv. Sardar, the yield per tree and Vitamin C were maximum in closely spaced trees.

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. Increase in plant density markedly increased the plant height while, the basal girth of the plant and spread of the crown decreased in guava cv. L-49 (Kundu, 2007). Singh *et al.* (2007) recorded maximum plant height and trunk circumference, while minimum canopy spread (NS/EW) in closely spaced guava trees (1.5×3.0 m) under closer spacing, increase in height might be due to competition for light because of insufficient space. Mate *et al*. (2009) used plant growth regulators during hasta bahar under Maharashtra condition and reported that, the foliar spray of combination of GA_3 100 ppm + Etherl 600 ppm + Cycocel 1000 ppm produced highest number of fruits (213.87 /tree), yield (38.29 kg/tree) and percentage of number of fruits (45.43). Foliar sprays of urea 2% + NAA 100 ppm produced maximum fruit weight (198.369 g) and highest yield (95.39 kg/tree) (Katiyar *et al*., 2009). Jain and Dashora (2010) studied the effect of different bioregulators in relation to fruit quality and yield of guava cv. Sardar under Rajasthan condition and reported that maximum yield (63.83 kg/tree) was recorded in 500 ppm PBZ treatment. Kumawat *et al*. (2014) reported that the yield of guava fruits can be influenced by high density planting. Higher yield per hectare was obtained with plant spacing 1.0x 1.0 m. Plant spacing caused an impact on fruit yield per plant, as the plant population per unit area increased, yield per plant decreased during both seasons and years. Lower number of flower bud and fruits per plant in closely spaced plants seems to be due to lesser photosynthetic activity, because of exposure of less number of leaves to sunlight, overlapping of branches and reduced fruiting area due to more number of plants per hectare and high competition for nutrient caused lower yield per plant, while higher yield per hectare with close spaced plants may be due to more plants accommodated per unit area in guava.

Conclusion

- HDP and meadow orcharding gives higher yield as well as returns/unit area due to increasing the no. of trees/unit area. It is possible by regular pruning and use of bioregulators for maintaining the size and shape of the tree.
- Guava planted at spacing 3m x 6m, 3.0 m x 3.0 m and 3.0x1.5 m under HDP and 2m x 1m under meadow gives higher production as well as more income in Shweta and L-49.

Future Thrust

- There is need to more research on time and intensity of pruning in guava
- Screen the varieties having less canopy area and erect growth.
- Research on PGR for increasing yield and improving quality under HDP as well as meadow orchard system.

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