Response of pruning in canopy management & high density planting in guava orchard under western Uttar Pradesh condition

Virendra Pal¹, Naveen Chandra², Anant Kumar³ and Mukesh Kumar⁴

^{1&2}KrishiVigyan Kendra, Hastinapur, (S.V.P. University of Agriculture & Technology, Meerut, U.P.)

³KrishiVigyan Kendra, Ghazaibad (S.V.P. University of Agriculture & Technology, Meerut, U.P.)

⁴Department of Horticulture, S.V.P. University of Agriculture & Technology, Meerut (U.P.)

Abstract

The current study was conducted to examine the response of pruning in canopy management and high density planting in Guava orchard under Western Uttar Pradesh condition. Observation revealed that with the pruning and high density with plant spacing (from 3.0 × 3.0 m) increased in yield significantly, similarly, with increase in spacing wise pruning in canopy management and high density was need to increased. Plant growth in term of stock girth (47.20 cm) of *P. guajava* cv. Florida seedless and scion girth (44.7 cm) of *P. guajava* cv. Allahabad seedless, tree spread (N - S) and canopy volume increased with the plant spacing (3.0 × 3.0 m), while tree height decreased. To increase in plant spacing, number of fruits per plant, yield per plant and fruit density was higher at 3.0 × 3.0 m and least in 6.0 × 6.0 m plant spacing. Pruning in canopy management and high planting density was found to be better owing to maximum absorption of solar radiation and optimum microclimate in the orchard leading to better yield in plants, higher fruit density and yield efficiency, However yield per hectare was maximum 3.0 × 3.0 m spacing in during rainy season and in 6.0 × 3.0 m spacing during winter.

Keywords: Pruning, Canopy management, High density and Guava orchard.

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Introduction

Guava (*Psidiumguajava* L.) is a very important tropical fruit crop grown in India. It is hardy, prolific bearer and highly remunerative fruit crop and also can be grown satisfactorily even in adverse soil and climatic conditions. Presently, it is major fruit crop after mango, pear, Litchi and banana and occupies an area of 284 lac hectare with an annual production of 24.8 lakh MT. In Meerut, guava ranks second in cultivation after mango and occupies an area of 1423 ha with a production of 4205 MT. Guava fruit is rich in vitamin C with fair amount of Ca, P, pantothenic acid, riboflavin, thiamin and niacin. The fruits are used for making juice, jam jellies and various culinary products. Guava fruit also have certain antioxidant properties and is known to control systolic

blood pressure. Guava flowers twice a year, in April-May for rainy season crop and flowers appear in the axils of new leaves. Guava tree respond well to annual pruning and considered suitable for high density planting.

Presently the productivity of guava is much below the productive potential, due to following traditional practices and practices and prevalence of old and unproductive orchards with declining yield efficiency. Moreover, large trees take several years before they come into bearing and less number of trees per unit area is author constraints in guava production. Therefore, the main emphasis should be laid on management of tree canopy in such a way fruits per unit area. Guava is recommended to be planted in the state at 7.5 × 7.5 m to 6.0 × 3.0 spacing but there is always a scope to increase production

and income from a unit land area by proper management of tree canopies. In the present, high density plantation with managed canopies is the need of the hour to achieve high productivity per unit area.

Canopy management in Guava

For managing the canopies of the trees under high density planting approaches like pruning and use of growth retardants singly or in combinations may be exploited. But under high density planting system, light and other microclimatic conditions are important aspects which directly or indirectly affect the vegetative growth, yield and quality of guava fruits. In case of temperate fruits like apple, pear and peach extensive study have been made but little work has been done on tropical and sub-tropical fruit crops. As guava tree respond well to canopy modification with respect to vegetative and reproductive growth (Singh and Canaan, 2005), therefore, modification of canopy through pruning and use of certain growth regulators in high density orchards may be steps to enhance the production efficiency.

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 (Singh and Singh, 2007). Therefore, vegetative growth, fruit yield and quality are functions of light interception and translocation of light energy into chemical energy. Quality fruit is function of absorption of light and light is directly proportional to the yield of fruit trees (Jackson, 1980; Palmer, 1989). Light interception was more in guava trees planted, at wider spacing and decrease significantly with the depth of the canopies irrespective of the planting densities (Singh *et al.*, 2005). It is observed that fruit yield and quality of guava fruits decreased with poor light interception at higher planting densities (Singh and Dhaliwal, 2007). Therefore, management of canopy under high density planting as must for proper

light penetration. Narrow spacing (6×2 m) in guava increased the production per unit area and fruits had significantly higher values for total soluble solids, vitamin C, sugars and lower values of acidity (Chundawat *et al.*, 1992). Increased yield of guava per unit area by increasing the plant population has also been reported by Singh *et al.*, (1980); Mitra *et al.*, (1984) and Avila'n and Milla'n (1984). 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).

Inspire of being a popular fruit, little efforts have made to determine the suitable planting density for guava and meager information is available on this aspect under western Uttar Pradesh conditions. The planting density of 132 plants per hectare (6×5 m) is now recommended. Thus, there is a need to determine proper plant population under high density planting system for producing good quality fruits and to get maximum yield per unit land area. Now, pruning has emerged as a commercial and alternative method for regulating the crop in guava (Tiwari *et al.*, 1992). Thus, the pruning may be helpful in reducing the tree size and improving the fruit quality as well. This gives an opportunity to increase the number of trees per unit area and subsequently the higher yield. Untrained or Untrained guava trees become huge and unmanageable even after 3-4 years of planting. The bearing area is reduced and the interior of the plant becomes entirely devoid of fruiting. Trees are pruned to increase the yield of quality fruits by removing the crowded and criss-crossed branches.

Training and pruning begins at an early stage of plant growth to develop single trunk trees with well spaced scaffold branches to form the strong frame work. Apical growth is to be controlled within the first year of planting for better canopy architecture. Trees are topped to a uniform height of 60-75 cm from the ground. As a result, new shoots

emerge. About 3 to 4 equally spaced shoots are retained around the stem to form the main scaffold limbs of the tree. These shoots are retained the stem to from the topping until they attain a length of about 40-50 cm. The selected shoots are further pruned to 50 per cent of their length for inducing multiple shoots form the buds below the cut ends and again emerged new shoots. This is mainly done to obtain the desired shape. The pruning operation continues maximize fruiting during the second year after density planting. After two years, the short branches within the canopy produce a compact and strong structure. All the plants are confined to a hedge and May-June of every year.

Pruning in canopy management of Guava

Tree pruning is an annual practice on Guava farms in India and is carried out to:

- Manage plant canopy and better plant architecture.
- Direct or control plant growth, to obtain the desired tree canopy.
- Encourage flower and fruit production to maximize production of high-quality fruit per unit area.
- Facilitate harvesting and to utilize the bearing area of the tree efficiently and obtain the desired leaf : fruit ratio.
- Optimize sunlight utilization and air movement in the tree. It is essential for obtaining optimal yield and high fruit quality. Dense canopies of plants results inadequate air movement promote fungal and insect pests within the tree.
- Effect rejuvenation by removing dead or excessive wood or shoots.
- Allow spraying and cultural practices to be applied more effectively.
- Extent the production period.

Guava fruit bears on current season's growth and respond very well to pruning. The production season of Guavas can be controlled by the time of pruning. If pruning is done later

in the season, fruit will also be harvested later. Pruning usually involves there basic techniques: thinning, heading back and pinching or tipping, Thinning involves the removal of entire branches at the point of origin. By thinning, the plant is reduced without obviously altering its size or form. Heading back is the process of pruning to shorten branches. Heading back is usually used to induce production of flowers and fruit and to limit tree size. Pinching involves the removal of the growth tip of the stem. This action will stimulate the growth of side branches. Plant growth substances play a vital role in development of auxiliary shoots. These different techniques are usually combined to obtain the desired tree structure. Limited sunlight penetration will adversely affect yield and fruit quality once the tree starts bearing.

Role of rootstocks in high density planting and canopy management

Root stocks and dwarfing cultivars can play a great role in high density planting and canopy management. Unfortunately little work has been done in this direction. Still no dwarfing rootstock or cultivar is available. (Sharma *et al.*, 1992) evaluated the different rootstocks of guava with Allahabad safeda guava at IARI New Delhi and found that *Psidiumpimilum* has some dwarfing effect as tree spread; plant height and stem girth was minimum as compared to other rootstocks (Table 1).

Sharma *et al.*, (1992) also developed dwarfing aneuploidy guava rootstock. The aneuploidno. 82 had great effect on restricting the plant growth (Table 2). Plant height, plant spread and canopy volume was significantly reduced when Allahabad safeda guava was grafted on aneuploid no. 82 guava. However, due to problem ofstability, the work may not be progressed further. More work on such lines should be conducted in this direction.

High density planting in Guava

Due to large tree canopy, the traditional system of cultivation has often

posed problems in obtaining desired fruit productivity per unit area. Therefore, there is need of changing production system in guava by manipulating its natural plant canopies. Currently, there is a worldwide trend of higher density planting to control tree size and maintain desired architecture for higher productivity. Better light interception and

improved microclimatic conditions in the orchard and within the plant canopy not only improved the productivity but improve the quality of fruits and reduce the stress of pests and disease. So, that the high density or meadow recharging facilitates enhance production and quality of fruits by managing the plant canopies in different ways.

Table 1: Effect of different rootstock on growth of Guava cv. Allahabad Safeda

Rootstock	Height (M)	Stock Girth (cm)	Scion girth (cm)	Spread	
				NS	EW
<i>P. cattleianum</i>	4.03	44.02	40.8	441	481
<i>P. cujavillus</i>	4.01	41.13	38.2	501	520
<i>P. pumilum</i>	3.72	40.15	40.1	427	462
<i>P. guajava</i> cv Allahabad Safeda	3.81	46.76	43.2	472	481
<i>P. guajava</i> cv Florida seedless	4.11	47.20	40.8	467	502
<i>P. guajava</i> cv. Allahabad seedless	4.25	47.17	44.7	506	501
CD 5%	NS	NS	NS	NS	NS

Table 2: Effect of aneuploid No. 82 guava on plant growth and fruit yield of Allahabad safeda guava.

Stock	Plant Height (cm)	Stock: Scion (cm)	Spread E-W × N-S (cm)	Volume (m ³)	No. of fruit per plant	Yield per plant (kg)	Yield Efficiency (kg/m ³)
A. Safeda on Aneuploid No. 82	181.8	16.7:17.0 0	170×177.5	12.3	92	17.8	1.39
Grafted Allahabad Sefeda	225.4	21.8:21.0	252.5×262.7	33.8	102	20.3	0.60
Safeda (seedling) Control	308.5	29.8:27.4	368.0 × 360.0	100.0	148	31.9	0.32
CD at 5%	20.1	1.9:1.6	24.6 × 24.9	-	23.32	4.63	-

There is a shift in farmers' insight from production to productivity and profitability which can be achieved through high density planting. Recently, there is a trend to plant fruit trees at closer spacing leading to high density or meadow orchard. Higher and quality production is achieved from densely planted orchards judicious canopy

management and the adoption of suitable tree training systems. (Singh, 2008)

Need of high density planting (HDP) in Guava

High density planting is very much desirable in guava and it is needed due to:

- Its low productivity than its production potential.
- Extensive vegetative growth of plants and it respond very well to canopy modification.
- Bearing on current season growth which is very helpful to regulate cropping throughout the year.

Benefits of high density planting:

- High production and net returns per unit area of land, especially during the first 10-15 years.
- Facilitates more efficient use of fertilizers and water.
- Effective weed control.
- Soil-fertility maintenance.
- Reduction in production costs.

Establishment of high density planting orchard (HDP):

Orchard establishment is at Research Farm, Krishi Vigyan Kendra, Hastinapur, Sardar Vallabhai Patel, University of Agriculture & Technology, Meerut, during the year 2013-2014 were studied. Rectangular system of planting/layout is preferred as it facilitates orchard operations. Planting can be done in the month of February- March and August-September. The pits of about 50 × 50 × 50 cm are dug as per layout plan. After 7 to 10days, each pit is filled with soil mixed with 10 to 15 kg organic manure and 500 gm of single super phosphate with the time of planting used of Chlorpyrphous 20 % @ 2.5 ml per liter. High density planting spacing for guava is 3 × 3m, which accommodates 1111 plants ha⁻¹. It is important to space the tree planting. Spacing of the plants in the system depends on fertility of the soil, availability of water, intensity of sunlight and wind exposure (Singh, 2008).

Table 3: Accommodation of plants in different planting systems

System of Planting	Normal Planting	High density Planting		
Plant Spacing (M)	7.5×7.5-6.0× 6.0	3.0×1.5	3.0×3.0	6.3×3.0
No. of Plants/ha.	175-275	2222	1111	555

Table 4: Comparison in Traditional and High density system of guava cultivation

Attributes	Traditional system	Meadow system
Bearing	After 3-4 years	From 2st year
Production	12-20 t/ha.	30-50 t/ha.
Management	Difficult due to large tree size	Easy due to small size
Production costs	Higher	Lower
Harvesting	Difficult	Easy
Quality	Relatively poor	Comparatively better

Future strategies

- Need to develop dwarf and semi-vigorous varieties of guava for high density planting.
- Selection and identification of dwarfing rootstock.
- Standardize pruning practices for restricting the canopy growth and for maximum interception of light.
- Effective use of various growth retardants and their concentration needs to be established.

Table 5: Fertilization application in Traditional vs. High Density orchards

Year	Urea g/plant		SSP g/plant	MOPg/plant
Traditional				
Traditional	June	September	September	June
1 st	182	78	375	100
2 nd	364	156	750	200
3 rd	546	234	1125	300
4 th	728	312	1500	400
5 th	910	390	1875	500
High Density				
1 st	90	40	185	50
2nd	180	110	370	100
3rd	270	115	555	150
4th	360	150	740	200
5th	450	190	900	250

Table 6: Yield (T/ha.): Different densities wise High Density orchards

Plant density	3 rd year	4 th year	5 th year	6 th year	7 th year
Traditional system / HDP					
1. 5 x3.0	26	38	47	52	55
3 .0 x3.0	18	26	30	35	38
6.0 x 3.0	11	17	24	28	31
6.0 x 6.0	06	12	15	19	27

Table 7: Net income from different density orchards (lakh)

Year	2.0 x 1.0	3.0 x1.5	3.0 x3.0	6.0 x3.0	6.0 x6.0
1 st	0	0	0	0	0
2 nd	1.093	0	0	0	0
3 rd	1.853	0.949	0.692	0.357	0.040
4 th	2.324	1.442	1.020	0.606	0.327
5 th	2.830	1.863	1.192	0.936	0.398
6 th	2.910	2.131	1.404	1.096	0.877
7 th	3.060	2.311	1.551	1.256	1.064

Conclusion

High density planting and canopy management 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 topical 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.

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