

## Improvement in yield and quality of guava through canopy management

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### Abstract

Guava (*Psidium guajava* L.) is important tropical fruit grown throughout the tropical and sub-tropical climatic conditions. It is hardy, prolific bearer and highly remunerative fruit crop and also can be grown satisfactorily even in adverse soil type and poor & erratic climatic conditions. The area and production of guava is increasing globally day by day, but there is no significant increase in higher productivity. So, the canopy management is helpful in achieving the high quality and productivity as well. Nowadays, there is a worldwide trend in fruit producing countries to accommodate maximum number of fruit growth using canopy management and pruning techniques to control the tree growth and tree shape ultimately to limit tree size while still maintaining high fruit production of desired quality and its significant traits. In Guava pruning is not only helps to encourage new shoots emergence after the harvest but has also been adapted for rejuvenation of unproductive orchards along with appropriate crop regulation. Canopy management includes high intensified training and pruning practices, selection of resistant and dwarf type of rootstocks with elite (100% pure) scion material, it also includes high density planting/ meadow orcharding and application of plant growth regulators. There is significant consequence of canopy management on vegetative growth, higher yield, quality attributes and improvement in bio-chemical compounds in guava, this article pertains detailed information on canopy management and its impact on Guava.

### Introduction

Guava 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. Its cultivation requires

little care and inputs. But, of late, this crop has exhibited a paradigm shift in the production system, from subsistence farming to commercial production. The traditional system of cultivation has often posed problems in attaining desired levels of productivity due to large tree canopy. Hence, a need arose to improve the existing production system, besides increasing its productivity.

Currently, there is a worldwide trend to plant fruit trees at higher density or meadow orcharding to control tree size and maintain desired architecture for better light interception and ease in operations such as pruning, pest control and harvesting. The high density or meadow orcharding facilitates enhance production and quality of fruits.

Guava (*Psidium guajava* L.) ‘The apple of the tropics’, is one of the most important fruit crops grown in India. It belongs to the family Myrtaceae. The guava fruit has gained a considerable prominence on account of its high food value, a pleasant aroma, rich flavour and availability in the market at moderate prices. It is a good source of Vitamin C (250-300mg/100g of pulp). It contains carotenoids and polyphenols which are the major classes of dietary antioxidant pigments among plant foods.

Due to their astringent properties, mature guava fruits, leaves, roots and bark are used in local medicines to treat gastroenteritis, asthma, high blood pressure, obesity and diarrhoea. Besides its high nutritive value, it yielded a heavy crop every year and gave good economics returns involving very little inputs. In general, guava bears in three seasons namely rainy, winter and spring seasons in a year. Fruits of rainy season crop are insipid, poor in quality, less nutritive and are also attacked by insect pests and diseases. On the other hand fruits of winter season crop are superior in quality, comparatively free from diseases and insect pests and fetch higher prices in the market. In Guava shoot pruning is very much successful in regulating the crop of guava in spite of that reduces the tree size and improves the fruit quality. This gives an opportunity to increase the number of trees per unit area. Moreover, several studies have shown that after 8-10 years of age, guava trees show considerable decline in yield with sub-optimal fruit quality owing to vigorous vegetative growth and frequent intermingling of the branches particularly in the lower half of the tree leading to unfruitfulness growth and frequent intermingling of the branches particularly in the lower half of the tree leading to unfruitfulness, as fruitful buds become blind. Such

unproductive trees can be made to bear profitable crop for more years by judicious canopy management.

Canopy management is resorted as a tool not only to control size but also maximize yields. Pruning not only helps to encourage new shoots after the harvest but has also been adopted for rejuvenation of old unproductive orchards along with crop regulations. Pruning is one of the oldest cultural practices which is adopted in temperate and sub-tropical fruit crops to bring a balance between vegetative and reproductive growth of the plant. In guava the flowers and fruits are borne on current season's growth. A light annual pruning is considered necessary to encourage new shoots after the harvest. A better understanding of the effect of pruning is the need of an hour. The pruning of guava has not received much attention, when we see its economic importance, it can be justified.

### **Present Scenario**

The fruit is in demand in domestic as well as international markets and is traded in more than 60 countries. Major guava producing countries are India, Brazil, Mexico, South Africa, Jamaica, Kenya, Cuba, United States of America Egypt, Thailand, Columbia and Pakistan. The international trade of guava is currently limited to processed products which are exported to United States, Japan and Europe. In India, guava is well adapted in almost all the states and principally produced in Maharashtra, Bihar, Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Karnataka and Tamil Nadu. Guava contributes 3.9- 4 per cent of the total fruit production % share in the world which is around 4.10 million metric tones from 0.27 million hectares area. The productivity is around 13.7 MT ha. Uttar Pradesh, followed by Madhya Pradesh, Bihar, Chhattisgarh and West Bengal is the leading states in area and Production. But its productivity is recorded highest in Punjab followed by Assam, Karnataka, Uttar Pradesh, Madhya Pradesh and Gujarat reported by **Horticultural Statistics (2018-2019) nhb.gov.in and Indian Horticos**. However, overall productivity is far from its actual potential.

### **Meadow Orchard A- Modern Approach in Sustainable Production of Guava**

Meadow orchard in guava is one of the techniques where higher number of plants/unit area is accommodated compared with the conventional planting density. Under meadow orcharding where fruiting starts with first year, a precise level of pruning is required to make

the balance between vegetative and reproductive phase. The traditional system of cultivation has often posed problems in attaining desired levels of productivity due to large tree canopy. Hence, a need arose to improve the existing production system, besides increasing its productivity. Currently, there is a worldwide trend in fruit trees in high density or meadow orcharding to control tree size and maintain desired architecture for better light interception and easy in operations such as pruning, pest control and harvesting. The meadow orcharding facilitates enhance production and quality of fruits. Pruning refers to removal of parts of tree specially shoots, roots, limbs, buds or nipping away of terminal parts. It is practiced to make a tree more productive and bear quality fruits. Some fruit trees bear on current season shoots while others do so on the past season growth. Pruning can be used for crop regulation. Pruning has its physiological effects basically due to changes in the partitioning of the reserves. It changes sink preference for allocation of photosynthesis. Depending upon the time of the year, the extent and frequency of pruning, some sites of accumulation will disappear and others will be created. As a result, changes in seasonal fluctuations of reserves can appear as well. In this way, pruning helps in both ways, firstly to regulate crop and secondly to manage high density. The efficient training and pruning practices can maintain the proper canopy size of the guava plant.

Pruning of guava is one of the most important practices that influence the vigour, productivity and quality of the fruits. Pruning at an early stage is done to develop a strong framework and capable for bearing a heavy crop load. The main advantages of pruning on bearing trees include the formation of new shoots avoid overcrowding of branches, removal of criss-cross branches, diseased branches as well as water sprouts and root suckers. Therefore, pruning could prove to be the most effective method for eliminating rainy season crop and maximizing the production of winter season guava. If the guava tree is left unpruned, they tend to prolong the vegetative growth, reduce the bearing area, thus leading to decrease in fruit size, yield and quality.

The guava is cultivated largely through a traditional system of plantation and therefore, it is not possible to obtain the desired levels of production per unit area and also needs high labour inputs. Since land area for fruit cultivation is shrinking due to urbanization and industrialization, under such limitations the concept of high density planting with intense canopy management has become extremely significant to increase the fruit yield and

productivity. The high density plant spacing increases production, productivity and improves fruits quality. It also helps to improve efficient use of land, water, light, fertilizers and pesticides, which are frequently lost in traditional planting systems.

Pruning is one of the oldest cultural practices, which is practiced in sub-tropical and temperate fruit crops to bring a balance between vegetative and reproductive growth in the plant. In guava, the flowers and fruits are born on current season growth. A light annual pruning considered necessary to encourage new shoots after the harvest. Better light distribution within canopy, increases the number of well illuminated leaves. It also promotes the rate of photosynthesis that leads to high yield per unit area. A better understanding of the effect of pruning is the need of an hour. The pruning of guava has not received much attention, when we observed its economic importance.

The pruning of guava tree is highly desirable to maintain the vigour and productivity as well as to improve fruit size and quality. The guava fruit is borne in the axial of young growing shoots of the current year and hence the trees require regular annual pruning to replace the old unproductive wood with new one. As in unpruned tree growth becomes weak and the fruit size, yield and quality of guava is reduced. Beneficial effects of pruning on yield and fruit quality of guava have been reported by various workers. Properly pruned guava plant produce excellent quality fruits.

### **Principles of Canopy Management**

The basic principles of canopy management are as described below.

- Maximum utilization of light.
- Avoidance of build-up of micro-climate congenial for the disease and pest.
- Convenience in carrying out the cultural operations.
- Maximizing the productivity and quality.
- Economy in obtaining the required canopy architecture.

### **Methods of Canopy Management**

The methods of canopy management are stated below mentioned:-

- Adoption of Training and Pruning practices. (Majorly Beheading/ Top Working & Shoot pruning)



- Selection of Root stocks & scion material from improved cultivars to increase higher yield & production.
- Approaches towards the modern hi-tech practices viz. High density planting and Meadow orcharding.
- Application of Plant Growth Regulators for the betterment and enhancement of Guava productive stages.

### **Sustainable Enhancement in Guava through Canopy Management Practices Concept of Canopy Modification in Guava**

Canopy management in Guava is done 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. In HDP system, light and other micro-climatic conditions are important aspects which directly or indirectly affect the vegetative growth, yield and quality of guava fruits. As guava tree respond well to canopy modification with respect to vegetative and reproductive growth therefore, modification of canopy through pruning and use of certain growth regulators in high density orchards may be steps to enhance the production efficiency. The different plant spacing with pruning severity increases the production, productivity and improves fruits quality. It helps to improve efficient use of land, water, light, fertilizers and pesticides, which are frequently lost in traditional planting systems. The high density plant spacing along with levels of pruning intensity facilitates the enhance production and quality of fruits. The Meadow Orchard is a modern method of fruit cultivation by adopting modified canopy system. This system of guava planting is revolutionizing the guava industry by enhancing productivity coupled with reduction in production costs. The meadow orchard system of guava accommodates 5000 plants ha<sup>-1</sup>, planted at 2.0 x 1.0 m standard planting density under HDP. At present, there is need to replace the traditional planting system with the improved high density planting.

**Production & Yield Enhancement in Guava through HDP System:** The production of guava in high density planting (1.5 x 3 m) is 26 tonnes ha<sup>-1</sup> in the third year. The yield goes up to 47 tonnes ha<sup>-1</sup> in the fifth and 55 tonnes ha<sup>-1</sup> in the seventh year of growth.





In the density of 6.0 x 6.0m, the yield is 6 tonnes ha<sup>-1</sup>. The meadow orchard system is more beneficial than any other system. In this system, the production starts in the first year itself giving an average yield of 13 tonnes ha<sup>-1</sup> which doubles in the next year. In the 3<sup>rd</sup> and 5<sup>th</sup> year yield is approximately 40 and 60 tonnes ha<sup>-1</sup>, respectively. "This clearly shows that the meadow orchard system is better than other planting system.

**Concept of Training & Pruning in Guava:** Pruning has emerged as a commercial and alternative method for regulating the crop in guava. Thus, pruning may be helpful in reducing the tree size and improving the fruit quality as well. 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.

**Pruning usually involves these 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.

Guava requires a precise level of pruning intensities at first year of its fruiting. Pruning is also required to make the balance between vegetative and reproductive phase in guava. Pruning can be used for crop regulation. Pruning has its physiological effects basically due to changes in the partitioning of the reserves. The different level of intensities of pruning has a significant effect on tree height, tree spread, canopy volume and fruit yield. As guava responds very well to pruning, the following plant densities have been recommended by Central Institute for Subtropical Horticulture, Lucknow for early, higher and quality guava production:

**A. 3.0m (row to row) x 1.5m (plant to plant) accommodating 2222 plants ha<sup>-1</sup>**

**B. 3.0m (row to row) x 3.0m (plant to plant) accommodating 1111 plants ha<sup>-1</sup>**

**C. 6.0m (row to row) x 3.0m (plant to plant) accommodating 555 plants ha<sup>-1</sup>**

Hence, for improving the growth, yield and quality of guava, pruning provides exact and correct removal of plant parts in terms of length (distance) instead of percentage.

**Practice of Topping in Guava**

Guava trees are topped to a uniform height of 60-75 cm from the ground level. 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.

### **Heading back in Guava**

It 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.