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IMPROVEMENT IN THE GUAVA PRODUCTION TECHNOLOGY- AN OVERVIEW

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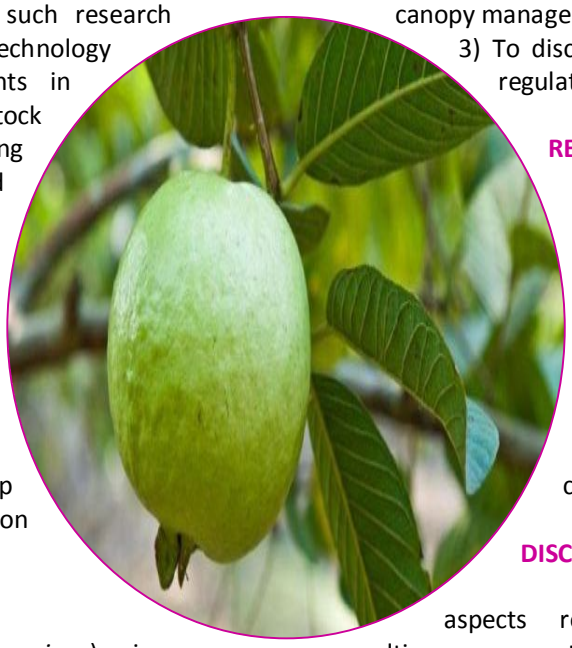
ABSTRACT

Guava is the most popularly grown fruit crop all over India owing to its hardiness, high nutritional value and profuse yield. With the alarming population rise, the cultivable area is shrinking day by day. Several researchers are aiming in refining the existing production technologies for quality and quantity yield with minimum resources and inputs.

Present paper focuses on such research efforts in guava production technology covering mainly refinements in propagation methods, rootstock standardization, planting densities, high density and ultra-high density plantations, crop regulation, rejuvenation of senile orchards and pest and disease management.

KEY WORDS: Guava, High-Density, Ultra high density, Rejuvenation, Crop regulation, Production technology



INTRODUCTION

Guava (*Psidium guajava*) is an important fruit crop of India belonging to family Myrtaceae. It is considered as Poor man's Apple being rich in pectin and vitamin C content (260mg/100gm pulp) as well as fair amount of calcium, phosphorus, iron and small amount of thiamine, riboflavin and niacin. It is hardy and prolific bearer and most importantly grown commercially all over India for years together. It is consumed as a fresh fruit, canned in sugar syrup, used in juices and ice creams, jelly preparation. Leaves are good source of dye and tannin and having medicinal value for curing diarrhea.

OBJECTIVES – FOLLOWING ARE THE OBJECTIVES OF THIS STUDY

1) To discuss about the improvements in the guava production technology
2) To discuss about concepts of high-density and ultra-high density guava plantation along with canopy management.
3) To discuss about concepts of crop regulation and guava rejuvenation

RESEARCH METHODOLOGY

This is descriptive study based on secondary data. Various research journals, books, websites & various reports related to guava production technology and high-density guava plantation were studied to draw the conclusions.

DISCUSSION

In this paper various aspects related to soil, climate, cultivars, propagation, cultivation technology, high-density plantation, crop regulation, interculture, intercropping, pest and disease management, harvesting, yield, etc. are discussed as follows:

AREA

Guava is originated in tropical America and now cultivated in more than 60 countries in the world. India, Brazil, Mexico, United States of America, Columbia, South Africa, Jamaica, Egypt,

Kenya, Cuba, Thailand, China and Pakistan are the major guava growing countries. In India it is grown in Maharashtra, Madhya Pradesh, Uttar Pradesh, Bihar, Andhra Pradesh, Karnataka, Tamil Nadu, Rajasthan, Gujarat, Punjab, West Bengal, Assam and Orissa. In India, the total area under guava cultivation was 268 thousand hectares and production was 3.66 million tons in the year 2013-14 (Indian Horticulture Database, 2014).

SOIL REQUIREMENT

Guava is a very hardy crop with wide soil adaptability ranging from sandy loam to clay. It grows very well even on the marginal soils and wastelands. Being hardy, it tolerates salty condition with pH 6.5 to 8.5. Guava is surface rooted and hence, top soil should be rich in nutrients. Being surface rooted, it is very sensitive to water logging condition.

CLIMATE

Guava is grown successfully under varied agro-climatic conditions. It has wide climatic adaptability from tropical to subtropical climates. It thrives well at optimum temperature of 23°C to 28 °C and annual rainfall below 100 cm. Distinct winter season leads to best guava growth and yield. Humid conditions lead to poor fruit quality though lead to heavy foliage. Dry climate is needed at the time of flowering and fruiting.

CULTIVARS

Lucknow 49, a selection from Allahabad Safeda in 1927 from Ganeshkhind Fruit Research Station and also known as Sardar guava is the only popular and commercially cultivated variety till today. Other commercial guava varieties are Allahabad Safeda, Banarasi, Chittidar, etc. Rodríguez-Medina, *et al*., 2010 illustrated a descriptor for guava.

PROPAGATION

Guava is propagated by seeds as well as by vegetative methods like tongue layering, air layering, grafting, cutting and budding. Owing to various disadvantages like not being true to type and late bearing, seed propagation is followed only for raising rootstock. For high density plantation in guava a dwarf rootstock, 'Pusa Srijan' is recommended for planting at 3m x 3m. This rootstock is tolerant to guava wilt.

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Several studies have been conducted for breeding nematode resistant rootstock (Milan, 2007), assessing nematode resistant rootstock (Milan, 2010; Antonio *et al*., 2010; González-Gaona *et al*., 2010; Bogantes-Arias and Mora-Newcomer, 2010; Da Costa *et al*., 2012, Robaina *et al*., 2012; Miranda *et al*., 2012), dwarfing rootstock (Sharma *et al*., 1992) compatibility with commercial varieties (Carneiro *et al*., 2007; Shrestha *et al.*, 2012; De Souza *et al*., 2015), effect on tree growth and yield (Singh and Singh, 2014).

For commercial purpose, guava is mainly propagated by tongue layering, air layering, and inarch grafting and stooling, i. e. mound layering. A study on efficacy of different propagation techniques in guava by Joshi *et al*., 2014 has suggested that in guava highest graft take success was obtained by using wedge grafting along with polycap on local guava as rootstock under polyhouse conditions. Studies on patch budding performance (Patel *et al*., 2007), standardization of best soil media and time of guava propagation (Rani *et al*., 2015), survival and growth of success air layers (Kumar *et al*., 2015) were conducted.

CULTIVATION TECHNOLOGY

PLANTING

Guava planting is best done in June-July i.e. beginning of monsoon. Land is deeply ploughed and leveled in the month of May. Pits of 0.75 m^3 to 1 m^3 size are dug up at 6m x 6m spacing accommodating 277

plants per hectare. Each pit is filled with top soil along with 15-20 kg FYM and 500 gm single super phosphate.

HIGH DENSITY/MEADOW ORCHARDING

Traditionally, guava is planted at 6m x 6m recommended spacing accommodating 277 plants per hectare in a square system of planting. A new concept of high density plantation (HDP) in guava is introduced in India by Central Institute of Subtropical Horticulture, Lucknow wherein planting is done at a spacing of 2m x 1m accommodating 5000 plant per hectare. These trees are grown with single tree stem. Each tree stem is headed back at 40 cm height. Only 3-4 well spaced new shoots just below the cut end are allowed to grow. These new shoots are again allowed to grow for 3-4 months and pruned to 50 % of their height. Again, new shoots emerge below the cut ends which are allowed to grow for 3-4 months and pruned to 50 % of their height. This way canopy management and crop regulation is done by adjusting the time and severity of pruning.

Studies conducted on planting density revealed 2m x 2m as a best spacing for producing better quality fruits (Kumawat *et al*., 2014), 6m x 3m having 555 plants/ha, giving the highest productivity in 'Allahabad Safeda' guava by sixth year of planting under North Coorg conditions (Ravishankar *et al*., 2008).

TRAINING AND PRUNING

In guava training of young trees is done to build the strong framework with open centre system. For the purpose, the main stem is headed back at up to 100 cm from ground level and only 3-4 well spaced shoots emerging just below the cut point are allowed to grow.

Prunning is done to avoid overcrowding. The dead, diseased, criss-crossing branches are pruned completely. Guava bears fruits on current season's growth. Hence, to promote new branches, light pruning up to 20-30 cm length from tip of previous season's shoots is done.

Mehta *et al.,* 2012 recommended pruning of guava plants thrice a year viz. March, May and October to 50% of shoot length for maximization of income from Ultra-high density guava orchard of cv. Sardar growing under eastern plateau and hill conditions.

GUAVA REJUVENATION

The senile plantations in India have a major drawback of low productivity due to thickly shaded branches, uncontrolled pest and diseases, making the orchard management highly impossible. Central Institute of Subtropical Horticulture, Lucknow has developed a technology to restore productivity of such senile orchard by rejuvenation. It involves heading back of old trees at 1 -1.5 m height above the ground level in the month of May-June or December- February. This allows fresh canopy from below the cut point. The shoots are allowed to grow up to the 40-45 cm length and then pruned to about 50 % of its length. This will facilitate emergence of multiple shoots below pruning point. These multiple shoots are capable of bearing flowers and fruits. This way, every year sequential and periodic pruning is continued.

Various studies related to development and standardization of the technology for guava rejuvenation (Singh, 2011), effect of integrated nutrients management after rejuvenation (Chandra *et al*., 2012; Meena *et al*., 2014), effect of thinning, bending and micronutrients sprays on rejuvenated guava (Kumawat *et al*., 2012), canopy management in rejuvenated guava (Singh and Singh, 2007; Basu *et al*., 2007) have been conducted so far.

High Density Plantation at MPKV, Rahuri farm

FLOWERING AND FRUIT SET

In guava, flowers are borne in the leaf axil on the current season growth. Single or two or three flowers are borne at one axil. Fruit set can be increased by foliar application of 15-30 ppm GA_3, and 10-20 ppm NAA.

CROP REGULATION

In northern India, two main blooming seasons are observed, one in February-March (fruit ripening in July to September) and the other in September-October (fruit ripening in February to April). In southern India, three blooming periods i.e. February-March (fruit ripening in July to September-Ambe Bahar), June-July (fruit ripening in November to January-Mrig Bahar) and September-October are observed (fruit ripening in February to April-Hasta Bahar).

Regulating the flowering season for quality fruit production is called as Bahar treatment. Flowering is regulated by forced defoliation (root pruning and withholding water for one and half month), hand thinning of flowers or by applying growth regulators like 100 ppm NAA, 30 ppm 2,4-D, etc. Winter crop is a desirable Bahar due to less pest, disease incidence and bigger size quality fruits. Spraying with urea (10%) or bending the erect branches is also effective in regulating the flowering.

Singh *et al.,* 1994 found 15 per cent urea spray optimum in regulating the guava crop with no adverse effect on the yield and quality of fruit. Das *et al.,* 2007 suggested foliar application of NAA (200 ppm) for winter season crop and 50 % hand deblossoming for rainy season crop. One leaf pair pruning of fruited shoots had also been suggested for crop regulation in winter season. (Tiwari and Lal 2007; Thakare *et al.,* 2013).

MANURING AND FERTILIZATION

Soil type, its nutrient status, climatic conditions, variety grown and management practices are the factors that decide the fertilizer requirement of particular crop. Soil and leaf analyses are the base for fixing the fertilizer requirement of a crop. General recommendation of NPK for one year old guava tree is100 gm N, 40 gm P and 40 gm K, 2 Kg FYM per tree per year. Every growing year the dose is increased and adult tree (6^{th} year onward) should be supplied with 600 gm N, 300 gm P and 330 gm K, 12-15 Kg FYM per tree per year. Total quantity of FYM, phosphorus, potash and half dose of nitrogen should be applied in June-July and remaining half dose nitrogen should be applied in October- November 30 cm away around the tree at 30-30 cm depth.

Foliar application of 1% urea and 0.5 % zinc twice a year (March-October) is beneficial in increasing guava yields. Mixed spray of $ZnSO_4$, $MgSO_4$, $MnSO_4$ (0.5%) and $CuSO_4$ and $FeSO_4$ (0.25%) at stages of new flushing, flowering and fruit set is generally given to avoid any micronutrient deficiency (Radha and Mathew,

2007). Also, micronutrient spray with 0.4% zinc sulphate and 0.4% boric acid were found beneficial for improvement of fruit quality in guava (Rawat *et al*., 2010). Pilania *et al*., 2010 attempted to standardize pruning intensity and integrated nutrient management in guava. He has suggested 50 gm, 20 gm, 50 gm NPK + 5 Kg vermicompost enriched with Azotobacter + *Aspergillus niger* + 50% pruning intensity for highest fruit yield. Goswami *et al*. (2015) suggested farm yard manure enriched with bio-fertilizers like *Trichoderma, Azotobacter*, *Azospirillum*, *Pseudomonas fluorescence* and *Aspergillus niger* for sustainable production of quality guava fruits.

IRRIGATION

Immediately after planting, guava plant requires irrigation as the root system is not fully developed. If no rain for 10-12 days, young guava plants should be irrigated immediately. Adult bearing trees should be irrigated at weekly intervals during summer and at fortnightly intervals during winter season.

INTER CULTURE

Interculture mainly includes mulching and weeding. Weeding either manually or by spraying weedicide is done as and when required. Soil loosening through two ploughings a year (October and January) is done which automatically helps in weeding, too.

To reduce the evaporation losses, mulching with black polythene sheet, rice husk or paddy straw in between the two guava lines is beneficial along with preventing weed growth.

INTERCROPPING

During initial 3-4 years, space between two lines can be used for planting intercrops like vegetables (cow pea, cauliflower, cluster bean, etc.) fruit crops (strawberry, pineapple, papaya, etc.). Under west Bengal conditions cow pea and groundnut were recommended as the best intercrops (Ghosh, 2001). Various other intercropping models like guava + chilli (Maji and Das, 2013) and guava + turmeric (Singh *et al*., 2014) have been suggested.

PEST MANAGEMENT

Major pests occurring in guava are fruit fly, scale insects, mealy bug, stem borer, fruit borer, etc.

1. Fruit fly (*Bractocera/Daucus dorsalis*):

This is a major pest during rainy season. Adult fruit fly lay eggs on fruit surface Maggots hatched from eggs enter fruit and feed on the soft pulp causing fruit drop. Collecting and burning the affected fruits, Avoiding Ambe Bahar i. e. rainy season crop, hoeing under tree canopy along with spraying 20 ml malathion/10 lit of water during post oviposition period is effective against guava fruit fly.

Viraktamath and Ravikumar (2006) suggested mass trapping by installing 8 or 16 methyl eugenol traps/acre as the most effective measure for management of fruit flies in guava. Morera-Montoya *et al.,* 2010 suggested use of the nylon bag offering the highest protection against the fruit fly but without protection against pathogens.

2. Guava scale (*Chloropulvinaria psidii*):

The flat, oval yellowish green to brown scale insects suck the sap from guava leaves, shoots and stems by adhering to it. Pruning and destroying the heavily infested plant parts, spraying crude oil emulsion @ 7.8 kg/450 liter of water, using Cryptolaemus beetle and spraying 10 ml of dimethoate/10 lit of water controls guava scale effectively.

3. Mealy bug (*Drosicha mangiferae*):

Saffron coloured mealy bugs with whitish cover all over its soft body stick to guava twigs, leaf petioles, leaves, flowers and fruits and suck the sap. Fastening polythene band around base of tree trunk to prevent the ascent of nymphs, soil application of thimet or and spraying with 0.08 % monocrotophos or dimethoate or 4 % neem oil is effective to control mealy bugs.

4. Stem borer (*Aristobia iestudo*):

This pest generally occurs in neglected, senile and crowded orchards. The young ones of the pest bores into twigs, branches and even the main trunk of the tree and lives inside the holes making silken galleries. It feeds voraciously and can be identified by fecal matter accumulated at the base of tree trunk. Collecting the adults manually with the help of iron spoke and destroying it as well as inserting the cotton swab soaked in dichlorovos or injecting 0.05 % monocrotophos and pluging the holes with mud helps to reduce the infestation.

5. Fruit borer (*Virachola isocrates*):

This pest occurs in north India. The caterpillar bore raw fruit and feed on the pulp inside. Such fruits dry up. Collection and destruction of infested fruits, spaying 0.1 % carbaryl before fruit set helps to reduce the pest infestation.

6. Nematode

Meloidogyne spp. as well as other nematode strains are seen affecting guava orchard all over the world. Plants affected with nematode show stunted growth and gradually decline. For effective control, nematicide application in the affected soil area is beneficial.

DISEASE MANAGEMENT

Guava wilt and anthracnose are the major guava diseases along with some other diseases like canker, cercospora leaf spot, and seedling blight, etc.,

1. Guava Wilt:

It is the most serious and destructive disease caused due to fungal infection owing to alkaline soil conditions. *Fusarium oxysporum* is the causal fungus appearing more seriously in rainy season making the branches and whole tree to dry up and die away.

Removing and destroying the dead branches, treating the alkaline soils with gypsum, drenching the soil with 15 gm Bavistin around the basin of each tree, using guava resistant varieties like Sardar, Allahabad Safeda, Banarasi are useful in controlling the fungal infection. Nematode infection is another cause for guava wilt or decline.

Efforts have been made for identifying guava wilt resistant varieties (Schoeman and Labuschagne, 2014), managing the decline by application of meat and bone meal (Almeida *et al*., 2013). Genotyping for *Fusarium spp.* strain level discrimination (Mishra *et al.,* 2013) along with developing a Molecular Diagnostic Kit for rapid detection of *Fusarium spp.* (Mishra, 2015) has been tried by various workers.

2. Guava Anthracnose:

This disease is caused by *Gloeosporium psidii* fungus that causes dieback from the tip of the branches turning them initially brown and then black. The fungal infestation occurs mainly in the high humid conditions. Fruits also get affected with initial circular, slight sunken brown spots with pink sticky spore mass in the centre leading to fruit rot at the end.

Prunning and destroying the affected plant parts, spraying of copper oxychloride or dithane Z- 78 @ 0.2 %, spraying Bordeaux mixture (3:3:50) at 10 days interval effectively controls the disease.

3. Fruit canker

The disease caused by *Pestalosia spp.* is characterized by numerous circular, raised, dark colour corky growth on fruit surface giving it a chickenpox appearance. Such fruits deform and do not ripe. 1% Bordeaux mixture 2-3 times at 15 days interval will help to control the disease.

MICRONUTRIENT DEFICIENCIES

1. Zink deficiency (Bronzing):

It is characterized by leaf interveinal yellowing turning reddish or purplish causing reduced leaf size, dieback of twigs and stunted plant growth. Spraying zinc sulphate with lime will help the tree to recover from deformity. Also soil application of zinc sulphate 800 gm per tree 10 -15 days before flowering is beneficial.

Gowada *et al*., 1992 reported foliar application of 0.5 per cent diammonium phosphate and zinc sulphate at weekly intervals for two months useful in bringing about notable improvement in bronzed plants.

2. Boron deficiency:

It causes internal necrosis making the affected portion hard. Leaf falling, fruits remained undersized and sometimes cracking occurs. Spraying the tree with 0.3 - 0.4 % boric acid before flowering helps to reduce the deficiency.

HARVESTING

Fruit bearing in vegetatively propagated Guava starts at the age of 2-3 years. Guava fruits are ready for harvest 110-135 days after flowering. The fruits should be harvested when colour changes to yellowish green with specific gravity below1.01 percent. Harvesting is done by hand picking 2-3 times a week.

YIELD

Cultural practices and age of the orchard are the yield deciding factors in guava. In a 2-3 year old orchard an average yield of 120-300 kg/tree is obtained in a year. A fully developed tree can produce 500-1000 fruit/ year.

CONCLUSION

In view of the above discussed research efforts, it can be summarized that Sardar, Allahabad Safeda are still the popular varieties available in India though various other improved and hybrid varieties have been developed. Studies on efficacy of different propagation techniques in guava has suggested wedge grafting along with polycap on local guava as rootstock under polyhouse conditions. Studies have been conducted for breeding nematode resistant rootstock dwarfing rootstock with recommendation of Pusa Srijan as dwarfing and wilt tolerant rootstock.

The Central Institute for Subtropical Horticulture, Lucknow has developed High density and Ultra-High density planting system for guava accommodating 5,000 plants per ha with standardization of canopy management. The Central Institute for Subtropical Horticulture, Lucknow has also developed the rejuvenation technique in guava for making the senile orchards productive. Integrated nutrient management with micronutrient sprays has been developed. Various intercropping models including cowpea, groundnut, marigold, pineapple, turmeric, chilli, etc. have been recommended. Control measures for pests and diseases and corrective measures for nutritional deficiencies have been suggested along with development of a Molecular Diagnostic Kit for rapid detection of *Fusarium spp.*

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