Int.J.Curr.Microbiol.App.Sci (2020) *9*(8): 1922-1934

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 8 (2020)**
Journal homepage: http://www.ijcmas.com

Review Article https://doi.org/10.20546/ijcmas.2020.908.220

A Review on Recent Advances in Enhancing the Productivity of Guava (*Psidium guajava* L.) through Hi-Tech Practices

V.P. Santhi[1*], S. Parthiban[2], K.Vijayalakshmi[3], J. Auxcilia[2] and P. Masilamani[4]

[1]Horticulture, Department of Fruit Science, [2]Department of Fruit Science, Horticultural College and Research Institute for Women, Tamil Nadu Agricultural University, Trichy- 620 027, India
[3]Department of Fruit Science, Central University of Tamil Nadu, Thiruvarur -610 005, India
[4]Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Trichy -620 027, Tamil Nadu, India

**Corresponding author*

Keywords

Hi-tech practices, Meadow orchard, Canopy management, Fertigation, Growth regulators, Micro nutrients, Rootstock, Productivity

Article Info

Accepted:
18 July 2020
Available Online:
10 August 2020

A B S T R A C T

Globally, India is bestowed with diverse agro-climate conditions which favour the production of a variety of fruit crops from arid, semi-arid, tropical, sub-tropical and temperate region. At present India is the second largest producer of fruits in the world after China. The need of hour is sustainable secure and affordable way to feed the entire population with nutritious food. Hence it is essential to incorporate high tech practices in our day to day cultivation practices that are potential enough to increase both quantity as well as quality of the produce. Even though, India ranks second in fruits production next to China, there is scope for increasing our productivity. In this review we have discussed an important hi – tech practices in guava for the enhancement of productivity. The novel techniques in guava practices *viz*., mulching, meadow orcharding, high density planting, pruning, flower induction, fruiting, fertilization, fertigation, crop regulation, foliar nutrition and crop regulation practices and using salinity tolerant rootstock improves the production, productivity and quality.

Introduction

Fruit culture is highly profitable as it increases the employment opportunities, besides commercialization is possible in the rural sector. It also provides ample opportunities for sustaining large number of agro-industries to generate substantial employment opportunities (Bardhan, 2016). Horticulture production in India increased

substantially recent years due to adoption of advanced technologies by the farmers. The higher production is progressed due to area expansion. Over the last decade, the area under horticulture grew by 2.6% per annum and annual production increased by 6% in India. During 2018-2019 production of horticulture crops with 314.67 Million MT of horticultural produce from an area of 25.87 Million Hectares surpasses the agricultural production of 285.21 Million MT from an area of 95.45 Million Hectares (Indian Hort. Database, 2018-19). The production of fruits has increased from 50.9 MT to 96.75 MT since 2004-05 to 2018-19. Fruit crops holds second rank in production by contributing 31.5 % production share. Due to tremendous increase in population and increased demand it is essential to improve the production with the available resources. Maximum of vitamin E contents was observed in Allahabad Safeda (19.4 mg/ g tissue) followed by Lucknow 49 (17.53 mg /g tissue) and Arka Kiran (11.34 mg /g tissue). reveal that guava fruits have potent antioxidant activities which may be responsible for its pharmacological effects. This can be achieved by increasing the productivity through hi-tech cultural practices. In this review, the recent hi-tech practices which have positive impact on the productivity of guava is compiled and presented

Guava (*Psidium guajava*) is one of the most important commercial fruits in India. Guava is native to tropical America stretching from Mexico to Peru. It is the fourth most important fruit after mango, banana and citrus. India is the major producer of Guava. The area under guava is 260.07 Thousand Ha and the production 3826.40 Thousand MT (2016-17).

The export from India is 1.23 Thousand MT and the Value is 553.26 Lakh Rupees (Indian Hort. Database, 2018-19). It grows very well in tropical as well as subtropical climate. It is considered to be more remunerative crop to the farmers due to its high productivity, easier cultivation and less cultivation cost. In the recent past, it has gained momentum owing to its versatility in adaptability to a wide range of soil conditions, especially problem soils such as saline, alkaline and even in clayey soils too. It is available at reasonable price and known for its rich nutraceutical values (Kumar and Mishra, 2012) thus, named as apple of tropics and super fruit (Maji *et al.,* 2015). Amongst various tropical fruit crops in India, guava, if left on its own, give the variable quantities and qualities from the various flowering flushes throughout the year. In general, guava flowers twice in a year i.e. in March-April (*Ambebahar*) and June-July (*Mrig bahar*), of which fruits ripen in rainy and winter season, respectively. However, in central and Southern part of India, there is a third crop with flowers appearing in October (*Hastha bahar*), of which fruits ripen in the month of March was also realised. This pattern of flowering and fruiting is not desirable for commercial exploitation. Moreover, the fruits of *Ambe bahar* which are harvested during the months of July-September and insipid, watery, and poor in quality and heavily infested with fruit fly resulting in significant loss to most of the guava growers (Mishra and Tiwari, 2000). The winter season fruits are superior in quality, free from pests which fetch high monetary returns (Singh *et al.,* 2000).

Many works have been carried out for improving the yield and fruit quality of guava in India through various technologies (Boora *et al.,* 2016, Lal *et al.,* 2017, Hojo *et al.,* 2007, Khan *et al.,* 2011, Mamum *et al.,* 2012, Atawia *et al.,* 2017). Hence, it is highly essential to implement certain important modern, innovative and hi-tech methods for improving the quality as well as quantity of guava production.

High density planting

There is a shift in farmers' insight from production to productivity and profitability which can be achieved through high density planting. High density planting has been in practice as a prime method for improving productivity of temperate fruit crops like Apple. In the past one decade, strenuous efforts were made to adopt high density planting in tropical fruit crops also. Presently, the trials on mango and guava HDP are practiced as successful technologies. Recently trials from Central Institute of Sub tropical Horticulture (CISH), Lucknow proved that guava can be successfully grown at closer spacing under high density planting to meadow orchard system with spacing of 2 m x 1m accommodating 5000 plants / hectare. By judicious canopy management and suitable tree training systems higher and quality production is achieved from densely planted orchards by regular topping and hedging especially during early stages. Average yield obtained in meadow orchard system of guava growing is 40 – 60 t /ha when compare to traditional system (Singh, 2008).

Guava layers of variety Lucknow- 49, was established well at a spacing of (3 x 1.5 m) accommodating 2222 plants/ hectare under sodic- alkaline soil conditions with the ESP of above 15% at HC & RI (W), TNAU, Trichy, Tamil Nadu (Auxcilia *et al.,* 2019).

The above studies indicated that though the yield of individual plant is less under HDP, compared to moderate density or low density, owing to the increased number of plants per hectare, the total yield realised from an hectare is doubled or tripled and thus profitable to farmers.

Apart from high density planting, moderate density levels were also found to increase the productivity of guava at certain places.

According to Brar *et al.,* (2009) fruit yield was increased significantly with decrease in density of plants during both the crop seasons. In rainy season, the yield per tree was significantly affected by plant spacing. At widest spacing of 6 x 5 m, highest yield of 35.15 kg/plant was obtained, followed by 6 x 4 m spacing, which gave a yield of 25.87 kg/plant and 6 x 2 m spacing gave the least yield of only 15.07 kg/plant. A highest yield of 17.25 kg/plant at 6 x 5 m spacing and minimum yield of 6.83 kg/plant at 6 x 2 m spacing was recorded during winter season. Similar results were reported by Lal *et al.,* (2000). and It was concluded that a spacing of 6 x 4 m with 416 plants/ha exhibited optimum microclimatic conditions in the canopies of plants and also accommodated 20% more plants when compared to the present recommendation of plant density without affecting the fruit yield and quality (Bal and Dhaliwal, 2003).

Canopy management practices

Training and pruning practices are integral part of high density planting systems. High density planting obviously needs to be combined with training and pruning techniques. Studies indicated that pruning of guava trees can enhance the productivity under high planting density. Guava responds well to pruning, because it bears fruits on current season's growth and flowers appear in leaf axils. Pruning restores the, ance between shoot and root system, besides maintains the growth and vigour of shoots by allowing fewer growing points to grow vigorously.

Flower induction

Flower production is bound to increase due to pruning, as pointed out by several studies. Singh *et al.,* (2001) studied the effect of pruning dates on yield of guava cultivars Allahabad Safeda and Sardar for five consecutive years. They reported that pruning

from April to June, enhanced the flowering percentage as compared to pruning in February and March. Jadhav *et al.,* (2002) noticed that the number of flowers per shoot on severely pruned (60%) trees of guava were more when compared to mild pruned (30%) trees and control.

Mohammed *et al.,* (2006) noticed that maximum flowers per shoot during winter season were in 60 cm pruning treatment. Mehta *et al.,* (2012) conducted an experiment to study the effect of pruning on guava cv. Sardar under ultra-high-density orchard system.

Pruning thrice a year produced maximum number of flowers per plant (20.13), while pruning of 80% of canopy in October produced minimum number of flowers per plant (7.72) during winter season of 2009-10. To study the effect of pruning and planting systems on growth, flowering, fruiting and yield of guava cv. Sardar an experiment was conducted by Kumar and Rattanpal (2010) (Fig. 1). The results revealed that pruning the 1/2nd of vegetative growth in 6m x 4m spacing recorded the highest yield of 544 number of fruits / tree and 55.1 kg /tree. The estimated yield was 54.4 t/ha.

Fruiting

In another study, maximum number of flower buds (62.2) was found in the treatment combination of one leaf pair pruning along with square system of planting (Pratibha *et al.,* 2013). At CISH, Lucknow, for meadow orchard (2 x 1 m), pruning of 50 per cent of the length of the shoot to produce multiple lateral shoots resulted in higher yield (10-12 kg fruits/plant) and pruning is ensured thrice in a year in May – June, September- October and January- February. The height of the plants was restricted to 1.0 meter from ground level (Singh, 2008).

Crop regulation

Amongst various tropical fruit crops in India, guava, if left on its own, give the variable quantities and qualities from the various flowering flushes throughout the year. Under natural conditions, these crops produce flowers thrice in a year i.e. February – March (*Ambe Bahar*), June –July (*Mrig Bahar*) and October – November (*Hasth Bahar*) with the corresponding harvest during rainy, winter and spring seasons, respectively (Boora *et al.,* 2016, Lal *et al.,* 2017).

However, the responses differed according to cultivars, tree conditions, soil types and agro-climatic conditions (Maji *et al.,* 2015). Regulated crops are desired to avoid glut in the market and also ensure the regular supply of fruits. The choice of bahar at a particular location is determined by prevailing production constraints like availability of irrigation water, quality of produce, market demand and extent of damage by insect-pests and diseases (Lal *et al.,* 2017).

The principle behind crop regulation is to induce flowering and fruiting in desired season of the year that contribute to increased fruit yield, quality, profitability and sustainability of the environment by reducing the use of the frequency of the pesticides (Lal *et al.,* 2017).

Gaps in prevailing system

Fruit production is seasonal activity and during the peak season price drops sharply owing to the glut in the market. At same time in multiple flushing species like citrus, guava and pomegranate, the desired yield and quality is not obtained during the peak demand period in the market. This condition is not economically sustainable. Therefore, to obtain higher fruit yield during a particular period, these fruit crops are given a resting

period with artificial means so that the natural flowering tendency of the trees is altered (Poerwanto *et al.,* 2008).

To increase fruit yield, quality and profit, the flowering and fruiting of guava can be regulated to produce flower on desired season of the year. In Northern Indian Plains, adoption of various practices such as withholding irrigation after harvesting during the months of April- May is followed. Following the shedding of flowers, the tree goes to rest and irrigated in June which produces profuse flowering after 30 -35 days. By the way, the crop is regulated (Boora *et al.,* 2016). Various methods adopted to regulate flowering in guava are as follows

Withholding of irrigation water

Withholding watering of trees from February to middle of May results in the shedding of flowers and trees go to a rest period during which accumulation of food materials takes place in branches (Sachin *et al.,* 2015). But not sandy in heavy soils (Tiwari and Lal, 2000).

Root exposure and root pruning

Carefully, 7-10cm upper soil around the tree trunk in a radius of 40-60 cm are removed so that roots are exposed to the sun which results in reduced moisture supply to the top, therefore, the leaves begin to shed the leaves and tree goes to a rest period. After above 3-4 weeks, the exposed roots again covered with soil and manure mixture followed by watering (Lal *et al.,* 2017) to get a good crop (Sachin *et al.,* 2015, Suresh *et al.,* 2016).

Shoot pruning

Guava flowers are always borne on newly emerging vegetative shoots; irrespective of the time of years, shoot pruning have been reported to be successful. Shoot pruning is helpful in reducing the tree size and improving the fruit quality (Singh and Bal, 2006, Lal *et al.,* 2000, Dhaliwal and Singh, 2004, Kumar and Mishra, 2010, Tiwari and Lal, 2007, Sharma *et al.,* 2013, Prakash *et al.,* 2012, Thakre *et al.,* 2013, Pratibha and Lal, 2013, Thakre *et al.,* 2016, Joshi *et al.,* 2016, Salah, 2005). The time and intensity of pruning affected tree sprout and yield guava cv. Paluma (Sarrano *et al.,* 2008a, Sarrano *et al.,* 2008b), in Nepal (Adhikari and Kandel, 2015), in Cairo, Egypt (Sahar and Hameed, 2014).

Deblossoming

Deblossoming of rainy season crop subsequently increased the winter season crop (Singh *et al.,* 2016, Lal *et al.,* 2017). Manual deblossoming on a commercial scale is economically not viable (Singh *et al.,* 2002). In contrast to this Das *et al.,* (2007) found it economically profitable when 50% of rainy season crop is removed manually. Deblossoming with 100 ppm NAA (Das *et al.,* 2007) and 200ppm NAA (More *et al.,* 2016) were effective for guava cv. L-49 in rainfed plateau conditions in Eastern India. Flower thinning by Naphthalene Acetamide (NAD) (Maji *et al.,* 2015), 2,4-D (Das *et al.,* 2007), Potassium Iodide (Sachin *et al.,* 2015) and ethephon (Singh *et al.,* 2000). Urea spray was also found efficient for deblossoming (Singh *et al.,* 2002).

Flower thinning during summer tends to improve fruit quality and increased the yield of winter season crop. Meanwhile, shoot bending is a highly potential method to have better quality off-season crop (Sarkar *et al.,* 2005).

Branch bending / Shoot Bending & Fruit Thinning

Breaking the apical dominance and activating the latent buds present on the branch (Samant

et al., 2016) produce better quality fruits in the offseason (Sarkar *et al.,* 2005, Mamun *et al.,* 2012) and maintaining increased C:N ratio and induce more flowering and fruit set (Mamun *et al.,* 2012).

Mamum *et al.,* (2012) studied the combined effect of variety and different management practices on fruit yield (kg/plant) and found that was significant both in on-season and off-season (Table 1). The highest fruit yield of 23.15 kg/plant was obtained in the variety Chiang Mai (round) in the treatment combination of 50% fruit thinning with bending during on-season. In variety Swarupkathi the same combination treatment recorded a yield of 16.06 kg/plant. Treatment details were given in Table 1.

Tahir and Hamid (2002) reported that flower and fruit drop was less due to fruit thinning which also supports the present experimental results (Fig. 2).

Fertilization

The amount of fertilizers to be applied in high density /meadow orchard of guava depends on the age of tree, condition of plant and type of soil. For proper growth and higher yield, following fertilizer doses should be applied (Table 2 and 3).

Fertigation

Fertilizers should be applied in a form that it becomes available in synchrony with crop demand for maximum utilization of nutrients from fertilizers. To meet the crop nutrient demand fertigation provides adequate supplies of water and nutrients with precise timing and uniform distribution. Fertigation also ensures substantial saving in usage of fertilizers and reduces leaching losses (Kumar *et al.,* 2007) than the conventional practice, optimum split applications of fertilizer will improve quality and quantity of crop yield which is similar to frequent water application. Sharma *et al.,* (2011) observed higher yield is obtained in guava through fertigation than basin irrigation. Jeyabal *et al.,* (2000) observed that in a 3 year old plantation of guava, fertigation at 75% recommended NK level with urea and multi-K gave 12.3% higher yield than soil application at 100% NK level indicating a saving of 25% NK in addition to improvement in productivity. Ramni was *et al.,* (2012) conducted an experiment on the effect of irrigation and fertigation scheduling on growth and yield of guava under meadow orchard system (2 x 1m) in guava var. Shweta. The results indicated that the maximum fruit diameter (6.69 cm) (polar) and 5.97 cm (equatorial) and fruit weight (182.17g) were recorded with application of 100 per cent irrigation of water/cumulative pan evaporation + 100% water soluble fertilizers. However, maximum benefit:cost ratio of 2.91 was obtained with 75% of irrigation of cumulative pan evaporation along with 75% of water soluble fertilizers, and hence, this can be considered as the best treatment. Sharma *et al.,* (2013) reported that the highest fruit yield of guava (18.7 t/ha) was obtained with drip irrigation at 100% ETc, while the lowest yield (11.0t/ha) was obtained with drip irrigation at 60% ETc. The interaction between irrigation schedules and N fertigation levels revealed that maximum fruit yield of 21.6t/ha and water productivity of 17.8 kg/ha-mm was demonstrated under drip irrigation at 100% ETc with 120% of recommended dose of N.

Fertigation scheduling for HDP in guava cv. Lucknow, the crop yielded on an average of 4.60 kg fruits/plant and the highest estimated fruit yield of 10.22 tonnes/ha at a fertigation dose of 50% of RDF (300:150:150g/ plant/year) as against 6.73 tonnes/ha in control with soil application of 100%RDF (Auxcilia *et al.,* 2019).

Table.1 Effect of fruit thinning of on- season and off- season on guava yield

Management practices	Percent fruit drop (%)		Percent fruit retention (%)		Yield (kg/plant)	
	On season	Off Season	On season	Off Season	On season	Off Season
Control	31.87	25.26	68.13	74.83	13.67	8.43
Shoot bending	29.33	24.42	70.75	76	16.66	13.5
25% fruit thinning	16.61	14.5	83.39	85.5	16.9	10.16
50% fruit thinning	10.72	9.53	89.28	90.47	20.46	12.43
75% fruit thinning	11.55	9.96	88.45	90.04	10.06	8.09
100% fruit thinning	0	9.63	0	90.37	0	7.19

Source: Mamun *et al*., 2012

Table.2 Fertiliser doses for meadow orchard of guava

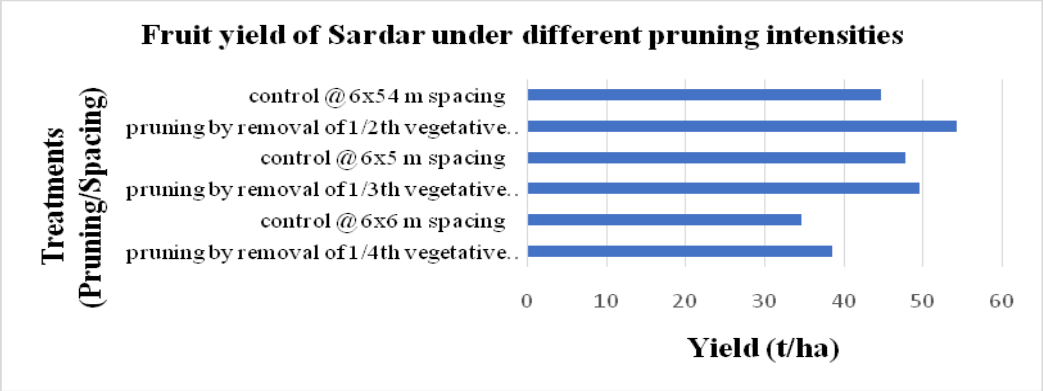
For spacing of 3.0 x 1.5 m (2222 plants/ha); 3.0 x 3.0 m (1111 plants/ha) and 6.0 x 3.0 (555 plants/ha)				
Year	Urea (g/ plant)		SSP (g/ plant)	MOP (g/ plant)
	June	September	September	June
1st	182	78	375	100
2nd	364	156	750	200
3rd	546	234	1125	300
4th	728	312	1500	400
5th& above	910	390	1875	500

Table.3 Fertiliser doses for high density orchard of guava

For spacing of 2.0 x 1.0 m (5000 plants/ha)				
Year	Urea (g/ plant)		SSP (g/ plant)	MOP (g/ plant)
	June	September	September	June
1st	90	40	185	50
2nd	180	110	370	100
3rd	270	115	555	150
4th	360	150	740	200
5th& above	450	190	900	250

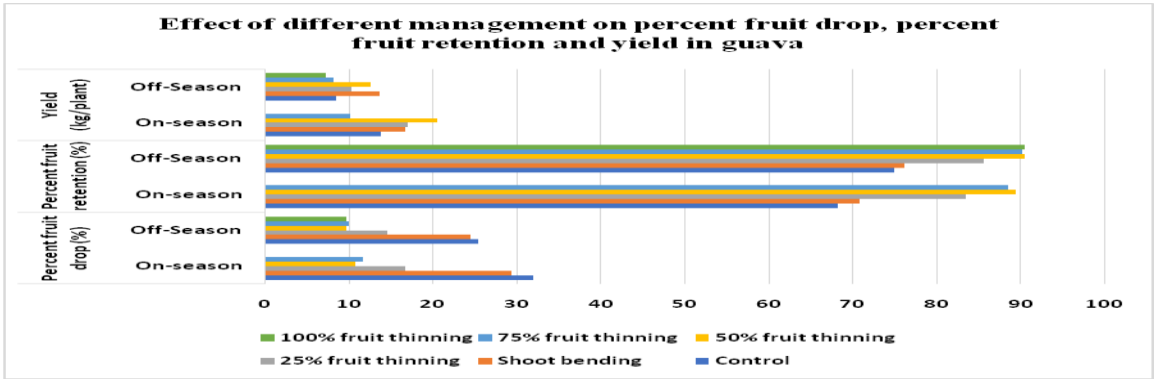
Source: CISH, Lucknow

Fig.1 Fruit yield of Sardar under different pruning intensities



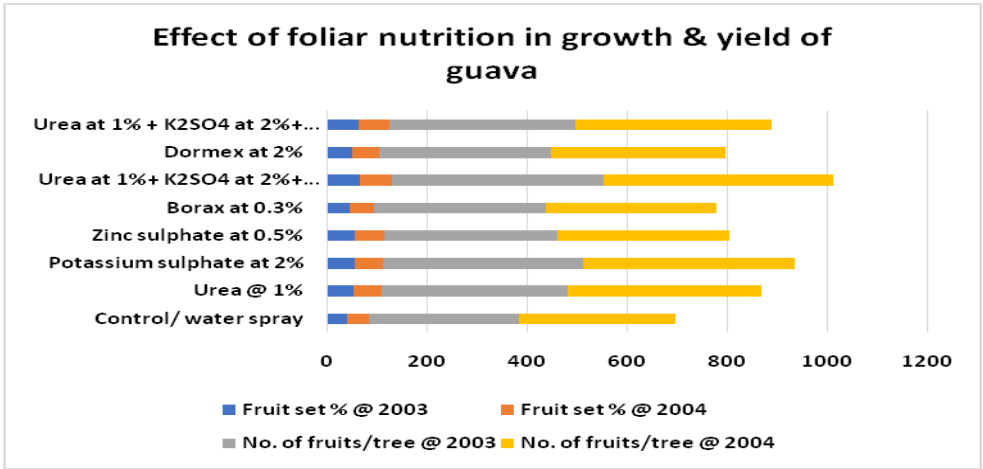
Source: Kumar and Rattanpal, (2010).

Fig.2 Effect of different management on per cent fruit drop, per cent fruit retention and yield in guava



Source: Tahir and Hamid (2002)

Fig.3 Effect of foliar nutrition in growth and yield of guava



Mulching

A study was conducted to evaluate the effect of organic and inorganic mulching materials on growth, fruiting and fruit quality of guava, grown on new alluvial zone of West Bengal. Different soil covers were used in the experiment instead of using polythene mulch as control. The soil covers used were cover crops like cowpea, Sugarcane trash (O cm thickness), Saw dust (5 cm thickness), Dry guava leaves (10 cm thickness), Paddy straw (10 cm thickness), black polythene (250 gauge) and white polythene (250 gauge). Maximum number of fruits (347.95) and the highest yield (47.05 kg) per plant was obtained when black polythene was used as a mulch (Das *et al.,* 2010). Different mulching treatments also showed increase in weight of individual fruit, number of fruits per plant, yield of fruit per plant as well as per hectare.

Foliar nutrition

Khamis *et al.,* (2007) studied that spray the guava trees with Dormex at 2% in January then sprays twice with combination from (urea at 1% + K_2SO_4 at 2% + $ZnSO_4$ at 0.5% + Borax at 0.3%) at full bloom and after fruit set (one month later) to improve vegetative growth; nutritional status; yield and fruit quality of guava (Fig. 3).

Root stock

Collection and evaluation of guava germplasm for physiological and biochemical basis for sodicity tolerance studies were carried out at Horticultural College and Research Institute for Women, Trichy during 2014 to 2019. 34 different accessions of guava were collected and evaluated for yield and physiological and biochemical parameters under saline- sodic condition. The maximum physiological activity and leaf K/Na ratio was recorded in Mirzapur Seedling (20.155) followed by Karela (18.928) and minimum recorded in Seedless (1.604). The maximum leaf K/Ca+Mg ratio was recorded in Cheeni guava (0.156) followed by Mirzapur Seedling (0.134) and minimum recorded in Lucknow 46 (0.008). Mirzapur Seedling, Cheeni guava and Karela could be used as rootstock under saline condition (Santhi *et al.,* 2019) which increases the area and productivity of guava in India.

It is concluded that the above-mentioned novel techniques for guava is scientifically proven that are highly potential enough to improve the crop productivity. The ultimate aim is to increase the productivity per unit area with the effective utilization of optimum inputs. All these studies showed that productivity can be increased by increasing the population per unit area. It is certain that the increased population will not alone perform well unless their stature maintained according to the space allotted to each of them. Hence, it is important to adopt canopy management and crop regulation practices viz., pruning, withholding of irrigation water, root exposure and root pruning, shoot pruning, shoot bending, deblossoming practices and using saline tolerant rootstock etc. Even though number of plants with well-developed frame work is maintained, the plants may starve for nutrients due to competition. This can be overcome by following the nutrient recommendation standardized for particular planting density. Fertigation and micronutrient application are the major practices in guava to obtain higher yields. The method of application of all essential inputs *viz*., growth regulators, and micro nutrients for plant growth also had influence on crop growth and productivity. For instance, using drip system for irrigation and fertigation ensure effective uptake of water and nutrients by the plants. Hence it is clear that the technologies capable of improving plant growth via different cultural

practices have to be utilized in an integrated manner for getting remarkable results. So, it is our duty to popularize and handover these techniques to farmers so that our ultimate goal can be achieved practically.

References

Adhikari, S and Kandel, T.K. 2015. Effect of time and level of pruning on vegetative growth, flowering, yield and quality of guava. *Int. J. Fruit Sci.*, 15(3):290-301.

Atawia, A.A.R., El-Gendy, F.M.A., Bakry, Kh.A.I., Abd El-Ghany, N.A. and Singer, M.A.A. 2017. Physiological studies on flowering and fruiting of guava trees. *Middle East J. Agric.*, 6(1):143-151.

Bal, J.S., Dhaliwal, G.S., 2003. High density planting studies in guava. *Haryana J. Hort. Sci.* 32, 19-22.

Bardhan, K. 2016. Crop Regulation: Concepts and its Commercial Uses. In: *Commercial Horticulture*, Patel N.L., Chawla, S.L. and Ablawat, T.R. (Eds.), New India Publishing Agency, New Delhi, pp. 257-275.

Boora, R.S., Dhaliwal, H.S. and Arora, N.K. 2016. Crop regulation in guava – A review. *Agric. Rev.*, 37(1):1-9.

Brar, J.S., Bali J.S., Singh, S.P., 2009. Relationship between canopy microclimate and flowering &fruiting behaviour of guava plants at varied densities. *Journal of Agro meteorology*. 11 (Special Issue), 121-128.

Das, B., Nath, V, Jana, B.R., Kumar, S. and Dey, P. 2007. Evaluation of crop regulation in guava grown under rainfed plateau conditions of eastern India. *Indian J. Hort.*, 64(3): 294-299.

Das, B.C., Maji, S., Mulieh, R., 2010. Response of soil covers on guava cv. L-49. Journal of Crop and Weed. 6 (2), 10-14.

Dhaliwal, G.S. and Singh, R. 2004. Effect of different pruning levels on vegetative growth, flowering and fruiting in Sardar guava. *Haryana J. Hort. Sci.*, 33(3-4): 175-177.

Gurusamy, K., V.P. Santhi, K. Indhumathi and S. Parthiban. Evaluation of antioxidant constituents of guava varieties grown under salt affected soil. national conference climate smart agriculture for livelihood security: challenges and opportunities 13-14, September 2019 held at Anbil Dharmalingam Agricultural College and Research Institute. Souvenier. : 67

Hojo, R.H., N.N.J. Chalfun, E.T.D. Hojo, R.D. Veiga, C.M. Paglis and L.C. deO-Lima. (2007). Production and quality of guava fruits 'Pedro Sato' submitted to different pruning times. *Pesq. Agropec, Brasil.*, 42:357-362.

Auxcilia, J., S. Parthiban, V.P. Santhi, A. Nithyadevi, P.Janaki and I. Indurani. 2019. Studies on fertigation scheduling for guava Cv. Lucknow 49 in sodic soil conditions under High Density Planting Systems. Paper presented on National conference Climate smart agriculture for livelihood security: challenges and opportunities 13-14, September 2019 held at Anbil Dharmalingam Agricultural College and Research Institute. Souvenier. Pp. 57.

Jadhav, B.J., Mahurkar, V.K., Kale, V.S. 2002. Effect of time and severity of pruning on growth and yield of guava (*Psidium guajava* L.) cv. Sardar. *Orissa J. Hor*t.30 (2), 83- 86.

Khamis, M.A., Bakry, Khaled and Moty, S.A. (2007). Improving growth and productivity of guava trees. *Minia J. Of Agric. Res. And Devel*. 27(1): 51-70.http://dx.doi.org/10.1590/1413-70542016403033315

Khan, A.S., Khan, M.R.G. Malik, A.U., Saleem, B.A., Rajwana, I.A and Ahmad, I. 2011. Influence of defoliation and deblossoming on the vegetative and reproductive growth of guava (*Psidium guajava* L.) Cv. *Gola. Pak. J. Bot.,* 43(6):2891-2896.

Kumar, A., Singh, R.K., Sinha, A.K., Singh, H.K., Mishra, A.P., (2007). Effect of fertigation on banana through drip irrigation in North Bihar. *J. Res. Birsa Agric. Univ.* 19, 81-86.

Kumar, R. and Mishra, D.S. 2010. Amrud ki labhkari kheti. *Kisan Bharti*, 41(10):5-6.

Kumar, R. and Mishra, D.S. 2012. Guava: A health capsule. *Indian Farmar's Digest*, 45(8):30-32.

Kumar, Y., Rattanpal, H.S., 2010. Effect of pruning in guava planted at different spacing under Punjab conditions. *Indian J. Hort.* 67(Special Issue), 115-119.

Lal, N., Sahu, N., Marboh, E.S., Gupta, A.K. and Patel, R.K. (2017). A review on crop regulation in fruit crops. *Int. J. Curr. Microbio. App. Sci.,* 6(7):4032-4043.

Lal, S. Tiwari, J.P. and Misra, K.K. 2000. Effect of plant spacing and shoot pruning intensity on fruit yield and quality of guava. *Prog. Hort.,* 32:20-25.

Lal, S., Tiwari, J.P., Misra, K.K., 2000. Effect of plant spacing and pruning intensity on fruit yield and quality of guava. *Prog. Hort*. 32, 20-25.

Maji, S., Das, B.C. and Sarkar, S.K. 2015. Efficiency of some chemicals on crop regulation of Sardar guava. *Sci. Hortic.,* 188:66-70.

Mamum, A.A., Rahman, H., Rahim, M.A., 2012. Effect of Shoot Bending and Fruit Thinning on Productivity of Guava. *J. Environ. Sci. & Natural Resources.*5 (2), 167 –172.

Mehta, S., Singh, S.K., Das, B., Jana, B.R., Mali, S., 2012. Effect of pruning on guava cv. Sardar under ultra high density orcharding system. Indian Journal. 25(2), 192-195.

Mishra, D.S and Tiwari, J.P. 2000. Guava: a potential fruit of subtropical and India. *Swarna Sedyam*, 3(9):47-49.

Mohammed, S., Sharma, J.R., Kumar, R., Gupta, R.B., Singh, S., 2006. Effect of pruning on growth and cropping pattern in guava cv. Lucknow-49. *Haryana J. Hort. Sci.* 35(3&4), 211-212.

More, D.B., Raut, U.A. and Bongane, Y.S. 2016. Effect of Different Growth Regulator on Vegetative Growth, Flowering and Yield of Winter Season Guava cv. Sardar. *Adv. Life. Sci.*, 5(12):5064-5066.

Poerwanto, R. Efendi, D., Widodo, W.D., Susanto, S. and Purwoko, B.S. (2008). Off season production of tropical fruits, *Acta Hort*., 772:127-133.

Prakash, S. Kumar, V., Saroj, P.L. and Sirohi, S.C. 2012. Response of yield and quality of winter guava to severity of summer pruning. *Indian J. Hort.*, 69(2): 173-176.

Pratibha, Shant L., Goswami, A.K., 2013. Effect of pruning and planting systems on growth, flowering, fruiting and yield of guava cv. Sardar. *Indian J. Hort*. 70 (4), 496-500.

Ramnivas, R., Kaushik, A., Sarolia, K, Sunil Pareek and Singh, V. 2012. Effect of irrigation and fertigation scheduling on growth and yield of guava (*Psidium guajava L*.) under meadow orcharding. *African Journal of Agricultural Research*: 7(47), pp.6350-6356.

S.Parthiban, V.P.Santhi and J. Auxcilia. 2019. Enhancing the productivity of fruit crops through hi tech practices. Invited paper on National conference

Climate smart agriculture for livelihood security: challenges and opportunities 13-14, September 2019 held at Anbil Dharmalingam Agricultural College and Research Institute. Souvenier. pp 143 -155.

Sachin, A.J., Ramteke, V. and Bharath, K.R. 2015. Flower Regulation in Guava and Pomegranate. *Prop. Kheti,* 3(4):53-54.

Sahar, A.F and Hameed, A.A.A. 2014. Effect of pruning on yield and fruit quality of guava trees. *J. Agric. Vet.Sci.,* 7(12):41-44.

Salah, A. El-D.M. 2005. Effect of pruning on growth, flowering and fruiting of some guava cultivars. M.Sc., Thesis, Fac. Agric, Cairo Univ.

Santhi, V.P., A. Ramesh Kumar , K. Gurusamy, J. Auxcilia and S.Parthiban. 2020. Collection and Evaluation of Guava Germplasm for Physiological and Biochemical Basis for Sodicity Tolerance. Paper presented on National conference Climate smart agriculture for livelihood security: challenges and opportunities 13-14, September 2019 held at Anbil Dharmalingam Agricultural College and Research Institute. Souvenier. pp :55.

Sarkar, A., Ghosh, B., Kundu, S., Sukul, P., 2005. Effect of shoot pruning and bending on yield and fruit quality in guava cv. L-49. *Environ. Ecol*.23 (3), 621-623.

Sarrano, L.A.L, Marinho, C.S., Gabetto, E., Silva, M. and Tardin, F.D. 2008a. Phenological and yield characteristics of "Paluma" guava tree pruned in different times and intensities, in north of Rio De Jeneiro State, Brazil. *Revista Ceres.,* 5(5): 416-424.

Sarrano, L.A.L, Martins, M.V.V., Lima, I.De M., Marinho, C.S. and Tardin, F.D. 2008b. Effect of pruning time and intensity on Paluma' guava trees, in Pinheiros, ES, Brazil. *Revista Brasileira de Fruticultura,* 30(4): 994-1000.

Sharma, A., Wali, V.K. Sharma, R.M., Jamwal, M. and Sharma, B. 2013. Effectiveness of Various Crop Regulation Treatments in Guava (*Psidium guajava*) cv. L-49. *Madras Agric. J.,* 100 (1-3): 747-750.

Sharma, S., Patra, S.K., Ray, R., 2011. Effect of drip fertigation on growth and yield of guava cv. Khaja. *Environ. Eco*. 29, 34-38.

Sharma.S, Sanmay KR. Patra, Gokul B.Roy and Soumen Bera. 2013b. Influence of drip irrigation and nitrogen fertigation on yield and water productivity of guava. *The Bioscan,* 8(3): 783-786.

Singh, G., 2008 & 2013. High density and meadow orcharding in guava. A Technical Bulletin Published by Central Institute for Subtropical Horticulture, Lucknow. 1-20.

Singh, G., Singh, A.K. and Verma, A. 2000. Economic evaluation of crop regulation treatment in guava *(Psidium guajava). Indian J. Agric. Sci.,* 70(4):226-230.

Singh, G., Singh, A.K., Rajan, S. and Bhriguvanshi, S.R. 2002. Strategy of crop regulation in guava *(Psidium guajava* L.*)* through foliar urea sprays and its effect on different N-forms in leaves. *J. Appl. Hort.,* 4(2):93-98.

Singh, G., Singh, A.K., Rajan, S., 2001. Influence of pruning date on fruit yield of guava (*Psidium guajava L.*) under subtropics. *J. Appl. Hort*. 3(1), 37-40.

Singh, H.J. and Bal, J.S. 2006. Effect of pruning and growth regulators on physio-chemical characters of guava during rainy season planted at different spacing. *Intr. J. Agric. Sci.,* 2(2):533-537.

Summat D., Kishore, K. and Singh, H.S.

2016. Branch bending for crop regulations in guava under hot and humid climate of eastern India. *J. Indian Soc. Coastal Agric. Res.*, 34(1):92-96.

Suresh, M., Kumar, S. and Swaminathan, V. 2016. Crop Regulation in Guava *(Psidium guajava* L.*)* A Review. *Agric. Sci.*, 5(12): 458-459.

Tahir, F.M., Hamid, K., 2002. Studies of physico-chemical changes due to fruit thinning in Guava (*Psidium guajava L.*). J. Biol. Sci. 2, 744-745.

Thakre, M.B., Lal, S., Goswami, A.K., Prakash, P. 2013. Effect of various methods of crop regulation in guava under double-hedge row system of planting. *Indian J. Hort.*, 70(2):211-216.

Thakre, M.B., Lal, S., Uniyal, S., Goswami, A.K., Prakash, P. 2016. Pruning for crop regulation in high density guava *(Psidium guajava* L.*)* plantation. *Spanish J. Agric. Res.*, 14(2)1-8. http://dx.xoi.org/10.5424/sjar/2016142-7846.

Tiwari, J.P. and Lal, S. 2000. Amrud ki kheti tatha bagh prabandh. Dir. Publ., GBPUAT, Pantnagar, pp. 47.

Tiwari, J.P. and Lal, S. 2007. Effect of NAA, flower bud thinning and pruning on crop regulation in guava (*Psidium guajava* L.) cv. Sardar. *Acta. Hort.*, 735:311-314.

How to cite this article:

Santhi, V.P., S. Parthiban, K.Vijayalakshmi, Auxcilia and Masilamani, P. 2020. A Review on Recent Advances in Enhancing the Productivity of Guava (*Psidium guajava* L.) through Hi-Tech Practices. *Int.J.Curr.Microbiol.App.Sci.* 9(08): 1922-1934.
doi: https://doi.org/10.20546/ijcmas.2020.908.220