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Review Article

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A Review on Techniques for Crop Regulation in Guava

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ABSTRACT

Guava is one of the most promising fruit crops of India and belongs to Myrtaceae family and is considered to be exquisite nutritionally valuable and remunerative crop. In recent years, the plantation of guava is getting popularity in the international trade due to its available nutritional value and processed products. The fruits produced in rainy season are rather insipid and watery and has poor shelf life with little consumer acceptance. The winter crop is the one ordinarily which is preferred by large masses due to larger size with much better fruit quality, edible mass and better Organoleptic value. Crop regulation is achieved by adoption and suitability of various techniques like withholding irrigation, flower bud thinning, shoot pruning and application of different chemicals. To regulate the guava crop for obtaining quality fruit produce, it is essential to reduce the fruit set during the rainy season which subsequently increases the quality fruit production during winter season. A good harvest is possible only if crop is regulated to single season bahar with better source-sink ratio otherwise the uninterrupted continuous blossoms would produce light crops over the whole year and require a high production cost involving watch and ward as well as poor marketing for inferior quality fruits, thereby increasing huge economic losses to the fruit growers.

Keywords: *Bahar treatment, Bioregulators, Flowering, Fruit quality*

INTRODUCTION

Guava (*Psidium guajava* L.) is the fifth most important fruit crop of India as well as popular fruit crop of tropical and sub tropical areas of the world due to its early availability and high nutritional value. It is easily available with reasonable price thus, named as "apple of tropics" and "super fruit" (Nimisha et al., 2013) for its immense nutraceutical values. It gives an assured crop on wastelands with minimal care. Its cost of production in terms of return of outputs is also low as compared to most of other commercial fruit crops. It has gained considerable prominence and consumer access on account of its high nutritive value, easy availability at moderate prices. It is a good source of Vitamin C (150-200 mg/100 g of pulp) as compared to many other fruits. Guava fruit contains antioxidant properties and is known to regulate the systolic blood pressure.

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The heaviest flowering is observed mainly for rainy season cropping because of profuse humidity and emergence of current shoots which bears fruit bud in leaf axils and fruit. But, the bearing fruits of rainy season crop are rough, insipid in taste, poor in quality, less nutritive and are heavily attacked by many insects, pests, and diseases. On the other hand, fruits in winter season are superior in size, quality, taste, aroma and fewer incidences of pests and diseases and fetch higher price than rainy season crop with better demand in the market. Several investigations were conducted to reduce the rainy season crop and to enforce more winter season crop by means of root exposure and root pruning, shoot pruning, mechanical flower thinning and chemical thinning by the use of Urea, growth substances like naphthalene acetic acid (NAA), naphthalene acid amide (NAD), 2,4-dichlorophenoxy acetic acid (2,4-D), dinitro-ortho-cresol (DNOC) *etc*. Some other methods, like withholding of irrigation water, defoliation *etc*. were also practiced by other research workers. But, the results of these experiments were differentially and the responses varied to applied method differed according to cultivars, tree conditions, soil types and agro-climatic conditions. The work carried out by various scientists on crop manipulation is being reviewed under different sub heads.

Why crop regulation?

The rainy season crop of guava is poor in terms of consumer acceptance quality and crop is affected by many biotic and abiotic stresses as compared to winter season crop. The environmental factors which are more supporting in obtaining winter season quality fruit production include diurnal variation during winter and also reduction in temperature facilities, higher total soluble solids content in guava fruits. The winter season crops which ripen from second fortnight of October to first fortnight of January are superior in quality, free from diseases and pests and fetch higher income. This requires regulation of flowering to obtain most profitable crop by withholding irrigation, root exposure, pruning and thinning of flowers. The flowering is more in guava during summer season because of heavy new flushes that lead to more fruit production in rainy season. In this season, duration of fruit harvesting is reduced to 30 days due to high temperature and rainfall and it causes glut in the market which lead to poor price and less demand in the market. Winter season crop is superior in quality which fetches higher prices than rainy season crop. In rainy season there is a serious attack of fruit flies which deteriorates its quality and fruits become unfit for human consumption. So far getting the quality fruits in guava only winter season crop should be taken and rainy season crop should be avoided. Water availability is also a big issue in Maharashtra, Rajasthan and Gujarat during summer season for guava grower. Farmers always avoid taking *ambe bahar* crop and regulate this crop to *mrig bahar* concurrent with the onset of monsoon and crop is harvested during winter.

Principle of crop regulation

The basic principle of crop regulation is to manipulate the natural flowering behaviour of the guava plant in desired season which contributes to increased fruit yield, quality and profitability. This concept is based on the fact that guava flowers are borne only on new, succulent, vigorously emerging vegetative growths. These new growth flushes can be either on new emergences of lateral bud on older stems or extensions of already established spurs of various size and vigour.

Objectives of crop regulation

The main objective of crop regulation is to force the tree for rest and produce profuse blossom and fruits during any one of the two or three flushes. The advantage is to regulate a uniform good quality of fruits with rise in the production as well as augmented profit to the growers. The prime benefit is to reduce cost of cultivation because uninterrupted continuous blossom would produce light crops over the whole year and requires a high cost for the monitoring and marketing.

The selection of *bahar* at a location is mainly determined by Number of factors:

The key factors which substantially regulates bahar includes availability of the irrigation water, quality of products, occurrence and extent of the damage done by the disease and pests, market demands, climate of the area, availability of fruits in the market and comparable yields with other fruit crops prevailing at a particular time are the major determinants and governing factors.

Methods of crop regulation

In order to get only winter season crop it is necessary to manipulate the flowering. The following practices are being adopted in order to get the remunerative fruit crop in winter season of better fruit quality in terms of size, shape, taste and aroma factors.

Pruning

Terminal portion of the guava up to 20 or 30 cm length should be pruned during April to avoid *Ambe bahar* and always avoid severe pruning. Pruning current season's growth of spring flush to avoid rainy season crop has been advocated in northern parts of the country. Annual pruning is used as a cheap and effective culture technique for regulating cropping pattern and increasing fruit yield and quality in guava (Bhagawati et al., 2015). The practice is popularly known as elicit treatment and is achieved by root exposure and root pruning or exposure to hot sun before the onset of monsoon. In guava maximum number of fruits in winter crop was obtained from trees in which three-fourth shoot length was pruned in the month of May (Singh, 2013). In order to have a good winter harvest deblossoming of rainy season crop and root pruning have been suggested in Uttar Pradesh where root pruning is not desirable. The pruning favoured the production of more flowers in July-August flush thereby more fruits in winter season. Maximum yield (88.0 kg/tree) was recorded with one leaf pair pruning during winter season (Tiwari & Lal 2007). Moreover, (Serrano et al., 2008) reported that the light pruning increased the number of productive branches and number of fruits per branch of Guava cv. paluma. Maximum crop regulation in terms of minimum fruit yield (5.82 kg/ tree) in summer season was recorded in pruning of the total flowering/fruit bearing portion of current season shoots followed by heading back of current season shoots to the levels of 2 basal leaves which resulted in maximum fruit yield of 104.98 kg/tree and 100.91 kg/tree respectively in winter season (Singh et al., 2007). Overall yield during both the seasons was maximal in control (110 kg/tree) however due to good quality fruits obtained during winter season; higher income was obtained with the treated trees as compared to control. Overall pruning was found to have rejuvenated impact on aged trees due to better light interception leading to better photosynthetic rate and improved nutrient and water supply with reduced canopy and better quality yields (Bhagawati et al., 2015). Singh & Bal (2006) reported that pruning help in reducing the tree size and improving the fruit quality.

Withholding irrigation

In guava the operations of withholding water, expose of feeder roots and pruning of fibrous roots to force blossom in the desired season are practiced in Maharashtra and Deccan plateau growing belt of guava in India. The *bahar* treatment is of greater significance in southern, central and western India where growth and flowering continue throughout the year. Some researchers recommended withholding of water for those areas of the western India where soils were lighter in texture. However, for heavier soils suggested root pruning in addition to the withholding of water during December or January is practiced. In northern plains withholding irrigation after harvesting of winter crop, results in the shedding of flowers and the tree goes to rest. The basin of the tree is dug up, manured and irrigated in June. After about 20-25 days, the tree put forth profuse flowering and fruit mature in winter. Induction of water stress by withholding irrigation from December to June or until the beginning of monsoon depending upon the prevailing conditions has been recommended by some scientists. Water stress can be induced by practices like root exposure and root pruning

to suppress the rainy season crop and for induction and obtaining a good winter crop.

Nutrition

To increase the quantum of winter crop the fertilizer schedule should be changed from April-May to May-June that will induce more vegetative growth that subsequently increases the winter cropping. Gupta and Nijjar (1978) advocated that application of a combination of NPK@ 40,100, 40 g respectively for induction of more vegetative growth. To increase the quantum of winter crop the fertilizer schedule should be changed from April-May to May-June that will induce more vegetative growth that subsequently increases the winter cropping (Boora et al., 2016).

Deblossoming

Growth regulators and certain chemicals have been found very effective in thinning of flowers and manipulating the cropping season NAA, NAD, 2, 4-D carbaryl and ethrel were found successful in reducing the rainy season and increasing the winter crop under different agro-climatic conditions. Manual deblossoming of rainy season flowers at small scale, kitchen garden and early age of the plant is very effective, but at large commercial plantation it is not easy to follow, which is very cumbersome, laborious and uneconomic. Flower thinning by using naphthalene acetic acid (NAA), naphthalene acetamide (NAD), 2,4-dichlorophenoxy acetic acid (2,4-D), potassium iodide (KI), 2-chloroethyl phosphonic acid (ethephon), 4,6-dinitro-o-cresol (DNOC) and urea have been tried with varying degree of success. This variation may be due to cultivars, tree condition, soil type and environment. Most of the workers are of the opinion that chemical thinning is economic and it increases the winter yield as well as helps in improvement of fruit quality. It was, however, found that hand thinning was effective in reducing the number of fruits in rainy season crop with the subsequent increase in winter crop. The maximum reduction in number of fruits during rainy season by manual removal of flowers was closely followed by pruning which subsequently produced more fruits per tree in the following winter.

In guava deblossoming with 600 ppm NAA prevents flowering and cropping during rainy season in order to augment cropping in winter season. It can also be achieved through manual removal of flowers or use of NAA at 50 ppm followed by 2, 4-D at 30 ppm and hand deblossoming followed by half shoot pruning. Application of NAA @ 600 ppm and 800 ppm, flower bud thinning by hand and one leaf pair and two leaf pair shoot pruning carried out in the first week of May significantly reduced the rainy season crop and subsequently increased the winter season crop as reported by Tiwari and Lal (2007). According to Sahay and Kumar (2004) double spray of urea (15%) at 50 per cent bloom stage and second 10 days after first spray, hand deblossoming and three-fourth current shoot pruning on 30 May can be used for winter cropping in Sardar guava. Maximum deblossoming has been observed with 20 per cent urea spray in guava (Singh et al., 1996). However, Choudhary et al. (1997) found 15 per cent urea most effective in deblossoming the rainy season guava crop. Similar findings were reported by Singh et al. (1993) who investigated that deblossoming can be carried out by spray of 10 per cent urea or naphthalene acetic acid (NAA) @ 600 ppm during the month of May, when maximum flowers have opened. By deblossoming or thinning in April-May flowers, the trees become rejuvenated by carbohydrate assimilation to produce profuse flowering in June- July and fruit harvesting in the month of November to February. Dubey et al. (2002) reported that 250 ppm of NAA caused maximum deblossoming in the rainy season and maximum yield and quality fruits during winter season. (Singh et al., 2000) observed that subsequent sprays of ethephon (600, 1200 or 1800 ppm), NAA (200, 400 or 600 ppm), urea (10, 15 or 20%) or potassium iodide (0.5, 1 or 2%) applied at flowering in April and again 2 weeks later in May on guava cv. Allahabad Safeda and pruning (50, 75 or 100%) of current season's growth performed on 10 May reduced fruit yield during the rainy season and produced the highest yield in the winter season. Agnihotri et al. (2013) reported

that guava cv. Lucknow- 49 trees sprayed twice (last week of April and 2 weeks later) with NAA (200, 250 or 300 ppm), maleic hydrazide (150, 200 or 250 ppm), urea (5, 10 or 15%), 2,4-D (20, 30 or 40 ppm) or NAD (naphthalene acetamide) (25, 50 or 75 ppm) reduced fruit set in the rainy season crop but increased it in the winter season**.** Bose et al., (2002) while working in a fruit management programme with Beaumont guava at Hawaii noted that maximum number of lateral shoot production occurred by defoliation with ethepon at 1200 ppm and maximum shoot length with application of ethepon at 600 ppm. Maji et al., (2015) concluded that summer deblossoming with NAD @ 60 ppm might be the most effective crop regulating treatment followed by NAA @ 500 ppm and NAD @ 40 ppm to get superior quality fruits of guava cv. L-49 (Sardar) as well as more remunerative profit from winter season yield.

Bending of shoot

This practice is very much dependent on training of guava branches. On the basis of calculation of expected flowering the branches of guava plants are bent down about 45-60 days before the expected date of flowering so as to produce fruits in the off season. First time bending of branches of guava plant should be employed at the age of 2 years of plant. Before bending the leaves small shoots, flowers and fruits from branch are removed or cut off keeping 10-12 inches of terminal twigs intact. During autumn (September-November) the new shootlets take 20-25 days to emerge. Bent branches should be untied when the new shootlets are about 1 cm in length. Flowering occurs in the new shootlets at 4-5 pairs of leaf stage after 45-50 days of summer and 60-65 days of autumn bending. Manures and fertilizers should be applied 15 days before bending of branches and again at pea stage of fruit growth followed by irrigation.

In case of bending of branches of guava wood tension of branch is increased and phloem formation decreased. As a result photosynthetic assimilates pass slowly from the shoots of bent branch to the other parts, maintaining increased C: N ratio and induce more flowering and fruit set. Bending forces dormant reproductive buds into active growth. Shoot bending is one of the ways to produce better quality fruits in the off-season of guava (Sarker et al., 2005). The upright branch produces fewer flowers and fruits than the bent branch (Ito et al., 1999). Bending induces profuse flowering and fruiting, as well as fetches greater returns and regulate flowering by bending of shoots (Mitra et al., 2008). Bending consistently increased the lipid, tryptophan, proline, polyphenol oxidase, catalase, and peroxidase levels in leaves, bark, and fruits, but decreased phenolics (Eassa et al., 2012). These changes may have resulted in greater flowering and fruiting, giving rise to higher yield (Bagchi et al., 2008) on guava. Mamum et al., (2012) found that the highest number of fruit set per plant when shoot bending treatment was given during on-season (312.33) and off-season value was (111.33). Shoot bending increased the fruit set per plant during off-season was also reported by Sarker and Ghosh (2006). Shoot bending increased the fruit yield per plant and quality fruit during off-season (Sarker et al., 2005). Samant et al. (2016) has also shown the positive effect of shoot bending in guava. Branch bending was done during May by retaining 10-15 pairs of leaves at apex and removing all the leaves, flowers and developing fruits manually. Branches were bent dawn by applying pressure gradually from proximal to distal end of branch. They were kept at bent position by tying the tip of branches to the wooden pegs fixed on the ground with the help of rope till flushing completes *i.e.* for 40-45 days.

CONCLUSION

The various methods involving use of different chemicals and bending technique has been adopted by different research workers across the globe. Crop regulation in guava can be adopted successfully by employing various cultural and chemical methods. Differential studies by research workers have substantially advocated that application of various cultural and chemical methods was effective to regulate flowering of summer flowers and to

produce fruits in winter. The outcome of different studies reported by scientists in guava has revealed that the fruits of winter season were significantly superior in every respect, *i.e.,* attractive size, weight and better internal bio- quality parameters than the fruits of rainy season, which helped to fetch remunerative price of fruits to growers as well as affordable price to consumers. Depending upon the availability of manpower and chemicals, a suitable technique suited to edaphic conditions should be adopted to obtain higher quantitative and qualitative outcome of fruits from guava orchards. The suitability of crop regulation method must be tried first at micro-level before adopting it at large scale level. Climate, water stress and plant nutrition plays an important role as determinants in selection of suitable method Vis a Vis efficacy of regulation of flowering in guava either by use of growth regulators, chemicals or by employing shoot bending technique in guava.

REFERENCES

Agnihotri, A., Tiwari, R., & Singh, O.P. (2013). Effect of crop regulators on growth, yield and quality of guava. *Annals Pt. Soil Res. 15*(1), 54-57.

Bagchi, T.B., Sukul, P., & Ghosh, B. (2008). Biochemical changes during off-season flowering in guava induced by bending and pruning. *Journal Tropi. Agri*., *46*(1/2), 64-66.

Bhagawati, R., Bhagawati, K., Choudhary, V.K., Rajkhowa, D.J., & Sharma, R.J. (2015). Effect of pruning intensities on the performance of fruit plants under mid-hill condition of eastern Himalayas, case study on guava. *International Lett. Natu. Sci*. *46*, 46-51.

Boora, R.S, Dhaliwal, H.S., & Arora, N.K. (2016). Crop regulation in guava-A review, *Agri. Reviw*., *37* (1), 1-9.

Choudhary, R., Singh, U.P., & Sharma, R.K. (1997). Deblossoming of rainy season crop of guava. *Horticultural J*., *10*, 93-95.

Dubey, A.K., Singh, D.B., & Dubey, N. (2002). Crop regulation in guava (*Psidium guajava* L) cv Allahabad Safeda. *Progressive Horticulture 34*(2), 200-203.

Eassa, K. B., Gowda, A. M., & El-Taweel, A. A. (2012). Effect of GA_3, hand pollination and branch-bending on productivity and quality of banati guava trees grown in sandy soils. *J. Plant Production, 3*(2), 241 – 251.

Gupta, M. R., & Nijjar, G. S. (1978). Crop regulation in guava. *Indian J. Hort., 35*, 23-27.

Ito, A., Yaegaki, H., Hayama, H., Kusaba, S., Yamaguchi, I., & Yoshioka, H. (1999). Bending shoots stimulates flowering and influences hormone levels in lateral buds of Japanese pear. *Hort. Sci., 34*, 1224–1228.

Maji, S., Das, B.C., & Sarkar, S.K. (2015). Efficiency of some chemicals on crop regulation of Sardar guava. *Scientia Horti. 188*, 66-70.

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

Mitra, S. K., Gurung, M. R., & Pathak, P. K. (2008). Sustainable guava production in West Bengal, India. *Acta Hort. 773*, 179-182.

Nimisha, S., Kherwar, D., Ajay, K.M., Singh, B., & Usha, K. (2013). Molecular breeding toimprove guava (*Psidium guajava* L.), current status and future prospective. *Sci. Hort. 164*, 578–588.

Sahay, S., & Kumar, N. (2004). Crop regulation and quality control in guava (*Psidium guajava* L). *Progressive Horti. 36*(1), 152-154.

Samant, D., Kishore, K., & Singh, H.S. (2016). Branch Bending for Crop Regulation in Guava under Hot and Humid Climate of Eastern India. *J. Indian Soc. Coastal agric. Res., 34*(1), 92-96.

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. *Environment and Ecology*, 23S, Special *3*, 621-623

Serrano, L.A.L, Marinho, C. S., Gabetto, E., Silva, M., & Tardin, F. D. (2008). Phenological and yield characteristics of "Paluma" guava tree pruned in different times and intensities, in north of Rio de Janeiro State, *Brazil. Revista Ceres, 55*(5), 416-424.

Singh, A. K., Gorakh, S., Pandey, D., Rajan, S., & Singh, G. (1996). Effect of cropping pattern on quality attributes of guava (*Psidium guajava*) fruits. *Indian J. Agric. Sci., 66*(6), 348-352.

Singh, G., Singh, A. K., & Verma, A. (2000). Economic evaluation of crop regulation treatments in guava (*Psidium guajava* L). *Indian J. Agri. Sci. 70*(4), 226-230.

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

Singh, H., Boora, R.S., & Singh, G. (2007). Effect of pruning on crop regulation of guava cv. Allahabad Safeda. *Haryana J. Hort. Sci. 36*(3-4), 270.

Singh, H., Mehrotra, N. K., & Shergill, T. S. (1994). Effect of urea spray on the crop regulation of guava cv. Allahabad Safeda.*Indian J. Hort. 51*, 331-36.

Singh, U.P., Sharma, R.K., & Hoda, M. N. (1993). Regulation of cropping in guava. *The Hort, J. 6*, 1-6.

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