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Crop Regulation: Need to be Good Quality and Higher Production of Fruit Crops

R. K. Jat, Mohan Lal Jat*, Jitendra Singh Shivran and O. P. Kumawat

[1]*Department of Fruit Science, College of Horticulture, SDAU, Jagudan, Mehsana, Gujarat, India*
[2]*Department of Horticulture, College of Agriculture, CCS HAU, Hisar, Haryana, India*
[3]*Department of Horticulture, College of Agriculture, GBPU&T, Pantnagar, Uttarakhand , India*
[4]*Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur, India*

**Corresponding author*

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A B S T R A C T

India is major fruit producing country in the world after china. India have rich fruit diversity in tropical, subtropical and temperate regions. Some of the fruits like Guava, pomegranate, lemon, acid lime, mandarin *etc.*, give various flowering flushes throughout the year if left without any treatment. These crop shows three distinct flowering seasons *i.e.* February-March (*AmbeBahar*), June-July (*MrigBahar*) and October-November (*HastaBahar*) with the corresponding harvest period during rainy (June – July), winter (November- December) and spring season(February- March), respectively. The main prime objective of crop regulation is to give the force of the tree for rest and produce profuse blossom and fruits during any one of the two or three flushes. To get good quality production *bahar* regulation are necessary in such a way that they could produce only one crop instead of two or three flushes in a year. It can be achieved through various treatments and methods like withholding irrigation, root pruning, root exposure, shoot pruning, defoliation, flowers thinning, one leaf pair pruning, spray of chemical *e.g.* NAA, urea, NAD, 2.4 D *etc.* Selection of *bahar* depends upon location and some prevailing production constraints like availability of the irrigation water, fruit quality, market prices and occurrence and infestations of the diseases and pests. Crop regulation is planning method to obtain good quality fruit and yield with good income generation by selected season crops. It is sustainable operation because this must be achieved without negatively impacting people, the environment or the financial bottom line.

Introduction

Some fruit crops bear blooming throughout the year without any resting period and produce two or three crops known as *bahar*, in a year but yield and quality is not so well in all crop harvest. It is very essential to know the flowering and fruiting behaviors of crops and

which *bahar* will give good crop with considering all the factors related with a particular *bahar*. *Bahar* treatment is practice which manipulates the flowering of any crop toward desired season by various methods and treatments. It is a vital for regularity and increased production of fruit crops along with qualitative traits. It can be achieved through debloosming of flowers, root pruning, withholding of irrigation, one pair leaf pruning, manual thinning, chemical thinning, selective harvesting, training, summer and winter pruning, prevention of pre harvest fruit drop *etc*. It helps in crop load density. When crop density is higher under high fruit set conditions, competition for assimilates is intense, which result not only in decreased fruit size and quality but also promotes alternate bearing.

Crop density, a measure of fruit crop, influences fruit growth and eventually fruit size at harvest. It mainly depends upon flowering and fruit set. With ideal conditions, most fruits often set heavier crop that cannot be satisfactorily sized to meet market requirement for higher price. This needs retention of well-spaced fruits after selective removal of some of the fruits on the trees. Leaf to fruit ratio fairly guide about the extent of thinning to be carried out in a particular orchard. Usually 30-40 leaves per fruit are sufficient to produce fruit of good quality. Though, thinning may reduce the total yield, but net return increases as larger fruits fetch much higher price in the market. The acid limes bloom throughout the year but the main blooming period is spring season (February-March)with lean period from July to August. There are three distinct flowering seasons with corresponding harvesting periods *i.e.*rainy, winter and spring. It is desirable to take only one crop in a year. Under South Indian conditions, the rainy season crop is preferred owing to higher price in market at this time but fruits of this season are of poor quality. In North India, winter crop is of better quality and the fruits also escape the attack of white flies. In Western India, root pruning of guava is practiced to regulate the season of harvesting, as is done in the case of mandarins, is recommended in heavy soils only. In lighter soils, withholding of water serves the purpose. This practice is known as bahar treatment.

Principle of crop regulation

The basic principle of crop regulation is to manipulates the natural flowering of the fruit plant in desired season that contribute to increased fruit yield, quality and profitability. This concept is based on the fact that most of the crops bear flowers 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 terminals of various size and vigour. Guava, citrus, pomegranate *etc*.are the best examples that accomplish such features for crop regulation.

Objective of crop regulation

To obtain suitable crop ata desired season

To force the tree for rest and produce profuse blossom and fruits during any one of the two or three flushes

To regulate a uniform and good quality of fruits

To maximize the production as well as profit to the grower

Reduce crop load intensity

To get better market price

To obtain good quality fruit e.g. winter guava

To maintain balance between vegetative and reproductive phases in next year which crop taken.

To prevent flower and fruit drop.

To reduce cost of cultivation because uninterrupted blossom would produce light crops over the whole year and require a high cost for the monitoring and marketing.

Criteria for bahar selection

The selection of a *bahar* at a location is mainly determined by prevailing production constraints like:

Availability of irrigation water

Occurrence and extent of damage by diseases and pests

Market demand

Quality of products

Climate of the area

Availability of fruit in the market

Comparable yields

Why to need crop regulation?

Some fruit crops which bloom more than one in a year do not produce good yield and quality of the fruit throughout the year. In guava, the fruits produced in the rainy season are rather insipid and watery and do not keep well. The winter season crop is the one ordinarily desired as it is not only larger in size, but of much better quality. The winter season crops (*mrigbahar*) 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. Winter season crop is superior in quality which fetches higher prices than rainy season crop. Second, 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.

Which methods are used in crop regulations?

To get only appropriate season crop it is necessary to manipulate the flowering. The following practices can be done:

Withholding irrigation

Root exposure

Flower thinning

Shoot pruning

Shoot bending

Nutrient application

Deblossoming of flowers

Use of growth regulators

Withholding irrigation

The irrigation is withheld for 2-3 month during February- March. As soon as the growth of plant ceases and leaves start turning yellow and fall off due to water stress, tree undergoes rest. At the end of May or early June, the soil of orchard is ploughed and manured with Farm yard manure to individual tree. After application, tree is irrigated. The first two irrigations should be given at an interval of three days and subsequent may be

given at 10-15 days intervals till the monsoon sets in. The plants then resume growth and bloom heavily in August– September producing very high yield and quality fruits in winter season.

Root exposure

Various degree of root pruning has been found suitable for minimizing the rainy season crop. The practice of root exposure and pruning is done in regions with high atmospheric humidity and water table. The procedure involves exposing the upper roots of the tree up to 1.5 ft. radius around the trunk on removing the upper 8 cm soil. The main root system is not disturbed while the fibrous roots on them are removed by pruning shear. This results in shedding or leaves from the tree. At this stage, the exposed roots are again covered with soil, mixed with manures and immediately irrigated. Root pruning should, however be avoided as it has adverse effect on plant longevity. In Maharashtra, withholding of water and root exposure is commonly followed to regular cropping.

Flower thinning

Deblossoming of rainy season crop is another method for crop regulation. Thinning of flowers and small fruits practiced by hand, twice during April-May at 15 days interval, has been found quite effective in this regard. However, the technique is costly and cumbersome. The total yield of the plant in year is also reduced by this method.

Shoot pruning

The pruning of new shoot (current season) growths in first week of May has been found very effective for crop regulation in guava. This method involves the removal of half to 3/4th portion of the shoot growth. This pruning automatically removes the flowers and flower buds of spring season flowering and consequently the rainy season crop can be reduced. This method has been found effective and economical without much adverse effect on total yield of the plant in a year. Significantly maximum TSS, Sugar: acid and yield were recorded when guava plants pruned up to 45 cm in May (Meena *et al.,* 2017).Patil *et al.,* (2018) found significantly superior flowers/meter shoot and fruit set with pruning of 10 cm terminal shoot at the date of 15th September in acid lime. Bera *et al.,* (2012) reported maximum fruit weight, total number of fruits/ plant, fruit production, TSS and reducing sugar when pruning of pomegranate plants was done at the earliest date of 15 November.

Shoot bending

Bending induces profuse flowering and fruiting in guava and fetches greater returns (Ghosh and Sukul, 2003; Sarkar *et al.,* 2005). Before doing bending some of the shoots were thinned off and rest of the shoots was cleaned from the base of the shoot except 25-30 cm of terminal portion.

Then all the branches of plant were bent down and tied to the base of the plant by coconut thread. In case of bending of branch wood tension of branch is increased and phloem formation decreased. As a result, photosynthetic products pass slowly from the shoots of bent branch towards the other parts maintaining increased C: N ratio and induce more flowering and fruit set.

Time of bending

Branch bending improved yield, TSS, TSS/ acid ratio and Vit. C in winter season guava cv. 'Lucknow-49' (Samant *et al.,* 2016). Nandi *et al.,* (2017) also noted the highest yield of guava when bending was done in October.

Nutrient application

Nutrients are also responsible for crop regulation. To reduce rainy season crop and increase winter crop, two sprays with urea @ 15 per cent in April-May at 15 days intervals was more effectively (Singh *et al.,* 1996). Two sprays of 10 and 15 % urea at 10-day intervals during flowering in the summer season was economically feasible for crop regulation in Allahabad Safeda and Sardar guava, respectively (Singh and Singh, 2000). Gupta and Nijjar (1978) advocated application of combination of NPK@ 40,100, 40 g per tree for guava crop. Singh and Singh (2009) observed maximum flower bud formation, fruit weight and fruit yield in guava with 10 % concentration of urea.

Use of growth regulators

Manipulation of flowering season by application of growth regulators has been found to be very effective for crop regulation in guava. Growth regulators such as NAD, NAA and 2, 4 – D have been found very effective in thinning of flowers and manipulating the cropping season in guava. Chemical treatment of NAD at 30 and 50 ppm, NAA 100 and 125 ppm and 2, 4 – D at 15 and 30 ppm can be successfully used for thinning of summer flowers. Experiments conducted at Pantnagar have suggested that foliar spray of NAA @ 800 ppm twice in Mayat 15days interval has been found effective in minimizing the rainy season crop. First spray should be done when about 50 per cent of flower buds are opened. This method can be applied on a large scale. Teaotia and Pandey (1970) observed that spraying of NAA at 100 ppm reduced the season crop considerably, but the best result was obtained by hand thinning of summer flowers, which reduced the rainy season crop by 81 per cent and increased the following winter crop by 18. 4 percent. Rathore (1975) reported that NAA at 80 and 100 ppm greatly reduced the fruit set of guavas when sprayed in the month of April. Among the different fruit thinning chemicals used, NAD at 50ppm and 2, 4–D at 30 ppm were found the most effective chemicals for deblossoming of summer flowers as suggested by Kumar and Hoda (1977). By deblossoming the summer flowers, an increase in yield by 200 - 300 per cent was obtained and NAD at50 mg /litre was more effective than NAAor2, 4 - D (Mitra *et al.,* 1981, 1995). GA_3 (50 ppm) increased yield and quality of Allahabad Safeda guava in Assam condition (Lal and Das, 2017).

Treatment with ethrel (1ml/l) resulted in the highest ethylene forming enzyme activity in leaves and maximum number of flowers and fruits (Castelan Estrada and Becorril Roman, 1994). The flowering was greatly enhanced by spraying urea at 25% and ethrel at2000 ppm (Chandra and Govind, 1994). Brahmachari *et al.,* (1996) reported that CCCat500 ppm induced the earliest flowering and highest number of flowers. Supe *et al.,* (2015) observed maximum fruit set, fruit weight, number of fruits/ tree and yield by spraying of ethrel 2 ml/l in pomegranate crop.

Mahalle *et al.*,(2010) reported that two sprays of cycocel @ l000 ppm at an interval of one month before initiation of flowering in August and September for *Hasta bahar* flowering (*i.e*., September and October) of acid lime resulted in maximum yield in terms of number of fruits per tree and weight of fruits per tree and this treatment also improved the fruit quality in respect to juice %, TSS, acidity, ascorbic acid content, peel and pomace per centage. Prabhu *et al.,* (2017) reported maximum initial fruit set, fruit retention, number of fruit/ tree, fruit weight and fruit yield in summer season acid lime cv. PKM 1 with spraying of GA_3 50 ppm in June + Cycoce'l 1000 ppm in September + Spraying of 2 % KNO_3 in October. The highest fruit

yield was significantly recorded with the GA_3 50 ppm (single spray) + 15 cm shoot pruning in Assam Lemon (Mahesha and Singh, 2018).

The water stress with hormones played an important role in regulation of flowering and there is relationship between severity of stress and flowering response (South Wick and Davenport, 1987; Barbera and Garimi, 1988).

Crop regulation is the basis for the regular and quality crop. It may be adopted successfully in guava, citrus, pomegranate *etc.*by adoption of different methods *viz.*,with holding irrigation, root exposure, flower thinning, shoot pruning, shoot bending, nutrient application, and use of growth regulators to increase production with enhanced fruit quality.

Table.1

Bahar	**Month**		
	Water stress	**Flowering**	**Fruiting**
Ambebahar	December-January	February-March	July-August
Mrigbahar	April-May	June -July	November- December
Hasta bahar	August-September	October-November	February- March

Table.2

	Summer bending	**Autumn bending**
Time of bending	April-June	September- November
Shoot emergence	8-10days after bending	20-25 days after bending
Flowering	40-45 days after bending	60-65 days after bending

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