J. Indian Soc. Coastal agric. Res. 34(1): 92-96 (2016)

Branch Bending for Crop Regulation in Guava under Hot and Humid Climate of Eastern India

DEEPA SAMANT*, KUNDAN KISHORE and H.S. SINGH
Central Horticultural Experiment Station-ICAR-IIHR
Aiginia, Bhubaneswar - 751 019, Odisha

Received: 27.01.2016 Accepted: 12.06.2016

Guava (*Psidium guajava* L.) exhibits two distinct periods of flowering, i.e., spring (*Ambe bahar*) and rainy (*Mrig bahar*) under hot and humid climate of Odisha. *Ambe bahar* gives the rainy crop whereas, *mrig bahar* gives the winter crop. Though, the quantum of production is low during winter yet, it fetches high market value and superior in quality. Considering the fruit quality and better market price of winter guava, a field experiment was carried out on five-year-old plants of guava cv. 'Lucknow-49' at research farm of Central Horticultural Experiment Station-ICAR-IIHR, Bhubaneswar during 2013-2015. The objective was to standardize the crop regulation technique in guava for obtaining winter crop. The experiment was laid out in randomized block design with five treatments, i.e., shoot pruning at 30, 50 and 70% intensity, branch bending and control. Each treatment was replicated four times with four plants in each replicate. Treatments were imposed in May. Observations recorded on shoot growth showed that, the branch bending treatment contains the growth (56.91cm) of newly emerged shoots whereas, shoot pruning resulted in production of vigorous (83.68 ±3.95cm) shoots as compare to control (68.10cm). The same treatment was found very effective in inducing flowering (46.27%) and recorded the highest yield (26.48kg plant^{-1}) whereas, pruning did not show yield improvement over the control. Fruit quality parameters, viz., total soluble solids (10.18°B) and vitamin C content (204.6 mg 100g^{-1} pulp) were also improved by the branch bending.

(***Key words:*** *Branch bending, Crop regulation, Eastern India, Guava, Pruning*)

Guava (*Psidium guajava* L., Myrtaceae) produces varying amount of crop throughout the year, depending upon the prevailing climatic condition of the growing area. Under hot and humid climate of eastern, it exhibits two distinct periods of flowering/*bahar*, *i.e.,* spring (March-April) and rainy (July-August), which are known as *Ambe bahar* and *Mrig bahar,* respectively. *Mrig bahar* is less intense as food reserves are already exhausted by the *Ambe bahar* in the process of flushing, flowering and fruiting (Agnihotri *et al*., 2013). Thus, *Ambe bahar* produces heavy crop during rainy season (August-October) whereas, *Mrig bahar* gives light crop during winter (December-January). Though, the quantum of production is low in winter crop yet, it fetches high market value and throughout the India, it is preferred over the rainy crop on account of being better in fruit and keeping qualities (Prakash *et al*., 2012; Kumar *et al*., 2013; Parmar *et al*., 2014). Therefore, the natural flowering and fruiting behaviour of guava are needed to be regulated, towards the production of heavy crop load during winter season to make guava cultivation highly profitable and market oriented.

Guava is amenable to crop regulation, i.e., a guava plant could be forced to produce heavy *Mrig bahar* by fulfilling two pre-requisites of flowering- one is production of large number of shoots during summer (May-June), as it bears flowers on newly emerging lateral shoots and second is reducing the exhaustion of food reserves by the *Ambe bahar* to induce flowering in newly emerged summer shoots. In this context, branch bending and pruning could be of great use. Both, the cultural practices are known to induce the lateral shoot production by breaking the apical dominance and invigorating the latent buds present on the branch. Therefore, investigations were carried out to evaluate the feasibility of summer pruning and branch bending for crop regulation in guava.

MATERIALS AND METHODS

The study was carried out on five-year-old plants of guava cv. 'Lucknow-49' at the research farm of Central Horticultural Experiment Station-ICAR-IIHR, Bhubaneswar, Odisha during 2013-2015. The experimental site is located at 20°15' N latitude and 85°15' E longitude at an elevation of 25.5 m above mean

**Corresponding Author :* E-mail: horti.deepa@gmail.com

sea level. Bhubaneswar falls under hot and humid tropical climate and receives on an average 1400 mm annual rainfall between June to September. The soil of the experimental site is sandy loam (80.45% sand, 10.19% silt and 9.36% clay) and strongly acidic (pH 4.6), low in organic carbon (0.20%), N (189.8 kg ha^{-1}), P (8.5 kg ha^{-1}) and K (140.58 kg ha^{-1}). Guava plants were spaced at 5m x 5m accommodating 400 plants ha^{-1}. The experiment was laid out in randomized block design with five treatments, *i.e.,* shoot pruning at 30, 50 and 70% intensity, branch bending and control. Each treatment was replicated four times with four plants in each replicate. Treatments were imposed in the month of May. Branch bending was done by retaining 10-15 pairs of leaves at apex and removing all the leaves, flowers and developing fruits manually (Fig. 1). 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. All the plants were subjected to similar cultural practices.

Observations were recorded on flushing (shoots emerged m^{-1} of branch and shoot length), flowering and fruiting (flowering intensity, fruit set and fruit drop), yield and fruit quality parameters (total soluble solids, acidity and vitamin C content). For recording observation on shoot emergence, four branches (one in each direction of canopy) were selected in case of branch bending and control treatments whereas, in pruning treatments five pruned shoots in each direction were selected. Total number of shoots emerged after imposition of treatments were counted and divided by the total length (m) of branch/pruned shoot. Flowering intensity was determined by counting the numbers of flowering shoots emerged on the same selected branches and pruned shoots, and expressed in percentage. To record the observations on shoot growth, fruit set and fruit drop, 20 flowering and 20 non-flowering shoots were tagged in each plant (5 flowering and 5 non-flowering shoots in each direction of canopy). Shoot length was measured after 180 days of their emergence. Fruit set and fruit drop were computed using following formulae

Fig. 1. *Branch bending in guava*

$$\text{Fruit set at pea stage (\%)} = \frac{\text{Number of fruitlets developed}}{\text{Number of flowers}} \times 100$$

$$\text{Fruit drop (\%)} = \frac{\text{Number of set fruits - Number of fruits reached harvesting stage}}{\text{Number of set fruits}} \times 100$$

Fruits were harvested at full maturity counted and weighed with physical balance, and yield was expressed in kg $tree^{-1}$. Average fruit weight was computed by dividing the yield obtained from the tree by the number of fruits obtained. Ten mature fruits from each replication unit were taken randomly for recording observations on chemical quality attributes. Total soluble solid content (TSS) was determined using digital refractometer (0-85°B). Acidity was estimated by titrating the fresh fruit juice with 0.1N NaOH using phenolphthalein as indicator and expressed as per cent citric acid equivalents. Vitamin C content was determined as per the methods described in AOAC (2005).

The data generated on various parameters were tabulated and statistically analyzed using OPSTAT package of Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana for interpretation of results and drawing conclusion.

RESULTS AND DISCUSSIONS

Flowering and fruiting behaviour

The observations recorded for three consecutive years from 2013-15, on characteristics of flushing, flowering and fruiting were pooled and presented in Table 1. From the perusal of data, it is evident that branch bending and pruning at higher intensity levels (50 and 70%) had significant influence on summer flushing. The effect of branch bending on production of new shoots during summer is shown in Fig. 2. The highest number of shoots per branch was observed in branch bending

Table 1. *Effect of summer shoot pruning and branch bending on characteristics of flushing, flowering and fruiting in guava cv. 'Lucknow-49'*

Treatment	Number of shoots emerged m^{-1} of branch	Length of shoots (180 Days after emergence)		Flowering intensity (%)	Fruit set (%)	Fruit drop (%)
		Non-flowering (cm)	Flowering shoots (cm)			
30% Shoot pruning	16.38	81.21	53.13	8.74	63.43	60.48
50% Shoot pruning	18.81	85.13	56.98	9.51	67.14	59.47
70% Shoot pruning	20.31	89.52	58.85	9.14	64.12	57.55
Branch bending	23.88	59.43	31.21	46.27	64.94	56.31
Control	15.88	67.08	41.95	12.04	65.87	60.97
Sem ±	0.75	3.55	2.94	1.34	3.38	2.71
CD (0.05)	2.33	11.06	9.15	4.19	ns	ns

Fig. 2. *Flushing after branch bending*

(23.88) followed by 70% shoot pruning (20.31) whereas, the lowest was observed in control (15.88). Similar effects of pruning and branch bending on shoot emergence have also been reported earlier (Ferdaus, 2007; Shaban and Haseeb, 2009 and Sherif, 2012). Shoots emerged after pruning, were found to be vigorous in nature. Shoot length increased with the increase in pruning intensity, though the differences among the pruning treatments were insignificant. The trend is common in flowering and non-flowering shoots, both. The longest non-flowering (89.52cm) and flowering shoots (58.85cm) were observed in 70% shoot pruning. These results are in agreement with the findings of Jadhav *et al.* (1998) and Lakpathi *et al.* (2013). In contrary to pruning, branch bending contained the shoot growth and produced shortest flowering (31.21cm) and non-flowering (59.43cm) shoots. Similar impact of bending on shoot growth was reported by Lauri *et al.* (1998) in sweet cherry.

In our study, branch bending was found effective in enhancing the flowering (Fig. 3) whereas, summer pruning, which has been reported to induce profuse flowering during rainy season in guava by Pilania *et al.* (2010) and Joshi *et al.* (2014) failed to do so. The possible reason could be alteration in carbon nitrogen (C:N) ratio of plants. Removal of biomass during pruning might have reduced the C: N ratio of the plant (Fig. 4). Under the influence of low C: N ratio, the pruned plant might have showed light flowering and vigorous shoot growth. The positive effect of branch bending on flowering could be explained by high C: N Ratio (Fig. 4). The wood tension generated under bent position of branch affects the functioning of phloem. Photosynthetic products pass slowly from the shoots of bent branch to other parts, which in turn results into increased C: N ratio (Mamun *et al.*, 2012). Moreover, branch bending opens up the canopy and improves leaf photosynthesis via change in leaf exposure to sunlight (Li and Lakso, 2004). As far as fruit set and drop is concerned, no significant differences were observed among the treatments.

Fig. 3. *Flowering after branch bending*

Table 2. *Effect of summer shoot pruning and branch bending on fruit yield and quality in guava cv. 'Lucknow-49'*

Treatment	Yield (kg plant^{-1})			Fruit quality of winter guava				
	Winter crop	Rainy crop	Cumulative yield	Fruit weight (g fruit^{-1})	TSS (°B)	Acidity (%)	TSS/acid ratio	Vitamin C (mg 100g^{-1} of pulp)
30% Shoot pruning	2.19	14.05	16.23	225.74	9.15	0.48	19.14	189.25
50% Shoot pruning	2.45	11.41	13.85	224.18	9.45	0.52	18.48	191.60
70% Shoot pruning	2.31	10.34	12.64	230.31	9.35	0.46	20.64	182.46
Branch bending	26.48	0.00	26.48	202.05	10.18	0.40	26.43	204.60
Control	5.17	17.34	22.50	221.55	9.23	0.51	18.29	185.03
SEm ±	0.59	0.76	0.85	4.16	0.19	0.03	1.44	3.3
CD (0.05)	1.84	2.37	2.65	12.95	0.59	ns	4.47	10.36

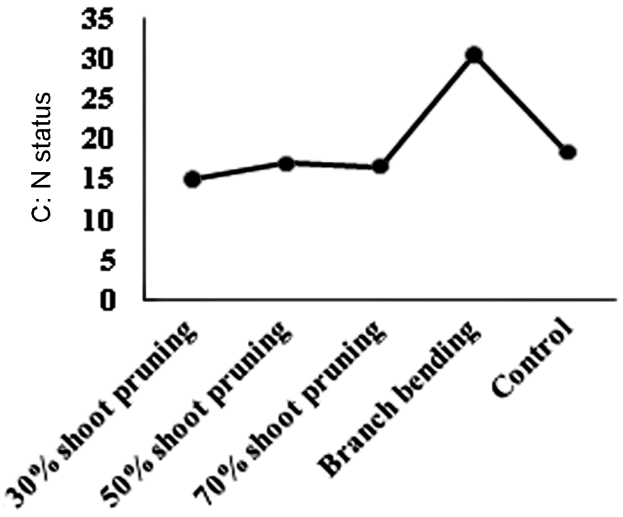

Fig. 4. *C: N status of guava plant*

Fruit yield and quality

The data pertaining to yield and fruit quality parameters, viz., fruit weight, TSS, acidity, TSS: acidity ratio and vitamin C content are presented in Table 2. It is evident from the data that the pruning treatments had significant impact on reducing the rainy season crop but failed to improve the share of winter crop. Moreover, summer pruning reduced the cumulative yield of both rainy and winter seasons (14.44±1.8 kg tree^{-1}). The maximum value for winter crop was recorded in branch bending (26.48 kg plant^{-1}), which was significantly more than the cumulative yield of both rainy and winter crop obtained under control (22.5 kg tree^{-1}). Sarkar *et al*. (2005) also reported improvement in off season fruit yield over control due to branch bending. The increase in yield was mainly due to profuse flowering (46.27%) not due to fruit weight, as average fruit weight in branch bending treatment was significantly low (202.05 g fruit^{-1}). Our findings are in conformity with the results obtained by Lauri *et al*. (1998).

With respect to chemical parameters of fruit quality, significant improvements have been observed in TSS, TSS/acidity ratio and Vitamin C content by branch bending. Improvement in fruit quality could be due to complete removal of rainy crop and subsequent diversion of stored food material to winter crop. Further, branch bending improves the light penetration inside the canopy and increases the rate of photosynthesis. This could have improved the fruit quality.

CONCLUSION

In our study summer pruning, that has been reported as an effective tool for crop regulation in guava in different parts of the country, did not yield any positive impact on regulation of winter crop. Instead, it resulted in reduction of total yield (rainy and winter). The differential response of pruning could be due to climate and its influence on plant physiology. In contrary to summer pruning, branch bending had shown positive influence on shoot growth, flowering intensity, yield and fruit quality. Hence, it may be concluded that under hot and humid climate of eastern India, branch bending could be adopted as a technology to regulate cropping in guava.

REFERENCES

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

AOAC (2005). *Official Methods of Analysis*, Eighteenth edition, Association of Official Analytical Chemists, Washington, DC, USA.

Ferdaus, J. (2007). Effect of shoot bending on productivity of guava. *Unpublished M. Sc. Thesis*, Bangladesh Agricultural Universiy, Mymensingh, Bangladesh.

Jadhav, B. J., Mahurkar, V. K. and Kale, V. S. (1998). Effect of time and severity of pruning on growth and yield of guava (*Psidium guajava* L.) cv. Sardar. *Orissa Journal of Horticulture* **30**(2): 83-86.

Joshi, P., Lal, S., Nautiyal, P. and Pal, M. (2014). Response of plant spacing and pruning intensity on yield contributing characteristics of guava cv. Pant Prabhat. *Journal of Hill Agriculture* **5**(2): 163-167.

Kumar, R., Tiwari, R. and Kumawat, B. R. (2013). Quantitative and qualitative enhancement in guava (*Psidium guajava* L.) cv. Chittidar through foliar feeding. *International Journal of Agricultural Sciences* **9(1)**: 177-181.

Lakpathi, G., Rajkumar, M. and Chandrasekhar, R. (2013). Effect of pruning intensities and fruit load on growth, yield and quality of guava (*Psidium guajava* L.) cv. Allahabad Safeda under high density planting. *International Journal of Current Research* **5**(12): 4083-4090.

Lauri, P. E., Claverie, J. and Lespinasse, J. M. (1998). The effect of bending on the growth and fruit production of Inra Fercer® sweet cherry. *Acta Horticulture* **468**: 411-417.

Li, K. T. and Lakso, A. N. (2004). Photosynthetic characteristics of apple spur leaves after summer pruning to improve exposure to light. *Horticulture Science* **39**: 969-972.

Mamun, A. A., Rahman, M. H. and Farooque, A. M. (2012). Effet of bending and fruit thinning for off-season production of guava. *Journal of Agroforestry and Environment* **6**(1): 111-116.

Parmar, J. M., Karetha, K. M. and Rathod, P. J. (2014). Effect of urea and zinc treatments on biochemical components of guava fruits cv. Bhavnagar Red. *International Journal of Forestry and Crop Improvement* **2**: 61-64.

Pilania, S., Shukla, A. K., Mahawer, L. N., Sharma, R and Bairwa, H. L. (2010). Standardization of pruning intensity and integrated nutrient management in meadow orcharding of guava (*Psidium guajava*). *Indian Journal of Agricultural Sciences* **80**(8): 673-678.

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 Journal of Horticulture* **69(2)**: 173-176.

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

Shaban, A. E. A. and Haseeb, G. M. M. (2009). Effect of pruning severity and spraying some chemical substances on growth and fruiting of guava trees. *American-Eurasian Journal of Agriculture and Environmental Science* **5**(6): 825-831.

Sherif, H. M. (2012). Effect of bending date on spur formation and fruit set of Le-Cote pear trees. *World Rural Observations* **4**(4): 82-87.