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Short communication

Biochemical changes during off-season flowering in guava (*Psidium guajava* L.) induced by bending and pruning

Torit Baran Bagchi*, Premasis Sukul, and Bikash Ghosh

Department of Agricultural Biochemistry, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohonpur, Nadia, West Bengal 741252, India.

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Abstract

A field experiment was conducted during 2003-2004 to study the biochemical changes in the leaf and bark of guava under different bending and pruning treatments during off-season flowering. Lipid, carbohydrate, enzymes, phenolics, free amino acids, proline, and tryptophan concentrations were monitored after new shoot initiation and before flower initiation. Bending and pruning treatments consistently increased the lipid, tryptophan, proline, polyphenol oxidase, catalase, and peroxidase levels in leaves, bark, and fruits, but decreased phenolics compared to that of the control. Such biomolecular changes within the guava shoots may have resulted in greater flowering and fruiting, giving rise to higher yield per plant. Total fruit yield increased from 18.55 to 48.64 kg per plant following this treatment.

Keywords: Off-season flowering, Proline, Tryptophan, Polyphenol oxidase, Catalase, Peroxidase.

Guava (*Psidium guajava* L.), one of the most important fruits of India, is a good source of energy (51 calories/ 100 g edible portions), vitamins, and minerals (Mitra and Sanyal, 2004). As a tree management strategy to increase shoot numbers and induce off-season flowering, farmers in the Baruipur area of South 24 Parganas district of West Bengal, often resort to bending and pruning the shoots. Bending induces profuse flowering and fruiting, as well as fetches greater returns (Ghosh, 2003). It is usually practiced in the summer (April-May) and autumn (September-October) seasons. Although bending and pruning are generally perceived as beneficial, the biochemical changes taking place within the guava shoots when the treatments are imposed is not clearly understood. Hence, leaf and bark samples of the new guava shoots emerged following bending and pruning treatments and in different growth stages were analyzed to find out the profile of different biomolecules.

The experiment was conducted in randomized block design with five treatments and three replications at the Mondouri farm of BCKV campus. The soil of the experimental site is clay loam and slightly alkaline type (Inceptisol). All the guava plants (six years old) from a plot (cv. 'Allahabad safeda', a locally important variety) were selected for this experiment (plot size: 12 x 12 m with 16 plants per plot). The experimental variables included: control, i.e., without bending and pruning, bending of lateral branches and partial removal of old leaves, one leaf pair pinching with complete removal of old leaves, 10 cm pruning with complete removal of old leaves, and 20 cm pruning with complete removal of old leaves. In the treatments with bending, 8 to 10 lateral branches per plant were bent down 45 to 60 days before flowering to open the crowns. Ropes were tied to the tip of branches, which were curved carefully by tying the other end of the rope to the base of the plant. Within 2 to 3 days after bending, Planofix @ 0.5 ml L^{-1} of water and Metacid @ 1 ml L^{-1} were applied. After 16 to 19 days, new shoots emerged from the bent portions, when the

*Author for correspondence (present address): Central Seed Research Station for Jute & Allied Fibres (CSRSJAF), P.O. Bud Bud, Burdwan 713403, West Bengal, India; Phone 9232765144; Fax 03432512007; Email <torit_crijaf@ indiatimes.com>.

rope attachments were disconnected. Besides bending the shoots, the lateral branches of guava were also pruned with a sharp knife. In the present experiment three types of pruning were done: one leaf pair pruning, 10 cm pruning, and 20 cm pruning. In all cases removal of old leaves had been done and the cultural practices adopted were similar. Fertilizers at the rate of 450 g N, 300 g P_2O_5, and 450 g K_2O were applied per plant in two equal split doses, viz., 15 days before bending and marble stage of fruit growth (*ca.* 30 days after flower initiation).

Leaf and bark samples were collected from the new shoots at two leaf pair stage (16 to 19 days after treatment), and at flower initiation stage (41 to 52 days after treatment). One portion of the sample was oven-dried at 50°C and ground. The other portion was cold stored (4°C). Different biomolecules (lipid, carbohydrates, enzymes, phenolics, free amino acids, proline and tryptophan) were estimated adopting standard methods (Sadasivam and Manickam, 1992). Enzymatic activity was observed only in the control and bending treatments and yield data recorded on individual plants. The experimental data on biochemical attributes (pooled over seasons) and fruit yield parameters were analysed by ANOVA. Proline concentrations were regressed on fruit yield per tree.

Bending increased the total free amino acid in leaf and bark samples compared to the control (Table 1). This may be on account of the inefficient utilization of amino acids in protein synthesis or due to proteolysis. Tryptophan accumulation in the leaves increased following bending presumably because of the appearance of N-malonyl D-tryptophan, which induced tryptophan synthesis (Rekoslavskaya et.al., 1991). Higher lipids in bark at the initial stage and in leaves at the later stage signify the tendency of plants to overcome the shock effects of bending and pruning. Total soluble sugars and reducing sugars were also higher in the bending/pruning treatments; for starch, however, it followed a reverse trend (Table 2). Likewise, total phenol content in leaves and bark was greater in the control compared to other treatments.

Peroxidase and catalase activities were also higher in the

Table 1. Average concentration of different biomolecules in new shoots of guava as influenced by bending and pruning treatments at Mondouri, West Bengal.

Treatments	Total free aminoacids (mg g^{-1})	Tryp. (mg g^{-1})	Proline (mg g^{-1})	Total phenol (mg g^{-1})	Lipid (%)	Total soluble sugar (mg g^{-1})	Reducing sugar (mg g^{-1})	Starch (mg g^{-1})	Peroxidase (min g^{-1})	Catalase (min g^{-1})	PPO (ΔAmin^{-1}g^{-1})
						Leaf					
T_0	0.411	0.124	0.022	0.012	19.1	28.5	24.8	131.9	0.2	1.2	0.07
T_1	0.449	0.306	0.067	0.005	20.0	34.0	31.7	101.9	0.6	3.5	0.11
T_2	0.359	0.172	0.051	0.002	42.9	47.6	34.4	85.1	-	-	-
T_3	0.283	0.237	0.052	0.001	29.9	50.8	36.7	53.8	-	-	-
T_4	0.174	0.243	0.048	0.001	23.3	35.6	24.9	61.1	-	-	-
SEm	0.010	0.004	0.007	0.003	2.62	0.42	1.10	1.72	-	-	-
CD5%	0.025	0.010	0.002	0.008	6.49	1.04	2.72	1.20	-	-	-
						Bark					
T_0	1.196	0.118	0.006	0.005	26.9	17.2	11.6	94.6	0.4	0.13	0.13
T_1	1.586	0.083	0.075	0.001	24.5	17.1	5.60	73.7	0.1	0.23	0.23
T_2	0.784	0.079	0.050	0.001	24.9	14.4	3.80	57.3	-	-	-
T_3	0.487	0.037	0.048	-	24.8	8.90	3.80	76.9	-	-	-
T_4	0.758	0.101	0.032	-	28.5	9.80	3.90	93.5	-	-	-
SEm	0.032	0.006	0.001	0.016	1.51	0.29	0.18	0.25	-	-	-
CD5%	0.079	0.010	0.004	0.003	3.71	0.73	0.44	0.64	-	-	-

T_0 - Control, T_1 - Bending of lateral branches and partial removal of old leaves, T_2 - one leaf pair pinching with complete removal of old leaves, T_3 - 10 cm pruning with complete removal of old leaves, and T_4 – 20 cm pruning with complete removal of old leaves; PPO= polyphenoloxidase.

Table 2. Fruit yield of guava as influenced by bending and pruning treatments at Mondouri, West Bengal.

Treatment	Mean number of fruits retained per branch (up to harvest)	Mean number of fruits retained per plant (up to harvest)	Mean fruit weight (g)	Yield per plant (kg)
T_0	1.82	75.7	203	15.0
T_1	12.99	195.5	242	48.6
T_2	2.27	89.8	222	21.1
T_3	1.96	77.4	220	18.6
T_4	6.06	94.1	234	23.0
SEm$\pm$	0.04	0.16	7.4	0.03
CD $_{(0.05)}$	0.10	0.40	18.4	0.07

T_0 - Control, T_1 - Bending of lateral branches and partial removal of old leaves, T_2 - one leaf pair pinching with complete removal of old leaves, T_3 - 10 cm pruning with complete removal of old leaves, and T_4 - 20 cm pruning with complete removal of old leaves.

new leaves emerged after bending compared to the control. Plants under bending treatments may use a self-defensive mechanism by increasing the activity of these two enzymes. In both leaf and bark samples, polyphenoloxidase activity increased under bending treatment compared to control (Table 2). The activity of this enzyme is important with regard to plant defence mechanisms and O_2 scavenging in photosynthesis under stress (Shivashankar and Nagaraja, 1996; Stout et.al., 1994).

A comparison of the data in Table 2 indicates that bending and pruning exerted a significant positive influence on guava fruit production. For example, bending of shoots gave the highest yield per plant (48.6 kg plant^{-1}), followed by 20 cm pruning (23 kg plant^{-1}). As proline biosynthesis is stimulated under an episode of stress, profuse flower bud initiation occurs in the stressed plants (bent/pruned). A positive relationship between fruit yield and proline concentration in the leaves illustrates this point (Fig. 1). Definite biochemical changes in guava shoots under an episode of stress may produce off-season flowering of guava leading to higher fruit production.

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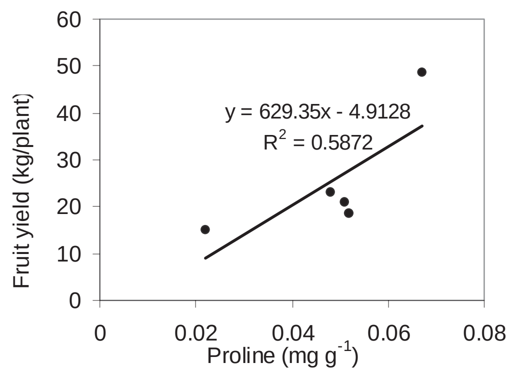

Figure 1. Correlation between proline content in leaf and fruit yield of guava in Mondouri, West Bengal.

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