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Effect of various methods of crop regulation in guava under double-hedge row system of planting

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ABSTRACT

A field experiment was conducted on guava cv. Pant Prabhat planted under double-hedge row system. In order to regulate the crop, seven pruning treatments, *viz*., flower bud thinning by hand (T_1, FBT); flower bud thinning by hand followed by removal of terminal one leaf pair (T_2, FBTT); removal of leaves and flower buds by hand, retaining one leaf pair at the top (T_3, RLFO); removal of all leaves and flowers by hand (T_4, RLF); one leaf pair shoot pruning (T_5, OLPS); full shoot pruning (T_6, FSP); one leaf pair pruning of fruited shoots only (T_7, OLPF) and control (T_8, C) were studied to know their effect on yield of guava. The maximum new shoot emergence (98.31 per branch) for winter season crop was observed with the treatment T_4 (RLF) and minimum with the treatment T_8 (C). The maximum flower bud emergence (23.19 per branch) for winter season crop was recorded with the treatment T_7 (OLPF) and minimum with the treatment T_8 (C). For rainy season crop, there was non-significant difference for these parameters. The maximum number of fruits (499.29 per tree), yield (55.30 kg per tree and 191.90 q per hectare) for winter season were recorded with the treatment T_7 (OLPF) and minimum with the treatment T_8 (C). During rainy season, the reverse trends were observed. The per cent flower/fruit drop followed the reverse trend to that of per cent fruit set. The treatment T_7 (OLPF) recorded the highest cost: benefit ratio.

Key words: Guava, crop regulation, pruning, double-hedge row system.

INTRODUCTION

Guava (*Psidium guajava* L.) is considered as “Apple of the tropics”, owing to its high nutritional richness. It is the third richest source of vitamin C after Baraedos cherry and *aonla* (Gupta and Naik, 6). In India, guava productivity is 12 MT/ha during 2010-11 (Anon, 1), which is very less from several guava producing countries of the world. Therefore, there is an urgent need to raise level of productivity on sustainable basis. Combination of crop regulation along with high density planting is definitely a good option to increase productivity. As far as crop regulation is concerned, it is a way to force a tree for its rest and to produce profuse blossom and fruits during any one of the two or three flushes. The operation also aims to regulate into a uniform and good quality fruit and to maximize the production as well as profit to the grower (Singh, 12). Pruning had a significant effect on the tree height, tree spread, canopy volume and fruit yield (Kumar and Rattanpal , 8). While, the double-hedge row system of planting in guava accommodates 347 trees per hectare, which accommodates 2.22 times more trees than square system of planting and also recorded the highest yield per hectare, *i.e.*, 262.26 q/ha (Lal *et al.*, 9). Guava tree normally produces as many as three crops in a year which is a unique phenomenon of the tropical and sub-tropical regions because there is more than one growing season (Bal, 2). In *tarai,* out of three flowering seasons (April-May, July-August, and October-November), April-May flowering is significantly more which results in heavy rainy season crop of poor quality and also affected by fruit fly and diseases. This causes exhaustion of tree, which results in production of less winter season crop of superior quality, providing higher income to the farmers. Hence, for profitable cultivation, it is necessary to regulate the crop. Various scientists have worked on the crop regulation in guava by using different methods of removal of rainy season crop, *viz.*, by using plant bio regulators (like NAA, ethephon), urea, potassium iodide etc. These methods are not farmer friendly as well as some of the approaches are not eco-friendly. Some workers have also worked on different methods and forms of pruning and thinning of flowers for crop regulation in guava. Various workers (Lal, 9; Dhaliwal and Singh, 4; Dubey *et al.*, 5) worked on different types, forms and levels of pruning for crop regulation in guava to obtain good quality winter crop. Keeping in view the above mentioned facts, the present investigation was conducted.

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MATERIALS AND METHODS

The experiment was conducted at Horticulture Research Centre, Patharchatta, G.B.P.U.A.&T., Pantnagar, U.S. Nagar, Uttarakhand during 2009-10 to 2010-11 to study the effect of various methods of crop regulation in guava under double-hedge row system. The study was conducted on six-year-old guava trees of cv. Pant Prabhat. The experimental plants were planted under double-hedge row system accommodating 347 trees per hectare. There were eight treatments (Fig. 1) under study, *viz.*, T1 : Flower bud thinning by hand (FBT), T2 : Flower bud thinning by hand followed by removal of terminal one leaf pair (FBTT), T3 : Removal of leaves and flower buds by hand, retaining one leaf pair at the top of shoot (RLFO), T4 : Removal of all leaves and flower buds by hand (RLF), T5 : One leaf pair shoot pruning (retaining one leaf pair at the base of the shoots, (OLPS), T6 : Full shoot pruning (FST), T7 : One leaf pair pruning of fruited shoots only (OLPF) and T8 : Control (C). Each treatment was replicated four times. Two trees were taken under each treatment. The treatments were applied in the last week of April. Only the treatment T1 is applied twice at 15 days interval and rest of the treatment applied once. All the trees were maintained under uniform cultural practices during the entire investigation period. The new shoot emergence per branch, flower bud emergence per branch, per cent fruit set, per cent fruit drop were recorded on randomly selected four branches. The number of fruits per tree and yield per tree were recorded on whole tree basis. The cost: benefit ratio for all the treatments were calculated by considering all inputs and fruit yield during both the years. The data of two years were analyzed as per method suggested by Snedecor and Cochran (14) using pooled mean of two years data.

RESULTS AND DISCUSSION

One of the most critical botanical characteristic of guava is that the flowers are always borne on newly emerged vegetative shoots irrespective of the time of year (Lotter, 10) and it formed the basis for this experiment. The current season growth and flowers of rainy season crop were removed to encourage vegetative growth to produce flowers for winter season crop. In this investigation, the new shoot

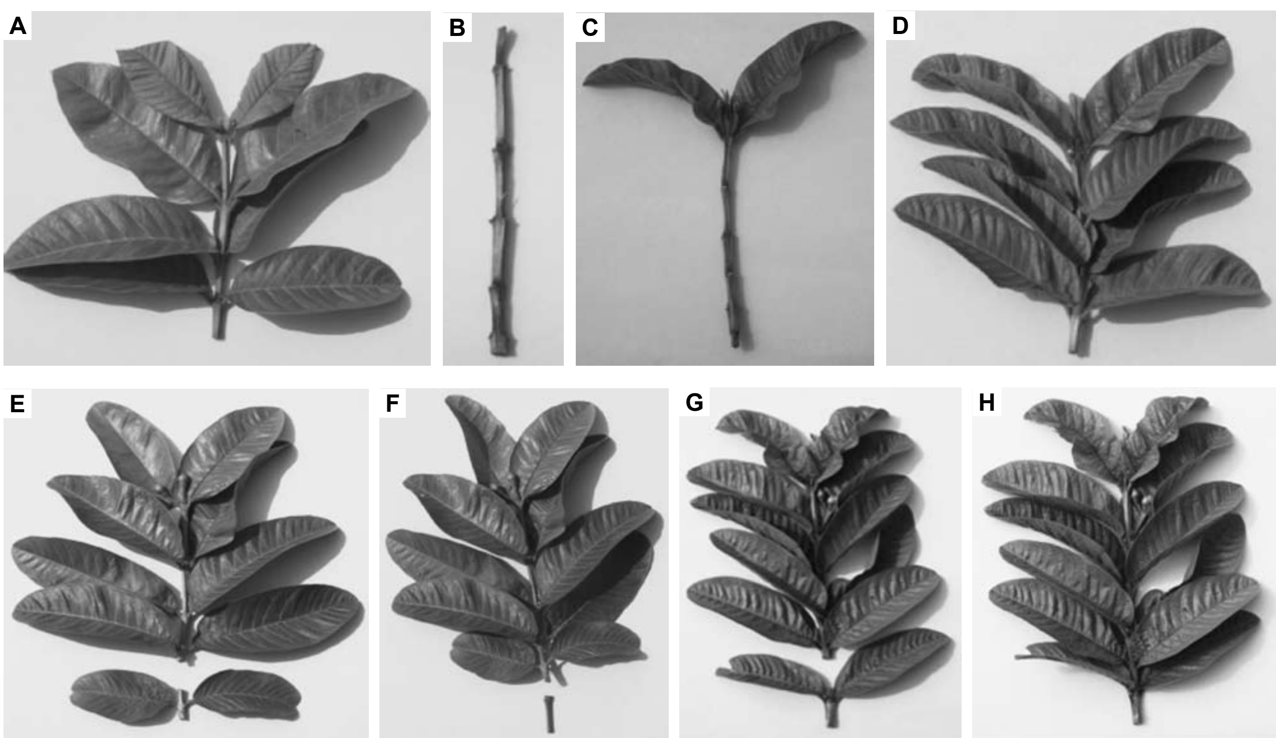

Fig. 1. Different methods of crop regulation in guava. (A) Flower bud thinning by hand (FBT), (B) Flower bud thinning by hand followed by removal of terminal one leaf pair (FBTT), (C) Removal of leaves and flower buds by hand, retaining one leaf pair at the top (RLFO), (D) Removal of all leaves and flowers by hand (RLF), (E) One leaf pair shoot pruning (OLPS), (F) Full shoot pruning (FSP), (G) One leaf pair pruning of fruited shoots only (OLPF), and (H) Control (C).

emergence per branch and flower bud emergence per branch (Table 1) for rainy season crop (before treatment application) was found non significant. It was obviously due to uniformity in selection of branches. The maximum new shoot emergence per branch for winter season crop (after treatment application) was found with the treatment T4 (RLF) followed by treatments T6 (FSP), T7 (OLPF) and T 5 (OLPS). They differed non-significantly with each other but differed significantly with the treatment T4. The minimum new shoot emergence per branch was recorded with the treatment T8 (control). In the treatments, T4, T5, T6 and T7, plants were severely pruned and they recorded more number of new shoot emergence than the other treatments or without pruning (control: T8). Lal (8) also found similar results with full shoot pruning followed by one leaf pair pruning and two leaf pair pruning produced significantly higher number of new shoots than other pruning intensities. This is due to breaking of apical dominance, which results in the emergence of new shoots in greater number (Dubey *et al*., 5). The shoot apex served as the primary source of auxin for the entire plant and its polar transport from shoot tip to root tip could be responsible for creating auxin gradient. Decapitation results in more auxin concentration in lateral buds as compared to shoot apex, thus favouring the growth of lateral buds through cell elongation (Taiz and Zeiger, 15).

As far as flower bud emergence per branch for winter season is concerned (Table 1), it was recorded maximum with the treatment T7 (OLPF) followed by the treatments T1 (FBT), T2 (FBTT), T3 (RLFO) and T5 (OLPS) which were *at par* with the treatment T7 and minimum flower bud emergence per branch was recorded in control T8. Though the higher number of new shoot emergence was recorded with the treatments T4 and T6 than other treatments but there was no higher flower bud emergence with the same treatments. This is due to fact that they had more number of non fruited shoots than fruited shoots (Lal, 9). The control trees recorded the maximum per cent fruit set followed by treatment T7 (OLPF) and T5 (OLPS) (Fig. 2). These three treatments differed significantly with respect to per cent fruit set for rainy season. In control, there was no treatment applied it recorded highest per cent fruit set as compared to other treatments. The treatments T1 (FBT), T2 (FBTT), T3 (RLFO), T4 (RLF) and T6 (FSP) recorded zero per cent fruit set due to complete removal of rainy season crop. The reverse trend was observed for per cent flower/ fruit drop during rainy season (Fig. 2). The per cent fruit set and per cent flower/ fruit drop during winter season significantly affected by various treatments (Fig. 2). The treatments T1 (FBT), T2 (FBTT), T3 (RLFO), T5 (OLPS) and T7 (OLPF) recorded higher per cent fruit set and differed non-significantly. The lower per cent fruit set was recorded for the treatments T4 (RLF), T6 (FSP) and T8 (C). The reverse trend for flower/ fruit drop was observed. These results are in conformity with Singh *et al.* (13) who also reported that the pruning treatments produced a significant reduction in fruit set in guava during rainy season and a subsequent significant increase was found during winter season in cvs. Sardar and Allahabad Safeda. During rainy season, the significantly highest number of fruits per tree (Table 1) was recorded with the treatment T8 (control) followed by T5 (OLPS) and T7 (OLPF). The treatment T8 differed significantly with the treatment T5 and T7. In case of T7, only fruited shoots were pruned (*i.e.* the other current season shoots which did not have fruits were not pruned) and in case of T5, all current season shoots were pruned through one leaf pair shoot pruning. In both cases the removal of fruited shoots resulted in non significant difference in the number of fruits for rainy season crop. These treatments were also had non-significant difference for per cent fruit set. The present finding is in accordance with Mohammed *et al.* (11). The treatments, T1 (FBT), T2 (FBTT), T3 (RLFO), T5 (OLPS) and T7 (OLPF) were non-significant with respect to number of fruits per tree during winter season (Table 1). However, the maximum number of fruits per tree during winter season was recorded with the treatment T7 (OLPF). The minimum number of fruits per tree during winter season was in one leaf pair shoot pruning followed by flower bud thinning by hand. However, minimum number of fruits was found in control. The total number of fruits was obviously highest with the treatment T7 (OLPF). However, it had non significant difference with the treatment T2 (FBTT), T5 (OLPS) and T8 (C). This is due to fact that control recorded more number of fruits during rainy season, whereas, the treatments T5 and T7 recorded fruits during both seasons, *i.e.,* rainy and winter seasons. Their aggregate effect recorded higher average number of fruits per tree.

The yield per tree as well as yield per hectare during rainy season (Table 1) was found maximum with the control trees. The minimum yield per tree and yield per hectare were recorded with the treatment T7 (OLPF) which was *at par* with T5 (OLPS). Remaining treatments (T1, T2, T3, T4 and T6) had recorded zero yield as a result of complete removal of rainy season crop. As the maximum number of fruits and higher fruit weight (data not given) were recorded with control, the maximum yield per tree during rainy season (Table 1) was also recorded with the treatment T8 (control) followed by T5 and T7. The maximum winter season yield per tree as well as yield per ha (Table 1) was recorded with the treatment T7 (OLPF), which was *at*

Table 1. Effect of different methods of crop regulation on vegetative growth, flowering, fruiting and economics of guava cv. Pant Prabhat production.

Treatment	New shoot emergence per branch		Flower bud emergence per branch		No. of fruits per tree			Yield per tree (kg/tree)			Yield (q/ ha)			Cost: benefit ratio
	Rainy	Winter	Rainy	Winter	Rainy	Winter	Total	Rainy	Winter	Total	Rainy	Winter	Total	
T_1 (FBT)	49.25	44.12	50.27	20.63	0.00 0.71)	449.10	449.10	0 (0.71)	52.01	52.01	0 (0.71)	180.46	180.46	1:1.53
T_2 (FBTT)	44.91	44.63	52.63	21.98	0.00 (0.71)	475.19	475.19	0 (0.71)	53.99	53.99	0 (0.71)	187.35	187.35	1:1.84
T_3 (RLFO)	46.47	44.47	36.36	19.01	0.00 (0.71)	447.53	447.53	0 (0.71)	50.27	50.27	0 (0.71)	174.45	174.45	1:1.87
T_4 (RLF)	41.27	98.31	50.06	12.91	0.00 (0.71)	338.36	338.36	0 (0.71)	33.29	33.29	0 (0.71)	115.50	115.50	1:0.90
T_5 (OLPS)	48.39	72.82	43.88	21.83	31.52 (3.99)	488.07	519.59	4.60 (2.25)	52.27	56.87	15.95 (4.04)	181.38	197.33	1:2.11
T_6 (FSP)	45.11	78.39	37.27	13.89	0.00 (0.71)	348.97	348.97	0 (0.71)	33.50	33.50	0 (0.71)	116.24	116.24	1:1.09
T_7 (OLPF)	48.91	75.88	38.84	23.19	34.14 (3.99)	499.29	533.43	4.57 (2.25)	55.30	59.87	15.86 (4.03)	191.90	207.76	1:2.96
T_8 (C)	42.89	33.72	45.66	4.65	458.09 (13.32)	58.75	516.84	51.52 (13.46)	6.28	57.79	178.76 (13.39)	21.78	200.55	1:1.78
$CD_{0.05}$	NS	6.735	NS	5.357	(0.305)	58.068	59.999	(0.162)	3.952	3.946	(0.313)	13.711	13.692	

Figures in parenthesis indicate transformed values

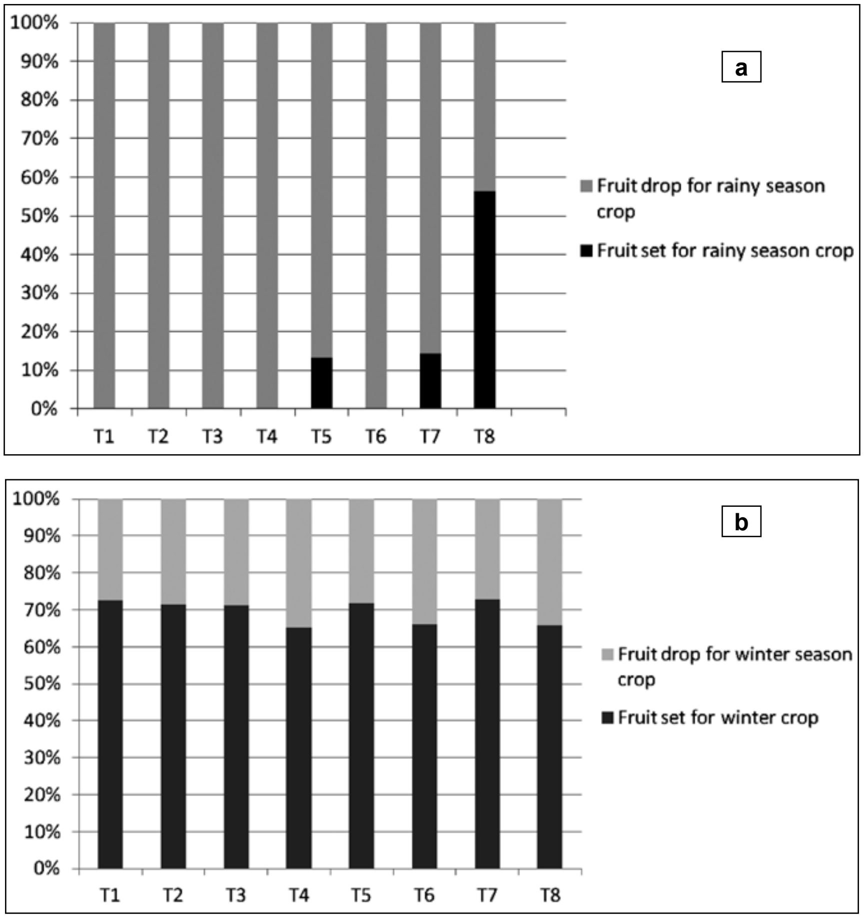

Fig. 2. Per cent fruit set and per cent flower/fruit drop for rainy (a) and winter season crop (b) of guava cv. Pant Prabhat.

par with the treatments T1 (FBT), T2 (FBTT) and T5 (OLPS). The minimum yield per tree and per hectare area during winter season was recorded in treatment T8 (C). This is due to fact that these treatments also differed non-significantly for the number of fruits as well as fruit weight (data not given) for winter season crop. The present findings are in accordance with Kindo (7). The total yield per tree and yield per hectare (Table 1) was recorded with the treatments T7 (OLPF), and the minimum total yield per tree and yield per hectare was recorded with the treatment T4 (RLF). The treatment T8 recorded the highest total yield per tree during rainy season, whereas the treatments T5 and T7 recorded higher yield per tree during winter as well as some yield during rainy season also. The minimum total yield per tree was recorded with the treatment T4 (RLF). Similar finding was reported by Kindo (7). The maximum cost: benefit ratio (1:2.96) was obtained with treatment T7 (OLPF) followed by the treatment T5 (OLPS, 1:2.11) (Table 1). The minimum cost: benefit ratio (1:0.90) was observed with the treatment T4 (RLF) as it obtained the second lowest return after control.

When there is no intervention in normal flowering and fruiting season of guava, it produced significantly more flowers and fruits during rainy season crop than for the crop of either winter or spring season. In this case, pruning not only helped to restore optimum balance between shoot and root system, but also to maintain growth and vigour of shoots by allowing only less growing points to grow vigorously and regulate the crop (Dubey *et al.*, 5). This event created changes in the partitioning of the food reserves. Depending upon the time of the year, the extent and frequency of pruning, some sites of accumulation disappear and other creates. Changes in seasonal fluctuations of reserves can appear as well (Clair *et al.*, 3). On the basis of above mentioned results it can be concluded that "One leaf pair pruning of fruited shoots only (OLPF, T7)" is more profitable for quality guava production under double-hedge row system of planting in *tarai* areas of India.

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