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Evaluation of different methods of crop regulation in guava grown under rainfed plateau conditions of eastern India

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ABSTRACT

In Allahabad Safeda guava, foliar application of NAA (200 ppm) resulted in maximum yield of winter season crop. With respect to the profitability of crop regulation through chemical spray the net profit was the maximum in case of 2,4-D (40 ppm) followed by 2,4-D (60 ppm), NAA (200 ppm) and NAA (100 ppm). In case of Lucknow-49, the maximum increase in yield of winter season crop was observed in case of foliar application of NAA (200 ppm). With respect to profitability of crop regulation, the maximum net profit per plant due to crop regulation, it was the maximum in case of NAA (200 ppm). With respect to crop regulation through hand deblossoming in guava cv. Allahabad Safeda, removal of 50% rainy season crop was at par with that in case of 100% crop removal with respect to yield of winter season crop during both the years. Profitability of crop regulation through manual removal of rainy season crop indicated maximum net profit in case of 50% removal of rainy season crop during both the years. In case of Lucknow-49, the maximum total yield was observed in case of 50% crop removal. With respect to profitability of crop regulation, the maximum net profit with sufficient yield was obtained in case of 50% crop removal.

Key words: Guava, crop regulation, foliar spray, deblossoming.

INTRODUCTION

Guava is an important fruit crop which is successfully grown over a wide range of climatic conditions due to its wide adaptability. The Chotanagpur region of eastern plateau and hills agro-climatic zone has been a traditional guava growing region where the crop is mostly grown under rainfed conditions. Being a drought hardy, precocious bearing crop with medium size canopy, it provides a suitable option to be grown as a filler crop under the fruit based multitier cropping system recommended for the rainfed uplands of Eastern plateau and hill agro-ecological zone for improving the land use efficiency. However, poor soil fertility coupled with low water holding capacity of soil of guava orchards of the region results in smaller sized guava fruits obtained from the region, which fetches lower market price than that obtained from other traditionally guava growing areas like Uttar Pradesh and West Bengal. Different methods of crop regulation have been successfully demonstrated for improving the yield and fruit quality of guava. Reduction of crop load of rainy season crop through foliar application of different crop regulating chemicals like urea (Rajput *et al.*, 6; Singh *et al.*, 9, 10; Sahay and Kumar, 7), 2,4-D (Kumar and Hoda, 3), potassium iodide (Narayana *et al.*, 4), NAA (Choudhury *et al.*, 1) to increase the yield and quality of winter season crop have been successfully standardized for different agro-climatic zone. However, no such work has been reported under the rainfed conditions of sub-humid subtropical plateau conditions of eastern India. Manual deblossoming of flowers for rainy season crop for enhancement of winter season guava which does not involve any external input other than human labour, has also been found effective by different workers (Kumar and Hoda, 3; Singh *et al.*, 11). Singh *et al.* (8) reported economic feasibility of crop regulation in guava through foliar application of urea under Lucknow conditions. Keeping this in view, the investigations were carried out to evaluate the efficacy of chemical and manual methods of crop regulation of guava grown under rainfed plateau conditions of eastern India in terms of yield and profitability.

MATERIALS AND METHODS

The study was conducted at the Horticulture and Agro-forestry Research Programme, Ranchi during 2004-05 and 2005-06 under two experiments. The treatments were T_1 = urea (10%), T_2 = urea (20%), T_3 = NAA (100 ppm), T_4 = NAA (200 ppm), T_5 = 2,4-D (40 ppm), T_6 = 2,4-D (60 ppm), T7 = KI (1%), T9 = KI (2%) and control (water spray) were imposed on 7 years old guava plants of cultivars Allahabad Safeda and Lucknow-49 planted at a spacing of 5 m x 5 m. Foliar application of chemicals was done twice, first during the initiation of flowering stage (mid-April)) and again during first week of May at the rate of 3 litres of spray

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solution per plant per spray. Each treatment was replicated thrice with two plants per replication. For studying the effect of removal of different levels of crop load of rainy season guava through manual deblossoming, the treatments *viz.*, T_1 = 0% crop removal, T_2 = 25% crop removal, T_3 = 50% crop removal and T_4 = 100% crop removal were imposed on 7 years old guava plants of cultivars Allahabad Safeda and Lucknow-49 planted at a spacing of 5 m x 5 m. The different levels of crop removal were carried out by hand deblossoming of flowers during last week of April from respective canopy areas of the plant. Each treatment was replicated five times with two plants per replication. In both the experiments, mulching of experimental plants was carried out after the end of rainy season by using paddy straw during both the years. During both the years, the experimental plants were applied with 1500, 600, 1000, 100 and 100 g N,P,K, Zn and B in two splits. Observations were recorded on yield/plant, average fruit weight and TSS (°B) of rainy season and winter season crops. For calculating the profitability of crop regulating treatments, the prices of rainy season and winter season guava under farmers' field conditions were assumed to be Rs. 4 and Rs. 10 per kg, respectively based on the information collected from 10 local fruit traders. The experiments were laid out in randomized block design. The data on yield and fruit quality were subjected to analysis of variance (Panse and Sukhatme, 5). Data on profitability of treatments were subjected to mean value analysis.

RESULTS AND DISCUSSION

In case of Allahabad Safeda, none of the treatments except foliar application of urea (20%) and KI (2%) resulted in significant reduction in the yield of rainy season crop during 2004-05, whereas during 2005-06, all the treatments except foliar application of NAA (100 ppm) and 2,4-D (40 ppm) resulted in significant reduction in the yield of rainy season crop. During 2004-05, none of the treatments resulted in significant increase in the winter season crop whereas, during 2005-06, foliar application of NAA (200 ppm) resulted in the maximum yield of winter season crop which was at par with that in case of urea (20%), NAA (100 ppm), 2,4-D (40 ppm), 2,4-D (60 ppm) and KI (1%). Dubey *et al.* (2) also reported maximum yield of winter season crop in guava by foliar application of NAA (250 ppm) during rainy season. During both the years, it was interesting to note that the total yield per plant obtained in case of different auxin treatments were at par and, in general, higher than the other treatments. The marked increase in the yield of winter season crop during 2005-06 over that in case of 2004-05 can be attributed to the cumulative effects of mulching and application of micronutrients in the soil which was not done during the pre-experimentation years. With respect to fruit weight, foliar application of NAA (100 ppm) resulted in the maximum fruit weight of rainy season crop during 2004-05 while during 2005-06, the maximum fruit weight of rainy season crop was observed in case of foliar application of 2,4-D (40 ppm). During both the years, application of urea (20%) resulted in the minimum fruit weight. None of the treatments resulted in significant increase in the fruit weight of winter season crop over control during both the years. The treatments did not differ significantly with respect to TSS of rainy as well as winter season crop during both the years of observation. With respect to the profitability of crop regulation in guava through chemical spray in Allahabad Safeda (Table 3), the net profit per plant due to crop regulation was in the negative side during 2004-05 in all the treatments except that in case of NAA (100 ppm). The net profit increased sharply during 2005-06 over that in 2004-05 and was the maximum in case of 2,4-D (40 ppm) followed by 2,4-D (60 ppm), NAA (200 ppm) and NAA (100 ppm). In contrast to result obtained under Lucknow conditions (Singh *et al.*, 8), foliar application of auxins was found to the more profitable than that in case of foliar application of urea in case of guava cv. Allahabad Safeda. Keeping in view the poor accessibility of farmers to chemicals like 2,4-D in the local markets, foliar application of NAA (200 ppm) can be recommended for crop regulation of guava cv. Allahabad Safeda through chemical method.

Foliar application of potassium iodide resulted in maximum reduction in the yield of rainy season crop than the control plants during first year of experimentation whereas, during 2005-06, foliar application of NAA (200 ppm) resulted in maximum reduction of rainy season crop than the control followed by 2,4-D (60 ppm) (Table 2). Choudhury *et al.* (1) reported maximum total yield of guava cv. Lucknow-47 by crop regulation through foliar application of NAA (250 ppm). In the present study, during both the years, none of the treatments resulted in significant increase in the total yield per plant. Foliar application of 2 and 1% potassium iodide resulted in maximum fruit weight of winter season crops, during both years. Singh *et al.* (10) also reported non-significant effects of chemical methods of crop regulation on fruit quality of winter season crop. The maximum net profit per plant due to crop regulation during 2004-05 was obtained in case of 2,4-D (60 ppm) whereas, during 2005-06, it was the maximum in NAA (200 ppm). As observed in case of Allahabad Safeda, application of urea was not found to be a profitable method for crop regulation. Foliar

Table 1. Effect of foliar application of chemicals for minimizing rainy season crop on yield and fruit quality of guava cv. Allahabad Safeda.

Treatment	Yield (kg/plant)						Average fruit weight (g)				TSS (°B)			
	2004-05			2005-06			2004-05		2005-06		2004-05		2005-06	
	Rainy	Winter	Total	Rainy	Winter	Total	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
Urea (10%)	11.2	2.7	13.9	4.8	18.5	23.3	93.6	149.8	85.0	116.3	10.3	12.8	10.1	10.4
Urea (20%)	8.0	2.2	10.2	3.2	22.4	25.6	73.2	167.8	67.7	111.1	11.0	12.0	9.8	10.5
NAA (100 ppm)	14.2	3.8	18.0	10.2	24.3	34.5	100.3	139.3	89.1	108.2	11.3	12.1	9.4	10.8
NAA (200 ppm)	12.2	3.0	15.2	5.2	28.1	33.3	89.3	127.2	82.2	113.0	10.9	12.1	10.1	10.8
2,4-D (40 ppm)	11.9	2.7	14.6	7.5	27.6	35.1	79.2	171.3	90.7	109.1	10.5	11.8	10.6	11.0
2,4-D (60 ppm)	12.2	3.1	15.3	5.4	28.0	33.4	88.2	154.5	85.1	109.1	11.3	12.0	10.6	10.8
KI (1%)	10.4	2.8	13.2	2.3	27.3	29.6	91.3	158.2	88.4	115.3	9.8	12.8	9.4	9.8
KI (2%)	7.6	3.2	10.8	4.7	16.3	21.0	89.3	174.5	73.7	110.5	10.6	12.1	10.2	10.1
Control	13.8	3.0	16.8	10.0	13.5	23.5	88.4	172.2	82.4	112.7	11.1	12.6	10.3	10.9
CD at 5%	3.44	NS	4.38	3.21	8.69	10.98	20.61	42.55	19.34	NS	NS	NS	NS	NS

Table 2. Effect of foliar application of chemicals for minimizing rainy season crop on yield and fruit quality of guava cv. Lucknow-49.

Treatment	Yield (kg/plant)						Average fruit weight (g)				TSS (°B)			
	2004-05			2005-06			2004-05		2005-06		2004-05		2005-06	
	Rainy	Winter	Total	Rainy	Winter	Total	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
Urea (10%)	13.6	2.7	16.3	9.4	10.6	20.0	93.7	114.0	76.5	151.9	11.3	13.7	10.3	11.2
Urea (20%)	16.3	3.0	19.3	6.8	7.5	14.3	112.6	130.5	87.6	134.5	10.4	14.0	9.8	10.8
NAA (100 ppm)	20.5	2.7	23.2	13.6	11.4	25.1	121.4	126.0	90.5	145.7	11.6	12.0	10.3	11.8
NAA (200 ppm)	18.5	4.6	23.1	3.2	22.9	26.2	96.8	115.0	76.4	146.5	11.9	13.5	10.9	12.0
2,4-D (40 ppm)	19.8	3.1	22.9	7.0	9.4	16.4	79.2	126.6	79.0	143.1	10.3	13.6	10.4	11.4
2,4-D (60 ppm)	22.6	3.4	26.0	4.0	15.0	19.0	94.3	115.3	92.3	147.8	11.6	12.0	10.6	10.7
KI (1%)	8.9	4.1	13.0	6.9	10.9	17.8	108.4	114.0	89.6	161.2	11.1	12.9	10.2	11.0
KI (2%)	9.0	3.0	12.0	9.3	17.8	27.1	99.4	165.0	76.7	154.2	10.3	13.0	9.8	10.8
Control	18.2	2.9	21.1	17.4	5.0	22.4	101.3	141.0	85.8	146.2	11.6	14.2	10.1	10.1
CD at 5%	4.82	NS	5.31	4.86	3.29	7.21	20.31	45.51	NS	19.7	NS	NS	NS	NS

Table 3. Profitability of crop regulation in guava through chemical spray under rainfed conditions.

Treatment	Allahabad Safeda						Lucknow-49					
	2004-05			2005-06			2004-05			2005-06		
	Gross income (Rs) per plant (A)	Cost (Rs.) of crop regulation per plant (B)*	Net profit per plant (Rs) due to crop regulation [A-B-(gross income in control-cost of crop regulation in control)]	Gross income (Rs) per plant (A)	Cost (Rs) of crop regulation per plant (B)	Net profit per palnt (Rs) due to crop regulation [A-B-(gross income in control-cost of crop regulation in control)]	Gross income (Rs) per plant (A)	Cost (Rs.) of crop regulation per plant (B)*	Net profit per plant (Rs) due to crop regulation [A-B-(gross income in control-cost of crop regulation in control)]	Gross income (Rs) per plant (A)	Cost (Rs) of crop regulation per plant (B)	Net profit per palnt (Rs) due to crop regulation [A-B-(gross income in control-cost of crop regulation in control)]
Urea (10%)	77.6	7	-18.4	172.15	7	11.05	89.6	7	-27.6	132.34	7	1.95
Urea (20%)	57.6	10	-41.4	195.20	10	31.10	105.5	10	-14.7	94.39	10	-39.00
NAA (100 ppm)	101.4	6.4	6.0	245.65	6.4	85.15	124.1	6.4	7.5	159.98	6.4	30.19
NAA (200 ppm)	85.0	8.8	-12.8	250.80	8.8	87.90	129.3	8.8	10.3	199.93	8.8	67.74
2,4-D (40 ppm)	81.1	6.4	-14.3	258.60	6.4	98.10	123.8	6.4	7.2	110.35	6.4	-19.44
2,4-D (60 ppm)	85.8	8.8	-12.0	251.00	8.8	88.10	140.2	8.8	21.2	140.24	8.8	8.05
KI (1%)	74.4	164	-178.6	229.90	164	-88.20	77.3	164	-196.9	121.70	164	-165.69
KI (2%)	63.6	324	-349.4	154.15	324	-323.95	69.0	324	-365.2	189.44	324	-257.95
Control	93.0	4	0.0	158.10	4	0.00	114.2	4	0.0	127.39	4	0.00

* Cost of chemicals: Urea = Rs 5.00 per kg, NAA = Rs. 4.00 per gram, 2,4-D = Rs. 4.00 per gram, KI = Rs. 2.80 per gram; Volume of spray solution per plant - 3 l, Cost of labour = Rs. 2.00 per spray per plant (a group of 3 labours with a total labour cost of Rs. 300.00 can spray 150 plants of guava per day)

Table 4. Efect of manual removal of different levels of rainy season crop on yield and fruit quality of guava cv. Allahabad Safeda.

Levels of removal of rainy season crop (%)	Yield (kg/plant)						Average fruit weight (g)				TSS (°B)			
	2004-05			2005-06			2004-05		05-06		2004-05		2005-06	
	Rainy	Winter	Total	Rainy	Winter	Total	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
0	10.4	2.75	13.15	11.93	14.93	26.86	96.1	119.6	76.54	90.34	10.1	11.5	10.9	10.30
25	13.0	2.5	15.5	8.16	15.61	23.76	81.7	136.5	82.28	111.72	9.5	11.6	11.0	10.56
50	13.1	6.66	19.76	9.23	26.66	35.89	102.1	178.0	82.90	116.13	11.2	12.5	11.0	11.13
100	0	5.76	5.76	0	31.29	31.29	-	179.5	-	115.40	-	11.0	-	10.73
CD at 5%	4.63	2.41	6.43	2.32	6.89	7.62	NS	23.4	NS	12.36	NS	NS	NS	NS

Table 5. Effect of manual removal of different levels of rainy season crop on yield and fruit quality of guava cv. Lucknow-49.

Levels of removal of rainy season crop (%)	Yield (kg/plant)						Average fruit weight (g)				TSS (°B)			
	2004-05			2005-06			2004-05		2005-06		2004-05		2005-06	
	Rainy	Winter	Total	Rainy	Winter	Total	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
0	11.4	2.77	14.17	12.98	3.91	16.88	142.2	150.9	80.25	130.27	10.3	13.0	13.8	14.1
25	13.3	2.83	16.13	9.38	10.25	19.63	142.1	150.1	81.12	137.28	10.3	12.4	12.8	14.2
50	5.9	4.72	10.62	8.63	13.43	22.03	158.8	178.6	90.54	148.88	10.7	12.8	13.1	13.7
100	0	3.00	3.00	0	14.12	14.12	-	171.4	-	152.17	-	12.5	-	14.0
CD at 5%	4.82	NS	4.95	2.69	3.32	5.79	NS	NS	NS	12.69	NS	NS	NS	NS

Table 6. Profitability of crop regulation in guava through manual removal of rainy season crop under rainfed conditions.

Levels of removal of rainy season crop (%)	Allahabad Safeda						Lucknow-49					
	2004-05			2005-06			2004-05			2005-06		
	Gross income (Rs.) per plant (A)	Cost (Rs.) of crop regulation per plant (B)*	Net profit per plant (Rs.) due to crop regulation [A-B-(gross income in control-cost of crop regulation in control)]	Gross income (Rs.) per plant (A)	Cost (Rs.) of crop regulation per plant (B)	Net profit per palnt (Rs.) due to crop regulation [A-B-(gross income in control-cost of crop regulation in control)]	Gross income (Rs.) per Plant (A)	Cost (Rs.) of crop regulation per plant (B)*	Net profit per plant (Rs.) due to crop regulation [A-B-(gross income in control-cost of crop regulation in control)]	Gross income (Rs.) per plant (A)	Cost (Rs.) of crop regulation per plant (B)	Net profit per palnt (Rs.) due to crop regulation [A-B-(gross income in control-cost of crop regulation in control)]
0	74.0	0.0	0.00	179.1	0.0	0.0	79.1	0.0	0.0	96.1	0.0	0.0
25	85.0	2.5	8.50	165.6	2.5	-15.9	89.1	2.5	7.5	128.9	2.5	30.3
50	118.78	5.0	39.78	259.4	5.0	75.3	67.2	5.0	-16.9	150.3	5.0	49.2
100	46.08	10.0	-37.92	250.3	10	61.2	24.0	10.0	-65.1	112.9	10	6.8

* Cost of labour = Manual removal of 100% of rainy sesason crop in 10 plants can be done by one labour with a charge of Rs. 100.00 per day.

application of NAA (200 ppm) can also be recommended for crop regulation of guava cv. Lucknow-49 through chemical method. Manual deblossoming of rainy season crop is an efficient method which does not involve application of external input. This practice can also play an important role under the organic production system of guava. Removal 50% of rainy season crop resulted in maximum yield of winter season crop during 2004-05, which was at par with that in case of 100% removal of rainy season crop (Table 4). The minimum total yield was observed in case of 100% crop removal whereas the other treatments were at par with respect to total yield. During both the years, 50 and 100% removal of rainy season crop resulted in significant increase in fruit size than that in case of no crop removal. Profitability of crop regulation in guava cv Allahabad Safeda through manual removal of rainy season crop (Table 6) indicated maximum net profit due to crop regulation in case of 50% removal of rainy season crop during both the years. Hence, keeping in view the availability of family labour of farmer, removal of 50% rainy season crop through manual deblossoming can be recommended as an alternative to chemical method of crop regulation in guava cv. Allahabad Safeda.

In case of Lucknow-49, manual deblossoming of rainy season crop did not result in significant increase in the yield of winter season crop than that of control (Table 5). However, all the levels of crop removal resulted in significant increase in the yield of winter season crop during 2005-06. The maximum total yield was observed in case of 50% crop removal. None of the treatments resulted in significant change in the fruit weight of rainy as well as winter season crops. Both 100 and 50% removal of rainy season crop resulted in significant increase in the fruit weight of winter season crop. During both the years, the treatment effects on TSS of rainy as well as winter season crop was non-significant. With respect to profitability of crop regulation through manual deblossoming (Table 6), the maximum net profit during first year of experimentation was observed in case of 25% crop removal. However, during 2005-06, i.e. the year with sufficient yield, the maximum net profit was obtained in case of 50% crop removal. Removal of 50% of rainy season crop through manual deblossoming can also be recommended as an alternative method for crop regulation of guava cv. Lucknow-49 under rainfed uplands of eastern plateau region.

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