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Effect of Different Chemicals and Manual Thinning on Crop Regulation in Guava (*Psidium guajava*)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present experiment was conducted at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the session March 2022 – December 2022. The experiment was laid out in randomized block design with three replications, and the study consists of ten treatment combinations including control by using different chemicals and manual *thinning* on Crop Regulation in Guava (*Psidium guajava*)". The best treatment was T_9 (Manual Deblossoming) & T_6 (Ethrel@2500 ppm) which shows highest values in all the parameters viz., Number of flower plant^{-1} (120.55 & 130.55) Number of fruit plant^{-1} (101.22 & 120.15), Fruit set (%) (83.97 & 92.03), Fruit weight (g) (110.1 & 204.22), Fruit diameter (cm) (6.33& 6.78), Fruit yield plant^{-1} (kg) (11.14 & 24.54), Total soluble solids (^{0}Brix) (10.15 & 12.55), Acidity (%) (0.2 & 0.14), Ascorbic acid (mg/100 g) (160.25& 165.25) and Pectin (%) (0.94 & 0.98) during rainy and winter season. All the treatments were significantly superior in their

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flowering, fruit yield and quality of guava cv. Allahabad Safeda over control (T_0) and (T_9). Increase flowering, fruit yield and quality was might be due to the increased duration of fruit quality during winter season as compared to summer.

Keywords: Guava; NAA; Psidium guajava; urea; crop regulation.

1. INTRODUCTION

"Guava (*Psidium guajava*) is most important commercial fruit crop grown in sub-tropical region of the Indian subcontinent. It gives an assured crop with very little care. Its cost of production is also low as compared to most of other commercial fruit crops. It has gained considerable prominence on account of its high nutritive value, cheap and easily availability at moderate prices. It is a good source of Vitamin C (150-200 mg/100 g of pulp). Guava fruit contains antioxidant factors and is known to control the systolic blood pressure. In guava, two distinct seasons of flowering, spring (March-April) and rains (June-July) occur from which fruits ripen during rainy and winter season respectively. In North Indian climate the rainy season crop of guava is poor in quality and nutritive value and is affected by many insect pests and diseases. The winter season fruits are superior in quality free from diseases and pests and give higher income. The rainy season crop of guava is poor in quality and crop is affected by many biotic and abiotic stresses as compared to winter season crop. The winter season crops 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. This requires regulation of flowering to obtain most profitable crop by withholding irrigation, root exposure, pruning and thinning of flowers. Different chemicals caused deblossoming in rainy season crop and subsequently increased the winter season crop" [1-4]. "Deblossoming can also be done manually. By deblossoming or thinning in April May flowers, the trees become work potential to produce profuse flowering in June-July and fruit harvesting in the month of November to February.Growth regulators and certain chemicals have been found very effective in thinning of flowers and manipulating the cropping season NAA, NAD, 2,4-D carbaryl and ethrel were found successful in reducing the rainy season and increasing the winter crop under different agroclimatic conditions" [5] "Manual deblossoming of rainy season flowers at small scale ,kitchen garden and early age of the plant is very effective, but at large commercial plantation it is not in practice which is very cumbersome, laborious and uneconomic. Flower thinning by using *Naphthalene acetic acid* (NAA), *Naphthalene acetamide* (NAD), *2,4-Dichlorophenoxy acetic acid* (2,4-D), *Potassium iodide* (KI), *2-chloroethyl phosphonic acid* (ethephon), *4,6-Dinitro-o-cresol* (DNOC) and urea have been tried with varying degree of success. This variation may be due to cultivars, tree condition, soil type and environment. Most of the workers are in opinion that chemical thinning is economic and it increases the winter yield as well as improves fruit quality. It was, however, found that hand thinning was effective in reducing the number of fruits in rainy season crop with the subsequent increase in winter crop. Different methods have been tried for crop regulation in guava to reduce rainy season crop load through foliar application of various chemicals like 2, 4-D; urea" to increase the yield and quality of winter season crop [6]; NAA [7]. "The fundamental principle of crop manipulation in guava is to control the natural flowering and force the plant to induce flowering in desired season. This adds to increased fruit yield, quality, prosperity and sustainability of the agriculture by reducing the pesticides load" [8].

2. MATERIALS AND METHODS

The investigation on "Effect of Different Chemicals and Manual Thinning on Crop Regulation in Guava (*Psidium guajava*)" was conducted during March, 2022 to December, 2022 at Central Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom, University of Agriculture, Technology and Sciences, Prayagraj (Uttar Pradesh). The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^0C – 48^0C and seldom falls as low as 4^0C – 5^0C. The relative humidity ranged between 20 to 94 percent. "It is possible to regulate the cropping pattern in guava by hand thinning of flower buds and thinning of flowers during the months of April and May in Allahabad Safeda varieties which has proved to be the most effective in reducing the size of the rainy season crop by with holding water. The experiment was laid out in Randomized Block Design (RBD) which consisting of ten treatments; T_0 – Control, T_1- NAA @ 400 ppm, T_2- NAA @ 400 ppm, T_3- NAA @ 500 ppm, T_4- Ethrel @ 1500 ppm, T_5- Ethrel @ 2000 ppm, T_6- Ethrel @ 2500 ppm, T_7- Urea @ 10%, T_8- Urea @ 15%, T_9- 100 % Manual Deblossoming.

3. RESULTS AND DISCUSSION

The data on fruit yield and quality of guava cv. Allahabad safeda in each treatment is presented in Table 1, 2 and 3 during rainy and winter season of experiment. The data shown that foliar spray of different levels of plant growth regulator, urea and manual thinning have significant effect on fruit yield and quality as compared to control (T_0). The treatment T_6 (Ethrel@2500 ppm) gave the maximum number flower per plant (120.55) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum number of flower plant^{-1} (130.55) during winter season of experiment. All the treatments were significantly superior in their number of flower plant^{-1} over control (T_0) and (T_9) during rainy and winter season of experiment. Increase number of flower plant^{-1} was might be due to the increased duration of flowering during winter season as compare to summer. This might be due to the fact their more food reserves were available for less number of flower buds. However, Hussein [9] reported "significantly greater total yield of guava in association with 20% twig pruning compared to the other treatments". Similarly, about 75-80% increase in yield had been found in rejuvenated guava orchards as compared to control [10] "Spraying guava trees with 12% urea (as a defoliant) advanced the harvesting date and increased the yield with late winter application" [11]. "While fruit thinning practices responded maximum fruit numbers (501) in guava trees" [12]. The treatment T_6 (Ethrel@2500 ppm) gave the maximum number fruit per plant (101.22) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum number of fruit plant^{-1} (120.15) during winter season of experiment. All the treatments were significantly superior in their number of fruit plant^{-1} over control (T_9) and (T_0) during rainy and winter season of experiment. This might be due to the fact their more food reserves were available for less number of flower buds.

The treatment T_6 (Ethrel@2500 ppm) gave the maximum fruit set (%) (83.97) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum fruit set (%) (92.03) during winter season of experiment. The treatments were significantly superior in their fruit set (%) over control (T_9) and (T_0) during rainy and winter season of experiment. The treatment T_6 (Ethrel@2500 ppm) gave the maximum fruit weight (g) (110.1) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum fruit weight (g) (204.22) during winter season of experiment. All the treatments were significantly superior in their fruit weight (g) over control (T_9) and (T_0) during rainy and winter season of experiment. Similarly, maximum fruit weight was achieved with branch pruning (30 cm of length) of guava trees [12,9]. Due to deblossoming levels, there was a chanceto penetrate light freely inside the canopy. So it might be possible that net photosynthesis increased and maximum reserves were collected in the trees which ultimately utilized by the fruit during their growth and development. Those reserves were utilized by the fruits which helped them to attained increased fruit weight. Similarly, thinning treatments of plums have been fund significantly effective to improve the mean fruit weight [13]. Similar increase in fruit weight, size, and pulp in winter by summer deblossoming was also reported by Sahay and Singh [14], Dubey et al. [15], Sahay and Kumar [16] and Dutta and Banik [17].

The data on fruit yield and quality of guava cv. Allahabad safeda in each treatment is presented in Table 1, 2 and 3 during rainy and winter season of experiment. The data shown that foliar spray of different levels of plant growth regulator, urea and manual thinning have significant effect on fruit yield and quality as compared to control (T_0). The treatment T_6 (Ethrel@2500 ppm) gave the maximum fruit diameter (cm) (6.33) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum fruit diameter (6.78) during winter season of experiment. All the treatments were significantly superior in their fruit diameter over control (T_9) and (T_0) during rainy and winter season of experiment. Similar results were found with double spray of 15% urea followed by hand deblossoming in summer crop of guava, significantly increased fruit size during winter season compared to the control [14]. While these results contradicting the findings of Njoroge & Rieghard, [18] who reported that fruit diameter decreased linearly with increase in time to thin and increased linearly with increase in fruit spacing in peachcv. 'Contender'. Similar increase in fruit weight, size, and pulp in winter by summer

Table 1. Effect of plant growth regulator, urea and manual thinning on yield attributes of guava (*Psidium guajava*) cv. Allahabad safeda

Treatment Notation	Treatments Details	Yield Attributes							
		Number of flower plant^{-1}		Number of fruit plant^{-1}		Fruit set (%)		Fruit weight (g)	
		Rainy season	Winter season	Rainy season	Winter season	Rainy season	Winter season	Rainy season	Winter season
T_0	(Control)	88.25	101.22	48.55	80.55	55.01	79.58	101.15	171.25
T_1	(NAA@400 ppm)	97.25	109.55	68.25	92.15	70.18	84.12	102.25	174.22
T_2	(NAA@500 ppm)	98.25	106.55	71.45	88.25	72.72	82.82	103.25	175.25
T_3	(NAA@600 ppm)	110.15	120.55	92.14	105.22	83.65	87.28	109.15	198.25
T_4	(Ethrel@1500 ppm)	102.55	105.22	78.25	82.15	76.30	78.07	104.25	178.25
T_5	(Ethrel@2000 ppm)	99.25	110.11	75.25	95.25	75.82	86.50	105.15	182.15
T_6	(Ethrel@2500 ppm)	120.55	125.52	101.22	110.15	83.97	87.75	110.1	201.55
T_7	(Urea@10%)	105.11	115.2	81.44	98.25	77.48	85.29	106.25	188.25
T_8	(Urea@15%)	108.55	117.22	88.45	101.22	81.48	86.35	107.82	197.25
T_9	(Manual Deblossoming)	0.00	130.55	0	120.15	0.00	92.03	0.00	204.22
	F-test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	S.Ed. ($\pm$)	**0.125**	**0.204**	**0.195**	**0.167**	**0.135**	**0.141**	**0.158**	**0.226**
	C.D.at 0.5%	**0.429**	**0.429**	**0.409**	**0.350**	**0.284**	**0.297**	**0.331**	**0.476**
	CV	**0.164**	**0.219**	**0.337**	**0.209**	**0.243**	**0.204**	**0.203**	**0.148**

Table 2. Effect of plant growth regulator, urea and manual thinning on fruit yield and quality of guava (*Psidium guajava*) cv. Allahabad safeda

Treatment Notation	Treatments Details	Fruit yield and quality							
		Fruit diameter (cm)		Fruit yield plant^{-1} (kg)		Total soluble solids (^{0}Brix)		Acidity (%)	
		Rainy season	Winter season	Rainy season	Winter season	Rainy season	Winter season	Rainy season	Winter season
T_0	(Control)	5.15	**5.66**	4.91	13.79	8.15	9.22	0.38	0.35
T_1	(NAA@400 ppm)	5.82	6.15	6.98	16.05	9.33	10.33	0.28	0.25
T_2	(NAA@500 ppm)	5.71	6.05	7.38	15.47	9.22	10.88	0.25	0.23
T_3	(NAA@600 ppm)	6.15	6.58	10.06	20.86	10.05	12.28	0.23	0.22
T_4	(Ethrel@1500 ppm)	5.45	5.88	8.16	14.64	9.25	11.05	0.3	0.27
T_5	(Ethrel@2000 ppm)	5.28	5.71	7.91	17.35	9.15	10.88	0.32	0.3
T_6	(Ethrel@2500 ppm)	6.33	6.66	11.14	22.20	10.15	12.33	0.2	0.18
T_7	(Urea@10%)	5.65	6.28	8.65	18.50	9.33	11.78	0.31	0.28
T_8	(Urea@15%)	5.88	6.45	9.54	19.97	9.55	12.05	0.28	0.26
T_9	(Manual Deblossoming)	0	6.78	0.00	24.54	0	12.55	0	0.14
	F-test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	S.Ed. ($\pm$)	**0.204**	**0.130**	**0.172**	**0.199**	**0.115**	**0.403**	**0.028**	**0.034**
	C.D.at 0.5%	**0.428**	**0.274**	**0.362**	**0.417**	**0.241**	**0.847**	**0.059**	**0.016**
	CV	**4.780**	**2.628**	**2.839**	**1.350**	**1.637**	**4.386**	**13.50**	**7.347**

Table 3. Effect of plant growth regulator, urea and manual thinning on quality parameters of guava (*Psidium guajava*) cv. Allahabad safeda

Treatment Notation	Treatments Details	Quality parameters			
		Ascorbic acid (mg/100 g)		Pectin (%)	
		Rainy season	Winter season	Rainy season	Winter season
T_0	(Control)	141.15	148.55	0.63	0.64
T_1	(NAA@400 ppm)	148.55	150.22	0.74	0.82
T_2	(NAA@500 ppm)	151.25	152.22	0.81	0.89
T_3	(NAA@600 ppm)	158.3	161.52	0.91	0.93
T_4	(Ethrel@1500 ppm)	154.66	155.41	0.76	0.84
T_5	(Ethrel@2000 ppm)	151.32	156.25	0.77	0.85
T_6	(Ethrel@2500 ppm)	160.25	164.25	0.94	0.96
T_7	(Urea@10%)	155.52	157.25	0.81	0.88
T_8	(Urea@15%)	157.11	158.15	0.88	0.90
T_9	(Manual Deblossoming)	0	165.25	0	0.98
	F-test	**S**	**S**	**S**	**S**
	S.Ed. (+)	**0.468**	**0.161**	**0.014**	**0.016**
	C.D.at 0.5%	**0.982**	**0.339**	**0.030**	**0.034**
	CV	**0.415**	**0.126**	**2.409**	**2.314**

deblossoming was also reported by Sahay and Singh [14], Dubey et al. [15], Sahay and Kumar [16] and Dutta and Banik [17]. The treatment T_6 (Ethrel@2500 ppm) gave the maximum fruit yield plant^{-1}(kg) (11.14) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum fruit yield plant^{-1}(kg) (24.54) during winter season of experiment. All the treatments were significantly superior in their fruit yield plant^{-1}(kg) over control (T_9) and (T_0) during rainy and winter season of experiment. Increase fruit yield plant^{-1}(kg) was might be due to the increased duration of yield attributes during winter season as compare to summer. Pandey et al. [19] obtained maximum yield in winter season by deblossoming with 800 ppm NAA followed by 600 ppm NAA.

The treatment T_6 (Ethrel@2500 ppm) gave the maximum total soluble solids (^{0}Brix) (10.15) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum total soluble solids (^{0}Brix) (12.55) during winter season of experiment. All the treatments were significantly superior in their total soluble solids (^{0}Brix) over control (T_9) and (T_0) during rainy and winter season of experiment. The similar improvement in fruit quality in guava through deblossoming with NAD, NAA, Urea, and manual means had also been reported by Dubey et al. [15], Sahay and Kumar [16], Dutta and Banik [17], Tiwari and Lal [20] and Singh [10]. The treatment T_6 (Ethrel@2500 ppm) gave the minimum acidity (%) (0.20) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the minimum acidty (%) (0.14) during winter season of experiment. All the treatments were significantly superior in their acidity (%) over control (T_9) and (T_0) during rainy and winter season of experiment. The similar improvement in fruit quality in guava through deblossoming with NAD, NAA, Urea, and manual means had also been reported by Dubey et al. [15], Sahay and Kumar [16], Dutta and Banik [17], Tiwari and Lal [20], and Singh [10].

The treatment T_6 (Ethrel@2500 ppm) gave the maximum ascorbic acid (mg/100 g) (160.25) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum ascorbic acid (mg/100 g) (165.25) during winter season of experiment. Whereas the minimum ascorbic acid (mg/100 g) (0.00) was found in treatments T_9 (Manual Deblossoming) during rainy seaon. Deblossoming might be play an active role in the production of auxin in plant species as the production of auxin increases ascorbic acid content in fruits. However, deblossoming in guava improved the level of ascorbic `acid contents [21]. The similar improvement in fruit quality in guava through deblossoming with NAD, NAA, Urea, and manual means had also been reported by Dubey et al. [15], Sahay and Kumar [16], Dutta and Banik [17], Tiwari and Lal [20], and Singh [10]. All the treatments were significantly superior in their ascorbic acid (mg/100 g) over control (T_0) and (T_9) during rainy and winter season of experiment. The treatment T_6 (Ethrel@2500 ppm) gave the maximum pectin (%) (0.94) during rainy season. Where as the treatment T_9 (Manual Deblossoming) gave the maximum pectin (%) (0.98) during winter season of experiment. All the treatments were significantly superior in their pectin (%) over control (T_0) and (T_9) during rainy and winter season of experiment. The similar improvement in fruit quality in guava through deblossoming with NAD, NAA, Urea, and manual means had also been reported by Dubey et al. [15], Sahay and Kumar [16], Dutta and Banik [17], Tiwari and Lal [20], and Singh [10].

4. CONCLUSION

From the present investigation it was concluded from trail of the effect of different chemicals and manual thinning on crop regulation in guava (*Psidium guajava*). The best treatment was T_9 (Manual Deblossoming) & T_6 (Ethrel@2500ppm) which shows highest values in all the parameters *viz*., number of flower plant^{-1} (120.55 & 130.55) number of fruit plant^{-1} (101.22 & 120.15), fruit set (%) (83.97 & 92.03), fruit weight (g) (110.1 & 204.22), fruit diameter (cm) (6.33& 6.78), fruit yield plant^{-1}(kg) (11.14 & 24.54), total soluble solids (^{0}brix) (10.15 & 12.55), acidity (%) (0.2 & 0.14), ascorbic acid (mg/100 g) (160.25& 165.25) and pectin (%) (0.94& 0.98) during rainy and winter season. All the treatments were significantly superior in their flowering, fruit yield and quality of guava cv. Allahabad Safeda over control (T_0) and (T_9). Increase flowering, fruit yield and quality was might be due to the increased duration of fruit quality during winter season as compare to summer.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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