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Kuldeep Singh
M.Sc. Scholar, Department of Horticulture (Fruit Science), Naini Agricultural institute, SHUATS, Prayagraj, Uttar Pradesh, India

Dr. Saket Mishra
Assistant Professor, Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, India.

Corresponding Author:
Kuldeep Singh
M.Sc. Scholar, Department of Horticulture (Fruit Science), Naini Agricultural institute, SHUATS, Prayagraj, Uttar Pradesh, India.

Effect of foliar spray of zinc sulphate and gibberellic acid (GA_3) on growth, yield of guava (*Psidium guajava* L.) c.v. Allahabad Surkha

Kuldeep Singh and Dr. Saket Mishra

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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. Prayagraj during the session 2023-2024. The experiment was laid out in randomized block design with three replications, and the study consists of Ten treatment combinations including control by using "Effect of foliar spray of zinc sulphate and gibberellic acid (GA_3) on growth, yield and quality of guava c.v. Allahabad Surkha.". The best treatment was T_9 (Zn 0.35% + GA_3 100 ppm) & T_8 (GA_3 100 ppm) which shows highest values in all the parameters *viz*., Number of days to anthesis (12), Number of flower/plant (80.44), Fruit set (%) (70.92%), Fruit length (8.22 cm), Fruit weight (g) (182.24 g), Number of fruit/plant (60.11), Fruit yield/plant (12.27 kg). All the treatments were significantly superior in their flowering, fruit yield and quality of guava cv. Allahabad Surkha 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.

Keywords: Guava, zinc sulphate, *Psidium guajava*, GA_3, crop regulation

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. But it is advisable to take only one crop every year. This requires management of flowering to obtain the most desirable crop, by the methods like withholding irrigation, pruning, thinning of flowers by chemically or manually.
Guava is mainly grown in the states of Uttar Pradesh, Madhya Pradesh, Maharashtra and Bihar. The excellent quality guava fruit in the world is produced from Allahabad district of Uttar Pradesh. Uttar Pradesh occupied first rank in production of guava in India with production of 4,86,700 Metric tones. Approximately 30 – 50 percent of losses are seen in post- harvest handling due to the lack of marketing and storage facilities (Pooja *et al*. 2020) [7]. The three times flowering seasons have been observed in North Indian conditions while two flowering seasons have been reported in the climatic condition of Assam. This fruit crop has immense potential in increasing productivity and yield sustainability in Assam. In Assam, guava occupies 4.522 thousand hectare of area and it produces 87.195 MT of guava with 19282 kg per hectare of productivity. In guava crop regulation has been reported by various means *i.e.* use of chemicals, withholding irrigation, exposure of roots, manual removal of flower buds, shoot pruning and bending of shoots. The treatments other than chemicals are very labor intensive. This adds to increased fruit yield, quality, prosperity and sustainability of the agriculture by reducing the pesticides load.

This study aimes to the effect of foliar spray of zinc sulphate and gibberlic acid (GA_3) on growth, yield of guava and to estimate the economics of different treatment.

Materials and Methods

The investigation was conducted during 2023 to January, 2024 at Central Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom, University of Agriculture, Technology and Sciences, Prayagraj (Uttar Pradesh). The area is situated on the south of Prayagraj on the right side of the river Yamuna on the South of Rewa Road at a distance of about 6 Km from Prayagraj city. It is situated at 25024'23" N latitude, 81050'38" E longitude and at the altitude of 98 meter above the sea level. Which consisting of ten treatment with T_0 – Control, T_1 - Zn 0.15%, T_2 - GA_3 40 ppm, T_3 - Zn 0.15% + GA_3 40 ppm, T_4 - Zn 0.25%, T_5 - GA_3 70ppm, T_6 - Zn 0.25% + GA_3 70 ppm, T_7 - Zn 0.35%, T_8 - GA_3 100 ppm, T_9 - Zn 0.35% + GA_3 100 ppm.

Result and Discussion

(A) Growth parameters

Number of days to anthesis of Guava

The data on Number of days to anthesis of guava as influenced by Foliar spray of zinc sulphate, GA_3 in Table number 1. The data reveals that the Number of days to anthesis of guava decreased significantly by the application of foliar spray of zinc sulphate, GA_3 under experimentation over the control. The minimum number of days to anthesis (12) was recorded with treatments 9 (Zn 0.35% + GA_3 100 ppm). While the maximum Number of days to anthesis (26) was recorded under control. Decrease in number of days to anthesis might be due to the increased absorption of nutrients.

Number of flower/plant of Guava

The data on number of flower/plant of guava cv. Allahabad surkha in each treatment is presented in table 1. The data shown that foliar spray of zinc sulphate, GA_3 and their interaction significant effect on number of flower/plant as compared to control (T_0). The treatment T_9 (Zn 0.35% + GA_3 100 ppm) gave the maximum number of flower/plant (80.44) of experiment. While as the minimum number of flower per plant (47.77) was found in treatmemt T_0 (Conrol). All the treatments were significantly superior in their number of flower/plant over control (T_9) and (T_0) of experiment.

Days taken to fruit harvest of Guava

The data on Days taken to fruit harvest of guava cv. Allahabad surkha in each treatment is presented in table 1. The data shown that Effect of foliar spray of zinc sulphate, GA_3 and their interaction have significant effect on Days taken to fruit harvest as compared to control (T_0). The treatment T_9 (Zn 0.35% + GA_3 100 ppm) gave the maximum Days taken to fruit harvest (43.75) experiment. As the minimum Days taken to fruit harvest (47.69) was found in treamtnet T_0 (Control). All the treatments were significantly superior in their Days taken to fruit harvest in guava.

Number of fruit set (%) of Guava

The data on fruit set (%) of guava cv. Allahabad surkha in each treatment is presented in table 1. The data shown that Effect of foliar spray of zinc sulphate, GA_3 and their interaction have significant effect on fruit set (%) as compared to control (T_0). The treatment T_9 (Zn 0.35% + GA_3 100 ppm) gave the maximum fruit set (%) (70.92) in experiment. All the treatments were significantly superior in their fruit set (%) in guava.

(B) Yield parameters

Length of fruit (cm) of Guava

The data on Length of fruit (cm) of guava cv. Allahabad safeda in each treatment is presented in table 2. The data shown that foliar spray of zinc sulphate, GA_3 and their interaction have significant effect on Length of fruit (cm) as compared to control (T_0). The treatment T_9 (Zn 0.35% + GA_3 100 ppm) gave the maximum Length of fruit (cm) (8.22) during winter season of experiment. While as the minimum fruit weight (g) (5.65) was found in treatment T_0 (Conrol). All the treatments were significantly superior in their Length of fruit (cm) in guava.

Weight of fruit (g) of Guava

The data on weight of fruit (g) of guava cv. Allahabad surkha in each treatment is presented in table 2. The data shown that foliar spray of zinc sulphate, GA_3 and their interaction significant effect on weight of fruit (g) as compared to control (T_0). The treatment T_9 (Zn 0.35% + GA_3 100 ppm) gave the maximum weight of fruit (g) (182.24) of experiment. While as the minimum weight of fruit (g) (148.10) was found in treatment T_0 (Conrol). All the treatments were significantly superior in their weight of fruit (g) in guava.

Number of fruit/tree of Guava

The data on number of fruit/plant of guava cv. Allahabad surkha in each treatment is presented in table 2. The data shown that foliar spray of zinc sulphate, GA_3 and their interaction significant effect on number of fruit/plant as compared to control (T_0). The treatment T_9 (Zn 0.35% + GA_3 100 ppm) gave the maximum number of fruit/plant (60.11) of experiment. While as the minimum number of flower per plant (47.77) was found in treamtnet T_0 (Conrol). All the treatments were significantly superior in their number of fruit/plant in guava. Increase number of fruit plant was might be due to the increased duration of flowering. This might be due to the fact their more food reserves were available for less number of flower buds.

Fruit yield/plant (kg) of Guava

The data on fruit yield/plant (kg) of guava cv. Allahabad surkha in each treatment is presented in table 2. The data shown that foliar spray of zinc sulphate, GA_3 and their interaction significant effect on fruit yield/plant (kg) as compared to control (T_0). The treatment T_9 (Zn 0.35% + GA_3 100 ppm) gave the maximum fruit yield/plant (kg) (12.27) of experiment. While as the minimum fruit yield/plant (kg) (6.19) was found in treamtnet T_0 (Conrol). All the treatments were significantly superior in their fruit yield/plant (kg) in guava.

Economics

Cost of cultivation/plant

The Maximum cost of cultivation (Rs.122.7) was observed in T_9 (Zn 0.35% + GA3 100 ppm) followed by (Rs.114) was observed in T_8 ($GA_3$100 ppm) while the minimum gross return (Rs. 100) was observed in T_0 (Control).

Gross Return/plant

The Maximum gross return (Rs. 638.04) was observed in T_9 (Zn 0.35% + GA3 100 ppm) followed by (Rs. 551.0) was observed in T_8 ($GA_3$100 ppm) while the minimum gross return (Rs. 201) was observed in T_0 (Control).

Net Return/plant

The Maximum net return (Rs. 515.34) was observed in T_9 (Zn 0.35% + GA3 100 ppm) followed by (Rs. 437) was observed in T_8 ($GA_3$100 ppm) while the minimum net return (Rs. 101) was observed in T_0 (Control).

Benefit Cost ratio (B:C)

The Maximum benefit cost ratio (4.2) was observed in T_9 (Zn 0.35% + GA3 100 ppm) followed by (3.9) was observed in T_7 (Zn 0.35%) while the minimum benefit cost ratio (Rs. 1.01) was observed in T_0 (Control).

Table 1: Effect of foliar application of zinc sulphate and gibberellic acid (GA_3) on growth, yield parameters

Treatment Notation	Treatment Combination	Number of days to anthesis	Number of flower/plant	Days taken to fruit harvest	Fruit set %
T_0	Control	26	47.77	47.69	47.81
T_1	Zn 0.15%	16	63.44	50.25	56.66
T_2	GA_3 40 ppm	16	70.11	51.91	56.92
T_3	Zn 0.15% + GA_3 40 ppm	21	74.66	53.61	53.85
T_4	Zn 0.25%	22	73.44	54.75	62.52
T_5	GA_3 70ppm	17	73.11	53.61	63.62
T_6	Zn 0.25% + GA_3 70 ppm	22	57.55	53.27	64.81
T_7	Zn 0.35%	16	74.77	52.16	63.62
T_8	GA_3 100 ppm	13	77.33	60.83	69.07
T_9	Zn 0.35% + GA_3 100 ppm	12	80.44	43.75	70.92
	F – test	**S**	**S**	**S**	**S**
	S.Em. (+)	0.40	0.59	0.59	0.43
	C.D.at 5%	1.19	1.76	1.75	1.29
	CV	3.82	1.46	1.96	1.24

Table 2: Effect of foliar application of zinc sulphate and gibberellic acid (GA_3) on Yield parameters

Treatment Notation	Treatment Combination	Length of fruit (cm)	Weight of fruit (g)	Number of fruit/plant	Fruit yield/plant (kg)
T_0	Control	5.65	148.10	34.22	4.02
T_1	Zn 0.15%	5.72	151.05	40.22	6.93
T_2	GA_3 40 ppm	5.27	155.31	39.66	7.27
T_3	Zn 0.15% + GA_3 40 ppm	6.23	162.27	44.88	7.91
T_4	Zn 0.25%	6.40	164.17	47.77	8.00
T_5	GA_3 70ppm	6.59	171.95	51.33	8.63
T_6	Zn 0.25% + GA_3 70 ppm	6.76	174.42	53.66	9.54
T_7	Zn 0.35%	7.27	176.98	54.55	10.78
T_8	GA_3 100 ppm	7.37	178.93	55.88	11.02
T_9	Zn 0.35% + GA_3 100 ppm	8.22	182.24	60.11	12.27
	F – test	**S**	**S**	**S**	**S**
	S.Em. (+)	0.17	0.19	0.42	0.20
	C.D.at 5%	0.34	0.56	1.26	0.60
	CV	1.53	0.19	1.52	4.01

Table 3: Effect of foliar application of zinc sulphate and gibberellic acid (GA_3) on Economics

Treatment No.	Treatment	Cost of cultivation Rs. Plant/plant	Gross return Rs. Plant/plant	Net return Rs. Plant/plant	Benefit cost ratio
T_0	Control	100	201	101	1.01
T_1	Zn 0.15%	103.7	346.5	242.8	2.34
T_2	GA_3 40 ppm	105.6	363.5	257.9	2.44
T_3	Zn 0.15% + GA_3 40 ppm	109.3	395.5	286.2	2.61
T_4	Zn 0.25%	106.2	400.0	293.8	2.76
T_5	GA_3 70ppm	109.8	431.5	321.7	2.92
T_6	Zn 0.25% + GA_3 70 ppm	116.0	477.0	361	3.11
T_7	Zn 0.35%	108.7	539	430.3	3.95
T_8	GA_3 100 ppm	114	551.0	437	3.83
T_9	Zn 0.35% + GA_3 100 ppm	122.7	638.04	515.34	4.2

Conclusion

From the present investigation entitled was concluded that treatment T_9 (Zn 0.35% + GA_3 100 ppm) was best in terms of growth, yield parameters. recorded highest number of flower/plant (80.44), number of days to anthesis (12), days taken to fruit harvesting (43.75), fruit set (70.92%), fruit length (8.22 cm), fruit weight (182.24 g), number fruit/plant (60.11), fruit yield/plant (12.27 kg), gross return (Rs. 638.04), net return (Rs. 515.34). benefit cost ratio (4.2).

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