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Effect of foliar application of elicitors on growth and yield of turmeric (*Curcuma longa* L.)

Mahammad Javid M¹, Vijaykumar Kurnalliker¹, Ningdalli Mallikarjun^{2*}, Gnyandev B³ and N.M. Shakuntala⁴

¹Seed Unit, University of Agricultural Sciences, Raichur, Karnataka, India

²College of Agriculture, Kalaburagi, Karnataka, India

³ICAR-Krishi Vigyan Kendra, Raddewadgi, Karnataka, India

⁴DSST, ACR, University of Agricultural Sciences, Raichur, Karnataka, India

*Corresponding author's Email: nmalluhorti@gmail.com (N. Mallikarjun)

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ABSTRACT

A field experiment was conducted during 2024-25 at farmer's field to study the effect of foliar spray of elicitors on growth and yield of turmeric. The experiment was laid out in RBD with seven treatments replicated thrice. Application of salicylic acid (100 ppm) at 150, 180 and 210 days after planting (DAP), consistently produced maximum plant height (103.39 cm), number of leaves (15.82), leaf length (60.48 cm) and leaf width (16.24 cm). Yield attributes viz., total rhizomes (26.15), number and weight of mother rhizomes (2.95; 186.12 g), number and weight of primary rhizomes (10.12; 199.53 g), number and weight of secondary rhizomes (11.40; 58.07 g), yield per plant (443.72 g) and dry recovery (26.17%) were recorded highest with salicylic acid (100 ppm) sprayed at 150, 180 and 210 DAP. Therefore, salicylic acid at 100 ppm is recommended to improve growth and yield of turmeric.

Introduction

Turmeric (*Curcuma longa* L.) is an important spice crop cultivated widely in tropical and subtropical regions. India is the leading producer of turmeric, contributing nearly 80% of the global output, with an area of 2.97 lakh ha and production of 10.42 lakh tonnes during 2023-24, with an average productivity of 3.5 t/ha (Turmeric Outlook, 2025). Major turmeric producing states in India include Maharashtra, Telangana, Tamil Nadu, Karnataka, Madhya Pradesh, Odisha and West Bengal. The presence of curcuminoids, particularly curcumin, imparts important medicinal properties (Anusuya and

Sathiyabama, 2015). Despite its value, turmeric faces poor sprouting, weak growth, low yield and quality due to lack of effective crop management practices.

In recent years, foliar application of elicitors has emerged as an eco-friendly and sustainable approach to improve crop growth, yield and quality (Brugger *et al.*, 2006). Jasmonic acid plays a vital role in regulating plant growth, rhizome development, senescence and stress responses (Ahmad and Murali, 2015). Salicylic acid improves ion regulation, stress tolerance and phenolic compound synthesis (Ghasemzadeh and Jaafar, 2012). Thus, the use of elicitors represents a promising approach to enhance vegetative growth and yield attributes. In view of this,

the present study was undertaken to assess the effectiveness of foliar application of different elicitors on the growth and yield of turmeric.

Material and Methods

A field experiment was conducted at farmer's field in Sindhol village near Manhalli, Bidar, Karnataka during 2024-25. The experiment was laid out in a Randomized Block Design (RBD) with seven treatments and three replications. Each plot measured 6 m x 6 m. Rhizomes of cultivar IISR Prathibha were planted at a spacing of 40 cm between rows and 15 cm between plants. The treatments consisted of control (water spray), salicylic acid (100 and 150 ppm), jasmonic acid (200 ppm), chitosan (100 and 150 ppm) and potassium silicate (1500 ppm). Foliar sprays were applied at 120, 150, 180 and 210 days after planting (DAP).

Growth parameters viz., plant height, number of leaves, leaf length, leaf width and number of tillers per plant were recorded on ten plants. Observations on growth parameters were recorded at 120 DAP (before spray application), 150 DAP (30 days after the first spray), 180 DAP (30 days after the second spray) and 210 DAP (30 days after the third spray).

Rhizome yield was determined at the time of harvest. Yield parameters viz., number of rhizomes/ plant, number of mother rhizomes/ plant, weight of mother rhizomes per plant, number of primary rhizomes/ plant, weight of primary rhizome/ plant, number of secondary rhizomes/ plant, weight of secondary rhizomes/ plant, fresh rhizome yield/ plant, fresh rhizome yield/ plot and dry rhizome recovery (%) were recorded. The observations were recorded following the standard procedures (DASD, 2020) and data were subjected to statistical analysis (Fisher, 1950).

For dry rhizome recovery (%), fingers were separated from the mother rhizomes. Fresh samples were boiled in clean water at 50–60°C for 60 minutes until soft. The boiled rhizomes were then sun-dried for 15 days, ground into powder and sieved. The dry rhizome recovery (%) was calculated using the following formula:

$$\text{Dry recovery (\%)} = \frac{\text{Dry weight of powder (g)}}{\text{Fresh weight of the rhizome (g)}} \times 100$$

Results and Discussion

Effect of elicitors on growth attributes

The results revealed that foliar application of elicitors significantly influenced all plant growth parameters of turmeric at 150, 180 and 210 DAS. Foliar spray of salicylic acid @ 100 ppm produced the highest plant height (98.14-103.39 cm), which is on par with chitosan @ 100 ppm, both significantly exceeding the control (Table 1). Salicylic acid @ 150 ppm and chitosan @ 150 ppm showed moderate improvements over the control, but they were less effective. Jasmonic acid @ 200 ppm and potassium silicate @ 1500 ppm recorded only marginal gains.

Salicylic acid @ 100 ppm producing the highest leaf numbers (13.50–15.82), which is on par with chitosan @ 100 ppm (12.92–15.23), both surpassing the control (Table 1). Higher concentrations (150 ppm) were less effective, indicating a dose-dependent response.

Salicylic acid @ 100 ppm produced the longest leaves (58.20-60.48 cm), which is on par with chitosan @ 100 ppm, Treatments with salicylic acid @ 150 ppm and chitosan @ 150 ppm also increased leaf length compared to the control but were less effective than their lower-dose counterparts. Jasmonic acid @ 200 ppm and potassium silicate @ 1500 ppm recorded moderate improvements, whereas the untreated control maintained the shortest leaves (Table 2).

Salicylic acid @ 100 ppm produced the widest leaves (15.90-16.75 cm), which is on par with chitosan @ 100 ppm (14.86-15.41 cm), whereas higher doses showed reduced effectiveness. Jasmonic acid and potassium silicate provided moderate increases, while the control recorded the narrowest leaves (11.92–12.49 cm) (Table 2).

Salicylic acid @ 100 ppm recorded the highest tiller numbers (1.65-1.90), which is on par with chitosan @ 100 ppm (1.59-1.86). Treatments with salicylic acid @ 150 ppm and chitosan @ 150 ppm also improved tiller production compared to the control but were less effective than their lower dose counterparts. Jasmonic acid @ 200 ppm and potassium silicate @ 1500 ppm recorded relatively lower tiller counts while, the control had the lowest tiller numbers (1.20–1.36) (Table 3). These findings are consistent with the finding of Harish *et al.* (2021), El-Sherif *et al.* (2022), Aduguba *et al.* (2024), Sivaranjani *et al.* (2022) and Chintakovid *et al.* (2025).

Table 1. Effect of foliar spray of elicitors on plant height and number of leaves on turmeric

Treatments	Plant height (cm)				Number of leaves per plant			
	120 DAP	150 DAP	180 DAP	210 DAP	120 DAP	150 DAP	180 DAP	210 DAP
Control	76.61	81.58	85.84	86.46	7.93	9.88	10.70	11.20
Chitosan @ 100 ppm	77.38	95.41	99.08	100.27	8.00	12.92	14.40	15.23
Chitosan @ 150 ppm	78.48	89.48	93.13	95.98	7.80	10.95	12.70	12.95
Jasmonic acid @ 200 ppm	77.62	84.06	88.84	89.89	7.93	10.50	11.79	12.65
Potassium silicate @ 1500 ppm	76.07	83.28	87.80	88.12	8.13	9.81	10.77	11.55
Salicylic acid @ 100 ppm	78.10	98.14	102.30	103.39	8.06	13.50	14.97	15.82
Salicylic acid @ 150 ppm	77.73	91.62	95.62	96.33	7.80	11.02	13.06	13.19
Mean	77.43	89.08	93.23	94.35	7.95	11.23	12.63	13.23
SEm±	2.64	2.83	2.85	3.10	0.27	0.42	0.47	0.63
CD (5%)	NS	8.72	8.79	9.57	NS	1.28	1.46	1.95

Table 2. Effect of foliar spray of elicitors on leaf length and leaf width of turmeric

Treatments	Leaf length (cm)				Leaf width (cm)			
	120 DAP	150 DAP	180 DAP	210 DAP	120 DAP	150 DAP	180 DAP	210 DAP
Control	47.43	49.07	50.30	51.40	10.54	12.02	12.49	11.92
Chitosan @ 100 ppm	49.23	57.10	58.10	59.30	11.21	14.96	15.41	14.86
Chitosan @ 150 ppm	48.65	55.97	56.98	58.10	11.08	13.55	14.24	13.91
Jasmonic acid @ 200 ppm	46.42	51.63	52.63	53.80	10.40	12.35	12.95	12.58
Potassium silicate @ 1500 ppm	46.17	50.74	51.74	52.94	10.31	12.94	13.04	12.73
Salicylic acid @ 100 ppm	49.83	58.20	59.50	60.48	11.41	15.90	16.75	16.24
Salicylic acid @ 150 ppm	48.62	56.12	57.12	58.40	11.17	13.97	14.37	14.07
Mean	50.05	54.12	55.19	56.34	10.87	13.67	14.18	13.76
SEm±	1.64	1.67	1.80	1.82	0.37	0.49	0.53	0.49
CD (5%)	NS	5.15	5.55	5.46	NS	1.50	1.62	1.51

Table 3. Effect of foliar spray of elicitors on number of tillers per plant in turmeric

Treatments	120 DAP	150 DAP	180 DAP	210 DAP
Control	1.10	1.20	1.27	1.36
Chitosan @ 100 ppm	1.00	1.59	1.76	1.86
Chitosan @ 150 ppm	1.10	1.45	1.66	1.78
Jasmonic acid @ 200 ppm	1.00	1.31	1.46	1.49
Potassium silicate @ 1500 ppm	1.00	1.37	1.49	1.51
Salicylic acid @ 100 ppm	1.10	1.65	1.80	1.90
Salicylic acid @ 150 ppm	1.10	1.51	1.70	1.75
Mean	1.06	1.44	1.59	1.66
SEm±	0.04	0.07	0.10	0.11
CD (5%)	NS	0.21	0.31	0.34

Effect of elicitors on yield attributes

Foliar application of elicitors significantly enhanced rhizome production in turmeric (Table 4). Salicylic acid at 100 ppm recorded the highest total number of rhizomes per plant (24.47), mother rhizomes (2.95), primary rhizomes (10.12) and secondary rhizomes (11.40), which is on par with chitosan at 100 ppm, which recorded high values for total number of rhizomes per plant (23.39), mother rhizomes (2.90), primary rhizomes (9.42) and secondary rhizomes (11.05). Treatments with salicylic acid at 150 ppm and chitosan at 150 ppm also showed moderate increases. Jasmonic acid @ 200 ppm and potassium silicate @ 1500 ppm recorded only slight improvements over the control.

Foliar application of elicitors significantly influenced rhizomes weight in turmeric (Table 5). The maximum weight of mother rhizomes (186.12 g), primary rhizomes (199.53 g) and secondary rhizomes (58.07 g) were recorded with salicylic acid at 100 ppm, which is on par with chitosan at 100 ppm. Moderate

increases were observed with higher concentrations of salicylic acid at 150 ppm and chitosan at 150 ppm, indicating a dose-dependent response where moderate doses were more effective than higher levels. Jasmonic acid at 200 ppm and potassium silicate at 1500 ppm showed only slight improvements over the control.

The fresh rhizome yield of turmeric was significantly influenced by foliar application of elicitors (Table 6). The salicylic acid at 100 ppm produced the highest values (443.72 g/ plant and 88.75 kg/ plot), which is on par with chitosan at 100 ppm (431.89 g/ plant and 86.38 kg/ plot). Dry recovery (Table 6) was highest with salicylic acid @ 100 ppm (26.17%) and chitosan @ 100 ppm (25.06%) showing a substantial increase over the control (18.20%). These findings are in agreement with the results reported by Velayutham and Parthiban (2013), Harish et al. (2021), El-Sherif et al. (2022), El-Sherif et al. (2022), Sivaranjani et al. (2022), Aduguba et al. (2024) and Tantawy et al. (2021).

Table 4. Effect of foliar spray of elicitors on number of rhizomes/ plant in turmeric

Treatments	Number of rhizomes	Number of mother rhizomes	Number of primary rhizomes	Number of secondary rhizomes
Control	16.97	2.53	6.70	7.70
Chitosan @ 100 ppm	23.39	2.90	9.42	11.05
Chitosan @ 150 ppm	21.39	2.77	8.69	9.93
Jasmonic acid @ 200 ppm	19.07	2.68	7.89	8.50
Potassium silicate @ 1500 ppm	18.10	2.59	7.35	8.16
Salicylic acid @ 100 ppm	24.47	2.95	10.12	11.40
Salicylic acid @ 150 ppm	21.89	2.86	8.77	10.26
Mean	20.75	2.76	8.42	9.57
SEm±	0.64	0.09	0.27	0.36
CD (5%)	1.98	0.28	0.82	1.11

Table 5. Effect of foliar spray of elicitors on weight of rhizomes per plant (g)

Treatments	Weight of mother rhizomes	Weight of primary rhizomes	Weight of secondary rhizomes
Control	155.64	165.99	48.52
Chitosan @ 100 ppm	179.08	195.17	57.64
Chitosan @ 150 ppm	167.79	179.31	53.30
Jasmonic acid @ 200 ppm	160.85	169.06	49.55
Potassium silicate @ 1500 ppm	158.97	174.86	50.50
Salicylic acid @ 100 ppm	186.12	199.53	58.07
Salicylic acid @ 150 ppm	169.40	181.69	54.20
Mean	168.27	180.80	53.11
SEm±	5.29	5.37	1.63
CD (5%)	16.29	16.56	5.01

Table 6. Effect of foliar spray of elicitors on fresh rhizome yield and dry recovery

Treatments	Fresh rhizome yield/ plant (g)	Fresh rhizome yield/ plot (kg)	Dry recovery (%)
Control	370.15	74.03	18.20
Chitosan @ 100 ppm	431.89	86.38	25.06
Chitosan @ 150 ppm	400.40	80.08	21.50
Jasmonic acid @ 200 ppm	379.46	75.90	19.93
Potassium silicate @ 1500 ppm	384.33	76.87	18.53
Salicylic acid @ 100 ppm	443.72	88.75	26.17
Salicylic acid @ 150 ppm	405.29	81.06	22.87
Mean	402.18	80.44	21.75
SEm±	5.29	2.37	0.89
CD (5%)	16.29	7.30	2.75

Conclusion

In conclusion, foliar application of elicitors had a significant positive effect on the growth and yield of turmeric. Among the treatments, salicylic acid at 100 ppm emerged as the most effective, recording the highest plant height (103.39 cm), number of leaves (15.23), leaf length (60.8 cm), leaf width (16.24 cm) and tillers/ plant (1.90). Its performance was found to be statistically on par with chitosan at 100 ppm when applied at 150, 180, and 210 DAP. Furthermore, salicylic acid at 100 ppm significantly enhanced yield attributes, including the number of rhizomes (24.47), number of mother rhizomes (2.95) and weight (186.12 g), number of primary rhizomes (10.12) and weight (199.53 g), number of secondary rhizomes (11.40) and weight (58.07), yield per plant (443.72 g), yield per plot (88.75 kg) and dry recovery (26.17).

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Conflict of Interest

The authors declare no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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