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RHIZOME PRIMING IMPROVES GROWTH, YIELD AND DRY MATTER RECOVERY OF TURMERIC (*Curcuma longa* L.) cv. 'RAJENDRA SONIA' UNDER PLATEAU CONDITIONS OF JHARKHAND, INDIA

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ABSTRACT

A field experiment was conducted during the *Kharif* season of 2024-25 at the Experimental Farm Unit, Department of Horticulture, Ranchi Agriculture College, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, to evaluate the effect of rhizome priming on crop establishment, vegetative growth, yield and dry matter recovery of turmeric (*Curcuma longa* L.) cv. 'Rajendra Sonia'. The experiment was laid out in a randomized block design with five treatments and five replications. Treatments comprised Trichoprime (T_1), Metalaxyl–Mancozeb + Imidacloprid (T_2), Tebuconazole + Imidacloprid (T_3), Metalaxyl–Mancozeb alone (T_4) and an unprimed control (T_5). Treatment means showed that T_4 recorded the highest sprouting percentage (98.24%), although the treatment effect was non-significant, while T_1 produced the highest plant height (85.23 cm), tiller number (3.43 clump⁻¹), fresh clump weight (329.01 g), yield per plant (248.61 g), fresh rhizome yield (33.15 t ha⁻¹), dry rhizome yield (6.90 t ha⁻¹) and dry matter recovery (20.82%). Plant population at 50 days after planting was also numerically highest under T_1 (97.47%), but was non-significant. The control recorded the lowest values for the major vegetative, yield and dry matter traits. Trichoprime-treated rhizomes therefore showed the most consistent improvement across the crop establishment, vegetative growth, yield and dry matter recovery attributes evaluated in the study.

Key words : Rhizome priming, *Curcuma longa*, Turmeric, Growth, Yield.

Introduction

Turmeric (*Curcuma longa* L.) is an important rhizomatous spice crop cultivated widely in tropical and subtropical regions. The crop is propagated vegetatively through seed rhizomes and the physiological condition of the planting material has an important bearing on sprouting, stand establishment, vegetative growth and subsequent rhizome production. Turmeric production practices are therefore closely associated with the selection and management of healthy planting material (Prasath *et al.*, 2019; Chitra, 2019).

Priming is a pre-sowing treatment in which the propagule is exposed to a controlled treatment that activates physiological processes before planting. In seed crops, priming has been associated with faster and more uniform emergence, improved vigour and better crop

establishment (Heydecker and Coolbear, 1977; Pawar and Laware, 2018). Reviews of vegetable and spice crops have likewise emphasized the potential of priming to improve establishment and yield through better early growth and physiological readiness (Arunkumar *et al.*, 2019; Mal *et al.*, 2019).

The relevance of priming is particularly strong in rhizomatous crops because the treatment is applied directly to the propagule that gives rise to the crop. In ginger, hydropriming, ethephon and microbial treatments have improved vigour and establishment of transplants (Baby *et al.*, 2020; Chittaragi *et al.*, 2022; Sumitha and Jisha, 2023). In turmeric, rhizome treatments with growth regulators and other pre-planting treatments have been reported to influence plant height, tillering, clump weight and rhizome yield (Hore *et al.*, 2014; Harsha *et al.*, 2016;

Dodamani *et al.*, 2017; Pujari *et al.*, 2018).

Biological inputs are also relevant because beneficial microorganisms can influence nutrient acquisition, root development and plant growth. Studies on turmeric have documented positive responses to bio-inoculants and microbial inputs, while recent reviews have highlighted the importance of plant-growth-promoting microorganisms associated with *Curcuma longa* (Tripura *et al.*, 2018; Khan *et al.*, 2023). More recent work across primed horticultural crops has continued to demonstrate improvements in emergence, growth and yield components following appropriate priming treatments (Abdelkader *et al.*, 2023; Awasthi *et al.*, 2023; Yadav *et al.*, 2025).

However, treatment responses can vary with cultivar, planting material, treatment type and agro-climatic conditions. The present study was therefore undertaken to evaluate biological and chemical rhizome-priming treatments for their effects on crop establishment, vegetative growth, yield attributes, dry rhizome yield and dry matter recovery of turmeric (*Curcuma longa* L.) cv. 'Rajendra Sonia' under the plateau conditions of Jharkhand.

Materials and Methods

Experimental site and design

The experiment was conducted during the *Kharif* season of 2024-25 at the Experimental Farm Unit, Department of Horticulture, Ranchi Agriculture College, Birsa Agricultural University, Kanke, Ranchi, Jharkhand. Uniform and healthy seed rhizomes of turmeric (*Curcuma longa* L.) cv. 'Rajendra Sonia' were used as the experimental material. The crop was planted on 22 June 2024 and harvested on 27 February 2025. The experiment was laid out in a randomized block design (RBD) with five treatments and five replications. Each plot measured 3 m × 1 m, with 25 cm × 25 cm spacing and 40 plants per plot, giving a total of 25 plots. The recommended fertilizer schedule was FYM at 20 t ha⁻¹ and N:P:K at 100:60:60 kg ha⁻¹. The rhizome treatments were applied one month before planting, and the treated rhizomes were soaked for 30 min according to the respective treatment protocol.

Rhizome-priming treatments

Five rhizome-priming treatments were evaluated. T₁ consisted of Trichoprime, for which 250 g was dissolved in 2.5 L water to treat 6.25 kg turmeric rhizomes, equivalent to 100 g L⁻¹ and the rhizomes were soaked for 30 min. T₂ comprised Metalaxyl–Mancozeb at 1.25 g L⁻¹ + Imidacloprid at 0.5 mL L⁻¹ for 30 min. T₃ comprised Tebuconazole at 1 mL L⁻¹ + Imidacloprid at 0.5 mL L⁻¹

Table 1 : Rhizome-priming treatments used in turmeric (*Curcuma longa* L.) cv. 'Rajendra Sonia'.

Treatment	Priming treatment	Dose and duration
T ₁	Trichoprime	250 g in 2.5 L water to treat 6.25 kg rhizomes (100 g L ⁻¹); 30 min
T ₂	Metalaxyl–Mancozeb + Imidacloprid	1.25 g L ⁻¹ + 0.5 mL L ⁻¹ ; 30 min
T ₃	Tebuconazole + Imidacloprid	1 mL L ⁻¹ + 0.5 mL L ⁻¹ ; 30 min
T ₄	Metalaxyl–Mancozeb	1.5 g L ⁻¹ ; 30 min
T ₅	Control	No priming

for 30 min. T₄ comprised Metalaxyl–Mancozeb at 1.5 g L⁻¹ for 30 min. T₅ was the unprimed control. All other agronomic practices were kept uniform.

The rhizome treatments were applied one month before planting, and the treated rhizomes were soaked for 30 min according to the respective treatment protocol.

Observations and statistical analysis

Observations were recorded for sprouting percentage, plant population at 50 DAP, plant height, number of tillers per clump, fresh weight of clump, yield per plant, yield per plot, fresh rhizome yield per hectare, dry rhizome yield and dry matter recovery. Sprouting percentage and plant population were expressed as the percentage of established plants relative to the number of rhizomes planted. Fresh yield per hectare was derived from the observed yield on a plot basis. Dry rhizome yield was calculated from dry rhizome weight and plant population per hectare. Dry matter recovery was calculated as the ratio of dry sample weight to fresh sample weight multiplied by 100. The experimental data were subjected to analysis of variance (ANOVA) appropriate to RBD following Fisher (1935). Treatment means were compared using the critical difference (CD) at the 5% level of significance.

Results and Discussion

Crop establishment and vegetative growth

Rhizome priming produced only small numerical differences in sprouting and plant population, but larger differences were observed in plant height and tillering (Table 2). Sprouting percentage ranged from 96.61% in the control (T₅) to 98.24% in T₄. The differences were non-significant at the 5% level. Plant population at 50 DAP similarly varied from 95.72% in T₅ to 97.47% in T₁,

Table 2 : Effect of rhizome priming on crop establishment and vegetative growth of turmeric (*Curcuma longa* L.) cv. 'Rajendra Sonia'.

Treatment	Sprouting (%)	Plant population at 50 DAP (%)	Plant height (cm)	Tillers clump ⁻¹
T ₁ – Trichoprime	97.55	97.47	85.23	3.43
T ₂ – Metalaxyl–Mancozeb + Imidacloprid	97.01	96.81	80.11	3.07
T ₃ – Tebuconazole + Imidacloprid	96.71	96.01	76.86	2.81
T ₄ – Metalaxyl–Mancozeb	98.24	97.32	83.68	3.31
T ₅ – Control	96.61	95.72	71.38	2.16
SEm ±	0.46	0.47	1.66	0.17
CD (5%)	NS	NS	4.97	0.51
CV (%)	1.05	1.09	4.66	12.83

Values are treatment means of five replications. NS, non-significant at the 5% level.

with the treatment effect remaining non-significant. These observations indicate that the experimental planting material already exhibited high establishment potential and that priming did not significantly alter final early stand under the conditions of the present experiment. Improved emergence and early establishment after priming have nevertheless been documented in several horticultural crops (Mal *et al.*, 2019; Thakur *et al.*, 2020; Abdelkader *et al.*, 2023).

Plant height differed significantly among treatments. T₁ recorded the maximum plant height (85.23 cm), followed by T₄ (83.68 cm), T₂ (80.11 cm) and T₃ (76.86 cm), whereas T₅ recorded the minimum (71.38 cm). The superiority of T₁ over the control indicates a strong vegetative response to the biological rhizome treatment. Similar improvement in plant height following rhizome treatment has been reported in turmeric (Hore *et al.*, 2014; Harsha *et al.*, 2016; Dodamani *et al.*, 2017). Bio-inoculant-based approaches have also been associated with greater plant height and other vegetative traits in turmeric (Tripura *et al.*, 2018; Khan *et al.*, 2023; Vamshi Krishna *et al.*, 2026).

Number of tillers per clump was highest in T₁ (3.43), followed by T₄ (3.31), T₂ (3.07) and T₃ (2.81), while T₅ recorded the lowest value (2.16). The significant increase in tiller production under T₁ suggests that rhizome priming influenced vegetative vigour beyond initial sprouting. Comparable responses in tillering following pre-planting treatment have been reported in turmeric (Harsha *et al.*, 2016; Pujari *et al.*, 2018) and in rhizomatous ginger following priming treatments (Baby *et al.*, 2020; Chittaragi *et al.*, 2022).

Yield attributes and rhizome productivity

The treatment effects on yield attributes were

pronounced (Table 3). T₁ produced the highest fresh weight of clump (329.01 g), followed by T₄ (314.12 g) and T₂ (308.92 g), whereas T₅ recorded the lowest value (225.51 g). Yield per plant showed the same ranking, with 248.61 g in T₁ and 185.00 g in T₅. The greater clump biomass and individual-plant yield under T₁ are consistent with the superior plant height and tiller production observed under the same treatment (Barad *et al.*, 2023).

Yield per plot ranged from 7.40 kg in T₅ to 9.94 kg in T₁. The corresponding fresh rhizome yield was 33.15 t ha⁻¹ under T₁, followed by 31.10 t ha⁻¹ under T₄, 30.18 t ha⁻¹ under T₂ and 26.27 t ha⁻¹ under T₃, while the control produced 24.67 t ha⁻¹. Thus, T₁ produced approximately 34.4% higher fresh rhizome yield than the untreated control. Earlier turmeric studies have also shown that appropriate rhizome treatments can increase clump development and final rhizome yield (Hore *et al.*, 2014; Dodamani *et al.*, 2017; Tripura *et al.*, 2018). In related rhizomatous crops, priming treatments have likewise improved yield through better vigour and establishment (Chittaragi *et al.*, 2022; Sumitha and Jisha, 2023).

The improvement under T₁ may be related to the biological nature of the priming treatment and the resulting improvement in vegetative growth. Plant-growth-promoting microbial interactions can contribute to nutrient mobilization, phytohormonal activity and improved plant development, providing a plausible physiological basis for greater biomass accumulation (Khan *et al.*, 2023). The present findings are also consistent with the broader concept that priming activates physiological processes before or around establishment, which can translate into greater vigour and yield potential (Heydecker and Coolbear, 1977; Pawar and Laware, 2018; Arunkumar *et al.*, 2019).

Table 3 : Effect of rhizome priming on yield attributes, fresh and dry rhizome yield and dry matter recovery of turmeric (*Curcuma longa* L.) cv. 'Rajendra Sonia'.

Treatment	Fresh clump wt. (g)	Yield plant ⁻¹ (g)	Yield plot ⁻¹ (kg)	Fresh yield (t ha ⁻¹)	Dry yield (t ha ⁻¹)	Dry matter recovery (%)
T ₁ – Trichoprime	329.01	248.61	9.94	33.15	6.90	20.82
T ₂ – Metalaxyl–Mancozeb + Imidacloprid	308.92	226.32	9.05	30.18	5.50	18.25
T ₃ – Tebuconazole + Imidacloprid	241.38	197.03	7.88	26.27	4.59	17.48
T ₄ – Metalaxyl–Mancozeb	314.12	233.24	9.33	31.10	6.17	19.83
T ₅ – Control	225.51	185.00	7.40	24.67	3.75	15.20
SEm±	8.00	11.82	0.47	1.58	0.32	0.73
CD (5%)	23.97	35.44	1.42	4.73	0.98	2.20
CV (%)	6.30	12.12	12.12	12.12	13.54	8.96

Values are treatment means of five replications. SEm, standard error of mean; CD, critical difference; CV, coefficient of variation.

Dry rhizome yield and dry matter recovery

Dry rhizome yield differed significantly among treatments (Table 3). T₁ recorded the highest dry rhizome yield (6.90 t ha⁻¹), followed by T₄ (6.17 t ha⁻¹), T₂ (5.50 t ha⁻¹) and T₃ (4.59 t ha⁻¹), while T₅ recorded the lowest value (3.75 t ha⁻¹). The higher dry yield under T₁ indicates that the advantage of Trichoprime was not restricted to fresh biomass but was retained after drying. The response agrees with previous observations that pre-planting treatments can improve biomass accumulation and yield components in turmeric (Harsha *et al.*, 2016; Dodamani *et al.*, 2017).

Dry matter recovery followed a similar pattern, ranging from 15.20% in T₅ to 20.82% in T₁. T₄ recorded 19.83%, while T₂ and T₃ recorded 18.25 and 17.48%, respectively. The higher dry matter recovery under the primed treatments suggests improved accumulation of dry biomass in the harvested rhizomes. Priming has been reported to influence reserve mobilization and early metabolic activity, which can contribute to subsequent growth and biomass formation (Thejeshwini *et al.*, 2019; Thakur *et al.*, 2020). Similar positive effects of priming on growth and yield traits have been reported across vegetable crops (Awasthi *et al.*, 2023; Yadav *et al.*, 2025).

Overall, the treatment response was most consistent under T₁. Although, T₄ recorded the numerically highest sprouting percentage, the difference was non-significant; T₁, in contrast, expressed the strongest response across plant height, tillering, clump biomass, fresh yield, dry yield and dry matter recovery. This distinction is important because maximum early establishment and maximum final productivity were not necessarily associated with the same treatment.

Conclusion

Rhizome priming improved the vegetative growth, yield attributes, fresh rhizome yield, dry rhizome yield and dry matter recovery of turmeric (*Curcuma longa* L.) cv. 'Rajendra Sonia' under the plateau conditions of Jharkhand. Trichoprime (T₁) produced the highest plant height (85.23 cm), tiller number (3.43 clump⁻¹), fresh clump weight (329.01 g), yield per plant (248.61 g), yield per plot (9.94 kg), fresh rhizome yield (33.15 t ha⁻¹), dry rhizome yield (6.90 t ha⁻¹) and dry matter recovery (20.82%). Metalaxyl–Mancozeb at 1.5 g L⁻¹ (T₄) recorded the highest numerical sprouting percentage (98.24%), but sprouting and plant population differences were non-significant. Under the conditions of this single-season experiment, Trichoprime showed the most consistent potential for enhancing crop vigour and rhizome productivity. Multi-season and multi-location evaluation would be useful to confirm treatment stability for broader recommendation.

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