



RESEARCH ARTICLE

Yield and yield attributing traits influenced by priming treatments of humic acid and Panchgavya in coriander (*Coriandrum sativum* L.)

Jay Singh¹, C L Maurya^{1*}, Ajay Pratap Singh¹, Aparna Jyoti¹, Rishabh Gupta², Dhruvendra Singh Sachan³, Suraj Gopal Mutteparwar⁴, Yogendra Pratap Singh¹, Ravisankar Dubey¹ & Narang Kapoor¹

¹Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur 208 002, Uttar Pradesh, India

²Division of Biotechnology, Indian Institute of Pulses Research, Kanpur 208 024, Uttar Pradesh, India

³Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur 208 002, Uttar Pradesh, India

⁴Department of Genetics and Plant Breeding, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur 208 002, Uttar Pradesh, India

*Correspondence email - clmaurya@csauk.ac.in

Received: 04 August 2025; Accepted: 19 February 2026; Available online: Version 1.0: 27 April 2026

Cite this article: Jay S, Maurya CL, Ajay PS, Aparna J, Rishabh G, Dhruvendra SS, Suraj GM, Yogendra PS, Ravisankar D, Narang K. Yield and yield attributing traits influenced by priming treatments of humic acid and Panchgavya in coriander (*Coriandrum sativum* L.). Plant Science Today. 2026; 13(sp2): 1-6. <https://doi.org/10.14719/pst.10943>

Abstract

Organic priming, the process of treating seeds with beneficial naturally occurring compounds or organic formulations before to planting, has attracted a lot of interest in modern agriculture due to its potential to boost crop output and promote sustainable farming practices. Recent advances in organic priming have demonstrated how it may enhance the availability of nutrients and promote plant growth, both of which increase output. This study investigated the effects of various seed priming techniques on the growth and yield of the Coriander, cv- Azad Dhan-1, during the rabi season of 2023–24 and 2024–25 using a randomized block design (RBD). The experiment was conducted at the Vegetable Research Farm (Kalyanpur), Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India. The following treatments were used: T₀- control, T₁- hydropriming for 24 hr soaking, T₂- vermi wash 15 % for 24 hr soaking, T₃- cow urine 20 % for 24 hr soaking, T₄- panchgavya 15 % for 24 hr soaking, T₅- humic acid 20 % for 24 hr soaking, T₆- GA₃ 50 ppm for 24 hr soaking, T₇- NAA 50 ppm for 24 hr soaking, T₈- cytokinin 100 ppm for 16 hr soaking, T₉- KNO₃ 3 % for 16 hr soaking and T₁₀- NaCl 4 g L⁻¹ for 16 hr soaking. The best results were obtained in T₄ for number of primary branches (7.61), number of secondary branches (10.72), while, T₅ for number of tertiary branches (4.06), number of umbel per plant (42.94), number of seed per umbel (41.88), raw seed yield per plant (11.63 g), graded seed yield per plant (10.48 g), raw seed yield per plot (0.767 kg), graded seed yield per plot (0.692 kg), raw seed yield per hectare (1534.72 kg) and graded seed yield per hectare (1383.84 kg) in pooled. Therefore, it can be said that priming with organics like panchgavya and humic acid is more advantageous for improving coriander growth and production.

Keywords: graded seed yield; humic acid; hydropriming; panchgavya; umbel per plant

Introduction

Coriander (*Coriandrum sativum* L.), popularly known as cilantro or Chinese parsley, is a feathery annual plant of the parsley family, Umbelliferae (Apiaceae). It has 2n = 22 chromosomes and reproduces via cross-pollination. The genus *Coriandrum* includes both domesticated and wild species (*Coriandrum tordylium* L.). Since coriander is a tropical crop, it needs a cold, dry climate free of frost, especially during the flowering and seed production stages, to produce high-yielding, high-quality coriander. It can be used as a spice and an herb in different parts. The ideal temperature for coriander's germination and early growth is 20–25 °C. The plant has a tap root and epigeal germination.

Russia, Ukraine, Romania, Canada and Morocco are significant producers worldwide. India, Turkey, Egypt, Romania, Morocco, Iran and China are major exporters of coriander, with an expected annual trade of 0.85–100000 tonnes. Important growing

states include Rajasthan, Gujarat, Madhya Pradesh, Andhra Pradesh and Tamil Nadu. India, known as the "Home of Spices," is the world's largest producer of coriander. Madhya Pradesh leads globally in coriander seed volume and the country ranks first worldwide with an annual production of 1.40 million metric tons (1). In 2023–24, India exported 108624 MT of coriander worth 94820.97 lakh rupees (2).

Priming strategies may help to some extent in preventing the degradation of strength (3). One method for enhancing seed performance is hydropriming, which involves soaking seeds in water to start the early stages of germination but not long enough to allow radicle protrusion, then drying them (4). Since the first stages of the germination process, such as the leakage of inhibiting substances, repair of free radical damage to membranes, breakdown of reserves and build-up of enzymes required for endosperm breakdown during the priming treatment, this technique could improve speed and uniformity of germination,

particularly under challenging conditions (5). Many vegetable seeds, including cauliflower (6), watermelon (7), pepper, aubergine (8) and tomato, have been effectively shown to benefit from hydro-priming to increase germination and emergence (9). Previous researchers reported that hydropriming of coriander seeds speed up the germination process (10). The hydropriming of coriander seeds following accelerated aging, however, has not been documented yet.

Vermiwash is a liquid leachate that is obtained by letting too much water soak into the substrate that is actively vermicomposting. The water then washes the substrate so that the vermicast is expelled by the earthworms as they feed on it and as well as the surface of their bodies. It is commonly recognised that vermiwash is a rich source of macronutrients, micronutrients, enzymes, vitamins and hormones that, when applied to plants, promote effective development (11). Vermiwash includes earthworm-secreted enzymes that enhance plant growth, yield and resistance in the crops it is applied (12).

Panchagavya is a combination of 5 commodities made from cows in Sanskrit. Everything from cow dung and pee to milk and curd and ghee are part of the 5 different products. Every one of these is called a "Gavya," and when combined they form a "Panchagavya." Each of these 5 items is essential to the preparation of Panchagavya. Sugarcane juice, ripe bananas, jaggery, yeast and soft coconut water are some of the extra components used to boost fermentation and encourage the growth of good microbes. Panchagavya is an old Vedic recipe that calls for 5 byproducts from a local cow: dung, urine, milk, curd and ghee. The initial expenditure is reduced since the farmer can easily create all 5 components and has quick access to them. It is rich in growth-promoting substances such chemical compounds, hormones, micro and macronutrients and minerals, in addition to its antibacterial and insecticidal properties. Panchagavya boosts productivity and eventually contributes to a high yield and yield attributes by encouraging the growth of roots, stems, branches and leaves as well as related parameters like root length, stem length, branch count, leaf area index, chlorophyll content, oil content, protein content and other quality parameters (13). It is therefore essential for increasing production and profitability as well as for the overall growth and development of agricultural plants. Additionally, it is good for the ecology (13).

Growth and productivity can be enhanced and stimulated by humic acid, which can also reduce disease and increase stress tolerance. Fulvic acid can strengthen the root system and encourage seed germination, growth and yield. The most significant effects of fulvic acid, humic acid and salicylic acid are highlighted in the book entitled "Plant", along with their roles in contemporary sustainable agricultural production (14). Humic compounds are a common class of plant biostimulants because they may be applied directly to plants at low concentrations to improve nutrient absorption, growth and yield (15).

Materials and Methods

Experimental site

The field experiment was conducted during the rabi season of 2023–24 and 2024–25 at the Vegetable Research Farm (Kalyanpur), Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, using a randomized block design (RBD) for the experiment. Kalyanpur is located on the Hardoi-Kanpur route (besides NH-34,

GT Road), about 12 km away from the Central Railway Station, Kanpur. The experimental site was located between 26.496219° North latitude and 80.271222° East longitude, at an altitude of roughly 124 m above mean sea level and is subject to sub-tropical weather with exceptional humidity. The experimental field was levelled out effectively, guaranteeing adequate drainage and good irrigation systems. The experimental site had sandy loam soil with pH range of (7.68 in 2023–24 and 7.73 in 2024–25), available nitrogen (170.5 in 2023–24 and 184.9 in 2024–25 kg ha⁻¹), available phosphorus (14.7 in 2023–24 and 16.5 kg ha⁻¹ in 2024–25) and low in available potassium (126.8 in 2023–24 and 134.5 kg ha⁻¹ in 2024–25).

Climatic condition

The Kanpur district has a sub-humid climate, with a mean annual rainfall of about 1010 mm, 90 % of which comes between mid-July and the end of September. However, wintertime showers are also typical on occasion. The winter months are chilly, with sporadic frosts during this time. Westerly hot winds predominant from the second fortnight of April to the first fortnight of June and the summer season are hot and dry. The crop period indicates that the total rainfall for the crop period in 2023–24 was 89.20 mm and for 2024–25, it was 76.1 mm. The lowest temperatures ever recorded were 5.1 °C in January of 2023–2024 and 6.2 °C in December of 2024–25. Meanwhile, the highest recorded temperatures were 35.8 °C in March 2023–24 and 34.3 °C in November 2024–25. From November to March of 2023–24, the relative humidity reached its greatest point of 96 % and lowest of 31 % and during 2024–25, the highest humidity was 95 % and the lowest was 31 %.

Experimental design and treatments

The experimental design consisted of 11 treatments carried out in randomized block design (RBD) with 3 replications. The treatments comprises of T₀- control (untreated), T₁ - hydro-primed for 24 hr soaking, T₂ - vermiwash (15 % for 24 hr soaking), T₃ - cow urine (20 % for 24 hr soaking), T₄ - panchgavya (15 % for 24 hr soaking), T₅ - humic acid (20 % for 24 hr soaking), T₆ - GA₃ (50 ppm for 24 hr soaking), T₇ - IAA (50 ppm for 24 hr soaking), T₈ - cytokinin (100 ppm for 16 hr soaking), T₉ - KNO₃ (3 % for 16 hr soaking), T₁₀ - NaCl (4 g L⁻¹ for 16 hr soaking).

Crop management

The coriander variety Azad dhan-1 (duration 115–125 days, average yield 15 q ha⁻¹, greenish brown colour) was used in the experiment. Coriander seeds were primed as per the treatments and dried in shade, utilising thin paper to reduce the moisture for proper handling and sowing. The seeds were sown at a spacing of 15 cm within the rows with 20 cm spacing between the rows. The grass plot size (6 m²) and net plot size (5 m²) were used as per standard recommendation. The recommended dose of fertilisers was applied in ratio of 80:40:40 N:P₂O₅:K₂O kg ha⁻¹, one third dose of nitrogen and full dose of phosphorus and potash was applied during field preparation (before last ploughing) and one third dose of nitrogen was applied at 40–50 days (growth stage) of sowing and one third dose of nitrogen was applied before flowering stage. Most of the field data was collected and calculated as per 5 randomly selected (tagged) plants of each plot.

Statistical analysis

Data collected on different parameters were analysed for RBD by using OPState software to find the significant difference at 5 % level. Which was utilised to test for significant differences among means of 11 treatments in both years 2023–24 and 2024–25.

Results and Discussion

The treatments had significant effect on the number of primary branches, number of secondary branches and number of tertiary branches (Table 1, Fig. 1). In the pooled comparison, the maximum number of primary branches was observed with T₄ (7.61), which was significantly superior to all other treatments except T₅ (7.35), followed by T₈ (6.89) and T₁ (6.78). The smallest number of primary branches was found in T₀ (5.47). The highest number of secondary branches were found in T₄ (10.89) being statistically at par with the T₅ (10.11). The lowest secondary branches were observed in T₀ (5.89). It is indicated that higher number of tertiary branches observed in T₅(4.06) which was significantly superior to all other treatments except T₈ (3.83) followed by T₁₀(3.72), T₃ & T₄(3.50). The lowest tertiary branches achieved by T₀(2.50).

Coriander's branch count is a crucial growth characteristic that directly affects the plant's design, photosynthetic efficiency and potential output. The present study's combined findings showed that primary, secondary and tertiary branch growth was significantly impacted by seed priming treatments, with notable variations across treatments. These findings suggest that panchgavya was very successful in encouraging vegetative

development, maybe as a result of the essential nutrients, growth-promoting hormones and advantageous microbes it contained. Since cytokinins are known to promote cell division and shoot proliferation, their role in tertiary branching was particularly notable. It's important to remember that while cytokinins benefited tertiary branching, previous studies showed that higher doses could delay flowering and maturity, highlighting a trade-off between reproductive development and vegetative growth. It is indicated that previous researcher also found more number branches in blackgram primed with 6 % Panchgavya (16), Panchagavya at 3 % for 12 hr was also found more effective for number of branches per plant (7.93) in cow pea (17).

The treatments had significant effect on umbel per plant and seed per umbel (Table 1, Fig. 1). In pooled data showed that T₅ (42.94) perform superior, which was significantly superior to all other treatments except T₄ (37.90) and least performer was found in T₀(23.01). Treatment T₅ (41.88) had significant effect in case of seeds per umbel and being statistically at par with T₄ (40.86), which was significantly superior to all other treatments except T₁ (38.77), T₈ (38.20), T₂ (37.01) and T₆ (35.16). The least performer was observed in T₀(28.59).

Table 1. Effect of seed priming treatments on number of primary branches, number of secondary branches and number of tertiary branches, number of umbels per plant and number of seeds per umbel of coriander in pooled (2023–24 and 2024–25)

Treatments	Description	Number of primary branches	Number of secondary branches	Number of tertiary branches	Number of umbels per plant	Number of seeds per umbel
T ₀	Control (untreated)	5.47	5.89	2.50	23.01	28.59
T ₁	Tap water soaking for 24 hr	6.78	8.06	2.94	29.85	38.77
T ₂	15 % solution of vermiwash soaking for 24 hr	6.48	7.56	2.61	25.22	37.01
T ₃	20 % solution of cow urine soaking for 24 hr	6.35	8.50	3.50	27.35	34.88
T ₄	15 % solution of panchgavya soaking for 24 hr	7.61	10.89	3.50	37.90	40.86
T ₅	20 % solution of humic acid soaking for 24 hr	7.35	10.11	4.06	42.94	41.88
T ₆	50 ppm solution of GA ₃ soaking for 24 hr	6.06	8.33	3.33	33.22	35.16
T ₇	50 ppm solution of IAA soaking for 24 hr	5.67	6.33	2.83	24.63	30.14
T ₈	100 ppm solution of cytokinin soaking for 16 hr	6.89	8.39	3.83	25.96	38.20
T ₉	3 % solution of KNO ₃ soaking for 16 hr	6.31	8.17	3.22	26.79	34.10
T ₁₀	4 g/L solution of NaCl soaking for 16 hr	5.61	7.22	3.72	24.06	31.54
SE (m±)		0.34	0.37	0.21	1.71	1.97
C. D.		1.03	1.11	0.63	5.08	5.86
C.V. (%)		9.43	7.97	11.26	10.16	9.62

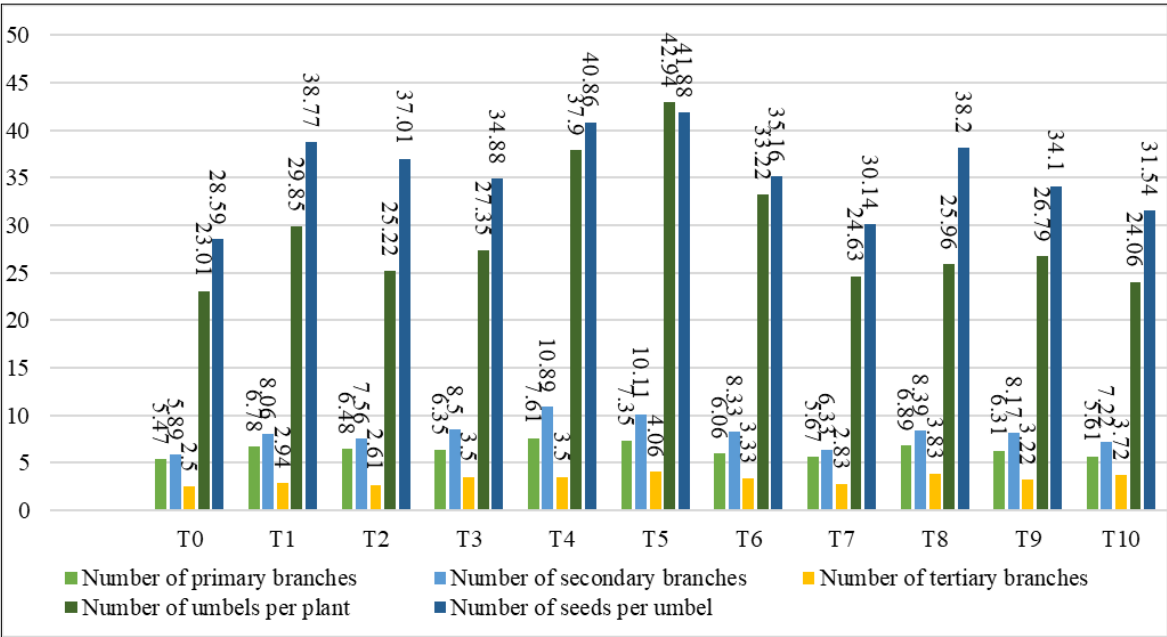


Fig. 1. Effect of seed priming treatments on number of primary branches, number of secondary branches, number of tertiary branches, number of umbels per plant and number of seeds per umbel of coriander in pooled (2023–24 and 2024–25).

Increased nutrient intake, improved pollination efficiency due to increased flowering and enhanced carbohydrate partitioning towards reproductive structures may be the reasons for the larger number of seeds per umbel in the humic acid and panchgavya treatments. Auxins and cytokinins, which control reproductive growth, are known to be influenced by humic chemicals. Additionally, Panchgavya includes cytokinins, gibberellins and natural auxins that enhance seed set per umbel and encourage seed growth. Similar results were obtained in coriandar found significant higher umbels, seeds primed with GA₃ at 100 ppm and humic acid (18). Higher number of pods per plant, number of seed per pod were observed in blackgram primed with 6 % panchgavya (16), panchagavya at 3 % for 12 hr was also found more effective for number of pods per plant (19.4), pod length (42.97 cm), number of seeds per pod (13.73), in cow pea (17).

The most crucial factor in coriander production is seed yield, which captures the combined impact of growth and reproductive characteristics. Pre-sowing seed priming treatments significantly affected raw and graded seed yield per plant, per plot and per hectare, according to the study's pooled analysis, indicating how well these treatments increased productivity. The treatments had significant effect on raw seed yield per plant, graded seed yield

per plant, raw seed yield per plot and graded seed yield per plot (Table 1, Fig. 2). In pooled data highest raw seed yield per plant was observed in T₅ (11.63) being statistically at par with T₄ (11.45) followed by T₆ (11.04). The minimum raw seed yield per plant was observed T₀ (9.73). In pooled highest graded seed yield per plant was found in T₅ (10.48) being statistically at par with the T₄ (10.20) followed by T₆ (9.91) and lowest graded seed yield per plant was found in T₀ (8.45). In pooled highest raw seed yield per plot was observed in T₅ (0.767) being statistically at par with T₄ (0.756) and T₆ (0.729). The lowest raw seed yield per plot was observed T₈ (0.603). In pooled highest graded seed yield per plot was found in T₅ (0.692) being statistically at par with the T₄ (0.673) followed by T₆ (0.654). The minimum graded seed yield per plot was found in T₈ (0.542). The treatments had significant effect on raw seed yield per hectare and graded seed yield per hectare (Table 2, Fig. 3). In the pooled highest raw seed yield per hectare was observed in T₅ (1534.72), which was significantly superior to all other treatments except T₄ (1511.84) and T₆ (1457.06). The lowest raw seed yield per hectare was observed in T₈ (1206.71). Highest graded seed yield per hectare was found in T₅ (1383.84), which was significantly superior to all other treatments except T₄ (1346.53), followed by T₆ (1308.25). The lowest graded seed yield per hectare was found in T₈ (1084.66).

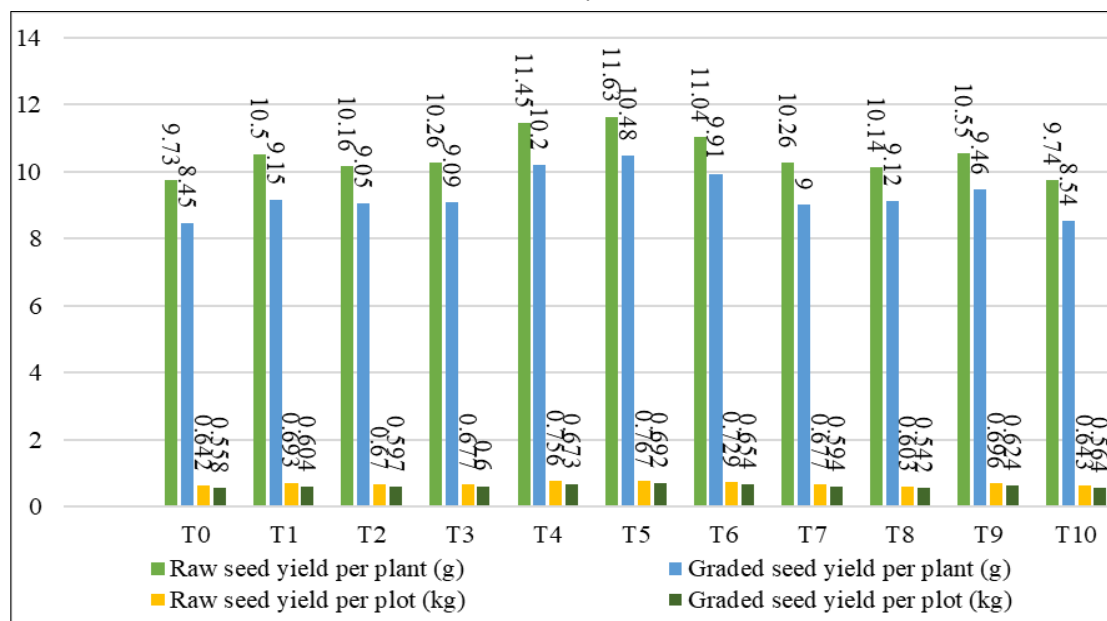


Fig. 2. Effect of seed priming treatments on raw seed yield per plant (g), graded seed yield per plant (g), raw seed yield per plot (kg) and graded seed yield per plot (kg) of coriander in pooled (2023–24 and 2024–25).

Table 2. Effect of seed priming treatments on raw seed yield per plant, graded seed yield per plant, raw seed yield per plot (kg), graded seed yield per plot (kg), raw seed yield per hectare and graded seed yield per hectare coriander in pooled (2023–24 and 2024–25)

Treatments	Description	Raw seed yield per plant (g)	Graded seed yield per plant (g)	Raw seed yield per plot (kg)	Graded seed yield per plot (kg)	Raw seed yield per hectare (kg)	Graded seed yield per hectare (kg)
T ₀	Control (untreated)	9.73	8.45	0.642	0.558	1284.10	1115.53
T ₁	Tap water soaking for 24 hr	10.50	9.15	0.693	0.604	1386.26	1207.27
T ₂	15 % solution of vermiwash soaking for 24 hr	10.16	9.05	0.670	0.597	1340.68	1193.94
T ₃	20 % solution of cow urine soaking for 24 hr	10.26	9.09	0.677	0.600	1354.41	1199.22
T ₄	15 % solution of Panchgavya soaking for 24 hr	11.45	10.20	0.756	0.673	1511.84	1346.53
T ₅	20 % solution of humic acid soaking for 24 hr	11.63	10.48	0.767	0.692	1534.72	1383.84
T ₆	50 ppm solution of GA ₃ soaking for 24 hr	11.04	9.91	0.729	0.654	1457.06	1308.25
T ₇	50 ppm solution of IAA soaking for 24 hr	10.26	9.00	0.677	0.594	1354.54	1188.22
T ₈	100 ppm solution of cytokinin soaking for 16 hr	10.14	9.12	0.603	0.542	1206.71	1084.66
T ₉	3 % solution of KNO ₃ soaking for 16 hr	10.55	9.46	0.696	0.624	1392.82	1248.41
T ₁₀	4 g/L solution of NaCl soaking for 16 hr	9.74	8.54	0.643	0.564	1285.46	1127.21
SE (m±)		0.29	0.30	0.019	0.020	38.74	40.73
C. D.		0.87	0.91	0.058	0.060	115.11	121.02
C.V. (%)		4.85	5.75	4.888	5.780	4.67	5.79

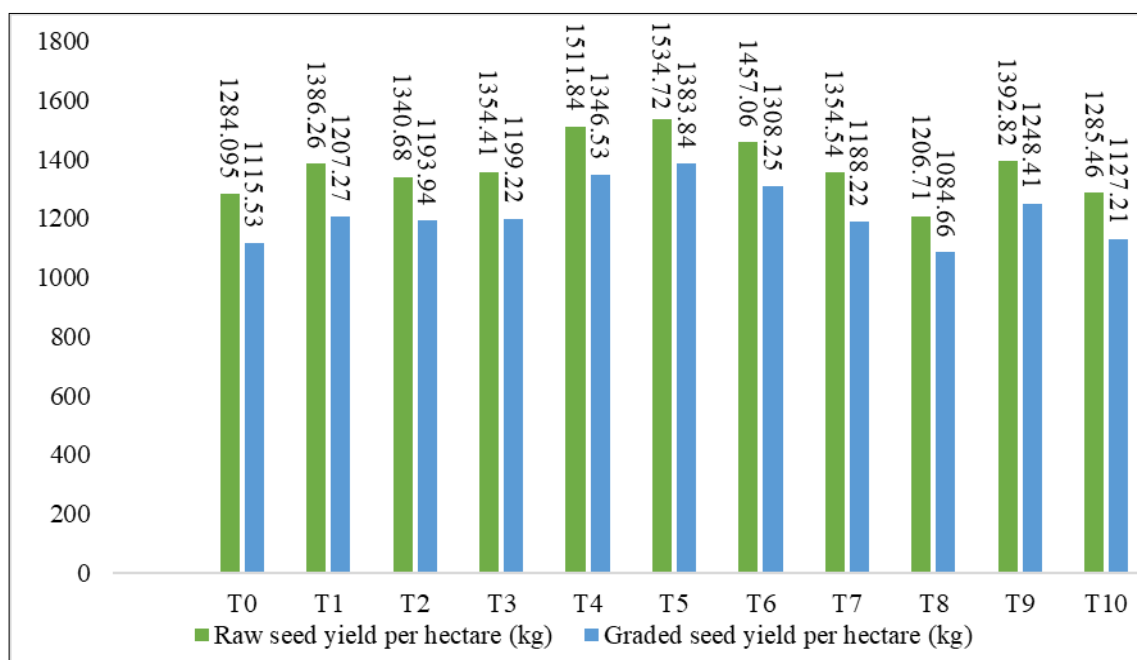


Fig. 3. Effect of seed priming treatments on raw seed yield per hectare (kg) and graded seed yield per hectare (kg) of coriander in pooled (2023–24 and 2024–25).

The combined gains in branching, umbels per plant and seeds per umbel seen in previous research can account for the increased yields under T₅-humic acid 20 % soaking for 24 hr and T₄-Panchgavya 15 % soaking for 24 hr. Larger reproductive production was supported by better vegetative development and larger yields were obtained by improved seed filling brought about by effective assimilate partitioning. Although it was marginally less successful than organic therapies, GA₃ has also shown efficacy, most likely because of its function in promoting enzyme activity and improving metabolic efficiency. The ineffectiveness of T₈-cytokinin 100 ppm soaking for 16 hr highlights how crucial it is to use growth regulators in balanced amounts. Indicated that higher seed yield per plant and number of seeds per plant were obtained in mungbean when primed with GA₃-100 ppm (19), priming with panchagavya at 3 % for 12 hr was found higher seed yield per plant (39.78) and seed yield per plot (835.56) in cow pea (17).

Conclusion

Concluded that, seed priming with humic acid (20 % for 24 hr) greatly increased yield characteristics and seed yield at plant, plot and hectare levels, whereas Panchgavya (15 % for 24 hr) promoted primary and secondary branching in coriander cv. Azad Dhan-1. All things considered, organic seed priming was successful in enhancing growth, yield and seed quality, confirming its place in the production of coriander that is sustainable. For improved vegetative development and increased yield, farmers are advised to use panchgavya priming and humic acid priming. To confirm these results, more research involving more genotypes, treatments and seasons is advised.

Acknowledgements

The authors extend their gratitude to The Department of Seed Science and Technology at Chandra Shekhar Azad University of Agriculture and Technology in Kanpur, Uttar Pradesh, India, for providing support and facilities for this study.

Authors' contributions

JS carried out the experiment, took observations, CLM supervised the experiments and provided the guidance to conduct the experiment. CLM and APS contributed by developing the ideas, guided the research by formulated the research concepts. AJ, DSS, SGM and RG editing the manuscript. DSS, NK, RD and YPS helped during the experiment conduction and manuscript preparation. All authors have read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

References

- Anonymous. Area, production and yield report of coriander 2022-23, Directorate of Economics and Statistics, Ministry of Agriculture and Farmer Welfare GOI, 2023. <https://data.desagri.gov.in/website/crops-apy-report-web>
- Anonymous. Review of Export Performance of Spices during 2023-24. Spice board of India, ministry of commerce and industry GOI, 2024.
- Szafirowska A, Grzesik M, Habdas H, Staniaszek M, Improving germination and vigour of aged and stored onion seeds by matricconditioning. *Acta Physiologiae Plantarum*. 2002;24:167–71. <https://doi.org/10.1007/s11738-002-0008-6>
- McDonald, MB. Seed priming. In: Black M, Bewley JD, Seed Technology and its Biological Basis. Sheffield Academic Press Ltd, England. 2000;287–325.
- Bruggink GT. Flower seed priming, pre-germination, pelleting and coating. 2005;249- 262. In: McDonald MB, Kwong FY. Flower Seeds Biology and Technology, CABI, UK. <https://doi.org/10.1079/9780851999067.0249>
- Powell AA, Yule LJ, Jing H, Groot SPC, Bino RJ, Pritchard HW. The influence of aerated hydration seed treatment on seed longevity as assessed by the viability equations. *J Exp Bot*. 2000;51:2031–43. <https://doi.org/10.1093/jexbot/51.353.2031>

7. Huang R, Sukprakarn S, Thongket T, Juntakool S. Effect of hydropriming and redrying on the germination of triploid watermelon seeds. *Kasetsart J (Nat Sci)*, 2002;36:219–24.
8. Demir I, Okcu, G. Aerated hydration treatment for improved germination and seedling growth in aubergine (*Solanum melongena*) and pepper (*Capsicum annum* L.). *Ann Appl Biol*. 2004;144:121–3. <https://doi.org/10.1111/j.1744-7348.2004.tb00324.x>
9. Badex B, Duijn BV, Grzesik M. Effects of water supply methods and seed moisture content on germination of China aster (*Callistephus chinensis* L.) and tomato (*Lycopersicon esculentum* Mill.) seeds. *Europ J Agr*, 2006;24:45–51. <https://doi.org/10.1016/j.eja.2005.04.004>
10. Rithichai P, Pipatkornsakul A. Effects of hydropriming treatments on germination and vigor of coriander seeds. *Khon Kaen Agri J*. 2008;36:235–40.
11. Prabakaran J. Biomass resources in vermicomposting, In: *Proceedings of the State Level Symposium on Vermicomposting Technology for Rural Development*, Madurai, Tamil Nadu, India. 2005:27–40.
12. Shivasubramanian K, Ganeshkumar M. Influence of vermiwash on the biological productivity of marigold. *Madras Agric*. 2004;91(4–6):221–5. <https://doi.org/10.29321/MAJ.10.A00095>
13. Kumar CS, Singh G. Effect of Panchagavya on growth and yield: A review. *Int J Curr Microbiol App Sci*. 2020;9:617–24. <https://doi.org/10.20546/ijcmas.2020.912.073>
14. Shahrajabian MH, Sun W. The importance of salicylic acid, humic acid and fulvic acid on crop production. *Lett Drug Des Disc*. 2024;21(9):1465–80. <https://doi.org/10.2174/1570180820666230411102209>
15. Canellas LP, Canellas NO, da S, Irineu LES, Olivares FL, & Piccolo A. Plant chemical priming by humic acids. *Chem Biol Tech Agri*. 2020;7:1–17. <https://doi.org/10.1186/s40538-020-00178-4>
16. Vighneshawaran G, Rajan REB, Kumar PS, Ruban SJ, Joshi JL, Muraleedharan A. Effect of different seed priming methods on field performance and seed quality of black gram (*Vigna mungo* L.). *cv. VBN 5 G. Recent Trends in Agriculture towards Food Security & Rural Livelihood Volume II*, 2020;20(2):1672–4.
17. Rai PK, Samatha B. Standardization of different pre-sowing seed treatments with Jeevamrutha, Panchagavya, neem oil and vermiwash on plant growth yield and yield attributing traits of cowpea (*Vigna unguiculata* L.) var. SSC-06. *Int J Plant Soil Sci*. 2022;458–65. <https://doi.org/10.9734/ijpss/2022/v34i2331610>
18. Jamshidian Z, Talat F. Effects of seed priming on morphological and phonological characteristics of the coriander (*Coriandrum sativum* L.). *Adv Plants Agri Res*. 2017;7(6):411–5. <https://doi.org/10.15406/apar.2017.07.00275>
19. Nandan R, Yadav RK, Singh SP, Singh AK, Singh AK. Effect of seed priming with plant growth regulators on growth, biochemical changes and yield of mung bean (*Vigna radiata* L.). *Int J Chem Stud*. 2021;9(1):2922–7. <https://doi.org/10.22271/chemi.2021.v9.i1ao.11673>

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonpublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonpublishing.com/journals/index.php/PST/indexing_abstracting

Copyright: © The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited (<https://creativecommons.org/licenses/by/4.0/>)

Publisher information: Plant Science Today is published by HORIZON e-Publishing Group with support from Empirion Publishers Private Limited, Thiruvananthapuram, India.