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STUDIES ON EFFECT OF SEED PRIMING ON SEED QUALITY PARAMETERS OF CORIANDER (*CORIANDRUM SATIVUM* L.) UNDER LABORATORY CONDITION

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ABSTRACT

A laboratory experiment was conducted during 2023-2024 at Department of Seed Science and Technology, University of Agricultural Sciences, Raichur to study effect of seed priming on seed quality parameters of coriander**.** The experiment consisted of sixteen various priming treatments which included control (no seed priming), hydropriming, bioagents (*Azotobacter chroococcum, Pseudomonas fluorescens, Trichoderma harzianum*), bioregulators (IAA, NAA, GA_3, Humic acid) and micronutrients ($CuSO_4$, $MnSO_4$, $ZnSO_4$, $FeSO_4$, $ZnSO_4$+$FeSO_4$, $CuSO_4$+$MnSO_4$+$ZnSO_4$+$FeSO_4$) laid out in Completely Randomised Design with four replications. The results revealed that among all the treatments, seeds primed with GA_3 (100 ppm) exhibited significantly highest seed germination (86.75 %), seedling length (26.33 cm), seedling dry weight (41.23 mg), seedling vigour index-I (2284.00) and other seed quality parameters compared to control. Thus, it can be concluded that seed priming with GA_3 can be used to enhance seed germination in coriander instead of using seeds directly for sowing.

***Keywords*:** Bioagents, coriander, GA_3, seed priming and seed quality

Introduction

Coriander is an annual herb, which belongs to the family Apiaceae with chromosome number 2n=22, generally grown in winter season in India. It is native to the Eastern Mediterranean region and southern Europe. It is an upright and branched annual plant that grows to a height of 80 cm. The flowers are small, white and pink in colour produced in umbels. Fully mature seeds on getting dried turn light brown in colour. All parts of the plant are edible, but the fresh leaves and the dried seeds are most traditionally used in cooking. Both the seeds and leaves of coriander offer significant health benefits. The leaves are rich in vitamins A, C, and K, as well as β-carotene, fiber, and essential minerals like calcium and iron (Girenko, 1982). Coriander seeds contain nearly 11 g of starch, 20 g of fat, 11 g of protein and nearly 30 g of crude fibre per 100 g of seeds (Peter, 2004).

Seed germination and seedling establishment are critical steps in plant life, and the successful establishment of plants depends on rapid and uniform germination of seeds under adverse environmental conditions. The major constraints in successful crop production in coriander are poor germination and inappropriate plant stand. . Poor germination in coriander seeds occurs due to the presence of water-soluble inhibitors like polyphenols and organic acids and hard seed coat. To improve seed quality several approaches like seed hardening, seed soaking and seed coating have been employed but yet another alternative simple and cost-effective technique that can be used is seed priming.

Seed priming is a pre-sowing seed enhancement technique that allows controlled hydration of seeds to imbibe water and go through the first stage of germination but does not allow radical protrusion through the seed coat (McDonald, 2000). Seed priming has several benefits to crop like seed germination improvement, early and rapid emergence, crop establishment, higher water use efficiency, deeper roots, increase in root growth, uniformity in emergence, synchronize of germination of individual seeds, breaking of seed dormancy, initiation of reproductive organs, better competition with weed, early flowering and maturity, resistance to environmental stresses (such as drought and salinity) and diseases (*Sclerotium rolfsii* L.) as well as increment in yield thereby providing a simple and cheap technology to the farmers for better seed production.

Seed priming can be achieved through various methods. The present study involves priming methodologies like hydropriming, biopriming, harmonal priming and nutri-priming to improve seed germination in coriander. Hydropriming (soaking of seeds in distilled water) causes some physiological changes including the sugar content, organic compounds and ions in the seed, root and finally in the plant leaves leading to high rate of germination and more resistance to inclement conditions (Alvarado *et al*., 1987). Biopriming is a process of biological seed treatment that refers combination of seed hydration (physiological aspect of disease control) and inoculation (biological aspect of disease control) of seed with beneficial organisms to protect the seed. Seed priming with bioagents like *Trichoderma* sp., *Azotobacter* sp. *and Pseudomonas* sp. helps to suppress harmful microorganisms and pathogen, produce endogenous plant growth regulators (such as gibberellins and cytokinins), improve mineral and ion availability and enhances water uptake in seed (Ramamoorthy *et al*., 2001). Harmonal priming refers to the fortification of the priming solution with growth regulators or hormones such as GA_3 or cytokinin. In hormonal priming gibberellins and cytokinins control different developmental processes in plants. Cytokinins act early during shoot initiation and control meristem activity, while gibberellins are responsible for expansion and cell division in shoot elongation and seed germination (Pospisilova, 2003). Among various priming techniques, seed priming with micronutrients (nutri-priming) has been reported to be a physiological beneficial method for overcoming the micronutrient deficiency in seeds which improves seedling emergence (Farooq *et al*., 2012). Nutri-priming significantly improves germination rate, seed quality, early seedling growth and stress tolerance in different plants (Imran *et al*., 2017).

Keeping all the above aspects in view, the present study "Studies on effect of seed priming on seed quality parameters of coriander under laboratory condition" was conducted.

Material and Methods

The laboratory experiment pertaining to "Studies on effect of seed priming on seed quality parameters of coriander under laboratory condition" was conducted at Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur during 2023-24. Truthfully labelled coriander seeds of variety "DCC- 81" were obtained from University of Horticultural Sciences, Bagalkot, Karnataka.

The bioagents used in the studies *i.e*., *Trichoderma harzianum*, *Azotobacter chroococcum* and *Pseudomonas fluorescens* were collected from Bio-inputs entrepreneurship centre, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka.

The experiment consisted of sixteen priming treatments with four replications which was statistically analyzed using Completely Randomized Design (CRD). The treatments were: T_1: Control (No seed priming), T_2: Hydropriming, T_3: *Trichoderma harzianum* @4 per cent, T_4: *Azotobacter chroococcum* @ 10 per cent, T_5: *Pseudomonas fluorescens*@ 10 per cent , T_6: *Trichodermaharzianum* @ 4 per cent+ *Azotobacter chroococcum* @ 10 per cent + *Pseudomonas fluorescens*@10 per cent, T_7: IAA @ 50 ppm, T_8: NAA @ 50 ppm, T_9: GA_3 @ 100 ppm, T_{10}: Humic acid @ 200 ppm, T_{11}: $CuSO_4$ @ 0.045 per cent, T_{12}: $MnSO_4$ @ 0.045 per cent, T_{13}: $ZnSO_4$ @ 0.05 per cent, T_{14}: $FeSO_4$ @ 0.05 per cent, T_{15}: $ZnSO_4$ @ 0.05 per cent + $FeSO_4$ @ 0.05 per cent, T_{16}: $CuSO_4$ @ 0.045 per cent + $MnSO_4$ @ 0.045 per cent + $ZnSO_4$ @ 0.05 per cent + $FeSO_4$ @ 0.05 per cent.

Imposition of treatments

The seeds were primed with the respective solutions of priming treatments at their concentrations with 1:2 seed to solution ratio (weight by volume) for 12 hours at room temperature (25±2 ºC). After that, the seeds were uniformly spread over the blotter paper and kept for air drying under shade to re-dry to their original moisture content. Finally, such seeds were used for seed germination test for assessing the seed quality parameters.

The observations were recorded on seed germination (%), root length (cm), shoot length (cm),

seedling length (cm), seedling dry weight (mg) as per ISTA procedures (Anon., 2014), seedling vigour index-I (Abdul-Baki and Anderson, 1973) and II. The standard seed germination test was conducted with four replications of 100 seeds of each treatment by following between paper method and incubated in the seed germination chamber maintained at 25±2 ºC temperature and 90±5 per cent relative humidity. The final germination count was recorded on 21stday (Anon., 2014). Ten normal seedlings were randomly selected from each treatment and replications of the germination test on 21st day (final count) and used for measuring root and shoot length. The root length was measured from collar region to the tip of root of the seedlings by using metric scale. The shoot length was measured from collar region to the tip of shoot of the seedlings by using metric scale. The mean root and shoot length of the seedlings were calculated and expressed in centimeter (Anon., 2014). Seedling length was obtained by adding shoot length and root length and the mean seedling length was expressed in centimeter (Anon., 2014). The ten normal seedlings selected for shoot and root length measurement were placed in butter paper packet and kept in hot air oven maintained at 70 ºC for 24 hours and the weight of the dry seedlings was recorded using electronic balance. The average weight was calculated and expressed in milligram (Anon., 2014). Seedling vigour index-I was calculated by multiplying the seed germination (%) with seedling length (cm) (Abdul-Baki and Anderson, 1973) and seedling vigour index-II was computed by multiplying the seed germination (%) with seedling dry weight (mg).

Results and Discussion

The analysis of variance revealed the significant differences between the treatments for all the seed quality parameters studied like germination percentage, root length(cm), shoot length(cm), seedling length(cm), seedling dry weight(mg), seed vigour index-I and seed vigour index-II.

The results on seed germination percentage, root length and shoot length of coriander as influenced by various seed priming treatments like bioagents, bioregulators and micronutrients has been tabulated in Table 1.

Based on results of present study it was found that coriander seeds primed with GA_3 @ 100 ppm (T_9) have recorded significantly highest seed germination (86.75 %), root length (15.25 cm) and shoot length (11.08 cm) when compared to all other treatments. Whereas, the lowest seed germination (73.75 %), root length (9.83 cm), shoot length (6.65 cm) were registered in control (T_1). There was 17.62 per cent improvement in seed germination in GA_3 (100 ppm) primed seeds as compared to unprimed seeds.

The results of seedling length (cm) and seedling dry weight (mg) obtained by seed priming with different bioagents, bioregulators and micronutrients is presented in Table 2.

Among the different seed priming treatments, significantly highest seedling length (26.33 cm) and seedling dry weight (41.23 mg) were recorded by seed priming with GA_3 @ 100 ppm (T_9). Whereas, the unprimed seeds (T_1) recorded the significantly lowest seedling length (16.48 cm) and seedling dry weight (24.69 mg) when compared to all the seed priming treatments.

The data recorded on seedling vigour index-I and II influenced by different bioagents, bioregulators and micronutrients in the present study has been tabulated in Table 3.

Out of all the treatments, significantly highest seedling vigour index-I (2284) and II (3577) were obtained in (T_9) GA_3 (100 ppm) primed seeds in contrast with all the other treatments and control (T_1). Whereas, unprimed seeds (T_1) have recorded significantly lowest (1215) seedling vigour index-I and II (1821).

The increase in seed germination by priming of coriander seeds with GA_3 is due to the production of the hydrolytic enzymes by GA_3, which are responsible for endosperm degradation and cause faster germination. During seed priming with GA_3, bio actives are produced by the embryo and transferred to aleurone layer, where they induce the expression of α-amylase, which ultimately results in breakdown of reserve food material in the seeds. It results in the conversion of starch into simple sugars such as glucose and maltose, which positively affects the embryo's development capacity and improves germination in GA_3 primed seeds. Similar results of enhanced germination due to seed priming with GA_3 have also been found in bell pepper (Yogananda *et al*., 2004), cumin (Heidari and Sadeghi, 2014) and onion (Muruli *et al*., 2016 and Brar *et al*., 2020).

An increase in root length by soaking of coriander seeds in GA_3 solution (priming) might be due to the involvement of GA_3 in accelerated cell division and cell elongation in the apical meristem region of the radicle. The enhancement in shoot length in GA_3 (100 ppm) primed seeds may be attributed to the enlarged embryos, higher rate of metabolic activity, respiration, better utilization and mobilization of metabolites to the growing points and higher activity of enzymes thereby

leading to increased shoot length. Similar results with respect to increase in root length and shoot length due to GA_3 priming were obtained by Prakash *et al*. (2017) in spinach and Muruli *et al.* (2016) in onion.

The increase in seedling length by priming with GA_3 might be due to the enhancement of the mobilization of starch reserves and increasing amylase activity in cotyledons, which ultimately leads to better seedlings growth. Furthermore, GA_3 is known to enhance the water uptake of the seedlings which might have activated the enzymes mobilizing embryo food reserves resultantly producing taller and vigorous seedlings. Similar results where seedling length increased due to GA_3 priming were obtained by Debbarma *et al.* (2018) in coriander and Sabrina *et al.* (2024) in fenugreek.

The increased seedling dry weight due to GA_3 priming might be due to enhanced water uptake of the seedling which ultimately triggered the enzymes involved for the mobilization of food reserves in endosperm which positively worked for the vigorous seedling production. As a result, the fresh weight of seedlings increased, favourably correlated with the dry weight of seedlings. Similar findings of higher seedling dry weight due to seed priming with GA_3 have also been reported in onion (Yarina and Tabrizi, 2012), black cumin (Jayamani *et al*., 2020) and Lamichhane *et al*. (2021) in okra.

Seed priming with GA_3 has increased the seedling vigour indices which might be due to the increased soluble protein content in primed seeds. This boost in protein levels supports membrane synthesis and repair and facilitates the activation and resynthesis of DNA, RNA, and essential enzymes. These processes enhance reserve mobilization, leading to improved germination, seedling development and ultimately a higher Seedling vigour. Similar findings of higher seed vigour index-I and II due to seed priming with GA_3 have also been reported in bitter gourd (Narender *et al*., 2015) and onion (Yarina and Tabrizi, 2012).

Table 1 : Effect of seed priming with bioagents, bioregulators and micronutrients on seed germination, root length and shoot lengthof coriander

Treatment	Seed germination (%)	Root length (cm)	Shoot length (cm)
T_1: Control	73.75	9.83	6.65
T_2: Hydropriming	80.25	12.11	8.07
T_3: *Trichodermaharzianum*@ 4 per cent	82.50	12.50	8.42
T_4: *Azotobacterchroococcum*@ 10 per cent	85.50	14.53	10.31
T_5: *Pseudomonas fluorescens*@ 10 per cent	84.50	13.81	9.61
T_6: *Trichodermaharzianum* @ 4 per cent+ *Azotobacterchroococcum* @ 10 per cent + *Pseudomonas fluorescens*@10 per cent	86.00	15.12	10.83
T_7: IAA @ 50 ppm	81.00	13.08	9.08
T_8: NAA @ 50 ppm	80.00	11.77	7.50
T_9: GA_3 @ 100 ppm	86.75	15.25	11.08
T_{10}: Humic acid @ 200 ppm	84.75	14.18	9.80
T_{11}: $CuSO_4$ @ 0.045 per cent	79.50	10.85	7.33
T_{12}: $MnSO_4$ @ 0.045 per cent	78.75	10.53	7.21
T_{13}: $ZnSO_4$ @ 0.05 per cent	83.00	13.79	9.46
T_{14}: $FeSO_4$ @ 0.05 per cent	81.75	12.74	8.83
T_{15}: $ZnSO_4$ @ 0.05 per cent + $FeSO_4$ @ 0.05 per cent	82.75	13.34	9.25
T_{16}: $CuSO_4$ @ 0.045 per cent + $MnSO_4$ @ 0.045 per cent + $ZnSO_4$ @ 0.05 per cent + $FeSO_4$ @ 0.05 per cent	85.00	14.35	10.25
Mean	**82.23**	**12.98**	**8.98**
S.Em. ±	**0.69**	**0.20**	**0.17**
CD @ 1 %	**2.62**	**0.74**	**0.65**

Table 2 : Effect of seed priming with bioagents, bioregulators and micronutrients on seedling length and seedling dry weight of coriander

Treatment	Seedling length (cm)	Seedling dry weight (mg)
T_1: Control	16.48	24.69
T_2: Hydropriming	20.18	28.25
T_3: *Trichodermaharzianum*@ 4 per cent	20.92	30.32

T_4: *Azotobacterchroococcum*@ 10 per cent	24.84	39.21
T_5: *Pseudomonas fluorescens*@ 10 per cent	23.42	35.23
T_6: *Trichodermaharzianum* @ 4 per cent+ *Azotobacterchroococcum* @ 10 per cent + *Pseudomonas fluorescens*@10 per cent	25.95	39.85
T_7: IAA @ 50 ppm	22.16	32.40
T_8: NAA @ 50 ppm	19.27	27.62
T_9: GA_3 @ 100 ppm	26.33	41.23
T_{10}: Humic acid @ 200 ppm	23.98	37.52
T_{11}: $CuSO_4$ @ 0.045 per cent	18.18	27.36
T_{12}: $MnSO_4$ @ 0.045 per cent	17.74	26.85
T_{13}: $ZnSO_4$ @ 0.05 per cent	23.25	34.54
T_{14}: $FeSO_4$ @ 0.05 per cent	21.57	30.89
T_{15}: $ZnSO_4$ @ 0.05 per cent + $FeSO_4$ @ 0.05 per cent	22.59	32.89
T_{16}: $CuSO_4$ @ 0.045 per cent + $MnSO_4$ @ 0.045 per cent + $ZnSO_4$ @ 0.05 per cent + $FeSO_4$ @ 0.05 per cent	24.60	38.00
Mean	**21.97**	**32.93**
S.Em. ±	**0.27**	**0.68**
CD @ 1 %	**1.04**	**2.56**

Table 3 : Effect of seed priming with bioagents, bioregulators and micronutrients on seedling vigour indices of coriander

Treatment	Seedling vigour index-I	Seedling vigour index-II
T_1: Control	1215	1821
T_2: Hydropriming	1619	2267
T_3: *Trichodermaharzianum*@ 4 per cent	1726	2501
T_4: *Azotobacterchroococcum*@ 10 per cent	2124	3352
T_5: *Pseudomonas fluorescens*@ 10 per cent	1979	2977
T_6: *Trichodermaharzianum* @ 4 per cent+ *Azotobacterchroococcum* @ 10 per cent + *Pseudomonas fluorescens*@10 per cent	2232	3427
T_7: IAA @ 50 ppm	1795	2624
T_8: NAA @ 50 ppm	1542	2210
T_9: GA_3 @ 100 ppm	2284	3577
T_{10}: Humic acid @ 200 ppm	2032	3180
T_{11}: $CuSO_4$ @ 0.045 per cent	1445	2175
T_{12}: $MnSO_4$ @ 0.045 per cent	1397	2114
T_{13}: $ZnSO_4$ @ 0.05 per cent	1930	2867
T_{14}: $FeSO_4$ @ 0.05 per cent	1763	2525
T_{15}: $ZnSO_4$ @ 0.05 per cent + $FeSO_4$ @ 0.05 per cent	1869	2722
T_{16}: $CuSO_4$ @ 0.045 per cent + $MnSO_4$ @ 0.045 per cent + $ZnSO_4$ @ 0.05 per cent + $FeSO_4$ @ 0.05 per cent	2091	3230
Mean	**1815**	**2723**
S.Em. ±	**23.50**	**58.11**
CD @ 1 %	**89.11**	**220.41**

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