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Seed yield and quality of coriander (*Coriandrum sativum* L.) as influenced by seed priming

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ABSTRACT

Seed priming, a controlled hydration process, is a simple and cheap technology to the farmers for better germination of seed ensuring a good yield and quality.An experiment was conducted to evaluate the effects of different priming media, and duration on seed germination, growth, yield and essential oil content of coriander at the Horticultural Research Station, Mondouri, West Bengal.There werethreedifferent concentrations of chemical (KH_2PO_4) viz., 3-, 2-,1% and control (distilled water) with three different duration of soaking viz., 12-, - 16- and 20 hrs.Seed priming with KH_2PO_4 has significant influence on plant height of coriander.Maximum number of primary branches per plant (7.0), number of secondary branches per plant (12.3), maximum germination (91%), were recorded with 1% KH_2PO_4 for 20 hrs. 3% KH_2PO_4 for 12 hrs was found to produce maximum test weight (13.0 g),whereas, seed priming with 1% KH_2PO_4 for 20 hrs out-yielded all other treatments resulting in the highest number of umbels per plant (23.3),umbellets per umbel (5.7), seed per umbel (38.4), seed yield per plant (3.5 g), seed yield per meter square (15.0 g), projected seed yield (13.5 q ha^{-1}), respectively.It may be concluded from the results that to obtain higher germination, seed yield and essential oil of coriander, seeds should be treated with 2% KH_2PO_4 as seed priming chemical for 20 hrsunder this Gangetic alluvial region as revealed from the result.

Keywords: Coriander, essential oil seed, germination, priming, yield

Coriander (*Coriandrumsativum* L.), is an important winter season seed spice of the family Apiaceae. Its leaves are extensively used for flavouring dishes and seeds as spices and condiments throughout the world including India. Coriander is native to South Europe and the Mediterranean region, and is extensively grown in Russia, Bulgaria, Mexico, USA, Argentina, China, Romania, Italy, Japan, Hungary, Poland, Czech, Morocco and India since human antiquity. The seeds and different parts of the plant have been reported for multiple health functions and biological activities (Nadkarni, 1976, Saeed and Tariq, 2007;Matasyoh *et al*., 2009; Begnami *et al*., 2010). It is used in the preparation of many household medicines to cure cold, seasonal fever, nausea, vomiting and stomach disorder. Pharmaceutical use of coriander is essentially to mask the taste of other medicinal compounds or to calm the irritating effects on the stomach that some medicines cause.Coriander leaves and seeds are valued as food mainly for its high Vitamin A and Vitamin C. Coriander oil is a clear, colourless to light yellow liquid. Indian coriander seeds are poor in oil content (0.1–0.4%). The content of essential oil in ripe fruit is comparatively low (typically, less than 1%) (Kumar *et al*.,1977).

Seed priming is a controlled hydration process followed by re-drying that allows seed to imbibe water and begin internal biological processes necessary for germination, but which does not allow the seed to actually germinate. Priming allows some of the metabolic processes necessary for germination to occur. In priming, seeds are soaked in different solutions with high osmotic potential. This prevents the seeds from absorbing enough water for radical protrusion, thus suspending the seeds in the lag phase (Taylor *et al.*, 1998). Seed priming has been commonly used to reduce the time between seed sowing and seedling emergence and to synchronize emergence (Parera and Cantliffe, 1994).Several investigations (Taylor and Harman 1990, Van Hulten *et al*., 2006) confirmed that seed priming has many benefits including early and rapid emergence, stand establishment, crop establishment, higher water use efficiency, deeper roots, increasein root growth, uniformity in emergence, synchronize the germination of individual seeds break 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 crop production. Seed priming can be accomplished through different methods such as hydro-priming (soaking in distilled water), osmo-priming (soaking in osmotic solutions such as poly ethylene glycol, potassium salts, *e.g*., KCl, K_2SO_4) and plant growth inducers (CCC, Ethephon, IAA) (Capron *et al*., 2000).Osmopriming and hydropriming of seeds may improve germination and emergence (Ashraf and Abu-Shakra, 1978) and may promote vigorous root growth (Carceller and Soriano, 1972).

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The information regarding safe limits of priming duration and concentration in coriander and the associated effects on growth, yield and quality is very much scanty especially under Gangetic alluvial region. There are also no comprehensive understanding on germination behavior of the crop leading to field establishment and its subsequent translation towards yield and quality. Keeping in view the above, the present experiment was undertaken to evaluate the effects of different priming media and duration on seed germination on growth, yield and essential oil content of coriander.

MATERIALS AND METHODS

An investigation on the effect of seed priming in coriander (*Coriandrum sativum* L.)was carried out at the Horticultural Research Station, Mondouri, Faculty of Horticulture, Bidhan Chandra KrishiViswavidyalaya, Nadia, West Bengal during the year 2018-19 in the month of November to March for identifying the best seed priming concentration and duration to get the improvedgermination of coriander and its growth yield and quality under Gangetic alluvial plains of West Bengal. The Research Station was located at 23.5^0 North Latitude, 89^0 East Longitude having an average altitude of 9.75 m above mean sea level. The experimental site was located in subtropical humid climate with Gangetic alluvial soil having sandy clay loam texture, with good water holding capacity, well drained, and with acidic to neutral reaction (pH 6.7) and moderate fertility status (organic carbon: 0.74%, available N: 140.5 kg ha^{-1}, available P_2O_5: 28.5 kg ha^{-1}, available K_2O : 87.0 kg ha^{-1}).

The present investigation was laid out in Randomized Block Design replicatedthrice with threedifferent concentrations of potassium dihydrogen phosphate (KH_2PO_4)viz., C_1(Seed priming with 3% KH_2PO_4),C_2(2% KH_2PO_4),C_3 (1% KH_2PO_4)and one control (C_0,without KH_2PO_4, with water). The coriander seeds weresoaked for three different durations namely D_1 (12 hrs), D_2(16 hrs), D_3(20 hrs). Therewere twelve number of treatment combination randomized in the plots of 2 x 1.5 m^2 size with spacing of 25 cm X 10 cm and 120 plants per plot. The statistical analysis was done by using OP-STAT, SPSS (IBM v. 20.0) and MS Excel software.

RESULTS AND DISCUSSION

Seed germination, root and shoot length

A remarkable positive effect on germination of coriander seed was found on seed priming with KH_2PO_4 asobserved in fig.1. The highest germination per plant (91%) was recorded with C_2D_3treatment combination (seed priming with 2% KH_2PO_4 for 20 hrs) followed by C_2D_2(89.7%), C_2D_1 (87%) and the lowest germination per plant was observed in C_0D_3 (73.3%).The highest root and shoot length per plant (21.4 and 12.3 cm, respectively) was found with C_2D_3 (seed priming with 2% KH_2PO_4 for 20 hrs) treatment combination which was statistically at par with the other treatments (Table 1). The highest seedling vigour index (3000) was obtained from the treatment (C_2D_3) where seed priming was done with 2% KH_2PO_4 for 20 hrs closely followed by C_2D_2 and C_3D_1 which were statistically at par (Fig.2). There are several other reports that seed priming can homogenize seed germination in a short period of time (Zhu, 2002; Khajeh-Hosseini, 2003)

Morphological characters

Seed priming with KH_2PO_4 has significant influence on plant height of coriander (Fig. 3). The observations recorded on 30, 60 and 120 days after sowing (DAS)showed that among the treatment C_2D_3 (seed priming with 2% KH_2PO_4 for 20 hrs) recorded the highest plant height (64.3 cm) on 30 DAS and at harvest.However, for 60 DAS C_2D_2treatment combination recorded the highest plant height (60.3cm). Plants from primed seeds might enhance water and nutrients intake resulting in increased plant height as was observed by Farooq *et al*. (2006) in rice seed. The number of branches per plant has significant effect on the seed priming with KH_2PO_4 in coriander (Fig. 4). The highest number of primary and secondary branches per plant (7 and12.3, respectively) was recorded with C_2D_3 (seed priming with 2% KH_2PO_4 for 20 hrs) treatment combination.The similar result was also observed by Ranjita Devi and Sharangi (2019) in case of a few germplasms on plant height (64.8 cm)and number of primary branches (3.8 to 10.5) in coriander.

Yield and yield attributes

The maximum number of umbels per $plant^{-1}$ (23.3), number of umbellets $umbel^{-1}$ (5.7), and seed $umbel^{-1}$ (38.4) (Fig 5) were recorded with C_2D_3 (seed priming with 2% KH_2PO_4 for 20 hrs) treatment combination. The maximumtest weight (1000 seed, 13 g) was obtained from C_1D_1 (seed priming with 3% KH_2PO_4 for 12 hrs) followed by C_3D_2 (12.5 g) and C_2D_1 (12.1g).The maximum seed yield (15.0 g m^2) was obtained with C_2D_3 (seed priming with 2% KH_2PO_4 for 20 hrs) followed by $C_3D_1$and C_2D_2 (14.7 g/ m^2)which were statistically at par and the lowest seed yield was observed in C_0D_3 (12.4g/ m^2). The seed yield (g $plant^{-1}$)has also a similar trend with significant effects on the seed priming with KH_2PO_4 in coriander. The seed priming with KH_2PO_4 has a significant effect on projected seed yield. The highest projected seed yield (13.5 q/ha) was recorded with C_2D_3

Table1: Effect of seed priming with KH_2PO_4 on root and shoot length of coriander

Treatments	Root length (cm)*	Shoot length (cm)*
C_1D_1 (Seed priming with 3% KH_2PO_4 for 12 hrs)	18.5±0.38	9.8±0.43
C_1D_2 (Seed priming with 3% KH_2PO_4 for 16 hrs)	19.5±0.35	9.9±0.18
C_1D_3 (Seed priming with 3% KH_2PO_4 for 20 hrs)	20.4±0.61	10.2±0.31
C_2D_1 (Seed priming with 2% KH_2PO_4 for 12 hrs)	20.1±0.17	11.1±0.35
C_2D_2 (Seed priming with 2% KH_2PO_4 for 16 hrs)	19.9±0.22	10.9±0.32
C_2D_3 (Seed priming with 2% KH_2PO_4 for 20 hrs)	21.4±0.38	12.3±0.21
C_3D_1 (Seed priming with 1% KH_2PO_4 for 12 hrs)	20.7±0.78	11.2±0.49
C_3D_2 (Seed priming with 1% KH_2PO_4 for 16 hrs)	19.1±0.49	10.8±0.23
C_3D_3 (Seed priming with 1% KH_2PO_4 for 20 hrs)	19.4±0.38	10.7±0.58
C_0D_1 (Distilled water for 12 hrs)	18.2±0.58	11.2±0.23
C_0D_2 (Distilled water for 16 hrs)	17.7±0.35	10.5±0.93
C_0D_3 (Distilled water for 20 hrs)	17.6±0.33	10.2±0.20
SEm(±)	**0.46**	**0.42**
LSD(0.05)	**1.36**	**1.24**

**Values represent Mean±SE*

Table 2 : Effect of seed priming with KH_2PO_4 on seed yield of coriander

Treatments	Seed Yield (g plant^{-1})	Seed Yield (g m^2)	Projected Seed Yield(q ha^{-1})
C_1D_1	3.1	13.5	12.2
C_1D_2	3.2	13.9	12.5
C_1D_3	3.2	14.1	12.7
C_2D_1	3.3	14.4	12.9
C_2D_2	3.4	14.7	13.2
C_2D_3	3.5	15.0	13.5
C_3D_1	3.4	14.7	13.2
C_3D_2	3.1	13.5	12.2
C_3D_3	3.3	14.1	12.7
C_0D_1	3.0	13.1	11.8
C_0D_2	2.9	12.7	11.5
C_0D_3	2.9	12.4	11.2
SEm(±)	**0.16**	**0.51**	**0.12**
LSD(0.05)	**0.47**	**1.52**	**0.36**

Table 3 : Effect of seed priming with KH_2PO_4 on essential oil (%) of coriander

Treatments	Essential oil content (%) of seed*
C_1D_1 (Seed priming with 3% KH_2PO_4 for 12 hrs)	0.26±0.003
C_1D_2 (Seed priming with 3% KH_2PO_4 for 16 hrs)	0.25±0.003
C_1D_3 (Seed priming with 3% KH_2PO_4 for 20 hrs)	0.26±0.003
C_2D_1 (Seed priming with 2% KH_2PO_4 for 12 hrs)	0.27±0.003
C_2D_2 (Seed priming with 2% KH_2PO_4 for 16 hrs)	0.27±0.007
C_2D_3 (Seed priming with 2% KH_2PO_4 for 20 hrs)	0.28±0.006
C_3D_1 (Seed priming with 1% KH_2PO_4 for 12 hrs)	0.26±0.003
C_3D_2 (Seed priming with 1% KH_2PO_4 for 16 hrs)	0.26±0.003
C_3D_3 (Seed priming with 1% KH_2PO_4 for 20 hrs)	0.25±0.003
C_0D_1 (Distilled water for 12 hrs)	0.23±0.003
C_0D_2 (Distilled water for 16 hrs)	0.24±0.003
C_0D_3 (Distilled water for 20 hrs)	0.23±0.003
SEm(±)	**0.004**
LSD(0.05)	**0.011**

**Values represent Mean±SE*

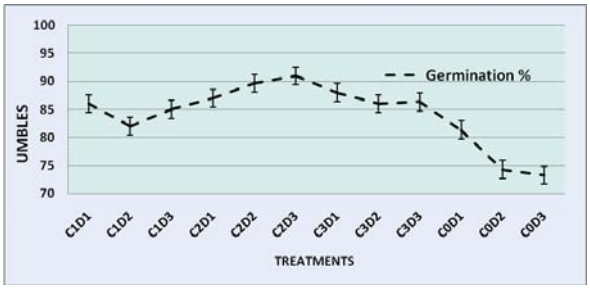

Fig. 1: Effect of seed priming with KH_2PO_4 on germination of coriander

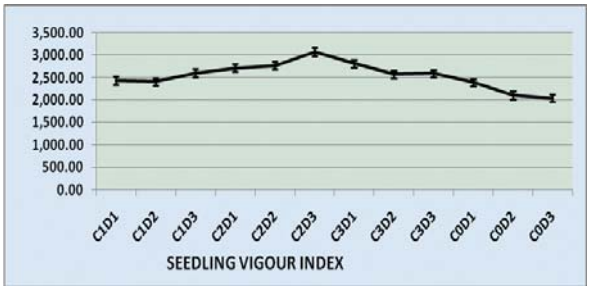

Fig. 2: Effect of seed priming with KH_2PO_4 onseedling vigour indexof coriander

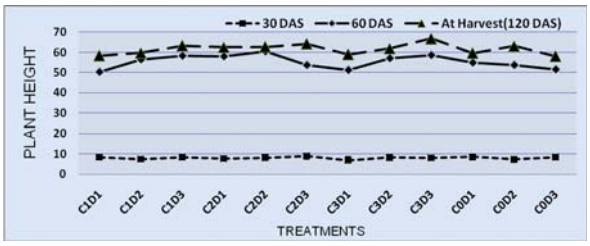

Fig. 3: Effect of seed priming with KH_2PO_4 on plant hight of coriander

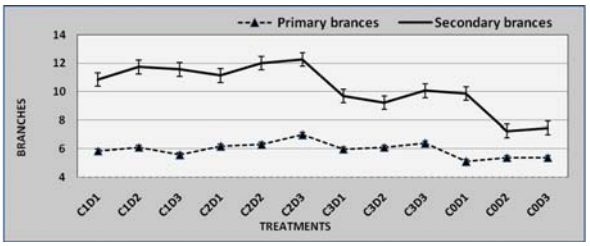

Fig. 4: Effect of seed priming with KH_2PO_4 on primary and secondary brances of coriander

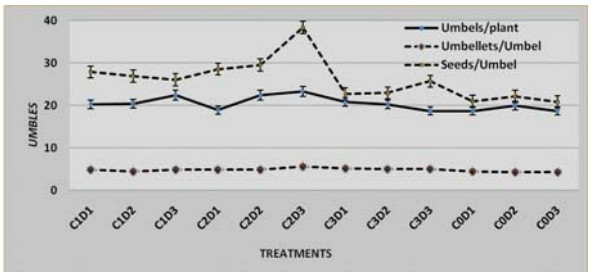

Fig. 5 :Effect of seed priming with KH_2PO_4 on yield attributing parameters of coriander

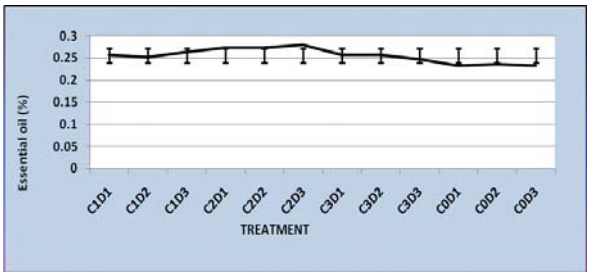

Fig. 6: Effect of seed priming with KH_2PO_4 on essential oil of coriander

(seed priming with 2% KH_2PO_4 for 20 hrs) treatment combination followed by C_3D_1 (13.2 q ha^{-1}), C_2D_2 (13.2 q ha^{-1}) and the lowest seed yield quintal per hector was observed in C_0D_3 (11.2 q ha^{-1}). Seed priming might have increased the performance by altering the mechanism of enzymes which are responsible for enhancing yield attributes and yield thereby (Jamshidian and Talat, 2017).

Essential oil content (%)

It is evident from table 3 and figure 6 that seed priming with KH_2PO_4 has significant effect on essential oil content in coriander seed. The essential oil content (0.28 %) was the highest as recorded with C_2D_3 (seed priming with 2% KH_2PO_4 for 20 hrs) followed by C_2D_2 (0.27 %)and C_2D_1 (0.27 %) whereas the lowest oil content was observed in C_0D_3 (0.23 %).The essential oil content and composition of *C. sativum* can be influenced by cultivation practices, ontogenetic and genetic factors (Msaada *et al.*, 2007; Telci *et al.*, 2006). The essential oil content of coriander in the present study corresponded with the earlier reports obtained by Bandara *et al*. (2000).

The study showed a significant effect of both concentration of seed priming chemical and duration of soaking on germination, growth,yield and quality of coriander. So it may be concluded from the results that to obtain higher germination, seed yield and essential oil of coriander, seeds should be treated with 2% KH_2PO_4 as seed priming chemical for 20 hrs under this Gangetic alluvial region.

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