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Effect of seed priming treatment on cumin [*Cuminum cyminum* (L.)] seed germination and growth

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Abstract

The investigation on the effect of seed priming treatment on cumin [*Cuminum cyminum* (L.)] seed germination and growth was carried out at Seed Technology Laboratory, Department of Genetics and plant breeding, SDAU, Sardarkrushinagar, during Rabi 2019-20. Seeds of Gujarat Cumin-1, Gujarat Cumin-2, Gujarat Cumin-3 and Gujarat Cumin-4 were were treated with five treatments *viz.*, Control, -1.4 MPa PEG, -1.0 MPa PEG, 0.2% KNO_3 and 0.4% KNO_3. The experiment was laid out in a completely randomized design (factorial concept) with three replications comprising five treatment combinations. The combined effect of pre-sowing seed treatment and varieties showed a significant effect on seed germination and growth of the seedling. The variety GC-4 was superior to the variety GC-1, GC-2, and GC-3. The analysis of data collected under laboratory conditions for the variety GC-4 and treatment T3 (-1.0 MPa PEG) combination revealed characteristics such as the highest germination percentage (80.81%), the longest root length (5.20 cm), the longest shoot length (4.61 cm), the longest seedling length (9.59 cm), the highest seedling fresh weight (216.40 mg), the highest seedling dry weight (11.81 mg), the highest seedling vigour index-I (812.47) and the highest seedling vigour index-II (952.70).

Key words: Cumin, pre-sowing treatments, germination, growth.

Introduction

Cumin (*Cuminum cyminum* L.) seed is commonly known as “Jeera” in India. Cumin is considered one of the important seed spices of an annual herbaceous plant. Cumin belongs to the family Apiaceae, a dicotyledonous group and has an origin in the Mediterranean region. Cumin has been grown and used as a spice since ancient times and is mentioned in the Sacred Bible. Cumin is an essential ingredient in many mixed spices, chutney and curry powder. In the Middle East, it is a familiar spice as flavour over meat and vegetables in Europe.

Cumin seed and oil are used in culinary preparations for flavouring vegetables, pickles, soup, sauces, cheese, bread, cakes, and biscuits. It enjoyed a major role as a flavouring spice and was of medicinal value throughout history. Cumin is used mainly where highly spiced foods are preferred. It is also valued for its typical pleasant aroma from its volatile or essential oil (2.3 to 4.8%). Apart from its culinary value, cumin is also extensively used in Ayurvedic medicines. Traditionally, it has been used in natural remedies and herbal medicine. It is useful as a diuretic to settle the stomach and stop flatulence. The nutritional value of cumin seeds is as follows: 17.7% protein, 23.8% fat, 35.5% carbohydrate and 7.7% minerals (Anonymous, 2015).

However, the production and productivity of cumin are decreasing year after year due to many reasons. Non-availability of good quality seed, slow and uneven seed germination, a low adaptation of seed production technologies, degradation of quality due to microbial load, a heavy infestation of diseases and pests, traditional harvesting and processing, unscientific and unhygienic handling post-harvest storage are the major problem in realizing the production potential of cumin. Poor germination value of seeds directly affects the establishment of plant population and causes diseases in the field conditions leading to poor seed yield in cumin (Mahajan *et al.,* 2013).

Hence, seed treatment is one of the methods adopted for quality seed production as it not only reduces the deleterious effects of damage to seed viability and vigour but also provides better avenues for the establishment, growth and development of seedlings. Various seed enhancement priming treatments before sowing have also been devised to improve the rate and uniform seed germination as well as vigour in several crop species.

This study examines how seed priming affects cumin seed germination and growth in Gujarat cumin varieties. The study analyses the best pre-sowing seed treatment and variety combination to maximise germination percentage, root and shoot length, seedling dimensions, and vigour indices to improve cumin cultivation.

Materials and methods

The experiment was conducted at Seed Technology Laboratory, Department of Genetics and Plant Breeding, SDAU, Sardarkrushinagar. Four varieties were taken under consideration, *viz.*, Gujarat Cumin-1, Gujarat Cumin-2, Gujarat Cumin-3 and Gujarat Cumin-4 were obtained from the Centre for Seed Spices Research Station, SDAU, Jagudan, Gujarat. The seeds were treated with five treatments *viz.*, Control, -1.4 MPa PEG, -1.0 MPa

PEG, 0.2% KNO_3 and 0.4% KNO_3 and kept for germination. Five normal seedlings were randomly selected from each replication and observations were recorded for germination percentage, root length (cm), shoot length (cm), seedling length (cm), seedling fresh weight (mg), seedling dry weight (mg), vigour index-I, vigour index-II. The vigour index was calculated using the procedure suggested by Abdul- Baki and Anderson (1973).

Vigour index-I = Germination (%) x Seedling length (cm)
Vigour index-II = Germination (%) x Seedling dry weight. (mg)

The data obtained from various observations were analyzed by using a Factorial Completely Randomized Design (FCRD).

Results and discussion

The final germination count was considered as germination percent and recorded on the 14^{th} day. The highest germination percent was noticed in variety V_4 (70.63 %) and it was at par with the variety V_3 (69.98 %) as compared to the mean performance of the rest of the varieties (Table 1). Among all the treatment's means, high germination percent was found in T_3 when -1.0 MPa PEG (75.53 %) compared to the rest of the treatments. The interaction between varieties and treatments has shown a significant variation. The highest germination percentage was recorded by the variety V_4 and treatment T_3 combination (80.81 %) and the lowest in V_1T_1 (60.14 %) which was at par with V_4T_1 (60.63) followed by V_2T_1 (62.06) as compared to the rest of the other interactions. The results confirmed the reports of Rahimi *et al.* (2013) in cumin, Jat *et al.* (2015) in cluster bean, Sohail *et al.* (2018) in chickpea, Arunkumar *et al.* (2019) in spice crop, Ghiyasi *et al.* (2019) in black cumin, Mirmazloum *et al.* (2020) in *Carum carvi,* Nomkhosi et al. (2021) in okra and Uddin *et al.* (2021) in mung bean.

The investigation unveiled notable variations in root length, with the maximum observed in variety V4 (GC-4) subjected to treatment T3 (-1.0 MPa PEG) at 5.20 cm, surpassing other combinations, including V3T3 (5.15 cm), V2T3 (5.03 cm), and V1T3 (4.99 cm). Treatment T3 alone demonstrated the highest root length (5.09 cm), while variety V4 showed a commendable 4.17 cm, at par with V3 (4.10 cm) among varieties. These findings align with existing studies on cumin (Rahimi *et al.*, 2013), cluster bean (Jat *et al.*, 2015), chickpea (Sohail *et al.*, 2017), and mung bean (Uddin *et al.*, 2021), corroborating the positive impact

Table 1. Effect of pre-sowing seed treatments on seedling characters

Variety	Germination (%)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh Weight (mg)	Seedling dry Weight (mg)	Seedling vigour index-I	Seedling vigour index-II
V_1	66.50	4.00	3.16	7.13	153.28	9.80	484.95	655.33
V_2	67.78	4.02	3.22	7.24	155.57	10.02	501.22	681.66
V_3	69.98	4.10	3.34	7.40	163.80	10.27	534.43	724.32
V_4	70.63	4.17	3.52	7.62	167.38	10.42	558.41	742.52
SEm±	0.51	0.03	0.03	0.03	0.98	0.04	5.71	9.24
CD 5%	1.48	0.11	0.09	0.08	2.81	0.12	16.34	26.95
Treatment								
T_1	62.06	3.13	2.29	5.36	130.88	9.02	337.67	560.33
T_2	71.52	4.63	3.75	8.38	178.72	11.01	601.89	786.95
T_3	75.53	5.09	4.35	9.42	206.27	11.71	732.54	884.82
T_4	66.75	3.57	2.88	6.42	133.72	9.59	438.35	642.40
T_5	67.76	3.92	3.28	7.27	150.44	9.30	488.51	630.30
SEm±	0.57	0.04	0.03	0.03	1.09	0.04	6.39	10.54
CD 5%	1.65	0.12	0.11	0.09	3.14	0.13	18.27	30.13
Interaction								
V_1T_1	60.14	3.21	2.23	5.44	130.17	8.71	326.88	521.47
V_1T_2	66.47	4.31	3.60	7.93	172.60	10.49	536.18	695.50
V_1T_3	73.47	4.99	4.07	9.00	193.50	11.64	676.76	854.90
V_1T_4	64.33	3.67	2.71	6.29	136.26	9.21	432.94	596.10
V_1T_5	68.00	3.81	3.18	7.00	133.86	8.95	451.04	608.70
V_2T_1	62.06	3.02	2.26	5.30	125.58	8.96	329.84	554.17
V_2T_2	70.96	4.61	3.76	8.37	172.76	10.81	586.15	768.84
V_2T_3	71.73	5.03	4.23	9.12	200.87	11.62	688.58	831.33
V_2T_4	66.33	3.59	2.80	6.37	128.58	9.54	433.57	630.33
V_2T_5	67.66	3.83	3.05	7.02	150.05	9.18	469.67	623.62
V_3T_1	65.40	3.09	2.30	5.29	131.74	9.15	354.34	605.88
V_3T_2	72.65	4.81	3.61	8.48	182.35	11.25	617.86	811.19
V_3T_3	76.10	5.15	4.51	9.56	241.34	11.79	752.35	900.34
V_3T_4	66.00	3.50	2.96	6.35	133.28	9.67	447.97	644.98
V_3T_5	69.76	3.97	3.33	7.35	157.31	9.48	499.64	659.23
V_4T_1	60.63	3.21	2.36	5.42	136.03	9.27	339.60	559.81
V_4T_2	76.02	4.81	4.01	8.74	187.18	11.48	667.36	872.28
V_4T_3	80.81	5.20	4.61	9.59	216.40	11.81	812.47	952.70
V_4T_4	70.33	3.54	3.07	6.65	136.75	9.93	438.93	698.18
V_4T_5	65.37	4.07	3.58	7.73	160.55	9.59	533.69	629.63
GM	68.72	4.07	3.31	7.34	160.00	10.12	519.79	700.95
SEm±	1.15	0.08	0.07	0.06	2.19	0.09	12.78	21.08
CD 5%	3.31	0.25	0.22	0.19	6.28	0.27	36.54	60.26
CV%	2.91%	3.76%	4.03%	1.64%	2.38%	1.61%	4.26%	5.20%

of seed priming. Regarding shoot length, V4 maintained the highest (3.52 cm), whereas V1 exhibited the lowest (3.16 cm), in agreement with previous studies. Treatment T3 demonstrated the maximum shoot length (4.35 cm) compared to other treatments.

Seedling length exhibited superior values in variety V4 (7.62 cm) and treatment T3 (9.42 cm) compared to other treatments. The combination of V4 and T3 (9.59 cm) produced the highest seedling length, consistent with findings in cumin, cluster bean, chickpea, and mung bean. The highest seedling fresh weight was recorded in V4 (167.38 mg), while the lowest was in V1 (153.28 mg), aligning with the trend observed in variety V2 (155.57 mg). Treatment T3 demonstrated the highest mean seedling fresh weight (206.27 mg), emphasizing its effectiveness. Notably, the V4 and T3 combination (216.40 mg) outperformed other combinations (V3T3 at 214.34 mg).

Analysis of seedling dry weights showcased V4 (10.42 mg) and T3 (11.71 mg) as superior, with significant variations in the interaction between treatments and varieties. The V4 and T3 combination (11.81 mg) displayed superiority in seedling dry weight, consistent with studies in maize, rice, cucumber (Reza and Mehdi, 2012), cluster bean (Jat *et al.*, 2015), and chickpea (Sohail *et al.*, 2017).

Seedling vigour indices-I and II reached their highest values in V4 (558.41 and 742.52, respectively) and T3 (732.54 and 884.82, respectively). The V4 and T3 combination exhibited the maximum seedling vigour indices (812.47 for index-I and 952.70 for index-II), emphasizing their synergistic effect. Similar trends were reported in cumin (Rahimi *et al.*, 2013), cluster bean (Jat *et al.*, 2015), and mung bean (Uddin *et al.*, 2021).

The study highlights the efficacy of -1.0 MPa PEG seed priming, particularly in conjunction with variety GC-4, in significantly improving key germination and growth parameters in cumin. The consistent superior performance of GC-4 across various metrics underscores the potential for enhancing cumin crop cultivation through targeted seed treatment. These findings contribute valuable insights to seed technology, emphasizing the practical benefits of pre-sowing treatments for optimizing cumin cultivation practices.

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