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IMPACT OF SEED PRIMING WITH CHEMICALS ON SEED QUALITY OF CHICKPEA (*Cicer arietinum* L.)

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ABSTRACT

The present experiment was conducted to know the impact of seed priming with chemicals on seed quality of chickpea, by subjecting seed of chickpea to various priming treatments *viz*., hydration, hydration followed by seed primed with 2% KH_2PO_4, 2% $CaCl_2$ and 100 ppm GA_3 for9 hours followed by shade drying to bring back its original moisture content. The primed seed along with untreated seed (control or check) was tested for seed quality parameters. Among priming treatments, seeds primed with GA_3 showed significantly higher seed quality parameters over other treatments. Among the genotypes, NBeG-452 was found to be superior over NBeG-119 in seed quality parameters. Among interactions, G_1T_5 (seed of NBeG-452 primed with 100 ppm of GA_3) showed significantly higher seed quality parameters like shoot length, root length, seedling length, seedling vigour index and field emergence over other interactions.

KEYWORDS: Gibberillic acid, NBeG-452, Priming, Seed quality parameters.

INTRODUCTION

Chickpea is a highly nutritious pulse crop and its seed is the main edible part of the plant, which is having a rich source of protein (23.3-28.9%), carbohydrate (52.0-70.0%), fat (4.0-10.0%), minerals (phosphorus, calcium, magnesium, iron and zinc) and vitamins. Globally, it is grown in an area of 137 lakh hectares with a production of 142.4 lakh tonnes and productivity of 1038 kg ha^{-1} (FAO STAT, 2019). Among the pulses, the chickpea occupies a predominant position in the country so it is known as the king of pulses. In India, chickpea takes first place in total pulse production followed by black gram with an area of 112 lakh hectares, production of 116.2 lakh tonnes and productivity of 1036 kg ha^{-1} (agricoop.nic.in, 2020-21). In Andhra Pradesh, it is grown in an area of 4.65 lakh hectares, with an annual production of 5.66 lakh tonnes and productivity of 1218 kg ha^{-1} (Third Advance Estimates, 2020-21, DES-AP).

Seed priming is an easy and suitable method to enhance seed quality, crop stand establishment in the field. It is a process of controlled hydration to such a level, that permits pre- germinative metabolic activity to proceed, but prevents the actual emergence of the radicle within the seed. Pre-sowing soaking of seed leads to increased tissue hydration, improve respiratory activity and redistribution of nutrients, stimulation of seedling growth and development. The virtue of different priming agents varies under different stresses and in different crop species (Ashraf and Foolad, 2005). Seed priming is a low-risk technology, which is easily adopted by resource poor farmers. It improves the yield of the crop in marginal areas by a combination of better crop establishment and enhancing the individual plant performance.

Keeping these in view, the present study was conducted to know the impact of seed priming with chemicals on seed quality of chickpea.

MATERIAL AND METHODS

The present experiment was conducted during 2021-2022 in a factorial completely randomized design with four replications at Agricultural Research Station, Jangamaheswarapuram, Guntur. Freshly harvested seeds of chickpea genotypes Desi (NBeG-452) and Kabuli (NBeG-119) type were collected from Regional Agricultural Research Station, Nandyal, Kurnool (dist). Seeds of chickpea genotypes were subjected to various priming treatments viz., hydration, hydration followed by seed priming with 2% KH_2PO_4, 2% CaCl2 and 100 ppm GA3 for 9 hours. After the priming duration, primed seed were shade dried to bring back to their original moisture content.

2% of KH_2PO_4 and $CaCl_2$ solutions were prepared by dissolving 20 g of respective chemicals in 1 litre of distilled water. 100 ppm of GA_3 was prepared by dissolving 100 mg of GA_3 in 10 mL of ethyl alcohol and making up the final volume to 1 litre using distilled water.

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Soaking of seed with their respective chemical solutions using 1:5 seed weight to solution volume (w/v) ratio for 9 hours. Primed seeds were dried back to their original moisture content under the shade at room temperature. Along with the primed seed, un-primed seeds (control) were used for evaluation of seed quality by germination test.

Seed quality testing

Four replicates of 100 seeds from each treatment were placed at a uniform spacing in between two wetted germination paper towels. The paper towels were rolled, secured with rubber bands on both sides and kept in plastic trays in an upright position and the trays were incubated in the germinator at 25 ± 2 °C and 95% RH for 8 days. Data on germination and other seed quality parameters were recorded after 8 days of the test period as detailed below:

The number of normal seedlings was counted and expressed as germination (%) as per the formula:

Germination (%) =

$$\frac{\text{Number of normal seedlings}}{\text{Total number of seed sown}} \times 100$$

The root length, shoot length and seedling length was determined by randomly selecting ten normal seedlings in each treatment and each replication at the end of the germination count and expressed in centimeters. The root length was measured from the tip of the primary root to the base of the hypocotyl. Shoot length was measured from the tip of the primary leaf to the base of the hypocotyl. The seedling length was calculated by adding root and shoot lengths.

Seedling vigour index was computed by adopting the following formula as suggested by Abdul- Baki and Anderson (1973) and was expressed in whole number:

Seedling vigour index =

Germination (%) × Seedling length (cm)

Field emergence (%): One hundred seed from each treatment in each replication were counted and sown in well prepared soil at 3 cm depth. The field emergence was recorded on the 15th day after sowing and the field emergence percentage was calculated as per the formula:

Field emergence (%) =

$$\frac{\text{Number of seedlings emerged}}{\text{Total number of seed sown}} \times 100$$

Statistical analysis

The data were subjected to Analysis of Variance (ANOVA) by using SPSS software (version 16.0) at 1% and 5% level of significance.

RESULTS AND DISCUSSION

Seed Quality Parameters

Observations were recorded on various seed quality parameters after priming *viz*., germination, root length, shoot length, seedling length and seedling vigour index. Seed quality parameters were analyzed statistically and presented below with available literature:

Germination (%)

Seed priming showed a significant effect on germination percentage in genotype and treatment but it was not observed in genotype × treatment interaction (Table 2). The genotypes NBeG-452 and NBeG-119 recorded 89.95 and 55.7 per cent mean germination, respectively. The mean germination of treatments ranged from 67.5 to 77.0 per cent. The treatment T_5 was found highest mean germination over all the treatments while the least mean germination was observed in T_1 (67.5%). The treatments T_5 and T_4 recorded germination greater than the overall mean germination (72.25%). The treatment T_2 (72.25%) was slightly lower than T_3 (72.75%) but statistically on par with each other.

Improvement in germination with GA_3 was reported earlier in green gram (Ganesh *et al*., 2013), mung bean (Tiwari *et al*., 2015), bitter gourd (Islam *et al*., 2012) and mung bean (Sivakumar and Nandhita, 2017).

Root length (cm)

The genotype and treatment as well as genotype x treatment interaction in root length (cm) exhibited significant differences (Table 2). Among the two genotypes, NBeG-452 and NBeG-119 had a mean value of root length of 9.95 and 6.74 cm, respectively. The mean value of root length of treatments ranged from 7.63 to 9.13 cm with an overall mean of 8.34 cm. The treatment T_5 recorded the highest mean value (9.13 cm) followed by T_3 (8.91 cm), T_4 (8.16 cm), T_1 (7.90 cm) and T_2 (7.63 cm). Out of five treatments, two treatments (T_5 and T_3) exceeded the grand mean value of root length

Table 1. Mean sum of squares for seed quality traits in chickpea as affected by seed priming

Source	D.f	Germination (%)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling vigor index I	Field emergence (%)
Genotype	1	5,531.67**	103.39**	11.64**	181.86**	8938322**	174.60**
Treatment	4	54.50**	3.37**	42.91**	67.97**	663701.3**	123.70**
Genotype × Treatment	4	5.09NS	6.35**	11.63**	31.64**	296934.8**	8.16*
Error	30	5.21	0.15	0.20	0.26	4600.02	2.79

*, ** Significant difference at 5% and 1% level, respectively

Table 2. Effect of seed priming on seed quality of chickpea genotypes

Treatment	Germination (%)			Root length (cm)			Shoot length (cm)			Seedling length (cm)			Seedling vigor index I			Field emergence (%)		
	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean
T_1	84.25 (66.66)	50.75 (45.43)	**67.5 (56.05)**	8.38	7.41	**7.90**	6.42	7.97	**7.19**	14.80	15.38	**15.09**	1245.82	780.92	**1013.37**	82.25 (65.10)	72.75 (58.56)	**77.50 (61.83)**
T_2	89.75 (71.52)	54.75 (47.73)	**72.25 (59.63)**	8.52	6.73	**7.63**	8.01	7.96	**7.98**	16.52	14.69	**15.61**	1483.61	806.35	**1144.98**	86 (68.06)	81 (64.18)	**83.50 (66.12)**
T_3	91.25 (72.94)	54.25 (47.44)	**72.75 (60.19)**	10.78	7.04	**8.91**	10.00	10.36	**10.18**	20.88	17.39	**19.14**	1897.20	943.10	**1420.15**	86.75 (68.68)	79.25 (62.92)	**83.00 (65.80)**
T_4	91 (72.61)	58.25 (49.76)	**74.63 (61.18)**	10.34	5.99	**8.16**	12.70	9.41	**11.05**	23.04	15.40	**19.22**	2154.05	931.23	**1542.64**	89.25 (70.88)	87.5 (69.38)	**88.38 (70.13)**
T_5	93.5 (75.28)	60.5 (51.07)	**77.00 (63.17)**	11.74	6.51	**9.13**	14.89	10.93	**12.91**	26.63	17.69	**22.16**	2422.93	1014.88	**1718.90**	91.75 (73.41)	88.5 (70.22)	**90.13 (71.82)**
Mean	**89.95 (71.81)**	**55.7 (48.29)**	**72.83 (60.05)**	**9.95**	**6.74**	**8.34**	**10.40**	**9.32**	**9.86**	**20.37**	**16.11**	**18.24**	**1840.72**	**895.25**	**1368.01**	**87.20 (69.23)**	**81.80 (65.05)**	**84.50 (67.14)**
	G	**T**	**G × T**	**G**	**T**	**G × T**	**G**	**T**	**G × T**	**G**	**T**	**G × T**	**G**	**T**	**G × T**	**G**	**T**	**G × T**
S Em ±	0.51	0.81	1.14	0.09	0.14	0.19	0.10	0.16	0.22	0.12	0.18	0.26	15.17	23.98	33.91	**0.37**	**0.59**	**0.84**
CD (5%)	1.48	2.34	NS	0.25	0.40	0.56	0.29	0.46	0.65	0.33	0.53	0.74	44.01	69.59	98.42	1.08	1.71	2.42
CV (%)		3.80			4.66			4.54			2.81			4.96			2.49	

G_1 : NBeG-452 (Desi)
G_2 : NBeG-119 (Kabuli)

T_1 : Control
T_2 : Hydro priming
T_3 : Seed primed with 2% of KH_2PO_4
T_4 : Seed primed with 2% of $CaCl_2$
T_5 : Seed primed with 100 ppm of GA_3

(8.34 cm). The treatment T_2 (7.63 cm) was slightly lower than T1 (7.90 cm) but statistically on par with each other. In case of genotype x treatment interaction G_1T_5 recorded a significantly higher root length (11.74 cm) over the other interactions along with hydro- priming and control.

An increase in root length of seedlings with GA_3 was earlier observed in seeds of chilli, coriander (Debbarma *et al*., 2017), bitter gourd (Debbarma *et al*., 2018) and black gram (Dheeba *et al*., 2015).

Shoot length (cm)

For the trait shoot length, the genotype, treatment and genotype x treatment interaction showed a significant effect on seeds of chickpea with priming agents (Table 2). The mean shoot lengths of NBeG-452 and NBeG-119 were recorded as 10.4 and 9.32 cm, respectively. Among treatments, the shoot length had a mean value of 9.86 cm with a minimum length of 7.19 cm (T_1) and a maximum length of 12.91 cm (T_5). Three treatments (T_3, T_4 and T_5) recorded greater shoot length compared to an overall mean of the treatments (9.86 cm). The G_1T_5 interaction recorded a significantly higher shoot length (14.89 cm) over all the interactions.

Similar results were also reported by Chaturvedi *et al.* (2017) noticed an increase in shoot length in wheat by priming with GA_3. The increased shoot length is due to increased cell division within the apical meristem (Farooq *et al.,* 2008) and an early emergence was induced by the priming of seeds (Vishwas *et al.,* 2017).

Seedling length (cm)

The genotype, treatment and genotype x treatment interaction showed significant influence on the seedling length of chickpea by priming method (Table 2). Out of two genotypes, NBeG-452 exhibited maximum seedling length (20.37 cm) whereas minimum seedling length was recorded with NBeG-119 (16.11 cm). The mean value of treatments in seedling length ranged from 15.09 cm (T_1) to 22.16 cm (T_5). The overall mean of treatments (18.24 cm), was exceeded by three treatments (T_3, T_4 and T_5). The treatment T_3 (19.14 cm) was slightly lower than T_4 (19.22 cm) but statistically on par with each other. Among interactions, G_1T_5 showed a significantly higher seedling length (26.63 cm) followed by G_1T_4 (23.04 cm) and G_1T_3 (20.88 cm).

Enhancement of growth parameters might be the result of exogenous application of plant growth regulators through seed priming which improves the seed quality parameters by enhancing the process of cell division, cell enlargement and activation of several enzymes which are involved in the germination process. Similar results were reported earlier in wheat (Iqbal and Ashraf, 2007), mung bean (Tiwari *et al*., 2013) and chickpea (Rashid *et al*., 2004).

Seedling vigour index I

Significant difference was observed in genotype, treatment and genotype x treatment interaction of seedling vigour index on seeds of chickpea with priming agents (Table 2). The general mean value of genotypes NBeG-452 and NBeG-119 were 1840.72 and 895.25, respectively. The mean seedling vigour index of treatments ranged from 1013.37 (T_1) to 1718.90 (T_5) with an overall mean of 1368.01. Out of five treatments, T5 recorded the highest mean seedling vigour index (1718.90) followed by T_4 (1542.64), T_3 (1420.15) and T_2 (1144.98). While the lowest mean seedling vigour index was recorded with T_1 (1013.37). In case of genotype x treatment interaction G_1T_5 recorded a significantly higher seedling vigour index (2422.93) over the other interactions along with hydro-priming and control. Among ten genotype treatment interactions G_1T_5, G_1T_4 and G_1T_3 exceeded the mean interaction.

Improvement in growth parameters including vigour of seed might be the result of the application of GA3 through seed priming which could enhance the seed quality parameters during the seedling stage by enhancing the process of cell enlargement, cell division and activation of several enzymes involved in the germination process (Tiwari *et al*., 2015). Similar results were also observed in green gram (Ganesh *et al*., 2013), bitter gourd (Islam *et al*., 2012) and mung bean (Sivakumar and Nandhita, 2017).

Field emergence (%)

Significant effect was observed in genotype, treatment and genotype x treatment interaction in the trait of field emergence (%) (Table 4.3). The genotypes NBeG-452 and NBeG-119 were recorded at 87.2 and 81.80 percent mean field emergence, respectively. The treatments T4 and T5 recorded field emergence greater than the overall mean field emergence (84.5%). The treatment T_3 (83%) was slightly lower than T_2 (83.5%) but statistically on par with each other. Based on the mean performance of five treatments, the treatments

T_5, T_4, T_2, T_3 and T_1 recorded the highest per se performance in descending order for field emergence. In case of genotype x treatment interaction G_1T_5 recorded significantly higher field emergence (91.75%) over the other interactions along with hydro-priming and control. Out of ten interactions, six interactions G_1T_5, G_1T_4, G_2T_5, G_2T4, G_1T_3 and G_1T_2 were found to be higher field emergence than the overall mean of treatment interaction (84.5%).

Seed primed with GA_3 recorded higher field emergence these results were earlier found in green gram and mung bean by Devi *et al*. (2021) and Tiwari *et al*. (2015), respectively.

Among the various priming chemicals used in the present study, seeds primed with GA_3 showed significantly higher seed quality parameters like germination, root length, shoot length, seedling length and seedling vigour index over other treatments. In case of genotypes, NBeG-452 (Desi) recorded a better performance in seed quality than NBeG-119 (Kabuli). Among interactions, G_1T_5 recorded significantly superior seed quality parameters like shoot length, root length, seedling length and seedling vigour index over other interactions.

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