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Effect of seed priming on chickpea (*Cicer arietinum* L.)

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Abstract
Chickpea botanically (*Cicer arietinum* L.) a member of fabaceae family, which is a self-pollinated crop. The present investigation entitled "Effect of seed priming on chickpea (*Cicer arietinum* L.)" was carried out during the year 2020-21. The laboretory experiment was conducted in Bioscience Research Centre, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during 2020, while field experiment was conducted at Centre for Crop Improvement, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, during *rabi* season 2020-2021, to find out the best priming method for both chickpea varieties GJG-3 and KAK-2 (Desi & Kabuli). Eight seed priming treatments with different chemicals *viz*., T_1 (no-treated seed), T_2 (Hydro-priming) for 12 hrs, T_3 (PEG 5%) for 12 hrs, T_4 (PEG 10%) for 12 hrs, T_5 (PEG 15%) for 12 hrs, T_6 (AMT 0.25%) for 12 hrs, AMT (0.50%) (T_7) for 12 hrs and AMT (0.75%) (T_8) for 12 hrs. It was found that, seed primed with Hydro-priming, AMT 0.25%, PEG 10% for 12 hrs was best treatment which enhanced the seed quality parameters and seed yield attributes *viz.* germination percentage, shoot length (cm), root length (cm), fresh weight of seedling (mg), dry weight of seedling (mg), mean seedling length (cm), seedling vigour index-I and II, mean emergence time, days to flowering, days to maturity, plant height, number of branches per plant, number of pods per plant, seed yield per plant, 100-seed weight and protein content. This study helps to improve the seedling character, growth and seed yield with the help of seed priming treatments which are effective, economic, non-toxic and eco-friendly sources.

Keywords: Chickpea (Desi & Kabuli), priming methods, characters, treatments

Introduction
Pulses are the wonderful gift of nature plays an important role in both Indian economy and diet (Jat *et al.*, 2012) [7]. Among the pulses chickpea (*Cicer arietinum* L.) is having vital role in the diet of rural and urban masses. Chickpea is important food legumes for production worldwide. It is one of the most extensively grown *rabi* pulse crop in India. Chickpea (*Cicer arietinum* L.) a member of Fabaceae, is a self-pollinated true diploid (2n = 2x = 16) with genome size of 738 Mbp. It is an ancient cool season food legume crop cultivated by man and has been found in Middle Eastern archaeological sites dated 7500–6800 BC. Its cultivation is mainly concentrated in semiarid environments. Chickpea is the second most important food legume crop after common bean. It is grown in more than 50 countries on an area of 13.2 m ha, producing approximately 11.62 m tonnes annually. India ranks first in the world's production and area by contributing around 70.7 % to the world's total production. In India, the area under chickpea was 10.76 million hectares with a production of 11.16 million tones and productivity of 1037 kg/ha during *rabi* 2017-18. In Gujarat, area under chickpea was 0.293 million hectares with a total production of 0.367 million tones and productivity of 1253 kg/ha during 2017-18. It is one of the most important food legume plants in sustainable agriculture system because of its low production cost, wider adaptation, ability to fix atmospheric nitrogen and fix in various crop rotations and presence of prolific tap root system.

Chickpea is classified based on seed size, shape and colour. Two main types of chickpea cultivars grown globally are kabuli and desi, representing two diverse gene pools. Where, white seeded 'kabuli chickpea' being grown in Northern parts and brown seeded 'Desi' type grown in Southern parts of India. Chickpea contain 20% protein, 4.8% fat, 9.1% crude fiber, 1.37% lysine, 195-205 mg/g carotene, 89 - 94 mg/g Ca and 9.2 - 9.4 mg/g Fe. Also, it is an important crop for both human consumption and animal feed due to 17 - 31% protein in seeds and biological activity of its protein ranges between 52 - 78%.

In seed priming, seeds are soaked in different solutions with high osmotic potential (Ghobadi *et al*., 2012) [6]. This technique has become a common seed treatment that can increase rate, percentage and uniformity of germination or seedling emergence, mainly under unfavorable environmental conditions.

Rapid seed germination and stand establishment are critical factors for crop production under stress conditions.

Materials and Methods

The present investigation entitled "Effect of seed priming on chickpea (*Cicer arietinum* L.)" was carried out during the year 2020-21. The laboretory experiment was conducted in Bioscience Research Centre, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during 2020, while field experiment was conducted at Centre for Crop Improvement, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, during *rabi* season 2020-2021, in order to find out the best priming method for both chickpea varieties GJG-3 and KAK-2 (Desi & Kabuli). T_1 (no-treated seed), T_2 (Hydro-priming) for 12 hrs, T_3 (PEG 5%) for 12 hrs, T_4 (PEG 10%) for 12 hrs, T_5 (PEG 15%) for 12 hrs, T_6 (AMT 0.25%) for 12 hrs, AMT (0.50%) (T_7) for 12 hrs and AMT (0.75%) (T_8) for 12 hrs are used to find best priming treatment for chickpea (Desi & Kabuli), seeds were placed on paper towel (Between paper Method for germination percentage.

Seed quality parameters

For seed quality assessment germination test was conducted using the between paper method at 20 °C, by providing the optimum conditions. The germination counts was made on normal seedlings and expressed in per cent. Vigour indices were computed by adopting the following formula as suggested by Abdul and Baki (1973) [1] and expressed in number. Vigour Index I = Germination (%) X Seedling length (cm) Vigour Index II = Germination (%) X Seedling dry weight (mg). Mean emergence time was counted by the procedure of Ellis and Roberts (1981) [5] MET= $\Sigma Dn/\Sigma n$.

Seed yield and yield attributing characteristics

Days to flowering, Days to maturity, Plant height (cm), Number of branches per plant, Number of pods per plant, Seed yield per plant (g), 100-seed weight (g) and Protein content (%) of each treatment and replication were recorded at maturity.

Result and Discussion

It is evident from the present investigation that different types of treatments *viz*., T_1 (no-treated seed), T_2 (Hydro-priming) for 12 hrs, T_3 (PEG 5%) for 12 hrs, T_4 (PEG 10%) for 12 hrs, T_5 (PEG 15%) for 12 hrs, T_6 (AMT 0.25%) for 12 hrs, AMT (0.50%) (T_7) for 12 hrs and AMT (0.75%) (T_8) for 12 hrs. Have differential positive effect on the seed quality parameters and Seed Yield and yield attributing character for both the varieties of chickpea.

Seed quality parameters

GJG-3 variety (V_1) seed priming treatments, seeds primed with hydro-priming (T_2) increased the germination percentage, dry weight of seedling, fresh weight of seedling, seedling vigour index-I and seedling vigour index-II. The shoot length, root length, and mean seedling length increased and mean emergence time also better result with AMT (0.25%) (T_6).

In KAK-2 variety (V_2) seeds primed with hydro-priming (T_2) increased the germination percentage, shoot length, root length, mean seedling length and seedling vigour index-I. The variety KAK-2 also showed maximum fresh weight of seedling, dry weight of seedling, and seedling vigour index-II as well as minimum mean emergence time also better result with PEG-6000 (10%) (T_4) for 12 hrs.

The results of the characters like germination percentage, shoot length, root length, fresh weight of seedling, dry weight of seedling, mean seedling length, seedling vigour index I and II were in accordance with Choudhary *et al.* (2008) [4] in chickpea, Saglam *et al.* (2010) [14] in lentil, Sadeghi *et al.* (2011) [13] and Arif *et al.* (2014) [2] in soyabean, Singh *et al.* (2014) [9] in cowpea, Sori, A. (2014) [10] and Chandra *et al.* (2019) [3] in chickpea, AlSalhy and Rasheed (2020) [15] in mungbean.

Table 1: Effect of seed priming treatments on variety GJG-3 (V_1) on germination(%), shoot length (cm), root length (cm), fresh weight of seedlings (mg), dry weight of seedling (mg), mean seedling length (cm), seedling vigour index-I, seedling vigour index –II, mean emergence time

Sr. no.	Treatment	Germination percentage (%)	Shoot length (cm)	Root length (cm)	Fresh weight of seedling (mg)	Dry weight of seedling (mg)	Mean seedling length (cm)	Seedling vigour index I	Seedling vigour index II	Mean emergence time (MET)
1	T_1 (no-treated seed)	84.17	19.38	13.14	1.06	0.20	32.51	2735.78	16.95	5.13
2	T_2 (Hydro-priming)	96.67	18.00	16.47	1.17	0.29	34.47	3332.73	28.13	4.91
3	T_3 (PEG 5%)	75.00	17.48	13.70	1.11	0.25	31.18	2335.90	18.99	5.19
4	T_4 (PEG 10%)	94.17	17.38	14.10	1.13	0.25	31.48	2964.67	23.44	4.99
5	T_5 (PEG 15%)	78.33	15.98	13.28	1.09	0.24	29.25	2285.44	19.18	5.00
6	T_6 (AMT 0.25%)	87.50	20.10	17.35	1.24	0.28	37.45	3278.00	24.89	4.87
MEAN		85.97	18.05	14.67	1.13	0.25	32.72	2822.09	21.93	5.02
C.V. %		4.07	4.53	5.04	4.63	4.13	3.64	4.63	5.62	5.48
S.Em±		1.71	0.36	0.32	0.03	0.01	0.52	57.89	0.72	0.14
C.D.5%		4.91	1.03	0.93	0.09	0.02	1.50	166.03	2.06	0.41

Table 2: Effect of seed priming treatments on variety KAK-2(V_2) on germination(%), shoot length (cm), root length (cm), fresh weight of seedlings (mg), dry weight of seedling (mg), mean seedling length (cm), seedling vigour index-I, seedling vigour index –II, mean emergence time

Sr. no.	Treatment	Germination percentage (%)	Shoot length (cm)	Root length (cm)	Fresh weight of seedling (mg)	Dry weight of seedling (mg)	Mean seedling length (cm)	Seedling vigour index I	Seedling vigour index II	Mean emergence time (MET)
1	T_1 (no-treated seed)	91.67	15.13	11.83	1.63	0.34	26.95	2469.20	31.22	5.51
2	T_2 (Hydro-priming)	97.50	15.78	14.73	1.70	0.37	30.50	2972.83	35.81	5.43
3	T_3 (PEG 5%)	89.17	15.00	11.13	1.56	0.32	26.13	2328.36	28.75	5.31
4	T_4 (PEG 10%)	94.17	14.68	13.38	1.73	0.39	28.05	2640.12	36.53	5.18
5	T_5 (PEG 15%)	90.83	13.90	11.88	1.52	0.36	25.78	2340.47	32.79	5.24
6	T_6 (AMT 0.25%)	30.83	6.85	3.63	1.22	0.34	10.48	324.66	10.43	6.17
MEAN		82.36	13.56	11.10	1.56	0.35	24.65	2179.27	29.26	5.47
C.V. %		4.07	4.53	5.04	4.63	4.13	3.64	4.63	5.62	5.48
S.Em±		1.71	0.36	0.32	0.03	0.01	0.52	57.89	0.72	0.14
C.D.5%		4.91	1.03	0.93	0.09	0.02	1.50	166.03	2.06	0.41

Seed Yield and yield attributing character

In GJG-3 variety (V_1), the highest seed yield per plant and 100-seed weight was recorded by seed priming treatment AMT (0.25%) (T_6) for 12 hrs. The seed treatment with PEG-6000 (10%) (T_4) also showed maximum number of pods per plant. Maximum number of branches per plant and higher protein content was recorded by the seed treatment with PEG-6000 (15%) (T_5). Seed primed with hydro-priming (T_2), PEG-6000 (15%) (T_5) and AMT (0.25%) (T_6) for 12 hrs also recorded earliness in days to flowering, PEG-6000(5%) (T_3) for 12 hrs recorded earliness in days to maturity.

KAK-2 variety (V_2) seed soaked in PEG-6000(10%) (T_4) for 12 hrs recorded the highest seed yield per plant along with highest number of branches per plant, number of pods per plant, plant height and protein content. The treatment with hydro-priming (T_2) for 12 hrs also recorded better seed yield per plant along with highest 100 seed weight in KAK-2 variety. With respect to earliness in days to flowering and days to maturity.

The characters like days to flowering, days to maturity, plant height, number of branches per plant, number of pods per plant, seed yield per plant, 100-seed weight, protein content % had similar results in accordance with Khan *et al.* (2008) in mungbean, Kaya *et al.* (2010) [8] and Zare *et al.* (2011) [11] in chickpea, Arif *et al.* (2014) [2] in soyabean, Singh *et al.* (2014) [9] in cowpea, Chandra *et al.* (2019) [3] in chickpea.

Table 3: Effect of seed priming treatments on variety GJG-3 (V_1) on days to flowering, days to maturity, plant height (cm), number of branches per plant, number of pods per plant, seed yield per plant (g), 100 seed weight (g), protein content (%)

Sr. no.	Treatment	Days to flowering	Days to maturity	Plant height(cm)	Number of branches per plant	Number of pods per plant	Seed yield per plant(g)	100 seed weight(g)	Protein content (%)
1	T_1 (no-treated seed)	45.00	97.00	52.78	4.00	45.45	12.68	20.89	15.31
2	T_2 (Hydro-priming)	44.75	97.75	52.90	4.40	49.75	15.57	22.21	15.62
3	T_3 (PEG 5%)	45.00	96.25	53.27	4.30	47.95	11.93	21.03	14.95
4	T_4 (PEG 10%)	45.00	96.75	52.87	4.60	57.45	16.60	21.81	15.21
5	T_5 (PEG 15%)	44.75	96.50	54.57	4.65	46.75	15.47	21.62	15.13
6	T_6 (AMT 0.25%)	44.75	97.00	49.33	4.55	50.10	16.65	23.19	14.64
MEAN		44.88	96.88	52.62	4.42	49.58	14.82	21.79	15.14
C.V. %		3.32	2.26	10.85	8.84	9.64	12.74	9.46	2.38
S.Em.±		0.73	1.16	2.51	0.18	1.92	0.69	1.30	0.17
C.D.5%		2.098	3.333	NS	0.521	NS	1.986	3.74	0.484

Table 4: Effect of seed priming treatments on variety KAK-2(V_2) on days to flowering, days to maturity, plant height (cm), number of branches per plant, number of pods per plant, seed yield per plant (g), 100 seed weight (g), protein content (%)

Sr. no.	Treatment	Days to flowering	Days to maturity	Plant height(cm)	Number of branches per plant	Number of pods per plant	Seed yield per plant(g)	100 seed weight(g)	Protein content (%)
1	T_1 (no-treated seed)	42.00	106.25	40.65	3.80	27.15	6.92	34.65	13.02
2	T_2 (Hydro-priming)	42.50	107.00	41.40	3.95	32.50	7.56	37.29	13.17
3	T_3 (PEG 5%)	42.50	107.50	41.55	3.80	28.50	7.04	35.16	12.89
4	T_4 (PEG 10%)	42.00	107.25	44.05	4.05	32.70	7.79	32.98	13.73
5	T_5 (PEG 15%)	42.00	110.00	40.55	3.95	31.50	7.09	31.30	13.52
6	T_6 (AMT 0.25%)	46.50	113.75	31.13	3.13	26.90	4.72	27.75	12.41
MEAN		42.92	108.63	39.89	20.07	29.88	6.85	33.19	13.12
C.V. %		3.32	2.26	10.85	8.84	9.64	12.74	9.46	2.38
S.Em.±		0.73	1.16	2.51	0.18	1.92	0.69	1.30	0.17
C.D.5%		2.098	3.333	NS	0.521	NS	1.986	3.74	0.484

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