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Effect of seed priming with inorganics on growth, yield and physiological parameters of chickpea (*Cicer arietinum* L.) under drought

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Abstract
A field experiment was conducted in the Department of Biological Sciences at SHUATS Allahabad, during Rabi session 2017-2018 to study the "Effect of seed priming with inorganics on growth, yield and physiological parameters of chickpea (*Cicer arietinum* L.) Under drought". The chickpea var. pusa-362 was imposed with seven inorganic seed priming treatments *viz.*, 2% KNO3, 2% NaCl2, 2% CaCl2, 2% KH2PO4, 2% KCl, water soaked for 8 Hours, and control. The treated seeds along with control were evaluated for their morpho-physiological, growth, yield, root parameters and biochemical parameters under laboratory and field conditions. The study revealed that seeds priming techniques with CaCl2 @ 2% recorded highest in plant height (cm), seed yield (g), no. of pods/plant and root parameters of nodules/plant and other biochemical parameters. The increased seed yield in seed priming with CaCl2-2% attributed to increase in the total chlorophyll, chl-a. and chl-b, total chlorophyll content, proline content, relative water content, protein content as compare to control. The treatments of 2% CaCl2 followed by 2% KNO3 were found to be superior for most physiological parameters. Thus this study indicates that seed priming with inorganics modifies the physiological and biochemical nature of seeds so as to get the characters that are favorable for drought tolerance which more with CaCl2-2% as compared to other treatments.

Keywords: Seed priming, CaCl2-2%**,** chickpea, Drought, protein, relative water content, chlorophyll

1. Introduction

Chickpea *(Cicer arietinum* L.) is an important source of protein generally ranges between 20 and 22 %, while a wide range of variation from 12 to 30 % exists in chickpea germplasm (Jadhav *et al.*, 2015) [12]**.** The chromosome number of chickpea consists of 2n=16 and self-pollinated major rabi season important pulse crop grown in India, on about 12 million ha of land from temperate to sub-tropical regions of the world. There are two distinct types in chickpea, desi and kabuli. The desi types have thick and coloured (mostly brown) seed coat, while the kabuli types have thin and cream-coloured seed coat (Rizivi *et al.*, 2014) [20]. Chickpea is the third most important pulse crop and is grown on about 12 million ha of land from temperate to sub- tropical regions of the world, with some 72% of world production from South Asian countries (Foyer *et al.*, 2016) [6].

However, chickpea in drought stress was imposed during the pre-anthesis phase and reduced the chlorophyll and percentage of seed storage protein, plant height, number of pods, where increased the level of total phenolic content and anti-oxidants like proline, SOD, APX, MDA (Patel *et al.*, 2015) [19]. Drought is one of the major abiotic stresses in the world. Water stress from anthesis to maturity affects numerous morphological and physiological activities of plant resulting extensively reduces in crop yield and productivity (Hallajian 2016) [8].

Seed priming, a promising technique has been successfully employed to overcome the problem associated with poor germination, dormancy and subsequent erratic crop stand under normal and stressful conditions, and increases crop vigor, nutritional value, grain and biological yield (Jafar *et al.*, 2012) [13]. The commonly used priming agents are CaCl2 (calcium chloride), KNO3 (potassium nitrate), NaCl (sodium chloride), KH2PO4 (potassium phosphate), KCl (potassium chloride), PEG (polyethanol glycol). These are inorganic in nature used for priming methods to break seed dormancy, for uniform germination, vigorous growth and alleviates the negative effects of drought stress on emergence. Currently available priming methods vary in the technique of water application and include: hydro priming (seeds are soaked in pre-determined amount of water or imbibition periods are limited), osmopriming (seeds are soaked in osmotic solutions e.g., polyethylene glycol, mannitol, sorbitol, glycerol or in salt solutions), matrix priming (seeds are mixed with organic or inorganic solid materials) and drum-priming (seeds are rotated in drum and water is added gradually as water vapour) (Jisha *et al.,* 2013) [14]

Materials and Methods

A field and lab experiments were carried out during rabi season of 2017-2018 to study Effect of seed priming with inorganics on growth, yield and physiological parameters of chickpea (*Cicer arietinum* L.) under drought. The details of materials used and techniques adopted in the present investigation are described below. This trails were laid out in RBD with three replications of chickpea var. 362 (desi type) source – IARI, with seven treatments consists of T0- control, T1- hydration for 8 hrs in water, T2- hydration with KNO3 (2%), T3- hydration with NaCl (2%), T4- hydration CaCl2 (2%), with T5- hydration with KH2PO4 (2%), T6- hydration with KCl (2%) and these data were statistically analyzed using 'ANOVA' (Fisher 1950) [5].

The observations recorded under morpho-physiological parameters were plant height (cm), no. of primary and secondary branches, relative water content (%). Biochemical parameters were chl a, chl b, total chl content (mg/g), proline (µg/g), carotenoid (µg/g), protein (%) and root parameters- No. of nodules/ plant, nodule fresh weight, dry weight (g). Growth parameters were of Crop Growth Rate (CGR) and Relative Growth Rate (RGR) and yield parameters of no. of pods/plant, 100 seed weight (g), no. of seeds/ plant, harvest index (%) and seed yield/ plant (g).

Results and Discussion

Morpho-physiological parameters

Seeds primed with inoragnics have the better capability to cope up with stress conditions compared to the control ones. In chickpea, Plant height was observed in three different stages, (Table 1) at 40 DAS, 70 DAS and 100 DAS reached maximum height in T4-CaCl2 @ 2% (39.00 cm), (41.00 cm), (61.20 cm) (Mohammad *et al.,* 2013) [16]. Number of primary branches at 40 DAS, 70 DAS and 100 DAS reached maximum in T4-CaCl2 @ 2% (4.00), (8.00), (12.00) while the secondary branches are protruded even under drought from the main stems as compared to the non-primed seeds. The maximum recorded significant value was interestingly recorded highest in the same plot treated with CaCl2 @ 2% - T4 (7.00) at 40 DAS; (15.00) at 70 DAS; (30.00) at 100 DAS (Galahitigama *et al*., 2016) [7]. As the stomata was having low water potential, relative water content (Weatherley. 1962) [21] was effected during drought. In order to overcome this severity, seeds were prior treated well with inoraganics. Plants raised from the priming treated seeds with inorganics resulted best performance, early and vigorous growth compared to the unprimed ones (Haseen *et al.,* 2017) [9].

Biochemical parameters

Biochemical parameters such as chlorophyll 'a', chlorophyll 'b', total chlorophyll content and carotenoid content (Bates *et al.,* 1973) [3] (Table 2) was maximum in T4-CaCl2 @ 2% (0.44 µg/g). At the time of flowering stage, these parameters were sustainably decreased due to the effect of deficiency of water levels, but there would be an increment even under stress conditions, if the seeds were prior treated with inoragnics there would be a breakage in dormancy levels Chengbin *et al*., (2013) [4] and recorded the highest significant values among all the treatments chl-a (2.50 mg/g), chl-b (2.50 mg/g), total chl- (2.25 mg/g). Proline content (Wellburn 1983) [22] was found highest in the treatment T4-CaCl2 @ 2% (0.36 µg/g) even under water deficit conditions compared to non-treated, due to the alternate presoaking and sowing of seeds with inorganics gave the best results to withstand under drought (Hossam *et al*., 2017) [10]. Protein content (Lowry *et al.,* 1950) in chickpea under unfavorable conditions was analyzed significant and recorded highest in T4-CaCl2 @ 2% (19.08 %) due to priming techniques involved and could be able to tolerate stress conditions.

Root parameters

As this chickpea is rich in legumes can establish symbiosis with rhizobia bacteria and from nodules where the bacteria reduces the atmospheric nitrogen into ammonia. Number of nodules/ plant was highest in CaCl2 @ (2%) –T4 consisting of (15.00) presented in (table 2). This nodule fresh weight (1.30 gm) and dried at autoclave at 121 lbs pressure for 2 hours, this was recorded as dry weight (0.9 gm) could also be noted as a high requirement in only CaCl2 @ (2%) **(Muhammad *et al*., 2015) [17].** by this parameters we could find the amount of legumes contained for the better growth.

Yield parameters

Seed priming has the positive influence on yield parameters listed below (Table 3) such as no. of pods/plant as it was observed that the best result was with CaCl2 @ 2% among all the priming treatments (58.16) (Bakht *et al.,* 2011). However, interestingly we found that 100 seed weight (76.88 gm) (Hossein *et al.,* 2013) [11], no. of seeds/plant (79.83) and harvest index (57.80 %) (Abebe *et al.,* 2016) [1]. Seed yield was observed to be the highest in T4- CaCl2 @ 2% compared to non-primed seeds. This seed presoaking sowing process elevates the negative effect of drought and makes active in metabolic process (Murad *et al*., 2016) [18]; (Mohammad *et al.,* 2013) [16].

Conclusion

Based on present study, it was concluded that drought stress was deleterious to chickpea growth and yield. Seed hardening with CaCl2 @ 2% (T4) was found to induce higher physiological and metabolic activities and increased chickpea plants and yield as compared with the other treatments and control. This could have the utility against different stresses and offered as a solution to the problem faced with drought stress and preferably could help economically for the resource poor farmers for best quality, and quantity yield under adverse conditions.

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Table 1: Mean performance of morphological parameters in chickpea due to the effect of seed priming with inoragnics under drought

Treatments	Plant height (cm)			No. of primary branches			No. of secondary branches			RWC (%)
	40 DAS	70 DAS	100 DAS	40 DAS	70 DAS	100 DAS	40 DAS	70 DAS	100 DAS	
T0 – control	18.00	37.00	40.40	1.00	4.00	7.00	2.00	8.00	13.00	9.09
T1 - H20 (2%)	22.00	40.00	45.40	2.00	5.00	8.00	2.00	9.00	15.00	10.71
T2 - KNO3 (2%)	34.00	47.00	57.00	4.00	7.00	11.00	6.00	15.00	24.00	20.83
T3 - NaCl (2%)	23.00	40.00	47.20	2.00	6.00	9.00	3.00	9.00	18.00	12.90
T4 - CaCl2 (2%)	35.00	49.00	61.20	4.00	8.00	12.00	7.00	15.00	30.00	21.30
T5-KH2PO4 (2%)	24.00	46.00	52.00	3.00	7.00	10.00	5.00	12.00	23.00	16.66
T6 - KCl (2%)	24.00	42.00	49.20	3.00	6.00	10.00	4.00	10.00	22.00	14.28
Mean	25.71	43	50.34	2.71	6.14	9.57	4.14	11.14	20.71	15.11
F-test	S	S	S	S	S	S	S	S	S	S
S.Em±	2.22	5.12	2.54	2.22	1.85	2.22	3.02	4.27	7.07	4.19
CD @ 5%	1.39	3.22	1.60	1.39	1.16	1.39	1.90	2.68	4.45	2.64

Table 2: Mean performance of physiological and root parameters in chickpea due to the effect of seed priming with inorganics under drought

Treatments	Chlorophyll 'a' (mg/g)	Chlorophyll 'b' (mg/g)	Total chlorophyll (mg/g)	Pro line (µg/g)	Carotenoid (µg/g)	Protein (%)	No. of nodules/plant	Nodule fresh weight (gm)	Nodule dry weight (gm)
T0 – control	0.73	0.70	0.64	0.07	0.42	17.50	5.00	0.06	0.10
T1 - H20 (2%)	1.03	0.80	0.89	0.07	0.43	17.55	6.00	0.20	0.20
T2 - KNO3 (2%)	2.26	1.92	2.00	0.22	0.43	19.02	13.00	0.90	0.70
T3 - NaCl (2%)	1.37	0.88	1.21	0.11	0.43	17.93	7.00	0.40	0.30
T4 - CaCl2 (2%)	2.50	2.50	2.25	0.36	0.44	19.08	15.00	1.30	0.9
T5 -KH2PO (2%)	1.62	1.52	1.43	0.13	0.43	18.62	10.00	0.80	0.60
T6 - KCl (2%)	1.50	1.10	1.33	0.19	0.43	18.25	9.00	0.60	0.40
Mean	1.57	1.34	1.39	0.16	0.43	18.27	9.28	0.60	0.8
F-test	S	S	S	S	NS	S	S	S	S
S.Em ±	0.68	1.19	0.35	0.18	0.12	0.34	2.30	0.20	1.08
CD @ 5%	0.43	1.05	0.22	0.11	-	0.21	1.45	0.12	2.16

Table 3: Mean performance of growth and yield parameters in chickpea due to the effect of seed priming with inoraganics under drought

Treatments	Crop Growth Rate (g g -1 day -1)	Relative Growth Rate (g g -1 day -1)	No. of pods/plant	100 seed weight (gm)	No. of seeds/plant	Harvest Index (%)	Seed yield/plant(gm)
T0 –control	5.53	0.13	32.73	60.66	37.06	41.05	17.73
T1 -H20 (2%)	7.41	0.16	48.43	70.16	51.40	46.56	23.01
T2 -KNO3 (2%)	9.23	0.32	54.43	76.00	68.06	55.83	26.93
T3 -NaCl (2%)	7.7	0.19	49.00	73.13	57.59	49.95	23.76
T4 -CaCl2 (2%)	10.23	0.41	58.16	76.88	79.83	57.80	30.20
T5 -KH2PO4 (2%)	9.05	0.29	53.50	74.20	59.87	52.22	26.05
T6 -KCl (2%)	8.39	0.21	52.63	73.96	58.50	51.50	24.91
Mean	8.23	0.25	49.84	72.14	58.90	50.71	24.65
F-test	S	S	S	S	S	NS	S
S.Em±	1.85	2.10	0.93	1.82	0.36	38.35	1.07
CD @ 5%	0.01	1.32	0.58	0.01	0.22	-	0.67

References

1. Abebe Sori Negewo. Effect of hydro and osmo priming on yield and yield components of Chickpea (*Cicer arietinum* L.). Africal Journal of Reasearch. 2016; 11:3027-3036.
2. Bakht J, Shafi M, Jamal Y, Sher H. Response of maize (*Zea mays* L.) to seed priming with NaCl and salinity stress. Spanish Journal of Agricultural Research. 2012; 9:252-261.
3. Bates LS, waldren RP, Teare LD. Rapid determination of free proline for water stress studies. Journal of plant and soil. 1973; 39:205-207.
4. Chengbin Xu, Xuemei Li, Lihong Zhang. The Effect of Calcium Chloride on Growth, Photosynthesis, and Antioxidant Responses of *Zoysia japonica* under Drought Conditions. *Plos One.* 2013; 8:7-10.
5. Fisher RA. Statistical methods for research workers, *Oliver and Boyd publishers*, Edinburg, London, 1950
6. Foyer CH, Lam HM, Nguyen HT, Siddique KHM, Varshney RK, Colmer TD *et al*. Neglecting legumes has compromised human health and sustainable food production. Nature Plant. 2016; 2:16112.
7. Galahitigama GAH, Wathugala DL. Pre-sowing Seed Treatments Improves the Growth and Drought Tolerance of Rice (*Oryza sativa* L.). Imperial Journal of Interdisciplinary Research (IJIR). 2016; 2:9.
8. Hallajian MT. Mutation Breeding and Drought Stress Tolerance in Plants. In: Drought Stress Tolerance in Plants. International journal of Springer. 2016; 2:359-383.
9. Haseenaloui, ekouaer mohamed aymen, hannaicherif. Seed Priming to Improve Seedling Growth of Pepper Cultivars Exposed to Salt Concentrations. International Journal of Vegetable sciences. 2017; 23:489-507.
10. Hossam H, Manaf Hatem M, Ashour, Mahmoud M, El-Hamady. Impact of Calcium Chloride on Resistance Drought and Blossom-end Rot in Sweet Pepper Plants (*Capsicum annuum* L.). Middle East Journal of Applied

Sciences. 2017; 07:335-348.
11. Hossein Soleimanzadeh. Effect of seed priming on germination and yield of Corn. International Journal of Agricultural Crop Science. 2013; 5:366-369
12. Jadhav AA, Rayate J, Mhase IB, Thudi M, Chitikineni A, Harer PN *et al*. Marker-trait association study for protein content in chickpea (*Cicer arietinum* L.). Journal of Genetics. 2015; 94:2.
13. Jafar MZ, Farooq M, Cheema MA, Afzal I, Basra SMA, Wahid MA *et al*. Improving the performance of wheat by seed priming under saline conditions. Journal of Agronomy and Crop Sciences. 2012; 198:38-45.
14. Jisha KC, Vijayakumari K, Jos Puthur T. Seed priming for abiotic stress tolerance. Acta Physiologiae Plantarum. 2013; 35:1381-1396.
15. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Total Protein Estimation by Lowry's Method. Journal of Biology and Chemistry. 1951; 193:265.
16. Mohammad Khodadadi. Effect of Drought Stress on yield and Water Relative content in Chickpea. International Journal of Agronomy and Plant Production. 2013; 4:1168-1172.
17. Muhammad Bismillah Khan, Mubshar Hussain, Abid Raza, Shahid Farooq, Khawar Jabran. Seed priming with CaCl2 and ridge planting for improved drought resistance in maize. Turkish Journal of Agriculture and Forestry. 2015; 39:193-203.
18. Murad Ali, Zia Ullah, Ishaq Ahmad Mian, Naseem Khan, Nangialkhan, Muhammad Adnan *et al*. Response of maize to nitrogen levels and seed priming. Pure and Applied Biology. 2016; 5:578-587.
19. Patel PK, Sarma BK, Singh R. Salicylic acid induced alteration in dry matter partitioning, antioxidant defense system and yield in chickpea (*Cicer arietinum* L.) under drought stress. Asian Journal Crop Science. 2015; 4:86-102.
20. Rizvi AH, Kumar V, Dwivedi SK, Sairam RK, Yadav SS, Bharadwaj C *et al*. Physiological studies on moisture stress tolerance in chickpea (*Cicer Arietinum* L.) genotypes. International Journal of Scientific Research in Agriculture and Science. 2014; 1:23-31.
21. Weatherley PE. A reexamination of the relative water turgidity technique for estimating water deficit in leaves. Australian Journal of biological Sciences. 1962; 15:413-428.
22. Wellburn AR. Determinations of total carotenoids and chlorophylls *a* and *b* of leaf extracts in different solvents. Biochemical Society Transactions. 1983; 11:591-592.