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Growth, yield attributes and grain yield of chickpea as influenced by seed priming and sowing depth under acidic soil

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ABSTRACT

An experiment was conducted to determine the effects of priming and sowing depth of desi chickpea variety JG-14 during rabi season of 2014-15 and 2015-16. Hydro priming and sowing of chickpea at 10 cm depth recorded significantly highest growth parameters and yield (852.73 kg/ha) followed by Mannitol (4%) priming with 10 cm sowing depth. Lowest grain yield (754.30 kg/ha) was recorded in the treatment combination, NaCl (1%) priming with 5 cm sowing depth. Study on individual effect showed that, highest values for growth parameters, yield attributes and yield was obtained with a sowing depth of 10cm while higher values of such growth and yield parameters were recorded with hydro-priming. However, higher root length (9.94cm) and root dry matter (1.11 g) were obtained from the plants primed with KNO_3. Higher gross return, net return and B:C ratio was obtained with hydro priming at sowing depth of 10 cm. It may therefore be inferred that the practice of seed priming with distilled water and sowing depth of 10 cm can be recommended in cultivation of chickpea for improving the yield and popularize the cultivation of chickpea in this region.

Keywords: Chickpea, Growth, Seed priming, Sowing depth, Yield attributes, Yield

Chickpea (*Cicer arietinum* L.) belonging to sub family Papilionaceae of the family Leguminaceae is an important pulse crop of the semi-arid tropics, particularly in the rainfed ecology of the Indian subcontinent. It is the world's third-most important food legume (pulse) and is consumed as a high-quality protein food with India being the world's largest producer and consumer of pulses. Chickpea contains 17-22 % protein and 60-64% carbohydrates (Sindhu *et al*. 1974). Chickpea helps in sustaining the productivity of the cropping systems through their ability to fix atmospheric nitrogen. India is the largest chickpea producing country accounting for 64% of the global chickpea production. Seed priming is a commercially used technique for improv-ing seed germination and vigour. It involves imbibitions of seeds in water under controlled conditions up to the point of radical emergence followed by drying the seed back to the initial moisture content of the seeds. Priming of seeds in Mannitol (osmo-priming), sodium chloride (halo-priming) and water (hydro-priming) has been reported to be an economical, simple and a safe technique for increasing the capacity of seeds to osmotic adjustment and enhancing seedling establishment and crop production under stressed conditions. This could be due to faster emergence of roots and shoots, lower incidence of re-sowing, more vigorous plants, better drought tolerance, earlier ûowering, earlier harvest and higher grain yield under adverse conditions (Passam and Kakouriotis, 1994).

Seed priming is a pre-sowing strategy for influencing seedling development by modulating pre-germination metabolic activity prior to emergence of the radicle and generally enhances emergence and plant performance to achieve high vigour and better yields. Common priming techniques include osmo-priming, halo-priming and hydro-priming. Priming of chickpea seeds with mannitol and water improved seedling growth under salt stressed conditions. The effect of seeding depth is more important in rainfed areas, where crops are raised on conserved moisture. Deeper seeding may cause poor emergence and shallow depth may lead to poor germination on account of low soil moisture in the surface layer. Germination of all the cool season pulses is hypogeal and therefore, they can be planted relatively at deeper depth depending on availability of adequate moisture. In rainfed areas, deep sowing of chickpea was proved better than shallow depth. Further, deep planting reduces incidence of *Fusarium wilt* as compared to shallow planting and also promotes better root development. The benefits of deep sowing may be attributed to the optimum use of moisture stored in soil from monsoon rainfall. Besides the above facts, there is limited information available pertaining to the agronomic practices of chickpea in Manipur particularls study on seed priming and sowing depth. Hence, the study was undertaken.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2014-15 and 2015-16 at Research Farm of Agronomy, College of Agriculture, Central Agricultural University, Imphal. Soil of the experimental site was clay in texture. A composite soil sample was collected from the site at 0-15cm depth before starting the experiment and was analysed for physico-chemical properties. Soil was medium in nitrogen (280.53 kg/ha), medium in phosphorus (18.20 kg/ha), medium in potassium (210.44 kg/ha) and acidic in reaction (pH 5.2). The average monthly maximum and minimum temperature during the crop growth period was 22.70°C to 28.55°C and 6.25°C to 11.67°C respectively during 2014-15 and 15-16 respectively. The field experiment consisted of 2 factors *viz.,* priming methods (Distilled water, 4% Mannitol, 1% NaCl, 1% KNO_3) and sowing depth (5 cm, 7.5 cm and 10 cm). Field emergence (%) was calculated for all the treatments by using the formula:

$$\text{Field emergence (\%)} = \frac{\text{No. of healthy seedlings}}{\text{Total seeds sown}} \times 100$$

The ratio of economic yield (seed yield) to the biological yield (seed and haulm yield) was worked out as harvest index (Donald, 1962) and expressed in percentage (%).

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100$$

The benefit cost ratio was worked out by using the following formula:

$$\text{Benefit Cost Ratio} = \frac{\text{Net return (₹/ha)}}{\text{Cost of cultivation (₹/ha)}}$$

All the Experimental data obtained were subjected to statistical analysis using FRBD with three replications.

RESULTS AND DISCUSSION

Field emergence: Hydro priming and sowing depth of 10 cm recorded the highest field emergence of 75.42% followed by hydro priming and 7.5 cm sowing depth (73.69%). It is presumed that superiority of hydro priming on germination could be due to its ability to imbibe water for a longer time, that facilitate the initial stage of germination without protrusion of radicle. The adverse effect of germination synchrony in osmo-priming treatments may be related to the decreased water uptake in osmo-priming treatments and resulted in less advanced metabolic processes and slower germination. Similar results have been reported by Ekloca *et al.* (2007) for highest germination percentage in lentil. This may be related to rapid water uptake in priming treatment with hydro-priming and more availability of conserved moisture in deeper layer of soil which is required for seed germination, thus reducing the likelihood of lodging.

Days to field emergence: Hydro priming seeds sown at 5 cm depth took least no. Of days to germinate (12.67 days) in followed by treatment combination of hydro priming at 5 cm sowing depth (13.38 days). However, treatment combination of NaCl priming at 10 cm sowing depth took maximum days to emerge (14.32 days). These may be due to the stimulatory effects of priming at the early stages of the germination process by mediation of cell division in germinating seeds as reported by Sivritepe *et al*. (2003).

Branching potential: Number of branches per plant was significantly remarkable from 50 DAS onwards. Highest number of branch (7.30) was recorded in treatment combination of hydro priming at 10cm sowing depth, (7.20) followed by hydro priming with 7.50 cm sowing depth. Least number of branch per plant (5.20) was found in treatment combination of NaCl priming with 10 cm sowing depth. The better crop growth due to seed treatment may also be attributed to the fact that water treatment activates the synthesis of proteins, RNA, free amino acids and soluble sugars in the first phase of germination which could be advantages for subsequent phases of growth as observed by Jyotsna and Srivastava (1998).

Root length: Root length was highest (10.21 cm) in treatment combination of KNO_3 with 10cm sowing depth that was followed by KNO_3 priming (9.83 cm) 7.5 cm with sowing depth. This may be due to better development of lateral root near soil surface. Root system in terms of length, lateral branches and nodules was more developed in hydro and Mannitol primed plants than other primed plants. Similar results were reported on chickpea by Kaur *et al.* (2005). Deeper sown crop perform better than shallow sown crop, which may be due to better establishment of chickpea as availability of more moisture in soil at deeper sowing (10 cm) than shallow sowing (5 cm). Similar results were

Table 1. Growth, yield attributes and grain yield of chickpea as influenced by priming and sowing depth of (Pooled mean of two years)

Treatments	Field emergence (%)	Plant height (cm)	Branches/ Plant	Dry matter (g)	Root length (cm)	Root weight (g)	Days to germination	Days to maturity	Pods/ Plant	100 seed weight (g)	Grain yield (kg/ha)
T_1: P_1D_1	70.79	36.47	7.12	23.37	8.92	0.83	12.67	110.15	65.20	19.93	841.45
T_2: P_1D_2	73.69	38.51	7.20	24.05	9.35	0.89	13.65	109.79	66.20	20.07	842.59
T_3: P_1D_3	75.42	40.60	7.30	26.40	9.54	0.99	14.02	109.33	67.40	20.53	852.73
T_4: P_2D_1	69.01	33.52	6.60	16.86	9.42	1.02	13.38	110.63	54.60	19.70	767.47
T_5: P_2D_2	69.73	34.63	6.83	20.01	9.43	1.04	13.53	110.50	61.80	19.70	768.57
T_6: P_2D_3	71.42	35.41	6.94	21.69	9.55	1.08	13.66	110.00	63.20	19.92	807.23
T_7: P_3D_1	63.95	30.67	5.20	12.40	8.40	0.70	13.53	113.78	47.00	19.13	754.30
T_8 : P_3D_2	65.70	31.46	5.28	12.66	8.60	0.75	13.87	112.67	47.60	19.13	754.97
T_9: P_3D_3	67.25	32.12	5.54	13.33	9.15	0.76	14.32	111.89	50.10	19.17	755.93
T_{10}: P_4D_1	69.07	32.41	5.60	13.76	9.79	1.08	13.46	111.00	51.60	19.43	757.60
T_{11}: P_4D_2	69.68	32.67	5.63	14.08	9.83	1.10	13.81	110.88	53.80	19.56	758.33
T_{12}: P_4D_3	71.41	33.81	6.40	14.27	10.21	1.15	14.05	110.05	57.60	19.67	765.33
SEm (±)	**0.05**	**0.074**	**0.010**	**0.129**	**0.019**	**0.003**	**0.035**	**0.26**	**0.16**	**0.06**	**0.877**
CD (0.05)	**0.14**	**0.212**	**0.027**	**0.369**	**0.055**	**NS**	**0.100**	**0.75**	**0.44**	**NS**	**2.499**

P1= Hydro priming; P2= Priming with Mannitol (4%); P3= Priming with NaCl (1%); P4= Priming with KNO_3 (1%); D1= Sowing at 5 cm depth; D2=Sowing at 7.5 cm depth: D3= Sowing at 10 cm depth reported by Gan *et al.* (2003).

Root biomass: Root weight is found highest (1.15 g/plant) in treatment combination of KNO_3 with 10cm sowing depth which was followed by KNO_3 priming with 7.5 cm sowing depth (1.10) minimum root weight (0.70g) was found in treatment combination of NaCl priming with 5cm sowing depth. This may be due to greater biomass and number of nodules in primed plants. The increased biomass of nodules could be due to allocation of more photosynthate to nodules because of greater growth of primed plants. This was supported by Kaur *et al.* (2005).

Plant height: The interaction effects seed priming and sowing depth on the plant height at 25 DAS was found non-significant while significant results were found on 50, 75 DAS and at harvest, with hydro-priming and sowing depth of 10 cm recording highest values (17.62, 23.66, 40.60 cm) respectively. However, minimum plant heights were recorded in priming with NaCl at sowing depth of 5 cm. The enhanced plant height as a result of seed priming might be due to cell enlargement and increase in normal cell division as also reported by Karivaratharaju and Ramakrishnan (1985). The enhancement of plant height may also be due to the improvement and faster plant emergence in invigorated seeds which might have created cooperative competition among the plants for light and resulted in taller plants.

Dry matter production: The interaction effects of seed priming and sowing depth on the dry weight at 25 DAS was found non-significant while significant result were found at harvest with highest values recorded in hydro primed seeds sown at a depth of 10 cm. However, least dry weight was found in priming with NaCl at 5 cm sowing depth. Seed primed with water were significantly superior in dry weight than KNO_3 and NaCl primed seed as reported by Eskandari and Kazemi (2011).

Days to maturity: Hydro primed seeds sown at 10 cm depth took least days (109.33 days) to natures, followed by hydro-primed seeds sown at 7.5 cm depth. Whereas, maximum depth (13.78 days) mature was taken by NaCl primed seeds sown at 5 cm depth. This may be due to proper crop establishment in deeper sowing depth and effect of hydro-priming. Similar results were found by Harris (1996) in sorghum.

Yield attributes: Priming and sowing depth significantly increased the pods/plant in chickpea. The number of pods/ plant was highest (66.27) in hydro priming followed by priming with Mannitol. With respect to sowing depth, sowing depth of 10 cm recorded maximum number of pods (59.58) followed by sowing depth of 7.5 cm (57.35). Significantly highest number of pods (67.40) was found after hydro priming and sowing at 10 cm depth followed hydro priming and 7.5 cm is sowing depth (66.20). Similar finding was also observed by Mehri (2015) in soybean. The effect of priming methods and sowing depth is not significant and so interaction effect is not significant. The interaction of methods of seed priming and sowing depth on 100 seed weight at harvest was found non-significant.

Grain yield: The effect of seed priming and sowing depth on grain yield at harvest was found significant with a highest yield (852.73 kg/ha) recorded in hydro priming seeds sown at 10 cm depth and lowest yield (754.3 kg/ha) was found with NaCl priming and sowing depth of 5cm. The improved grain yield may be due to early and improved emergence, more pods per plant and better yield attributes. Higher productivity with deeper sowing seems to be due to better crop establishment and seed germination (Siddique and Loss, 1996). The results of increased in grain yield due to such priming method and sowing depth are in conformity with the findings of Gupta and Singh (2012).

REFERENCES

Elkoca K, Haliloglu K, Esitken A and Ercisli S. 2007. Hydro and osmopriming improve chickpea germination. Acta Agriculturae Scandinavica **57**: 193-200.

Eskandari H and Kazemi K. 2011. Effect of seed priming on germination properties and seedling establishment of cowpea (*Vigna sinensis*). Notulae Scientia Biologicae **3(4):** 113-116.

Gan YT, Miller PR and Mc Donald CL. 2003. Response of *kabuli* chickpea to seed size and planting depth. Canadian Journal of Plant Science **83**: 39-46.

Gupta V and Singh M. 2012. Effect of seed priming and fungicide treatment on chickpea (*Cicer arietinum*) sown at different sowing depths in kandi belt of low altitude subtropical zone of Jammu. Applied Biological Research **14(2):** 187-192.

Harris D. 1996. The effects of manure, genotype, seed priming, depth and date of sowing on the emergence and early growth of Sorghum (*Sorghum bicolor* L. Moench) in semi-arid Botswana. Soil and Tillage Research **40**: 73-88.

Jyotsna V and Srivastava AK. 1998. Physiological basis of salt stress resistance in pigeonpea (*Cajanus cajan* L.). Pre-sowing seed soaking treatment in regulating early seedling metabolism during seed germination. Plant Physiology and Biochemistry **25**: 89-94.

Karivaratharaju TV and Ramakrishnan V. 1985. Seed hardening studies in two varieties of ragi (*Eleusine coracana* Gaertn). Indian Journal of Plant Physiology **28**: 243-248.

Kaur S, Gupta AK and Kaur N. 2005. Seed priming increases crop yield possibly by modulating enzymes of sucrose metabolism in chickpea. Journal of Agronomy and Crop Science **191**: 81-87.

Mehri S. 2015. Effect of seed priming on yield and yield components of soybean. American-Eurasian Journal of Agricultural & Environmental Sciences **15(3):** 399-403.

Passam HC and Kakouriotis D. 1994. The effects of osmoconditioning on the germination, emergence and early plant growth of cucumber under saline conditions. Scientia Horticulturae **57**: 233-240.

Siddique KHM and Loss SP. 1996. Effect of deep sowing in chickpea in Western Australia. Australian Journal of Agricultural Research **3**: 31.

Sindhu SS, Kein KF, Houdgs HF and Nygust WE. 1974. Inheritance of protein and sulphur content of seed of chickpea. Crop Science **14**: 649-653.

Sivritepe N, Sivritepe HO and Eris A. 2003. The effects of NaCl priming on salt tolerance in melon seedlings grown under saline conditions. Scientia Horticulturae **97**: 229-237.