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Assessment of different priming methods for seed quality parameters in pigeon pea (*Cajanus cajan* L.*)* seeds

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Abstract
The experiment was conducted in laboratory Department of Genetic and Plant Breeding SHUATS Allahabad UP during 2017, in order standardize the best method of priming specific to Red gram. Seed priming using various method like that viz., hydropriming, helopriming and osmoprimong, biopriming were evaluated by screening a range of duration and concentration viz., T_0 Control, hydropriming, osmopriming- PEG (20%), helopriming (KCl 1%), ($CaCl_2$ 1%), bioprming (Neem leaf Extract 5%) and (Eucalyptus extract 5%)for 14 hours. It was found that all the priming method showed signification difference with the control and the highest per centage germination, seedling length, weight and germination index were observed for PEG priming for 14 hours.

Keywords: pigeon pea, method of priming, duration

Introduction
Pigeon pea is a protein rich staple food. It contains about 22 percent protein, which is almost three times that of cereals. Pigeon pea supplies a major share of protein requirement of vegetarian population of the country. Pigeon pea is mainly consumed in the form of split pulse as Dal, which is an essential supplement of cereal based diet. The combinations of Dal-Chawal (pulse-rice) or Dal-Roti (pulse-wheat bread) are the main ingredients in the average Indian diet. In addition to being an important source of human food and animal feed, Pigeon pea also plays an important role in sustaining soil fertility by improving physical properties of soil and fixing atmospheric nitrogen. Being a drought resistant crop, it is suitable for dryland farming and predominantly used as an intercrop with other crops. Pigeon pea [*Cajanus cajan* (L.) Millsp.] belongs to family Leguminosae. Numerous nodules are present on roots, these nodules contain Rhizobium bacteria, which fixes atmospheric nitrogen. The flowers are self-pollinated but cross-fertilization may also occur to some extent. The fruit of the Pigeon pea is a pod. Seeds are round or lens shaped. Numerou species of Cajanus are known, differing in height, habit, time of maturity, colour, size and shape of pods and seeds.Halo priming refers to soaking of seeds in solution of inorganic salts i.e. NaCl, KNO3 CaCl2, CaSO4, etc. Osmopriming or osmoconditioning include alternate wetting and drying, pre germination and controlled hydration by means of an osmoticum such as poly ethylene glycol PEG. Fifty three farmers tested maize seeds priming in the kharif season in 1996 in tribal areas of Rajasthan, Gujarat and Madhya Pradesh; India (Harris et al., 1999) [8]. Almost all farmers thought that primed crops grew more vigorously, flowered and matured earlier and produced bigger cobs and higher yield. Independent measurements on a subset of 35 trials showed a mean increase in cob weight of 6% (Harris et al., 2001) [9]. Seed priming is a technique which improves the germination and early growth under prevailing environmental conditions. Priming repairs damage of aged seeds (Butler *et al*., 2009) [2] or seeds exposed to abiotic stresses such as salinity (Ehsanfar *et al*., 2006) [5], improving germination performance. Priming treatment consists of soaking seeds in an osmotica of low water potential to control the amount of water supply to the seed. At the cellular level, few processes have been described to act during priming some of these being: activation of cell cycle (De Castro *et al*., 2000) [4] and mobilization of storage proteins (Gallardo *et al*., 2001) [7]. The priming-induced increase in the rate of seed germination has been associated with the initiation of germination-related processes (Soeda *et al*., 2005) [15], repair processes (Sivritepe and Dourado, 1995) [14] and increase in various free radical scavenging enzymes, such as superoxide dismutase, catalase and peroxidase have also been demonstrated (Gallardo *et al*., 2001) [7]. The theory of seed priming was proposed by Heydecker in 1973.

Basically it is a pre sowing treatment in which seeds are soaked in some way to a moisture level sufficient to initiate the early events of germination (imbibitions) but not sufficient to permit radical protrusion. It is technique for controlling seed slow adsorption and post dehydration. Seed priming has been successfully demonstrated to improve germination and emergence in seeds of many crops specially vegetables and small seeded grasses**.** Seed priming has presented promising, and even surprising result, for many seed including the legume seeds. Hydro-priming soaking the seeds in water before sowing and may or may not be followed by air drying of the seeds. Hydro-priming may enhance seed germination and seedling emergence under both saline and non- saline conditions. Hydro-priming plays an important role in the seed germination, radical and plumule emergence in different crop species. Similar to other priming techniques, hydro-priming generally enhance seed germination and seedling emergence under saline and non-saline conditions and also have beneficial effect on enzyme activity required for rapid germination.Hydro priming is a controlled hydration by soaking seeds in solution of low water potential followed by re-drying that allows per germination metabolic activities to proceed but prevent radical emergence. In simple words, Hydro priming in its traditional sense, soaking of seeds in water before sowing, has been the experience of farmers I India in an attempt to improve crop stand establishment but the practice was without the knowledge of the safe limit of soaking duration**.** Hydro priming is simplest form of priming which can be practiced on the farm itself and it is very useful for the farmers. Harris *et al*. (1999) [8], promoted a low cost, low risk technology called 'on-farm seed priming' that would be appropriate for all farmer, irrespective of their socio economic statud.

Osmopriming or osmoconditioning include alternate wetting and drying, pre germination and controlled hydration by means of an osmoticum such as poly ethylene glycol PEG, KNO_3, Nacl. According to, osmotic conditioning in its modern sense, aims to reduce the time of seedling emergence, as well as synchronize and improve the germination percentage, by subjecting the seed to a certain period of imbibitions using osmotic solutions. The seeds normally begin water uptake on contact with this solution and stop the process as soon as they become balanced with the water potential of the solution. Rapid germination and emergence is an important factor of successful establishment. It is reported that seed priming is one of the most important development to help rapid and uniform germination and emergence of seeds and to increase seed tolerance to adverse environment condition**.** The advance of seed priming in reducing the germination time and improving emergence uniformity is well established under laboratory condition. This technique used for improvement of germination speed, germination vigor, seedling establishment and yield**.** Improvement in priming is affected by some factors such as plant species, water potential form priming factor, priming duration, temperature, vigour and seed primed storage condition. The beneficial effects of priming have also been demonstrated for many field crops such as wheat, sugar beet, maize, soybean and sunflower reported that priming of aged seeds of Green gram and Black gram resulted in good germination and stand establishment in the field trials.

Halo-priming refers to soaking of seeds in solution of inorganic salts i.e NaCl, KNO3, CaCl2 and CaSO4 etc. A number of studies have shown a significant improvement in seed germination, seedling emergence and establishment and final crop yield in salt affected soil in response to halo-priming. Khan *et al*. (2009) [13] evaluated the response of seeds primed with NaCl solution at different salinity levels 0, 3, 6 and 9 dSm-1 in relation to early growth stage and concluded that seed priming with NaCl has found to be better treatment as compared to nonprime seeds. Priming with NaCl and KCl was helpful in removing the deleterious effects of salts (Iqbal *et al*., 2006) [12]. In sorghum seeds soaked in CaCl2 or KNO3 solution increased the activity of total amylase and proteases in germinating seeds under salt stress It was conducted with salt Nacl 5% solution, KCL 5% and $CaCl_2$ 1% solution concentration. Seeds were soaked 25 ^{0}C for 14 hour in Petri plates. After dried and at room temperature and subjected to germination test, done at 25 ^{0}C for 14 hrs. Evaluated the effects of NaCl priming with KNO_3 on the germination traits and seedling growth of four *Helianthus annuus L.* cultivars under salinity conditions and reported that germination percentage of primed seeds was greater than that of un-primed seeds Bajehbaj (2010) [16].

Materials and Methods

The present investigation was carried using genetically pure seeds of pigeon pea cultivar Bahar and the Experiment was conducted in the Seed science post graduate laboratory, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad. After cleaning and grading, the seeds were soaked in respective priming solutions at 1/3rd volume of seeds for eight and twelve hours. Then the seeds were air dried under the shade to bring back to their original moisture content and used for sowing. For priming of seeds kcl, $Cacl_2$,Neem leaf Extract, Eucalyptus Leaf Extract are taken according to standards.

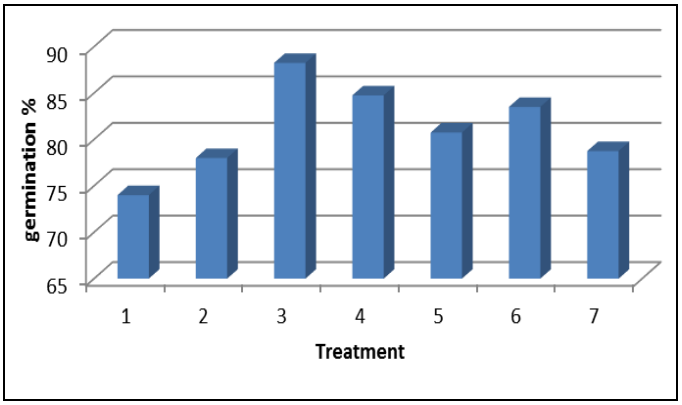
The observation on the characters *viz.,* Germination percent (ISTA 2004), Root length (cm), Shoot length (cm), Seedling length (cm), seedling Fresh weight (g), seedling dry weight (g), Seedling vigour index Ist, Vigor index IInd (Baki and Anderson 1973) [3] were recorded. The experimental data recorded were subjected to statistical analysis for calculating analysis of variance, range, mean, critical difference and coefficient of variation (R.A. Fisher 1936) [6, 11].

The data collected from the experiments were analyzed statistically by the procedure prescribed by Panse and Sukhatme (1978). The investigations are details of materials and using of experimental design in complete randomized block methods. Critical difference were calculated at 1% level wherever 'F' test was significant. The data on percentage of germination and seed infection were transferred into arc sine square root percentage values and the transferred data were used for statistical analysis. Absolute control treatment was compared with rest of the treatment by following ANOVA statistical analysis.

Result and Discussion

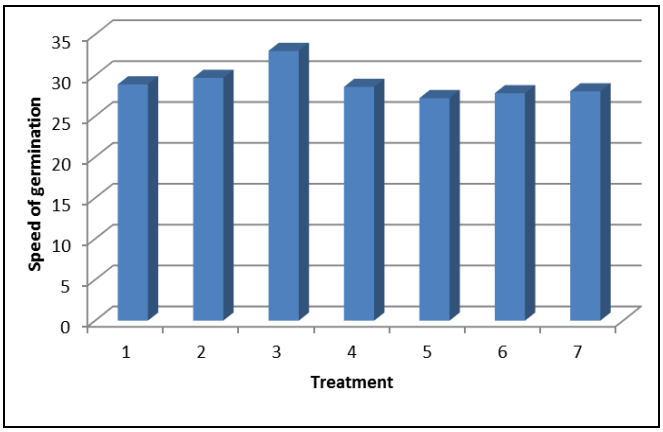
1. Germination percentage

The response of different priming was differs in germination of Pigeon pea. The grand mean of germination was 81.21% in pigeon pea Significantly highest percentage of germination was reported in the priming with PEG (20%) in pigeon pea (88.25%) followed by 1% KCl (84.75%), 5% Neem leaf extract (83.5%),1% $CaCl_2$ (80.75%), 5% Eucalyptus leaf extract (78.7%), hydration by distilled water (78.00%) and control (74.50%).



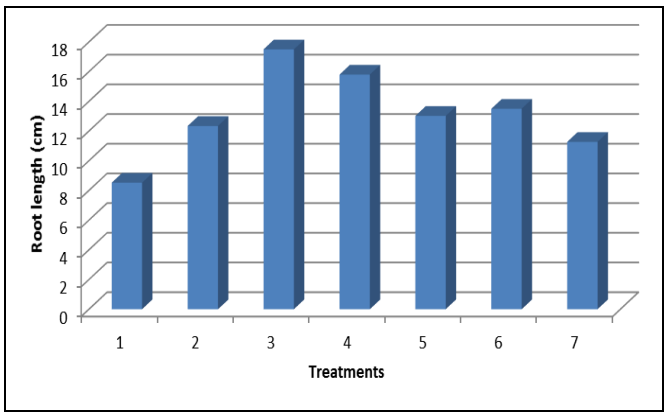
2. Speed of germination

The mean performance of speed of germination ranged from 27.22 to 33 with mean value of 33. Significantly highest percentage of germination (33) was reported in the priming withT_2 Polyethylene Glycol (PEG) 20% and it was followed by T_1 (29.7) with control (28.9) and application of T_3 (KCl) 1% and eucalyptus leaf extract T_7 (28.05) with application T_5: Neem leaf extract @ (5%) T_6 (27.82) Minimum speed of germination was recorded by T_4 $CaCl_2$ (1%) (27.22).



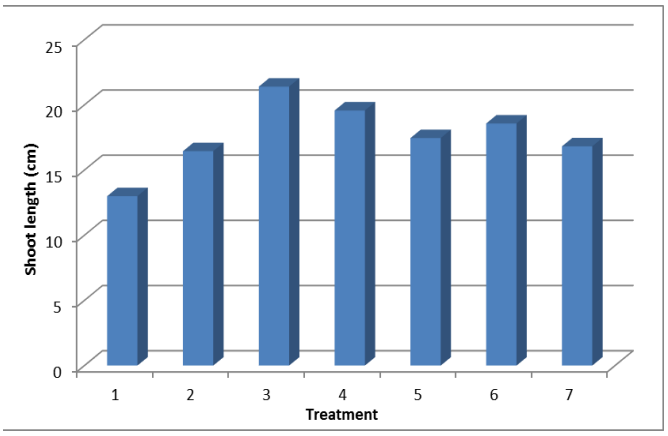
3. Root length

The effect of priming on the root length of pigeon pea is displayed in Table 4.5 and Fig.4.3. The overall mean of root length was 13.13 pigeon pea, respectively. The result showed that PEG (20%) had significantly longest root (20.8cm) in pigeon pea and then in KCl (1%) (17.2cm), neem leaf extract (5%) (14.3), $CaCl_2$ (1%) (14.2cm), eucalyptus leaf extract (5%) (12.00cm) and hydration of distilled water (11.00cm). Shorted root length was recorded in control (7.00cm)



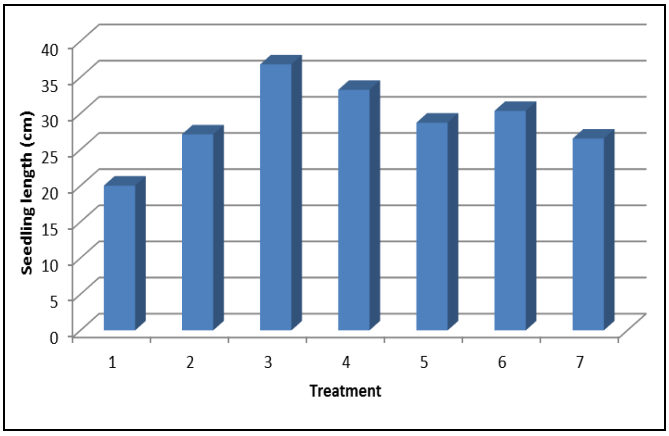
4. Shoot length

The effect of priming on the shoot length of seedling of pigeon pea. The grand mean of shoot length was 17.61 in pigeon pea, respectively. In case of pigeon pea, significantly maximum shoot length (21.4cm) was found under the influence of PEG (20%) which was followed by KCl (1%) (19.57cm), neem leaf extract (5%) (18.57) and $CaCl_2$ (1%) (17.45cm).and eucalyptus leaf extract (5%) (16.82) and distilled water hydration (16.45cm), the shortest shoot was found in control (13.cm).



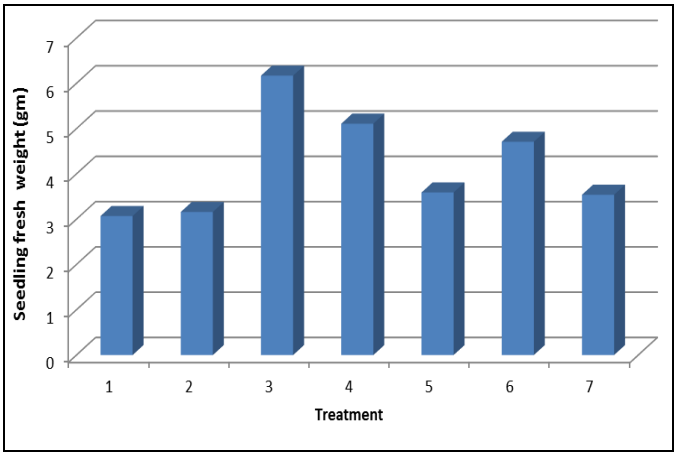
5. Seedling length

Displayed the mean value of seedling length as affected by different priming methods. The overall mean of seedling length was 18.97 in pigeon pea respectively. The mean analysis exhibited that the PEG (20%) had statistically tallest seedling (36.67cm) in pigeon pea and then, KCl (1%) (33.27%), and neem leaf extract (5%) (30.36) and $CaCl_2$ (1%) (28.38cm) and eucalyptus leaf extract (5%) (26.53cm). in hydration by distilled water (27.11cm) Shortest seedling length was recorded in control (20.02cm).



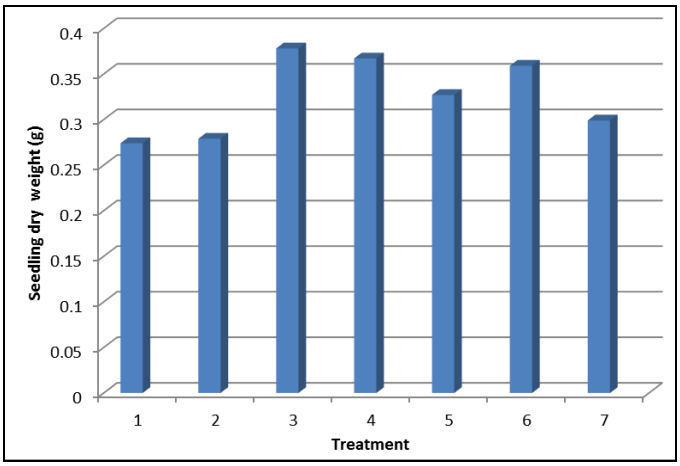
6. Seedling fresh weight

The grand mean of seedling fresh weight was (4.19g) in pigeon pea, respectively. The different priming solution didn't show statistically significant effect on the seedling fresh weight of the pigeon pea over control. However, high seedling fresh weight (6.17g) was recorded in PEG (20%) in pigeon pea and then), KCl (1%) (5.11g),: neem leaf extract @ (5%) (4.71) $CaCl_2$ (1%) (3.59g) and eucalyptus leaf extract (1%) (3.54g).and in distilled water hydration (3.16g) Lowest value was found in control (3.07g).



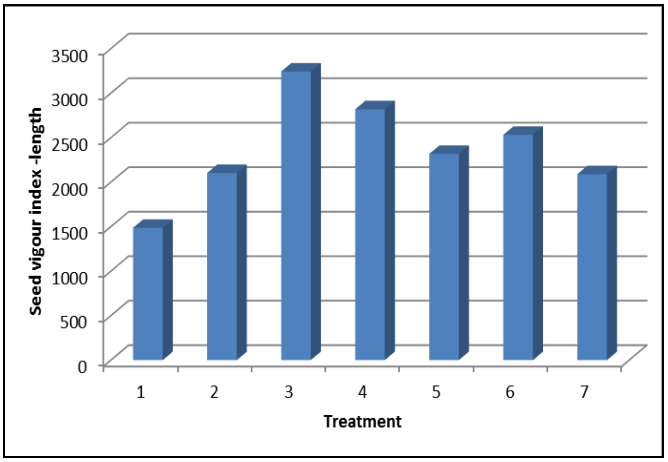
7. Seedling dry weight

The grand mean of seedling dry weight was 0.326 in pigeon pea, respectively. The different priming solution exhibited statistically significant effect on the seedling dry weight accumulation of the pigeon pea over control. In pigeon pea, statistically maximum seedling dry weight accumulation (0.378 g) was reported in PEG (20%) followed by) KCl (1%) (0.53 g),. The priming with neem leaf extract (5%) (0.359 g) and $CaCl_2$ (1%) (0.327 g) and eucalyptus leaf extract (5%) (0.299 g) showed. Distilled water hydration (0.279g) lowest value was found in control (0.274g).



8. Seed vigour index –Length

The overall mean of seed vigour index- Length was 2369.51 in pigeon pea. The priming effects were found statistically significant for seed vigour index- Length for over control. In pigeon pea, statistically highest seed vigour index- Length (3242.7) was reported in PEG (20%) followed by KCl (1%) (2818.3). the seed treated with neem leaf extract (5%) (2531.6) $CaCl_2$ (1%) (2316.2), eucalyptus leaf extract (5%) (2088.9) and distilled water (2102.6) showed statistically at par value for seed vigour index- Length to each other. Lowest value was found in control (1486.7).



9. Seed vigour index-Mass

The grand mean of seed vigour index- Mass was 26.62 pigeon pea, respectively. The priming effects were found statistically significant for seed vigour index- Mass for pigeon pea over control. In pigeon pea, statistically maximum seed vigour index- Mass (33.33) was reported in PEG (20%). The seed treated with and KCl (1%) (31.23) recorded statistically similar value for seed vigour index- Mass to each other. Statistically *at par* value for seed vigour index- Mass was also found in: neem leaf extract (5%) (30.23) and CaCl2 (1%) (26.29), eucalyptus leaf extract (5%) (23.53) distilled water hydration (21.39) and control. Lowest value was found in control (20.36).

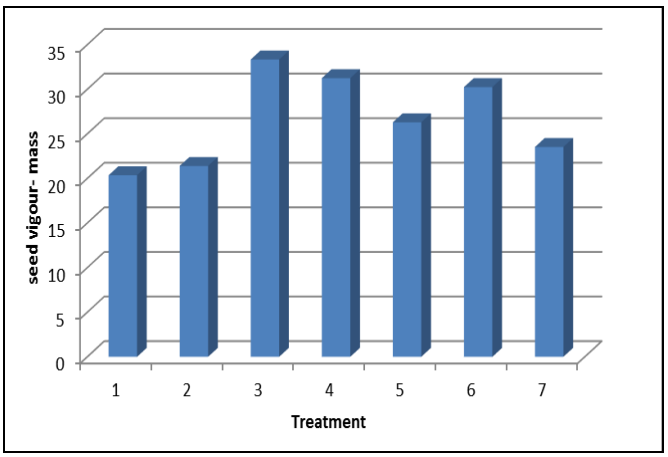


Table 1.1: Analysis of variance for different seedling growth parameters in Pigeon pea

Characters	Mean Sum of Square (MSS)	
	Treatment (df = 6)	Error (df = 21)
Germination%	85.95**	30.238
Germination index	15.094	14.28
Seedling root length	34.414**	2.56
Seedling shoot length	28.248**	3.800
Seedling length	114.0705**	8.93
Seedling fresh weight	5.511**	0.5224
Seedling dry weight	0.007417**	0.001878
Seed vigour index-Length	1281365**	57105.69
Seed vigour index –Mass	103.733**	16.13758

** Significant at 1% level of significance

Table 2.1: Mean Comparison of Germination and Vigour Traits In Pigeon pea.

Treatment	Speed of germination	Germination%	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Seedling Fresh weight(g)	Seedling Dry weight (g)	Vigour index-length	Vigour index - mass
T0	29.9	74.5	13.00	8.52	20.02	3.15	0.274	1486.72	20.36
T1	29.7	78	16.45	12.34	27.11	3.04	0.278	2102.63	21.33
T2	33	88.25	21.4	17.5	36.79	6.177	0.377	3242.65	33.33
T3	28.6	84.75	19.575	15.8	33.27	5.11	0.367	2818.28	31.23
T4	27.22	80.75	17.45	13.025	28.73	3.37	0.326	2316.15	26.28
T5	27.82	83.5	18.57	13.5	30.36	4.71	0.359	2531.23	30.23
T6	28.05	78.75	16.82	11.275	26.53	3.77	0.298	2988.90	23.53
G Mean	29.18	81.21	17.61	13.13	28.97	4.19	0.325	2369.57	26.62
SEM+	1.035	2.74	0.97471	0.80108	1.4944	0.36179	0.021	119.48	2.00
CD@5%	3.044	8.08	2.86	2.355	4.39	1.06	0.0063	351.40	5.90
F test	S	S	S	s	S	S	s	S	s

Summary
All the priming methods have positive influence on seed quality parameters of Pigeon pea individually but the effect of priming method was found significant. Speed of germination and Germination percentage were (33.0% and 88.25%) respectively were highest in osmoprimed (PEG) seeds and it was significantly low in unprimed (control) seeds (88.25% and 74.5%). However seedling attributes were also positively influenced by priming and highest seedling length (36.79 cm) and seedling dry weight (377.5 mg) was observed in osmoprimed (PEG) seeds followed by haloprimed (KCl) seeds having seedling length and seedling dry weight (33.27 cm and 367.0 mg) respectively and found to be lowest in unprimed seeds having seedling attributes (20.02 cm and 274.0 mg respectively).

Conclusion
It can be concluded from the present investigation that treatment T_2 [Polyethylene Glycol (PEG) 20%] exhibited high mean value for germination, seedling parameters, field emergence and nodules characters in compared with other treatments. Soaking of seed with PEG solution is advantageous to obtain healthy seedlings. The second best option for priming is halopriming with KCl.

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