Effects of different pre-sowing seed priming agents on chickpea vigor and germination

ABSTRACT

The effect of organic priming on the germination behavior and vigor of chickpeas, Cicer arielinum (L.), was examined in an experiment conducted during the Zaid season of 2023 at the Post Graduate Laboratory, Seed Science and Technology, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini Agricultural Institute, Allahabad, Uttar Pradesh. Ten genotypes and three treatments—T0 (Control), Hormonal priming T_1-Salicylic Acid [SA (200pm)], Osmo priming T_2-(Mannitol 5%), and Botanical priming T_3-Aloe vera leaf extract (5%), respectively-were used to complete the statistical analysis used in the design. The seeds were steeped for 24 hours at 25°C in diluted water that was used to make all of the priming media. Significant variations in treatments were also noted. T_3 Aloe vera exhibited the highest germination rate (81%) and the longest root length in control (T_0), shoot length (T_3), seedling length (T_3), and seedling vigour index (T_3). T_2 Mannitol had the highest seedling weight in both fresh and dry conditions, followed by T_2 Mannitol, which displayed the highest germination rate (80%), root length, shoot length with salicylic acid, and seedling length (T_2) in mannitol.

Keywords: *Seed Priming, Chick pea, Salicylic acid, Mannitol, Aloe vera.*

1. INTRODUCTION

After common bean and field pea, Chickpea, a popular cool-season food legume crop (Khan *et al*., 2008; Annonymopus, 1966), is grown in over 50 countries in Africa and Asia, Europe, and Australia are cultivating the crop (Asaduzzaman, 2014)**.** Three wild annual *Cicer species*, *Cicer bijigum*, *Cicer echinospermum*, and *Cicer reticulatum,* have been discovered in the aforementioned areas that are now South Eastern Turkey and adjacent territories of Syria (Ashraf and Foolad, 2005). With 80% of the world's production, South-East Asia is the most productive region for chickpeas production (Patra *et al*., 2024). Ethiopia is the leading producer of chickpeas in Africa, both in terms of total production (284640 t/year) and area farmed (213187 ha/year) (Adhikari *et al*., 2021).

Chickpeas are a valuable crop due to their high protein content (17-31% in seeds) and biological activity (52-78% in seeds), making them suitable for human consumption and animal feed with a high content of lysine, carotene, calcium, and iron (Bahl and Salimath, 1996; Bezaukova *et al*., 2001, Vilasrao *et al*., 2023). The plant, known as "poor man's meat," has a caloric content equal to rice, provides four times as much protein and eight times as much riboflavin (Ciftic, 2004), and can serve as a versatile nutrient source for soil, animals, and people.

The acid is being expelled; primarily Oxalic and malic acids are commonly used in refreshing drinks and medicinally for blood purification. , its tender leaves are utilized as vegetables (Csacentral Statistical Authority, 2010). Animals are given soaked grain as roughage and concentrate, respectively. Additionally, the account for Soil enrichment through symbiotic nitrogen fixation is effective, obtaining over 70% of its nitrogen needs from this source, and is drought-tolerant. Priming could be useful in lowering the possibility of poor stand establishment in nursery settings. The reduced he study found that lipid peroxidation and elevated antioxidant activities were observed during seed imbibition's may play a role in priming in better seed performance.

Despite the chickpea's current significance and expanding demand around the world , this crop currently produces very little, The crop often struggles to establish rapidly and consistently in dry and semi-arid regions which causes low p l a n t numbers to result in decreased output. The two most widely farmed varieties of chickpea, Desi and Kabuli have low germination percentages, causing weak stands, and the cause has not been investigated (Dagne *et al*., 2010) which in turn result in lower yields, and this has a negative impact on how widely used it is in most nations. Dezfuli *et al*. (2008) claimed that the formation of a strong stand is crucial crop failure and low yields are frequently caused by patchy stands that arise from uneven Pre-sowing seed treatments have been proven to enhance legume germination. This method can enhance chickpea germinationand boost production. Priming of seed is one of the effective pre sowing seed treatments that can enhanced ling emergence (Ellis and Roberts, 1981; FAO, 2013). A straightforward pre sowing procedure called seed priming causes Seed priming is a regulated hydration procedure that enhances the rate of uniform germination and growth in various plant species (Farahbakhsh, 2012; İlbaş *et al*., 2012). Consistency, and occasionally overall percentage of germination. This hydration is only sufficient for pre germination metabolic processes, not for promote germination. The osmo-priming process involves pre- soaking seeds in low water potential solutions like

PEG (Poly Ethylene Glycol and Mannitol) (ICRISAT, 2013, Jeeshitha *et al*., 2024)**.** Imran *et al*. (2014) studied the priming of chickpea seeds with water and mannitol to encourage seedling growth in situations where salt is scarce.

However, low-income farmers are unable to prime seeds with expensive plant hormones, anti-oxidants, or minerals. Therefore, it is necessary to research environmentally safe and natural plant growth stimulants; one such potential source of plant nutrients is the gel from aloe vera leaves (Jam *et al*., 2012); enzymes- amylase, lipase, catalase oxidase and superoxide dismutase (Kaul, 1982); amino acids- Alanine, leucine, glycine and proline (Kaur *et al*., 2003); Vitamins include B complex, C, -carotene, and alpha-tocopherol, as well as other organic compounds like potassium sorbate, triglicerides, and triterpenoid (Khan, 1981). Impact of distinct seed priming methods on the development and robustness oftwo genotypes of bread wheat (*Triticum aestivum* L.).

Fennel seeds under low water potential treated with salicyclic acid in addition for good germination (Maih, 1976). Additionally Malek *et al*. (2012) additionally demonstrated that salicylic acid (100 ppm) seed priming promoted photosynthesis and metabolic activities, which in turn raised seedling vigour. According to McDonals (2020), priming with 2% Aloevera gel increased seedling germination rates and successful growth under chilling circumstances.

Present study has been designed Analyze how seed priming treatments affect the vigor and germination of chickpea seeds, and investigate the impact of seed priming at various concentrations.

2. MATERIALS AND METHOD

The research was carried out at Sam Higginbottom University of Agriculture, Technology and Sciences Prayagraj's Seed Testing Laboratory, Department of Genetics and Plant Breeding, Naini Agriculture Institute to study the percent germination. We were taken 10 genotypes of chickpea. G1(IPC-12-100), G2(IPCK-9-40), G3(ICC- 495),G4(RAT1LA),G5(FLIP-97-53C),G6(BG-212), G7(RSG-963),G8(JG-36), G9(FLIP-09-162), G 10 BEG-3). The seeds were grown on moist germination paper (moistened with distilled water). Before that seeds are soaked petri plates with treatments were used having 10 seeds in each plate. The germination percentage was recorded from first day to seventh day. Similarly, at the same intervals, the length of radicle or plumule were also recorded a long with fresh and dry weight. Chickpea seeds are treated with various chemicals.

T0 (Control) was used to represent the treatment. Hormonal priming T1- Salicylic Acid [SA (200 ppm, Osmo priming T2- (Mannitol 5%), Botanical priming T3- Aloevera leaf extract (5%). The seeds were immersed in distilled water for 24 hours at 25^{o}C to prepare all of the priming.

The splashed seeds were surface dried for one day beneath research facility conditions and were assessed for the seed quality parameters *viz* ., germination (%), speed of germination, shoot length (cm), root length (cm), seedling length (cm), new weight of seedling (g), dry weight of seedling (g), seedling energy record length and seedling energy list .

All medications set in a germination chamber at 25°C. Germination prepare was watched every day and proceeded until settled state. Radicle length of more than 2 mm was respected as developed case. After 12 days seeds come to the settled state, hence germination files and development characters of seedlings were measured. Germination files incorporates; Germination percentage is calculated by dividing the total number of seeds sown by number of seeds that have germinated and then multiplying by 100(ISTA 2009). Seed vigour index (SVI) is determined by multiplying germination percentage by seedling length (Diapari, 2013). Mean germination time (MGT) is determined using the formula (Farooq *et al*., 2006) MGT=∑(ni/di), where ni is the number of germinated seeds and di is the day of counting. When measuring growth characteristics, parameters such as shoot length, dry weight, root length, and total dry weight were recorded .The dry weight (DW) was obtained by drying the seedlings for 48hrs at 72^{o}C. Seed vigour index (SVl) SVl was calculated as follows: SVl = Seedling length x GP x Angular Transformation (Arcsin) Value. Readings were taken thrice and shown as mean value

3. RESULT AND DISCUSSION

Hydro-priming and no preparing of chickpea seed brought about in a destitute germination rate. It is conceivable that hydro-priming was delayed which may have caused an oxygen insufficiency the build-up of inhibitor which prevents germination (Mohamed *et al*., 2019).

According to Raskin salicyclic acid is crucial in boosting tolerance (Raskin, 1992) to environmental stress. According to reports, SA improves resistance to salinity tolerance and resistance to water deficit in seedlings (Reynolds and Dweck, 1999).

It was reported that the final germination percentage, radius length and fresh weight of lentils *(Lensculinaris Medik*) seeds germinated in different concentrations (1-5%) of Aloe veraleaf extract were increased compared to a single control seed germinated in distilled water. In addition, it was reported that

all tested concentrations (2, 5, 10, 20 and 40%). Aloe vera leaf extract original caused a significant inhibition on the radicle length of *Allium cepa* seeds germinated under normal conditions (Basra *et al*., 2005).

Mannitol and water priming chickpea seeds improved seed ling growth in salt stressed conditions, according to research (Imran *et al*., 2014). However, poor farmers are unable to use expensive plant hormones, antioxidants or nutrients in seed priming.

In this research we revealed from the Significant variations between the various treatments were also noted. T_3 Aloe vera showed maximum Germination (81%), maximum Root length (13.03 cm) in control, maximum shoot length (10.42cm), maximum seedling length (21.26 cm) and maximum seedling vigour index (1740.70) in aloe vera maximum seedlings fresh weight (0.69gm) and seedlings dry weight (0.45). More specifically, T_2 Mannitol demonstrated 80% germination, 1.60 cm of root length, 7.41 cm of shoot length (salicylic acid), 20.67 cm of seedlings length, 0.67 gm of fresh and 0.34gm of dry seedlings weight, and 1653 gm of seedling vigour index mass in mannitol similar to research by Keerthana *et al*. (2024).

Table 1- Analysis of variance of chick pea seedlings

S.No.	Characters	Mean sum of squares		
		Treatment (d.f=3)	Replication (d.f=9)	Error (d.t=36)
l	Germination (%)	816.667	132.222	76.111
2	Root length(cm)	9.294	8.124	5.136
3	Shoot length(cm)	37.008	2.234	2.711
4	Seedling length(cm)	11.914	11.477	10.792
5	Fresh weight of seedling(gm)	0.024	0.053	0.027
6	Weight of dry seedling(gm)	0.051	0.009	0.012
7	Seedling vigour index mass	614368.292	135924.803	105632 .892

Table 2- Comparison of Mean performance of seedling characters in chickpea

Treatment	Germinton (%)	Root length (cm)	Shoot length (cm)	Seedlig length (cm)	Fresh seedling weight (gm)	Dry seedling weight (gm)	Seedling vigour index mass
T0	62	13.03	6.01	19.04	0.58	0.28	1177
T1	79	11.80	7.41	19.21	0.66	0.33	1512.60
T2	80	12.60	7.40	20.67	0.69	0.34	1653.80

T3		81	10.84	10.42	21.26	0.67	0.45	1740.70
Grand Mean		75.50	12.07	8.23	20.05	0.65	0.35	1521.03
Range	Max	81	13.03	10.42	21.26	0.69	0.45	1720.70
	Min	82	10.84	6.01	19.04	0.58	0.28	1177
c.v		11.55	18.780	19.973	16.388	25.580	30.681	21.368
S.E(m)		2.759	0.717	0.520	1.039	0.052	0.034	102.778
CD at 5%		7.913	2.056	1.491	2.980	0.150	0.098	294.783
CD at 1%		10.610	2.756	1.999	3.995	0.202	0.131	395.277

4. CONCLUSION

In the present research, the maximum seed germination, maximum seedling length and maxi mum seed vigour index was observed with 5% of aloevera leaf extract over selected genotypes of chickpea. So, seed priming with 5% aloevera leaf extract ensure the highest seed germination and vigour. The moderate seed germination, seedling length and seed vigour index was observed with 5% mannitol. The results show that seed coating is effective way to enhance seed vigour index and germination for higher yield and productivity.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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