Seed priming with osmolytes chemical to enhance germination and vigour in blackgram (Vigna mungo. L)

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Abstract
Seed priming is one of the most important advancements in seed germination and emergence, as well as seed tolerance to adverse environmental conditions. Seeds of Black gram var. VBN 11 were treated with various osmolytes viz., Mannitol, Sorbitol, Chitosan and Salicylic acid @ 100 ppm, biochar 100g kg⁻¹. Water and untreated seed as control. The results revealed that all osmolytic treatments differed significantly from the control and the seeds primed with Mannitol 1% for 3 h were recorded highest germination percentage (94%) and vigorous seedling growth.

Keywords: Black gram, priming and seed quality

1. Introduction
Pulses grow mostly in marginal and rainfed areas leading to low productivity. The major constraint in increasing the productivity levels of pulses in drylands are inadequate soil moisture and poor fertility of the soil. Black gram (Vigna mungo L.) is one of the India's most important legume crop. Black gram is a drought resistant crop, hence ideal for dryland farming and is often used as an intercrop with other crops. In addition, it helps to maintain fertility of soil by enhancing soil physical qualities and fixing atmospheric nitrogen.

Seed priming is a controlled hydration technique in which seeds are immersed in water or low osmotic potential until germination related metabolic activities begin but radical protrusion (Mc Donald, 2000 and Farooq et al., 2007). Seed priming is a pre-sowing treatment that has the potential to enhance post-harvest seed quality and enable the release of dormancy, which will increase ultimate germination and increase speed of germination and uniform growth. The strategy involves regulating seed hydration and stimulating various metabolic processes without enabling radical protrusion (Heydecker, 1973; Bradford, 1986 and Taylor et al., 1998). It also encourages the development of secondary metabolites, which increases the plant ability to withstand drought. The physiological mechanisms to increase crop production under drought stress are induced by seed priming methods.

Among the different priming treatments, using osmolytes is one of the pre-sowing treatments which encourages the development of secondary metabolites and increases the ability to withstand drought. Osmolytes are compatible osmoprotectant solutes that enhance the cell potential to maintain water without hampering the normal metabolism. The main purpose of these metabolites is to regulate osmotic adjustment and also used as an osmoticant to make solutions with low water potential (Heydecker, 1973) and improve the seedling under abiotic stress tolerance. With this background, a study was undertakenin black gram var. VBN 11 with the objective to evaluate the effect of various seed osmolytes on physiological seed quality parameters in black gram.

2. Materials and Methods
The research was carried out in the Department of Seed Science and Technology, Agricultural College and Research Institute, TNAU, Madurai. The graded black gram seeds were primed with the chemicals viz., T₁- Control, T₂-Water, T₃- Mannitol 1%, T₄- Sorbitol 1%, T₅- Chitosan 1%, T₆- Salicylic acid 100 ppm and T₇- Biochar 100g kg⁻¹. The seeds were soaked in different chemicals 1:1 ratio (Seed: Solution) for 3 h after soaking, the seeds were dried to their original moisture content and tested for its seed quality.

The experiment was carried out using a completely randomized block design (CRD) with two replications. The treated seeds were tested in roll towel paper method at the temperature of 25±2 °C and 95±3% RH with the germination period of 7 days (ISTA, 1990), speed of germination...
Mannitol recorded higher root length (16.35 cm), shoot length (19.86 cm) followed by chitosan with the root length (15.76 cm), shoot length (20.54 cm) when compared to control seeds as a result of increased DNA, RNA, and protein synthesis during priming (Bray et al., 1989) [3]. Higher seedling length might be due to increase in number of adventitious roots (Ma et al., 2011) [13]. Chitosan also increases root growth and induces specific enzymes such as chitinases, pectinases and glucanases (Hien, 2004) [9].
Mannitol (T3) recorded more dry matter production (0.273 g seedlings$^{-1}$) followed by chitosan (0.266 g seedlings$^{-1}$) when compared to untreated seeds (0.189 g seedlings$^{-1}$) (Table 1) due to the simultaneous effect of a repair mechanism induced by primed and synchronised earlier germination, which causes seedlings to enter the autotrophic state much earlier, producing more photo assimilates from source to sink and thus increasing dry matter production Shah's (2007). Mannitol results in higher vigour (3404) followed by chitosan (3267) when compared to control (2316) (Table 1). Higher dry matter production enhances higher vigour index with increased germination percentage, root length and shoot length (Cokkizgin et al., 2019 and Balaji (2019) in millets. It also enhances the emergence index, synchronized emergence, and seedling vigour due to genetic repair mechanisms that take place during the priming process (Parera and Cantliffe, 1994) [19]. According to Sadeghi et al. (2011) [22], osmotic priming improves seed germination and vigour which was typically influenced by the mobilization of food reserves, activation and resynthesis of certain enzymes, DNA and RNA. Seed vigour and viability were associated with biochemical factors such as electrical conductivity and dehydrogenase activity. Higher the germination percentage and dry matter production results lower the electrolyte leakage in 1% Mannitol and 1% Chitosan (0.19 ds$m^{-1}$) and (0.19 ds$m^{-1}$) respectively (Fig. 2) due to the quenching of free radicals, which restores membrane integrity (Powell and Matthews, 1977) [20]. The dehydrogenase activity was higher in 1% Mannitol (0.614) followed by 1% Chitosan (0.591) this may be possibly by the result of low moisture and low catabolic processes which was reported in black gram (Kavitha, 2002) [11] and green gram (Shenbaganathan, 2001) [24].

4. Conclusion

It can be concluded that seed priming with osmolytes of 1% Mannitol for 3 h performed well and increased seed quality and biochemical parameters of black gram and it could be recommended as pre sowing seed treatments for black gram.

5. References

2. Balaji DS, Sathiya Narayanan G. Effect of osmo priming
seed treatments on seed quality in certain minor millets. 2019;19:508-514.