The Pharma Innovation Journal 2021; 10(10): 1585-1587

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(10): 1585-1587

www.thepharmajournal.com
Received: 02-07-2021
Accepted: 10-09-2021

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Seed priming with Osmoprotectants to enhance drought tolerance capacity in green gram (*Vigna radiata* L.)

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Abstract
Green gram (*Vigna radiata* L.) grows mainly in rain-fed conditions with moderate rainfall. Drought during different growth stages results in lower productivity of the crop. In the present study seed priming of green gram with osmoprotectants was carried out to perceive the drought tolerance capacity of osmoprotectants on the growth of the crop. The seeds were primed with water and priming agents *viz*., glycine betaine and proline at concentrations of 100, 200 and 300 ppm with unprimed seeds served as control. Drought stress was imposed using polyethylene glycol (PEG) 6000 at -0.5 bar. The results revealed that glycine betaine @ 200 ppm recorded the highest speed of germination (25.00) with 94% germination and higher vigour index value (18.61) with the stress tolerance index of 94.28%. The performance of proline was also better at 300ppm concentration which was the next best treatment. Primed seeds performed better than unprimed seeds with enhanced germination and vigour of the seedlings under water stress condition.

Keywords: Drought stress, glycine betaine, green gram, priming, proline

Introduction
Pulses are the second most important group of crops worldwide. Green gram (*Vigna radiata* L.) grows mainly as rain-fed crop at high temperatures (27–30 °C), with low humidity and moderate rainfall. It suffers from water stress at various phases of crop growth when grown in the post-rainy season. Seed priming is a controlled hydration process that involves exposing seeds to low water potentials that restrict germination but permits pre-germinative physiological and biochemical changes (Khan, 1992) [7]. Primed seeds perform well under drought stress conditions particularly at early stages of crop growth since primed seeds can retain the memory of previous stress and enable protection through earlier activation of the cellular defense mechanism and reduced imbibition time (Marthandan *et al*., 2020) [9]. Some researches demonstrated that certain chemicals have shown potential to act under specific conditions as a priming agent against a range of different abiotic stresses, such chemicals include osmolytes like glycine betaine and proline. Both are thought to have positive effects on enzyme and membrane integrity along with adaptive roles by osmotic adjustment in plants grown under stress conditions (Ashraf and Foolad, 2007) [3]. Application of osmoprotectants such as glycine betaine and proline through seed priming can be a useful strategy for mitigating the harmful effects of drought stress and promoting seedling emergence. Hence the experiment was carried out to standardize the suitable osmoprotectant to prime the seeds of green gram for improving its drought tolerance capacity.

Materials and Methods
The experiment was carried out at the Department of Seed Science and Technology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai in green gram seeds. Water stress was created using polyethylene glycol (PEG) 6000 at -0.5 bar concentration which has given 40 to 50% seedling mortality. Seeds of green gram were primed with water and priming agents *viz*., glycine betaine and proline each at concentrations of 100, 200 and 300 ppm for a duration of 3hours with unprimed seeds had been serving as control. Sterilized seeds were sown in paper medium moistened with -0.5 bar PEG 6000 to impose drought stress.

The experiment was carried out with three replications in a completely randomized block design. Seeds were evaluated for speed of germination (Maguire 1962), germination (ISTA 2013) [6], shoot length (cm), root length (cm), dry matter production per 10seedlings (g), and vigour index values computed using dry matter (Abdul-Baki and Anderson 1973). Seedlings raised from unprimed seeds without water stress as per ISTA procedure were taken as absolute control and the Stress Tolerance Index (STI) was calculated using the following formula proposed by Dhopte and Livera (1989) [4] and expressed as percent.

$$STI\ (\%) = \frac{\text{Vigour index of the treated seedlings}}{\text{Vigour index of the Absolute control seedlings}} \times 100$$

Results and Discussion

In the present study drought stress imposed by PEG adversely affected the germination traits of unprimed seeds compared to seeds primed with water and Osmoprotectants irrespective of concentration of the solutes. Among the priming treatments seed priming with Glycine betaine @200 ppm have outperformed others and proline @ 300ppm also showed its superiority in alleviating stress imposed by PEG on germination. Seed priming induces rapid imbibition of seeds with a limited amount of water to start the pre-requisite metabolic events for pre-germination without radical protrusion. Due to the rapid uptake of water, the induction of germination and the emergence and establishment of primed seeds occurs earlier compared to that of control seeds (Stanley *et al*., 2016) [11]. Thus unprimed seeds shown the lowest speed of germination (18.50), germination percentage (66%), root length (9.58 cm), shoot length (9.25 cm), dry matter production (0.154 g/10 seedlings) (Figure 1) and vigour (10.16) compared to primed seeds (Table 1).Seed treatment with glycine betaine relieved the negative effects of water stress on seed germination and seedling growth, which is primarily due to its higher antioxidant activity and maintenance of cellular membrane integrity (Ahmed *et al*., 2019) [2]. The highest speed of germination (25.00), germination percentage (94%), root length (16.35 cm), shoot length (13.85 cm), dry matter production (0.198 g/10 seedlings) (Figure 1) and vigour index (18.61) values were obtained from glycine betaine @ 200ppm (Table 1). Similar results were obtained in wheat and turf grass (Ahmed *et al*., 2019; Zhang *et al*., 2014) [2, 13]. The next best treatment was proline @ 300ppm, which is an important osmoprotectant and plays a major role as ROS scavenger and membrane stabilizer, which on pre-seed treatment enhanced the drought tolerance capacity in wheat (Singh and Bhardwaj, 2019) [10].

The data shows that the stress tolerance index of control and hydro primed seeds was lower than the seeds treated with glycine betaine and proline. Among the priming treatments, glycine betaine @ 200ppm recorded the highest stress tolerance index of 94.28% followed by proline @ 300 ppm (84.35%), The unprimed seeds had the lowest stress tolerance per cent of 51.47% (Table 1).Water-stress tolerance is substantially associated with tissue water potential and antioxidant system, exogenous application of glycine betaine significantly reduced adversities of water-stress in seedlings of fine grain aromatic rice and improved leaf water potential and had higher antioxidant activity and better photosynthetic ability under water-deprived conditions (Farooq *et al*., 2008; Wani *et al*., 2013) [5, 12].

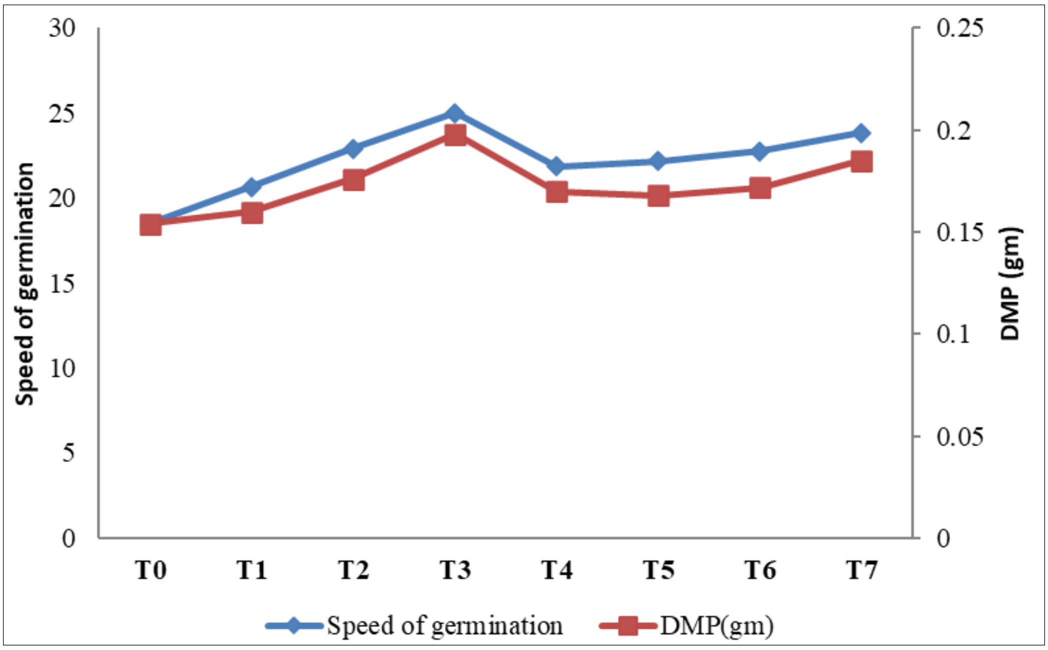

Fig 1: Effect on drought stress on speed of germination and dry matter production (gm)

Table 1: Similar results were obtained in wheat and turf grass

Treatments	Germination%	Root Length (cm)	Shoot Length (cm)	Vigor Index	Stress Tolerance Index (%)
T_0 – Control	66 (54.333)	9.58	9.25	10.16	51.47 (45.843)
T_1 – Hydropriming	74 (59.344)	12.50	10.98	11.84	59.98 (50.758)
T_2 - Glycine Betaine 100 ppm	86 (68.029)	14.07	12.46	15.14	76.70 (61.139)
T_3 - Glycine Betaine 200 ppm	94 (75.823)	16.20	13.85	18.61	94.28 (76.164)
T_4 - Glycine Betaine 300 ppm	84 (66.423)	13.06	11.58	14.28	72.34 (58.271)

T_5 - Proline 100 ppm	82 (64.897)	13.17	11.18	13.78	69.81 (56.672)
T_6 - Proline 200 ppm	86 (68.029)	14.81	12.32	14.79	74.92 (59.948)
T_7 -Proline 300 ppm	90 (71.567)	15.15	13.00	16.65	84.35 (66.698)
Mean	66.07	13.56	11.82	14.41	59.51
S.Ed	0.958	0.287	0.240	0.321	1.689
CD(0.05)	2.032	0.609	0.510	0.680	3.582

Conclusion

From our study, it was observed that seed priming with osmoprotectants have shown better performance than unprimed seeds especially glycine betaine @200ppm recorded the highest speed of germination, germination %, dry matter and vigour of seedlings with improved drought stress tolerance capacity. Hence it is concluded that seeds of green gram can be primed with glycine betaine at a concentration of 200ppm for using the seeds under water deficit conditions.

References

1. Abdul- Baki AA, Anderson JD. Vigor determination in soybean seed by multiple criteria 1. Crop science 1973;13(6):630-633.
2. Ahmed N, Zhang Y, Yu H, Gabar A, Zhou Y, Li Z, Zhang M. Seed priming with glycine betaine improve seed germination characteristics and antioxidant capacity of wheat (*Triticum aestivum* L.) seedlings under water-stress conditions. Applied Ecology and Environmental Research 2019;17(4):8333-8350.
3. Ashraf, Muhammad, Foolad, Majid. Roles of Glycine Betaine and Proline in Improving Plant Abiotic Stress Resistance. Environmental and Experimental Botany. 2007;59:206-216.
4. Dhopte AM, Livera MM. Useful Techniques for Plant Scientists, Forum for Plant Physiologists, Murly Printers, Shivnagar, Akola, India 1989.
5. Farooq M, Basra SMA, Wahid A, Cheema ZA, Cheema MA, Khaliq A. Physiological role of exogenously applied glycinebetaine to improve drought tolerance in fine grain Aromatic Rice (*Oryza sativa* L.). – Journal of Agronomy and Crop Science 2008;194:325-333.
6. ISTA. International rules for seed testing. In International Seed Testing Association, Bassersdorf, Switzerland 2013.
7. Khan AA. Preplant physiological seed conditioning. Horticultural reviews 1992;13:131-181.
8. Maguire JD. "Speed of Germination-Aid In Selection And Evaluation for Seedling Emergence And Vigour 1." Crop Science 1962;2(2):176-177.
9. Marthandan V, Geetha R, Kumutha K, Renganathan VG, Karthikeyan A, Ramalingam J. Seed Priming: A Feasible Strategy to Enhance Drought Tolerance in Crop Plants. International Journal of Molecular Sciences 2020;21(21):8258.
10. Singh N, Bhardwaj RD. Proline treatment ameliorates water deficit induced oxidative damage in wheat seedlings. Indian Journal of Experimental Biology 2019;57:399-407.
11. Stanley Lutts, Paolo Benincasa, Lukasz Wojtyla, Szymon Kubala S, Roberta Pace, Katzarina Lechowska *et al*. Seed Priming: New Comprehensive Approaches for an Old Empirical technique, New Challenges in Seed Biology - Basic and Translational Research Driving Seed Technology, Susana Araujo and Alma Balestrazzi, Intech Open, October 12th 2016 DOI: 10.5772/64420.
12. Wani SH, Singh NB, Haribhushan A, Mir JI. Compatible solute engineering in plants for abiotic stress tolerance - Role of glycine betaine. – Current Genomics 2013;14:157-165.
13. Zhang Q, Rue K, Mueller J. The effect of glycinebetaine priming on seed germination of six turfgrass species under drought, salinity, or temperature stress. Hort Science 2014;49(11):1454-1460.