

Standardization of seed Hydro-priming durations on germination and seedling growth of Finger millet (*Eleusine coracana*)

S. Seemansethupathi* and A. Kamaraj

Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University Annamalainagar - 608002 (India)

*Corresponding author E mail: seemansethupathi2@.com

Abstract

Seed priming is a pre – sowing treatment which permits the seed to germinate more efficiently and improve seedling vigour. The goal of this research is standardization of hydro priming duration on Co 15 finger millet seed germination performance establishing by hydro priming as 1:1 ratio with different seed soaking durations of 6,8,10,12,14 and 16 hours, respectively and unprimed seeds serving as a control. Investigation was carried out with seven treatments (T₀: Control, T₁: 6 h, T₂: 8 h, T₃: 10 h, T₄: 12 h, T₅: 14 h and T₆: 16 h) with four replications. A completely randomized design (CRD) was used to measure the germination test. Hydro primed with 8 hours significantly improved germination performance and early seedling growth of Co 15 finger millet seed compared to unprimed seeds in germination studies. We can conclude that during the initial stage of soaking duration of 8 hours enhanced the germination as well as seed vigour in finger millet and seedling growth had the best responses than other priming treatments.

Key words : Finger millet, Seed priming, Germination percentage, Mean time germination and Speed of emergence.

Finger millet (*Elusine coracana* L. Garten.) commonly called as ragi in India. It is native to Ehiopian highlands. Finger millet is grown in different agro-ecological conditions hence seed germination and vigour are also influenced by various unfavorable environmental factors such as extreme temperature, drought, untimely planting and so on. Seeds that have been primed have higher germination rates, resulting in higher levels of biotic and abiotic stress resistance and agricultural yields. Priming technique is the need for achieving uniform and quick seedling emergence is critical for crop performance. Seed priming is a controlled hydration technique that triggers the metabolic-restart during early phase of germination before radicle protrusion¹³. It involves imbibition of seeds to start the initial events of germination followed by seed drying up to its original weight. Soaking seed in water

overnight before sowing can increase the rate of germination and emergence even in soil conditions where moisture content is very low⁸. The effects of priming are associated with the repairing and building up of nucleic acids, increased synthesis of proteins as well as the repairing of membranes and also enhances the activities of anti-oxidative enzymes in treated seeds^{13,16}. Various seed priming techniques have been developed, including hydro-priming (soaking in water), halo-priming (soaking in inorganic salt solutions), osmo-priming (soaking in solutions of different organic osmotic solution), thermo-priming (treatment of seeds with low or high temperatures), solid matrix priming (treatment of seed with solid matrices) and bio-priming (hydration using biological compounds)².

Hydro-priming involves non-controlled water uptake, whereas other methods are associated with controlled water uptake by using osmotic solutions. In the triphasic model of water uptake by dry orthodox seed, phase I (rapid water uptake) and II (lag phase with least water uptake or the activation phase) represent the most delicate phases for the process of germination and are crucial for successful seed priming treatment⁴. The major disadvantage of hydro-priming is the non-controlled water uptake that may proceed until radicle protrusion if the process is not stopped at a precise moment before phase III begins (rapid water uptake followed by radicle emergence). So, the most critical stage of hydro-priming is to determine the right amount of water required to hydrate seeds that initiates germination metabolism and carry out repair processes while preventing the radicle emergence, *i.e.* the beginning of phase III. The

disadvantages associated with other methods include the accumulation of salts in seeds that could determine toxicity when salts are used as osmoticum for priming treatment⁴. Although hydro-priming is the easiest and the most economical method, hence, it is more appropriate to optimize the water absorption patterns and the duration of priming for crops/genotypes of economic importance for making hydro-priming an economically viable and farmer-friendly technique.

The study was carried out in the laboratory of Seed science and technology, Department of Genetics and Plant Breeding, Faculty of agriculture, Annamalai University, Tamil nadu, India during the year of 2022. The seeds of finger millet cultivar “Co 15” were used for present investigation to know the effect of seed hydro-priming durations on germination and seedling growth of finger millet.

The experiment was laid out in Completely Randomized Design with four replications of each treatment. The seeds were soaked in respective solution with duration of 6, 8, 10, 12, 14 and 16 hours with 1:1 ratio (v/w). After hydro-priming, seeds were treated with sodium hypochlorite 0.05% for 5 min and placed in open air to dry to moisture content <10% of the dry weight of the seeds, *i.e.*, equilibration conditions⁹. Twenty five seeds were placed on paper media in Petri dish for each replication. Each treatment was replicated four times. Seeds which did not treated were used as control. The test conditions were 25±2°C temperature, 95±5% Relative Humidity. Speed of germination after the seed began to germinate they were checked daily at approximately the same time each day. Final count of

normal seedling was recorded on 8th day. The number of normal seedlings was defined in accordance with ISTA criteria (2003). This procedure was continued until all seed that were capable of producing a normal seedling had germinated. Physiological parameters such as speed of emergence, germination percentage, mean germination time and germination index were calculated. Shoot and root length of all seedlings were measured by using a transparent ruler. Shoot and root fresh weights were measured using sensitive balance (g/10 Seedlings) and vigour index I & II.

Primed and unprimed seeds of finger millet cultivar of Co 15 evaluated with different durations at laboratory conditions and at 8 DAS (Days after seeding), observed the results of the study were collected significant differences by measuring different germination parameters and seedling growth parameters.

Speed of emergence :

The germination evaluation at 8th day of seedling, the higher germination was observed in hydro-primed seeds than unprimed seeds (T_0 – control). Speed of germination showed significant variation with different priming durations. The maximum speed of germination (15.6) was recorded with T_2 (8 hours) and minimum speed of germination (5.8) was observed in the control (T_0). Table-1. Hydro priming increase the respiration activities, ATP production, induced RNA activity and protein synthesis in the primed seeds enhanced emergence rate⁷.

Germination percentage (%) :

The maximum germination percentage (86 %) was recorded in T_2 (8 hours) of hydro-priming and minimum germination percentage (72 %) was observed in control (T_0). Table-1. Similar positive observations were also reported in finger millet by Kumar *et al.*,¹¹

Table-1. Standardization of hydro priming on speed of emergence, germination percentage (%), mean time germination, germination index and seedling shoot length

Treatments (Soaking durations)	Speed of emer- gence	Germination Percentage (%)	Mean time germination	Germination index	Seedling shoot length (cm)
T_0 - Control	5.8	72	3.6	5.7	1.4
T_1 - 6 hours	13.8	83	2.0	13.8	1.9
T_2 - 8 hours	15.6	86	1.5	15.6	2.0
T_3 - 10 hours	12.8	81	1.9	12.8	1.9
T_4 - 12 hours	14.8	79	3.0	14.8	1.8
T_5 - 14 hours	5.9	74	3.2	5.9	1.7
T_6 - 16 hours	5.8	73	3.4	5.8	1.7
Mean	10.6	78	2.7	10.6	1.8
S. Ed \pm	0.639	4.406	0.149	0.642	0.018
CD (p=0.05)	1.338	9.225	0.313	1.344	0.037

Table-2. Standardization of hydro priming on seedling root length, Seedling fresh weight, Seedling dry matter production, Vigour index I and Vigour index II

Treatments (Priming durations)	Seedling root length (cm)	Seedling fresh weight (g)	Seedling dry matter produ- ction (g)	Vigour index I	Vigour index II
T ₀ - Control	3.5	0.72	0.007	357	0.53
T ₁ - 6 hours	5.1	0.84	0.010	580	0.83
T ₂ - 8 hours	5.4	0.85	0.011	631	0.92
T ₃ - 10 hours	5.0	0.83	0.008	561	0.68
T ₄ - 12 hours	4.7	0.83	0.008	512	0.66
T ₅ - 14 hours	4.8	0.82	0.007	482	0.54
T ₆ - 16 hours	4.4	0.80	0.007	444	0.54
Mean	4.7	0.81	0.008	510	0.67
S. Ed ±	0.198	0.002	0.000	31.243	0.050
CD (p=0.05)	0.414	0.004	0.001	65.411	0.104

found the maximum safe lengths of soaking duration eight hours for finger millet. Hydro priming causes some physiological changes including the sugar content, organic compounds and cumulated ions in the seed, root and finally in the plant leaves leading to high rate of germination¹.

Mean time germination :

The recorded data showed that the germination percentage of finger millet increased with the decrease in the duration of germination period by hydro-priming as shown in Table-1. Among the priming durations, 8 hours (T₂) took the shortest period (1.5 days) to attain higher germination percentage while un-primed seeds of control (T₀) took more periods for higher germination percentage (3.6 days). This is in coordination to the findings of Bruggink *et al.*,⁶ that soaking of seeds reduce time to germination often leading to improved

emergence. Although hydro priming type had positive effect on early growth, so seedling and radicle length were greater significantly in hydro priming compared to un primed seeds.

Germination index :

The highest germination index values (15.6) were recorded in the soaking duration of 8 hours T₂ and lowest germination index values (5.7) were recorded in the un-primed seeds of control (T₀). Our study have confirmed with Moreno *et al.*¹⁴ hydro-priming advanced germination of different crop species resulting in higher values of germination parameters, seedling growth and germination index.

Seedlings shoot length and root length :

Increased hydro-priming durations, there was observed changes in seedling height. The tallest seedlings shoot and root length was

recorded on 8 hours of seed-hydro priming, which was significantly higher than other priming durations (Table-1 and 2). The maximum shoot length (2.0 cm) and root length (5.4 cm) was recorded in T₂ (8 hours) and minimum shoot length (1.4 cm) and root length (3.5 cm) was recorded in control (T₀). These observations are in conformity with Shahazad¹⁵ who reported increased shoot length in hydro primed seeds of wheat as compared to non-primed seeds. The increase in root and shoot ratio with hydro priming treatments might be due to the fact that, priming induced nuclear replication in root tips of fresh seeds¹⁶.

Seedling fresh and dry matter production :

Significantly highest seedling fresh weight (0.85) and seedling dry weight (0.011) were reported in T₂ (8 hours). Minimum seedling fresh weight (0.72) and seedling dry weight (0.007) were reported in control (T₀). These results are in accordance with Ghassemi *et al.*,¹⁰ reporting that hydro priming significantly improved root and shoot length, seedling dry weights and seed vigour index in chickpea.

Vigour index I and II :

Highest seedling vigour index I (631) and vigour index II (0.92) were observed in T₂ (8 hours). Lowest seedling Vigour index I (357) and vigour index II (0.53) were observed in control (T₀). These results resemble with the previous findings in maize with Mohammed and Rasheed¹².

From this study, it is revealed that hydro priming of seeds with 8 hours of soaking

durations help for improve the germination parameters and seedling growth parameters. However, further research needs to be done to know the impact of seed priming on the morphological characters and yield of finger millet.

References :

1. Alvarado, A. D., K. J. Bradford and J. D. Hewitt. (1987). *J. Amer. Soc. Hort. Sci.*, 112: 427-432.
2. Ashraf, M. and M. R. Foolad (2005). *Advances in Agron.* 88: 223-271.
3. Bekendam, J. and R. Grob, (2003). Hand Book for Seedling Evaluation, 3rd ed.; International Seed Testing Association (ISTA): Zurich, Switzerland, p. 143.
4. Bewley JD. (1997). *Plant Cell* 9: 1055-1066.
5. Bradford, KJ. (1995). Water relations in seed germination. In J Kigel, G Galili, eds, *Seed Development and Germination*, Marcel Dekker, Inc., New York, pp 351-396.
6. Bruggink, G. T., J. J Ooms, and P.V. Toom (1999). *Seed Science Research*, 9: 49-53.
7. Chojnowski, F. C. and D. Come. (1997). Physiological and biochemical changes induced in sunflower seeds by osmopriming and subsequent drying. Storage and aging. *Seed Sci. Res.* 7: 323-331.
8. Clarke LJ, WR Whalley, JE Jones, K Dent, HR Rowse, WEF Sawage and T Gatsai *et al.* (2001). On-farm seed priming in maize: A physiological evaluation. Seventh Eastern and Southern Africa Regional Maize Conference, 268-278.
9. Di Girolamo, G and L. Barbanti, (2012). *Italian J. Agron*, 7: e25.

10. Ghassemi - Golezani, K., P. Sheikhzadeh-Mosaddegh. and M. Valizadeh, (2008). *Research Journal of Seed Science*, 1: 34-40.
11. Kumar A, JS Gangwar, SC Prasad, and D Harris (2002). *Intl. Sorghum Millets Newsl.* 43: 90-92.
12. Mohammed, A. A., and A. A. Rasheed, (2016). *Iraqi Journal of Agriculture.* 21(2): 12-25.
13. McDonald, MB. (2000). Seed priming, seed technology and its biological basis. In MBlack, JD Bewley, eds, Sheffield, UK, pp 287-325.
14. Moreno, C., C.E. Seal, and J Papenbrock, (2018). *J. Agron. Crop Sci.*, 204: 40-48.
15. Shahzad Ali, Nadir Zaman, Waqar Ali, Majid Khan (2003). *Food and Nutrition Bulletin* 24(1): 104-125.
16. Stofella, P. J., D. P. Lipucci, A. Pardossi and F. Tognoni, (1992). *Horticultural Science*, 27: 214-5.
17. Wang, H. Y., C. L. Chen and J. M. Sung (2003). *Seed Sci. Technol.* 31: 47-56.