

EFFECT OF DIFFERENT PRIMING METHODS IN RICE (ORYZA SATIVA)

R. Subedi¹, B.K. Maharjan¹ and R. Adhikari²

ABSTRACT

Good germination of rice is considered critical for the plant life cycle. A laboratory experiment was conducted in IAAS, Lamjung campus, Sundarbazar to study the effect of different priming methods in rice. The experiment was done in completely randomized design using 12 treatments replicated thrice. The treatments consisted: Control (No priming), Hydro priming (soaking of seeds in distilled water for 72 hrs), PEG6000 - 5% and 10%, CaCl₂ - 0.5% and 1%, KCl - 2% and 4%, KNO₃ - 1% and 2% and NaCl - 1.8% and 3.6% where seeds were soaked for 12 hours followed by 12 hours drying. Both hydro priming and PEG improved germination energy, germination index, germination speed, radical length, and plumule length. The effect due to varied doses were not observed in the priming substances except PEG 6000, where PEG6000 - 5% was better as compared to PEG - 10% in overall observations.

Keywords: Halopriming, hydropriming, osmopriming, polyethylene glycol (PEG), seed priming.

INTRODUCTION

Rice (*Oryza sativa* L.) is a major food crop for the people of Asia; nearly 90% of the world's rice is produced and consumed in this region. Germination and seedling establishment are critical stages in the plant life cycle. Cereal production is widely limited by poor seed germination and crop establishment (Jones and Wanbi, 1992). Germination tends to be irregular and can extend over long periods particularly in drought-prone environments (Bougne *et al.*, 2000). The resulting poor crop germination leave gaps in the canopy, which are rapidly filled by vigorously growing weeds at the onset of the short rainy season which compete with the crop plants for light, water and nutrients (Kropff and Van Laar, 1993). Accelerating and homogenizing the germination process is a prerequisite for a good crop establishment, the efficient use of resources, and eventually to increase yields (Harris, 1996).

Seed priming can be low cost technology which can replace the traditional transplanting method which takes more labour force and longer duration to maturity compared to primed seed cultivation. Crop failure may occur reducing crop productivity if poor seed germination behavior occurs in field crop (Ghiyasi *et. al.*, 2008) which can be addressed by priming treatment leading to better germination and establishment in any crop (Basra *et. al.*, 2005; Ghiyasi *et. al.*, 2008). Rapid seed germination and stand establishment are critical factors for crop production under stress conditions. In many crop species, seed germination and early seedling growth are the most sensitive stages to stresses. Seed

¹ Institute of Agriculture and Animal Science, Lamjung Campus, Sundarbazar, Lamjung

² Plant Protection Officer, Plant Quarantine Checkpost, Tribhuvan International Airport, Kathmandu, Nepal

priming is known as the seed treatment which improves seed performance adverse under stressful environmental conditions (Ashraf and Foolad, 2005). Seed priming is defined as pre sowing treatments in water (hydropriming) or in an osmotic solution (osmopriming) that allows seed to imbibe water to proceed to the first stage of germination, but prevents radicle protrusion through the seed coat. Presowing treatment with inorganic salts (halo priming) not only promotes seed germination of most crops, but also stimulates later growth, metabolic processes and, hence, ultimate crop yield. Seed priming stimulates a different biochemical changes in the seed that are essential to initiate the germination process e.g. water imbibition, breaking of dormancy, activation of certain enzyme etc. (Ajour *et al.*, 2004). Primed seeds emerged 12h earlier than non primed seeds (Dell-Aquila and Tritto, 1990). This is due to increase in activity of enzymes such as amylase, protease and lipase which have great role in breakdown of macromolecules for growth and development of embryo that ultimately resulted in early and higher seedling emergence. The most important priming treatments are osmopriming, halopriming and hydro priming.

MATERIALS AND METHODS

The experiment was conducted in Agronomy lab of Lamjung Campus of Institute of Agriculture and Animal Sciences, Sundarbazar, Lamjung. Sookha dhan -2 variety of rice was used in the experiment. The experiment was carried out in completely randomized design consisting of 12 treatments replicated 3 times. The treatments consisted of priming with different priming substances followed by re-drying for 12 hours. The treatments used were Control (No Priming), Hydro priming (soaking of seeds for 72 hrs), PEG6000 5% and 10%, CaCl₂ - 0.5% and 1%, KCl - 2% and 4%, KNO₃ - 1% and 2% and NaCl - 1.8% and 3.6% for 12 hours followed by 12 hours drying. Observations were taken regularly for germination and counting was done regularly until final germination was recorded. For radical and plumule length reading was taken in 5th day with a measuring scale.

All the recorded data were tested for normality and homogeneity and analyzed using SPSS. The mean separation was done using LSD (at 5% level of significance).

RESULTS AND DISCUSSION

GERMINATION ENERGY(GE)

The results shows that there was significant difference between different priming methods on GE (Table 1). Hydro priming, KNO₃ - 2% and PEG - 5% showed significantly higher GE than control and NaCl - 3.6%. However, no any priming substances used brought significant alterations to GE when used in varied levels.

GERMINATION INDEX(GI)

All the priming methods (hydro priming, KNO₃, KCl, NaCl, PEG and CaCl₂) showed significantly higher germination index than control at both the levels but in case of KNO₃, KCl, and CaCl₂, there was statistical similarity between the varied doses (Table. 1). However, significant decrease in germination index was observed with increase in level of NaCl and PEG.

GERMINATION SPEED(GS)

Hydro priming, KCl - 1%, KNO₃ - 2%, NaCl - 1.8%, PEG - 5% and CaCl₂ - 1% showed higher GS than control and NaCl - 3.6%. There was statistical similarity among varied doses of all chemicals except NaCl, where increase in salt concentration significantly reduced the GS.

Table 1. Effect of different methods of priming on rice germination indices in Sundarbazar, Lamjung during 2014.

Treatment	Germination energy (GE)	Germination index (GI)	Germination speed (GS)	Radical (cm)	Plumule (cm)	Radical:plumule ratio (cm)
T1 (control)	90 ^b	6.556 ^d	94.54 ^b	3.860 ^c	1.467 ^c	2.676
T2 (hydro priming)	100 ^a	9.361 ^a	100 ^a	5.373 ^{ab}	2.453 ^a	2.302
T3 (KCl@1%)	95 ^{ab}	9.167 ^{ab}	100 ^a	4.680 ^{bc}	1.940 ^b	2.467
T4 (KCl@2%)	95 ^{ab}	8.361 ^{bc}	98.25 ^{ab}	5.033 ^b	1.720 ^{bc}	2.924
T5 (KNO ₃ @2%)	98.33 ^a	9.028 ^{ab}	100 ^a	5.273 ^a	1.820 ^{bc}	2.910
T6 (KNO ₃ @4%)	95 ^{ab}	8.694 ^{ab}	98.33 ^{ab}	4.867 ^b	1.887 ^b	2.582
T7 (NaCl@ 1.8%)	93.33 ^{ab}	9.139 ^{ab}	100 ^a	5.387 ^{ab}	2.047 ^{ab}	2.637
T8 (NaCl@3.6%)	83.33 ^b	7.694 ^c	90.93 ^b	4.200 ^{bc}	1.467 ^c	2.939
T9 (PEG6000@5%)	100 ^a	9.333 ^a	100 ^a	5.940 ^a	2.433 ^a	2.450
T10 PEG6000@10%)	93.33 ^{ab}	8.500 ^b	96.58 ^{ab}	4.400 ^{bc}	1.680 ^{bc}	2.718
T11 (CaCl ₂ @0.5%)	96.67 ^{ab}	8.333 ^{bc}	96.39 ^{ab}	5.127 ^{ab}	1.927 ^b	2.668
T12 (CaCl ₂ @1%)	93.33 ^{ab}	8.944 ^{ab}	100 ^a	4.580 ^{bc}	1.527 ^{bc}	3.041
N	94.44	8.593	97.92	4.893	1.864	2.693
LSD	8.061	0.7214	5.110	0.8523	0.4201	(ns)
CV	5.0%	5.0%	3.1%	10.3%	13.4%	18.6%

ns: non significant at p < 0.05. Different letters indicate significant difference at p < 0.05.

RADICAL LENGTH

Hydro priming, KCl - 2%, KNO₃ - 2% and 4%, NaCl - 1.8%, CaCl₂ - 0.5% and PEG - 5% resulted higher radical length than control. Different levels of KCl, NaCl and CaCl₂ were statistically similar (Table 1) but variation among different doses were observed in KNO₃ and PEG, where increase in level of both chemicals significantly decreased the radical length.

PLUMULE LENGTH

Hydro priming, NaCl - 1.8% and PEG - 5% resulted significantly higher plumule length than other priming methods. There was no significant difference between different levels of KCl, KNO₃, and CaCl₂ (Table 1) but among various level of NaCl and PEG there was significant difference which indicates that with increase in levels of both chemicals there is decrease in plumule length.

RADICAL TO PLUMULE RATIO

There was no significant difference between for root:shoot ratio because there was corresponding growth of radical and plumule among various priming methods.

Pre-germination metabolic activities are completed during seed priming, making the seed ready for germination compared with unprimed seeds (Sadeghi *et al.*, 2011). The embryo expands and compresses the endosperm due to effect of priming (Liptay and Zaiffa, 1993). Due to this compression force of the embryo and hydrolytic activities on the endosperm cell wall, that deforms the tissues that have lost their flexibility upon dehydration (Lin *et al.*, 1993), producing free space and facilitating root protrusion after rehydration. Due to faster water uptake and earlier initiation of metabolic processes, there is fastest rate of germination obtained by seed priming. Seeds would be simultaneously subjected to processes of repair and deterioration and force between the two determines the success or failure of the treatment due to which early seed germination occurs during priming (McDonald, 2000). Good germination and emergence is the key to control stand establishment. Seed hydration of wheat, barley and oats seeds improved the uniformity of seedling emergence (Kibite and Harker, 1991). Hydro priming enhanced seedling establishment and early vigor of upland rice, maize and chickpea, resulting in faster development, earlier flowering and maturity and higher yields (Harris *et al.*, 1999). There is rapid and uniform seed germination of several cereal crops specially rice as seed priming was done (Basra *et al.*, 2005; Jie *et al.*, 2002).

Cell growth and division play a great role in early stages of germination and seedling growth this needs the transmission of necessary nutrients like soluble sugars and low weight proteins from storage organs of seed to growth sites for transpiration (Bewley and Black, 1994). Significant improvement in radicle and plumule length may be attributed to earlier germination induced by primed over un-primed seeds (Farooq *et al.*, 2005), which resulted in vigorous seedlings with more root and shoot length than the seedlings from un-primed seeds.

CONCLUSION

In many rainfed areas, germination and subsequent seedling growth can be inhibited by adverse conditions in the field. Priming is helpful in reducing the risk of poor stand establishment under a wide range of environmental conditions. Hydro priming and PEG6000 - 5% resulted better performances compared to other priming methods for different germination indices in the experiment. Therefore, it is advisable to practice hydro priming or priming with PEG6000 - 5% as a successful technique for increasing and hastening of seed germination and better crop stand.

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