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Evaluation of Seedling Vigor of Hydro and Matriprimed Wheat (*Triticum aestivum* L.) Seeds

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ABSTRACT

An experiment was conducted to study the emergence and seedling establishment of wheat (*Triticum aestivum* L.) cv. Auqab-2000 seeds. Wheat seeds were subjected to hydropriming for 6, 12 or 24 h and matriconditioning with gunny bags or sugarcane press mud for 12 or 24 h. Early emergence was recorded in hydroprimed seeds. However, maximum emergence percentage was recorded for hydropriming and matriconditioning with gunny bags for 24 h including control. The best priming treatment was found to be hydropriming for 24 h followed by matriconditioning with gunny bags for 24 h. Hydroprimed seeds had lesser electrical conductivity (EC) of seeds leachates than control. Matriconditioning with gunny bag or press mud resulted in increased EC than control. Hydropriming for 12 or 24 h reduced the germination time and increased the seedling vigor under present experimental conditions.

Key Words: Hydropriming; Matricondioning; Seedling vigor; Wheat

INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important cereal crop in Pakistan and ranks first in the world cereal crops production. It is a staple food of 1/3rd of the world's population and a principal source of carbohydrates and nutrition both for human being and animals. Despite its higher potential, average yield in Pakistan is less than that of the most countries of the world. Among various constraints limiting wheat productivity in Pakistan, poor quality of seed and late sowing are of prime importance. Various seed invigoration treatments have been used to improve seed germination and seedling establishment. These include alternate hydration-dehydration (Nath *et al*., 1991), water soaking (Rudrapal & Nakamura, 1988) and seed priming (Khan, 1992).

Seed priming is a pre-germination seed treatment in which seeds are held at water potential that allows imbibition, but prevents radicle extension (Bradford, 1986). Seed priming has been used to improve germination, reduce seedling germination time, improve stand establishment and yield (Khan, 1992). In priming enhancement of physiological and biochemical events in seeds takes place during suspension of germination by low osmotic potential and negligible matric potential of the imbibing medium. Salts or non-penetrating organic solutes in liquid medium (osmoconditioning) or solid matrices (matriconditioning) are used to establish an equilibrium of water potential between seed and osmotic medium needed for conditioning (Khan, 1992).

Priming also expands the temperature range at which germination may occur (Welbaum & Bradford, 1991). So priming can be used to invigorate and to compensate the losses due to late sowing of wheat. Very little work has been done in Pakistan in this regard especially for wheat seed. The objectives of the present study were to test the response of wheat seed to different priming treatments and to test their germination and seedling establishment.

MATERIALS AND METHODS

Seed of wheat cv. Auqab-2000 were obtained from Wheat Research Institute, AARI, Faisalabad. The initial moisture contents were 9.6% estimated by using three seed samples according to the recommendations of Ellis *et al*. (1985).

Seed priming. The seeds were primed with distilled water, saturated gunny bags or sugarcane press mud as under:

I. Hydropriming. Seeds were soaked in continuously aerated distilled water for 6, 12 or 24 h. After soaking, seeds were redried to original weight with forced air under shade (Bennett & Waters, 1987).

II. Solid matrix priming. Solid matrix priming was carried out with two solid matrix carriers i.e. press mud and gunny bag, which are cheaper as compared to calcined clay and Micro Cell E, most widely commercial solid matrices being used in developed countries. First of all, 500 g seeds were mixed with 1 kg press mud and 350 mL of distilled water in closed plastic containers. The containers were placed under shade at room temperature for 12 or 24 h. The partially hydrated seeds then were screened from press mud. Five hundred grams seeds were also primed matrically with saturated gunny bag for 12 or 24 h under shade (Afzal *et al.,* 2002).

Post priming operations. After prescribed soaking period, seeds were given three surface washings with distilled water and redried under shade to original weight with forced air. Seeds were sealed in air tight polythene bags and stored in a refrigerator at 8±2^{o}C. The treated seeds were compared with control ones for vigor by emergence and electrical conductivity tests.

Vigor evaluation

Emergence test. The experiment was carried out in pots (5 x 5 inches) filled with sand. Ten seeds were sown per pot at the depth of 3 cm and replicated three times. The pots were placed in incubator at 25°C with 60% relative humidity during 14/10 h photoperiod. Irrigation was applied whenever required. The data regarding emergence, days to 50% emergence (E_{50}) and mean emergence time (MET) were recorded upto 7th day of sowing. After 10 days of sowing, the data regarding shoot length, root length, shoot fresh and dry weights and root fresh and dry weights were recorded.

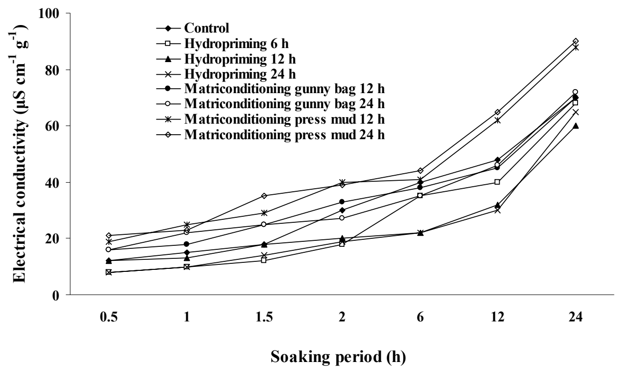
Electrical conductivity of seed leachates. After washing with distilled water, 5 g of wheat seeds were soaked in 50 mL of distilled water at 25ºC. Electrical conductivity of seed leachates was measured 0.5, 1, 1.5, 2, 6, 12 and 24 h after the soaking period using the conductivity meter (Model Twin Cod B-173) and expressed as µS cm^{-1} g^{-1}. The experiment was replicated thrice.

The data collected was analyzed using Fisher's analysis of variance technique and treatment means were compared using least significant test (LSD) at 5% level of probability (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Comparison of treatment means (Table I) indicated emergence and root shoot lengths were significantly affected by matriconditioning with press mud, gunny bag, and hydropriming treatments. Highest emergence (100%) was recorded in seeds hypdroprimed and matriconditioned with gunny bags for 24 h as against 70.33% from control (Table I). Minimum emergence percentage was recorded in case of hydropriming for 6 h. Hydropriming for 12 or 24 h required less time to complete 50% emergence. All the matriconditioning treatments significantly increased the E_{50}. Maximum invigoration was achieved in hydropriming for 24 h supporting earlier work done by Fujikura *et al.* (1993) who reported that hydropriming cause greater increase in germination rate in cauliflower than other priming treatment. Generally, fast germination is due to the synthesis of DNA, RNA and protein during priming (Bray *et al.*, 1989). The increased plant biomass might be due to synchronized germination and early stand establishment in treated seeds (Khan, 1992). These findings are similar with earlier research on asparagus (Evan & Pill, 1989), pepper (Smith & Cobb, 1991), Canola (Zhang *et al*., 1994) and wheat (Nayyar *et al*., 1995). Shoot length was increased in hydroprimed and matriconditioned seeds for 12 or 24 h as compared to hydroprimed for 6 h and non-primed seeds. An increase in root length was recorded in matriconditioning treatment which might be the result of higher embryo-cell wall extensibility. These results are in line with the work done by Beckman *et al.* (1993) who reported that solid matrix priming significantly increased adventitious roots than that of control in switch grass during green house experiment. Jett *et al.* (1996) also reported that root growth rates of matricprimed seeds were significantly higher than either osmotic or non-primed seedlings at most temperatures.

Fig. 1. Solute leakage of wheat cv. Auqab-2000 as affected by various pre-sowing seed treatments



The increase in root/shoot ratio with hydropriming treatments may be due to the fact that, priming induced nuclear replication in root tips of fresh seeds. These observations are in conformity with earlier work on wheat and pepper seeds (Stofella *et al*., 1992). Compared to control, maximal dry weight of roots was obtained by hydropriming and matriconditioning with press mud for 12 or 24 h. Hydropriming (6, 12 or 24 h) and matriconditioning with press mud (24 h) increased dry weight of shoots as

Table I. Influence of seed priming on vigor of wheat cv. Auqab-2000

Treatments	Final Emergence (%)	E_{50} (days)	MET (days)	Shoot length (cm)	Root length (cm)	Root shoot ratio	Root dry weight (g)	Shoot dry weight (g)
Control	70.33ab*	4.60ab	4.92ab	12.61b	7.86ab	1.60ab	0.27b	0.64c
Hydropriming 6 h	32.50c	4.60ab	5.90bc	18.20ab	6.60c	2.48a	0.21b	0.85ab
Hydropriming 12 h	90.00ab	4.06a	4.50a	25.11a	8.71ab	1.50ab	0.31a	1.00a
Hydropriming 24 h	100.00a	4.03a	4.79ab	23.02a	8.43c	1.51ab	0.44a	1.75a
MC with gunny bags 12 h	67.50b	5.10b	5.13ab	23.91a	6.89c	0.48b	0.30b	0.44c
MC with gunny bags 24 h	100.00a	5.10b	6.23b	20.01a	8.74ab	1.55ab	0.38b	0.79bc
MC with press mud 12 h	59.17b	6.29b	7.14c	19.02ab	7.46bc	0.53b	0.40a	0.58cd
MC with press mud 24 h	90.50ab	6.30b	7.23c	21.91a	9.43a	1.66ab	0.41a	0.84ab

* Letters with different alphabets are statistically different at p 0.05; MC= matriconditioning; E_{50}= Time to 50% emergence; MET= Mean emergence time

compared to other priming treatments. These results favor the findings of Pill and Necker (2001) who reported that matriprimed compared to non-primed resulted in greater shoot dry weights in Kentucky blue grass.

The conductivity of leachates from non-primed and matriconditioned (press mud) seeds increased readily during the first 30 min of imbibition and maintained the increasing trend upto 12 h of imbibition (Fig. 1). Hydropriming treatment for 24 h had minimal electrical conductivity than all other treatments. Maximum EC value was recorded in matriconditioning with press mud for 24 h. Overall results of electrical conductive test show that EC of seed leachates was increased with matriconditioning while hydropriming treatments reduced the EC than that of control. The increased EC by matriconditioning might due to increased ionic absorption from press mud. The low EC for other primed seed may be due to better plasma membrane structure by slow hydration. These results positively correlate with the findings of Jett *et al*. (1996) for broccoli seeds, Parera and Cantliffe (1991) for Shrunkan-2 corn and Khan *et al*. (1992) for super sweet corn who reported that electrolyte leakage from matriconditioned seeds was consistently less than non-primed seeds at all temperatures. The results of present study are also in consistent with Rudrapal and Nakamura (1988) who observed lower EC of seeds leachates and reduced leakage of sugars in egg plant and radish seeds in result of soaking seeds in simple water.

CONCLUSION

Wheat seeds genotype Auqab-2000 respond to different pre-sowing seed treatment and hydropriming treatments for 24 h showed the maximum invigoration followed by matriconditioning with gunny bag for 24 h than all other treatments including control.

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