ENHANCEMENT OF GERMINATION AND EMERGENCE OF CANOLA SEEDS BY DIFFERENT PRIMING TECHNIQUES

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ABSTRACT

The present study was conducted to enhance the germination and emergence of canola (Brassica napus) CV. Zafar-2000 seeds using different priming treatments. For comparison with non-soaked control, different priming techniques i.e. osmopriming with PEG-6000, hydropriming and matriconditioning with compost, jute mat and press mud of sugar mill for 24 hours were used. All priming treatments were effective in improving germination percentage as compared to control except SMP with press mud. The osmopriming and matriconditioning (jute mat) proved to be the best in reducing the time to 50% germination and mean germination time among all priming treatments. During emergence test, both priming treatments i.e. osmopriming and matriconditioning (jute mat) for 24 hours reduced the time to 50% emergence and mean emergence time. Maximum root and shoot lengths were recorded in hydroprimed seeds. Highest electrical conductivity was recorded for control while lowest electrical conductivity was recorded in osmoprimed seeds. It is concluded that priming of seeds with PEG-6000 and matriconditioning (jute mat) are most effective in improving germination and seedling emergence of canola seeds.

Keywords: canola seed, hydropriming, matriconditioning and osmopriming.

INTRODUCTION

Canola is the world’s third largest source of edible oil after soybean and palm oil. Canola yield is very low as compared to its production potential (NOWLIN, 1991). Out of many constraints regarding low production of oilseeds, seed quality is of prime importance. Oilseeds are deteriorated more rapidly during storage, which reduces the quality of seeds. Oilseeds are more susceptible to...
deterioration due to membrane disruption, high free fatty acid level in seeds, free radicle production, mutation and low metabolic processes. (DELL’AQUILLA and TRITTO, 1990). These all are the symptoms of less vigorous seed. Many seed priming treatments have been used to accelerate the germination and seedling growth in most of the crops under normal and stress conditions (BASRA et al., 2003).

Pre-sowing hydration treatments (priming) include non-controlled water uptake systems (methods in which water is freely available and not restricted by the environment) and controlled systems (methods that regulate seed moisture content preventing the completion of germination). Three techniques are used for controlled water uptake: priming with solutions or with solid particulate systems or by controlled hydration with water (TAYLOR et al., 1998).

There are several indications that many physiological mechanisms are involved in seed priming (osmoconditioning); the repair of the age related cellular and subcellular damage that could accumulate during seed development (BURGASS and POWELL, 1984; BRAY, 1995); and an advancement of metabolic events during the prolonged lag phase – II of imbibition that prepares the radicle protrusion. (DELL’AQUILLA and BEWLEY, 1989). Some morphological changes also occur in the primed seeds, which are helpful in the later growth of embryo, e.g., a portion of the seed endosperm is hydrolyzed during priming that permits faster embryo growth (BURGASS and POWELL, 1984).

The present investigation therefore, was designed with the objective to accelerate the germination and seedling emergence of canola seeds through different seed priming techniques.

MATERIALS AND METHODS

Seeds of Brassica napus (Canola) CV. Zafar 2000 were collected from Pakistan Oil Seed Department Board (POSDB) Office, Jain Mandar, Lahore. Five different seed priming treatments as previously described by BENNETT and WATER (1987) accompanied with an independent control (table 1) were evaluated for test material. Techniques such as Hydropriming, osmo-priming and Solid matrix priming (BENNETT and WATER, 1987) were used in the study.

<table>
<thead>
<tr>
<th>No</th>
<th>Treatments</th>
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<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Control</td>
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<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Hydropriming for 24 h</td>
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<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>Osmopriming with PEG-6000 for 24 h</td>
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<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>Solid matrix priming, with saturated jute mat for 24 h</td>
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<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>Solid matrix priming with distilled water saturated compost for 24 h</td>
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<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>Solid matrix priming, with saturated press mud of Sugar Mills for 24 h</td>
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For each treatment 100 g of seeds were taken. During priming period, continuous fresh air was supplied to T<sub>2</sub> and T<sub>4</sub> treatments through plastic pipes with aeration pump.

PRE-SOWING SEED TREATMENTS:

**For hydropriming** 100 g seeds were soaked in distilled water for 24 hours and then seeds were re-dried to their original weight with fan air under shade. The seeds were sealed in airtight polythene bags and placed in refrigerator at 8°C till further use.

**For osmopriming**, seeds were soaked in -0.6 MPa Polyethylene glycol (ave.mol wt.6000) solution at 25°C for 24 hours. The primed seeds were washed with running tap water (LEE and KIM, 1999).

**For solid matrix priming**, first of all seeds were mixed with 1 kg sterilized compost and press mud separately and 350 ml of distilled water in closed plastic containers for 24 hours. The partially hydrated seeds were then screened from the compost and press mud. In case of 3<sup>rd</sup> solid matrix carrier, pieces of jute mat were cut and a layer of these mat were made at table and then 100 g seeds were spread on it and covered by a 2<sup>nd</sup> layer of jute mat pieces. Gunny bag pieces were saturated with distilled water. This treatment was also given for 24 hours.
**POST PRIMING OPERATIONS:**

After osmo and matri conditioning, seeds were given three surface washings with distilled water (KHAN, 1992) and redried to original weight with forced air under shade. These seeds were packed in polythene bags and stored in refrigerator for further studies.

**VIGOR EVALUATION**

**Germination Test:** Germination experiments were conducted in germinator at 25°C in 9-cm petridishes (25 seeds per dish, 4 replicates), on a layer of filter paper moistened with distilled water. A seed was considered germinated when the radical pierced the coats upto 2mm. Germination counts were made daily for 7 days (CHOJNOWSKI et al., 1997). Total numbers of seed germinated/ emerged were counted and the percentage was calculated. \( T_{50} \) (days to 50% germination) is expressed as time taken for half of seed to germinate (ZHENG et al., 1994). Mean germination time was calculated according to Ellis and Roberts (1981).

**Emergence Test:** In case of emergence test, 50 seeds for each priming treatment were used. The pre-treated seeds were surface sterilized with 5% NaOCl (Sodium Hypochloride) for 5 minutes to avoid fungal invasion followed by washing with distilled water (BASRA et al., 2002). The control and treated seeds were sown in deep bottom plates of 15cm diameter, containing moist sand. 50 seeds were sown per tray with three replicates. The trays were placed in growth chamber at 25°C. The data regarding the final emergence percentage, days to 50% emergence \( E_{50} \) and mean emergence time \( MET \) (days) were recorded. The data for the shoot length (cm), root length (cm), root/shoot ratio, fresh weight of seedling (g) and dry weight of seedling (g) was recorded after 5 days of sowing (BASRA et al., 2002).

**Electrical Conductivity (EC) of seed leachates:** A total of 5g of Canola seeds were soaked in 50mL of distilled water at 25°C. EC of seed leachate was measured after 0.5, 1, 1.5, 2, 6, 12 and 24 hours using the EC meter (Model Twin CodB-173) and expressed as \( \mu S/cm/g \) (AFZAL et al., 2002). The experiment was repeated thrice.

**Statistical analysis:** The data collected was analyzed using the Fisher's analysis of variance technique under completely randomized design (CRD) and the treatment means were compared by Least Significant Difference (LSD) test at 0.05 probability level (STEEL and TORRIE, 1984).

**RESULTS**

**Germination Test**

The analysis of resulting data (Fig. 1) indicates that germination, \( T_{50} \) and mean germination time were significantly affected by different priming tools during germination test. All the seed treatments except SMP with press mud resulted in increased germination as compared to control (Fig 1a). Highest germination (100%) was recorded in hydroprimed and matriconditioned (jute mat) seeds followed by osmoconditioning and matriconditioning with compost. In contrast, final germination percentage was reduced in seeds matriconditioned with press mud. The highest decrease in \( T_{50} \) value was recorded in seeds primed with matriconditioning with jute mat, which was significantly lower than control (Fig 1b). Osmo-priming also decrease the time to 50% germination but the decrease was lower as compared to the matriconditioning with jute mat while hydropriming and matriconditioning with compost induced a non-significant effect on \( T_{50} \). On the other hand, matriconditioning with press mud significantly delayed the germination time of seeds. Maximum MGT was recorded for SMP with press mud and minimum MGT was recorded for SMP with jute mat (1.29) that was statistically equivalent to hydropriming and osmoconditioning (Fig 1c).

**Emergence Test**

Different priming techniques induce significant effect on emergence, \( E_{50} \) and MET during emergence test (Fig. 2). Except SMP with press mud, all treatments had statistically similar final emergence percentage (Fig 2a). SMP (press mud) significantly decreased final emergence percentage as compared to control. The results (Fig 2b) indicate that hydropriming, osmopriming and matriconditioning with compost and jute mat enhanced the emergence of canola seeds as compared with control i.e; minimum \( E_{50} \), as compared to control. SMP with jute mat maximally reduced the time to 50% emergence during emergence test. Except SMP with press mud, all priming treatments showed less mean emergence time than control (Fig 2c). Minimum mean emergence time was recorded in hydroprimed seeds.
The electrical conductivity (EC) of seed leachate from hydro primed and Osmoprimed, matric primed and non-primed canola seeds was measured after 1, 2, 6, 12 and 24 hours of soaking (Fig 4). The conductivity of leachate from none primed and SMP with press mud seeds increased rapidly during first hour and maintained the increasing trend up to 6 hours. After 12 hours the EC value of hydro priming and SMP with jute mat increased sharply. EC value of osmoprimed seeds was still low than other all treatments upto 6hrs. After 12 hours it was noted that the SMP with press mud has highest value of conductivity but hydroprimed and matric primed seeds with compost have comparatively less value of conductivity. Electrolyte leakage from hydroprimed, matric condition with jute mat was consistently high than osmoprimed seeds during imbibition.

**DISCUSSION**

**Germination Test**

These results of germination test demonstrate that germination of canola was better by hydropriming and matricconditioning with jute mat than control (Fig 1). These findings relate to the work done by Sivritepe and Eris (2000) who observed that hydropriming for 2, 4 and 6 days decreased mean germination time and hence increased germination. Present results of matricconditioning are in accordance with the work done by Yamamoto et al. (1997) and Fret and Pill (1995) who reported that solid matrix priming increased germination percentage. The results of germination due to matricconditioning are in consistent with the finding of Khan et al. (1992) and Afzal et al. (2002). The superiority of matricconditioning may be due to higher water holding capacity and higher porosity that increases oxygen availability. In PEG solution it is lower that may result in limiting water and oxygen contents during osmotic priming treatments (MEXAL et al., 1975). Reduction of germination % age and mean time to germination in case of SMP with press mud or compost might be due to accumulation of some toxic substances in tissue, which cause toxicity (SMITH and COBB, 1991).

**Emergence Test**

Reductions of (FGP) in seeds, matricconditioned with press mud and compost, is due to accumulation of toxic substance from medium into tissues (SMITH and COBB, 1991). The results as show that all hydro primed, osmoprimed and SMP with compost emerged rapidly than that of control (Fig. 2). Hydroprimed, osmoprimed and SMP with compost shows similar results, which are statistically at par by comparison. SMP with jute mat showed minimum E50. These results are in agreement with Yamamoto et al. (1997) who observed that solid matrix priming treatments reduced time required for emergence and in proceeding final emergence.

The priming treatments accelerated the germination of canola seeds as compared to control, which resulted in rapid emergence of seedlings (BASRA et al., 2003). Present results due to hydropriming are also correlated with previous work done by Zheng et al. (1994) who studied the effect of priming on canola and observed that seed germination and seedling emergence were enhanced for several cultivars of both species due to priming. In the present study, time to 50% germination and emergence was also reduced, as a result of osmopriming as also reported in other previous studies (ALVARADO et al., 1987; PILL and EVANS, 1991) in which it was concluded that carrot from treated seed emerged more rapidly than those from untreated seeds but seed treatment had no effect on emergence percentage (FGP). The increase in emergence with osmopriming might be due to initiating metabolic events in primed seeds. Another possible reason is that priming may also leach germination inhibitors from seeds (HEYDECKER and COOLBEAR, 1978).

The more value of MET by osmopriming might be due to use of more concentration of PEG for canola seeds (MURRAY, 1990). Previous work revealed that seeds soaked in water and matricconditioning germinate rapidly and seedling emerges quickly and uniformly (BENNETT and WATERS, 1987). Chilembe et al. 1992 stated that soaking seeds of four citrus root stocks in aerated water significantly increase germination and emergence over unsoaked seeds. Priming seeds in one of the three solution of PEG (-0.6 to -1.2MPa) was not successful, as germination and emergence percentage were lower than in distilled water.

Maximum shoot length was recorded in hydroprimed seeds which was statistically at par with matricconditioning with jute mat. The results of present research work done not co-relate with Afzal et al. (2002), who reported that osmopriming does not enhance the shoot length. These results are in consistent with work done by Stofella et al. (1992) for pepper seeds and Tarquis and Bradford (1992) for lettuce seeds. The results of present research work concerning matricconditioning are opposite to the work done by Beckman et al. (1993), who reported that solid matrix priming significantly increased adventitious roots than that of control. Results are also opposite to the work of Jett et al. (1996) who reported that root growth rates of matric primed seeds were significantly higher then either osmotic or non primed seedlings at most temperatures.
Membrane Permeability Test

The beneficial effects may be due to the flushing of solutes from seed during the priming procedure and prior to determination of leaked substances (OSBURN and SCHROTH, 1988). The low value of EC for the osmoprimed seeds may be due to better plasma membrane structure by slow hydration (JETT et al., 1996). Matricconditioned seeds showed high conductivity (Fig. 4), reason for this might be contribution of some mineral nutrients even after post priming washing. Seed leachate electrical conductivity is considered as an effective indicator of seed germination in sweet corn (WATERS and BLANCHETTE 1983). Increased seed leachate conductivity of matricconditioned seeds was probably due to the loss of ability to recognize cellular membranes rapidly and completely (MCDONALD, 1980). The results of present research work are not in consistence with the results of Afzal et al., (2002) on maize and Basra et al., (2002) on canola.

CONCLUSION

It shows that priming can improve the performance of low vigor seeds and induce early, synchronized and healthier crop stand. Matricconditioning with jute mat and osmo and hydropurging could invigorate the seeds at early seedling stage.
FIGURE 2 - Effect of different priming techniques (as listed in table 1) on Final emergence % (a), T_{50} (b), and MET (c) of canola (*Brassica napus* L.) cv. Zafar-2000 in germination test. Bars within each treatment not marked with the same letter are significantly different (P<0.05) according to the Least Significant Difference Test.

FIGURE 3 - Effect of different priming techniques (as listed in table 1) on root length (a), shoot length (b), and root shoot ratio (c) of canola (*Brassica napus* L.) cv. Zafar-2000. Bars within each treatment not marked with the same letter are significantly different (P<0.05) according to the Least Significant Difference Test.
AFZAL, I. et al. Enhancement of Germination and Emergence of Canola Seeds... 


REFERENCES


JETT, L.W.; WELBAUM, G.E.; MORSE, R.D. Effect of matric and osmotic priming treatments on Broccoli seed germination. Journal of American Society of
Enhancement of Germination and Emergence of Canola Seeds...

HortSciences, 121, p. 423-429, 1996.


