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Effect of Storage on Growth and Yield of Primed Canola (*Brassica napus*) Seeds

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ABSTRACT

An experiment was conducted to assess the effects of freshly primed and stored for six months after priming of canola seeds on crop growth, development and yield. Seeds were primed with polyethylene glycol (PEG-10,000) for 4 or 8 h, dried back and stored in sealed containers in a refrigerator for six months. For fresh priming, the seeds were subjected to hydro-and/ or osmopriming for 4 or 8 h and dried back. The fresh or stored primed seeds were compared with control for crop growth and development under field conditions. Osmopriming for 8 h fresh and 4 h stored resulted in more leaf area index, dry matter accumulation, crop growth rate and ultimately higher seed yield than all other treatments including control. Overall, osmopriming performed better than hydropriming and control.

Key Words: Priming; Canola; Seed storage; Growth; Yield

INTRODUCTION

Pakistan has been facing a chronic shortage of edible oil. The indigenous edible oil production can not match the growing demand of population. As a result, a large quantity of edible oil is being imported annually from other countries to bridge up the gap, existing between local production and consumption. In 2000-2001, the total consumption was estimated as 1.95 million tons and the local production was sufficient to meet merely 29% of the consumption; while, the remaining 71% was met through imports (Economic Survey of Pakistan, 2001).

The rapeseed and mustard are second source of edible oil after cotton seed contributing towards the national production of edible oil, but its oil is of low quality due to the presence of high concentration of erucic acid and glucosinolates. Because of the health concerns, Canadian scientists developed rapeseed cultivars "CANOLA" with low erucic acid and glucosinolates contents. These cultivars are called as "double zero" or "double low" varieties. The name "CANOLA" (Canadian oil low in acids) was at first trade mark registered with Canola council of Canada (Thomas, 1986). Canola oil is now the world's third largest source of edible oil after soybean and palm oil (Nowlin, 1991).

The average yield of canola is very low as compared to its production potential. Out of many constraints regarding low production of oil seeds, seed quality is of prime importance. By providing some special pre-sowing treatments, seeds can be invigorated. There are many invigoration techniques such as pre-sowing hydration treatments (priming) coating technologies and seed conditioning (Taylor *et al.,* 1998). The most important is the pre-sowing hydration treatments. These include hydration dehydration (Nath *et al.,* 1991), water soaking (Harris *et al.,* 1999) and seed priming (Khan, 1992; Parera & Cantliffe, 1994). Seed priming, also known as osmoconditioning, is a controlled hydration process by soaking seeds in solutions of low water potential followed by redrying that allows pre-germinative metabolic activities to proceed but prevents radical emergence (Bradford, 1986). Seed priming has been used to improve germination, reduce seedling emergence time and improve stand establishment and yield (Khan, 1992). Primed seeds are usually loose their storage life, therefore, used immediately after priming. The objective of this study was to explore the effects of seed priming and storage of primed seeds on growth and yield of canola.

MATERIALS AND METHODS

Plant material. The study was carried out at the students farm, University of Agriculture, Faisalabad, during the year 2000-2001.The experiment was laid out in RCBD with three replications. The net plot size was 1.2 x 6 m. Canola cv. Hyola-401 at the seed rate 5 kg $ha^{-1}$was sown in six rows spaced at 30 cm in each plot. The treatments used in the experiment were:

I. Primed and stored: T_1 = Hydropriming for 4 h;T_2 = Hydropriming for 8 h; T_3 = Priming with plyethylene glycol (PEG-10000) for 4 h; T_4 = Priming with plyethylene glycol (PEG-10000) for 8 h. After prescribed priming periods, seeds were given three surface washings with distilled water (Khan *et al.,* 1992) and redried to original weight with forced air under shade. There dried seeds were sealed in air tight polythene bags and placed in refrigerator at 8±2°C for six months (Bennett & Waters, 1987).

II. Fresh priming: T_5 = Priming with polyethylene glycol (PEG-10000) for 4 h; T_6 = Priming with polyethylene glycol (PEG-10000) for 8 h. The primed seeds were redried according to the method described earlier and sown immediately.

For each priming treatment, 100 g seeds were used. The seeds were surface sterilized with 5% NaOCl (sodium hypochlorite) for 5 min to avoid fungal invasion, followed by washing with distilled water. For priming, seeds were soaked in 300 mL of distilled water or PEG solution. During soaking period, the water or solution was aerated continuously.

Six–months–stored primed seed, freshly primed seeds and non-primed (control) were planted in field. The experiment was laid out in completely randomized block design with three replications with a net plot size of 1.2 x 6.0 m. Crop was sown in October 2000, using a seed rate of 5 kg ha^{-1} in 30 cm apart rows with the help of dibbler on a well prepared fine seed bed. All agronomic and plant protection treatments were kept normal and uniform. The crop was harvested in March 2001 and left in the field for sun drying and then threshed manually.

Observations

Emergence. The number of seedlings emerged were counted daily until complete emergence.

Growth. Randomly selected five plants per plot were harvested at two week interval and analyzed for leaf area and dry matter accumulation. The leaf area was measured with the help of leaf area meter (LICOR, Model 3100, USA). The crop growth rate was calculated according to the formulae described by Hunt (1978).

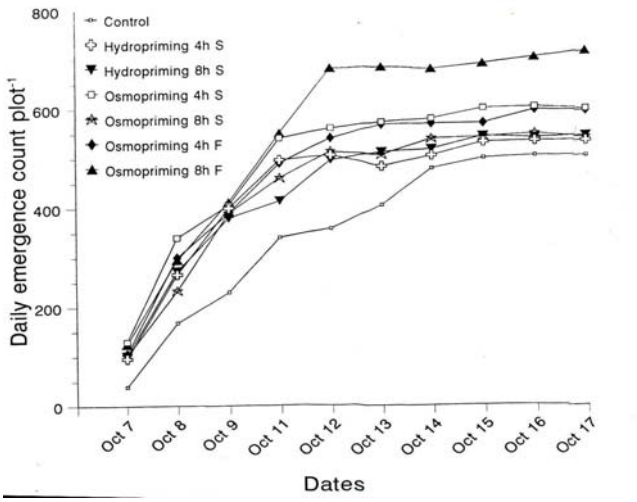
Yield and yield components. From each plot five plants were randomly selected at the time of harvest. The data regarding plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds $pod^{-1}$and 1000 seed weight were recorded. Seed yield and total biomass were recorded after harvesting from central four rows from each plot.

The data were subjected to statistical analysis according to the methods described by Steel and Torrie (1984).

RESULTS

Emergence. Rapid seedling emergence was observed in primed seeds as compared to control (Fig. 1). Highest emergence was recorded from seeds freshly osmoprimed for 8 h followed by fresh or stored primed seeds for 4 h; while, the lowest daily emergence count was observed from control.

Fig. 1. Influence of storage on primed canola (*Brassica napus* cv. Hyola 401) seeds on daily emergence. S= stored; F = fresh



Growth. Priming treatments significantly affected the growth parameters. Leaf area index (LAI) was significantly affected by various priming techniques. Higher LAI was recorded from seeds freshly osmoprimed for 8 h and the seeds previously osmoconditioned for 4 h treatments, where LAI values were statistically at par. Both these treatments achieved maximum LAI greater than 4.20 at 30 December harvest. Thereafter, LAI consistently declined in all the presowing treatments. Lower LAI was recorded by control as compared to all other priming treatments at all the harvesting dates during the growing season (Fig. 2).

Priming treatments accumulated greater amount of dry matter than the control. Maximum dry weight was recorded from freshly primed for 8 h and previously primed for 4 h seeds. Minimum dry weight was recorded from control at all the harvest dates throughout the growing season (Fig. 3). Total dry matter accumulation continued to increase until 29th January and then there was a steady decline until final harvest (22 March), irrespective of treatments.

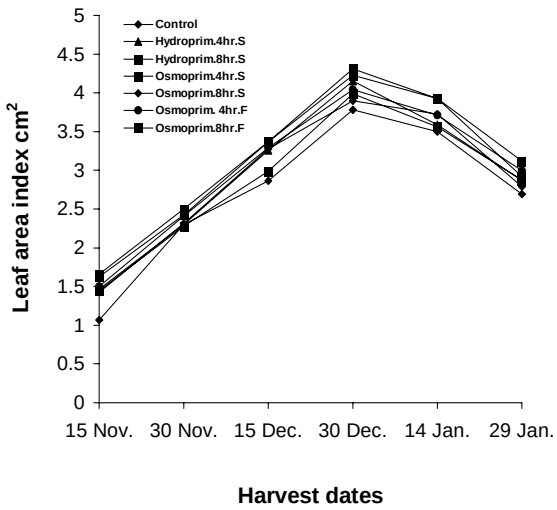
Crop growth rate was significantly affected by different pre-sowing seed treatments. Maximum Crop growth rate (CGR) was recorded from previously osmoprimed seeds for 8 h. Minimum CGR was recorded by control treatment (Table I). CGR was higher by primed

Table 1: Influence of storage on primed canola (*Brassica napus*) cv. Hyola 401 seeds on growth and yield

Treatment	Crop growth rate ($g\ m^{-2}\ day^{-1}$)	Plant height (cm)	No. of Branches $plant^{-1}$	No. of pods $plant^{-1}$	No. of seed pod^{-1}	1000 seed weight ($kg\ ha^{-1}$)	Biological yield ($kg\ ha^{-1}$)	Seed yield ($kg\ ha^{-1}$)
Control	10.60c	157.24	13.60d	230.6e	23.07c	3.10c	13990c	2594d
Hydropriming 4 h S	11.80ab	161.81	13.80cd	343.1d	24.07bc	3.60b	15570ab	3022bc
Hydropriming 8 h S	11.74ab	159.91	14.80bc	238.6de	23.17c	3.47b	15500ab	2955c
Osmopriming 4 h S	11.78ab	173.64	16.40a	282.8a	26.07ab	3.98a	15550ab	3313a
Osmopriming 8 h S)	11.83a	167.94	15.47ab	258.0c	24.73bc	3.63b	156320a	3097abc
Osmopriming 4 h F	11.61ab	162.90	16.16a	269.3bc	25.66ab	3.92a	15320b	3175ab
Osmopriming 8 h F	11.64a	165.16	16.43a	277.9ab	27.65a	3.98a	15370ab	3247a
LSD at 0.05	*0.19*	-	*1.11*	*11.66*	*2.32*	*0.17*		

F = Fresh; S = Stored

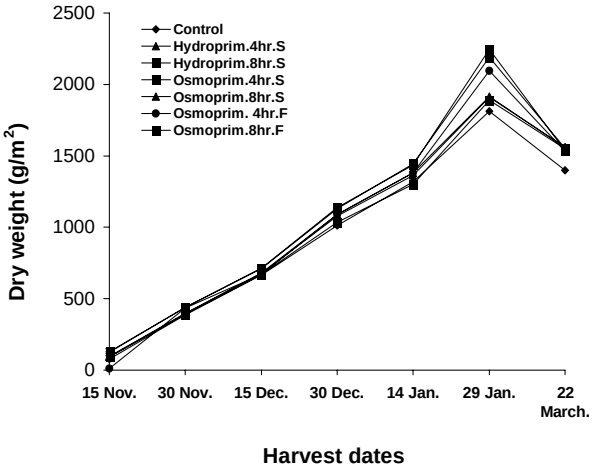
Fig. 2. Influence of storage of primed canola (*Brassica napus* cv. Hyola 401) seeds on leaf area index. S= stored; F= fresh



seeds sown fresh or after storage as compared to the unprimed seeds.

Yield and yield components. The effect of storage on primed canola seeds on yield and yield parameters are shown in Table I. The plant height at maturity was not significantly affected by various pre-sowing seed treatments. Number of branches plant^{-1} was significantly

Fig. Influence of storage of primed canola (*Brassica napus* cv. Hyola 401) seeds on dry weight. S= stored; F=fresh



affected by different priming treatments. Maximum number of branches plant^{-1} was achieved by freshly osmoprimed for 8 h and statistically at par with previously osmoprimed for 4 h. Number of seeds plant^{-1} was maximum by previously osmoprimed for 4 h followed by freshly osmoprimed for 4 h or 8 h. Similarly, maximum number of seeds pod^{-1}, 1000 seed weight, biological yield and seed yield were maximum by previously osmoprimed for 4 h or freshly osmoprimed for 8 h (Table I).

DISCUSSION

Osmopriming fresh or stored and hydropriming stored were better than control treatments overall, osmopriming showed better results than hydropriming. The priming treatments accelerated the emergence of canola seeds. Priming induced rapid and uniform germination of canola seeds, which resulted in rapid emergence of seedlings. These results are supported by the previous study on canola (Zheng *et al.*, 1994). The increase in emergence with priming might be due to initiating metabolic events in primed seeds. Another possible reason is that priming may also leach germination inhibitors from seeds (Heydecker & Coolbear, 1978).

Due to the priming treatments, there was increase in leaf area index and dry matter accumulation and ultimately more seed yield of canola. Increased leaf area duration due to early emergence by priming might have enhanced yield by increasing the amount of light intercepted by canopy throughout the season (Henckel, 1964; Scotte *et al.*, 1973). The beneficial effects of priming were maintained after six months of storage at low temperature. Akers *et al.* (1987) reported that priming effect was not lost during eight months of storage. Similar results were observed by (Alvarado & Bradford, 1988; Dearman *et al.*, 1987).

CONCLUSION

On the basis of these observations, it may be concluded that canola seeds responded to different priming treatments and seed yield was increased due to priming. Osmoconditioning performed better than hydropriming. Freshly osmoprimed seeds for 8 h proved better than the other treatments. Primed seeds maintained their increased vigor by six months of low temperature storage.

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