EFFECT OF SEED OSMOPRIMING ON SEED GERMINATION BEHAVIOR AND VIGOR OF SOYBEAN (*Glysin max* L.)

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INTRODUCTION

Oil seeds are very sensitive to the harsh environmental conditions. It is hypothesized that their oil content readily oxidize, which deteriorate the seed health in storage (Kausar *et al*., 2009). One of the most important aspects for oil seed production is rapid emergence and good seedling establishment in field. In the other hand germination and emergence are important issues in plant production and they have significant effect on the next stages of plant growth in field. Rapid and uniform field emergence is essential to achieve high yield with having good quality and quantity in annual crops (Yari *et al*., 2010). Seed priming has been successfully demonstrated to improve germination and emergence in seeds of many crops, particularly seeds of vegetables and small seeded grasses (Dell Aquila and Tritto, 1991; Donaldson *et al*., 2001). It was reported that soybean seed priming made better seedling emergence and yield improvement (Arif *et al*., 2008). Ghiyasy et al.(2008) declared osmopriming of maize (Zea mays L.) seeds with polyethylene glycol 8000 (PEG 8000) at -0.5 MPa osmotic potential had improved emergence, grain and biological yields compared with other treatments. The objective of this study was to evaluate the effect of seed osmopriming with different concentration and duration on soybean germination behavior of Cv. 033.

MATERIALS AND METHODS

This experiment was conducted at Seed analysis laboratory of agricultural and natural resources center of Sari, Iran. Seeds were primed with six levels of PEG 6000 as priming media (distilled water as control, -0.4, -0.8, -1.2, -1.6 and -2 MPa) for 6, 12, 24 and 48 hours at 25°C. Experimental units were arranged factorial in a completely randomized design with three replications. Dry soybean seeds considered as a control treatment (non primed). Solution osmotic potential was calculated as described in Michel (1973) (equation 1).

Water potential (bar index) = - (1.18 ×10 -2) C- (1. 18 ×10 -4) C2 + (2.67 × 10-4) CT + (8.39 × 10-7) C2 [1]

Where C is Poly ethylene glycol concentration, T is temperature (centigrade).After treatment, seeds were given three surface washings with distilled water and re-dried to original weight with forced air under shade at 27 ± 3°C ((Mubshar *et al*., 2006). Fifty seeds from each of the treatments were placed in 90-mm-diameter Petri dishes on whatman No.2 filter paper moistened with 10 ml of distilled water. Seed was kept at room temperature (25°C) under normal light. Germination progress was measured at 12 h intervals and continued until fixed state. The number of germinated seeds was recorded 8 days after planting as final germination percent (FGP) (ISTA, 1993 and ISTA, 1999). Mean germination time (MGT) was calculated according to the equation 2 (Moradi Dezfuli *et al*., 2008).

$$MGT=\Sigma Dn/\Sigma n \quad [2]$$

Where n is the number of seeds, which were germinated on day D, and D is the number of days counted from the beginning of germination.

The germination index (GI) was calculated as described in the Association of Official Seed Analysts (AOSA, 1983) by following formula:

$$GI=\frac{\text{No. of germinated seed}}{\text{Days of first count}} + - -+ \frac{\text{No. of germinated seed}}{\text{Days of final count}} \quad [3]$$

The time to 50% germination (T50) was calculated according to the following formula of Coolbear et al. (1984) modified by Farooq et al. (2005):

$$T50 = ti + \frac{\{(N/2) - ni\}(ti - tj)}{ni - nj} \quad [4]$$

Where N is the final number of germination and ni, nj cumulative number of seeds germinated by adjacent counts at times ti and tj when ni<N/2< nj. Energy of emergence (EG) was recorded on the 4th day after planting. It is the percentage of germinating seeds 4 days after planting relative to the total

number of seeds tested (Ruan et al., 2002).The vigor index was calculated according to equation 5 (Orchard, T. 1977).

Seedling vigor index (SVI) = [seedling length (cm) × germination percentage] [5]

A sample of 50 seed was taken from each treatment, placed in a 250Ml flask with 200mL of distilled water. The flasks were stirred to remove air bubbles and floating seed, covered with aluminum foil and were kept at 20°C for 24 h. after soaking, seeds were gently swirled and the conductivity of the soaked water was measured with a dip type cell (Cell Constant of 1.0) conductivity meter. Experimental data were analyzed using SAS (Statistical software, SAS institute, 2002) and treatment means were compared using Duncan's multiple range tests at 5% level of probability.

RESULTS AND DISCUSSION

According to the results, all studied traits were affected by the experimental factors and there was completely significant difference between control (non primed seeds) and primed seeds (Table 1). Final germination percentage (FGP) was affected by PEG concentration as well it was increased (91%) by decreasing of PEG osmotic potential from 0 to -1.2 MPa and then it was declined by more reduction of PEG osmotic potential from -1.6 to –2 MPa. Also FGP was increased (90.22%) by increasing of hydro priming duration from 6 to 12 h but it was decreased by increasing of hydro priming duration from 18 to 24 h. Mean comparison by Duncan multiple range test displayed significant difference between control and primed seeds as well more FGP was attained in seed primed than control in all osmotic potential (Table 2).Basra et al. (2003) reported improvement in germination percent, emergence and seedling stand by using seed priming techniques. The highest germination index was attained from -1.2 osmotic potential and 12 h seed priming duration treatments (21.15 and 20.15 respectively). Meanwhile germination index decreased by osmotic potential reduction and increment of seed hydro priming duration. Furthermore there was significant difference between control and priming treatments so as germination index from primed seed was more than control (Table 1& 2). It has been declared that priming had been resulted in more germination speed especially in drought stress, saline stress and low temperatures in sorghum, sunflower and melon (Demir Kaya *et al*.,). Variance analysis and mean comparison results displayed that mean germination time and the time to get 50% germination were affected by different osmotic potentials and seed hydro priming duration. The least MGT and T50 was obtained from -1.2 osmotic potential (2.7 and 1.7 respectively) and 12 h hydro priming duration (2.89 and 2.13) treatments. Generally less MGT and T50 was attained from seed priming treatment than control (Table 1& 2).

Like germination percentage, prime seeds had lower Mean Emergence Time (MET) compared with un-primed seeds. These positive effects are probably due to the stimulatory effects of priming on the early stages of germination process by mediation of cell division in germinating seeds (Hassanpour Aghdam et al., 2009). The highest seedling dry weight and energy of germination (EG) was attained from -1.2 osmotic potential (1.669 and 1.76 respectively) and 12 h seed priming duration treatments (1.55 and 1.75 respectively). Also SVI in primed seeds was more than control treatment and its highest amount was achieved from -1.2 osmotic potential (152.22) and 12 h seed priming duration treatments (140.41) (Table 2). Priming presumably allowed some repairs of damaged to membrane caused by deterioration (Ruan et al., 2002). The improvement in germination and vigor of normal/low-vigor seed might be due to reserve mobilization of food material, activation and re-synthesis of some enzymes DNA and RNA synthesis start during osmotic priming. Rapid embryo growth resulted when the obstacle to germination was removed (Basra et al., 2003). Variance analysis results showed that there was significant difference between priming and control treatment from the aspect of electrical conductivity (EC) so as the highest EC was related to control treatment. Furthermore the lowest EC was attained from -1.2 osmotic potential and 12 h seed priming duration treatments (38.01 and 43.72 ds cm-1 gr-1 respectively) among primed treatments. Priming can repair some damages that have been arisen from seed erosion and improve seed quality (Arif et al., 2008). Generally it was recognized that -1.2 MPa osmotic potential increased germination percentages, germination index and seed vigor meanwhile decreased mean germination time, the time to get 50% germination and electrical conductivity of seeds. Also it was observed that 12 h priming duration had most effect on studied traits as -1.2 MPa osmotic potential treatments. According to the results it is suggest that soybean seeds be primed with PEG, -1.2 MPa osmotic potential for 12 hours for improving germination percentage and its related traits.

Table-1. variance analysis of studied traits in soybean **(**Cv 033).

SOV	Mean square								
	df	Final germination	Seedling weight	Electrical conductivity	Time to50 germination	Germination index	Mean germination time	Germination energy	Seedling vigor index
Treatment	24	21.86**	1588.4**	61.16**	0.659**	23.9**	3.02**	30.85**	1722.57**
Control VS. treatment	(1)	66.21**	2750.3**	144.27**	1.228**	40.19**	7.52**	61.97**	3093.98*
Osmotic potential	5	54.95**	4560.7**	245.54**	2.76**	61.72**	7.22**	43.35**	4866.31**
Duration	3	57.71**	3853.3**	28.11**	0.239**	69.21**	8.77**	59.351**	4293.72**
Duration × osmotic potential	15	0.706 ns	67.24 ns	0.768 ns	0.0049*	1.15 ns	0.178 ns	0.38 ns	69.01 ns
Error	26	2.11	741.59	0.43	0.00059	2.59	0.302	2.25	177.62
Total	74								

*and ** significant at 5% and 1% respectively

Table-2. Means comparison of studied traits in soybean by Duncan multiple range test (DMRT).

	Final germination	Seedling dry weight	Electrical conductivity	Time to 50% germination	Germination index	Mean germination time	Germination energy	Seedling vigor index
Duration (hour)								
6	86.77 c	1.246 c	44.57 b	2.23 c	16.30 c	4.24 a	71.61 c	108.53 c
12	90.22 a	1.55 a	43.72 c	2.13 d	20.15 a	2.89 c	75.10 a	140.41 a
18	88 b	1.375 b	46.26 a	2.30 b	17.54 b	3.74 b	72.83 b	121.47 b
24	86.1 6c	1.237 c	46.18 a	2.40 a	15.75 c	4.47 a	71 c	107.08 c
Control (dry seed)	83	1.043	45.189	2.92	13.70	5.45	68	86.6
Osmotic potential								
0	84.75 e	1.096 d	49.5 b	2.75 b	14.51 d	4.95 a	67.83 d	93.08 d
-0.4	86.58 d	1.272 c	44.96 c	2.37 c	16.38 c	47.2 b	71.58 c	110.63 c
-0.8	88.16 bc	1.352 bc	44.56 c	1.99 d	17.54 bc	3.73 cd	73.16 b	119.59 bc
-1.2	91 a	1.669 a	38.01 e	1.70 f	21.15 a	2.70 e	76 a	152.22 a
-1.6	89 b	1.455 b	43.5 d	1.91 e	18.56 b	3.34 d	74.33 a	129.82 b
-2	87.25 cd	1.267 c	50.53 a	2.88 a	16.46 c	4.04 bc	72.41 bc	110.89 c
Control (dry seed)	83	1.043	45.189	2.92	13.70	5.45	68	86.6