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Seed Priming Improves the Germination Traits of Tall Fescue (*Festuca arundinacea*)

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Abstract

A couple of experiments were carried out to investigate the effects of osmopriming and hydropriming treatments on the germination indexes and seed vigor of Tall fescue (*Festuca arundinacea*). In the first experiment, fulfilled based on randomized complete block designed with four replicates, the effect of polyethyleneglycol 6000 solution with five osmotic potentials (-8, -10, -12, -14 and -16 bar), two temperatures (15 and 25°C) and four time intervals (12, 24, 36 and 48 hours) was analized. The second experiment was fulfilled by using distilled water at two temperatures (15 and 25°C) and four time intervals (12, 24, 36 and 48 hours) with four replicates on the above mentioned data. Then, based on the maximum germination rate and vigor indexes, the optimal treatment composition was determined for osmopriming and hydropriming solutions in regard to the osmotic potential, temperature and priming duration. In osmopriming experiment, treatment composition of 12 hours at 15°C and -8 bar had the most significant effect on the percent and speed of germination, length of radicle, coleoptile and seedling, as well as vigor indexes in Tall fescue. For hydropriming, the effect analyzed in the same condition as osmopriming, was observed in the majority of evaluated traits; treatment composition of 12 hours prime and 15°C had the maximum numerical value in comparison to control and other treatments. Finally, it is inferred that favorable effects of osmo- and hydropriming at 15°C temperature are more significant in comparison with the control group (none prime seeds).

Keywords: germination, hydropriming, osmopriming, temperature, seed

Introduction

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 priming is known as the seed treatment which improves seed performance under environmental conditions (Ashraf and Foolad, 2005). In fact, seed priming is a procedure that partially hydrates the seed, after which the seeds are dried, this determing the germination process to start, but with no radicle emergence. Methods of seed priming have been described comprehensively by Bradford (1986) and Khan (1992) who include soaking seed in water or osmotic solution, and intermixture with porous matrix material. Lots of information is available, showing the hydration of seeds up to, but not exceeding, the lag phase with priming increased RNA and protein synthesis (Fu *et al.,* 1988), faster embryo growth (Dahal *et al.,* 1990) and reduced leakage of metabolites (Styer and Cantliffe, 1983) compared with control group. Seed priming has been found a doable technology to enhance rapid and uniform emergence, high vigor, and better yields for vegetable and flower species (Dearman *et al.,* 1987; Parera and Cantliffe, 1994; Bruggink *et al.,* 1999) small seeded grasses (Heydecker and Coolbaer, 1978; Bradford, 1986) and some field crops (Hartz and Caprile, 1995; Chiu *et al.,* 2002; Giri and Schillinger, 2003; Basra *et al.,* 2005, 2006; Kaur *et al.,* 2005; Kaya *et al.,* 2006; Janmohammadi *et al.*, 2009; Rouhi *et al.*, 2011).

Seed priming is commonly used to reduce the time between seed sowing and seedling emergence (Parera and Cantliffe, 1994). Earlier works show that the success of seed priming is influenced by the complex interaction of factors including plant species, water potentiality of the priming agent, duration of priming, temperature, seed vigor and dehydration, as well as storage conditions of the primed seed (Parera and Cantliffe, 1994). Although, the previous studies indicate that some benefits are associated with pre-sowing treatments for seed vigor enhancement, there is a dearth of information about the germination traits of primed seeds of Tall fescue. Therefore, the present study was carried out considering the objective of evaluating the effects of different priming treatments on seed germination, manner of Tall fescue, under different temperature, in order to find out the most effective priming composition treatments.

Materials and methods

Sample preparation and treatment

This study was carried out at the Department of Agronomy, Faculty of Agriculture, University of Tehran, Iran. Tall fescue seeds were used as seed material and were

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obtained from the Natural Resources Organization of Gorgan (from Golestan province, Iran).

For osmopriming, Tall fescue seeds were immersed in osmotic potentials of -8, -10, -12, -14, -16 bar, for polyethylene glycol (PEG 6000) at 15°C and 25°C for 12, 24, 36 and 48 h under dark conditions (Michel and Kaufmann, 1973). Thereafter, the seeds were rinsed with distilled water three times. The treated seeds were surface-dried and dried back to their original moisture content via experience at room temperature. Osmoprimed treated seeds was equilibrated at room temperature (about 25°C) for 24 hours.

For hydropriming, seeds were immersed in distilled water at 15°C and 25°C for 12, 24, 36 and 48 h under dark conditions. The treated seeds were surface-dried and dried back to their original moisture content at room temperature (about 25°C) for 24 hours.

Germination tests

Four replicates of 50 seeds were put to germinate on top of double layered papers with 5 ml of water in 9 cm Petri dishes. These Petri dishes with the seeds were put into sealed plastic bags to avoid moisture loss. Seeds were allowed to germinate at 15-25±1°C for 14 days (ISTA, 1996). Germination was considered to have occurred when the radicles were 2 mm long. Germination percentage was recorded every 12 h until final mentioned days. Germination rate was calculated as described in following formula (ISTA, 1996):

$$GR = \frac{\text{No. of germinated seed at first count}}{\text{Days of first count}} \ldots\ldots \frac{\text{No. of germinated seeds at first count}}{\text{Days of final count}}$$

Seedling length and seedling dry weight were measured after the 14th days. Vigor indexes 1and2 were calculated according to the following formula:

Vigor index 1 (VI1) = [seedling length (cm) × germination percentage]

Vigor index 2 (VI2) = [seedling dry weight (g) × germination percentage]

Statistical analysis

The Statistical analysis was based on a randomized complete blocks design (RCBD); with four replications and 50 seeds per replicate. Data for germination percentage were subjected to arcsine transformation before the analysis of variance was carried out with SAS software. Mean comparison was performed with Duncan's test if F-test was significant at ($P < 0.05$).

Results and discussion

Optimization of Tall fescue seed priming

In order to determine the effects of priming treatments on germination characteristics, the first analysis of variance was performed for germination data without a control group. Significant three-way interactions (time, temperature and osmotic potential) were found for all investigated characters (data not shown). Secondly, the analysis of variance was performed for germination data with the control group.

In the first experiment, which was done in order to evaluate the best osmotic potential level, as well as osmopriming duration and temperatures, the variance analysis of data showed that all of the germination traits of Tall fescue seeds are affected by osmopriming treatments (Tab. 1 and Tab. 3).

Variance analysis of the second experiment was investigated in order to study hydropriming effect on Tall fescue seed under different intervals (12, 24, 36 and 48 h) and two temperatures (15 and 25°C); it showed that germination percentage and some of the measured traits are effected by hydropriming in comparison with the control group (Tab. 2 and Tab. 4).

Final Germination Percentage (FGP)

In the osmopriming treatment, the maximum amount of final germination percentage was for the interval of 36 h, potential of -10 bar and temperature of 15°C, which did not have significant differences compared with the time of 12 and 24 h, at the same temperature. But it was different within the interval of 48 h and other potentials in this time and at the same temperature (Tab. 3). The recommended time treatment is 12 h. Superior treatment (12 h × -8bar × 15°C) was more than control group. Demir and Van de Vanter (1999) reported that osmopriming of watermelon seeds caused the decrease of the mean germination time and the increase of its percentage.

For the hydropriming treatment, the maximum amount of this trait was for the interval of 12 h, and temperature of 15°C (Tab. 4). Moradi *et al.* (2008) showed that, for most evaluated germination parameters of corn seeds, hydropriming was the effective treatment.

Tab. 1. The ANOVA table showing the osmopriming treatment in comparison with control on germination traits of Tall fescue

		Mean of squares (MS)							
S.O.V	df	FGP (%)	GR (1/day)	CL (cm)	RL (cm)	SL (cm)	SDW (gr)	VI1	VI2
Block	3	203.18 ns	0.0000076 ns	2.36 ns	0.048 ns	3.01 ns	0.0000013 ns	568 ns	0.11 ns
Treatment	40	1095.85**	0.000046**	6.2**	5.9**	21.97**	0.0000044**	3137**	0.55**
Error	120	42.37	0.0015	0.35	2.21	2.2	0.0000013	157	0.03

ns,**,* Respectively non significant and significant of 1 and 5 percent of probability; FGP : Final Germination Percentage; GR: Germination Rate; CL: Coleoptile Length; RL: Radicle Length; SL: Seedling Length; SDW: Seedling Dry Weight; VI1: Vigor Index 1; VI2: Vigor Index 2

Tab. 2. The ANOVA table showing the hydropriming treatment in comparison with control on germination traits of Tall fescue

		Mean of squares (MS)							
S.O.V	df	FGP (%)	GR (1/day)	CL (cm)	RL (cm)	SL (cm)	SDW (gr)	VI1	VI2
Block	3	3.86 ns	0.0000072 ns	0.36 ns	0.11 ns	0.07 ns	0.00000031 ns	26 ns	0.03 ns
Treatment	8	4218.55**	0.00051**	32.29**	11.64**	78.62**	0.0000074**	9997**	2.37**
Error	24	4.47	0.00000094	0.13	0.13	0.44	0.0000003	36	0.004

ns,**,* Respectively non significant and significant of 1 and 5 percent of probability; FGP: Final Germination Percentage; GR: Germination Rate; CL: Coleoptile Length; RL: Radicle Length; SL: Seedling Length; SDW: Seedling Dry Weight; VI1: Vigor Index 1; VI2: Vigor Index 2

Germination Rate (GR)

In the osmopriming treatment, the maximum amount of germination rate was in the potential of -8 bar for 12 h at 15°C and it did not have significant differences with the treatment combination of 36 h, potential of -10 bar at the same temperature. So, potential of -8 bar in the time of 12 h is recommended because of the lower time needed and high potential. Moreover, superior treatment was more than control group (Tab. 3). Hur (1991) showed that in Italian ryegrass and sorghum, germination percentage, as well as germination rate, increased in response to osmopriming.

In the hydropriming treatment, treatments for all time intervals at in 15°C were higher than at 25°C, and the maximum amount of germination rate was in the case of 12 h, and temperature of 15°C (Tab. 4). Harris *et al.* (1999), Giri and Schilinger (2003) and Finch-Savage *et al.* (2004) reported that the priming effect on germination rate was positive in comparison with control group.

Coleoptile Length (CL)

In the osmopriming treatment, the longest coleoptile was observed in the interval of 36 h, potential of -8 bar and temperature of 15°C. This temperature had higher amount of time and potential in comparison with the one at 25°C. So, it can be said that the most suitable treatment combination is at 15°C, potential of -8 bar and 12 h, which was more than control group (Tab. 3). In a study with Turkish pine (*Pinus brutia*) var. eldarica, Khalil *et al.* (1997) determined that plants raised from seed preconditioned at room temperature in aerated solution of PEG 8000 for different time periods exhibited faster germination and higher shoot length compared to plants raised from untreated seed.

In the hydropriming treatment, the longest coleoptile was observed in the interval of 12 h and temperature of 15°C, which was higher than control group (Tab. 4). Tomato seed primed resulted in significant increases in stem length, shoot weight, leaf area, number of flowers, fruit set, and final yield (Khalil and Moursy, 1983).

Radicle Length (RL)

In the osmopriming treatment, on this trait, because of the existence of several superior treatment combinations, the first treatment which is higher than control group and includes 15°C, 12 h, potential of -8 bar is recommended (Tab. 3). Osmoconditioning promoted the rates of radicle extension, seedling emergence,, expansion of the cotyledons and the first leaf of cucumber (Passam and Kakouriotis, 1994).

In the hydropriming treatment, the maximum radicle length was in the interval of 24 h with 15°C and it did not have significant differences compared with treatment combination of 12 h at the same temperature. So, it seems that the time interval of 12 h is recommended because of a lower time (Tab. 4). Priming has been shown to induce nuclear DNA synthesis in the radicle tip cells in tomato (Liu *et al.*, 1997).

Seedling Length (SL)

In the osmopriming experiment, the analysis of treatments, including the control group, the temperature of 15°C proved optimal, showing higher results, which regarding to the economic aspect can be introduced as the superior treatment, beside the potential of -8 bar and time interval of 12 h (Tab. 2). Osmoconditioning of Bermuda grass (*Cynodon dactylon*) seed using PEG followed by immediate sowing improved germination and seedling growth under saline conditions (Al-Humaid, 2002).

In the hydropriming treatment, all seedling had lengths higher at the temperature of 15°C than at 25°C, but the time interval of 12 h and 24 h at 15°C did not have significant differences. So, the interval of 12 h is recommended because of the lower time and preserve seeds from electrolyte leakage (Tab. 4). In snap beans (*Phaseolus vulgaris*), hydropriming resulted in improved germination and seedling emergence and growth (Suzuki and Khan, 2001).

Seedling Dry Weight (SDW)

In the osmopriming treatment, on this trait, regarding the optimal use of time and material, it was the time interval of 12 h, at temperature of 15°C and potential of -12 bar that showed higher amounts in comparison with control group and other treatments (Tab. 3). Khalil *et al.* (1997) showed that plants raised from osmoprimed seed exhibited higher dry weight in comparison with control group. Similar positive effect of osmopriming on dry weight in Italian ryegrass (*Lolium multiflorum*) and sorghum (*Sorghum bicolor*) was observed (Hur, 1991). Dabrowska *et al.* (2001) determined that both solid matrix priming and osmopriming significantly increased the speed's capability of emergence and mean dry weight of hot pepper seedlings.

Tab. 3. Effect of osmopriming treatments on the germination and seedling characteristics of *Festuca arundinacea*

Treatments			Traits								
Temperature (Celsius)	Time (hours)	Potential (bar)	FGP (%)	GR (1/day)	CL (cm)	RL (cm)	SL (cm)	SDW (gr)	VI1	VI2
15	12	-8	68.90bc	0.016a	7.71a-f	5.13 a-f	12.84abc	0.025a	884.6cd	1.72bc
		-10	65.38bcd	0.015bc	7.12d-h	5.84abc	12.96abc	0.021e-k	847.3de	1.37b-e
		-12	68.62bc	0.015bc	7.14d-h	4.72 a-h	11.86b-f	0.024ab	813.8ef	1.64bcd
		-14	65.54bcd	0.0145c	8.36ab	4.23c-k	12.59a-d	0.021e-k	825.1e	1.37b-e
		-16	69.04bc	0.015bc	7.31c-g	5.1 a-f	12.42a-e	0.023a-d	857.4d	1.58bcd
	24	-8	62.13b-e	0.014bcd	8.22abc	5.48 a-e	13.70ab	0.022a-g	851de	1.36b-f
		-10	63.56b-e	0.014bcd	7.54b-f	4.1 c-k	11.63b-f	0.021e-k	739.2gh	1.33b-e
		-12	67.14bc	0.015bc	8.37ab	6.19ab	14.57a	0.021e-k	977.6b	1.40b-e
		-14	65.14bcd	0.014bcd	7.8a-e	5.85abc	13.65ab	0.021e-k	888.6cd	1.36b-e
		-16	67.28bc	0.015bc	7.98a-d	5.13 a-f	13.10ab	0.021e-k	881.3bcd	1.41bcd
	36	-8	62.07b-e	0.013b-e	8.58a	4.68a-h	13.27ab	0.02f-k	823.6ef	1.24b-f
		-10	90 a	0.016ab	7.69a-f	5.57a-e	13.26ab	0.022a-g	1193.4 a	1.98a
		-12	68.18bc	0.015bc	7.54b-f	6.24a	13.78ab	0.021e-k	938.4bc	1.43b-e
		-14	67.74bc	0.015bc	7.47b-f	5.7a-d	13.17ab	0.021d-k	892.1c	1.42bcd
		-16	71.08b	0.0155b	7.98a-d	5.7a-d	13.68ab	0.0216a-i	972.3b	1.53bcd
	48	-8	61.96b-e	0.013 b-e	7.69a-f	5.27a-e	12.97abc	0.0213c-j	803.6f	1.31b-f
		-10	64.90bcd	0.014bcd	6.81e-i	4.88a-g	11.69b-f	0.021e-k	758.7g	1.36b-e
		-12	63.18b-e	0.013b-e	6.81a-d	4.53a-j	11.34b-f	0.023a-d	716.5h	1.45f-i
		-14	65.82bcd	0.014bcd	7.98a-d	5.21a-f	13.19ab	0.021e-k	868.1cd	1.38b-e
		-16	68.93bc	0.015bc	7.72a-f	5.11a-f	12.84abc	0.0214b-j	884.6cd	1.47bcd
25	12	-8	66.18bcd	0.014bcd	6.76f-i	5.54a-e	12.3a-f	0.021e-k	814.0ef	1.38bcd
		-10	50.39fg	0.0115fg	6 i-l	4.31b-j	10.32d-h	0.021e-k	520m	1.05e-h
		-12	61.53b-e	0.013b-e	6.18h-k	4.3b-j	10.49c-h	0.0195g-k	645j	1.19bc
		-14	24.14kl	0.01kl	4.03p	2.67j-m	6.71k	0.021e-k	162u	0.50k
		-16	49.25fg	0.011fg	5.32k-o	3.3f-l	8.615g-j	0.02f-k	424.2o	0.98d-g
	24	-8	59.39c-f	0.0125 c-f	6.21h-k	3.8d-l	10.05e-i	0.021e-k	596.8k	1.24b-e
		-10	55.55def	0.012d	5.93i-l	3.96c-k	9.89f-i	0.021e-k	549.3l	1.16c-f
		-12	66.15bcd	0.014bcd	6.38g-j	3.96c-k	10.34d-h	0.019h-k	683.9i	1.25bcd
		-14	31.69ijk	0.0114ijk	4.86m-p	1.46m	6.323k	0.018k	200.3t	0.57jk
		-16	31.31jk	0.0112jk	5.45j-n	4.43a-j	9.89f-i	0.02f-k	310r	0.62jk
	36	-8	38.33hij	0.0115hij	4.69nop	2.9h-m	7.59ijk	0.02f-k	291s	0.76hij
		-10	53.30ef	0.0121ef	6.36g-j	3.73f-l	10.09f-i	0.02f-k	537.7lm	1.06b-f
		-12	41.76gh	0.012ghi	5.03l-o	2.36klm	7.39e-h	0.0185jk	307rs	0.77g-j
		-14	19.38l	0.0095l	4.42op	2.74i-m	7.17jk	0.019h-k	138.9v	0.36k
		-16	23.57kl	0.01kl	5.52j-n	3.14g-m	8.65g-j	0.0182ijk	203.8t	0.42k
	48	-8	37.72hij	0.0115hij	4.88m-p	4.59a-i	9.475g-j	0.02f-k	357.4p	0.75hij
		-10	42.98gh	0.0152gh	5.71j-n	2.64j-m	8.35g-j	0.02f-k	358.1lp	0.85b-e
		-12	52.98ef	0.0121ef	5.43j-n	3.14g-m	8.58g-j	0.0182ijk	454.5n	0.96b-f
		-14	19l	0.0095l	4.79m-p	1.98lmn	6.783k	0.02f-k	128.8w	0.38k
		-16	35.76hij	0.015hij	6.1ijk	3.78d-l	9.89f-i	0.019h-k	350.4pq	0.67ij
Control			55.12 def	0.0115hij	7.27c-g	3.34f-l	10.6ghi	0.02f-k	584.2k	1.1b

In each column means followed by the same letter are not significantly different at the $P < 0.05$ level; FGP : Final Germination Percentage; GR: Germination Rate; CL: Coleoptile Length; RL: Radicle Length; SL: Seedling Length; SDW: Seedling Dry Weight; VI1: Vigor Index1; VI2: Vigor Index2

In the hydropriming treatment, all of maximum amounts of this trait were observed at temperature of 15°C. The interval of 12 h was better than other treatments at same temperature because it took higher dry weight, compared with the other treatments and control group (Tab. 4). In field experiments, hydropriming of safflower (*Carthamus tinctorius*) seeds for 12 h resulted in higher capitula per plant, grains per capitulum, 1000-seed weight, grain yield, and oil content compared to untreated seeds (Bastia *et al.,* 1999). Similar improvements were ob-

Tab. 4. Effect of hydropriming treatments on the germination and seedling characteristics of *Festuca arundinacea*

Treatments		Traits							
Temperature (Celsius)	Time (hours)	FGP (%)	GR (1/day)	CL (cm)	RL (cm)	SL (cm)	SDW (gr)	VI1	VI2
15	12	77.31a	0.016a	8.98ab	5.43a	14.41a	0.025a	1114a	1.93a
	24	65.54b	0.015ab	8.73bc	5.48 a	14.21a	0.023ab	931.3b	1.53b
	36	63 c	0.013bc	8.37c	3.92 c	12.3 b	0.023ab	757.9c	1.45c
	48	55.72e	0.011e	8.4 c	4.17 b	12.57b	0.022 b	700.4d	1.22d
25	12	40.6 f	0.008f	5.87e	3.7 c	9.57 c	0.021 c	388.5f	0.85f
	24	27.6 g	0.005g	3.38 f	1.6 e	4.98 e	0.0211 c	137.5f	0.58g
	36	6.89 h	0.001h	1.64 h	0.23 f	1.87 g	0.018 e	13h	0.125h
	48	6.89 h	0.001h	2.4 g	1.37 e	3.77 f	0.02 d	26g	0.13h
Control		58 d	0.012d	7.03 d	2.05d	9.08 d	0.02 d	526.6e	1.16e

In each column means followed by the same letter are not significantly different at the $P < 0.05$ level; FGP: Final Germination Percentage; GR: Germination Rate; CL: Coleoptile Length; RL: Radicle Length; SL: Seedling Length; SDW: Seedling Dry Weight; VI1: Vigor Index 1; VI2: Vigor Index 2

served on maize, rice, chickpea (Harris *et al.,* 1999), and pearl millet (Kumar *et al.*, 2002) grown under dry land conditions.

Vigor Index 1

In the osmopriming treatment, the treatment combination of 36 h, potential of -10 bar, at15°C can be regarded as superior in comparison with control group, by showing higher amounts (Tab. 3). Osmopriming may contribute to rapid seed germination by affecting active oxygen metabolism. In wild rye (*Leymus chinensis*) seeds, for example, priming with 30% PEG for 24 h resulted in an increase of the activity of superoxide dismutase (SOD) and peroxidase (POD) and a rapid increase of the respiratory intensity, which were associated with an increase of germination vigor (Jie *et al.,* 2002).

In the hydropriming treatment, the maximum amount of this trait was in the time interval of 12 h and temperature of 15°C, which has significant differences compared with the other treatments and control group (Tab. 4). Hydropriming resulted in a significant improvement of germination and seedling vigor and a decrease in leakage of electrolytes from germinating seeds (Srinivasan *et al.,* 1999).

Vigor Index 2

In the osmopriming treatment, on this trait, superior treatment showed higher amount (15°C×12h×-8bar) compared with control group (Tab. 3). Fu *et al.* (1988) determined that soaking peanut (*Arachis hypogaea*) seed in 20-25% PEG for 48 h greatly increased phosphate uptake and RNA synthesis in embryonic axes while improving seeds' vigor.

In the hydropriming treatment, same as vigor index1, the maximum amount of this trait was in the time interval of 12 h at temperature of 15°C, which has significant differences compared with the other treatments and control group (Tab. 4). Thornton and Powell (1992) determined that for seeds of cauliflower (*Brassica oleracea*) and Brussels sprouts (*Brassica oleracea*), an 8 h hydropriming treatment at 25°C were the most effective for improving the rate and uniformity of germination, root growth, and seed vigor.

Conclusions

During the osmopriming experiment upon this plant, time treatments of 12 h and 36 h allocated above amounts to themselves, and were superior to control group in the majority of investigated traits. Priming's temperature had an outstanding effect, since on all of the investigated traits, the temperature of 15°C was the best. It seems that the temperature of 15°C is near the optimum temperature of germination for this plant. So, it has significant effect on germination factors and indexes. Between the time intervals which are candidates of a superior treatment, the 12 h one can be introduced, because it can save time as well as prevent possible damages, like infection of seeds (because of seeds being in the solution for the longer time).

Researches explain that priming is a practical technique to increase germination rate and consistence, as well as vigor increase and a better performance in vegetables, flower plant and crops (Bruggink, 1999; Chiu *et al.,* 2002; Farooq *et al.,* 2008).

In hydropriming, time interval of 12 h and temperature of 15°C were superior than other treatments and control group. Zheng *et al.* (2002) reported that, at lower temperature, priming had significant effect on the germination rate of rice seeds. Shivankar *et al.* (2003) explained that hydropriming can increase germination rate and consistency in seeds with low viability. Singh *et al.* (1999) also conveyed the similar results. Effects of hydropriming on water potential, the driving force for water uptake during imbibitions, and the activity of α-amylase were examined on wheat and rice kernels (Andoh and Kobata, 2002). Amylases are key enzymes that play a vital role in hydrolyzing the seed's starch reserve, thereby supplying sugars to the developing embryo is a must (Ashraf and Foolad, 2005). Hydropriming of cereal rye and perennial ryegrass can significantly increase the rate percentage of germination (Snap *et al.,* 2008). Giri and Schilinger (2003) showed that the effect of hydropriming with water is equal, and in some cases even more significant, than other priming environments.

Regarding the positive effects of seed priming on germination characteristic of Tall fescue, it could be used as pre-sowing treatment in field conditions. In order to maintain a high quality of the primed seeds for extended storage periods, seeds should be stored at a low temperature and low moisture content, or after seed priming, seeds should be planted.

Finally it is recommended that the results of this study to be investigated in the farm condition in order to confirm the fulfilled experiments of this project.

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