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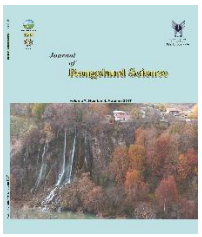

**Research and Short Length Article:**

# Evaluation of Profitability of Seed Priming for Improvement Seed Germination Performance of Two Rangeland Plants (*Festuca ovina* and *Bromus tomentellus*) under Drought Conditions

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**Abstract.** The possible effects of seed priming on mitigating the effects of drought stress on germination and early seedling growth of two rangeland plants were evaluated in a laboratory research during 2015-16 growing season. The research was conducted as a 2×3×3 factorial experiment based on completely randomized design with three replications. The first factor was plant type (*Festuca ovina* and *Bromus tomentellus*), the second factor was drought stress (including 0.0, -0.3, -0.6, -0.9 and -1.2 MPa simulated with PEG6000) and the third factor was seed priming technique (including no-priming or control, hydro priming and salt priming with $KNO_3$). Results indicated that drought stress reduced germination performances of two rangeland plants, where germination percentage, seedling dry weight, root length and stem length decreased under water deficit condition. However, *B. tomentellus* tolerated low-to-moderate levels of drought stress (osmotic potential of -0.3 and -0.6 MPa) but *F. ovina* showed a high sensitivity to drought stress where this plant did not tolerate even low levels of drought stress (-0.3 MPa). Seed priming improved germination performance of *B. tomentellus* under drought stress conditions but primed seeds of *F. ovina* had no improved germination under low availability of water. Therefore, *F. ovina* should experience no-stress during seed germination and seedling establishment. There was no significant ($P \leq 0.01$) difference between hydro and osmo priming for improving *B. tomentellus* under drought stress. However, because of low cost and easy use of hydro priming, this priming technique can be suggested for improving germination performance of *B. tomentellus* under low and moderate drought stress.

**Key words:** *Bromus tomentellus*, *Festuca ovina*, Germination performance, Seedling growth, Water deficit

## Introduction

In the Steppeic rangelands of southwest of Iran rainfall is not only low but also variable which severs one of the major constraint to high plants performance i.e. lack of synchronized seed germination and seedling establishment (Eskandari and Alizade-Amraie, 2014). Inadequate soil moisture content is also probable during seed germination because of the lack of rainfall at sowing time. However, the seeds are occasionally sown in seedbeds receiving favorable rainfall before sowing but topsoil water evaporation results in irregular seed germination and stand establishment. However, if the stress effect can be alleviated at the germination stage, the chances for attaining good plant establishment, growth and finally forage production would be increased.

Seed priming is a pre-sowing technique for improvement of germination performance during which seeds are partially hydrated but radicle protrusion is not occurred. (Ghassemi-Golezani *et al.,* 2008). The beneficial effects of priming have been shown for many rangeland plants. In this case, Gadir *et al.* (2011) reported that osmo priming with $KNO_3$ improved germination of *Cenchrus ciliaris*, *Cenchrus setigerus* and *Panicum antidotale*. Moradi *et al.* (2012) indicated that hydro priming provided a seed germination protection of *Agropyron elongatum* when exposed to drought stress. Nouman *et al.* (2012) observed a better germination of *Echinochloa crusgalli* with the application of seed priming.

Albeit previous researches have showed some useful effects of seed priming on germination and early growth of pasture plants, the effect of seed priming on the alleviation of adverse environmental conditions on the germination of pasture plants need to be more documented. Therefore, this research was aimed to evaluate the possibilities to overcome the negative effects of drought stress, as a main responsible factor for germination failure of rangeland plants under low rainfall condition, by hydro and $KNO_3$ priming.

## Materials and Methods

This experiment was carried out at the Department of Agriculture, University of Payame-Noor, Khuzestan, Iran during 2015-16 growing season. Seeds of two rangeland plants (*Festuca ovina* and *Bromus tomentellus*) were used as seed material. Seed germination and early seedling growth of these two plants were evaluated under two growing conditions: control (distilled water) and drought stress (simulated by poly ethylene glycol 6000 under osmotic potentials of -0.3, -0.6, -0.9 and -1.2 MPa).

Seed sample was divided into three sub-samples. One of the sub-samples was considered as control (unprimed) and the other two sub-samples were prepared for priming treatments. For hydro priming, seeds were soaked in distilled water for 18 hours under dark conditions of an incubator adjusted on 25˚C. For $KNO_3$ priming treatment, seeds were immersed in 500 ppm $KNO_3$ solution at 25˚C for 2 hours. After priming, seed samples were rinsed three times in distilled water and then dried back to their original moisture content.

Three replicates of 50 seeds were germinated between double layered rolled germination papers in plastic bags to avoid moisture loss. Seeds were allowed to germinate at 10˚C in the dark for seven days. Germination was considered to have occurred when the radicles were 2 mm long. Germinated seeds were recorded every 24 hour for 7 days. The seedlings with short, thick and spiral formed hypocotyls and stunted primary roots were considered as abnormal germination (ISTA, 2003). At the end of germination test (seven days) root length, shoot length and seedling dry

weight and germination percentage were measured.

A three factors factorial experiment (2×3×3) based on completely randomized design with three replications was employed. The first factor was plant type (*Festuca ovina* and *Bromus tomentellus*), the second factor was drought stress (including 0.0, -0.3, -0.6, -0.9 and -1.2 MPa simulated with PEG6000) and the third factor was seed priming technique (including no-priming or control, hydro priming and salt priming with $KNO_3$). Analysis of variance of the data was carried out using MSTATC program. Means were compared using Duncan's multiple range test at 5% probability level.

## Results

Except for the interaction Drought stress× priming for stem length, none of interaction effects of treatments were significant for germination performance of *Festuca ovina* and *Bromus tomentellus* seeds. However, main effects of drought stress and seed priming (main effects) had a significant (P≤0.01) n germination percentage, seedling dry weight, root length and stem length of two rangeland plants.

Results indicated that drought stress reduced germination properties of *Bromus tomentellus* including germination percentage, seedling dry weight, root length and stem length. However, there was a difference among germination properties in terms of drought tolerance where stem growth was more sensitive to water shortage compared with other traits. Increasing in water deficit from 0.0 to -0.6 MPa (moderate stress) resulted in 64%, 39%, 38% and 25% reduction of stem length, root length, seedling dry weight and germination percentage, respectively. Since germination percentage, seedling dry weight and root length of *Bromus tomentellus* was not significantly changed from 0.0 to -0.6 MPa, it can be concluded that this rangeland plant is able to tolerate low to moderate levels of drought and is sensitive to high (-0.9 and -1.2 MPa) levels of drought stress (Fig. 1).

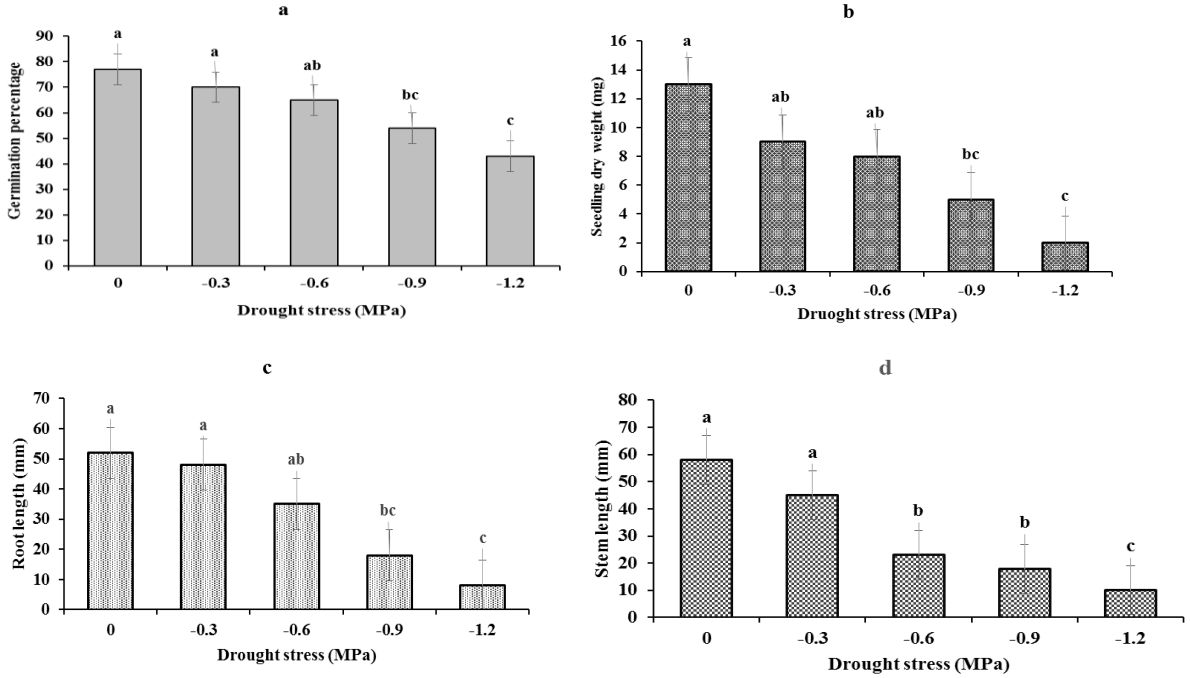


Fig. 1. Effect of drought stress on germination performance of Bromus tomentellus. a: germination percentage, b: seedling dry weight, c: root length, d: stem length. Means of column followed with the same letter are not significantly different (P<5%)

Germination performance of *Festuca ovina* showed a reduction with increasing in water shortage level (Fig. 2). The lowest germination percentage was observed at -0.9 and -1.2 MPa. However, there was a significant difference between -0.6 MPa and lower levels of drought stress where germination percentage reduction was 70% in this level. In the other words, *Festuca ovina* cannot tolerant the moderate and high levels of water deficit conditions. Seedling dry weight showed a similar response to drought stress and was reduced with increasing in drought stress level (Fig. 2). Stem length was more sensitive to low water availability compared with germination percentage and seedling dry weight. There was a significant difference between the fist and the second levels of drought stress in terms of stem length, indicating the high sensitivity of these traits to water shortage (Fig. 2).

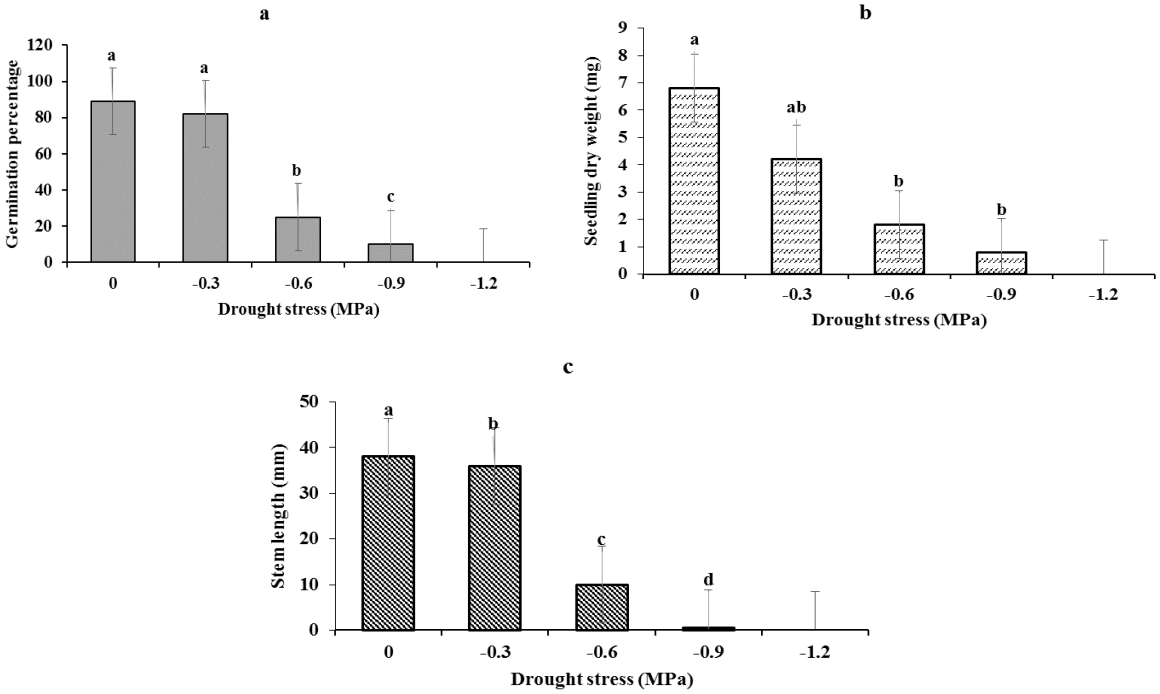


**Fig. 2.** Effect of drought stress on germination performance of *Festuca ovina*. a: germination percentage, b: seedling dry weight, c: stem length. Means of column followed with the same letter are not significantly different (P<5%)

Regarding the effect of priming on seed germination performance, germination properties of *Bromus tomentellus* were affected by priming, while in *Festuca ovina* the only trait affected by priming was root length. In other words, at the time of rangelands restoration with *F. ovina* seeds, it is crucial that the plant experience no stress conditions to have a good germination and seedling growth. However, all germination properties of *B. tomentellus* were improved by seed priming. In this case, hydro priming was a superior treatment (Table 1).

**Table 1.** Effect of seed priming on germination properties of *B. tomentellus* seeds

| Seed priming treatment | Germination percentage | Seedling dry weight (mg) | Root length (mm) | Stem length (mm) |
|---|---|---|---|---|
| No-priming (control) | 55b | 4.5b | 19b | 22b |
| Hydro priming | 65a | 8.5a | 43a | 36a |
| Osmo priming ($KNO_3$) | 63ab | 8.5a | 29b | 29ab |

Means of column followed with the same letter are not significantly different (P<5%)

## Discussion

Regarding seed germination and early seedling growth of *Bromus tomentellus* and *Festuca ovina*, an inhibition was occurred due to drought stress (simulated by PEG) which is in line with findings of Saeedi Goraghani *et al.* 2013 reported that germination properties of *Agropyron desertorum* were decreased under drought conditions. The negative effects of PEG on germination properties may result from osmotic effects of PEG not its accumulation. Therefore, reducing in water penetration and inset of enzymatic processes may be a reason for lower germination performance under drought stress conditions (Saeedi Goraghani *et al.*, 2013).

Different pre-sowing treatments are applied for improving germination performance of rangeland seeds (Tavili *et al*., 2014). In this case, improved seed performance of *Bromus tomentellus* under no-stress conditions due to seed priming was observed which is compatible with the results reporting in the primed seeds of *Secale montanum* (Araghi Shahri *et al.*, 2014). Longer water imbibitions duration is considered as logical reason for superiority of hydropriming on germination percentage compared to $KNO_3$. However, beneficial effects of $KNO_3$ on *Bromus tomentellus* germination properties were also found in this study. Seedling dry weight of $KNO_3$ treated seeds was improved, suggesting that $KNO_3$ had no toxicity effect on seed of *Bromus tomentellus*. However, because of low cost and easy use of hydro priming, this priming technique can be suggested for improving germination performance of *Bromus tomentellus* under low and moderate drought stress.

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# ارزیابی سودمندی پرایمینگ بذر در کاهش اثرات تنش خشکی بر جوانه‌زنی و رشد اولیه گیاهچه دو گونه گیاه مرتعی (*Festuca ovina* and *Bromus tomentellus*)

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**چکیده.** اثرات احتمالی پرایمینگ بذر بر کاهش اثرات منفی تنش خشکی بر جوانه‌زنی و رشد اولیه گیاهچه دو گونه گیاه مرتعی در یک پژوهش آزمایشگاهی، در سال ۱۳۹۵ مورد ارزیابی قرار گرفت. آزمایش به صورت فاکتوریل سه عاملی (۲×۳×۳) بر پایه طرح کاملاً تصادفی در سه تکرار اجرا شد. عامل اول نوع گیاه (*Festuca ovina* و *Bromus tomentellus*)، عامل دوم تنش خشکی (شبیه سازی شده با پلی‌اتیلن گلیکول ۶۰۰۰ در پتانسیل‌های اسمزی صفر، ۰/۳-، ۰/۶-، ۰/۹- و ۱/۲- مگاپاسکال) و عامل سوم روش پرایمینگ بذر (شامل کنترل یا عدم پرایمینگ، هیدرو پرایمینگ و اسموپرایمینگ با استفاده از نیترات پتاسیم) بود. نتایج نشان داد که تنش خشکی عملکرد جوانه‌زنی دو گونه مرتعی را کاهش داد به طوری که درصد جوانه‌زنی، وزن خشک گیاهچه، طول ریشه‌چه و طول ساقه‌چه در شرایط کمبود آب کاهش یافتند. با این حال، بروموس سطوح کم تا متوسط تنش خشکی را تحمل کرد (پتانسیل‌های اسمزی ۰/۳- و ۰/۶- مگاپاسکال) اما فستوکا حساسیت بیشتری به تنش خشکی نشان داد به طوری که قادر به تحمل تنش کم (۰/۳- مگاپاسکال) نیز نبود. پرایمینگ بذر باعث بهبود عملکرد جوانه‌نی بروموس در شرایط تنش خشکی شد اما فستوکا به پرایمینگ بذر واکنش نشان نداد به طوری که بذرهای پرایم شده فستوکا در شرایط تنش خشکی هیچگونه بهبودی در جوانه‌زنی نشان نداند. بنابراین، فستوکا در طول مرحله جوانه‌زنی و رشد اولیه گیاهچه نباید با تنش خشکی روبرو شود. تفاوت معنی‌داری بین اسموپرایمینگ و هیدروپرایمینگ از نظر بهبود جوانه‌زنی بروموس وجود نداشت. با این حال، به دلیل ارزانی و سادگی کاربرد، استفاده از روش هیدروپرایمینگ برای بهبود جوانه‌زنی بروموس توصیه می‌شود.

**کلمات کلیدی:** بروموس، فستوکا، عملکرد جوانه‌زنی، رشد گیاهچه، کمبود آب