DETERMINATION OF GERMINATION CHARACTERISTICS OF COVERED *LOLIUM PERENNE* L. SEEDS UNDER DROUGHT STRESS

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Lolium perenne (L.) is one of the most used turfgrass species for the establishment of multipurpose turfgrass both in Turkey and around the world. *Lolium perenne* (L.) is sensitive to environmental abiotic stress conditions such as drought and salinity. This study aims to improve the germination properties of *Lolium perenne* (L.) seeds (turf varieties of Sun and Ringle) under drought stress. The seeds of Sun and Ringle were covered with the seed coating solution, included *Endomycorrhiza, Trichoderma spp., Bacillus subtilis, Bacillus megaterium.* The coating solution was applied 4 liters 1000 kg seeds^{-1}. This germination experiment was conducted in randomized parcel design with 4 replications. A total 6 different drought stress levels (0, -2, -4, -6, -8, -9.8 Mpa) were created in this study and used Polyethylene glycol-6000 (PEG-6000). 20 seeds were laid in each petri dish and placed in the germination cabinet (70% humidity, 20 ^{o}C temperature, 14 hours light-2000 lux, and 10 hours darkness). At the end of the 14th day, the germination rate was calculated and the fresh weight of the shoots and roots, and length of shoots and roots were determined. The results obtained in this study indicated that the coating treatments improved to germination properties of *Lolium perenne* (L.) seeds under drought stress.

Keyword: *Lolium perenne* (L.), seed coating, drought stress, germination

INTRODUCTİON

Lolium perenne also known as “English grass” is the widely used cool climate type in the world. Especially in parks, which have a cool and humid climate, is preferred. In the green areas or from houses to golf courses, L. perenne is the most grown grass type. It is also used for climatization in living areas. Especially L. perenne is used in different kinds of green areas or mixed fields because the seed is cheap and easily available as well as creates a fresh and green appearance in a short time (Gül and Avcıoğlu 1997).

Plants are exposed to important abiotic stress factors such as drought, salinity, the high or low temperature that cause yield losses in agricultural production (Janmohammadi et al., 2008). In general, Drought as a meteorological concept refers to the period without precipitation, which may cause a significant decrease in the development of plants with the water contained in the soil (Örs and Ekinci, 2015). In this dry period, drought occurrence depends on the water holding capacity of the soil in addition to the rate and amount of evapotranspiration by plants (Kalefetoğlu and Ekmekçi, 2005). Drought is affecting approximately 26% of the worldwide area used for agricultural purposes. From this point of view, it can be said that drought is one of the immense environmental stress factors (Blum, 1986; Kalefetoğlu and Ekmekçi, 2005). The problem of water scarcity, extreme temperatures, and low atmospheric humidity causes drought that restraint plant growth and decrease yield (Mostafavi, 2011). Although it varies according to plant species, germination time, early seedling development and flowering periods are most sensitive to drought (Ahmadi et al., 2009).

To combat such stress factors, the development of resistant/tolerant species and varieties with the help of traditional breeding methods, biotechnological applications, and molecular assisted selection technologies is seen as the most top solutions (Samancıoğlu and Yıldırım, 2015). However, since these methods and applications are costly and take a long time, more practical solutions should be emphasized. Nowadays, seeds are coated with many active substances give tolerance to plants grown under stress conditions and ensuring germination and early seedling development period (Kaufman, 1991). In addition, with the coating method, it is possible to carry the materials that will increase the germination performance of the seed as well as decrease disease and pests susceptibility during the germination and seedling period (Taylor et al., 1998). For this purpose, the transfer of rhizobacteria group bacteria to seeds for biocontrol purposes is one of the appropriate techniques (Deaker et al., 2004; Junges et al., 2013; Vavrina and McGovern, 1990).

MATERIAL AND METHODS

This research was carried out under laboratory conditions at Akdeniz University, Faculty of Agriculture, Department of Agronomy. In the experiment, seeds of Sun and Ringle grass type (turf) Lolium perenne cultivars were used. As the coating material, the commercial product called Panoramix, which is a new generation seed coating preparation and containing Trichoderma harzianum, Bacillus subtilis, and Bacillus megaterium, was preferred. Panoramix was obtained from Koppert Biological Systems.

The coating solution was applied to the seeds as 4 L/1000 kg of seeds. In addition, control trials were created with 0 dose application. The seeds were mixed with the coating solution and covered in a laboratory environment in a way that they would not expose to sunlight.

The experiment was carried out in the "Random Plots Trial Design" with 4 replications. In order to examine the responses of seeds to drought stress during germination periods, 6 different drought levels were determined. To establish these drought stress levels, solutions with PEG-6000 and 0, -2, -4, -6, -8, and -9.8 bar water holding power were used. The osmotic potentials for each drought level were adjusted as suggested by Michel and Kaufmann (1973). Polyethylene glycol (PEG), a high molecular weight substance, regulates water uptake and creates water stress in the environment. However, PEG-6000 is not taken up by plant roots and does not cause any toxic effects to plants. Due to the decrease in the oxygen of the solution prepared with PEG-6000 over time, the papers of the germination medium were changed every 3-4 days, as recommended by Çarpici and Erdel (2015).

A total of 48 petri dishes with a diameter of 15 cm were used in this research. Covered seeds were placed in petri dishes containing double-layer germination paper as 20 seeds per petri dish. The seeds placed between double-layered germination papers were poured with 10 ml of solutions containing various PEG6000 concentrations, and then the petri dishes were wrapped with parafilm to prevent evaporation. The petri dishes were placed in germination cabinets with 10 hours of darkness and 14 hours of light, set at 20±1°C. Petri dishes were kept here for 14 days and necessary observations were taken in the petri dishes opened afterward (Şehirali, 1997; Castroluna et al., 2014).

In the experiment, observations were made at the same time every day, and seeds with a rootlet length exceeding 2 mm were considered germinated according to Soltani et al. (2012). At the end of the 14^{th} day, the germination percentage (%) was determined by counting the total germinated seeds (Scott et al., 1984). In addition, 10 shots were taken as a sample from each

petri dish on the 14th day of germination and the lengths of petiole and rootlets and fresh weights were measured in these samples.

As a result of the experiment, Analysis of variance was performed on the data obtained following the experimental designs, and the means were compared according to the Duncan test at the 5% significance level. For this purpose, the SPSS package program was used.

RESULTS AND DISCUSSIONS

As seen in Table 1, drought stress and coating application influenced the germination rate and other early seedling characteristics in this study (Table 1). There are significant interactions among cover application and drought stress levels except for the fresh weight of roots. Drought stress at different levels reduced germination rate, dramatically. The highest germination rate (80.00%) was observed in 0 drought stress-control (Table 1). On the other hand, the lowest ratio was 10.00% in -8 MPa drought stress level. Furthermore, as the level of drought stress increased, seedling values such as length of roots and shoots, fresh weight of roots and shoots decreased. However, coating applications contributed positively to the development of *Lolium perenne* seeds germinating under drought stress. Another important result seen in Table 1 is that the Sun variety showed better germination performance than the Ringle. For example, Sun had the highest length of shoots of 73.87 mm while Ringle had 57.46 mm.

Table 1. Average values obtained in drought stresses and Duncan groups

Turfgrass variety	**Drought stresss, MPa**	**Germination rate, %**	**Length of roots, mm**	**Length of shoots, mm**	**Fresh weight of roots, mg/plant**	**Fresh weight of shoots, mg/plant**
Sun	0	80.00a	53.58a	73.87a	1.44a	6.11a
	-2	62.50b	44.45a	69.65a	1.14ab	6.60a
	-4	58.12b	49.23a	57.81b	0.58bc	3.01b
	-6	46.25c	27.18b	27.55c	0.23c	1.27c
	-8	18.12d	17.56c	9.51d	0.01c	1.16c
Ringle	0	63.12a	48.55a	57.46a	1.54a	6.95a
	-2	53.75b	46.78a	55.76a	0.65b	5.35a
	-4	50.00b	30.70b	37.57b	0.17bc	1.92b
	-6	40.62c	22.26bc	25.83c	0.26bc	1.47b
	-8	10.00d	9.68c	6.92d	0.01c	0.29b
Coating (C)		**	**	**	ns	ns
Drought Stress (DS)		**	**	**	**	**
C*DS		**	**	**	ns	**

**: Means with a different letter(s) in each trait is significantly different at a 1% probability level according to Duncan's multiple range test. ns: not significant

Lolium perenne is commonly known as having poor drought tolerance with a low recuperative ability (Pornaro et al., 2020). Based on this, Pornaro et al. (2020) conducted a drought tolerance experiment with 11 *Lolium perenne* varieties. Although there are differences between the varieties, it has been stated that the recovery of the turfgrasses was slow and at the end of the experiment the variability in green cover between cultivars was greater than at the beginning.

Drought adversely affects the germination of the plants during the germination or early seedling periods, preventing reaching a sufficient number of plants per unit area, causing the plant to not receive the water it needs (Öztürk, 2015). Furthermore, drought stress causes morphological changes of plant parts such as roots and leaves under arid conditions (Yılmaz and Kısakürek, 2021). Similarly, drought stress inhibited to germination ratio and other seedling growth traits in our study.

CONCLUSION

The germination stage is one of the most critical steps for all plant development. Because plants are very sensitive to environmental factors during this period. As a result of the data obtained in this study, it was determined that *Lolium perenne* is sensitive to drought stress during the germination period. However, with coating applications, the severity of drought stress was reduced and a positive contribution was made to germination performance.

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