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THE EFFECT OF SEED AGE AND TREATMENT BY PRORADIX METHOD ON GERMINABILITY AND INITIAL GROWTH OF SELECTED MEADOW GRASS (*POA PRATENSIS*) VARIETIES

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Abstract

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The goal of the study conducted in 2008 and 2010 at the Research Forage Production Station in Vatín was to investigate the influence of seed age and seed treatment by Proradix method on the germination dynamics, total germinating capacity and initial growth rate of selected meadow grass varieties. The testing was carried out in controlled conditions on the germinator. Our results indicate that the age of seed significantly affects both the germination dynamics and the total germinating capacity. On day 7 after the establishment of the trial, a significantly higher germinating capacity was observed in the 4-year old seed (33.3%) as compared with the 2-year old seed (17.4%). Nevertheless, from day 13, higher germination values were recorded in the younger seed and its total achieved germinating capacity was significantly higher too (+7.2%). Interesting was a finding that the older seed of most varieties showed a more readily oncoming germination, which may play a quite important role in some cases namely in meadow grass, which is known by slow initial growth. The older seed exhibited significantly lower values of both above-ground biomass and the biomass of roots. The Proradix method appeared as efficient in boosting the total germinating capacity. It significantly increased germination rate as well as total germinating capacity. At the same time, a positive effect was observed of treatment by this method on the length of both shoot and root parts; the difference was statistically insignificant though.

Poa pratensis, germinability, seed age, seed treatment, Proradix

Meadow grass is one of grass species with the slowest germination and subsequent growth. The success of sowing depends on a range of factors in such a species. One of the most important of them is seed germinating capacity. Germination starts in consequence of numerous events occurring at molecular level, which pass into the growth of embryo (BRADBEER, 1988). Germination and germinating capacity are affected by many external factors such as sufficient water and oxygen supply, optimum temperature etc. In many grass species, light plays a certain role and meadow grass is one of those. Germination is also affected by internal factors such as genetic nature and actual condition of the seed (COPENLAND and MC DONALD, 1995; MÍKA, 2002). Age of the seed plays an important role too, and this holds true twice in meadow grass if we consider the species' dormancy. Too fresh a seed may exhibit low germination values in meadow grass (BOCKSCH, 2004). The influence of light on the germinating capacity decreases with the increasing seed age (EVENARI, 1965).

For the above reasons it is very crucial that the meadow grass seed used for sowing is of the highest possible quality. Some methods of seed treatment were developed to support the initial development of meadow grass, which are to boost the growth after sowing, e.g. Headstart, Pregerm, Iseed or Proradix, which was tested in our experiment. According to KNOT *et al.* (2008), Proradix is a method of seed

treatment based on the preventive treatment of naked grains with *Pseudomonas* sp. bacteria. The effect of this method shows in the biological protection of emerging plants against the pathogenic fungi of *Pythium* and *Rhizoctonia* genera, in the activation of soil nutrients, reliable germination and emergence as well as in the increased production of roots.

The goal of the submitted work was to find out what role plays the seed age and the seed treatment by the Proradix method in the dynamics of germination, total germinating capacity, length of the above-ground part and roots in selected varieties of meadow grass, which are used in turf-grass management practice.

MATERIAL AND METHODS

In 2008 and 2010, naked seeds of selected turf varieties of meadow grass were tested in the Research Forage Production Station in Vatín for the effect of seed age and seed treatment by Proradix method on the initial growth. In both years was used the same seeds. Experimental variants are presented in Tab. I. In the experiment, we used a TZ 8-046 germinator. Each tested variant represented in three replications included twenty naked seeds placed on the filter paper in the Petri dish (diameter 90 mm). The contact with water was provided by means of filter paper wicks 260 mm long and 30 mm wide. Microclimate was achieved by bell-shaped cover pieces with air holes in the upper part to allow for air circulation. The germinator was adjusted for a daily regime of 16 and 8 hours (temperatures 20 °C and 10 °C). The higher temperature and 16 hours simulated the day and the lower temperature and 8 hours simulated the night. The light, which was during the day used for illumination of all variants, was switched off during the night regime.

I: *Experimental variants*

Factor	Level
1. Cultivar	1.1. Cocktail 1.2. Yvette 1.3. Miracle 1.4. Festina
2. Seed age	2.1. 2 years (2008) 2.2. 4 years (2010)
3. Treatment	3.1. untreated 3.2. Proradix

Studied characteristics

Germination dynamics was measured on day 7, 10, 13 and 16, and total germinating capacity was established on day 20 after establishing the experiment. On these days and in these intervals, germinated naked grains were counted for the respective experimental variants. After the end of the experiment, on day 20 after its establishment, eight largest individuals were chosen from each variant, which were measured for the above-ground part height and root length. As the results of germination were in the form of relative abundance and the measured percentages cannot be expressed by means of Gaussian division, the values were converted by using the arcus sinus square root transformation (GOMEZ and GOMEZ, 1984). The statistical analysis was carried out using Statistica vers. 8.0. (STATSOFT, 2007). The significance test was made by using the variance analysis) and the subsequent Tukey test ($p \leq 0.05$).

RESULTS AND DISCUSSION

The effect of age on germination dynamics and total germinating capacity

Seed age affected highly significantly both the germination dynamics in the initial stage and total attained germinating capacity (Tab. II, Tab. III, Fig. 1). As compared with the 2-year old seed, the 4-year old seed showed a significantly higher germinating capacity on day 7 after the establishment in the average of all varieties or their treatments. The difference between the two variants was 15.9%. However, no statistical differences were recorded in other terms of measuring the germinating dynamics. On day 13 after the establishment, the germinating capacity of experimental variants was equable and in the following measurements, a higher germinating

II: *Germination dynamics and total germinating capacity on day 20 after the establishment of the experiment in the studied varieties resp. treatments (Vatín, 2008)*

Cultivar (treatment)	Day after the establishment of the trial				
	7	10	13	17	20
Cocktail	21.1ab	41.1a	53.8a	61.2a	66.1a
Cocktail (Proradix)	23.2b	50.8ab	62.3a	65.0a	72.0a
Yvette	0.0a	37.1a	50.0a	58.1a	66.0a
Yvette (Proradix)	0.0a	46.0ab	62.5a	70.7a	75.2a
Miracle	14.3ab	51.1ab	57.7a	59.7a	63.9a
Miracle (Proradix)	18.0ab	62.4b	68.9a	71.6a	77.1a
Festina	34.2b	50.0ab	60.1a	60.1a	62.3a
Festina (Proradix)	28.5b	54.8ab	60.1a	64.7a	67.4a

Values followed by the same letter in each column are not significantly different ($P \leq 0.05$).

III: *Germination dynamics and total germinating capacity (%) on day 20 after the establishment of the experiment in the studied varieties resp. treatments (Vatín, 2010)*

Cultivar (treatment)	Day after the establishment of the trial				
	7	10	13	17	20
Cocktail	18.0a	44.0a	55.9abc	60.1abc	60.1ab
Cocktail (Proradix)	35.1c	60.3a	65.0bc	66.8bc	66.8ab
Yvette	16.6a	41.2a	47.0a	48.1a	49.2a
Yvette (Proradix)	21.3abc	47.9ab	58.9abc	63.5abc	56.1ab
Miracle	46.9d	61.2b	65.0bc	65.0abc	65.0ab
Miracle (Proradix)	48.9d	61.5b	72.0c	72.0c	72.0b
Festina	33.2bc	44.0a	49.9ab	52.8ab	52.8ab
Festina (Proradix)	45.9d	55.0ab	59.3abc	62.4abc	62.4ab

Values followed by the same letter in each column are not significantly different ($P \leq 0.05$).

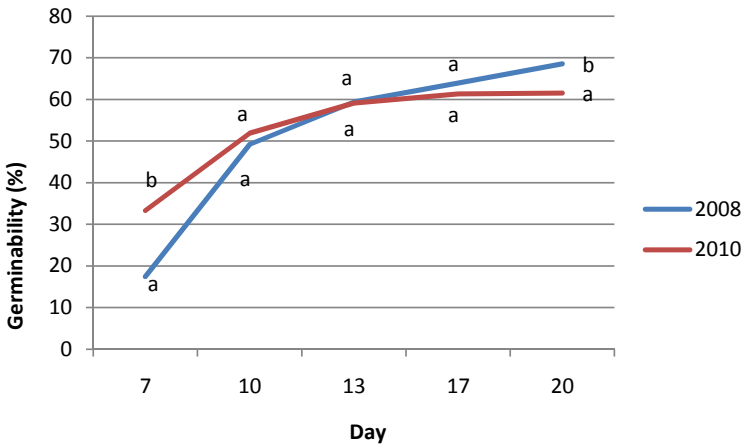
capacity was recorded already in the variant of 2-year old seed. Similarly, the final germinating capacity on day 20 after the establishment was higher in the 2-year old variant (significantly) than in the 4-year old variant by 7%. Similar results with the meadow grass were reported also by KNOT (2010) who observed a difference of 6.1% between the 2- and 4-year old meadow grass varieties.

The effect of Proradix treatment on germination dynamics and total germinating capacity

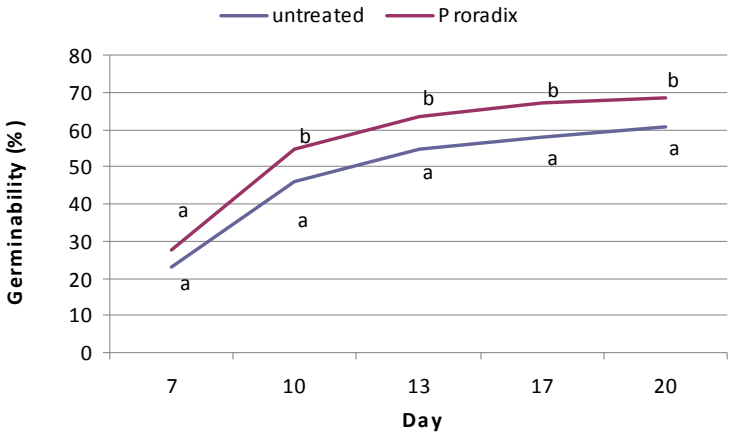
The seed treatment by the Proradix method appeared as beneficial (Fig. 2). The treated variant showed a germinating capacity of 27.6% already on day 7 after the establishment in the average of all varieties and both lengths of experimental periods, which was by 4.7% (insignificantly) more than in untreated variants. However, a statistically positive context with the seed treatment was proven in all other terms of measurements. The total germinating capacity on day 20 after the establishment was 68.6% in the treated variant, which was significantly more than in the untreated variants (60.7%). The Proradix method showed itself beneficial in contrast to for example studies published by KNOT (2006) and KNOT *et al.* (2004) who did not observe any significantly positive influence on the germinating capacity with Headstart and Pregerm methods used to treat the meadow grass seed.

The effect of seed age on the length of above-ground and root parts

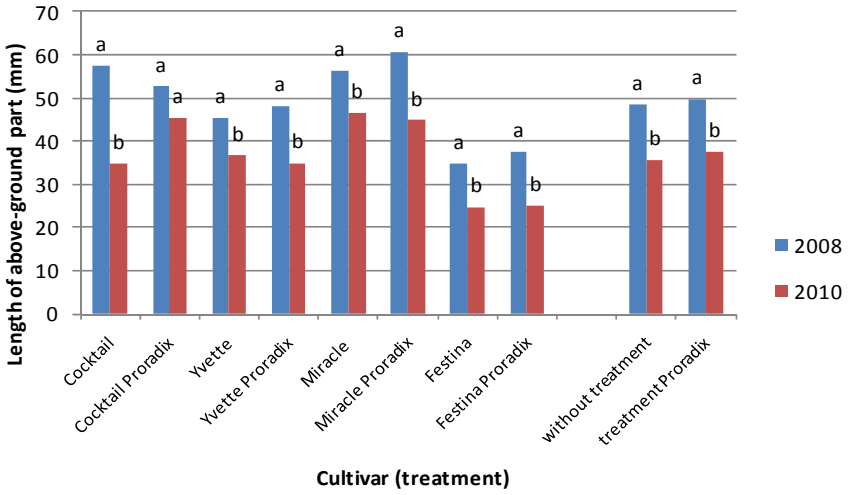
A significantly lower height of the above-ground part in variants with the 4-year old seed was proven on the average of all varieties (Fig. 3). The difference amounted on average to 12.8 mm and 12.3 mm in the untreated and treated varieties, respectively. As a single one, the Cocktail (Proradix) variety did not show a significant difference in spite of the fact that its treated variant reached in 2008 a length of the above-ground part by 7.3 mm greater than the same variant in 2010. The greatest difference between the years was observed in the variety Miracle (Proradix) – 15.9 mm. This variety reached in the treated variant the greatest length of the above-ground part (60.7 mm) in 2008. Significant differences were



1: *Germination dynamics and total germinating capacity (%) in 2008 and 2010 – variants (average of all varieties and treatments). Values in the same day characterised by the same letter are not significantly different ($P \leq 0.05$).*



2: *Germination dynamics and total germinating capacity in the treated and untreated variants (average of years 2008–2010 and varieties). Values in the same day characterised by the same letter are not significantly different (P ≤ 0.05).*



3: *The length of above-ground part on day 20 since the trial establishment. Values in the same variety (treatment) characterised by the same letter are not significantly different (P ≤ 0.05).*

recorded also among the individual varieties and treatments in both survey years.

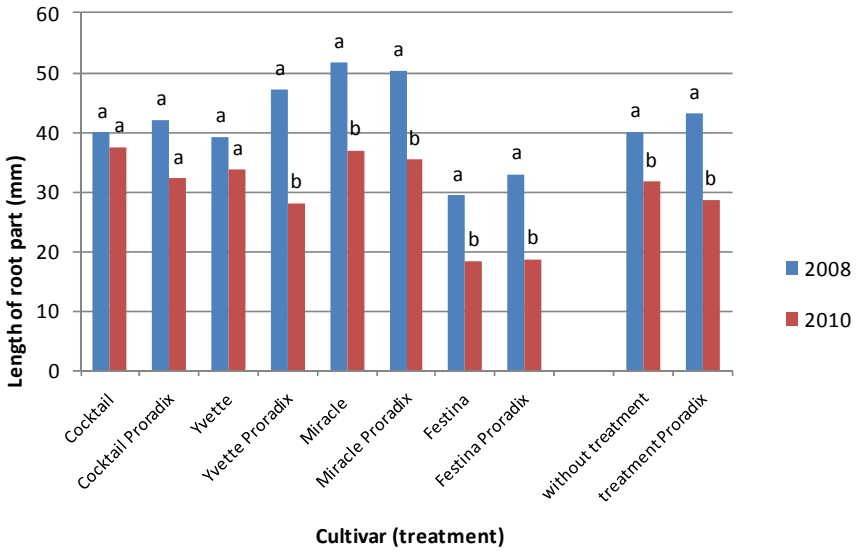
The 2-year old seed reached a significantly greater length of the root part than the 4-year old seed on the average of both untreated and treated meadow grass varieties. The difference was 8.4 mm in the untreated variants and 14.5 mm in the treated variants (Fig. 4). Even with respect to individual varieties, the root part length reached in 2008 was greater than in 2010. The difference was significant in most varieties. Exceptions were varieties Cocktail, Cocktail (Proradix) and Yvette, in which the difference was statistically insignificant.

The effect of Proradix treatment on the length of above-ground and root part

The results show that the treatment with Proradix had a positive effect on the length of both above-ground and root part on the average of all varieties; however, the difference was insignificant in both cases (Tab. IV). On the average of the two years of study, the differences were 1.5 mm in the above-ground part and 0.1 mm in the root part. VRZALOVÁ *et al.* (2008) studied the effect of Headstart treatment on the height of above-ground part and did not record a significantly positive effect of this seed treatment method either.

CONCLUSIONS

The effect of seed age on the germination dynamics and total germinating capacity on day 20 after the establishment of the experiment was demonstrated. The first term of the measurement on day 7 after the establishment revealed a significantly higher germinating capacity in the older seed. On day 13, the germinating capacity became equable



4: *The length of root part on day 20 since the trial establishment. Values in the same variety (treatment) characterised by the same letter are not significantly different (P ≤ 0.05).*

IV: *Length of above-ground part and root part on day 20 since the trial establishment (average of varieties)*

Year	Above-ground part		Root part	
	without treatment	with treatment	without treatment	with treatment
2008	48.5a	49.7a	40.0a	43.1a
2010	35.7a	37.5a	31.6a	28.6a
average	42.1a	43.6a	35.8a	35.9a

Values followed by the same letter in line are not significantly different (P ≤ 0.05).

and later on higher values were observed only in the 2-year old seed. At the end of study, a significantly higher germinating capacity was demonstrated in variants with the 2-year old seed. The higher germination dynamics at the initial stage may be in some cases much advantageous in the older seed.

Seed age significantly affected both the above-ground part and the root part of the plants. Older variants showed lower values. It follows that the increasing age of seed slows down the initial growth after germination.

The seed treatment by Proradix method appeared very beneficial both for the germination dynamics and for the total germinating capacity achieved. Differences were significant with an exception of the first survey on day 7 after the trial establishment.

No significantly positive effect of Proradix treatment was demonstrated on the initial growth of the above-ground and root part of meadow grass.

SUMMARY

The goal of the study was to investigate the influence of seed age and seed treatment by Proradix method on the germination dynamics, total germinating capacity and initial growth rate of selected meadow grass varieties. The work was carried out in 2008 and 2010 at the Research forage production station in Vatín. The testing was made on the germinator under controlled conditions. Our results indicate that the age of seed significantly affects both, the germination dynamics and the total germinating capacity. On day 7, after the establishment of the trial, a significantly higher germinating capacity was observed with the 4-year-old seed as compared to the 2-year-old seed. Nevertheless, from day 13, higher germination values were recorded in the younger seed and it's total achieved germinating capacity was significantly higher too. The older seed exhibited significantly lower values of both, above-ground biomass and the biomass of roots. The Proradix method appeared efficient in boosting the total germinating capacity. It significantly increased germination rate as well as total germinating capacity. At the same time we have observed positive effect of this method's treatment on the length of both, shoot and root parts. However, the difference was statistically insignificant.

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