Quality characteristics of seed material from selected species of a nutrient poor *Arrhenatherion* community

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Abstract

Arrhenatherion meadows are rich in biodiversity and the most important type of semi-natural grassland in central Europe. A problem is that the seed quality of selected wild flowers from local provenance is broadly undetermined. Therefore seven species were tested according to the rules of the International Seed Testing Association (ISTA, 2011) to determine the quality of wild flower seeds. An Arrhenatherion meadow was harvested in July 2009 with a plot combine thresher. After the material was dried and roughly cleaned, it was split and stored under different conditions. Three years after harvesting the thousand seed weight and the germination capacity were tested for seven of the main characteristic species: *Arrhenatherum elatius, Bromus erectus, Dactylis glomerata, Festuca pratensis, Poa pratensis, Trisetum flavescens* and *Dianthus carthusianorum*. The results showed that the germination capacity of the seed material stored in the cooling chamber is higher than at room temperature, except for *Dactylis glomerata*. The germination capacity of the assessed species still remained between 60% and 90% under both storage conditions.

Keywords: germination capacity, local provenance, Jacobsen germination apparatus, ISTA

Introduction

Before the marketing of cultivars of forage species in Central Europe was made possible by plant breeding, the most commonly used material for sowing grassland was the seed of semi-natural meadows, which was obtained from hay lofts (Scotton *et al*., 2009). The importance of seed propagation of native ecotypes has now increased, to provide seed for restoration and re-establishment of species-rich grassland (Kirmer *et al*., 2012). The quality parameters of a single species of regional provenance, propagated for seed mixtures, should as far as possible be aligned with the methods of the International Seed Testing Association (ISTA). The primary purpose of the Association is to develop, adopt and publish standard procedures for sampling and testing seeds, and to promote uniform application of these procedures for evaluation of seeds moving in international trade (ISTA, 2011). Seed of some native ecotypes (e.g. most grasses) can sprout almost immediately, but many seeds require a period of dormancy before they are able to germinate. This paper addresses the following research questions: (i) are there any differences in the germination capacity of seven dominant species of an *Arrhenatherion* community; (ii) is it influenced by different storage conditions; and (iii) how is the germination capacity of the assessed species affected after three years of storage?

Materials and methods

The study site (nutrient-poor *Arrhenatherion* community) is located at 48°18'27" N, 14°03'98" E; 310 m a.s.l., in the province of Upper Austria near the capital Linz. The mean annual air temperature in 2009 (year of harvest) was 9.6°C and the annual precipitation was 1017 mm. A combine plot harvester with a cutting width of 1.5 m was used for harvesting the meadow on 1 July 2009. The harvested material was air-dried, roughly cleaned and afterwards the seed

material was split in two fractions and stored under different conditions (i) room 15-20°C with 7-15 g m^{-3} absolute humidity, and (ii) cooling chamber 2-5°C with 3-4 g m^{-3} absolute humidity. The germination capacity of the seven most characteristic species was tested after three years (2012) of storage under different conditions. The tested species were *Arrhenatherum elatius, Bromus erectus, Dactylis glomerata, Festuca pratensis, Poa pratensis, Trisetum flavescens* and *Dianthus carthusianorum.* Before testing the germination capacity, the thousand seed weight (TSW) was analysed for both storage conditions (Table 1). From every species 4×100 resp. 4×50 pure seeds were randomly separated from the samples and tested on a Jacobsen germinations apparatus. The germination capacity indicates the proportion of seeds that have produced seedlings (ISTA, 2011). The seeds were uniformly spread on moist (distilled water) filter paper. Two Jacobsen apparatuses were needed because of different night and day temperatures (20/30°C, 15/25°C) as well as different dormancy breaking treatments: (i) pre-chilling for a week; (ii) addition of KNO_3 and (iii) light (Table 1) The duration of the germination trial is described in Table 1. The first count was after 5 or 7 days depending on the species, and afterwards at a 4-day interval up to the last counting date. The statistical analysis was done with the statistical language R (R Core Team, 2012). A one-way ANOVA was created to obtain significant differences between the different storage conditions.

Results and discussion

The results clearly showed that seeds stored under room temperature revealed a lower TSW than seeds stored in the cooling chamber (Table 1). The lower TSW measured under room temperature can be explained by higher respiration losses caused by higher temperatures and higher humidity (Sherman, 1921).

Table 1. Prescriptions for testing the germination capacity of selected species in the Jacobsen germination apparatus according to ISTA (2011). The results of the thousand seed weight (TSW) for both storage conditions.

Species	Night/day temperature, °C	Duration days	Pre-chilling	KNO_3	Light	TSW-room g	TSW-cool g
Arrhenatherum elatius	20-30	14	yes	-	yes	3.18	3.47
Bromus erectus	15-25	14	yes	yes	yes	4.37	4.49
Dactylis glomerata	15-25	21	yes	yes	yes	0.72	0.79
Festuca pratensis	15-25	14	yes	yes	yes	1.98	2.04
Poa pratensis	15-25	28	yes	yes	yes	0.18	0.19
Trisetum flavescens	20-30	21	yes	yes	yes	0.21	0.23
Dianthus carthusianorum	20-30	14	yes	-	yes	0.63	0.70

The moisture content of the seed mixture was on average 9.5%. The results show that *Trisetum flavescence* (P>0.001, R^2=0.94), *Bromus erectus* (P>0.01, R^2=0.76), *Arrhenaterum elatius* (P=0.1, R^2=0.39) and *Festuca pratensis* (P=0.08, R^2=0.43) revealed a significantly higher germination capacity when seeds were stored in the cooling chamber compared to room temperature. There were no significant differences in the germination capacity for seeds of *Dactylis glomerata, Poa pratensis* and *Dianthus carthusianorum* concerning the storage conditions. Seeds of *Bromus erectus, Festuca praensis* and *Poa pratensis* reached a germination capacity of 90% and higher, when stored in the cooling chamber, and were even exceeding the ISTA (2011) threshold. Grime *et al.* (1981) assessed that, for most species, germination capacity increased during dry storage conditions, but our experiments showed opposite results. All species except *Dactylis glomerata* reached higher germination capacities when the seeds were stored under cool and dry conditions. Thompson and Ooi (2010) reported in their paper that temperature can both break dormancy and stimulate or reduce germination capacity, sometimes even at the same time, which underlines our results.

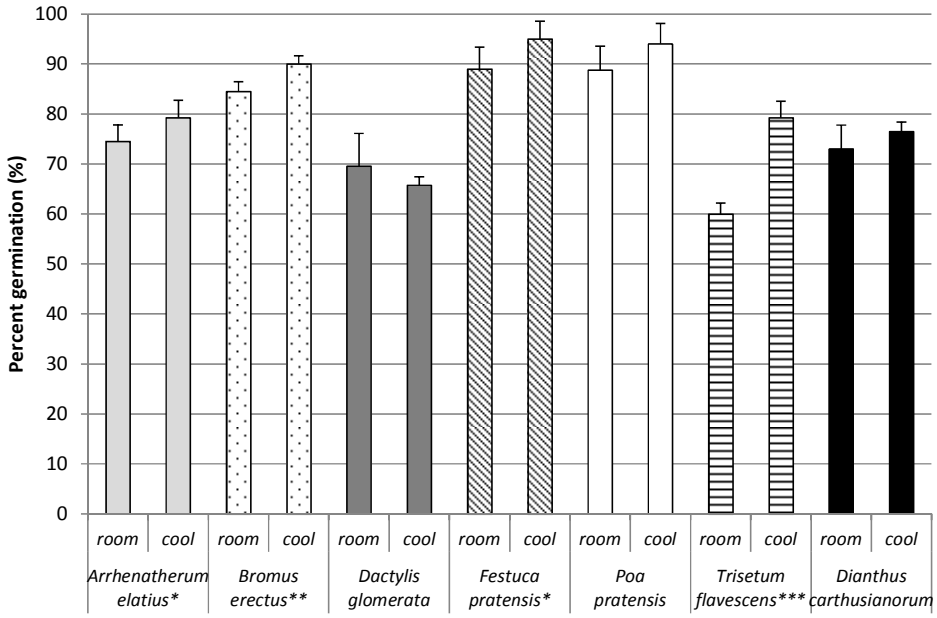

Figure 1. Results of the germination capacity after three years of storage under different conditions (i) room 15-20°C with 7-15 g m^{-3} absolute humidity and (ii) cooling chamber 2-5°C with 3-4 g m^{-3} absolute humidity of seven dominant species *Arrhenatherum elatius, Bromus erectus, Dactylis glomerata, Festuca pratensis, Poa pratensis, Trisetum flavescens* and *Dianthus carthusianorum* of an *Arrhenatherion* community (significance level: **P*<0.05, ***P*<0.01, ****P*<0.001).

Conclusion

Wild flower seeds harvested with on-site threshing can be tested with the same methods as commercial seeds according to the rules of the International Seed Testing Association (ISTA 2011). The germination capacity of the selected main characteristic species is generally high and seed dormancy strategies could not be assessed. Harvested seeds of wild flowers can be easily stored at least for three years under dry and cool conditions and will still hold sufficient germination capacity.

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