Variability in the germination performance of *Lotus tenuis* (Waldst et Kit)

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Introduction

The productivity of some grasslands in the area called "Pampa Deprimida Bonaerense" in Argentina can be improved through the incorporation of *Lotus tenuis* (Waldst et Kit). Some data indicate the feasibility of its establishment through the inter-sowing (Miñon et al, 1988; 1990). However, the low vigor of the seedling affect the success of the inter-sowing. Seed weight is a trait associated to seedling vigor as it was found in different populations of *L. tenuis* (Beuselinck and McGraw, 1982; Mujica and Rumi, 1991).

The germination speed and their uniformity are characters that also would condition the establishment and these could be little or not determined by the seed weight. Furthermore, the longevity of the seeds is also a character that facilitates the use of the improved materials. Mujica and Rumi (1991) observed that seeds of different populations preserved at 5-7 °C maintained its viability during 6 years.

The objective of this work was to evaluate the variability in the germination performance and seed longevity of *L. tenuis*.

Material and methods

Seeds of 20 clones produced in polycross among 32 clones with 25 repetitions were used. The harvest and threshing of the fruits was accomplished manually, in January 1991. The seeds were maintained in a refrigerator (5-7°C) until the experiment began, 47 months after the threshing, therefore being unnecessary its scarification (Mujica and Rumi 1991). It was determined the weight of 100 seeds of each clone (average of 4 samples). These were germinated in 285 x 208 x 25 mm "telgopor" sandwich boxes on a moist (water saturated) blotting paper. The experimental unit consisted of 50 seeds, sown in lines. Each box included 10 treatments (clones) and 2 border lines. It was used a complete randomized design with 3 repetitions.

Germination tests were performed in the laboratory with the daily monitoring of the extreme temperatures in a maximum and minimum thermometer. The extreme minimum and maximum temperatures recorded during the experiment were 16.5 and 20.5 °C, respectively. Each 24 h the number of germinated seeds (radicles ≥ 2 mm) was registered, and simultaneously the seeds were removed from the boxes. The trial ended 8

days after the sowing. For quantitative analysis of the germination speed the following index was applied according with Maguire (1962):

$$GSI = \frac{\text{No. of germinated seeds on day 1}}{1} + \ldots + \frac{\text{No. of germinated seeds on day n}}{n}$$

GSI: germination speed index.
n: number of days after sowing.

For daily percentage of germination, accumulative germination and GSI the analysis of variance of data was performed. The percentages were transformed into arcsin. Tukey test was used at the 1% level to compare the treatments. Also the regression of the GSI on the germination percentage and on the daily accumulative germination were determined.

The broad-sense heritability (h^2b) of GSI was calculated. The variance of the experimental error and the variance of the treatments were considered estimates of the environmental variance (VE) and the genetic variance (VG), respectively. Therefore $h^2b = VG/(VG + VE/r)$

Results

The analysis of variance of the accumulated germination for each day after sowing, indicated the existence of significant differences (P=0,01) among the clones in days 2, 3, 4 and 5.

From day 6 until the end of the experiment (day 8), significant differences (P=0,05) were not found and all the clones reached a high value in the accumulated germination (general mean = 98.146% ± 1.436). Considering the age of the seeds (47 months), the maintenance of the viability under the conditions described was very acceptable. These results were in agreement to those previously reported for seeds of the same species preserved at low temperature during 3 and 6 years (Mujica and Rumi, 1991). The differences observed among the clones during the first days were reflected in the GSI values, which showed significant differences ($P < 0,01$; Table 1). The averages of 20 clones were distributed according to:

$s^2 = 16.01$, cv = 13.63%, minimum value = 21.86 and maximum value = 35.21.

These differences in the vigor of the seeds could have existed from the harvest or either could have expressed at some moment during the conservation stage. If the second alternative would be true the results would mean the early detection of some loss of vigor, possibly related with seed longevity.

The regression analyses of the GSI on the accumulative and daily germination show that GSI was more strongly determined by the germination on day 2, (Fig 1). This implies that the germination performance two days after sowing would allow to evaluate indirectly the speed of the germination.

The value of broad-sense heritability (h^2b) of the GSI was very high (h^2b= 0,919). This is due to the genetic variability available and to the scarce variation originated by environmental causes.

The correlation coefficient among the germination speed and the 100-seed weights (r = 0.406) was not significant at 5% level ($r_{0.05}$ = 0.444).

Beuselinck and McGraw (1982) determined a positive and significant correlation ($P<0.01$) among the weight of 100 seeds and the total dry weight of the seedling at 2, 4, and 6 weeks after sowing. Mujica and Rumi (1991) in two populations of the same species reported similar results. This implies that the seed weight is a component of seedling vigor. According to the results of this experiment, the speed of the germination would not be an important way through which the weight of the seed would determine the vigor of the seedling.

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Table 1. Analysis of variance for the germination speed index (GSI) values.

Source of variation	df	Mean square	F-ratio	Sig. level
Between clones	19	48.05	12.20	.0000
Within clones	40	3.94		

X = 29.41
c.v.= 6.74%

Figure 1. Regression of germination speed on the germination two days after sowing.