Factors Influencing Germination in Beardless Wildrye[1]

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Highlight

The effects of pretreatment, strains, temperature and germination solutions on germination were studied in beardless wildrye. Rate of imbibition was also studied. Total imbibition was not influenced by either strains or solutions. For the two strains studied optimum conditions appear to be germination in distilled water with alternating temperatures of 15–20 C preceded by moist prechilling at 1.5 C.

Optimum conditions for germination in crop species are of interest to the grower because of implications in stand establishment, to the seedsman for accurate laboratory analyses of seed quality, and to the researcher because of the basic physiological and genetic processes involved. Optimum laboratory germination conditions have been identified for many cultivated crop species; however, there is an apparent lack of such information for many native forage species.

Dewey (1960) studied salt tolerance among 14 *Agropyron* species in field and laboratory tests. He detected wide differences among strains and suggested that differences in salt tolerance are inherited and that relative tolerance can be improved through plant breeding. He also noted a negative relationship between salinity and percent germination and between salinity and rate of germination: as salinity increased, both percent and rate of germination decreased.

The relation between moisture availability and germination varies with species. Ayres (1952) reported a decrease in total germination and reduction in rate of germination with increasing moisture in onions. McGinnies (1960) reported a reduction in rate and total germination with moisture stress in six range grass species. In addition he noted that maximum laboratory germination occurred at 20 C and that both moisture stress and temperature influenced germination. In other laboratory studies, Ellern and Tadmor (1967) found that low temperatures (4–10 C range) delayed germination in pasture plants, notably in perennial grasses, and that high temperatures depressed total germination, but had little affect on rate of germination. According to Ellern and Tadmor (1966) speed of germination, not total germination, is influenced by unfavorable alternating regimes in laboratory studies. Palmer, Becker, and Chapman (1968) reported that rate, not total germination, was influenced by salinity.

Materials and Methods

Beardless wildrye (*Elymus triticoides* Buckl.) is a native, rhizominous, perennial grass of significant forage potential in Montana. It is usually found on moist or alkaline soils from Montana and Washington south to Texas and Baja, California (Hitchcock, 1951). To determine optimum germination conditions for this species, four factors and various interactions among them were studied in replicated growth chamber tests: (1) temperature (15 C constant, 20 C constant, 15 C–25 C alternating, and 15 C–30 C alternating), (2) pretreat-

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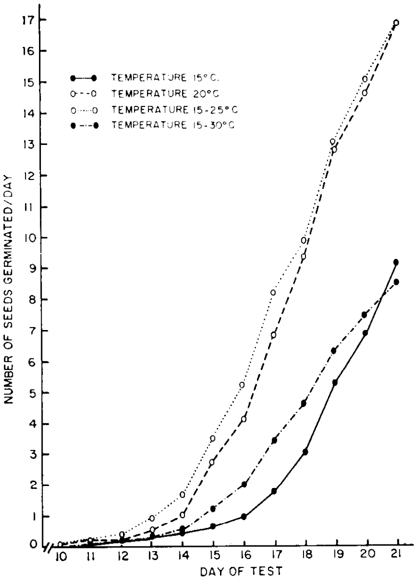

FIG. 1. Mean germination of two strains of beardless wildrye under four temperature conditions.

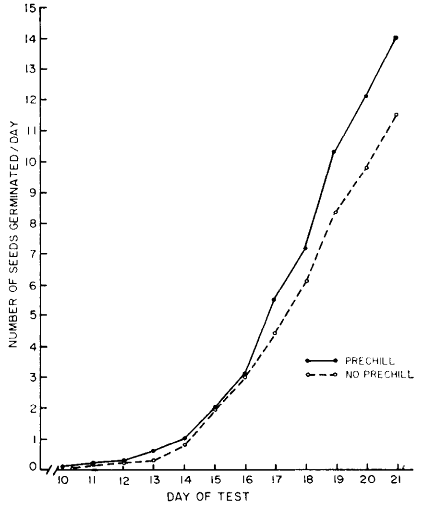

FIG. 2. Mean germination of two strains of beardless wildrye with and without prechilling.

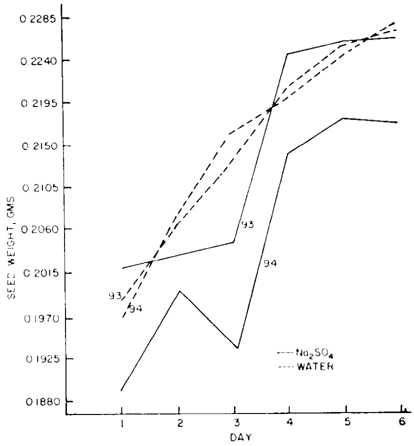

FIG. 3. Pattern of water uptake (increase in seed weight) for two strains of beardless wildrye in two germination solutions.

ment (no prechilling vs prechilling on moist blotters at 1.5 C for 5 days), (3) germination solution (distilled water vs Na_2SO_4 solution at 7.2 atm), and (4) ecotypes or strains (P-15593 and P-15594 obtained from the Soil Conservation Service Plant Materials Center, Bridger, Montana). Germination was scored daily over a 21 day period for four replicates of 50 seeds each of each treatment following the procedures generally used in germination tests of forage grass species by the Montana Grain Inspection Laboratory.

In a second study, the effects of strains and solutions on rate of water uptake (imbibition) and their interaction were studied. Replicated lots of 50 seeds each of the strains used in the previous study were placed on blotters moistened with either distilled water or Na_2SO_4 solution adjusted to 7.2 atm. Each seed lot was weighed daily to determine change in seed weight due to moisture uptake.

Results and Discussion

Analyses are based on data for a 12 day period, beginning with the 10th day through the last (21st) day of the test. No visible signs of germination were detected during the first 9 days.

The effects of strains and of germination solutions and their interaction are significant for all 12 days. Highest germinations occurred in strains P-15593 germinated in distilled water. The effect of temperatures and temperature × solution interactions are significant from the 13th and 14th day of the test to the 21st day, respectively. Apparently, there were a few seeds which germinated early in the test period. These were insensitive to variation in temperature; however, seeds which germinate later were sensitive to variation in temperature. From the 14th day to the end of the test, response to the four temperature regimes can be grouped in two classes: 15–25 C alternating and 20 C constant vs 15–30 C alternating and 15 C constant. The difference between these classes accounts for the majority of the significant variation among temperature means (Fig. 1). The strain × temperature interaction is significant for days 14–20. There is no apparent reason for the pattern of significance of this effect.

The effect of pretreatment is significant only for days 17–21. Like temperature, apparently pretreatment is relatively unimportant in early germination, but plays a significant role in germination at the end of 21 days. Pretreatment becomes increasingly important from the 17th to the last day of the test (Fig. 2). The temperature × pretreatment interaction is significant for days 19–21.

Optimum germination conditions have been specified for total germination over a defined test period for many crop species. Our results indicate that factors which significantly influence total germination over a 21 day period, pretreatment and temperature, are non-significant during the early days of the test. We suggest this pattern may reflect an adaptive mechanism which allows some seed to germinate under a wide array of environmental conditions and other seed to germinate under more strictly defined conditions. Thus, in nature, this type of variation enhances the chance of successful seedling establishment. Patterns of genetic variation in annual fescue reported by Chapman (1967) tend to support this contention.

From an agronomic point of view, this type of variation may explain the improvement in stand of many forage species in the months after seeding; it may also explain the occurrence of weeds in what appear to be "clean fields."

The highest total germination for both strains was obtained by prechilling seed at 1.5 C for 5 days followed by germination in distilled water at 15–25 C alternating temperature. This is the best combination for total germination and compares favorably with all other treatments at all stages in the test.

The strains were not significantly different in dry seed weights. Based on eight samples of 50 random seeds each, the mean weight of strain '93' was .122 grams and of strain '94,' .115 grams. One measurable effect of prechilling was a significant increase in seed weight due to water uptake; mean weight of prechilled seed was .203 grams compared to mean dry weight of .119 grams.

Prechilling significantly influenced seed weight. Water uptake was significantly influenced by strains and germination solution only on the third day of the study. The strains were quite similar in response to both Na_2SO_4 and distilled water; increase in weight in water appears to be linear; in salt it is apparently curvilinear (Fig. 3).

The biological effect of prechilling cannot be fully explained. The two studies, rate of water uptake and rate of germination, cannot be compared directly; in the water uptake study, the effect of solutions (distilled water vs Na_2SO_4 solution) is significant only for the third day. In the germination study this effect is significant throughout the experiment. We suggest if the effect of prechilling is water uptake alone, the response to solutions should be parallel in the two experiments. Since it is not, we conclude prechilling must influence both water uptake and enzymatic activity not associated with water uptake, but necessary for germination.

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