Seed Germination Requirements of Four Species Co-Occurring in a Wisconsin Sedge Meadow

John L. Larson
Applied Ecological Services, Inc.
P.O. Box 256
Brodhead, Wisconsin 53520

Abstract. Seeds of four colonizing species which occur together in a recently revegetated sedge meadow were tested for germination after storage under three different conditions. Seeds were tested at an alternating temperature regime of 21°C dark, and 32°C light. Three species, *Bidens frondosa*, *B. coronata*, and *Scirpus cyperinus* germinated most successfully when stored under moist-cool conditions. Germination of *Carex scoparia* was consistently high and was not affected by storage condition. Differences in seed germination among the four species may contribute to their coexistence in highly disturbed environments such as newly revegetated sedge meadows.

Introduction

Wetland seed germination studies have observed four general characteristics (Harris and Marshall 1960, Thompson 1974, Comes et al. 1978, Galinato and van der Valk 1986, Baskin and Baskin 1988). These are: 1) A requirement of many wetland seeds for light for germination; 2) The need of light requiring species for fluctuating, or relatively high, temperatures for germination; 3) The fact that most wetland seeds are dormant at maturity; 4) Finally, although many wetland seeds do not require stratification prior to germination, stratification improves germination.

In this study of seed germination requirements of wetland species I compared the seed germination requirements of two dominant perennial monocots (*Carex scoparia* Schk, and *Scirpus cyperinus* Kunth) and two dominant annuals (*Bidens coronata* (L.) Britt and *Bidens frondosa* L.) that were found in a recently established sedge meadow.

Methods

Seeds were collected in 1988 from a sedge meadow located in Waukesha County, Wisconsin and described by Larson and Stearns (1989) and Larson (1989). Seeds were harvested and placed in paper bags, at ambient room temperature (dry-warm) for 7 days. Within one week of collection, a portion of the seed was stored dry in a cold room at 4°C (dry-cool) and on moist filter paper at 4°C (moist-cool). The purpose of this study was to determine the need for storage and the effect of various storage treatments upon germination of apparently sound seed. Therefore, seeds that were moldy or apparently unsound were not included in germination tests.

For each species, 100 freshly harvested seeds (269 seeds of *Scirpus cyperinus*) were immediately tested for germinability. Seeds were germinated in a Sherer controlled environment chamber (model CEL 25-7HL) at an alternating temperature of 21°C-dark and 32°C-light. A 14-hour light, 10-hour dark regime was used. Daytime light level, supplied by cool white fluorescent tubes, was 200 umol m^{-2} s^{-1} at seed level.

For germination tests, fifty seeds/petri dish (except for *Scirpus cyperinus*) were placed on filter paper (Whatman No. 1) moistened with 5-6 ml of distilled water. *Scirpus cyperinus* seed presents a special problem in that the very small seeds easily become entangled in their bristles. To avoid injury to the seed, a sample estimated to contain 50-100 seeds was used for each replicate with the exact number of seed determined at the end of a test.

For each species, four replicate petri dishes were used for each storage condition. Dishes were watered every other day with distilled water. Initial germination counts were made when the first shoots and radicles were evident and every 3-5 days thereafter, until an experiment was terminated at 21 days. Seed had been held in storage approximately 6 months after collection when tested for germination.

For each species, differences among storage conditions were analyzed using one-way analysis of variance. If variances were heterogenous, the Games and Howell test for equality of means was employed

(Sokal and Rohlf 1981). Differences were considered significant if their probability was less than 0.05.

Results and Discussion

Of the four species, some seeds of one annual (*Bidens frondosa*, 60%) and one perennial (*Scirpus cyperinus*, 2%) were capable of germination immediately after harvest (Table 1). Baskin and Baskin (1988) found dormant seeds became nondormant only at specific temperatures and nondormant seeds had specific temperature requirements for germination. Since seeds in my study were initially tested only at one temperature regime, it is not possible to determine if nongerminating seeds were completely dormant. In an earlier germination study, *Carex scoparia* and *Scirpus cyperinus* seeds were found to be dormant at several alternating temperatures, suggesting seeds of these plants were initially dormant (Larson 1989).

Table 1. Percent germination of four species at 21/32°C. Number in parentheses are one standard deviation. Percentages with the same letter across columns are not significantly different.

Species	No Storage	Storage Conditions		
		Dry-Warm	Dry-Cool	Moist-Cool
Bidens frondosa	60	35a (5.3)	19b (19.6)	53c (3.2)
Bidens coronata	0	15a (7.6)	0b (0.0)	68c (10.6)
Carex scoparia	0	81a (4.1)	78a (7.6)	78a (7.5)
Scirpus cyperinus	2	36a (6.3)	44a (13.0)	96b (3.9)

The lower germination of *Bidens frondosa* when stored dry-cool compared to the initial germination may indicate that dry-cool storage induced a secondary dormancy response. Stratification appears to be beneficial for *Bidens frondosa* as moist-cool stored seeds had the highest germination of the three storage conditions.

Carex scoparia and *Scirpus cyperinus* seeds gave consistently higher germination than either *Bidens* species. *Carex scoparia* exhibited the best overall germination and its seeds germinated equally well regardless of storage condition. Other studies by Larson (1989, 1992) and Larson and Stearns (1990) found stratified *Carex scoparia* seed generally did not germinate as well as non-stratified seed. However, the range of alternating temperatures used in the previous studies was only 4 to 7°C (21/25 and 25/32°C) compared to 11°C (21/32°C) in this study. Baskin and Baskin (1988) found temperature to be the overriding factor in the germination of temperate species and the larger fluctuation in temperature in this study, compared to the earlier studies, suggests that temperature may have a greater influence on germination than storage condition.

Three of the four species responded similarly to the storage conditions. That is, the highest germination occurred in moist-cool storage and the lowest occurred in dry-cool storage. Angevine and Chabot (1979) found that there may be more than one germination pattern within a particular habitat. Coexisting species have been assumed by ecologists to differ in various ways to permit their intimate association (Pickett and Bazzaz 1978). Colonizing species, such as these four species, may have similar germination responses to available soil moisture (Pickett and Bazzaz 1978). A similar response may indicate convergent evolution for the exploitation of a particular range of soil moistures that are likely to be encountered in nature during the usual period of germination. Further field studies on germination and soil moistures conditions are necessary in order to evaluate in situ germination responses.

The different germination responses of the four species may contribute to their coexistence in sedge meadows. Differences in soil surface features and the size and shape of microsites have been found to favor germination of some species (Harper et al. 1965). The annuals would be expected to have both greater seasonal and year to year fluctuations in frequency and density of plants compared to the more permanent perennials.

Overall, moist-cool (74%) storage resulted in higher mean germination than either dry-warm (42%) or dry-cool (35%) storage. This has been observed for other wetland species (Galinato and van de Valk 1986, Larson, in preparation). Lower seed germination when stored dry (warm or cool) may indicate that these seeds enter a secondary dormancy or may have died because of a lack of moisture. Seeds with secondary dormancy mechanisms may be long-lived and test the environment over a number of years.

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