Perigynia Removal Improved Germination in Two Native Sedge Species

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Introduction

Sedges (*Carex* spp.) are commonly used in wetland restoration projects and rain gardens because of their tolerance of fluctuating water levels. For larger projects, achene propagation is the most economical. Physiological dormancy is frequently reported in sedges (Baskin and Baskin, 2014). Even when physiological dormancy is relieved, germination may still be slow. Removing the perigynium (perigynia, plural), a bladder–like sac that adheres to the pericarp of the achene, has decreased germination time and increased percent germination of some sedges. Hoag et al. (2001) found that Nebraska sedge (*C. nebrascensis* Dewy) germination was increased from 38% to 60% and time needed to 50% germination was reduced by removing perigynia. Jones et al. (2004) found that perigynia removal increased germination of Nebraska sedge and Northwest Territory sedge (*C. utriculata* Boott) when achenes were grown in the light and reduced time to 50% germination by 4 to 9 days. Hough-Snee and Cooper (2011) found that perigynia removal increased percent germination of awl-fruited sedge (*C. stipata* Muhl) from 21% to 58%. We tested four sedge species native to the north central U.S. to determine if perigynia removal would increase germination and decrease time to 50% germination. Two of the four sedge species are shown in figure 1.

Materials and Methods

Potted plants of yellow fox sedge (*C. annectens* Bicknell), porcupine sedge (*C. hystericina* Muhl. Ex Willd), plains oval sedge (*C. brevior* Mack) and palm sedge (*Carex muskingumensis* Schwein) were purchased from Minnesota and North Dakota nurseries and planted in a garden plot located on the campus of North Dakota State University, Fargo, USA, in 2014. Mature achenes of the four species were harvested when ripe. Achenes were cleaned using an air column separator and stored dry in paper bags at 21 ^{o}C until the start of the experiment. Achene storage ranged from 19 – 22 weeks. Achene viability was tested using tetrazolium chloride (TZ) and viability percentages for plains oval sedge, yellow fox sedge, porcupine sedge, and palm sedge were 62%, 60%, 62%, and 72% respectively.

A total of 25 pure live seed of each species with and without perigyina were placed into 6.0 x 1.5 cm^2 petri dishes containing one 5.5 mm diameter filter paper. Perigynia were removed from achenes by rubbing between thumb and palm of hand (Figure 2). Filter paper was moistened with reverse osmosis water and added as needed. Each petri dish was placed inside of a 7.6 cm x 10.2 cm plastic bag to prevent excessive evaporation. Achenes were placed in a growth chamber and grown for four weeks under approximately 110 µmol·m^{-2} ·s^{-1} irradiance for 12-hours from cool, white fluorescent light, with alternating 27 ^{o}C, 10-hour days/15 ^{o}C, 10-hour nights with a 2-hour transition period. Germination counts were taken every other day and germinated achenes were removed. Germination was defined by emergence of radical and hypocotyl. At the conclusion of the study, all non-germinated achenes from each petri dish were collected and viability was determined using TZ. Germination percentage for each petri dish was calculated by dividing the number of germinated achenes by the number of viable achenes. Time to 50% germination was calculated by adding up the number of days needed, using the cumulative germination data, until 50% germination was reached.

Figure 1. Plains oval sedge (left) and yellow fox sedge (right).

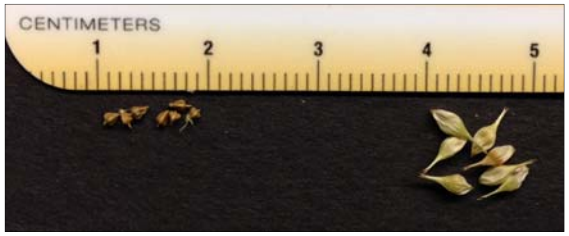

Figure 2. Achenes of porcupine sedge with perigyina removed (left) or intact (right). Perigyina were removed by rubbing achenes between thumb and palm of hand.

Experimental Design and Statistical Analysis

Experiment was arranged as a completely random design with a factorial arrangement consisting of each species with perigynia intact or removed and replicated four times. The study was repeated twice. Data was subjected to one-way analysis of variance and treatment means were separated using Tukey's honestly significant difference. Means were considered significant at the $P < 0.05$ level. Germination proportions were $\log_{10}$ transformed prior to analysis to standardize the variance. Germination proportions were backtransformed and are reported as percentages.

Results and Discussion

A significant species by perigynia interaction occurred. Removing the perigynia of yellow fox sedge significantly increased germination from 51% to 93% (Figure 3). However, perigynia removal did not significantly increase germination of palm sedge, plains oval sedge, or porcupine sedge. Time to 50% germination was significantly reduced from 26 to 17 days and 15 to 10 days by removing perigynia for yellow fox sedge and porcupine sedge, respectively (Figures 4 and 5). Perigynia removal did not significantly decrease time to 50% germination for palm sedge and plains oval sedge.

Increased germination from perigynia removal appears to be species specific. It is unclear why this occurs. Jones et al. (2004) suggests that an intact perigyinium reduces light reception by the achene. Therefore, sedges with a strict light requirement may be sensitive to the light absorbed by the perigynium. This may help to explain why some sedge species in the current study had an increase in germination and a decrease in time needed to reach 50% germination when perigynia were removed. The results of this study suggest perigynia removal is an effective strategy to increase percent germination of yellow fox sedge and reduce time needed to achieve 50% germination of yellow fox sedge and porcupine sedge.

Literature Cited

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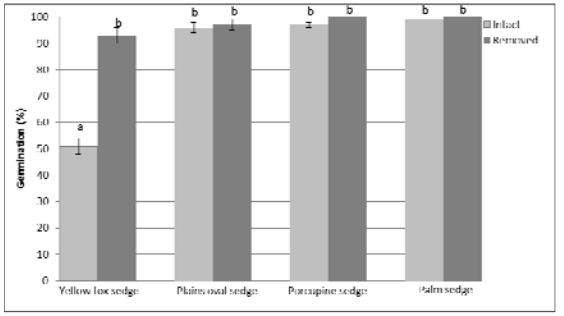

Figure 3. The effect of perigynia removal on percent germination of four sedge species. Half of achenes had their perigynia left intact while the other half was removed. Error bars represent standard error. Mean values labeled with different lower case letters were significantly different according to Tukey's honestly significant difference test at $P< 0.05$.

Figure 4. Achenes of porcupine sedge with perigyina removed (left) or intact (right) after 10 days of incubation.

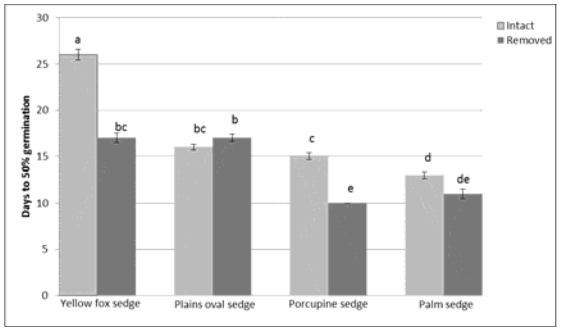

Figure 5. The effect of perigynia removal on time to 50% achene germination of four sedge species. Half of achenes had their perigynia left intact while the other half was removed. Error bars represent standard error. Mean values labeled with different lower case letters were significantly different according to Tukey's honestly significant difference test at $P< 0.05$.