

Restoration of Threadleaf Sedge

Final Report

Prepared by

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Abstract

Threadleaf sedge (*Carex filifolia* Nutt.) is one of the main components of the natural vegetation at Scotts Bluff National Monument (SCBL). Vegetative transplants of threadleaf sedge are required for restoration because seeding methods have not been developed nor are seeds available. We conducted two identical experiments in 2002-2003 and 2003-2004 to assess the greenhouse growth and field survival of transplanted threadleaf sedge as influenced by fertility. Small sections of threadleaf sedge sod were collected at SCBL in November 2002 and 2003, transported to the University of Nebraska, divided, and planted into Ray Leach Cone-tainers™. Over 7,000 plants were grown in the greenhouse with a subsample treated with four rates of fertilizer: (1) no fertilizer (control), (2) 20 ppm NPK, (3) 40 ppm NPK, and (4) 60 ppm NPK. Aboveground and belowground biomass significantly increased with fertilizer application, with the greatest biomass occurring with the 60 ppm NPK treatment. Following six months of growth in the greenhouse, the remaining plants were transplanted at SCBL. Threadleaf sedge survival was monitored at six and 12 months following transplanting. We determined there was no significant difference in field survival among the fertilizer treatments, indicating that the fertilizer application in the greenhouse did not result in a carry-over effect that enhanced field survival. In 2003, the 12-month threadleaf sedge survival was 82%, and the 12-month survival in 2004 was only 29%. Environmental conditions including herbivory, dry growing conditions, and competition from annual weedy species appear to have had more of an influence on transplant survival than previous treatment in the greenhouse.

Introduction

Prairie restoration is a priority of Scotts Bluff National Monument (SCBL). The park lies in the northern mixed-grass prairie region, and the most predominant vegetation community is the *Agropyron-Hesperostipa* association. Dominant species are needleandthread [*Hesperostipa comata* (Trin. & Rupr.) Barkw.], threadleaf sedge (*Carex filifolia* Nutt.), western wheatgrass [*Elymus smithii* (Rybd.) Gould], blue grama [*Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths], buffalograss [*Buchloe dactyloides* (Nutt.) Engelm.], and many forbs. Much is known about propagation of the grasses, but little is known about threadleaf sedge. This important component of the vegetation is valuable for soil stabilization in the windy environment, and it provides food for many species of wildlife.

Two restoration units (12 and 5 ha) were planted to mixtures of grasses and forbs in 1997. Threadleaf sedge, one of the main components of the vegetation, was not included because seeds were not available. Research at the University of Nebraska has shown that both seed production and seed germination are extremely low (Griffith 2002; Fassett 2003). In order to fully restore the vegetation to meet the goals of the park, greenhouse-grown threadleaf sedge plants will need to be transplanted into the restoration sites.

Scotts Bluff National Monument has a long history of grass restoration on previously farmed and other disturbed sites. The first plantings included only a few species of grasses. While these plantings provided perennial grass cover to the land, they were not prairie restorations. In 1997, a grant from the Nebraska Environmental Trust Fund was used to begin the restoration of the former site of the Scotts Bluff Country Club. This included removal of building foundations, swimming pool, irrigation canals, non-native tree removal, land contouring, native seed purchases, and preliminary research on threadleaf sedge propagation.

Seed mixtures of native grasses and forbs were planted in 1997. Success of those seedings has been rated as excellent.

The University of Nebraska has been the leader in research on propagation and establishment of threadleaf sedge. The University's research continues on enhancing seed production and establishment from seed, but techniques to establish plants from seed are not completely developed nor are seeds available. The University's research on vegetative propagation has shown that sod plugging was not successful, but transplanting greenhouse-grown plants into the plant community has been highly successful (Stubbendieck et al. 2002). Earlier research indicated that threadleaf sedge survival and growth was directly related to the fertility of the growth medium (Tichota 2000). It was not known if plant responses to fertility in the greenhouse would carry over to better survival and growth in the field. Therefore, our objective was to assess the response of threadleaf sedge to fertilizer treatments in the greenhouse and determine the residual influences of the treatments on survival and growth in the field on two restoration sites at SCBL.

Methods

The greenhouse portion of this study was conducted at the University of Nebraska-Lincoln and the field portion conducted at SCBL. This study was repeated in 2002-2003 and 2003-2004 with identical treatments applied to the greenhouse grown threadleaf sedge each year. Threadleaf sedge sod was collected from SCBL in early November 2002 and 2003. The sod was transported to the University of Nebraska-Lincoln where it was separated into individual plants and planted into Ray Leach Cone-tainers™ (3.8 cm in diameter, 20 cm depth) in a 2:1 soil mixture of silty clay loam:sand. After the plants were separated and prior to treatment applications, the plants were clipped to a 2.5 cm height.

The greenhouse portion of this study was designed as a randomized block design. Blocking by row is necessary because of the inconsistent air movement and fluctuating temperatures in the greenhouse. A full compliment of four fertilizer treatments was applied to each of the four blocks. The treatments consisted of (1) no fertilizer (control), (2) 20 ppm NPK, (3) 40 ppm NPK, and (4) 60 ppm NPK (grade 20-20-20 commercial fertilizer in granular form) and applied as an aqueous solution every three weeks. Prior to transplanting in April 2003 and 2004, a subsample from each treatment was harvested for aboveground and belowground biomass. Analysis of variance was used to assess aboveground and belowground biomass response among treatments (Proc Mixed; SAS 2000).

Following six months of growth in the greenhouse, the threadleaf sedge plants were transplanted into two restoration sites at SCBL. In order to monitor treatment response over time, the threadleaf sedges plants were planted in 6 x 6 m plots using a randomized block design with the blocking criteria being slope and exposure and a total of four blocks. The treatments consisted of the fertilizer treatment received in the greenhouse, with no additional fertilizer applied in the field. Threadleaf sedge survival was evaluated six and 12 months after transplanting, and treatment differences determined using analysis of variance (Proc Mixed; SAS 2000).

Results and Discussion

In both years of the study, aboveground and belowground biomass significantly increased as the fertilizer rate increased (Table 1). The fertilizer rate of 40 ppm NPK was the level at which biomass had an initial increase, which indicates that applying 20 ppm NPK would suffice as a maintenance fertilizer level, but would be ineffective in increasing biomass. In 2003 and 2004, aboveground and belowground biomass significantly increased as the fertilizer rate

increased from 40 ppm NPK to 60 ppm NPK, demonstrating that threadleaf sedge grown in the greenhouse may require more than 60 ppm NPK.

Numerous studies have been conducted on fertilization of native rangeland (Vallentine 1989), but few studies have focused on the fertilization of threadleaf sedge (Tichota 2000; Fassett 2003). Most fertilization studies investigate how fertilizer increases production or enhances forage quality, whereas few studies have been conducted where fertilizer is applied to greenhouse grown plants to enhance field survival after transplanting. In a greenhouse study that investigated the aboveground response of threadleaf sedge to various rates of fertilizer, it was determined that the plants receiving the highest rate of fertilizer had the greatest leaf length, the greatest number of leaves, and the highest survival (Tichota 2000). Our results are similar to those of Tichota (2000) in that the highest rate of fertilizer in our study had the greatest aboveground and belowground biomass. However, Tichota (2000) did not evaluate field survival of threadleaf sedge after the plants were transplanted.

We determined there was no significant difference among fertilizer treatments for field survival of the transplants at six and 12 months after transplanting (Table 2). Fertilizer application to greenhouse grown plants has shown a carry over effect in some horticultural species after they are transplanted in the field (Liptay and Nicholls 1993). Our results demonstrate that fertilizer applied to greenhouse grown threadleaf sedge did not result in a carry over effect of increased survival. We expected that plants receiving supplemental nutrients would be better adapted and more successful after being transplanted, but this was not the case. It became evident that environmental conditions were more likely influencing transplant survival more than prior exposure to fertilizer. A lack of growing season precipitation did not appear to

decrease the overall transplant survival in 2003, but an increase in annual weeds in 2004 resulted in a negative influence on transplant survival.

Conclusions

The application of fertilizer to greenhouse grown threadleaf sedge transplants increased aboveground and belowground biomass. The supplemental nutrients stimulated greenhouse growth, but did not enhance field survival of the transplants. The method of collecting threadleaf sedge sod, growing the plants in the greenhouse for six months, and transplanting in the field was successful in 2003. However, the increase in annual weedy species and soil disturbance from pocket gopher activity in 2004 reduced the success of the transplants. We initially transplanted about 7,000 threadleaf sedge plants in both 2003 and 2004. Although the overall survival decreased from the 2003 transplants compared to the 2004 transplants, we estimate survival was greater on the restoration unit where the plants not included in the fertilizer study were transplanted. The high density of Russian thistle and soil disturbance on the plot area in 2004 was not representative of the entire restoration unit, therefore, the chance for threadleaf sedge survival is expected to be greater on the restoration unit. We determined that this method of transplanting can be a viable restoration method, but environmental conditions need to be considered in order to achieve a high level of transplant success.

Literature Cited

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Table 1. Threadleaf sedge biomass $\bar{x} \pm (se)$ (g) response to various rates of fertilizer following six months of greenhouse growth for the 2003 and 2004 transplants (n=80). Means within rows followed by the same little letter are not significantly different.

Year	Biomass	Control	20 ppm N	40 ppm N	60 ppm N
2003	Aboveground	0.202 (0.006)a	0.214 (0.007)ac	0.227 (0.009)bc	0.253 (0.008)d
	Belowground	0.931 (0.029)a	1.060 (0.037)b	1.034 (0.036)b	1.165 (0.038)c
2004	Aboveground	0.181 (0.006)a	0.194 (0.007)a	0.228 (0.007)b	0.264 (0.007)c
	Belowground	0.671 (0.021)a	0.730 (0.026)a	0.870 (0.039)b	0.982 (0.038)c

Table 2. Field survival of threadleaf sedge plants 12 months after transplanting at Scotts Bluff National Monument (n=40). Means within rows followed by the same little letter are not significantly different.

Year	Control		20 ppm N		40 ppm N		60 ppm N	
	$\bar{x} \pm (se)$	%	$\bar{x} \pm (se)$	%	$\bar{x} \pm (se)$	%	$\bar{x} \pm (se)$	%
2003	32.0 (1.6)a	80.0	35.0 (1.6)a	87.5	32.0 (1.9)a	80.0	31.5 (3.2)a	78.8
2004	10.8 (3.9)a	27.0	13.1 (3.4)a	32.8	8.8 (2.6)a	22.0	13.0 (3.6)a	32.5