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Introducing Big Sagebrush into a Crested Wheatgrass Monoculture

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ABSTRACT

*Crested wheatgrass (*Agropyron desertorum or A. cristatum*) has been effectively used to stabilize arid and semi-arid range sites for decades. Reestablishing native plant materials into these areas is often desirable to increase wildlife habitat and ecological diversity. Due to its competitive nature, efforts to reestablish native plants into crested wheatgrass monocultures have had limited success. Tillage will control the grass but leaves the soil vulnerable to erosion and weed invasion. This publication will report on a trial conducted near Nephi, Utah to find a method of introducing native plants into a crested wheatgrass monoculture without subjecting the resource base to degradation in the conversion process. In this trial, the effect of chemically controlling crested wheatgrass before transplanting big sagebrush (*Artemisia tridentata*) was studied. Small container grown plants of sagebrush were transplanted either directly into a 60 year-old stand of crested wheatgrass or after chemically controlling the grass. Three different subspecies of big sagebrush; Basin big sagebrush (*Artemisia tridentata *Nutt*. ssp. tridentata*), Mountain big sagebrush (*Artemisia tridentata *Nutt*. ssp. vaseyana *(Rydb.) Beetle) and Wyoming big sagebrush (*Artemisia tridentata *Nutt*. ssp. wyomingensis *Beetle & Young); were planted to see if there would be differences among subspecies. Four years of data indicate that controlling crested wheatgrass prior to transplanting resulted in higher sagebrush survival and faster establishment. There were some differences among sagebrush subspecies. Basin big sagebrush survived equally well with or without grass control but grew faster with grass control. Chemical control of the grass was important for both the survival and growth of Mountain big sage and Wyoming big sage.*

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INTRODUCTION

Crested Wheatgrass (*Agropyron cristatum* and *Agropyron desertorum*) has proven its effectiveness as a means to control wind and soil erosion in arid and semi-arid areas over many decades. Its ability to persist is both an asset and a potential hurdle. Once it becomes established the area resources are protected and stabilized from further degradation, but ecological succession may be slowed or halted, depending on the time frame being measured. The ability to establish other plants within crested wheatgrass monocultures is limited at best. Reestablishing native plant materials into these areas is warranted for such purposes as increased wildlife habitat, ecological diversity, and aesthetics. It is possible to consider crested wheatgrass as the beginning of an ecological ladder that stabilizes and protects the resource base. It then can allow transitions to a more diverse community. The methodology used to traverse this ladder has often resulted in less-than-hoped-for results within expected time frames.

A method to accomplish this transition from a monoculture of crested wheatgrass to a more diverse plant community would be welcomed if the resource base were not subjected to degradation in the conversion process. Tillage of most types (disking, chiseling, plowing, roto-tilling, etc.) to reduce the stand of crested wheatgrass and decrease its competitive effect can result in unacceptable soil erosion. Preservation of the soil stabilizing and weed control benefits of crested wheatgrass is an important issue when considering conversion. Drilling of desired species directly into these stands often meets with failure due to the competitiveness of the grass. Transplanting of small plant materials in containers may provide a method to overcome the initial poor establishment for seed-sown techniques. The potential higher establishment costs associated with transplanting should be measured against the costs of continued failure or relative low success of seeding techniques. With many sources of restoration funding there is only a one-time opportunity for success. This technique might be useful in the establishment of seed gardens which are often planted as a way to increase the seed bank of desired species in areas of interest.

MATERIALS AND METHODS

Transplants of basin big sagebrush (*Artemisia tridentata* Nutt. *ssp. tridentata*), Mountain big sagebrush (*Artemisia tridentata* Nutt*. ssp. vaseyana* (Rydb.) Beetle), and Wyoming big sagebrush (*Artemisia tridentate* Nutt. ssp. *wyomingensis* Beetle & Young) were obtained from the State of Utah's Forestry, Fire and State Lands; Lone Peak Conservation Nursery; Draper Utah. Plants were grown as containerized seedlings using 3.8 x 21 cm Super Cell Cone-Tainers (Ray Leach Cone-Tainer).

Herbicide treatments (60 year old stand of Nordan Crested Wheatgrass) were completed on April 20, 2004, with 1.75 l/ha of Round-up Ultra (glyphosate). The field was then allowed to lay fallow for a year. Field transplanting was completed on April 7-8, 2005, in both the chemically treated and control treatments. Of the total experimental area (1748 m2) half was treated chemically after dividing into individual treatment blocks (130 m2) each.

Plot location is at the Utah State University Nephi Experiment Station Farm, approximately 6 km south of Nephi, Utah (39° 38' 43" N, 111° 52' 22" W, 1573 m elevation). The Ecological Site designation for the location is: Upland Loam (Mountain Big Sagebrush). Soil at the site is a Nephi Silt Loam (fine-silty, mixed, superactive, mesic Calcic Argixerolls). Mean annual precipitation is 37 cm per year. A randomized complete block design (five replications) was used with twenty-one plants per sub-species planted within each of the treatment blocks. They were arranged in three rows with only the 5 plants in the middle of each species block used for date collection. Inter-transplant spacing was 1.0 m between and within rows.

Survival and plant height was measured in the fall of each year following establishment through 2009. Survival was recorded as a percentage of transplants still living. Plant height was measured only on live plants. Analysis of variance (Repeated Measures procedure) and mean separations (Least Significant Difference) were accomplished using Statistix 9 (Analytical Software, Tallahassee, Florida). In the analysis of variance, main plot was the subject factor, spray treatment was a between subject factor and sub-species and year were within subject factors.

RESULTS AND DISCUSSION

Means for plant survival and plant height are reported in Table 1. The photos of plots of each sub-species illustrated in Figures 1-6 were taken in June 2009. The spray treatment X sub-species X year interaction was significant for plant survival and plant height and therefore, the three-way interaction means are reported. In other words, the three sub-species of big sagebrush responded differently to the treatments.

Basin big sagebrush was the best adapted to this particular site with 100 percent plant survival in both sprayed and control plots. Plants in the sprayed plots grew rapidly in the first two years after establishment and started leveling off near 100 cm by 2007. In control plots, Basin big sagebrush grew to 28 cm in 2005 and continued to grow through 2009 reaching 58 cm with no indication of a plateau.

Mountain big sagebrush was poorly adapted to the site. Survival was 96 percent in 2005 but dropped off to 68 percent and 12 percent by 2009 in the sprayed plots and control plots, respectively. Where the competition from crested wheatgrass was controlled, plants grew from 18 cm in 2005 to 79 cm in 2008 but declined to 59 cm by 2009. In control plots, plant height was greatest in 2005 at 11 cm. The site was probably too dry for successful establishment of this sub-species even without competition from crested wheatgrass.

Wyoming big sagebrush was intermediate in adaptation with 100 percent survival in the sprayed plots throughout the study. Survival dropped in the control plots from 88 percent in 2005 to 48 percent in 2009. In sprayed plots, plants grew from 23 cm in 2005 to 89 cm in 2009. In control plots, plant height was 19 cm in 2005 and didn't increase throughout the study. Killing the crested wheatgrass prior to planting was critical to the success of Wyoming big sagebrush.

Figure 1. Basin big sagebrush—control.

Figure 2. Basin big sagebrush—sprayed.

Figure 3. Mountain big sagebrush—control.

Figure 4. Basin big sagebrush—sprayed.

Figure 5. Wyoming big sagebrush—control.

Figure 6. Wyoming big sagebrush—sprayed.

Table 1. Plant Survival and Plant Height of Big Sagebrush transplants in a stand of Crested Wheatgrass.

		Plant Survival		Plant Height	
Sub-Species	**Year**	**Control**	**Sprayed**	**Control**	**Sprayed**
		%	%	cm	cm
Basin	2005	100	100	28	45
	2006	100	100	29	83
	2007	100	100	37	99
	2008	100	100	48	104
	2009	100	100	58	105
Mountain	2005	96	96	11	18
	2006	64	96	8	45
	2007	64	96	9	73
	2008	52	96	10	79
	2009	12	68	4	59
Wyoming	2005	88	100	19	23
	2006	64	100	11	57
	2007	64	100	12	77
	2008	64	100	18	85
	2009	48	100	17	89
$LSD_{0.05}$		13		9	

The differential response of the three sub-species of big sagebrush underscores the importance of using adapted plant materials in the conversion of crested wheatgrass lands. In this study, Basin big sagebrush would be the material of choice. The decision to control the wheatgrass with herbicides before planting would depend on the goal of the planting. If the goal was the rapid establishment of patches of sagebrush perhaps to establish seed gardens, then chemical control of the grass could be advantageous. If a more gradual conversion was desired, then transplanting into established uncontrolled stands of grass could be successful with the caveat that success may be more risky in dry years. In either situation, this case study suggests that transplanting containerized plants can be successful.

CONCLUSIONS

Five years of data indicate that controlling crested wheatgrass prior to transplanting resulted in higher sagebrush survival and faster establishment. There were differences between sagebrush subspecies. Basin big sagebrush survived equally well with or without grass control but grew faster with grass control. Chemical control of the grass was important for both the survival and growth of Mountain big sage and Wyoming big sage. The ability to grow viable plant materials in a site long stabilized by a monoculture of Crested Wheatgrass provide possible evidence of methods to reintroduce native plant materials into our protected rangelands.

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