Technical Note

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Swingle Bench Project

Species and Technology for Revegetation of Abandoned Cropland

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This Technical Note summarizes results of the Swingle Bench Project. The Swingle Bench Project was established to test species and technology for use in revegetation of abandoned cropland.

Introduction

Rapid population growth in the Great Basin states has greatly increased demands on limited water resources. In many areas, water rights have been transferred from agricultural lands to urban areas to support continued population growth. This redistribution of water rights has resulted in large acreages of abandoned cropland. After water is removed from cropland, the area becomes susceptible to wind erosion and encroachment by noxious weeds. In areas where abandoned cropland is adjacent to roads, wind erosion poses a significant safety hazard when airborne dust obscures driver visibility. Problems associated with noxious weed establishment in abandoned cropland include increased costs of weed control in contiguous crop production areas and increased risk of wildfire. Consequently, it is important that a revegetation plan be implemented when water rights are transferred from cropland. The objective of this study was to identify adapted plant species and plant cultivation techniques/technology that could be used for revegetation of abandoned cropland.

Materials and Methods

Site Description

The planting was conducted on Swingle Bench (Latitude 39^{o} 31' 27.1" N, Longitude 118^{o} 59' 53.0" W) near the city of Fallon, NV. The site had been in agriculture for over 50 years with alfalfa being the predominant crop. Approximately 10 years before the planting, water rights had been transferred from the site and the cropland was abandoned.

According to records at the National Climatic Data Center, average annual precipitation in this area is 5.2 inches (13.2 cm) (World Climate 2008). The warmest month is July, when the average daily maximum temperature is 91.0^{o}F (32.8^{o}C) and the average daily minimum temperature is 53.4^{o}F (10.8^{o}C). The coldest month is January with an average maximum temperature of 44.1^{o}F (6.7^{o}C) and an average minimum temperature of 18.1^{o}F (-7.7^{o}C).

The predominant soils at the site are Tipperary Sand and Swingler Clay Loam (USDA Soil Conservation Service 1975). The Tipperary soil series is classified as a mixed, mesic Typic Torripsamment. Tipperary Sand occurs on the terraces of ancient Lake Lahontan, with sandy soil layers to a depth of 60 inches. The Swingler soil series is classified as a fine-silty, mixed (calcareous), mesic Typic Torriorthent. Swingler Clay Loam is characterized by a surface layer of clay loam that is about 12 inches thick with dense silty lacustrine sediment 2 to 4 feet beneath the soil surface.

Planting

The first phase of the planting occurred in Fall of 2004. Plots were approximately 30 feet wide and 1000 feet long. Two plots were planted with a wheat cover crop at 18 pounds of seed per acre, and 2 plots were planted with a rye cover crop at 18 pounds per acre. Revegetation species (Table 1) were planted in the remaining 4 plots. An untreated control area was located between each study plot.

Within each plot seeded with revegetation species, 'Volga' Mammoth wildrye was seeded in a 3-foot strip along each border. Seven species were then seeded between the 'Volga' strips, with each species also occupying a 3-foot strip (Figure 1). Seeding rates were based on established rates for these species in the intermountain west (Ogle et al. 2007). Seed was planted with a grain drill at a depth of 0.25 to 0.5 inches.

Table 1. Revegetation species used in Swingle Bench Project

Cultivar	Species Common Name	Species Scientific Name	Seeding Rate*
Nezpar	Indian Ricegrass†	*Achnatherum hymenoides*	9
Pryor	Slender Wheatgrass†	*Elymus trachycaulus*	9
Vavilov	Siberian Wheatgrass	*Agropyron fragile*	9
Bozoisky	Russian Wildrye	*Psathyrostachys juncea*	9
Snake River Plains	Fourwing Saltbush†	*Atriplex canescens*	0.3
Cedar	Palmer Penstemon†	*Penstemon palmeri*	6
N/A	Munro Globemallow†	*Sphaeralcea munroana*	6
Immigrant	Forage Kochia	*Bassia prostrate*	1
Volga	Mammoth Wildrye	*Leymus racemosus*	9
Magnar	Basin Wildrye†	*Leymus cinereus*	9

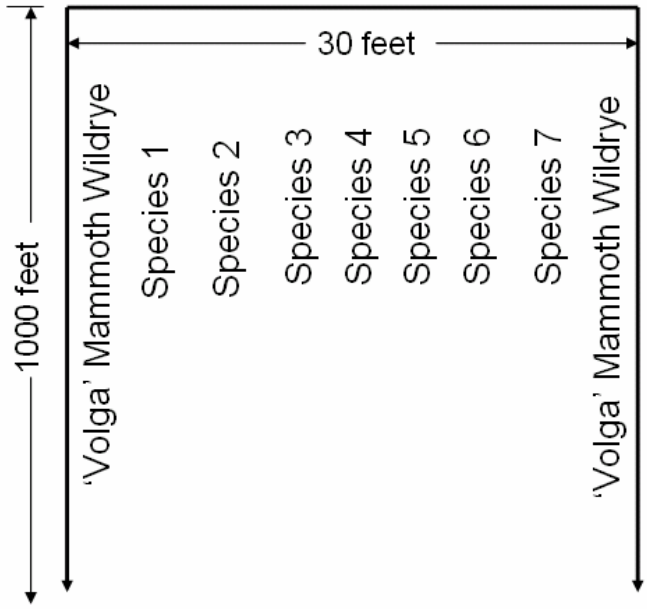
*Seeding rate is pure live seed pounds per acre
†Native species

In Fall of 2005, plots with cover crops were seeded with revegetation species following the same protocol described for 2004 (Table 1, Figure 1). All plots were irrigated in 2004 and 2005 to facilitate initial establishment. In 2006 and 2007, no supplemental water was applied to plots.

Weed Control

A mechanical weed control treatment was applied during 2005. All the plots were cut in mid-summer using a conventional swather. The cut vegetation

Figure 1. Plot layout. Each plot is approximately 30 feet wide and 1000 feet long. 'Volga' Mammoth wildrye was planted in 3-foot strips along the plot borders and 7 species were planted in 3-foot strips between the 'Volga' strips. The 7 species and their order varied among plots.



was allowed to dry before it was baled and removed from each plot. No other weed control treatments were applied.

Data Collection

Data was collected in Fall of 2007 after 2 growing seasons without supplemental irrigation. A square-meter quadrat was used to estimate species composition and percent cover within plots. The quadrat was placed in 10 random locations within each species strip in each plot, resulting in 50 to 60 quadrats per species. In each quadrat, species composition and ocular estimates of cover were recorded. Twenty quadrats were randomly placed within each of the untreated control areas.

Results and Discussion

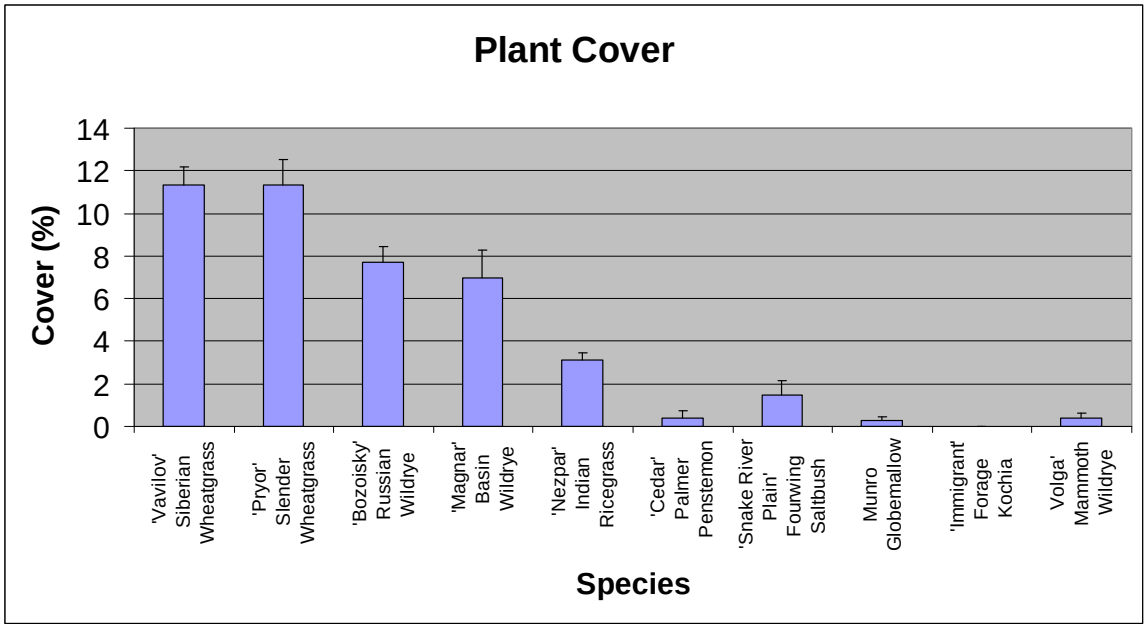
In plots with a cover crop, none of the revegetation species were successfully established. At 18 pounds per acre, the wheat and rye cover crop seeding rate may have been too high and the resulting competition may have suppressed establishment of the revegetation species. Based on observations, it appeared that populations of wheat and rye were as high or higher during the 2006 growing season as in the first growing season (2005). This may have been due to the

weed control treatment that was applied in mid-summer of 2005. The plots were cut using a conventional swather with vegetation being baled and removed approximately 1 week later. Seed from the annual grains were scattered during the process and successfully established during the 2006 growing season.

Most of the ground in cover crop plots was covered with litter (72%). The majority of vegetation cover was comprised of weedy species, including Russian thistle (*Salsola tragus*) with 3% cover, tumble mustard (*Sisymbrium altissimum*) with 1% cover, annual kochia (*Kochia scoparia*) with 2% cover, and cheatgrass (*Bromus tectorum*) with 1% cover. Cover of weedy species in the cover crop plots was much lower than in adjacent untreated areas, indicating that the cover crop suppressed establishment of weedy species as well as revegetation species.

In plots without a cover crop, most of the ground was covered with litter (approximately 80% cover). Several revegetation species were established in the plots (Figure 2), with 'Vavilov' Siberian wheatgrass and 'Pryor' slender wheatgrass being most successful with approximately 11% cover. 'Bozoisky' Russian wildrye and 'Magnar' Basin wildrye both had approximately 7% cover. 'Nezpar' Indian ricegrass had only 3% cover as a result of wildlife grazing. Nearly all individuals of 'Nezpar' had been grazed to the ground by a large population of black-tailed jackrabbits, greatly reducing cover and likely resulting in higher mortality.

Figure 2. Cover of revegetation species in plots without cover crop. Error bars indicate standard error.

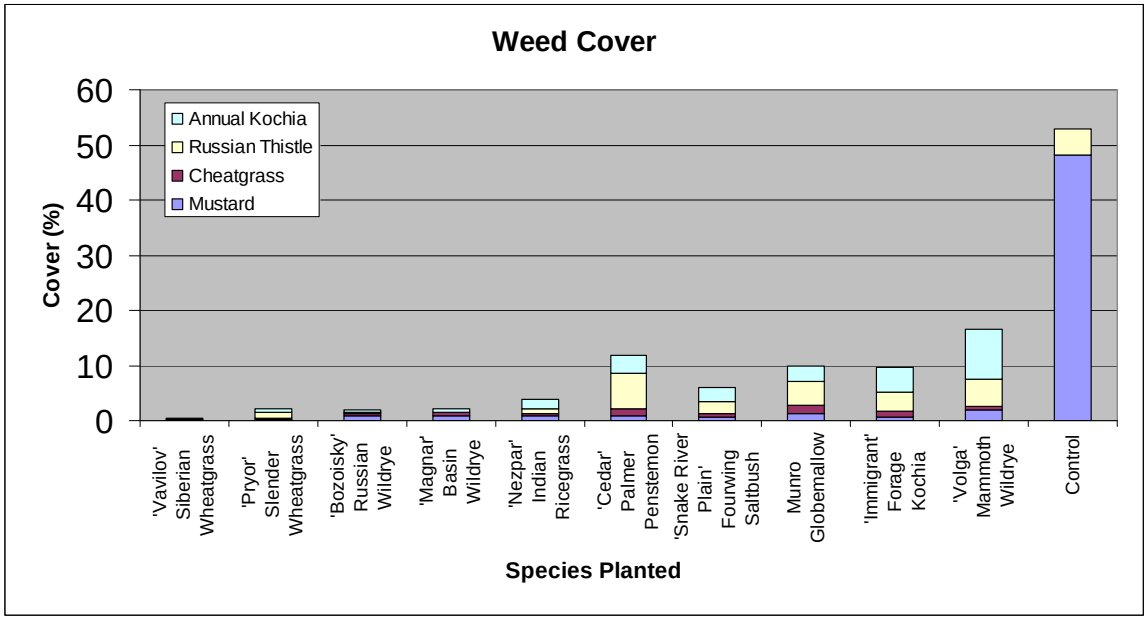


There was essentially no establishment of 'Immigrant' forage kochia. This may have been due to the seed having been planted too deep. Forage kochia rarely germinates or becomes established when planted more than 0.06 inches deep (Tilley et al. 2006). The planting depth for the Swingle Bench project was 0.25 to 0.5 inches, which may have been too deep for successful establishment.

Establishment was poor for 'Cedar' Palmer Penstemon, Munro globemallow, and 'Volga' Mammoth Wildrye, and cover for each of these species was less than 1%. Cover of 'Snake River Plains' Fourwing Saltbush was also low at 1.5%. Poor establishment of Munro globemallow and fourwing saltbush was likely due, at least in part, to preferential utilization of these species by California quail. The California quail population exceeded 200 individuals on the experimental plots, resulting in excessive use of both Munro globemallow and fourwing saltbush.

In the untreated control areas, cover of weedy species was greater than 50% (Figure 3). The most common weed was tumble mustard (48%) followed by Russian thistle (5%). Planting revegetation species substantially reduced weed cover. Total weed cover was less than 5% in areas seeded with 'Vavilov' Siberian wheatgrass, 'Pryor' slender wheatgrass, 'Bozoisky' Russian wildrye, 'Magnar' Basin wildrye, and 'Nezpar' Indian ricegrass. Weed cover was highest in the 'Volga' Mammoth wildrye strips where cover was 17%, which was still much lower than in the untreated control areas.

Figure 3. Average weed cover in plots as influenced by revegetation species.



Management Implications

In plots where a cover crop was planted, there was essentially no establishment of revegetation species and low weed cover. Consequently, the results of this study indicate that a cover crop may suppress subsequent survival and establishment of planted revegetation species as well as weeds. However, the cover crop seeding rate was high (18 pounds per acre), and a lower seeding rate may create microsite conditions conducive to seedling establishment for revegetation species.

'Vavilov' Siberian wheatgrass and 'Pryor' slender wheatgrass were the two most successful species as determined by percent cover (Figure 2). 'Bozoisky' Russian wildrye, 'Magnar' Basin wildrye, and 'Nezpar' Indian ricegrass were also able to become established (Figure 2). The relative success of these 5 species indicates their potential to persist on abandoned cropland following the cessation of supplemental irrigation. Indian ricegrass was grazed most heavily by wildlife while slender wheatgrass was moderately grazed. Consequently, potential cover for these species could be much higher in a protected site.

Weed cover was much lower in plots with and without cover crops as compared to the untreated control areas (Figure 3). In particular, in plots without a cover crop, weed cover was lowest in areas planted with the 5 most successful revegetation species, namely 'Vavilov' Siberian wheatgrass, 'Pryor' slender wheatgrass, 'Bozoisky' Russian wildrye, 'Magnar' Basin wildrye, and 'Nezpar' Indian ricegrass. Weed cover in areas with these 5 species was 90 to 99% lower than in untreated control areas.

Although conclusions based on a single non-replicated study are tenuous, results from the Swingle Bench project indicate three promising outcomes following revegetation of abandoned cropland. First, it appears that there are several species that may be well-suited for establishment on abandoned cropland and which may persist and stabilize a site after supplemental irrigation applications cease. Second, a revegetation project on abandoned cropland may drastically reduce problems associated with weed encroachment on abandoned cropland. Third, it is possible to enhance wildlife habitat on abandoned cropland through a revegetation program. These preliminary conclusions based on the Swingle Bench project can be used to enhance revegetation efforts by land managers and provide a basis for future research efforts.

References

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