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Revegetation of Disturbed Well Sites with Selected Cool Season Native and Non-Native Grasses for Stand Establishment in the Intermountain Region of Northwest New Mexico

Research Report 768

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ABSTRACT

Revegetation of disturbed well sites in semi-arid lands requires rapid stabilization of ecological processes and soil resources. The most frequent goal of revegetation is to re-establish an ecosystem that will structurally and functionally resemble the undisturbed native ecosystem. We conducted a three-year experiment at different disturbed well site locations in the San Juan Oil and Gas Producing Basin of the intermountain region of northwest New Mexico to evaluate grass stand establishment of selected cool season native and non-native grasses. Native grasses Arriba western wheatgrass, bottlebrush squirreltail, Paloma Indian ricegrass, San Luis slender wheatgrass, and needle and thread grass, and non-native grasses Canada wild ryegrass and Bozoisky Russian wild ryegrass, established better than the other native and non-native grasses employed in this study, regardless of well site or annual rainfall.

INTRODUCTION

The true grasses comprise several thousand species and are found in all parts of the world, but it is in the drier, temperate regions that they often form the chief vegetation. They owe their dominance in such regions to their ability to survive under all conditions where flowering plants can't live at all, their aggressive methods of natural vegetative propagation, and their usually abundant seed crop and its wide dispersal by natural conditions, such as wind and water (Wheeler, 1950). The grasses that persist naturally in any given region over long periods of time are those that have been successful in adjusting themselves to the factors that limit growth. In order to survive, they must withstand extremes of drought, cold, wind, diseases, insects, competition, and grazing (Wheeler, 1950).

Activities associated with oil and natural gas exploration and production can damage large areas of semi-arid rangeland in San Juan and Rio Arriba Counties in New Mexico. Construction of drilling sites, roads and pipeline rights-of-way and on-site disposal of drilling fluids can reduce forage production and domesticated and non-domesticated browse production, increase soil erosion, and in many cases result in persistent stands of undesirable weeds (McFarland et al., 1987; U.S. Department of the Interior and U.S. Department of Agriculture, 2007). In extreme climatic regimes, desert and/or tundra ecosystems have often been cited as being among the most difficult biome types to revegetate following disturbance (Chambers and Wade, 1992; Allen, 1988).

In the semi-arid intermountain region of northwest New Mexico, moisture is the most critical element for revegetation success. Revegetation of disturbed areas with annual rainfall levels less than eight to ten in. depends heavily on the amount and timing of rainfall after planting (Arnold, 2005; Wright, 2005). Seeding in these areas of low rainfall is problematic and may require several reseeding attempts, depending on weather patterns in any given year (Wright, 2005).

In the San Juan Oil and Gas Producing Basin in the intermountain region of northwest New Mexico, it is estimated that approximately 20,000 to 30,000 acres of disturbed lands created by oil and natural gas drilling will need to be revegetated during the next ten years (S. Henke, personal communication, 2009; D. Wirth, personal communication, 2009). Annual rainfall in this area will usually vary between eight and 12 in., depending on location.

The long-term objective of revegetation is to set the course for eventual ecosystem restoration of a natural vegetation community, hydrology, and domesticated and non-domesticated habitats. In most cases, this means returning the disturbed area to a condition approximating or equal to that which existed prior to the disturbance (D. Wirth, personal communication, 2009). According to the Bureau of Land Management Farmington Field Office, seeding shall be accomplished within 120 days of completion of an oil or gas construction project. Seeding shall be repeated if a satisfac-

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Table 1. Location, Date of Planting, and Years Research Plots Were Evaluated

Location	Date of Planting	Years Evaluated
Williams Production Rosa 159A	April 1, 2002	3, mid- to late July 2003–2005
Williams Production Rosa 354	April 1, 2002	3, mid- to late July 2003–2005
El Paso Tapacitas	April 4, 2002	3, mid- to late July 2003–2005
BP Americas Arboles 29A	April 10, 2002	3, mid- to late July 2003–2005
XTO Kutz Federal 11E	October 15, 2002	3, mid- to late July 2003–2005
XTO Kutz Federal Gas Com 2E	April 24, 2003	2, late July 2004–2005
Pure Resources Rincon 202M	April 24, 2003	2, late July 2004–2005
Burlington Resources 6M[a]	April 22, 2004	0

[a] Burlington Resources 6M did not show any native or non-native grass establishment one or two years after planting.

Table 2. Names of Cultivars Planted at Each Site, April through October 2002–2005

Variety or Cultivar	Seeding Rate (lb pls/aca)
Arriba Western Wheatgrass	8.0
Chief Intermediate Wheatgrass	10.0
Luna Pubescent Wheatgrass	10.0
Hy-Crest Crested Wheatgrass	5.0
VNS[b] Canada Wild Ryegrass	7.0
Bozoisky Russian Wild Ryegrass	5.0
Critana Thickspike Wheatgrass	6.0
VNS Bottlebrush Squirreltail	8.0
Redondo Arizona Fescue	3.0
Covar Sheep Fescue	2.0
Paloma Indian Ricegrass	6.0
Anatone Bluebunch Wheatgrass	9.0
San Luiz Slender Wheatgrass	6.0
VNS Needle and Thread Grass	8.0
VNS Junegrass	4.0
Alma Blue Grama Grass	6.0

[a] pls = pure live seed

[b] VNS = variety or cultivar not stated

tory stand is not obtained as determined by the authorized officer upon evaluation after the second growing season (M. Kelly, personal communication, 2009).

OBJECTIVES

The objectives of this research are to select several native or non-native cool season cultivars that may be adapted to the intermountain region of northwest New Mexico and to evaluate stand establishment of theses cultivars.

MATERIAL AND METHODS

Research plots were established in April and October of each year from 2002 through 2003 in the intermountain region of northwest New Mexico (San Juan and Rio Arriba Counties) to determine stand establishment of selected native and non-native cool season grasses in the San Juan Oil and Gas Producing Basin. These research plots were located anywhere from 65 to 95 miles from the New Mexico State University Agricultural Science Center at Farmington, NM. Before a disturbed site was planted, reserve pits on the well site were allowed to precipitate down by temperature to a level optimum for bulldozing and leveling. The reserve pits were then covered with at least six in. of topsoil and leveled before reseeding began. All well site soils were of a Travessilla-Rock outcrop Weska, which is very shallow to deep, nearly level, and well drained (U.S. Department of Agriculture Soil Conservation Service, 1980). Individual plots were planted with a tractor driven cone seeder in six rows, each ten in. by 25 ft. Native and non-native grasses were planted to a depth of approximately 0.5 in. Table 1 indicates the location, date of planting, and years research plots were evaluated. During each year, the experimental design was a randomized complete block with four to six replications, depending on well site. The native and non-native cool season grasses were rated on a scale from 1 to 9, with 1 being no stand establishment or survival and 9 being 100% stand establishment or survival. Data logging tipping bucket rain gauges were installed at each well site to determine the amount of rainfall. Table 2 gives the name of the cultivar and seeding rate planted at each site in lb pls/ac (pure live seed). Stand establishment ratings were subjected to analysis of variance, and treatment means were separated by Fisher's LSD test at the 5% level of significance (CoHort Software, 2001). There were no year by treatment interactions, so data were combined.

RESULTS AND DISCUSSION

Rainfall Averages, 2003–2005

Cumulative precipitation collected in 2003 through 2005 is given in Figure 1. Average rainfall for the three-year period ranged from a low of 8.7 in. at El Paso Tapacitas to a high of 13.2 in. at BP Americas Arboles 29A. Burlington Resources 6M had a cumulative precipitation average from 2004 to 2005 of 7.8 in. BP Americas Arboles 29A had the highest amount of rainfall with approximately 18.3 in. in 2005. The average rainfall in the years 2002, 2003, 2004, and 2005 at the Agricultural Science Center at Farmington was 7.7, 6.3, 8.7, and 8.7 in., respectively.

Table 3. Three- and two-year average stand establishment of native and non-native grasses, rated from 2003–2005 and 2004–2005.

		Stand Establishment[a]						
Cultivar	lb pls/ac	El Paso Tapacitas[b]	BP Americas Arboles 29A[b]	Williams Production Rosa 354[b]	Williams Production Rosa 159A[b]	XTO Energy Kutz 11E[c]	XTO Energy Com 2E[d]	Pure Resources Rincon 202M[d]
		no.						
Arriba Western	8.0	1.8	1.8	2.1	2.4	1.6	1.2	2.0
Wheatgrass Chief	10.0	1.5	2.5	1.1	1.4	1.2	1.5	1.8
Intermediate Wheatgrass Luna	10.0	1.5	2.0	1.0	1.4	1.4	1.0	1.3
Pubescent Hy-Crest Crested	5.0	1.6	2.0	1.1	1.4	1.3	1.0	1.6
Wheatgrass Canada Wild	7.0	1.6	1.9	1.7	4.0	3.0	1.0	2.2
Ryegrass Bozoisky	5.0	1.8	1.8	1.4	2.2	1.1	1.0	3.4
Russian Wild Ryegrass Critana	6.0	1.7	2.0	1.0	1.3	1.2	1.0	1.7
Thickspike Wheatgrass Bottlebrush	8.0	1.8	1.4	1.7	2.4	1.5	1.3	2.5
Squirreltail Redondo	3.0	1.0	1.7	1.0	1.1	1.0	1.0	1.4
Arizona Fescue Covar Sheep	2.0	1.0	1.8	1.1	1.1	1.4	1.0	1.0
Fescue Paloma	6.0	2.0	1.9	2.0	3.0	4.0	1.8	1.9
Indian Ricegrass Anatone	9.0	1.0	1.8	1.0	1.1	1.1	1.0	2.1
Bluebunch Wheatgrass San Luis	6.0	1.7	2.3	1.1	3.2	2.0	1.0	1.9
Slender Wheatgrass Needle and	8.0	2.0	2.3	2.0	3.4	2.9	1.4	1.4
Thread Grass Junegrass	4.0	1.0	1.7	1.1	1.0	1.0	1.0	1.0
Alma Blue Grama Grass	6.0	1.0	1.5	1.0	1.0	1.3	1.0	1.1
LSD 0.05		0.4	0.2	0.4	1.0	0.8	0.2	0.6

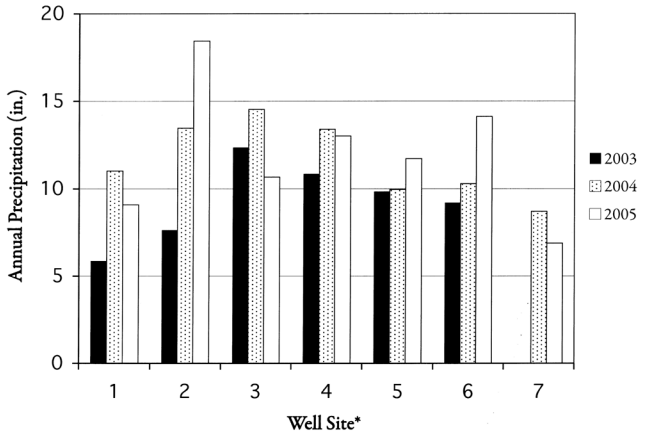
[a] Stand establishment rated on a scale from 1 to 9, with 1 being no stand establishment or survival and 9 being 100% stand establishment or survival.
[b] Disturbed area planted in early April 2002 and rated in mid- to late July each year from 2003–2005.
[c] Disturbed area planted in mid-October 2002 and rated in mid- to late July each year from 2003–2005.
[d] Disturbed area planted in late April 2003 and rated in late July of 2004 and 2005.

Stand Establishment Averages Three Years after Planting

Evaluations of grasses planted in April 2002 and rated in late July of each year from 2003 through 2005 showed that native grasses Arriba western wheatgrass, Paloma Indian ricegrass, San Luis Slender wheatgrass, and needle and thread grass and the non-native grass Canada wild ryegrass averaged a rating of 2.0 or better for stand establishment or survival on four locations when rated three years after planting (Table 3). Williams Production Rosa 159A well site had the best stand establishment or survival three years after planting for Arriba western wheatgrass, Canada wild ryegrass, bottlebrush squirreltail, Paloma Indian ricegrass, San Luis slender wheatgrass, and needle and thread grass as compared to the other grasses planted at other locations. XTO Energy Kutz 11E well site planted in October 2002 and rated in late July of each year from 2003 through 2005 showed that native grasses Paloma Indian ricegrass and needle and thread grass and non-native grass Canada wild ryegrass had the best stand establishment with rates of 4.0, 2.9, and 3.0, respectively, three years after planting (Table 3).

Stand Establishment Averages Two Years after Planting

At Pure Resources Rincon 202M well site, native grasses Arriba western wheatgrass, bottlebrush squirreltail, and Anatone bluebunch wheatgrass had stand establishment ratings of 2.0, 2.5, and 2.1, respectively. Non-native grasses Canada wild ryegrass and Bozoisky Russian wild ryegrass had stand establishment ratings of 2.2 and 3.4, respectively. Two years after planting, XTO Energy Com 2E had the worst stand establishment ratings for all grasses when compared to other well sites planted (Table 3).



*Well Site No.	Description	Mean Annual Precipitation (in.)
1	El Paso Tapacitas	8.7
2	BP Americas Arboles 29A	13.2
3	Williams Production Rosa 354	12.5
4	Williams Production Rosa 159A	12.4
5	XTO Kutz Fed 11E & Gas Com 2E	10.5
6	Pure Resources Rincon 202M	11.2
7	Burlington Resources 6M	7.8[a]

[a] 2004 and 2005 only

Figure 1. Total annual and mean annual precipitation from 2002–2005 at eight different disturbed well sites.

CONCLUSIONS

Moisture is probably the most critical element for revegetation success. Revegetation of these disturbed well sites, which have annual precipitation levels averaging between approximately eight and 13 in., depends on the rainfall received the first two years. In the intermountain region of northwest New Mexico, rainfall usually comes in April and then again in July and August, with some snowfall during the winter months. These rains can vary between light, intermittent showers and heavy downpours that can bring at least 0.75 to 1.5 in. of precipitation in a very short period of time. Much of this water runoff does not percolate down into the soil in quantities adequate for seed germination.

Native grasses Arriba western wheatgrass, bottlebrush squirreltail, Paloma Indian ricegrass, San Luis slender wheatgrass, and needle and thread grass and non-native grasses Canada Wild ryegrass and Bozoisky Russian wild ryegrass had the best overall stand establishment at all well sites planted. This research has given the Bureau of Reclamation Farmington Field Office a rangeland grass mixture of native grasses containing Arriba western wheatgrass, bottlebrush squirreltail, Paloma Indian Ricegrass, San Luis slender wheatgrass, and needle and thread grass that possibly will germinate and survive under these limited and timely rainfall conditions in the semi-arid intermountain region of northwest New Mexico.

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