Agricultural Science Center
Farmington

Revegetation of Pipeline Right-of-Way and or Well Sites with Selected Cool and Warm Season Cultivar's and Forbes for Palatability, Stand Establishment, and Erosion Control in the Intermountain Region of Northwest New Mexico

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Project Number 09-06-61223: Funds provided by several oil and gas producers in the San Juan Oil and Gas producing basin and in Cooperation with the Bureau of Land Management Field Office.

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Revegetation of Pipeline Right-of-Way and/or well sites with selected cool and warm season Cultivar's, and Forbes for Palatability, stand establishment, and erosion Control in the Intermountain Region of Northwest New Mexico.

Establishment of native and non-native grasses on pipeline-right-of ways and/or well sites in the San Juan Oil and Gas producing basin.

Richard N. Arnold

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 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, to their aggressive methods of natural vegetative propagation, and to their usually abundant seed crop and its wide dispersal by natural conditions, such as wind and water.

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 and insects, competition, and grazing.

Objectives

- Select several native or non-native cool and warm season cultivar's that are adapted to the intermountain regions of northwest New Mexico.

- Determine the most adequate time of planting for establishment of the forages.

Material and methods

Research plots were established in April and October 2002 to determine time of planting and stand establishment of selected native and non-native grasses in the San Juan Oil and Gas producing region of northwest New Mexico. Individual plots were planted with a cone seeder with six, ten in rows by 25 ft long. El Paso Tapacitas pipeline right-of-way, BP Americas Arboles 29A, William Production Rosa Units 159A and 354 were all planted the first week in April. XTO Kutz 11E and Pure Resources Rincon Unit 172 were planted in mid October. The experimental design was a randomized complete with four to six replications depending on well site. The native and non-native grasses will be rated on a scale from 1 to 9 with 1 being no stand establishment or survival and 9 being 100% stand establishment or survival. El Paso Tapacitas pipeline right-of-way, BP Americas Arboles 29A, Williams Production Rosa Units 354 and 159A, and XTO Kutz 11E and Pure Resources Rincon Unit 172 were rated for stand establishment or survival in mid July and mid October 2003. Rain gauges have been installed at each well site to determine amount and time of rainfall. Table 1 gives the name of the cultivar or variety planted at each site.

Table 1. Names of cultivars or varieties planted at each site, April and October 2002.

Variety or Cultivar	Seeding Rate (lb/pls/A[a])
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[b] Bottle Brush 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[b] Needle and Threadgrass	8.0
VNS[b] Junegrass	4.0
Alma Blue Gramagrass	6.0

[a] pls = pure live seed
[b] VNS = cultivar or variety not stated

Results and discussion

Stand Establishment or Survival: In Figure 1 and Figure 2, cumulative precipitation collected in 2002 and 2003 is given. In 2002 data showed that WP Rosa 354 had the most precipitation of approximately 7.7 in and BP Americas Arboles 29A had the least amount of precipitation of 4.1 in. Most of the precipitation for all of the four sites fell with in the months of early September to early October. In 2003, WP Rosa 354 has the highest rainfall of 12.4 in and EL Paso Tapacitas had the least amount of rainfall of 5.9 in. The BP Americas Arboles 29A rain gauge was knocked over presumably by wild horses and moisture was not registered correctly since possibly September.

In Table 2, data showed that there was no significant differences in stand establishment for El Paso Tapacitas right-of-way plantings. BP Americas Arboles 29A indicated that Chief Intermediate Wheatgrass, San Luis Slender Wheatgrass, and Needle and Threadgrass had the highest stand establishment ratings of 2.3. The Williams Rosa units 354 and 159A indicated that, Paloma Indian Ricegrass and Canada Wild Ryegrass had the highest stand establishment ratings of 1.8 and 2.3. The overall average across all spring plantings, rated for stand establishment approximately 15 months after planting, showed that Arriba Western Wheatgrass, Canada Wild Ryegrass, San Luis Slender Wheatgrass, and Needle and Threadgrass averaged 1.5 or better. Data further showed that Redondo Arizona Fescue and Anatone Bluebunch Wheatgrass had the lowest overall average for stand establishment of 1.05 and 1.07. Of the fall plantings of 2002, XTO Energy Kutz 11E showed that Paloma Indian Ricegrass had the highest stand establishment rating of 3.8 followed by Needle and Threadgrass at 2.6. Pure Resources Rincon 172 did not show any grass stand survival one year after planting.

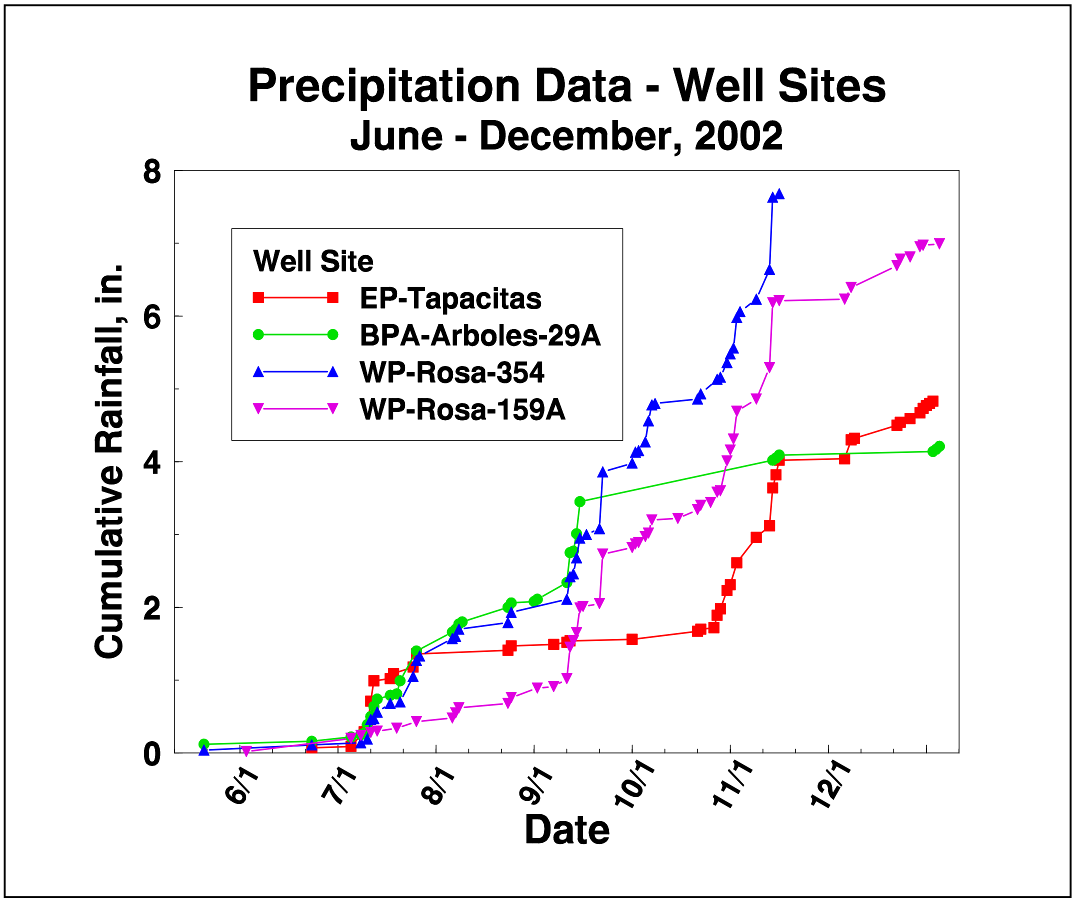


Figure 1. Cumulative precipitation collected from four well sites.

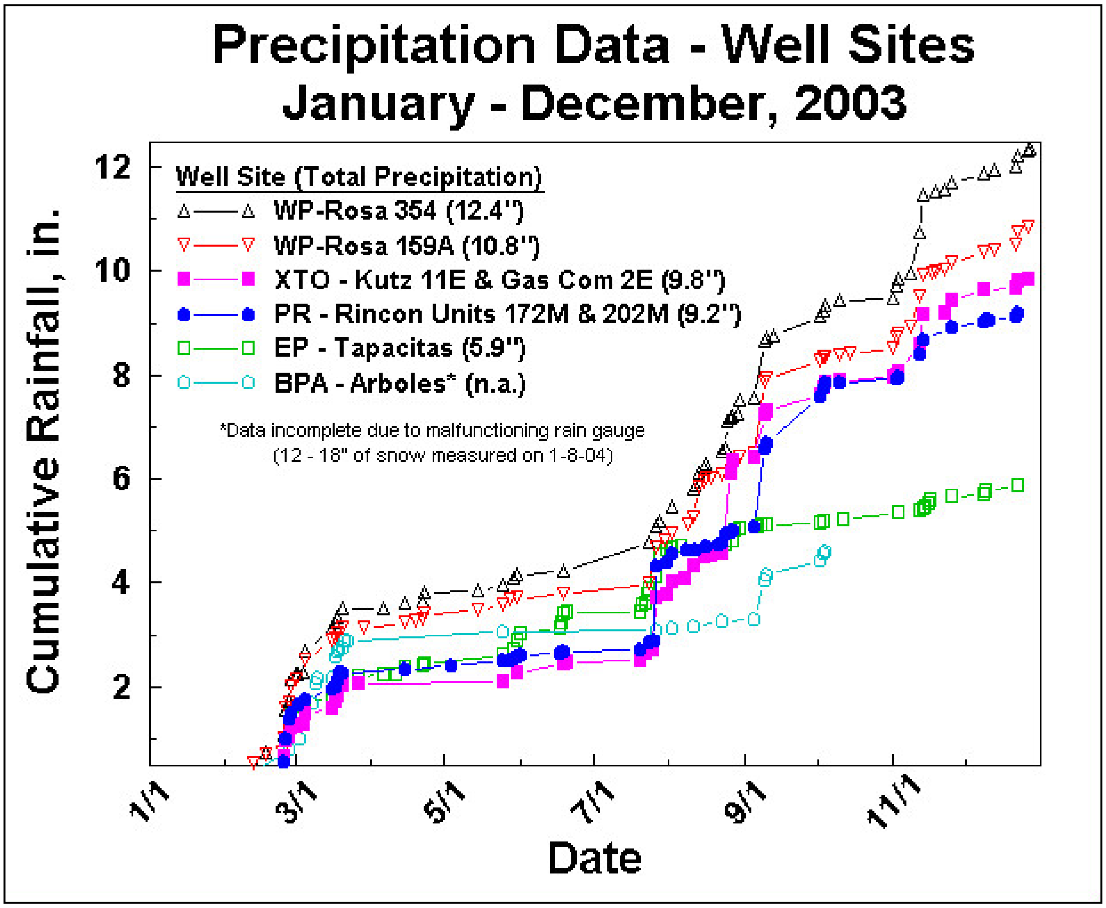


Figure 2. Cumulative precipitation collected from six well sites.

Table 2. Stand establishment of native and non-native grasses in 2003.

Cultivar	lbs/pls/A	Stand establishment[1]: EL Paso Tapacitas[2]	BP Americas Arboles 29A[2]	Williams Prod. Rosa 354[2]	Williams Prod. Rosa 159A[2]	XTO Energy Kutz 11E[3]
Arriba Western Wheatgrass	8.0	1.3	2.0	1.2	1.5	1.2
Chief Intermediate Wheatgrass	10.0	1.3	2.3	1.0	1.2	1.0
Luna Pubescent Wheatgrass	10.0	1.3	1.8	1.0	1.0	1.4
Hy-Crest Crested Wheatgrass	5.0	1.0	1.5	1.0	1.0	1.0
Canada Wild Ryegrass	7.0	1.0	1.5	1.4	2.3	2.8
Bozoisky Russian Wild Ryegrass	5.0	1.3	1.5	1.2	1.8	1.0
Critana Thickspike Wheatgrass	6.0	1.3	1.8	1.0	1.3	1.0
Bottlebrush Squirreltail	8.0	1.3	1.0	1.4	1.3	1.6
Redondo Arizona Fescue	3.0	1.0	1.0	1.0	1.2	1.0
Covar Sheep Fescue	2.0	1.0	1.0	1.0	1.2	1.2
Paloma Indian Ricegrass	6.0	1.5	1.3	1.8	1.0	3.8
Anatone Bluebunch Wheatgrass	9.0	1.0	1.3	1.0	1.0	1.0
San Luis Slender Wheatgrass	6.0	1.3	2.3	1.0	1.7	2.0
Needle and Threadgrass	8.0	1.5	2.3	1.6	1.3	2.6
Junegrass	4.0	1.0	1.5	1.0	1.0	1.0
Alma Blue Grama Grass	6.0	1.0	1.5	1.0	1.0	1.2
LSD 0.05		ns	0.8	0.4	0.7	0.8

[1] Stand establishment rated on a scale from 1 to 9 with 1 being no stand establishment or survival and 9 being 100 percent stand establishment or survival.
[2] Areas planted in early April 2002 and rated in mid July 2003.
[3] Area planted in mid October 2002 and rated in mid October 2003.

Using Coal Bed Methane Produced Water from Well-Sites for Native and Non-Native Grass Stand Establishment.

Objectives

- Select several native or non-native cool and warm season cultivar's that are adapted to the intermountain regions of northwest New Mexico.
- Applying coal bed methane produced water varying in Total Dissolved Salts, to native and non-native grasses for stand establishment.

Material and methods

Research plots were established in mid August to look at possible coal bed methane produced water for native and non-native grass establishment. The Williams Production (WP) well site Rosa 159A and BP Americas Florence K5M were chosen for this research study. Research plots were planted on August 6 with a cone seeder with six, ten in rows 25 ft long. The experimental design was a randomized complete block with four replications for both sites. Table 1 gives the names of the variety or cultivar planted at both sites. A soil sample was taken from both sites at a depth from 0 to 12 in before and after produced water was applied to determine pH, electrical conductivity (EC), calcium, magnesium, sodium, texture, and sodium adsorption ratio (SAR). Table 2 shows the results of soil samples before and after produced water application. EC describes the amount of electrical current conducted by a saturated soil extract at a fixed temperature. The more salts in solution, the greater the EC reading and the greater the toxicity to plants. This test does not distinguish between salt types, units of measure are usually in decisiemens per meter (dS/m). SAR describes the ratio of sodium relative to calcium and magnesium, to cations that moderate the adverse effects of sodium. The greater the SAR value, the more sodium relative to calcium and magnesium, the greater the toxicity. The exchangeable sodium percentage (ESP) provides a measure of the amount of exchangeable sodium relative to the total cation exchange capacity of the soil expressed as a percentage. As ESP goes up, more exchangeable sodium is available, and the greater the potential for negative plant and soil impacts. A 400-barrel tank (holds approximately 16,800 gallons) was supplied and put on each well site. Produced water was then pumped through a 3 in irrigation pipe consisting of a line spacing of 50 ft and a sprinkler spacing of 30 ft. Rainbird 25 ASFP-TNT sprinkler heads with 11/64 nozzles were used. Produced water was applied on WP Rosa 159A on August 13 and 19, September 17 and 23 at approximately 1.12 in per application for a total of 4.48 in or 640 barrels (26,880 gallons). Produced water was applied to BP Americas Florence K5M on August 12 and 20, and September 16 at approximately 2.8 in per application for a total of 8.4 in or 1200 barrels (50,400 gallons). Water samples were taken during application and sent to EnviroTech Labs for analysis. Table 3 gives the water analysis for WP Rosa 159A and BP

Americas Florence K5M. Research plots for stand establishment will be rated approximately 12 to 15 months after planting.

Results and discussion

Soil Tests: Before and after soil test results are given in Table 2. Soil tests taken before produced water application on WP Rosa 159A showed a pH of 7.32, EC of 3.39 dS/m, sodium content of 533 parts per million (ppm) and an SAR value of 7.32. After application of 4.48 in of produced water pH, EC dS/m, sodium in ppm, and SAR values each increased to 7.53, 5.12, 725 and 9.17. The BP Americas Florence K5M site showed a significant increase in EC levels from 1.71 to 6 dS/m, sodium in ppm (36.3 to 917) and an SAR value (0.6 to 11.6) in the before and after soil samples. Usually an EC in dS/m above 15 from a soil salinity test is unsuitable for most crops and where a decrease in forage production occurs. For example crested wheatgrass, western wheatgrass, slender wheatgrass, Canadian and Russian wild ryegrass, and intermediate wheatgrass, are moderate to tolerant at EC levels ranging from 10 to 15 dS/m. The EC levels in dS/m for both WP Rosa 159A and BP Americas Florence K5M EC in dS/m levels are 6 and below after produced water was applied. An SAR value evaluates the sodium content of the soil. A value of 15 or greater indicates an excess of sodium will be adsorbed by the soil clay particles. Excess sodium can cause soil to be hard and cloddy when dry, to crust badly, and take water very slowly. At both sites the soil SAR value after produced water was applied were less than 15. Both the EC values in dS/m and SAR values were under the described values for restricting forage production for most of these grasses planted.

Water Analysis: Water analyses are given in Table 3. The water analysis conducted by EnviroTech Labs showed that WP Rosa 159A averaged approximately 8,061 milliequivalents per liter (meq/L) of total dissolved salts (TDS), SAR value of 96, and an EC value in dS/m of 17. BP Americas Florence K5M averaged 6432 meq/L TDS, SAR value of 86, and an EC value in dS/m of approximately 14. A total of 4.48 and 8.4 in of produced water containing the above average values were applied to WP Rosa 159A and BP Americas Florence K5M, during August and September 2003. Usually if the irrigation water EC values in dS/m are over 3 except for tolerant crops (usually 8 to 12) and SAR values are above 26 (values below 10 acceptable for production) that water is unsuitable for production. The most influential water quality guideline on crop productivity is the salinity hazard as measured by EC. The primary effect of high EC water on crop productivity is the inability of the plant to compete with ions in the soil solution for water (physiological drought). The higher the EC, the less water available to plants, even though a field may appear wet. Usually water with an EC value of 1.15 dS/m contains approximately 2,000 lbs of salt for every acre foot of water. With this in mind approximately 5.52 and 8.52 tons of salt were applied to WP 159A and BP Americas Florence K5M, respectively. While EC is an assessment of all soluble salts in a sample, sodium hazard is defined separately because of its specific detrimental effects on soil physical properties. With higher SAR values the soil becomes more dispersed, will readily crust and have water infiltration and permeability problems. However, many factors including soil texture, organic matter, crop type, climate, irrigation system, and management impact how sodium in the irrigation water affects soils. With the relative small amount of produced water containing high EC and SAR values, it is hoped that most of the salt tolerant native and non-native grasses planted in these studies will survive and become established productive grasses of the these disturbed sites. We will continue this study by selecting two more sites for produced water application and grass establishment in the spring of 2004.

Table 1. Names of cultivars or varieties planted at each site, mid August 2003.

Variety or Cultivar	Seeding Rate (lb/pls/A[a])
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[b] 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 Luis Slender Wheatgrass	6.0
VNS[b] Needle and Threadgrass	8.0
VNS[b] Junegrass	4.0
Alma Blue Gramagrass	6.0

[a] pls = pure live seed
[b] VNS = cultivar or variety not stated

Table 2. Soil sample results before and after produced water application on WP Rosa 159A and BP Americas Florence K5M, 2003.

Well Site[1]	pH	EC (dS/m	Ca (ppm)	Mg (ppm)	Na (ppm)	SAR	Texture
WP Rosa 159A (before)	7.32	3.39	912	66.8	533	7.32	loam
WP Rosa 159A (after)	7.53	5.12	341	79.7	725	9.17	loam
BP Americas Florence K5M (before)	6.95	1.71	253	42.4	36.3	0.6	loamy sand
BP Americas Florence K5M (after)	6.92	6.0	346	74.6	917	11.6	loamy sand

[1] Before means sample taken before produced water application and after means soil samples taken after last produced water application.

Table 3 Produced water analysis for WP Rosa 159A and BP Americas Florence K5M, 2003.

Well-site	Date	pH	TDS (meq/L)	SAR	EC (dS/m
WP Rosa 159A	9-19-03	8.5	5440	71.1	16.1
WP Rosa 159A	9-17-03	8.0	10682	122.4	17.4
BP Americas Florence K5M	8-12-03	8.3	4190	51.4	11.1
BP Americas Florence K5M	8-20-03	8.4	6980	105.2	17.6
BP Americas Florence K5M	9-16-03	8.1	8126	100.8	13.6

Appendices

Photos of Revegetated Disturbed Sites and Produced Coal Bed Methane Water for Stand Establishment of Selected Native and Non-Native Grasses in the San Juan Oil and Gas Producing Basin.

Picture showing rain gauge

Picture showing rain gauge being read

El Paso Tapacitas plot area, July 2003

El Paso Tapacitas Paloma Indian Ricegrass, July 2003

BP Americas Arboles 29A plot area, July 2003

BP Americas Arboles 29 Needle and Threadgrass, July 2003

BP Americas Arboles 29 Hy Crest Crested Wheatgrass, July 2003

BP Americas Arboles 29 San Luis Slender Wheatgrass, July 2003

Williams Production Rosa 354, Bottlebrush Squirreltail, July 2003

Williams Production Rosa 354 Canada Wild Ryegrass, July 2003

Williams Production Rosa 159A San Luis Slender Wheatgrass, July 2003

Williams Production Rosa 159A Paloma Indian Ricegrass, July 2003

Williams Production Rosa 159A Needle and Threadgrass, July 2003

Williams Production Rosa 159A Bozoisky Russian Wild Ryegrass, July 2003

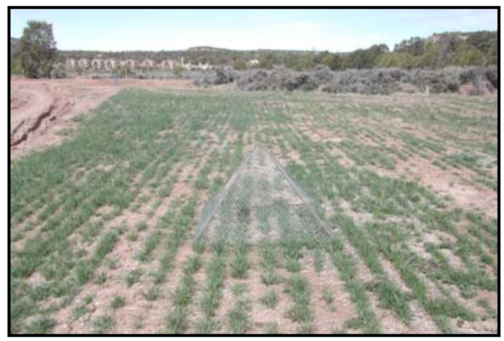
Williams Production Rosa 354 Bottlebrush Squirreltail, July 2003

Williams Production Rosa 354 Canada Wild Ryegrass, July 2003

Williams Production 159A showing cages being installed on plot area, March 2003

Williams Production Pipeline right-of-way with clumps of Hy Crest Crested Wheatgrass pulled out of soil, July 2003

Burlington Resources Brookhaven 10, showing cage and seeded area, May 2003



ConocoPhillips 253 showing cage, and seeded area, April 2003

Williams Production Rosa 159A showing 400 barrel tank and pump, August 2003

BP Americas Florence K5M showing sprinklers running, August 2003

BP Americas Florence K5M showing sweet corn emergence, August 2003

BP Americas Florence K5M showing sweet corn, October 2003

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