Revegetation of Retired Farmland: Evaluation of Six Range Grasses Under Three Irrigation Regimes

G. Thacker and J. Cox

ABSTRACT

Buffelgrass, kleingrass, "Catalina" lovegrass, "Cochise" lovegrass, bottlebrush, and sideoats grama grass were seeded on retired farmland in the Avra Valley west of Tucson in 1986 and again in 1987. Each grass species was seeded in plots that received no irrigation, or two establishment irrigations or four establishment irrigations. For both year's tests, buffelgrass had a significantly higher percent cover than the other grasses at three months after planting. In the evaluation of the 1986 test in October 1987, buffelgrass, kleingrass, Cochise lovegrass, and Catalina lovegrass had increased their presence in the irrigated plots from one year before and appeared promising for the revegetaion of retired farmland. Plots that did not receive establishment irrigations did not have significantly higher cover ratings than plots with no cover at all. The one exception to this was buffelgrass in the first evaluation of the 1986 test.

INTRODUCTION

The need to secure water rights for municipal and industrial uses has caused a modern-day land rush of municipal water providers buying farmland for water transfers. As of March 1988, 575,260 acres of land in Arizona had been purchased as "water farms" (4).

When farmland is retired from production, tumbleweeds (Salsola kali) will dominate the land during the early phase of secondary succession (3). The tumbleweeds and blowing dust have been a nuisance to rural residents and a liability to owners of retired farms. The City of Tucson has resorted to periodic mowings of its Avra Valley holdings to prevent the tumbleweeds from blowing off the property.

These problems can be greatly reduced if an adapted vegetative cover can be established on the land before it is retired. In Pima County, most of the farmland was grassland before overgrazing and a drought in the 1880's changed the semidesert grassland to a semidesert shrubland (1).

The establishment of a grass cover before retirement will not only reduce the tumbleweed problems, but can also speed up the process of secondary succession. A grass cover will improve water infiltration and reduce the amount of runoff leaving the farm. The litter of dead leaves provides a seedbed for other plants, allowing native vegetation to become established sooner than possible without a cover.

In areas of the state where a portion of the water right can be reserved for irrigation after the water is transferred away from the "water farm," range grasses may be useful as permanent irrigated pastures. Property managers for the City of Phoenix are considering the establishment of low-input pastures on the City's McMullen Valley holdings.

Previous range seeding research on retired farmland near Tucson failed to identify any plant materials that would persits on the silty clay loam soil (2). This experiment was initiated to evaluate the suitability of six range grass species as vegetative cover on retired farmland, and to develop practical techniques to establish a grass cover.

MATERIALS AND METHODS

The test site at the Three Points Test Area is a farm purchased by the City of Tucson and retired for a water transfer. The soil types in the 1986 planting vary from Anthony sandy loam to Glendale silty clay loam. The 1987 planting is on a Glendale silty clay loam. The 1986 test area was last farmed in 1984 and the 1987 area was last farmed in 1985.

The first year, test plots were planted in July 1986; the second year test was planted in July 1987, near the 1986 plots.

Land preparation procedures in both years were to double disk a solid stand of tumbleweeds and then plow 10-12" deep, followed by a second double disking. Borders were then run to separate all plots. In 1986, plots were 20' wide by 300' long. In 1987, plots were 20' by 150'. The plots were oriented to the slope of the land to maintain a dead level grade over the length of the plot. After running borders, the plots were double-disked along the length of the plot.

Range grasses selected for this test were buffelgrass (Cenchrus ciliaris), kleingrass (Panicum coloratum), "Catalina" Boer lovegrass (Eragrostis curvula), "Cochise" lovegrass (E. lehmanniana Nees x E. trichophora Coss and Dur.), bottlebrush (Anthephora pubescens), and sideoats grama (Bouteloua curtipendula). Only sideoats grama is native to Arizona; the others all originated in Africa. These grasses were selected for testing because they are known to be tolerant to high sodium soils and because deep rooting is not essential to their survival. In some cases, we would expect plow layers to impair deep rooting.

Irrigation treatments were: 1) no irrigation; 2) two irrigations on a one week interval after planting; and 3) four irrigations on weekly intervals after planting.

Each species x irrigation treatment is entered as a separate plot. Plot design is 3 replications of randomized complete blocks.

In each year, the grasses were hand-sown in late July, just as the summer monsoons were expected to start. Irrigation treatments were started immediately after seeding.

Rainfall, temperature, and relative humidity were recorded with a hygrothermograph and three recording rain gauges.

Stand evaluations were made of the 1986 planting in Otober 1986, and both year's plantings were evaluated in October 1987. Evaluations were made by 20 random drops of a one-half square meter quadrat per plot; counting the number of seeded grasses within the quadrat, and measuring the basal diameters of the plants. The data are presented here as the percent of ground surface covered by the basal area of the range grasses. No attempt was made to evaluate weed cover.

RESULTS AND DISCUSSION

1986 Planting

The October 1986 stand evaluations of the 1986 planting are shown in Table 1. The irrigated buffelgrass was significantly superior to all other grasses at this point. Even the unirrigated buffelgrass had a numerically higher percent cover than all of the other grasses, but this was not significantly higher than most of the other treatments. At this point, the unirrigated plots had only received the 2.51 inches of rainfall that came between the time of planting and stand evaluation (Table 2).

The percent cover of all of the other grasses was not significantly different. However, the very low percent covers of sideoats grama and bottlebrush at all irrigation rates is notable.

Table 1. Percent cover of six range grasses planted in July 1986, irrigated at three rates, and evaluated in October 1986.

Grass Species	Establishment Irrigations	Percent Cover
Buffelgrass	4x	1.198 a*
Buffelgrass	2x	1.001 a
Buffelgrass	none	0.408 b
Catalina lovegrass	2x	0.384 b c
Kleingrass	4x	0.326 b c
Catalina lovegras	4x	0.205 b c
Cochise lovegrass	2x	0.114 b c
Kleingrass	none	0.071 b c
Kleingrass	2x	0.065 b c
Catalina lovegrass	none	0.054 b c
Bottlebrush	none	0.029 b c
Cochise lovegrass	4x	0.017 b c
Bottlebrush	2x	0.016 b c
Sideoats grama	4x	0.006 b c
Sideoats grama	none	0.003 b c
Sideoats grama	2x	0.002 b c
Cochise lovegrass	none	0.001 c
Bottlebrush	4x	0.000 c

*Means followed by the same letter are not significantly different at the 0.05 level. CV = 114%.

Table 2. Precipitation at the Three Points Test Area, inches.

Month	1986	1987
January		0.46
February		1.20
March		0.60
April		0.22
May		0.77
June		0.00
July	0.20	2.61
August	1.77	1.28
September	0.38	0.04
October	0.16	0.82
November	0.14	0.00
December	1.49	1.05
Total	4.14	9.05

When the grass species were evaluated as separate treatments, Buffelgrass had a significantly higher percent cover than all other species (Table 3.).

Table 3. Percent cover of range grass species planted July 1986 and evaluated October 1986.

Grass Species	Percent Cover
Buffelgrass	0.869 a*
Catalina lovegrass	0.214 b
Kleingrass	0.015 b
Cochise lovegrass	0.004 b
Bottlebrush	0.001 b
Sideoats grama	0.000 b

*Means followed by the same letter are not significantly different at the 0.05 level. CV = 114%.

When the stand was evaluated again on October 1987, the rankings of the treatments has changed (Table 4). All of the plots that received establishment irrigations had higher percent covers than they did in October 1986. However, buffelgrass and Kleingrass were the only grasses with stands that were significantly better than no stand at all. The decline in the unirrigated buffelgrass was largely due to cold weather in January 1987, when temperatures dipped to 25 F (data not shown).

Table 4. Percent cover of six range grasses planted in July 1986, irrigated at three rates, and evaluated in October 1987.

Grass Species	Irrigations	Percent Cover
Buffelgrass	4x	3.976 a*
Kleingrass	2x	2.546 a b
Kleingrass	4x	2.001 a b c
Buffelgrass	2x	1.987 a b c
Cochise lovegrass	2x	1.607 b c
Cochise lovegrass	4x	1.525 b c
Catalina lovegrass	2x	1.436 b c
Catalina lovegrass	4x	1.208 b c
Sideoats grama	4x	0.137 c
Bottlebrush	2x	0.069 c
Sideoats grama	2x	0.543 c
Buffelgrass	none	0.016 c
Catalina lovegrass	none	0.000 c
Cochise lovegrass	none	0.000 c
Kleingrass	none	0.000 c
Bottlebrush	4x	0.000 c
Bottlebrush	none	0.000 c
Sideoats grama	none	0.000 c

*Means followed by the same letter are not significantly different at the 0.05 level. CV = 146%.

When the percent cover of the grass species on October 1987 was analyzed as a separate treatment, Buffelgrass and Kleingrass had significantly higher percent covers sideoats grama and bottlebrush, but not significantly higher than either of the lovegrasses (Table 5.).

Table 5. Percent cover of range grass species planted in July 1986 and evaluated in October 1987

Grass Species	Percent Cover
Buffelgrass	1.993 a*
Kleingrass	1.516 a
Cochise lovegrass	1.044 a b
Catalina lovegrass	0.882 a b
Sideoats grama	0.006 b
Bottlebrush	0.000 b

*Means followed by the same letter are not significantly different at the 0.05 level. CV = 146%.

As expected, the percent cover of the plots which received establishment irrigations was significantly higher than the unirrigated plots (Table 6.). There was no significant difference between two irrigations and four irrigations. It is important to note that the percent cover of the irrigated plots actually increased between October 1986 and October 1987, while the percent cover of the unirrigated plots decreased to virtually nothing. This underlines the fact that irrigations will be essential to get range grasses established on retired farmland.

Table 6. Response of range grasses planted in July 1986 to establishment irrigations.

Establishment Irrigations	Percent Cover on October 1986	Percent Cover on October 1987
4 Irrigations	0.003 a*	1.474 a*
2 Irrigations	0.003 a	1.283 a
No Irrigation	0.001 b	0.000 b

*Means followed by the same letter within a column are not significantly different at the 0.05 level. CV = 114% in 1986 and 146% in 1987.

1987 Planting

The 1987 seeding was not nearly as successful as was the 1986 test (Table 7.). Only irrigated buffelgrass had a significantly higher percent cover than no stand at all. We believe that the reason for the low success was the unusually hot and dry weather that persisted after planting (data not shown). The high temperatures, combined with a low relative humidity, quickly dried the surface of the soil, even in the irrigated plots. Irrigating at weekly intervals did not keep the top centimeter of the soil moist long enough to allow many grass seedlings to get established.

An additional factor was that the 1987 test was all on a silty clay loam soil; this fine texture aggravated the lack of available soil moisture the the seedlings. In 1986, the weather after planting was more humid and overcast, and the soil surface did not dry as quickly; the best stands were achieved on the sandy loam area of the test.

Table 7. Percent cover of range grasses planted in July 1987, irrigated at three rates, and evaluated in October 1987.

Grass Species	Irrigations	Percent Cover
Buffelgrass	2x	0.403 a*
Buffelgrass	4x	0.287 b
Catalina lovegrass	2x	0.136 b c
Cochise lovegrass	2x	0.063 b c
Kleingrass	2x	0.055 b c
Kleingrass	4x	0.036 c
Catalina lovegrass	4x	0.009 c
Buffelgrass	none	0.009 c
Bottlebrush	none	0.006 c
Sideoats grama	none	0.002 c
Bottlebrush	2x	0.001 c
Sideoats grama	4x	0.001 c
Catalina lovegrass	none	0.001 c
Cochise lovegrass	4x	0.000 c
Sideoats grama	2x	0.000 c
Cochise lovegrass	none	0.000 c
Kleingrass	none	0.000 c
Bottlebrush	4x	0.000 c

*Means followed by the same letter are not significantly different at the 0.05 level. CV = 194%.

When the grass species were statistically analyzed as separate treatments, buffelgrass had a significantly higher cover than all of the other grasses (Table 8).

Table 8. Percent cover of range grass species planted in July 1987 and evaluated in October 1987.

Grass Species	Percent Cover
Buffelgrass	0.207 a*
Catalina lovegrass	0.049 b
Kleingrass	0.030 b
Cochise lovegrass	0.021 b
Bottlebrush	0.002 b
Sideoats grama	0.001 b

*Means followed by the same letter are not significantly different at the 0.05 level. CV = 194%.

As expected, the irrigated plots had significantly higher percent covers than the unirrigated plots (Table 9.). There was no significant difference between two irrigations and four irrigations.

Table 9. Response of range grasses planted in July 1987 to establishment irrigations.

Irrigations	Percent Cover in October 1987
2 Irrigations	0.110 a*
4 Irrigations	0.042 a
No Irrigation	0.003 b

*Means followed by the same letter are not significantly different at the 0.05 level. CV = 194%.

Evaluations of these experiments will continue for several years. We will determine which, if any, of these grasses will persist on retired farmland. Up until now, buffelgrass has had the highest percent covers. Kleingrass, Catalina lovegrass, and Cochise lovegrass are also promising.

So far, the data indicate that irrigations will be essential to establish range grasses on retired farmland. We are continuimg to plant tests; the 1988 planting was irrigated on two to three day intervals in order to keep the top centimeter of soil moist long enough to allow the seedlings to get established.

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