Perennial Grass Species Yield in Dryland and Limited Irrigation Production in the Semi-Arid Southern High Plains

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ABSTRACT

As Ogallala irrigation levels decline the Southern High Plains of Texas, producers concede that irrigation levels will no longer sustain popular crop options such as corn, cotton, and wheat at satisfactory yield levels. Perennial grass pastures offer a low-input alternative to irrigated crops under irrigation as well as a suitable alternative for dryland cropping systems. The objective was to evaluate twelve species of perennial grass for forage production with zero, low, and moderate irrigation levels. The trial was initiated in 2006 near Lockney, TX using old world bluestems (3), buffalograss, blue grama, sideoats grama, Alamo switchgrass, Kleingrass, Indiangrass, and Bermuda grass (2) with the three irrigation levels overlaying the species. Forage harvests were conducted twice per year, weighed, and a subsample saved for forage quality analyses. Multi-year average forage yields demonstrated that Alamo switchgrass yielded over 13,000 kg/ha DM per hectare with no irrigation, and 16,000 kg/ha at the moderate level of irrigation, which averaged 25 cm over the year. Old world bluestems (WWB-Dahl, Spar, and Caucasian) yielded near 8,000-9,200 kg/ha without irrigation. Native range species like blue grama and sideoats grama, which are highly palatable to livestock, yielded 40-50% less than switchgrass. Bermudagrass yielded about 1,500 kg/ha less than the old world bluestems. Producers are encouraged to avoid so-called 'wonder' grasses but focus on proven varieties with regional adaptation to achieve satisfactory results. This is especially important as the water irrigation resource from the Ogallala steadily declines.

PROJECT BACKGROUND—PERRENIAL GRASSES

- In 2004 & 2005 as the Texas Alliance for Water Conservation (TAWC) was implemented, we estimated 10,000-25,000 acres/year of land would be returning to permanent range pasture for several reasons
  - Lower inputs
  - Stop the bleeding of continued borrowing and debt
  - Irrigation levels declining made row cropping more difficult
  - Earlier Texas Tech University research suggested perennial grasses, particularly old world bluestems, could serve a vital role in both irrigated and dryland integrated crop/livestock systems
- Producers frequently ask 'Which grass is better if seeding back to permanent pasture?'
  - Answer will depend on intended use, resources available (water), desired level of management
- There are numerous perennial grass choices—Which one(s) might be most viable?
  - Improved native range species (lower yielding, but higher potential forage quality) vs. introduced species that may yield more as well as grasses that are pure biomass producers (e.g. 'Alamo' switchgrass)

OBJECTIVES

1. Choose grasses for testing that are adapted to the region and can perform well under a wide variety of conditions
2. Implement a demonstration/applied research trial with a TAWC producer cooperator
3. Impose two irrigation levels in addition to dryland to evaluate the yield effect of added irrigation

MATERIALS AND METHODS

Choice of Grasses

Species selection base on TAWC and local experience, NRCS suggestions, regional grass seed company expertise.

- Buffalograss ('Plains')
- Sideoats grama ('Haskell')
- Blue grama ('Hatchita')
- Floyd Co. NRCS blend—50% blue grama, 40% sideoats grama, 10% green sprangletop
- Switchgrass ('Alamo')
- Kleingrass ('Selection 75')
- Old world bluestem
  - 'Spar'
  - 'WW-B Dahl'
  - 'Caucasian'
- Indiangrass ('Cheyenne')
- Bermudagrass
  - Sprigged ('Ozark')
  - Seeded (1:1 Giant/Common mix)

Site Selection, Establishment, Maintenance

The test sites was located on a farmer cooperator (Eddie Teeter) of the TAWC project. The site was drilled with a Tye grass drill in April & May, 2006 (Bermudagrass established later). Irrigation was used to ensure that the grasses were established, and yield data for the first season is not reported (no true dryland). Test area was fertilized with N annually at 33 kg N/ha regardless of irrigation level.

Irrigation

Grass strips (3 reps each) measuring 3.5 m X 25 m were divided into threes sections and assigned dryland, low irrigation (~5 cm/month), and moderate irrigation (~10 cm/month) for target irrigation levels (Fig. 1). Irrigation was applied by hand using a hose connected to the farmer's irrigation system. Water volume was calculated and the time needed to apply irrigation in 2.5 cm increments. Irrigation levels varied depending on annual rainfall (Table 1).

Harvest

Forage harvest occurred 2 to 3 times per year in 2008-2010 using a Carter harvester with a 1 m wide swath. Forage subsamples were weighed then dried to adjust field wet weights to oven-dry basis. Statistical analyses were conducted using an ANOVA procedure in SYSTAT. Due to the massive drought in 2011 that data is not included.

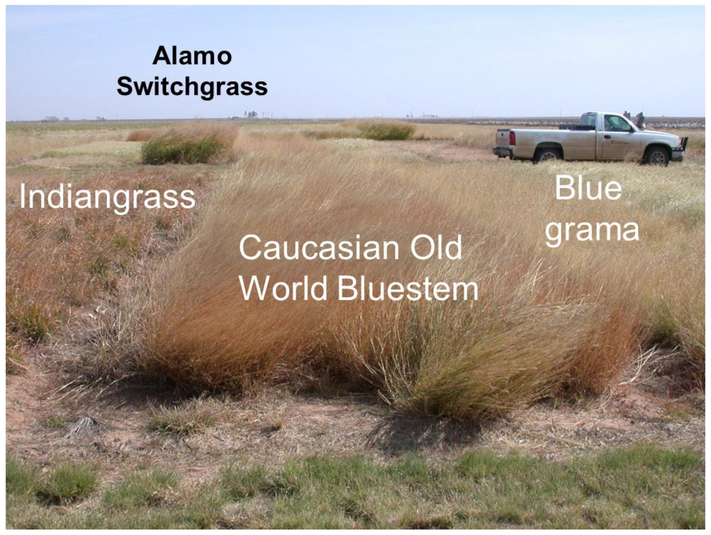

Figure 1. Grass species dryland and irrigated forage test, 2008-2010, Lockney, Texas. Each strip maintains one plot for moderate irrigation (foreground), low irrigation, and dryland testing (visible in background).

Table 1. Rainfall and irrigation levels applied during perennial grass speciation test, Lockney, TX (2008-2010).

Water Status	2007 (cm)	2008 (cm)	2009 (cm)	2010 (cm)
Jan.-Oct. Rainfall	54.4	41.9	37.3	59.4
Dryland	0.0	0.0	0.0	0.0
Low Irrigation	5.1	12.7	17.8	7.6
Moderate Irrigation	10.2	25.4	35.6	15.2

RESULTS

In general rainfall was at or above normal for the three years of harvest (annual rainfall, ~48 cm; in contrast, 2011 was <10 cm January-October).

Species Growth

- Switchgrass significantly out yielded other grasses, including dryland; but this grass' management in a grazing system would be quite different vs. being cut 2X per year
- Old world bluestems (esp. WW-B Dahl) and Kleingrass also demonstrated good yield over four years
- Popular improved native species blue grama and sideoats grama yielded about 1/3 less than OWB grasses, but may offer better nutritional profiles.

Irrigation Response

- January-October rainfall has been average to above average during this trial resulting in good yields even for dryland
  - Yield potential in these conditions w/o irrigation demonstrates production viability for perennial grasses, sufficient to provide an alternative to tillable agriculture
- Minimal irrigation levels (8-18 cm) have added significantly to forage yield
  - Among all species, ~400 kg/ha per 2.5 cm water (switchgrass approximately double the growth) (Fig. 2)
- Additional irrigation has resulted in only nominal increased yield
  - Across all species, ~130 kg/ha. per 2.5 cm water

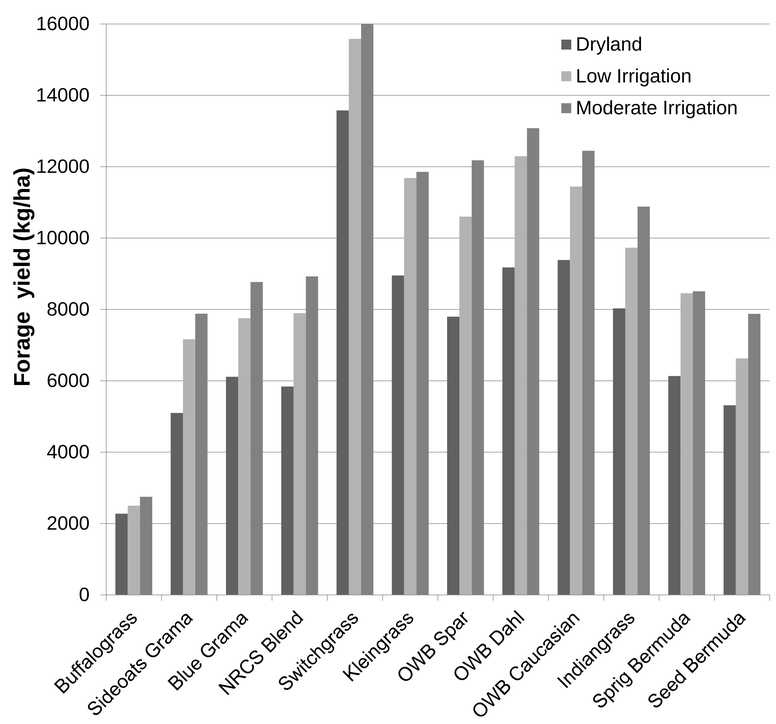

Figure 2. Forage biomass yield (kg/ha) for 12 perennial grass species averaged 2008-2010 at dryland, low irrigation (5 cm/month), and moderate irrigation (10 cm/month), Lockney, Texas.

SUMMARY

- Perennial grasses provide an opportunity to save water with an alternative and sustainable system that has minimal maintenance costs
- Producer choice in grass species selection may emphasize tonnage vs. less yield but higher nutritive value
- Higher irrigation levels to not appear to have merit for perennial grass, which fits water conservation goals in the Texas High Plains

Acknowledgement

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