Grazing Persistence of Perennial Cool-Season Grasses

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Summary

Ten cool-season grass varieties were evaluated for persistence under severe grazing stress in the variable climate of west-central Kansas. All grasses persisted and total plant survival was greater than expected across all varieties after two years of excessive grazing. However, it was evident that the western wheatgrass and tall wheatgrass varieties had greater tiller densities and yields following excessive defoliation. Smooth bromegrass had the greatest decline in plant number and tiller density, while pubescent wheatgrass varieties also tended to decline in tiller density. Western wheatgrass and tall wheatgrass should provide persistent early spring or late fall grazable forage in west-central Kansas.

Introduction

Grazing animal-sward interactions are especially important in environments where high temperatures and drought conditions may lead to excessive forage utilization if stocking rates are not adjusted accordingly. Grasses in western Kansas have shown greater yields in years of moisture stress if grasses have greater tiller density. Grass survival under these circumstances is important for future production and environmental sustainability. Response to severe defoliation stress has recently been shown as a useful selection criteria for experimental lines of some perennial cool-season grasses and legumes.

Growth of perennial cool-season grasses usually occurs from April to June and from late August through October in the Great Plains, but great environmental stress from extremely hot, dry conditions during the late spring, summer, and early fall coupled with defoliation from grazing could limit usefulness of some perennial cool-season grasses. This project was initiated to evaluate production and stand responses of native and introduced cool-season grass varieties selected for adaptation to the Great Plains while undergoing severe defoliation stress in the variable climate of west-central Kansas.

Methods

Ten perennial cool-season grasses were seeded at two locations (upland and lowland), each in a randomized complete block design with four replications near Hays, KS.

Grasses included ‘Lincoln’ smooth bromegrass, ‘Bozoisky’ Russian wildrye, ‘Luna’ and ‘Manska’ pubescent wheatgrass, ‘Alkar’ and ‘Jose’ tall wheatgrass, ‘Slate’ and ‘Oahe’ intermediate wheatgrass, and, the only native grasses in the study, ‘Barton’ and ‘Flintlock’ western wheatgrass. Plots were seeded at 30 pure live seeds (PLS)/ft^2 in a firm and clean tilled seed bed. Seeding occurred on 10 April 2000 at the upland site and 28 April 2000 at the lowland site. Plots received 40 lb N/acre in the form of ammonium nitrate prior to seeding, and an additional 40 lb N/acre from early March to early April in 2001 through 2005. Plots also were sprayed with 1qt 2,4-D/acre following the first harvest in 2000 and 2001 to reduce broadleaf weed competition.

Before this trial began, from 2000-2002, when grasses reached approximately 10-12 inch heights, plots were intermittently grazed to a 2-inch residual height within 3 days of stocking by 550 to 850 lb steers. The upland site was grazed twice in 2000, and three times in both 2001 and 2002. The lowland site was grazed twice in 2000, four times in 2001, and three times in 2002. Grazing events were separated by at least 35 days.

Beginning in 2003 and continuing through 2004, plots were extensively grazed to exert severe defoliation stress upon the stands. In 2003 and 2004, steers were stocked when grasses reached approximately an 8-inch height. Animals flash grazed until residual height was approximately 2 inches. In 2003, three animals grazed on plots for another 83 days and were fed supplemental hay in an adjacent location. Animals were restocked from 15 Sept. until 10 Oct., a critical time period for grasses to accumulate energy reserves for the next season. At each location, plots received a total of 436 steer grazing days per acre.

In 2004, warm, dry spring conditions in April and May did not allow for any regrowth after the initial grazing, and plots were restocked 7 June. Steers grazed through 24 Sept. A total of 337 steer grazing days were implemented in 2004. After initial grazing in 2003 and 2004, grasses remained at or below a 2-inch height through the rest of the season. In 2005, grasses were not grazed and were allowed to accumulate biomass to peak standing crop in late June. Grasses were then cut to a two inch height and forage was removed.

A metal frame divided into 30 units, each 1dm X 1 dm, was placed over three adjacent seeded rows at each of three locations in each plot, and the number of units with a live plant base within the unit were recorded. Frequency equaled 30 if all units contained a live plant base. Frequency was measured early each spring, in mid-summer, and again in late fall during 2003 and 2004, but only spring and late fall measurements were taken in 2005.

Tiller density was determined within two 1 ft^2 frames in each plot during the summer and fall of 2003 and 2004. In 2005, tiller density was estimated in the spring and summer. Vegetation within two 1 ft^2 frames was also hand clipped to ground level in the early spring of 2004 and 2005 to measure initial spring growth, and at peak standing crop in late June of 2005 after two seasons of severe defoliation.

Analysis was performed using Proc Mixed of SAS, with locations, varieties, and years as fixed effects and replication as the random effect. If interactions existed with years, data were sorted and analyzed again by year. All effects were found to be significant if the probability level was less than P=0.05.

Results and Discussion

Fall Tiller Density 2002-2004

In the fall of 2002 prior to the first season of severe defoliation, Barton and Flintlock had the greatest tiller densities at the upland location (Fig. 1). Manska had the lowest tiller density in the fall of 2002. By 2004, Barton, Flintlock, and Jose had increased tiller density by nearly 100 tillers/ft^2, and had the greatest densities. Although all varieties had increased tiller density from 2002 to 2004, Lincoln smooth bromegrass, both intermediate wheatgrass varieties, and both pubescent wheatgrass varieties increased the least and had the lowest tiller densities of 2004.

At the lowland location, Barton, Flintlock, and Jose had the greatest tiller densities of 2002. In 2003 and 2004, Barton tiller density increased and had much greater tiller density than any other variety (Fig 2). The two pubescent wheatgrass varieties had the greatest decline in tiller density from 2003 to 2004, and were among the lowest tiller densities of 2004. Lincoln smooth bromegrass and Bozoisky Russian wildrye also had two of the lowest tiller densities in the spring of 2004

Summer Tiller Density 2003-2005

At the upland location in 2003, no difference in summer tiller density was found between varieties, and averaged 53 tillers/ft^2. In 2004, Barton, Flintlock, Bozoisky, Jose, and Manska had the greatest tiller densities near 100 tillers/ft^2 or greater. In 2005, after a spring of recovery, both western wheatgrass varieties had the greatest increase in tiller density (Fig. 3). The lowest tiller densities were found in both intermediate wheatgrass, both pubescent wheatgrass, and the smooth bromegrass varieties.

At the lowland location in 2003, again no differences were seen between varieties for summer tiller density, with an average of 38 tillers/ft^2. In 2004, Barton western wheatgrass had much greater tiller density than any other grass. In 2005, results were similar to the upland location, with Barton and Flintlock having the greatest tiller densities of over 300 tillers/ft^2 (Fig. 4) Similar to 2004, the intermediate and pubescent wheatgrass varieties had the lowest summer tiller densities in 2005.

Fall Frequency 2002-2004

Fall frequency from 2002 to 2004 was lowest for Lincoln smooth bromegrass and Bozoisky Russian wildrye at the upland location (Table 1). At the lowland location, both western wheatgrass varieties again had the greatest frequency, but two intermediate wheatgrass and one pubescent wheatgrass varieties, Slate, Oahe, and Manska, had frequencies that were as great as western wheatgrass.

Spring Frequency 2003-2005

At the upland location, both western wheatgrass varieties and both intermediate wheatgrass varieties had the greatest spring frequencies in 2003. Lincoln smooth bromegrass also had one of the greatest frequencies in the spring of 2003. However, in 2004, Lincoln had one of the lowest frequencies. Seven of the remaining nine varieties had equal to the greatest spring frequency. In 2005, Lincoln smooth bromegrass and Bozoisky Russian wildrye had lower frequency than all other varieties. All eight other varieties had equal to the greatest frequency.

At the lowland location, all varieties except the two tall wheatgrass varieties and both pubescent wheatgrass varieties had among the greatest spring frequency in 2003. In 2004 and 2005, Luna, Jose, or Alkar had less frequency than all other varieties. All other varieties had equal to the greatest frequency.

Summer Yield

The summer following two consecutive seasons of excessive defoliation, stands were allowed to accumulate peak biomass. Alkar tall wheatgrass had the greatest yield at both locations, but was not different than Flintlock western wheatgrass at the upland location or Barton western wheatgrass at the lowland location (Fig. 5). Lincoln smoothbrome, Manska pubescent wheatgrass, Bozoisky Russian wildrye, and Slate intermediate wheatgrass had among the lowest yields at both locations. None of these varieties produced over 3000 lb/acre at either location.

Conclusion

Total plant survival was greater than expected across all varieties, however, it was evident that the western wheatgrass and tall wheatgrass varieties had greater tiller densities and yields following excessive defoliation. Since western wheatgrass is native to the region, it was not surprising that it was able to persist and produce better than most other species in the extreme climatic and defoliation stress applied in 2003 and 2004. For stands that will experience extreme stress after establishment, native western wheatgrass and introduced tall wheatgrass appear to be more capable of persisting and producing than other cool-season grasses. These grasses should provide persistent early spring or late fall grazable forage.

Table 1. Fall plant frequency of ten cool-season grass varieties following extensive defoliation in 2003 and 2004 on upland and lowland soils near Hays, KS.

Grass	Upland Frequency (Plants / 30 units)†	Lowland Frequency (Plants / 30 units)†
'Alkar' TW	28.5 a	27.6 e
'Barton' WW	30.0 a	30.0 a
'Bozoisky' RW	25.4 b	29.3 bc
'Flintlock' WW	30.0 a	30.0 a
'Jose' TW	29.0 a	28.4 d
'Lincoln' SB	23.0 c	29.0 cd
'Luna' PW	28.1 a	29.1 c
'Manska' PW	29.2 a	29.5 abc
'Oahe' IW	29.0 a	29.5 abc
'Slate' IW	29.5 a	29.8 ab

†Values in columns with the same letter are statistically equal.

Fig. 1. Upland fall tiller density of ten perennial cool-season grass varieties following extensive defoliation near Hays, KS.

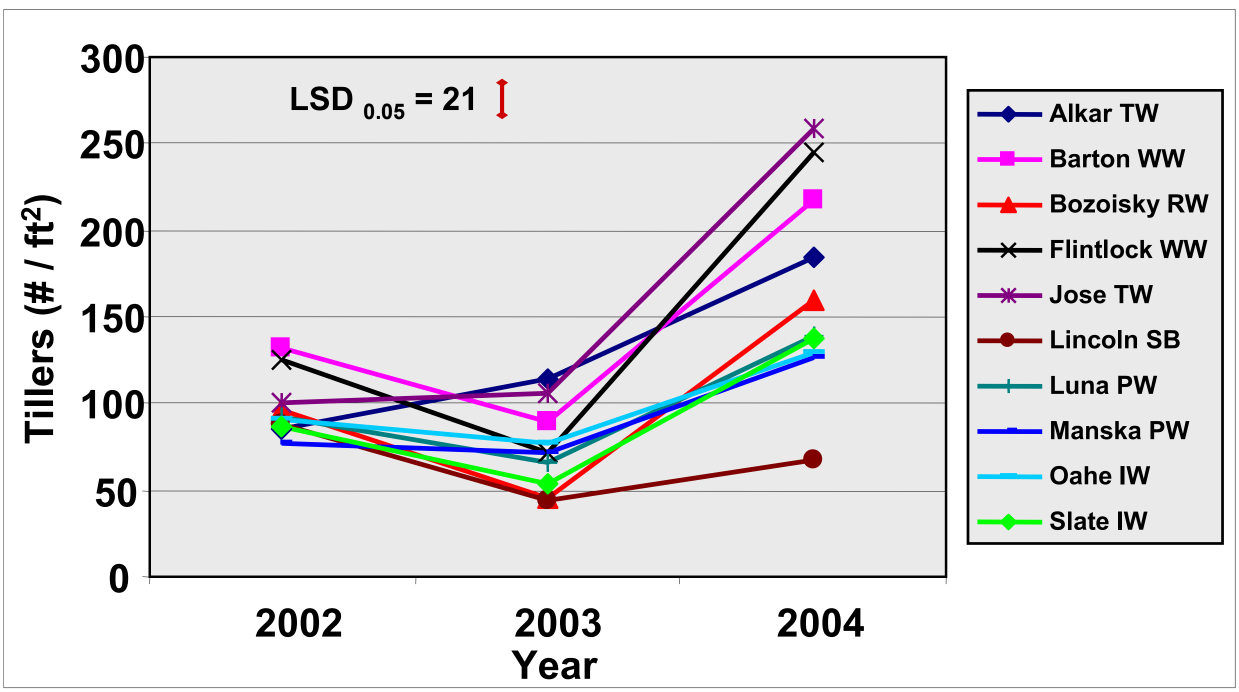

Fig. 2. Lowland fall tiller density of ten perennial cool-season grass varieties following extensive defoliation near Hays, KS.

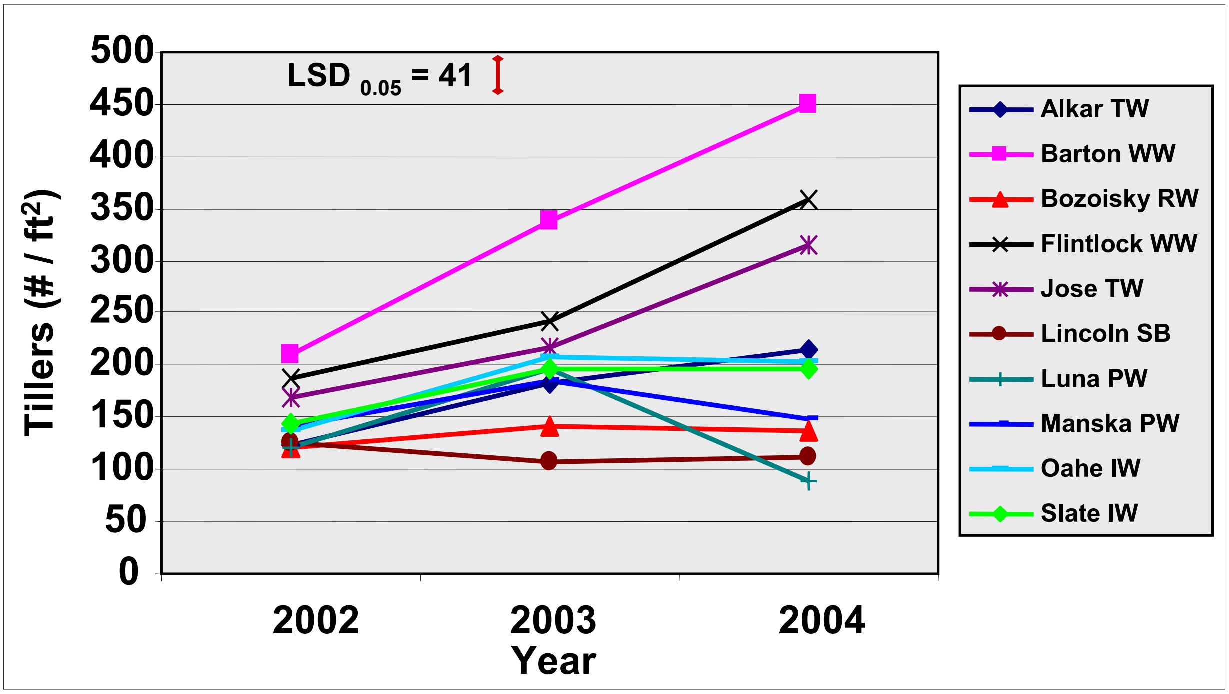

Fig. 3. Upland summer tiller density of ten perennial cool-season grass varieties following extensive defoliation near Hays, KS.

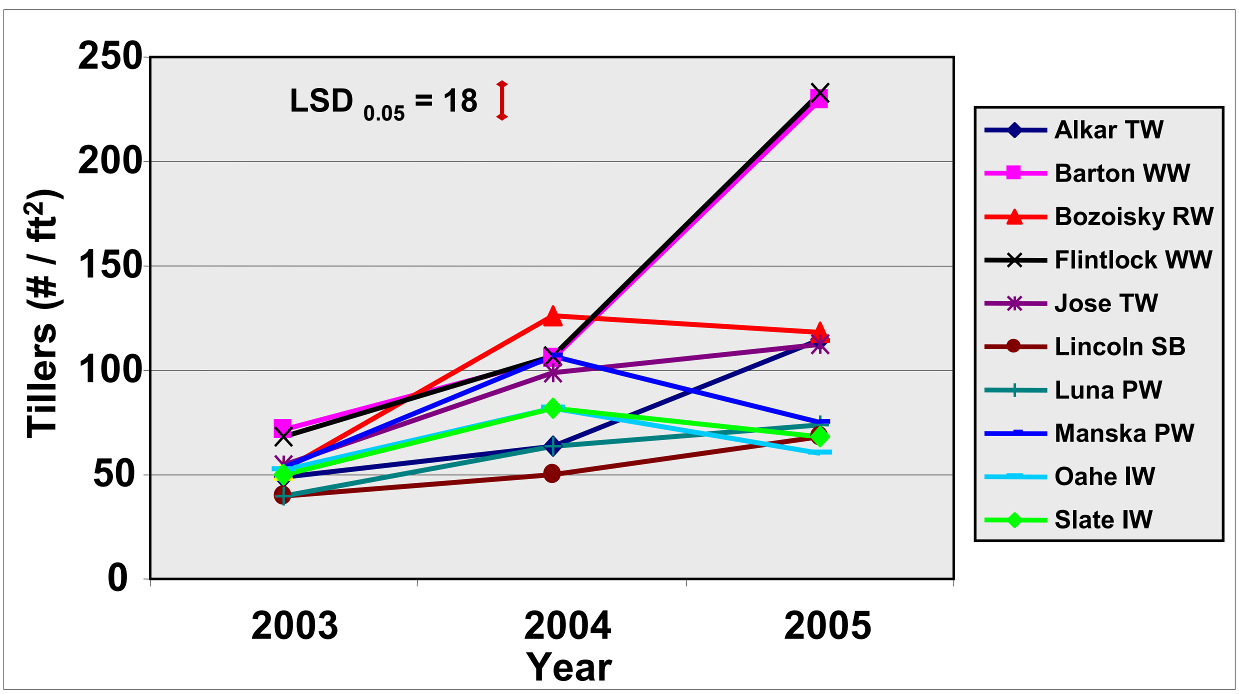

Fig. 4. Lowland summer tiller density of ten perennial cool-season grass varieties following extensive defoliation near Hays, KS.

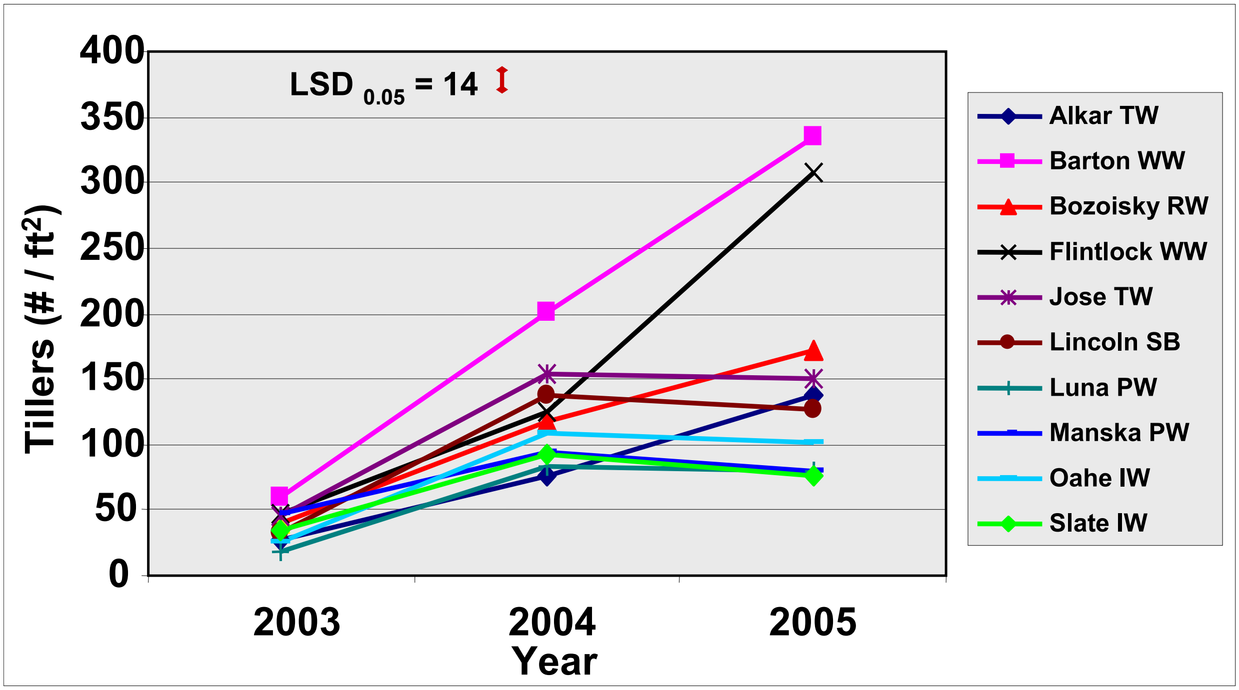

Fig. 5. Upland and lowland peak yield of ten perennial cool-season grass varieties the summer following two consecutive seasons of extensive defoliation near Hays, KS.