FORAGE PRODUCTION AND PERFORMANCE OF BEEF YEARLINGS GRAZING DIPLOID AND TETRAPLOID CRESTED WHEATGRASSES

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ABSTRACT

A series of experiments were conducted during 1994 and 1995 at Swift Current, Saskatchewan, Canada to evaluate forage production and animal performance on tetraploid Kirk (*Agropyron cristatum* (L.) Gaertn.) and diploid Fairway (*Agropyron cristatum* (L.) Gaertn.) crested wheatgrass pastures under grazing conditions imposed by beef (*Bos taurus*) yearling steers at four stock density levels (3, 4, 6 and 8 steers ha^{-1}). Total ungrazed forage production for Kirk was greater (<0.05) than Fairway (6302 kg ha^{-1} vs. 5235 kg ha^{-1}) in 1994 but less ($P<0.05$) than Fairway in 1995 (3709 kg ha^{-1} vs. 4633 kg ha^{-1}). Animal performance (average daily gain, animal grazing days and total animal production) did not differ ($P>0.05$) for steers grazing either Kirk or Fairway pastures. Plant vigour and available energy reserves following one season of grazing were evaluated through etiolated growth with no significant cultivar differences detected.

KEYWORDS

Crested wheatgrass, cattle, grazing, forage production, animal performance

INTRODUCTION

Crested wheatgrass was introduced to North America in the 1920's and early cultivars earned much of their popularity and success because native rangelands had been destroyed by the homesteader's plow. When drought conditions struck, this cool-season species was a solution to blowing topsoil and virtual ecological disaster. Vast areas were seeded to crested wheatgrass as a means of returning the land to a productive, sustainable state.

Fairway crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.), a diploid, is the original cultivar released for use on the Canadian Prairies in 1932. This forage source is recognized for its excellent seed production, drought resistance, palatability, high yield and forage quality (Rogler, 1960). Kirk crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.), a tetraploid cultivar, was released in 1987 and performed similarly to Fairway in small plot trials with slight improvements in forage yield and seed production. The effects of grazing upon this cultivar have not been evaluated and questions as to its palatability and longevity under long-term pasture use have been raised. Therefore, this study was conducted to evaluate Kirk and Fairway crested wheatgrass under grazing conditions imposed by yearling beef steers. The project was designed to investigate grazing effects upon forage production, quality, growth and development and plant vigour with consideration of grazing animal performance.

MATERIALS AND METHODS

A grazing trial was conducted during the summers of 1994 and 1995 at the Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada, at Swift Current, Saskatchewan. The study area was prepared in 1993 by seeding replicated pastures of Kirk and Fairway crested wheatgrass. Topography was gently rolling to level with Haverhill and Swinton loam Chernozemic orthic brown soils. Long-term weather records from Swift Current report a mean maximum and minimum temperature of 9.7½C and -2.6½C. Average yearly precipitation is 360 mm.

Yearling Hereford and Angus steers (314 kg ± 19) were randomly allocated to pastures in numbers necessary to obtain stock densities of 3, 4, 6 and 8 steers ha^{-1} with each individual pasture receiving the same grazing treatment in both years of the trial. An initial grazing period occurred in the spring (May 18, 1994 and May 16, 1995) of each grazing season. Steers remained on each pasture until all forage was grazed to a uniform level of 3 cm. Pastures were allowed an adequate rest period and animals were returned to the same pasture for a second grazing period.

Biweekly weighings of steers occurred throughout the grazing periods of both years. Steers were weighed following an overnight fast of 16 h without feed and water. All animals were handled according to the Guidelines of the Canadian Council on Animal Care (Canadian Council on Animal Care, 1993).

Forage sampling for available yield was carried out biweekly in 1994 and 1995. Randomly placed quadrats (0.36 m^2) were clipped with all forage harvested above 2.5 cm. Forage quality samples were collected weekly using the hand plucking method as evaluated by Wallis de Vries (1995).

Etiolated growth, as a measure of plant vigour, was evaluated in the spring of 1995 by placing metal cans (13.5 cm diameter, 25 cm height) over clipped plants and allowing growth to occur in the exclusion of light (Edwards, 1964). Plant growth was harvested on May 15 and samples were dried and weighed.

All forage samples were dried and ground according to the Association of Official Analytical Chemists (AOAC 1984) procedures. Samples were dried in a forced draught oven at 50½C for 48 h to approximately 90% dry matter. They were then weighed and ground through a Thomas-Wiley mill with a 1 mm screen. *In vitro* organic matter digestibility (IVOMD) of forage samples was determined using the procedures of Tilley and Terry (1963) as modified by Troelson (1969). Crude protein (CP) concentration (N x 6.25) was determined following the Kjeldahl procedure (AOAC No. 7.022, 1984) and the method of Varley (1966) was used to determine phosphorous (P) concentrations in forage samples.

The experimental design was completely random with a factorial arrangement of treatments. Data for each year were analyzed separately using the SAS General Linear Models procedures for analysis of variance and regression (SAS Institute Inc., 1990).

RESULTS AND DISCUSSION

Ungrazed forage production at the end of each grazing season was significantly ($P<0.05$) different between Kirk and Fairway crested wheatgrass in both study years. Kirk yielded more ($P<0.05$) forage than Fairway (6302 kg ha^{-1} vs. 5235 kg ha^{-1}) in 1994 but less than Fairway (3709 kg ha^{-1} vs. 4633 kg ha^{-1}) in 1995.

Forage available yield did not differ ($P>0.05$) between Kirk and Fairway on any individual sampling date in either study year. When orthogonal contrasts of available pasture yield at each stock density were compared across sampling dates, significant ($P<0.05$) cultivar differences were detected. At a stock density of 3 steers ha^{-1} Kirk yielded more ($P<0.05$) forage than Fairway in both 1994 (2307 kg ha^{-1} ± 468 vs. 1444 kg ha^{-1} ± 205) and 1995 (1795 kg ha^{-1} ± 448 vs. 1491 kg ha^{-1} ± 357). However, with increasing stock density (6, 8 steers ha^{-1}) Fairway was observed to produce greater quantities of available forage than Kirk. At the highest stock density (8 steers ha^{-1}), Fairway (1547 kg ha^{-1}± 434) yielded more available forage ($P<0.05$) than Kirk (1347 kg ha^{-1} ±543) in 1994. Increasing levels of grazing pressure appear to reduce available forage yield of Kirk crested wheatgrass.

Forage quality (IVOMD, CP and P) of Kirk and Fairway crested wheatgrass declined throughout the growing season (Table 1). Comparisons of the slopes of regression lines determined that the rate of decline with forage maturation was similar for the two cultivars.

Performance of steers grazing Kirk and Fairway pastures (Table 2) was comparable to that reported in previous grazing studies evaluating crested wheatgrass (Hart et al., 1983; Mayland, 1986; Vogel et al., 1993). Cultivar differences were not detected, however animal performance differences were detected between grazing periods. Significantly ($P<0.05$) more animal grazing days (d ha^{-1}) were obtained in grazing period 1 of 1994 for both cultivars, resulting in greater total animal production (kg ha^{-1}) for this period. Grazing management strategies, including immediate grazing of forage regrowth, may explain differences in animal performance between grazing periods.

Forage production values for Kirk suggested a reduction in tolerance to grazing pressure at relatively high stock densities following only one season of grazing. However, plant vigor following one season of grazing pressure, as measured by etiolated growth, did not differ ($P>0.05$) between Kirk and Fairway plants. Forage quality and animal performance indicate that Kirk and Fairway crested wheatgrass are successful forage sources for grazing animals in southwestern Saskatchewan. However, further investigation into the sensitivity of Kirk to high stocking density is recommended.

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Table 1

Regression equations for relationships between forage quality parameters and Julian day for Kirk and Fairway crested wheatgrass during the 1994 and 1995 growing seasons at Swift Current, Saskatchewan.

	IVOMD	Crude Protein	Phosphorous
1994			
Kirk	y=88.4-0.17x	y=39.0-0.14x	y=0.44-0.001x
	(r^2=0.81; RSD=1.91; P<0.01)	(r^2=0.53; RSD=3.07; P<0.01)	(r^2=0.38; RSD=0.04; P<0.01)
Fairway	y=81.9-0.12x	y=34.5-0.11x	y=0.45-0.001x
	(r^2=0.56; RSD=2.73; P<0.01)	(r^2=0.44; RSD=3.28; P<0.01)	(r^2=0.46; RSD=0.04; P<0.01)
1995			
Kirk	y=109.9-0.27x	y=46.4-0.16x	y=0.45-0.001x
	(r^2=0.81; RSD=4.02; P<0.01)	(r^2=0.79; RSD=2.58; P<0.01)	(r^2=0.54; RSD=0.04; P<0.01)
Fairway	y=107.4-0.25x	y=46.8-0.17x	y=0.50-0.69x
	(r^2=0.80; RSD=4.16; P<0.01)	(r^2=0.85; RSD=2.35; P<0.01)	(r^2=0.69; RSD=0.04; P<0.01)

Table 2

Performance of beef yearlings grazing two crested wheatgrass cultivars during two grazing seasons at Swift Current, Saskatchewan.

		1994			1995		
		Kirk	Fairway	SE	Kirk	Fairway	SE
Average daily gain (kg d^{-1})							
	Period 1	1.12	1.01	0.05	0.89*	0.79	0.11
	Period 2	0.80	0.77	0.10	1.41	1.40	0.14
	SE	0.10	0.08		0.18	0.14	
Animal grazing days (d ha^{-1})							
	Period 1	176*	172*	4.8	150	126	12
	Period 2	89	75	8.8	91	86	9.8
	SE	17	17		17	9	
Total animal production (kg ha^{-1})							
	Period 1	198*	173*	12	138	100	20
	Period 2	77	68	11	112	118	11
	SE	24	20		19	14	

* Means within columns significantly different ($P<0.05$).