2009

Winter Cereals as a Pasture-Hay System in Montana

A. N. Hafla
Montana State University - Bozeman

S. D. Cash
Montana State University - Bozeman

L. M. M. Surber
Montana State University - Bozeman

J. A. Paterson
Montana State University - Bozeman

A. W. Lenssen
USDA-ARS

See next page for additional authors

Authors
A. N. Hafla, S. D. Cash, L. M. M. Surber, J. A. Paterson, A. W. Lenssen, A. L. Todd, and M. Huffman

Proceedings, Western Section, American Society of Animal Science

Vol. 60, 2009

WINTER CEREALS AS A PASTURE-HAY SYSTEM IN MONTANA

A. N. Hafla[1], S. D. Cash[1], L.M.M. Surber[1], J. A. Paterson[1], A. W. Lenssen[2], A. L. Todd[1], M. Huffman[1]
[1]Department of Animal and Range Sciences; Montana State University, Bozeman, MT 59717.
[2]Northern Plains Agricultural Systems Research Unit, USDA-ARS, Sidney, MT 59270.

ABSTRACT: In 2006-2008 'Willow Creek' winter wheat (*Triticum aestivum* L.) and 'Trical 102' triticale (X *Triticosecale* Wttn.) were evaluated, under dryland conditions, for biomass production and forage quality under grazing and haying systems. Grazing enclosures were constructed in uniform sites of the fields. Each enclosure was randomly assigned a treatment (date to be grazed) and a replication (r = 3 in 2006 and 2008, r = 4 in 2007). For the hay-only component, cereals were harvested at the anthesis stage (**A**). For pasture, the cereals were subjected to a single grazing event at three stages of maturity, vegetative (**V**), boot (**B**), and heading (**H**). Ewe lambs grazed plots to approximately 5 cm. Subsequent regrowth was harvested as hay at **A**, and forage yield and quality were measured. Ungrazed forage plots were evaluated for forage yield and quality at each stage of maturity. Hay yields of ungrazed plots at **A** were 4,030 to 13,072 kg/ha for wheat and 8,541 to 12,569 kg/ha for triticale. Grazing wheat at most stages of maturity reduced ($P < 0.05$) subsequent forage yields when regrowth was measured at **A**. Triticale grazed at early **V**, resulted in subsequent forage yields similar to ungrazed triticale ($P > 0.05$), when regrowth was measured at **A**. A single-grazing event of wheat at **V** had available forage yields of 61 to 3,159 kg/ha, and 215 to 601 kg/ha for triticale. Delaying grazing to later stages of maturity resulted in successively greater losses of subsequent forage yield. In a mixed pasture-hay system, total forage availability was impacted by -10 to -29% for wheat and -8 to -28% for triticale, when grazed at **V**. Forage quality was greatest at early **V** and declined throughout maturity. These data indicate that grazing winter cereals in a pasture-hay system at early **V** will maximize total available biomass and forage quality. High forage quality (CP and digestibility) and minimal risk of nitrate toxicity occurred in the mixed pasture-hay system.

Key words: grazing, forage yield, forage quality

Introduction

Livestock producers in Montana are often confronted with the challenge of obtaining affordable feed that provides adequate nutrition to foster animal performance. Annual cereals harvested as hay have become a valuable source of livestock feed and gained popularity as an alternative feed source to traditional hays due to their forage quality and yield (Todd et al., 2007). Cereal forages provide a relatively high protein source for livestock and produce a high total dry matter yield (Stoskopf, 1985).

Winter cereals are rapidly gaining acceptance by producers in Montana as an inexpensive source of livestock hay, and could offer potential as spring pasture. Winter cereals grown in Montana have several advantages when compared to spring seeded cereals. Planting in the fall allows forage harvest to be earlier than spring cereal forage, and can help reduce spring workloads for producers who have livestock and crop enterprises. Additionally, winter cereals generally have greater forage production (Cash et al., 2007). Drake and Orloff (2005) reported that plant stage of maturity at the initiation of clipping affected the amount of subsequent regrowth, under irrigated conditions in intermountain California. No literature is available regarding impacts of livestock grazing on subsequent forage yield of winter cereals in Montana. The objective of this study was to evaluate winter wheat and triticale for biomass production and forage quality under grazing and haying systems, when grown under dryland conditions in Montana.

Materials and Methods

Research Sites and Animals. In a three year grazing study, ewe lambs (*Ovis aries*) were used to evaluate grazing effects on forage yield and quality on plots of winter cereals. Two awnletted, high-yielding cultivars, 'Willow Creek' winter wheat and 'Trical 102' triticale were evaluated. The crops were planted in the fall of the years prior to each study using best management practices for grazing experiments at the Fort Ellis Research and Teaching Farm near Bozeman, MT. Grazing enclosures were constructed in uniform sites of the fields, where wheat and triticale were planted in adjacent strips. Each enclosure was randomly assigned a treatment (date to be grazed) and a replication (r = 3 in 2006 and 2008, r = 4 in 2007). The protocol for this experiment was to subject the crops to a single grazing event at three different growth stages, vegetative (V), boot (B), or heading (H) (Nelson et al., 1998). The first grazing date varied by year, followed by grazing at 14-d intervals to include grazing at B and H. When the ungrazed controls reached anthesis (A), hay harvest occurred. This date varied by year, but is considered to be the forage termination date to preclude excessive soil water depletion in a dryland crop system. Four to eight (depending on forage availability), mixed breed lambs were allowed to graze forage within enclosures to a height of approximately 5 cm, at each date. All experimental animal use was approved by the Montana State University Agricultural Animal Care and Use Committee (MSU-AACUC).

Measurements. Forage biomass was monitored on all treatments throughout the season from V until grain harvest. Total available forage yield was measured by 0.5

m^2 clip samples taken from ungrazed cells at each grazing date and at haying. Clip samples were taken from the inside of plots immediately following grazing to estimate forage utilization at each date. Grazing cell locations were maintained through the season and repeated clip samples were taken from grazed cells at 14-d intervals to evaluate forage regrowth at each grazing date following grazing and at haying. All forage yield estimates were calculated on a DM basis following drying 96 h in a forced air drying oven at 40º C.

Ungrazed forage sampled at each grazing date and at haying were analyzed for forage quality. Forage samples were ground through a 5-mm screen in a Wiley mill and analyzed for 48 h in situ dry matter disappearance (ISDMD) (Van Soest et al., 1991). The unused remainder of each sample was ground through a 1-mm screen and analyzed for CP and nitrate concentration (NO_3-N) (AOAC, 2000).

Statistical Analyses. The experimental design was a completely random design with grazing plots considered the experimental units. Cultivars and grazing treatments (dates) were considered independent variables with forage yield and quality parameters considered dependent variables. Forage biomass and quality variables were analyzed in linear models using ANOVA of Statstix 9.0 software. Means were separated by LSD and considered different at $P < 0.05$.

Results and Discussion

Biomass production. Forage production of ungrazed winter cereals, when measured at forage termination, ranged from 4030 to 13,072 kg/ha for wheat and from 8541 to 12,569 kg/ha for triticale (Table 1). Daily forage dry matter accumulation range from 87 to 246 kg/ha (Table 1). A single grazing event at early V resulted in available forage yields of 61 to 3159 kg/ha for winter wheat and 215 to 601 kg/ha for triticale. Winter wheat grazed at most stages of maturity experienced reduced ($P < 0.05$) forage yields when regrowth was measured at the forage termination date (Table 1). When grazing wheat was delayed until B, forage regrowth was significantly reduced by 48 to 86% when measured at the forage termination date. Triticale grazed at early V had similar ($P > 0.05$) forage yields when regrowth was measured at the forage termination date (Table 1). When triticale was grazed at H, regrowth biomass was reduced by 86 to 92%, when measured at the forage termination date. These results are consistent with Drake and Orloff (2005), who reported that a single clipping event of Trical 102 triticale, occurring at V, produced forage regrowth yield similar ($P < 0.05$) to triticale than had not been clipped. When clipping was delayed to B, forage yield of regrowth was reduced 20% when compared to unclipped triticale (Drake and Orloff, 2005). Delaying grazing of winter cereals to later dates of maturity resulted in successively greater losses in regrowth forage yield.

Total forage biomass in a mixed pasture-hay system ranged from 2865 to 11825 kg/ha for wheat and 6964 to 7502 kg/ha for triticale, when crops were grazed at early V (data not presented). Total forage biomass produced by the pasture hay system was reduced significantly ($P < 0.05$) when grazing was delayed beyond V. When grazing occurred at early V, total biomass production of winter wheat was impacted by -10 to -29%. Total biomass production of triticale was impacted by -8 to -28% when grazed at early V. Grazing winter wheat at B impacted total biomass production of the pasture-hay system by -37 to -51% (data not presented). Similarly, grazing triticale at H impacted the total biomass production by -43 to -47% (data not shown). Data indicate that winter cereals grazed at early V suffer minimal impacts on total forage biomass in a mixed pasture hay system.

Forage Quality and Nitrate Concentration. Digestibility and CP concentrations were highest ($P < 0.05$) at early V, and decreased with maturity (Figures 1 and 2). Cash et al. (2002) recommends that forages with NO_3-N values of 0.2260% and higher be restricted as feed. In 2008, NO_3-N concentrations were between 0.2340 to 0.2434% during the first three dates measured (154 d, 168 d, and 182 d), and then dropped to safe levels at the forage termination date (Figure 2). In 2006 and 2007, NO_3-N concentrations were found to be safe at all dates. Nitrate accumulation is a common problem of cereal forages in Montana, and can affect the feeding value of forages.

Conclusions. These data indicate that grazing winter cereals in a pasture-hay system at early V will maximize total available biomass and forage quality. Digestibility and CP of winter cereals at V was excellent. It will be necessary for livestock producers to consider available biomass, value or pasture and hay, and forage quality and NO_3-N concentrations when using winter cereals in a mixed pasture-hay system in Montana.

Acknowledgments

We would like to thank the Montana Sheep Institute at Montana State University and the Four-State Ruminant Consortium for partial funding this project.

Literature Cited

AOAC. 2000. Official Methods of Analysis (17th Ed.). Association of Official Analytical Chemists, Gaithersburg, MD.

Cash, S. D., R. Funston, M. King, D. Wichman. 2002. Nitrate toxicity of Montana forages. Mont. St. Univ. Ext.Serv.Available: http://www.animalrangeextension.montana.edu/articles/forage /General/Nitrate-tox.htm. Accessed Aug. 17, 2007.

Drake, D. J., and Orloff, S. B. 2005. Simulated grazing effects on triticale forage yield. Plant Management Network. Available: http://www.plantmanagementnetwork.org/pub/fg/research/2005/triticale/. Accessed Aug. 19, 2008.

Nelson, J. E., K. D. Kephart, A. Bauer, and J. F. Connor. 1988. Growth Staging of wheat, barley, and wild oat. Mt. Ext. Serv. Miscellaneous Bulletin # 4387.

Todd, A. L., L. M. M. Surber, S. D. Cash, M. M. Stamm, C. S. Shauer, and M. M. Thompson. 2007. Backgrounding calves with annual forage crops. Proc. West. Sect. Am. Soc. Anim. Sci. 58:344-347.

Table 1. Forage biomass and regrowth of winter cereals following grazing in a dryland crop system in Montana, 2006 - 2008.

Year, crop and treatment	Date measured (Julian date)						
2006	139 d	153 d	167 d	186 d[†]		Slope	R^2
Wheat	DM, kg/ha						
Control, ungrazed	61	280[c]	1537[c]	4030[b]		86.8	0.91
Regrowth when grazed at early V (139 d)		125[c]	708[d]	2804[c]		82.9	0.95
Regrowth when grazed at V (153 d)			271[d]	1873[d]			
Regrowth when grazed at B (167 d)				1008[e]			
Triticale							
Control, ungrazed	215	1073[a]	3344[a]	8541[a]		179.5	0.93
Regrowth when grazed at early V (139 d)		621[b]	2281[b]	6749[a]		188.5	0.97
Regrowth when grazed at V (153 d)			364[d]	2909[c]			
Regrowth when grazed af H (167 d)				1224[e]			
P, wheat vs. triticale	*0.1531*	*0.0002*	*0.0000*	*0.0000*			
P, crop x treatment	-	*0.8626*	*0.0388*	*0.0072*			
2007	151 d	165 d	179 d	194 d[†]		Slope	R^2
Wheat	DM, kg/ha						
Control, ungrazed	3159	4063[a]	9682[a]	13072[a]		247.5	0.94
Regrowth when grazed at early V (151 d)		1535[b]	4381[b]	8666[b]		246.4	0.99
Regrowth when grazed at B (165 d)			1591[c]	1875[d]			
Regrowth when grazed at H (179 d)				4509[c]			
2008	154 d	168 d	182 d	196 d	210 d[†]	Slope	R^2
Wheat	DM, kg/ha						
Control, ungrazed	1352	2995[a]	4682[ab]	10687[a]	11037[ab]	193.3	0.92
Regrowth when grazed at early V (154 d)		1253[b]	2721[bc]	6478[b]	8386[bc]	179.7	0.97
Regrowth when grazed at B (168 d)			2251[cd]	5326[bc]	5742[c]	124.7	0.84
Regrowth when grazed at H (182 d)				574[d]	830[d]		
Triticale							
Control, ungrazed	601	1717[ab]	5142[a]	9332[a]	12569[a]	225.4	0.97
Regrowth when grazed at early V (154 d)		411[c]	2828[abc]	6901[b]	11447[a]	265.6	0.98
Regrowth when grazed at B (168 d)			1399[d]	4091[c]	6598[c]	185.7	0.99
Regrowth when grazed at H (182 d)				187[d]	983[d]		
P, wheat vs. triticale	*0.0187*	*0.0275*	*0.5103*	*0.0203*	*0.0254*		
P, crop x treatment	-	*0.4979*	*0.3766*	*0.0942*	*0.8177*		

[†] Date of forage harvest for hay was when the ungrazed forage reached the anthesis stage. Mid-July was considered as the target forage termination date in a continuous crop system.

[a, b c, d] Values within a column and year followed by unlike superscript letters differ at $P < 0.05$.

Data transformed by natural log prior to ANOVA; levels of significance and LSD tests were based on transformed data.

Figure 1. Digestibility (%) and crude protein (%) of wheat and triticale, in 2008.

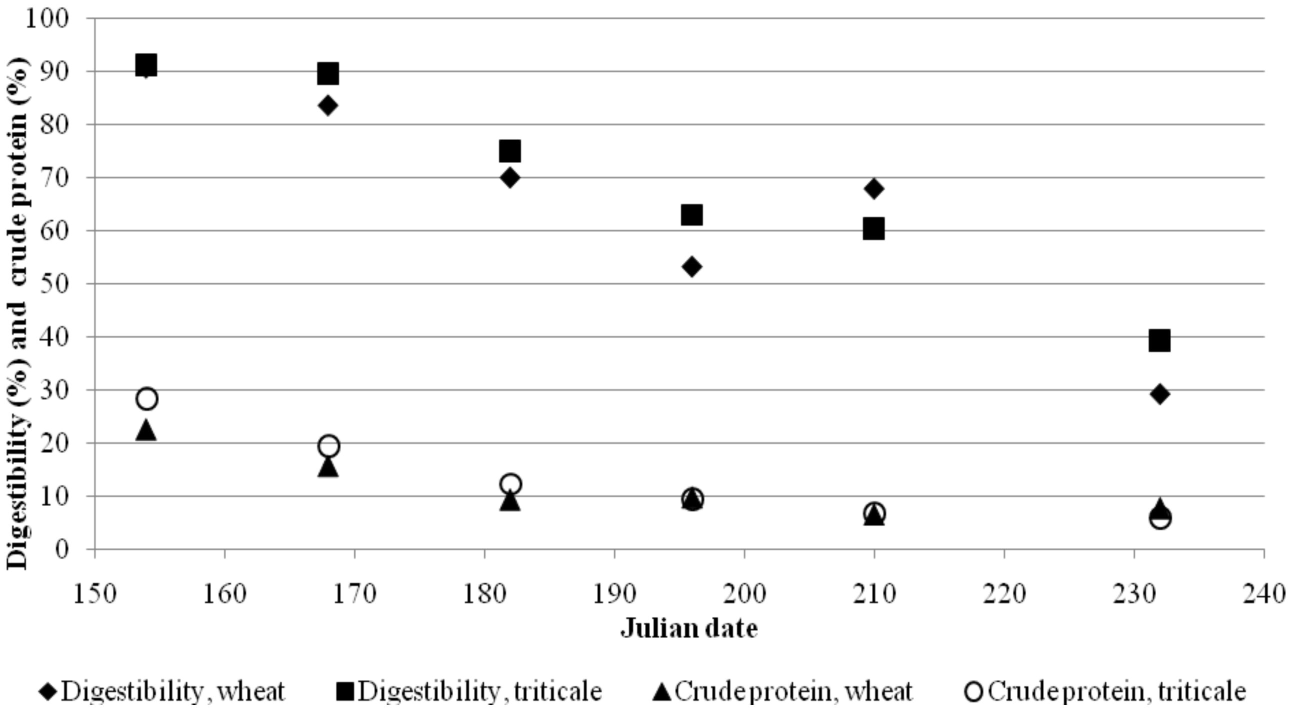

Figure 2. Nitrate concentrations (%) of wheat and triticale, 2006 and 2008.