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Annual Report

FORAGE PRODUCTION AND QUALITY AND NUTRIENT REMOVAL FROM A SMOOTH BROMEGRASS VTA NEAR HOWARD, SD DURING 2007

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Study Area: VTA composed of a sward of smooth bromegrass (*Bromus inermis*) on the John Reisch farm near Howard, SD.

Objectives: The primary objectives are to determine the effect of harvest frequency on forage production, forage quality, and removal of soil nitrogen and phosphorus in the harvested forage. Secondary objectives include determining the effect of harvest frequency on sward and tiller morphology, sward vigor and density, and root and rhizome mass.

Experimental Approach: Experiment I was established in 2005 and was harvested in 2005, 2006, and 2007. Experiment II was established in 2006 and was harvested in 2006 and 2007. Experiments are latin square designs with 4 treatments and 4 replications of 3.1-m x 3.1-m square individual plots. Treatments are: 1) an unharvested control, 2) a single harvest during late June-early July shortly after anthesis at peak standing crop (1-harvest), 3) harvests at peak standing crop and at the end of the growing season (2-harvest), and 4) harvests at peak standing crop, mid-summer, and at the end of the growing season (3-harvest). Experiment I is located about 200 meters southeast of the collection basin at the end of the VTA. Experiment II is located at the beginning of the VTA about 10 meters east of the gated pipe that carries effluent from the collection basin after rainfall events. Plots are harvested at a stubble height of 5 cm with a rotary mower equipped with a bagger. Plot weight forage weights are taken in the field. Forage samples taken in the field are dried at 60° C for 72 hours to determine dry matter concentration for calculation of dry matter forage yield. Data are also collected on stand density, tiller morphology, and root and rhizome mass.

Nitrogen and phosphorus concentrations were determined by standard analytical procedures for each harvest. Crude protein was determined by multiplying percentage nitrogen by 6.25. Nitrogen and phosphorus removal from the soil was determined as the product of nutrient concentration and dry matter yield.

Data Analysis: Data were analyzed separately for each experiment with analysis of variance. Treatment means are separated using Fisher's protected least significant difference (LSD) at P=0.05.

Results and Discussion for 2007

Forage Production and Quality

No significant difference was detected among harvest systems for forage production in Experiment I, with a grand mean of 6.4 Mg DM ha^{-1} (Table 1). These results were in contrast to what occurred in 2005 and 2006. In 2006, the 2- and 3- cut systems produced 8.3 Mg DM ha^{-1} compared with 4.5 Mg DM ha^{-1} for the 1-cut system. This indicated that two consecutive years of 2 or 3 harvests during the growing season weakened the stand. Evidence for this can be seen in Table 2 where the first harvest in 2007 (i.e., 27 June) was 35% higher for the 1-cut system compared with the multiple cut systems.

Table 1. Total dry matter forage production from three harvest treatments for smooth bromegrass on a VTA near Howard, SD during 2007. Experiment I.

Harvest System (number of harvests/growing season)	Harvest Dates	Total Production (Mg DM ha^{-1})
1	27 June	5.99
2	27 June and 2 November	6.08
3	27 June, 31 August, and 2 November	7.17
LSD (0.05)		NS†

†NS, difference between means not significant at P=0.05.

Table 2. Effect of harvest frequency during 2005 and 2006 on biomass production of first harvest during 2007. Experiment I.

Harvest System (number of harvests/growing season)	**Mg DM ha^{-1}**
1	5.99
2	4.65
3	4.15
LSD (0.05)	1.20

Significant differences were found among harvest systems for forage production in Experiment II. The 2- and 3-harvest systems produced 30% more forage than the 1-cut system (Table 3). Mean forage yield, averaged across harvest systems, was 40% higher for Experiment II compared with Experiment I (Tables 1 and 3). This difference in production may be related to proximity to the collection basin, which could affect the amount of runoff water and nutrients received by each Experiment, and thus favor Experiment II. Or, since Experiment II has only been in place for two years compared with three years for Experiment I, the difference may be related to cumulative number of harvests. Data collected during 2008 will provide critical information for determining the long-term impact of harvest systems on stand production and persistence.

As expected, forage production from regrowth during late summer to mid autumn was considerably lower than regrowth during early summer to late summer or early summer to mid autumn for both experiments (Table 4). Little forage accumulation occurred between 31 August and 2 November on stockpiled stands. Cutting in late August did allow for production of a moderate amount of very high quality forage by the end of the growing season (Tables 4 and 5).

Crude protein (CP) concentrations varied significantly for forage accumulated at different times during the growing season. The CP of the first harvest taken at peak standing crop during late June-early July was 13.7% for Experiment I and 15.6% for Experiment II. The CP of regrowth from 27 June/3 July to 31 August and from 31 August to 2 November were about 27% for both experiments. Stockpiling regrowth from 27 June/3 July resulted in slightly lower protein concentration compared with the two shorter regrowth periods (Table 5).

Table 3. Total dry matter forage production from three harvest treatments for smooth bromegrass on a VTA near Howard, SD during 2007. Experiment II.

Harvest System (number of harvests/growing season)	Harvest Dates	Total Production (Mg DM ha^{-1})
1	3 July	7.49
2	3 July and 2 November	9.47
3	3 July, 31 August, and 2 November	10.11
LSD (0.05)		1.83

Table 4. Dry matter forage production of regrowth from the 2- and 3-harvest systems for smooth bromegrass on a VTA near Howard, SD during 2007. Experiments I and II.

Harvest System (number of harvests/growing season)	**Regrowth Period**	**Experiment I** **Mg DM ha^{-1}**	**Experiment II** **Mg DM ha^{-1}**
2	27 June-2 November	1.94	2.40
3	27 June-31 August	1.79	1.91
3	31 August-2 November	0.73	1.29
LSD (0.05)		0.31	0.62

Table 5. Crude protein concentrations for smooth bromegrass forage from different growth periods on a VTA near Howard, SD during 2007. Experiments I and II.

Experiment I		**Experiment II**	
Duration of Growth	Crude protein	Duration of Growth	Crude protein
	g kg^{-1}		g kg^{-1}
Up to 27 June	137	Up to 3 July	156
27 June to 31 Aug.	269	3 July to 31 Aug.	271
27 June to 2 Nov.	230	3 July to 2 Nov.	245
31 Aug. to 2 Nov.	270	31 Aug. to 2 Nov.	273
LSD (0.05)	23		29

Nutrient Removal

Multiple-harvest systems removed significantly more N and P than the single-harvest system in both experiments (Tables 6 and 7). Although there was no significant difference among harvest systems for dry matter forage production in Experiment I, the 2- and 3-cut systems removed more nutrients due to the regrowth harvests having a higher concentration of nutrients than the single harvest taken at peak standing crop during late June.

Table 6. Nutrient removal by 3 different harvest systems for smooth bromegrass on a VTA near Howard, SD during 2007. Experiment I. Data collection began 2005. Location is southeast corner of VTA.

		Kg Removed $Hectare^{-1}$	
Harvest System	Harvest Dates	Nitrogen	Phosphorus
1-cut	27 June	132	13
2-cut	27 June and 2 November	179	17
3-cut	27 June, 31 August, and 2 November	206	16
LSD (0.05)		24	0.6

Table 7. Nutrient removal by 3 different harvest systems for smooth bromegrass on a VTA near Howard, SD during 2007. Experiment II. Data collection began 2006. Location is 10 meters downslope of the gated pipe that carries effluent from the drainage basin.

		Kg Removed $Hectare^{-1}$	
Harvest System	**Harvest Dates**	**Nitrogen**	**Phosphorus**
1-cut	3 July	186	20
2-cut	3 July and 2 November	270	28
3-cut	3 July, 31 August, and 2 November	311	32
LSD (0.05)		43	3.0