PROGRESS REPORT
Plant Responses to Grazing

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Properly managed, Northern Plains rangelands can be maintained at high levels of production and provide forage for livestock, habitat for wildlife and plants, clean air, clean water, open spaces for recreation and sightseeing, and food, fiber, and energy for people. The health and productivity of the prairie ecosystem can be maintained only with management strategies that place grass plant biological requirements and ecosystem processes as the highest priority.

Proper management of rangelands requires an understanding of plant response to grazing. Grass plants developed defoliation resistance mechanisms over 20 million years ago, in response to grazing during the long period of coevolution with early herbivores that are now extinct. A resistance mechanism important for the development of proper management practices is the stimulation of vegetative reproduction by tiller development from axillary buds (Manske 1999). Grazing applied during some phenological growth stages of grasses triggers the adaptive processes, or resistance mechanisms, and therefore has beneficial effects on grass plant growth (Manske 1999). The biological processes and the manipulation of the mechanisms are not completely understood. The goal of this project is to increase the knowledge of this process so that defoliation can be used to stimulate vegetative tillering in grass plants.

Tiller development of grass plants as a response to timing and frequency of grazing has been studied at the South Dakota State University Cottonwood Research Station for twelve years and at the North Dakota State University Dickinson Research Extension Center for nineteen years. A collaborative research project funded by North Dakota State Board of Agricultural Research and Education (SBARE) was conducted at both the Cottonwood Research Station in southwestern South Dakota and the Dickinson Research Extension Center in southwestern North Dakota. This project collected detailed data to evaluate grass plant response to changes in time of defoliation and differences in severity of defoliation. These data will assist in the refinement of grazing management practices so that the biological requirements of the grass plants can be met. Identical defoliation treatments were conducted at the Cottonwood and Dickinson locations. Comparison of data collected at the two study sites enhances the understanding of the relationships between defoliation and grass plant responses in the region, and these data expand the core information previously collected at the respective research stations to allow its application across the entire Northern Plains.

Methods

Identical research trials were conducted at the SDSU Cottonwood Research Station and the NDSU Dickinson Research Extension Center. Three exclosures were established on native rangeland, with 35 microplots located within each exclosure. To isolate each microplot and the grass tillers within it from the surrounding plant community, a 15 cm deep section of 8 cm diameter PVC conduit barrier open at both ends was inserted into the ground. Each western wheatgrass tiller present on the plot establishment date was individually identified with a loop of colored wire that encircled the tiller at the base and distinguished the tiller from the others in the microplot. New tillers were marked in a similar manner as they developed.

Four defoliation treatments, based on actual livestock grazing patterns, and a control of no defoliation were applied during year 1 in each of the three exclosures at both research locations. Seven microplots were randomly assigned to each treatment, and all tillers within a microplot received the same timing and severity of defoliation. Two treatments to determine the effect of time of defoliation were conducted at critical phenological stages of development: 1) before apical meristem elevation (mid May) and 2) during apical meristem elevation (mid June). Two treatments to determine the effects of severity of defoliation were conducted: 1) 25% and 2) 50% removal of current aboveground biomass. The five defoliation treatments were A) no defoliation, control, B) defoliation, mid May-25%, C) defoliation, mid May-50%, D) defoliation, mid June-25%, and E) defoliation, mid June-50%.

Data collection in years 1 and 2 began in early May and continued into fall. During the regular monitoring period, data for each marked tiller were collected weekly the first year and biweekly the second year; data included plant height, phenological growth stage, number of leaves, plant viability (live or dead), and notation of any insect or other damage. New tillers were included in the data set as they developed during the growing season and early fall.

At the end of data collection in year 2, three randomly selected microplots of each treatment in each exclosure were excavated. The PVC barrier isolating the microplot was removed, and the soil was carefully washed from each microplot. Data collected for each marked tiller included number and origin (i.e., location from lead tiller) of crown and rhizome tillers, rhizome length, number and length of rhizome branches, total number of tiller crown nodes, and number of active nodes with axillary bud growth.

Results

The total number of tillers for the defoliation treatments of this study at the Dickinson Research Extension Center is shown in table 1. The number of western wheatgrass tillers on the study sites changed during the two growing seasons as a result of natural grass phenological development and various effects caused by the different defoliation treatments. The total number of tillers at mid season increased from the first year to the second year on all the control treatments and all the defoliation treatments except the mid May-25% and mid June-50% treatments on the 6.0-month seasonlong and 4.5-month seasonlong grazing treatments. During the second season, the mid June-50% defoliation treatment on the respective grazing treatments had the lowest total tiller populations at mid season. The mid May-25%, mid May-50%, and mid June-25% defoliation treatments on the respective grazing treatments had greater total tiller populations at mid season than the control treatments. The mid June-25% defoliation treatment on the twice-over rotation grazing treatment had a greater total tiller population at mid season than the other defoliation treatments on all of the grazing treatments.

Grass tiller development from axillary buds is affected by the timing of defoliation in relation to lead tiller phenological stages and by the severity of defoliation. Certain grazing defoliation treatments stimulate tiller development that results in greater numbers of tillers than on the control treatment with no defoliation.

Literature Cited

Manske, L.L. 1999. Can native prairie be sustained under livestock grazing? p.99-108. in J. Thorpe, T.A. Steeves, and M. Gollop (eds.). Proceedings of the Fifth Prairie Conservation and Endangered Species Conference. Provincial Museum of Alberta. Natural History Occasional Paper No. 24. Edmonton, Alberta.

Table 1. Total number of western wheatgrass tillers per square meter at mid season for five defoliation treatments on three grazing treatments during 2000 and 2001.

		Defoliation Treatments				
Grazing Treatments	**Year**	**Control**	**mid May 25%**	**mid May 50%**	**mid June 25%**	**mid June 50%**
6.0-m Seasonlong	2000	469.9	908.5	908.5	532.5	626.5
	2001	626.5	845.8	1033.8	657.9	563.9
4.5-m Seasonlong	2000	250.6	626.5	313.3	407.2	375.9
	2001	375.9	563.9	438.6	501.2	344.6
4.5-m Twice-over	2000	908.5	939.8	1065.1	1221.7	783.2
	2001	1065.1	1190.4	1159.1	1472.3	908.5