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A Five-Year Study of Fertilization of Extremely Grazed and Moderately Grazed Mixed-Grass Prairie with Slow-Release Phosphorus and Urea

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Introduction

A shortage of available nutrients may be limiting productivity of rangeland in portions of the Northern Great Plains (Lorenz and Rogler 1972). Grazing animals harvest forage each year and remove nitrogen (N) and phosphorus (P) from the system. Over an extended period of time, productivity and species composition of grasslands can be adversely impacted. Increases in demand for forage production to support livestock will require intensive management practices, potentially including range fertilization (Lorenz and Rogler 1972).

Most range fertilization studies in North Dakota have involved fast-release fertilizers such as ammonium nitrate and super-phosphate. With fast-release fertilizers, cool-season graminoids, which dominate Northern Great Plains grasslands, are usually favored and warm-season grasses and most non-weedy forbs decrease in the species composition. The slow-release fertilization study was superimposed on the grazing intensity trial initiated in 1989 on the Central Grasslands Research and Extension Center (CGREC). Slow-release fertilizers were applied to extremely and moderately grazed

pastures with a historic stocking rate of 2.73 and 1.01 AUMs/ac, respectively.

Study Objectives

1. Determine changes in species composition resulting from fertilization with slow-release P and urea on extremely and moderately grazed mixed-grass prairie.
2. Estimate production of cool-season grasses, warm-season grasses, forbs, and shrubs following annual applications of slow-release fertilizer treatments.
3. Examine seasonal uptake of P in selected plant species.
4. Evaluate the plant available soil P levels at depths of 0-6 inches and 6-12 inches.

Methods

The slow-release fertilization project was started in 2000 and will be finished early in 2005. Two sites of 148 ft by 197 ft were blocked, one on the extremely grazed pasture, characterized by having 20% of the standing crop produced remaining at the end of the grazing season, or stocked at a historic average of 2.73 AUMs/ac since 1988; and the second on the moderately grazed pasture characterized by having 50% of the standing crop produced remaining at the end of the grazing season, or stocked at a historic average of 1.01 AUMs/ac since 1988. The study area was fenced to exclude grazing. Annual fertilizer treatments of 24 lb P/ac and 48 lb P/ac were applied on May 1 and June 20, and 33 lb N/ac and 66 lb N/ac applied on June 20. Both the phosphorus and nitrogen fertilizers are slow-release fertilizers encapsulated with a synthetic polymer. This fertilizer is designed to give a steady and uniform nutrient release over a period of time. Treatments were applied using an All Terrain Vehicle (ATV) pulling a Gandy fertilizer spreader calibrated for the treatment rates.

Initial Results

Extremely Grazed Trial

- Forage production among fertilizer treatments did not differ in 2000, 2001, or 2002. Results from 2003 showed higher forage production in the nitrogen applications.
- Forb diversity was lowest on the nitrogen treatments and highest on the control (no fertilizer application).

- Basal cover among fertilizer treatments did not differ in 2000, 2001, or 2002 for cool-season grasses, warm-season grasses, or sedges. In 2003 basal cover of Kentucky bluegrass increased on the nitrogen treatments.
- Seasonal uptake of phosphorus in selected plant species increased with phosphorus applications meeting the minimum phosphorus requirements of a lactating cow longer into the grazing season.

Moderately Grazed Trial

- Forage production among fertilizer treatments did not differ in 2000, 2001, 2002, or 2003.
- Forb diversity was not impacted by fertilization applications; only slight differences occurred.
- Basal cover among fertilizer treatments did not differ in 2000, 2001, 2002, or 2003.
- Seasonal uptake of phosphorus in selected plant species increased with phosphorus applications, meeting the minimum phosphorus requirements of a lactating cow longer into the grazing season.

Initial Conclusions

Low ecological condition of rangeland, as noted by Heady (1975), results from extended periods of overgrazing, early spring grazing, and higher than recommended stocking rates. Low condition ranges have poor soil surface conditions, reduced nutrient levels, and reduced total forage production. The extremely grazed trial has been overgrazed since 1988 and has resulted in different plant communities and lower plant vigor than the moderately grazed trial. With this lower plant vigor, the extremely grazed trial responded more to additional inputs, such as slow-release fertilization. Definite trends were seen in both the extremely grazed and moderately grazed trial. For instance, plant species of selected grasses in both the extremely grazed and moderately grazed trials were deficient in phosphorus for the majority of the grazing season. With the slow- release phosphorus applications, phosphorus levels increased to a level that meets the need of a 1,200 pound lactating cow longer into the grazing season. Species diversity also seems to be affected by slow-release fertilization. The species diversity on the slow-release urea treatment is decreasing and an increase in introduced grasses, such as Kentucky bluegrass and smooth bromegrass is occurring. This change in species diversity due to slow-release fertilization is the same response that is reported with fast-release nitrogen fertilizers. There is more data analysis to come. Complete results and statistical analysis will be available spring of 2005.