Ley Farming: A Systems Approach To Integrating Crop and Livestock Enterprises

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Research Summary

Integrating crop and livestock enterprises can enhance the economic and environmental sustainability of agricultural production in the Great Plains. The development of ley farming, where wheat (*Triticum aestivum*) and legume pasture are rotated, created biological and economic synergies between crops and livestock enterprises in Australia. This 2-yr project will determine the potential for adoption of ley farming in Montana, North Dakota, South Dakota, and Wyoming. Field experiments were established successfully in all four states in the fall of 2004 and the spring of 2005. Plant stand and forage yield data were collected in 2005, and again will be in 2006. Analyses and interpretation of data will be completed after the second year of field experiments in 2006.

Introduction

The region encompassed by the Four State Ruminant Consortium (4-SRC) resides within the northern Great Plains, a vast area that includes about 8 million hectares of cultivated hay and pasture land. A large portion of the region also is devoted to dryland production of grain and seed crops. Although both crop and livestock enterprises are widespread across the region, less than 10% of agricultural land is dedicated to integrated crop-livestock systems. The lack of integrated crop and livestock enterprises prevents benefits in environmental quality, economic diversity, and pest management from occurring.

Integrated crop-livestock systems have been developed as a response to the environmental degradation and poor economic returns that result from single enterprise systems (i.e., crops or livestock), although not in the region encompassed by the 4-SRC. In ley farming, wheat is rotated with legume pastures to form flexible agricultural systems. Ley farming offers advantages compared with crop production systems that exclude a legume pasture phase, including more profitable wheat production, high-quality livestock forage, integrated pest management with a break to pest and disease life cycles and weed suppression, reduced fertilizer inputs and improved air and water quality, soil conservation, and the potential global benefit of C-sequestration as related to the higher primary productivity of ley farming.

The PI and two co-PIs of the grant proposal have been working with farmers and ranchers in North Dakota and Wyoming to identify legume species for use as dryland pasture in rotation with wheat since the mid-1990s. Limitations in what is known about best management practices have been identified. This project is designed to develop strategies that optimize performance of legume species in a ley farming system by meeting four objectives: (1) identify legumes suited for self-regenerating pasture in short rotations with wheat and other grain crops in the region encompassed by the 4-SRC; (2) develop methods for establishing and maintaining productive, high-quality legume pasture that can be used in ley farming systems; (3) demonstrate the benefits of ley farming on wheat yield and grain quality as well as livestock performance compared with wheat production systems which do not include a legume pasture phase and livestock grazing systems that exclude grain and seed crops; (4) determine the economic costs/benefits generated from ley farming compared with grain-only and livestock-only systems. An outcome of this project will be the development of a ley farming working group that includes a web-based interactive forum for crop and livestock producers, researchers, and others interested in integrated crop-livestock systems.

Materials and Methods

Four studies are included in the project to meet the objectives. A *Legume species adaptation study (Objective 1)* includes field experiments in

Montana, North Dakota, South Dakota, and Wyoming where four fall-seeded species (rigid medic, Austrian winter pea, hairy vetch, and wooly pod vetch) and three spring-seeded species [birdsfoot trefoil (two cultivars), white annual sweetclover, and alfalfa] are being compared for vegetative and reproductive growth traits in each of two yr, beginning in 2005. Vegetative and reproductive growth of rigid medic and birdsfoot trefoil are being compared in a *Tillage and seeding method study (Objective 2)* that encompasses field experiments at the same four locations over the same 2-yr period as field experiments included in the *Legume species adaptation study*. Four legume species (alfalfa, annual sweetclover, birdsfoot trefoil, and rigid medic) are being compared in a *legume pasture preference study (Objectives 1, 3)* in field experiments located near Dickinson, ND. The legume treatments were established in April 2005. A ley farming system (wheat-birdsfoot trefoil pasture) has been established in 1-ha paddocks along with a wheat-pea grain production system and a wheat-alfalfa system in a *Ley farming grazing study (Objectives 3 and 4)* at the NDSU Dickinson Research Extension Center in southwestern North Dakota. Preliminary results of this project will be maintained on the NDSU Dickinson Research Extension Center's web page, with a direct link on the home page or indirectly from both the Agronomy and Beef icons at the web site, as they become available. A working group of researchers, extension service personnel, and commercial producers has formed during development of this project.

Results and Discussion

Legume treatments were established during September 2004 (fall-seeded treatments) and during April and May 2005 (spring-seeded treatments) in all field experiments included in the study. Plant stands were evaluated by counting seedlings in November (fall-seeded treatments) and/or May and June (fall- and spring-seeded treatments) in the small-plot studies (*Legume species adaptation* and *Tillage and seeding method studies*) and the *legume pasture preference study*. Excellent winter survival was demonstrated by rigid medic and other fall-seeded legume species at the Wyoming site, while these same species winterkilled at other locations. Spring-seeded legume treatments were established successfully at all locations, probably because greater-than-average amounts of precipitation were received in May and seedbed moisture levels favored germination at all locations. Forage yields were determined and will be reported once the 2-yr project is completed.