Improving Profitability and Resource Efficiency of Conventional and Alternative Crops With Legume Pasture in Western North Dakota

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Research Summary

Negative economic returns are generated by many alternative and conventional crops grown for grain and seed in western North Dakota. Our overall objective is to determine if incorporating a legume pasture phase into rotations with grain and seed crops can enhance profitability of grain and seed crop production. Our short-term objectives are to: (i) identify legume species with potential as 1- or 2-yr pasture crops in rotation with hard red spring wheat (*Triticum aestivum*), and (ii) determine livestock performance on legume pasture in a wheat-pasture crop sequence. Cultivars of 30 different legume species were seeded in 2000 and evaluated for the ability to reseed naturally in 2001. Cultivars were evaluated at a second site in 2001 and the ability to reseed was determined in 2002. Species with the greatest ability to reseed across both years included balansa clover (*Trifolium balansae*), black medic (*Medicago lupulina*), birdsfoot trefoil (*Lotus corniculatus*), crimson clover (*T. incarnatum*), Persian clover (*T. resupinatum*), and red clover (*T. pratense*). Between 22 and 73 seedlings ft^{-2} became established from seed produced the previous year, depending on the legume species. Birdsfoot trefoil produced 0.9 tons dry matter (DM) $acre^{-1}$ and red clover produced 0.8 tons DM $acre^{-1}$ during the year following the establishment year. The other four legume species produced <0.4 tons DM $acre^{-1}$. By comparison, overwintering alfalfa (*Medicago sativa* and *M. sativa* subsp. *falcata*) produced an average of 1.8 tons DM $acre^{-1}$. These preliminary results suggest that birdsfoot trefoil may have potential as pasture in a rotation with wheat. Alfalfa and black medic were seeded in 2.5-acre paddocks in 2002 to assess the potential of both legume species for pasture in a separate study. Dry conditions following seeding resulted in poor establishment of alfalfa and particularly black medic plots, and developing legume plants were unable to suppress weeds. Only limited grazing of alfalfa and medic paddocks occurred.

Introduction

Economic returns presently are negative for most alternative and conventional crops grown for grain or seed. Novel production and marketing strategies are needed to make alternative and conventional crops profitable when grown in western North Dakota. Such systems exist in similar regions outside of the USA. It has been known in Australia for decades that rotating legume pasture with wheat enhances grain production while reducing input costs compared with rotations that exclude legume pasture (Donald, 1981).

Legume species were considered as a replacement for summerfallow in North Dakota in the late 1980s and 1990s (Gardner et al., 1992). The objective of this project wis to identify legume species that are suited best to pasture-based cropping systems in the Great Plains, and develop the management strategies for these systems.

Materials and Methods

Thirty-six legume cultivars representing 30 different species were established in plots arranged in an RCB design with treatments replicated three times in 2000. Plots were left undisturbed and seedlings counted in 2001 to determine how many plants regenerated naturally from seed produced in 2000. A second field experiment was established in 2001 and seedlings counted in 2002.

Results and Discussion

Legume species most capable of reseeding (seedlings counted ft^{-2}) across both years included black medic (73), crimson clover (64), Persian clover (38), balansa clover (33), red clover (26), and birdsfoot trefoil (22). Berseem clover (*T. alexandrium*) also reseeded (18), but at levels slightly below the 20 plants ft^{-2} threshold considered necessary for maintenance of productive legume pasture in wheat-pasture rotational systems used successfully in Australia.

Forage was harvested to the soil surface manually in a 5.3-ft^2 area within each plot and DM production determined for the six legume species capable of reseeding naturally, along with berseem clover. Dry matter production was 1.2 tons $acre^{-1}$ for birdsfoot trefoil and 1.5 tons $acre^{-1}$ for red clover across both years. Forage yield was 0.9 tons $acre^{-1}$ for birdsfoot trefoil and 0.8 tons $acre^{-1}$ for red clover when forage was harvested to a 2.5-in stubble height with a small-plot forage harvester in each plot. Dry matter production of the other five legume species was < 0.4 tons $acre^{-1}$ whether harvested manually or mechanically. By comparison, DM production for alfalfa averaged 2.5 tons $acre^{-1}$ when harvested manually, and 1.8 tons $acre^{-1}$ when harvested mechanically.

An undetermined proportion of the DM yield in birdsfoot trefoil and red clover plots was produced by overwintering plants, although plants that grew from seed produced the previous year also contributed to DM yield. Conversely, DM production by alfalfa resulted exclusively from overwintering plants, since few if any plants developing from seed were observed after the establishment year.

Forage quality for both birdsfoot trefoil and red clover was superior to the forage quality of alfalfa across both years. Crude protein was 2% more concentrated in birdsfoot trefoil compared with alfalfa forage, and 3% more concentrated in red clover compared with alfalfa forage. Conversely, acid detergent fiber concentration was 6%[1] lower for birdfoot trefoil forage and 3% for red clover forage compared with alfalfa forage, and neutral detergent fiber concentration was 8% lower for birdsfoot trefoil forage and 6% lower for red clover forage.

Alfalfa and black medic each were seeded in 1-ha paddocks in a separate grazing study. The paddocks were arranged in an RCB design with treatments replicated three times. Poor establishment of alfalfa and particularly black medic plants occurred in 2002 because of dry conditions that developed after seeding. The legume plants were unable to suppress the growth of annual grass and broadleaf weeds and infestations developed in many paddocks. Only limited grazing during the growing season occurred because of poor growth of legume pasture crops. A comparison of the effects of advancing season on the nutrient quality was conducted in alfalfa paddocks where weed infestations were limited. Results of this study will be presented at the annual midwestern meeting of the American Society of Animal Science.

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