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

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This material is based upon work supported by the Cooperative State Research, Education and Extension Service, U.S. Department of Agriculture, under Agreement No. 2001-34216-10563. All opinions, findings, conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.

Research Summary

Many alternative and conventional crops generate negative returns when grown for grain or seed in western North Dakota. Our overall objective is to determine if incorporating pasture legumes into rotations with grain and seed crops can enhance profitability of alternative and conventional crops. Our short-term objective is to identify legume species with potential as 1- or 2-yr pasture crops in rotation with hard red spring wheat (*Triticum aestivum*). Cultivars of 30 different legume species were seeded in 2000 and evaluated for the ability to reseed naturally in 2001. Species with the greatest ability to reseed included balansa clover (*Trifolium balansae*), black medic (*Medicago lupulina*), burr medic (M. minima), crimson clover (*T. incarnatum*), Persian clover (*T. resupinatum*), and red clover (*T. pratense*). Between 120 and 890 seedlings m^{-2} became established from seed produced in 2000, depending on the species. However, these five species produced less than 2 Mg dry matter (DM) ha^{-1} when harvested at the early-flowering stage. By comparison, overwintering alfalfa (*Medicago sativa* and *M. sativa* subsp. *falcata*) and sweetclover (*Melilotus alba* and *M. officinalis*) produced up to almost 10 and 6 Mg DM ha^{-1}, respectively. Alsike clover (*T. hybridum*), Kura clover (*T. ambiguum*), cicer milkvetch (*Astragalus cicer*), and sainfoin (*Onobruchis viciifolia*) produced more DM (mean = 3.8 Mg ha^{-1}) than the reseeding species and also superior-quality forage compared with alfalfa and sweetclover. These preliminary results suggest that forage legume alternatives to alfalfa and sweetclover exist for use in pasture-based

cropping systems.

Introduction

Economic returns were negative for most alternative and conventional crops grown for grain or seed during the late-1990s. For example, hard red spring wheat generated average net returns of $-6.57/acre in 1999 on cash-rented land, as reported in the ND Farm and Ranch Business Management Annual Report for Region 4 (western North Dakota). Similarly, durum generated $-5.79/acre, barley generated $-7.75/acre, and oats generated $-6.47/acre. Among alternative crops, canola generated $-6.25/acre, field peas generated $-16.77/acre, and sunflowers generated $-23.72/acre.

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). Data collected recently at Hettinger seem to corroborate a similar impact of legume pasture on alternative and conventional crops grown for grain or seed in North Dakota (T. Faller, personal communication, 2000).

Many legume species were considered as a replacement for summerfallow in North Dakota in the late 1980s and 1990s (Badaruddin and Meyers, 1990; Gardner et al., 1992). Legume species were identified that can be used as cover or green manure crops. However, income is not generated directly while cover or green manure crops are grown, so there has been a hesitancy of incorporating cover or green manure crops in crop rotations. The objective of this study is 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. Development of these systems will enhance the economic and environmental sustainability of cropping systems by reducing inputs of N-fertilizer, providing weed control benefits, and producing a readily marketable, value-added commodity (i.e., meat). Using legumes for forage also will offer producers with an income-generating alternative to the use of legumes as cover or green manure crops.

Materials and Methods

Thirty-six legume cultivars representing 30 different species were established in plots arranged in a RCB with treatments replicated three times in 2000. Most legume cultivars produced seed, including some cultivars of perennial species (e.g., birdsfoot trefoil [*Lotus corniculatus*]). Plots were left undisturbed to determine how many plants regenerated naturally in 2001 from seed produced in 2000. Seedlings were counted within each plot in 2001 and forage was harvested within each plot and yield determined for all 36 legume cultivars.

Results and Discussion

Legume species most capable of reseeding (seedlings counted m^{-2}) included black medic (870), Persian clover (380), balansa clover

(265), red clover (193), crimson clover (132), and burr medic (120). Both berseem clover (T. alexandrium) (91) and snail medic (M. scutellata) (65) reseeded to a limited extent. Fewer than 50 seedlings m^{-2} were established in the plots of other entries.

Dry matter yield ranged from <0.01 Mg ha^{-1} for Austrian winter pea (*Pisum sativum* subsp. *arvense*), barrel medic (*M. truncatula*), and *M. rigulata* (SA10344), to almost 10 Mg ha^{-1} for alfalfa (cv. Travois and Yellowhead). Dry matter yield for the reseeding legume species generally was between 0.5 and 1 Mg ha^{-1}, except for red clover. Almost 4 Mg DM ha^{-1} was produced by red clover, but most of this was produced by plants that overwintered and not from plants that became established in 2001from seed produced in 2000.

Forage harvest for quality analyses was delayed to maximize dry matter production. Still, forage quality could not be determined for 21 legume cultivars because of very low DM yields. Fifteen cultivars representing nine different species produced enough DM for forage quality to be determined. These 15 cultivars included alfalfa (seven cultivars and two subspecies), alsike clover (one cultivar), birdfoot trefoil (one cultivar), cicer milkvetch (one cultivar), kura clover (one cultivar), red clover (one cultivar), sainfoin (one cultivar), and sweetclover (two cultivars and two species). Crude protein concentration ranged from 10% for yellow-flowered sweetclover to 22% for alsike clover. Other legume species producing forage with relatively high-protein content included birdfoot trefoil (17%), cicer milkvetch (19%), kura clover (19%), and red clover (18%). Legume species producing forage with lowest acid-detergent fiber percentages included alsike clover (33%), cicer milkvetch (35%), kura clover (30%), and sainfoin (35%), while those with relatively low neutral-detergent fiber percentages included alsike clover (34%), cicer milkvetch (37%), and kura clover.

Alfalfa was established in replicated and randomized 1-ha paddocks in a separate grazing study. Both crop and livestock data will be collected, beginning in 2002.

Site visits were made by 40 Harvest States Cooperative members on 25 June, 35 crop producers on 11 July, and 10 organic crop producers on 30 July. The project also was discussed with 35 crop producers on 16 July near Glen Ullin, ND, with 30 producers on July 18 near Hannover, ND, and with 8 crop producers on 1 August near Beulah, ND. Preliminary results from the project were presented at the eighteenth annual western Dakota crops to 80 crop and livestock producers on 20 December at Hettinger, ND.

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