2002 Annual Report

Beef Section

Dickinson Research Extension Center
1089 State Avenue
Dickinson, ND 58601

Expanding annual forage production and use in the Northern Great Plains

Woodrow W. Poland and Patrick Carr
Dickinson R/E Center

The intent of this project is to further identify factors that may be used to increase the value (quality and/or quantity) of forages produced in the Northern Great Plains. Results obtained should provide crop and livestock producers information necessary for matching forage production with marketing/use objectives. In areas where hay is marketed on a quality basis, increasing forage quality could translate into increased economic value per unit. Livestock can be used to convert higher-quality forage into economic value in the absence of an active hay market. Conversely, beef cows producers should be able to merge production and quality criteria to reduce the overall costs of providing harvested winter feeds.

Introduction

Economists at North Dakota State University projected dismal economic returns for many annual crops in southwestern North Dakota in 2001. Economic reality suggests that new production and marketing methods are needed for annual crops to be grown profitably in southwestern ND. Preliminary data indicate that forage production from annual crops has the potential of generating greater returns per acre than traditional grain production.

Cost associated with winter feeding the cow herd is a major expense associated with cow/calf operations in ND. Procurement and feeding of harvested forages account for a large portion of this total expense. Forage production systems developed to minimize unit costs of production and extend periods of time when higher quality forages are available could substantially lower overall operating costs of beef production. Reducing overall costs of production while maintaining productivity should provide an opportunity to increase the profitability of cow/calf enterprises.

Optimizing forage production and use requires a careful balance between forage production and quality. This project is designed to complement and expand upon the existing data on forage production in southwestern ND. Specific objectives will address 1) if forage

production can be enhanced by interseeding winter and spring cereals, 2) if annual forages are superior to perennial grasses for forage production, and 3) current forage management and production parameters to assess where improvements can realistically occur.

Brief literature review

Small-grains are popular annual forages in the Great Plains. According to the 1997 Census of Agriculture, small-grains were harvested for forage from 686,606 ac across Montana, North Dakota, and South Dakota (USDA, 1999).

Oat is the most popular, cool-season, annual forage grown in the Great Plains, particularly in the northern tier states of the USA. For example, oat comprised approximately 80% of the small-grain area devoted to hay production in 1997 in North Dakota (E. Stabenow, 2000, per. comm.). The remaining area consisted of barley (14%) and other (e.g. rye, wheat) small-grain crops. Oat comprised approximately 90% of small-grain hay production in South Dakota, and almost 50% in Montana. These data demonstrate the popularity of oat among small-grain crops when grown for forage.

Research indicates that barley produces higher-quality forage compared with oat in sub-humid regions. Barley had greater nutritive value than oat, triticale, and wheat in Minnesota (Cherney and Martin, 1982a). Barley forage was highest in digestible dry matter and lowest in acid detergent fiber concentrations. Crude protein (CP) concentration of barley forage was 16 g kg^{-1} greater than oat forage.

The superior quality of barley forage compared with oat and other small-grain forages probably results from a greater proportion of dry matter consisting of the inflorescence in barley. Over 25% of the dry matter of barley forage consisted of inflorescence compared with 20% for oat, triticale, and wheat forage across six maturity stages (Cherney and Marten, 1982b). The inflorescence is more digestible and nutritious than other plant components. The leaf blade and sheath of barley also had a lower percentage lignified area than did oat.

The CP concentration of barley and barley-pea forage has been shown to be superior to that of oat and oat-pea forage in a study at Dickinson, ND (Carr et al., 1998). Additional small-grain quality data have been compared in sub-humid regions (Cherney and Marten, 1982b), but not in the Great Plains. Factors in addition to CP concentration are important in determining the nutritive and economic value of forage, so energy, digestibility, and mineral data are needed for comparisons among annual crops grown for forage in the Northern Great Plains.

Barley forage yield has been equal or superior to forage yield of oat in sub-humid regions, whether grown alone (Cherney et al., 1982a) or with pea as a companion crop for alfalfa (Medicago sativa L.) establishment (Chapko et al., 1991). Barley forage yield has been inconsistent compared with oat in the Great Plains. 'Dumont' and 'Magnum' oat were superior to 'Bowman' and 'Horsford' barley for yield when the cultivars were grown alone and in combination with field pea in 1993 and 1994 (Carr et al., 1998). However, differences in yield between 'Chopper', 'Haybet', and 'B 7518' barley cultivars and Dumont oat did not exist in a subsequent study (Carr et al., 1996). These data indicate that cultivar selection impacts forage yield. Additional research is needed to determine the forage potential of barley and oat in the Great Plains. This is particularly true at the producer level.

Typical nutritional summaries (e.g. NRC, 1984) of hays that are fed to livestock are reported in table 1. These data would not suggest a quality advantage to small grain forage compared to perennial sources of hay. Recent data collected at the Dickinson R/E Center suggest that the quality of small grain forage is as good or better than "book values" and can be improved with proper management (e.g. seeding rates, cultivar and varietal selection, physiological stage at harvest). Thus, the potential of small grain crops to produce forage in the Northern Great Plains may not be completely appreciated.

An assessment of typical yield and composition among small grain forages and between annual and perennial forages at the producer level has not been done. This type of comparison is needed to determine the current state of affairs in forage production. This assessment would also provide clues as to where substantial improvements in forage yield and/or quality can be made.

This project will include experiments where 1) winter and spring cereals are intercropped in an attempt to increase forage yield and extend the period when higher quality forage is available for harvest and 2) annual and perennial forage production are compared under experimental and field conditions. Results of these experiments will be used to identify crops that are the best adapted and most profitable for forage production in the Northern Great Plains.

Procedures

Winter-spring cereals. A spring barley (*Hordeum vulgare*), oat (*Avena sativa*) and triticale (X *Tritiosecale*) cultivar was seeded in monoculture and with a winter rye (*Secale cereale*), triticale or wheat (*Triticum aestivum*) at the NDSU Dickinson R/E Center in 2001. These same treatments will be repeated in the spring of 2002. The treatments were arranged in a randomized complete block design (RCBD) with each treatment represented in each of four (4) blocks. Acceptable agronomic procedures reflecting local climatic and edaphic conditions will be used to initiate and manage the study. Weeds and other pests will be controlled, as needed.

Forage will be harvested in plots when spring cereal cultivars are at the early heading to soft dough stages of development. Plots will be harvested again in mid- to late-September of the seeding year, and in mid- to late-May of the following year. A North Dakota Automated Weather Network station located within .5 km of the study area will be used to determine growing-degree-days for wheat that coincide with specific harvest dates.

Forage yield will be determined by harvesting 4.6-m^2 area from the center of each plot and recording fresh weight. A subsample of approximately 900 g will be randomly selected from the harvested portion of each plot. Forage samples will be dried at 50C until a constant weight is attained. Dry matter percentage of harvested material will be determined. Forage crude protein (CP) and acid- and neutral-detergent fiber (ADF and NDF, respectively) concentrations will be determined by a commercial chemical laboratory using standard procedures (AOAC, 1990) from three randomly selected blocks.

Annual/perennial grasses. Five (5) perennial grasses plots were established in the spring of 2000. Entries included crested wheatgrass (*Agropyron desertorum*), western wheatgrass (*Pascopyrum smithii*), perennial rye (*Lolium perenne*), Russian wildrye (*Psathyrostachys juncea*), and meadow bromegrass (*Bromos riparius*). Plots of spring barley and oat were also included as annual forages. The treatments

were arranged in a randomized complete block design (RCBD) with each treatment represented in each of four (4) blocks. Acceptable agronomic procedures reflecting local climatic and edaphic conditions were used to initiate and manage the study. Weeds and other pests will be controlled, as needed. Plots of western wheatgrass did not adequately establish and were subsequently dropped from the study.

In 2002 and 2003, forage will be harvested when plots are at approximately 50% heading. Any regrowth in plots will be harvested again at the same stage of physiological development. Forage yield and composition will be determined similarly to that described in previous study.

Forage survey. A management and production survey of annual forages in southwestern ND will be conducted. A maximum of one hundred-fifty (150) forage samples will be collected from producers in each of two years (2002 and 2003). County extension agents will be utilized in locating participating producers. A goal of the project will be to collect hay samples from 100 annual forages (70 oat or barley and 30 others) and 50 perennial forages (25 grass and 25 mixed grass/alfalfa).

Forage samples will be collected in late summer and early fall and results used in helping producers development specific winter feeding programs. Producers will be asked to cover a portion of the analytical costs (approximately $5/sample). When submitting each sample, producers will be asked to complete a questionnaire. The questionnaire will address agronomic (e.g. seeding rates, fertilization practices, development stage with harvested) and production (e.g. yield) issues related to that particular sample. Forage samples will be analyzed for DM, CP, ADF, NDF and Ca and P using standard procedures (AOAC, 1990) in a commercial laboratory.

Summarization of questionnaire will provide a basis from which to describe typical forage production practices in southwestern ND. Forage quality and yield data will be used to compare the potential of annual and perennial forages as feed sources for beef cattle at the producer level. Results will be used to identify strengths and limitations of annual forage production.

Results and Discussion

This is a newly funded 2-yr project that will be initiated in the summer of 2002. Final data collected in fall 2003. A final report should be available in spring 2004.

Literature cited

References available upon request.

Table 1. Nutritional composition (% dry matter) of common forages.

Forage	TDN	Crude Protein	Calcium	Phosphorus

Perennial				
Alfalfa	50-60	13-18	1.1-1.4	.18-.22
Brome	55-60	10-16	.29-.32	.28-.37
Crested Wheatgrass	53	12.4	.33	.21
Annual				
Oat	55	9.3	.24	.22
Barley	56	8.7	.23	.26
Wheat	58	8.5	.15	.20

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