Complementary Rotation Grazing System in Western North Dakota

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Complementary grazing uses domesticated grass, legume, or annual crop pastures to add to or complement native range pastures. Management of native range and domesticated grass pastures must be based on sound ecological principles that consider the growth and development of the dominant species and the physiological needs, weaknesses and strengths of the plants to maintain productive stands. The nutritional needs of the livestock must be included in management considerations. Sound management recommendations can only be based on reliable scientific research.

Many research projects have contributed to the process of developing the complementary rotation grazing system at the Dickinson Experiment Station. Each successive step in this process has been built on previous work. Research on domesticated grass and use of domesticated grass pastures has been conducted at the Dickinson Experiment Station since 1907 (Waldron, 1908). Crested wheatgrass has been included in studies since 1920 (Moomaw, 1922). Grazing studies on crested wheatgrass have ben conducted since 1955 (Whitman et al., 1963). Grazing research on complementary systems has been conducted since 1972 using steers (Nyren et al., 1983) and since 1978 using cow-calf pairs (Manske et al., 1984). The process of developing a three or four-pasture, twice over rotation grazing system on native range has been a joint effort over a long period of time. The data was collected from 1974 to 1980 on the Sheyenne National Grasslands, from 1982 to present at the Dickinson Experiment Station and from 1983 to present at the Central Grasslands Research Station.

GENERAL PROCEDURES

The present complementary rotation grazing system (Fig. 1) has been in place at the ranch headquarters of the Dickinson Experiment Station since 1983. It consists of a crested wheatgrass (*Agropyron desertorum*) pasture for spring grazing and an altai wildrye (*Elymus angustus*) pasture for fall and early winter grazing. Native range has been grazed during the summer and managed with a three-pasture, twice over rotation system.

The purpose of the trial is to maximize herbage and livestock production for a cow-calf operation, lengthen the grazing season in the spring and fall, improve range condition of native range, and reduce total acreage required to carry a cow and calf. The intention is to accomplish these goals with a low number of pastures with few rotation times and develop a system flexible enough to be adapted by a wide range of livestock operations. This type of grazing system should improve operation efficiency, reduce costs and decrease labor per unit of production, and increase saleable production per acre.

Data collected on the pastures in this study are above ground herbage production, plant species composition, leaf height measurements and phenological phases of eight major graminoid species, and animal weight performance. Commercial crossbred cattle are used in this trial.

RESULTS

Condition of the pastures has improved since the beginning of this study. Plant species composition (Table 1) has improved and herbage production (Table 2) has generally improved in relation to environmental conditions. Stocking rate (Table 3) has been increased annually as condition of the pastures improved.

Animal weight performance in the first three years of this study has been very good on crested wheatgrass grazed from early May to early June (Table 4). Average cow weight gains have been 2.65 pounds per day and 98.9 pounds per acre. Average calf weight gains have been 1.93 pounds per day and 72.4 pounds per acre.

Cows were generally in very good condition coming off the crested wheatgrass and going onto native range in early June. Cow average weight gains were 0.52 pounds per day and 5.8 pounds per acre on native range (Table 4). Cows on the three-pasture, twice over rotation grazing system did not lose weight after July as previously experienced on pastures grazed season long (Manske et al., 1984). Loss of weight was delayed until late September or early October. This delay in weight loss was due to the rotation system, the delay in turn-in date or a combination of both. Cows were left on the native range until mid October, which was two to three weeks after they had started to experience some weight loss. Calves generally have not experienced any decrease in weight gains during this short period. Calf average weight gains have been 2.05 pounds per day and 23.5 pounds per acre on this native range grazing system in the first three years of the study (Table 4).

Cows and calves were moved to an altai wildrye pasture in mid October. No problems in grazing altai wildrye have

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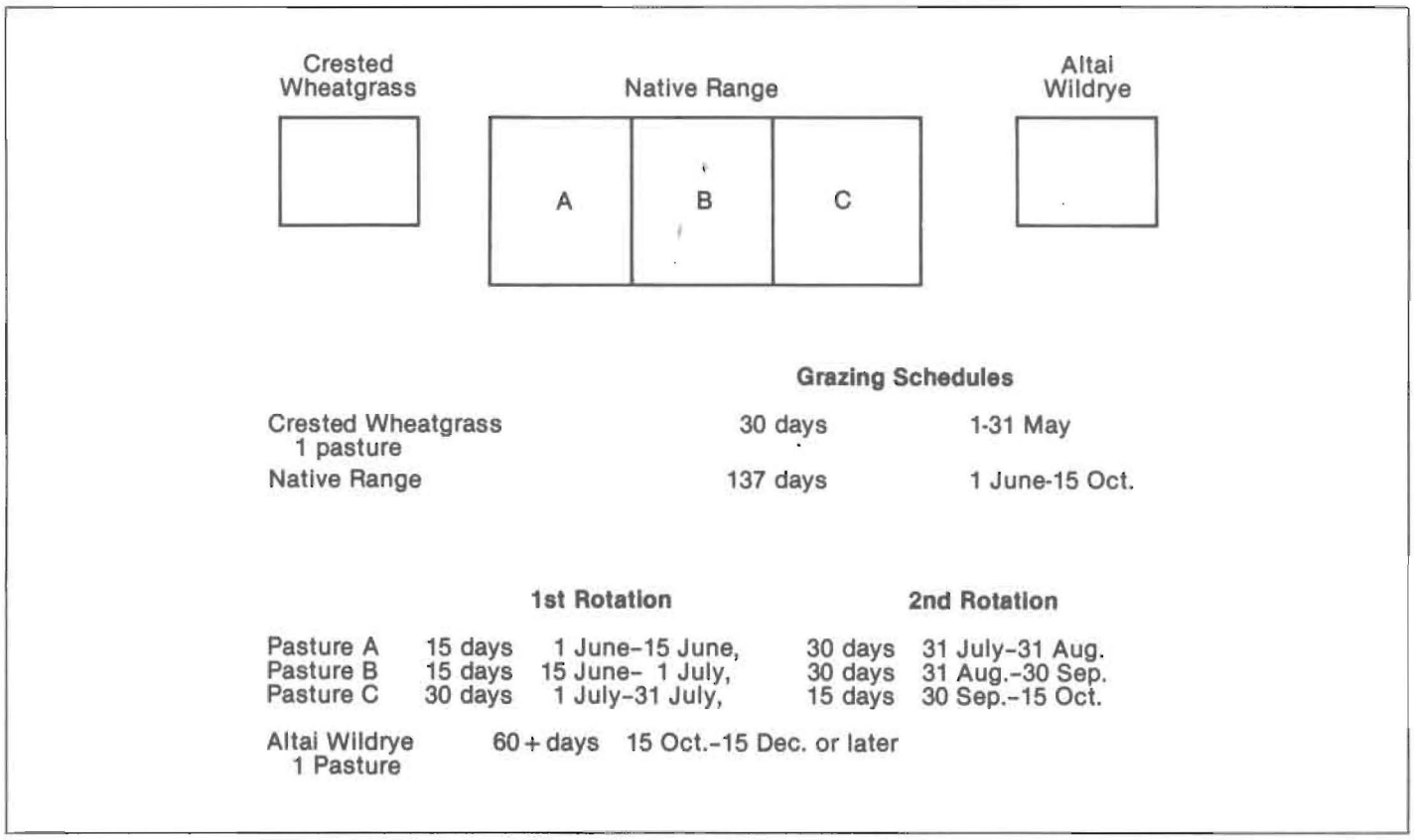

Figure 1. Pastures and grazing schedule of the complementary rotation grazing system.

Table 1. Total percent basal cover for native range pastures, Dickinson Experiment Station, 1982 and 1984.

	Live Vegetation	Litter	Soil
1982	30	54	16
1984	36	63	1

Table 2. Above ground herbage production for crested wheatgrass, native range and altai wildrye pastures, Dickinson Experiment Station, 1983-1985.

	lbs/acre		
	1983	1984	1985
Crested Wheatgrass	1663	1661	2142
Native Range			
Clayey (18 %)	1337	1142	1701
Sandy (26 %)	1416	1231	1976
Shallow (28%)	1084	884	1277
Silty (18%)	1618	1413	1901
Altai wildrye	2020	4058	4115

Table 3. Stocking rate for crested wheatgrass, native range and altai wildrye pastures, Dickinson Experiment Station, 1983-1985.

	Acres/AUM				
	S.C.S. recommended	1983	1984	1985	1986 projected
#Cow-calf pairs	13	16	19	24	26
Crested Wheatgrass		0.83	0.90	0.72	0.69
Native Range	4.07	3.33	2.75	2.10	2.00
Altai Wildrye		2.70	0.63	0.84	0.58

occurred during the early period of mid October to mid November. Early gains by cows on altai wildrye were very high and considered to be, in part, compensatory after coming off the native range with a couple weeks of weight reduction. Average daily gain for cows has been 1.55 pounds per day for the period of mid October to mid November. Average calf gains were 1.83 pounds per day for the same period.

Problems have developed on altai wildrye during the grazing period after mid November. In 1984, calves were left with the cows until 3 December. The cows lost 1.67 pounds per day between mid November and weaning. After weaning, dry cows maintained their weight with a slight gain

Table 4. Average daily gain per head (ADG) and gain per acre (G/A) for cows and calves grazing crested wheatgrass, native range and altai wildrye pastures, Dickinson Experiment Station, 1983-1985.

	Crested Wheatgrass		Native Range		Altai Wildrye		System	
	ADG	G/A	ADG	G/A	ADG	G/A	ADG	G/A
1983								
Cow	2.65	97.9	0.82	7.4	0.51	5.7	1.10	11.4
Calf	1.76	65.0	2.21	19.9	1.52	17.0	2.06	21.7
1984								
Cow	3.11	105.3	0.25	2.8	0.02	1.0	0.46	7.4
Calf	2.14	72.4	1.96	21.7	1.16	35.3	1.81	25.5
1985								
Cow	2.20	93.4	0.50	7.3	−1.90	−68.4	0.17	3.1
Calf	1.88	79.8	1.99	28.9	2.58	51.6	2.05	33.7
Mean								
Cow	2.65	98.9	0.52	5.8	−0.46	−20.6	0.58	7.3
Calf	1.93	72.4	2.05	23.5	1.75	34.6	1.97	27.0

of 0.13 pounds per day until 31 December. Calf gain between mid November and 3 December was not very good at 0.84 pounds per day. As a result, it is recommended that calves be weaned before 15 November. In 1985, calves were weaned 12 November with the intent of leaving the dry cows on the altai wildrye as long as weather would permit. An early winter snow storm occurred in November and the cows were fed hay. The cows did not go out and graze the altai wildrye after this single feeding. They lost an average of 7.54 pounds per day from 12 November to 2 December. Dry cows should, however, be able to maintain body weight on altai wildrye between mid November and late December if they continue to graze.

DISCUSSION

Optimum season of use of each pasture type seems to be a major key to successful management for maximum sustained potential production. Management for optimum season of use must consider the strengths, weaknesses and limitations of each pasture type and major plant species. Native range is a complex community of many perennial and some annual plant species. Each species has different needs for maximum growth and development at different times of the year. The wide diversity of plant species which respond differently to any give set of environmental circumstances results in dynamic changes in the structure of plant communities. These changes make native range a relatively stable source of forage.

In years of near normal precipitation, total herbage production on native range may be a little below the production of domesticated grasses, but fluctuations in production between high and low precipitation years are small on native range compared to domesticated forage sources. Native range is more tolerant of drought conditions than other forage sources. The percent reduction in herbage production is lower than the percent reduction for domesticated forage and fewer individual plants die.

Native range is generally very tolerant of mismanagement. After several years of abusive management, a native range pasture will have below potential herbage production but most of the grass species will still be present. There is no alternative forage source for grazing livestock that can outperform native range for stability of production and tolerance to adverse conditions such as drought and mismanagement. This stable forage production on native range is provided without the costs of cultivation.

Even though native range is very tolerant, it can benefit greatly from proper management. Management that considers the physiological needs of the major plants can improve native range. One of the simplist ways to improve native range is to delay grazing in the spring. Management to maximize herbage and livestock production on native range in the Northern Great Plains should delay grazing until mid June on pastures grazed season long (Campbell, 1952; Whitman, 1954; Rogler et al., 1962; Dodds, 1971; and Smoliak et al., 1982). Early grazing reduces the annual total herbage production by 40 percent to 60 percent. This lost herbage is never available to the grazing animal and the carrying capacity of the pasture is greatly reduced from its potential.

Early grazing of native range is extremely costly to livestock producers. This lost production is not directly observable. Many of these pastures have been plowed and put into "more productive use." Livestock producers in western North Dakota that graze their native range early in the spring should be able to increase carrying capacity 20 percent to 30 percent just by delaying turn-in date to mid June. Implementation of some type of rotation grazing system would permit the turn-in date to be moved up to early June. An additional 10 percent to 50 percent increase in carrying capacity over season long grazing could be possible by using a rotation grazing system (Table 3).

A three-pasture, twice over rotation grazing system is used to manage the native range pastures in this study. Three native range pastures are grazed from early June through mid October. Each pasture is grazed twice during the summer grazing season. The rotation dates (Fig. 1) are

based on critical phenological periods of the major grasses. The three critical periods are considered to be: 1) during early growth when the plants are drawing from stored carbohydrate reserves following winter dormancy, 2) when the seed heads of the grasses begin to elevate and ends at seed maturity, and 3) when perennial plants are storing carbohydrates for use during winter dormancy and for initial growth the following spring.

The dates of these critical periods will be slightly different for each grass species and will vary from region to region. The dates for major grasses in North Dakota have been studied since 1975. These dates were similar for all of the warm-season and all of the cool-season species studied, so they have been combined to help simplify the management schemes. For the warm-season graminoids, the first period is from 10 May to 15 June, the second period is from 10 July to 20 August and the third period is from 1 August to the first hard frost, which usually occurs in October. For the cool-season graminoids, the first period is from 1 April to 15 May, the second period is from 1 to 15 June and the third period is from 1 August to shortly after the first hard frost. The grazing rotation dates should be timed so that no one pasture is grazed for more than 50 percent of a critical period.

Nutritional quality of major native range grasses decreases early in the growing season in western North Dakota. Most native grass species drop below the crude protein requirements for lactating cows (9.2 percent) in mid July (Whitman et al., 1951). Daily gains of cows on native range pastures grazed season long decrease greatly after mid July and cows often lose weight after mid August. Gains of calves with these cows decrease after mid August (Manske et al., 1984). Loss of weight by cows in late summer may not be harmful to the health of the animals but does indicate that they are unable to maintain body weight and lactation on the forage available. Calf weight gain decrease that coincides with loss of weight of the cow indicates that milk production is reduced. This decrease in calf daily gains greatly affects weaning weight, which affects saleable production per acre.

Major limitations of native range are its relatively modest total herbage production, vulnerability to early grazing and low nutritional quality of mature vegetation. These limitations need to be considered in the overall management of a livestock unit and are the reasons for using domesticated grass pastures for spring and fall and early winter grazing.

Grazing of the complementary rotation grazing system at the Dickinson Experiment Station begins in early May on crested wheatgrass. The crested wheatgrass has been ready to graze on 20 April each year of this study but additional research needs to be conducted before the recommended starting date of early May can be moved to late April. Grazing crested wheatgrass at high stocking rates from early May to early June puts the plants under considerable stress. These stressed plants need the remaining portion of the growing season ungrazed to recover and replace the stored carbohydrates used during the grazing period. If the grazing starting date were moved to late April, additional special management would be needed to provide for sufficient recovery.

Crested wheatgrass has been a good producer of herbage and tolerates low precipitation conditions and grazing. Crested wheatgrass plants respond favorably to nitrogen fertilization, which is very beneficial in maintaining a dense, productive stand. In previous studies, herbage production was increased by 76 percent, stocking rate increased by 143 percent, cow daily gain increased by 51 percent and gain per acre increased by 149 percent. Calf daily gains and gain per acre increased by 15 percent and 132 percent, respectively (Manske et al., 1984). The cost of the fertilization on crested wheatgrass has more than paid for itself in increased beef production on all trials at the Dickinson Experiment Station, even during years with drought conditions.

The nutritional quality of crested wheatgrass is very good in May and early June. After mid June, quality drops off very quickly. The crude protein level drops below 10 percent in late June (Whitman et al., 1951). Crested wheatgrass can generally be grazed through June with good animal weight gains. Animal gains in July are usually very low or the animals lose weight. Existing data show a distinct disadvantage to livestock performance by grazing crested wheatgrass after late June. Many domesticated grass species have been studied with varying success over the years, but crested wheatgrass still remains the best spring pasture grass for western North Dakota.

Most grass species decrease in nutritional quality in fall when they reach maturity. Livestock generally lose weight in the fall by grazing these low quality forages. This loss of weight may not reach a point of being harmful to the health of the animals, but it may increase the costs of feed to maintain those animals over winter and has the potential to delay rebreeding the following season.

Many grass species in the wildrye (*Elymus*) genus retain acceptable nutritional quality late into fall and early winter. Russian wildrye (*Elymus junceus*) has been successfully used as a fall pasture grass in North Dakota. It has good production of herbage, good fall nutritional quality and can tolerate grazing. It generally has been more difficult to establish than crested wheatgrass. Its leaves generally grow close to the soil surface and are easily covered by snow. It is best to graze this grass prior to seasonal snow cover.

Altai wildrye is a relatively recent introduction into North Dakota. It has been an excellent producer of herbage and can tolerate low precipitation and grazing. Its leaves and stems are stiff and upright and stand up under relatively large amounts of snow. Its nutritional quality is good late into the fall and early winter. The potential of this grass and closely related species and hybrids show considerable promise for use in North Dakota.

This complementary rotation grazing system has been grazed for three years from early May to mid December for 217 days (7.1 months). This compares to the traditional grazing season of 183 days (six months) from 15 May to 15 November. This system has the potential to expand the grazing season from 20 April to 31 December for 255 days (8.4 months). Additional research needs to be conducted before all the problems of this very early and late grazing can be worked out.

The acreage required to feed a cow and a calf for the 7.1 month grazing season on this complementary grazing system was 11. 58 acres in 1985. It would require 24.42 acres to feed the same cow and calf on a six-month season long grazing system using native range alone in the same area. The longer grazing season reduces the length of the winter feeding period, which would reduce the acreage required for harvested forage per animal unit.

SUMMARY

The management of this complementary rotation grazing system has been based on ecological principles that consider the physiological needs, weaknesses, and strengths of the dominant plant species. Consideration of the nutritional needs of the livestock have been incorporated. Season of use of each pasture type was limited to periods of grazing when the detrimental effects of grazing were minimized and the potential for improvement in animal weight performance was maximized to near potential. Effort has been made to limit the number of pastures and rotation times to the minimum. One pasture of crested wheatgrass was used for spring grazing. A second pasture may be necessary to move the starting date earlier. The native range was managed with three pastures, each grazed two times during the grazing season. One pasture of altai wildrye was used in this system for fall and early winter grazing. The grazing season has been lengthened from the traditional six months to 7.1 months. This system has the potential to lengthen the grazing season to 8.4 months with additional research. The acreage required to carry a cow and calf was reduced from 24.4 acres for six months to 11.6 acres for 7.1 months.

By using a complementary rotation grazing system similar to the one at the Dickinson Experiment Station, livestock producers have the potential to: lengthen the grazing season, reduce the acreage required to feed a cow and calf, and increase the amount of saleable beef produced from each livestock unit.

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