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GRAZING ANNUAL FORAGES IN THE NORTHERN GREAT PLAINS

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ABSTRACT

A study was designed to evaluate the potential of grazing annual forages to support beef cattle production. Crossbred cows and calves were grazed on a sequence of annual forages in each of two yr. Annual forages included winter rye (*Secale cereale*), a cereal/pea intercrop (oat [*Avena sativa*], field pea [*Pisum sativum arvense*] and rye), barley (*Hordeum vulgare*) and Siberian millet (*Setaria italica*). Replicated pastures (8.3 ac) of each forage type were grazed at a stocking rate of 1.2 cow/calf pair per ac. A 107-d (15 May to 31 August) grazing period was desired, where rye would be grazed in late May, cereal/pea in June, barley in July and millet in August. Total herbage (lb/ac) available for grazing did not differ between yr, but tended to be lower for rye than cereal/pea, barley and millet. The sequence of annual pastures provided 77 and 68 d of grazing in yr 1 and 2, respectively. While grazing annual forages, cows gained less BW and lost more body condition in yr 1. Despite differences in cow performance, seasonal calf performance was not different between yr. Calf ADG was 2.6 lb/d, while production per head and per ac were 191.4 lb and 57.6 lb, respectively. Calf production (lb/ac), while grazing specific forages types, differed between yr. In general, calf production per ac was greatest while grazing barley during late July and early August, least while grazing rye during late May and early June and intermediate for cereal/pea during late June and July and millet in August. Cow and calf pairs can be grazed effectively on annual forages during the summer in the northern Great Plains. Further work is needed to establish potential forage sequences and optimal seeding dates, initial grazing dates, stocking rate and grazing management for annual forage pastures.

INTRODUCTION

Prices received for agricultural commodities are often low compared to the relatively high costs of production. This results in relatively low net returns per acre for the amount of capital invested. At the same time, a reduction in government control of agricultural production has given crop producers greater flexibility in developing their own farming plans. As these producers contemplate new cropping decisions, "atypical" crop rotations involving annual forages are gaining in popularity. Annual forages have potential for increasing net returns to crop acres by providing feed for livestock production. Forages can be grazed in the field or harvested and fed. Studies have been initiated to evaluate the potential of using traditional crop land for cattle production by growing a sequence of annual forages and grazing cow/calf pairs during the summer.

MATERIALS AND METHODS

The study site (47 14 N., 102 50 W) is located 20 m N and 2 m W of Dickinson, in southwestern North Dakota, USA. The site is situated on the Manning ranch of the Dickinson Research Extension Center operated by North Dakota State University. Eight pastures (8.3 ac/pasture) were arranged into two, four pasture blocks. Each block of pastures had unlimited access to a common waterer and mineral feeder through a grass alleyway located on the western edge of each pasture. Within each pasture block, annual forages were randomly seeded into individual pastures and grazed sequentially with a constant stocking rate (1.2 cow/calf pair per ac) using crossbred cows (live weight (BW) = 1243.0 lb; body condition score (BCS) = 6.3) and calves (BW = 208.6 lb) in each of two yr. Within the context of this report, a cow/calf pair will constitute one animal unit (AU) and 30 d of grazing by one AU constitutes an animal unit month (AUM).

Annual forages selected for grazing evaluation included: winter rye (*Secale cereale* var. Dacold), a cereal/pea intercrop (oat [*Avena sativa* var. Hytest], field pea [*Pisum sativum arvense* var. Trapper] and rye), barley (*Hardeum vulgare* var. Horesford) and Siberian millet (*Setaria italica*). Within each yr, the desired grazing management involved grazing rye in May, cereal/pea in June, barley in July and millet in August. Seeding rates (lb/ac; percentage of germinating seeds exceeded 90% for all seed lots) were 29/100/32, 80 and 20 for cereal/pea (oat/pea/rye), barley and millet, respectively. Seeding dates (Table 1) of individual annual forages were selected in an attempt to allow continuous grazing of cattle throughout the summer (107-d grazing period; 15 May to 31 August). One exception to annual seeding dates was that rye grazed in the spring was actually seeded prior to the year in which grazing occurred. The rye grazed in yr 1 was seeded two years previously, grazed briefly in the year following seeding and then mowed and disked. In yr 1, rye was interseeded in cereal/pea pastures and spring growth the following year represented rye in yr 2. The desired phenological stage of grass development at the initiation of grazing was pre-boot (approximately 5 leaves). The actual time of grazing initiation was a compromise between desired stage of development and maintenance of grazing sequence. In as much as possible, once grazing commenced in the spring cattle were continuously grazed on annual forages until available forage was depleted. Cattle were moved to pastures of either crested wheatgrass (*Agropryon desertorum*) or native range if a break in the grazing of annual forages was necessary. Only cattle performance while grazing annual forages has been included in this report.

Commercial crossbred cows and calves were weighed at the initiation and termination of grazing in each pasture. Accumulated live weight gain, average daily gain and gain per ha were used to evaluate each forage type. Initial and final body condition scores of cows were also recorded. Aboveground plant biomass was collected on initial and final grazing dates in each pasture by clipping ten 2.7 ft^2 (0.25 m^2) quadrants to ground level distributed across the length of the pasture. Plant biomass was separated into seeded forage plants and unseeded weeds. Samples were dried at 140F (60C) and are expressed on a dry matter basis. Forage disappearance was defined as the difference in component weight between samples collected on initial and final grazing dates.

Data were analyzed as a randomized complete block design using an analysis of variance (PROC ANOVA) procedure of SAS. Main effects included year and forage type. The interaction between year and forage type was used to test for significant effects due to forage type. Animal performance while grazing native range is included for comparative purposes (Table 7 and 8). These values represent a long-term average for a 4.5 m (3-pasture, twice-over-rotation) grazing system (Manske and Nelson, 1995). Animal performance on native range is presented as calf production per day and per ac for an entire 4.5 m (137 d) grazing period. Production per head is average daily gain (ADG) multiplied by 137 d.

RESULTS

Seeding and grazing dates. Seeding dates, grazing intervals and stocking rates are shown in (Table 1). With the exception of rye, seeding dates varied less than 2.5 wk between yr. Seeding dates averaged 26 April, 28 May and

21 June for cereal/pea, barley and millet, respectively. Compared to year 1, actual seeding date in year 2 varied by -13, -8 and 17 d. Pastures of rye were seeded prior to the year of grazing.

A 107-d (15 may - 31 August) summer grazing period was desired. Annual forages provided 77 d of grazing in yr 1. Grazing initiated in mid May and continued until 30 August, with the exception of 30 d in June. This occurred between the grazing of rye and cereal/pea, when forage was depleted in pastures of rye but was not sufficiently developed for grazing in cereal/pea pastures. In yr 2, annual forages provided 68 d of grazing. Grazing initiated later in May, was interrupted in early July and terminated earlier in August. The interruption of the grazing cycle in July of yr 2 occurred between the grazing of cereal/pea and barley. The difference bewteen yr 1 and 2 relative to this deficiency of grazable forage may relate to differences in the respective seeding date of cereal/pea pastures. The interval between seeding and the initiation of grazing of cereal/pea pastures was similar between yr (57 and 55 d in yr 1 and 2, respectively). Thus, the earlier seeding date of cereal/pea in yr 2 provided grazable forage earlier in the season and shifted the forage deficit from mid June in yr 1 to early July in yr 2. The interval between seeding and grazing of barley was 56 and 61 d in yr 1 and 2, respectively. Attempts to maintain a continuous grazing sequence in yr 2 resulted in the interval from seeding to grazing of millet being reduced from 61 d in yr 1 to 39 d in yr 2. This difference did not seem to appreicably reduce the carrying capacity (AUM/ac) of millet between yr (Table 1).

Ten AU were grazed per pasture replicate in each yr, thus giving a stocking rate of 1.2 AU/ac. Average grazing days per pasture was 18 d (19 and 17 d for years 1 and 2, respectively). Pasture AUM/ac ranged across yr from .52 to 1.07. The combined, 4-pasture system provided grazing for 72 and 64% of the desired grazing period and produced .76 and .67 AUM/ac in yr 1 and 2, respectively.

Herbage production and disappearance. Initial aboveground biomass yield and botanical composition and disappearance during grazing are presented in(Table 2). Initial aboveground biomass (IAB, lb/ac) did not differ between yr (P=.2). Pastures of rye (P<.1) produced less IAB than cereal/pea, barley or millet. Botanically (as a percentage of IAB), pastures were comprised of primarily seeded plants (> 90%), while non-seeded plants (i.e. weeds) averaged less than 10% for all pastures. Forage disappearance (as a percentage IAB) ranged from 37 to 54 % and averaged 46% across forage types. Forage disappearance (Table 2) represents the difference between subsequent growth and forage removed during a grazing period. All seeded forages were removed at a faster rate than new growth (positive disappearance). Removal of weeds exceeded growth in pastures of cereal/pea and barley, but the opposite was true for pastures of rye and millet (negative disappearance) where weed growth exceeded removal..

Cow performance. Overall cow performance is presented in (Table 3.) Cows gained more BW (P<.1) and body condition (P<.1) and had higher average daily gains (ADG; P<.05) in yr 2. Total gain (lb/hd; P<.01) and ADG (lb/d; P<.01) differed among forage types within yr (Table 4), but the magnitude of the differences were not consistent between years. In general, cows tended to gain weight while grazing rye and barley, lose weight while grazing cereal/pea and maintain weight while grazing millet. Body condition scores did not differ by forage type (P=.11) or between forage type within yr (P=.26).

Calf performance. Overall calf performance while grazing with their dam on annual forages is presented in(Table 5). Average daily gain (2.65 lb/d; P=.26), gain per head (191.3 lb/hd; P=.77) and gain per ac (57.6 lb/ac; P=.77) did not differ between yr. All measures of calf performance differed between forage types. In general, average daily gain (P<.1) was greatest in calves grazing barley, intermediate for millet and least for rye and cereal/pea. Combining daily performance with grazing days altered this ranking. Calf gain per head (P<.1) and gain per ac (P<.1) was greatest for barley, least for rye and intermediate for cereal/pea and millet. Apparently, the lower ADG of calves grazing cereal/pea was offset by a larger carrying capacity (.56 vs .88 AUM/ac for rye and cereal/pea, respectively). Total calf gain (P<.05; Table 6) differed among forage types within yr (Table 6). Compared to cereal/pea, millet supported lower gains in yr 1 and higher gains in yr 2. Nonetheless, gains on both forage types were intermediate to barley and rye and average performance across yr was similar for cereal/pea and millet(Table 5).

Comparison of grazing systems. Calf production from crop land using an annual forage grazing system is compared to native range managed using a rotational grazing system in(Table 7). Data for the comparison are either across yr averages (annual forage system) or chosen to represent long-term average production (native range; Manske and Nelson, 1995) in similar environments (all data originated from studies on the DREC Manning ranch). The acreage required to provide an AUM is reduced, while production per calf and per acre is increased, in an annual forage system. Assuming a 4.5 m (137 d) grazing season, the total number of acres required for a cow/calf pair is reduced by 32% in an annual forage system, while calf gain per head and per acre are increased 20% and 72%, respectively.

A break-even calculation for grazing annual forages on crop land or grazing native range is included in(Table 8). The costs associated with providing forage for cattle to graze is substantially different between the two systems. Costs per acre are approximately 5 times higher for growing annual forages compared to utilizing native range. This cost multiplier drops to 3.36 when total costs per grazing season are compared. The cost of producing added calf weight also favors grazing native range. However, if annual forages are used in a crop rotation in place of fallow, then the land charge would be allo-cated to the subsequent wheat crop. Removing land costs from total costs reduces the cost of added calf weight to $38.68/cwt. Although costs of calf pro-duction from crop land still exceeds native range, grazing cattle on annually-seeded forages within a wheat cropping system is feasible and has potential for adding value to traditionally fallowed acres.

SUMMARY

Annually-seeded forages have potential for increasing net returns to crop acres by providing feed for livestock production. In the northern Great Plains, crop land can be used for cattle production by grazing cattle on a sequence of annual forages during the summer. While grazing cow/calf pairs on a sequence of annual forages, calves gained 1.2 kg/d and produced 64.6 kg per ha. For annual forage grazing to be adopted in the northern Great Plains, further work is needed to establish potential forage sequences and optimal seeding dates, initial grazing dates, stocking rates and grazing management for annual forage pastures.

REFERENCES

Manske, L.L. and J.L. Nelson. 1995. Grazing annual forages on cropland in western North Dakota. DREC Range Research Report 95-1010.

Table 1. Seeding and grazing dates and stocking rates for cow/calf pairs grazing various annual forages.

Forage type	Seeding date	Grazing dates	Days	AUM[a]/ pasture	AUM/ac

1995						
	Winter rye	August, 1993	15 May - 30 May	15	4.9	.59
	CP intercrop[b]	03 May	29 June - 26 July	27	8.9	1.07
	Barley	01 June	27 July - 11 August	16	5.2	.62
	Siberian Millet	12 June	12 August - 30 August	19	6.2	.75
Overall for season[c]		--	15 May - 31 August[e]	77	25.2	.76
1996						
	Winter rye	May, 1995	28 May - 10 June	13	4.3	.52
	CP intercrop[b]	20 April	14 June - 01 July	17	5.6	.68
	Barley	24 May	16 July - 6 August	21	6.9	.83
	Siberian Millet	29 June	7 August - 23 August	17	5.6	.68
Overall for season[d]		--	15 May - 31 August[e]	68	22.3	.67

[a] One animal unit month (AUM) is defined as grazing potential one cow/calf pair for 30 d.

[b] Oat, pea and winter rye intercrop.

[c] Animals were moved to crested wheatgrass pastures for 30 d after grazing rye for breeding and to wait for the oat in cereal/pea to reach approximately the 5th leaf stage.

[d] Animals moved to native range pastures in three separate periods (11-14 June; 2-16 July; 24-31 August).

[e] 107 d of grazing desired.

Table 2. Initial aboveground biomass and disappearance for various forages grazed by cow/calf pairs.				
Year	Aboveground biomass[a]			Disappearance[b]
	lb/ac[x]	sd[c]	%[d]	% of initial
1	1565	573		40.7
2	1381	299		51.5
Forage type				
Winter rye	911	359		37.2
Rye			95.1	37.0
Weeds			4.9	51.0
CP intercrop[e]	1597	360		48.2
Oat			45.7	65.4
Pea			21.7	86.0
Rye			24.6	47.5
Weeds			8.0	-331.8
Barley	1685	237		53.5
Barley			90.5	68.7

Weeds			9.5	-99.2
Siberian Millet	1699	368		45.4
Millet			94.3	44.5
Weeds			5.7	61.4

[a] Initial aboveground biomass.
[b] Disappearance equals initial minus final biomasses divided by initial biomass.
[c] sd = standard deviation.
[d] Percentage is expressed relative to total biomass in pasture.
[e] Oat, pea and winter rye intercrop
[x] Forage types differ (P<.10).

Table 3. Overall cow performance when various annual forages are grazed in sequence by cow/calf pairs.

Year[c]	Live weight gain[a]				Body condition change[a]			
	lb/hd[x,z]	sd[b]	lb/d[y,z]	sd	Total[x]	sd	Daily[x]	sd
1	36.4	7.43	0.46	0.097	-0.58	0.247	-0.008	0.0035
2	61.7	5.26	0.90	0.075	0.20	0.141	0.003	0.0021
Forage type								
Winter rye	59.7	18.20	4.37	1.656	-0.04	0.243	-0.002	0.0169

	CP intercrop[d]	-37.0	16.20	-1.17	0.470	-0.33	0.171	-0.015	0.0080
	Barley	29.3	34.40	1.81	2.161	0.24	0.095	0.014	0.0060
	Siberian millet	-2.9	18.30	-0.11	0.999	-0.06	0.250	-0.003	0.0136

[a] Liveweight gain is expressed as total gain (lb/hd) and average daily gain (lb/d). BCS = body condition score (1 to 9 point scale).

[b] sd = standard deviation.

[c] Yearly production is for the entire grazing season accounting for all production obtained while grazing annual forages.

[d] Oat, pea and winter rye intercrop.

[x] Years differ (P<.1).

[y] Years differ (P,.05).

[z] Interaction between year and forage type was significant (P<.01).

Table 4. Yearly cow performance when various annual forages are grazed in sequence by cow/calf pairs.

Forage Type		Live weight gain[a]				Body condition change[a]			
		lb/hd[x]	sd[b]	lb/d[x]	sd	Total	sd	Daily	sd
Year 1									
	Winter rye	44.1	0.84	2.94	0.057	-0.23	0.177	-0.015	0.0113
	CP intercrop[c]	-46.7	19.29	-1.73	0.715	-0.40	0.141	-0.015	0.0057

	Barley	56.4	23.96	3.52	1.498	0.28	0.035	0.018	0.0021
	Siberian millet	-17.4	12.94	-0.91	0.681	-0.23	0.247	-0.012	0.0127
Year 2									
	Winter rye	75.2	4.32	5.78	0.332	0.15	0.071	0.012	0.0049
	CP intercrop[c]	-27.6	6.35	-1.62	0.374	-0.25	0.212	-0.015	0.0127
	Barley	2.4	8.07	0.11	0.384	0.20	0.141	0.010	0.0064
	Siberian millet	11.5	0.84	0.68	0.050	0.10	0.141	0.006	0.0085

[a] Liveweight gain is expressed as total gain (lb/hd) and average daily gain (lb/d). BCS = body condition score (1 to 9 point scale).

[b] sd = standard deviation.

[c] Oat, pea and winter rye intercrop.

[X] Interaction between year and forage type was significant.

Table 5. Overall calf performance when various annual forages are grazed in sequence by cow/calf pairs.

Year[b]		Live weight gain					
		lb/d[x]	sd[a]	lb/hd[x,y]	sd	lb/ac[x,y]	sd
	1	2.50	0.002	192.6	0.14	58.0	0.00
	2	2.79	0.179	190.0	12.16	57.2	3.68
Forage type							

	Winter rye	2.22	0.144	31.1	3.24	37.4	3.94
	CP intercrop[c]	2.27	0.301	48.8	6.66	58.7	8.04
	Barley	3.39	0.375	62.2	7.05	74.9	8.49
	Siberian millet	2.75	0.416	49.3	5.50	59.4	6.62

[a] sd = standard deviation.
[b] Yearly production is for the entire grazing season accounting for all production obtained while grazing annual forages.
[c] Oat, pea and winter rye intercrop.
[x] Forage types differ (P<.1).
[y] Interaction between year and forage type significant (P<.05).

Table 6. Yearly calf performance when various annual forages are grazed in sequence by cow/calf pairs.

Forage type		Live weight gain					
		lb/d[x]	sd[a]	lb/hd[x,y]	sd	lb/ac[x,y]	sd
Year 1							
	Winter rye	2.22	0.071	33.4	1.06	40.2	1.27
	CP intercrop[b]	2.02	0.060	54.5	1.63	65.6	1.98
	Barley	3.61	0.442	57.7	7.07	69.5	8.49
	Siberian millet	2.48	0.335	47.1	6.36	56.8	7.71

Year 2							
	Winter rye	2.22	0.240	28.8	3.11	34.7	3.75
	CP intercrop[b]	2.53	0.046	43.1	0.78	51.9	0.92
	Barley	3.18	0.202	66.7	4.24	80.4	5.16
	Siberian millet	3.03	0.329	51.5	5.59	62.0	6.72

[a] sd = standard deviation.
[b] Oat, pea and winter rye intercrop.
[x] Forage types differ (P<.1).
[y] Interaction between year and forage type significant (P<.05).

Table 7. Comparing the utilization of annual forages seeded into crop land to native range for supporting cow/calf production during a 4.5 m grazing season - animal performance[a].

Item	Crop land	Native range
Acres required per AUM[b]	1.39	2.04
AUM required per grazing season[c]	6.25	9.18
Calf average daily gain (lb/d)	2.65	2.21
Calf gain per acre (lb/ac)[c]	58.1	33.7
Calf gain per season (lb/hd)[c]	363.1	303.3

[a] Data for crop land are across yr averages for this study. Values for native range are representative of a TOR managed grazing system (Manske and Nelson, 1995).

[b] AUM = animal unit month, grazing for one cow/calf pair for 30 d.
[c] Values are calculated assuming a 4.5 m grazing season, using acres/AUM and average daily gains provided.

Table 8. Comparing the utilization of annual forages seeded into crop land to native range for supporting cow/calf production during a 4.5 m grazing season - breakeven analysis[a].

Item	Native range	Crop land	Crop land (excluding land costs)
Cost ($/acre)[b]			
land rent	8.76	20.80	.
seed	.	12.53	12.53
seeding	.	9.94	9.94
total costs/acre	8.76	43.27	22.47
AUM[c] required per grazing season	9.18	6.25	6.25
Total costs per AU[c]	80.42	270.44	140.44
Calf gain per season (lb/hd)	303.3	363.1	363.1
Cost of added calf weight ($/cwt)	26.52	74.48	38.68

[a] Animal performance taken from table 8.
[b] Average cost data per acre taken from Manske and Nelson, 1995.
[c] AU = cow/calf pair. AUM = animal unit month, grazing for one AU for 30 d.

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