Effect of various alternative forages on late summer forage production and grazing livestock performance

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Abstract

The potential of using millet (M; *Setaria italica*), sweetclover (C; *Melilotus officinalis*) and alfalfa (A; *Medicago sativa*) as grazable forage in late summer was evaluated in southwestern ND. Forage treatments (TRT) were seeded into paddocks (1-ha) in each of two year and included M, C, A, barley (B; *Hordeum vulgare*), pea (P; *Pisum arvense*) and combinations of MC and MA. Paddocks were grazed starting in early August using three yearling beef heifers (BW=432±4.6 kg). At initiation of grazing, seeded (P<.01; x=4170 kg/ha; SE=720) and total forage (P<.01; x=5845 kg/ha; SE=622) DM and percentage seeded of total forage (P<.01; x=68.0%; SE=5.9) differed by TRT. P produced more seeded DM than A and C (3670 vs 2056 and 2308 kg/ha). MC and MA produced more seeded (6219 and 5757 vs 2056 and 2308 kg/ha) and total (7598 and 7149 vs 4459 and 4523 kg/ha) DM than A and C. Percentage seeded forage was greater in P (66%) compared to A (47%) and C (48%); in M (74%) compared to A, C, MA (81%) and MC (79%); and in MA and MC compared to A and C. Concentrations of CP (P<.05; x=11.9%; SE=1.3), NDF (P<.01; x=57.5%; SE=2.0) and ADF (P<.01; x=38.9%; SE=1.1) differed by TRT. CP was greater in B (12.3%) compared to M (9.4%); in A (13.3%), C (16.1%), MA (11.5%) and MC (10.9%) compared to M; and in A and C compared to MA and MC. NDF was reduced in A (51.5%), C (47.0%), MA (60.9%) and MC (63.0%) compared to M (63.7%); and in A and C compared to MA and MC. ADF was reduced in B (35.8%) compared to M (41.3%); in A (37.3%), C (35.5%), MA (39.1%) and MC (39.5%) compared to M; and in A and C compared to MA and MC. Grazing days (P<.05; x=35.0 d; SE=2.9), final BW (P<.1; x=465 kg; SE=5.1) , ADG (P<.1; x=.91 kg/d; SE=.14) and gain (P<.1; x=95.0 kg/ha; SE=15.1) differed by TRT. Grazing days were greater in M (41 d) compared to B (33 d); in M compared to A (28 d), C (31 d), MA (37 d) and MC (35 d); and in MA and MC compared to A and C. A and C had heavier final weights (464 and 466 vs 453 kg) and larger ADG (1.04 and 1.00 vs .64 kg/d) and total gain (90.9 and 94.6 vs 59.3 kg/ha) compared to P. Annual grasses produced more forage of a lower quality compared to legumes. However with the exception of P, animal performance was not affected by forage treatment. Although forages differed with respect to production and quality, these characteristics alone are not accurate predictors of grazing animal performance.

Introduction

Prices received for agricultural commodities are often low compared to the high costs of production. This results in relatively low net returns per acre for the amount of capital invested. Traditional cropping systems in the Northern Great Plains include continuous small grains or a small grain-fallow rotation. However as governmental control of agricultural production recedes, producers are being given greater flexibility in the development of unique farming plans. As producers contemplate possible cropping decisions, crop rotations involving annual forages are gaining in popularity among diversified operations that manage both crops and cattle enterprises.

Annual forage production can provide a basis for establishing an integrated system between crop and cattle production. Annual forages offer crop producers a wider variety of alternative crops that can be included in a rotating crop sequence. In addition to diversified agricultural operations, when cattle and crops are produced in close proximity, local livestock can create a readily-available market for excess forage production.

Cattle enterprises can also benefit from integrated crop-livestock systems. One of the principal limitations to cattle production in the Northern Great Plains is the need to supply a sufficient quantity of high-quality forage for grazing during the mid- to late-summer months (late July through September). This is a time frame when most traditional pastures become unproductive, provide lower quality forage, or both. Expanding annual forage production within the region would expand the total feed base available to cattle producers. Using this forage within the context of a grazing system should help reduce costs of beef production, while simultaneously generating revenue on crop acreage.

The proposed experiment addressed the potential of using a warm-season annual grass (Siberian foxtail millet; *Setaria italica*), sweetclover (*Melilotus alba*), and alfalfa (*Medicago sativa*) as grazable forages during late summer in an integrated crop-livestock system. Specifically, the objective was to determine production of and yearling heifer performance from forages produced on traditional small grain crop land in the Northern Great Plains during late summer.

Materials and Methods

Twenty-six, 1-ha paddocks have been established to support research efforts involving the integration of crop and beef cattle systems in the Northern Great Plains. Paddocks were segregated into 2 blocks of 13 paddocks and 2-yr forage sequences were randomly assigned to paddocks within block. Forage treatments were seeded into replicated paddocks (n=2) in each of two years. Treatments (Table 1) included Siberian millet (M), sweetclover (C), alfalfa (A), barley, field pea (P) and combinations of MC and MA. Forage production resulting from these seedings was grazed using pregnant yearling beef heifers. Additionally in year 1, 3 paddock pairs were seeded to small grain and used in a separate experiment and 1 paddock pair was seeded to a second alfalfa variety. Subsequent forage production from previously seeded S or A was also grazed in year 2 of the study. Legume establishment in MA and MC was very poor and paddocks were reseeded to M in year 2.

Paddocks were seeded to respective forages using no-till seeding techniques in the spring of each year. Grazing of paddocks with yearling beef heifers initiated in late July or early August of each year and continued for at least 28 days (actually length depended upon forage availability and maintenance of live weight gain). Forage samples and animal weights will be collected at the beginning and end of the grazing period, and at 14-day intervals during the grazing period. Forage samples were used to determine dry matter available for grazing and chemical composition (crude protein [CP], acid detergent fiber [ADF] and neutral detergent fiber [NDF]). Chemical composition was determined in a commercial laboratory and total digestible nutrients (TDN) estimated from ADF concentrations. Animal weights were used to calculate total live weight production during the grazing period and average daily performance.

Animal and forage data were analyzed as a randomized complete block design (Steel and Torrie, 1980). Forage treatment will be considered as a fixed effect, while year and block were considered random. Sources of variation included year, block and treatment. Additionally, Final body weight was analyzed using initial body weight as a covariate. Significant treatment effects were described using a pre-determined set of orthogonal and nonorthogonal contrasts (Table 2).

Summary

<u>Forage Yields</u> (Figure1)

- Yields of seeded, weedy and total DM at the initiation of grazing were affected by forage treatment.
- Pea paddocks had higher seeded, and lower weedy, forage components compared to alfalfa and sweet clover. Total forage DM was not different between pea, alfalfa and sweet clover forage.
- Millet intercropped with alfalfa or sweet clover produced more seeded and total, and less weedy, forage compared to alfalfa or sweet clover.
- Paddocks seeded to alfalfa or sweet clover contained less forage material as a percentage of total DM compared to millet, millet intercrops or pea (Figure 2).

<u>Forage Quality</u> (Figure 3)

- Barley was a better quality forage compared to millet.
- Alfalfa, sweet clover and millet intercrops had higher forage quality compared to millet.
- Alfalfa and sweet clover had higher quality forage compared to millet intercrops.

<u>Animal Performance</u> (Table 3)

- Millet produced the most grazing days.
- Heifer grazing barley had heavier 28-d weights compared to millet. Final weights were not different.
- Alfalfa and sweet clover had heavier 28-d and final weights compared to pea.
- Livestock gains were depressed when grazing field pea.

Conclusions

Annual grasses produced more forage of a lower quality compared to legumes. However with the exception of P, overall animal performance was not affected by forage treatment. Although forages differed substantially with respect to production and quality, these characteristics alone are not accurate predictors of grazing animal performance from annual forages in late summer.

Table 1. Forage seeded in replicated paddocks (n=2) in years 1 and 2.

Paddock	Year 1	Year 2
1	M[a]	P
2	A	--
3	MA	M
4	B	P
5	C	--
6	MC	M
7	P	B
8	P	M
9	M	A
11	Small grain[c]	MA
12	Small grain[c]	C
13	Small grain[c]	MC

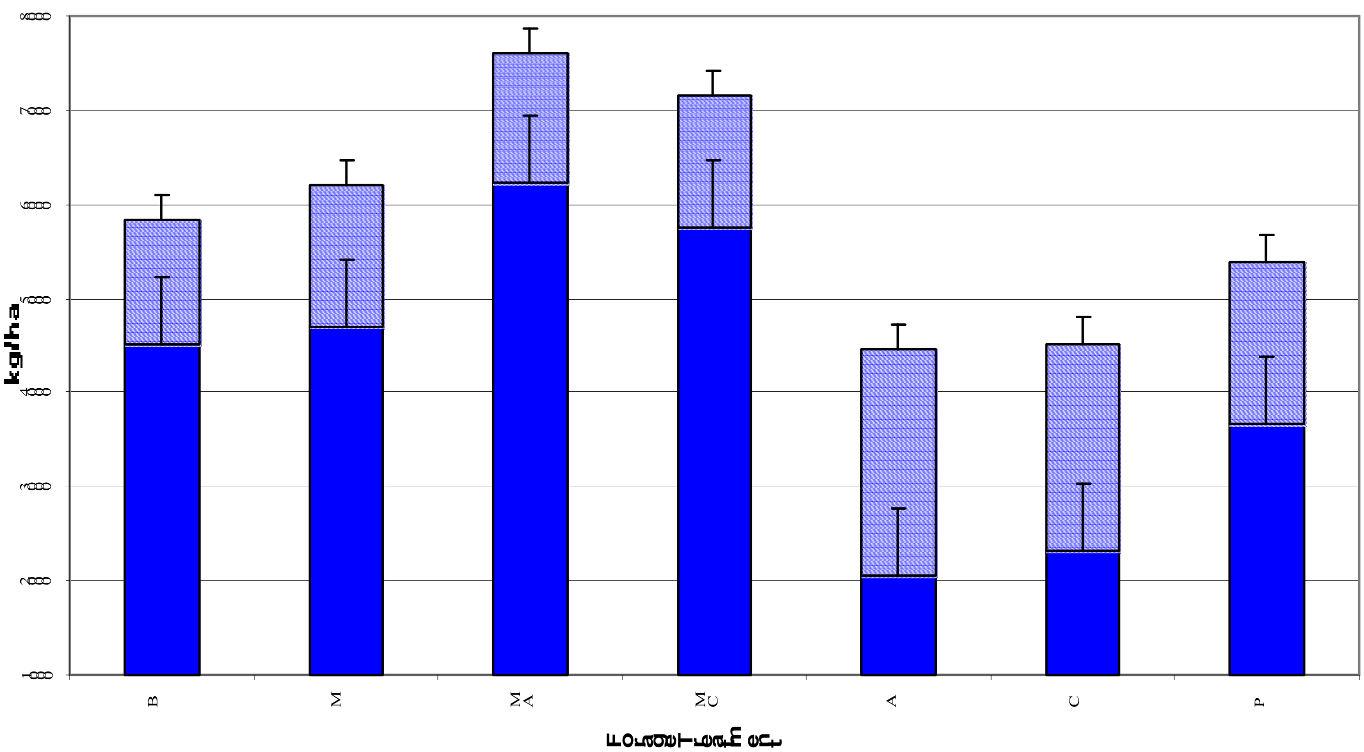
[a] Treatment designations: millet, M; alfalfa (var. Nitro), A; alfalfa (var. Travios), AA; sweet clover, C; intercropped millet and alfalfa (var. Travois), MA; intercropped millet and sweet clover, MC; barley, B; and pea, P.
[b] Data from these treatments in year 1 not included in this study (Poland et al., 2002).

Table 2. Contrasts to be used to describe significant treatment effects.

	Comparison[a]					
	B vs M	A,C vs P	M vs A,C,MA,MC	A,C vs MA,MC	A,MA vs C,MC	A,MC vs C,MA
Forage treatment[b]						
B	2	0	0	0	0	0
M	-2	0	-4	0	0	0
MA	0	0	1	1	-1	1
MC	0	0	1	1	1	-1
A	0	-1	1	-1	-1	-1
C	0	-1	1	-1	1	1
P[c]	0	2	0	0	0	0

[a] Numbers in table refer to individual treatment coefficients for a contrast comparison.
[b] Treatment designations: millet, M; alfalfa (var. Nitro), A; alfalfa (var. Travios), AA; sweet clover, C; intercropped millet and alfalfa (var. Travois), MA; intercropped millet and sweet clover, MC; barley, B; and pea, P.

Figure 1. Dry Matter Yield of Seeded and Weed Forage

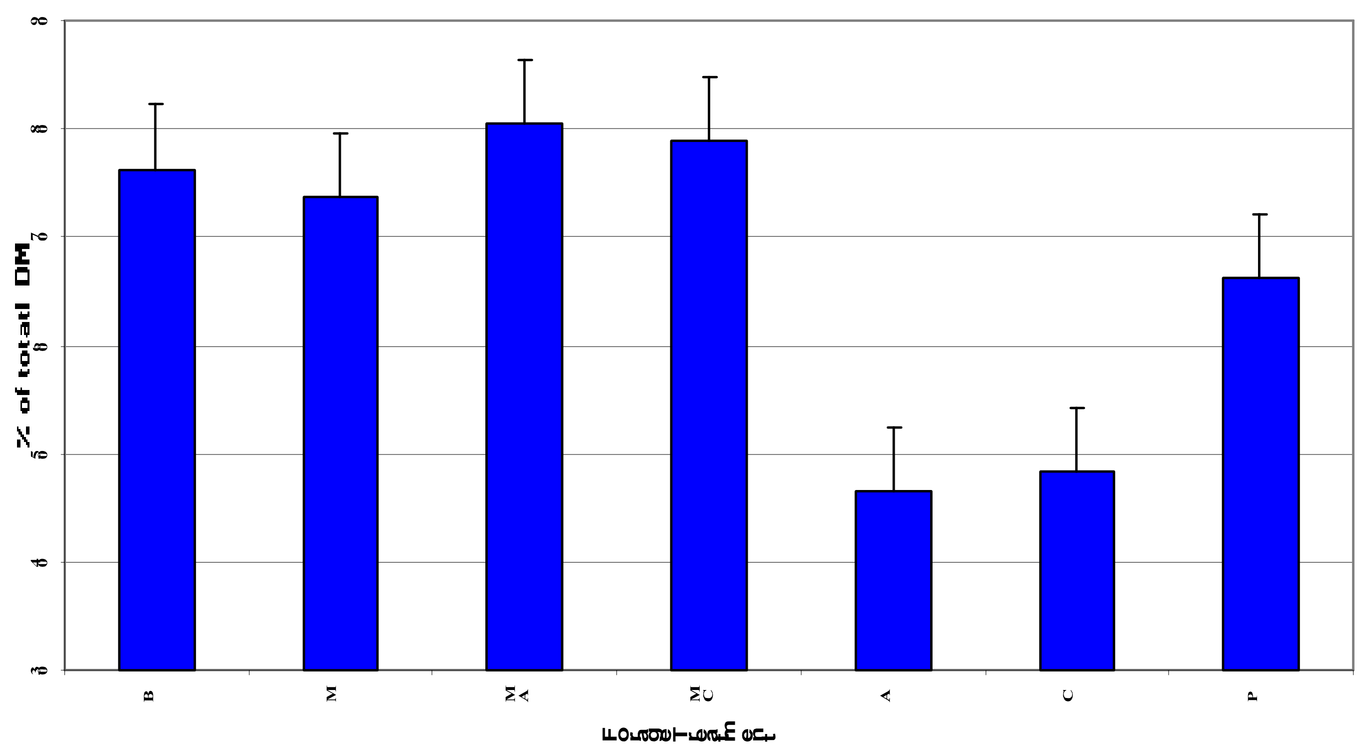


	Probability of a significant comparison					
	B vs M[a]	A,C vs P	M vs A,C,MA,MC	A,C vs MA,MC	A,MA vs C,MC	A,MC vs C,MA
Item						
Seeded***	.83	.05	.31	<.01	.88	.62
Weed**	.57	.05	.13	<.01	.75	.72
Total***	.62	.16	.61	<.01	.76	.68

[a] Forage treatments are barley (B), millet (M), millet/alfalfa intercrop (MA), millet/sweet clover intercrop (MC), alfalfa (A), sweet clover (C) and field pea (P).

*,**,*** Probability of a significant overall effect of forage treatment (P < .10, .05 and .01, respectively).

Figure 2. Percentage Seeded of Total DM Yield

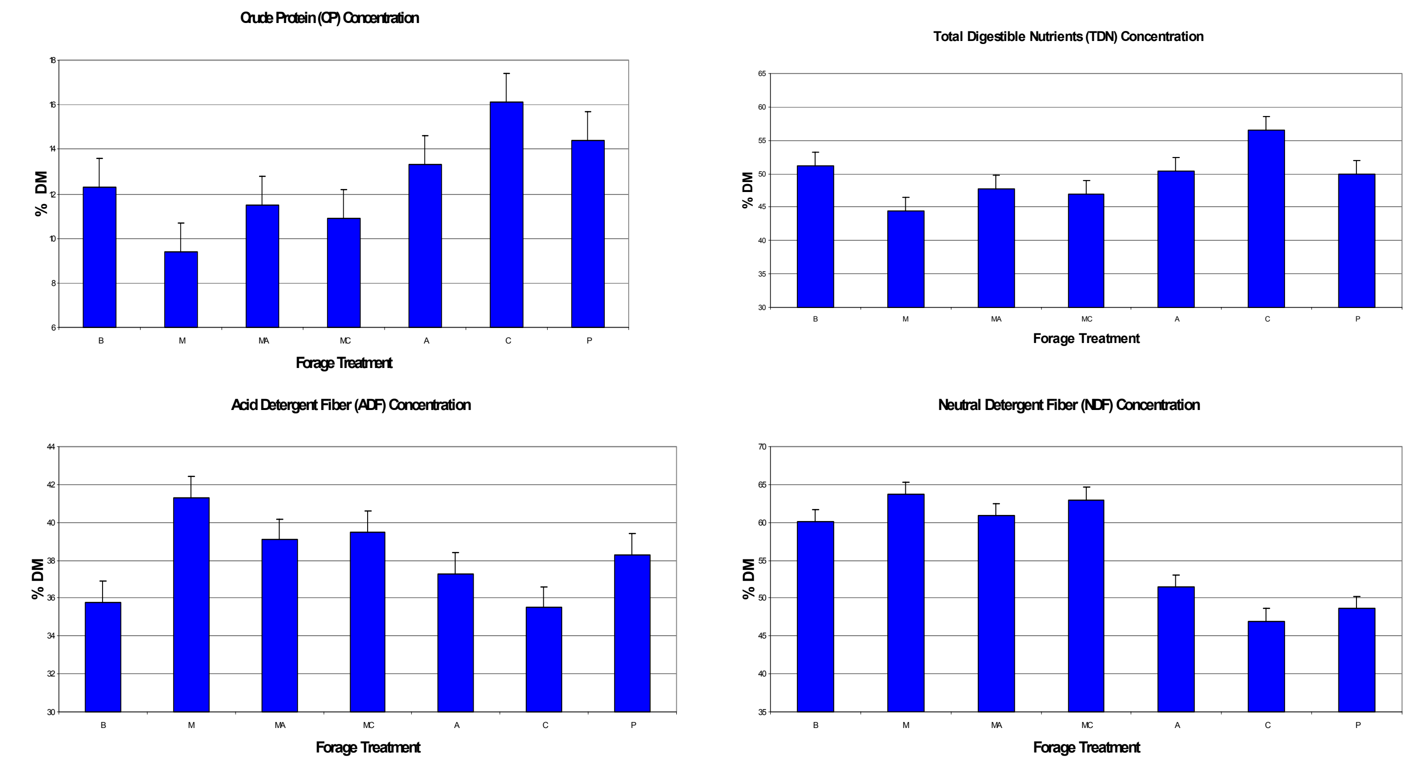


	Probability of a significant comparison					
	B vs M[a]	A,C vs P	M vs A,C,MA,MC	A,C vs MA,MC	A,MA vs C,MC	A,MC vs C,MA
Item						
Seeded***	.72	<.01	.04	<.01	.98	.79

[a] Forage treatments are barley (B), millet (M), millet/alfalfa intercrop (MA), millet/sweet clover intercrop (MC), alfalfa (A), sweet clover (C) and field pea (P).

*,**,*** Probability of a significant overall effect of forage treatment ($P < .10$, .05 and .01, respectively).

Figure 3. Forage Quality Components



	Probability of a significant comparison					
	B vs M[a]	A,C vs P	M vs A,C,MA,MC	A,C vs MA,MC	A,MA vs C,MC	A,MC vs C,MA
Item						
CP**	.07	.82	<.01	.02	.25	.43
TDN***	<.01	.07	<.01	<.01	.07	.16
ADF***	<.01	.15	<.01	.02	.38	.54
NDF***	.14	.77	<.01	<.01	.14	.59

[a] Forage treatments are barley (B), millet (M), millet/alfalfa intercrop (MA), millet/sweet clover intercrop (MC), alfalfa (A), sweet clover (C) and field pea (P).
*,**,*** Probability of a significant overall effect of forage treatment (P < .10, .05 and .01, respectively).

Table 3. Effect of forage treatment on total grazing days and animal weight (BW), gain and condition (BC).

Item	Treatments[a]								Probability of a significant comparison					
	B	M	MA	MC	A	C	P	SE[b]	B vs M[a]	A,C vs P	M vs A,C,MA,MC	A,C vs MA,MC	A,MA vs C,MC	A,MC vs C,MA
Grazing days[**]	33.3	40.9	36.8	35.0	28.3	30.9	32.4	2.9	0.04	0.37	0.01	0.05	0.88	0.48
Body Weight, lb														
Initial	434	433	435	431	432	433	434	2.3	0.77	0.57	0.79	0.64	0.61	0.33
Day 14	456	450	451	454	455	451	450	3.9	0.15	0.54	0.34	0.90	0.95	0.46
Day 28[***]	473	464	462	467	463	466	452	4.3	0.04	0.01	0.71	0.97	0.41	0.85
Final[*]	470	470	464	474	464	466	453	5.1	0.98	0.03	0.50	0.52	0.28	0.47
Body Weight Gain, lb														
per head/d[*]	1.13	0.91	0.95	1.18	1.04	1.00	0.64	0.14	0.17	0.01	0.22	0.84	0.44	0.33
per head[*]	37.4	36.9	31.7	40.0	30.7	33.0	20.0	5.1	0.94	0.04	0.47	0.46	0.33	0.59
per ac	110.9	109.5	94.0	118.4	90.9	94.6	59.3	15.0	--	--	--	--	--	--
Body Condition Score														
Initial	6.4	6.5	6.4	6.4	6.3	6.3	6.3	.15	0.58	0.60	0.34	0.79	0.83	0.92
Change	0.2	0.3	0.4	0.3	0.3	0.2	0.3	.17	0.86	0.90	0.80	0.78	0.50	0.90

[a] Forage treatments are barley (B), millet (M), millet/alfalfa intercrop (MA), millet/sweet clover intercrop (MC), alfalfa (A), sweet clover (C) and field pea (P).
[b] Standard error of a mean.
[*,**,***] Probability of a significant overall effect of forage treatment (P < .10, .05 and .01, respectively).