Impact of Strip-Grazing Stockpiled Annual/Cover Crop Forages on Carrying Capacity and Animal Performance

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Summary with Implications

Annual forages/cover crops can be used to fill the fall/winter grazing gap, and strip grazing may increase carrying capacity by reducing trampling losses of the forage. The current experiment utilized a series of on-farm experiments across two growing seasons to compare continuous and strip grazing of various summer planted cover crops. Strip grazing increased carrying capacity by an average of 47 ± 15% and gain per acre by 44 ± 5% compared to continuous grazing although significant variability in the amount of increase was observed. This variability can likely be attributed to forage type (quality), frequency of moves, and forage allowance. Overall, strip grazing can be a valuable tool to increase carrying capacity when grazing summer planted cover crops during the fall and winter.

Introduction

Annual forages/cover crops can be used to fill the grazing gap in between perennial pasture in the fall and start of corn residue grazing. Currently, small cereal grains, warm season grasses, and brassicas are all commonly planted in the summer for fall/winter grazing. The cool season species (small cereals and brassicas) typically produce less forage than the warm seasons but are higher in quality.

Grazing management is a key component that impacts the profitability of grazing these annual forages. Strip grazing can increase forage utilization by allocating animals to a smaller portion of a larger paddock for relatively short times. When compared to continuous grazing, strip grazing has been shown to result in greater harvest efficiency and thus allowing more grazing from the same acres in perennial grass systems. However, this usually comes at the cost of reduced forage selectivity and thus reduced individual performance, such as reduced average daily gain for growing calves. Also, there may be an increase in labor needed to move fence with strip grazing.

Thus, a series of on-farm experiments were conducted over two growing seasons (2020 and 2021) in Nebraska to evaluate the effects of strip grazing on cattle performance when utilizing various annual forage resources during the late fall and winter.

Procedure

Research was conducted at 5 locations across the state of Nebraska (Table 1). One location in eastern NE had three groups of cattle that grazed their paddock continuously (CONT) and three that were strip grazed (STRIP) in each of the two years, while the remaining 4 locations each had one group that was continuously grazed and one group that was strip grazed. One of these four locations had data collected in both years and the other three only had data collected in a single year. The eastern NE location had replication within year, but used different forage types in each year. Thus, these data from the eastern NE locations were first analyzed to compare the effects of grazing management within year and then averaged within treatment and year replicates for a single value within year in a pooled analysis with the other locations. This was done to ensure that in the pooled analysis (n = 7 site years), all site years had a similar statistical weight to analyze the effect of grazing management across all locations.

Eastern Nebraska Year 1: Oats and Brassicas

Just prior to planting on August 12, 2020, an herbicide was applied to control weeds that grew after spring oats were harvested. Then the 93-acre irrigated field was no-till drilled with 50 lb/ac of Jerry oats and 3 lb/ac of Trophy rapeseed. Post emergence, nitrogen was applied at a rate of 38 lb/ac. The field received 1.6 ac-inches of water through a pivot during growth of the cover crop. The field was divided into 6 paddocks split between 2 treatments for a total of 3 replicates per treatment. Treatments were arranged in a completely randomized block design where paddock was the experimental unit. Paddocks were separated into 3 blocks with 2 blocks containing only irrigated land and 1 block which included dryland corners.

Steers (n = 84) were stratified by initial body weight (524 lbs) and assigned to 1 of 6 groups (n = 14 per group) that were assigned to a paddock. Seven of the 14 steers in each group were designated as testers and used to measure animal performance. Grazing began on November 12, 2020 and was terminated on February 3, 2021 (83 d) when the average forage height of CONT was 2 inches. The STRIP treatment groups were given access to new forage twice weekly, with a target of 2-inch post-grazing height and cattle were not back fenced. Steers grazing continuously had access to 15.5 ± 0.01 acres (1.11 acre/head) while STRIP calves used 8.5 ± 1.36 acres (0.60 acre/head).

Prior to grazing, forage was clipped at ground level and sorted by species to determine forage biomass and quality. Four locations (3 x 2 ft) in each of the irrigated paddocks and 5 locations of the paddocks containing the dryland corners were clipped (3 from the irrigated and 2 in the dryland portion of the paddock). On days 21, 41, and 70 of grazing, biomass was clipped again from 4 locations in each of the CONT paddocks. On these days for STRIP, 2 locations were clipped in the strip

Table 1. Summary of management of experiment sites located in Nebraska to evaluate the effect of continuous (CONT) vs. strip-grazing (STRIP) of summer planted annual forages in the fall/winter.

Site	Year	Planting Date	Species	Initial biomass lb/ac	Start Grazing Date	Treatment	Days grazed	Animal Type	Stocking density, lb BW/ac	AUM/ ac1	Increase in grazing capacity, %	Frequency of moves
East	2020	Early Aug	Oat and Rapeseed mix	4,356	Mid Nov	CONT	83	600 lb steer	560	1.48	-	-
						STRIP	83		21,000	2.75	86%	Twice a week
East	2021	Mid-July	17 species mix with millet and sunflower predominate	2,364	Early Dec	CONT	54	675 lb steer	675	1.20	-	-
						STRIP	54		13,235	1.70	42%	Twice a week
North west	2020	August	Oat and Turnip	-	Late Nov	CONT	44	1400 lb cow	1,225	1.53	-	-
						STRIP	38		9,224	2.12	39%	Once a week
North west	2021	August	Oat and Turnip	-	Early Nov	CONT	73	475 lb heifer	1,676	2.17	-	-
						STRIP	73		8,177	2.44	12%	Once a week
South west	2020	Mid-August	Oat and Rapeseed	989	Early Nov	CONT	7	1400 lb cow	1,300	0.28	-	-
						STRIP	16		5,040	0.61	118%	Twice a week
South central	2020	Early Aug	Oats and Rapeseed	1,164	Early Oct	CONT	26	1400 lb cow	790	0.76	-	-
						STRIP	26		5,287	0.87	14%	Once a week
North east	2021	August	forage sorghum, radish, turnip, pea, vetch, rye, oat, sunflower	2,108	Mid October	CONT	33	1400 lb cow	940	1.40	-	-
						STRIP	56		40,084	1.70	21%	Daily

[1]AUM = Animal Unit Month, a 1000-pound animal over a month of time

Table 2. Initial forage species composition and quality of oat-rapeseed mix grazed in the fall/ winter in Eastern NE Year 1: Oats and Brassicas

Forage type	Biomass, %	DOM[1], %	CP[2], %
Oats	74.5	70.5	8.4
Rapeseed	25.5	80.1	15.8
Forage as offered		72.3	10.3

[1]DOM = Digestible Organic Matter, a proxy for TDN (energy)

[2]CP = Crude Protein

that would be allocated and 2 locations from the grazed strip that was previously sampled for pre-graze biomass were taken to allow for a more accurate estimate of disappearance. No final biomass clippings were able to be collected as steers from an adjacent field grazed in the experimental paddocks prior to sample collection.

Forage samples were then dried for 48–72 hours in a 60°forced air oven to determine biomass and analyzed for crude protein (combustion method) and digestible organic matter (DOM) to determine quality. The DOM was determined by incubating samples in buffered rumen fluid for 48 hours to determine invitro organic matter digestibility (IVOMD) and then multiplying that by the organic matter content of the sample. This serves as an evaluation of the energy content of the forage and is a proxy for total digestible nutrients (TDN).

To determine the economics of grazing a partial budget analysis was conducted. Costs included seed ($10.80/ac), seeding ($12.00/ac), irrigation ($15.02/ac), nitrogen fertilizer ($15/ac) and nitrogen application ($8.75/ac), herbicide ($18.77) and herbicide application ($7.00/ac) and temporary perimeter fencing ($5.00/ac). Labor for moving the STRIP fence was charged at $20/hr and 0.5 hr per move per group ($28.04/ac). In total, continuous grazing costs were budgeted at $92.34 per acre while strip grazing was $120.38.

Eastern Nebraska Year 2: Diverse Annual Mix

In mid-July after wheat harvest, a 17 species mix which included warm and cool season grasses, legumes, and forbs was planted on 60 ac of irrigated land. No irrigation or nitrogen fertilizer was applied. The field was divided into six, 10 acre paddocks that were blocked by location in the field. Treatment (CONT or STRIP) was randomly assigned to paddock within block for a total of 3 replicates per treatment. Paddock was considered the experimental unit. The STRIP groups were allocated forage approximately twice a week, with new strips provided when approximately 40% of the forage had disappeared.

Steers (n = 60) were stratified by initial body weight (635 ± 0.71 lb) with 10 steers assigned to each paddock. Grazing was initiated on December 9, 2021 and terminated on February 1, 2022 (54 d) when the average forage disappearance of the CONT was approximately 40% of the biomass. Steers grazing continuously had access to 9.99 ± 0.01 acres (1 acre/head) while STRIP calves used 7.16 ± 1.21 acres (0.72 acre/head).

Forage clippings for biomass and quality analysis were collected prior to grazing initiation (pre-graze) and clippings for biomass analysis were collected following grazing termination (post-graze). Each paddock was divided into 5 equal parts and biomass was clipped from a random location (3 feet by 2 feet area) with each of the five zones. Following collection, forage samples were sorted by plant functional type and pre-graze samples were analyzed for quality as described previously.

A partial budget analysis was again conducted to determine the economics of grazing. Between treatments, costs kept consistent in the budget included seed ($50.00/ac), seeding ($12.00/ac), and temporary perimeter fence ($5.00/ac). Expenses applied only to STRIP paddocks included labor for moving the STRIP fence and was charged at $20/hr and 0.5 hr per move per group. In total, continuous grazing cost $67.00/ac while strip grazing cost $85.16/ac.

Pooled Analysis: Stockpiled Mixes Across Nebraska

A total of 4 additional locations, across 2 years were utilized for a total of 5 additional site years of the comparison of CONT to STRIP grazing of stockpiled cover crops (Table 1). An oat brassica mix (purple top turnips or rapeseed) was planted on 4 of the 5 site years with the remaining site year being planted to a mix of forage sorghum, radish, turnip, pea, vetch, rye, oat, and sunflower. Cows were utilized on 4 of the 5 site years with the remaining utilizing developing heifers. Grazing was initiated in the fall and was terminated when the producer felt that forage was limited.

Results

Eastern Nebraska Year1: Oats and Brassicas

The initial forage biomass was predominantly oats with the rapeseed comprising about a quarter of the forage available (Table 2). The amount of forage (initial biomass 4328 vs. 4383 ± 300 lbs/ac for CONT and STRIP, respectively) and energy content (DOM, % DM) of the forage offered were not different ($P \geq 0.58$) between CONT and STRIP. Both species were relatively high in energy with the rapeseed having almost double the amount of CP of the oats. As designed, the initial BW of steers did not differ ($P = 0.54$) between treatments (Table 3). Following grazing termination, STRIP steers were lighter ($P = 0.01$) due to lesser ADG (difference of 0.31 lb/d) than CONT steers. However, the STRIP steers were allotted about a third less acres per calf compared to CONT. Consequently, STRIP had increased ($P = 0.03$) carrying capacity with 82% more AUM/ac and increased gain per acre ($P = 0.02$) with 56% more lb of gain/ac than CONT. Though numerically there was a 10-cent decrease in cost per pound of gain for STRIP calves compared to CONT, this was not statistically significant ($P = 0.11$). This indicates that even though strip grazing might be more expensive on a dollars per acre basis, the additional gain will at minimum pay for the extra labor.

Eastern Nebraska Year 2: Diverse Annual Mix

Initial forage quality and portions of the biomass made up by various plant functional groups are shown in Table 4. Although 17 species were seeded, biomass composition predominantly consisted of pearl millet,

Table 3. Carrying capacity and performance of steers grazing an oat-rapeseed mix continuously (CONT) or strip-grazed (STRIP) over an 83 d period in the fall/winter in Eastern NE Year 1: Oats and Brassicas

Variable	CONT	STRIP	SEM	*P*-value
Initial BW, lb	524	524	0.6	0.54
Final BW, lb	687	661	2.7	0.01
ADG, lb	1.98	1.67	0.025	0.01
AUM/ac[1]	1.49	2.71	0.156	0.03
Gain, lb/ac	148	232	9.3	0.02
Cost of gain, $/lb	0.62	0.52	0.26	0.11

[1]AUM = Animal Unit Month, a 1000-pound animal over a month of time

Table 4. Initial forage species composition and quality of 17 species mix grazed in the winter in Eastern NE Year 2: Diverse Annual Mix.

Forage type	Biomass, %	DOM[1], %	CP[2], %
Grasses[3]	72.6	52.5	5.7
Grass seedheads[4]	12.6	65.1	9.9
Legumes[5]	4.4	66.1	17.1
Forbs[6]	8.6	45.6	6.8
Sunflower heads	1.8	63.9	10.9
Forage as offered	—	54.2	6.9

[1]DOM = Digestible Organic Matter, a proxy for TDN (energy)
[2]CP = Crude Protein
[3] mostly pearl, german and browtop millet
[4] german and browtop millet
[5] cowpea, mungbean, spring pea and vetch
[6] mostly sunflower stems

Table 5. Forage biomass and disappearance of summer planted 17 species mix when continuously grazed (CONT) or strip-grazed (STRIP) in the fall/winter in Eastern NE Year 2: Diverse Annual Mix

Variable	CONT	STRIP	SEM	*P*-Value
Initial biomass, lb/ac	2,509	2,219	213	0.44
Final biomass, lb/ac	1,358	1,367	51	0.91
Disappearance, lb DM/ AUM[1]	963	523	208	0.28
	Disappearance, % change from initial biomass			
Grasses	36.0	29.3	10.2	0.69
Grass Seedheads	81.0	74.7	3.2	0.29
Forbs and legumes[2]	54.7	27.7	15.0	0.33
Sunflower heads	100	100	-	-

[1]AUM = Animal Unit Month = 1000-pound animal grazing over a month of time; calculated based on the weight and number of the grazing animals and duration of grazing; expected intake would be 702 lb of DM per AUM
[2]mostly sunflower stems

german millet, browntop millet and sunflower. At the start of grazing the german and browntop millets had fully developed seedheads with hand plucked samples containing 32% and 20% starch (DM basis), respectively. The sunflower heads had started to fill with seed and hand plucked samples contained 7.5% fat (DM basis).

Initial and final biomass were not different ($P \geq 0.44$) between treatments (Table 5). Calves were allowed to be selective with a target disappearance of 40% of the total biomass. Steers selected the sunflower heads (no heads remaining post-grazing) and grass seedheads [with the majority (78%) disappearing in the grazed areas]. Following the disappearance of the reproductive structures, calves appeared to select forbs and legumes then cool-season grasses. Disappearance (lb DM/AUM) was not different ($P = 0.28$) between CONT and STRIP.

The initial BW, final BW and ADG of steers did not differ ($P \geq 0.55$). The carrying capacity (AUM/ac) tended to be increased ($P = 0.10$) by 43% in STRIP whereas gain per acre was increased ($P = 0.02$) by 31% for STRIP over CONT. The cost of gain did not differ ($P = 0.56$) between treatments, again suggesting the increased harvest efficiency can pay for the increased labor.

Eastern Nebraska Year 1 vs. Eastern Nebraska Year 2

When grazing the oat/brassica mix in year 1, ADG of steers in the STRIP was reduced (16%) compared to the CONT. However, in year 2, there was no difference in ADG between treatments, although there was a numerical decrease (6%) in the STRIP. This difference in individual animal performance response could be a result of the greater forage quality found in the oats and brassica mix (73% DOM and 10.3% CP) compared to the 17 species mix (54% DOM and 6.9% CP) which resulted in high-

Table 6. Carrying capacity and performance of steers grazing a summer planted 17 way mix continuously (CONT) or strip-grazed (STRIP) over a 54 d period in the fall/winter in Eastern NE Year 2: Diverse Annual Mix

Variable	CONT	STRIP	SEM	*P*-value
Initial BW, lb	635	635	0.7	1.00
Final BW, lb	718	713	5.3	0.55
ADG, lb	1.54	1.45	0.08	0.55
AUM/ac[1]	1.20	1.71	0.13	0.10
Gain, lb/ac	83	109	2.9	0.02
Cost of gain, $/lb	0.81	0.78	0.03	0.56

[1]AUM = Animal Unit Month, a 1000-pound animal grazing for one month; calculated based on the weight and number of the grazing animals and duration of grazing

Table 7. Effect of continuously grazing (CONT) vs. strip-grazing (STRIP) stockpiled annual forages in the fall/winter on carrying capacity and forage disappearance over 7 site years

Variable	CONT	STRIP	SEM	*P* value
Initial biomass, lb/ac	2,288	2,104	605	0.27
Final biomass, lb/ac	940	802	259	0.16
AUM/ac	1.26	1.74	0.26	0.02
Disappearance, lb DM/AUM	1,643	767	544	0.20

[1]AUM = Animal Unit Month = 1000-pound animal grazing over a month of time; calculated based on the weight and number of the grazing animals and duration of grazing; expected intake would be 702 lb of DM per AUM

er gains in year 1 than year 2. It may also be due to differences in forage allocation. In year 1, the difference in forage offered per AUM between CONT and STRIP was greater than in year 2, however the amount of forage offered in the STRIP treatments were not vastly different. Forage offered in year 1 was 2943 lb/AUM for CONT and 1584 lb/AUM for STRIP. In year 2, the forage offered per AUM was 1970 lb/AUM for CONT and 1390 lb/AUM for STRIP. Altogether, these data show the benefit of strip grazing appeared to be greater in year 1 when there was a greater quantity and quality of forage available than in year 2. Though no direct comparison can be made from this study, strip grazing forages of higher nutritional value may provide greater gain on the same number of acres when compared to strip grazing forages of lower nutritional value.

Pooled Analysis: Stockpiled Annual Forage Mixes

Initial biomass varied greatly between sites and years (Table 1), but the average initial and final biomass was not different between CONT and STRIP (Table 7). The STRIP treatment had greater ($P = 0.02$) carrying capacity (AUM/ac) compared to CONT. In fact, across all the sites strip grazing increased carrying capacity by 47%, although this varied substantially ranging from an increase of 12% to 118%. Statistically, there was no difference ($P = 0.20$) in forage disappearance (lb DM/AUM) between the STRIP and CONT, although across sites STRIP numerically reduced disappearance per AUM by 53%. The expected intake per AUM is 702 lb of dry matter. This means that STRIP only lost an estimated 8.5% of forage to trampling loss compared to the CONT treatment which lost an estimated 57%.

Conclusions

Strip grazing increased carrying capacity and gain per acre when compared to continuously grazing stockpiled annual forages in the fall/winter. Variability in the response to strip grazing may be attributed to forage type, stocking density, frequency of moves, and how selective cattle are allowed to be when grazing (forage allowance). Overall, strip grazing can be a valuable tool to increase carrying capacity when grazing summer planted cover crops during the fall and winter.

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