Livestock Integration

UPDATE MARCH 2025

Why Livestock are Integrated at Dakota Lakes

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Livestock play a vital role in harvesting cover crops and perennial forages used in crop rotations. Livestock grazing generates short-term economic returns while forages provide long-term soil benefits. Grazing crops in the field, rather than removing grain and hay, ensures that organic matter and mineral nutrients remain in place and are returned to the soil.

Perennials offer additional advantages. Their deep root systems stay active deeper in the soil and for a longer portion of the growing season compared to annuals. These roots transport nutrients from deeper layers back to the surface, making them accessible to subsequent crops. In areas with high water tables, perennials also help reduce salinity by drawing down excess water and mitigating saline seeps. When cattle graze cropland and consume supplemental feed such as soybean meal and grain, most of the nutrients and organic matter from those inputs remain on the land, contributing to soil fertility.

Figure 1. January 9, 2025. Steers bale graze on the edge of a field at Dakota Lakes Research Farm.

March 2025

Winter wheat was harvested from our North Unit “South” field on July 18th. A forage cover crop of barley, oats, and triticale was planted on August 6. This is a dryland field with heavy clay soils. This forage crop and volunteer winter wheat were ready to graze on Sept. 25, when we received 151 steers weighing 768 lb. from a cooperator. Because the previous two crops on this field were wheat, there appeared to be abundant soil “armor” provided by wheat straw, although this was not quantified. One steer died of bloat the following day. This presumably happened because the steers were shipped early in the morning and were put directly onto the high-quality cover crop. The death probably would have been prevented by shipping later in the day, after the steers had time to eat some hay so that they didn’t arrive at the cover crop with an empty rumen.

The steers grazed the standing cover crop and milo residue in an adjacent field until Oct. 15, when they moved to the main farm. At the main farm, they primarily grazed swathed cover crops and corn residue, with supplemental hay, until Dec. 19, when their diet became mostly hay. Hay was primarily alfalfa or alfalfa/orchardgrass but switchgrass and prairie hay was also included. Hay was fed either as bale-grazing on field margins (Figures 1-2), bale-grazing or rolling out bales in a grassy draw, or by processing the bales onto irrigator wheel tracks.

Figure 2. January 9, 2025. Steers bale graze on the edge of a field at Dakota Lakes Research Farm.

We started feeding grain and oilseed meal on Nov. 13th and increased this supplement to 6 lb/hd/day on Dec. 13. Supplement increased to 8 lb/hd/day on Jan. 25. When we were feeding cover crop swaths and using irrigators to move fences, we also pulled the feedbunks with the irrigator so that the bunks were in a different location every day (see the March 2024 report for more info on the mobile feedbunks). On Feb. 14, steers left Dakota Lakes for a feedlot in Iowa. They weighed an average of 1009 lb (979 after a 3% shrink), having gained 211 lb over the course of 142 days, for an average of 1.48 lb/day (Figure 3). Death loss was 1.5% (two head).

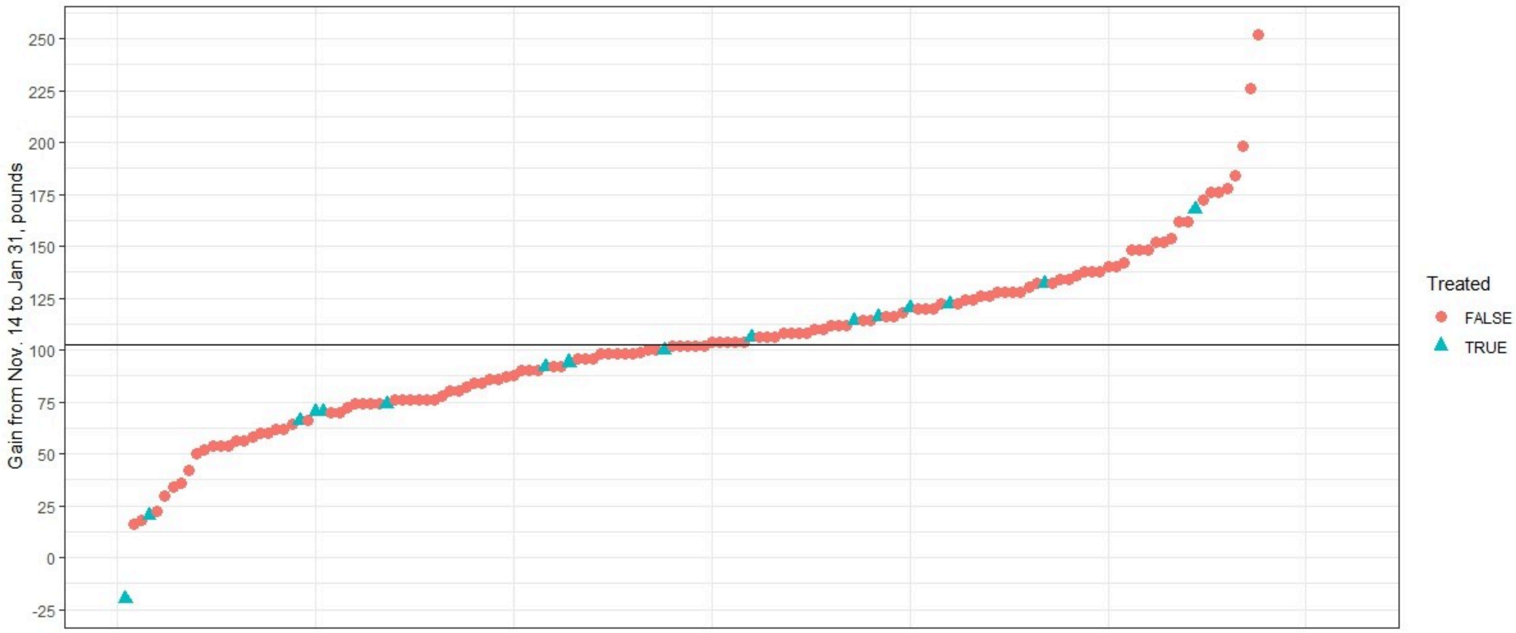


Figure 3. Each dot represents an individual steer. As expected, the amount of weight gained varied widely across individual steers. Steers that were treated with antibiotic for illness (mostly pinkeye) are indicated with a blue triangle. The complete grazing period extended from Sep. 25 to Feb. 14. This plot shows weight gained from Nov. 14 to Jan 31, only, because those are the dates that individual weights were collected.

Stocker and cover crop economics

To calculate the cost to graze stockers over the fall and winter, we estimated the cost of producing the cover crops (reported in our Sept. 2024 semi-annual report) and added the additional costs to care for cattle (fencing, water, husbandry, mineral). We calculated the number of animal units following the NRCS procedure (simply divide weight by 1000 lb) and multiplied by the number of days in the field to find the animal units * days. We divided this into the cost/ac. to find the cost of keeping one animal unit for one day on each cover crop. The results are shown in Table 1. Although these scenarios all show an economic loss for grazing the cover crops, the budgets do not include the value of the nutrients returned to the soil in the form of dung, urine, and crop residue. Nor do the budgets include any value for difficult-to-quantify benefits of cover crops, such as the presence of living roots.

Table 1. Economics of grazing cover crops and feeding hay at Dakota Lakes Research Farm during the fall/winter of 2024/2025.

Field name	Type	Production cost, $/ac.	Animal units * days per ac.	$/ (animal unit * day)	Net profit if paid $1.20 per pound of live-weight gained	Break even, $ per pound of live-weight gained	Break even with a chemical fallow
North Unit – South field	Dryland cover crop, grazed standing	$115	33	$3.52	$40/ac. loss	$1.84	$1.31
0-3	Irrigated, swathed cover crop	$191	80	$2.39	$23/ac. loss	$1.37	$1.13
2-6	Irrigated, swathed cover crop	$145	63	$2.31	$6/ac. loss	$1.26	$1.26 (no chemical was applied)
Hay	Irrigated, alfalfa-orchardgrass			$2.38			
Hay	Dryland alfalfa (low yield year)			$3.39			

Alfalfa impacted by feeding on hayfield

During the previous winter, we fed hay and grain in portable bunks on alfalfa field, “3-1.” We previously reported that the soil near the bunk (3’ from the center) was enriched in soil N, Olsen P, K, Na, B, and soluble salts relative to distances 15’ and 45’ from the bunks. We now report the results of forage quality collected on June 3, immediately before the first alfalfa cutting. We did not find differences in forage tissue for the following: crude protein (21%), ADF (31%), NDF (37%), NDF digestibility (43%), ash (9%), lignin (7%), ether extract (2.4%), total digestible nutrients (0.65), P (0.26), K (3.2), Ca (1.9), Mg (0.51), Na (0.023), Fe (80), Cu (5.5), B (54), or Mo (0.22).

We found sulfur and manganese were higher at 3’ from the bunk than at 15’ or 45’ (Table 2). Zinc was similar, but the difference only occurred on the west side of the bunk (the direction the steers approached the bunk from), and there was more zinc on the west side than the east side (Table 3). All three of these nutrients had positive, statistically significant correlations with the percentage of kochia in the sample. That is to say, as the percentage of kochia increased, so did the concentration of these minerals. Thus, the change in overall forage mineral value is probably NOT due to changes in alfalfa, but rather is due to changes in the quantity of kochia in the sample.

Table 2. Concentration of two nutrients in forage tissue, as impacted by feeding on the alfalfa hayfield. Within a column, values followed by the same letter are not different ($p > 0.05$).

Distance from feedbunk, ft	Sulfur, %	Manganese, ppm
3	0.35 a	106 a
15	0.27 b	64 b
45	0.28 b	54 b

In Dec. 2023, the steers at Dakota Lakes were fed out of feedbunks on the alfalfa field. In the foreground, you can see a trail of hay that didn't get eaten, where the feedbunk was sitting previously. It was moved every few days.

Table 3. Concentration (ppm) of zinc in forage. Within a column (row), values followed by the same lowercase (uppercase) letter are not different ($p > 0.05$).

Distance from feedbunk, ft	East	West
3	23 a A	31 a B
15	22 a A	20 b A
45	22 a A	24 b A

Standing cover crop

Heifers grazed a standing cover crop composed of barley, oats, and triticale at our Raptor Roost property. When they first started grazing, fecal samples predicted dry matter intake (DMI) of 2.85% of body weight, weight gain of 2.8 lb/day, dietary CP of 19%, and digestible organic matter of 73%. These dietary predictions exceed forage quality measurements (Figs. 4-5), as would be expected, because grazing animals select a diet that is higher quality than the average available forage.

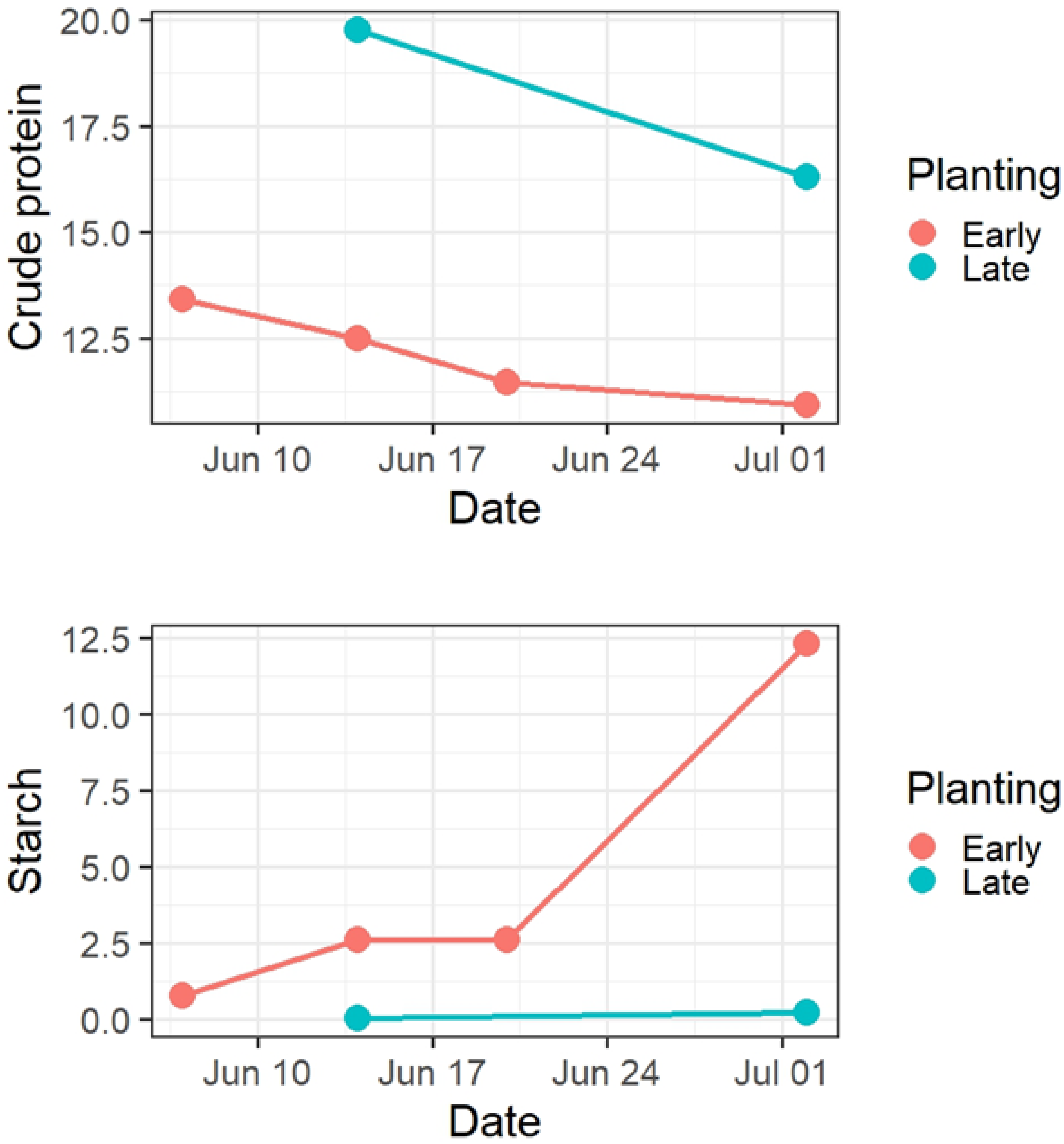
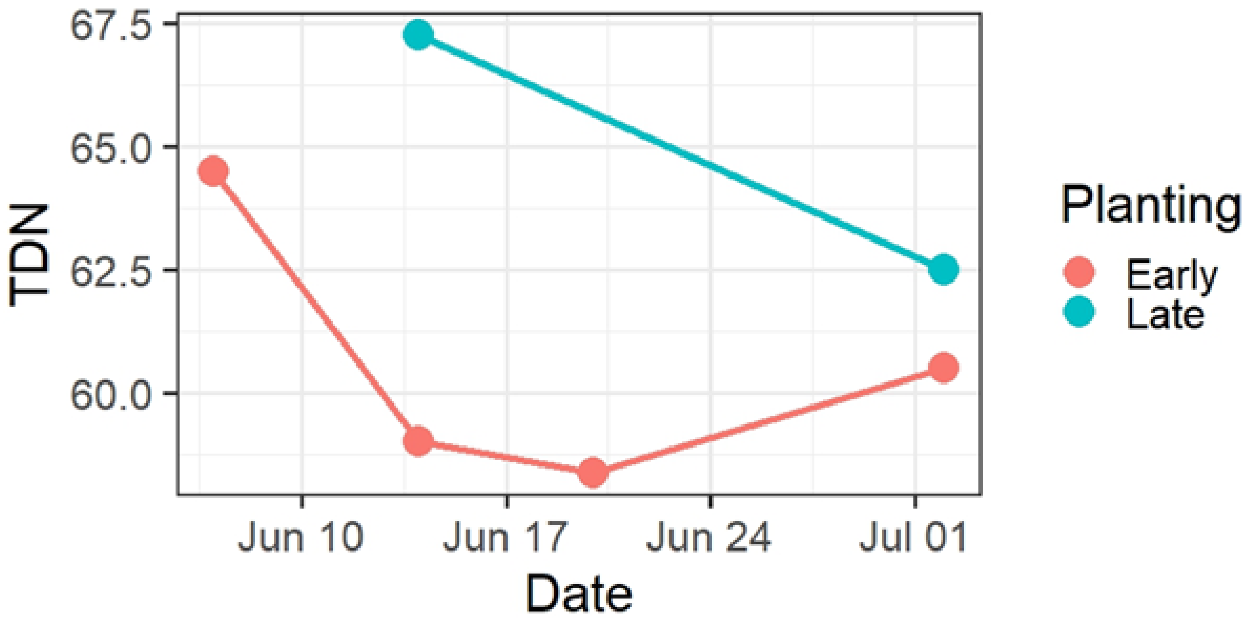


Figure 4. Crude protein and starch of a standing cover crop. Both fields were planted to the same species mixture, but the early field was planted on April 10 whereas the late field was planted on May 10. Note that crude protein steadily declined as the crop matured. In contrast, starch content remained very low until it began accumulating rapidly in the seed. Crude protein remained relatively high throughout the grazing period.



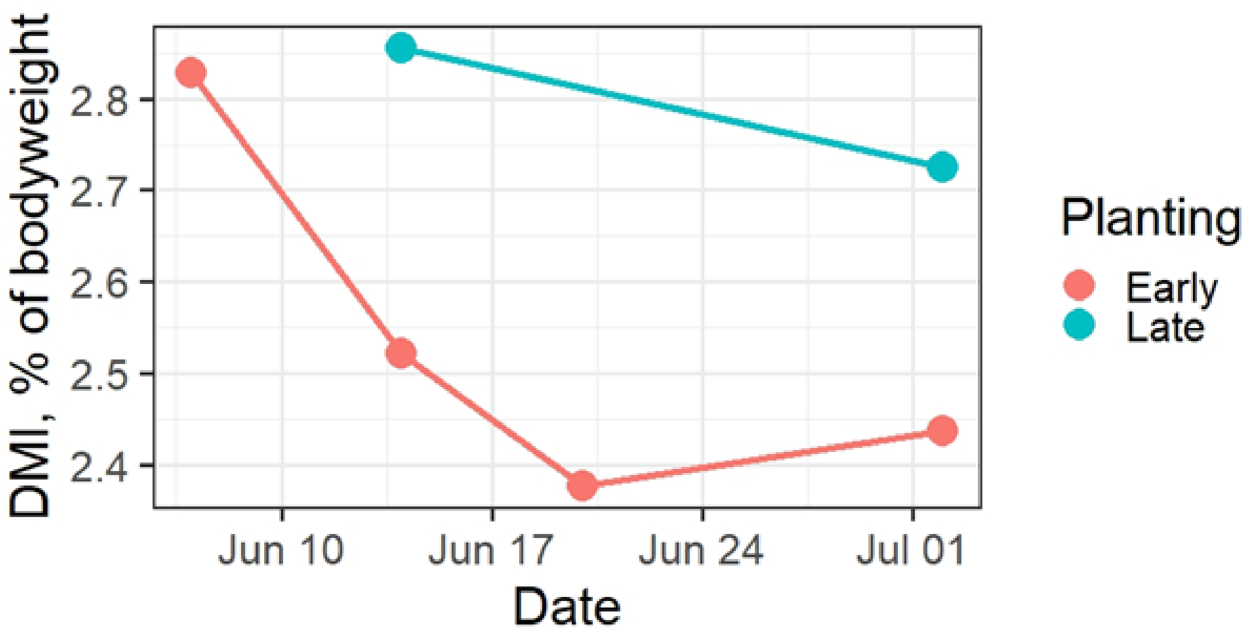


Figure 5. Total digestible nutrients (TDN) and predicted dry matter intake (DMI) of a standing cover crop. Both fields were planted to the same species mixture but the early field was planted on April 10 whereas the late field was planted on May 10. Dry matter intake is predicted by TDN; both TDN and DMI typically decline as a crop matures.

In October 2024, steers grazed swathed cover crops at Dakota Lakes Research Farm. An experiment was conducted to measure the effect of spraying the cover crop with a fungicide. The forage quality parameters measured showed no differences from the fungicide.

Cover crop swaths

We measured forage quality of cover crop swaths on two irrigated fields (field 0-3 and field 2-6) at the time we began grazing (Oct. 8, 2024). In one of those fields (field 2-6), we conducted an experiment to determine the effect of spraying a fungicide (Tebaconazole @ 4 oz./ac.) to control leaf rust. We measured forage quality parameters but did not detect any differences due to the fungicide ($p > 0.05$; Table 4).

Table 4. Forage quality of cover crop swaths in two irrigated fields.

Field	CP	ADF	NDF	NDF digestibility	Ash	Lignin	Fat	TDN
0-3	13.5	36	60	66	11	3.1	2.1	60
2-6	12.1	35	61	66	10	2.7	2.5	61

Hay quality

We collected core samples from hay produced, as shown in Table 5. Because most of our hay was at least partially alfalfa, our crude protein (CP) levels were higher than necessary for cattle diets if fed alone, but could help balance a diet that includes low CP feeds, such as corn residue. For alfalfa hay, our TDN values fall in the USDA Good (58-60), Premium (60.5-62), and Supreme (> 62) categories.

Table 5. Nutrient density of hay on hand in summer of 2024, dry matter basis

Field	Cutting	CP	TDN	# bales
3-1, dryland alfalfa	1st, 2024	20	62	19
3-1, dryland alfalfa	2nd, 2024	25	64	3
1-2, irrigated alfalfa/orchardgrass	1st, 2024	21	65	41
1-2, irrigated alfalfa/orchardgrass	2nd, 2024	19	59	22
1-2, irrigated alfalfa/orchardgrass	3rd, 2024	24	63	13
1-2, irrigated alfalfa/orchardgrass	4th, 2024	18	57	21
1-2, irrigated alfaflfa/orchardgrass	2023	22	59	
1-2, irrigated alfalfa/orchardgrass	2023	21	59	
Prairie hay	2023	11	57	
Barley	2023	19	58	

Corn hand harvest data

We hand-harvested corn from a field (field 0-7) that had been grazed most winters since 2017. Grazing was of cover crop swaths (1 year out of 4) or of corn residue (2 years out of 4). We collected samples within grazing exclosures and outside of grazing exclosures. The grazing exclosures have been used every winter that grazing occurred. We found no difference in population (13 plants/ten feet), ears (11 ears/ten feet), or yield (187 bu/ac). We also measured concentration of 12 elements in grain but did not find any differences due to grazing (Table 6).

Table 6. Concentration of elements in corn grain. Values are averaged across all samples because there was no difference between grazed and non-grazed areas.

N, %	P, %	K, %	S, %	Ca, %	Mg, %
1.24	0.20	0.31	0.10	0.02	0.09
Fe, ppm	**Mn, ppm**	**Cu, ppm**	**B, ppm**	**Mo, ppm**	**Zn, ppm**
30	3.8	1.8	2.2	0.07	19

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