Integrated Crop / Livestock ystems – 2017 Summary

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Late summer and fall grazing (Phase 3)

Phase 3 of the Integrated Crop/Livestock (ICL) systems project was initiated in 2015 focusing on providing forages at times when native range may not be of adequate quality to maintain the rate of animal weight gain. Previous phases looked at the late fall (Phase II) and winter periods (Phase I). In this phase, we continue to focus on the late fall grazing period, but also include potential needs during the late summer. In Phase 3, we are also looking to increase grain production while meeting critical forage needs, so harvestable grain crops are included for two years out of a three year rotation.

Cropping system – integrated treatments:

1. Spring wheat, which is inter-seeded at or around the 4-leaf stage with a 6-way mixture of intermediate wheatgrass, alfalfa, hairy vetch, red clover, daikon radish, and chicory.
2. Inter-seeded mix from previous spring wheat allowed to grow, then hayed during the growing season.
3. Corn for grain inter-seeded with soybean.

Check strips – grain-only treatments:

1. Spring wheat
2. Soybean
3. Corn

Grazing treatments – 20 yearling steers in each group (5 per replication):

1. Graze cropping system grazing treatment strips beginning in the fall. Hay harvested from the strips fed to the steers on those strips.
2. Graze native and introduced pastures and feed hay as needed.

Summary

All spring wheat and corn strips were sprayed May 11 with Durango (24 oz/ac) + 2,4-D LV6 (8 oz/ac) surfactant. Spring wheat (integrated treatment and check strips) was seeded with a JD 750 drill on May 12. An 11-row JD MaxEmerge II planter with 15 inch row spacing was used to plant the interseeded corn and soybean "integrated" treatment, with corn seed and soybean seed loaded in alternating planter boxes (6 rows of corn, 5 rows of soybean). The corn check strips were planted May 18 and the integrated treatments on May 19.

Both corn treatments were sprayed post-emergent June 29 (Cornerstone 5 Plus 32 oz/ac + surfactant) and the integrated treatment July 26 (Cornerstone 5 Plus 30 oz/ac + surfactant). The soybean check strips were planted May 23 and sprayed post-emergent June 12 (Durango 24 oz/ac + surfactant) and July 18 (Durango 26 oz/ac + surfactant).

Because of insufficient precipitation in spring the spring wheat integrated treatment was not inter-seeded. A 7-species cover crop mix (modified from the previous year) was seeded after wheat harvest on Aug 31 using a JD 750 drill. Prior to cover crop seeding the wheat stubble was sprayed with Durango (24 oz/ac) + surfactant on Aug 29. Both spring wheat treatments were swathed Aug 22.


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The integrated treatment was combined Aug 24 without the straw chopper and straw swathes were baled Aug 29 (765 lb/ac). The spring wheat check treatment was combined Aug 28 with the straw chopper (yields, Fig. 1). Soybean check strips were combined Oct 17. Also due to insufficient spring precipitation, the integrated corn treatment did not reach maturity and was grazed standing.

The corn check strips were combined Nov 1 & 16. The full season cover crop strips (seeded in 2016) were mowed with a 9 ft. sickle mower to facilitate drying on June 19, raked on the 21st and baled the 22nd (2725 lb/ac). They were mowed a second time Sept. 27, raked and baled Oct. 4th & 5th (1600 lb/ac).

On September 19th, Angus yearlings (steers and heifers) were put on portions of each of the four ICL fields with standing corn and on four control pastures (a mixture of five yearling steers and heifers per field or pasture). The control yearlings consumed only the forage they found in the pastures with free choice access to rural tap water and a mineral mixture and the ICL yearlings consumed only feedstuffs that were produced in their particular field (or equivalent feedstuffs).

Using electric fencing, the ICL yearlings were allowed access to only small parts of each field each day and given a non-grazed part of each field two to three times per week.

The average weight of all 40 yearlings was 857 lbs. at the start of the study. On October 21st, yearlings on the four ICL fields were also given access to cover crops in the wheat stubble because we suspected that they were not getting enough protein from the corn residue. On October 31st, we began feeding a ground mixture of cover crop hay and wheat straw to the yearlings in two of the fields (Reps 2 & 4), since they had grazed most of the standing corn.

The yearlings on the other two fields (Reps 1 & 3) transitioned to the feed mixtures on November 7th and 9th, respectively. The forage mixture fed was 85% hay and 15% straw plus four lbs. per yearling per day of whole corn grain and was fed on different spots of the cover crop production area of each field in an attempt to spread spilled feed, feces and urine somewhat uniformly across this area of each field. We increased the amount of whole corn in the feed mixture to 8 lbs per yearling per day on November 14th.

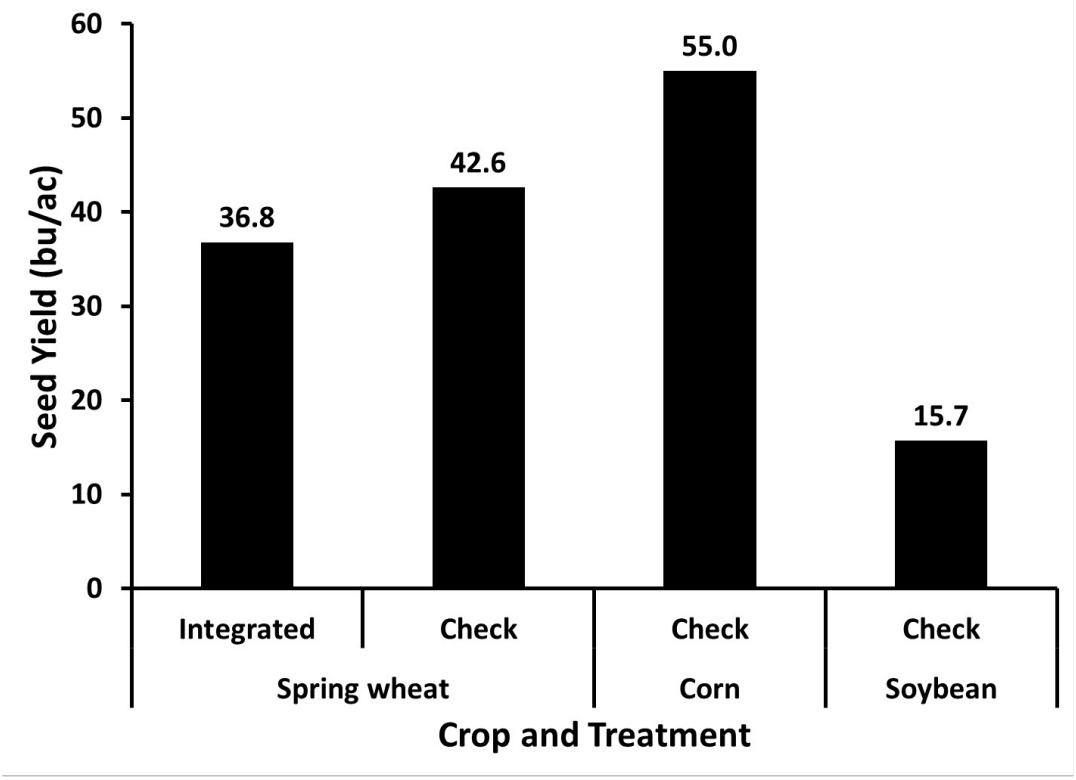

Fig. 1. 2017 grain/seed production for the grazed (Integrated) and grain crop check (Check) strips.

Table 1. Crop parameters for 2017.

Crop	Cultivar/ Type	Planting	Planting Rate	Fertilizer	Harvest
Spring wheat	Glenn	5/12/17	100 lb/ac	Urea - 30 lb N/ac MAP - 30 lb mat/ac	8/24/17
Cover crop mix:		8/31/17	26.5 lb/ac	None	None
Intermediate Wheatgrass	Manifest		6 lb/ac		
Timothy grass	VNS		6 lb/ac		
Alfalfa	Vernal		6 lb/ac		
Red clover	common		3.5 lb/ac		
Hairy vetch	Haymaker		1 lb/ac		
Radish	Daikon		3.5 lb/ac		
Chicory	common		0.5 lb/ac		
Corn	Mycogen 2R158b	5/19/17	24,500 seeds/ac	Urea - 40 lb N/ac MAP - 30 lb mat/ac	grazed
Interseeded w/ Soybean	Mycogen 5B024 R2	5/19/17	80,200 seeds/ac		
Check strips					
Spring wheat	Glenn	5/12/17	90 lb/ac	Urea - 30 lb N/ac MAP - 30 lb mat/ac	8/28/17
Corn	Mycogen 2R158b	5/18/17	24,500 seeds/ac	Urea - 40 lb N/ac MAP - 30 lb mat/ac	11/1/17 11/16/17
Soybean	Mycogen 5B024 R2	5/23/17	180,000 seeds/ac	None	10/17/17

All yearlings were removed from the control pastures on November 14th because we did not expect them to have good daily gains after this time. Average weight of these 20 control yearlings was 1011 lbs. at this time and their average daily gain from the beginning of the study was 2.33 lbs. Ten yearlings were removed from two fields (Reps 1 & 2) on December 15th when they had consumed all of the cover crop hay and straw produced on these fields in 2017. Average weight of these 10 yearlings was 1077 lbs. on December 15th and their average daily gain was 2.21 lbs. Finally, ten yearlings were removed from the other two fields (Reps 3 & 4) on December 27th when most of the cover crop and straw produced on these fields was consumed and the weather was turning much colder. Their average weight was 1119 lbs. on December 27th and their average daily gain was 2.26 lbs.

Soil, water, and gas analyses were conducted on ICL treatments throughout 2017. Surface soil samples (0-5 and 5-15 cm depths) were collected in the spring (26 May), summer (20 July), and fall (18 October) from the 'b' zone in each phase of each crop rotation and analyzed for physical and chemical properties. As a reference to the grazed and "crop only" treatments, grazed and ungrazed perennial grass pasture sites were also sampled. Processing and analyses of collected soil samples is underway.

Rainfall simulations were conducted before grazing in September and October to evaluate surface runoff and soil infiltration water quality in ICL and perennial grass pasture treatments. Water samples were analyzed off-site by collaborators in Brookings, SD for nitrate-N, nitrite-N, ammonium-N, and phosphate-P and on-site for total suspended solids. Rainfall simulations will be conducted again in March/April 2018 to compare pre- and post-graze effects on surface runoff and soil infiltration.

Trace greenhouse gas fluxes (CO_2, CH_4, N_2O) were measured using static chamber methodology near sample collection points for soil and water quality assessments. Samples were collected weekly from April through November, and every other week when the soil was frozen. Additional samplings occurred during "opportunistic" times following significant precipitation events or during mid-winter thaws. Following the first year of measurements, cumulative N_2O flux was found to be greater in grazed crops compared to ungrazed crops and grazed and ungrazed pasture (Faust and Liebig, 2017).

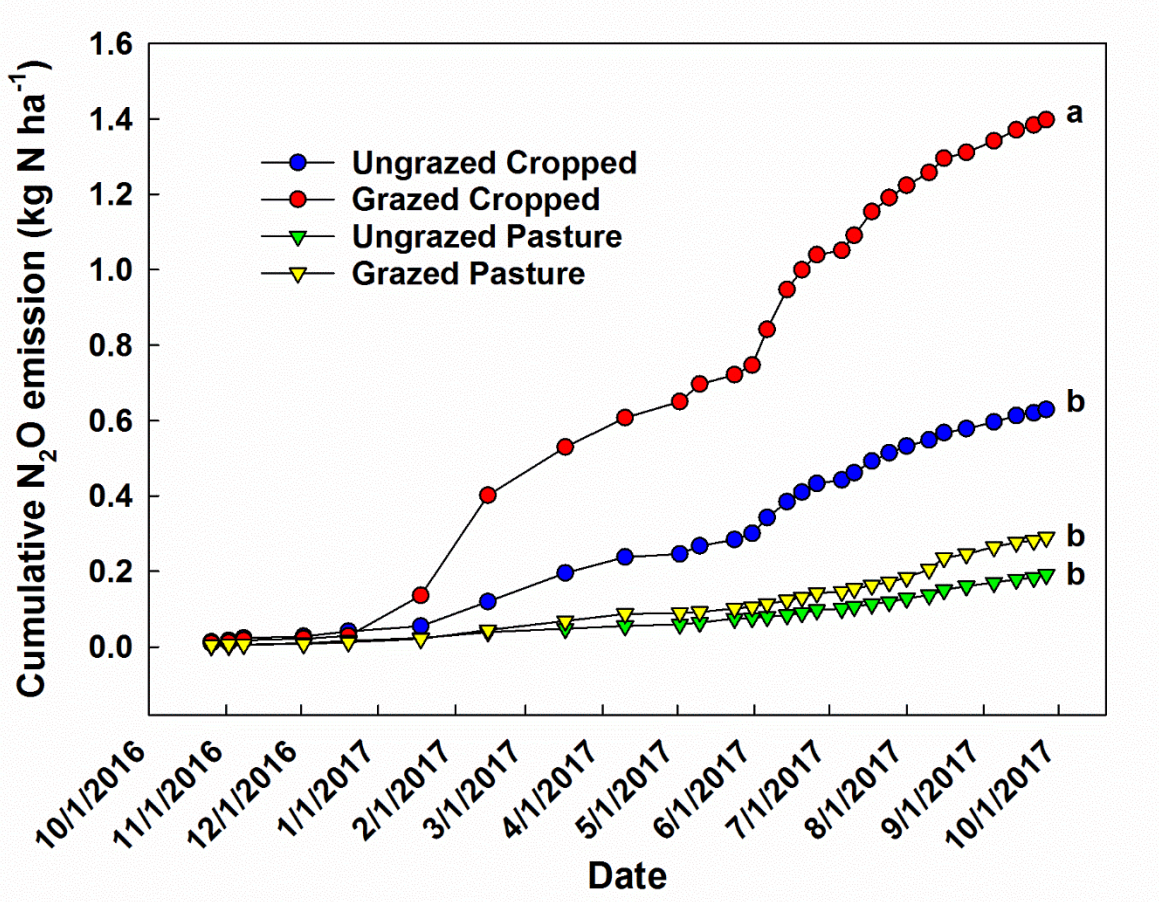

Fig. 2. Cumulative N_2O flux from integrated crop-livestock treatments including grazed and ungrazed crops and pasture, October 2016 – October 2017. Different letters to the right of the cumulative flux values signify treatment differences at P≤0.05.

References

Faust, D.R., and M.A. Liebig. 2017. Greenhouse gas fluxes from integrated crop-livestock systems in central North Dakota. ASA-CSSA-SSSA Annual Meeting, Tampa, FL. October 23, 2017. 5-minute Rapid Oral Presentation and Poster Presentation