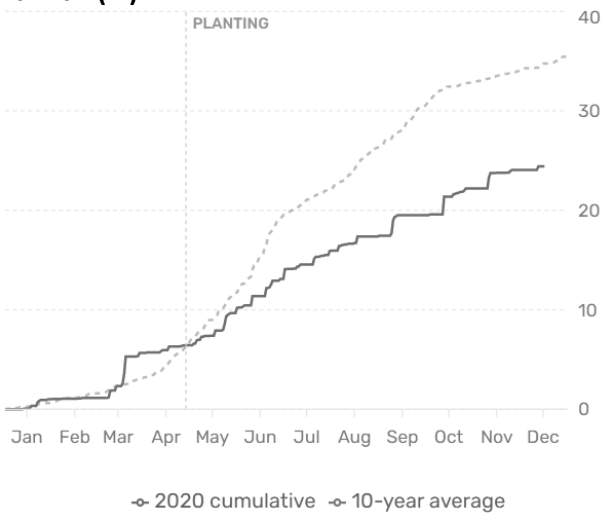
Incorporation of Small Grains and Cover Crop in a Corn-Soybean Rotation, NRCS Demo Farm

Study ID: 0933053202002
County: Dodge
Soil Type: Belfore silty clay loam 0-2% slope; Nora silty clay loam 6-11% slopes; Moody silty clay loam 2-6% slopes; Moody silty clay loam 2-6% slopes, eroded
Planting Date: 4/28/20
Harvest Date: 10/14/20
Population: 29,000
Row Spacing (in): 30
Hybrid: Channel® 217-41 DroughtGard® VT2P RIB Complete, DEKALB® DKC62-98 VT2P RIB
Reps: 4
Previous Crop: Soybean
Tillage: No-Till
Herbicides: ***Pre:*** 32 oz/ac Roundup PowerMAX® with AMS on 4/23/20 burndown; 1.5 qt/ac Harness® Xtra, 3 oz/ac Balance® Flexx, 1.3 qt/ac Roundup PowerMAX® on 4/30/20 pre-emerge
Post: 16 oz/ac ZAAR®, 32 oz/ac Roundup®, 3 oz/ac Laudis®, and 8 oz/ac atrazine on 6/11/20
Seed Treatment: BAS250
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 176 lb/ac MESZ 12-40-0-10S-1Zn, 50 lb/ac 0-0-60 Potash applied on 12/26/19; 421 lb/ac UAN 32-0-0 on 4/30/20
Irrigation: None
Rainfall (in):



Introduction: This study is being conducted on a soil health demonstration farm as part of the Nebraska USDA/Natural Resources Conservation Service's (NRCS) Soil Health Initiative, and involves the farmer, the Nebraska On-Farm Research Network, and the USDA/NRCS. The traditional crop rotation for this producer is corn and soybean with a cover crop following soybeans and no-till residue management. There is interest in intensifying the cropping system by incorporating a cool-season cash crop such as winter wheat and increasing the amount of time living plants are growing in the field. The two treatments, a check and an intensified system, will be used in this five-year study (2017-2022). The check treatment is a corn and soybean rotation with a cover crop following corn and soybeans. The intensive cropping system is a corn, soybean, small grain rotation with cover crop following each cash crop. Both phases of the rotation (corn—soybean) are present each year in this field. This report focuses on the portion of the field with corn phase in 2020. For the corn phase in 2020, 3-way mix cover crops (35 lb/ac winter rye, 2 lb/ac rapeseed, and 1 lb/ac red clover) were drilled on October 15, 2019 following soybean harvest on both plots (intensive and check). Cover crop was terminated on April 23, 2020. Then corn was planted on April 28, 2020, and harvested on October 14, 2020. Baseline and soil health measures were collected in 2017, 2019, and 2020 (Table 1).

Results:

Table 1. Soil physical, chemical, and biological properties for check and intensive system treatments.

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm^3)	Soil temp. (F)	Soil respiration[1]	Total soil health score[2]
2017 *(1 sample per treatment replication, n=4 per treatment; samples collected on Nov. 14, 2020)*						
Check	0.01 A*	24.5 A	1.21 A	41.9 A	3.67 A	12.6 A
Intensive System	0.48 A	23.5 A	1.06 A	42.5 A	3.92 A	15.2 A
P-Value	0.55	0.3471	0.315	0.500	0.678	0.272

Table 1 Continued

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm^3)	Soil temp. (F)	Soil respiration[1]	Total soil health score[2]
2019 *(1 sample per treatment replication, n=4 per treatment; samples collected on Nov. 6, 2019)*						
Check	1.84 A	26.8 A	1.06 A	39.92 A	3.12 A	14.9 B
Intensive System	3.20 A	25.8 A	1.06 A	39.95 A	3.00 A	18.5 A
P-Value	0.2692	0.591	0.869	0.718	0.638	0.0721
2020 *(2 samples per treatment replication, n=8 per treatment; samples collected on Nov. 3, 2020)*						
Check	1.36 A	28.7 A	1.14 A	44.1 A	2.94 A	17.8 B
Intensive System	3.46 A	28.7 A	1.14 A	44.0 A	2.94 A	18.6 A
P-Value	0.117	0.969	0.992	0.781	1.00	0.055

[1]Soil respiration (Solvita® burst).
[2]Score based on field assessment. The overall indicator score is based on the sum of 8 indicators (1=degraded, 2=in transition, 3=healthy): soil structure, structure type, surface condition, soil management, soil pores, earthworms, biological activity, and smell. Soil assessment was not completed in 2018 as it was originally planned for every other year interval.
*Values with the same letter are not significantly different at a 90% confidence level.

Table 2. Cover crop biomass and green cover for check and intensive system treatments. Cover crop biomass measured on April 22, 2020.

	Biomass (lbs./acre)	Green cover (%)
Check	602 A*	10.55 A*
Intensive System	507 A	7.28 B
P-Value	0.2160	0.0031

*Values with the same letter are not significantly different at a 90% confidence level.

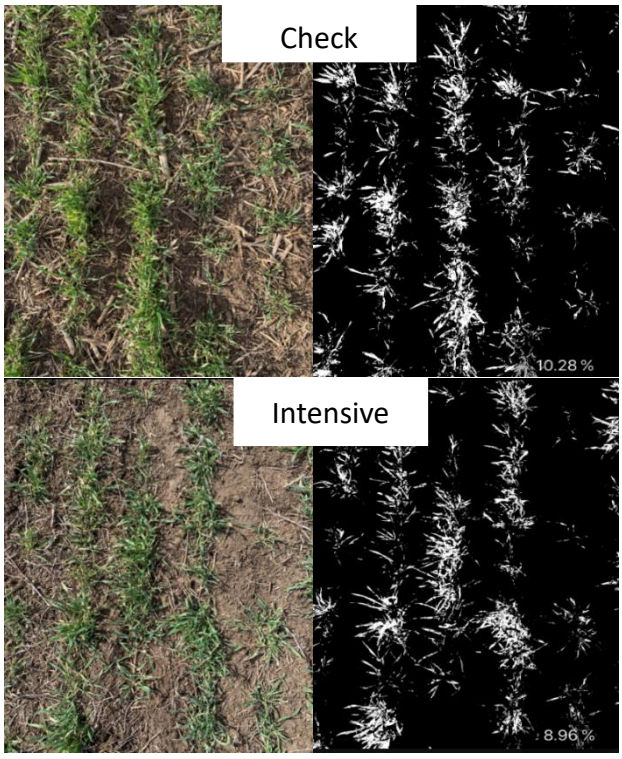


Figure 1. Cover crop green cover of check (top) and intensive system (bottom) strips displayed as true color (left) and using the Canopeo measurement tool (right). Samples collected on April 22, 2020.

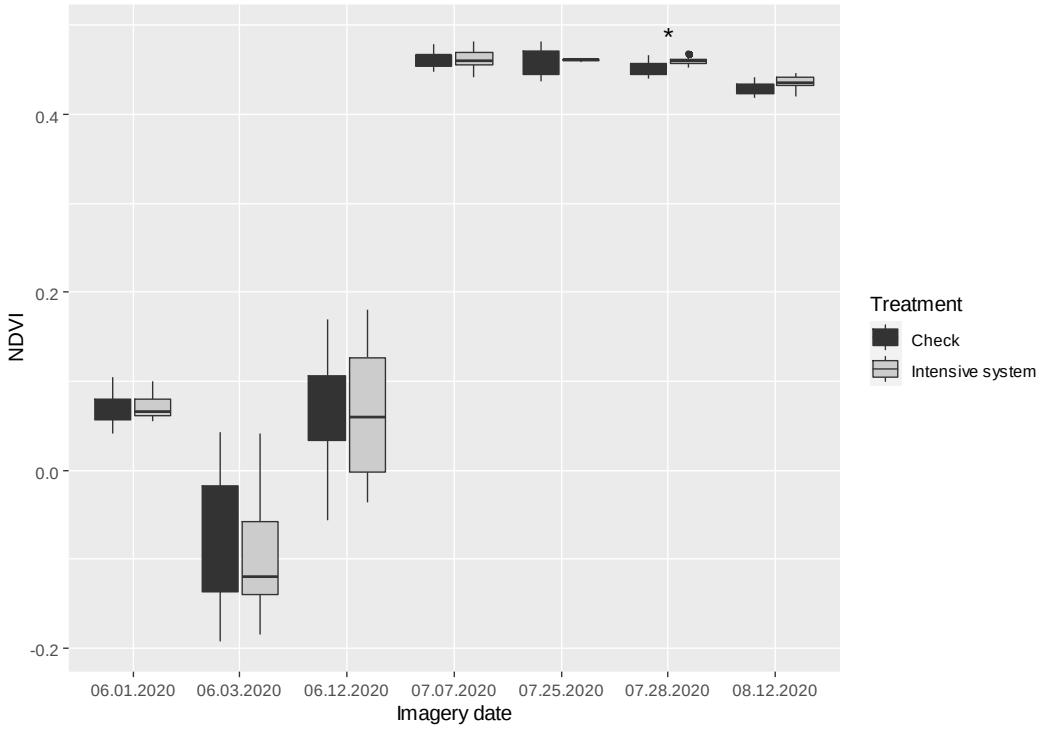


Figure 2. Normalized difference vegetation index (NDVI) values from aerial imagery for the corn crop following intensive management and non-intensive check. Asterisk (*) within each date indicates a significant difference ($p < 0.10$) between treatments at a 90% confidence level.

Table 3: 2020 corn moisture, yield, and net return for check and intensive system treatments.

	Moisture (%)	**Corn Yield (bu/ac)†**
Check	14.7 A	183 B
Intensive System	14.3 A	202 A
P-Value	0.168	0.00413

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 15.5% moisture.

Summary:

- June and July were hot, dry, and windy. On June 3, the field received 0.10"; on June 9, the field received 0.40" rain with strong southwest winds. On June 18, the field received 0.80" rain. No measureable rain events were recorded in July.
- Aerial imagery normalized difference vegetation index (NDVI) analysis showed higher values for corn in the intensive system treatment on July 28 (Figure 2).
- Total soil health score was lower for the check than the intensive system treatment both in 2019 and 2020.
- Corn planted in the intensive system had higher yield than the check strips. These observations are in agreement with the crop vigor analysis (NDVI) that showed higher values in the intensive system strips. Results from previous years follow.

Summary of Previous Years

YEAR ONE | In year one, soybeans were planted across both, check and intensive plots, on May 10, 2017, and harvested on October 17, 2017. In 2017, soybeans had no difference in yield following check or intensive system.

Table 4. 2017 soybean moisture, yield, and net return for check and intensive system treatments.

	Moisture (%)	Soybean Yield (bu/acre)†
Check	12.9 A	61.3 A
Intensive System	12.1 B	64.2 A
P-Value	0.0331	0.127

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.

YEAR TWO | In year two, following soybean harvest in 2017, cover crop mix of 30 lbs/ac rye, 3.5 lbs/ac radish, 5lbs/ac hairy vetch, 1lbs/ac crimson Clover was drilled on October 18, 2017, in the check plots. Cover crop mixes were terminated on April 28, 2018, with 42 oz. Roundup® burndown application, then corn was planted on May 7, 2018, and harvest on November 1, 2018. In the intensive system plots, wheat was planted on October 18, 2017, and harvested on August 6, 2018. As this was the first time the farmer had planted or harvested wheat, it was not successful as far as weed control and harvest yield. Therefore, no measurements were made on wheat yields in the intensive system strips.

Table 5. 2018 corn and wheat moisture, yield, and net return for check and intensive system treatments.

Treatment	Crop	Moisture (%)	Yield (bu/ac)†
Check	corn	14.5	181.4
Intensive System	wheat	-	-

†Bushels per acre corrected to15.5% (corn) and 13.5% (wheat) moisture.

YEAR THREE | In year three, 20 lbs/ac rye, 2 lb/ac radishes, 0.5 lb/ac African cabbage, 8 lb/ac winter pea, 5 lb/ac common vetch, 3 lb/ac sunn hemp, 5 lbs/ac buckwheat, 10lbs/ac spring oats cover crop mix was drilled on August 7, 2018, following wheat (intensive plots) and 65 lbs/ac rye drilled on November 7, 2018, following corn (check plots) harvest. Plots were sprayed on April 23, 2019, prior to soybean planting. Soybeans were planted on May 14, 2019, and harvested on October 14, 2019. In 2019, soybean yield was higher in the check plots compared to the intensive system plots that followed wheat.

Table 6. 2019 soybean moisture, yield, and net return for check and intensive system treatments.

	Moisture (%)	Soybean Yield (bu/acre)†
Check	13.1 B	49.1 A
Intensive System	13.3 A	46.7 B
P-Value	0.0471	0.087

*Values with the same letter are not significantly different at a 90% confidence level.
†Bushels per acre corrected to 13% moisture.

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