

Impact of Monoculture Rye Cover Crop versus Multispecies Cover Crop on Subsequent Crop Yield and Soil Quality Indicators, NRCS Demo Farm

Study ID: 0732167202001

County: Stanton

Soil Type: Nora-Crofton complex 6-11% slopes; Nora silty clay loam 11-17% slopes; Moody silty clay loam 2-6% slopes; Nora silty clay loam 6-11% slopes; Alcester silty clay loam 2-6% slopes

Planting Date: 4/30/20

Harvest Date: 10/9/20

Population: 133,650

Row Spacing (in): 20

Hybrid: Golden Harvest® GH2041X

Reps: 10

Previous Crop: Corn

Tillage: No-Till

Herbicides: **Pre:** 1.5 pt/ac Stalwart® C, 1.0 pt/ac Clash™, 32 oz/ac Buccaneer®, 3.0 oz/ac Tronido™ on 5/14/20 **Post:** 12 oz/ac fomesafen, 0.4 oz/ac Cadet®, 32 oz/ac Buccaneer®, 10.0 oz/ac clethodim, 1.0 pt/ac Helmet on 6/26/20

Seed Treatment: CruiserMaxx®, Vibrance®

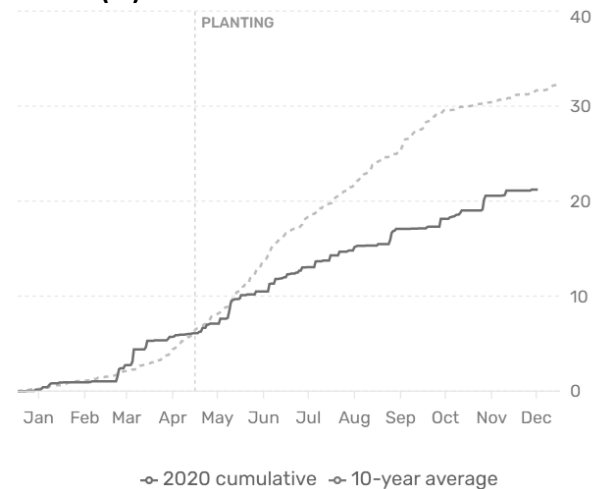
Foliar Insecticides: None

Foliar Fungicides: 10 oz/ac Quilt Xcel®

Fertilizer: 5 gal/ac 5-18-5 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. Two treatments are being evaluated in this five-year study (2017-2021): a monoculture rye cover crop versus a cover crop mix. These treatment plots will be maintained throughout the project. 2020 was the third year of this study. Cover crops were drilled in November following corn harvest in 2019. The monoculture cover crop was 50 lb/ac cereal rye. The cover crop multispecies mix was 30 lb/ac cereal rye, 10 lb/ac winter barley, 3 lb/ac red clover, 1 lb/ac rapeseed, 4 lb/ac hairy vetch, and 0.5 lb/ac camelina. Soybeans were planted on April 30, cover crops were terminated on May 14, and soybeans were harvested on October 9. Baseline and soil health measures were collected in 2016, 2019, and 2020 (Table 1).

Results:

Table 1. Soil physical, chemical, and biological properties for single species and multispecies cover crop treatments.

Treatment	Infiltration (in/hr)	Soil moisture (%)	Bulk density (g/cm ³)	Soil temp. (F)	Soil respiration ¹	Total soil health score ²
2016 (2-5 composite samples collected for all replications of a treatment; samples collected on Nov. 14, 2016)						
Single species	3.13 A*	26.7 A	1.02 A	48.3 A	3.33 A	19.7 A
Multispecies	8.50 A	27.6 A	1.17 A	48.2 A	2.33 B	17.2 B
P-Value	0.762	0.734	0.103	0.991	<0.001	0.0903
2019 (1 sample per treatment replication, n=7 per treatment; samples collected on Nov. 5, 2019)						
Single species	12.24 A	25.63 A	1.13 A	36.24 A	3.13 A	19.9 A
Multispecies	18.88 A	25.11 A	1.10 A	36.61 A	3.22 A	19.8 A
P-Value	0.356	0.766	0.5083	0.454	0.879	0.885

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
2020 (1 sample per treatment replication, n=7 per treatment; samples collected on Nov. 4, 2020)						
Single species	12.7 A	23.1 A	1.17 A	45.1 A	3.19 A	19.6 A
Multispecies	13.6 A	22.7 A	1.11 A	46.5 A	3.64 A	17.9 B
P-Value	0.873	0.615	0.201	0.449	0.252	0.023

¹Soil respiration (Solvita® burst).

²Score 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 2017 and 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. 2020 cover crop biomass and green cover for single species and multispecies cover crop treatments. Cover crop biomass measured on May 6, 2020.

	Biomass (lbs./acre)	Green cover (%)
Single species Cover Crop	85.3 A*	3.303 A
Multispecies Cover Crop	14.9 B	0.703 B
P-Value	<.0001	0.0002

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



Figure 1. Cover crop green cover of single species (top) and multispecies (bottom) strips displayed as true color (left) and using the Canopeo measurement tool (right). Cover crop biomass measured on May 6, 2020.

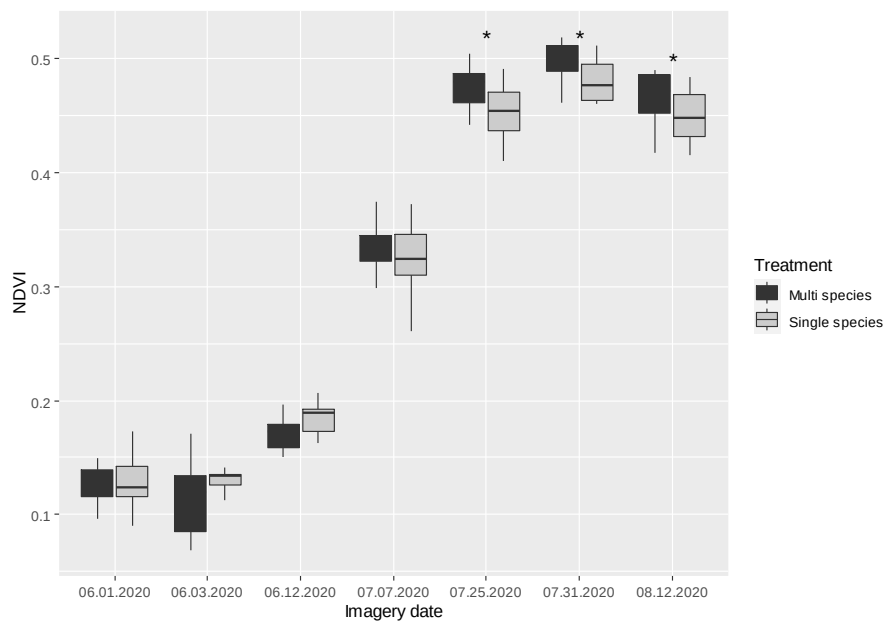


Figure 2. Normalized difference vegetation index (NDVI) values from aerial imagery for the soybean crop following single species and multispecies cover crops. Asterisk (*) within each date indicates significant difference ($p < 0.10$) between single species and multispecies cover crop at a 90% confidence level.

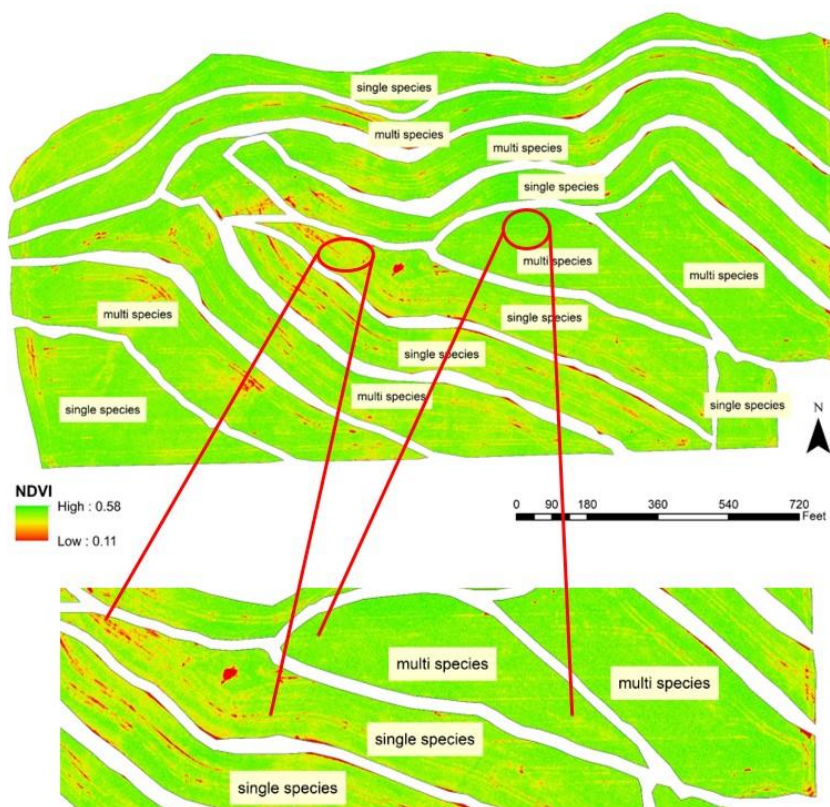


Figure 3. Aerial imagery from July 31 displayed as soybean normalized difference vegetation index (NDVI). Strips with single and multispecies cover crop are indicated.

Table 3. 2020 soybean moisture, yield, and net return for single species and multispecies cover crop treatments.

	Moisture (%)	Soybean Yield (bu/acre) [†]	Marginal Net Return [‡] (\$/ac)
Single species Cover Crop	8.25 A*	48.3 B	431 B
Multispecies Cover Crop	7.63 B	55.4 A	495 A
P-Value	0.032	0.0497	0.0589

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

[†]Bushels per acre corrected to 13% moisture.

[‡]Marginal net return based on \$9.50/bu soybean, \$27.33/ac for the rye seed and drilling, and \$31.34/ac for the mix seed and drilling.

Summary:

- Aerial imagery normalized difference vegetation index (NDVI) analysis showed higher values for soybeans in the multispecies in treatment in late July and early August (Figures 1 and 2).
- Soybeans planted in the multispecies treatment had a higher yield than the single species strips (Table 3). These observations are in agreement with the crop vigor analysis (NDVI) that showed higher values in the multispecies strips.
- Total soil health score was lower for the multispecies treatment both in 2016 and 2020 (Table 1). Results from previous years follow.

Summary of Previous Years

YEAR ONE | In year one, cover crops were drilled in October 2016. The single species cover crop was 50 lb/ac rye. The cover crop mix consisted of 35 lb/ac Elbon rye, 0.5 lb/ac Bayou kale, 0.5 lb/ac Impact forage collards, 0.5 lb/ac Trophy rapeseed, 0.5 lb/ac purple top turnip, 0.5 lb/ac African cabbage, 3.5 lb/ac hairy vetch, 30 lb/ac Austrian winter pea, and 2 lb/ac winter lentil. Cover crops were terminated on May 14, 2017, and soybeans were planted on May 25, 2017, and harvested on September 29, 2017. Wheat was planted in October 2017. Wheat yield was obtained for each treatment using yield monitor data with a 15' buffer applied to the treatments. There was no difference in wheat yield or moisture for the monoculture versus cover crop mix. The field was hailed on June 23, 2018.

Table 4. 2018 wheat moisture and yield for single species and multispecies treatments.

	Moisture (%)	Wheat Yield [†] (bu/ac)
Single species Cover Crop	14.2 A*	35 A
Multispecies Cover Crop	14.6 A	33 A
P-Value	0.591	0.366

[†]Yield values are from cleaned yield monitor data. Bushels per acre corrected to 13.5% moisture.

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

YEAR TWO | In year two, cover crops were drilled in July 27, 2018, following wheat harvest in July 2018. The single species cover crop was 50 lb/ac cereal rye. The cover crop mix was 30 lb/ac cereal rye, 3 lb/ac red clover, 2 lb/ac rapeseed/canola, and 6 lb/ac hairy vetch. Cover crops were terminated on May 16, 2019, and corn was planted on May 17, 2019. Yield was very close to statistically significant, with the monoculture rye cover crop having a higher yield than the multispecies cover crop. The monoculture rye cover crop had a higher net return.

Table 5. 2019 corn yield, moisture, and marginal net return for single species and multispecies treatments.

	Moisture (%)	Corn Yield (bu/ac) [†]	Marginal Net Return [‡] (\$/ac)
Single species Cover Crop	20.3 A*	192 A	708.03 A
P-Value	0.317	0.101	0.085

[†]Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.

[‡]Marginal net return based on \$3.83/bu corn, \$27.33/ac for the rye seed and drilling, and \$31.34/ac for the mix seed and drilling.

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

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