Farmer-driven Research into Planting Green along the Red

Farm fields near Town, County: Gentilly, Polk; Browns Valley, Traverse; Tintah, Traverse; Barrett, Grant; Appleton, Swift.

Experimental Design: Treatments arranged as large strips wide enough to accommodate farmer's equipment in a randomized complete block design with three replications. While nutrient cycling & soil health data were also collected, here are reported rye biomass at termination, soybean stand count, yield, moisture & test weight data.

Treatments: 1) Current tillage practice without a fall-seeded cereal rye cover crop (CC), 2) CC terminated (term.) with glyphosate 1-2 weeks before soybean planting, 3) CC term. at planting, or CC term. 1-2 weeks after soybean planting.

Purpose of Study:

Minnesota (MN) farmers face difficult choices when deciding to prioritize either long-term soil health goals or the immediate benefits of tillage for residue management and seedbed preparation. Despite the reported soil health benefits of cover crops, a short growing season makes delays to spring field work risky. Research on cover cropping suggests that early season cover crops can stabilize yields by mitigating excess and limited soil moisture, improving field trafficability, and reducing wind erosion. Reliable advice on agronomic outcomes of cover cropping is critically needed by MN farmers interested in adopting reduced-tillage and cover cropping systems. To meet this need, we partnered with MN farmers to design 5 replicated, production-scale research and demonstration trials that were sown to cereal rye in *Fall 2021* (**Fig. 1, Table 1**). Soybeans were seeded in spring 2022 and cover crops terminated before, at or after soybean planting.

Here we summarize the effect of cover crop termination timing on rye biomass, soybean stand count and seed moisture, test weight and yield.

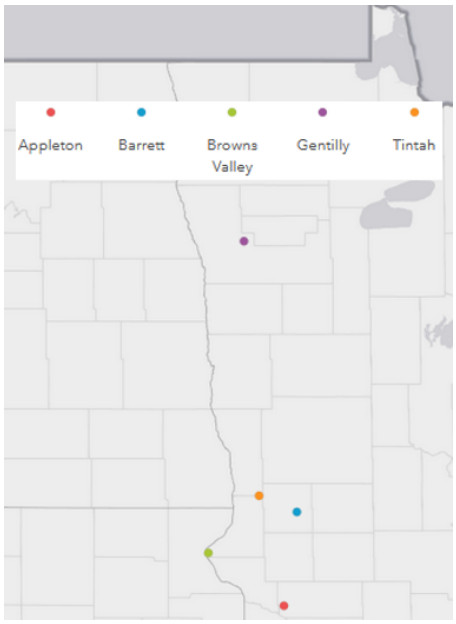

Fig. 1. On-farm trial locations in 2021-2022.

Results:

Table 1. Dates that the 2021 winter rye cover and 2022 soybean crop were seeded and soybean seeding rate in five Minnesota farm fields

Town	Rye seeded ('21)	Soybean seeded ('22)	Soybean seeding rate (per acre)
Appleton	Oct 30-31	May 10	140,000
Browns Valley	Oct 31	May 23	165,000
Tintah	Sep 8	Jun 8	140,000
Barrett	Oct 31	May 27	165,000
Gentilly	Sep 7	Jun 7	175,000

Each trial location grew different soybean varieties and had a different soybean seeding dates and rates and therefore different dates of rye termination and so results are presented by location.

Browns Valley. Aerial seeding of rye into a standing silage corn crop in the fall of 2021 allowed some seed to drift into the no-rye plots (**Table 2**). The before-planting and no-rye plots had similar biomass, the at-planting treatment accumulated 245 lb/A more biomass and after-planting still an additional 125 lb/A biomass.

There was a numerical trend with the lower rye biomass the greater the soybean stand count, with the after-planting rye termination averaging 21,511 fewer plants/A than the other treatments.

Soybean yields were similar for all but the lower yielding after-planting rye termination timing. Soybean moisture and test weights were similar among treatments.

Tintah. Termination timing had a significant effect on rye biomass, with greater biomass with each successive timing (**Table 3**). The no-rye and before-planting termination timing treatments had significantly higher soybean stand counts than the plots in which rye was terminated at or after soybean planting.

The yields in the no-rye or before-planting termination timing plots were similar and greater than when rye was terminated at planting. Yield was lowest when rye termination took place after soybean planting. Oddly, soybean test weights were…..

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….. significantly lower in plots with no rye or when rye was terminated before planting than when rye was terminated at planting.

Table 2. The effect of rye termination timing on rye biomass, soybean stand count, yield, moisture and test weight at the farm near Browns Valley, MN

Rye termination timing	Rye biomass (lb/A)	Soybean stand count (plants/A)	Yield (bu/A)	Moisture (%)	Test weight (lb/bu)
Before planting	116 a	104,221 b	41.7 b	11.6	57.7
At planting	351 b	103,576 b	41.2 b	11.6	57.7
After planting	476 c	83,248 a	34.5 a	11.6	47.3
No rye	97 a	106,480 b	39.4 b	11.7	57.20
LSD (90% CL)	53	10,492	2.61	NS	NS
CV (%)	16.15	6.65	4.19	0.81	15.76

Table 3. The effect of rye termination timing on rye biomass, soybean stand count, yield, moisture and test weight at the farm near Tintah, MN

Rye termination timing	Rye biomass (lb/A)	Soybean stand count (plants/A)	Yield (bu/A)	Moisture (%)	Test weight (lb/bu)
Before planting	154 a	111,320 b	44.4 c	10.8	58.4 a
At planting	383 b	95,040 a	40.0 b	10.7	59.3 b
After planting	515 c	87,560 a	36.5 a	10.9	59.0 ab
No rye		109,120 b	45.6 c	10.8	58.3 a
LSD (90% CL)	71	11,257	1.60	NS	0.71
CV (%)	13.18	7.04	2.42	0.99	0.70

Barrett. Rye biomass was significantly lower when terminated before soybean, than when terminated either at or after soybean planting (**Table 4**). Soybean stand did not differ among treatments.

Soybean yield was statistically similar regardless of rye termination timing, and lower than when grown without the rye cover crop. Soybean moisture was lowest in plots in which rye was terminated after soybean planting and highest in plots without rye or when rye was terminated before soybean planting.

Gentilly. The exceptional drought and early wheat harvest in 2021 allowed for timely rye seeding and the abnormally wet 2022 spring led to delayed soybean planting at the northernmost location (the farm near Gentilly) allowing considerable rye growth.

Each successive rye termination timing allowed for significantly more biomass to accumulate when compared to the previous timing (**Table 5**). Rye biomass was perhaps responsible for the lower soybean stand count, the greater the biomass accummulation, and significantly lower stands in the plots in which rye was terminated at or after soybean planting.

Surprisingly, soybean yields were statistically similar and greater in the plots with no-rye, at-planting and after-planting rye termination treatments than in the plots in which rye was terminated before planting. Soybean moisture content was significantly similar and higher in the rye plots than in the no-rye plots. Soybean test weight was significantly higher in the plots in which rye was terminated after-planting than at-planting.

Table 4. The effect of rye termination timing on rye biomass, soybean stand count, yield, moisture and test weight at a farm near Barrett, MN

Rye termination timing	Rye biomass (lb/A)	Soybean stand count (plants/A)	Yield (bu/A)	Moisture (%)	Test weight (lb/bu)
Before planting	126 a	130,357	45.9 a	10.8 b	57.3
At planting	250 b	128,421	46.9 a	10.7 ab	57.2
After planting	299 b	139,392	45.3 a	10.6 a	56.7
No rye		147,781	54.9 b	10.8 b	56.8
LSD (90% CL)	66	NS	3.1	0.2	NS
CV (%)	17.71	9.35	4.5	1.27	0.64

Table 5. The effect of rye termination timing on rye biomass, soybean stand count, yield, moisture and test weight at a farm near Gentilly, MN

Rye termination timing	Rye biomass (lb/A)	Soybean stand count (plants/A)	Yield (bu/A)	Moisture (%)	Test weight (lb/bu)
Before planting	231 a	196,698 ab	35.7 a	12.2 b	60.7 ab
At planting	387 b	175,015 a	41.4 b	12.5 b	60.2 a
After planting	501 c	168,045 a	40.9 b	12.5 b	60.9 b
No rye		215,283 b	44.2 b	11.5 a	60.8 ab
LSD (90% CL)	107	29,186	4.9	0.6	0.7
CV (%)	38.74	9.75	7.63	2.85	0.77

Appleton. The first rye termination at the near Appleton took place at soybean planting. A significant additional 105 lb/A of rye biomass were added in the 13 days between soybean planting and the after-planting termination timing (**Table 6**). A numerical trend was ….

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….observed in that the greater the greater the cover crop biomass, the lower the soybean stand count. But this slight trend did not result in any statistical differences among treatments for soybean yield, moisture and test weight.

Table 5. The effect of rye termination timing on rye biomass, soybean stand count, yield, moisture and test weight at a farm near Appleton, MN

Rye termination timing	Rye biomass (lb/A)	Soybean stand count (plants/A)	Yield (bu/A)	Moisture (%)	Test weight (lb/bu)
Before planting	Treatment not included at this location				
At planting	55 a	115,837	39.9	10.9	56.2
After planting	160 b	114,869	36.8	10.5	56.9
No rye		116,483	46.4	10.0	55.9
LSD (90% CL)		NS	NS	NS	NS
CV (%)	30.86	1.70	10.64	8.13	1.74

Summary. This document summarizes crops grown in farmer cooperators' fields in two abnormal growing seasons. The rye cover crop was seeded after an abnormally early harvest of the 2021 wheat crop (Gentilly) due to exceptional drought conditions or into standing corn crops (Barrett, Browns Valley, Tintah, Appleton) and then in spring 2022, soybean was seeded a month (or greater) later than normal due to very wet soil conditions. Only time will reveal how 'typical' the results of this 2021-22 study were.

Rye biomass & soybean stand count. Delaying cover crop termination until 1-2 weeks after soybean planting produced more cover crop biomass; at four of the five trial locations, there was significantly more biomass with this delayed termination. However, at most of the locations, planting soybean into a living cover crop that was then terminated either immediately after planting or numerically lower soybean stand counts when compared to soybeans grown in plots in which the rye was terminated before planting or in plots without rye (**Figure 1**).

Soybean yield, moisture & test weight. At one location, there were no differences in yield among cover crops treatments; at another, all of the treatment yields were similar with the surprising exception of lower yield in plots terminated before soybean planting. At two locations, regardless of termination timing rye plots yielded significantly less than the no-rye plots. In another location, yield in the no-rye plots was statistically similar to yield in rye plots terminated before soybean planting, with each later termination timing yielding significantly less than plots of earlier termination timing.

Soybean moisture and test weight were not affected by cover crops treatments at 3 of the trial locations. At one location soybean moisture was higher when a cover crop was grown than when not; at another, soybean moisture was lower in rye plots that were terminated after planting than in the no rye or other rye termination timings. At one location test weight was higher and at another lower when rye was terminated at planting.

Stay tuned. Watch for news about this project as additional tests are currently being run and data analyzed. Look for more research results on the effects of different combinations of cover crop seeding rate, tillage strategies and cover crop termination timing on nutrient cycling, soil health metrics, iron deficiency chlorosis and weed management at the UMN Research & Outreach Centers (ROC) in Crookston and Morris, MN.

In fall 2022, rye was seeded at 3 on-farm locations surrounding each of the two ROCs in anticipation of planting soybean "green" for further study in 2023. This project will run both on ROCs and on cooperators' farms through 2025.

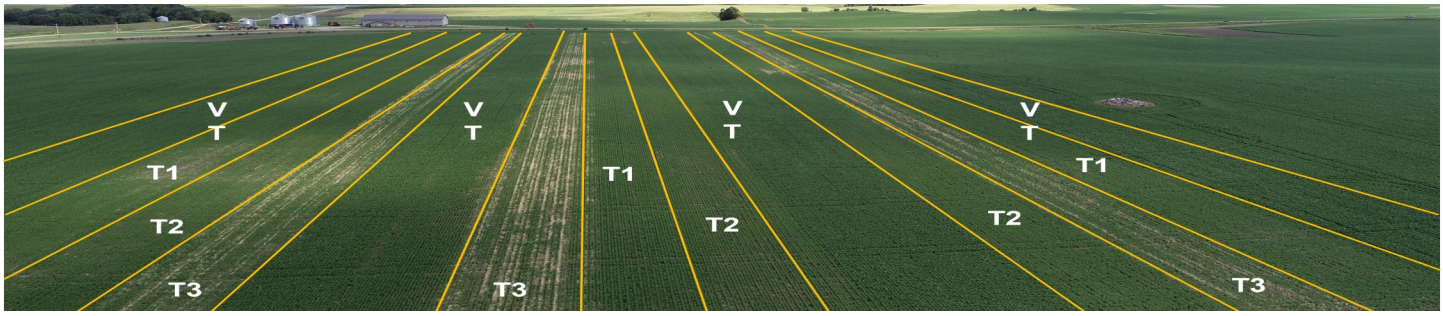

Figure 1. One can see the effects of cover crop termination timing on soybean stand at the Barrett field location. Plot edges are delineated by lines and the before, at and after soybean seeding are labeled T1, T2 and T3, respectively. Vertical tillage plots without a cover crop are labeled VT. (Photo: Dorian Gatchell & Jodi DeJong-Hughes)

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