Project Title: Tackling Twin Threats to Soybean in NW MN: SCN & IDC

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Project Period: May 1 – Nov 15, 2024

Research Question/Objectives:

a. Collect SCN soil samples in both spring and fall from which to estimate SCN egg counts, collect foliar IDC ratings and soybean yield parameters in the OF "*Tackling Twin Threats to Soybean in NW MN: SCN & IDC"* pilot study.

b. Hold an in-season, OF field day focusing on IDC, SCN and the "*Tackling Twin Threats to Soybean in NW MN: SCN & IDC"* study being conducted on-farm in Norman County near Gary, MN. This field day is essential to remind farmers in NW MN of the tremendous threat that SCN poses to long-term soybean production and how to test for and manage it.

Results:

Stand Count. The soybeans in the experimental field experienced hail injury during the late vegetative growth stages. The wet conditions experienced by the crop after planting along with hail-associated injury, led to many fewer plants compared to the 160,000 to 165,000 seeds planted per acre (**Figure 1**). There were no treatment differences observed in this trial for stand count and all treatments had more than 100,000 plants/acre, the density at which a soybean crop is thought to have sufficient population to maximize yield potential.

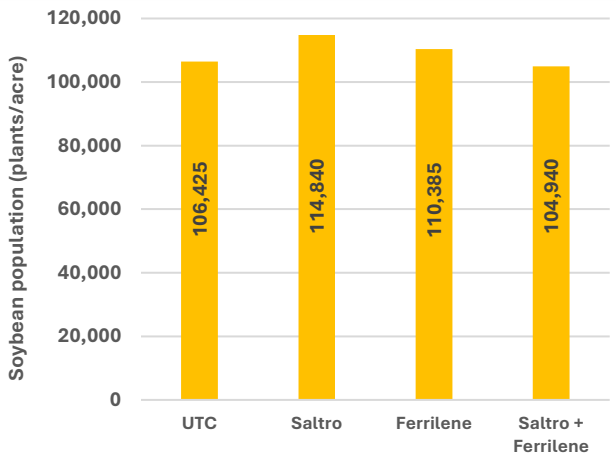

Fig. 1. Per acre soybean plant population (P = 0.255, CV = 10.45%).

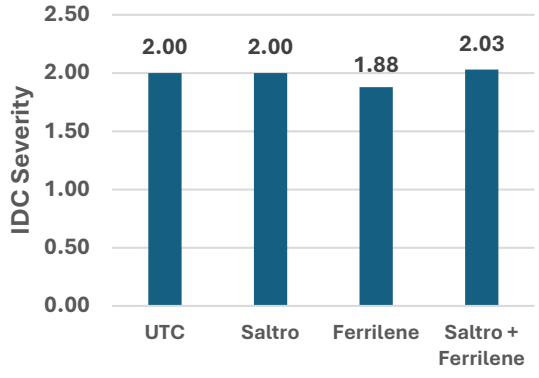

Fig. 2. IDC symptom severity, *P* = 0.49, CV - 11.01%.

IDC. The 2024 growing season was a 'tale of two planting date ranges' in that early planted soybeans were met with very wet, cool weather resulting in severe symptoms of iron deficiency chlorosis. Later planted soybeans, particularly those in fields with a history of IDC and poor drainage also resulted in both severe and lasting IDC symptoms and slowed crop growth and development. However, although there was a history of IDC and soils were wetter than in a typical growing season in the study field, pattern tiling and the resulting adequate drainage likely decreased overall IDC symptom severity,

regardless of treatment (**Figure 2**). In addition, while there may have been plants exhibiting more or less IDC symptom severity, areas of the field rated for IDC severity were selected randomly. No differences in IDC severity were observed among treatments.

Soybean yield. Despite the late planting date of this experiment, soybean yields averaged between 49.6 and 54.0 bushels/acre (**Figure 3**) when corrected to 13% moisture. Untreated control (UTC) plots, in which neither treatment was applied, had the lowest yield at 49.6 bu/A, the plots grown to soybean treated with either the in-furrow iron chelate or the Saltro seed treatment and vice-versa yielded 52.6-52.9 bu/A and the plots in which both treatments were applied had the highest numerical yield at 54 bu/A. While the trends appear promising, there is little certainty that the trends would be similar in a different growing season or field without statistically significant differences being observed.

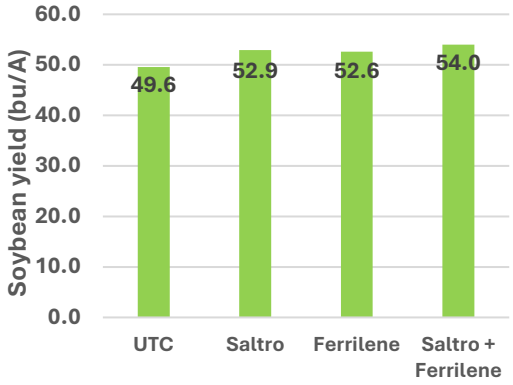

Fig. 3. Soybean yield, P = 0.138, CV = 5.550%.

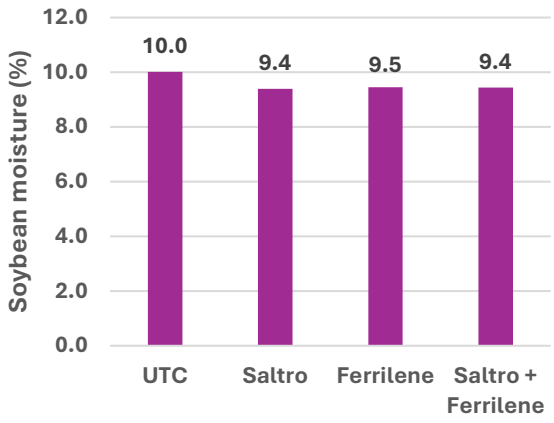

Fig. 4. Soybean moisture, P = 0.404, CV = 7.495%.

Soybean moisture. The 2024 growing season began with wetter than normal conditions that delayed spring field work including planting and both pre- and post-emergence herbicide applications. Contrastingly, the end of the 2024 growing season was unseasonably hot and dry, with many days reaching above 80 degrees and strong winds resulting in overly dry grain at harvest. Untreated control plots had numerically higher soybean moisture than the plots treated with either Saltro or Ferrilene or both (**Figure 4**). There were no statistical differences among treatments.

Soybean cyst nematode. To determine soybean cyst nematode egg counts (a population density estimate), fifteen 8-inch soil cores were collected at an angle from within the rooting zone of soybean rows of each plot on June 26 and on October 17 & 18, 2024, before and after soybeans were grown, respectively. Egg counts can provide information about population density growth as affected by our experimental treatments during the growing season.

Spring, initial SCN egg counts were moderate, ranging from an average of 350 to 850 eggs/100 cc (**Table 1**). The in-field variability of SCN egg counts resulted in there being no statistically significant differences in the initial SCN population to which soybeans were exposed. Initial numerical population densities were lowest in the plots assigned the Ferrilene treatment (x) with the Saltro-alone and Saltro + Ferrilene plots with egg counts 1.5x that of the Ferrilene plots and the untreated control plot with an initial population density 2.4x that of the Ferrilene plots.

Table 1. SCN egg count in spring, fall and the difference between spring and fall (egg count growth) along with results of a statistical analysis at the Corey Hanson Farm near Gary, MN

Treatment	Spring egg count	Fall egg count	Egg count growth
	Mean SCN eggs per 100 cubic centimeters of soil		
Untreated control (UTC)	850	3,783	2,933
Saltro alone	563	2,567	1,538
Ferrilene alone	350	3,917	3,567
Saltro + Ferrilene	538	2,483	1,425
P=	0.751	0.526	0.464
CV(%)	98	46	62

The fall egg counts ranged from 2,483 to 3,917 eggs/100 cc (**Table 1**). The same relationship among plots for relative egg counts was not observed after soybeans were produced in the field. The two treatments with the lowest fall SCN egg counts were those that included the Saltro seed treatment, suggesting that although the in-field variability didn't allow for statistical differences, the plots in which seed was treated with a seed treatment labeled for SCN may have had an impact on SCN population growth. Twelve hundred to 1,400 more eggs/100 cc were observed in the plots that had not been planted to soybeans treated with Saltro than in plots that had.

SCN population density growth throughout the 2024 growing season in the plots planted to seed treated with Saltro was approximately half that of plots planted to seed that didn't have the Saltro seed treatment. While the soybean variety planted was labeled by the seed company as having the PI88788 source of SCN resistance, it appears that the multiple generations of SCN that occurred in 2024 added between 3 and up to 10 times the population density that had been present in the field in the spring. As non-host crops prove less profitable or the PI88788 source of SCN resistance continues to lose its potency as an SCN management tactic, farmers may more frequently begin to consider using a biological or chemical soybean seed treatment labeled for SCN management.

Materials and Methods: Abnormally wet weather during spring 2024 led to a delay in planting this experiment at the Corey Hanson Farm near Gary, MN in Norman County, MN. The experiment was planted to Integra 0544EFortus at a depth of 1 inch into soil characterized as a Grimstad or Rockwell fine sandy loam at 160,000-165,000 seeds/ A on June 9 using seed treated with CruiserMax Apex at 1.95 oz/130,000 either with or without 0.8 fl oz/140,000 seeds Saltro (a.i. pydiflymetofen). Saltro is labeled for plant parasitic nematodes including soybean cyst nematode. Ferrilene, a liquid, EDDHA-chelated form of iron (6%) was also applied at 3 lbs/A to some plots in-furrow at planting.

Treatments included, 1) no Saltro + no Ferrilene, 2) Saltro + Ferrilene, 3) Saltro + no Ferrilene and 4) no Saltro + Ferrilene. Each on-farm, 700 ft long strip plot was planted to a soybean variety with a PI88788 source of SCN resistance (not lab-confirmed by this team) in a randomized complete block design in ten 22-inch spaced rows with two unplanted rows

between each plot. Only 610 ft of each strip plot was harvested on October 17 with a 12-row reel on a farm-scale John Deere combine. Plot yields were determined with a weigh wagon, with samples collected to determine soybean moisture content.

Iron deficiency chlorosis ratings of foliar symptoms were collected from two locations throughout each plot using the 1-5 ratings scale used by NDSU soybean breeders (**Figure 5**). Soybean stand count data were also collected from two locations in each plot.

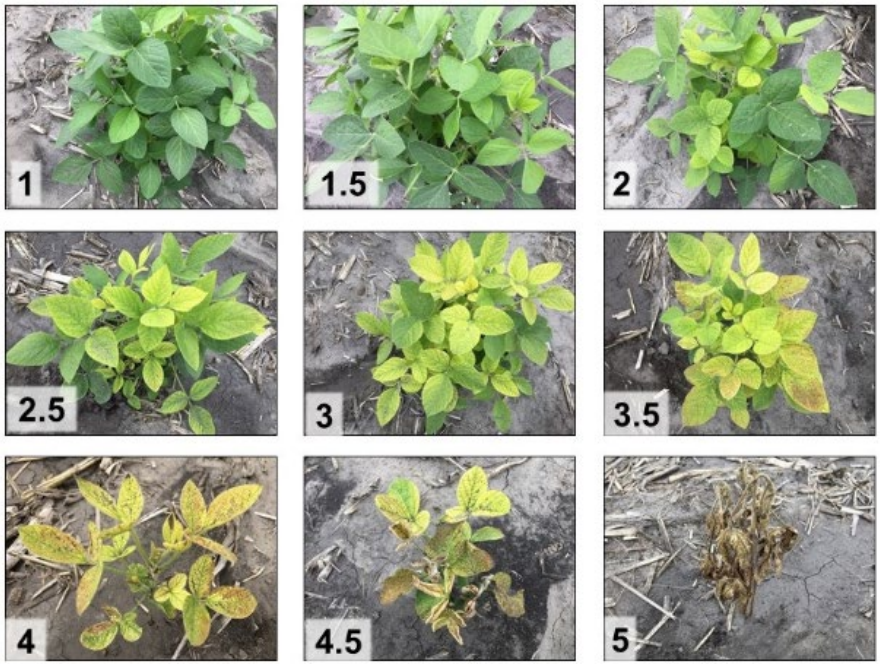

Figure 5. Iron deficiency chlorosis foliar ratings scale, where a score of 1 indicates green, healthy leaf tissue and a score of 5 indicates severe symptoms leading to plant death, used to estimate foliar symptoms of IDC. Source: North Dakota State University.

A field day focused on iron deficiency chlorosis and soybean cyst nematode was held for approximately 35 attendees at the plot location in Norman County on August 28, 2024.

Economic Benefit to a Typical 500 Acre Soybean Enterprise: Soybean cyst nematode is the most yield-limiting pathogen of soybean, responsible for significant yield losses each growing season. What makes SCN particularly pernicious is that it can cause up to 30% yield losses without there being any above-ground symptoms to alert the soybean producer of its presence. Other than an errant frost, drought or flooding, we argue that iron deficiency chlorosis is the abiotic disease most limiting to soybean yield potential in western Minnesota, capable of resulting in an average loss in yield potential of 20% for each increase in the IDC severity score of ‘1’ (**Figure 5**). The goal of this experiment was to demonstrate the utility of actively managing both diseases. The inherent variability in this farm field and the limited number of replications did not result in statistical differences among treatments, meaning that we have little certainty that the results we saw in this field in 2024 would be similar in different fields or years. However, from a thought-experiment standpoint, with $9.30 soybeans (on Nov 14, 2024), had we been able to say with any certainty that these results were likely to happen

in different fields or different years, each treatment on its own would have paid for itself or nearly paid for itself, but together would have cost ~$9/A more than was made back in yield.

Recommended Future Research: The goal of this experiment was to test two means of managing the most economically impactful biological and abiotic soybean diseases in northwest Minnesota. To give the SCN seed treatment Saltro ‘a fighting chance’ against a pathogen that can have 3 to 4 generations a year in northwest Minnesota. This experiment was planted in a field with known moderate SCN population densities. Perhaps either a more substantial population density or additional replications so that treatments can better overcome inherent in-field variability is indeed required to observe statistical differences among treatments. Despite the experiment being planted in a field with a known history of IDC, perhaps the fact that the field had subsurface drainage and so was less likely to have the saturated soil conditions that often favors IDC development didn’t give the Ferrilene enough of a chance to visibly ‘work’.

The authors would like to thank the Minnesota soybean farmer, the councilors of the Minnesota Soybean Research & Promotion Council and Agrimax.