

Progress report 1 – August 31, 2023

MSRPC Projects:

10-15-44-22014 & 10-15-44-23152

## **Minnesota SCN Squad: 2022 Minnesota Soybean Cyst Nematode (SCN) Sampling and Education Program**

**&**

## **Team Soybean!: 2023 Minnesota Soybean Cyst Nematode (SCN) Sampling and Education Program**

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**Project Summary:** Results of a prior Minnesota Soybean Research & Promotion Council-sponsored SCN sampling program administered by UMN Extension was disappointing. In 2018-2019, only 363 samples were returned for analysis after more than 5,000 sample bags were distributed to more than 1800 soybean producers, limiting the ability of UMN Extension and MSRPC members to get a '30,000 ft view' of sample results that might drive both further sampling efforts and changes to soybean production practices to more actively manage SCN populations. The Team Soybean! project was designed to excite the next generation of soybean producers, agronomists and ag service providers and provide them with practical, hands-on experience in how best to detect and monitor SCN and end up getting a better '30,000 ft view'.

### **Project progress:**

Minnesota high school ag instructors were provided with an educational curriculum designed to provide research-based information to teachers with little to no experience with sampling for or managing SCN that consisted of:

- An [annotated introductory presentation](#) (see **Figure 1** below, read left to right, top to bottom) detailing
  - The contribution of both soybeans and SCN to Minnesota's economy
  - SCN, what it is, its life cycle and why one should care about it
  - Symptoms of SCN infection on soybeans and how it spreads
  - How to collect a representative soil sample from fields you both know are infested and from those you don't
- An [annotated post-sampling presentation](#) detailing:
  - What 100cc's means
  - SCN management strategies: growing non-host crops and deploying SCN-resistant varieties
  - How SCN populations have shifted to overcome the PI88788 source of resistance and how to manage SCN given this fact
  - How to communicate results to farmers
  - Step-by-step instructions for two different ways to visualize SCN egg count data: graphing and mapping
- A [fill-in-the-blank press release](#) that can be used to notify the community of chapter's participation in Team Soybean!

- Another fill-in-the-blank [press release](#) notifying community about chapter's progress and results

**Welcome to Team Soybean!**

Learn new things!  
Have fun!  
Help those that produce the food we eat!

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**Contribution of soybean to Minnesota economy**

- In 2021 MN farmers grew 7,580,000 acres of soybeans
- Question: How many square miles of soybeans is this?
- In 2021, MN soybeans were sold for an average of \$13.10/bu
- Question: How much \$\$ were MN's 2021 soybeans worth?

Source: USDA National Ag Statistics Service

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**What is SCN?**

Soybean cyst nematode (SCN)

- A microscopic worm
- Lives in soil
- Feeds on soybean and dry bean roots
- Cysts are survival structures

Picture of soybean grown near Mankato, MN

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**SCN life cycle**

4 weeks

Photo: Guoping Yan, NDSU. Diagram: Iowa State Univ.

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**Why care about SCN?**

- # 1 yield-limiting soybean pathogen (MN: 7.46 million bu loss in 2021)
- Question: How much yield loss can SCN cause without also causing any above-ground symptoms?
- SCN is a hidden yield robber
  - If Egg counts = 1 Chance of lost yield
  - Infection slows plant growth and canopy closure
  - Complicates weed control

MN SCN Mgmt. Guide, SCN Coalition, Crop Protect. Network

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**Stunted, yellow soybeans**

Photo: Sam Markel, NDSU

University of Minnesota Extension

**SCN moves any way that soil does**

Photo: Acid DeJong-Hughes

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**To begin to manage SCN, it is important to know if you have it!**

- Collecting a soil sample is key for:
  - A first detection
    - Begin active management
  - A population density estimate
    - Management recommendations are based on population density
    - Estimate a 'baseline' population
    - Can monitor effectiveness of management

Photo: Guoping Yan, NDSU

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**SCN soil sampling kit for your FFA chapter!**

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**Step 1: Identify fields to sample**

- Do you live on a farm?
- Does a grandparent or other family member live on a farm?
- Do you have friends with family members that farm?
  - Ask your parents, grandparents, or other family members whether there are fields that you and your classmates can sample for SCN.
  - Assume them that you'll only be collecting a couple of cups from each field

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**Step 2: Get permission to collect samples & share results**

- Don't trespass! Always make sure that you have permission to collect a sample.
- Make sure that the farmer(s) know that results will be compiled & discussed within your chapter & eventually used to make a map of Minnesota with all of the results (no one will be able to pick out individual farm fields)

Like this!

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**Step 3: Mark 8 inches from bottom of soil probe with large Sharpie**

Measure 8 inches

Mark probe with Sharpie

Each time you get done collecting a sample, check and re-mark if needed

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**Step 4: Where to sample (if you don't know whether a field is infested)**

Drawing: SCN Coalition

University of Minnesota Extension

**Step 5: Where to sample (if you know a field is infested)**

Collect only 1 sample per field using either strategy

Drawing: SCN Coalition

University of Minnesota Extension

**Step 5: Collect ~twenty 8-inch deep soil cores from each field**

Question: How many SCN eggs are in a field?

- "Good" SCN samples are representative

Question: How do we ensure that a sample is representative?

- Best estimates: More soil cores, from smaller area
- Area should be less than 10 acres

Question: How many football fields make up a 10 acre area?

Pro tip: Walk in a zig-zag pattern throughout the area being sampled, stopping every 25 to 50 steps to collect a core

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**Step 6: Sampling strategy depends on crop: Before soybean/beans**

- If you are sampling after corn and before soybean or beans.
  - An egg count can provide an estimate of the maximum number of SCN eggs next year's soybeans may encounter
  - Question: Why is it an estimate of the maximum number?

Pro tip: It works best if soil is tilled after corn before collecting cores

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**Step 6: Sampling strategy depends on goal: After soybean/bean crop**

- Sampling after soybeans or beans:
  - Tells you how high the SCN egg population has gotten after it's fed on it's favorite host(s)!

Pro tip: If the field hasn't been tilled, ...

- Collect cores at an angle, through some of the soybean root zone

Like this!

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Open Google maps & touch blue circle to select your location

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**Step 7: Find field's GPS coordinates & zipcode for bag**

Touch the small white line to find GPS coordinates and zipcode

Zipcode

GPS coordinates

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**Step 7: Fill out the bag's label**

- Fill out the label on the sample bag before trying to fill it.
- Pro tip: It is much easier to fill out the label while the bag is empty
- If the farmer would rather not share their name, include their initials and a field name so that you can understand which sample results correspond to which fields
- So that your chapter has a list of your samples, please also enter label information into an online form: <https://z.umn.edu/SCNentry>


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**Steps 8-12: How to handle the cores you collect**

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### Step 12: Shipping samples to the lab for analysis

- Make sure that all samples are together before shipping a box to the lab
- Have your teacher email Team Soybean headquarters (apeller@umn.edu) with your box dimensions and weight to get a pre-paid shipping label
- Avoid shipping samples toward the end of the week
  - You don't want them to sit in a hot car over a weekend!



### Caution!

- Do not sample wet soil
- Wet soil will stick to your shoes & the probe, be impossible to mix, difficult to package and hard to analyze at the lab
- Remove as much soil as possible from the sampling bucket and probe, your pants and shoes before leaving the field you just sampled
- Avoid spreading SCN eggs to other fields!
- Brainstorm ways to practice good sanitation practices with your team

### Next steps.....

- Start sampling!
- Have fun!
- Snap pictures along the way
- Results of the lab analysis of your samples will be shared with your chapter as soon as they are available
- You will next be learning about SCN management strategies, interpreting the results and sharing them and SCN management recommendations with farmers.

Figure 1. Annotated introductory presentation shared with MN ag teachers from participating schools.

### Now that you have your sample results Team Soybean!.....



### The process

FFA chapter learns about SCN? → best to put if and what extent a field is infested

Students take turns taking kit samples from home- or volunteer-farms

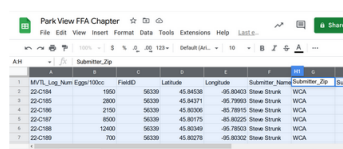
Sample to lab → shipped analysis

Extension receives raw data, sends report to FFA advisor & raw data to students

Students submit results summary to local paper using a fill-in-the-blank style press release

Students interpret data and prepare reports to share with farmers (advisor compares against answer key)

### Your results are organized on a "spreadsheet"



Wk	Log Num	Eggs/100cc	FieldID	Lat/lon	Longitude	Latitude	County	State	Country	Zip	Student
1	25C185	3800	56330	45.84308	-95.04043	45.84308	Steele	SD	USA	57001	WCA
2	25C186	2700	56330	45.84308	-95.04043	45.84308	Steele	SD	USA	57001	WCA
3	25C187	8000	56330	45.84308	-95.04043	45.84308	Steele	SD	USA	57001	WCA
4	25C188	12400	56330	45.84308	-95.04043	45.84308	Steele	SD	USA	57001	WCA
5	25C189	700	56330	45.84308	-95.04043	45.84308	Steele	SD	USA	57001	WCA

### What does 100 cc's mean?

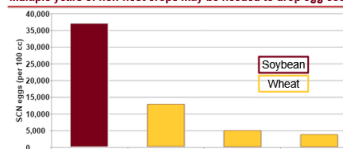
- 100 cc's is an abbreviation for 100 cubic centimeters
- At the lab SCN cysts were extracted from 100 cc's of soil
- The units used to talk about SCN population density:
  - Number of SCN eggs in 100 cc's of soil

Question: How many cups of soil are in 100 cc's?

### SCN Management Strategy: Grow Poor Hosts

Good hosts	Poor hosts
• Dry Edible Beans	• Wheat
• Hairy vetch	• Barley
• Sweet Clover	• Oats
• Chickweed	• Corn
• Field Pennycress	• Sugar beet
• Purslane	• Sunflower
• Shepard's Purse	• Canola
• Wild Mustard	

### Multiple years of non-host crops may be needed to drop egg counts

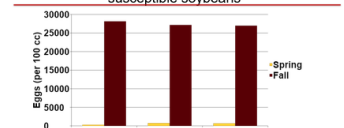


Year	Soybean (eggs/100 cc)	Wheat (eggs/100 cc)
2006	~35,000	~10,000
2007	~15,000	~5,000
2008	~5,000	~2,000
2009	~2,000	~1,000

### Soybean varieties vary in susceptibility to SCN

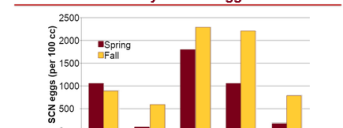
- Growing susceptible soybean varieties in SCN-infested fields
  - SCN population densities can grow significantly over a single growing season
  - Can cause a significant soybean yield reduction
- "Resistant" varieties will still get infected by SCN
  - But fewer females complete their life cycle to produce cysts and eggs

### Populations (eggs/100 cc) can explode quickly with susceptible soybeans



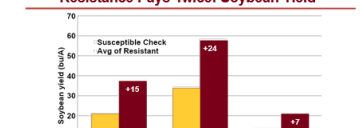
Susceptible Variety	Spring (eggs/100 cc)	Fall (eggs/100 cc)
A	~25,000	~25,000
B	~25,000	~25,000
C	~25,000	~25,000

### Resistance Pays Twice: Egg Counts



Resistant Variety	Spring (eggs/100 cc)	Fall (eggs/100 cc)
A	~1,000	~1,000
B	~500	~500
C	~1,500	~1,500
D	~1,000	~1,000
E	~500	~500

### Resistance Pays Twice: Soybean Yield



Location	Susceptible Check (bu/ha)	Avg of Resistant (bu/ha)
Location 1	~20	~35 (+15)
Location 2	~30	~55 (+24)
Location 3	~10	~27 (+17)

### Eventually, biology "wins"

- Resistance ≠ immunity
- Conferred by multiple genes
- Can cause yield drag in absence of SCN

### Eventually, biology "wins"

- Few genetic resistance sources available
  - PI88788
  - PI88788 + Peking or PI507354
  - Peking
  - PI438489B/PI90763
- Resistance declines under single tactic approach (PI88788)
  - Shifts may be permanent
- Rotate to a different source of resistance (ex. Peking)

### Not all varieties with the PI88788 source of resistance are the same

Not every soybean variety with the same source of resistance has the same # of resistance genes

- Rotate varieties within the same source of SCN resistance

### Gene mutations + selection = evolution




○ = susceptible  
● = resistant

### Gene mutations + selection = evolution



○ = susceptible  
● = resistant

### Recommendation: resistance + rotation



- Field history:
  - SCN
  - Grew PI88788 source of resistance
  - PI88788-resistant SCN

Photo: Phil Glogozza, UMN

### Communicating results to farmers

- We have created a form that you will use to fill out
  - Carefully copy over results from spreadsheet
  - Add in management recommendations
    - Whether or not to plant soybean in the field
    - Which non-host crops they can plant
    - Whether varieties with additional sources of SCN resistance are available in locally-adapted varieties

### Visualizing your data



SCN eggs per 100 cc's	Number of farmers
>50	~6
50-200	~7
201-2000	~1
2000-10,000	~3
10,001-20,000	~7
20,001+	~1

**Select all columns in your spreadsheet with data by holding down the ctrl key and clicking on the column heading**

**Sort your data by eggs/100 cc**

**Write down how many samples fall into ranges**

- >50 eggs / 100 cc's
- 50-200 eggs / 100 cc's
- 201-2,000 eggs / 100 cc's
- 2,001-10,000 eggs / 100 cc's
- 10,000-20,000 eggs / 100 cc's
- <20,000 eggs / 100 cc's

**Don't risk your data, open a new sheet**

**Add the data that you want to graph to spreadsheet**

**A pie chart is the default chart**

**Customize your graph**

**Download or copy your chart**

**Visualizing your results**

**First things first! Create your dataset**

- What are you going to map?
  - Choose place data (choose one)
    - Latitude, longitude (ex: 45.0000, -95.0000)
    - Address
    - City, State
  - Choose category data
    - Use consistent ranges
    - Include column names
    - Save as csv or xlsx
    - Example is an Excel file

**Create your new map (mymaps.google.com)**

**Title your new map and import data**

- Add your title
- Import your data
  - Data can be in csv, xlsx, etc. files

**Choose your file to import**

**Select your placemark**

- Choose the column that has your placemark data in the popup

**First look at the map**

- "Uniform style" is the default. We will want to change this.

**Group your data by category**

- Click on the roller brush
- Select the category to group your placemarks
  - This example is "eggs per 100 cm"

**Map with category labels**

**Need to make changes? Edit data within My Maps**

- Click on layer options (3 dots on right side)
- Select "Open data table"
- Edit directly in table

**Customize your map!**

- Change label colors and styles
  - Hover over the item you want to change and click on the bucket

**Change your base map**

- You can even change how your base map looks!
- Have fun and good luck!

**Figure 2.** An annotated presentation designed to be used after samples have been submitted and results returned from the lab.

Nineteen FFA chapters (Aitkin, Battle Lake, Bertha-Hewitt, Brandon-Evansville, Chatfield, Climax-Shelly, Fosston, Frazee-Vergas, Hawley, Herman-Norcross, Litchfield, Minnewaska-Glenwood Area, Norman County East, Osakis, Paynesville, Pierz-Healy, Sebeka, Ulen-Hitterdal, West-Central Area, Wheaton) were provided with a Team Soybean! sampling kit in fall

2022. Items in the kit (**Figure 3**) included a bright yellow 2 gallon bucket with lid, a soil probe “branded” with an MSRPC sticker, 35 soil sample bags including chapter-specific bag labels, a fine and ultra-fine point Sharpies for labeling, a pair of work gloves, laminated sampling instructions (**Figure 4**), a shipping box and a pre-paid shipping label.



**Figure 3.** Contents of MSRPC-sponsored and branded Team Soybean! sampling kit.

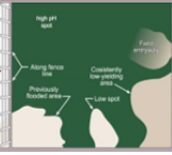
**Soybean cyst nematode sampling instructions**

Note: sampling strategy depends upon whether the field is known to be infested with SCN.

**Caution: Don't sample wet soil!**


**In fields that are not yet known to be infested with SCN:**

- 1) Using the ultra-fine tip Sharpie, fill out the label on a sample bag.
- 2) Make sure that the soil probe is clearly marked 8 inches from bottom with the fine-tip Sharpie.
- 3) Collect 15-20 eight-inch-deep soil cores (through the soybean root zone if possible), from those field areas that SCN is most likely to first infest or accumulate.
- 4) Once all cores have been collected, gently break them up & pour about 2 cups of soil into the sample bag.
- 5) Close the sample bag by rolling the top of the bag down & bend the wire in on either side to keep bag closed.
- 6) Store filled sample bags in a cool, dry place until all have been collected and are ready to ship to the lab.
- 7) **Practice sanitation to avoid spreading SCN:** brush soil from sampling bucket, probe, your clothing and shoes before getting into vehicle to leave field site.




**In fields that are known to be infested with SCN:**

- 1) Using the ultra-fine tip Sharpie, fill out the label on a sample bag.
- 2) Make sure that the soil probe is clearly marked 8 inches from bottom with the fine-tip Sharpie.
- 3) Walking in a zig-zag fashion, collect 15-20 eight-inch-deep soil cores (through soybean root zone if possible), from a field area no larger than 10 acres.
- 4) Once all cores have been collected, gently break them up, mix the soil together & pour about 2 cups of soil into the sample bag.
- 5) Close the sample bag by rolling the top of the bag down and bend the wire in on either side to prevent the bag from opening.
- 6) Store filled sample bags in a cool, dry place until all have been collected and are ready to ship to the lab.
- 7) **Practice sanitation to avoid spreading SCN:** brush soil from sampling bucket, probe, your clothing and shoes before getting into vehicle to leave field site.



For answers to your sampling questions, contact: Angie Peltier (218) 281-8692, [apeltier@umn.edu](mailto:apeltier@umn.edu) or Anthony Hanson (320) 589-1711 ext. 2124, [hans4022@umn.edu](mailto:hans4022@umn.edu)

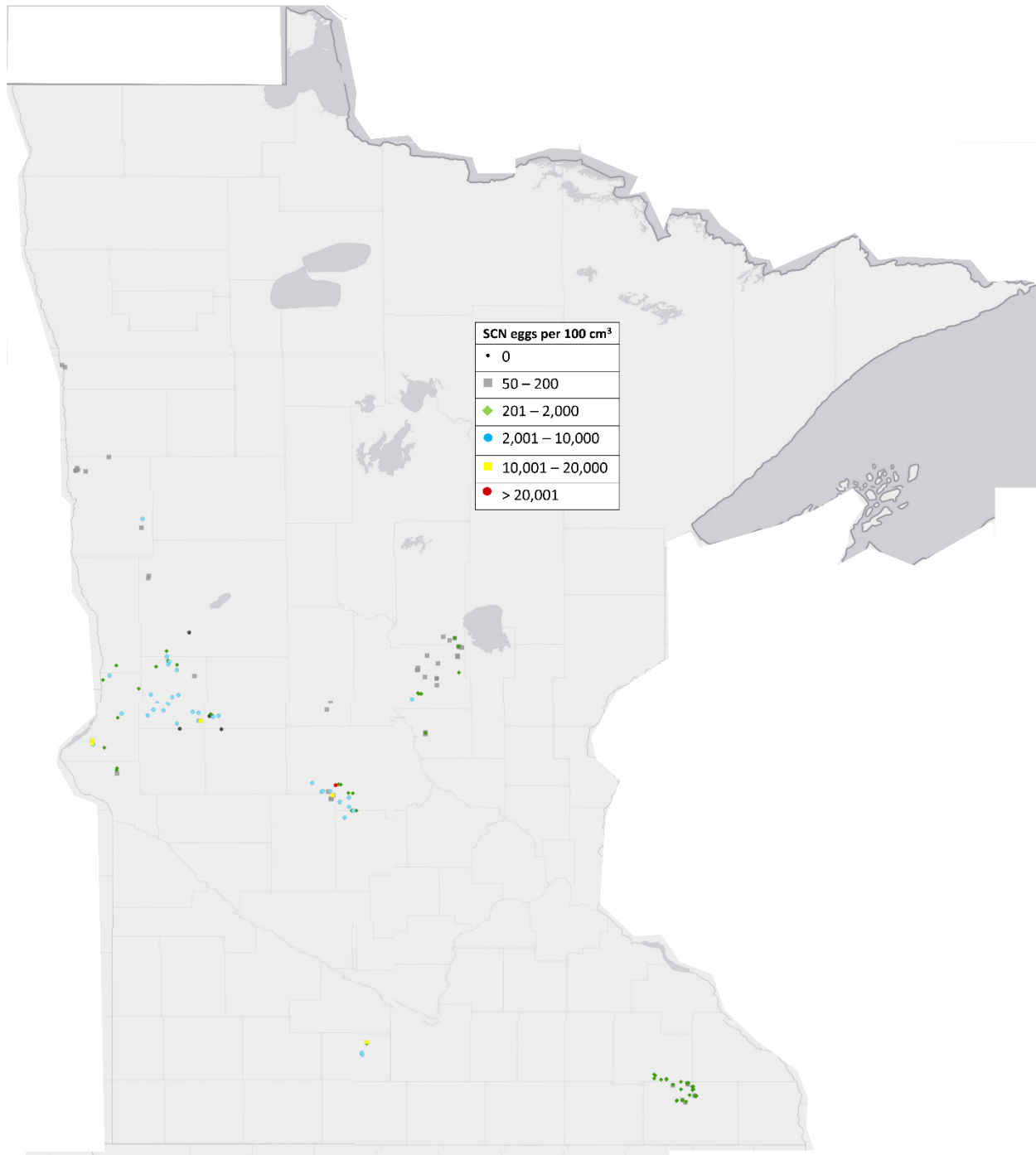
 UNIVERSITY OF MINNESOTA EXTENSION

Program sponsored with the generous support of the Minnesota Soybean Research & Promotion Council

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**Figure 4.** An image of the laminated soil sampling instructions attached to yellow buckets with zip-tie. Note the credit to MSRPC included in the yellow banner across the bottom of the page.

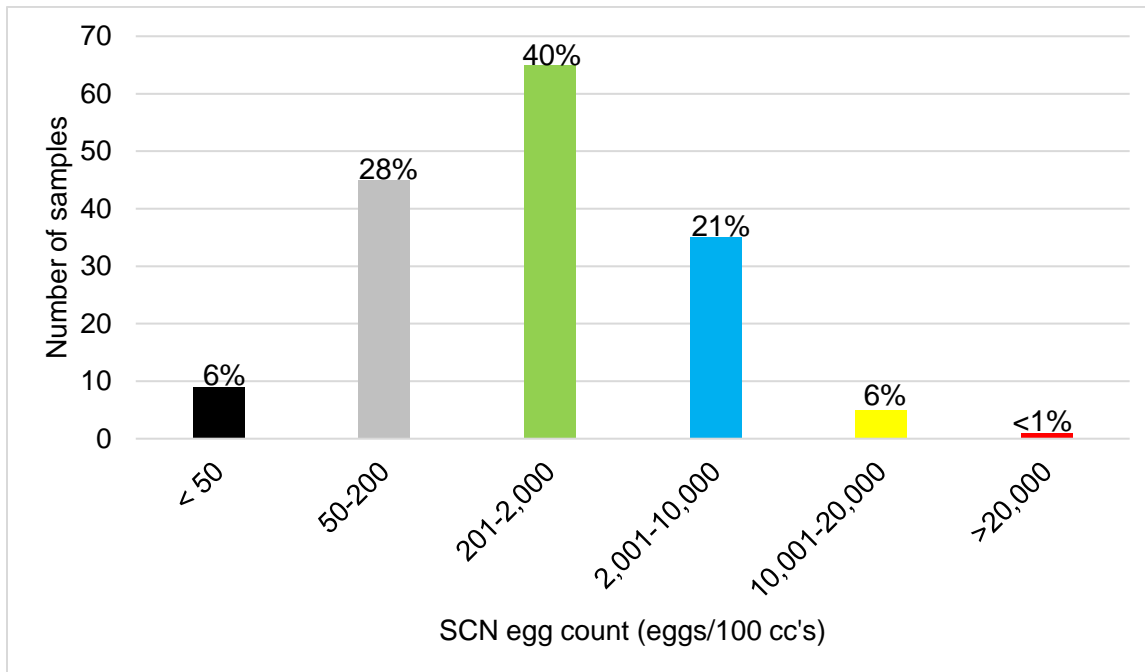
Of the 19 chapters participating, only half (Climax-Shelly, Herman-Norcross, Minnewaska-Glenwood, Paynesville, Pierz-Healy, West Central Area, Hawley, Wheat and Chatfield) collected and submitted a total of 163 soil samples to the lab for analysis. The results were overlaid on a map of Minnesota using the web-version of ARC-GIS, and while anyone viewing the map will be unable to pick out individual townships or fields, the map's resolution will allow one to zoom in when viewing it on their computer (**Figure 5**). Sample results are expressed as the number of SCN eggs per 100 cubic centimeters (cc's) of soil or a little bit less than ½ cup of soil.



**Figure 5.** Map of the results of the 163 SCN samples submitted by Minnesota FFA chapters in 2022.

Six percent of samples had SCN egg counts below the limit of detection (**Figure 6**); this does not mean that the field from which the sample originated is not infested with SCN, rather only that the soil cores collected from the field or the subsample used at the lab for the extraction did not contain an SCN cyst. Twenty-eight percent of samples had between 50 and 200 eggs per 100 cc's, a population density low enough that one could have grown an SCN-susceptible soybean variety in the field in 2023 as yield loss would be unlikely to occur. Forty percent of

samples had densities between 201 and 2,000 eggs/100 cc, a density at which it would be wise to plant an SCN-resistant soybean variety in 2023 as yield loss would be expected with an SCN-susceptible variety. Twenty-one percent of samples had an egg density between 2,001 and 10,000 eggs/100 cc, a density at which some yield loss is expected to occur even when an SCN resistant variety is planted. Three percent had between 10,001 and 20,000 eggs/100 cc, a density at which soybeans are no longer recommended as yield loss would be prohibitively high. One sample had 29,350 eggs/100 cc, a density at which *multiple* years of a non-host crop such as corn or one of the small grains followed by retesting would be recommended before again planting soybeans.



**Figure 6.** The number (and percentage) of soil samples collected by FFA chapters in 2022 that fell into each SCN egg count category.

Ag instructors were provided with two chapter-specific spreadsheets.

- One spreadsheet intended for use by students that contained the chapter's sample numbers, GPS coordinates and raw SCN egg count data. Students use this to place samples into one of the categories important from a management standpoint and used in Figures 5&6. Students were to take and add management recommendations that correspond with each category before sharing the results and recommendations with participating farmers.
- A similar spreadsheet intended for use by the instructor was designed to contain all of the information (sample number, GPS coordinates, egg count, SCN egg count category and specific management recommendations. This spreadsheet would be used as an 'answer sheet' to double-check students' egg count categories and management recommendations against.

Ag instructors were also provided a link to a [Career's in Agriculture](#) panel discussion that was recorded using Zoom and housed on YouTube. The goal of this discussion was to introduce students to some of the very diverse professions that there are in agriculture in an effort to keep



rural Minnesota's next generation living in and contributing to their rural community. Four people with diverse, non-farming jobs in agriculture were panelists:

- A woman from NW MN that farms and owns and operates her own agronomy center and seed sales business
- A man from NW MN that farms and is the precision ag supervisor for a regional equipment dealership
- A man from NW MN that manages small-plot research at a university research center
- A man from WC MN that is an agriculture teacher and owns and operates a for-hire drone company.

Several rewards were provided to FFA chapters that sent in samples:

- Ag instructors were sent a template and instructions for how to merge their class list onto individualized certificates of participation (**Figure 7**) for participating students.
- Ag instructors were also sent Team Soybean! stickers and temporary tattoos for each participating student (**Figure 8**)
- Three "star" FFA chapters that submitted 35 or more SCN samples were each awarded a trio of user-friendly books for their classroom, "A Farmer's Guide to Soybean Diseases" "A Farmer's Guide to Corn Diseases" and "A Farmer's Guide to Wheat Diseases".



**Figure 7.** Certificate of Team Soybean! participation provided to FFA instructors of chapters that submitted SCN samples.



**Figure 8.** Team Soybean! logo designed to be used for temporary tattoos and stickers as chapter rewards for participation.

During the spring, the UMN Extension members of Team Soybean! surveyed ag teachers from participating FFA chapters:

**Ag Teacher Impressions of Team Soybean Educational Materials.** Educators were asked about which of the Team Soybean educational materials they used with their classes, 86% (6 of 7 respondents) used the introductory annotated PowerPoint presentation. Respondents indicated that 86% used the annotated post-sampling PowerPoint presentation putting results into context and 43% (3 of 7 respondents) used the [Careers in Agriculture](#) video.

Of the seven respondents that used the introductory PowerPoint, four rated their response to statements about this resource (**Table 1**) on a scale of 0 to 10 where a score of “0” means disagree, a score of ‘5’ means neither disagree nor agree and a score of ‘10’ means agree.

**Table 1.** Summary statistics for response ratings regarding the post-sampling PowerPoint; a score of “0” means disagree, a score of ‘5’ means neither disagree nor agree and a score of ‘10’ means agree (n=4)

Statement	Minimum	Maximum	Mean	Std. Dev.
I used this PowerPoint in class	5.0	10.0	7.5	2.5
I used this PowerPoint to prepare for a less formal discussion in class	0.0	10.0	5.8	3.8
The notes in the PowerPoint were helpful	4.0	10.0	7.5	2.2
The content was understandable to my students	2.0	8.0	5.5	2.3
The PowerPoint stimulated good discussion in my class	5.0	8.0	6.5	1.1
The PowerPoint provided content of value to my class	4.0	10.0	6.8	2.4

Forty percent of the responding instructors used the “Now that you have your sampling results” PowerPoint in class (**Table 2**), 40% used it to prepare for class and 60% thought that the annotation was useful the PowerPoint was understandable to students, stimulated good discussion and provided content of value.

**Table 2.** Number and (percentage) of responses to statements regarding the post-sampling PowerPoint (n=5)

Statement	Disagree	Neither agree nor disagree	Agree
I used this PowerPoint in class	2 (40%)	1 (20%)	2 (40%)
I used this PowerPoint to prepare for a less formal discussion in class	0 (0%)	2 (40%)	2 (40%)
The notes in the PowerPoint were helpful	0 (0%)	2 (40%)	3 (60%)
The content was understandable to my students	0 (0%)	2 (40%)	3 (60%)

The PowerPoint stimulated good discussion in my class	0 (0%)	2 (40%)	3 (60%)
The PowerPoint provided content of value to my class	0 (0%)	1 (20%)	3 (60%)

Instructors were also asked to rate their impression of their students' level of knowledge before and after engaging with Team Soybean educational materials (**Table 3**). Before engaging with the educational materials, 100% of the respondents (n=5) indicated that their students had either no knowledge or a low level of knowledge of the importance of SCN to soybean yield, how to collect a representative soil sample, how to interpret lab test results or map or graph data. After engaging with the educational materials, 100% of instructors indicated that their students had a moderate or high level of knowledge regarding how to collect a representative soil sample, 80% that their students' level of knowledge regarding the importance of SCN to soybean yield was moderate or high, 80% indicated that the students now have moderate or high levels of knowledge regarding how to map and graph data and 40% indicated that the students now have moderate or high knowledge regarding how to interpret lab test results.

**Table 3.** Instructor's impression of their students' level of knowledge BEFORE and AFTER engaging with Team Soybean provided educational materials regarding the following statements and skills; the number and (percentage) of respondents' impressions are reported here (n=5)

Statement	Level of knowledge BEFORE				Level of knowledge AFTER			
	None	Low	Moderate	High	None	Low	Moderate	High
Importance of SCN to soybean yield	3 (60%)	2 (40%)	0 (0%)	0 (0%)	0 (0%)	1 (20%)	3 (60%)	1 (20%)
How to collect a representative soil sample	2 (40%)	3 (60%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (40%)	3 (60%)
How to interpret lab test results	3 (60%)	2 (40%)	0 (0%)	0 (0%)	0 (0%)	3 (60%)	1 (20%)	1 (20%)
How to graph data	1 (20%)	4 (80%)	0 (0%)	0 (0%)	0 (0%)	2 (40%)	2 (40%)	1 (20%)
How to map data	1 (20%)	4 (80%)	0 (0%)	0 (0%)	0 (0%)	2 (40%)	2 (40%)	1 (20%)

Respondents were asked to rate their level of agreement to the statements listed in **Table 4** related to the "Careers in Agriculture" video on a scale of 0 to 10 where a score of "0" means disagree, a score of '5' means neither disagree nor agree and a score of '10' means agree. One instructor (of the three that claimed to have used the video) agreed that they both used the video in class and that it provided information of value, but neither agreed, nor disagreed that it stimulated good discussion.

**Table 4.** Summary statistics for response ratings regarding the “Careers in Agriculture” video; a score of “0” means disagree, a score of ‘5’ means neither disagree nor agree and a score of ‘10’ means agree (n=1)

Statement	Score
I used this video in class	10
This video provided information of value to my class	8
This video stimulated good discussion with my class	6

**Educator Impressions of Team Soybean Promotional Materials.** When asked about the press releases developed for the program, which included a [fill-in-the-blank-style press release \(PR1\) announcing their chapter’s participation in the sampling program](#) and a [fill-in-the-blank-style press release \(PR2\) announcing a chapter’s sample](#) results, two instructors used PR1 and one used PR2. Respondents were asked to rate their responses to statements regarding PR1 on a scale of 0 to 10 where a score of “0” means disagree, a score of ‘5’ means neither disagree nor agree and a score of ‘10’ means agree (**Table 5**). The one person that indicated they used PR2 agreed (score of 10) that it was both easy to fill in the blanks to complete the press release, and that they submitted PR2 to their local newspaper, although they failed to score their level of agreement with the statement, “The press release was printed in the local newspaper”.

**Table 5.** Summary statistics for response ratings regarding the press release “PR1”; a score of “0” means disagree, a score of ‘5’ means neither disagree nor agree and a score of ‘10’ means agree (n=2)

Statement	Minimum	Maximum	Mean	Std. Dev.
It was easy to ‘fill in the blanks’ to complete the press release	5.0	10.0	7.5	2.5
I submitted a press release to the local newspaper	0.0	10.0	5.0	5.0
The press release was printed in the local newspaper	10.0	10.0	10.0	0.0

**Educator Impressions of Team Soybean Rewards.** FFA instructors were asked to rate their impressions of the Team Soybean rewards presented to their students (**Table 6**) on a scale of 0 to 10 where a score of “0” means negative, a score of ‘5’ means neutral and a score of ‘10’ means positive; with the average response indicating neutrality. Two instructors also provided additional comments regarding the rewards: “We loved the program, and the rewards were a sweet surprise” and “Appreciate the thought, but we didn’t need any rewards”.

**Table 6.** Summary statistics for response ratings regarding Team Soybean rewards provided to students on a score of “0” means negative, a score of ‘5’ means neutral and a score of ‘10’ means positive (n=6)

Statement	Minimum	Maximum	Mean	Std. Dev.
Stickers	0.0	10.0	5.5	3.3
Temporary tattoos	0.0	10.0	5.7	3.3
Certificates of participation	0.0	10.0	6.2	3.3

**Instructors were asked about whether they'd like their chapter to participate in 2023.**

Instructors were notified that we received funding to continue the program in 2023 and were asked about their interest in participating in various aspects of the current program (sampling program, careers discussion) or an in-class soybean experiment during the 2023/2024 school year. Of the six instructors that responded to the survey, five (83%) indicated that they are interested in participating in the sampling program and three (50%) in the careers discussion.

Instructors also offered general comments regarding the program, including: "I currently have sampling equipment for one student to sample at a time so having additional equipment would help students collect samples when they have time and not being able to miss those opportunities because of things like sports or other extra curriculums" and "Last year students did not have enough time to collect samples and send in by the deadline. This is a great program and I hope to better implement it next year".

**Summer/Fall 2023 activities.** In anticipation of the 2023/24 school year that begins this fall, members of Team Soybean! met with the boards of several county Soybean Grower's (or Soybean & Corn Grower's) Associations to share with them the goals of the project, show them the sampling kit and solicit their help in reaching out to ag and science instructors in their counties or communities to urge their participation in Team Soybean!. Letters were sent to 40 instructors from an additional 25 school districts, including: Adrian, Alexandria, Atwater-Cosmos-Grove City, Benson, Braham, Brainerd, Brekenridge, Browerville, Buffalo-Hanover-Montrose, Canby, Dassel-Cokato, Eden Valley-Watkins, Farmington, Foley, Granada-Huntley-East Chain, Hastings, Holdingford, Hutchinson, Kimball, Little Falls, NRHEG, Ogilvie, Princeton, Sauk Rapids-Rice and Willmar.

Immediately after the Labor Day holiday when the school year will have begun in all districts, tailored email inquiries will be sent to:

- The teachers from the 25 school districts listed above
- Those teachers that were not interested in participating when invited to do so during the 2022/23 school year
- Those teachers that participated during the 2022/23 school year, but their chapter did not submit samples
- Those teachers that both participated during the 2022/23 school year *and* whose chapter submitted samples.

In addition, instructions will be disseminated through multiple avenues for farmers interested in having their check-off funds used for paying for SCN sample analysis to request sample bag labels from UMN Extension:

- An article will be posted to the MN Crop News Blog and distributed to its email mailing list of 3200
- An article will be posted to the Cropping Issues in NW MN Blog and distributed to its email mailing list of 716 people
- A link to these articles will be shared with Dr. David Kee, research director of the Minnesota Soybean Research & Promotion Council
- A flier detailing the program and how to obtain sample bags to have the program pay for analysis will be shared with a crop advisor email list under the control of the UMN Extension Institute of Ag Professionals

- A flier will be shared with the Minnesota Ag Retailers association for distribution to their membership.