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Getting it Right: Soybean Diseases

Sam Markell, Ph.D.
Extension Plant Pathologist

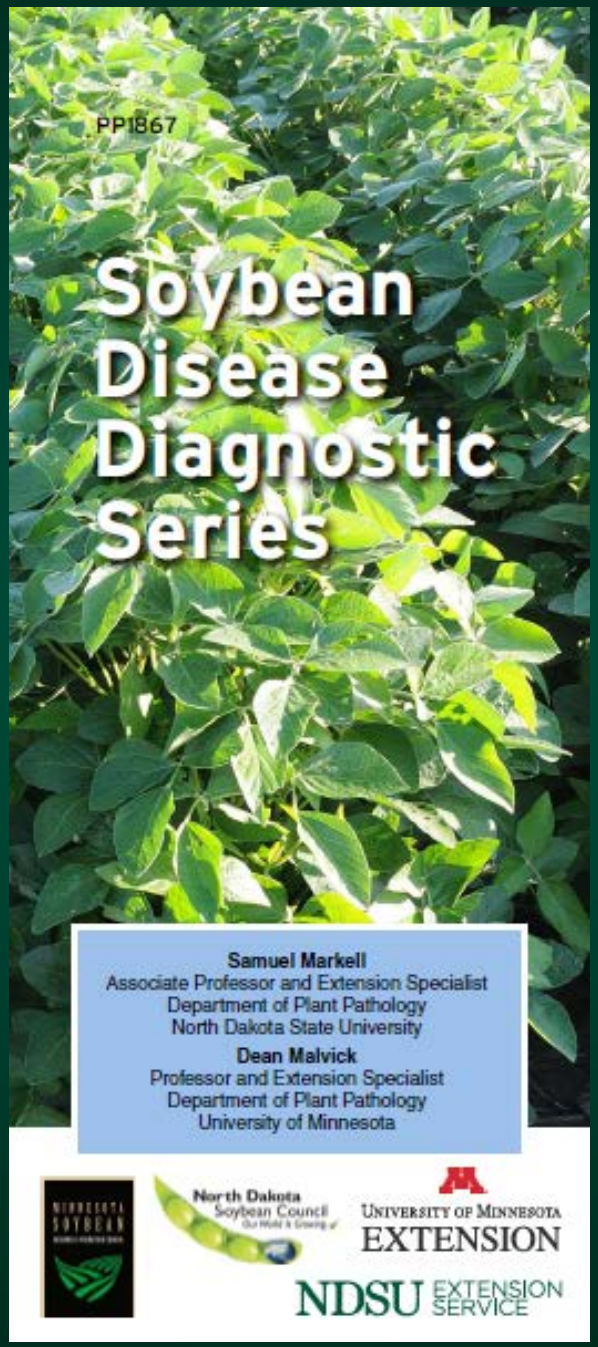
NDSU NORTH DAKOTA STATE UNIVERSITY

Diseases of Soybean

- Roots
  - Root Rots
  - Soybean Cyst Nematode
- Stems
  - White Mold
  - Some other diseases, especially over time
- Leaves
  - Usually minor issues (bacteria, brown spot, downy mildew)

https://www.ag.ndsu.edu/publications/crops/soybean-disease-diagnostic-series

Diagnosis



Root Diseases

Fusarium root rot	PP1867-1
Phythophthora root and stem rot	PP1867-2
Pythium root rot	PP1867-3
Rhizoctonia root rot	PP1867-4
Seed and seedling rot complex	PP1867-5
Soybean cyst nematode	PP1867-6
Sudden death syndrome	PP1867-7

Stem Diseases

Anthracnose	PP1867-8
Brown stem rot	PP1867-9
Charcoal rot	PP1867-10
Pod and stem blight	PP1867-11
Stem canker	PP1867-12
White mold	PP1867-13

Leaf Diseases

Bacterial blight	PP1867-14
Bacterial pustule	PP1867-15
Bean pod mottle virus	PP1867-16
Cercospora leaf blight	PP1867-17
Downy mildew	PP1867-18
Frogeye leaf spot	PP1867-19
Powdery mildew	PP1867-20
Septoria brown spot	PP1867-21
Soybean mosaic virus	PP1867-22

Additional Diseases (not known to occur in ND/MN)

Soybean rust	PP1867-23

Cover photo: Sam Markell, NDSU

For more information on this and other topics, see www.ag.ndsu.edu

2.5M-1-18

North Dakota Soybean Council
Our World Is Growing.

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https://www.ag.ndsu.edu/publications/crops/soybean-disease-diagnostic-series

PP1867-13
Soybean Disease Diagnostic Series

White mold (Sclerotinia stem rot)

Sclerotinia sclerotiorum (fungus)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- **Stem lesions begin as water-soaked spots near nodes**
- **Lesions enlarge, fluffy white fungal growth develops on moist stems**
- **Infected stems become bleached white and may shred**
- **Hard black structures (sclerotia) form on infected tissue**

FIGURE 1 - Lesions with white mold and sclerotia
FIGURE 2 - Severe white mold infection
FIGURE 3 - Black sclerotia among shriveled seeds
FIGURE 4 - Apothecia

FACTORS FAVORING DEVELOPMENT

- Wet soils prior to and during soybean flowering
- Frequent wetness (rain, fog, heavy dew) and cool temperatures during bloom
- Dense plant canopy, high fertility, high plant populations
- Disease history in field

IMPORTANT FACTS

- Severe yield losses can occur when July and early August are cool and wet
- Many broadleaf crops and weeds are hosts
- Pathogen survives in soil for many years as sclerotia
- Sclerotia produce apothecia (about 1/4-inch mushrooms), which produce ascospores that initiate infection
- Apothecia commonly confused with bird's nest fungi
- Management options: partially resistant varieties and fungicides

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North Dakota Soybean Council

https://www.ag.ndsu.edu/publications/crops/soybean-disease-diagnostic-series

PP1867-9
Soybean Disease Diagnc

Brown st
(BSF

Cadophora gregat

Figure 3

PP1867-10
Soybean Disease Diagnc

Charcoa

Macrophomina phase

Fi

PP1867-11
Soybean Disease Dia

Pod and st
Phomopsis

Diaporthe sojae and *Dia*

PP1867-12
Soybean Disease Dia

Stem c

Diaporthe caulivora (nort
D. aspalathi (southern

PP1867-13
Soybean Disease Diagnostic Series

White mold
(Sclerotinia stem rot)

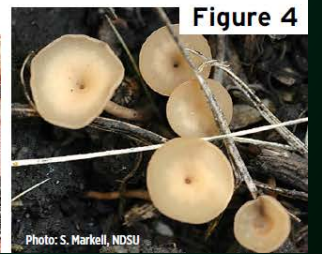
Sclerotinia sclerotiorum (fungus)

Figure 1

Figure 2

Figure 3

Figure 4



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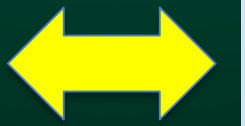

PP1867-10
Soybean Disease Diagnostic Series

Charcoal rot

Macrophomina phaseolina (fungus)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- **Symptoms usually not apparent until flowering or later**
- **Taproot and lower stem may appear gray/silver**
- **Numerous black fungal specks (microsclerotia) under epidermis give a "charcoal" appearance**
- **Premature death with wilted leaves attached**
- **Frequently occurs in patches in fields**

FIGURE 1 - Large patches of soybean with charcoal rot
FIGURE 2 - Patch of wilting soybeans
FIGURE 3 - Infected (L and C) and healthy soybean (R)
FIGURE 4 - External gray lesion peeling away, revealing profuse "charcoal' sclerotia

FACTORS FAVORING DEVELOPMENT

- Hot temperatures
- Drought stress
- May be more severe when soybean cyst nematode is present

IMPORTANT FACTS

- Yield loss may occur in hot, dry growing seasons
- Disease typically most severe in drought-prone areas of fields
- Very wide host range, which includes corn, sunflower, other legume crops and weeds
- Commonly confused with anthracnose, Phytophthora stem rot, pod and stem blight, stem canker

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Root Rots

Lots of pathogens

	Soil moisture	Soil temperature
Pythium	Flooded	Cool (50-60 F)
Phytophthora	Flooded	Warm (70s F)
Fusarium	Wet to dry	Cool to warm
Rhizoctonia	Damp to wet	Warm (70-80s)

Adapted from Robertson et al.

Fusarium Rhizoctonia

Photos Carl Bradley

- True Fungi
- Fusarium
  - ‘Dry Rot’
  - General Browning
- Rhizoctonia
  - ‘Dry Rot’
  - Red Cankers

Pythium

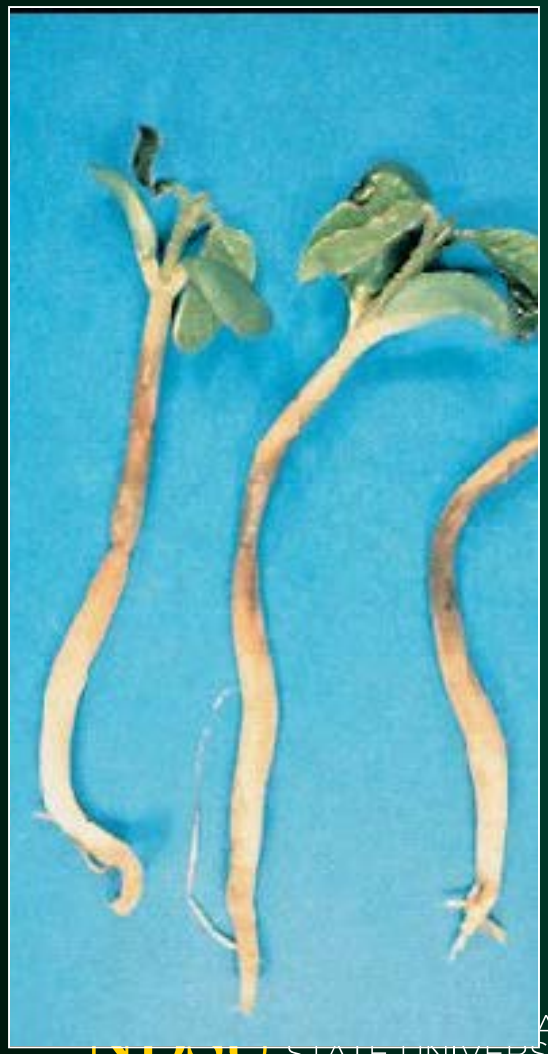
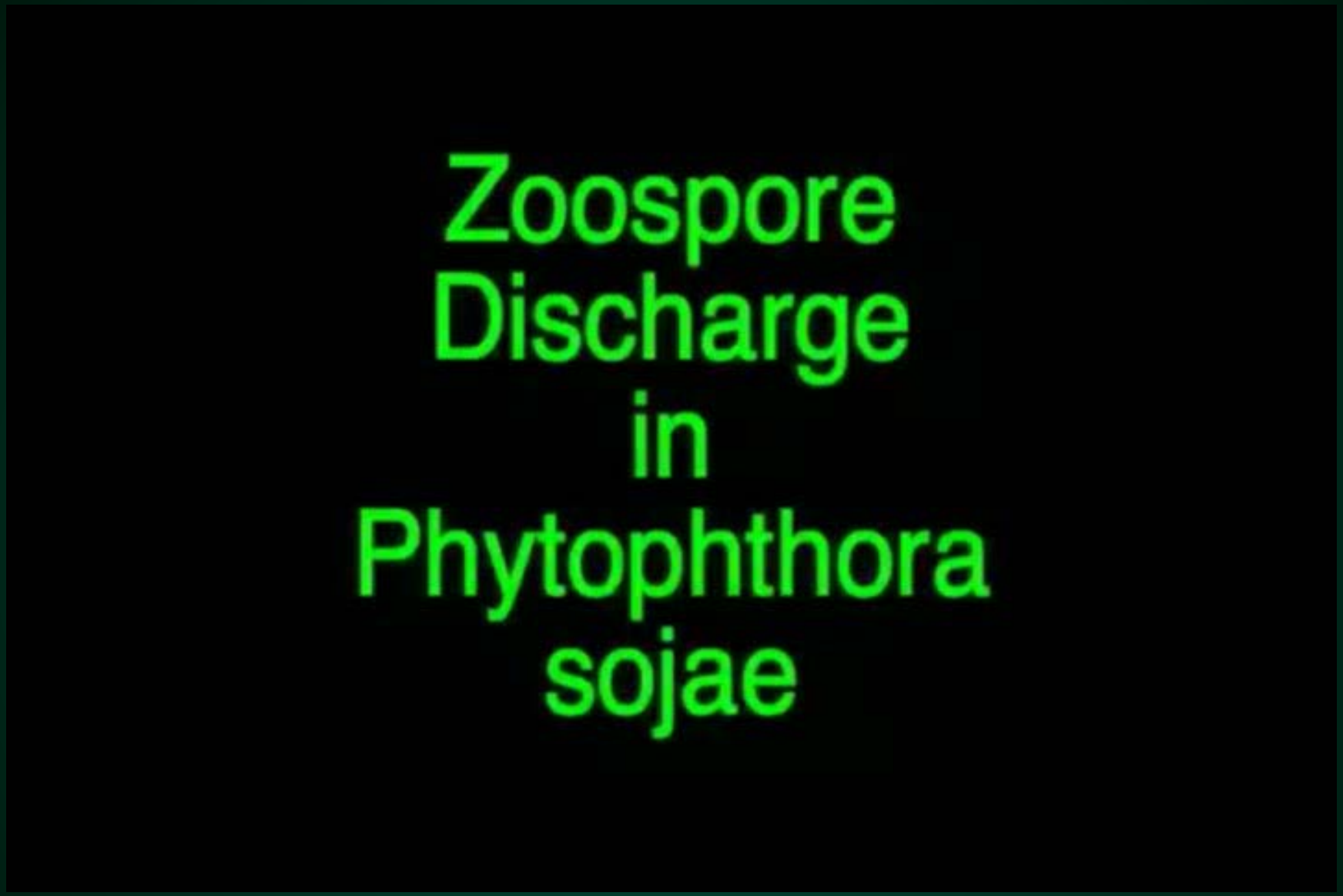


Photo: U of Wisc

Phytophthora

Photo: Berlin Nelson

- Not ‘true’ Fungi
- Black/wet lesions
- Need Wet Soil!



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Courtesy of Dr. Tom Chase, South Dakota State University

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Courtesy of Dr. Tom Chase, South Dakota State University

Root Rot Management

- Rotation

Root Rot Management

Rotation

- *Pythium* and *Fusarium* are ‘broad’
- *Rhizoctonia* is semi-specific to crop
- *Phytophthora* is specific to crop

Consider similarly of crops

Root Rot Management

- Rotation
- Resistance genes to *Phytophthora*

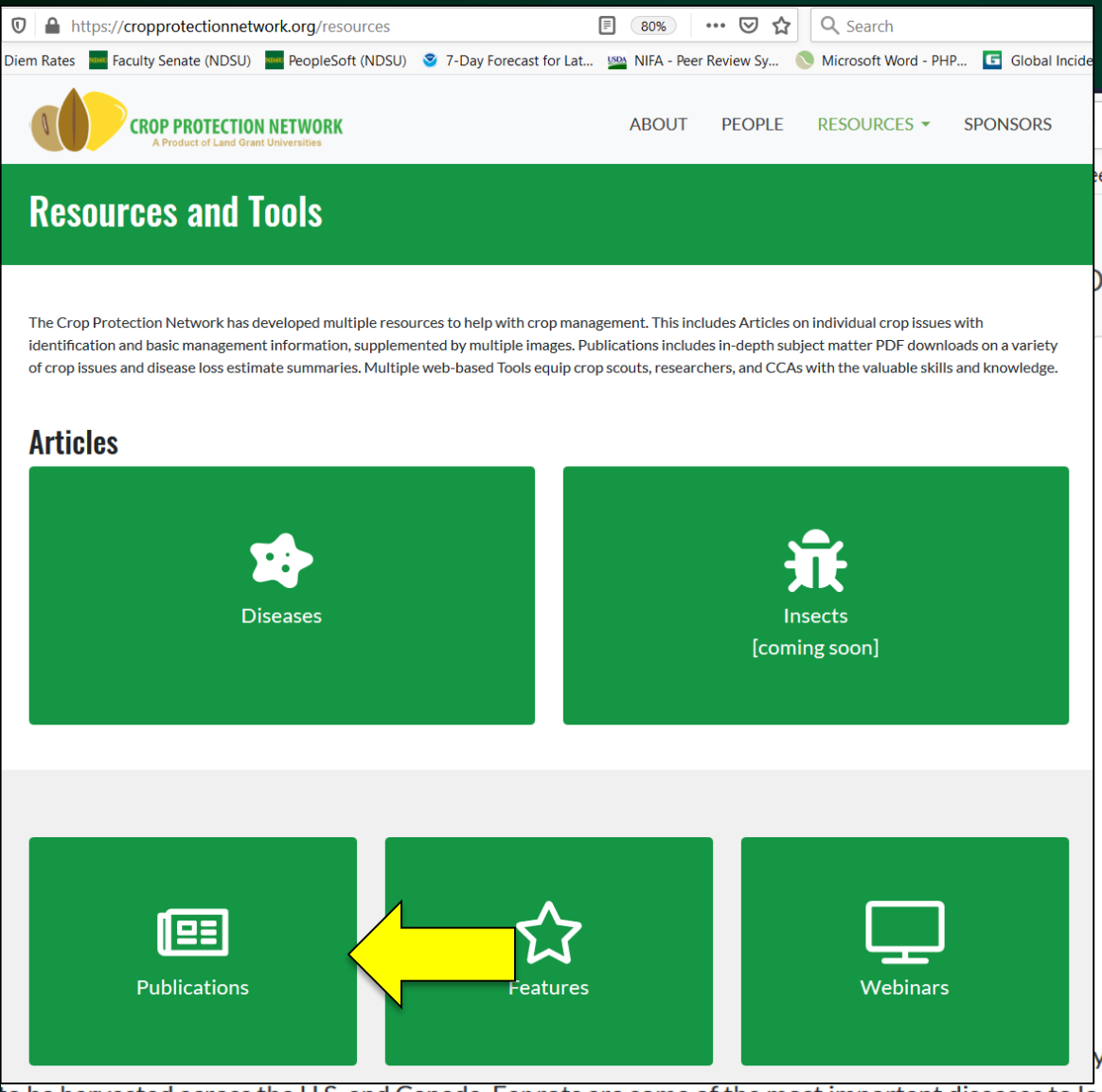
Root Rot Management

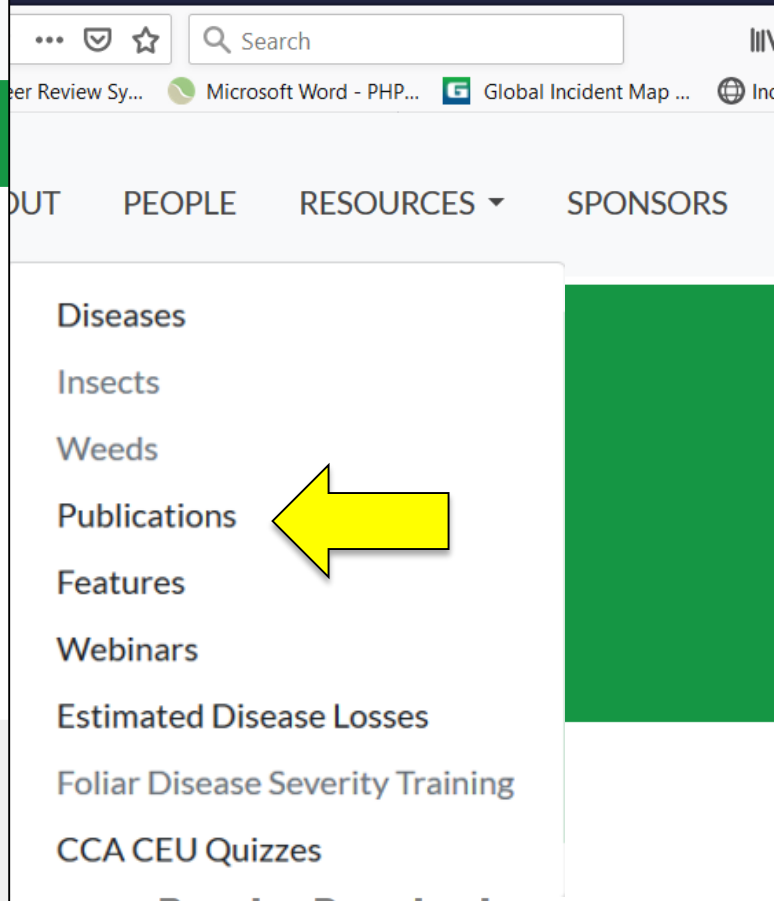
- Rotation
- Resistance genes to *Phytophthora*
- Field tolerance / resistance

Root Rot Management

- Rotation
- Resistance genes to *Phytophthora*
- Field tolerance / resistance
- Seed Treatments
  - Broad Spectrum
  - Effective for several weeks
  - Help germination and stand establishment

https://cropprotectionnetwork.org





yet
to be harvested across the U.S. and Canada. Ear rots are some of the most important diseases to look for because they decrease yield and grain quality and several produce mycotoxins. Read More

SOYBEANS

Charcoal Rot
CPN-1004 | doi.org/10.31274/cpn-20190620-010 | PDF | CCA CEU Quiz

Considerations for Selecting Soybean Varieties
CPN-4004 | doi.org/10.31274/cpn-20190620-011 | PDF | CCA CEU Quiz

Factors to Consider Before Using a Soybean Seed Treatment
CPN-4003 | doi.org/10.31274/cpn-20190620-012 | PDF | CCA CEU Quiz

Frogeye Leaf Spot
CPN-1017 | doi.org/10.31274/cpn-20190620-013 | PDF | CCA CEU Quiz

Fungicide Efficacy for Control of Soybean Foliar Diseases
CPN-1019 | doi.org/10.31274/cpn-20190620-014 | PDF

Fungicide Efficacy for Control of Soybean Seedling Diseases
CPN-1020 | doi.org/10.31274/cpn-20190620-015 | PDF

Pod and Stem Blight and Phomopsis Seed Decay
CPN-1007 | doi.org/10.31274/cpn-20190620-016 | PDF | CCA CEU Quiz

Scouting for Phytophthora Root and Stem Rot
CPN-1014 | doi.org/10.31274/cpn-20190620-017 | PDF

Scouting for Soybean Seed Diseases
CPN-1001 | doi.org/10.31274/cpn-20190620-018 | PDF

Scouting for Soybean Seedling Diseases
CPN-1009 | doi.org/10.31274/cpn-20190620-019 | PDF

Scouting for Soybean Stem Diseases
CPN-1002 | doi.org/10.31274/cpn-20190620-020 | PDF

Disease Loss Estimates

CORN

Disease Loss Estimates – 2012
CPN-2007-12 | doi.org/10.31274/cpn-20190620-035 | PDF

Disease Loss Estimates – 2013
CPN-2007-13 | doi.org/10.31274/cpn-20190620-036 | PDF

Disease Loss Estimates – 2014
CPN-2007-14 | doi.org/10.31274/cpn-20190620-037 | PDF

https://cropprotectionnetwork.org

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SOYBEAN DISEASE MANAGEMENT
CPN-1020-W

Fungicide Efficacy for Control of Soybean Seedling Diseases

The members of the **North Central Regional Committee on Soybean Diseases (NCERA-137)**, with the support of the United Soybean Board, have developed the following ratings for how well fungicide seed treatments control

fungicide-treated seed. This information is provided only as a guide. It is the applicator's and user's legal responsibility to read and follow all current label directions. Reference in this publication to any specific

https://cropprotectionnetwork.org

Fungicide Efficacy for Control of Soybean Seedling Diseases

Fungicide Active Ingredient	*Pythium* sp.[1]	*Phytophthora*	*Rhizoctonia* sp.	*Fusarium* sp.[1,3]	Sudden death syndrome (SDS) (*Fusarium virguliforme*)	*Phomopsis* sp.
azoxystrobin	P-G	NS	VG	F-G	NR	P
carboxin	U	U	G	U	NR	U
ethaboxam	E	E	NR	NR	NR	NR
fludioxonil	NR	NR	G	F-VG	NR	G
fluopyram	NR	NR	NR	NR	VG	NR
fluxapyroxad	U	U	E	G	NR	G
ipconazole	P	NR	F-G	F-E	NR	G
mefenoxam	E[2]	E	NR	NR	NR	NR

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https://ipcm.wisc.edu/download/pubsPM/Whats_on_your_seed_web.pdf

Treatment Type Legend

- F Fungicide
- I Insecticide
- N Nematicide
- P Plant Growth Regulator

	Active Ingredient (s)	Product Trade Name	Crop
F	azoxystrobin	Dynasty®	Corn, Soybean, Small Grains
F	*Bacillus pumilus*	Sonata®	Corn, Soybean, Small Grains, Alfalfa
F	*Bacillus subtilis*	HiStick® N/T	Soybean, Alfalfa
		Integral®	Soybean
F	captan	Captan 4L ST	Corn, Soybean, Small Grains, Alfalfa
F	copper hydroxide	Champ® Formula 2	Small Grains
F	copper hydroxide + mancozeb	ManKocide®	Small Grains
F F I	metalaxyl, metconazole, clothianidin	NipsIt™ Suite Cereals	Small Grains
F F I	mefenoxam, difenoconazole, thiamethoxam	Cruiser Maxx® Cereals	Small Grains
F F F F	azoxystrobin, fludioxonil, mefenoxam, thiabendazole	Maxim® Quattro	Corn
F F F I	azoxystrobin, fludioxonil, mefenoxam, thiamethoxam	Seed Shield®	Soybean
F F F I	mefenoxam, fludioxonil, sedaxane, thiamethoxam	CruiserMaxx® Vibrance	Soybean
		Warden® CX	Soybean
F F F I	mefenoxam, fludioxonil, sedaxane, thiamethoxam, *Pasteuria nishizawae*-Pn1	Clariva Elite Beans	Soybean

White Mold

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White mold

- Fungal pathogen
  - *Sclerotinia sclerotiorum*
- Yield loss *possible*
- Manage with an Integrated Strategy

- Sunflower
- Dry Edible Beans
- Canola
- Soybean
- Pulse Crops
- Broadleaf weeds

White Mold

- Wet Soil
  - 1-2 inches of rain before bloom (minimum)
- Bloom
  - Infection begins with flower petals
- Cool
  - 60^{o}’s and 70^{o}’s
  - Over 85^{o} F is unfavorable
- Wet
  - Humid canopy

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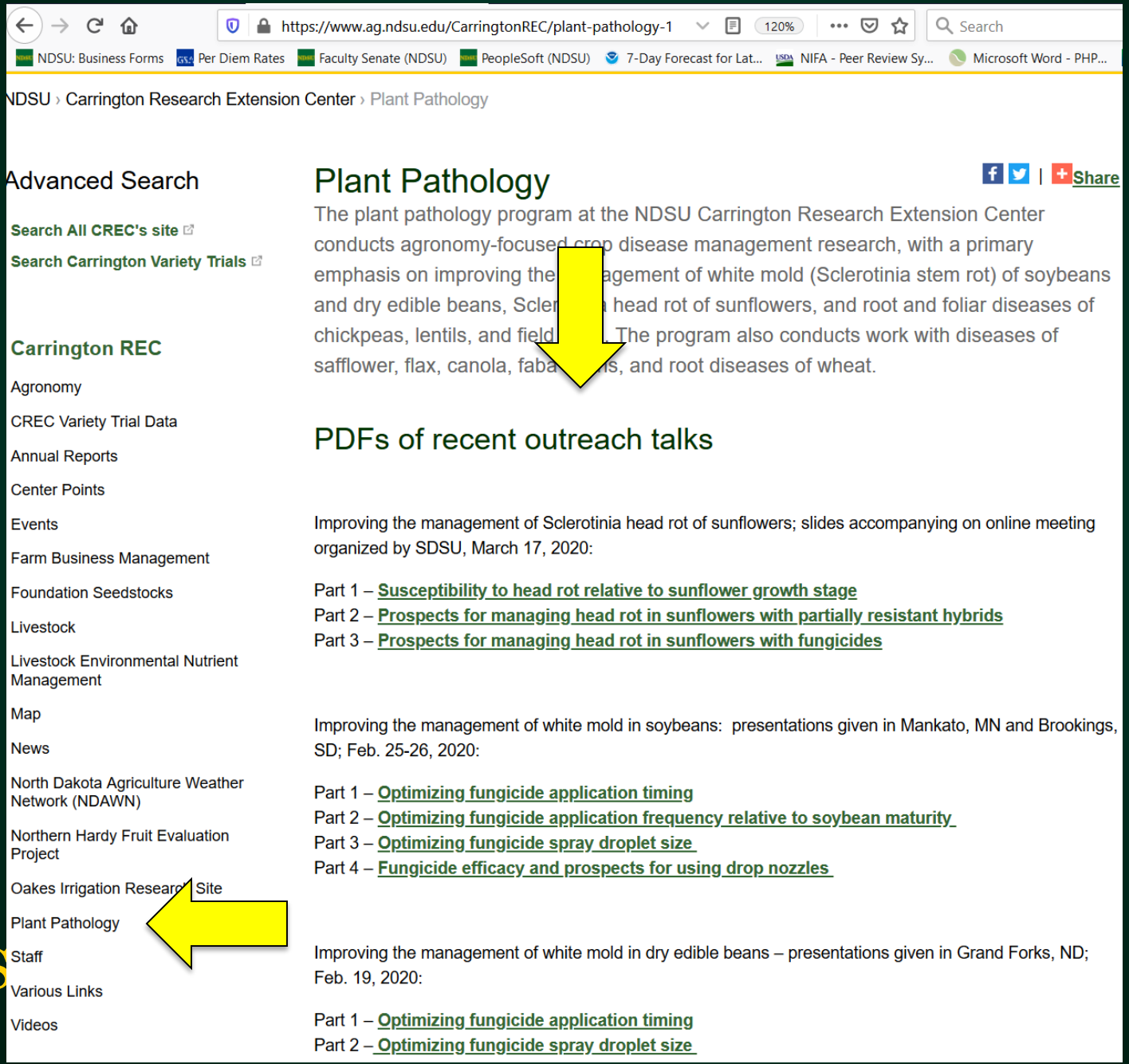
Managing White Mold

- Cultural Practices
  - Tillage…..?
  - Row spacing……..?
- Rotation
  - Cereals and corn are best rotation crops
  - Broadleaf crops susceptible
- Resistance
  - ‘Partial’ Resistance

Managing white mold… Cont..

- Fungicides –
  - Favorable for disease?
  - Economic return…..?
  - Product selection?
  - Timing (R1-R2)

https://www.ag.ndsu.edu/CarringtonREC/plant-pathology-1



Courtesy: Dr. Michael Wunsch

Differences in susceptibility to white mold across soybean varieties

White mold severity index and soybean yield averaged across fungicide-treated and non-treated soybeans.

Carrington, ND
2018

Completely randomized split-plot design

Main factor = Variety

Sub-factor = Fungicide treatment

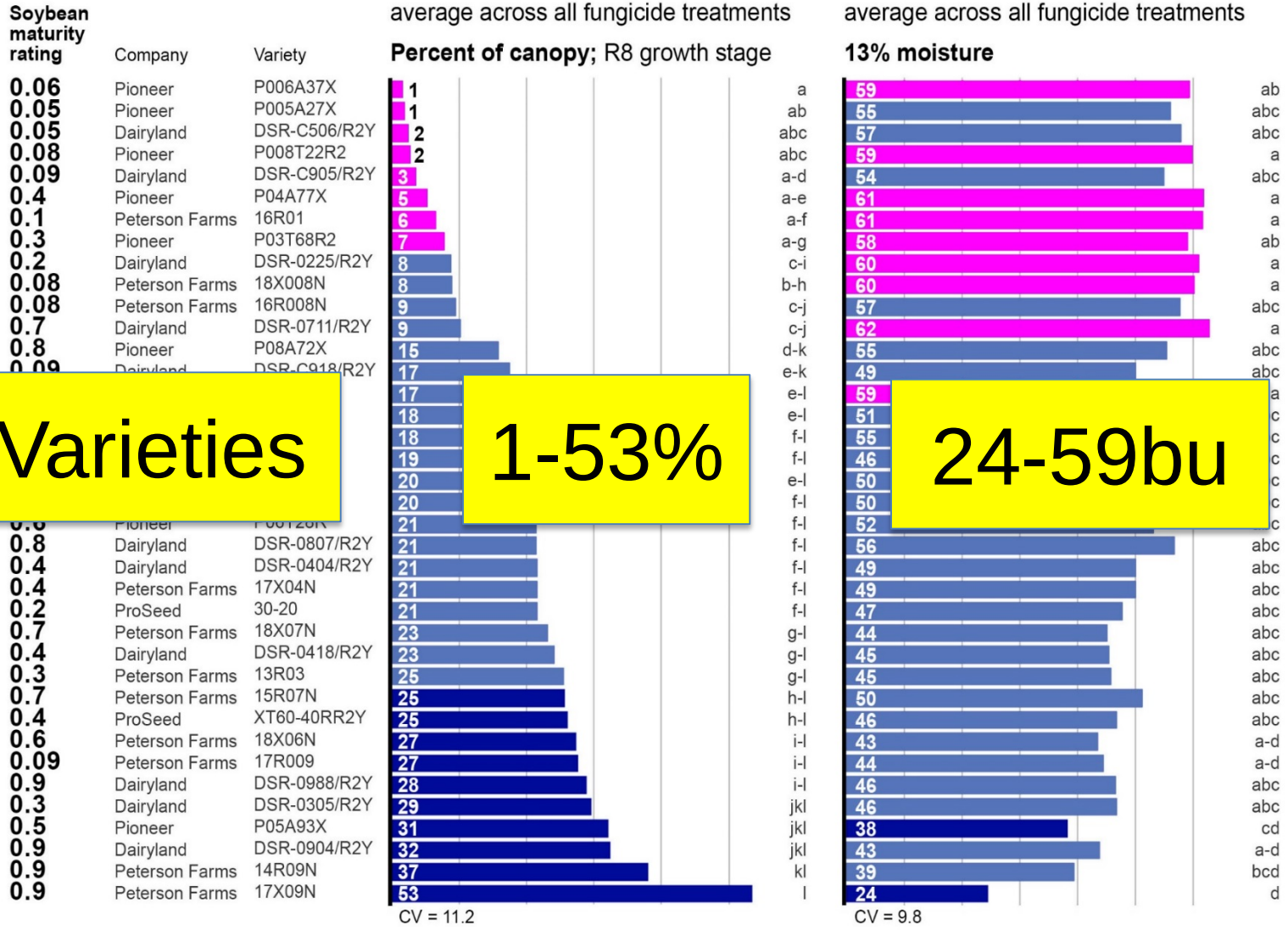
1. No foliar fungicide
2. Endura 5.5 oz *applied once at late R1 to early R2*
3. Endura 5.5 oz *applied twice R1/R2 + 10-12 days*

Fungicides applied with XR110015 flat-fan nozzles at 40 psi (fine droplets); spray volume = 15 gal/ac

Varieties

1-53%

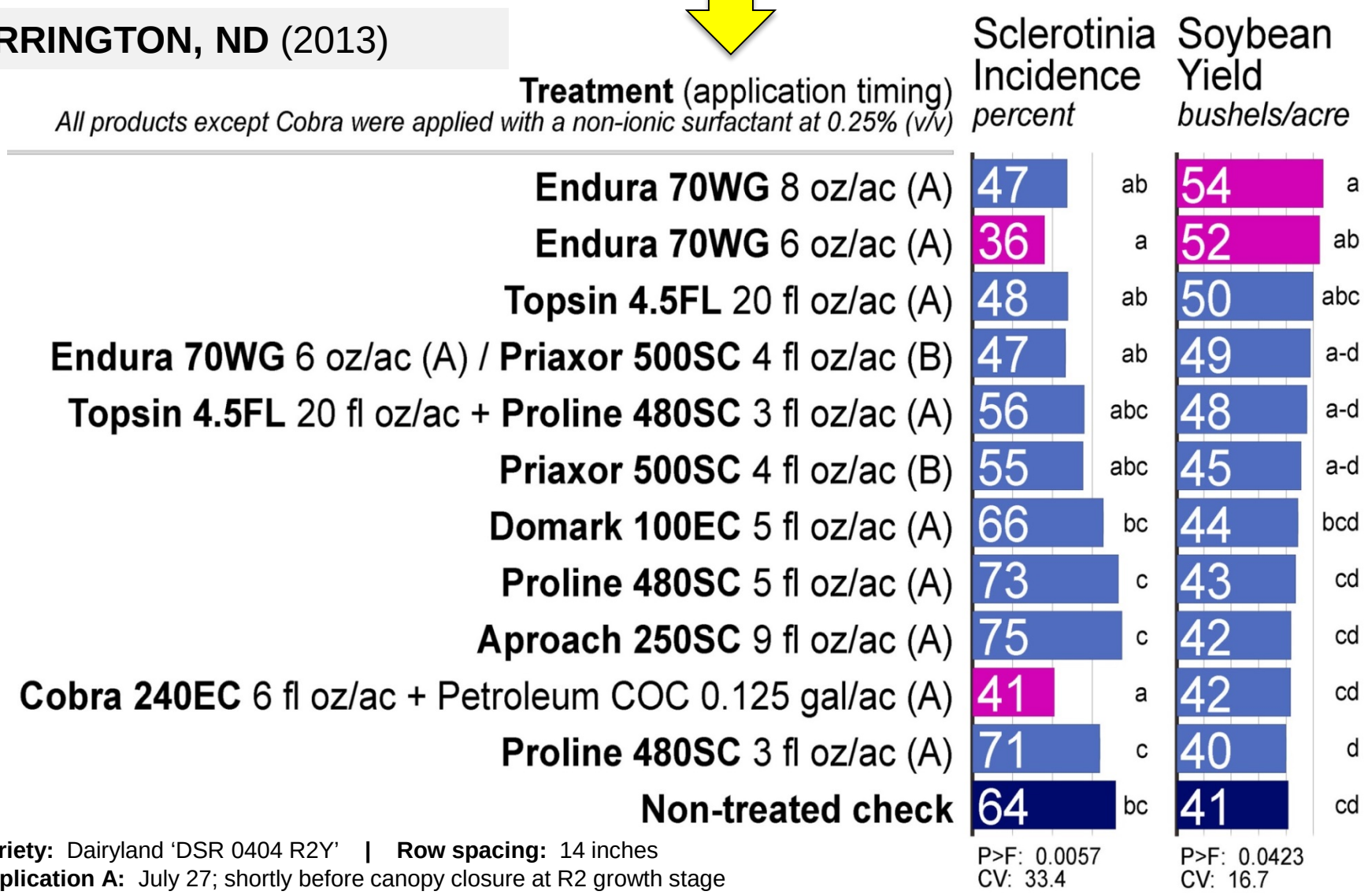
24-59bu



Within-column means followed by different, non-overlapping ranges of letters are significantly different ($P < 0.05$; Tukey procedure)

Fungicide efficacy

CARRINGTON, ND (2013)



Variety: Dairyland 'DSR 0404 R2Y' | **Row spacing:** 14 inches
Application A: July 27; shortly before canopy closure at R2 growth stage
Application B: August 8; early R4 growth stage
Application methods: 15 gal water/A; 35 psi; 8001VS flat-fan nozzles

Courtesy: Dr. Michael Wunsch

Optimizing application timing

Courtesy: Dr. Michael Wunsch

When conditions favored white mold as soybeans entered bloom:

Applying fungicides at the mid/late R1 growth stage (60-85% R1)
optimized white mold management
when the canopy was closed at mid/late R1.
(100% of the ground covered by the canopy)

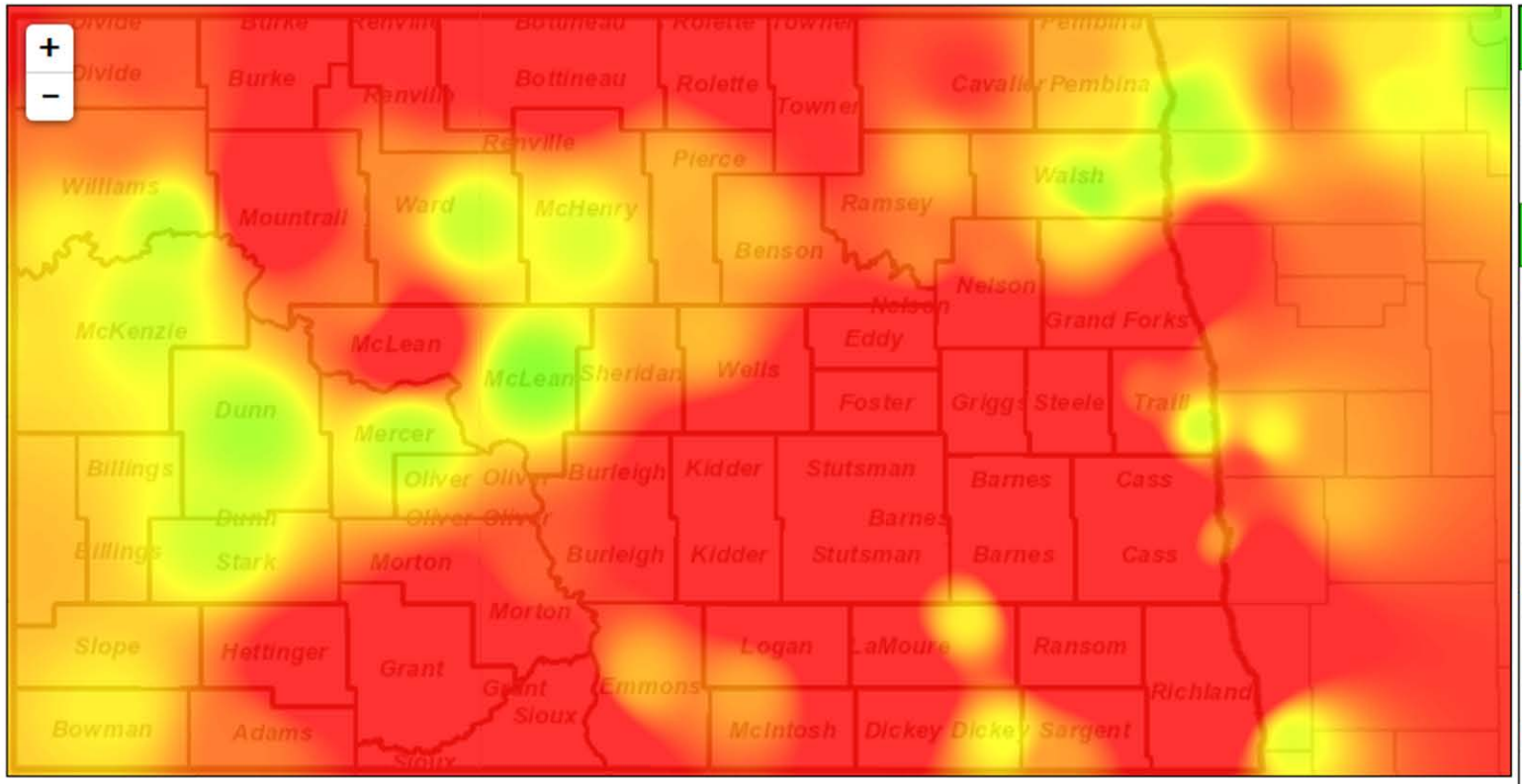
Applying fungicides at early R2 growth stage (80-99% R2)
optimized white mold management
when the canopy was at or near closure at early R2.
(97-100% of the ground covered by the canopy)

Applying fungicides at full R2 growth stage (100% R2)
optimized white mold management
when the canopy was open at early R2.
(<95% of the ground covered by the canopy)

R1: at least one open blossom on the plant.
R2: at least one open blossom at one of the top two nodes of the plant.

https://www.ag.ndsu.edu/sclerotinia/riskmap.html

Estimated risk of Sclerotinia stem rot development for canola 07/04/2020



Previous risk maps

Select date:

Thu Jul 04 2019

Get Map

Risk calculator

Closest NDAWN Station:

Last time planted to canola:

Sclerotinia on last canola:

Last year's crop in this field:

Tillage last year:

Canola Row Spacing:

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Northern CANOLA GROWERS Association

Soybean Cyst Nematode

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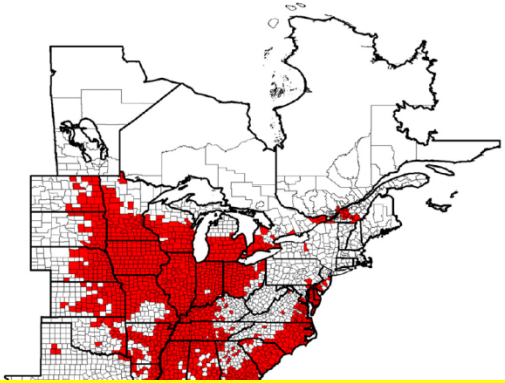
What's your number?

Take the test. Beat the pest.

The **SCN** Coalition™

Funded by the soybean checkoff

The New SCN Coalition

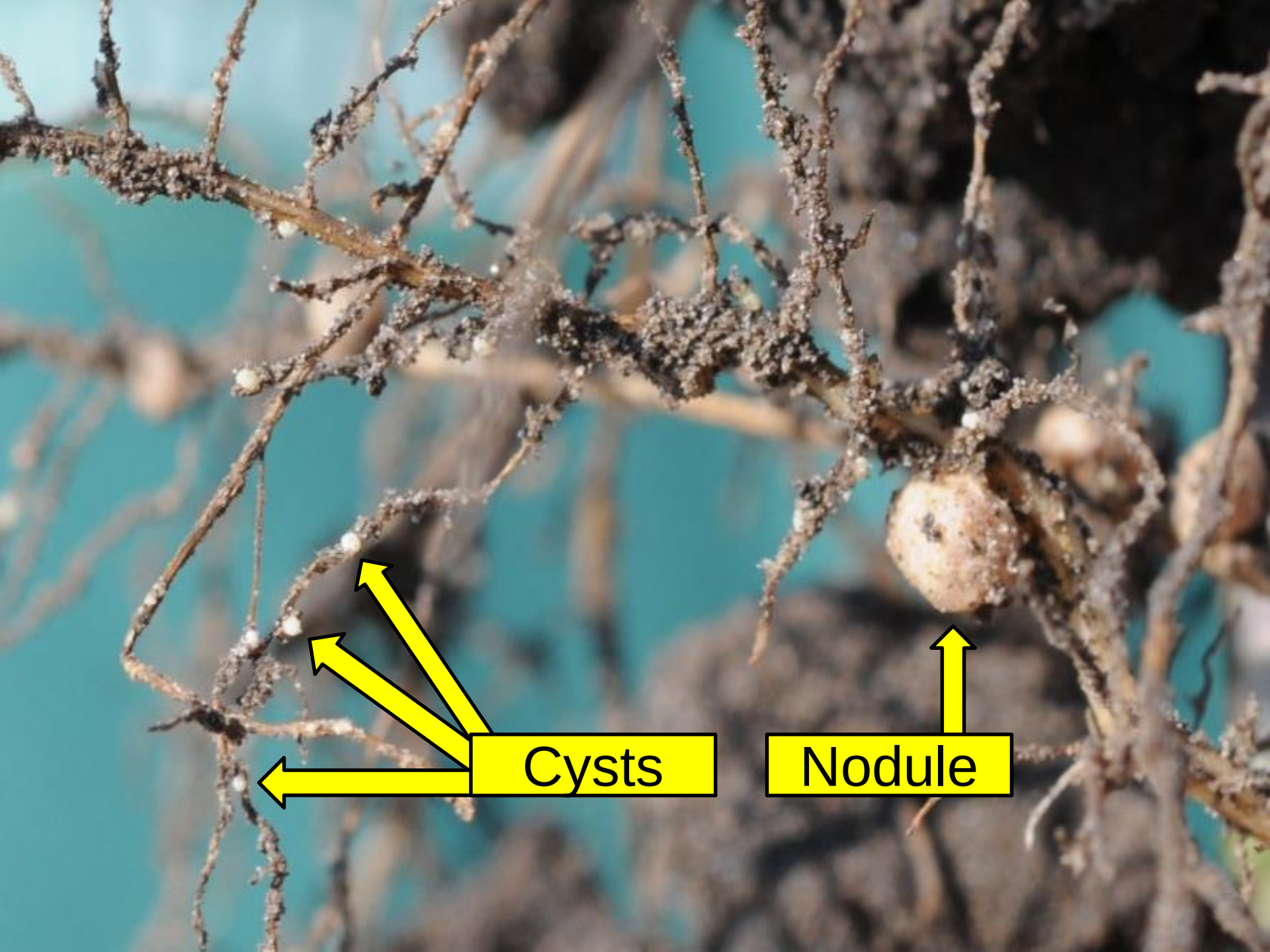


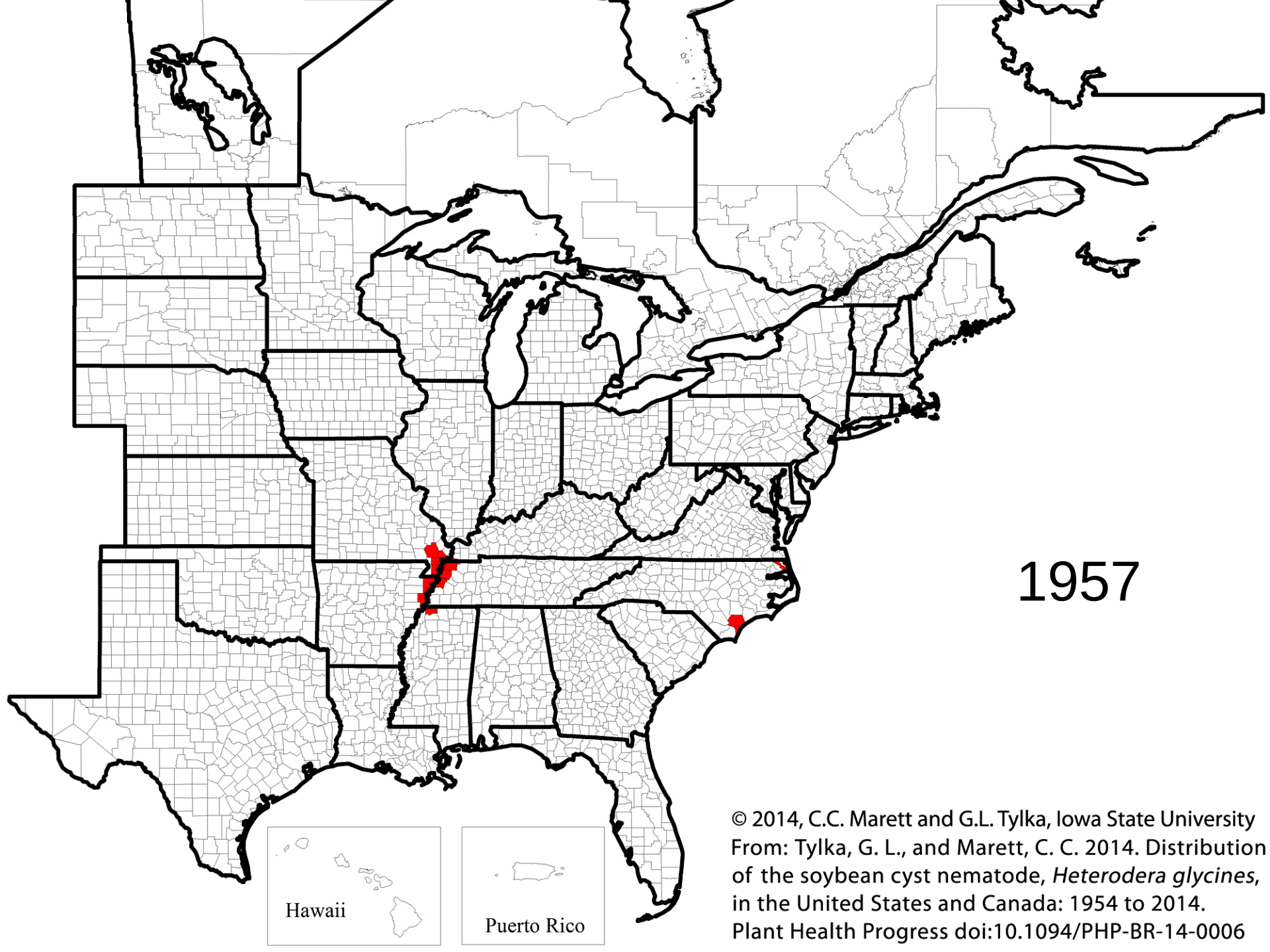
www.thescncoalition.com

Soybean Cyst Nematode (SCN)

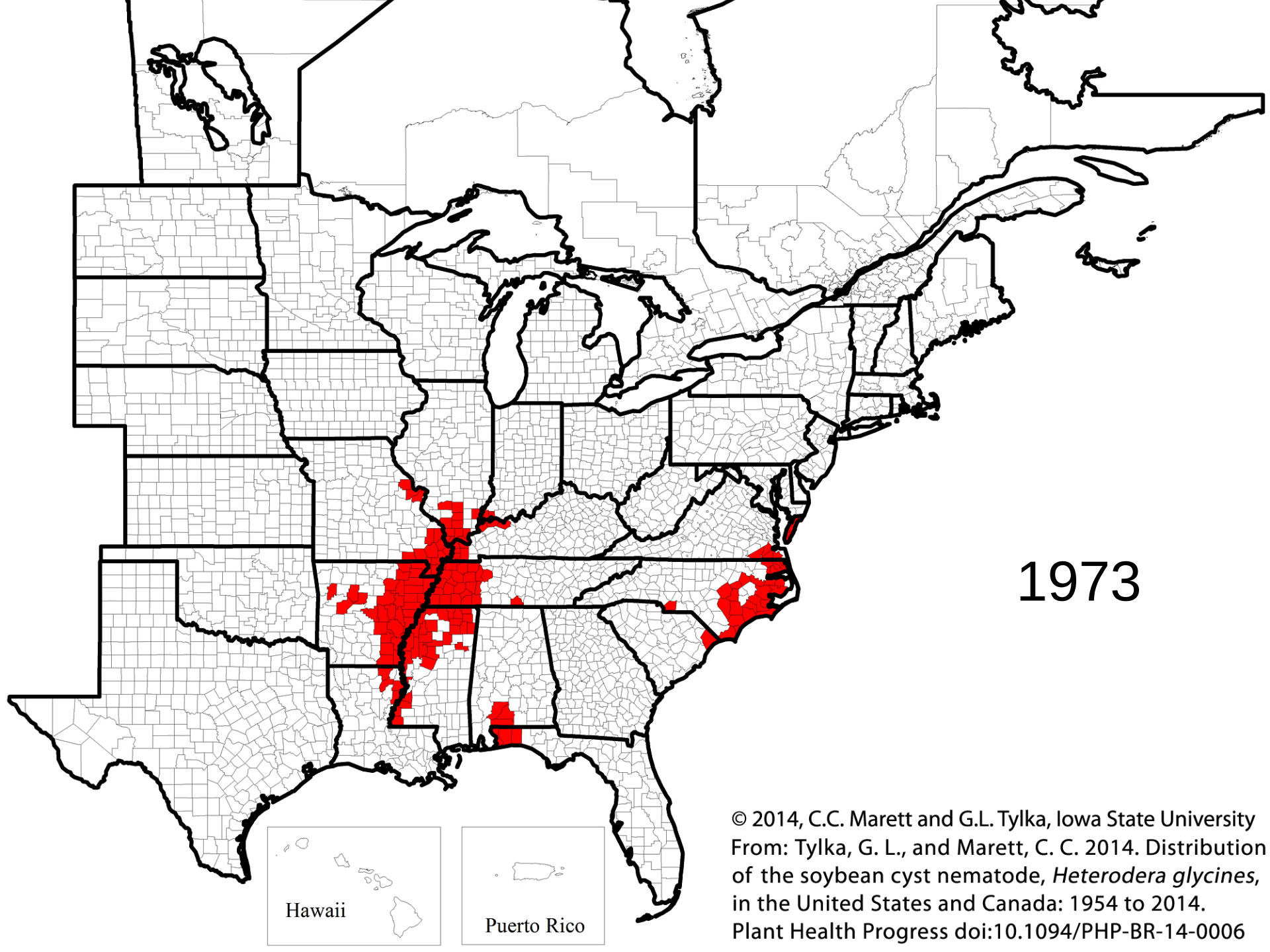
- A future concern
- Yield reductions (15-30%) before above ground symptoms are present
- Once in soil… you will have it forever
- Spreading
- Few above ground symptoms
- Can manage SCN if you find it


https://en.wikipedia.org/wiki/Soybean_cyst_nematode


Cysts
Nodule



From: Tylka, G. L., and Marett, C. C. 2014. Distribution of the soybean cyst nematode, *Heterodera glycines*, in the United States and Canada: 1954 to 2014. Plant Health Progress doi:10.1094/PHP-BR-14-0006



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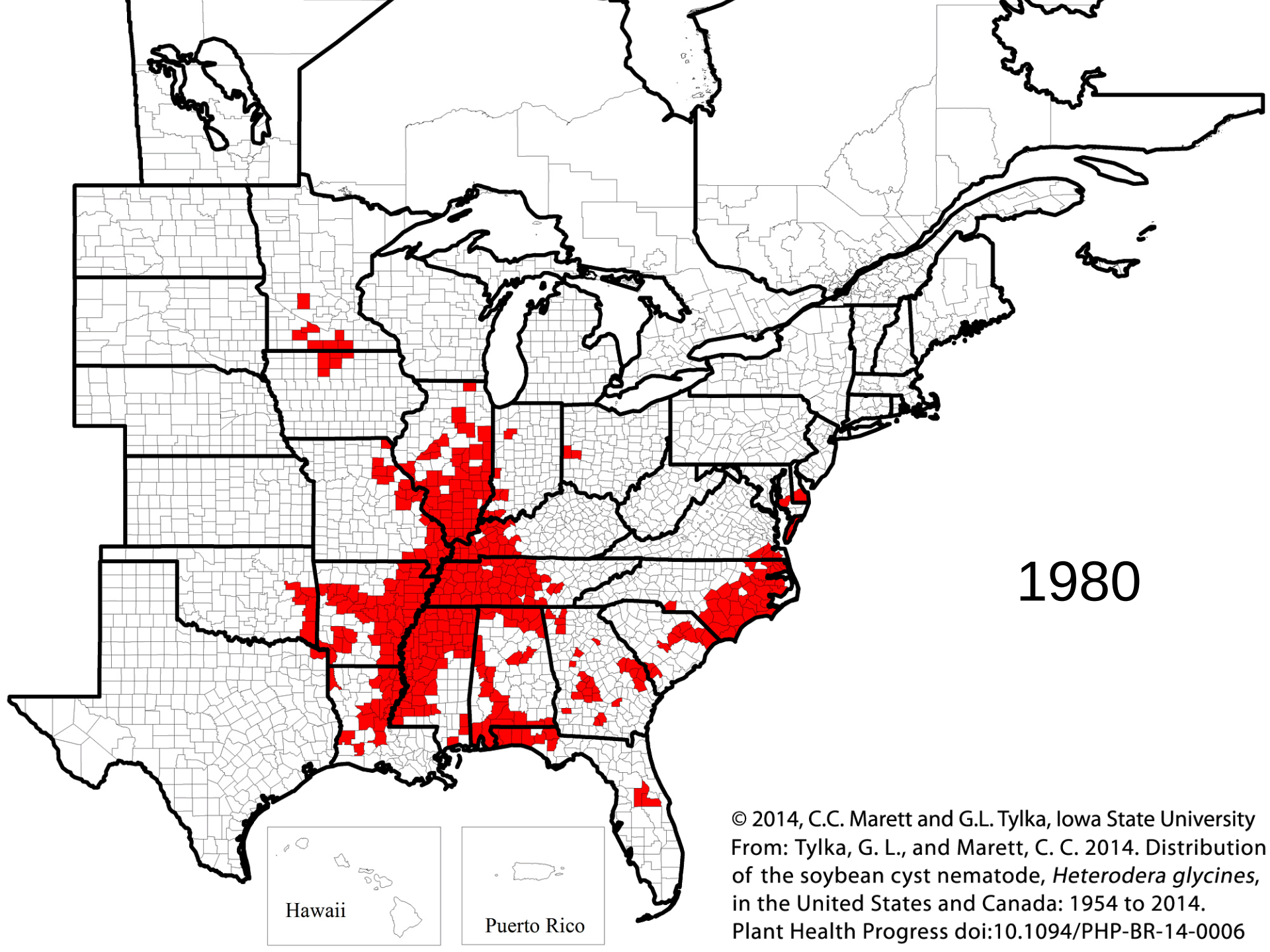

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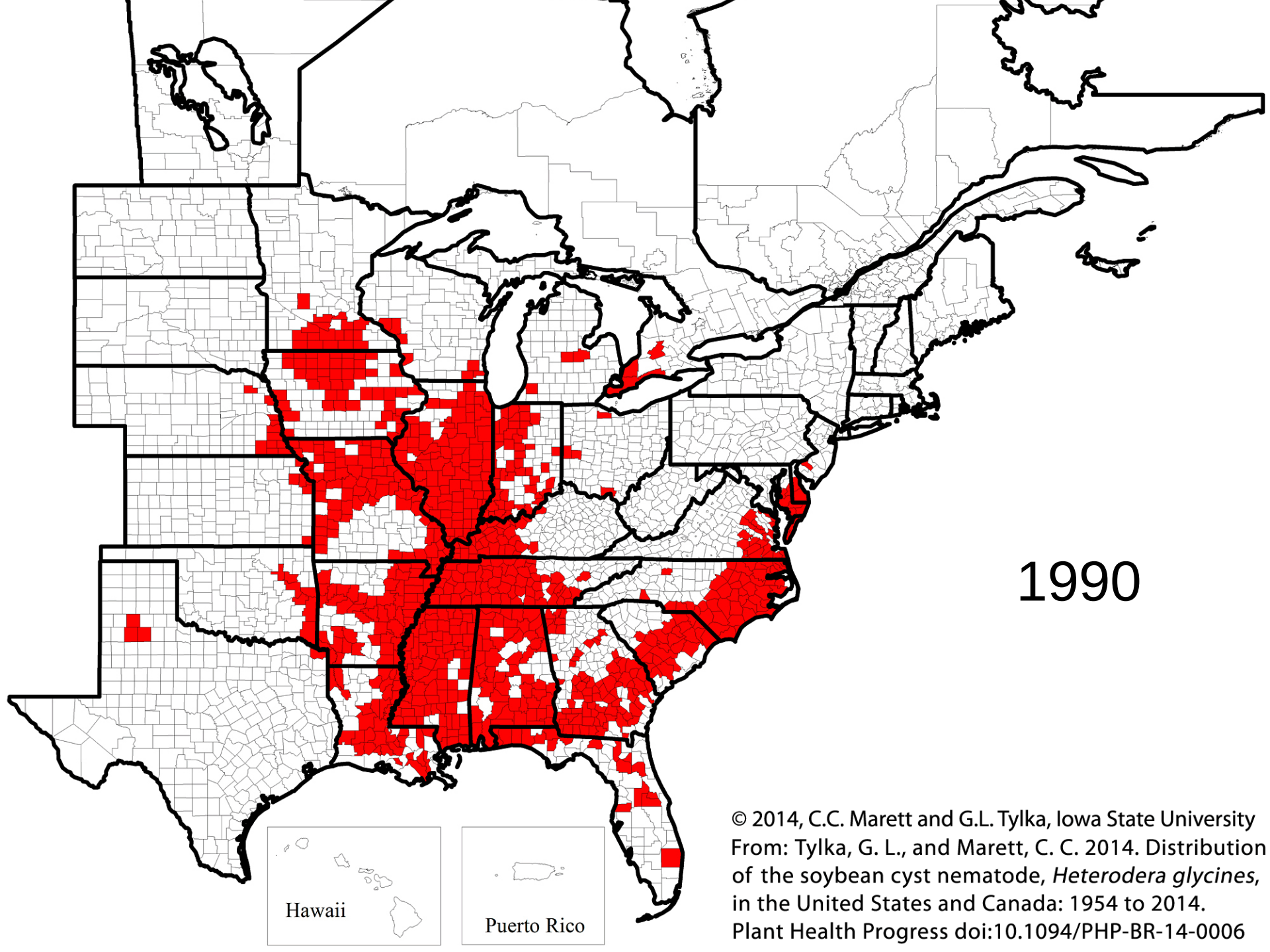

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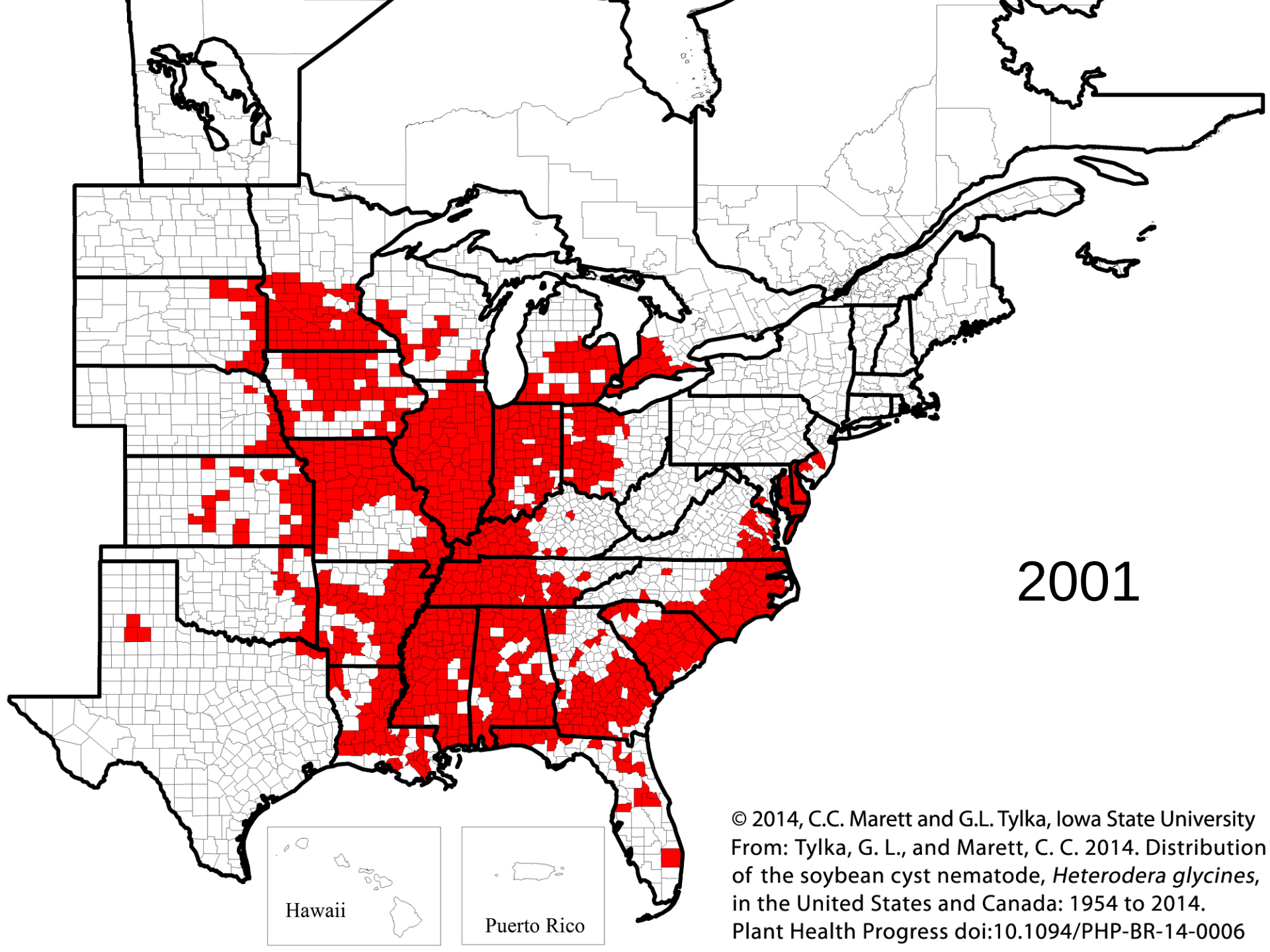

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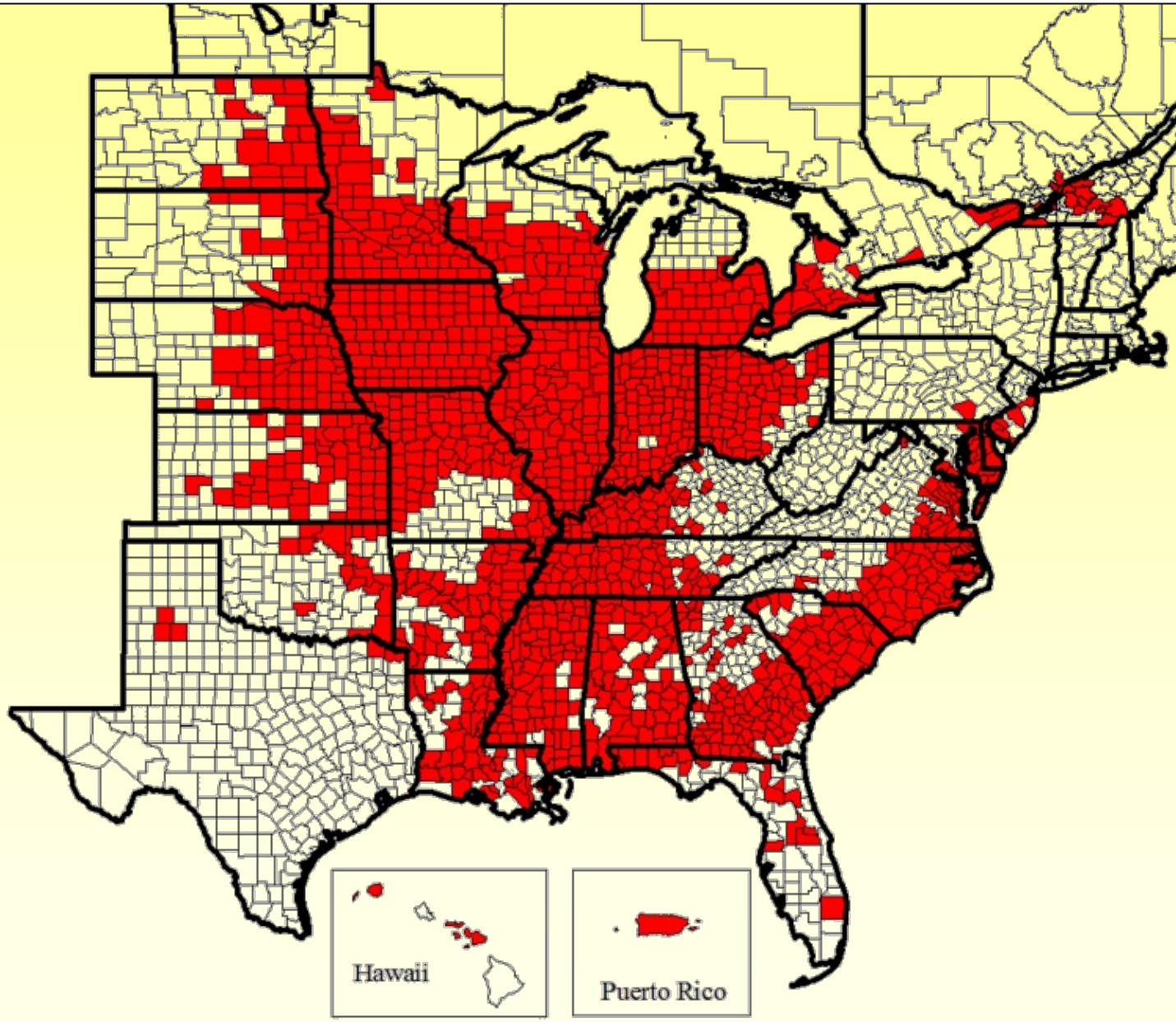
Known SCN-Infested Counties – Feb. 2017



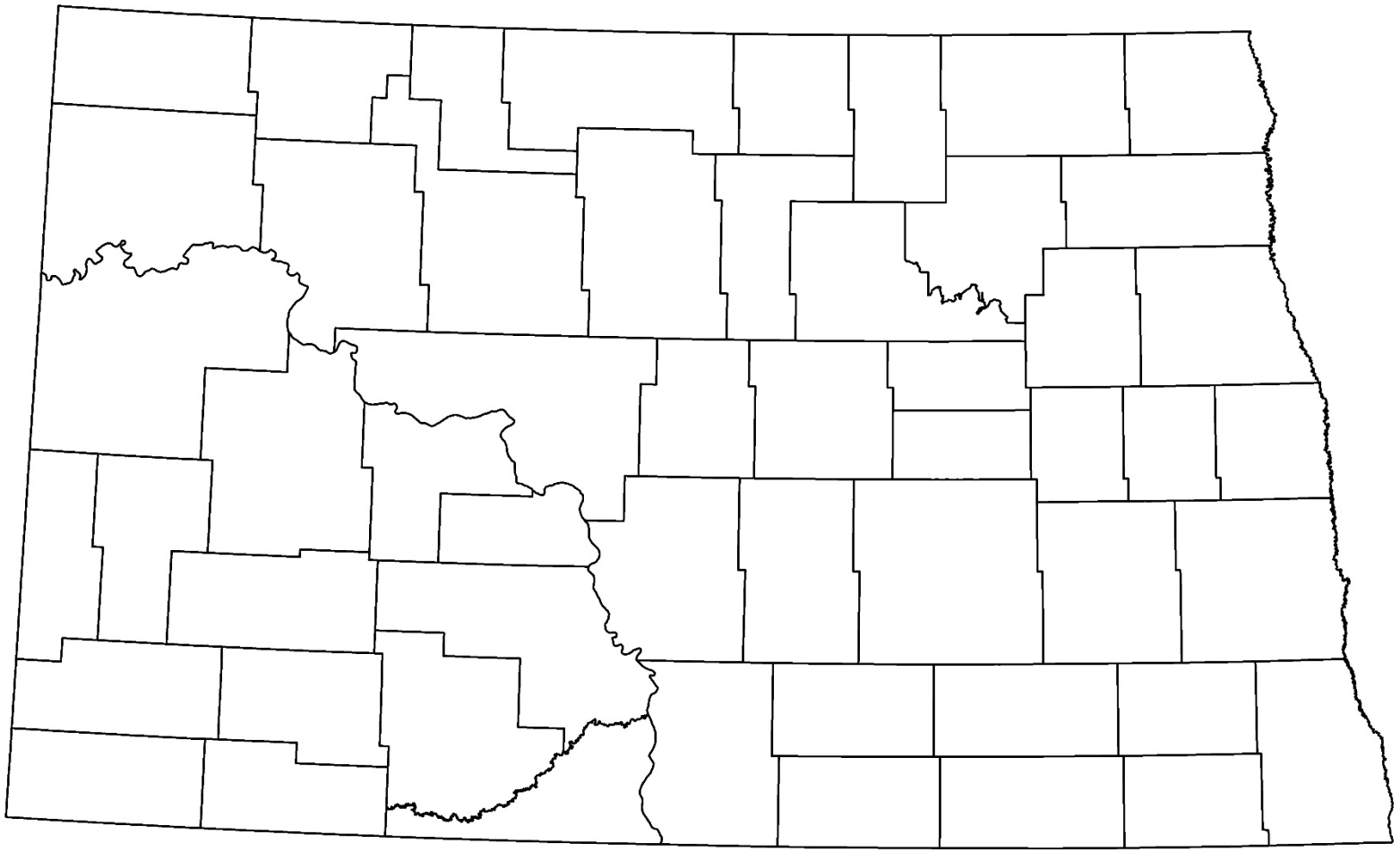
33 new since 2014:

- Alabama = 1
- Georgia = 3
- Indiana = 1
- Iowa = 1
- Kansas = 2
- Kentucky = 3
- Minnesota = 2
- Missouri = 1
- N. Carolina = 4
- N. Dakota = 7
- Ohio = 3
- S. Dakota = 1
- Virginia = 2
- Wisconsin = 1
- Quebec = 1

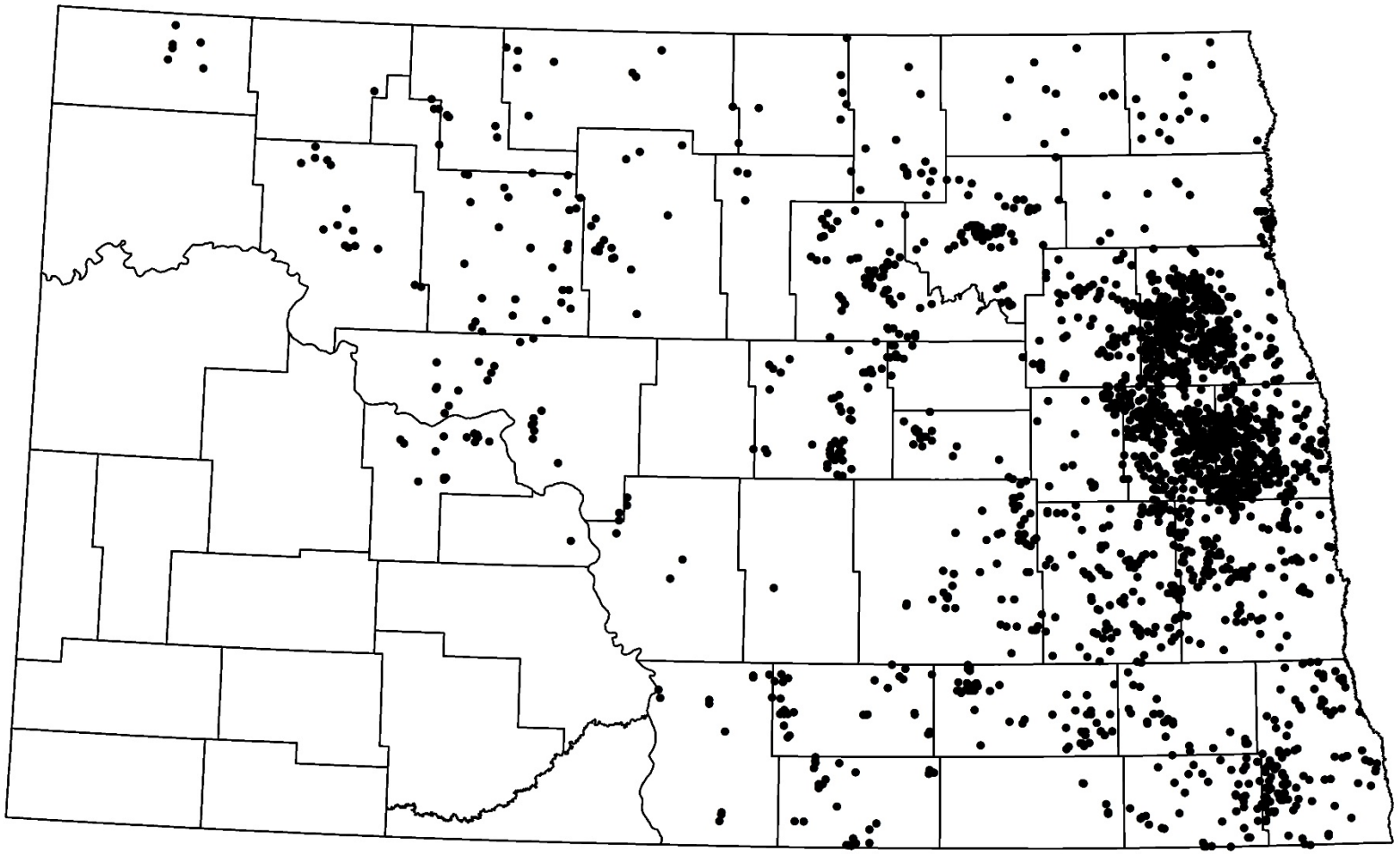
ND Sampling Program (2013-2020)

- Funding = North Dakota Soybean Council
- Pick up sample bags at County Extension Office (Mid-August or later)
- Soil Sample – Send in sample
- Data mailed to you
- Reported in eggs/100cc

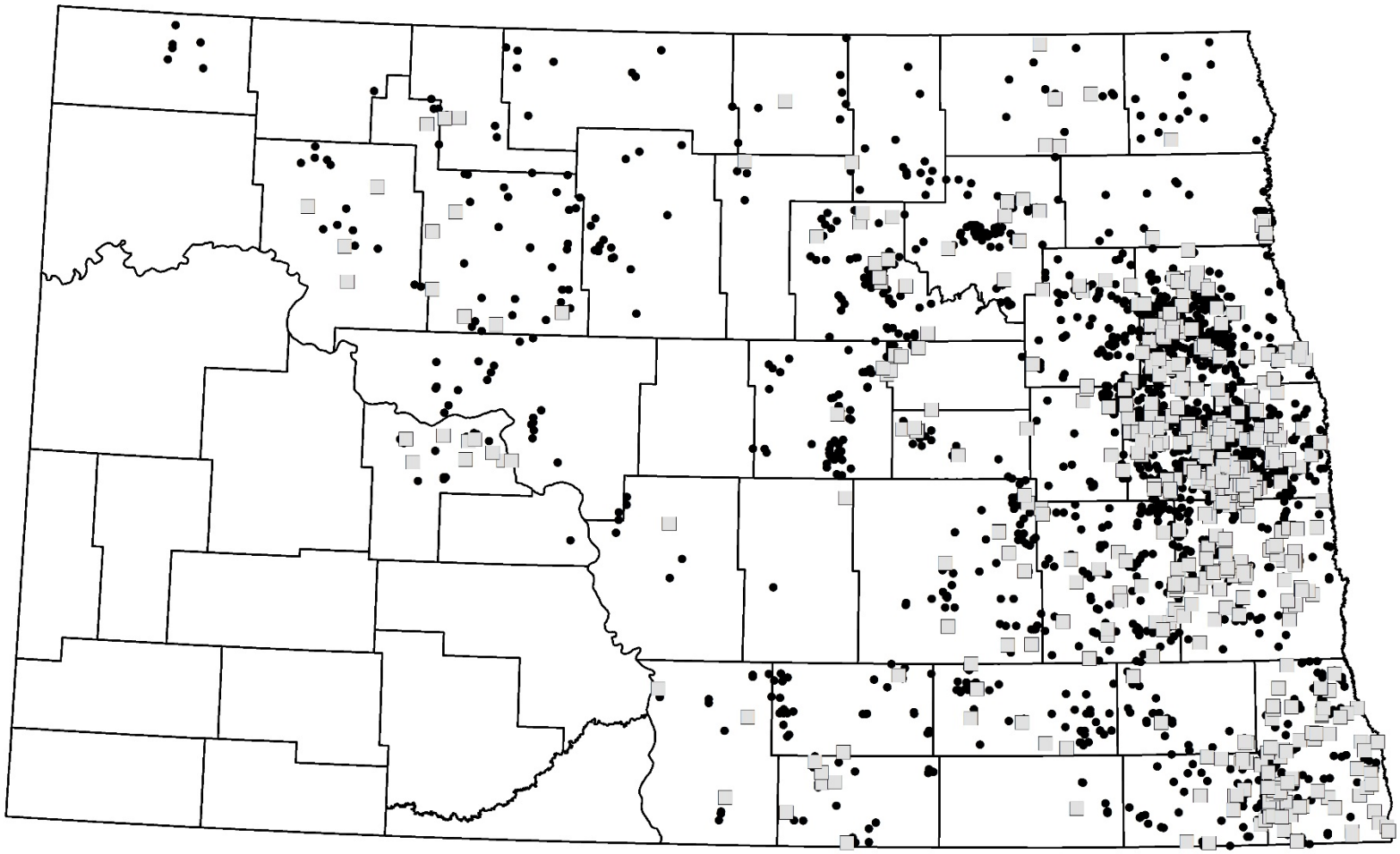
SCN Survey 2013-2019



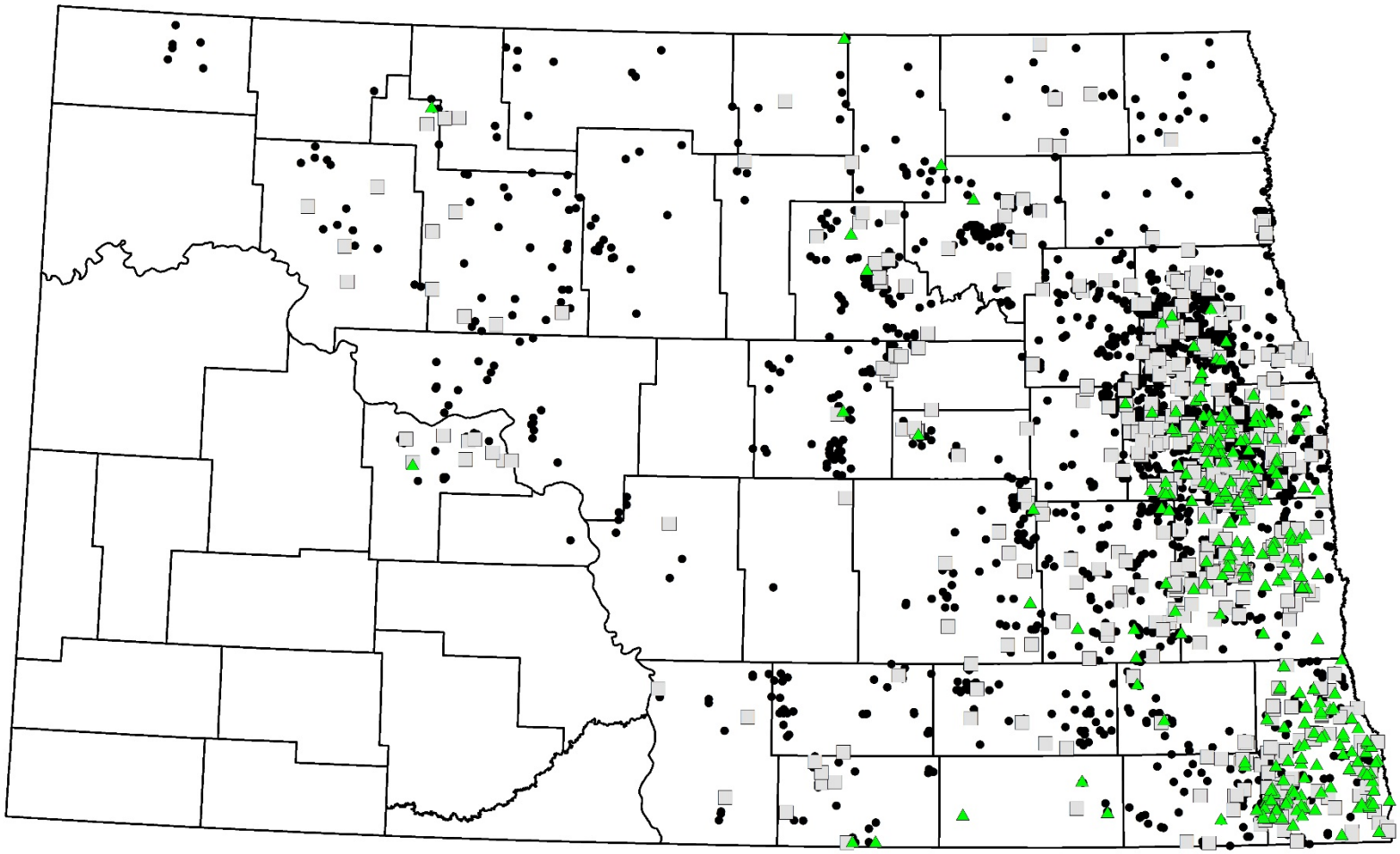
SCN Survey 2013-2019



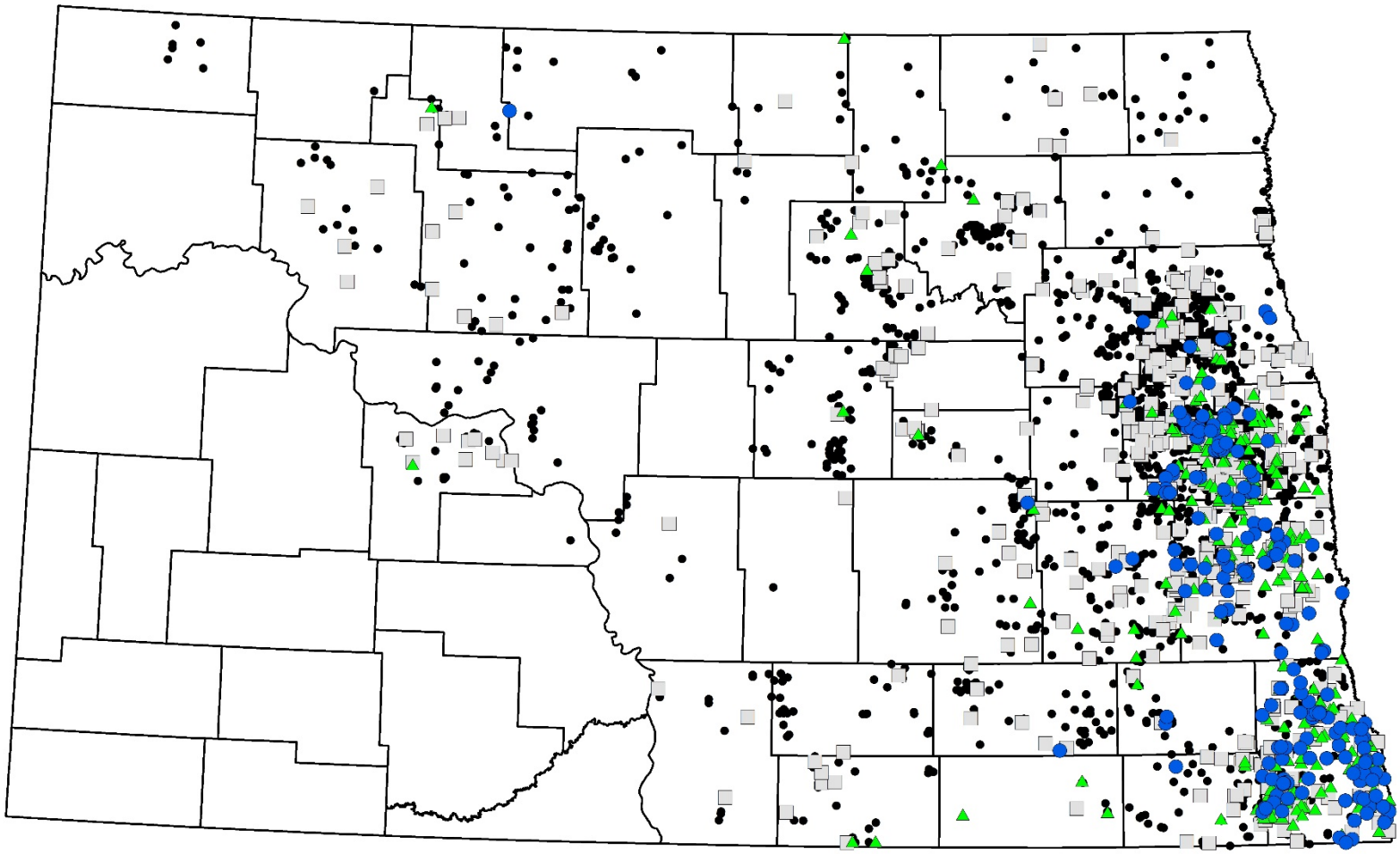
SCN Survey 2013-2019



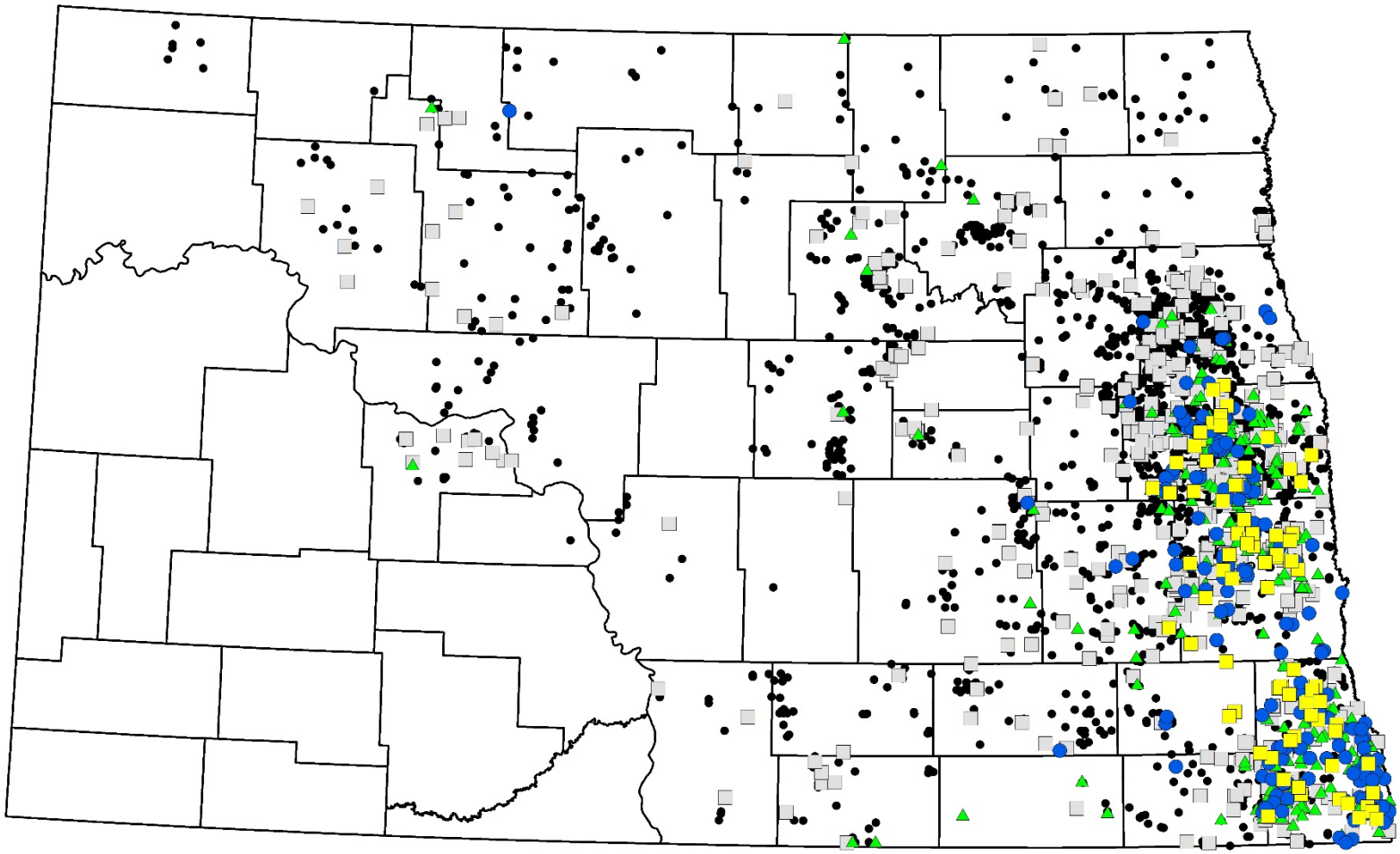
SCN Survey 2013-2019



SCN Survey 2013-2019



SCN Survey 2013-2019



North Dakota Soybean Council
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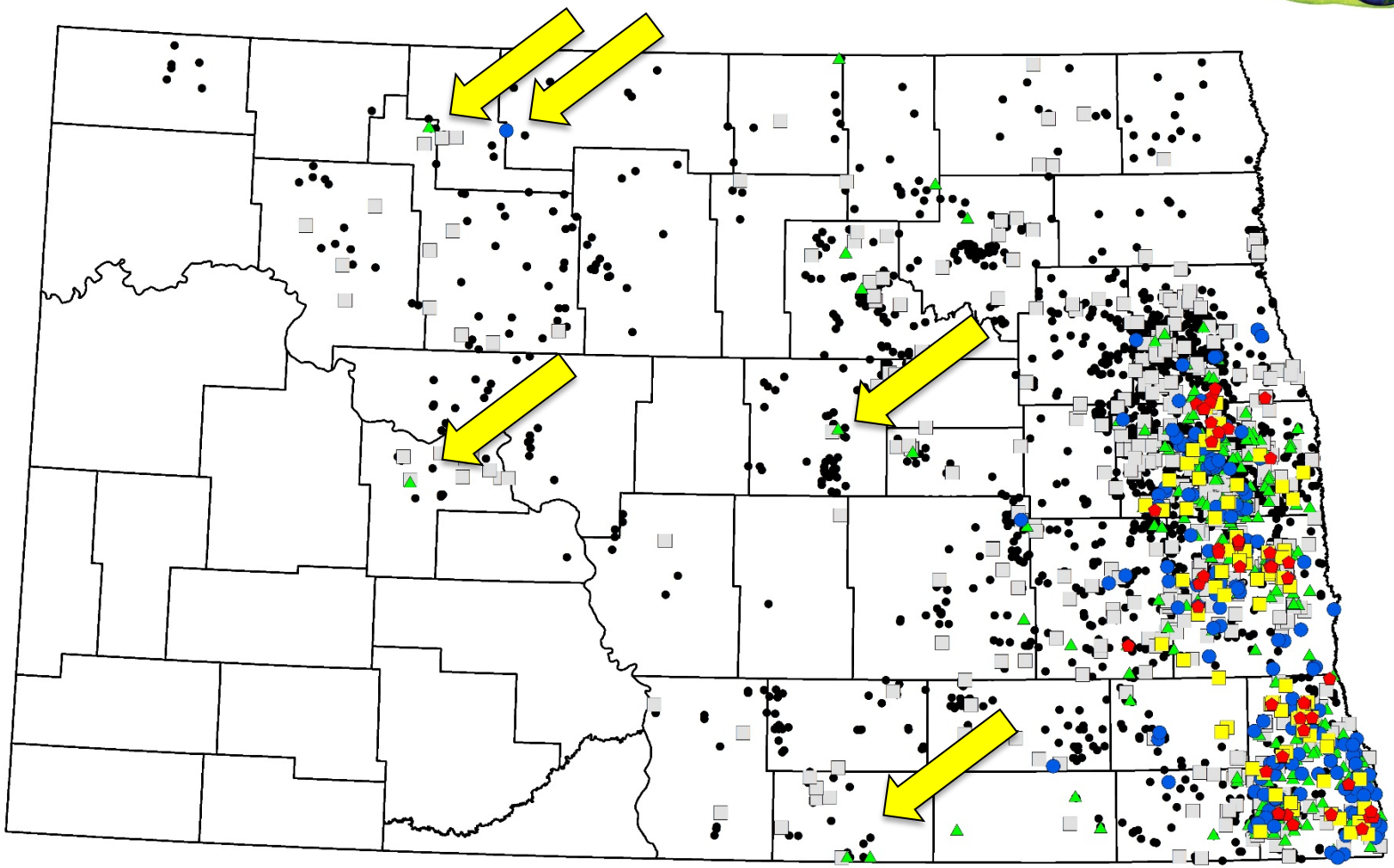
SCN Survey 2013-2019



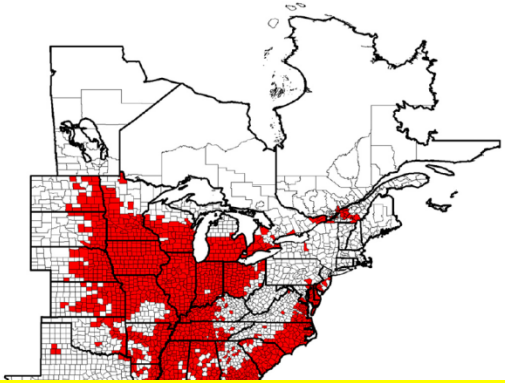
What's your number?

Take the test. Beat the pest.

The **SCN** Coalition™

Funded by the soybean checkoff

The New SCN Coalition



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