SCN: What Do We Do Now?

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Agvise Seminar
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University of Manitoba

The Quick March North

Developed by Mario Tenuta

2015 Soyben Disease Losses U.S. and Ontario

Table 1. Estimated soybean yield losses from diseases in the top 28 U.S. soybean-producing states and Ontario, Canada, in 2015.

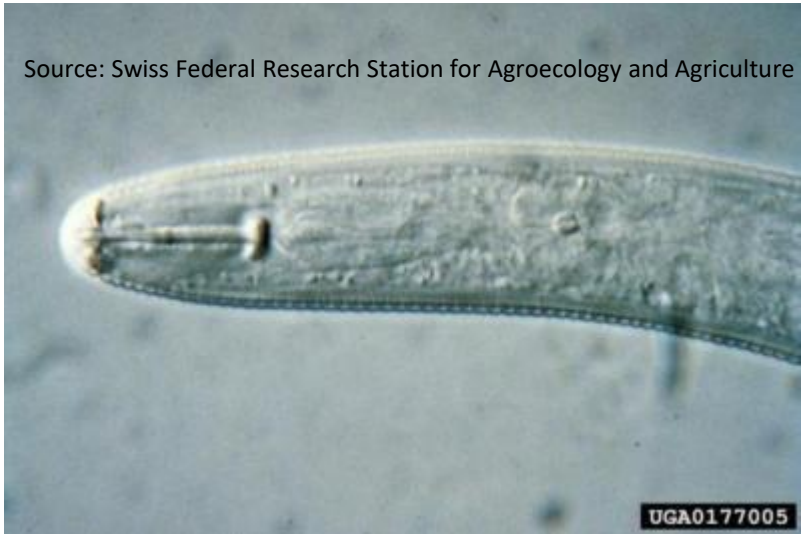
Disease/Pathogen	2015 Estimated Yield Losses for U.S. (thousands of bushels)	2015 Estimated Yield Losses for Ontario (thousands of bushels)
Root Rots and Seedling Blights		
Soybean cyst nematode	109,288	3,696
Seedling diseases (caused by species of *Fusarium*, *Pythium*, or *Rhizoctonia*)	62,948	2,957
Root-knot nematode	12,366	0
Reniform nematode	4,438	0
Other nematodes (lesion, Columbia lance, sting, stubby root)	1,465	148
Leaf and Aboveground Diseases		
Septoria brown spot	26,868	37
Frogeye leaf spot	17,662	15
Cercospora leaf blight	12,840	0
Downy mildew	4,383	7
Bacterial diseases (bacterial blight and bacterial pustule)	2,774	4
Virus Diseases (AMV, BPMV, SbDV, SMV, SVNV, TRSV, TSV)*	2,602	74
Other leaf and aboveground diseases (Phyllosticta leaf spot, target spot)	2,427	0
Purple seed stain	1,594	15
Rhizoctonia aerial blight	652	0
Soybean rust	157	0
Stem Diseases		
Sudden death syndrome	43,776	2,218
Sclerotinia stem rot (also known as white mold, caused by *Sclerotinia sclerotiorum*)	40,083	2,957
Phytophthora root and stem rot	28,275	1,479
Charcoal rot	20,808	15
Brown stem rot	17,389	74
Stem canker	12,349	222
Pod and stem blight	10,718	296
Anthracnose	5,188	0
Diaporthe/Phomopsis complex (seed rot)	3,612	44
Fusarium wilt and root rot	3,169	1,109
Other stem diseases (Phymatotrichopsis root rot, red crown rot, taproot decline)	2,253	0
Southern blight	523	0

*AMV = alfalfa mosaic virus, BPMV = bean pod mottle virus, SbDV = soybean dwarf virus, SMV = soybean mosaic virus, TRSV = tobacco ringspot virus, TSV = tobacco streak virus.

Cropprotectionnetwork.org

Soybean Cyst Nematode (SCN)

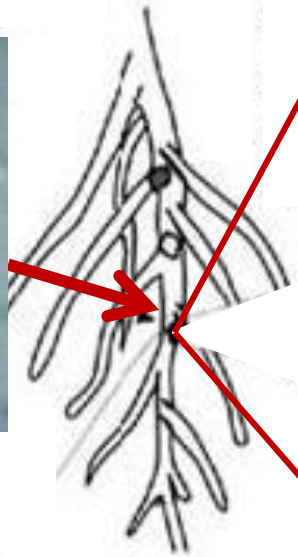
- Is a nematode (round worm) that parasitizes roots of soybean
- Like people, not all nematodes are bad, but SCN is bad

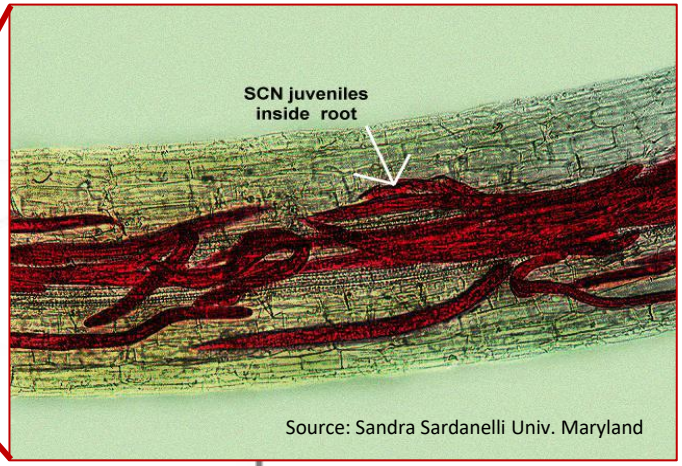


The Life of a SCN Female

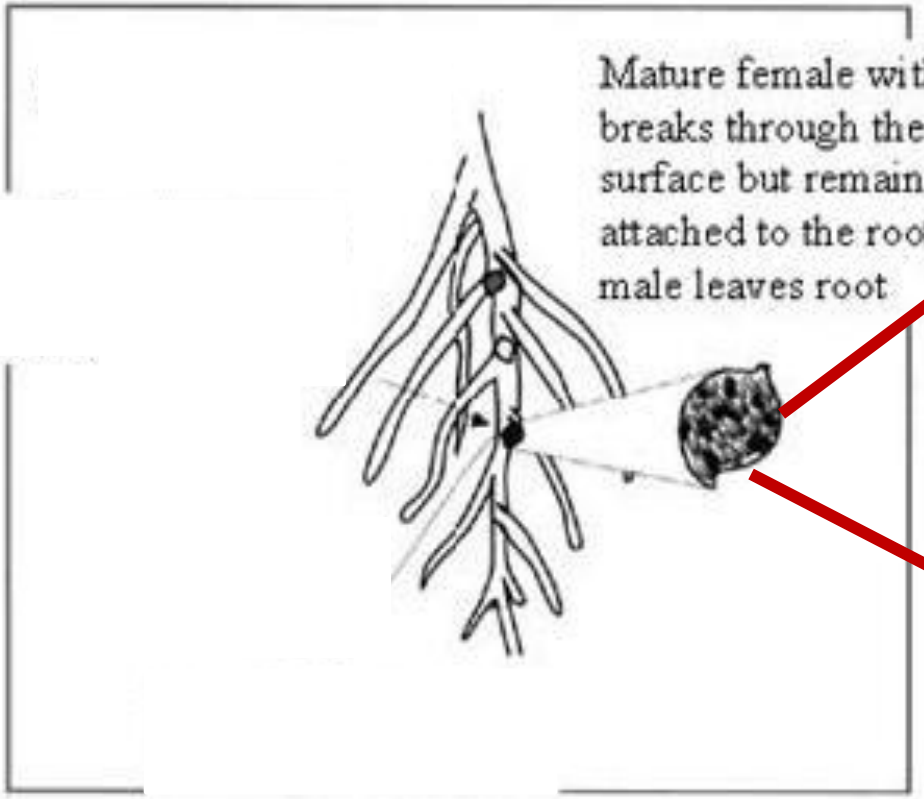
Soil

Root

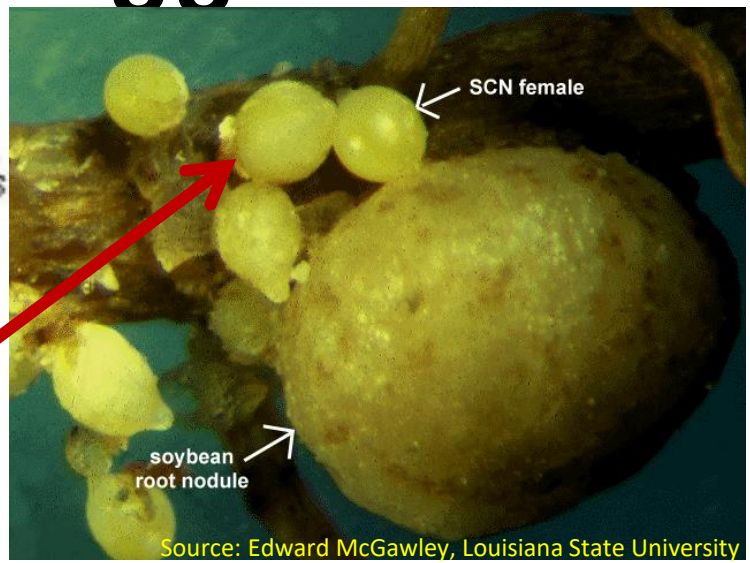


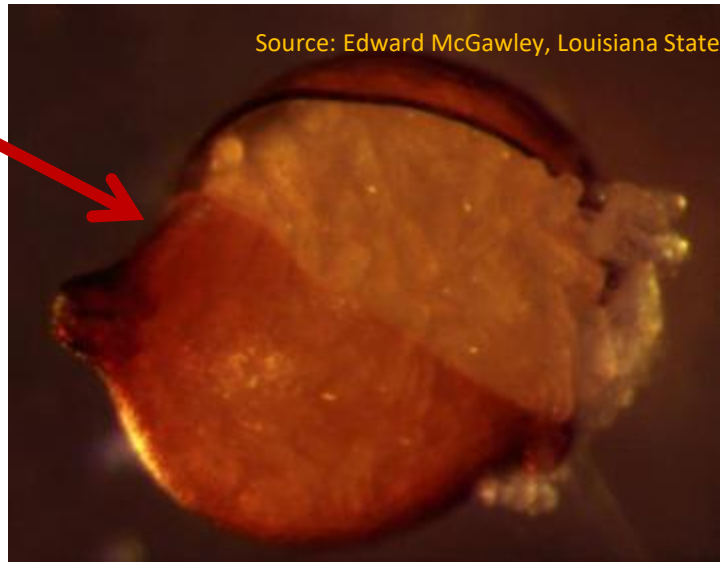


Female Settles Down to Feed and Produce Eggs

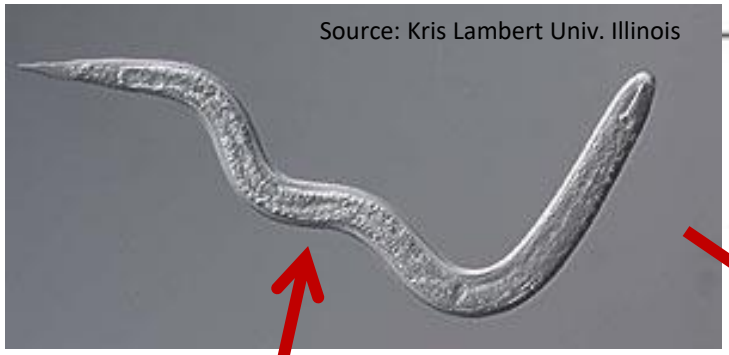


Source: Greg Tylka Iowa State Univ.





Female Becomes Cyst Eventually Rupturing and Releasing Eggs

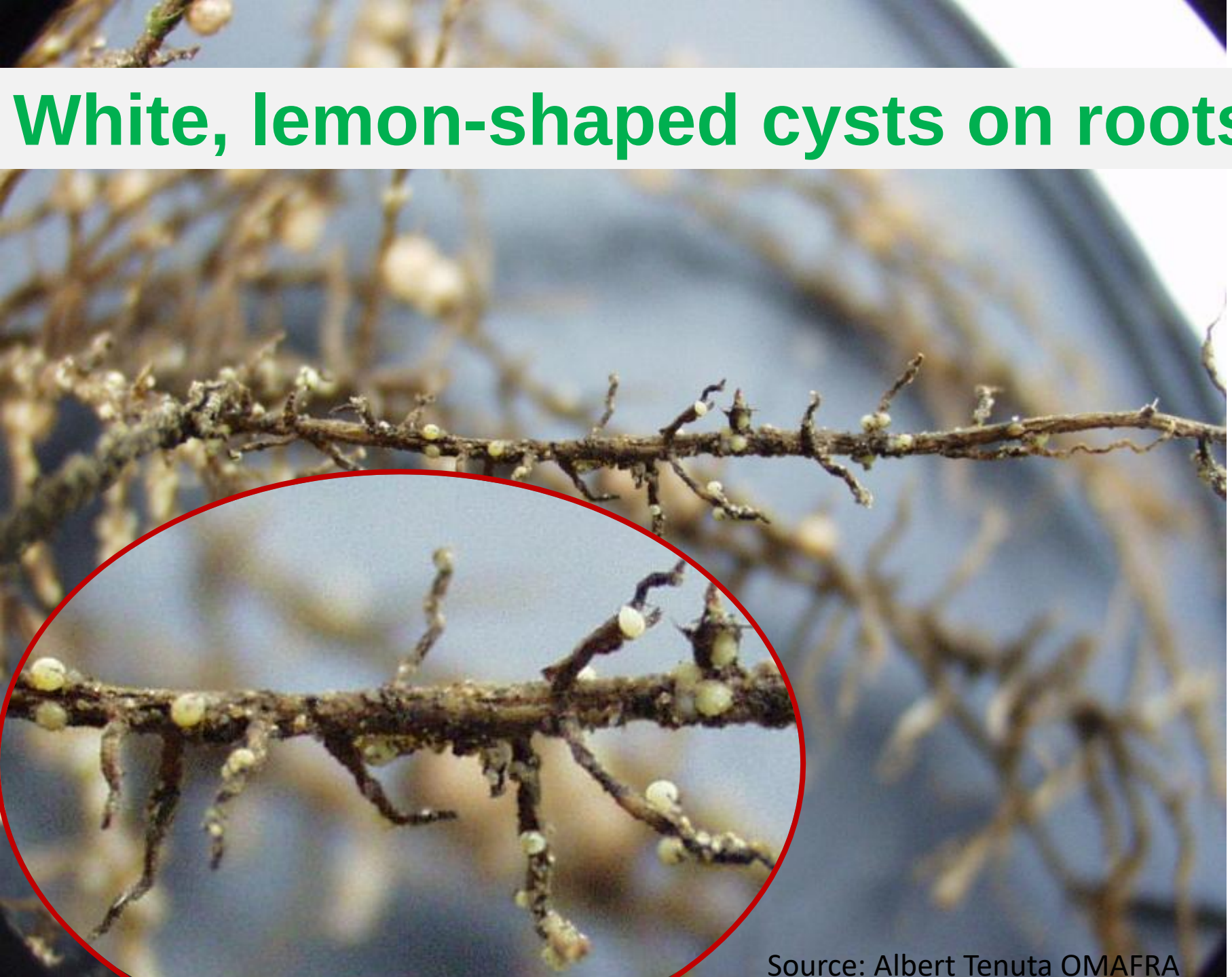


Soil

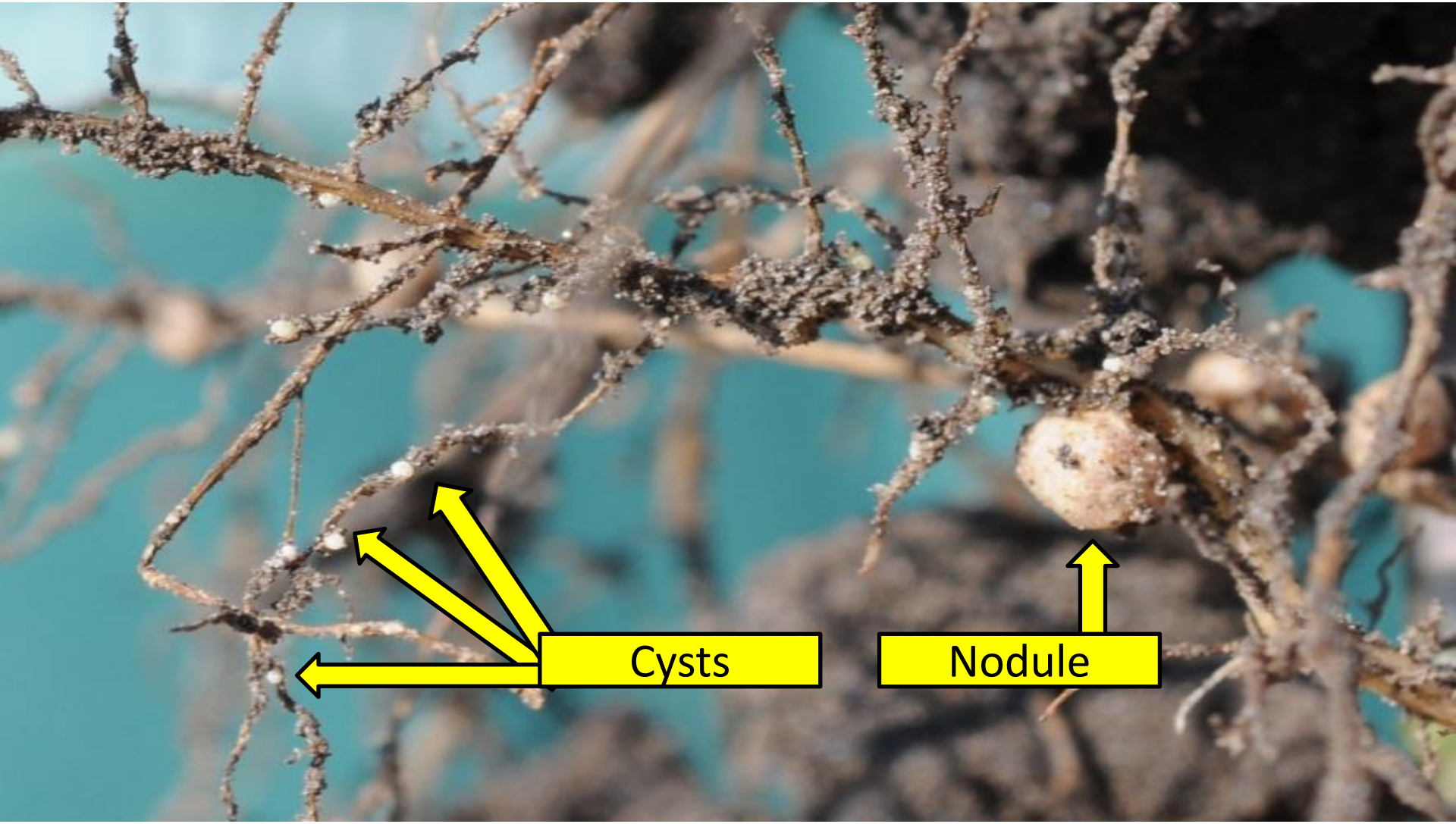
Source: Edward McGawley, Louisiana State University

Eggs released in soil, develop into juveniles

White, lemon-shaped cysts on roots



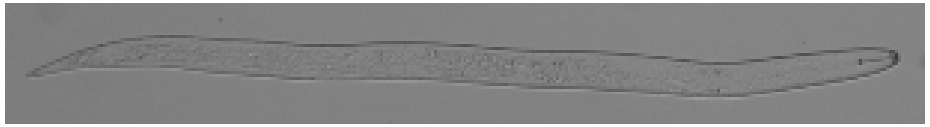
Source: Albert Tenuta OMAFRA

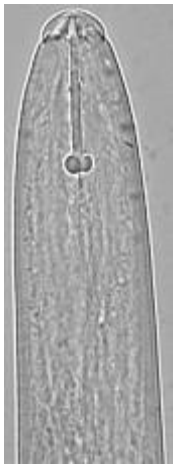

Cysts
Nodule

SCN Survey of Manitoba 2012-2015

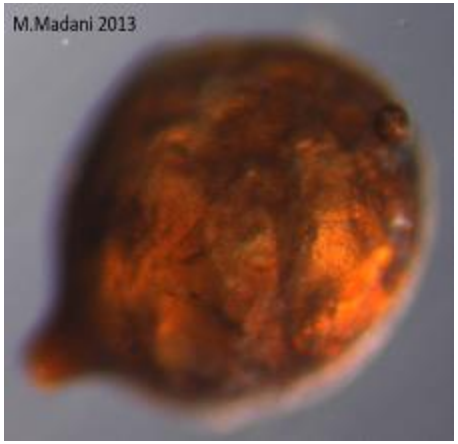
- 76 soybean fields sampled
- > 5500 soil samples
- 487 composite samples for processing
- Priority fields based on
  - Proximity to water courses from U.S. that flood
  - Number of soybean years
  - History of dry beans
  - Sampled prone areas of fields

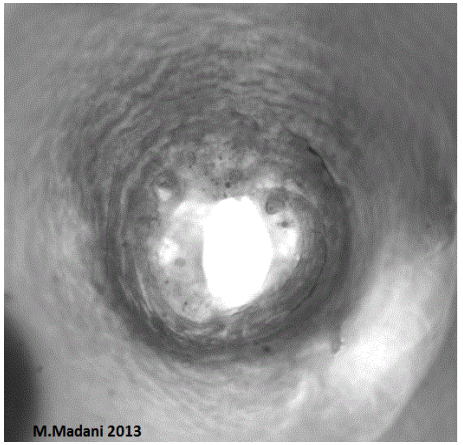
Few Juveniles and Cysts of Cysts Nematodes Found



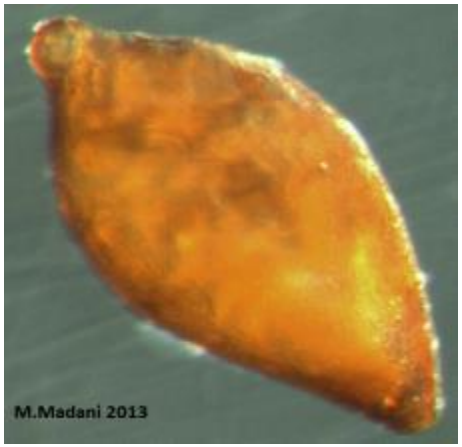


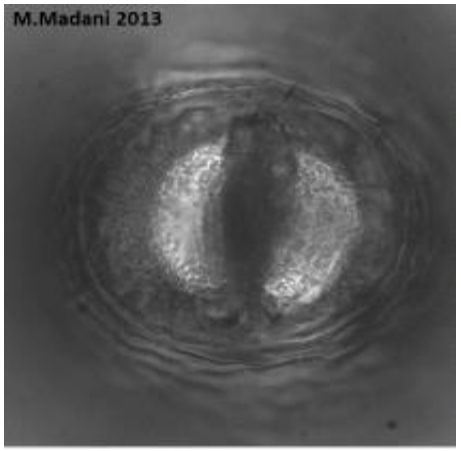
Circumfenestrate





Bifenestrate





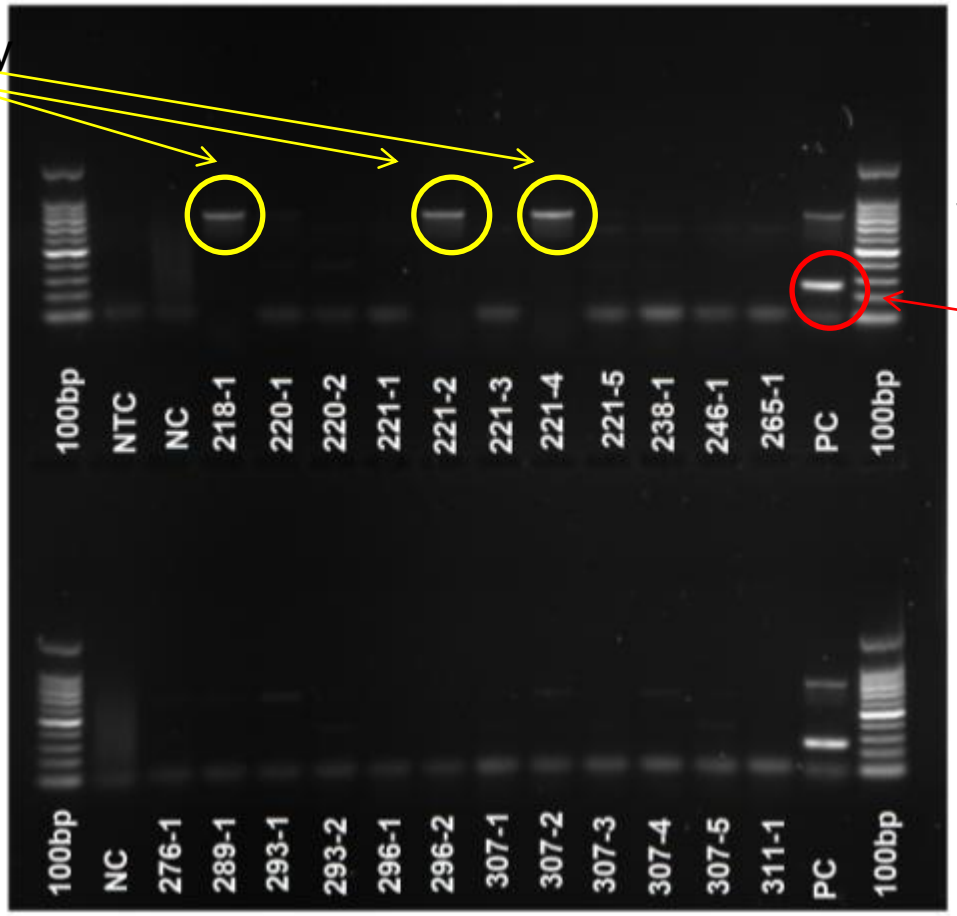
Tenuta Lab

Results 2012-15 for SCN

- Nothing

Species-Specific PCR for SCN

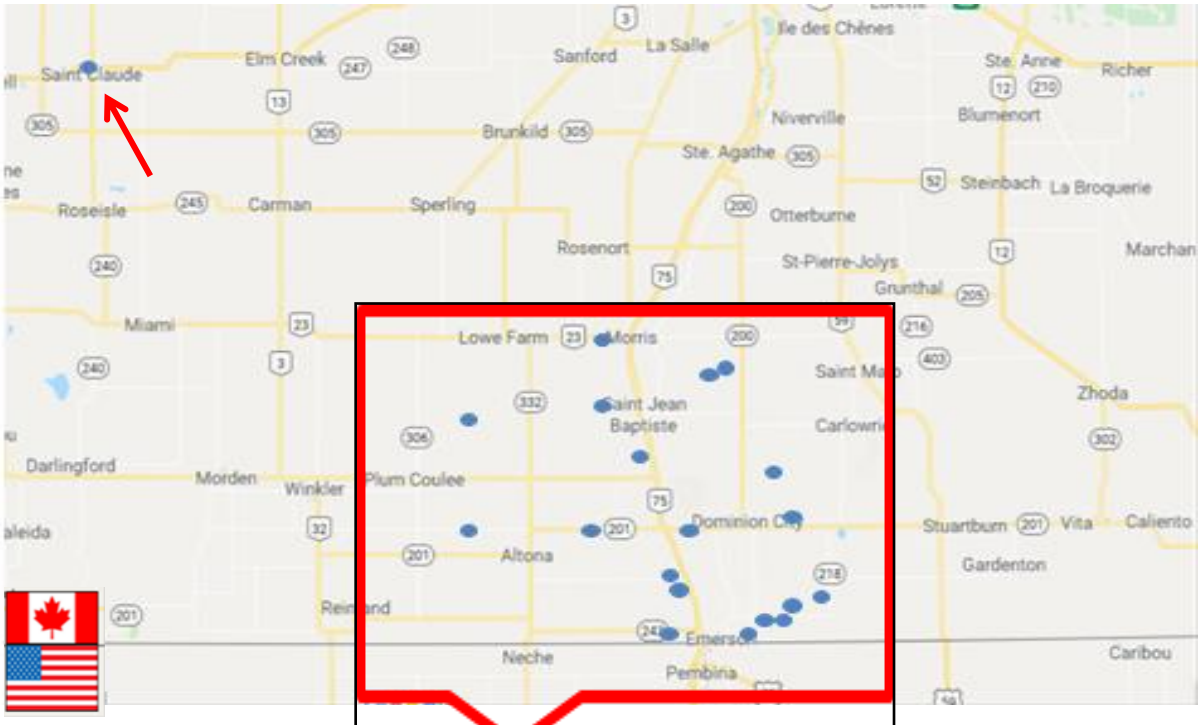
3 cysts yielding quality DNA but not positive For SCN



Positive control SCN yielding good DNA and giving band for SCN

Manitoba 2017-2018 SCN Survey

- Fall 2017, 30 soybean fields soil sampled



PhD student: Nazanin Ghavami
University of Manitoba

Results 2017-2018

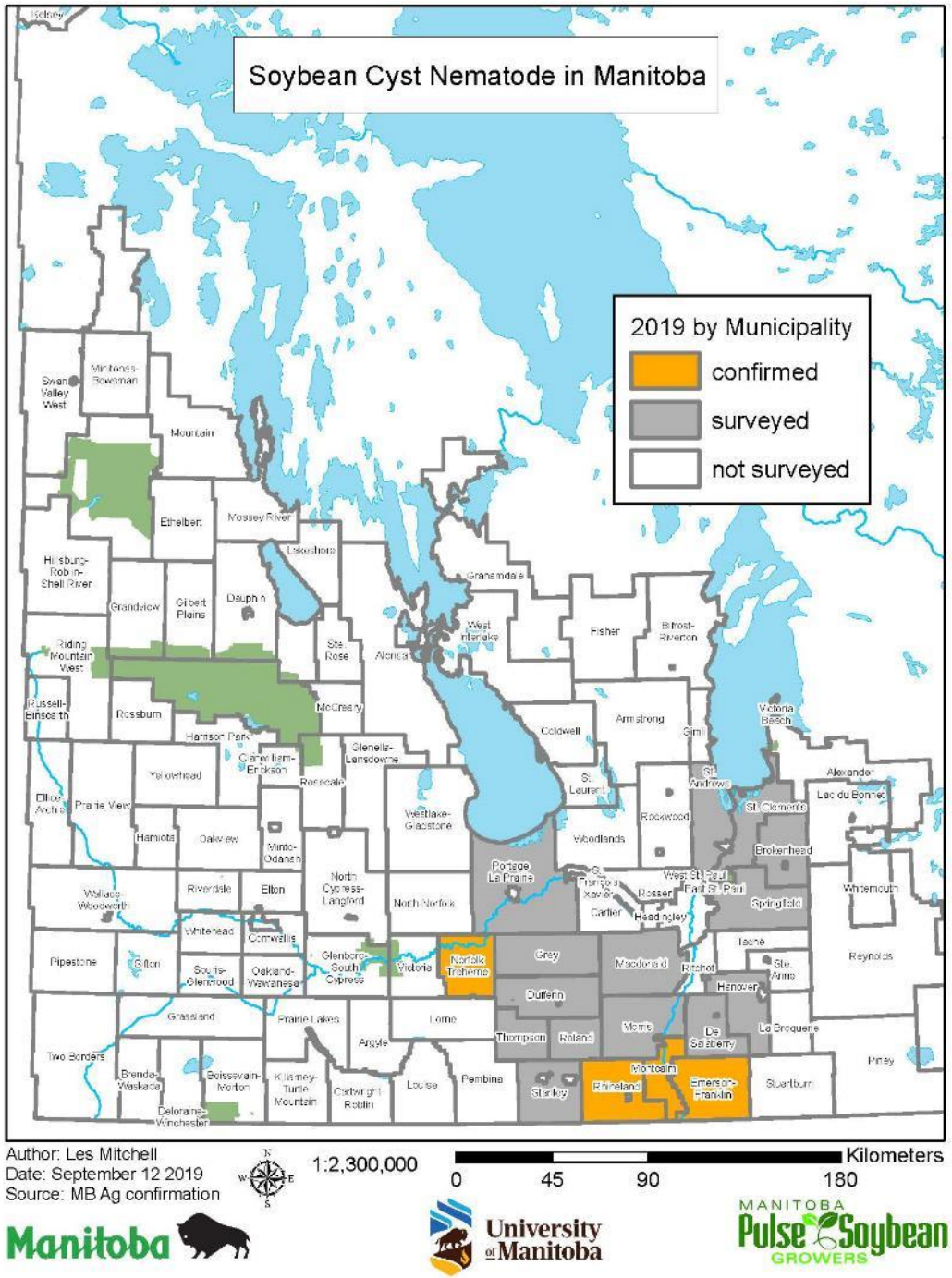
- Cyst numbers were 1, 2, 4, and 14 kg^{-1} soil for each of the fields
- PCR of 7-12 lemon-shaped cysts for the CoxIII gene & SCAR gene regions were SCN
- DNA sequencing of 18s and ITS genes also confirmed cysts were SCN
- Morphology of cysts and nematode juveniles also consistent with being SCN

- In 2019, soy grown on field in Norfolk Treherne
- Visited the field twice and on second visit found SCN on roots of soy

Results 2019

Photo: Mario Tenuta

SCN in Manitoba 2019



Soybean Dwarfing Patch in late June 2021

Table 1. Crop rotation history in the symptomatic field	
Year	**Crop**
2021	soybean
2020	Corn
2019	Navy Beans
2018	Wheat
2017	Soybean
2016	Corn
2015	Soybean
2014	Canola
2013	Corn
2012	Soybean
2011	Canola
2010	Corn
2009	Canola


Photo: Mario Tenuta


Photo: Mario Tenuta

Field

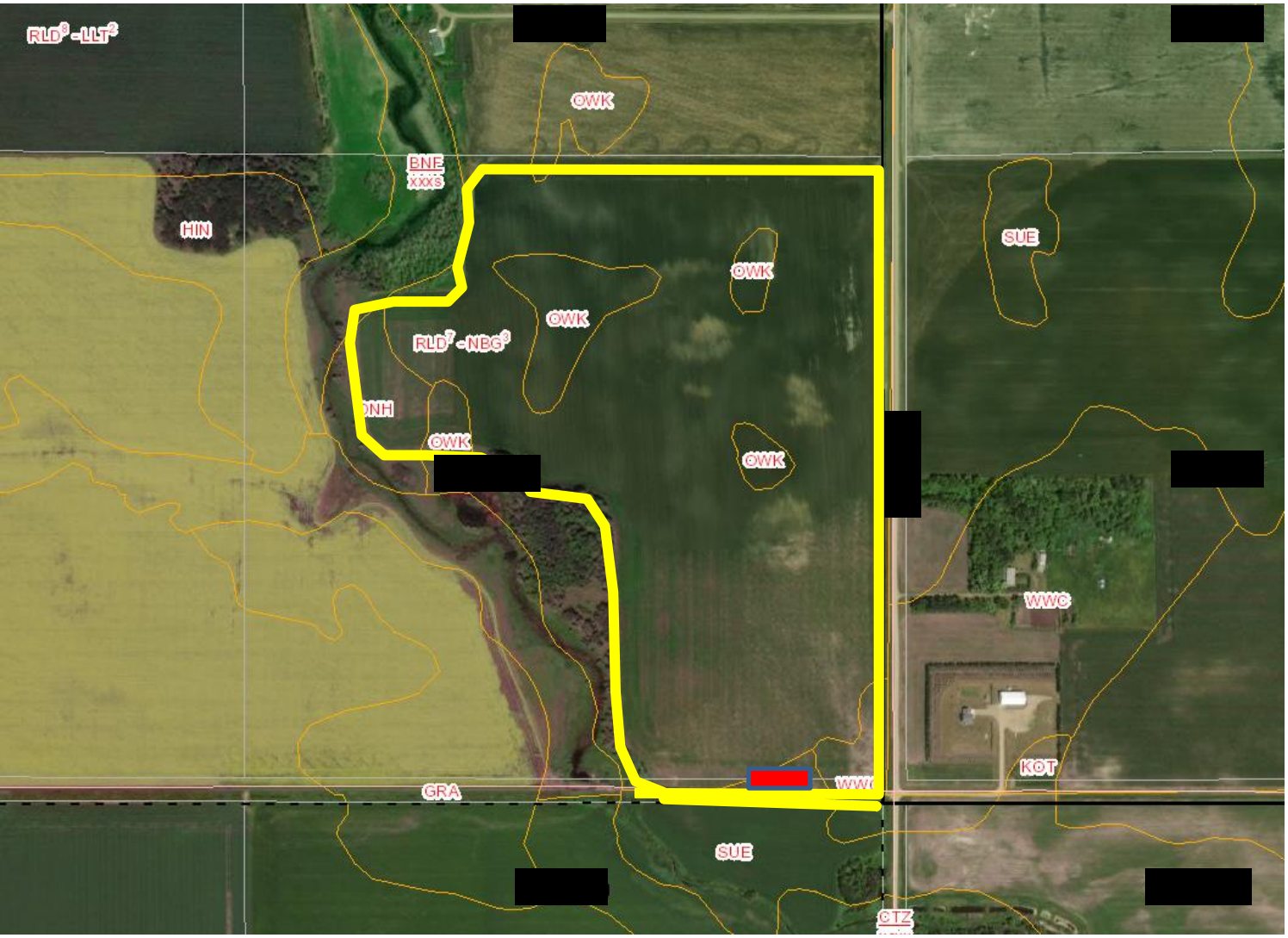

Photo: Tenuta Lab


Photo: Tenuta Lab


Photo: Tenuta Lab

Lab

SCN Infested Field 37.2 ha



SCN Patch

Patch in Early Sept 2021

Photo of patch from Slide 11 later in early spring following rains
Growth resumed, now starting pod filling but too late

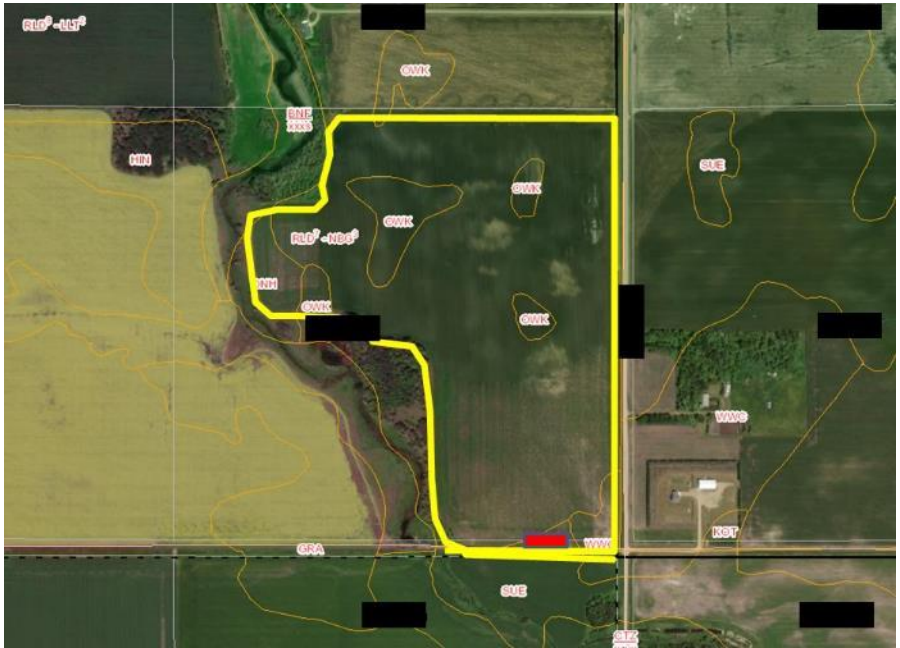
Grid Analysis of SCN Levels in the Patch

SCN Patch Analysis #eggs/100cm3

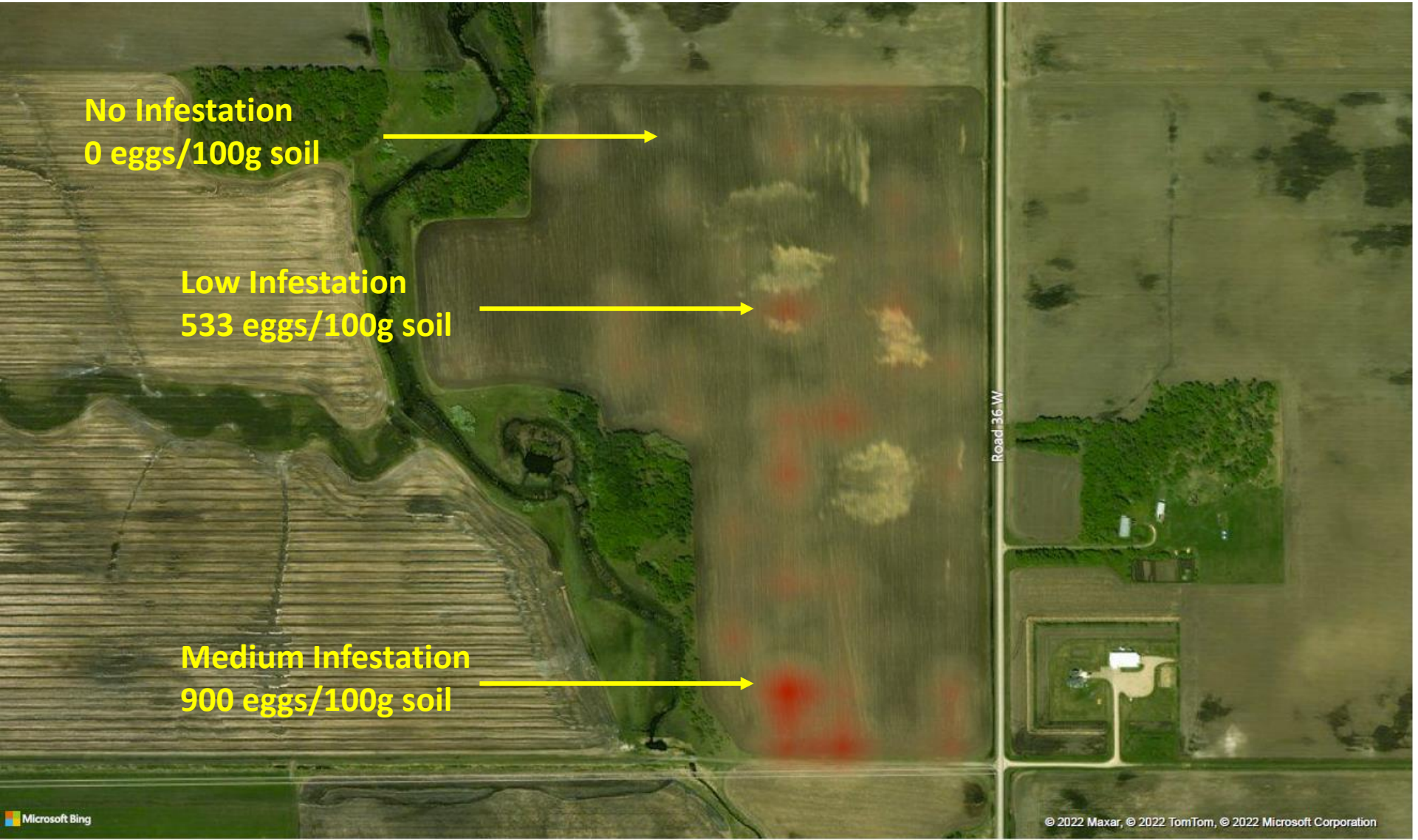
Miami,MB Field September 2021

					North into good Soy Growth					
	Distance (m)	***0***	***10***	***20***	***30***	***40***	***50***	***60***	***70***	Distance (m)
	24	0	0		0	0		0	0	***24***
	18	0	0		0	0		0	0	***18***
West into good Soy Growth	***12***	0	295		2,540	68		38	65	***12***
	6	0	1,365	1,989	4,956	4,632	7,797	4,153	1,524	***6***
	0	24	33		149	255		163	33	***0***
	Distance (m)	***0***	***10***	***20***	***30***	***40***	***50***	***60***	***70***	Distance (m)
					South Dirt Road Edge					

East into good Soy Growth



Distribution of SCN in a Coarse Texture Field in Manitoba 2021



SCN (HG) Type or Race Test of the MB SCN Population

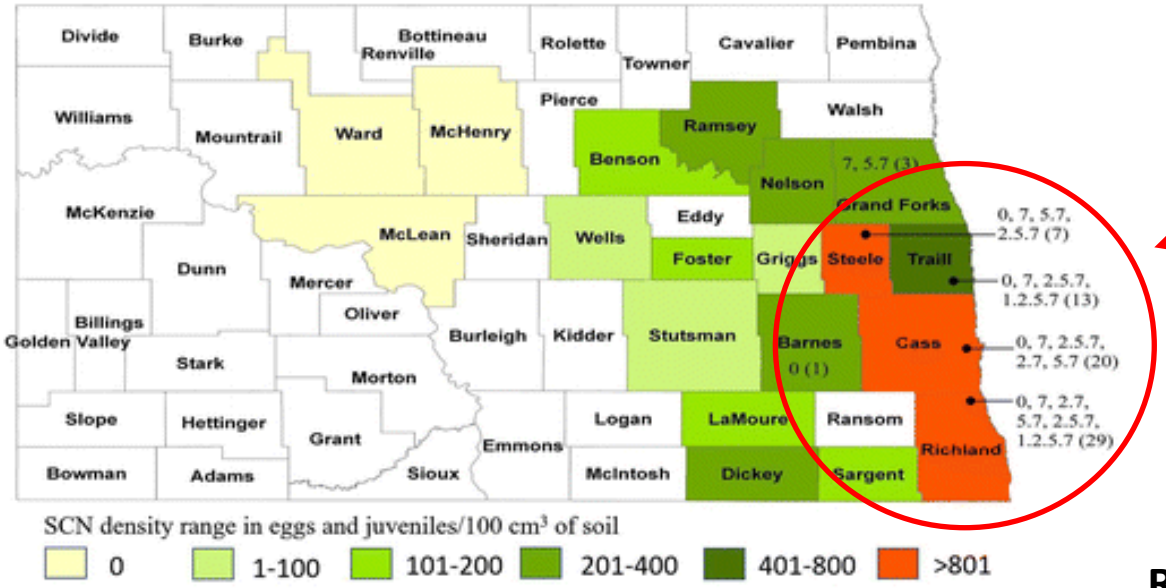
Indicator Line= Source of Resistance	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Female index (FI)=	≥10%
1) PI 548402 (Peking)	0	0	0	0	0	0%	-
2) PI 88788	4	16	8	15	7	4.2%	
3) PI 90763	0	0	1	0	0	0%	-
4) PI 437654	0	0	1	0	0	0%	-
5) PI 209322	1	5	10	2	3	1.8%	
6) PI 89772	0	0	0	0	0	0%	-
7) PI 548316 (Cloud)	34	33	41	32	X	14.6%	
Pickett	1	3	8	3	0	1.6%	-

HG type:	7
Race:	3

- Resistance profile indicates on the way to overcoming PI 88788

HG type testing was conducted by SCN Diagnostics at the University of Missouri

HG Types in North Dakota



Older SCN regions have greater resistance levels and types

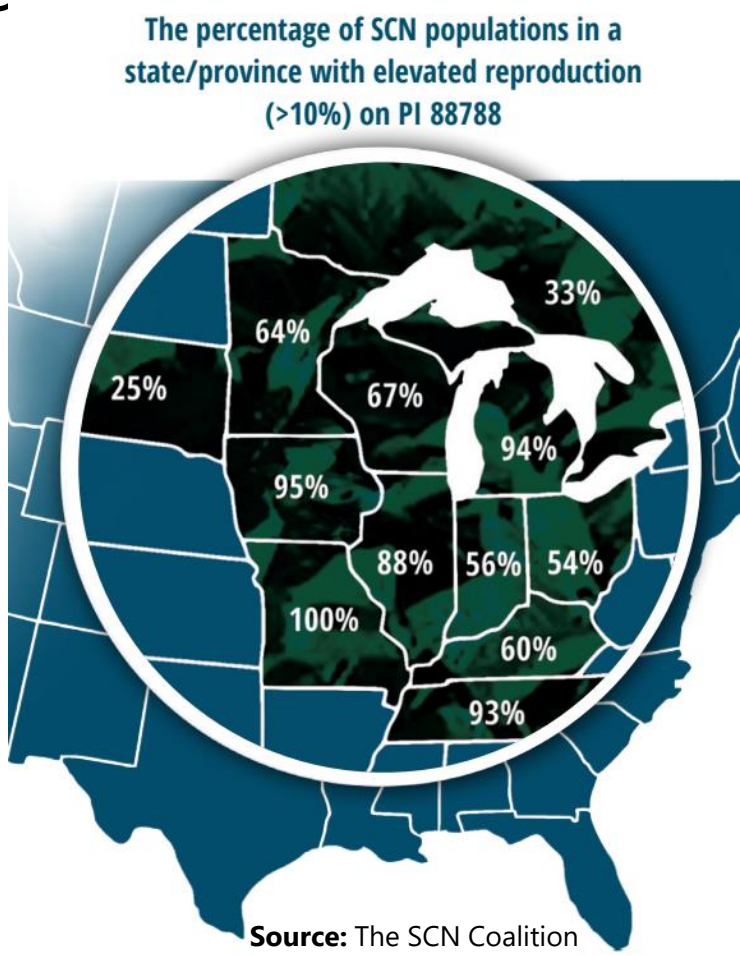
Resistance to lines 2, 5, 7

Chowdhury et al. 2021 Phytopath 111: 2100-2109

Soybean SCN Variety Resistance

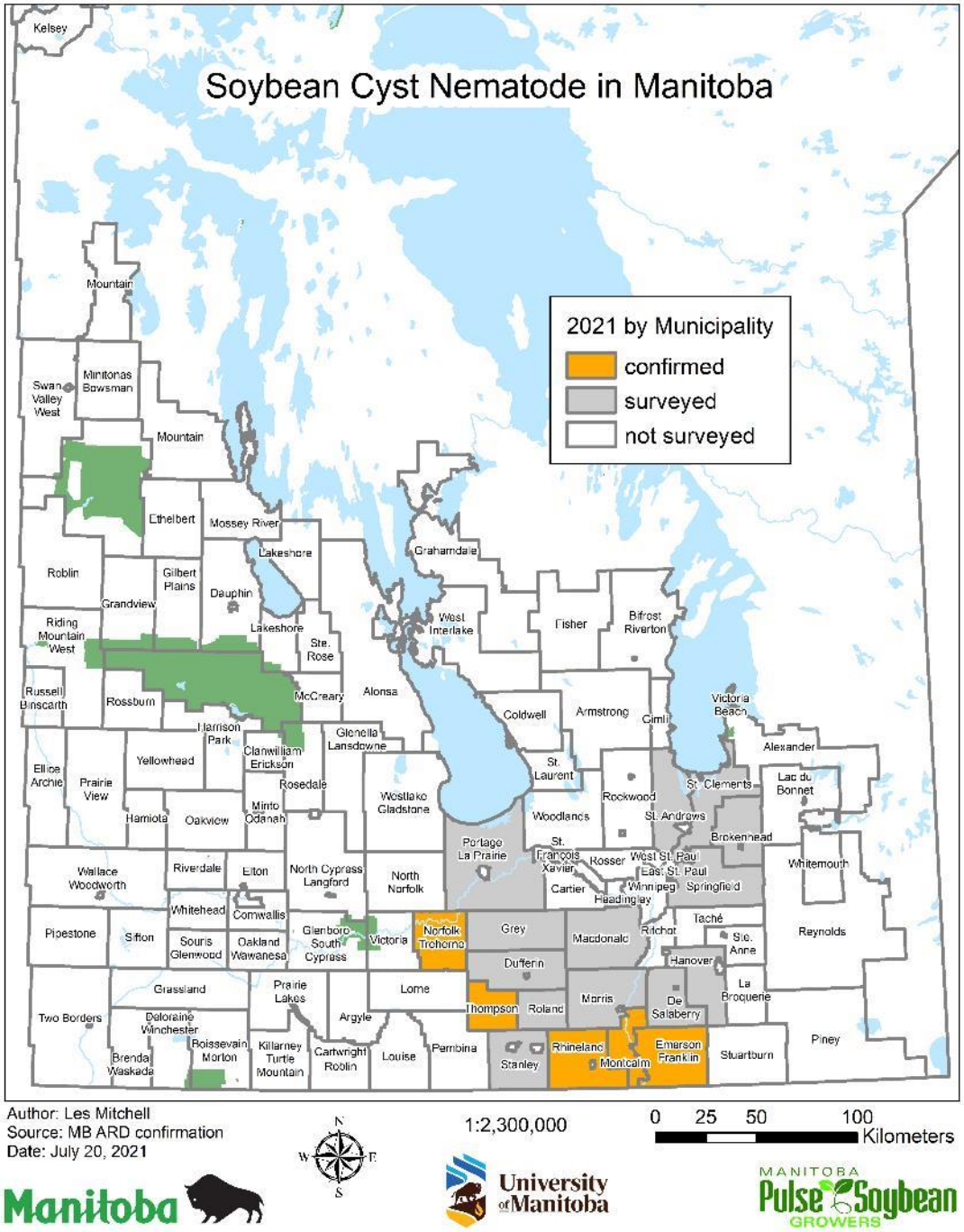
- Majority of varieties contain the same resistance source (PI 88788)
  - There are a few other genetic options, but they typically don't yield as well as PI 88788 or Peking resistance sources
- In the U.S., SCN is overcoming PI 88788 resistance
  - Resistance testing of Manitoba SCN populations indicates SCN is on the way to overcoming PI 88788 here too (Female Index = 4.2%)

Source: Dr. Mario Tenuta, U of M and SCN Diagnostics, University of Missouri



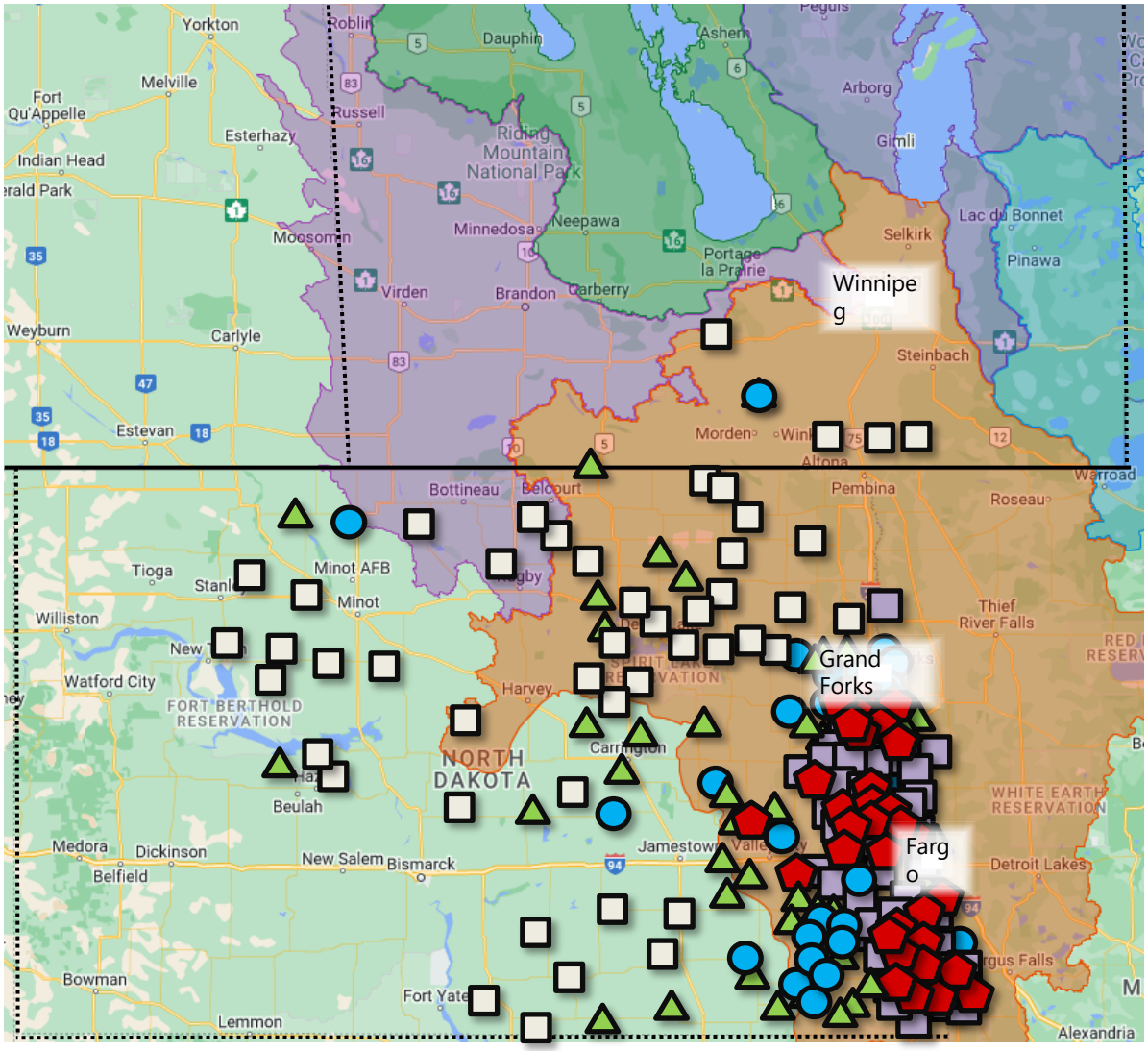
Source: The SCN Coalition

SCN in Manitoba 2021



The Quick March North Continues

SCN Densities MB and North Dakota



SCN Population
(EGGS + J2/100 CC SOIL)

- 50-200*
- 201-2,000
- 2,001-10,000
- 10,001 – 20,000
- >20,000

*In ND, ☐ are considered inconclusive results due to other nematodes in the soil. In MB, ☐ have been confirmed as SCN using molecular methods.

Data adapted from NDSU, North Dakota Soybean Council (2013-2022), and Dr. Mario Tenuta, U of M (2019, 2021)

MANITOBA Pulse Soybean GROWERS

Source: Laura Schmidt

SCN Emerging Issue for Dry Beans

plant disease

Editor-in-Chief: Alison E. Robertson
Published by The American Phytopathological Society

February 2017, Volume 101, Number 2
Page 391
https://doi.org/10.1094/PDIS-09-16-1257-PDN

DISEASE NOTES

First Report of the Soybean Cyst Nematode *Heterodera glycines* Infecting Dry Bean (*Phaseolus vulgaris* L.) in a Commercial Field in Minnesota

G. P. Yan, **A. Plaisance**, **I. Chowdhury**, **R. Baidoo**, **A. Upadhaya**, **J. Pasche**, **S. Markell**, and **B. Nelson**, North Dakota State University, Department of Plant Pathology, Fargo 58108-6050; and **S. Chen**, University of Minnesota, Department of Plant Pathology, St. Paul 55108.

- 2016 stunted patches in dark-red kidney bean field
- Roots infested with SCN females
- Soybean last grown in 2010

Effects of SCN on Soybean

What does it do?

- Takes away nutrients
- Water update disrupted
- Interferes with nodulation
- Damages roots (holes)

Field symptoms?

- **Yellowed plants**
  - **Resembles Iron Chlorosis**
- **Stunted plants**
  - **Uneven height**
- **Early maturity**
- **Reduction of yield**
- **Fewer pods**
- **Damage shows earlier on sands**

Integrated Management of SCN

Collect soil samples from fields to determine the situation - know your numbers!

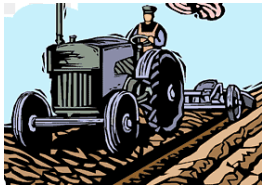
Grow nonhost crops (corn, wheat and other small grains, others)

Use nematode-protectant seed treatments

Grow resistant soybean varieties

- Continue using and rotate varieties with PI 88788
- Seek varieties with Peking, other sources of resistance
- Add other types of resistance when available

Cover crops? (usefulness and consistency of results not yet determined)



Use No-till

Damage Patches in Fields

Source: American Phytopathology Society

Source: Albert Tenuta OMAFRA

Can be Confused with Drown Outs

Source: Albert Tenuta OMAFRA

Can be Confused with Iron Chlorosis

Source: Jay Goos North Dakota State University

Sudden Death Syndrome Comes After SCN

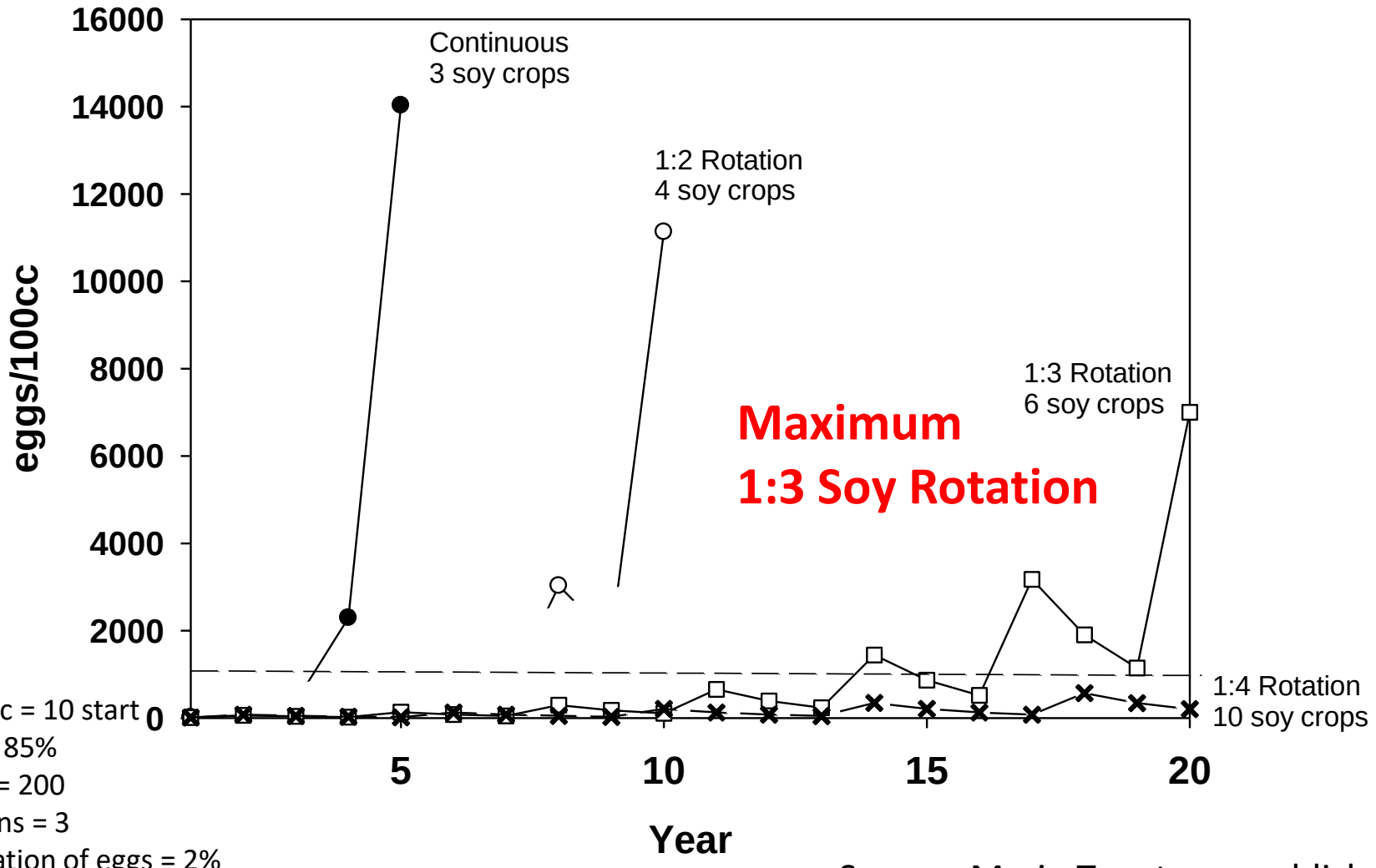
- First reported 1971 in Arkansas
- Disease complex of SCN with *Fusarium virguliforme*
- Occurs after first flowering
- In Ontario
- In Minnesota, North and South Dakota

Slide courtesy Albert Tenuta, OMAFRA

Avoid Host Plants in Fields

Crop Plants	Weed Plants
Adzuki Bean	American Vetch
Alsike Clover	Carolina Vetch
Bird's-foot Trefoil	**Common Chickweed**
Common Vetch	Common Mullein
Cowpea/Black-eyed Pea	**Field Pennycress**
Crimson Clover	Hemp Sesbania
Crownvetch	Henbit
Pinto, **Navy**, **Cranberry**, **Black**, **Kidney**,	Hop Clovers
Great Northern, Snap Bean	Milk Vetch
Hairy Vetch	Mouse-ear Chickweed
Lespedezas	Pokeweed
Lima Bean	Purple Deadnettle
Lupines	**Purslane**
Mung Bean	**Shepherd's Purse**
Pea	**Wild Mustard**
Soybean	Winged Pigweed
Sweet Clover	Wood Vetch

Avoid Too Much Soybean

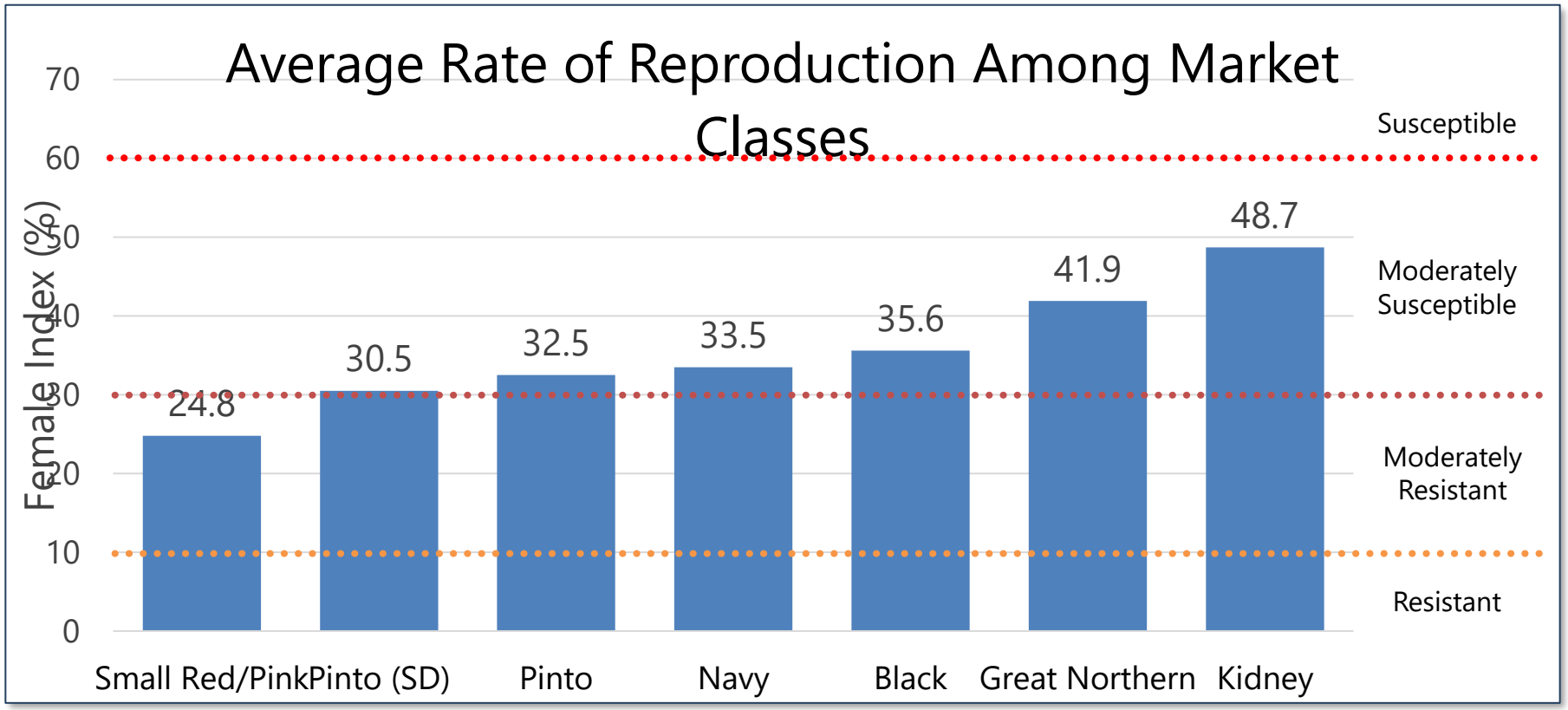


Assumes
eggs/100cc = 10 start
Females = 85%
eggs/cyst = 200
Generations = 3
Cyst formation of eggs = 2%
Survival = 60%

Source: Mario Tenuta, unpublished

Dry Bean Suitability to SCN

- Female index below 10% indicates resistance to SCN

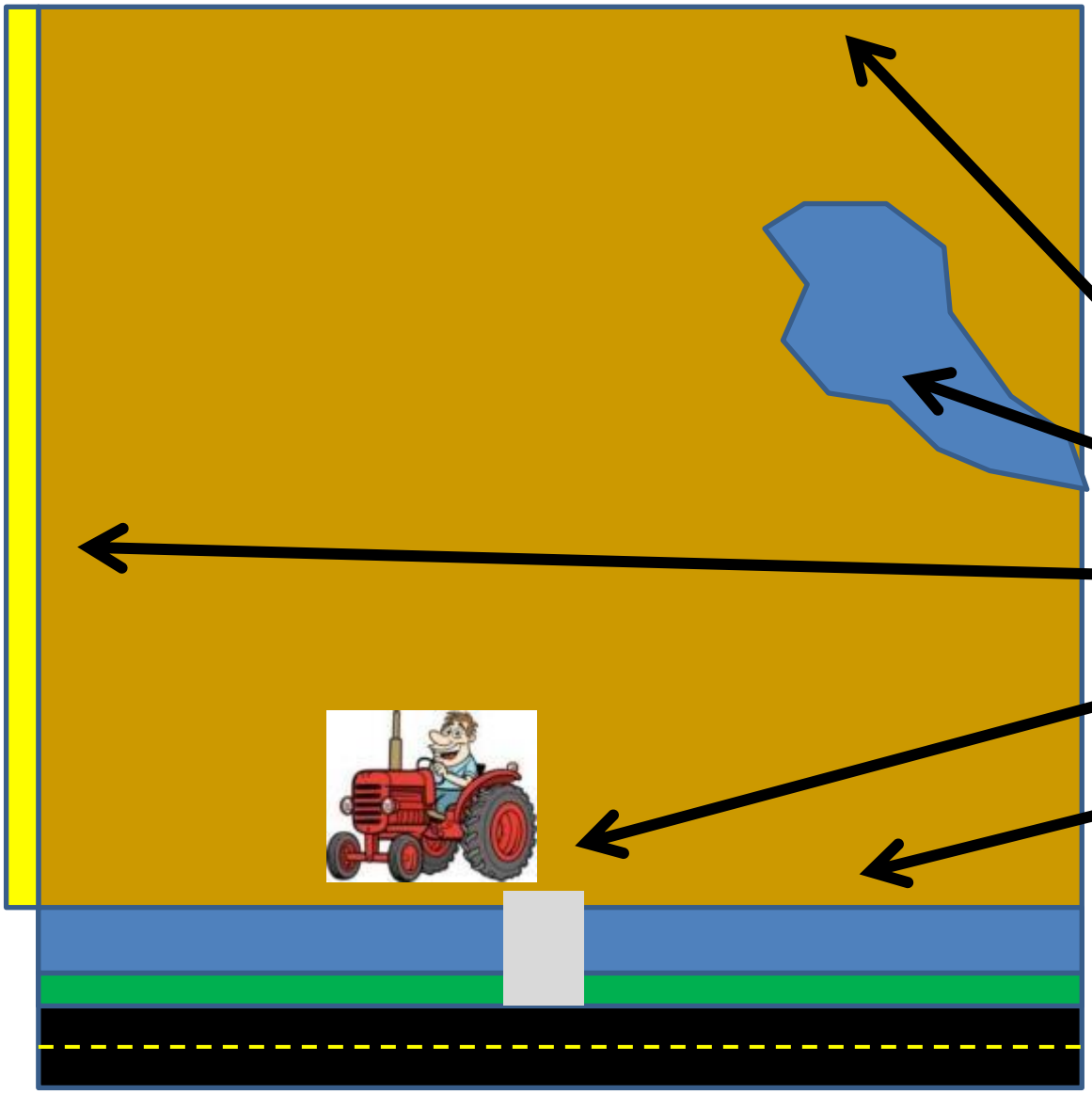


Source: Dr. Guiping Yan and Dr. Berlin Nelson, NDSU

MANITOBA Pulse Soybean GROWERS

Source: Laura Schmidt

Risk Areas in Fields



Headlands

Depressions

Fences

Entrance ways

Sloughs

Prevent Soil Movement Between Fields

- Purchase clean used equipment
- Wash implements and tires between fields
- Don’t drive pickups between fields
- Clean footwear

Source: Greg Tylka Iowa State Univ.

Source: Sandra Sardanelli Univ. Maryland

Prevent Birds From Landing on Fields

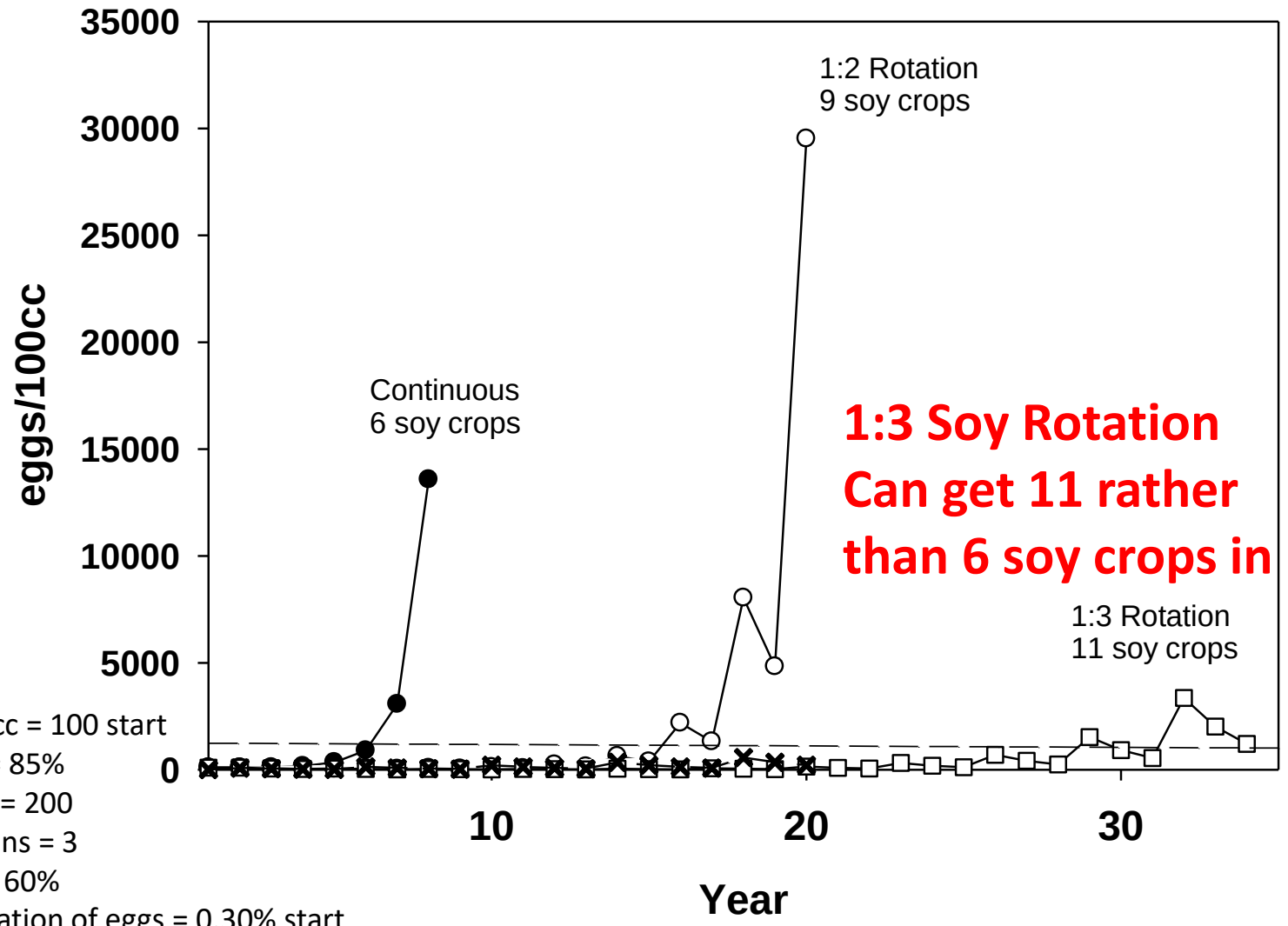
Use Resistant Soy Varieties

Resistant Varieties
Manitoba Seed Guide

HERBICIDE TOLERANT SOYBEANS ◆ VARIETY DESCRIPTIONS ◆ EASTERN MANITOBA

Manitoba Maturity Zone	Company Maturity Group	Variety	Type	Average DTM +/- Check†	Yield % Check	Site Years Tested	Hilum Colour	IDC		Resistance	
								Rating (1–5)	Group	SCN	PRR
Very Early-Season Zone	000.8	LS TRI8XT	R2X	-10	86	2	BL	1.9	ST	yes	1c
	000.5	NocomaR2	R2Y	-9	94	12	BL	2.0	ST	–	1c
	000.9	S0009-M2	R2Y	-9	89	12	IY	2.0	ST	–	6
	00.4	TH89004 R2X	R2X	-8	94	2	BR	1.8	ST	–	1c
	000.7	PS 00078 XRN	R2X	-7	95	8	BL	1.9	ST	yes	1c
	00.2	Devo R2X	R2X	-6	94	8	BR	1.8	ST	–	–
	000.9	RX000918	R2X	-6	103	2	BL	1.7	T	yes	1c
Early-Season Zone	00.1	P001A48X	R2X	-5	99	2	TN	1.7	T	–	1c
	00.1	PV 11s001 RR2	R2Y	-5	90	12	Y	1.9	ST	–	1c
	000.7	Karpo R2	R2Y	-5	104	2	GR	2.2	ST	–	–
	00.2	RX00218	R2X	-5	89	8	BR	1.9	ST	–	–
	000.2	Notus R2	R2Y	-5	103	8	BL	1.6	T	–	1c
	00.3	P003A97X	R2X	-5	99	2	GR	1.9	ST	yes	1k
	00.1	Torro R2	R2Y	-5	100	12	BL	2.2	ST	–	–
	00.2	NSC Redvers RR2X	R2X	-4	97	2	BL	1.9	ST	yes	1c
	000.9	PV 15s0009 R2X	R2X	-4	99	8	BL	2.0	ST	yes	1c
	00.4	NSC Culross RR2X	R2X	-3	98	2	BL	1.7	T	–	1c
	00.1	LS 001XT	R2X	-3	105	8	BL	1.7	T	yes	1k
	00.5	Lono R2	R2Y	-3	107	8	Y	2.0	ST	–	1c
	00.3	Dinero R2X	R2X	-2	97	8	IY	1.7	T	–	–
	00.4	TH 32004R2Y	R2Y	-2	102	2	BL	1.7	T	–	1c
	00.1	Prince R2X	R2X	-2	94	8	BL	1.7	T	–	1k
	00.6	S006-M4X	R2X	-2	98	8	IY	1.9	ST	–	1c
	00.5	S007-Y4	R2Y	-2	103	12	IY	2.0	ST	–	1c

Effect of Use of Resistance Varieties



Assumes
eggs/100cc = 100 start
Females = 85%
eggs/cyst = 200
Generations = 3
Survival = 60%
Cyst formation of eggs = 0.30% start
Adaption = 30% per year

Source: Mario Tenuta, unpublished

Scout for SCN

- Fields more than 3 years of soybean
- Get out of the truck and walk
- 30-45 days after emergence, gently lift roots with spade, dunk in bucket of water for clay, look for females using a hand lens
- Up to 21-28 before ready for harvest
- Collect soil samples and SCN test (Agvise or Soil Ecology Lab U Manitoba)

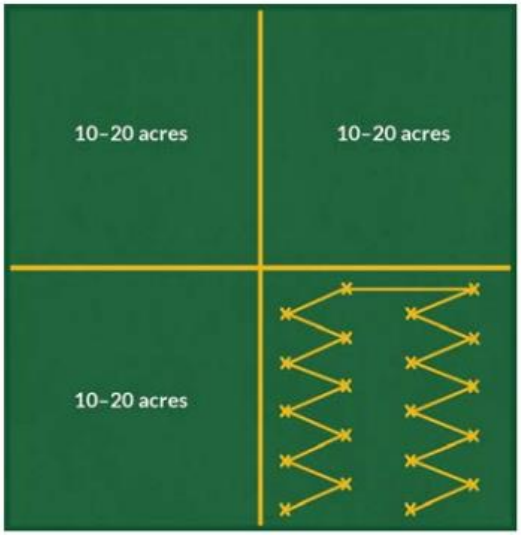
Checking Roots

http://www.nwroc.umn.edu/Cropping_Issues/2010/July_20/SoybeanCystNematodeScouting/index.htm

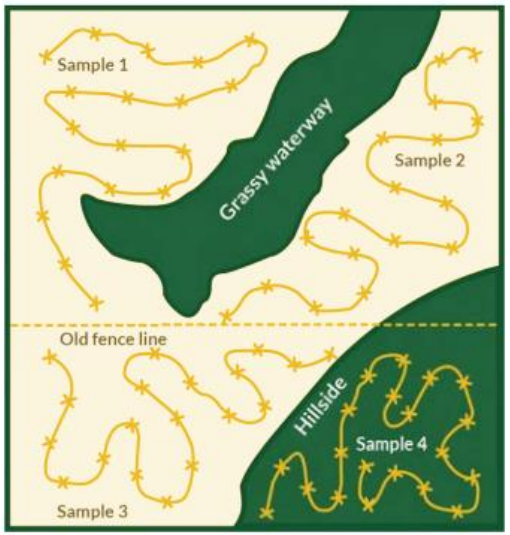
Soil Test for SCN

THREE APPROACHES to collecting soil samples.

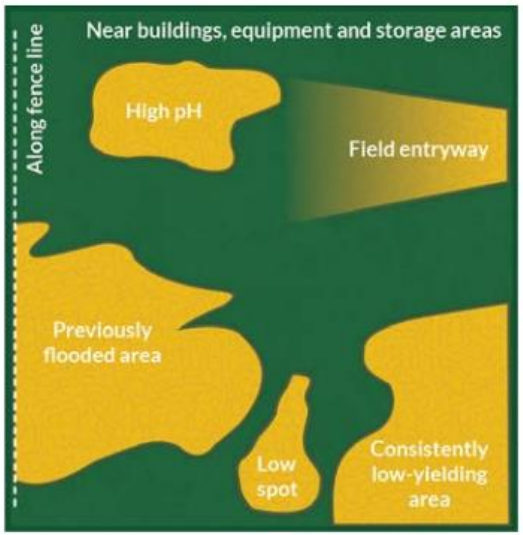
Collect 15–20 (or more) 1-inch-diameter core samples, 8 inches deep, for every 20 acres. Mix the cores well, put the mixed soil into a soil sample bag and send it to an SCN testing lab.



1 Collect soil cores using a zigzag pattern.



2 Collect soil cores from logical areas or management zones in the field.



3 Collect soil cores from high-risk areas in the field where SCN might first be discovered.

Source: The SCN Coalition

MANITOBA Pulse Soybean GROWERS

Source: Laura Schmidt

Send soil samples to Agvise Laboratories

@soilecologyUMan

THANK YOU

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