



Institute of Ag Professionals

Proceedings of the

2009 Crop Pest Management Shortcourse &

Minnesota Crop Production Retailers Association Trade Show

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CORN NEMATODES


What's the Big Deal about these Tiny Worms?

**Univ. of Minnesota
CPM Short Course
December 10, 2009**

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Why do we expect nematode damage in corn to increase?

- 
- 1. Changes in insecticide chemistries**
 - Less OPs and carbamates and more pyrethroids
 - 2. Reduction in soil insecticide use**
 - Transgenic insect resistant corn
 - 3. Shift back toward more continuous corn**





Why the renewed interest in corn nematodes?

1. Fine tuning other management practices

- E.g. nutrient and pest management

2. Industry driven

- New delivery system for Counter® (AMVAC)
- New and pending seed treatment products
 - Syngenta*, Bayer CropScience, Plant Health Inc.

3. Commodity prices

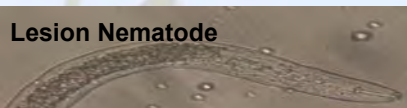
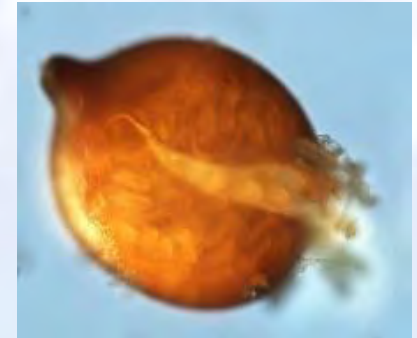
3 Facts About Corn Nematodes

Reject the Misconceptions

1. There are MANY types of nematodes that can damage corn.

- Usually aren't cysts!**
- At least 12 different genera (not species) exist nationwide**

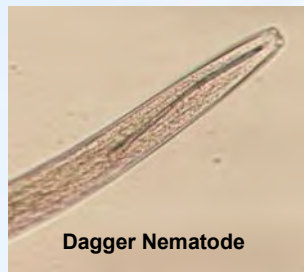
SCN



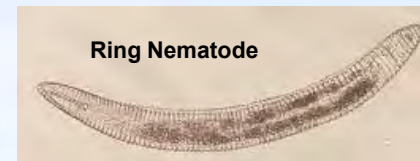
Lesion Nematode



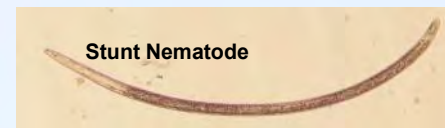
Lance Nematode



Dagger Nematode



Ring Nematode



Stunt Nematode



Spiral Nematode

Some Corn Nematodes in the Midwest

- **Needle**
- **Sting**
- **Dagger**
- **Spiral**
- **Stunt**
- **Stubby root**
- **Lance**
- **Lesion**

Ectoparasites



Courtesy S. W. Westcott III , APS

Endoparasites



Courtesy of D. Wixted, APS

Endoparasitic Nematodes

- **Spend most of their lives *inside* roots**
 - **Nematode analyses of soil samples are NOT enough**
 - **Labs should also extract nematodes from roots!**
 - **From separate root samples OR**
 - **Root fragments from soil cores**



Relative Damage Risks

- **High Risk:**
 - **Sting** (*Belonolaimus*)
 - **Needle** (*Longidorus*)
- **Moderate Risk:**
 - **Stubby-root** (*Paratrichodorus*)
 - **Lance** (*Hoplolaimus*)
 - **Lesion** (*Pratylenchus*)
- **Low or Undetermined Risk:**
 - **Spiral** (*Helicotylenchus*)
 - **Stunt** (*Tylenchorhynchus*)
 - **Dagger** (*Xiphinema*)

3 Facts About Corn Nematodes

Reject the Misconceptions

- 2. Corn nematodes occur in EVERY soil texture, not just sandy soils.**
- Only some require sandy soil**
 - One of the most common nematodes is lesion, found in >90% of Nebraska fields (450+ samples from 63 counties 2006-2007)**

Relative Sizes of Plant Parasitic Nematodes

Needle



Sting



Dagger



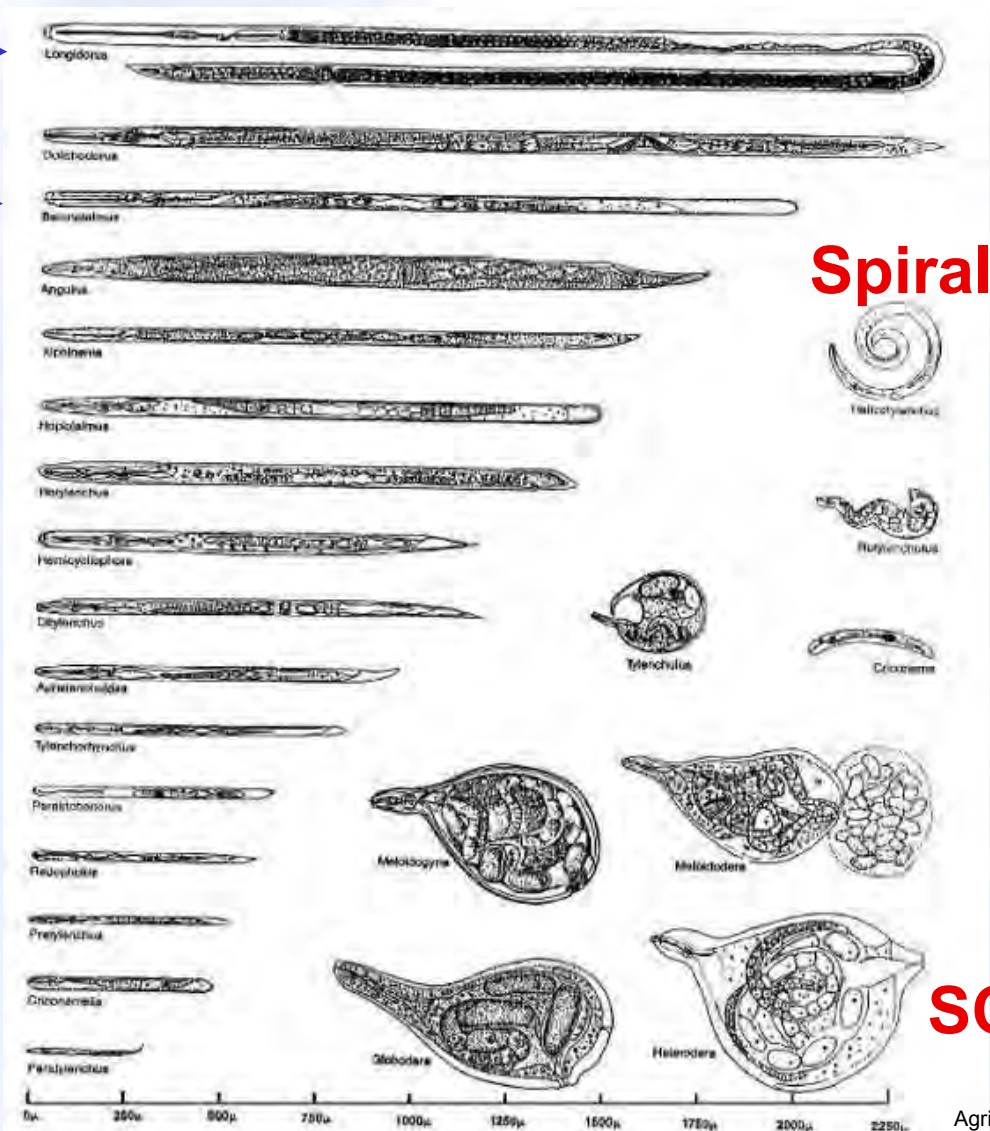
Lance



Stubby root



Lesion



Spiral

SCN

(Agrios, Intro. To Plant Pathology)

Agrios, 1997

3 Facts About Corn Nematodes

Reject the Misconceptions

- 3. Corn nematode damage is not rare; it is probably more common than expected and frequently misdiagnosed.**
- Many types of nematode symptoms**
 - Symptoms are not diagnostic and mimic those caused by many other common problems**

Soybean Cyst Nematode as a Model

- SCN: Substantial yield loss can occur w/o other visible or measurable symptoms
- Crop appearance may not indicate the below-ground variability
- What about corn nematodes? Need more research!!



Urbana, IL

Avg >10,000 eggs/ 100 cc soil

Range: 200 – 40,000 eggs/100 cc soil

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Some Types of Symptoms Caused by Nematodes in Corn

- **Chlorosis (yellowing)**
- **Stunting**
- **Root necrosis**
- **Uneven height**
- **Uneven tasseling**
- **Misshapened roots**
- **Yield Loss**

Needle Nematode

Holt County, NE



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Needle Nematode

Whiteside County, IL - July 2003



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Sting Nematode

Holt County, NE - July 2008



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Patchy Distribution of Symptoms Sting Nematode



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Dodge County, NE

June 2006

Lesion nematodes

Lance nematodes

Dagger nematodes

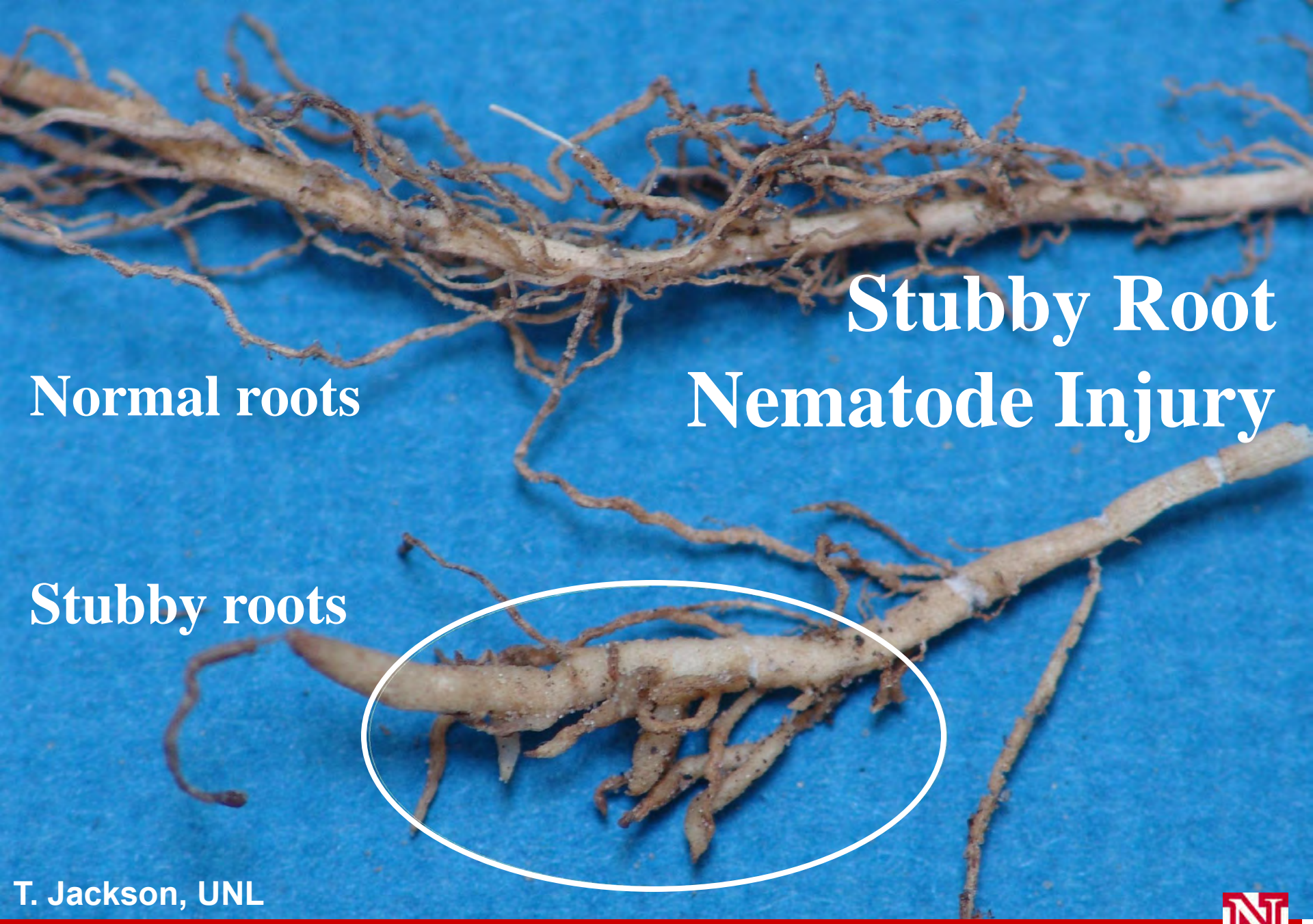
Stubby-root nematodes

* Farm average = 180 bu/A
Yield in small plots was as low as 30 bu/A

Upper Plant Symptoms

**Uneven
plant height**

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Normal roots

Stubby Root
Nematode Injury

Stubby roots

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Root Injury

Root-lesion nematodes+

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Root-Lesion Nematodes

- **Migratory endoparasites**
- **Believed to be the most important nematodes in corn**
- **Small and not restricted by soil texture**
- **Six known species parasitize corn; some have a wide host range limiting the effect of crop rotation**
- **Identified in >90% of surveyed NE fields**



Mimics

Don't be fooled!

- Symptoms caused by nematodes can mimic several other problems, such as:
 - Insect injury
 - Herbicide injury
 - Nutrient deficiency
 - Soil compaction
 - Low/high soil pH
 - More. . .

Low Ph (4.6)

Aluminum toxicity

Ca and Mg Deficiency



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Conclusions about Symptoms

- Many types of nematode symptoms in corn
- Symptoms are NOT diagnostic
- Symptoms may mimic those caused by other problems
- Symptoms can't and shouldn't be used exclusively to:
 - Make nematode diagnoses
 - Differentiate between nematode genera
 - Differentiate from other types of abiotic or biotic injury
- Symptoms should be used to identify locations for further testing and observation
- Definitive diagnoses may only be made after appropriate sample collection, submission, and completion of nematode analyses

Regional Survey 2007

Methodology

- 16 States
 - 727 counties
 - >20K acres corn
 - 3 samples/county
 - 2179 samples soil+roots
- Collection coordinated by private contractor
 - June/July 2007
- Samples submitted to 1 of 6 labs

State	Counties	Samples
Colorado	10	30
Illinois	90	268
Indiana	76	228
Iowa	99	297
Kansas	60	180
Kentucky	18	54
Michigan	33	99
Minnesota	57	171
Missouri	47	141
Nebraska	73	219
North Dakota	15	45
Ohio	48	144
Oklahoma	2	6
South Dakota	46	138
Wisconsin	52	156
Wyoming	1	3
16	727	2179

Regional Survey 2007

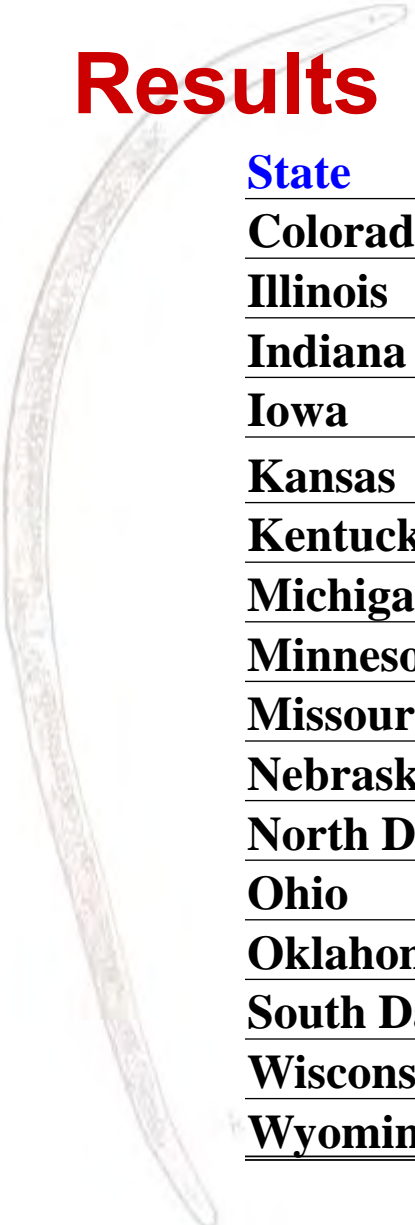
Results

- Root-lesion (*Pratylenchus* spp.) in 81% locations
- Sting (*Belonolaimus* spp.), needle (*Longidorus* spp.), and stubby-root (*Paratrichodorus* spp.) were NOT found
- 99.2% samples had plant parasites



Regional Survey

Results



State	Samples	Lesion (Soil)	Lesion (Roots)	Total Lesion	No Nematodes
Colorado	30	86.7%	53.3%	86.7	7
Illinois	268	76.1%	27.2%	79.5	0
Indiana	228	93.0%	36.0%	75.9	0
Iowa	297	66.0%	41.4%	79.8	0.7
Kansas	180	82.8%	71.1%	90.6	1
Kentucky	54	44.4%	9.3%	48.1	0
Michigan	99	63.6%	38.4%	89.1	1
Minnesota	171	83.0%	.	71.3	2
Missouri	141	80.9%	4.3%	85.8	0
Nebraska	219	77.2%	76.3%	93.6	0
North Dakota	45	22.2%	44.4%	55.6	4
Ohio	144	62.5%	18.1%	68.7	0
Oklahoma	6	100.0%	.	100.0	0
South Dakota	138	76.8%	41.3%	79.7	4
Wisconsin	156	97.4%	89.1%	99.4	0
Wyoming	3	100.0%	.	100.0	0
	2179	76.5%	40.4%	81.4%	0.8%



Regional Survey 2007

Conclusions and Interpretation

- Plant parasites are common in corn fields to varying degrees
- Sting, needle, and stubby-root
 - Sparse distribution vs. sample timing
- Other genera – dagger, stunt, spiral, ring, pin
 - Common
 - Less damaging



Regional Survey 2007

Conclusions and Interpretation

- Need more sampling?
- Variability by state
 - Variability among laboratories
- Raising awareness
- Research opportunities

Regional Survey 2007

Conclusions and Interpretation

- “Thresholds”
 - Guidelines
 - Differ by field env x crop year
 - Pitfalls
 - E.g. spiral (*Helicotylenchus* spp.)
 - Don't consider
 - Species differentiation
 - Environmental impacts
 - Interaction effects
 - Dated

Sampling Procedure

- Differs from SCN!
- “4-6 Rule”



– Timing

- 4-6 weeks after planting
 - Considering root and nematode depth
 - Some, not all, stay in the upper soil

– Probing

- 4-6 inches from plant
 - Through the root zone

Not all genera of corn nematodes are in the same place at the same time.

Depth of Sample	Nematodes per 100 cm ³ Soil			
	May 21		September 12	
	Needle	Root-Lesion	Needle	Root-Lesion
0 - 3.5"	25	124	3	440
3.6 - 6"	14	105	8	279
6.1 - 9.5"	10	127	17	222
9.6 - 12"	4	40	15	32
12.1-15.5"	1	27	4	30

Needle and root lesion nematodes showed a different pattern of vertical distribution in a corn field in Wisconsin.

MacGuidwin, J. *Nematology* 21:404-408, 1989

Sampling Procedure

- UNL Plant & Pest Diagnostic Clinic
- Sample at 45° angle
- Collect ≥ 2 c of soil
- Plastic zipper top bags
- **No root balls needed!**
- Your lab should test for BOTH endo- and ectoparasitic nematodes
- Contact your lab for specific questions



Nematodes MUST be alive!

Reliability of test results depends upon the quality of the sample!

Severe Needle Nematode Injury



Where should you sample?

Sampling Strategies

- Sampling strategy depends on your objective, so if you are trying to:
 - Diagnose a problem spot
 - If severe, sample perimeter, or use yield monitor to ID
 - Consider collecting a second sample from nearby
 - Determine a baseline
 - Random pattern
 - Evaluate nematicide efficacy
 - Sample BOTH at planting and 4-6 weeks later
 - For calculation of reproductive factor (Rf)
 - Smallest area that is possible and practical

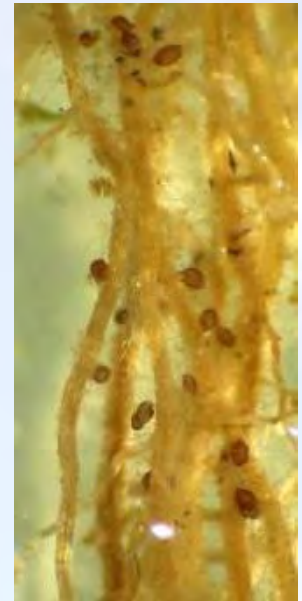
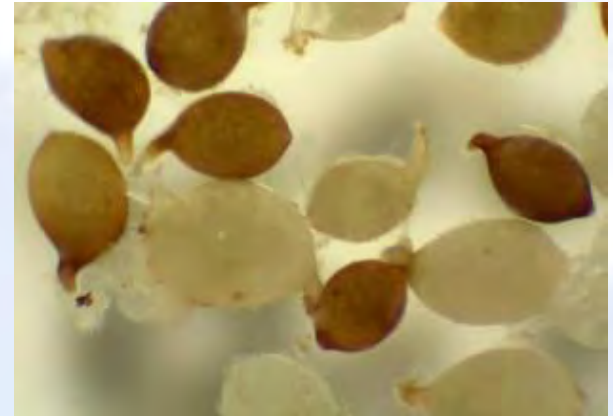


A New Cyst Nematode of Corn

- **Identified in a sample from northwestern Tennessee (Obion County) in 2006**

photos by University of Missouri-Columbia nematologists, R. Heinz and M. Mitchum

- **Distribution unclear**
- **Apparent narrow host range**
- **Could complicate future SCN sampling and research**
- **Not the same cyst nematode identified and quarantined in MD and VA**



Acknowledgments

- **Technical staff**

- J. Behn
- J. Millhouse
- Hourly employees

- **Other Survey Testing Laboratories:**

- A. MacGuidwin – Univ. of Wisconsin
- T. Todd – Kansas State Univ.
- R. Heinz & M. Mitchum – Univ. of Missouri
- D. MacDonald – Univ. of Minnesota
- G. Dappen – Nema-Test, Lincoln, NE
- Funding provided by Syngenta Seed Care





Plant Disease Central Extension Plant Pathology

pdc.unl.edu

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Plant Disease Central

Mission: *To be the plant disease information and management resource for the state of Nebraska.*

Plant Disease Central (PDC) was developed by the Extension Plant Pathology Team in the **Department of Plant Pathology** at the University of Nebraska-Lincoln for extension educators, home owners, urban landscape managers, agricultural consultants, crop producers and other agricultural professionals in Nebraska. This site will be updated and expanded as information becomes available, as additional and better images are acquired, and as resources allow.

The resources found on PDC were assembled to help users diagnose and manage plant diseases in Nebraska. The most critical issue for profitable management of plant diseases is obtaining a correct diagnosis. In any given year, the question is not whether or not diseases will occur in Nebraska but rather which diseases will occur and at what incidence and severity. Diagnosis of plant diseases can be difficult in the early stages of disease development. Users will find links to the University of Nebraska-Lincoln Plant and Pest Diagnostic Clinic, and the Panhandle Plant Disease Diagnostic Lab on this page for confirmation and assistance with diagnosis. For many diseases, symptoms become diagnostic and a reasonable level of confidence can be placed in diagnoses based on symptoms.

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