Nematode Management in Cotton

Louisiana Agricultural Technology & Management Conference

Marksville, LA

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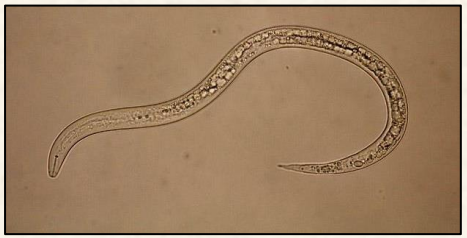
Presentation Outline

Topics:

- Nematode Problems on Cotton



- Overview of Nematode Management

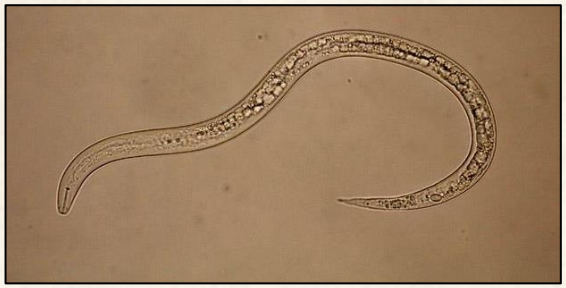
- Nematicide x Host Resistance Field Trial 2021

- Cover Crop x Host Resistance Field Trial

Nematode Problems on Cotton

Southern Root-Knot Nematode

(*Meloidogyne incognita***)**



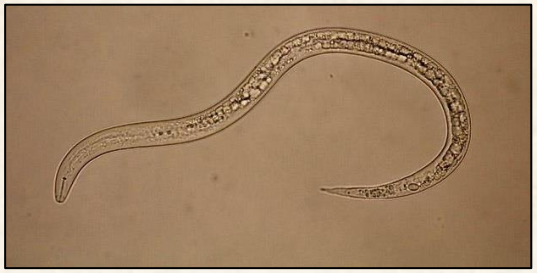
- Wide host range

- Forms galls on roots

- Aboveground:
  - Yellowing
  - Stunted growth

- Reduces yield
- ’Hot spots’ in a field

Nematode Problems on Sweetpotato



Guava Root-Knot Nematode

(*Meloidogyne enterolobii)*

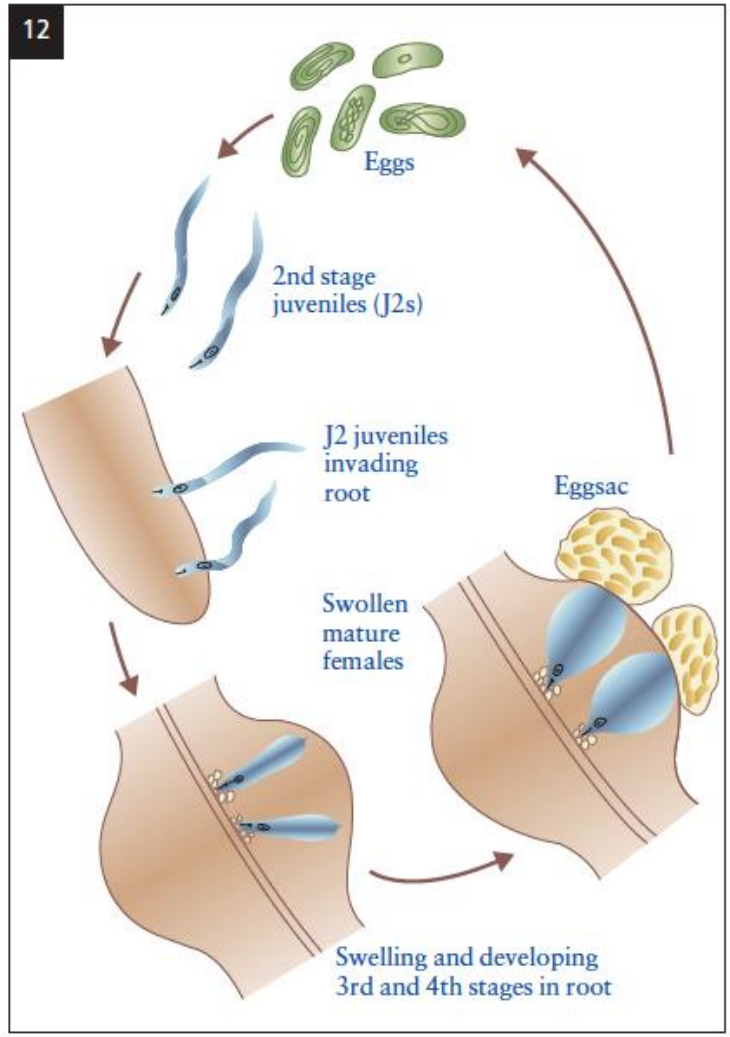
- Highly damaging

- Breaks available host resistance
- Introduced into Louisiana twice:
  - 2018 in Morehouse Parish
  - 2019 in Franklin Parish
- Not found in any LA production field during 2019 to 2021 surveys

Nematode Problems on Cotton

Root-Knot Nematode Life Cycle

1. J2-stage nematode emerges from egg
2. J2 seeks out and penetrates root tip
3. J2 establishes feeding site (giant cell)
4. Nematode ingests cytoplasmic contents
5. J2 increases in width and molts
   - J3-stage, J4-stage, Adult
6. Eggs are deposited in egg mass on roots



12 Life cycle of the sedentary endoparasite *Meloidogyne* spp.

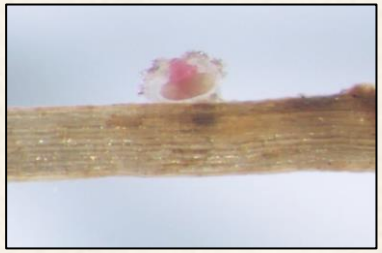
Nematode Problems on Cotton

Reniform Nematode

(*Rotylenchulus reniformis***)**

- Moderate host range
  - Corn and Grain Sorghum = non-host

- No obvious root symptoms



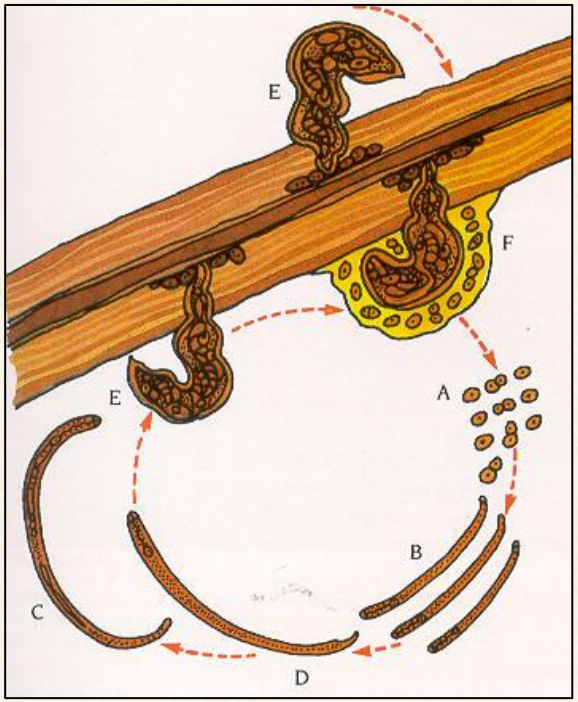
- Reduces yield

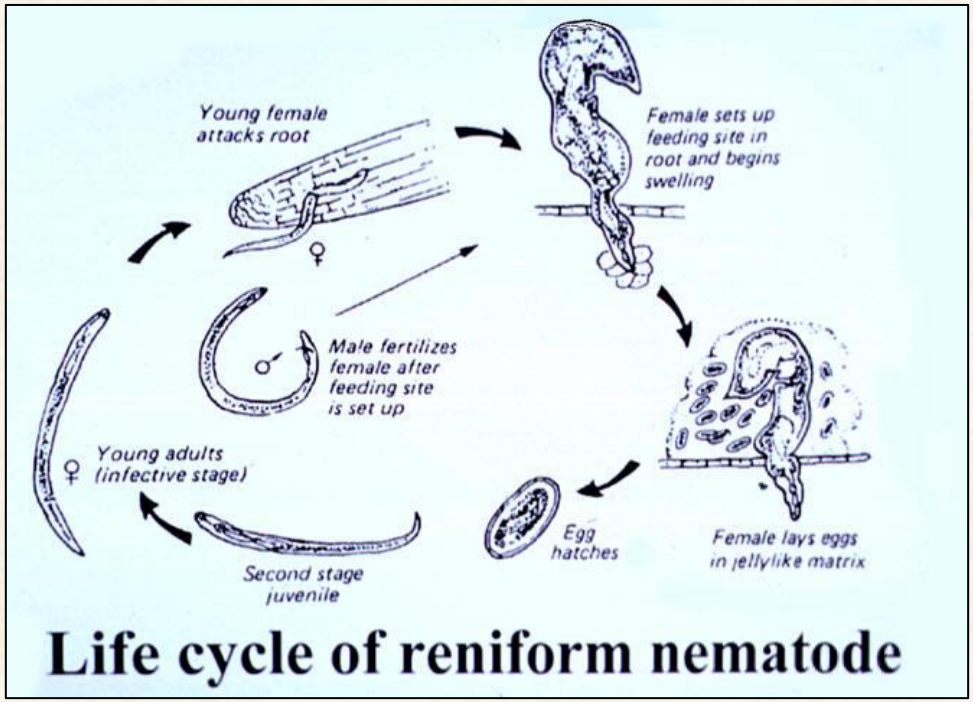
- Insert field level damage

Nematode Problems on Cotton

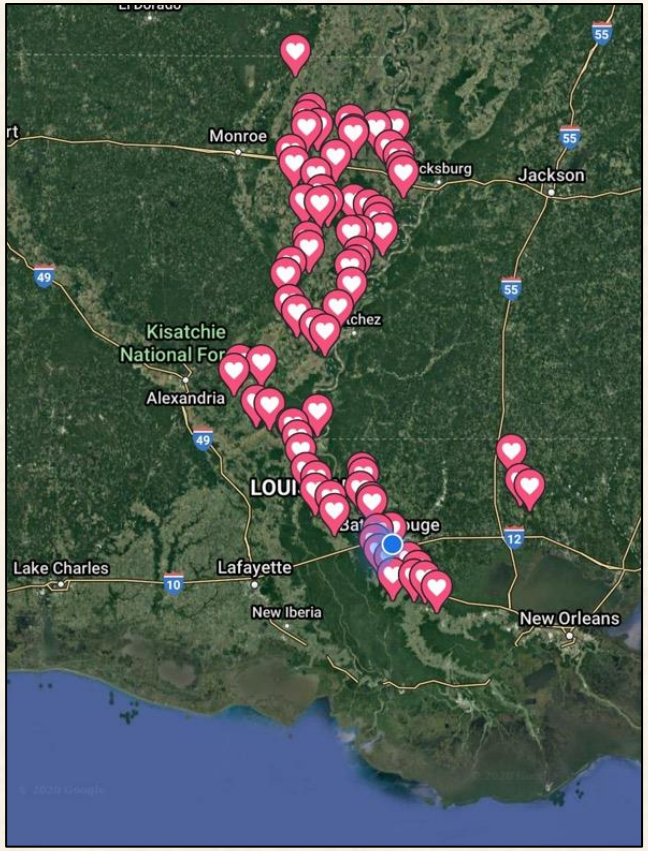
Reniform Nematode

(*Rotylenchulus reniformis***)**





Nematode Problems on Cotton



Distribution in Louisiana

- 16 Major Crop Producing Parishes
- Reniform nematode is widespread
- All root-knot nematode species were identified as *M. incognita*
- *M. enterolobii* was not detected

		Occurrence (%)		
Crop	**Fields (n)**	***R. reniformis***	***M. incognita***	***M. enterolobii***
Sweetpotato	40	97.5	17.5	0
Soybean	118	61.9	19.5	0
Cotton	43	41.9	23.3	0

Nematode Problems on Cotton

Nematode Advisory Service
Department of Plant Pathology and Crop Physiology
302 Life Science Building
Baton Rouge, LA 70803

Nematode Advisory Service
125 Life Science Annex
Louisiana State University

Provides nematode diagnostics, population monitoring, and management recommendations to the state of Louisiana

Dr. Tristan Watson
Director
Nematode Advisory Service

Dr. Josie Rezende
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Nematode Advisory Service

Nematode Advisory Service

Department of Plant Pathology & Crop Physiology
302 Life Sciences Building
110 LSU Union Square
Baton Rouge, LA 70803
Tel: (225) 578-2186

Nematode Assay Form

Grower's name and address:

Name _____
Address _____
City, State, Zip _____
Parish _____
Email _____
Date of sampling _____

Submitted by:

Name _____
Address _____
City, State, Zip _____
County Agent _____

Sample Information

Clinic number (leave blank)	Sample identification	Current crop or past crop	Next crop or alternatives

There is a charge of $10 per sample. Checks should be made out to "LSU AgCenter NAS".

Nematode Management

Clean Equipment

Cover Crops

Crop Rotation

Host Resistance

Nematicides

Nematode Management

Clean Your Equipment

- Nematodes inhabit the soil ecosystem.
- Nematodes are transferred from field to field via soil on equipment.
- Clean equipment after entering a nematode infested field.
- Use LSU AgCenter Nematode Advisory Service to determine if you have a nematode infestation.

Nematode Management

Crop Rotation

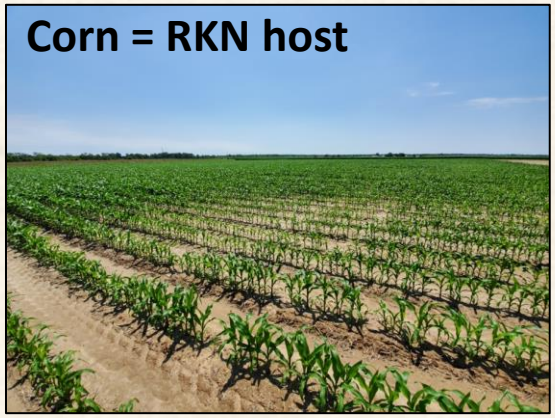
- Can rotate to a non-host to starve the nematode

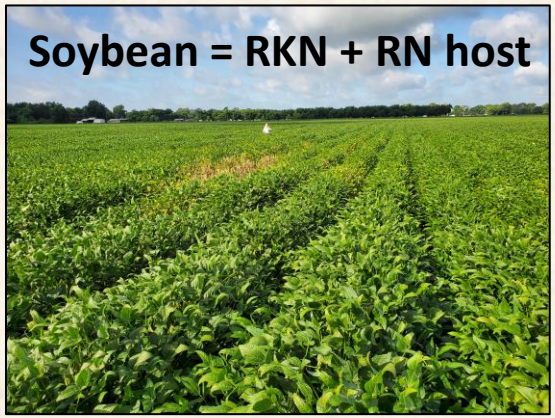
- Difficult when a field has a multiple nematode species

- Common rotation crops in Louisiana:

Rotation Crop	Reniform Nematode	Southern Root-Knot Nematode	Guava Root-Knot Nematode
Soybean	Host	Host*	Host
Sweetpotato	Host	Host*	Host
Corn	Non-host	Host	Non-host
Grain Sorghum	Non-host	Host	Non-host
Peanut	Non-host	Non-host	?

* = resistant varieties available





Nematode Management

Winter Cover Crops

- Can grow non-host winter cover crop between growing seasons
- Reduce weeds that may act as a '*green bridge*' between growing seasons
- Common winter cover crops in Louisiana:

Rotation Crop	Reniform Nematode	Southern Root-Knot Nematode	Guava Root-Knot Nematode
Winter Wheat	Poor Host	Moderate Host	Poor Host
Winter Rye	Poor Host	Poor Host	Poor Host
Hairy Vetch	Moderate Host	Host	Host
Austrian Winter Pea	Poor Host	Host	Host
Crimson Clover	Host	Host	Host


Winter Rye


Crimson Clover

Nematode Management

Host Resistance

Root-Knot Nematode Resistant

- PhytoGen PHY 400 W3FE
- PhytoGen PHY 417 WRF
- PhytoGen PHY 427 WRF
- PhytoGen PHY 480 W3FE
- PhytoGen PHY 500 W3FE
- PhytoGen PHY 545 W3FE
- PhytoGen PHY 580 W3FE
- Deltapine DP 1747 NR
- Stoneville ST 5600 B2XF

Root-Knot + Reniform Nematode Resistant*

- Deltapine 2141 NR B3XF
- PhytoGen PHY 332 W3FE
- PhytoGen PHY 443 W3FE

*Relatively new to market

Nematode Management

Nematicides

Crop	Product Choices	Rate	Comments	Nematicide Type
Cotton	Telone II	3-6 gal	Apply fumigant 1 week before planting at a depth of 14 inches beneath the soil surface. Soil should not be excessively wet at the time of application.	Soil Fumigant
	AgLogic 15G	3.5-7 lb 5 lb	Apply granules in seed furrow and cover with soil. Side-dress granules in furrow 6-10 inches on side of row. Apply once at 3 weeks through first squaring.	Granular – Carbamate
	Vydate C-LV	17 fl oz	Apply at 1-7 true leaf stage and a second application 14 days later. Use after initial treatment with a nematicide. For reniform, root-knot, and lance nematodes.	Liquid – Carbamate
	Acceleron INT-710	Seed application	Use in fields with low to moderate nematode levels only.	Seed Coat – Carbamate
	Avicta Duo COT202 Avicta Duo Cotton	Preordered seed treatment	Use in fields with low to moderate nematode levels only.	Seed Coat – Lactone
	Poncho Votivo	Seed application	Use in fields with low to moderate nematode levels only.	Seed Coat – Biological
	AERIS Seed Applied System	Preordered seed treatment	Use in fields with low to moderate nematode levels only.	Seed Coat – Carbamate
	Majestene	7.2-19.6 fl oz/1,000-foot row	Use in fields with low to moderate nematode levels only.	Seed Coat – Biological
	Velum	5.0-6.84 fl oz	In-furrow spray on or below seed. Do not apply more than 13.7 fl oz per year.	Liquid – 3F Nematicide

Nematicide x Host Resistance Field Trial 2021

LSU AgCenter Northeast Research Station – St. Joseph, Louisiana

- **Soil type:** Silty Loam

- **Nematode Problems:**
  - Reniform nematode (high pressure)
  - Root-knot nematode (low – moderate pressure)

- **Previous Crop History**
  - 2020 soybean crop

Experimental Design

Split-Plot Design

- Whole Plots = Variety
  - Deltapine 1646 (susceptible)
  - Deltapine 2141 NR (resistant)

- Sub Plots = Nematicide
  - Untreated
  - AgLogic
  - BioST
  - Copeo
  - Velum

Replicates = 4

Plot Size:
4 rows wide (38-inch) spacing
35 feet long
7 foot alley between plots

Influence on Reniform Nematode Populations

		R. reniformis / 500 mL soil		
Factor	Level	At Plant	Mid-Season	Harvest
Nematicide	NTC	10,720	5,840	17,840
	AgLogic	18,720	7,875	21,720
	BioST	14,210	5,555	16,200
	Copeo	16,681	5,180	14,920
	Velum	13,320	6,280	11,600
Variety	DP1646	18,512	6,640	18,912
	DP2141	10,989	5,652	14,000
P-value	Nematicide	0.683	0.710	0.376
	Variety	0.047	0.446	0.133
	Interaction	0.659	0.938	0.930

Interaction

- No interaction effect between main factors.

Nematicide

- No main factor effect of nematicide application.

Variety

- No effect on reniform nematode.

Influence on Root-Knot Nematode Populations

Factor	Level	*M. incognita* / 500 mL soil		
		At Plant	Mid-Season	Harvest
Nematicide	NTC	160	140	1,200
	AgLogic	46	380	800
	BioST	160	200	360
	Copeo	160	100	1,400
	Velum	280	100	1,040
Variety	DP1646	135	320 a	1,808 a
	DP2141	192	48 b	112 b
P-value	Nematicide	0.584	0.512	0.930
	Variety	0.516	0.024	0.037
	Interaction	0.509	0.234	0.931

Interaction

- No interaction effect between main factors.

Nematicide

- No main factor effect of nematicide application.

Factor	Level	Gall Index (0-10)
Nematicide	NTC	0.13
	AgLogic	0.09
	BioST	0.03
	Copeo	0.09
	Velum	0.09
Variety	DP1646	0.16 a
	DP2141	0.01 b
P-value	Nematicide	0.922
	Variety	0.027
	Interaction	0.963

Variety

- Mid-season and harvest root-knot nematode population densities were higher on DP1646 than DP2141.
- Root galling was greater on DP1646 than DP2141.

Influence on Emergence and Plant Growth

		Stand Count (plants/A)	
Factor	Level	14 DAP	28 DAP
Nematicide	NTC	18,276 a	18,276 a
	AgLogic	15,942 ab	15,942 ab
	BioST	15,819 b	15,819 b
	Copeo	18,521 ab	18,521 ab
	Velum	16,802 ab	16,802 ab
Variety	DP1646	16,831	16,831
	DP2141	17,313	17,313
P-value	Nematicide	0.030	0.030
	Variety	0.462	0.462
	Interaction	0.846	0.846

Factor	Level	Canopy Coverage (%)
Nematicide	NTC	35.9
	AgLogic	39.0
	BioST	36.5
	Copeo	39.2
	Velum	36.8
Variety	DP1646	32.3 b
	DP2141	42.6 a
P-value	Nematicide	0.505
	Variety	<0.001
	Interaction	0.963

Interaction

- No interaction effect between main factors.

Nematicide

- BioST reduced stand count at 14 and 28 DAP relative to the control

Variety

- Mid-season canopy coverage was greater for DP2141 than DP1646.

Influence on Seed Cotton Yield

Factor	Level	Seed Cotton (lb/A)
Nematicide	NTC	3,874
	AgLogic	3,820
	BioST	3,790
	Copeo	3,763
	Velum	3,830
Variety	DP1646	3,789
	DP2141	3,841
P-value	Nematicide	0.996
	Variety	0.763
	Interaction	0.650

Interaction

- No interaction effect between main factors.

Nematicide

- No main factor effect of nematicide application.

Variety

- No main factor effect of variety choice.

Summary

Nematicides

- No significant effect on reniform populations
- BioST seed coat decreased root-knot populations
- BioST seed coat treatment reduced cotton stand count
  - Phytotoxicity issues?

Resistant Variety

- No significant effect on reniform nematode populations
- DP2141 reduced root-knot nematode soil population densities and root galling
  - Confirmed root-knot nematode suppression in low–moderate pressure
- DP2141 had greater mid-season canopy coverage, but did not have a higher yield relative to DP1646

Cover Crop x Host Resistance Microplot Trial 2021

Objective 1

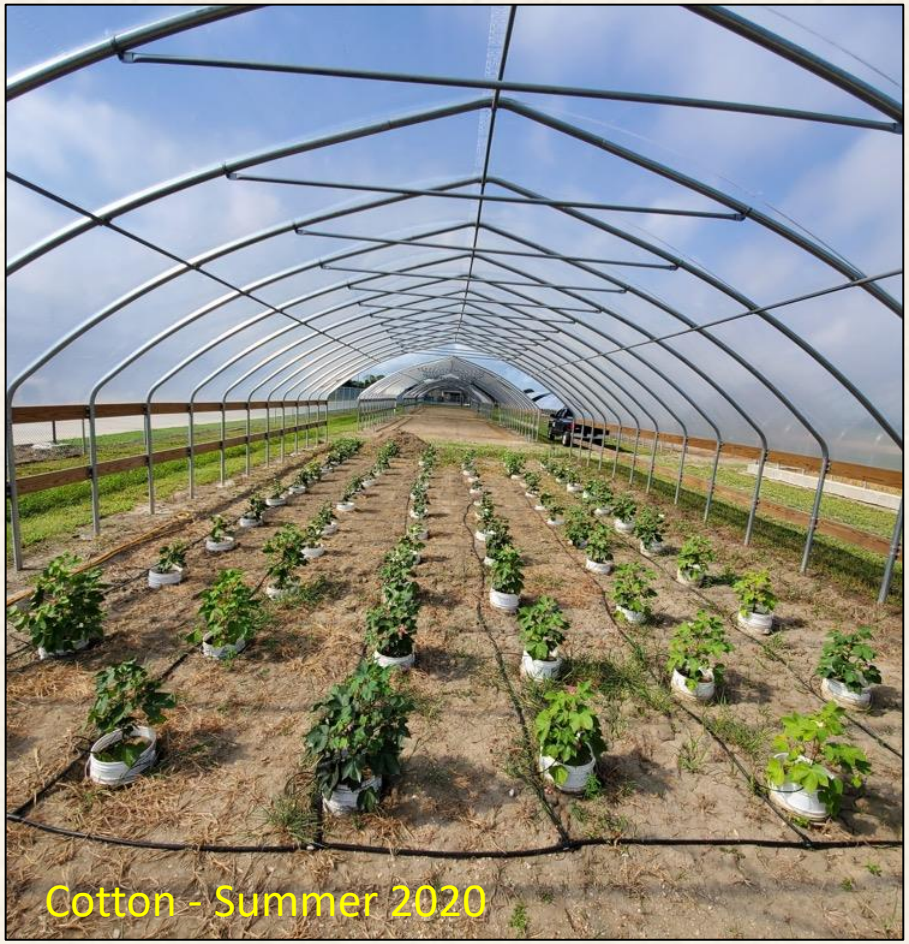
- Monitor reniform nematode population development in soil cropped under 12 different cropping sequences

Objective 2

- Evaluate the impact of each cropping sequence on soil nutrition and estimated lint yield

Nematology Microplots

- Constructed in March 2020



- Reniform Nematode Inoculation:

  May 2020

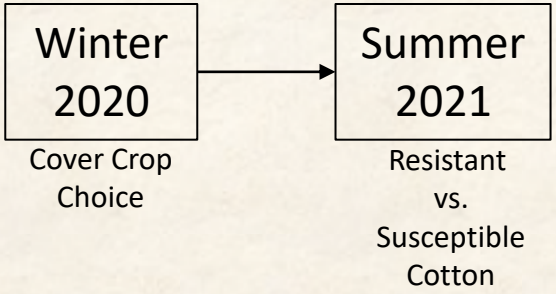
  - 20,000 nematodes/pot

- Planted with susceptible cotton (May 2020)

  September 2020

  - 93,000 nematodes/pot

12 Cropping Sequences



Crop Sequence	Replicates	Winter 2020	Summer 2021
1	6	Fallow	Deltapine 1646
2	6	Winter Wheat	Deltapine 1646
3	6	Winter Rye	Deltapine 1646
4	6	Hairy Vetch	Deltapine 1646
5	6	Crimson Clover	Deltapine 1646
6	6	Austrian Winter Pea	Deltapine 1646
7	6	Fallow	Deltapine 2141NR
8	6	Winter Wheat	Deltapine 2141NR
9	6	Winter Rye	Deltapine 2141NR
10	6	Hairy Vetch	Deltapine 2141NR
11	6	Crimson Clover	Deltapine 2141NR
12	6	Austrian Winter Pea	Deltapine 2141NR

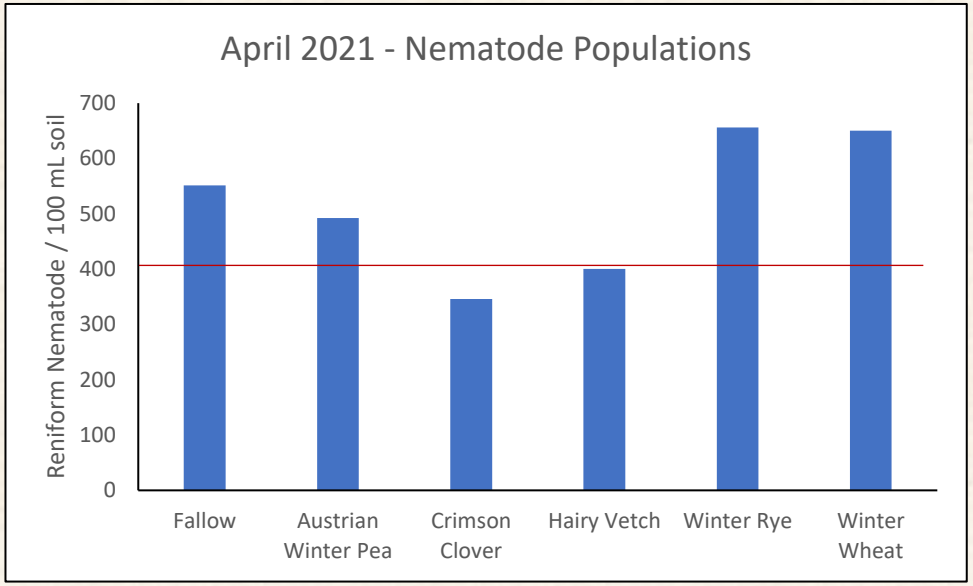
Cover Crop Treatments:

- Fallow
- Winter Wheat (120 lb/A)
- Winter Rye (40 lb/A)
- Hairy Vetch (30 lb/A)
- Crimson Clover (30 lb/A)
- Austrian Winter Pea (75 lb/A)

Variety Treatments:

- DP 1646 (susceptible)
- DP 2141NR (resistant)

Impact of Winter Cover Crops

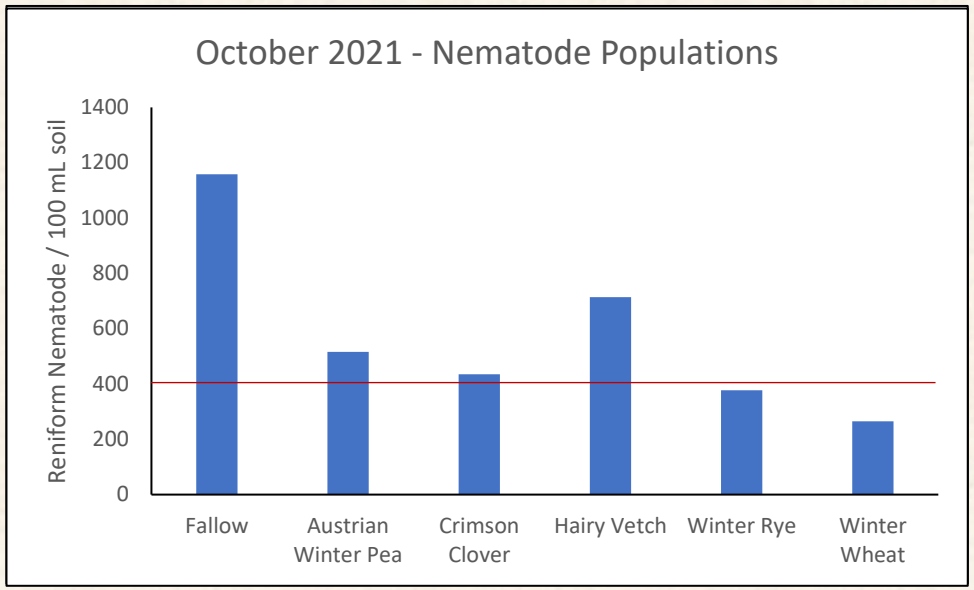


P-value = 0.382; n=12

Before Planting Cotton

- No significant impact of winter cover crop

Impact of Winter Cover Crops

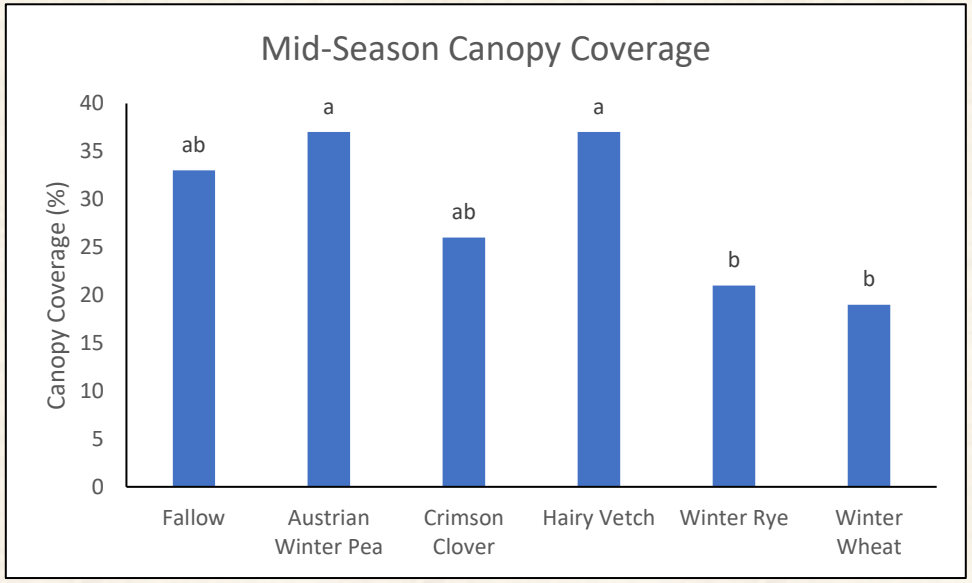


P-value = 0.204; n=12

After Planting Cotton

- No significant impact of winter cover crop

Impact of Winter Cover Crops

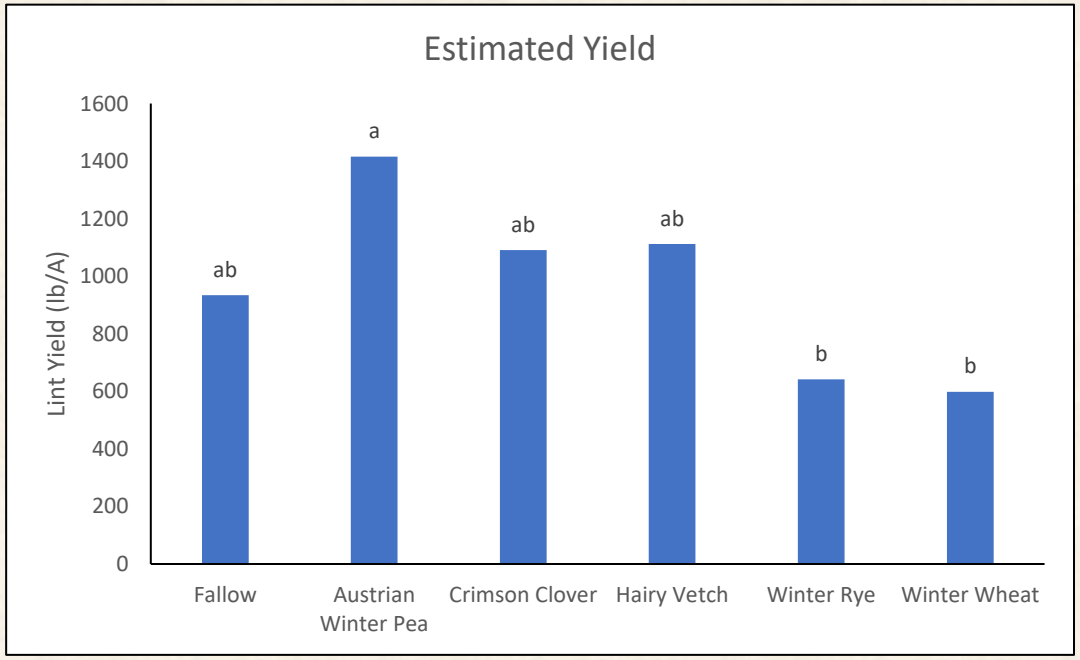


Canopy Coverage

- Austrian Winter Pea and Hairy Vetch increased canopy coverage relative to Winter Rye or Winter Wheat

Canopeo Image Analysis

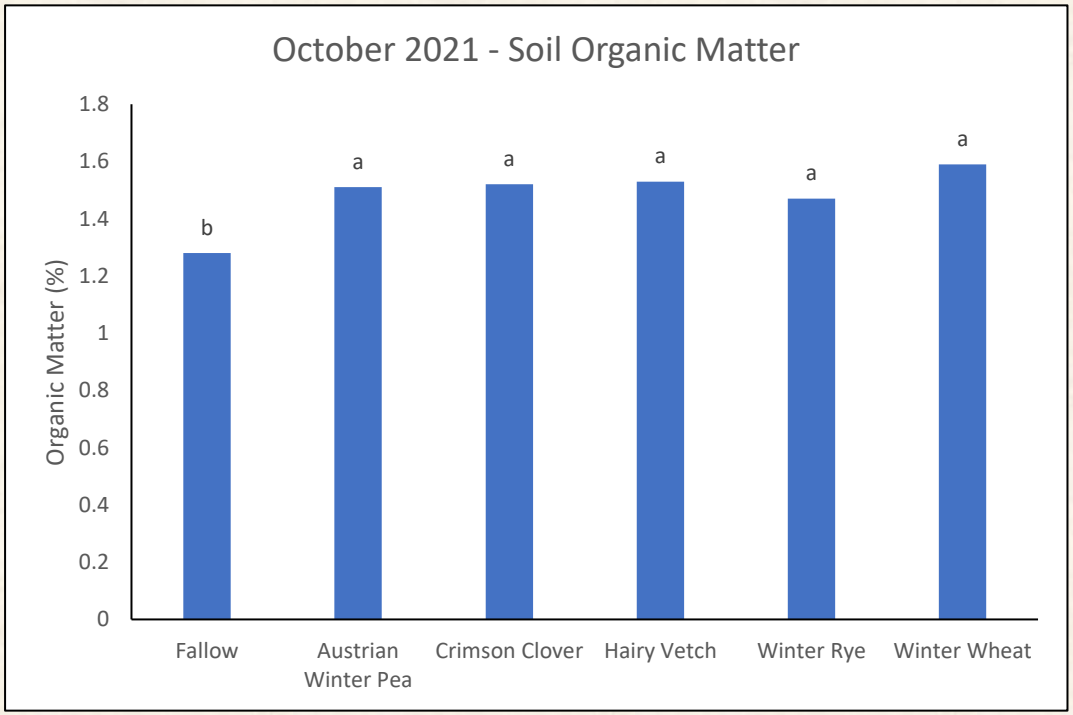
Impact of Winter Cover Crops



Cotton Harvest

- Austrian Winter Pea increased yield relative to Winter Rye and Winter Wheat

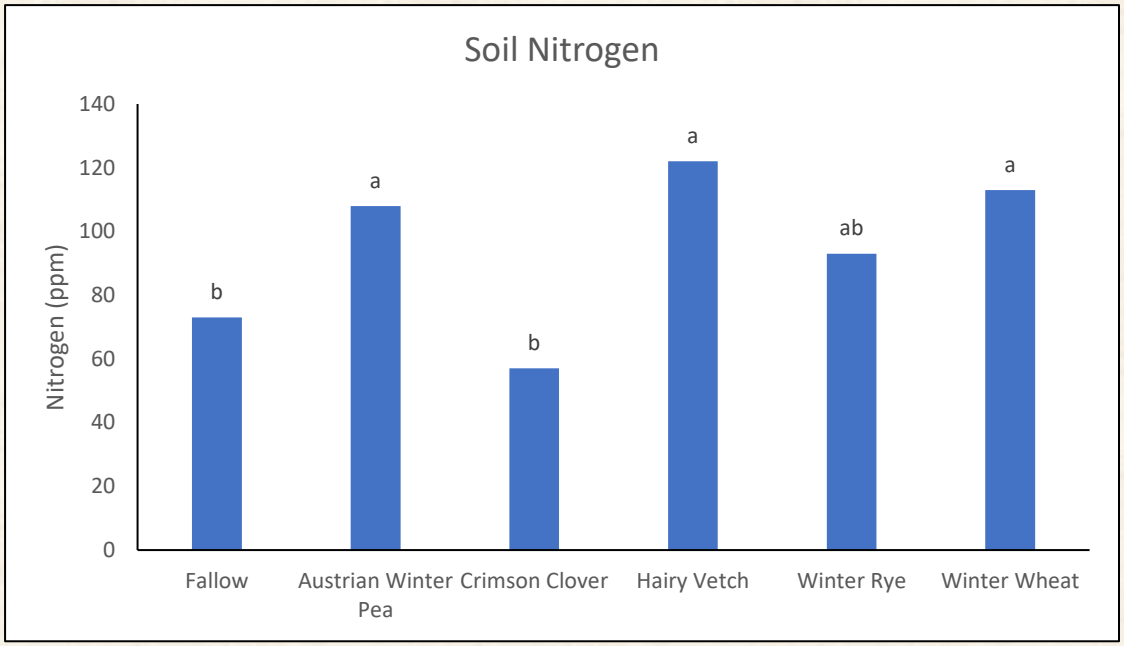
Impact of Winter Cover Crops



Soil Organic Matter

- All cover crops improved soil organic matter content

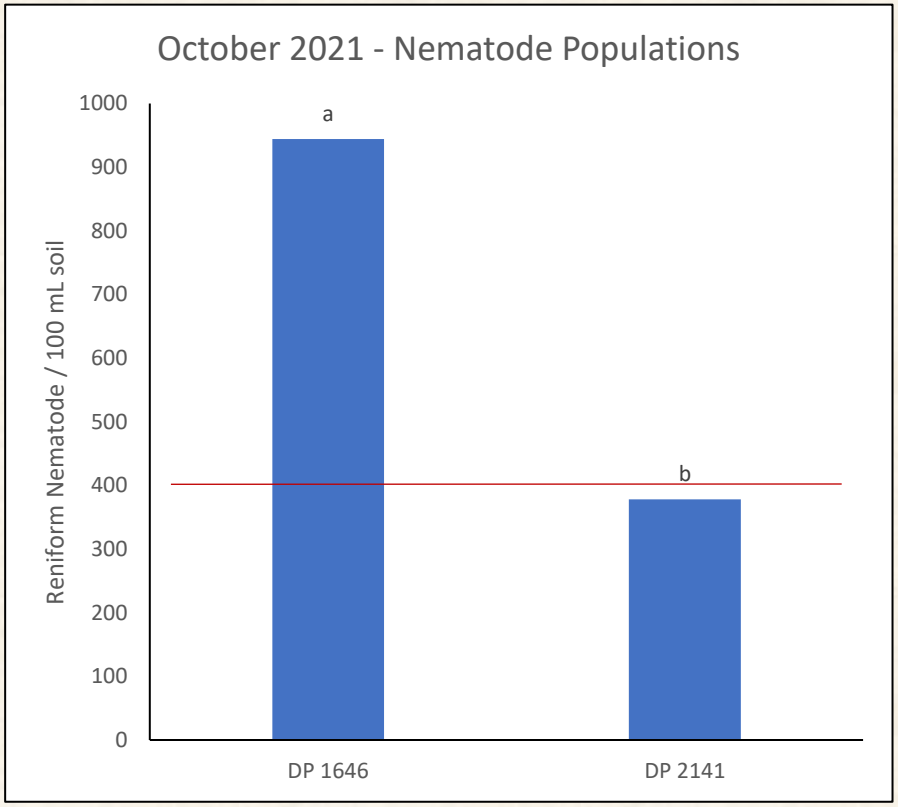
Impact of Winter Cover Crops



Soil Nitrogen Content

- Most cover crops increased soil N content

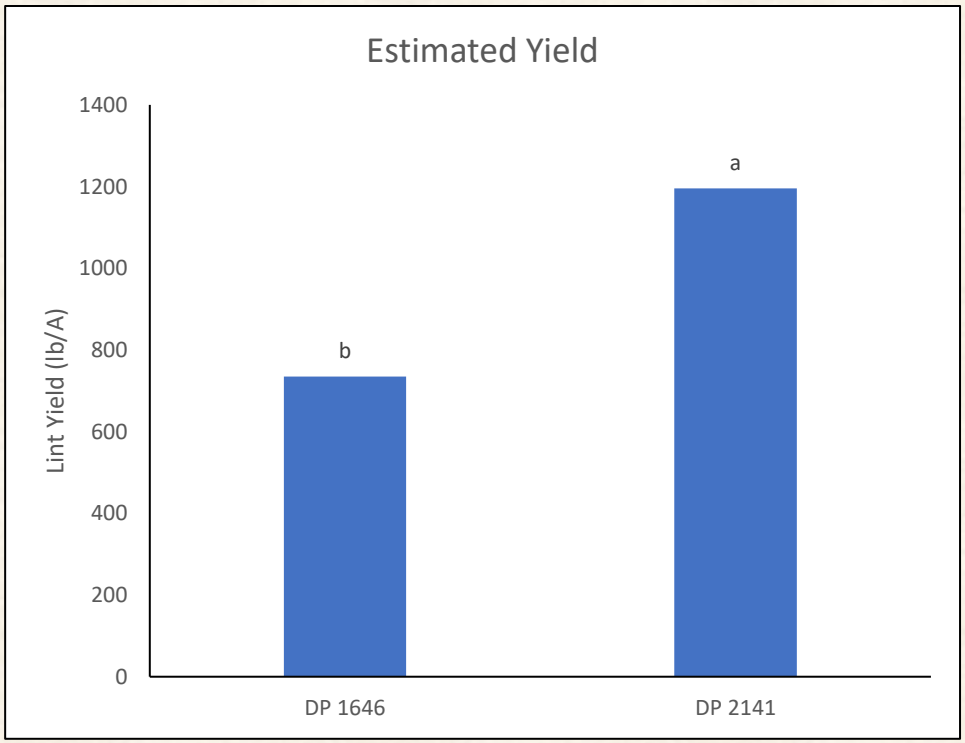
Impact of Resistant Cotton Variety



Reniform Nematode Populations

- Deltapine 2141NR maintained reniform nematode populations below the damage threshold

Impact of Resistant Cotton Variety



Estimated Lint Yield

- Deltapine 2141NR resulted in a 63% increase in lint yield

Top Performing Cropping Sequences

Crop Sequence 10

- Hairy Vetch winter cover followed by Deltapine 2141NR
  - 83 reniform nematodes per 100 mL soil (October 2021)
  - 1,813 lb lint per acre

Crop Sequence 12

- Austrian Winter Pea followed by Deltapine 2141NR
  - 223 reniform nematodes per 100 mL soil (October 2021)
  - 1,516 lb lint per acre

Summary

Winter Cover Crops

- No significant effect on reniform nematode populations prior to planting cotton
- Winter wheat and winter rye reduced cotton growth and yield
- Legumous cover crops increased cotton yield
  - Not solely related to enhanced N content

Resistant Cotton Varieties

- DP 2141NR suppressed reniform nematode populations
- DP 2141NR enhanced cotton yield relative to DP1646

Planting a legume winter cover crop followed by DP 2141NR provided the best lint yield and reniform nematode suppression

Acknowledgements

Watson Lab Team:

Dr. Josie Rezende (Research Associate)
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Caleb Hamm (MS student)
Iris Aguilar (MS student)
David Bonilla (Intern)
Michelle Gremillion (Undergrad)

Northeast Research Station:

Warren Ratcliff
Denis Burns
Farm crew members

Questions?