BENEFITS OF MIX COVER CROPPING ON SOIL HEALTH

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A FARMER'S FAVORITE COCKTAIL

MAY NOT BE WHAT YOU THINK.

INNOVATIVE FARMERS ARE BREATHING NEW LIFE INTO THEIR SOIL BY SEEDING A "COCKTAIL MIX" OF 6-12 PLANTS TO GET DIVERSITY ABOVE-GROUND, WHICH CREATES MUCH-NEEDED DIVERSITY BELOW THE GROUND. THROUGH THAT DIVERSITY, FARMERS ARE MIMICKING THE SOIL-BUILDING AND MICROBIAL-FRIENDLY CONDITIONS OF THE DIVERSE NATIVE PRAIRIES.

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MIX PLANTING LEGUME AND GRAIN COVER CROPS

When the N levels are high, the grass will dominate and when N levels are low, the legume will dominate the mixtures.

This can be an effective management tool to reduce leaching while making the N more available to the next crop.

Benefits of mixing high and low C: N cover crops

Low C: N	High C: N
• Stimulate bacteria decomposition.	• Stimulate fungal decomposition.
• Abundance of free-living (FL) nematodes will peak in 2 weeks.	• Abundance of FL nematodes remain high over time.
• Quick nutrient mineralization, might cause nutrient leach.	• Slow mineralization rate.
• Result in N-enriched conditions, but not for long.	• Result in N tying up condition initially.
• Replenish the rapidly decomposing organic matter, but provide negligible effect on humus.	• Replenish organic matter lost after cultivation.
✓ • Enhance parasitic nematode-trapping fungi (NTF)	✓ • Enhance saprophytic nematode-trapping fungi.

QUESTIONS TO BE ADDRESSED

- Does mix planting of leguminous and graminaceous cover crops increased abundance of free-living nematodes better than each planted alone?
- Does mix planting of these cover crops increased abundance of NTF better than each planted alone?


Crimson clover + rye mix

Maturity (MI), Enrichment (EI), and channel (CI) index of nematodes found in no-till corn grown under 4 management practices in Beltsville, MD.

Treatment	Indices		
	MI	EI	CI
Check (BG)	2.25 ± 0.04 a	48.4 ± 0.2 b	70.6 ± 2.6 a
Crimson clover	2.18 ± 0.09 ab	56.6 ± 5.9 ab	62.2 ± 13.7 a
Rye (R)	2.07 ± 0.05 b	63.4 ± 5.4 a	48.4 ± 12.8 a
Rye/CC mix	2.06 ± 0.08 b	65.0 ± 4.6 a	42.9 ± 9.7 a

Lease square means (n=4) over 4 sampling dates analyzed by Proc Mixed (SAS Inc).

- Mix planting of cover crop (CC) did not affect nematode community indices as compared to each CC planted alone.
- Usually one CC predominate it's effect on nematode communities.

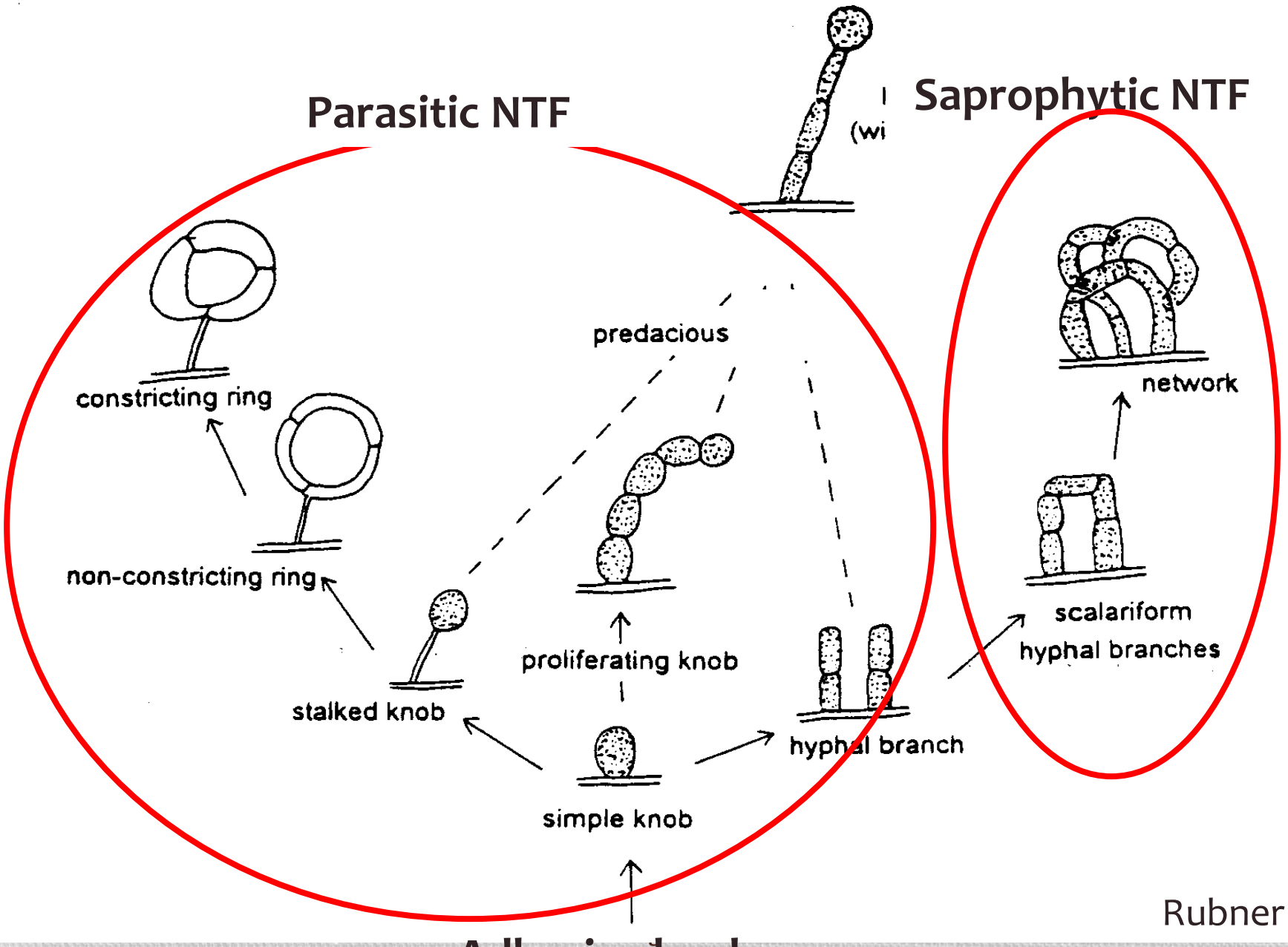
QUESTIONS TO BE ADDRESSED

- Does mix planting of leguminous and graminaceous cover crops increased abundance of free-living nematodes better than each planted alone?

  Not really, dominated by rye.

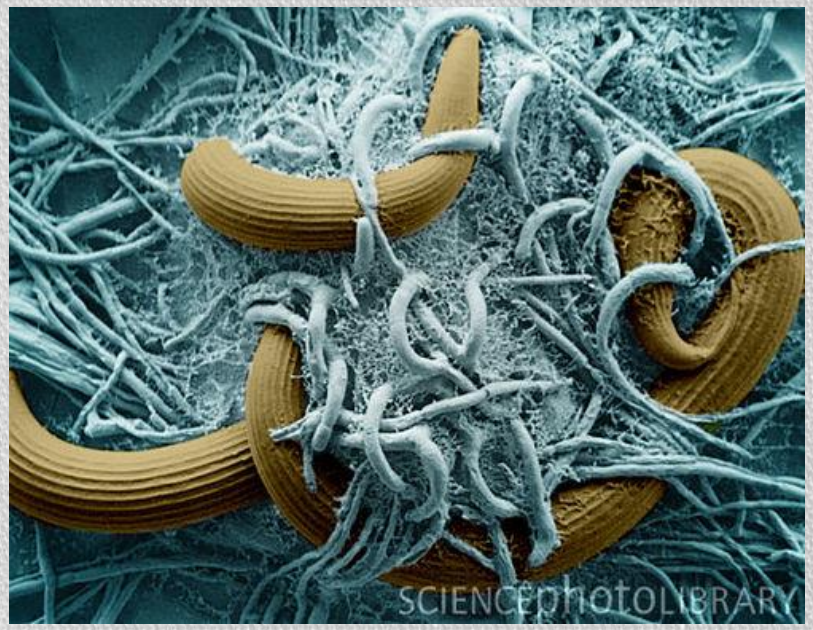
- ✓ Does mix planting of these cover crops increased abundance of NTF better than each planted alone?

Two Ecological Groups of NTF



Rubner

Saprophytic NTF



Arthrobotrys oligospora
Close-up of hyphae with adhesive matrix

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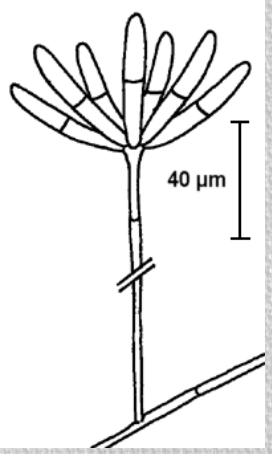
- Most common NTF.
- Rapid growth.
- Catch small and large nematodes.
- Mainly saprophytes.
- Do not form trap spontaneously.
- Produce toxin.
- Sensitive to fungistasis.

Adhesive Nets

Dactylaria eudermata
hyphae with adhesive matrix

Spindle shape conidium on a conidiophore

Parasitic NTF




Picture: Wang, K-H.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Arthrobotrys dactyloides

- Most sophisticated NTF.
- 3-cell ring on short stalk.
- As nematode moves into the ring, the 3 cells swell, and pinch the nematode.
- Catch medium size nematodes.
- Ring closure is triggered from inside edge of the ring.
- Form traps spontaneously.
- Conidia form traps under fungistatic condition.

Enhancing NTF using Cover Crops With different C: N ratios

2. Oat
High C:N
Saprophytic NTF

1. Sunn hemp
Low C:N
Parasitic NTF

3. mix SH and Oat
4. No cover crop

- No-till Cropping system (reduce disturbance to fungal hyphae)
- Intercropping eggplant with alternate rows of cover crop.
- Take soil samples at 2-month interval for 10 months.

Materials and Methods

SH=Sunn hemp (30 lb/acre)

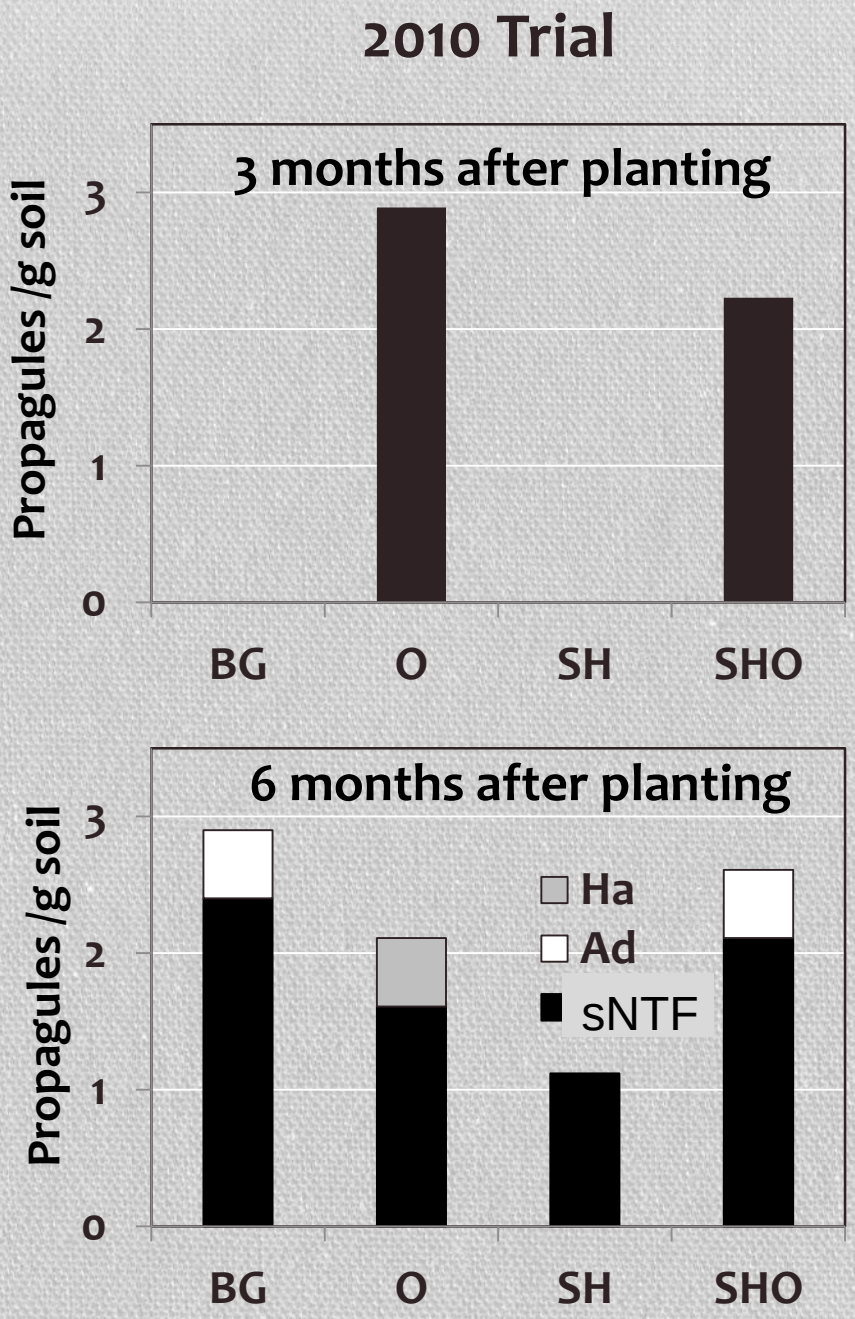
O='TAMU#5' Oat (60 lb/acre)

SHO=SH+O (15+30 lb/acre)

BG = Bare Ground

Quantify NTF

- Quantify NTF by soil serial dilution method (0.05, 0.005, & 0.0005 with 5 replication plates) on CMA/4.
- Examined at 3 weeks after plating, use Most Probably no. method to estimate cfu/g soil.
- Soil plating method recovered very few to almost no NTF.
- No significant difference detected.
- Mix planting of CC did not benefit the enhancement of NTF?



Ha = *Harposporium anguillulae*

Ad = *Arthrobotrys dactyloides*

Modification of NTF Quantification

- Although they are not plant parasites, many NTFs turn out to be root colonizers.

Soil from field plots

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Cowpea bioassay (10 wk)

Direct root assay from field

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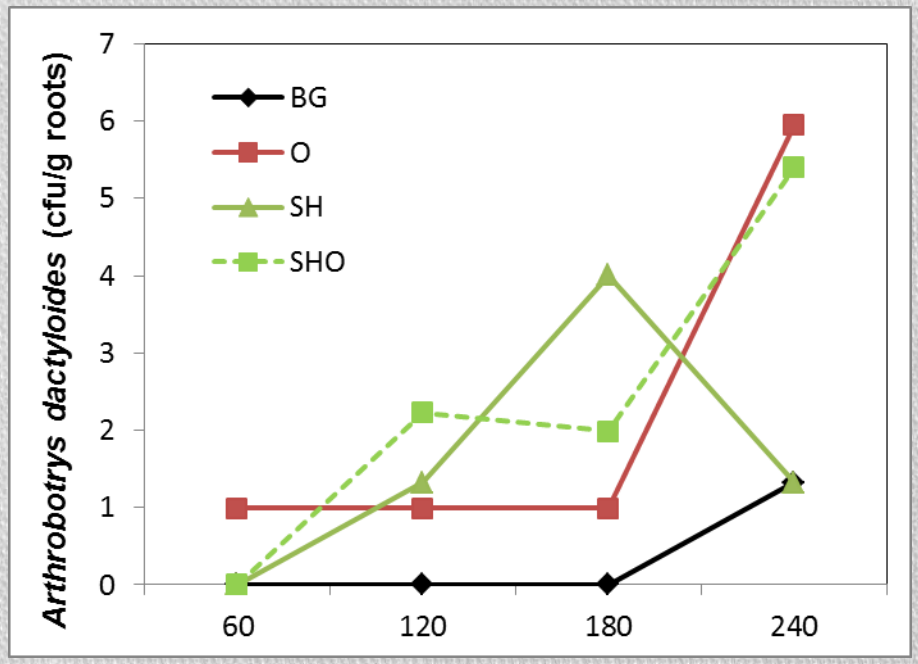
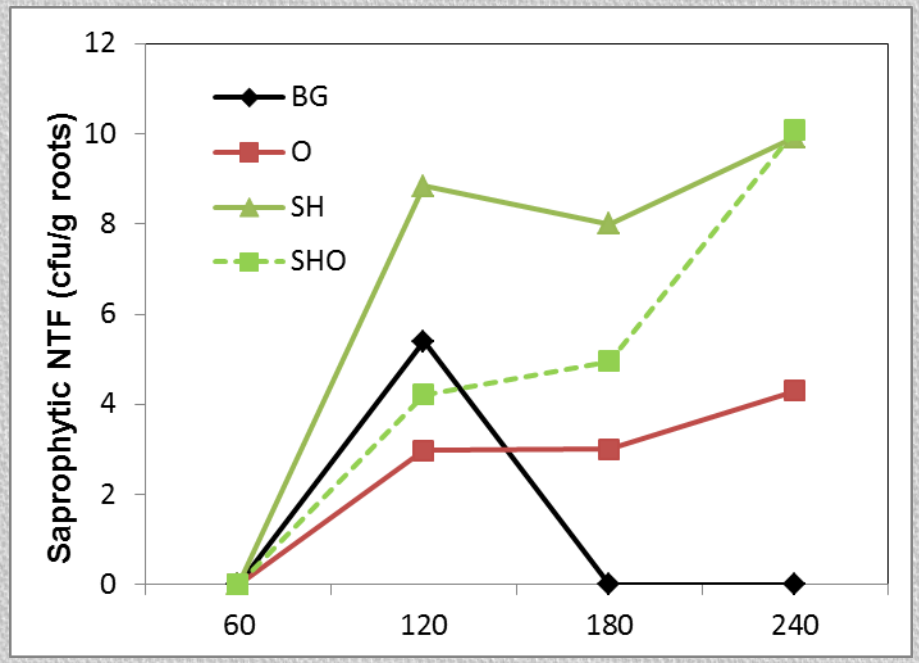
Root dilution plating on CMA/4

Root Bioassay for NTF



- Higher recovery rate of NTF than soil serial dilution plating used in 2010.

- SH or SHO increased Ad cfu faster than O alone.
- Mixing SH+O resulted in longer enhancement of NTF.
- Both CC increased NTF compared to the BG.



Repeated Measure of NTF using Root Bioassay

	pNTF	sNTF	Total NTF
SH	1.66	6.69	8.36
SHO	2.40	4.81	7.22
O	2.23	2.56	4.81
BG	0.33	1.32	1.66
Contrast analysis			
SH vs no SH	0.328	0.016 *	0.016 *
O vs no O	0.102	0.808	0.532
CC vs no CC	0.063 @	0.048 *	0.018 *

Lease square means (n=4) over 4 sampling dates analyzed by Proc Mixed (SAS Inc).

Sunn hemp cover crop enhanced NTF especially population densities of the sNTF, but not oat. Planting cover crop (CC) enhanced NTF better than the BG control.

QUESTIONS TO BE ADDRESSED

- Does mix planting of leguminous and graminaceous cover crops increased abundance of free-living nematodes better than each planted alone?
- Does mix planting of these cover crops increased abundance of NTF better than each planted alone?

  Not really, dominated by SH.

- ✓ Did NTF contribute to the suppression of PPN?

Pearson Correlation between nematode abundance and Nematode-Trapping Fungi (NTF)

	Ad	sNTF	TotalNTF
reni	-0.152	-0.024	-0.085
	0.259	0.854	0.521
root-knot	0.425	0.332	0.441
	0.001	0.010	0.001
fungi	-0.237	-0.165	-0.231
	0.071	0.211	0.079
herb	0.182	0.214	0.244
	0.169	0.104	0.063
TotalNTF	0.685	0.91	1
	<0.0001	<0.0001	

Ad=*Arthrobotrys dactyloides*, sNTF=Saprophytic NTF

- Abundance of NTF was density dependent on root-knot nematodes.
- Abundance of NTF was negatively correlated with that of fungivorous nematodes, indicating that these nematodes might be feeding on the Ad.
- Both pNTF and sNTF play roles in the relationship between PPN and NTF.

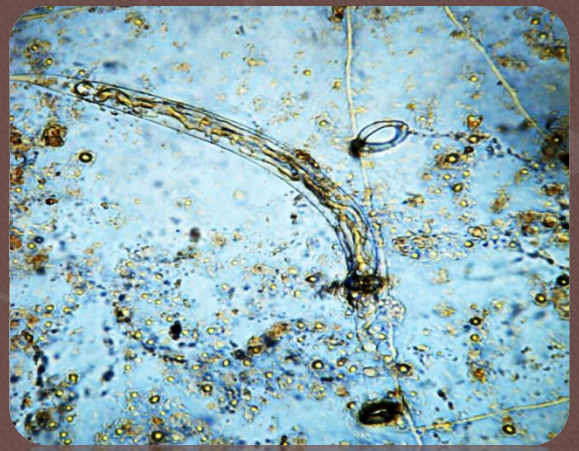
Summary

- Does mix planting of leguminous and graminaceous cover crops increased abundance of free-living nematodes better than each planted alone?
- Does mix planting of these cover crops increased abundance of NTF better than each planted alone?
- Did NTF contribute to the suppression of PPN?

Not really. It is density dependent on the number of root-knot nematodes.

Should we continue to promote mix cover crop planting?

Probably so, due to many other soil health benefits……..



Arthrobotrys dactyloides

Take Home Message

- Root bioassay provided better detection of NTF than the soil dilution method.
- Successful detection of NTF using root assays also suggested that NTF was abundant in the root zone.
- Mix planting of SH+O did not enhance more NTF than SH alone.