

Balancing Nematodes and Cover Crop Management

Session: Vegetables

Wednesday December 6th 2022; 9:00-9:30 a.m.

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Background: Balancing management of herbivore (plant-parasitic [PPN] or harmful) and beneficial (bacterivores, fungivores, predators and omnivores) nematodes and the benefits of diverse cropping systems (main, cover and rotation crops) in improving soil health is truly a catch 22 scenario. There is considerable information that shows effects of diverse cropping systems on soil health and nematodes, and PPN on the crops, albeit this information exists in disciplinary silos. Moreover, coexistence of multi-taxa, broad host range of most PPN and lack of resistance in either main, cover and/or rotation crops, and highly variable production soils further complicate integrated management of nematodes and cropping systems as well as growers' and stakeholders' decision-making practices. As part of overcoming some of these challenges, we developed an MSU Extension Bulletin E3457

(<https://www.canr.msu.edu/resources/managing-nematodes-cover-crops-and-soil-health-in-diverse-cropping-systems>).

to serve as a source of integrated information This bulletin represents a paradigm shift in managing nematodes, soil health and cover crops and cropping systems. This presentation focuses on 5 points.

First, improving accuracy of detecting nematodes.

Second, knowing what PPN species are in your fields (**Table 1 A**).

Third, considering if your main, cover and rotation crops are resistant, tolerant or susceptible to the PPN.

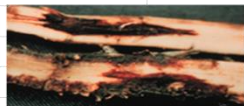
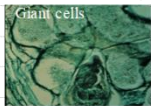

Fourth, understanding the biology of the PPN (**Table 1 B-D**). Life cycle of PPN includes an egg, four juvenile (J 1, J 2, J 3 and J 4) stages and an adult stage (**Fig. 1**). In most cases, the first molt occurs within the egg and the J 2 emerges to infect plants.

PPN parasitize plants as ectoparasites (partially embedded) and endoparasites (fully embedded) as migratory or sedentary as in the cyst- and non-cyst forming types (**Table 1B**). The ecto- and migratory endo-parasites kill host cells and move on to the next one while the sedentary types modify host cells as to be nutrient sinks (**Table 1C**). *Sedentary nematodes (green acronyms) are sitting ducks for trap cropping*.

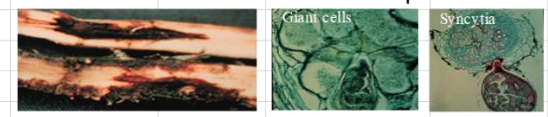
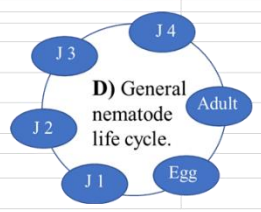
Fifth, designing cropping system to exploit the biology of the PPN (**Table 2**). For example, *sedentary nematodes (green acronyms in Tables 1 and shades in Table 2) are sitting ducks for disrupting their life cycle with trap cropping after J2s establish feeding sites and before adults reach egg-laying stage*. There will be a brief demonstration on how to populate the empty space in Table 2.

Table 1. Plant-parasitic nematodes of economic significance in the US Midwest (A) and how they parasitize (B) and cause cellular damage (C) to disrupt water and nutrient uptake and limit plant growth and crop yield over their life cycle (D).

A) Name		B) Modes of parasitism			
		Ectoparasites	Endoparasites		
			Migratory	Sedentary	
Common	Genus/species		Non-cyst forming	Cyst forming	
Dagger (DN)	<i>Xiphinema</i> spp.	X			
Needle (NN)	<i>Longidorus</i> spp.	X			
Pin (PN)	<i>Paratylenchus</i> spp.	X			
Sheath (SHN)	<i>Hemicyclophora</i> spp.	X			
Spiral (SPN)	<i>Helicotylenchus</i> spp.	X			
Stem and foliar (STFN)	<i>Ditylenchus</i> spp.	X			
Stubby root (SRN)	<i>Trichodorus</i> spp.	X			
Stunt (STN)	<i>Tylenchorhynchus</i> spp.	X			
Root lesion (RLN)	<i>Pratylenchus</i> spp.		X		
False root-knot (FRKN)	<i>Nacobbus batatiformis</i>			X	
Northern root-knot (NRKN)	<i>Meloidogyne hapla</i>			X	
Carrot cyst (CaCN)	<i>Heterodera carotae</i>				X
Clover cyst (CLCN)	<i>H. trifolii</i>				X
Hop cyst (HCN)	<i>H. humuli</i>				X
Soybean cyst (SCN)	<i>H. glycines</i>				X
Sugar beet cyst (SBCN)	<i>H. shechitti</i>				X

C) Modes of host cell damage		
		
Destructive (cells leak and die)	Modified (cells become sinks)	

D) General nematode life cycle.				
J 3	J 4	Adult	Egg	J 1
J 2				



C) Modes of host cell damage

sedentary nematodes (green acronyms in Tables 1 and shades in Table 2) are sitting ducks for disrupting their life cycle with trap cropping after J2s establish feeding sites and before adults reach egg-laying stage. There will be a brief demonstration on how to populate the empty space in Table 2.

Table 2: Partial list of the crops, cover crops and PPN present in the US Midwest. Acronyms and nematodes are grouped as mobile (don't care if host cell dies) and sedentary (will die if host cell dies) as shown in Table 1. Green-shaded nematodes are those where trap cropping will be most effective to disrupt their life cycle. Up-to-date information on nematodes and host crops can be accessed on the web sites below.

Crop groups		Scientific name	Nematodes and their mobility															
			Mobile							Sedentary								
			D	N	P	S	S	S	S	S	R	N	F	C	C	H	S	S
			N	N	N	P	H	T	T	R	L	R	R	a	L	C	C	B
						N	N	N	F	N	N	K	K	C	C	N	N	C
									N			N	N	N	N			N
Cereals	Annual/Perennial rye grass	<i>Lolium multiflorum</i>																
	Corn	<i>Zea mays</i>																
	Pearl millet	<i>Pennisetum glaucum</i>																
	Sorghum-Sudangrass	<i>Sorghum bicolor</i> x <i>Sorghum bicolor</i> var. Sudanese																
	Spring/winter barley	<i>Hordeum vulgare</i>																
	Spring/winter oats	<i>Avena sativa</i>																
	Spring/winter wheat	<i>Triticum aestivum</i>																
	Spring/winter triticale	<i>Triticum</i> x <i>Secale</i>																
Winter rye	<i>Secale cereal</i>																	
Legumes	Alfalfa	<i>Medicago sativa</i>																
	Berseem clover	<i>Trifolium alexandrinum</i>																
	Crimson clover	<i>Trifolium incarnatum</i>																
	Red clover	<i>Trifolium pretense</i>																
	Sweet clover	<i>Melilotus</i> spp.																
	Dry beans	<i>Phaseolus vulgaris</i>																
	Hairy vetch	<i>Vicia villosa</i>																
	Soybean	<i>Glycine max</i>																
	Sunn Hemp	<i>Crotalaria juncea</i>																
Brassicac	Kale	<i>Brassica napus</i> var. <i>pabularia</i>																
	Mustard	<i>Brassica</i> spp.																
	Oil seed radish	<i>Raphanus sativus</i>																
	Rape seed/Canola	<i>Brassica napus</i>																
	Field pennycress	<i>Thlaspi arvense</i>																
	Turnip (forage type)	<i>Brassica rapa</i>																
Winter camelina	<i>Camelina sativa</i>																	
Root/ tuber	Carrot	<i>Daucus carota</i>																
	Potato	<i>Solanum tuberosum</i>																
	Sugar beet	<i>Beta vulgaris</i>																
Vegetables	Asparagus	<i>Asparagus officinalis</i>																
	Arugula	<i>Eruca vesicaria</i>																
	Cabbage	<i>Brassica oleracea</i>																
	Celery	<i>Apium graveolens</i>																
	Lettuce	<i>Lactuca sativa</i>																
	Onion	<i>Allium cepa</i>																
	Pumpkin	<i>Cucurbita pepo</i>																
	Tomato	<i>Solanum lycopersicum</i>																

<http://mccc.msu.edu/covercroptool/covercroptool.php>; https://www.canr.msu.edu/cover_crops/species/;
<http://nemalex.ucdavis.edu/IndexFiles/common%20names.html>; <https://extension.umn.edu/soil-and-water/cover-crops>.

More details about the contents of this presentation and associated references can be found in this link (<https://www.canr.msu.edu/resources/managing-nematodes-cover-crops-and-soil-health-in-diverse-cropping-systems>).