Impact of Weeds on Nematode Management

Edward P. Caswell-Chen, Department of Nematology, University of California, Davis, CA 95616

Plant-parasitic nematode management in both annual and perennial cropping systems may involve the manipulation of crop cultivars and the management of in-field vegetation to minimize pest and pathogen problems. The status of plant as hosts for plant-parasitic nematodes can be manipulated. Depending on the particular nematode species that are present in a field and are the target of control efforts, it may be possible to reduce nematode numbers through cultivar selection, crop rotation to non-hosts, cover cropping, or fallow periods. The need to implement nematode control tactics depends on the nematode density in the field. If the nematode density is greater than the damage threshold for the primary crop, control tactics are usually deemed necessary.

Plant-parasitic nematodes are obligate parasites, and require host plants to complete their life cycles. Rotations to non-hosts can reduce nematode numbers by enhancing nematode population decline through the natural mortality that occurs in the absence of host. The anticipated rate of population decline is used to anticipate the length of rotation period. For example, rotation to nonhost plants for two-to-three years is effective in reducing numbers of sugarbeet cyst nematode, although the exact duration of the rotation depends on the nematode density in the field.

Poor weed management results in weeds remaining in the field, and those weeds may support substantial nematode reproduction. Weeds that support nematode development and reproduction negate the nematode suppressive effect of rotations to nonhosts or resistant host plants. The result is that the nematode population decline is less than anticipated, so that damage to the subsequent crop occurs despite the use of control tactics to reduce nematode numbers.

Weeds are good hosts for many nematode species (see the table). A host plant-nematode database called NEMABASE has been developed at the Nematology Department, University of California, Davis (Caswell-Chen et al., 1995). The database includes information obtained from the published literature, on the host status of plants to plant-parasitic nematodes, and the database currently includes approximately 32,382 records. NEMABASE can be used via the UCD Dept. of Nematology WWW homepage to determine the host status of some weeds to nematodes: (http://ucdnema.ucdavis.edu/imagemap/nemmap/ent156html/contents).

In my lab, we have examined the effect of Northern California weed species on hatch, penetration, development and reproduction of the sugarbeet cyst nematode, Heterodera schachtii, under growth chamber, greenhouse and microplot conditions (Bloom, 1997). Weed species were local collections of Sinapis arvensis, Raphanus raphinastrum, Capsella bursapastoris, Chenopodium album, Amaranthus retroflexus, Solanum nigrum, and Portulaca oleracea. Brassica oleracea and Beta vulgaris were included as known good hosts, and Medicago sativa was included as a known poor host. Egg hatch from cysts was stimulated by root diffusates of the weed S. arvensis. Second-stage juveniles of H. schachtii penetrated the
roots of all weeds in the experiments. Greater numbers of swollen juveniles and a higher ratio of swollen to vermiform juveniles were observed in roots of *B. vulgaris* and weeds *S. arvensis* and *R. raphanistrum* as compared to the other weed species. Greater numbers of cysts and eggs were recovered from *S. arvensis*, *R. raphanistrum*, *C. bursa pastoris* than other weed species. By comparing egg production on weeds to egg production on *B. vulgaris*, a relative reproductive index indicated that *S. arvensis* was a good host, *R. raphanistrum* and *C. bursa pastoris* were intermediate hosts, and *C. album*, *A. retroflexus*, *S. nigrum* and *P. oleracea* were poor hosts of *H. schachtii*. Our results indicate differential reproduction of *H. schachtii* on weeds, and that certain weeds may promote population increases of *H. schachtii* in fields during the non-host rotations that are the primary means of managing the nematode.

Proper weed management is desirable to prevent unanticipated population increases of plant-parasitic nematodes. Timely weed management is also necessary, because although cultivation will remove weeds, the roots are not immediately killed and they may survive and continue to support nematode development and reproduction after cultivation.

Weed management may be an important component of an integrated approach to nematode management.

**Table. Weeds and their nematode associations as recorded in NEMABASE.**
All the interactions presented here were obtained from the international nematology literature. They represent interactions between particular plant and nematode genotypes, and may not be representative of the interaction for other genotypes (geographic isolates) of the weed or nematode. Additionally, taxonomic designations do change over time and the designations here represent the information recorded in original research publications without correction for subsequent taxonomic refinements. I = immune, S = susceptible, MS = moderately susceptible, R = resistant, Ri=0.47 = the value of the reproductive index (Pf/Pi) as observed by experiment.

*Amaranthus palmeri* (Palmer amaranth)  
*Meloidogyne arenaria* race 2 - MS  
*Meloidogyne incognita* race 3 - MS

*Amaranthus retroflexus* (Redroot pigweed)  
*Punctodera punctata* - I (nonhost)  
*Meloidogyne incognita* - S  
*Heterodera zeae* - I (nonhost)  
*Ditylenchus dipsaci* - I (nonhost)  
*Meloidogyne chitwoodi* race 1 - R, Ri=0.47  
*Meloidogyne hapla* - R, Ri=0.0

*Ambrosia trifida* (Giant ragweed)  
*Meloidogyne incognita* - I (nonhost)

*Arctium minus* (Common burdock)  
*Subanguina picridis* - I (nonhost)

*Asclepias incarnata* (Swamp milkweed)
no records found

*Avena fatua* (Wild oat)
- *Heterodera avenae* - *S*
- *Meloidogyne* spp. - *S*
- *Meloidogyne incognita* - *S*
- *Anguina funesta* - *I* (nonhost)
- *Criconemella rustica* - *S*, *Ri=5.8*
- *Pratylenchus projectus* - *S*, *Ri=66*
- *Punctodera chalcoensis* - *I* (nonhost)
- *Heterodera avenae* - *S*, *Ri=4.4*

*Bellis perennis* (English daisy)
- *Meloidogyne incognita* - *MS*, *Ri=0.231*

*Brassica kaber* (Wild mustard)
no records found

*Brassica nigra* (Black mustard)
- *Meloidogyne arenaria* - *R*
- *Pratylenchus thornei* - *R*
- *Heterodera trifolii* - *S*
- *Ditylenchus dipsaci* - *S*

*Bromus carinatus* (California brome)
no records found

*Bromus catharticus* (Rescuegrass)
no records found

*Calandrinia ciliata* variety *menziesii* (Desert rockpurslane)
no records found

*Capsella bursa-pastoris* (Shepherd's-purse)
- *Meloidogyne incognita* - *S*
- *Xiphinema bakeri* - *R*
- *Heterodera zeae* - *I* (nonhost)
- *Longidorus elongatus* - *MS*
- *Heterodera schachtii* - *MS*
- *Meloidogyne hapla* - *R*, *Ri=0.47*

*Carduus acanthoides* (Plumeless thistle)
no records found

*Centaurea cyanus* (Cornflower)
- *Meloidogyne hapla* - *S*
- *Meloidogyne javanica* - *S*

*Chamaesyce maculata* (Prostrate and spotted spurge)
no records found
Chenopodium berlandieri (Netseed lambsquarters)
no records found

Chenopodium murale (Nettleleaf goosefoot)
no records found

Convolvulus arvensis (Field bindweed)
  Meloidogyne hapla - S
  Heterodera cajani - I (nonhost)
  Subanguina picridis - I (nonhost)
  Ditylenchus dipsaci - S
  Meloidogyne incognita - R

Cyperus esculentus (Yellow nutsedge)
  Meloidogyne incognita - S
  Meloidogyne arenaria - R (2 records)
  Meloidogyne incognita race 3 - R
  Meloidogyne javanica - S
  Heterodera zeae - I (nonhost)
  Criconemella onoensis - R
  Rotylenchulus reniformis – S, Ri=4.55
  Tylenchorhynchus acutus – MS, Ri=2.67
  Helicotylenchus dihystera – S, Ri=7.1

Cyperus rotundus (Purple nutsedge)
  Meloidogyne incognita - S
  Meloidogyne incognita race Acrita - MS
  Meloidogyne javanica - MS
  Meloidogyne graminicola - MR
  Meloidogyne incognita - MR
  Heterodera cajani - I (nonhost)
  Heterodera avenae - I (nonhost)
  Ditylenchus destructor - MR
  Criconemella xenoplax – R, Ri=0.32
  Radopholus similis (race banana) - S (2 records)
  Hoplolaimus colombus - S
  Heterodera mothi - S
  Meloidogyne konaensis – S, Ri=7.4
  Meloidogyne incognita - MS

Daucus carota (Wild carrot)
  213 records found, many different nematode genus

Digitaria sanguinalis (Large crabgrass)
  Meloidogyne naasi race 1 - S
  Meloidogyne naasi race 2 - S
  Meloidogyne naasi race 3 - S
  Meloidogyne naasi race 4 - S
  Meloidogyne naasi race 5 - S
Meloidogyne arenaria race 2 - R
Meloidogyne incognita race 3 - R
Pratylenchus scribneri - S
Heterodera zeae - I (nonhost)
Criconemella rustica - S, Ri=3.8
Pratylenchus projectus - S, Ri=67

Dipsacus fullonum (Common teasel)
Ditylenchus dipsaci - MS
Ditylenchus dipsaci race onion - I (nonhost) (2 records)
Ditylenchus dipsaci race oat - S
Ditylenchus dipsaci race tulip - S
Ditylenchus dipsaci race onion - S
Ditylenchus dipsaci race oat - R
Ditylenchus dipsaci race rye - R
Ditylenchus dipsaci race lucerne - I (nonhost)
Ditylenchus dipsaci race red clover - I (nonhost)
Ditylenchus dipsaci race rye - I (nonhost)
Ditylenchus dipsaci race narcissus - I (nonhost)

Echinochloa crus-galli (Barnyardgrass)
Meloidogyne arenaria race 2 - R
Meloidogyne incognita race 3 - R
Xiphinema bakeri - S
Heterodera zeae - S
Criconemella rustica - S, Ri=4.4
Pratylenchus neglectus - S, Ri=256

Elytrigia repens (Quackgrass)
no records found

Eragrostis cilianensis (Stinkgrass)
Heterodera zeae - I (nonhost)

Epilobium angustifolium (Fireweed)
no records found

Erodium cicutarium (Redstem filaree)
Meloidogyne hapla - R

Euphorbia dentata (Toothed spurge)
no records found

Euphorbia esula (Leafy spurge)
Subanguina pieridis - I (nonhost)

Hibiscus trionum
Meloidogyne javanica - S
Ditylenchus dipsaci race onion - S
Hordeum jubatum (Foxtail barley)
- Meloidogyne incognita - S (2 records)
- Criconemella rustica - S, Ri=5.6
- Pratylenchus projectus - S, Ri=330

Hordeum leporinum (Hare barley)
- Anguina funesta - I (nonhost)
- Heterodera avenae - MR, Ri=0.64

Hypericum perforatum (Common St. Johnswort)
- Subanguina picridis - I (nonhost)

Ipomoea coccinea (Red morningglory)
- no records found

Ipomoea nil (Ivyleaf)
- no records found

Ipomoea purpurea (Tall morningglory)
- Meloidogyne incognita - S

Lamium amplexicaule (Henbit)
- Meloidogyne hapla - MS
- Meloidogyne incognita - S
- Ditylenchus dipsaci race onion - I (nonhost)

Malva neglecta (Common mallow)
- Meloidogyne incognita - S

Medicago lupulina (Black medic)
- Meloidogyne incognita - S
- Meloidogyne hapla - S
- Heterodera cajani - I (nonhost)
- Heterodera trifolii - R
- Heterodera medicaginis - I (nonhost)
- Ditylenchus dipsaci race onion - I (nonhost)

Melilotus officinalis (Yellow sweetclover)
- 21 records found, Heterodera and Meloidogyne

Panicum miliaceum (Wild-proso millet)
- Meloidogyne incognita - S (2 records)
- Heterodera zeae - S
- Criconemella rustica - S, Ri=8.9
- Pratylenchus projectus - MS, Ri=1.4
- Aphelenchoides besseyi - S

Physalis virginiana (Virginia groundcherry)
- no records found
Physalis wrightii (Wright groundcherry)
no records found

Plantago major (Broadleaf plantain)
  Meloidogyne incognita - I (nonhost)
  Xiphinema bakeri - S
  Ditylenchus dipsaci - S

Polygonum aviculare (Prostrate knotweed)
  Pratylenchus penetrans - S
  Meloidoderita sp. - R
  Ditylenchus dipsaci - S
  Ditylenchus dipsaci race onion - I (nonhost)

Polygonum convolvulus (Wild buckwheat)
  Heterodera zeae - I (nonhost)
  Meloidoderita sp. - R
  Meloidogyne hapla – R, Ri=0.53

Portulaca oleracea (Common purslane)
  Meloidogyne arenaria race 2 - MS
  Meloidogyne incognita race 3 - MS
  Meloidogyne hapla - S
  Meloidogyne incognita - S
  Meloidogyne incognita race acrita - S
  Meloidogyne hapla - MS
  Meloidogyne graminicola - S
  Heterodera cajani - I (nonhost)
  Criconemella xenoplax – MS, Ri=1.7
  Helicotylenchus multicinctus - S
  Ditylenchus dipsaci race onion - I (nonhost)
  Meloidogyne hapla - R
  Meloidogyne incognita - MS

Raphanus sativus (Radish)
  94 records found, many different nematode genera

Salsola iberica (Russian thistle)
no records found

Salvia aethiopis (Mediterranean sage)
no records found

Salvia reflexa (Lanceleaf sage)
no records found

Sarcobatus vermiculatus (Greasewood)
no records found

Senecio jacobaea (Tansy ragwort)
Subanguina picridis - I (nonhost)

Sisymbrium irio (London rocket)
  no records found

Silene alba (White campion)
  Heterodera zeae - I (nonhost)

Sonchus oleraceus (Annual sowthistle)
  Meloidogyne hapla - S
  Pratylenchus penetrans - S

Solanum elaeagnifolium (Silverleaf nightshade)
  Ditylenchus phyllobius - S (2 records)
  Globodera tabacum (race solanacearum) - S

Solanum nigrum (Black nightshade)
  21 records found, many nematode genus

Solanum sarrachoides (Hairy nightshade)
  no records found

Sorghum halepense (Johnsongrass)
  Hoplolaimus colombus - S
  Heterodera betulae - I (nonhost)
  Meloidogyne incognita - S
  Meloidogyne javanica - S
  Meloidogyne arenaria - S
  Meloidogyne arenaria race 2 - R
  Meloidogyne incognita race 3 - R
  Heterodera graminiphila - S
  Heterodera zeae - I (nonhost)

Stellaria media (Common chickweed)
  23 records found, many different nematode genera

Taeniatherum caput-medusae (Medusahead)
  no records found

Tanacetum vulgare (Common tansy)
  no records found

Tribulus terrestris (Puncturevine)
  Meloidogyne incognita race acrita - MS
  Pratylenchus scribneri - S

Vicia villosa (Hairy vetch)
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<th>Nematode Species</th>
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<th>Resistance Index (RI)</th>
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References:

