Some Herbaceous Hosts of the Ring Nematode (*Criconemella xenoplax*)

E. I. ZEHR, Professor, S. A. LEWIS, Professor, and M. J. BONNER, Former Research Associate, Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29634-0377

ABSTRACT

Zehr, E. I., Lewis, S. A., and Bonner, M. J. 1986. Some herbaceous hosts of the ring nematode (*Criconemella xenoplax*). Plant Disease 70:1066-1069.

Certain indigenous herbaceous plants and peach orchard cover crops were investigated as hosts of *Criconemella xenoplax*. The nematode population increased on curly dock (*Rumex crispus*), perennial ryegrass (*Lolium perennae*), vetch (*Vicia sativa*), crimson clover (*Trifolium incarnatum* var. *elatius*), hairy vetch (*V. villosa*), and cowpea (*Vigna unguiculata* subsp. *unguiculata*). Populations were stable and the nematode may have reproduced on tall fescue (*Festuca arundinacea*) and white clover (*T. repens*). Populations declined on 31 other plant species.

The ring nematode (*Criconemella xenoplax* (Raski) Luc & Raski) is associated with roots of many woody plants, including some important for food, fiber, or ornamental purposes. Feeding of *C. xenoplax* results in tertiary root destruction, stunted growth, and general weakness that leads to increased susceptibility to diseases and environmental stresses. In peach (*Prunus persica* (L.) Batsch), *C. xenoplax* limits growth and productivity. *C. xenoplax* is an important contributing factor in the peach-tree short-life syndrome in the southeastern United States because the nematode increases susceptibility to bacterial canker caused by *Pseudomonas syringae* pv. *syringae* van Hall (15) and cold injury (17).

Host suitability of some economically important woody plants, vegetables, and row crops for *C. xenoplax* has been investigated, and field associations with roots of some other plants have been reported. The number of potential hosts studied relative to distribution of the nematode is very small and includes few noncultivated herbaceous plants.

Host plants, plant associations, and nonhost plants of *C. xenoplax* are as follows. (Reports of *C. xenoplax* associated with plants in the field but host status not confirmed by experimentation are listed as plant associations.)

Hosts: *Acer rubrum* (red maple) (22), *Dianthus caryophyllus* (carnation) (24), *Ilex cornuta* (Rotunda holly) (3), *I. crenata* (Japanese holly) (2), *Juglans*

Technical Contribution 2495 of the South Carolina Agricultural Experiment Station, Clemson University.

Accepted for publication 14 April 1986.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "*advertisement*" in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

hindsii (northern California black walnut) (14), *Juniperus horizontalis* (Blue Rug juniper) (4), *Lactuca sativa* (lettuce) (14), *Lycopersicon esculentum* (tomato) (23), *Melilotus alba* (sweet clover) (23), *Parthenium argentatum* (guayule) (27), *Pinus clausa* (sand pine) (21), *P. echinata* (shortleaf pine) (21), *P. elliottii* var. *elliottii* (slash pine) (21), *P. palustris* (longleaf pine) (21), *P. rigida* (pitch pine) (21), *P. serotina* (pond pine) (21), *P. taeda* (loblolly pine) (21), *Prunus amygdalus* (= *P. communis*) (Texas almond) (23), *P. armeniaca* (apricot) (14), *P. avium* (Mazzard cherry) (14), *P. cerasifera* × *P. munsoniana* (16), *P. cerasifera* (Myrobalan plum) (16), *P. domestica* (plum) (11), *P. mahaleb* (Mahaleb cherry) (14), *P. moseri* (16), *P. persica* (peach) (26), *Trifolium* sp. (ladino clover) (23), *Vaccinium macrocarpon* (cranberry) (5), and *Vitis vinifera* (Thompson seedless grape) (19).

Plant associations: *Aesculus* sp. (28), *Fragaria* × *ananassa* (strawberry) (28), *Juniperus deppeana* (20), *J. monosperma* (20), *J. scopulorum* (20), *Malus sylvestris* (apple) (25), *Picea glauca* var. *densata* (10), *P. pungens* (10), *Pinus edulis* (20), *P. ponderosa* (ponderosa pine) (20), *Prunus cerasoides* (= *P. puddum*) (9), *Psidium guajava* (guava) (12), *Rosa damascena* (7), *Umbellularia californica* (California laurel) (18), and *Ulmus americana* (American elm) (1).

Nonhosts: *Arachis hypogaea* (peanut) (23), *Beta vulgaris* (sugar beet) (23), *Buxus microphylla* var. *stricta* (Japanese boxwood) (4), *Cucumis sativus* (cucumber) (14), *Dactylis glomerata* (orchard grass) (14), *Dolichos lablab* (hyacinth bean) (23), *Gardenia jasminoides* (dwarf gardenia) (4), *Gossypium hirsutum* (cotton) (23), *Ilex vomitoria* var. *nana* (Yaupon holly) (3), *Juniperus excelsa* var. *stricta* (Spiny Greek juniper) (4), *Liriodendron tulipifera* (yellow poplar) (22), *Liquidambar styraciflua* (sweetgum) (22), *Medicago sativa* (alfalfa) (14), *Nandina domestica* (nandina) (4), *Pinus strobus* (eastern white pine) (21), *Platanus occidentalis* (sycamore) (22), *Populus heterophylla* (cottonwood) (22), *Pyrus communis* (pear) (14), *Solanum tuberosum* (potato) (23), and *Zea mays* (sweet corn) (23).

Because *C. xenoplax* is widespread in South Carolina and other southeastern peach orchards, we have been concerned about the role of orchard ground cover in the biology and reproduction of *C. xenoplax*. Although mechanical cultivation of orchards is common, root injury to trees and serious soil erosion may result. Little is known about the host suitability of native plants or ground cover crops planted in peach orchards. We report results of studies that assess the host status of some potentially useful orchard cover crops and other plants frequently found in peach orchards in the Southeast.

MATERIALS AND METHODS

Host suitability of 43 species or cultivars of plants for *C. xenoplax* was tested in the greenhouse in four separate experiments. Three experiments included 11 species or cultivars with six replicates arranged in a randomized complete block design, and one experiment included 10 species or cultivars. Each experiment included peach (cultivar Nemaguard) as a standard host and a fallow treatment to determine the survivability of the nematode in the absence of a host. The growth medium was autoclaved Lakeland sand (89% sand, 6% silt, and 5% clay). All plants were seeded directly in the pots, except the two digitgrass cultivars were transplanted as stolons, and peach seedlings were transplanted when 30 cm tall.

C. xenoplax was obtained from Nemaguard peach maintained in the greenhouse. Inoculum was extracted by a combination of decanting-sieving (8) and centrifugal flotation (13). Plants were established in 2-L pots before the soil was infested with 500 adult and juvenile *C. xenoplax* in an aqueous suspension. Nematodes were pipetted into three holes 3 cm deep and 0.75 cm in diameter next to the bases of plants.

Greenhouse temperatures ranged from 25 to 35 C, and multivapor lamps provided 16 hr of supplemental light. Fertilizers were applied when needed and alternated between 1) 45 g $CaNO_3$ + 15 g $MgSO_4$ 19 L^{-1} (5 gal) water and 2) 45 g 15-0-14, 12 g 0-46-0, and 2 ml Stoller Crop Mix 19 L^{-1} water.

Experiments were terminated 90 days after infestation of soil with nematodes. Numbers of nematodes and gravid females in 100 cm^3 soil were determined after elutriation (6) plus centrifugal flotation (13). Reproduction (final population density divided by initial population density) was calculated and used as a measure of reproduction among the different plants.

RESULTS AND DISCUSSION

The reproductive index of *C. xenoplax* on the plants tested showed that most were either poor hosts or nonhosts for *C.*

Table 1. Reproduction of *Criconemella xenoplax* in the greenhouse on certain indigenous or orchard ground cover plants in the southeastern U.S. peach orchards

Plant	Cultivar	R[a]	Gravid females/ 100 cm^3
Ambrosia artemisiifolia L. (common ragweed)	···	0.02	0.0
Axonopus affinis Chase (carpetgrass)	···	0.03	0.0
Cassia obtusifolia L. (sicklepod)	···	0.00	0.0
Chenopodium album L. (common lamb's-quarters)	···	0.37	0.3
Crotolaria spectabilis Roth (showy crotalaria)	···	0.08	0.0
Cynodon dactylon (L.) Pers. (common bermudagrass)	···	0.79	1.0
(coastal bermudagrass)	···	0.22	0.0
Cyperus esculentus L. (yellow nutsedge)	···	0.07	0.0
Dactylis glomerata L. (orchardgrass)	···	0.61	1.0
Digitaria decumbens Stent. (digitgrass)	Pangola	0.10	0.0
	Transvala	0.06	0.0
Digitaria sanguinalis (L.) Scop. (crabgrass)	···	0.22	0.0
Echinochloa crusgalli (L.) Beauv. (barnyard grass)	···	0.42	0.0
Eleusine indica (L.) Gaertn. (goosegrass)	···	0.00	0.0
Eremochloa ophiuroides (Munro.) Hack. (centipedegrass)	···	0.12	0.0
Euphorbia maculata L. (spotted spurge)	···	0.09	0.0
Festuca arundinacea Schreb. (tall fescue)	···	1.01	0.3
Helenium amarum (Rafin.) H. Rock (bitterweed, sneezeweed)	···	0.12	0.0
Heterotheca subaxillaris (Lam.) Britt. & Rusby (camphorweed)	···	0.01	0.0
Ipomoea hederacea (L.) Jacq. (ivy leaf morning glory)	···	0.00	0.0
Lepidium virginicum L. (Virginia pepperweed)	···	0.46	0.3

(*continued on next page*)

Table 1. (*continued from preceding page*)

Plant	Cultivar	R[a]	Gravid females/ 100 cm³
Lespedeza stipulacea Maxim. (Korean lespedeza)	···	0.11	0.0
Lolium perenne L. (perennial ryegrass)	···	2.17	2.3
Medicago sativa L. (alfalfa)	W1-311	0.87	0.3
Muhlenbergia schreberi J. F. Gmel (nimblewill)	···	0.01	0.0
Paspalum dilatatum Poir. (dallisgrass)	···	0.08	0.2
Paspalum notatum Flugge (bahia grass)	···	0.15	0.0
Plantago lanceolata L. (buckhorn, plantain)	···	0.00	0.0
Poa pratensis L. (Kentucky bluegrass)	···	0.71	1.0
Rumex crispus L. (curly dock)	···	3.64	3.7
Secale cereale L. (rye)	Wren's Abruzzi	0.84	0.8
Setaria viridis (L.) Beauv. (green foxtail)	···	0.07	0.0
Sida spinosa L. (prickly sida)	···	0.76	2.0
Sorghum halepense (L.) Pers. (johnsongrass)	···	0.41	0.0
Trifolium incarnatum L. var. *elatius* Gibbelli & Belli (crimson clover)	Dixie	6.60	25.8
Trifolium repens L. (white clover)	Tilman	1.10	2.7
Triticum aestivum L. (wheat)	Coker 6815	0.25	0.0
Vicia sativa L. (vetch)	Cahaba White	1.38	1.0
	Nova II	0.72	0.0
	Vanguard	0.49	1.3
	Vantage	0.76	0.7
Vicia villosa Roth (hairy vetch)	···	3.55	13.3
Vigna unguiculata (L.) Walp. subsp. *unguiculata* (cowpea)	Mississippi Purple	2.23	8.3
Prunus persica (L.) Batsch (peach)	Nemaguard	8.80	29.4
Fallow	···	0.03	0.0

[a] R = final population divided by initial population.

xenoplax (Table 1). However, *C. xenoplax* reproduced on perennial ryegrass (*Lolium perenne*) and was maintained on tall fescue (*Festuca arundinacea*), which are two of the most common orchard cover crops in the Southeast. Certain legumes, especially crimson clover (*Trifolium incarnatum* var. *elatius*), hairy vetch (*Vicia villosa*), and cowpea (*Vigna unguiculata* subsp. *unguiculata*) also were good hosts and would not be suitable as orchard cover crops. Peach and crimson clover supported the most rapid population increase.

A few gravid females were associated with some plants that had comparatively low reproductive indices (Table 1). These numbers suggest that some herbaceous plants that were not good hosts for *C. xenoplax* might sustain low populations in the field and thereby enable the nematode to persist indefinitely. Frequently, when orchard sites are replanted, numbers of *C. xenoplax* may increase very rapidly on peach trees even when cultivated crops not considered susceptible have grown there for many years. Perhaps native plants that are not considered hosts for *C. xenoplax* are responsible for maintaining the nematode during the intervening time.

The possibility that certain nonhosts might be antagonistic to *C. xenoplax* was not investigated. Because cover crops are planted in peach orchards for all or part of the year, those that inhibit nematode population increase could be important in an integrated nematode control program. The results reported here will be useful as an aid in selecting cover crops for planting in nematode-infested soil.

LITERATURE CITED

1. Anonymous. 1956. Notes on nematodes. Can. Insect Pest Rev. 34:335-337.
2. Aycock, R., Barker, K. R., and Benson, D. M. 1976. Susceptibility of Japanese holly to *Criconemoides xenoplax, Tylenchorhynchus claytoni*, and certain other plant-parasitic nematodes. J. Nematol. 8:26-31.
3. Barker, K. R., Benson, D. M., and Jones, R. K. 1979. Interactions of Burfordi, Rotunda, and Dwarf Yaupon hollies and Aucuba with selected plant-parasitic nematodes. Plant Dis. Rep. 63:113-116.
4. Benson, D. M., and Barker, K. R. 1982. Susceptibility of Japanese boxwood, dwarf gardenia, Compacta (Japanese) holly, Spiny Greek and Blue Rug junipers, and nandina to four nematode species. Plant Dis. 66:1176-1179.
5. Bird, G. W., and Jenkins, W. R. 1964. Occurrence, parasitism, and pathogenicity of nematodes associated with cranberry. Phytopathology 54:677-680.
6. Byrd, D. W., Jr., Barker, K. R., Ferris, H., Nusbaum, C. J., Griffin, W. E., Small, R. H., and Stone, C. A. 1976. Two semiautomatic elutriators for extracting nematodes and certain fungi from soil. J. Nematol. 8:206-212.
7. Choleva, B. M., Kataln-Gateva, S., and Tsenkova, M. K. 1980. The nematodes of the family Criconematidae Taylor, 1936 (Nematoda Rudolphi, 1808) and the family Longidoridae Thorne, 1935, on *Rosa damascena* Mill. in Bulgaria. Acta Zool. Bulg. 14:64-69.
8. Cobb, N. A. 1918. Estimating the nema population of soil. U.S. Dep. Agric. Tech. Circ. 1:1-48.
9. Edward, J. C., and Misra, S. L. 1963. *Criconemoides nainitalensis* n. sp. (Nematoda: Criconematidae). Nematologica 9:218-221.
10. Epstein, A. H., and Griffin, G. D. 1962. The occurrence of Cytospora canker on spruce in the presence of *Xiphinema americanum* and *Criconemoides xenoplax*. Plant Dis. Rep. 46:17.
11. Goodey, J. B., and Franklin, M. T. 1956. The Nematode Parasites of Plants Catalogued Under Their Hosts. Comm. Agric. Bur., Farnham Royal, Bucks, England. 140 pp.
12. Heyns, J. 1970. South African Criconematinae. Part 3. More species of *Hemicriconemoides* and *Macroposthonia* (Nematoda). Phytophylactica 2:243-249.
13. Jenkins, W. R. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. Plant Dis. Rep. 48:692.
14. Lownsbery, B. F. 1964. Effects of cropping on population levels of *Xiphinema americanum* and *Criconemoides xenoplax*. Plant Dis. Rep. 48:218-221.
15. Lownsbery, B. F., English, H., Moody, E. H., and Schick, F. J. 1973. *Criconemoides xenoplax* experimentally associated with a disease of peach. Phytopathology 63:994-998.
16. Mojtahedi, H., and Lownsbery, B. F. 1975. Pathogenicity of *Criconemoides xenoplax* to prune and plum rootstocks. J. Nematol. 7:114-119.
17. Nyczepir, A. P., Zehr, E. I., Lewis, S. A., and Harshman, D. C. 1983. Short life of peach trees induced by *Criconemella xenoplax*. Plant Dis. 67:507-508.
18. Raski, D. J. 1952. On the morphology of *Criconemoides* Taylor, 1936, with descriptions of six new species (Nematoda: Criconematidae). Proc. Helminthol. Soc. Wash. 19:85-89.
19. Raski, D. J., and Radewald, J. D. 1958. Reproduction and symptomatology of certain ectoparasitic nematodes on roots of Thompson seedless grape. Plant Dis. Rep. 42:941-943.
20. Raski, D. J., and Riffle, J. W. 1967. Two new species and further notes on *Criconemoides* Taylor, 1936 (Criconematidae: Nematoda). Proc. Helminthol. Soc. Wash. 34:212-219.
21. Ruehle, J. L. 1966. Nematodes parasitic on forest trees. I. Reproduction of ectoparasites on pines. Nematologica 12:443-447.
22. Ruehle, J. L. 1971. Nematodes parasitic on forest trees: III. Reproduction on selected hardwoods. J. Nematol. 3:170-173.
23. Seshadri, A. R. 1964. Investigations on the

biology and life cycle of *Criconemoides xenoplax* Raski 1952 (Nematoda: Criconematidae). Nematologica 10:540-562.
24. Sher, S. A. 1959. A disease of carnations caused by the nematode *Criconemoides xenoplax*. Phytopathology 49:761-763.
25. Siddiqi, M. R. 1961. Studies on species of Criconematinae (Nematoda: Tylenchida) from India. Proc. Helminthol. Soc. Wash. 28:19-34.
26. Thomas, H. A. 1959. On *Criconemoides xenoplax* Raski, with special reference to its biology under laboratory conditions. Proc. Helminthol. Soc. Wash. 26:55-59.
27. Thomas, S. H., and Goddard, C. J. 1985. Plant-parasitic nematode development on guayule, a latex-producing desert shrub. (Abstr.) J. Nematol. 17:515.
28. Williams, K. J. O. 1972. *Macroposthonia xenoplax*. Set 1, No. 12. Descriptions of Plant-Parasitic Nematodes. Commonw. Inst. Helminthol., Herts, England.