INCIDENCE AND INFLUENCE OF PLANT-PARASITIC NEMATODES IN SOUTHERN ILLINOIS PEACH ORCHARDS

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ABSTRACT

Walters, S. A., J. P. Bond, J. B. Russell, B. H. Taylor, and Z. A. Handoo. 2008. Incidence and influence of plant-parasitic nematodes in southern Illinois peach orchards. Nematropica 38:63-74.

The frequency, distribution and impact of plant-parasitic nematodes in southern Illinois peach orchards were determined. Nine plant-parasitic nematode genera were detected comprising 11 species: *Helicotylenchus platyurus*, *Helicotylenchus pseudorobustus*, *Hoplolaimus* spp., *Meloidogyne* spp., *Mesocriconema xenoplax*, *Paratylenchus dianthus*, *Paratylenchus projectus*, *Pratylenchus penetrans*, *Pratylenchus vulnus*, *Tylenchorhynchus annulatus*, *Tylenchorhynchus claytoni*, *Tylenchus hamatus* and *Xiphinema americanum*. Generally, *Helicotylenchus*, *Mesocriconema*, *Paratylenchus*, and *Xiphinema* were found at the highest densities. In the *Prunus* rootstock evaluation, growth and yield reductions of the scion 'Redhaven' depended on the rootstock and were associated with nematode population densities. *Xiphinema* populations were most closely linked to reductions in 'Redhaven' fruit yield and plant growth across a wide range of rootstocks. Our results indicate that *Mesocriconema*, *Pratylenchus*, and *Xiphinema* maintain populations that can limit peach production in southern Illinois.

Key words: Helicotylenchus, *Hoplolaimus*, *Meloidogyne*, *Mesocriconema*, *Paratylenchus*, *Pratylenchus*, *Prunus persica*, survey, *Tylenchorhynchus*, *Tylenchus*, *Xiphinema*.

RESUMEN

Walters, S. A., J. P. Bond, J. B. Russell, B. H. Taylor, and Z. A. Handoo. 2008. Incidencia e influencia de nematodos fitoparásitos en plantaciones de duraznero del sur de Illinois. Nematropica 38:63-74.

Se determinó la frecuencia, distribución e impacto de nematodos fitoparásitos en plantaciones de duraznero del sur de Illinois. Se detectaron nueve géneros y 11 especies de nematodos fitoparásitos: *Helicotylenchus platyurus*, *Helicotylenchus pseudorobustus*, *Hoplolaimus* spp., *Meloidogyne* spp., *Mesocriconema xenoplax*, *Paratylenchus dianthus*, *Paratylenchus projectus*, *Pratylenchus penetrans*, *Pratylenchus vulnus*, *Tylenchorhynchus annulatus*, *Tylenchorhynchus claytoni*, *Tylenchus hamatus* y *Xiphinema americanum*. En general, las densidades más altas halladas fueron de *Helicotylenchus*, *Mesocriconema*, *Paratylenchus*, y *Xiphinema*. En la evaluación de portainjertos de *Prunus*, el crecimiento y producción del injerto 'Redhaven' variarion según el portainjerto y la densidad de población de nematodos. Las poblaciones de *Xiphinema* fueron las de mayor efecto sobre la reducción en la producción de frutos y el crecimiento de la planta de 'Redhaven' en una amplia gama de portainjertos. Nuestros resultados indican que *Mesocriconema*, *Pratylenchus* y *Xiphinema* mantienen poblaciones que pueden limitar la producción de duraznos en el sur de Illinois.

Palabras clave: Helicotylenchus, *Hoplolaimus*, *Meloidogyne*, *Mesocriconema*, *Paratylenchus*, *Pratylenchus*, *Prunus persica*, inventario, *Tylenchorhynchus*, *Tylenchus*, *Xiphinema*.

INTRODUCTION

Peach [*Prunus persica* (L.) Batsch] trees in southern Illinois often begin to decline and then die prematurely, with resulting gaps in orchards directly reducing revenues. The death and decline of these trees can be attributed to many factors, includ-

ing damage from plant-parasitic nematodes (Nyczepir, 1990; Nyczepir and Wood, 1995; Ritchie, 1988; Ritchie and Clayton, 1981).

Peach growers throughout the U.S. suffer major economic losses due to certain plant-parasitic nematodes, as peach trees become less productive at high population densities (Bird and Melakeberhan, 1995; Nyczepir, 1991). Plant-parasitic nematodes most detrimental to peach production are *Meloidogyne* spp. (root-knot nematode) (Huettel and Hammerschlag, 1993), *Mesocriconema xenoplax* (Raski, 1952) Loof & de Grisse, 1989 [=*Criconemoides xenoplax* (Raski, 1952) Loof and de Grisse, 1967] (ring nematode) (Nyczepir, 1990; Nyczepir *et al.*, 1983), *Pratylenchus* spp. (root-lesion nematode) (Pinochet *et al.*, 1993, 1996), and *Xiphinema* spp. (dagger nematode) (Forer *et al.*, 1984).

There has been very little research conducted on the relationship between plant parasitic nematodes and peach production in southern Illinois (Melton *et al.*, 1985). Walters *et al.* (2003) indicated that *Mesocriconema* and *Xiphinema* often reach high population densities in southern Illinois peach orchards. Furthermore, excessively high populations of *Mesocriconema* (>250 per 100 cm^3 soil) were associated with trees exhibiting peach decline symptoms. Therefore, our objectives were to determine the frequency and distribution of plant-parasitic nematodes in southern Illinois peach orchard soils and to relate the effect of nematode populations on vegetative and reproductive growth of 'Redhaven' peach trees grafted on various rootstocks.

MATERIALS AND METHODS

Plant-parasitic Nematodes in Southern Illinois Peach Orchard Soils

Six peach orchards in southern Illinois maintained with herbicide strip culture under the dripline and mowing of tall fescue (*Festuca arundinacea* Schreb.) aisles were evaluated in 2000, 2001 and 2002 for the presence of plant parasitic nematodes: 1) Flamm's orchard (Union county; Alford silt loam soil), 2) Grammer's orchard (Jackson county; Hosmer silt loam soil), 3) Lightfoot's orchard (Jackson county; Camden silt loam soil), 4) Rendleman's orchard (Union county; Alford silt loam soil), 5) Southern Illinois University-Carbondale (SIUC) 1994 North Central-140 experimental rootstock orchard (Jackson County; Hosmer silt loam soil), 6) SIUC high density 'Loring' orchard (Jackson county; Hosmer silt loam soil) (Herman, 1979; Miles, 1979). In the top 20 to 25 cm, Hosmer and Alford silt loam soils are similar with 0% to 5% sand, 65% to 80% silt, and 10% to 25% clay; whereas, Camden silt loam soils average 5% to 20%, 65% to 85%, and 10% to 20% sand, silt, and clay, respectively. Hosmer and Alford silt loam soils have an organic matter content of 0.5% to 2%, while Camden silt loam soils average 1% to 3%.

The peach trees at most orchards had been planted between 10 to 20 years prior to sampling, except for the SIUC North Central-140 experimental rootstock orchard which was 7 years old when the experiment was initiated. Although most commercial peach orchards in southern Illinois use 'Lovell' as the rootstock, the SIUC high density 'Loring' peach orchard was planted in 1983 using the rootstock 'Halford'. Seven different rootstocks (see *Prunus* rootstock evaluation) were sampled in the SIUC North Central-140 experimental rootstock orchard.

For 2000, 2001 and 2002, nematode populations were determined by collecting soil samples at approximately the first of every month from each orchard during: July, 2000, September, 2001, November, 2001, March, 2002, July, 2002, September, 2002 and November, 2002. A total of 100 samples were taken over the three-year period. Most orchards sampled were again sampled on 10 January, 2005 to determine

the predominant nematode species, with 19 total soil samples collected: Flamm's orchard (4), Lightfoot's orchard (4), SIUC North Central-140 experimental rootstock orchard (4), Rendleman's orchard (5) and SIUC high density 'Loring' orchard (2).

Soil cores (2.5 cm diameter × 45 cm deep) were randomly collected from within the drip line of each sampled tree in each orchard by using a soil probe (Shurtleff and Averre, 2000). Ten soil cores were collected from at least 10 different trees selected by walking a zigzag pattern in each orchard. Soil cores were immediately combined to represent the sampled area. The soil samples were put into plastic bags, then immediately placed in a cooler and within six hours of collection, stored at 4°C until processed. Nematodes were extracted from a 100 cm^3 subsample by wet sieving through nested 425-um-pore and 38-um-pore sieves followed by sugar-flotation and centrifugation (Jenkins, 1964). Plant-parasitic nematodes from soil samples were identified to genus and enumerated using an inverted compound microscope. For the 19 soil samples collected in 2005, plant-parasitic nematodes were identified to species and enumerated. Nematodes were extracted from the soil as previously described. For species identification, nematodes were fixed in hot 3% formaldehyde solution, with some fixed specimens processed to anhydrous glycerin (Seinhorst, 1959) and examined under a compound microscope. Nematode identifications were based on the morphology of adult and larval forms and their identities were confirmed with recent taxonomic keys (Eisenback *et al.*, 1981; Handoo, 2000; Handoo and Golden, 1989, 1992; Mai *et al.*, 1996; Raski, 1975; Sher 1966).

Evaluation of Prunus Rootstocks

This experiment was conducted at the SIUC Horticulture Research Center utilizing the 1994 North Central-140 experimental rootstock study. Seven *Prunus* rootstocks ('Bailey', 'Chui Lum Tao', 'Guardian®', 'Higama', 'Lovell', 'Rubira', and 'Stark's Red Leaf') supporting 'Redhaven' scions were selected from the rootstock study with each rootstock replicated four times. An initial soil sampling on 1 July, 2000 was used to select individual rootstock plots based on plant parasitic nematode genera population densities. The selected plots were subsequently sampled on 1 September and 1 November, 2001, and 1 March, 1 July, 1 September and 1 November, 2002 to monitor nematode populations.

Soil samples were collected, stored, and processed as described for the peach orchard survey.

Vegetative and reproductive growth was measured on each of the selected rootstocks. Trunk circumference was measured at 30 cm above the soil on 1 February during 2001 and 2002. The previous years' shoot growth was recorded by measuring the current season extension shoot from its base to the bottom of the terminal bud scales on 15 randomly selected shoots on each tree during the dormant season. Total fruit number and yield (kg) per tree were determined from multiple harvests taken early to mid-July for 2001 and 2002.

All data were tested for normality and transformed where appropriate. Plant-parasitic nematode numbers were transformed using $\log_{10}$ (x + 1). Data were subjected to analysis of variance procedures (ANOVA) and regression analysis using SAS (SAS Institute, Cary, NC).

RESULTS

Plant-parasitic Nematodes in Southern Illinois Peach Orchard Soils—2000, 2001, and 2002

Eight genera of plant-parasitic nematodes were detected: *Helicotylenchus*, *Hoplolaimus*, *Meloidogyne*, *Mesocriconema*, *Paratylenchus*, *Pratylenchus*, *Tylenchorhynchus*, and

Xiphinema (Table 1). Nematodes found at the highest population densities (39 to 108 per cm^3 soil) across all sampling dates and orchards included *Helicotylenchus* spp., *Mesocriconema* spp., *Paratylenchus* spp., and *Xiphinema* spp. (Table 1). Two important parasitic nematodes of peach, *Mesocriconema* and *Xiphinema* averaged 84 and 39 per 100 cm^3 soil, respectively. Mean populations of other genera detected (*Hoplolaimus*, *Meloidogyne*, *Pratylenchus*, and *Tylenchorhynchus*) averaged less than 15 per 100 cm^3 soil.

Although *Mesocriconema* spp. was found in all orchards soils, high (47 per cm^3 soil) and extremely high (442 per cm^3 soil) soil population densities were detected at Flamm and Rendleman orchards, respectively (Table 1). In contrast, *Xiphinema* spp. population densities consistently ranged from 18 to 55 per 100 cm^3 soil in all the orchards sampled.

Plant-parasitic Nematodes in Southern Illinois Peach Orchard Soils—2005

Seven plant-parasitic nematode genera were detected comprising 11 different species: *Helicotylenchus platyurus* Perry in Perry, Darling & Thorne, 1959 and *H. pseudorobustus* (Steiner, 1914) Golden, 1956; *Mesocriconema xenoplax*; *Paratylenchus dianthus* Jenkins & Taylor, 1956 and *P. projectus* Jenkins, 1956; *Pratylenchus penetrans* (Cobb, 1917) Filipjev & Schuurmans Stekhoven, 1941 and *P. vulnus* Allen & Jensen, 1951; *Tylenchorhynchus annulatus* (Cassidy, 1930) Golden, 1971 and *T. claytoni* Steiner, 1937; *Tylenchus hamatus* Thorne & Malek, 1968; and *Xiphinema americanum* Cobb, 1913 (Table 2). Across the five orchards sampled, *Helicotylenchus* spp., *Paratylenchus* spp., *Pratylenchus* spp., and *Xiphinema americanum* were all present at densities greater than 30 per 100 cm^3 soil while *Mesocriconema xenoplax*, *Tylenchorhynchus* spp., and *Tylenchus hamatus* were generally detected at much lower densities.

Although *Helicotylenchus* spp. was detected at all orchards, their population densities were much higher at the Southern Illinois University peach orchards compared to other locations (Table 1). *Mesocriconema xenoplax* was found only at Flamm and Rendleman orchards, but the population densities were only 3% to 11% of those detected 3 to 5 years earlier; this difference could have resulted from various factors including the different sampling date during the winter or other orchard blocks sampled at these locations. *Paratylenchus* spp. were detected in all orchards except one, and high population densities (>56 per 100 cm^3 soil) were found at three commercial orchards. *Pratylenchus* spp. were detected in soils from all orchards, although only one orchard had a high population density of 98 per 100 cm^3 soil and two orchards had only 1 per 100 cm^3 soil. *Xiphinema americanum* was found at a consistent level throughout all orchards sampled ranging from 37 to 88 per 100 cm^3 soil. All other species identified were detected at low population densities.

Prunus Rootstock Evaluation

Peach growth and yield response relationships with the population densities of plant-parasitic nematodes most likely to cause damage were determined (Table 3).

Population densities of *Meloidogyne* spp. were detected at low levels at all sampling intervals with an overall mean of two juveniles per 100 cm^3 soil (Table 1). Population densities of *Meloidogyne* spp. were related to plant parameters only during 2002 (Table 3). Fruit number and weight increased for 'Rubira' as population densities increased, although fruit weight was inversely related to densities of *Meloidogyne* spp. for 'Chui Lum Tao' rootstocks. Shoot length for 'Rubira' was inversely related with population densities of *Meloidogyne* spp.

Table 1. Mean population densities (per 100 cm^3 soil) of plant-parasitic nematode genera associated with Illinois peach orchards during 2000, 2001, and 2002 growing seasons.[z]

Peach orchard	*Helicotylenchus* spp.	*Hoplolaimus* spp.	*Meloidogyne* spp.	*Mesocriconema* spp.	*Paratylenchus* spp.	*Pratylenchus* spp.	*Tylenchorhynchus* spp.	*Xiphinema* spp.
Flamm	41	5	1	47	59	4	4	18
Grammer	46	44	27	2	44	9	4	55
Lightfoot	4	0	6	2	29	5	7	30
Rendleman	13	1	4	442	177	7	0	42
SIUC NC-140 rootstock[y]	102	1	2	1	73	19	46	46
SIUC high density 'Loring'	439	1	3	2	19	4	20	44
Mean	108	8	7	84	67	8	14	39

[z]Means presented were derived from sub-samples collected from 10 randomly selected trees from each of 6 orchards in Jackson and Union counties. Soil samples were taken on seven approximate dates at each orchard: 1 July, 2000, 1 September, 2001, 1 November, 2001, 1 March, 2002, 1 July, 2002, 1 September, 2002 and 1 November, 2002.

[y]Orchard in which *Prunus* rootstock evaluation was conducted.

Table 2. Mean population densities (per 100 cm^3 soil) of plant-parasitic nematodes associated with Illinois peach orchards during 2005.[z]

Peach orchard (no. samples)	*Helicotylenchus* spp.	*Mesocriconema xenoplax*	*Paratylenchus* spp.	*Pratylenchus* spp.	*Tylenchorhynchus* spp.	*Tylenchus hamatus*	*Xiphinema americanum*
Flamm (4)	2	5	92	15	1	0	37
Lightfoot (4)	1	0	114	30	1	1	83
Rendleman (5)	6	12	57	1	0	1	38
SIUC NC-140 rootstock (4)	53	0	23	98	0	6	88
SIUC High Density 'Loring' (2)	188	0	0	1	44	9	80
Mean (19)	33	4	63	31	5	3	62

[z]Plant-parasitic nematodes were identified to species. *Helicotylenchus* spp. includes *H. platyurus* and *H. pseudorobustus*; *Paratylenchus* spp. includes *P. dianthus* and *P. projectus*; *Pratylenchus* spp. includes *P. penetrans* and *P. vulnus*; *Tylenchorhynchus* spp. includes *T. annulatus* and *T. claytoni*. Peach orchards are located in either Jackson or Union counties. Soil samples were collected on 10 January 2005.

Table 3. Regression of $\log_{10}$ (x +1) transformed average population densities of eight plant-parasitic nematodes against 'Redhaven' peach growth and yield responses on seven different *Prunus* spp. rootstocks.

Nematode/'Redhaven' growth and yield response/Rootstock	Best linear model	r^2	Significance value
Meloidogyne spp. (only in 2002)			
Fruit number per tree			
'Rubira'	y = 88.99x + 443.59	0.94	*
Fruit yield (kg) per tree			
'Chui Lum Tao'	y = -4.50x + 43.25	0.95	*
'Rubira'	y = 3.68x + 32.01	0.85	**
New shoot length (cm)			
'Rubira'	y = -4.28x + 38.77	0.77	**
Mesocriconema spp.			
No relationships detected			
Pratylenchus spp.			
Fruit number per tree			
'Lovell' (2001)	y = 356.16x – 36.99	0.67	*
'Guardian®' (2002)	y = -133.42x + 632.17	0.94	*
'Stark's Red Leaf' (2002)	y = -137.47x + 790.73	0.86	**
Fruit yield (kg) per tree (only in 2002)			
'Bailey'	y = 145.69x + 16.23	0.96	*
'Chui Lum Tao'	y = 35.45x + 162.74	0.90	*
'Guardian®'	y = -52.06x + 237.55	0.72	*
'Higama'	y = -68.50x + 271.95	0.79	*
'Stark's Red Leaf'	y = 47.89x + 182.06	0.72	**
New shoot length (cm)			
'Chui Lum Tao' (2001)	y = -9.98x + 67.34	0.79	**
'Lovell' (2001)	y = -8.23x + 60.81	0.91	**
'Stark's Red Leaf' (2001)	y = -5.80x + 60.93	0.96	**
'Lovell' (2002)	y = 7.16x + 60.48	0.79	**
Trunk circumference (cm)			
'Stark's Red Leaf' (2001)	y = 8.59x + 49.60	0.77	***
'Higama' (2002)	y = 5.54x + 61.98	0.70	***
'Lovell' (2002)	y = -5.87x + 73.50	0.79	**
'Rubira' (2002)	y = -24.80x + 103.45	0.99	*
Xiphinema spp.			
Fruit number per tree			
'Bailey' (2001)	y = -467.00x + 1071.40	0.77	*
'Chui Lum Tao' (2001)	y = -4.38x + 248.93	0.81	*

,,***Significant at $P < 0.05$, $P < 0.01$, and $P < 0.0001$, respectively.

Table 3. (Continued) Regression of $\log_{10}$ (x +1) transformed average population densities of eight plant-parasitic nematodes against 'Redhaven' peach growth and yield responses on seven different *Prunus* spp. rootstocks.

Nematode/'Redhaven' growth and yield response/Rootstock	Best linear model	r^2	Significance value
'Guardian®' (2001)	y = -230.31x + 531.58	0.98	**
'Lovell' (2001)	y = -429.65x + 916.34	0.72	*
'Higama' (2002)	y = -481.82x + 1221.30	0.97	*
'Stark's Red Leaf' (2002)	y = 298.78x – 8.94	0.92	*
Fruit weight (kg) per tree			
'Bailey' (2001)	y = -119.76x + 324.69	0.84	**
'Chui Lum Tao' (2001)	y = -2.12x + 125.47	0.71	*
'Chui Lum Tao' (2002)	y = -4.88x + 196.79	0.75	**
'Guardian®' (2002)	y = -251.50x + 587.72	0.88	*
'Stark's Red Leaf' (2002)	y = -1.88x + 124.80	0.74	*
New shoot growth (cm)			
'Bailey' (2001)	y = -10.35x + 46.89	0.97	**
'Chui Lum Tao' (2001)	y = -4.37x + 34.81	0.74	*
'Rubira' (2001)	y = -3.46x + 32.63	0.75	**
'Stark's Red Leaf' (2001)	y = -3.54x + 33.24	0.93	**
'Chui Lum Tao' (2002)	y = -3.29x + 33.25	0.94	**
'Higama' (2002)	y = 12.30x + 14.16	0.88	*
'Rubira' (2002)	y = 18.98x + 0.12	0.98	**
'Stark's Red Leaf' (2002)	y = 14.38x + 10.09	0.84	**
Trunk circumference (cm)			
'Guardian®' (2001)	y = -7.29x + 75.25	0.99	*
'Chui Lum Tao' (2002)	y = -9.11x + 73.10	0.91	*
'Guardian®' (2002)	y = 0.34x + 59.78	0.78	*
'Stark's Red Leaf' (2002)	y = -5.92x + 73.79	0.75	*

,,***Significant at $P < 0.05$, $P < 0.01$, and $P < 0.0001$, respectively.

There were no observed relationships between *Mesocriconema* spp. and the plant parameters measured in 2001 or 2002 due to the low population densities detected for this nematode (Table 1).

Population densities of *Pratylenchus* spp. were low at all sampling intervals with an average density of 19 nematodes per 100 cm^3 soil (Table 1). 'Redhaven' fruit number was inversely related to population densities of *Pratylenchus* spp. for 'Guardian®' and 'Stark's Red Leaf' rootstocks in 2002; but, fruit numbers increased with increasing *Pratylenchus* spp. densities for the 'Lovell' rootstock in 2001. In 2002, 'Redhaven' fruit weights were inversely related to population densities of *Pratylenchus* spp. for 'Guardian®' and 'Higama' rootstocks. However, there was an increase in 'Redhaven' fruit weights with increasing *Pratylenchus* spp. densities on 'Bailey', 'Chui Lum Tao', and 'Stark's Red Leaf'. An inverse linear relationship was detected between 'Redhaven' shoot growth and

Pratylenchus spp. population density in 2001 for 'Chui Lum Tao', 'Lovell', and 'Stark's Red Leaf' rootstocks. However, in 2002, 'Redhaven' shoot growth on 'Lovell' rootstocks increased with *Pratylenchus* spp. population density. In 2002, trunk circumference was inversely related to population densities for 'Lovell' and 'Rubira' rootstocks; however, trunk circumference increased for 'Stark's Red Leaf' (in 2001) and 'Higama' (in 2002) rootstocks as nematode populations increased (Table 3).

Population densities of *Xiphinema* spp. were recovered at most sampling dates, with an average density of 46 per 100 cm^3 soil (Table 1) and average population densities were inversely related to many growth and yield variables in 2001 and 2002 (Table 3). The number of 'Redhaven' fruit in 2001 was inversely related to population densities for 'Bailey', 'Chui Lum Tao', 'Guardian®', and 'Lovell' rootstocks. For 2002, *Xiphinema* spp. population densities were also inversely related to 'Redhaven' fruit number on the 'Higama' rootstock, while fruit numbers increased with increasing population densities on the 'Stark's Red Leaf' rootstock. *Xiphinema* spp. population densities were inversely associated with fruit weights for 'Bailey' and 'Chui Lum Tao' rootstocks in 2001, and 'Chui Lum Tao', 'Guardian®', and 'Stark's Red Leaf' rootstocks in 2002. Population densities were inversely related to 'Redhaven' shoot growth in 2001 for 'Bailey', 'Chui Lum Tao', 'Rubira', and 'Stark's Red Leaf' rootstocks, and in 2002, for 'Chui Lum Tao'. However, shoot growth in 2002 increased as population densities increased on 'Higama', 'Rubira', and 'Stark's Red Leaf' rootstocks. Population densities of *Xiphinema* spp. were inversely related to 'Redhaven' trunk circumference for 'Guardian®' in 2001, and 'Chui Lum Tao' and 'Stark's Red Leaf' in 2002. However, trunk circumference increased as densities of *Xiphinema* spp. increased for 'Guardian®' rootstocks in 2002.

DISCUSSION

Four of the nine plant-parasitic nematode genera detected (*Meloidogyne*, *Mesocriconema*, *Pratylenchus*, and *Xiphinema*) in southern Illinois peach orchards have been shown to possibly contribute to peach tree decline as well as reduce yields in other production areas (Forer *et al.*, 1984; Huettel and Hammerschlag, 1993; Nyczepir, 1990; Nyczepir *et al.*, 1983; Pinochet *et al.*, 1993, 1996). Damage thresholds in peach have not been established for plant-parasitic nematodes in the lower Midwest. For the most important plant-parasitic nematodes of peach in South Carolina, Dickerson *et al.* (2000) developed economic damage thresholds for clay loam to clay soils (nematode numbers per 100 cm^3 soil): *Mesocriconema* spp. (>39), *Meloidogyne* spp. (>99) and *Xiphinema* spp. (>49). Furthermore, economic damage thresholds for peaches per 100 cm^3 soil in Virginia were lower than those provided for South Carolina (Virginia Tech Plant Disease Clinic and Nematode Assay Laboratory, 2000): *Mesocriconema* spp. (>20), *Meloidogyne* spp. (>20), *Pratylenchus* (>30) and *Xiphinema* spp. (>4). Often, these damaging nematodes, except *Meloidogyne*, were detected in southern Illinois peach orchards at levels greater than these economic damage thresholds for South Carolina and Virginia.

Two peach orchards had *Mesocriconema xenoplax* population densities greater than the economic damage thresholds for South Carolina and Virginia (Table 1). The peach orchard with 442 nematodes per 100 cm^3 of soil, which is more than 10 and 20 times the South Carolina and Virginia damage thresholds, respectively, ultimately required removal because of severe tree debilitation and low yields. The low populations at

other sample sites suggests introduction with nursery stock and/or population increases through repeated peach plantings. Most commercial peach orchards in southern Illinois are multiple generation sites and have had previous peach plantings due to their optimal topographical conditions. Furthermore, the two sites with the highest *M. xenoplax* soil densities have had peach trees replanted into the same sites for multiple generations. Due to the population densities detected in certain orchards, *M. xenoplax* poses an extreme threat to peach culture in southern Illinois due to its involvement in the peach tree short life disease complex (Nyczepir, 1990; Nyczepir and Wood, 1995; Ritchie, 1988; Ritchie and Clayton, 1981).

Meloidogyne spp. were found in all of the orchards but did not exceed damage threshold of >99 juveniles per 100 cm^3 soil (Dickerson *et al.*, 2000); however, population densities of *Meloidogyne* spp. were detected above Georgia's recommended economic damage threshold of ≥1 nematode per 100 cm^3 soil (Davis *et al.*, 2001) at every orchard sampled. Although no distinct trend in the relationships between 'Redhaven' growth and yield parameters with *Meloidogyne* spp. were detected (Table 3), this nematode still poses a potential threat to southern Illinois peach production due to its destructive feeding habit and its role in disease complexes (Esmenjaud *et al.*, 1997; Marull *et al.*, 1991; Pinochet *et al.*, 1996).

Pratylenchus spp. were recovered from all orchards, with most orchards having population densities below the Virginia damage threshold of >30 nematodes per 100 cm^3 soil (Tables 1 and 2). *Pratylenchus* spp. are often migratory endoparasites that feed within the cortex of the root; therefore, densities could be underestimated since only soil samples were examined (Maggenti, 1981). Furthermore, in the *Prunus* rootstock evaluation, 9 of the 16 linear growth and yield response relationships detected were inversely related to *Pratylenchus* population densities. 'Lovell' and 'Guardian®' rootstocks were most often associated with decreased growth and yields, respectively, with increasing population densities of *Pratylenchus*.

Population densities of *Xiphinema* spp. were detected in all orchards; and, in most of the orchards, densities approached or exceeded the South Carolina and Virginia damage thresholds (Dickerson *et al.*, 2000; Virginia Tech Plant Disease Clinic and Nematode Assay Laboratory, 2000). In the *Prunus* rootstock evaluation, 18 of the 23 linear growth and yield response relationships detected (78%) were inversely related to *Xiphinema* population densities (Table 3). 'Bailey', 'Chui Lum Tao', and 'Guardian®' consistently had the greatest yield and shoot growth reduction responses to the *Xiphinema* population densities.

Xiphinema spp. was the most widely distributed of the four major nematode parasites detected in southern Illinois peach orchards. Similar economically damaging, high population densities of *Xiphinema* were found in almost all orchards; and, it was the nematode most often associated with suppression in peach tree growth and yield. Furthermore, this nematode has the potential to vector nepoviruses (Hewitt *et al.*, 1958; Taylor and Brown, 1997). Although *Mesocriconema* was not found at population densities high enough to suppress growth or yield suppression in the *Prunus* rootstock evaluation, the authors have observed specific southern Illinois peach orchards in which this nematode has been highly destructive. The results from our study indicate that *Mesocriconema*, *Pratylenchus*, and *Xiphinema* occur frequently at population densities sufficient to be limiting factors to peach production in southern Illinois.

ACKNOWLEDGMENTS

Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendations or endorsement by Southern Illinois University or the U.S. Department of Agriculture.

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Received: *Accepted for publication:*

2/VIII/2008 *3/V/2008*

Recibido: *Aceptado para publicación:*