INFLUENCE OF TIME ON POPULATION DEVELOPMENT AND PATHOGENICITY OF *TYLENCHORHYNCHUS AGRI* ON *TRIFOLIUM PRATENSE, POA PRATENSIS* AND *TRITICUM AESTIVUM*

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ABSTRACT

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In a greenhouse study conducted from December 1974 to December 1975, *Tylenchorhynchus agri* Ferris populations reached maximum levels in May on winter wheat (*Triticum aestivum* L.), and in July on bluegrass (*Poa pratensis* L.) and red clover (*Trifolium pratense* L.). Dry weights of individual and of cumulative clippings of shoots and dry root weights of infected bluegrass were significantly lighter than those of uninfected plants in May, October and July, respectively. Clover weights showed similar trends. Dense nematode populations at planting reduced the growth of a second planting of wheat.

Additional key words: soil temperature, stunt nematodes, ecology.

RESUMEN

Coates-Beckford, P.L. y R.B. Malek. 1982. Efectos del tiempo sobre el desarrollo de poblaciones y patogenicidad de *Tylenchorhynchus agri* en *Trifolium pratense, Poa pratensis* y *Triticum aestivum.* Nematrópica 12: 7-14.

En un experimento de invernadero de Diciembre 1974 a Diciembre 1975 las poblaciones de *Tylenchorhynchus agri* Ferris alcanzaron niveles máximos en Mayo en trigo invernal (*Triticum aestivum* L.) y en Julio en poa (*Poa pratensis* L.) y en trébol rojo (*Trifolium pratense* L.). Los pesos secos individuales y cumulativos de recortes de tallos y los pesos secos de las raíces de poa infectada fueron menores que los correspondientes de plantas sin infectar en Mayo, Octubre y Julio. Los pesos secos del trébol mostraron tendencias análogas. La presencia de altas poblaciones de nematodos durante la siembra resultó en una disminución en el crecimiento de una segunda cosecha de trigo.

Palabras claves adicionales: temperatura del suelo, nematodo del enanismo, gramíneas, legumbres, pastos, nematodos ectoparásitos, ciclos de vida.

INTRODUCTION

Tylenchorhynchus agri Ferris a species commonly found in Illinois soils has a wide host range among leguminous and graminaceous plants and dense populations of the nematode have been associated with fields showing poor growth of soybeans [*Glycine max* (L.) Merr.] (3). Amosu and Taylor (1) found no pathogenic effects of the nematode on red clover (*Trifolium pratense* L.) and showed that it stimulated plant growth in the greenhouse; numbers of *T. agri* decreased during a 3 mo period. Subsequently, Malek (4) found that *T. agri* required a soil temperature of at least 25C for multiplication on red clover and that the optimum temperature for growth of the plant was well below that for reproduction of the nematode. In earlier studies by Amosu and Taylor (1) temperatures may have been too low (<25C) for nematode reproduction. A greenhouse test with soil temperatures ranging from 14-33C later showed that populations of *T. agri* developed rapidly within 3 mo on several legumes, cereals and other grasses (3). Therefore we attempted to study the temporal changes in population and pathogenicity on three plant species grown in Illinois.

MATERIALS AND METHODS

Population changes and pathogenicity of *T. agri* were studied for a period of 1 yr in a greenhouse. Plants tested were 'Kenland' red clover, 'Newport' Kentucky bluegrass (*Poa pratensis* L.) and 'Benhur' winter wheat (*Triticum aestivum* L.), all hosts of *T. agri* (3). Plants were grown in 12.5-cm diam clay pots containing 850 cm^3 steam pasteurized soil. Clover and wheat were overseeded and after germination seedlings were thinned to five and two/pot, respectively. For bluegrass, each pot was sown with 0.12 g seed, equivalent to a rate of 1 kg/m^2. The soil in pots with clover was inoculated with *Rhizobium* sp.

Soil in each of 35 pots/host plant was inoculated in December 1974 with a suspension of 2,000 *T. agri* and an equal number of pots served as controls. The clover, bluegrass and wheat were inoculated 25, 38 and 10 days, respectively, after planting. Seven groups each containing five replicates of inoculated and uninoculated pots of each crop plant were arranged in a split-plot randomized complete block design on a greenhouse bench. Plants were fertilized at 45-day intervals after nematode inoculation with a commercial solution of 23-19-17 NPK. Fluorescent light was used to extend daylength to 14 hr. Daily mean soil temperatures varied from 22C (range = 14-26C) in midwinter to 28C (range = 23-33C) in midsummer.

Clover and bluegrass were clipped at monthly intervals to 4 cm to measure yield and to simulate stress by grazing under field conditions. At 1, 3, 5, 7, 9, 10 and 12 mo after inoculation, five pots of each crop were selected at random, shoots were cut to soil level and roots washed free of soil. Nematodes were extracted from the soil using the method of Christie and Perry (2). Populations were estimated by determining numbers in replicated 1-ml ali-

quots from 100-ml extract suspensions. Plant parts were oven-dried at 80C and weighed.

Wheat matured 5 mo after inoculation and shoots were removed, dried and weighed. Each pot was replanted with four seeds, emerged plants recorded and subsequently thinned to two seedlings/pot. The number of heads/plant and plant height at heading were measured for both wheat crops.

RESULTS AND DISCUSSION

The numbers of *T. agri* declined on all three crop species during the first month after inoculation, probably because of low midwinter temperatures and high nematode mortality. By March, however, the numbers had increased 4-5-fold as mean soil temperatures began to rise and continued to increase with the advent of summer (Fig. 1). Populations reached maximum levels in July on clover and bluegrass at 100 times their initial density. The maximum population on wheat was smaller and occurred in May synchronously with the maturation of the wheat. Numbers remained stable on wheat during July, despite the scarcity of live roots after replanting in May. After July, *T. agri* populations declined sharply on all crops and remained at low levels until December. Clover supported the greatest density of nematodes, 67,560/pot when the experiment ended in December, with 24,000 in bluegrass and 15,480 in wheat. Nematode population decline may have resulted from intraspecific competition for feeding sites and reduced rate of reproduction as soil temperatures declined, as noted for other species (5).

Monthly clipping weights from infested clover pots were lighter than those from uninfested soil after March, and the differences were significant ($P<0.05$) from May to July (Table 1). Although there was a reduction of the sample weights of cumulative clippings, the differences were never significant (Table 2), nor were there significant differences in root weights except in September.

Monthly clippings of infected bluegrass were consistently lighter than those from uninfected plants, and the differences were significant from May to July and in October and December (Table 1). Within treatments, plant growth was more uniform in bluegrass than in clover. Total clippings from infected bluegrass were significantly lighter than from uninfected plants after September (Table 2). After May, root weights of infected plants were reduced significantly, except in September.

Weights of wheat plants in the first crop did not differ significantly (Table 2) but infected plants were significantly taller than uninfected ones at heading (Table 3). During the second crop, shoots of infected plants were significantly lighter than those of uninfected ones at all samplings, and roots were significantly lighter in July and September (Table 2). Fewer plants emerged and plant heights 3 wk after planting and at heading were much shorter in inoculated soil (Table 3).

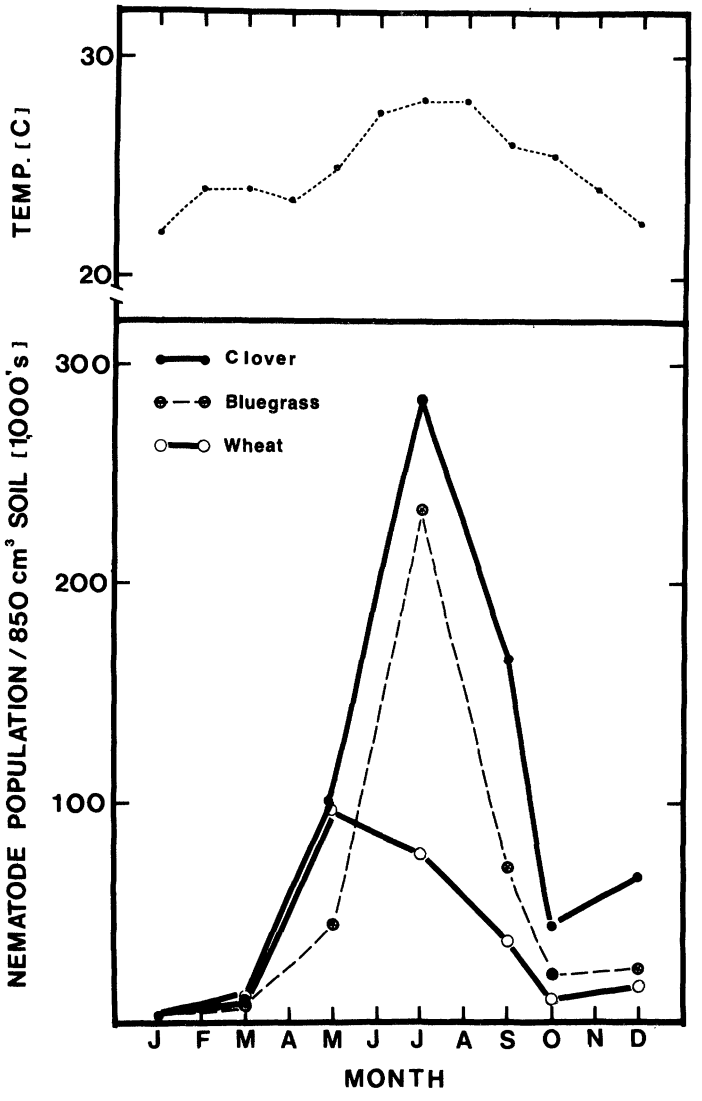

Fig. 1 Mean daily temperature and mean numbers of nematodes recovered from samples of soil supporting bluegrass, clover and wheat during one year after inoculation of soil with 2,000 *Tylenchorhynchus agri*/pot.

Significant differences in clipping weights between infected and uninfected clover and bluegrass occurred during the period when nematode populations were approaching a maximum density and probably were affecting plant growth. Although no differences occurred between cumulative clipping

Table 1. Mean dry weights of shoot clippings from bluegrass and clover at monthly intervals after inoculation of soil with 2,000 *Tylenchorhynchus agri*/ pot.

	Weights (g)					
	Clover			Bluegrass		
Month	No. of observations	Inoculated	Uninoculated	No. of observations	Inoculated	Uninoculated
Jan.	-[z]	-	-	-	-	-
Feb.	30	0.8	0.9	30	1.7	1.7
Mar.	25	3.0	2.9	25	1.9	1.9
Apr.	25	4.7	4.7	25	1.3	1.4
May	20	3.5*	4.1	20	1.2*	1.4
Jun.	15	2.0*	2.6	15	1.2*	1.4
Jul.	15	0.9*	1.3	15	0.8*	1.1
Aug.	10	0.4	0.4	10	0.5	0.6
Sep.	-	-	-	5	0.5	0.7
Oct.	-	-	-	5	0.9*	1.3
Nov.	-	-	-	-	-	-
Dec.	5	1.7	2.5	5	2.3*	2.8

[z] Growth inadequate for clipping

* Significantly different from the uninoculated ($P<0.05$).

Table 2. Mean dry shoot and root weights of clover, bluegrass and wheat at intervals over a period of 1 year, after inoculation of soil with 2,000 *Tylenchorhynchus agri*/pot.

Host		Weights (g) Jan.	Mar.	May	Jul.	Sep.	Oct.	Dec.
Shoots								
Clover	Inoculated	0.2[z]	3.3	11.1	15.3	20.0	15.3	17.2
	Uninoculated	0.2	3.3	11.2	16.8	22.0	18.4	19.9
Bluegrass	Inoculated	2.1	4.0	7.0	8.5	11.6	11.1*	13.3*
	Uninoculated	2.4	4.1	7.3	10.2	13.7	12.3	15.1
Wheat	Inoculated	1.3	4.3	11.9	0.1*	1.0*	1.5*	1.5*
	Uninoculated	1.4	3.7	11.3	0.9	2.3	2.8	2.2
Roots								
Clover	Inoculated	0.1	0.6	1.4	1.9	1.0*	0.1	0.2
	Uninoculated	0.1	0.6	1.5	1.8	1.5	0.3	0.4
Bluegrass	Inoculated	1.2	4.0	2.4	3.1*	2.9	2.2*	2.0
	Uninoculated	0.9	4.6	2.8	5.8	6.9	3.5	3.3
Wheat	Inoculated	0.1	3.3	4.5	0.4*	0.6*	0.5	0.1
	Uninoculated	0.1	3.2	4.0	1.3	1.8	0.6	0.1

[z] Each value is the mean of five replicates

* Significantly different from the uninoculated ($P<0.05$).

Table 3. Height of shoots, number of heads and germination of two consecutive plantings of wheat in soil initially inoculated with 2,000 *Tylenchorhynchus agri*/pot

	Character	No. of observations	Treatment means	
			Inoculated	Uninoculated
First planting	Plant height at heading (cm)	25	85.9*	80.9
	No. heads/pot	25	3.5	3.5
Second planting	No. seeds germinated/pot	20	2.9*	3.6
	Plant height 21 days after replanting (cm)	20	11.1*	27.0
	Plant height at heading (cm)	10	49.3*	58.3
	No. heads/pot	10	0.0	0.1

* Significantly different from the uninoculated ($P<0.05$)

weights of infected and uninfected clover, differences in bluegrass weights showed up in October when nematode populations were declining. Differences in root weights occurred in September for clover, following the maximum population density, but in July for bluegrass simultaneously with the maximum density.

In the first planting of wheat, *T. agri* appeared to stimulate the growth of its host. Growth stimulation probably occurred only at low nematode densities: the growth of the second wheat crop was decreased by high densities at replanting.

T. agri reduced the growth of clover, bluegrass and wheat during the summer when soil temperatures rose and populations increased rapidly. During this season soil may reach temperatures above the optimum for growth of several economic hosts of the nematode, but favourable for its reproduction. Under these conditions *T. agri* probably may contribute to the lowering of crop yields.

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