INFLUENCE OF TEMPERATURE AND INITIAL POPULATION DENSITY ON POPULATION DEVELOPMENT AND PATHOGENICITY OF *TYLENCHORHYNCHUS AGRI* ON *TRIFOLIUM PRATENSE* AND *POA PRATENSIS*

Phyllis L. Coates-Beckford
Department of Botany, University of the West Indies, Mona, Kingston 7, Jamaica.

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ABSTRACT

Coates-Beckford, Phyllis L. 1982. Influence of temperature and initial population density on population development and pathogenicity of *Tylenchorhynchus agri* on *Trifolium pratense* and *Poa pratensis.* Nematropica 12: 15-20.

At initial densities of 0 to 10,000 *Tylenchorhynchus agri* Ferris/pot and temperatures ranging from 22-36C, population increase was fastest at lower densities and at the higher temperatures on bluegrass (*Poa pratensis* L.) and clover (*Trifolium pratense* L.) Pathogenicity of *T. agri* was greatest at higher temperatures.

Additional key words: constant temperature tanks, fluctuating temperatures, life cycles, legumes, forages, grasses, hosts.

RESUMEN

Coates-Beckford, P.L. 1982. Efectos de la temperatura y de la densidad de la población inicial sobre el desarrollo poblacional y la patogenicidad de *Tylenchorhynchus agri* en *Trifolium pratense* y *Poa pratensis.* Nematrópica 12:15-20.

Con poblaciones iniciales entre 0 y 10,000 *Tylenchorhynchus agri* Ferris por maceta y temperaturas entre 22 y 36C el aumento en el tamaño de la población fué más rápido con las temperaturas más bajas que con las altas en poa (*Poa pratensis* L.) y en trébol (*Trifolium pratense* L.). La patogenicidad de *T. agri* fué mayor bajo temperaturas altas que con las más bajas del estudio.

Palabras claves adicionales: biología de nematodos, hospederos, ciclos de vida, gramíneas, leguminosas, pastos.

INTRODUCTION

Tylenchorhynchus agri Ferris was first described from temperate soils in Illinois (4). Nevertheless, Malek (5) showed that it was a thermophilic species. In a host test, *T. agri* parasitized both temperate and tropical plant species (3)

and its pathogenicity increased during the hot summer months when its numbers were increasing rapidly (2). This present study was conducted to clarify the effect of initial population density and temperatures on population increase and pathogenicity.

MATERIALS AND METHODS

The effect of initial density on population increase and pathogenicity of *T. agri* on 'Kenland' red clover (*Trifolium pratense* L.) and 'Newport' Kentucky bluegrass (*Poa pratensis* L.) was studied in constant temperature tanks at 22, 26, 30 and 34C and at soil temperatures fluctuating between 23-36C in a greenhouse. Four clover plants and bluegrass seeded at a rate of 0.12 g/pot were established in 10-cm diam pots containing 400 cm^3 steam-pasteurized soil. For each crop species 0, 100, 1,000, 5,000 or 10,000 nematodes/pot were added to the soil of five groups of 20 pots, 2 wk after planting. Four replicates of each density were arranged in a randomized complete-block design in each tank and on an adjacent greenhouse bench.

Rhizobium sp. was added to the soil in pots containing clover. Bluegrass shoots were clipped to a height of 4-cm, oven-dried at 80C and weighed 45 days after the inoculation of soil with *T. agri.* To avoid overstressing the plants at the higher temperatures, clover was not clipped. All plants were fertilized with a commercial nutrient solution. Ninety days after inoculation, shoots of both plant hosts, cut to soil level, and roots, were oven dried and weighed.

The nematodes were extracted from the soil by using the method of Christie and Perry (1). The size of nematode populations was estimated by counting their numbers in replicated 1-ml aliquots from 100-ml suspensions. The numbers were converted to logarithms and analysed to distinguish significant differences between final populations.

Part of the test with clover was repeated using five replicates/treatment, and here the soil was inoculated with 0, 1,000 or 10,000 nematodes/pot and incubated at 22 and 26C and at temperatures fluctuating from 19-30C. A density of 100 nematodes/pot was added in the latter experiment. Plants in this test were clipped 45 days after inoculation.

RESULTS AND DISCUSSION

In the first test, the influences of temperature and of initial nematode density on population increase were similar on clover and bluegrass (Tables 1 and 2). For the initial densities of 1,000 nematodes/pot and greater, final population levels were not significantly different at temperatures above 26C. At 22C, the lowest experimental temperature, where reproduction was slow, final densities usually increased with increasing initial densities. Growth of clover and bluegrass was poor at 34C, greatly restricting nematode population development.

Shoot weights of clover and clipping weights of bluegrass shoots decreased

Table 1. Numbers of nematodes recovered and dry weights of clover grown at various soil temperatures, 90 days after inoculation of soil with five densities of *Tylenchorhynchus agri* (Test I).

Temperature (C)	Nematode population (Log_{10} n+1) Initial	Final ±	95% Confidence[z] limits	Plant weight (g)[z] Shoot	Root
22	0.00	-		1.44a	0.37a
	2.00	2.66 ±	0.34a	1.45a	0.33a
	3.00	3.85 ±	0.24b	1.25a	0.30a
	3.70	4.48 ±	0.21c	1.08a	0.28a
	4.00	4.48 ±	0.28c	0.95a	0.26a
26	0.00	-		0.50a	0.09a
	2.00	3.02 ±	0.69a	0.48a	0.08a
	3.00	4.91 ±	2.54b	0.41a	0.07a
	3.70	3.81 ±	0.52ab	0.26a	0.05a
	4.00	4.11 ±	0.18ab	0.20a	0.06a
30	0.00	-		0.50a	0.08a
	2.00	3.71 ±	1.19a	0.34ab	0.06a
	3.00	4.08 ±	0.38a	0.16bc	0.04a
	3.70	4.16 ±	0.66a	0.17ab	0.04a
	4.00	3.84 ±	0.55a	0.07c	0.02a
34	0.00	-		0.34a	0.08a
	2.00	2.35 ±	2.56a	0.15b	0.04b
	3.00	3.53 ±	0.41a	0.12bc	0.03b
	3.70	3.32 ±	0.61a	0.01c	0.01b
	4.00	3.32 ±	0.13a	0.03c	0.01b
23-36	0.00	-		1.06ab	0.34a
	2.00	3.99 ±	0.28a	1.19a	0.35a
	3.00	4.75 ±	0.41b	1.79bc	0.24ab
	3.70	4.54 ±	0.41b	0.54cd	0.17b
	4.00	4.55 ±	0.17b	0.44d	0.13b

[z] Each value is the mean of four replicates; column means within temperatures followed by unlike letters are significantly different ($P<0.05$) according to Duncan's Multiple Range test.

with increasing initial nematode densities at 30C, 34C and fluctuating temperatures (Tables 1 and 2). Infested bluegrass also showed severe chlorosis at 30C and 34C. At 26C, only the first clippings of bluegrass showed an inverse relationship between growth and initial density of nematodes. No

Table 2. Numbers of nematodes recovered and dry weights of bluegrass grown at various soil temperatures, 90 days after inoculation of soil with five densities of *Tylenchorhynchus agri* (Test I).

Temperature (C)	Nematode population ($Log_{10}n+1$) Initial	Final ±	95% confidence[z] limits	Plant weight(g)[z] Clipping 1st	2nd	Root
22	0.00	-		0.65a	1.44a	1.03a
	2.00	2.52 ±	0.40a	0.57a	1.31a	0.83a
	3.00	3.83 ±	0.60b	0.73a	1.11a	0.95a
	3.70	4.36 ±	0.20c	0.70a	0.93a	0.75a
	4.00	4.66 ±	0.35c	0.73a	1.14a	0.86a
26	0.00	-		0.89a	1.46a	0.74a
	2.00	3.27 ±	0.64a	0.81abc	1.46a	0.74a
	3.00	4.94 ±	0.24b	0.82ab	1.45a	0.80a
	3.70	4.97 ±	0.16b	0.66bc	1.16a	0.45b
	4.00	4.37 ±	0.53c	0.61c	1.24a	0.49b
30	0.00	-		0.72a	1.40a	0.49a
	2.00	4.54 ±	0.23a	0.51a	1.28a	0.45ab
	3.00	4.50 ±	0.26a	0.62a	0.53b	0.31bc
	3.70	4.45 ±	0.27a	0.41a	0.32b	0.20c
	4.00	4.56 ±	0.34a	0.31a	0.31b	0.21c
34	0.00	-		0.24a	0.77a	0.21a
	2.00	2.20 ±	0.37a	0.21a	0.56b	0.17b
	3.00	3.29 ±	0.27b	0.23a	0.49bc	0.19a
	3.70	3.52 ±	0.24b	0.14a	0.34cd	0.14ab
	4.00	3.56 ±	0.35b	0.11a	0.20d	0.09b
23-36	0.00	-		0.71ab	2.02a	1.23a
	2.00	4.08 ±	0.60a	0.89b	1.81a	1.29a
	3.00	5.04 ±	0.12b	0.69ab	1.73a	0.87b
	3.70	4.81 ±	0.26b	0.62a	0.99b	0.52c
	4.00	4.76 ±	0.30b	0.54a	0.99b	0.47c

[z] Each value is the mean of four replicates; column means within temperatures followed by unlike letters are significantly different ($P<0.05$) according to Duncan's Multiple Range test.

differences occurred at 22C. Significant reduction in the growth of infested clover roots occurred at 34C and fluctuating temperatures, whereas for bluegrass, the reduction of root growth also occurred at 30C.

Table 3. Numbers of nematodes recovered and dry weights of clover grown at various soil temperatures, 90 days after inoculation of soil with three or four densities of *Tylenchorhynchus agri* (Test II).

Temperature (C)	Nematode population ($Log_{10}n+1$) Initial	Final ± 95% confidence[z] limits		Plant weight(g)[z] Clipping 1st	2nd	Root
22	0.00	-		0.28a	0.68a	0.14a
	3.00	3.95 ±	0.15a	0.29a	0.63a	0.14a
	4.00	4.34 ±	0.18b	0.16b	0.42b	0.11b
26	0.00	-		0.24a	0.62a	0.12a
	3.00	4.24 ±	0.25a	0.19a	0.31b	0.08b
	4.00	4.26 ±	0.15a	0.12a	0.25b	0.06c
19-30	0.00	-		0.31a	0.87a	0.22a
	2.00	3.00 ±	0.29a	0.30a	0.90a	0.22a
	3.00	4.09 ±	0.25b	0.29a	0.69b	0.19a
	4.00	4.25 ±	0.00b	0.15b	0.51c	0.12b

[z] Each value is the mean of five replicates; column means within temperatures followed by unlike letters are significantly different ($P<0.05$) according to Duncan's Multiple Range test.

In the repeat trial where clover was clipped, *T. agri* depressed growth at 22C and 26C in contrast to results obtained when plants were not trimmed (Table 3). Weights of first clippings from plants in soil inoculated with 10,000 nematodes were significantly less than those from soil with lower initial densities at 22C and at fluctuating temperatures. Weights of second clippings showed a similar trend at all test temperatures and plants from soil inoculated with 1,000 nematodes also showed reduced growth at 26C and at fluctuating temperatures. At all temperatures the root weights of plants from soil receiving 10,000 nematodes were lighter than those from soil with lower initial nematode densities, and this also applied to roots from soil inoculated with 1,000 nematodes at 26C.

Both initial nematode density and temperature influenced pathogenicity of *T. agri*. The nematode appeared to be pathogenic on suitable hosts only in dense populations. High population levels were reached when the soil temperatures were increased provided that plant growth remained vigorous. Therefore, practices such as the clipping or grazing of plants, which would disrupt their various physiological processes, would probably result in a lowering of their ability to withstand nematode attack, especially in warm soils.

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