RESEARCH/INVESTIGACIÓN

REACTION OF OAT AND WHEAT CULTIVARS AND POACEOUS GRASSES TO THE CYST NEMATODE *HETERODERA GOLDENI*

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ABSTRACT

Ibrahim, I. K. A., S. F. A. Awd-Allah, Z. A. Handoo, A. E. Khalil, and M. Kantor. 2019. Reaction of oat and wheat cultivars and poaceous grasses to the cyst nematode *Heterodera goldeni*. Nematropica 49:189-193.

The reaction of oat, eight wheat cultivars, and five weedy grasses to the cyst nematode *Heterodera goldeni* was studied in the greenhouse. The results showed that oat (*Avena sativa* (L.)) cv. Baladi, the common wheat (*Triticum vulgare* Vill.) cvs. Gemmieza 9, Gemmieza 10, Giza 168, Sids 1, Sakha 93, Sakha 94, and the durum wheat (*T. durum* Desf.) cvs. Bani Sewef 1 and Sohag 3 were susceptible to *H. goldeni*. In another test, the results indicated that the weedy grasses wild oats (*Avena fatua* (L).), Bermuda grass (*Cynodon dactylon* (L.) Pers.), jungle-rice (*Echinocloa colonum* (L.) Link.), barnyard grass (*E. crus-galli* (L.) Beauv.), and canary grass (*Phalaris minor* Retz.) were susceptible to *H. goldeni*. The tested oat, wheat cultivars, and weedy grasses were considered good hosts for *H. goldeni* because the nematode infected and reproduced successfully on all the plants tested. Infection with *H. goldeni* significantly reduced shoot and root dry weights of the oat and wheat cultivars tested.

Key words: Cyst nematode, Egypt, grasses, *Heterodera goldeni*, oats, pathogenicity, poaceous, wheat

RESUMEN

Ibrahim, I. K. A., S. F. A. Awd-Allah, Z. A. Handoo, A. E. Khalil, and M. Kantor. 2019. Reacción de cultivares de avena y trigo y gramíneas poáceas al quiste nematodo *Heterodera goldeni*. Nematropica 49:189-193.

Se estudió en el invernadero la reacción de la avena, ocho cultivares de trigo y cinco gramíneas al nematodo del quiste *Heterodera goldeni*. Los resultados mostraron que la avena (*Avena sativa* (L.)) cv. Baladi, el trigo común (*Triticum vulgare* Vill.) cvs. Gemmieza 9, Gemmieza 10, Giza 168, Sids 1, Sakha 93, Sakha 94 y el trigo duro (*T. durum* Desf.) cvs. Bani Sewef 1 y Sohag 3 fueron susceptibles a *H. goldeni.* En otra prueba, los resultados indicaron que las hierbas herbáceas de avena silvestre (*Avena fatua* (L).), Pasto Bermuda (*Cynodon dactylon* (L.) Pers.), Arroz de la selva (*Echinocloa colonum* (L.) Link.), Corral el pasto (*E. crus-galli* (L.) Beauv.) y el alpiste (*Phalaris minor* Retz.) fueron susceptibles a *H. goldeni*. La avena probada, los cultivares de trigo y los pastos de malezas se consideraron buenos anfitriones de *H. goldeni* porque el nematodo se infectó y reprodujo con éxito en todas las plantas probadas. La infección con *H. goldeni* redujo significativamente los brotes y el peso seco de las raíces de los cultivares de avena y trigo probados.

Palabras clave: Avena, Egipto, *Heterodera goldeni*, pastos, patogenicidad, poáceo, quiste nematodo, trigo

INTRODUCTION

In Egypt, plant-parasitic nematodes, especially the root-knot *(Meloidogyne* spp.) and cyst (*Heterodera* spp.) nematodes, are considered among the most important pests of many economic crop plants (Ibrahim and Handoo, 2007; Ibrahim *et al*., 2010, 2012, 2017). The cyst nematode *Heterodera goldeni* attacking qasaba-grass (*Panicum coloratum* (L.)) was described by Handoo and Ibrahim (2002) from a sample collected in Alexandria, Egypt. *H. goldeni* was also found attacking common reed (*Phragmites australis*) and Dutch rush (*Juncus acutus*) in Iran, as well as the wild grass *Pennisetum clandestinum* in Israel (Tanha Maafi *et al*., 2007). Furthermore, previous studies demonstrated that *H. goldeni* infected and reproduced successfully on sugarcane ratoon seedlings (Tanha Maafi *et al.,* 2007) as well as some corn, sorghum, and rice cultivars (Ibrahim *et al*., 2012).

Recently, *H. goldeni* was found associated with Bermuda grass in Alexandria Governorate, northern Egypt, and may be a potential parasite of major poaceous crop plants such as barley, corn, rice, and wheat. However, investigations into relative host suitability of poaceous crop cultivars and grasses to *H. goldeni* are limited. The objective of this study was to determine the reaction of some oat and wheat cultivars as well as poaceous grasses to the cyst nematode *H. goldeni.*

MATERIALS AND METHODS

An isolate of *H. goldeni* was obtained from infected roots of qasaba-grass in Maamoura, Alexandria, Egypt. This nematode was increased on qasaba-grass in the greenhouse for 60 days, and then mature intact cysts were collected from infected roots and rhizosphere soil (Ayoub, 1980; Ibrahim *et al.,* 2012).

The reaction of oat (*Avena sativa* (L.)) cv. Baladi, common wheat (*Triticum aestivum* Vill) cvs. Gemmieza 9, Gemmieza10, Giza 168, Sakha 93, Sakha 94, Sids 1, durum wheat (*T. durum* Desf.) cvs. Bani Sewef 1 and Sohag 3, and the poaceous grasses barnyard (*Echinochloa crus-galli* (L.) Beauv.), jungle-rice (*E. colonum* (L.) Link.), Bermuda grass (*Cynodon dactylon* (L.) Pers.), canary grass (*Phalaris minor* Retz.), and wild oats (*Avena fatua* (L.)) to *H. goldeni* was determined in a greenhouse experiment. Seeds of the oat and wheat cultivars and poaceous grasses were sown in 20-cm-diam. plastic pots (1.2 liter) filled with equal portions of sterilized sand and clay soil (v/v). After emergence, seedlings were thinned to three seedlings/pot. Three weeks after emergence, soil of treated pots was infested with an initial population density (Pi) of 140 crushed mature *H. goldeni* cysts/pot containing about 10,000 eggs (Ibrahim *et al.,* 2012). The number of *H. goldeni* eggs/cyst ranged from 66-74. Nontreated pots served as controls. All treatments were replicated five times. Pots were arranged in a randomized complete block design in a greenhouse at 20-28ºC. The experiment was conducted twice, in 2018 and 2019.

Ninety days after soil infestation the experiment was terminated. Roots were washed free of soil, and numbers of cysts (final population density, Pf) were counted. The tested cultivars and grasses were rated on a 0 to 5 scale for nematode reproduction factor (Rf), Rf = Pf/Pi. Plants with Rf = 0 were considered resistant, Rf = 0.1-0.5 moderately resistant, Rf = 0.6-1.0 moderately susceptible, Rf = 1.1-5.0 susceptible and Rf > 5 highly susceptible (Ibrahim *et al.,* 2012). The dry weight of the shoots and roots of oat and wheat cultivars were determined by drying the plant material in an oven at 60º C for 48 hr.

Analysis of variance (ANOVA) was conducted on the Pf (cysts/pot) of *H. goldeni* and the dry weights of the shoots and roots using the statistical analysis system (SAS) (SAS Institute, 1997).

RESULTS AND DISCUSSION

Results obtained in 2018 were almost identical to those in 2019 . Oat cv. Baladi, common wheat cvs. Gemmieza 9, Gemmieza 10, Giza 168, Sakha 93, Sakha 94, Sids 1, and Durum wheat cvs. Bani Sewef 1 and Sohag 3 were susceptible to *H. goldeni* with Rf = 1.1-3.2 (Table 1). *H. goldeni* reproduced well with Rf = 2.9-2.3 on oat cv. Baladi followed by Rf = 2.1-2.3 on wheat cvs. Sids, Bani

Sewef 1, and Sohag 3. The other wheat cultivars had relatively low Rf values (Rf = 1.1-1.9). Nematode infection resulted in significant reductions in shoot and root dry weights of the oat and wheat cultivars (Table 2).

All of the tested poaceous grasses were susceptible to *H. goldeni* (Table 3). The nematode infected and reproduced successfully on their roots with Rf = 2.2-3.5. Barnyard grass had the highest Rf value (Rf = 3.3-3.5), whereas other tested poaceous grasses had Rf = 2.2-2.7.

This research demonstrated that the tested poaceous cultivars and grasses were susceptible and good hosts for *H. goldeni* as this nematode infected and reproduced successfully on their roots. The results support earlier studies (Ibrahim *et al.*, 2012) indicating that *H. goldeni* can infect and reproduce on some corn, rice, and sorghum cultivars. Infection by *H. goldeni* significantly decreased shoot and root dry weights of the oat and wheat cultivars (Table 2.) Similar results were reported by Ibrahim *et al.* (2012) who found that infection with *H. goldeni* resulted in reduced growth of some corn hybrids.

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Table 1. Reaction of oat and wheat cultivars to the cyst nematode *Heterodera goldeni.*

		2018			2019		
Plant	Cultivar	Cysts/pot[w]	RF[x]	Host reaction[y]	Cysts/pot	RF	Host reaction
Oat							
	Baladi	454 a[z]	3.2	S	408 a	2.9	S
Common wheat							
	Gemmieza 9	195 d	1.4	S	211 d	1.5	S
	Gemmieza 10	150 e	1.1	S	151 e	1.1	S
	Giza 168	253 c	1.8	S	275 c	1.9	S
	Sakha 93	188 d	1.3	S	200 d	1.4	S
	Sakha 94	150 e	1.1	S	152 e	1.1	S
	Sids 1	309 b	2.2	S	290 b	2.1	S
Durum wheat							
	Bani Sewef 1	322 b	2.3	S	303 b	2.2	S
	Sohag 3	312 b	2.2	S	299 b	2.1	S

[w]Means are average of 5 replicates.
[x]Rf (reproduction factor) = Final nematode population/initial nematode population (Pf/Pi). Pi = 140 cysts/pot.
[y]S = Susceptible.
[z]Means with the same letter in each column are not significantly different at $P = 0.05$.

Table 2. Effect of *Heterodera goldeni* on the dry weights of the shoots and roots of oat and wheat cultivars.

			2018		2019	
			Dry wt (g)[y]		Dry wt (g)	
Plant	Cultivar	*H. goldeni*	Shoot	Root	Shoot	Root
Oat						
	Baladi	+	4.04 b[z]	3.03 b	3.98 b	2.96 b
		-	4.69 a	3.39 a	4.57 a	3.45 a
Common wheat						
	Gemmieza 9	+	4.09 b	3.01 b	4.17 b	2.83 b
		-	4.56 a	3.49 a	4.68 a	3.28 a
	Gemmieza 10	+	4.26 b	3.04 b	3.97 b	3.09 b
		-	4.89 a	3.56 a	4.38 a	3.53 a
	Giza 168	+	4.11 b	3.05 b	3.89 b	2.96 b
		-	4.68 a	3.48 a	4.33 a	3.87 a
	Sakha 93	+	3.71 b	2.77 b	4.07 b	2.92 b
		-	4.19 a	3.18 a	4.48 a	3.76 a
	Sakha 94	+	4.22 b	3.08 b	3.94 b	3.21 b
		-	4.63 a	3.52 a	4.32 a	3.89 a
	Sids 1	+	4.06 b	3.01 b	3.76 b	2.83 b
		-	4.74 a	3.45 a	4.73 a	3.91 a
Drum wheat						
	Bani Sewef 1	+	3.49 b	2.75 b	3.69 b	2.68 b
		-	4.27 a	3.33 a	4.44 a	3.22 a
	Sohag 3	+	3.98 b	3.04 b	3.83 b	2.93 b
		-	4.39 a	3.50 a	4.49 a	3.36 a

[y]Means are an average of 5 replicates.
[z]Means with the same letter within a column for each cultivar are not significantly different at $P = 0.05$.

Table 3. Reaction of five poaceous grasses to the cyst nematode *Heterodera goldeni*.

	2018			2019		
Grass	Cysts/pot[w]	Rf[y]	Reaction[z]	Cysts/pot	Rf	Reaction
Barnyard	461 a[x]	3.3	S	491 a[x]	3.5	S
Bermuda grass	347 c	2.5	S	319 c	2.3	S
Canary grass	372 b	2.7	S	323 c	2.3	S
Jungle rice	317 d	2.3	S	369 b	2.6	S
Wild oats	305 d	2.2	S	338 c	2.4	S

[w]Means are the average of 5 replicates.
[x]Means with the same letter within a column are not significantly different at $P = 0.05$.
[y]Rf (reproduction factor) = Final nematode population/initial nematode population (Pf/Pi) Pi =140 cysts/pot.
[z]S = Susceptible.

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