HOST SUITABILITY OF SOME POACEOUS CROP CULTIVARS FOR *HETERODERA GOLDENI**

I. K. A. Ibrahim[1], S. F. A. Awd-Allah[2], and Z. A. Handoo[3]**

[1]Department of Plant Pathology, Faculty of Agriculture, Alexandria University, Alexandria, Egypt. [2]Department of Nematology, Agriculture Research Center, Ministry of Agriculture, Alexandria, Egypt. [3]Nematology Laboratory, USDA, ARS, Beltsville Agricultural Research Center, Beltsville, MD 20705 USA.** Corresponding author: Zafar.Handoo@ars.usda.gov

ABSTRACT

Ibrahim, I. K. A., M. A. El-Saedy, S. F. A. Awd-Allah, and Z. A. Handoo. 2012. Host suitability of some poaceous crop cultivars for *Heterodera goldeni*. Nematropica 42:324-327.

The host suitability of four corn, four sorghum and five rice cultivars to the cyst nematode *Heterodera goldeni* was determined in the greenhouse. The results showed that *H. goldeni* infected and reproduced successfully on all the tested poaceous crop cultivars. The corn hybrids Pioneer 3062 and SC 10 were susceptible and moderately susceptible to *H. goldeni*, respectively, while the corn hybrids SC 123 and TWC 324 were moderately resistant. The sorghum cultivars Balady, Dorado, Giza 15 and H 1020 were susceptible to *H. goldeni.* The rice cultivars Giza 171, Giza 177, Giza 178, Sakha 101 and Sakha 102 were susceptible or highly susceptible to *H. goldeni*.

Key words: Corn, Egypt, *Heterodera goldeni*, host, maize, rice, sorghum.

RESUMO

Ibrahim, I. K. A. M. A. El-Saedy, S. F. A. Awd-Allah, and Z. A. Handoo. 2012. Susceptibilidad a *Heterodera goldeni* de algunos cultivares de plantas poáceas. Nematropica 42:324-327.

En ensayos de invernadero, se determinó la susceptibilidad al nematodo quiste *Heterodera goldeni* de cuatro cultivares de maíz, cuatro de sorgo, y cinco de arroz. Los resultados mostraron que *H. goldeni* infectó y se reprodujo de manera exitosa en todos los cultivares estudiados. El híbrido de maíz Pioneer 3062 fue susceptible y el híbrido SC 10 fue moderadamente susceptible a *H. goldeni*, mientras que los híbridos de maíz SC 123 y TWC 324 fueron moderadamente resistentes. Los cultivares de sorgo Balady, Dorado, Giza 15 y H 1020 fueron susceptibles a *H. goldeni*. Los cultivares Giza 171, Giza 177, Giza 178, Sakha 101 y Sakha 102 fueron susceptibles o altamente susceptibles a *H. goldeni*.

Palabras clave: arroz, Egipto, *Heterodera goldeni*, hospedante, maíz, sorgo.

INTRODUCTION

In Egypt, plant-parasitic nematodes, especially the root-knot and cyst nematodes, constitute one of the most important pest groups of many economic crop plants (Ibrahim and Handoo, 2007; Ibrahim *et al.*, 2010). The cyst nematode *Heterodera goldeni* was described by Handoo and Ibrahim (2002) attacking qasabagrass (*Panicum coloratum* L.) near the coast of the Mediterranean Sea in Alexandria, Egypt. This nematode is closely related to members of the *H. sacchari* species complex, which is mainly characterized and distinguished from other described *Heterodera* species by the presence of finger-like projections on the strongly developed underbridge in the vulval cone of the cysts.

Subsequently, *H. goldeni* was found attacking common reed *Phragmites australis* and Dutch rush *Juncus acutus* in Iran, as well as a wild grass, *Pennisetum clandestinum*, in Israel (Tanha Maafi *et al*., 2007). Furthermore, Tanha Maafi *et al*. (2007) showed that *H. goldeni* infected and reproduced successfully on sugarcane ratoon seedlings. *Heterodera goldeni* has never been reported from agricultural fields in Egypt, but its presence on grass plants makes it a potential parasite of other major crop plants of Poaceae such as corn, rice, and wheat. However, investigations into the relative host suitability of cultivars of these crops to this cyst nematode are not existant. The objective of the present study was to determine the host suitability and resistance of some corn, sorghum and rice cultivars for the cyst nematode *H. goldeni*.

*Mention of trade names or commercial products in this publication is solely for the purposes of providing specific information and does not imply recommendation or endorsement by the United States Department of Agriculture.

MATERIAL AND METHODS

An isolate of the cyst nematode *H. goldeni* was obtained from infected roots of qasabagrass *Panicum coloratum* L. in Maamoura, Alexandria, Egypt. It was increased on qasabagrass in the greenhouse for 7-8 weeks, then mature cysts were collected from the infected roots (Ayoub, 1980).

The reactions of four corn (*Zea mays* L.), four sorghum (*Sorghum bicolor* (L.) Moench) and five rice (*Oryza sativa* L.) cultivars to *H. goldeni* were determined in three greenhouse tests. Seeds of each of the tested 13 cultivars were sown in 12-cm-diameter plastic pots (0.75 liter) filled with a mixture of equal volumes of sterilized sand and clay soil. After emergence, seedlings of corn, sorghum and rice were thinned to 2, 3, and 5 seedlings/pot, respectively. Two weeks after emergence, soil of treated pots was infested by creating holes near the plant roots and then adding an initial population (Pi) of 75 crushed *H. goldeni* cysts/pot. Uninfested pots of soil with the same cultivars served as controls. Treatments and controls were replicated five times and the experiment was performed once. Pots were arranged in a randomized complete block design in a greenhouse at 20-26 °C.

Experiments were terminated 90 days after soil infestation. Roots were washed free of soil. Numbers of mature intact nematode cysts on roots and in soil (final population, Pf) were counted. The tested plant cultivars were rated on a scale of 0–5 according to nematode reproduction factor (Rf), Rf = Pf/Pi. Plants with Rf = 0 were considered resistant, Rf = 0.1 – 0.5 moderately

Table 1. Reactions of four corn (*Zea mays*) hybrids to the cyst nematode *Heterodera goldeni*.

Corn Hybrid	Treatment	No. of cysts/pot	Rf [x]	Host Reaction[z]	Shoot Dry Weight (g)	Root Dry Weight (g)
Pioneer 3062	*H. goldeni*	181a[wy]	2.41a	S	3.23cd	2.13d
Pioneer 3062	Control	0	0	-	4.08b	3.77a
SC 10	*H. goldeni*	51b	0.67b	MS	3.61c	2.70c
SC 10	Control	0	0	-	5.38a	3.39b
SC 123	*H. goldeni*	20c	0.26c	MR	2.88d	2.77c
SC 123	Control	0	0	-	2.79d	2.64c
TWC 324	*H. goldeni*	13d	0.17d	MR	3.25d	2.74c
TWC 324	Control	0	0	-	3.01d	2.63c

[w]Means are average of 5 replicates.
[x]Rf = Final nematode population/initial nematode population (Pf/Pi). Pi= 75cysts/pot.
[y]Means with the same letter in each column are not significantly different at P=0.05.
[z]MR= Moderately resistant, MS= Moderately susceptible, S= Susceptible.

Table 2. Reaction of four sorghum (*Sorghum bicolor* (L.) Moench) cultivars to the cyst nematode *Heterodera goldeni*.

Sorghum Cultivar	Treatment	No. of cysts/pot	Rf[x]	Host Reaction	Shoot Dry Weight (g)	Root Dry Weight (g)
Balady	*H. goldeni*	151d[wy]	2.10d	S[z]	1.75d	1.53bc
Balady	Control	0	0	-	1.98cd	1.76abc
Dorado	*H. goldeni*	197c	2.62	S	2.20bcd	1.59bc
Dorado	Control	0	0	-	2.86ab	1.68abc
Giza 15	*H. goldeni*	335a	4.46a	S	3.56a	1.90ab
Giza 15	Control	0	0	-	3.78a	2.10a
H 102	*H. goldeni*	260b	3.46b	S	2.07cd	1.43c
H 102	Control	0	0	-	2.60bc	1.46bc

[w]Means are average of 5 replicates.
[x]Rf = Final nematode population/initial nematode population (Pf/Pi). Pi= 75cysts/pot.
[y]Means with the same letter in each column are not significantly different at P=0.05.
[z]S= Susceptible.

Table 3. Reactions of five rice (*Oryza sativa*) cultivars to the cyst nematode *Heterodera goldeni*.

Rice Cultivar	Treatment	No. of cysts/pot	Rf[x]	Host Reaction[z]	Shoot Dry Weight (g)	Root Dry Weight (g)
Giza 171	*H. goldeni*	107d[wy]	1.43d	S	2.40ab	1.84abc
Giza 171	Control	0	0	-	2.79a	1.97ab
Giza 177	*H. goldeni*	211c	2.81c	S	2.12ab	1.54bc
Giza 177	Control	0	0	-	2.30ab	1.85abc
Giza 178	*H. goldeni*	340b	4.53b	S	1.97b	1.48c
Giza 178	Control	0	0	-	1.94b	2.08a
Sakha 101	*H. goldeni*	338a	5.17a	HS	2.17ab	1.61bc
Sakha 101	Control	0	0	-	2.49ab	1.75abc
Sakha 102	*H. goldeni*	335b	4.47b	S	1.84b	1.49c
Sakha 102	Control	0	0	-	2.07ab	1.50c

[w]Means are average of 5 replicates.
[x]Rf = Final nematode population/initial nematode population (Pf/Pi). Pi= 75cysts/pot.
[y]Means with the same letter in each column are not significantly different at P=0.05.
[z]S= Susceptible, HS= Highly susceptible.

resistant, Rf = 0.6 -1.0 moderately susceptible, Rf = 1.1 – 5.0 susceptible and Rf >5 highly susceptible (Golden et al., 1970, Niblack et al., 2002, Young, 1988). Harvested plants were dried in an electric oven at 60C for 48 hours, and dry weights of the root and shoot systems of the harvest plants were determined.

Analysis of variance (ANOVA) was carried out with SAS version 7 (SAS Institute, 1988) on the final population (Pf) of H. goldeni, the reproduction factor (Rf) and the dry weights of the shoot and root systems of the tested plants.

RESULTS AND DISCUSSION

The corn hybrids SC 123 and TWC 324 were moderately resistant to H. goldeni (Rf = 0.17-0.26). Corn hybrid SC 10 was moderately susceptible (Rf = 0.67). On the other hand, corn hybrid Pioneer 3062 appeared susceptible to *H. goldeni* with an Rf of 2.41 (Table 1). Nematode infections resulted in significant reductions in shoot and root dry weights of Pioneer 3062 and SC 10. Previous studies by Awd-Allah, 2005 showed that corn hybrid SC 123 was highly susceptible to the cyst nematode H. zeae Koshy, Swarup & Sethi, 1971.

All tested sorghum cultivars were susceptible to *H. goldeni* (Rf = 2.10–4.46) (Table 2). Nematode infections resulted in no significant reductions in the shoot and root dry weights of the tested sorghum cultivars (Table 2). Previous studies (Awd-Allah, 2005) indicated that the tested sorghum cultivars were either resistant or moderately resistant to the root-knot nematodes *Meloidogyne arenaria* (Neal, 1889) Chitwood, 1949 and *M. incognita* (Kofoid & White, 1919) Chitwood 1949 .

Among the rice cultivars, Sakha 101 was highly susceptible to *H. goldeni* with Rf = 5.17, while the other tested cultivars were susceptible with Rf = 1.43–4.53. Nematode infections resulted in no significant reductions in the shoot and root dry weights of the tested rice cultivars except the root dry weight of rice cultivar Giza 178 (Table 3).

It is evident that the tested rice cultivars were good hosts for *H. goldeni* as this nematode reproduced successfully on their roots. Previous studies showed that rice plants in Africa and Asia were attacked by certain species of the cyst nematodes, e.g., *Heterodera oryzae* in Côte d'Ivoire (Luc and Brizuela, 1961), *H. oryzicola* in India (Rao and Jayaprakash, 1978), *H. sacchari* in Congo-Brazzaville (Luc & Merny, 1963) and Côte d'Ivoire (Babatola, 1983) and in Liberia (Vovlas *et al*., 1986), and *H. elachista* in Japan (Shimizu, 1976).

ACKNOWLEDGMENTS

The authors thank David Chitwood for review of the manuscript and Joseph Mowery for technical assistance.

LITERATURE CITED

Awd-Allah, S. F. A. 2005. Pathological studies on root-knot and cyst nematodes attacking some gramineous crops. M. Sc. Thesis. Faculty of Agriculture, Alexandria University, Egypt. 109 p.

Ayoub, S. M 1980. Plant nematology: An agricultural

training aid. Nema Aid Publications, Sacramento, CA, USA. 195 p.

Babatola, J. O. 1983. Pathogenicity of *Heterodera sacchari* on rice. Nematologia Mediterranea 11:21-25.

Golden, A. M., J. M. Epps, R. D. Riggs, L. A. Duclos, J. A. Fox, and R. L. Bernard. 1970. Terminology and identity of intraspecific forms of the soybean cyst nematode (*Heterodera glycines*).Plant Disease Reporter 54:544-546.

Handoo, Z. A. and I. K. A. Ibrahim. 2002. Description and observation of a new species of cyst nematode *Heterodera goldeni* (Nematoda: Heteroderidae) attacking *Panicum coloratum* in Egypt. Journal of Nematology 34:312-318.

Ibrahim, I. K. A., and Z. A. Handoo. 2007. A survey of cyst nematodes (*Heterodera* spp.) in northern Egypt. Pakistan Journal of Nematology 25:335-337.

Ibrahim, I. K. A., A. A. Mokbel and Z. A. Handoo. 2010. Current status of phytoparasitic nematodes and their host plants in Egypt. Nematropica 40: 239-262.

Luc, M. and G. Merny. (1963). *Heterodera sacchari* n. sp. (Nematoda: Tylenchoidea) parasite de la canne à sucre au Congo-Brazzaville. Nematologica 9: 31-37.

Luc, M. and R. B. Brizuela. 1961. *Heterodera oryzae* n. sp. (Nematoda-Tylenchoidea) parasite du riz en Côte d'Ivoire. Nematologica 6: 272-279.

Niblack, T. L., P. R. Arelli, G. R. Noel, C. H. Opperman, J. H. Orf, D. P. Schmitt, J. G. Shannon,and G. L. Tylka. 2002. A revised classification scheme for genetically diverse populations of *Heterodera glycines*. Journal of Nematology 34: 279-288.

Rao, Y. S. and A. Jayaprakash. 1978. *Heterodera oryzicola* n. sp. (Nematoda: Heteroderidae) a cyst nematode on rice (*Oryza sativa* L.) from Kerala State, India. Nematologica 24:341-346.

SAS Institute. 1988. SAS/ STAT User's Guide, 6th Edition. SAS Institute, Cary, North Carolina, 1028 p.

Shimizu, K. 1976. Influence of the upland rice cyst nematode, *Heterodera elachista*, on the yield of the upland-cultured paddy rice. Japanese Journal of Nematology 6:1- 6.

Tanha Maafi, Z., D. Sturhan, Z. A. Handoo, M. Mor, M. Moens and S. A. Subbotin. 2007. Morphological and molecular studies on *Heterodera sacchari*, *H. goldeni*, and *H. leuceilyma* (Nematoda: Heteroderidae). Nematology 9: 483-497.

Vovlas, N., F. Lamberti and D. K. Tuopay. 1986. Observations on the morphology and histopathology of *Heterodera sacchari* attacking rice in Liberia. FAO Plant Protection Bulletin 34:153-156.

Young, L. D. 1998. Breeding for nematode resistance and tolerance. Pp.187-207, *in* K. R. Barker, G. A. Pedersen and G. L. Windham, Eds. Plant and Nematode Interactions. Agronomy Monograph No. 36. Madison, WI. ASA, CSSA, SSSA Publications.

Received: 9/VIII/2012
Recibido:

Accepted for publication: 16/X/2012
Aceptado para publicación: