REPRODUCTION OF THE RICE ROOT NEMATODE, *HIRSCHMANNIELLA ORYZAE* ON SOME FIELD CROPS AND COMMON WEEDS

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Summary. An investigation was conducted in a screen-house to asses the host status for an Egyptian population of the rice root nematode, *Hirschmanniella oryzae*, of some crop plants cultivated in rotation with rice and weeds commonly occurring in rice fields. The nematode infected and multiplied in the roots of the main host, rice cv. Giza 171, but not in those of cotton, maize, soybean, barley, wheat, Egyptian clover, alfalfa, horse bean and flax. However, the nematode did penetrate and multiply in the roots of several of the selected annual and perennial weeds. Among the weeds and grasses, barnyard (*Echinochloa crus-galli*) and *Juncus* spp. were classified as excellent hosts for *H. oryzae*, juncle rice, red rice, knot grass and bristle rush were classified as good hosts, nut grass, bermuda grass and common reed were classified as poor hosts, but false daisy, red stem or flat sedge and *Ammania* sp. were considered as non-hosts for the nematode.

Keywords: Host status, nematode reproduction, *Oryza sativa*, weeds.

Investigations on the host status for the rice root nematode, *Hirschmanniella oryzae* (van Breda de Haan) Luc *et* Goodey, of some field crops commonly rotated with rice have received attention in the last few decades. Babatola (1979) found that maize, sugar cane, wheat, okra and tomato were susceptible to *H. oryzae*, *H. imamuri* Sher and *H. spinicaudata* (Schuurmans Stekhoven) Luc *et* Goodey, but cowpea, groundnut, sweet potato, pigeon pea, and onion were not. In Egypt, Koura (1980, 1981) showed that the genus *Hirschmanniella* was found in flax and sugar beet soils but at low levels. Recently, Abd-Elgawad *et al.* (2007) found a number of species of plant parasitic nematodes, including of the genus *Hirschmanniella*, in cucurbitaceous crop fields.

With reference to the reproduction of *H. oryzae* on weeds commonly growing in rice fields, Yamasonart (1967) found that in Thailand the rice root nematode could infect ten weed species, among which was *Eclipta alba* (L.) Hasak. In India, Mathur and Prasad (1973) recovered *H. oryzae* from the roots of *Echinochloa crus-galli* (L.) Beauv., *E. alba* and other weed species. Also, this nematode parasitized certain monocotyledonous and dicotyledonous weeds occurring in rice fields (Mohandas *et al.*, 1979). Therefore, the objective of this work is to assess the host status to an Egyptian population of the rice root nematode, *H. oryzae*, widespread in Egyptian rice cropping areas (Eissa *et al.*, 1986, 1992; Bary *et al.*, 1992), of certain crop plants commonly rotated with rice and of weeds commonly growing in rice fields.

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Seeds of the tested crop plants were sown in plastic pots of 15 cm diameter containing 2 kg of solarized sandy loam soil. Five replicates were used for each plant species and cultivar. The winter crop plants alfalfa (*Medicago sativa* L.), barley (*Hordeum vulgaris* L.), flax (*Linum usitatissimum* L.), Egyptian clover (*Trifolium alexandrinum* L.), horse bean (*Vicia faba* L.) and wheat (*Triticum aestivum* L.) were sown in late November. The summer crop plants cotton (*Gossypium barbadense* L.), maize (*Zea mays* L.) and rice (*Oryza sativa* L.) were sown in late June. Some of the crop plants, such as alfalfa, Egyptian clover, rice and wheat, were planted in pots to form dense clumps, whereas the larger plants cotton, flax, horse bean and maize were thinned to two plants per pot before inoculation. Three weeks after emergence of the crop plants, a water suspension of 100 specimens of an Egyptian population of *H. oryzae* was poured around the plant roots in each pot. The nematode inoculum, a mixed population of juveniles, females and males, was extracted from naturally infested soil using the centrifugal-floatation technique (Jenkins, 1964) and picked up individually. All pots were arranged in a completely randomized block design in a screen-house and watered daily. Soil temperature was 30±5 °C in summer and 10±5 °C in winter. Four months after inoculation, the soil of each pot was processed for nematode extraction as mentioned before. The entire root systems were cut into small pieces and incubated in distilled water according to Young (1954).

The tested grass and sedge weeds, commonly found growing in rice fields, were obtained from seeds, tubers or rhizomes and grown in the same size plastic pots of 15 cm diameter, containing 2 kg of solarized sandy loam soil. They were inoculated with 100 specimens of *H. oryzae* per pot one month after sowing or planting tu-

bers or rhizomes. The weeds tested were false daisy [*Eclipta alba* (L.) Hasak], red stem (*Cyperus difformis* L.), nut grass or sedge (*Cyperus rotundus* L.), bermuda grass [*Cynodon dactylon* (L.) Pers.], barnyard grass [*Echinochloa crus-galli* (L.) Beauv.], juncle rice (*Echinochloa colona* L.), red rice (*Oryza sativa* L.), knot grass (*Paspalum distichum* L.), common reed (*Phragmites communis* Trin), bristle rush (*Scripus tuberosus* Deaf), *Juncus* spp. and *Ammania* spp. Three months after inoculation, the weeds were uprooted and soil and roots of each weed species were processed for nematode analysis as described before.

Hirschmmanniella oryzae failed to penetrate into and/or multiply inside roots of the tested crop plants, except rice cv. Giza 171. From pots of the tested crop plants, the nematode was recovered only from the soil, but its populations had declined by 26-100%. The greatest reduction (100%) occurred in the pots planted to soybean cv. Clark followed by cv. Crawford, maize cv. Cairo 1 and Giza 2, horse bean, cotton cv. Giza and flax cv. Giza 6 and cotton cv. Giza 75. Moderate reductions of the nematode population (68-88%) occurred with Egyptian clover cvs Giza 10 and Meskawi followed by wheat cv. Sakha 69 and alfalfa cvs Composite Sewah and El-Wadi El-Gadeid. The least nematode reduction (26%) was caused by barley Composite Hybrid 4.

Hirschmmanniella oryzae was recovered also from the roots of nine weed species out of twelve. On the basis of their relative nematode population potentials (RNPP) (See footnotes of Tables I and II), these weeds were arbitrarily classified into three groups as follows: excellent hosts with RNPP ranging from 61 to 100%; good hosts with RNPP ranging from 11 to 60% and poor hosts with RNPP less than 10%. Thus, *E. crus-galli* and *Juncus* spp. were categorized as excellent hosts for the rice root nematode and *E. colona*, *O. sativa*, *S. tuberosus* and *P. distichum* were categorized as good hosts. The weeds *C. rotundus*, *Cynodon dactylon* and *P. communis* were

Table I. Response of field crop plants commonly rotated with rice to an Egyptian population of *Hirschmanniella oryzae,* inoculated with 100 nematodes/pot.

Family	Scientific name	Common name	Cultivar	Final nematode population *	Reproduction rate (Pf/Pi)	% Nematode population potentials**	Nematode reduction (%)
Summer crops							
Gramineae	*Oryza sativa*	Rice	Giza 171	2160	21.60	100.00	0
	Zea mays	Maize	Cairo 1	2	0.02	0.09	98
			Giza 2	3	0.03	0.14	97
Leguminoseae	*Glycine max*	Soybean	Clark	0	0.00	0.00	100
			Crawford	2	0.02	0.09	98
Malvaceae	*Gossypium barbadense*	Cotton	Giza 75	10	0.10	0.46	90
			Giza 77	6	0.06	0.28	94
Winter crops							
Gramineae	*Hordeum vulgaris*	Barley	Composite Hybrid 4	74	0.74	3.43	26
			Giza 121	64	0.64	2.96	36
	Triticum aestivum	Wheat	Sakha 69	16	0.16	0.74	84
Leguminoseae	*Trifolium alexandrinum*	Egyptian clover (berseem)	Meskawi	24	0.24	1.11	76
			Giza 10	12	0.12	0.56	88
			Sakha 4	32	0.32	1.48	68
	Medicago sativa	Alfalfa	Sirivis	7	0.07	0.32	93
			El-Wadi El-Gadeid	24	0.24	1.11	76
			Composite Sewah	20	0.20	0.93	80
	Vicia faba	Horse bean	Giza 2	3	0.03	0.14	97
Linaceae	*Linum usitatissimum*	Flax	Giza 6	8	0.08	0.37	92

Values are averages of 5 replicates.-

*Population of rice root nematode in soil only except on rice as it is in soil and roots.

** Population potential % = Final population of each crop species or cultivar/the highest final population observed (on rice) x100.

Table II. Response of some common weeds grown in rice fields to an Egyptian population of *H. oryzae* inoculated at the rate of 100 nematodes/pot.

Family	Scientific name	Common name	Life span	Final nematode population			Reproduction rate (Pf/Pi)	% Population potential*	Host response
				In soil	In roots	Total			
Compositeae	*Eclipta alba*	False daisy	Annual	88	0	88	0.88	1.73	NH
Cyperaceae	*Cyperus difformis*	Red stem or Flat sedge	Annual	24	0	24	0.24	0.47	NH
	Cyperus rotundus	Nut grass	Perennial	56	3	59	0.59	1.16	P
Gramineae	*Cynodon dactylon*	Bermuda grass	Perennial	32	1	33	0.33	0.65	P
	Echinochloa crus-galli	Barnyard grass	Annual	4656	434	5090	50.90	100.00	E
	Oryza sativa	Red rice	Annual	1184	589	1713	17.13	34.83	G
	Paspalum distichum	Knot grass	Perennial	648	14	662	6.62	13.01	G
	Phragmites communis	Common reed	Perennial	88	15	103	1.03	2.02	P
	Scripus tuberosus	Bristle rush	Perennial	392	351	743	7.43	14.60	G
Juncaceae	*Juncus* sp.	None	Perennial	721	3250	3971	39.71	78.02	E
Poaceae	*Echinochloa colona*	Juncle rice	Annual	528	237	765	7.65	14.80	G
Lythraceae	*Ammania* sp.	None	Annual	13	0	13	0.13	0.25	NH

-Values are averages of 5 replicates
0-10% population potential = Poor (P)
11-60% population potential = Good (G)
61-100% population potential =Excellent (E)
* Population potential % = Total population on each weed species/the highest total population observed (*Echinochloa crus galli*) x 100.

classified as poor hosts. The nematode did not penetrate into or multiply inside the roots of *Ammania* spp., *C. difformis* and *E. alba*. Therefore, these wild plants were considered as non-hosts for *H. oryza*.

Mathur and Prasad (1973) reported that in India *H. oryzae* was not recovered from the roots of wheat or clover and that the nematode failed to multiply on maize and cotton and other commonly cultivated crops. These results agree with those obtained by Korayem (1993) in Egypt. On the other hand, Babatola (1979) reported that in Nigeria *H. oryzae* multiplied on maize, wheat and cotton. Our study suggests that the field crops commonly included in rice rotations could serve as an effective method of controlling this pest. The evaluation of weeds commonly growing in rice fields for their host status to *H. oryzae* is also important, as these weeds can allow the nematode to survive and reproduce between two successive rice crops. In the present study, some weeds, such as *Echinochloa crus-galli* and *Juncus* spp., were classified as excellent or good hosts for the nematode and, therefore, their control is suggested in rice growing areas. Anwar *et al.* (2011) considered the weeds juncle rice, red stem or flat sedge and knot grass to be good hosts for the rice root nematode in Pakistan, but in the present study red stem was classified as non-host. Babatola (2006) reported that in Nigeria weeds from Cyperaceae and Poaceae families were hosts for *H. spinicaudata*. Also, it was found that the rice root nema-

tode seems to be more active where annual weeds such as *E. crus-galli* are common. Thus, any programme designed to control or limit the spread of rice root nematodes should consider the use of herbicides, plowing, burning and any other weed control measures.

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