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Cultural control of rice root nematodes (*Hirschmanniella* spp.) with *Sphenoclea zeylanica*

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Abstract. *Sphenoclea zeylanica*, a non-host of rice root nematodes, *Hirschmanniella* spp., was found to control them to 95% within 6 weeks and 99% within 8 weeks in a heavily infested field. Water extracts of shoot and the entire plant at highest concentration were toxic to *Hirschmanniella oryzae* at 48 hr exposure whereas that of root were not toxic. But when *H. oryzae* were picked into a tube where the plant was grown hydroponically, 95% of the nematodes were killed at 60 hr exposure.

Keywords. Cultural control; *Hirschmanniella* spp.; *Sphenoclea zeylanica*; rice root nematode.

1. Introduction

Use of non-hosts or poor hosts as rotation crops to reduce the numbers of parasitic nematodes in economic crops has been recognised (Carter and Nieto 1975; Khan *et al* 1975). Rotation of jute (*Chorchorus olitorius*) with rice reduced the numbers of *Hirschmanniella mucronata* (Das 1960) Luc and Goodey 1963 on rice (Anon 1972). Preliminary surveys of several weeds and green manure crops occurring in rice fields indicated that low numbers of *Hirschmanniella* spp. (5–25/100 g soil) occurred in the rhizosphere of a common weed *Sphenoclea zeylanica* Gaertn. (Family—Campanulaceae) whereas 160–400 nematodes were found in plots free of the weed. Mohandas *et al* (1979) reported the weed as a non-host of *Hirschmanniella Oryzae* (Soltwedel 1889) Luc and Goodey 1963. *S. zeylanica* is a succulent herb common in low lying rice fields and has also been found to decompose fast when incorporated into soil. The low numbers of *Hirschmanniella* spp. in soil and their absence in root of *S. zeylanica* suggested their importance and stimulated further studies which are reported here.

2. Materials and methods

2.1. *Field test*

A rice field infested with *H. oryzae* and *H. mucronata* was selected and 10 sub-plots each 2 × 1 m were established. In five plots, *S. zeylanica* was allowed to grow

uniformly (81/m²) while in the other sub-plots, the plants were removed daily to keep the soil fallow. All plots were kept free of other weeds. A composite soil sample of five random sub-samples (2·5 cm diameter × 20 cm depth) was drawn with auger at 15-day intervals. An aliquot of 100 g soil was drawn from the sample and processed for estimation of the nematodes (Rao *et al* 1971). *S. zeylanica* plants (5/sub-plot) were drawn and roots were processed to estimate root population, if any (Rao *et al* 1971).

2.2. *Toxicological assays*

Aqueous extract of shoot, root and the entire plant were prepared by blending 50 g of fresh tissue in 100 ml distilled water and filtered. The filtrate (100%) was diluted to different concentrations (50 and 25). Five active *H. oryzae* were placed into each concentration with four replications and observed at 24 hr intervals. Five nematodes placed in distilled water were used as control.

2.3. *Hydroponic test*

S. zeylanica plants of 15–20 days age were carefully uprooted and transferred with intact root system, into 15 ml aerated distilled water for hydroponic growth in test tubes which were kept in green house to provide light. Active *H. oryzae* were picked into the water at the rate of ten in each tube. Aerated distilled water without the plants in tubes served as control. Mortality was assessed from four tubes at intervals of 12 hr up to 60 hr.

3. Results and discussion

3.1. *Field test*

The per cent reduction in numbers of *Hirschmanniella* spp. in soil with *S. zeylanica* and weed-free fallow was 42 and 22 after 16 days; 81 and 29 after 33 days; 95 and 35 after 48 days and 99 and 39 after 61 days respectively. In soil without *S. zeylanica*, numbers of nematodes declined slowly (39%); whereas, in soil with *S. zeylanica* the decline was 99% within two months (figure 1). The root system of the plant was free of the nematodes.

Many other plants are reported to control other parasitic nematodes over a long period of time, but did not give complete control as has been observed with *S. zeylanica* (Carter and Nieto 1975; Khan *et al* 1971; Ohbayashi and Chikaoka 1973). The additional advantages with *S. zeylanica* is that (i) the weeds can be established in rice fields without much difficulty. (ii) They are succulant and can be incorporated into soil as green manure to provide additional nitrogen before transplanting rice. Other plants, viz. marigolds reported earlier to be effective against parasitic nematodes have to be interplanted with the crop for control of nematodes (Khan *et al* 1971) and they require additional fertilizer for cultivation (Ohbayashi and Chikaoka 1973).

3.2. *Toxicological assays*

Only the highest concentration of whole plant and shoot extracts were toxic to the nematode. All the concentration of root extract and other concentrations of whole plant and shoot were not toxic (table 1).

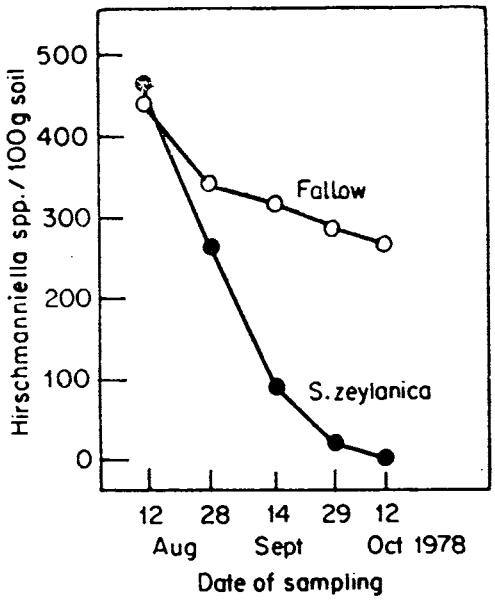

Figure 1. Effectiveness of *Sphenoclea zeylanica* in controlling the rice root nematode (*Hirschimanniella* spp.).

Table 1. Effect of shoot and root extracts of *S. zeylanica* on *H. oryzae*.

Extract	Concentration (%)	No. of nematodes	State of nematodes after	
			24 hr	48 hr
Shoot	100	5	Active	Dead
	50	5	Active	Active
	25	5	Active	Active
Root	100	5	Active	Active
	50	5	Active	Active
	25	5	Active	Active
Whole plant	100	5	Active	Dead
	50	5	Active	Active
	25	5	Active	Active
Distilled water	—	5	Active	Active

3.2. *Hydroponic test*

Mortality was 70% and 95% when the nematodes were exposed to the root exudate for 48 hr and 60 hr respectively (table 2). This indicates that chemicals toxic to the nematodes were released when the plants were kept alive in water.

Table 2. Effect of water bathing hydroponically grown roots of *Sphenoclea zeylanica* on *Hirschmanniella oryzae*.

Medium	No. of nematodes	Exposure time (hr)	Per cent mortality
Water with the culture	10	12	0
do	10	24	10
do	10	36	15
do	10	48	70
do	10	60	95
Distilled water	10	60	0

It is reasoned here that in the field also, the nematodes were controlled by similar substances released by the growing plant. Root exudates of margosa and marigold are found to be toxic to many other nematodes under laboratory conditions (Alam *et al* 1975). However this is the first record of root exudate being toxic to the rice root nematode under field conditions.

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