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Hirschmanniella spp. in Rice Fields of Vietnam[1]

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Abstract: Root and soil samples from one-crop and two-crop rice fields were collected in a survey for *Hirschmanniella* spp. in Vietnam during 1978–80. *Hirschmanniella* spp. were found in 50–78% of the soil samples and 98–100% of the root samples collected. Population densities of nematodes in root systems were lowest at posttransplanting and highest at heading time. Numbers of nematodes inside roots increased 20–22 times from transplanting to heading in fields with both crop sequences. Population densities of *Hirschmanniella* spp. in two-crop rice fields were more than twice those in one-crop rice fields.
Key words: *Hirschmanniella* spp., *Oryza sativa*, rice root nematode, survey, Vietnam.

Hirschmanniella oryzae was first reported as *Tylenchus oryzae* on rice (*Oryza sativa* L.) in Java, Indonesia (1). Subsequently, this species was reported from several countries and areas (Japan, Thailand, India, Pakistan, Malaysia, Madagascar, Sri Lanka, Nigeria, Venezuela, U.S.A., and Ivory Coast) (2,5,6). Sher (5) revised the genus in 1968, describing or redescribing 15 species, 7 of which were from rice roots. *Hirschmanniella* spp. were found for the first time in Vietnam in a general survey of nematodes made during 1974–78 (3).

Most rice in Vietnam is grown in flooded fields. The rice crop has four distinct growth stages: 1) seeding to transplanting (20–25 days), 2) transplanting to tillering (ca. 30 days), 3) tillering to heading (ca. 30 days), and 4) heading to harvest (ca. 30 days). Seedlings grown in high-lying seed beds are transplanted three to a hill with hills ca. 30 cm apart. Either one or two crops of rice are grown each year in Vietnam. A single crop is grown in fields flooded only by monsoon rains. During the dry season these fields are planted to vegetables, soybean, or tobacco. Two crops are grown in low-lying fields that remain flooded throughout the year. When a rice crop is not growing in these fields, they may contain up to 15 different weeds and grasses. Before a new crop of rice is transplanted, the weeds and grasses may or may not be cut off before being plowed under and allowed to decay.

A survey of *Hirschmanniella* spp. in rice fields in Vietnam was conducted during 1978–80, with 960 root and soil samples collected from one-crop and two-crop rice fields at various stages of growth.

MATERIALS AND METHODS

Two hundred and eighty samples each of roots and soil were collected from 70 fields growing one crop of rice and 200 samples each of roots and soil were collected from 50 fields growing two crops of rice in different parts of South Vietnam. The samples were collected from one hill per site at five widely separated sites in each field 1 week after transplanting (posttransplant), at tillering, at heading, and at harvest. All of the fields surveyed were 0.1 ha or larger. The subsamples were mixed, and nematodes were extracted from a 100-cm^3 aliquant of soil by centrifugal flotation in sugar solution. Nematodes were extracted from the roots by a modified Baermann funnel technique using 20% of the roots taken from five hills of rice.

RESULTS

High population densities of *Hirschmanniella* spp. found in the later stages of rice growth (Table 1) were associated with discolored, deteriorating, and rotting rice roots with no apparent above-ground symptoms except for small plant size. Table 2 shows percentages of soil and root samples containing *Hirschmanniella* spp. At posttransplant, 98% of the roots sampled

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TABLE 1. Population densities of *Hirschmanniella* spp. from soil (100 cm^3) and root (one hill) samples collected in Vietnam from 70 one-crop and 50 two-crop rice fields at various stages of growth.

	Soil					Root				
Field type	Trans*	Tillering	Heading	Harvest	Av	Trans*	Tillering	Heading	Harvest	Av
One-crop										
Average	3	2	4	5	4	12	86	267	92	114
Range	0–13	0–31	0–18	0–65		0–52	0–812	30–1,600	12–419	
Two-crop										
Average	8	6	4	18	9	26	223	534	165	237
Range	0–40	0–45	0–25	2–117		0–210	6–400	50–2,720	29–650	

* Trans = 1 week posttransplant.

were infected, whereas 100% were infected at later stages of growth. Infested soil samples varied from 50% at heading to 98% at harvest.

An average of four nematodes in 100 cm^3 soil occurred in samples from one-crop fields compared with nine per sample from two-crop fields. Averages for the root samples were 114 nematodes per sample for one-crop fields and 237 for two-crop fields. More than twice as many specimens of *Hirschmanniella* spp. occurred in rice roots in two-crop fields flooded all year long than in one-crop rice fields which were flooded for only part of the year. Nematode population densities in rice roots increased 20–22 times from transplanting to heading in both one-crop and two-crop fields (Table 1).

DISCUSSION

In two-crop fields, population densities of nematodes in the soil were low at posttransplant, tillering, and at heading and higher at harvest of rice (Table 1). That is logical because before transplanting rice, weeds and grasses in the fields are plowed under and the decomposition of their roots releases nematodes into the soil. After rice seedlings are transplanted into the fields, the nematodes enter the roots and thus populations in the soil decrease. After the rice plants form seed heads, the nematode populations in the soil increase, because at that time many of the older roots decay and the nematodes move out. The deterioration of roots also explains the decrease in nematode population densities in the roots at harvest. However, because more nematodes were found in roots than in the soil at all stages of plant growth, root samples were a better indicator of distribution of *Hirschmanniella* spp. than were soil samples.

The quantitative differences in root population densities of *Hirschmanniella* spp. in roots of one-crop versus two-crop rice is because these nematodes are parasites of marsh plants as well as rice (4). Fields flooded for 12 months a year and growing two crops of rice furnish marshy conditions and plants (rice or weeds) for continuous year-round nematode reproduction in the tropical climate of Vietnam. In monsoon-flooded fields, marshy conditions exist and nematode reproduction occurs only part of the year.

Preliminary data (Khuong, unpubl.) have shown that in inadequately fertilized fields, 800 or more specimens of *Hirschmanniella* spp. in roots per hill of rice at heading may result in economic damage. Thus, if ca. 40 nematodes are present in roots from a sin-

TABLE 2. Percentage of samples with *Hirschmanniella* spp. in 960 samples of soil and roots of rice plants in different growth stages.

Plant growth stage	Soil	Root
One week posttransplant	72	98
Tillering	61	100
Heading	50	100
Harvest	98	100

gle hill of rice one week after transplanting, economic damage can be expected, as these 40 would be expected to increase to 800 by heading. The number of nematodes that cause damage, however, is correlated with the amount of fertilizer used (2). Larger numbers of nematodes are required to cause economic damage when rice is fertilized.

Although sometimes *Hirschmanniella* spp. were found around the root systems of dry-season crops (vegetables, tobacco, etc.) in single-crop rice fields, population densities were always low, indicating that dry soil conditions may result in decline of populations of these nematodes and (or) that dry-season crops may not be hosts. During the survey, roots of at least 15 weeds and grasses, including *Cyperus* spp., *Echinochloa crusgalli, Fimbristylis* sp., and *Leptochoria chinensis*, were found infected by *Hirschmanniella* spp.

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