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Population Dynamics of *Hirschmanniella oryzae* in the Rice Root of Farmer Fields as Affected by Edaphic Factors

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Abstract: Population dynamics of *Hirschmanniella oryzae* were determined per 5 g root basis from the roots at different plant growth stages by survey of irrigated rice in Madarganj (Jamalpur district), Madhupur (Tangail district), Sutiakhali, Nilukkhar char and Bangladesh Agricultural University Farm (Mymensingh District) during December 2001 – March 2002. The highest nematode population 30.5/5 g root was recorded in BAU Farm having soil pH 5.6 sandy loam texture, 1.88% OM and balanced fertility status followed by a population 24.8/5 g root in Madhupur having soil pH 4.4, loamy texture and 0.99 % OM peak population was observed at soft dough stage covering booting, flowering and milking stage. The reduction in nematode population was recorded from hard dough to mature stage.

Key words: Rice, root nematode, *Hirschmanniella oryzae*, farmer fields

INTRODUCTION

Rice is the main cereal crop in Bangladesh. It covers about 75.5% of the total cropped area having 26.68 million acres and the only source of cash income for many farmers[1]. The total rice production in Bangladesh is about 23.07 million metric tons[1]. There are many constraints responsible for low yield of rice in Bangladesh. Among the constraints, disease is considered to be the most important one. About 43 diseases recorded, so far, to occur on rice in this country[2]. Plant parasitic nematodes are found to be harmful in rice cultivation. Among the plant parasitic nematodes, the rice root nematode, *Hirschmanniella spp.* are one of the most common nematodes inhabiting rice paddies throughout the world. Eleven species attack rice roots[3-6]. Although they were earlier considered to be the single species, *Hirschmanniella oryzae*. Vander Vecht and Bergman[7] observed the nematode penetrating into the roots of healthy rice plants, feeding on the parenchymatous tissues and multiply in them, the root cortex becoming discoloured. Reduction in total sugar, decrease in amino acids and liberation of phenols are some of the metabolic changes that have been recorded in *Hirshmanniella oryzae* infected rice crops[8]. The loss in vigor and yield are usually more prominent in non-fertilized crops than the fertilized ones. In non-fertilized fields, the yield loss may be upto 31% as against 19% in fertilized plots[9]. Soils are of different types viz., heavy clay, clay, clay loam, loany, sandy loam, sandy etc. These different types of soil and some other edaphic factors like soil texture, soil pH, soil organic matter etc. have great impact on survival, multiplication and density of a number of plant parasitic nematodes. Certain nematodes thrive well in specific types of soil and continue their parasitic activities. The present study has been undertaken to see the effect of different edaphic factors on the population dynamics of *Hirschmanniella oryzae* in irrigated rice field.

MATERIALS AND METHODS

Experimental site: The experiment was carried out in the farmers field of Madarganj (Jamalpur district), Madhupur (Tangail district), Sutiakhali, Nilukkhar char near the river Brahmaputtra and also BAU Farm (Mymensingh district). The laboratory work was performed in the Nematology Laboratory, Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh.

Assessment of soil related factors: For each location soil related factors viz., soil texture, soil pH and soil organic matter were assessed in the laboratory of Soil Science Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh.

Collection of samples: Soils along with hills of rice Cv. BRRI Dhan 29 were collected from selected locations at booting, flowering, milking, soft dough, hard dough and harvesting stages of growth of rice plant. In each growth stage, three samples were collected randomly from three fields of each location and brought to the laboratory in separate polythene bags.

Extraction of nematodes: Nematodes from roots were extracted by modified Baermann funnel technique[10]. Nematodes were counted under steriobinocular microscope.

Killing, fixing and identification: Isolated nematodes were killed by keeping them in a drop of water on the glass slide and moving over the flame of a spirit lamp with to and fro motion. Killed nematodes were preserved in TAF fixative solution kept in small vials with proper labeling. Preserved nematodes were identified followed the identification keys of C.I.H. sheets[6].

Analysis: Average of the nematode from three replications of each collected sample of each stage from each location were taken. The data on the number of nematode per 5 g root were analysed statistically following the RCBD to find out the level of significance.

RESULTS AND DISCUSSION

Soil analysis shows that Madarganj (Jamalpur district) soil is sandy loam in type having 66.04% sand, 23% silt and 10.96% clay. Madhupur (Tangail district) soil is loamy textured with 49.04% sands, 32% silt and 18.96% clay. Sutiakhali soil is also loamy soil having 41.04% sands, 35% silt and 23.96% clay. Nilukkhar char soil is found loamy textured containing 35.04% sand, 42% silt and 4.96% clay. Soil pH of the selected locations were assessed before sample collection. In that time following soil pH 5.9, 4.4, 5.4, 5.6 and 5.6 were recorded in Madarganj, Madhupur, Sutiakhali, Nilukkhar char and BAU farm soil, respectively. Organic matter in different soils were recorded to be 0.92, 0.99, 1.06, 1.38 and 1.88% in Madarganj, Madhupr, sutiakhali, Nilukkhar char and BAU farm soil, respectively (Table 1). Of the five locations, the highest number of root of *Hirschmanniella oryzae* was found in the rice root of Bangladesh Agricultural University farm in mist of the growth stages compared to other locations (Table 2). In the overall location wise population, significantly (p=0.05) the highest number 30.5 of the nematode was found in the rice root of BAU farm. Comparatively, higher and identical number 26.8 of the nematode was found in the rice root of both Madarganj and Nilukkhar char. Significantly lower and identical numbers 25.1 and 24.8 of the nematode in the rice root were observed in Sutiakhali and Madhupur, respectively (Table 3). Again in the overall Stage wise population. The highest significant (p=0.05) number 37.4 was found at soft dough stage. Significantly higher number 33.9 of the nematode was found at milking stage. Comparatively, lower number 29.3 of nematode was noted at flowering stage flowed by 23.3, 19.6 and 17.3 nematodes at booting, hard dough and harvesting stages, respectively (Table 4). Population of *Hirschmanniella oryzae*, significantly the highest population of the nematode was observed at soft dough stage followed by milking, flowering, booting and hard dough stage. The harvesting stage was found to have the minimum root population. The highest population of rice root nematode *Hirschmanniella oryzae*, was found to be prevalent at the highest level in the root of BAU soil compared to the other locations in all growth stages of rice. This might be due to application of balanced fertilizer

Table 1: Characteristics of soil from five locations

Location of soil collection	pH	% OM	Texture% Sand	Slit	Clay	Textural class
Madarganj	5.9	0.92	66.04	23	10.96	Sandy loam
Madhupur	4.4	0.99	49.04	32	18.96	Loam
Sutiakhali	5.4	1.06	41.04	35	23.96	Loam
Nilukkhar char	5.6	1.38	35.04	46	18.96	Loam
BAU farm	5.6	1.88	53.04	42	4.96	Sandy loam
Critical level for rice	5.5 - 7.0	-	2.0	-	-	-

The edaphic characters of five soils were assessed from the soil sciences division of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh

Table 2: Nematode population of *H.oryzae* recorded per 5 g root at different growth stages under different locations

Location	Booting	Flowering	Milking	Soft dought	Hard dought	Harvesting
Madarganj	22.0b	27.3b	34.0ab	43.3a	18.0bc	16.3c
Madhupur	19.0b	27.7b	33.3b	39.0ab	16.0c	14.0d
Sutiakhali	22.7b	26.3b	30.0b	35.7b	18.3bc	17.3bc
Nilukkhar char	24.0ab	28.7b	34.0ab	34.0b	21.0ab	19.0ab
BAU farm	28.7a	38.3a	38.3a	35.0b	24.7a	20.0a

Each values is an average of three replication. Values having same letter(s) do not differ significantly at p=0.05 by DMRT

Table 3: Overall location wise population of (*Hirschmanniella oryzae*) recorded per 5 g root

Location	Nematode population
Madarganj	26.8b
Madhupur	24.8c
Sutiakhali	25.1c
Nilukkhar char	26.8b
BAU farm	30.5a

Table 4: Stage wise variation of population of (*Hirschmanniella qryzae*) recorded per 5 g root under different locations

Growth stage	Nematode population
Booting	23.3d
Flowering	29.3c
Milking	35.9b
Soft dough	37.4a
Hard dough	19.6e
Harvesting	17.3f

Each values is an average of three replications (each location three replications). Values having same letter(s) do not differ significantly at p=0.05 DMRT

with N, P, K and S. Bary *et al.*[11] observed that highest population of *Hirschmanniella oryzae* was obtained at the recommended dosages of N, P and K inorganic fertilizers which improved the rice plant growth with increased nematode population. The balanced fertility in BAU might have worked in accommodating more number of root populations of *Hirschmanniella oryzae*. The very sandy looam characteristic of BAU farm soil with higher percentage of sand, medium silt and lower percentage of clay made the situation congenial for higher population of nematode as similarly observed by Gupta *et al.*[12] working with Hoplolaimus. Verma *et al.*[7] similarly reported that presence of coarse sand and increased soil pH increased nematode population. The higher soil pH (5.6) level along with sandy loam texture of BAU farm soil might have given good scope for development of *Hirschmanniella oryzae*. Babatola[13] found that activity and survival of three *Hirschmanniella* species were poorest at lower pH (3.0). Mohilal *et al.*[14] found significant positive relationship between nematode population and soil porosity and soil pH. More or less, higher populations were observed in Nilukkhar char (Table 2). The very edaphic and nutritional status of BAU soil might have helped in better growth of rice plants along with the development and reproduction of the nematode. Among the different growth stages of rice plants studied, soft dough stage was found to have maximum population followed by milking and flowering stages root populations. The peak period of multiplication of the nematode was found at soft dough stage both in soil and root population, whikeit decreased at the harvesting stage in both the cases. Similar observations were also made by Hendro[15], Ramakrishnan [16] and Korayem[17] working with *Hirschmanniella oryzae*.

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