BIOLOGY OF RICE ROOT NEMATODE *HIRSCHMANNIELLA ORYZAE* (LUC & GODEY, 1964) IN HLAING THARYAR TOWNSHIP

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Abstract

Hirschmanniella oryzae species is known as rice root nematode. This species is endo-parasitic and causes rice root rot disease. Diseased rice plants were collected from the rice fields of Hlaingtharyar Township. The *H. oryzae* nematodes were extracted from the roots of these rice plants. The biology of *H. oryzae* in this study field was observed that juvenile to adult took 1 week and adult to juvenile 3 weeks, juvenile to juvenile 4 weeks and adult to adult 4 weeks. Three generations had occurred during the rice growing season.

***Keywords*:** biology, rice root nematode, *Hirschmanniella oryzae*

Introduction

Rice is the dominant staple food crop in the developing countries. Almost 90 percent of rice is produce and consumed in Asia, and 96 percent in developing countries (FAO, 2004). In Myanmar, rice is the national food crop. Rice production needed for local consumption as well as for export. However, rice crop is subjected to a number of pests and diseases and plant parasitic nematodes are generally regarded as potentially serious constraints to crop productively. Among the rice diseases, nematode infestation can result in yield losses of up to 30 percent in general (Doberman and Fairhurst, 2000). More than one hundred species of plant parasitic nematodes have been found associated with cultivated rice. Four major species occur in the rice growing areas of Myanmar. They are rice stem nematode, *Ditylenchus angustus*, White tip nematode, *Aphelenchoides besseyi*, rice root-knot nematode, *Meloidogyne graminicola* and rice root nematode, *Hirschmanniella oryzae* (Mya Mya, 1983). *Hirschmanniella* spp. are long, slender nematodes, which enter the roots to feed and reproduce. They feed on root cell and near the base of the root hair, killing the cells in the process. Heavily attacked roots become the base of the root hair, killing the cells in the process. Heavily attacked roots become dark brown or black and eventually rot (Throne, 1961).

Rice root nematodes are well adapted to conditions in marshes and flooded rice paddies. (Taylor *et al.*, 1966). When the paddy becomes dry, the nematode would be remaining dormant until the next season. The nematode usually move out from rice roots into the soil soon after the seed formation or when rice growth ceased and survive in paddy soil up to 7 months (Park, Han and Lee, 1970). The life cycle of *Hirschmanniella oryzae* is egg stage, four larval stages and adult stage. All stages of life cycle are infective (Bridge *et al*., 1990). *Hirschmanniella oryzae* retarded the growth of rice, causing delayed tillering, fewer shoots, discoloration of older leaves and root-rot (Siddiqi, 1973). Yield losses due to the root of disease caused by *H. oryzae* may be much as 50-60% (Mian and Mondal, 1988). Root-rot disease occurred in some rice growing areas of the country; however, information about the disease was very limited. Thus a comprehensive research programmed for biology of *H. oryzae*, are initiated for long term increase in rice productivity. Therefore, the present work is conducted with the following objectives:

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- to investigate the long time of juvile to adult, adult to juvenile and adult to adult
- to assess the biology of *H. oryzae*

Materials and Methods

Study site and Study period

The investigation was conducted in Zoology Laboratory, West Yangon University. Study period lasted from August 2011to July 2012 (Plate. I A).

Biology of the field population pattern of *H. oryzae*

Life cycle of *H. oryzae* was observed in a naturally infested rice variety Theedatyin, Kyunlay Village, Hlaingtharyar Township (Fig. 1, Plate I B). A site with disease rice plants was selected for sample collection. Diseased rice plant samples were weekly collected from this site during the three months of rice growing season. The population of the nematodes in the soil and roots were obtained from selected field. Recording of the nematode population started from two weeks after transplanting of the seedlings in the field. This was done by randomly collecting 5-10 plants with soil and root samples. Soil samples were thoroughly mixed then 100 cc was taken out for nematode extraction by Whitehead tray method .The root samples were washed with tap water and cut into small pieces about 2 cm long and mixed together, and 5 g composite sample was taken out for nematode extraction by Whitehead tray method (Whitehead, 1965). Nematode from soil and roots were placed into counting dishes separately and the nematode numbers were counted into juveniles and adults under a dissecting microscope. Biological study of *H. oryzae* in the field population pattern was done weekly and recorded ten times.

Extraction of plant parasite nematode from soil and roots

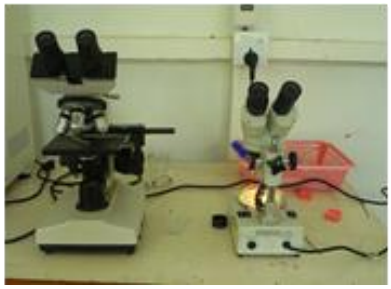
Extraction nematode from rice soils

Nematodes of *H. oryzae* were extracted by using the Whitehead tray Method (Whitehead, 1965). Randomly collected soil samples from each field were thoroughly mixed and 100 ml was taken out for nematode extraction. At first, 100 ml of mixed soil was spread in a thin layer over a muslin cloth in a plastic sieve (15x20) cm. The sieve was placed in a plastic tray (20x25) cm. A mount of 250 ml tap water was carefully added down from the edge of the tray until the soil layer in the sieve looked wet. It is important not to move the sieve after adding water to the tray. After 24 h, the sieve was removed and the nematode suspension in the tray was poured into a glass beaker (300 ml Pyrex) and left for 2-3 h. After which upper portion about 170 ml of suspension was discarded. Remaining 30 ml of nematode suspension in the beaker was thoroughly shaken and 5 ml of the nematode suspension was pipette into a counting dish where *H.oryzae* was examined under dissecting microscope (Plate I C).

Nematode extraction from rice roots

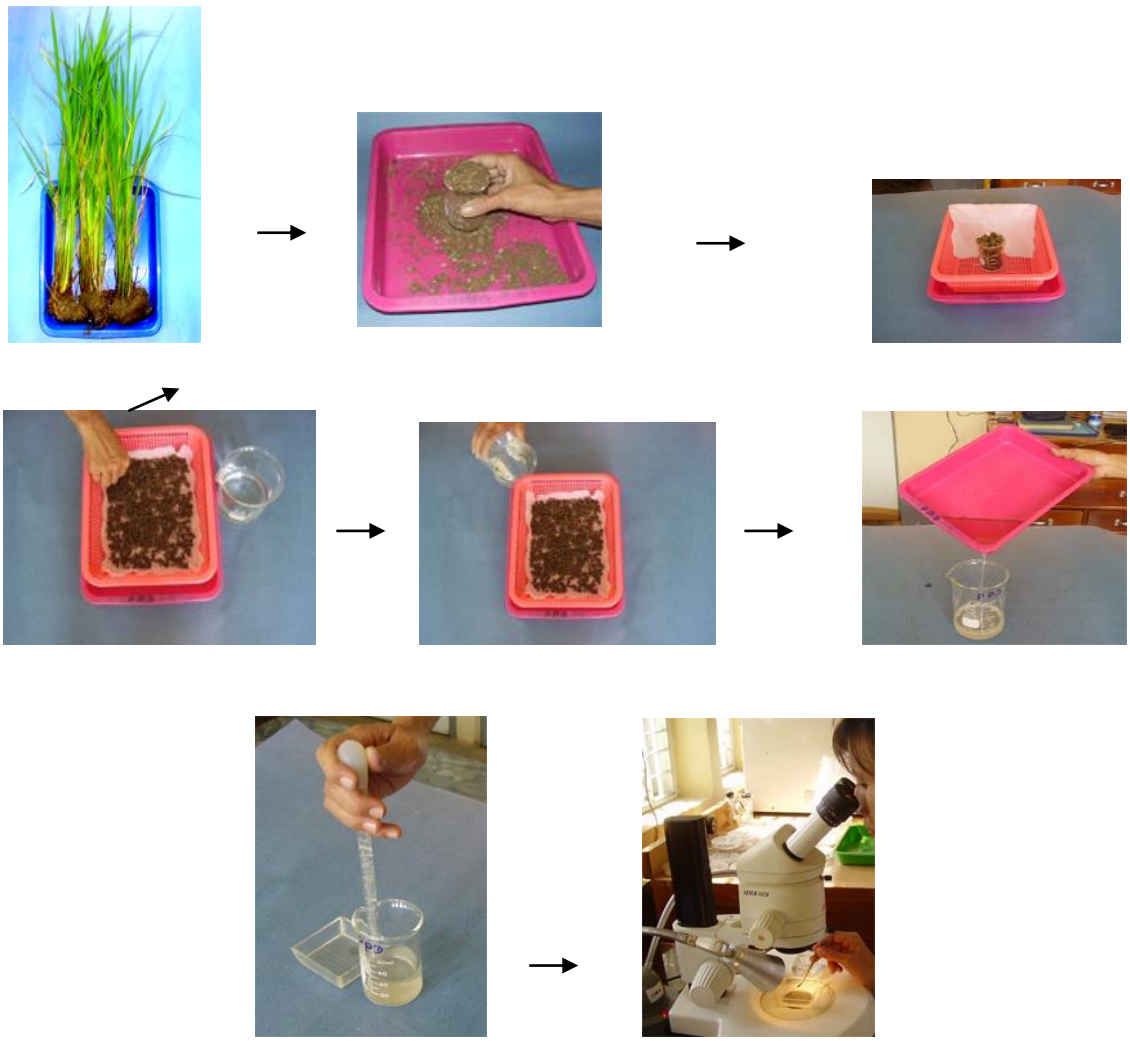
Infected rice root samples were washed with tap water, cut into small pieces about 1 cm long then mixed together. A 100 g of mixed root pieces was spread in a thin layer over a muslin cloth in a plastic sieve (15x20) cm. The sieve was placed in a plastic tray (20x25) cm. A mount of 250 ml tap water was carefully added down from the edge of the tray until the roots layer looked wet. It is important not to move the sieve after adding water to the tray. After 24 h, the sieve was removed from the tray and the nematode suspension from the tray was poured into a glass beaker (300 ml Pyrex) and left for 2-3 h. Upper portion about 170 ml of suspension was discarded and remaining 30 ml of nematode suspension in the beaker was thoroughly shaken and 5 ml of the nematode suspension was pipette into a counting dish where *H. oryzae* was examined under dissecting microscope. Data were analyzed by Microsoft Excel.

Fig. 1 Map of Hlaingthayar Township showing study area (From Department of Geography, West Yangon University)



A. Zoology Laboratory

B. Rice field



C. Extraction of plant parasitic nematode

Plate 1. Study site and extraction of plant parasite nematode

Identification

Morphological characters

Morphological characters of the extracted nematodes were studied under the microscope and recorded by taking the images. The observed morphological characters were; body elongated head hemispherical, stylet with well-developed basal knobs, median bulb ovoid, ventral overlapping esophagus, tail elongate conoid with mucron at tip, male with slightly arcuate spicules and terminal bursa Plate II). The nematode was identified as *Hirschmanniella oryzae* (Luc & Goodey, 1964) according to the key described by Hunt (Hunt, 2000).

Systematic position of *Hirschmanniella oryzae*

Phylum - Nematoda

Class - Secernentea

Order - Tylenchida

Super-family - Hoplolaimoidea

Family - Pratylenchidae

Subfamily - Hirschmanniellinae

Genus - *Hirschmanniella*

Species - *H. oryzae* Luc and Goodey, **1964**

Biology of rice root nematode *Hirschmanniella oryzae*

From this observation the life cycle of *H. oryzae*, juvenile to adult took 1 week, and adult to juvenile 3 weeks. Juvenile to juvenile 4 weeks, and adult to adult 4 weeks. Three generations had occurred during the rice growing season (Fig.2). Juvenile populations were found to be high while adult have a low population. When the adult populations were observed to be high, juveniles were found to below population.

Table 1. Population No. of nematodes *H.oryzae* in life cycle

	J2 (Root+Soil)	Adult (Root+Soil)
6.1.2012	58	74
13.1.2012	324	128
20.1.2012	36	292
27.1.2012	12	310
3.2.2012	0	410
10.20.2012	328	181
17.2.2012	43	298
24.2.2012	10	429
3.3.2012	0	320
10.3.2012	240	134

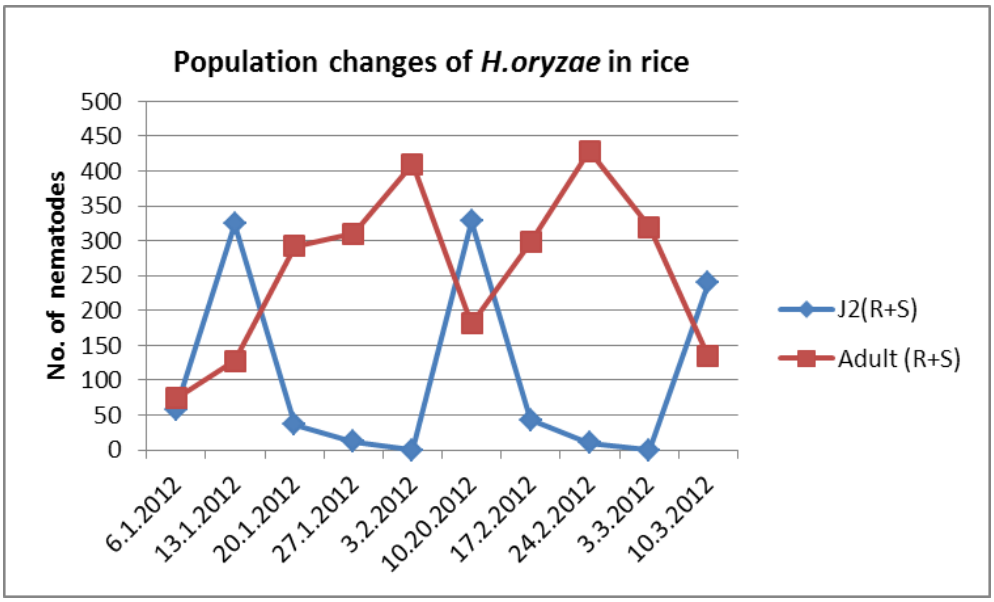
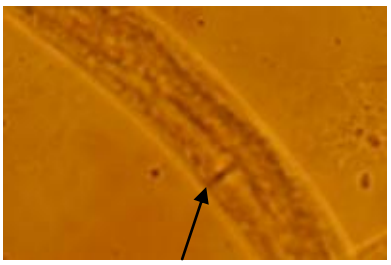


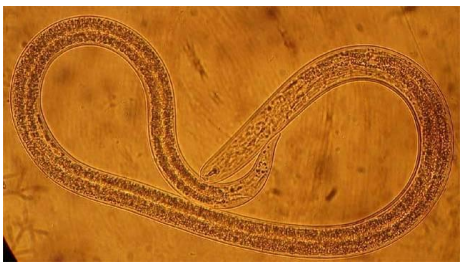
Fig. 2 Biology of rice root nematode *H. oryzae* in rice

A. Female



B. Vulva position

C. Juvenile



D. Male

E. Spicule

Plate II. Morphology of *H. oryzae* Female, Male and Juvenile

Discussion

Hirrschmanniella oryzae species is known as rice root nematode and endoparasite of rice plant. *H. oryzae* is distributed throughout the rice growing region of Myanmar and causes "root-rot" disease. Plants with the root system damaged by nematode showed retarded growth, chlorosis and reduced yield. Solving nematode problems plays an important role in improving crop yield. For managing nematode population to reduce crop loss, it is important to know the life cycle and population changes of *H. oryzae*.

Marthur and Prasard (1972) mentioned that the period from second stage larvae to adult was 4-16 days. This finding agreed with present investigation which showed that second stage juvenile to adult took place 7 days. From the present observation, the life cycle of *H. oryzae*, from juvenile to juvenile took 4 weeks and also adult to adult 4 weeks. Van der Vech and Bergman, (1952) reported that the minimum time of development from egg to adult is at least one month. *H. oryzae*, in West Africa, (produced one generation every 25 days Merny, (1966). According to Tun Win (1976), the duration of adult to adult was 18-24 days.

From this observation, in general, J2 to adult took 1 wk, J2 to J2 and adult to adult took 4 wk each. At the young stage of the plant, numbers of J2 were higher in the roots than those in the soil. Conversely, numbers of J2 at old stage of the plant were higher in the soil than those of in the roots. The older the plants, the more J2 were found in the soil. When juvenile numbers increase, there is competition for food and space, thus most of the juveniles migrate to new sources of food. The adult become old and they cannot migrate or move actively as the juvenile, thus there were more juveniles in the soil.

Then the adult it might be because of the age of plants. Root cells at old stage became harder than at the young stage, and more J2 could enter the young roots than old roots. In contrast, the more numbers of adult were observed in the roots of older plants than those in the soil. It, probably, because adults could easily enter the roots than J2 did. It might be stylets of adults were strong enough to enter the hard roots.

It is concluded that, the younger the plants are, the more J2 in roots were found. Conversely, in the older of the plants, the more numbers of adults in roots were found.

Babatola and Bridge (1980) examined that juvenile of *H. oryzae* were found as root tips and along the lateral roots, however roots growth after five weeks and were observed groups of adult nematodes within the roots. Ichinohe (1988) stated that large portion of the *H. oryzae* population was in the adult stage with the fewer juvenile into the root by the time of rice transplanting. It is finding was in agreement with present experiment of population patterns.

It was also observed from this study that there were three generations during rice planting season. This finding was similar to previous report of Minoru (1973) and Tun Win (1976), who mentioned that there were two or more generations a year. In Senegal, there were three generations (Fortuner and Merny, 1979) and two generations in Japan (Ou, 1985).

From this study, nematode populations reached a peak at 56 days after transplanting. Ramakrishnan (1992) also pointed out that the population of the *H. oryzae* nematode multiplied rapidly and reached a peak at 60 days after transplanting.

Summary

The life cycle of *Hirschmanniella oryzae* in this study field was observed that juvenile to adult took 1 week, juvenile to juvenile 4 weeks and adult to adult 4 weeks. Three generations had occurred during the rice growing season.

Acknowledgement

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