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Biology and life cycle of rice root-knot nematode (*Meloidogyne graminicola*)

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Abstract

Rice root-knot nematode (*Meloidogyne graminicola*) has emerged as a major threat throughout the world and it has occupied a place of 'National Pest' owing to its severity. This is a major constraint in successful rice cultivation leading to the significant loss to the rice grower. The present study was carried to know the biology and life cycle of *Meloidogyne graminicola* under glasshouse condition at Department of Plant Pathology, UAHS, Shivamogga by using cultivar "Jyothi". The results revealed that the infective second stage juveniles of *M. graminicola* entered the rice roots within 24 hrs of inoculation and they started feeding and became stationary. Due to continue feeding the body size increases. The duration of second, third, fourth and adult female stages lasted for 1-5, 6-8, 9-12 and 28 days respectively. Females laid about 250-300 eggs in an egg sac inside the root tissues. The total duration of life cycle including the preparasitic stage was 25-28 days.

Keywords: Biology, Life cycle, *Meloidogyne graminicola*, Rice root-knot nematode

1. Introduction

Rice (*Oryza sativa* L.) is the most important cereal crop worldwide since it provides food security for more than half of the world's human population. Severe yield losses can occur in this economically important crop as a result of infestation by nematodes. Among nematode species reported in association with rice, the most important rice pathogen is considered the root-knot nematode *Meloidogyne graminicola* Golden and Birchfield 1965 which is also listed as a quarantine pest in many countries [1, 2]. Rice root-knot nematode, *M. graminicola* Golden and Birchfield 1965 has emerged as a pest of international importance [3] and further provided an appealing explanation for its emergence as an important pest. A prime example of how a combination of agricultural, environmental, socioeconomic, and policy changes can affect the pest status of a plant-parasitic nematode in the tropics, is illustrated by *M. graminicola* on rice in Southeast Asia. A combination of socioeconomic and environmental changes responsible for increasing water shortages has increased the cost of rice production but, under circumstances severely limiting yields of rice, thus, threatening the food security. The major nematode pests associated with rice are *Ditylenchus angustus*, *Aphelenchoides besseyi*, *Hirschmanniella* spp., *Heterodera oryzicola* and *Meloidogyne graminicola*. However, *M. graminicola* has become a most important pest and is a serious problem in major rice producing countries of the world [4]. It causes yellowing, stunting, reduction of tillering, delayed maturation, and causes yield loss 17% to 32% [5, 6]. Narasimhamurthy (2016) [7] observed that there was no entry of juveniles to the roots at 24 hrs after inoculation and at 48 hrs after inoculation, the Infective second stage juvenile try to penetrate into root through the root tip and enters into the root system entry of juveniles ranged from 1 to 2, Juveniles take a minimum of 48 hours for penetration into root system. Typical for *M. graminicola* is the formation of hook-like galls at the root tip of young roots. Juveniles go through several molts inside the galls and complete their life cycle within approximately two to three weeks, depending on the temperature and flooding conditions [8-9]. Hence the present study was conducted to know the biology and life cycle of rice root-knot nematode (*Meloidogyne graminicola*) infesting rice in glasshouse condition.

2. Materials and Methods

The present study was conducted under glasshouse in Department of Plant Pathology, College of Agriculture, University of Agricultural and Horticultural Sciences,

Navile Shivamogga to know the biology of *M. graminicola*. The experiment was conducted using rice seedlings (cultivar Jyothi) raised in earthen pots containing sterilized soil (1.00kg).

M. graminicola infested roots that were collected during field surveys served as a source of inoculum. Egg masses were collected from the roots and eggs were allowed to hatch by incubating them in tap water for 3-4 days. Two weeks later, the suspension containing around 1000 J₂ were inoculated on to the exposed roots by making holes in the soil around the plant and were covered later by sterilized soil. The mean numbers of nematodes per ml of water were assessed by taking five counts in counting dish. Watering of pots was done regularly to keep the soil just moist by passing through a 400 mesh sieve to avoid contamination through the water. Observations on the development of embryonic or pre parasitic stages, first stage juvenile (J₁) and post embryonic stages or parasitic stages viz., second stage (J₂), third stage (J₃) and fourth stage juvenile (J₄) and adult of *M. graminicola* were recorded.

3. Results and Discussion

3.1. Biology and Life cycle

M. graminicola is the hidden enemy of a rice crop. It is soil borne and microscopic in nature. The investigation on biology of *M. graminicola* is presented in the plate 1, 2 and 3. The investigation on biological studies revealed that as the nematode developed in the egg, it molted to change from a first stage to a second stage juvenile (J₂) which then hatched out from the egg (Plate 3A). The infective second stage J₂ juveniles burrowed into the roots and they entered in to the root system within 24 hrs of inoculation and start feeding. Due to continuous feeding the body size increases, the tail of the nematode remained unchanged which showed spiked appearance and form 3rd stage juvenile. It takes 8 days (Plate 3B) and 12 days to attain 4th stage (Plate 3C). After 20-26th days of inoculation the developing females became typical flask shaped which is called as pre adult stage (Plate 3D) and the posterior region of the body increased in width as the ovary increased in size due to egg production. During feeding, normally the nematode releases enzymes and plant growth hormones into the root. This causes changes in the root's physiology, and "giant cells" were formed around the nematode's head. Nematodes examined after 20 days of inoculation were fully grown (Plate 3E) and the posterior end of the females lied in the middle portion of the cortex region and laid eggs in the gelatinous matrix in the cortex very close to the epidermis. The duration of second, third, fourth and adult female stages lasted for 1-5, 6-8, 9-12 and 28 days respectively. Females laid about 250-300 eggs in an egg sac inside the root tissues. (Plate 3F) The total life cycle including the preparasitic stage was 25-28 days (Plate 2 and 3). Root tissues became enlarged to form a gall or "root-knot" around the nematode and lays about 250-300 eggs in an egg sac inside the root tissues. Duration of different stages in the life cycle of rice-root knot nematode recorded in rice is given in Table 1.

The present results on the biology of *M. graminicola* revealed that the second stage juveniles were attracted to the roots and moved towards the root tip. The infective second stage juveniles of *M. graminicola* entered the rice roots within 24 hrs of inoculation and they started feeding and became stationary. Due to continue feeding the body size increases. The duration of second, third, fourth and adult female stages takes 1-5, 6-8, 9-12 and 28 days respectively. Females laid

about 250-300 eggs in an egg sac inside the root tissues. The total life cycle including the preparasitic stage was 25-28 days. The present results are in agreement with the finding of [10] who recorded egg laying females on the 20th day of inoculation of *M. graminicola* on paddy seedlings. [11] Found that this nematode completes its life cycle in 26-51 days on paddy round the year in eastern parts of India. [12] Reported that *M. graminicola* can complete its life cycle in 15-19 days. [13] Noticed that life cycle of *M. graminicola* takes 24 days for its completion. [14] Reported that *M. graminicola* required 15-20 days to complete its life cycle.

4. Conclusion

The present investigations revealed that the second stage juveniles were attracted to the roots and moved towards the root tip. Infective second stage juveniles of *M. graminicola* entered the roots within 24 hrs of inoculation and they started feeding. Due to continue feeding the body size increases. The duration of second, third, fourth and adult female stages completes at 1-5, 6-8, 9-12 and 28 days respectively and total life cycle completes within 25-28 days.

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Table 1: Duration of different stages in the life cycle of *M. graminicola*

S. No	Life stages	Duration (Days)
1.	Second stage juvenile (J ₂)	1-5
2.	Third stage juvenile (J ₃)	6-8
3.	Fourth stage juvenile (J ₄)	9-12
4.	Adult male	23
5	Adult female	26
6.	Total life cycle	25-28



Plate 1: View of Experimentation on biology of *M. graminicola*; B) infected seedlings 7th day after inoculation

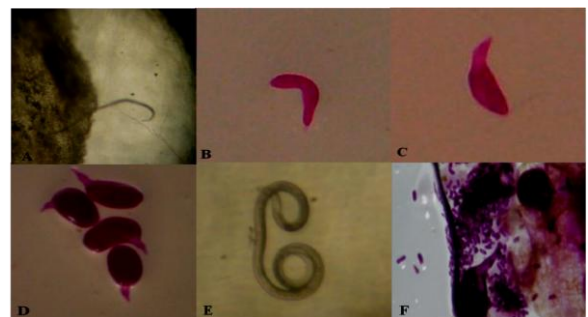


Plate 2: Biology of *M. graminicola*, A) Infective J₂, B) J₃, C) J₄, D) Adult females E) Adult male F) Female and egg

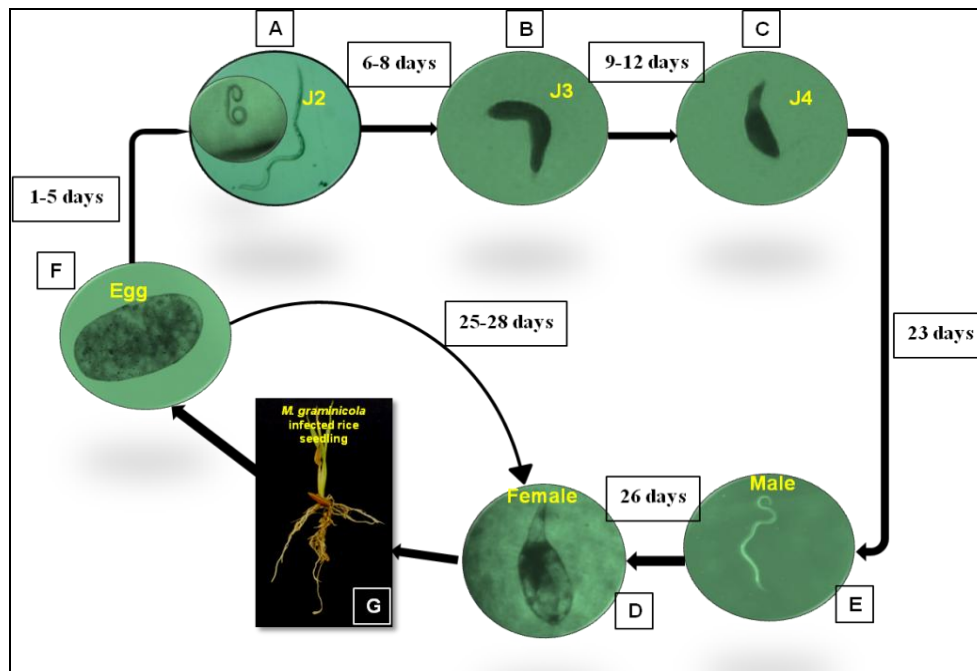


Plate 3: Life cycle of *M. graminicola*

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