P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 4; April 2025; Page No. 253-256

Received: 10-02-2025
Accepted: 15-03-2025

Indexed Journal
Peer Reviewed Journal

Life cycle and pathogenicity of rice root knot nematode (*Meloidogyne graminicola*)

Shivani Chaudhary, Kamal Khilari and Abhishek Kumar

Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

DOI: https://www.doi.org/10.33545/26180723.2025.v8.i4d.1775

Corresponding Author: Shivani Chaudhary

Abstract

Because of its severity, the rice root knot nematode (*Meloidogyne graminicola*) has been designated as a National Pest, making it a serious global hazard. The rice planter suffers large losses as a result of this, which is one of the main obstacles to effective rice production. In order to get a better understanding of the biology and life cycle of *M. graminicola*, the current study used the cultivar "PUSA Basmati 1121" in a laboratory setting at the Department of Plant Pathology, SVPUAT, Meerut. Within 36 hours of inoculation, the infectious second stage juvenile of *M. graminicola* entered the rice root, began feeding, and stayed motionless, according to the data. The life cycle, which included the preparasitic stage, lasted 25 to 30 days, and the females produced between 270 and 320 eggs in a single egg sac inside the root tissue. As the body continues to absorb nutrients, it gets bigger. For females, the duration of the second, third, and adult phases was 1-5 days, 5-9 days, 10-13 days, and 28 days, respectively.

Keywords: *Meloidogyne graminicola*, rice, life cycle, root-knot nematode, PUSA Basmati 1121, plant pathology

Introduction

Rice (*Oryza sativa* L.), which nourishes over 60% of the country's population and influences the economics and way of life of several billion people, mostly in Asia, Latin America, the Middle East, and the West Indies, is one of the most significant staple foods in India. Plant health is always in jeopardy. For this important crop, nematode infection can lead to large output losses. The primary nematode pests associated with rice include *Ditylenchus angustus, Aphelenchoides besseyi, Hirschmanniella spp., Heterodera oryzicola,* and *Meloidogyne graminicola.* However, *M. graminicola* has become a major problem and a pest in the world's leading rice-producing countries. (Jain *et al*., 2012) [6]. The root-knot nematode *M. graminicola* Golden and Birchfield 1965, which is also classified as a quarantine pest in several countries, is thought to be the most significant rice disease among the nematode species linked with rice. All varieties of rice agrosystems are at risk from this nematode, which thrives in flooded areas and creates knots in rice roots. (Bridge *et al*., 2005) [3]. *M. graminicola* on rice in Southeast Asia is a great example of how a combination of agricultural, environmental, social, and regulatory changes can affect the pest status of a plant-parasitic nematode in the tropics. It causes yellowing, stunting, reduced tillering, delayed maturation, and a 17% to 32% yield loss, among other adverse consequences. (Rao & Israel, 1973) [5]. According to (Narasimhamurty, 2016) [4], within 24 hours of the injection, no juveniles entered the roots. Within 48 hours of the inoculation, the infectious second stage juvenile attempted one or two times to enter the root system through the root tip. It took at least 48 hours for juveniles to enter the root system. The development of hook-like galls at the root tip of immature roots is a characteristic of *M. graminicola.* Depending on the temperature and flooding conditions, juveniles go through many moults inside the galls and finish their life cycle in two to three weeks. (Bridge *et al*., 2005) [3]. Finding out more about the biology and life cycle of the rice root-knot nematode (*M. graminicola*), which infests rice under glasshouse conditions, was the goal of the current study.

Materials & Methods

Experimental Site

The Nematology Field & Laboratory, Department of Plant Pathology, College of Agriculture, Meerut, Uttar Pradesh, India, was the site of the study at Sardar Vallabhbhai Patel University of Agriculture & Technology.

Biology and life cycle of rice root knot nematode (*M. graminicola*)

The current study was conducted in a glasshouse to have a better understanding of M. graminicola biology. The experiment was conducted using seedlings of Basmati rice (cultivar Pusa Basmati 1121). They were cultivated in sterile soil (0.50 kg) in earthen pots. The inoculum was derived from *M. graminicola*-infested roots collected during fieldwork. The eggs were taken out of the roots and allowed to develop by incubating them in tap water for one to two days. After two weeks, holes were made in the surrounding soil to inoculate the exposed roots with a suspension that contained around 1000 J2. After that, sterile dirt was spread over the exposed roots. The average number of nematodes per milliliter of water was calculated using five counts in a counting plate. Pots were watered frequently to keep the soil slightly moist. Post-embryonic or parasitic stages, i.e., the second, third, and fourth stages of the juvenile (J2), juvenile

(J3), and adult stages of *M. graminicola*, as well as the embryonic or pre-parasitic stages and the first stage juvenile (J1), were seen.

Pathogenicity test

The PB-1121 cultivar of basmati rice was chosen to perform the pathogenicity test. Sterilized clay soil was put into pots. Each pot included five rice seeds. The pathogenicity of M. graminicola was tested on infected second stage juveniles (J2) at 500, 1000, 1500, and 2000. Second-stage infected larvae were removed from the affected plant. Two days before to the injection, nematode-infected rice plants were collected from the field for this purpose. After being cut into little pieces, the roots of the removed rice plants were rinsed under running water and then teased. The nematode eggs and second stage juveniles (J2) were collected after the rice roots were teased and used for various inoculations. The J2 stage of *M. graminicola* was isolated by spreading the suspension onto a double-layered sheet of tissue paper that was set on wire gauze and then submerged in water in petri dishes. The required number of *M. graminicola* second stage juveniles was inoculated in sterilized pot soil following seven days of seed germination. Control pots were not inoculated with *M. graminicola* J2. Three replications were maintained for each treatment. Data on the root system and galls were recorded thirty days after inoculation.

Results and Discussion

Biology and Life cycle of rice root knot nematode (*M. graminicola*)

Based on scientific studies, the nematode developed in the egg by molting to become a second-stage juvenile (J2), which then emerged out of the egg (Plate 3A). The infected J2 juveniles in the second stage burrowed into the roots and started eating 24 hours after the injection. Due to continuous eating, the nematode's body size expanded, but its tail remained the same, giving it a spiky appearance and developing a third-stage juvenile. It takes 13 days to get to the fourth stage (Plate 3C), whereas Plate 3B requires 8 days. The pre-adult stage (Plate 3D) occurred 25-28 days after inoculation, during which the growing females took on a characteristic flask form. The back portion of their bodies enlarged as the ovaries became larger due to the production of eggs. The duration of the second, third, and fourth phases was: 3-7 days; 8-12 days; 13-16 days; 25-28 days; and 30-31 days, respectively. Females deposit between 250 and 300 eggs in an egg sac inside the root tissues (Plate 3F). The whole life cycle, which lasted 25-31 days, includes the preparasitic stage. The duration of each stage of the life cycle of the rice-root knot nematode is displayed in Table 1 and Plate 1.

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

S. No.	Life Stages	Duration (Days)
1.	Eggs	2
2.	Second stage juvenile (J2)	3-7
3.	Third stage juvenile (J3)	8-12
4.	Fourth stage juvenile (J4)	13-16
5.	Adult female/male	25-28
6.	Eggs Stages	30-31
7.	Total life cycle	25-31

Kavitha *et al.* (2019) [1] noted that the nematode changed from a first stage juvenile to a second stage juvenile (J2) during its molt as it matured within the egg, and then it came out of the egg. Usually, J2, the only infectious stage, burrows into the root at the root tip. The infectious second stage juveniles of *M. graminicola* entered the rice root within 24 hours after inoculation. The nematode stopped moving and started to eat. The body swells from constant eating. The nematode's tail, which had a spiky appearance in the perineal area, did not change throughout this period. The growing females acquired the distinctive flask-shaped appearance known as the preadult stage after 14-15 days of inoculation, and their rear portions became wider as the ovary grew larger due to the production of eggs. The nematodes were completely developed and assessed following a 20-day inoculation period. The duration of the second, third, and adult female stages was five to eight days, nine to twelve days, and twenty-five to twenty-eight days, respectively. The females deposited between 250 and 300 eggs in an egg sac inside the root tissue.

Pathogenicity test of rice root knot nematode (*M. graminicola*)

The pathogenicity test findings, which are shown in Table 2 and Plate 2, show that as the inoculum level of M. graminicola grew, so did the galls and plant root system. The largest number of juveniles per plant was 41.33 galls at 2000. Pots infected with 500, 1000, and 1500 second stage juveniles (J2) of *M. graminicola* yielded an average of 14.22, 27.00, and 35.67 galls/plant, respectively. Galls did not develop in the untreated control. The length of the roots and shoots was also recorded for each treatment. It was demonstrated that the length of the rice plants' roots and shoots reduced as the amount of *M. graminicola* inoculum grew. The maximum shoot length (28.56 cm) and root length (11.89 cm) in untreated pots were measured. The pots with the shortest shoot and root lengths (16.28 cm and 7.39 cm, respectively) were those infected with 2000 J2 of *M. graminicola* per pot. On the other hand, after 30 days after seeding, pots infected with 500 J2 of *M. graminicola* per pot had a root length of 9.28 cm and a shoot length of 24.33 cm.

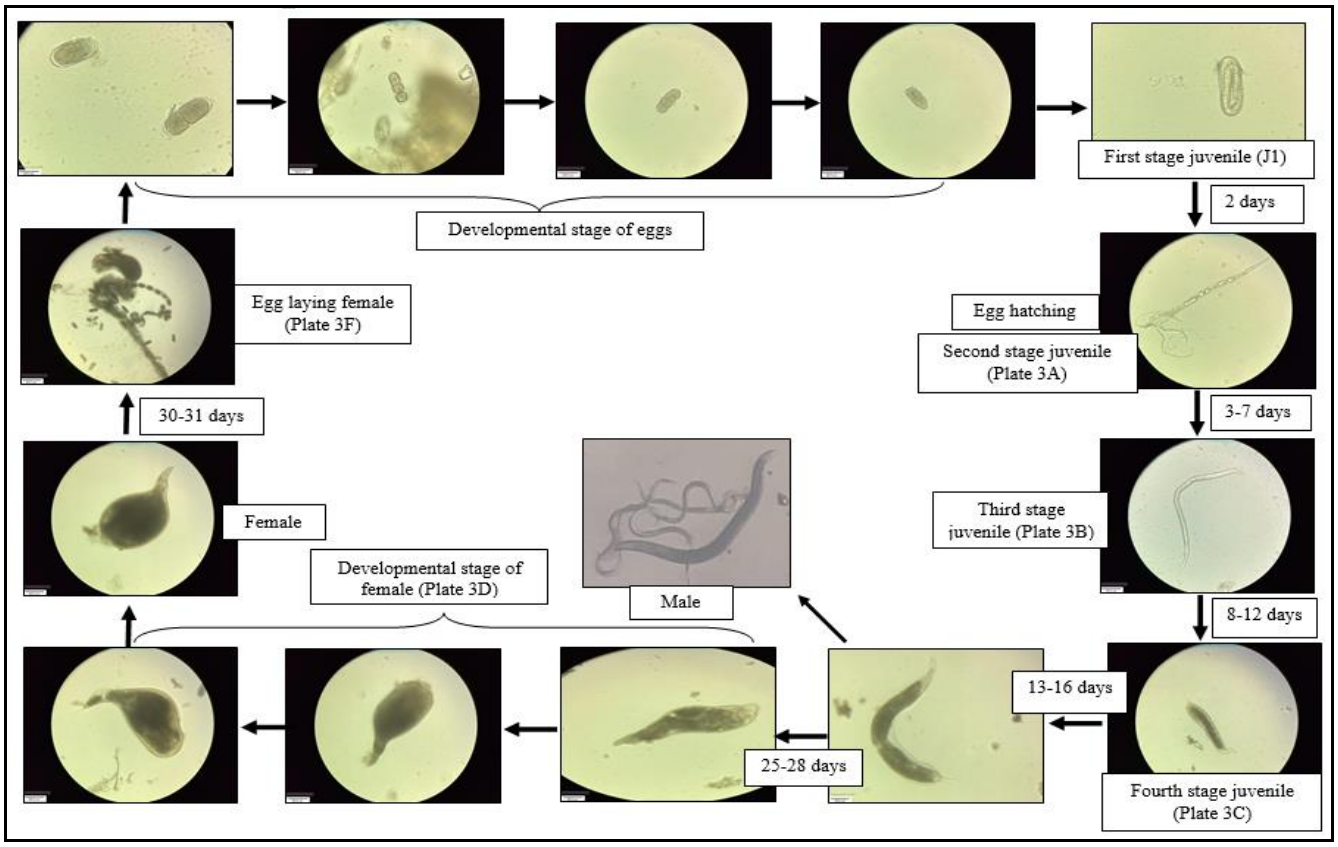

Plate 1: Life cycle of *M. graminicola*

Table 2: Pathogenicity test of rice root knot nematode

Treatment	Average shoot length (cm)	Average root length (cm)	Average galls/plant
500 J2	24.33	9.28	14.22
1000 J2	20.28	9.00	27.00
1500 J2	18.11	8.72	35.67
2000 J2	16.28	7.39	41.33
Control	28.56	11.89	0.00
CD at 5% level	0.641	0.907	2.047

The effects of *M. graminicola* population densities on plant height, heading, and photosynthetic indicators of rice were studied in a greenhouse. Two-week-old rice plants were infected with varying densities of *M. graminicola* (250, 500, 750, 1000, 1500, and 2000 J2s/plant). shown that whereas low *M. graminicola* population densities (0-500 J2s/plant) had no influence on plant height between 30-60 DAI, they dramatically decreased the height of the rice plants, their panicle growth rate, and their panicle length at 90 DAI. Rice inoculated with 500-2000 J2s had a substantially lower chlorophyll content than the control. Additionally, as compared to the control, the *M. graminicola* infection with 500 J2s/plant dramatically reduced the transpiration rate and net photosynthetic rate by 21.21% and 21.81%, respectively.

Conclusion

The current study offers a summary of the life cycle and activity of the root-knot nematode *Meloidogyne graminicola*. Here is a summary of the main points:

1. **Attraction and Movement:** The second-stage juveniles (J2) go toward the tips of the roots because they are drawn to them.
2. **Root Invasion and Feeding:** The J2 reach the roots and start eating 36 hours after inoculation.
3. **Developmental Stages and Duration:** The duration of the J2 stage is 1-5 days. The third stage (J3) lasts for five to nine days. Ten to thirteen days make up the fourth stage (J4). By about 28 days, the female reaches the adult stage.
4. **Life Cycle Completion:** Within 25 to 30 days, *M. graminicola* completes its life cycle.

Acknowledgment

The Department of Science and Technology, Government of India, provided the DST Inspire Fellowship for the experiments, and the HOD of the Department of Plant Pathology, S.V.P. University of Agriculture and Technology, Meerut-250110 (U.P.), provided facilities based on need for this research work.

References

1. Kavitha PG, Devi PA, Ravi V. The rice root-knot nematode, *Meloidogyne graminicola*-life cycle and histopathology. Research Explorer. 2019;5(22):71-75.
2. Chen B, Sikandar A, Ahmad S, Luo M, Wu H. *Meloidogyne graminicola*'s effect on growth performance of rice under low population density. Agronomy. 2022;12(3):587-594.
3. Bridge J, Luc M, Plowright RA, Peng D. Nematode parasites of rice. In: Luc M, Sikora RA, Bridge J, editors. Plant parasitic nematodes in tropical and subtropical agriculture. UK: CABI; 2005. p. 87-130.
4. Narasimhamurthy HB, Ravindra H. Invasion studies and symptomatology of rice root-knot nematode,

Meloidogyne graminicola. Advances in Life Sciences. 2016;5(22):10408-10411.
5. Rao YS, Israel P. Life history and binomics of *Meloidogyne graminicola*, the rice root-knot nematode. Indian Phytopathology. 1973;26(2):333-340.
6. Jain RK, Khan MR, Vinod K. Rice root-knot nematode (*Meloidogyne graminicola*) infestation in rice. Archives of Phytopathology and Plant Protection. 2012;45(6):635-645.