

First report of Root Knot Nematode, *Meloidogyne incognita* infecting Ginger (*Zingiber officinale*) in Jhansi, India

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ABSTRACT

In Jhansi Baruasagar area is a repository of commercially important medicinal plants including ginger (*Zingiber officinale* Zingiberaceae). Ginger is a crucial natural medicine that has been utilized to ameliorate numerous ailments, such as colds, nausea, arthritis, migraines, and hypertension. The investigation was undertaken on ginger crops infected by Root-knot nematodes, *Meloidogyne incognita*. Diseased plants displayed impaired shoot growth and presence of galls on roots and the deposition of numerous gelatinous egg masses. The severe invasion led to the generation of multiple galls, yellow leaves, reduced rhizome size and weight, root rot and gradually plant succumbed to death. The acid fuchsin stain confirmed the presence of *M. incognita* inside the root cells. Infective Juvenile stage (J2), eggs, and females with eggs were observed. The nematode caused histological changes in root tissue in the form of giant cells with multiple nuclei. This is the first report of *M. incognita* infecting ginger in Jhansi.

Figures : 03

References : 12

Table : 00

KEY WORDS : Acid fuchsin, Giant cells, *Meloidogyne incognita*, *Zingiber officinale*

Introduction

Baruasagar area in Jhansi is agroclimatically suitable for the cultivation of tuber crop ginger (*Zingiber officinale*) which has remarkable medicinal and aromatic properties. Since ancient times, ginger has been used to cure a wide range of ailments, including colds, nausea, arthritis, migraines, and hypertension. Ginger's therapeutic, chemical, and pharmacological effects have been well documented⁸.

Plant parasite nematodes are obligate biotrophic feeders that seriously harm the economic viability of growing medicinal and aromatic crops all over the world. Ginger is severely harmed by the destructive sedentary endoparasite root-knot nematode (*Meloidogyne* spp.), whose gravid females lodge and lay eggs in the host plant's roots. The formation of root galls, which reduces growth, nutrient and water uptake, increases wilting, and mineral deficiency, especially during times of moisture stress and high temperature, are signs of nematode infection¹. The distinctive characteristics of root-knot

nematode infestation include gall growth and the appearance of gelatinous egg masses. The present submission is the first report to investigate the histopathological changes caused by *M. incognita* in Ginger in Jhansi.

Materials and Methods

The samples of healthy and diseased rhizomes were gathered from the Baruasagar town of Jhansi, famous for ginger cultivation. The ginger rhizomes infected with *Meloidogyne* spp. were brought to the laboratory and cleaned with tap water to remove soil particles, then cut into small pieces^{5,7,11}. The roots were then cleaned by submerging them for 4 minutes in household bleach (NaOCl) diluted to a concentration of 0.8–2% available chlorine. The roots were rinsed for 45 seconds in running tap water and then soaked in tap water for 15 minutes to remove residual NaOCl. Later the roots were transferred to a beaker with 30-50 ml of tap water. Further, 1 ml of stock solution of acid fuchsin was added, prepared by dissolving 0.875 g acid fuchsin

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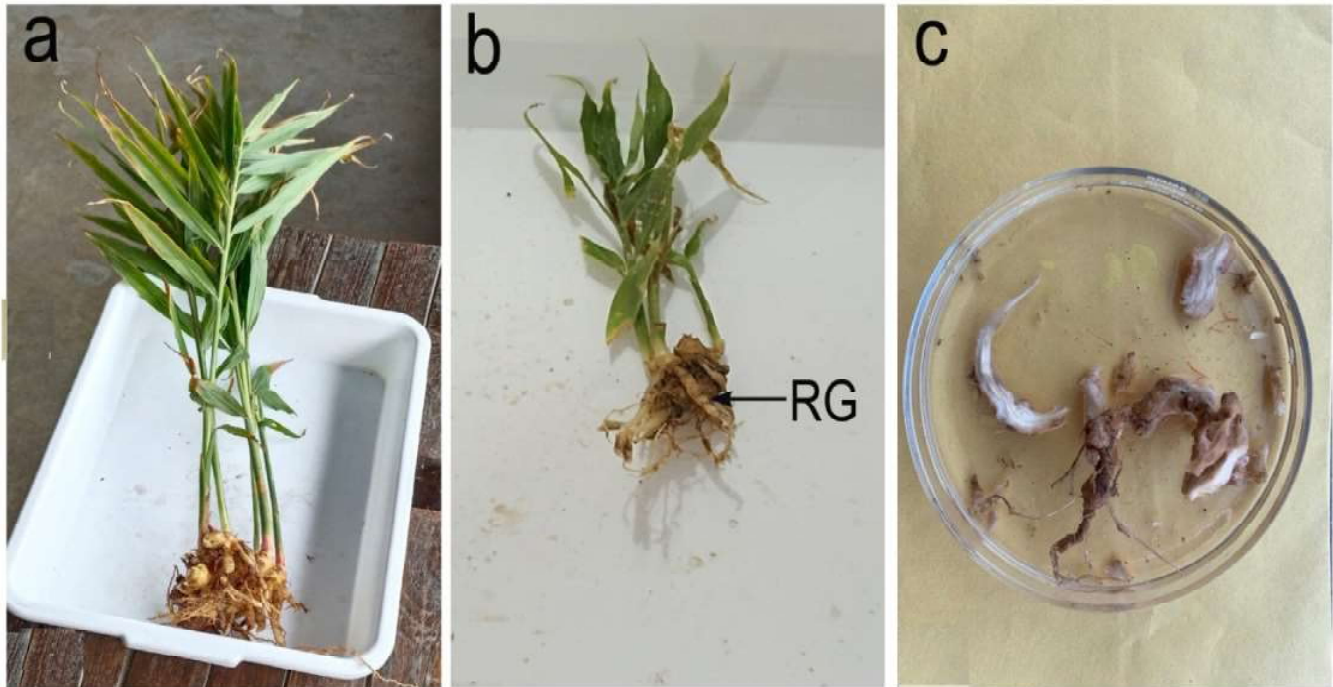


Fig. 1: (a) Healthy rhizome of ginger (b) Infected rhizome and adventitious root of ginger (c) Small pieces of infected rhizome in Petri dish

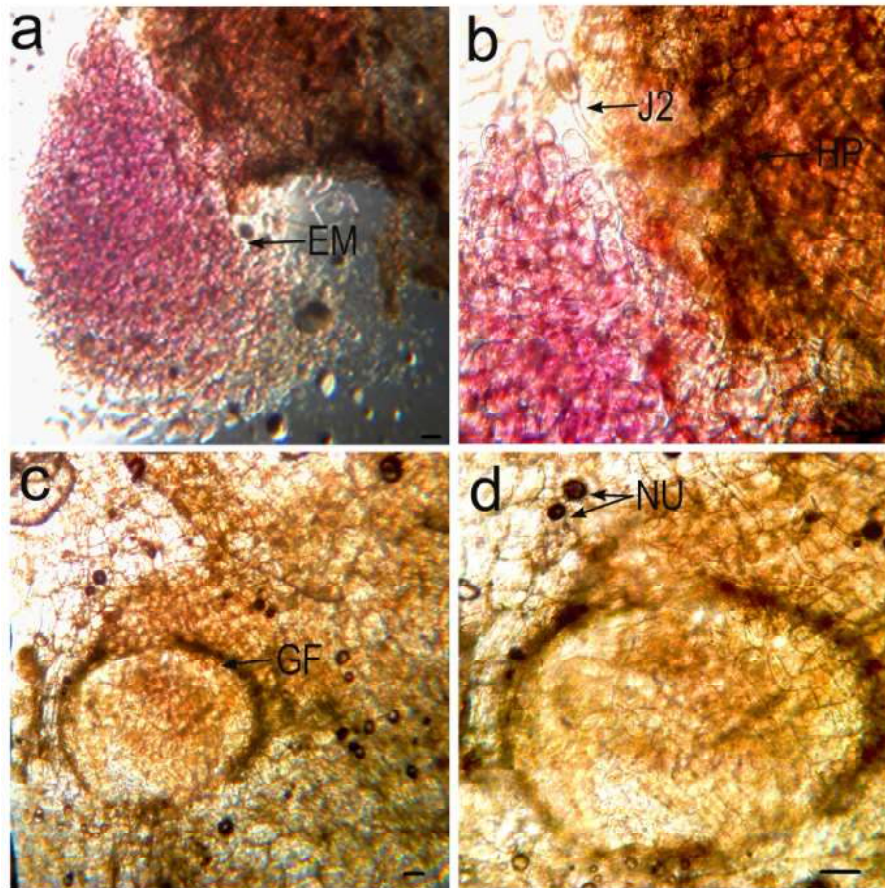


Fig. 2 : (a) Assemblance of Egg Masses (EM) of *M. incognita* close to the root surface. (Bar=100 μ m) (b) The magnified view of 2a displaying EM and J2 (Infective stages) penetrating the Hypodermis (HP) of root. (Bar = 60 μ m) (c) Gravid pear-shaped female (GF) inside the root. (Bar=100 μ m). (d) Magnified view of figure 2c demonstrates the scattered nuclei (NU). (Bar = 60 μ m).

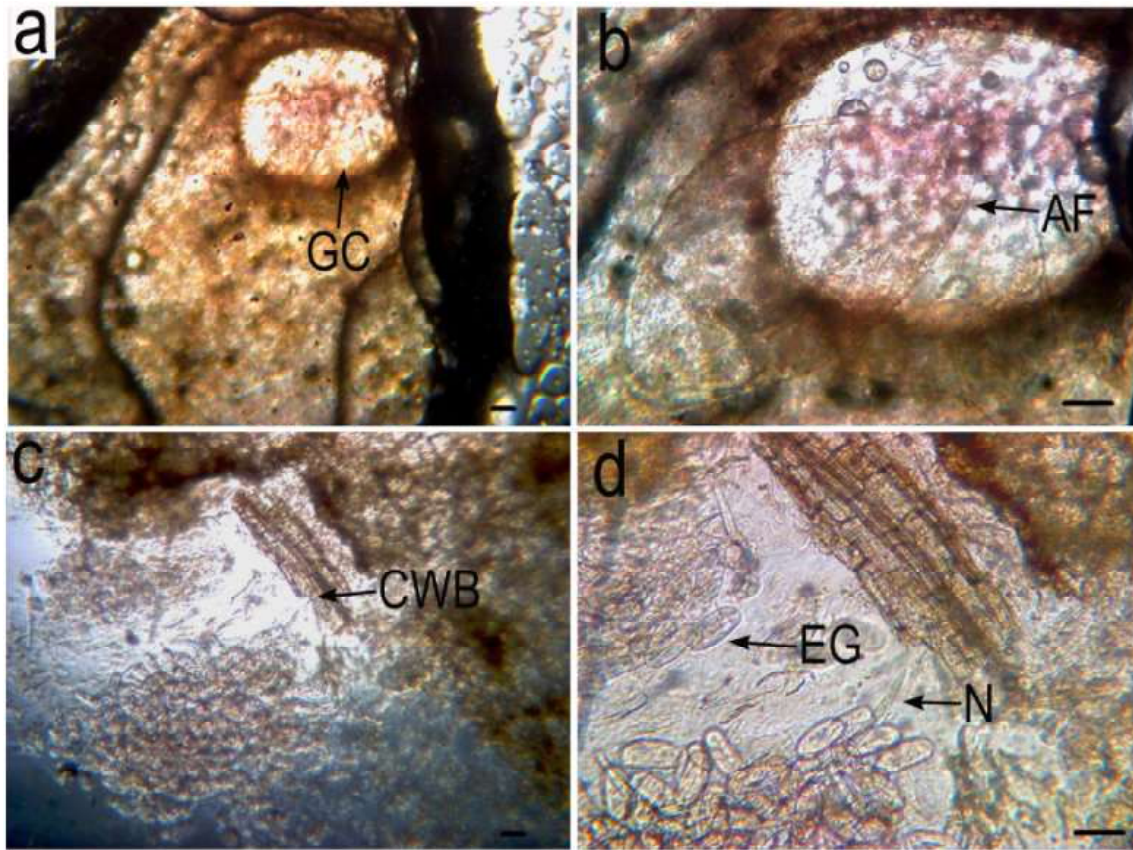


Fig. 3 : (a) Female of *M. incognita* inside the oval-shaped Giant Cell. (GC) (Bar100 μ m). (b) The magnified view of Fig. 3a revealed the Adult Female (AF) in a giant cell (Bar 60 μ m) (c) Figure 3c illustrated the congregation of EM and its infective J2 stage male approaching the root hypodermis and Cell Wall Breakage. (CWB) (Bar 100 μ m) (d) The magnified view of Fig. 3c demonstrated the necrosis held at root hypodermis in Nematodes (N) and Eggs (EG) (Bar 60 μ m).

in 62.5 ml acetic acid and 187.5 ml distilled water. Later the solution was heated to 40°C for about 40 seconds before letting it drop to room temperature. The roots were destained in 30–40 ml of acidified glycerine and mounted slides were observed with a stereomicroscope.

Results

The present investigation was undertaken to observe the morphological and anatomical alterations held in ginger infected by *M. incognita*. Figure 1a displayed the healthy stem and good growth of the rhizome. The yellowness of the leaf, stunted growth of the plant, and reduced size and weight of rhizomes were observed in Fig. 1b. The infested rhizomes of ginger showing the manifestation of root knots and formation of galls in rhizomes area were recorded (Fig. 1c).

The study of the perineal pattern revealed the nematode as *Meloidogyne incognita*. The gelatinous egg masses of this invasive nematode close to the root surface were examined (Fig. 2a). Infective second juvenile stage (J2) of *M. incognita* piercing the root cortex with its hypodermic needle-like feeding apparatus, the

stylet was discerned (Fig. 2b). Giant cells, known as nurse cells, were observed around the anterior part of the adult pear-shaped female nematode. The shape of the giant cells was irregular or ovoid (Figs. 2c and d). Giant cells had uniformly dense cytoplasm, contained multiple nuclei, and had enlarged vacuoles usually conglomerated in the middle of the cell. The number of giant cells at each feeding site differed from four to five, surrounded by a thickened cell wall. The infective J2 penetrated to xylem tissue and finally invaded the vascular system. Later, hyperplasia and hypertrophy of the vascular tissue were seen as consequences. Only the head and neck parts of the nematode entered the vascular system, and the rest oval-shaped posterior part of the female remained in the cortical tissue of the root. (Figs. 3a and b). The J2 stages infringed the endodermal and cortical layer of the root in quest of feeding sites and as a result, necrosis took place (Figs. 3c and d).

Discussion

The observations were made on the occurrence of destructive PPN *M. incognita* in the ginger plant

commonly cultivated at Baruasagar in Jhansi. The study revealed the invasion of *M. incognita* stimulated the formation of root swelling, that interfered with the plant water supply, resulting in stunted and chlorotic shoot growth^{6,9,12}. Similar findings Have been reported in *Vignamungo* and *Cynodondactylon*²⁻⁴.

The eggs and the second-stage juveniles of *M.*

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incognita were found in the proximity of the root surface, which travels intercellularly into the vascular cylinder toward the zone of differentiation for the exploration of a feeding site. The residues of cells inside the giant cells suggested a few closely placed cells that fused to form a giant cell. Multinucleated Giant cells with large vacuoles might act as nutrient sources for the gravid female. A similar observation was recorded in ash gourd¹⁰.

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