Survey, Isolation and Identification of Root Knot Nematode Associated with *Musa acuminata* L. (*Radopholus similis*) Crops in Solapur Region, (M.S), India.

Vijay Shivgunde., Sanket Kamale., Hussain Shaikh. and Valsange.A.B.

Department of Biotechnology, V.G. Shivdare College of Arts, Com and Science, Solapur, India.

Corresponding author
anmolvalasange@gmail.com

Abstract: Root knot nematodes (Meloidogyne spp.) and burrowing nematodes (*Radopholus similis*) are major pests affecting banana (Musa acuminata L.) crops worldwide. This research focuses on the survey, isolation, and identification of *Radopholus similis* in the Solapur region of Maharashtra, India. Field surveys were conducted across multiple banana-growing sites, collecting root and soil samples for nematode extraction and analysis. Morphological and molecular techniques were used for accurate nematode identification. The study revealed significant nematode populations affecting crop health and yield, emphasizing the need for effective management strategies.

Keywords: *Musa acuminata, Radopholus similis*, root knot nematode, Solapur region, nematode identification

Introduction

Banana (*Musa acuminata* L.) is an economically important fruit crop globally and in India. The productivity of banana crops is often threatened by root knot nematodes and burrowing nematodes, particularly *Radopholus similis*, which cause extensive root damage, leading to poor nutrient uptake and yield loss. Plant parasitic nematode cause 21.3% crop losses amounting to RS.102,039.79 million (USD 1.58 BILLION) annually ; the losses in 19 horticultural crops were assessed at RS.50,224.98 million , for 11 field crops it was estimated at RS.51,814.81 million .In Maharashtra were agricultural contributing around 11% to the states GDP ,plant parasitic nematodes suggest significant crop losses it could to reduction in agriculture GDP by 5 to 10%.This study aims to survey the incidence of these nematodes in the Solapur region and identify their impact on banana crops.

Life Cycle of Root Knot Nematodes

The root knot nematode has a complex and fascinating life cycle. Here is an overview of their life cycle:

Egg Stage: The life cycle begins with the female nematode laying eggs in a gelatinous matrix, usually on the root surface. This egg mass can contain hundreds of eggs. The eggs are protected by the gelatinous matrix from environmental conditions and predators.

First Juvenile Stage: Inside the egg, the nematode develops into the first juvenile stage (J1) but remains within the egg.

Second Juvenile Stage: The J1 molts to become the second-stage juvenile (J2). The J2 is the infective stage and is vermiform in shape, meaning it is worm-like and mobile. Once it hatches from the egg, it moves through soil water in search of suitable host roots. Third & Fourth Juvenile Stages: Inside the root, the J2 molts to J3 and subsequently to J4. During these molts, the nematode feeds on the root cells, inducing them to enlarge and become "giant cells". These giant cells serve as a food source for the nematodes.

Adult Stage: 14 further molts into the adult stage. Males may exit the root to move freely in the soil. Females become swollen and pear- shaped, losing their mobility. Females establish a feeding site with several giant cells and start laying eggs after mating with male.

Formation of Galls or Knots: As females feed and grow, they cause the surrounding root tissue to swell, leading to the formation of the characteristic galls or knots. These galls can disrupt water and nutrient uptake, weakening the plant. The whole life cycle from egg to egg-laying adult can take as little as a month under optimal conditions. However, this duration can vary based on species, temperature, host plant, and other environmental factors also this study describes the life cycle of root-knot nematodes, which are roundworms that invade plant roots and cause galls. The nematodes hatch from eggs, move through the soil, and invade roots near the root tip. They stimulate the surrounding tissues to enlarge, forming galls that disrupt nutrient and water uptake.

Materials and Methods

Field Survey and Sample Collection: A systematic survey was conducted in major banana-growing areas of Solapur. Root and soil samples were collected from plants showing symptoms like stunted growth, yellowing leaves, and root galls.

Nematode Extraction: Nematodes were extracted using the Baermann funnel technique, modified Cobb’s sieving method and Centrifugation method (MgSo4 and Sucrose).

Nematode Isolation: Isolated nematodes were observed under a light microscope to study the life cycle and morphological features.

Study of RKN Incidence with respect to depth of soil: A field survey, we investigated how soil nematode community characteristics changed at different soil depth (0-10 cm and 10-20).

Staining Method: Crystal violet or Methylene blue is used for staining root knot nematodes. By using stains, we can easily observe nematodes life cycle and its movement.

Permanent slide preparation for identification of root knot nematode: Permanent slide preparation for the identification of root knot nematodes involves several key steps to ensure that the nematodes can be properly observed and identified under a microscope.

Identification Techniques: Identification of *Radopholus similis* was performed based on morphological characteristics and confirmed through molecular techniques like PCR and sequencing.

Effective management of root knot nematode: Panchagavya is a plant immune booster and growth promoter due to its rich microbial content, nutrients, and bioactive compounds.

Results

Incidence and Distribution: Field surveys indicated varying degrees of nematode infestation across different sites, with high incidence observed in specific locations.

Localities	Total no. of field surveyed	No. of field with infection	Frequency (%)
Aaherwadi	5	3	60
Mandrup	5	2	40
Nimbergi	5	4	80
Bhanderkavathe	5	2	40

Frequency distributions root-knot nematodes in different localities around South Solapur.

Morphological Observations: Nematodes exhibited characteristic features of *Radopholus similis*, including their slender body shape and distinctive stylet.

pH: The pH range for the survival of nematodes depends on the species but most nematode are observed at alkaline environments. Typically, a pH range of 11-13 is favorable for most free living and parasitic nematodes. Extreme pH level either too acidic or too alkaline can harm or kill the nematodes.

Isolation depth: The nematodes are most commonly observed at the depth of 0-10 cm and these are observed less at 10-20 cm depth of soil layer.

Discussion

The presence of *Radopholus similis* poses a significant threat to banana production in Solapur. Integrated pest management strategies, including crop rotation, resistant varieties, and biological control, are essential to mitigate nematode damage. The use of Panchagavya helps to increase the yield and growth of plants against root knot nematodes.

Conclusion

This study highlights the widespread occurrence of *Radopholus similis* in Solapur's banana crops and underscores the importance of effective management practices to sustain production and minimize losses.

References

[1] Dama L.B. [2019] Survey And Identification Of Root-Knot Nematodes Meloidogyne Incognita Race II Associated With Tomato Crops In Solapur Region, (M.S.), INDIA. Open Access International Journal of Science and Engineering, 4(9).

[2]. Sasser J.N. (1979). Economic importance of *Meloidogne* in tropical countries. in: Root–knot nematodes (Meloidogne spp.) systematics, biology and Control (Eds. F. Lamberti and C.E. Taylor). Academic Press, London. pp. 359- 374.

[3]. Sasser J.N., Eisenback J.D., Carter C.C. and Triantaphyllou A.C. (1983). The International Meloidogyneproject - its goals and accomplishments. Annual Review of Phytopathol 21:272- 288.

[4]. Sikora R.A. and Fernandez E. (2005). Nematode parasites of vegetables. In: Luc, M., Sikora, R.A. and Bridge, J. (Eds). Plant parasitic nematodes in subtropical and tropical agriculture. 2nd Edition, CABI Publishing. pp. 319-392.

[5]. Dropkin V.H. (1980). Introduction to Plant Nematology. John wily and Sons, New York PP. 1-40.

[6]. Peacook F.C. (1957). Studies on root knot nematodes of the genus Meloidogyne in the Gold Coast part. Comparative development on susceptible and resistant host species. Nematologic 2:76-84.

[7]. Cobb N.A. (1918). Estimating the nematode population of the soil. *Agric. Tech. Circ. Bur. Pl. Ind.* U.S. Dep. Agric. No.1. pp.48.

[8]. Eisenback J.D. (2010). A New Technique for Photographing perineal Patterns of Root-knot Nematodes. J. Nematol. 42(1):33-34.

[9]. Taylor A.L. and Sasser J.N. (1978). Identification and control of root-knot nematodes (Meloidogyne spp.) crop. Publ. Dep. Plant Pathol, North Carolina State Univ. and U.S. Agrency Int. Dev. Raliegh, N.C. PP111.

[10]. Taylor A.L., Sasser J.N. and Nelson L.A. (1982). Relationship of climate and soil characteristics of geographical distribution of *Meloidogne* species in agricultural soil. IMP publication, Raleigh, North Carolina. Pp. 140.

[11]. Khan M., Wajid M.R., Khan. And Khan A.A. (1984). Identity of root –knot nematodes on certain vegetables of Aligarh District in Northern– India. Internat. Nematol. Network Newslet. 1: 6-7.