Rice Nematodes and their Management

Rupak Jena, SD Mohapatra, Gayatri Bandaru, Raghu S, Jeevan B, Prabhukartikeyan SR, Gurupirasanna Pandi G, Basana Gowda G.

Nematodes also known as eel worms, hook worms, pin worms etc. are the most abundant animals on earth surface. They are cylindrical, unsegmented, transparent, microscopic ubiquitous organisms possessing pseudocoelom. Plant parasitic nematodes are generally hydrophilic animals preferring sandy loam soil and attack almost all agricultural crops. More than 50% of the world's population consumes rice as a staple food. Rice (*Oryza sativa* L.) is also parasitized by over 210 species of plant parasitic nematodes representing 35 genera. The economically important nematodes associated with the crop are *Meloidogyne graminicola*, *Ditylenchus angustus*, *Heterodera oryzicola*, *Aphelenchoides besseyi* and *Hirschmanniella oryzae*. The combined yield loss due to rice root-knot nematode (*M. graminicola*), white tip nematode (*A. besseyi*), stem nematode (*D. angustus*) and cyst nematode (*H. oryzicola*) were estimated to be approximately 10.5% which accounted for loss up to 779.30 million rupees. In upland rice, yield loss has been reported to be 17–30% due to poorly filled kernels caused by nematode infection. Crop losses due to ufra disease caused by *D. angustus*, ranged from 20 to 90%, depending on the severity of infection. The white tip disease of rice is severe in the southern and eastern states, and a yield loss of nearly 20% has been reported.

1. Below ground nematodes of major economic importance in rice

1.1. Rice root-knot nematode (*Meloidogyne graminicola*, Golden & Birchfield 1968)

Symptoms and Nature of damage- The early stages of rice crop and seedlings in the nursery bed are intensively attacked and affected. The yellowish appearance of the rice field in patches are signs of *M. graminicola* infection. The infected young root tips exhibit swollen and hooked shaped galls. The infestation leads to stunting, growth reduction, unfilled spikelets, reduced tillering, chlorosis, wilting, poor yield and the newly emerged leaves appear distorted and crinkled.

Identification/Lifecycle- The economic threshold level of the nematode is 1J2 / gm of soil. The second stage juveniles invade rice roots behind the root tip and move intercellularly while feeding in vascular tissue and forming giant cells. Enlarged galls are formed as a result due to hypertrophy of cortical cells. The lifecycle of nematodes takes 25-28 days at 25-30^{0}C and they can survive for several weeks in absence of host under dry conditions.

Management

- Resistant varieties like TKM 6, Patani 6, N 136, Basant Bahar, Jagannath, Jayanthi support very meagre level of nematodes.
- Crop rotation with castor, cowpea, sweet potato, soybean, sunflower, sesame, onion, turnip, jute and okra reduce nematode population.
- Biocontrol agents like *Trichoderma harzianum* and *Pseudomonas fluorescens* at 20 g/m^2 are effective in reducing the nematode numbers.
- Soil drenching with Oxamyl, Fensulfothion or Carbofuran at 1kg a.i. /ha results in control of both the soil and root population of *M. graminicola*.

- Summer ploughing and soil solarization of nursery beds with polythene sheet effectively manage *M. graminicola* under field conditions.
- Application of organic amendments like neem, mustard, mahua, karanja oilcakes @1 t/ha reduces the soil nematode population.

Fig 1. *M. graminicola* infested rice seedlings

Fig 2. Yellowing of RRKN infected rice seedlings

1.2: Rice root nematodes (*Hirschmanniella oryzae*, Luc and Goodey, 1964)

Symptoms and Nature of damage - As above ground symptoms, yellowing of the rice plants are observed occasionally leading to retarded growth, reduced tillering and flowering. Roots infected by *Hirschmanniella* spp. turn yellowish brown, stubby and rot. Heavy damage to the roots leads to stunting, chlorosis and reduced grain weight. Yield loss to an extent of 25-40 % and straw yield loss up to 40% is reported due to this nematode.

Identification/ Lifecycle- The economic threshold level of the nematode is 2 J2 / gm of soil. The nematode is about 2mm long and are migratory endoparasites that enter the roots behind root tip infesting the root cortex region and cause extensive tunnelling by feeding upon the cells. Identifying symptom is the brown discoloration of root surface and necrosis.

Management

- Nursery bed treatment with carbofuran @ 0.3 g a.i /m^2 followed by field application of carbofuran @ 1 kg a.i /ha 40 days after transplanting in infected areas.
- Soil solarization of nursey beds with polythene sheets (25-50 um) for 15 days during summer.
- Rotation with nonhost crops like soybean, sweet potato, maize, jute, potato, sesamum or black gram is suggested to reduce nematode population.
- Use of well decomposed FYM @ 5 to 10 t/ha or neem, mustard, mahua, karanja oilcakes @1 t/ha reduces the soil nematode population.

Fig 3 & 4: Field view *of Hirschmanniella* infested rice seedlings and root infected with the nematode

2. Above ground nematodes

2.1: Foliar or white-tip nematode (*Aphelenchoides besseyi*, Cristie 1942)

Symptoms and Nature of damage - Symptoms include whitish or whiplike appearance on the top emerging leaf leading to crinkled or distorted leaves, abnormal leaf greening and distorted floral parts. Extensive feeding causes atrophied panicle, chaffy or shrunken grains. The yield of rice is decreased by approximately 50%.

Identification/Lifecycle- *Aphelenchoides* spp. are ectoparasitic nematodes feeding on above ground parts of rice plant. At the end of the growing season many nematodes are in a state of cryptobiosis under the hulls of seed and can remain in quiescent stage form eight months to three years. Residing in the seeds in anhydrobiosis and activated by rehydration, the nematodes start feeding on the tender primordium of the germinating rice seeds. Then they enter the spikelets and feed on the plant's reproductive organs causing chaffy grains on panicle.

Management

- *A. besseyi* infestations can be avoided by using nematode-free seeds and planting in nematode-free fields.
- Resistant cultivars like Tetep, Roxoro, Bluebonnet, Nira 43 can be adopted for protection against white-tip nematode.
- White tip nematode can be managed by soaking the affected seeds overnight and then hot water treatment at 52-53° C for 10 minutes.
- Chemical treatments of seed with Benomyl and Thiabendazole @ 3gm/kg of seeds effectively reduce the nematode population.
- Rice planted in standing water reduces the percentage of nematode infection.

Fig 5: Plants exhibiting white tip symptoms

Fig 6. *A. besseyi* infested rice seedlings

2.2: Rice Stem or Ufra nematode (*Ditylenchus angustus*, Butlers, 1913, Filipjev 1936)

Symptoms and Nature of damage- Yellowing and mottling of the leaves with contorted margins, blackening of the inter nodes, crinkled ear heads with sterile spikelet's and sometimes 3-4 ear heads in a single leaf sheath may also be seen leading to swollen ufra (where the panicle remains enclosed within the leaf sheath) and ripe ufra (the panicle emerges but produces some grains near the tip of the panicle). Between crops, *D. angustus* remains active in ratoons, stubbles and wild rice. The nematodes can survive in desiccated condition up to 7-15 months.

Identification/ Life cycle - *D. angustus* is an ectoparasite, feeding on young, foliar tissues. The infection starts during vegetative phase when the nematode migrates upwards to feed on newly forming tissues enclosed in the rolled leaf sheaths. They accumulate

and feed on the primordia of the developing panicles and at harvest are coiled in a quiescent state mainly within the dried glumes of the lower spikelet on each panicle.

Management

- Eliminate and burn any weeds and stubbles that are off-season hosts to the infective nematodes.
- Rice harvested from ufra infested area should not be used as seed for the next season.
- Delayed planting and use of short duration rice varieties helps escape the primary infection phase.
- Resistant cultivars like Rayada, Bazail 65, Padmapani and Digha can be used against *D. angustus*.

Fig 7: Infestation of Ufra (ripe ufra) nematode in rice

Fig 8: Neem formulation for nematodes

Fig 9: Pure Culture of *Bacillus* spp.

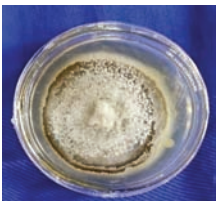

Fig 10: Culture of *Trichoderma* spp.

Do's

1. Always use resistant cultivars of rice varieties against nematode infected soil.
2. Infected soil should be upturned and exposed for soil solarization.
3. Applications of chemicals for management should be done at early morning and evening hours with proper gears.

Don'ts

1. Don't introduce contaminated plants or soil from infected fields.
2. Don't let stubbles stagnate in field as it may harbour harmful nematodes.

Technical Bulletin No-217
March-2024

© All Rights Reserved, ICAR-National Rice Research Institute, Cuttack
An ISO 9001: 2008 Certified Institute
Phone: +91-671-2367757; PABX: +91-671-2367768-783; Fax: +91-671-2367663;
Email: director.nrri@icar.gov.in | directorcrricuttack@gmail.com

Typesetting: ICAR-National Rice Research Institute, Cuttack-753006, Odisha
Published by: The Director, ICAR-National Rice Research Institute, Cuttack (Odisha) 753006
Printed at: Printtech Offset (P) Ltd., Bhubaneswar