

Lesion nematode (*Pratylenchus* spp.)

This migratory endo-parasitic nematode enters inside the root cortex and feed upon the cells there. Due to enzymatic action of their salivary secretion, cells become brown and form lesions. Severe root damage hampers nutrient and water uptake, thereby results in chlorosis of leaves, stunting and reduced yield.

There are several other nematode genera commonly associated with rice such as spiral nematode, lance nematode, ring nematode, sheath nematode etc. These nematodes are polyphagous and feed on root hairs and root cortex by inserting their stylet into cortical cells at the zone of root elongation. They are present in almost all rice growing states of India.

Integrated Nematode Management

- Summer ploughing and soil solarization of nursery beds with polythene sheet reduces nematode, insect pests, pathogens and weeds.
- Crop rotation with groundnut, soybean, sweet potato, maize, jute, potato, sesamum or blackgram is suggested to reduce nematode population.
- Destroy and burn the rice stubbles and weeds which support nematode population in off season.
- Rice harvested from ufra and white tip infested area should not be used as seed.
- Seed bed treatment with carbofuran 100mg ai/m² or seed soaking with 0.1% carbosulfan for 12 hrs or seedling dip in the above nematicides for 4 hours helps to eliminate the seed borne nematode inoculum.
- Soil application of carbofuran @ 1 kg ai/ha at 7th and 50th days after planting reduces nematode incidence or spraying the crop with chlorpyrifos or carbosulfan 0.4% twice at 15 day intervals reduces severity of disease.
- Use of well decomposed FYM @ 5 to 10 t/ha or neem, mustard, mahua, karanj oil cakes @ 1 t/ha reduces the soil nematode population.
- Application of neem cake at 100 g/m² in the nursery will take care of nematodes during early crop stage.
- *White tip nematode can be managed by soaking the affected seeds overnight and then heating to 52-53° C for 10 minutes.*
- Application of fresh leaves of *Azadirachta indica* and *Sesbania aculeata* or water

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Rice Nematodes and their Management

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Rice Nematodes and their Management

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Nematodes are slender, microscopic organisms characterized by transparent, cylindrical, elongated and unsegmented body. The plant parasitic nematodes are generally soil inhabiting root feeders characterized by the presence of feeding apparatus known as stylet, which resembles a hypodermic needle. It enables the nematode to puncture the plant cell wall and suck cell contents. Rice (*Oryza sativa* L.), the major staple food crop of India is infested by over 300 species of nematodes belonging to 35 genera. These parasitic nematodes account for the annual yield loss of 10 to 25% worldwide in rice crop, among which the rice root knot nematode (RKN), *Meloidogyne graminicola* is most important in aerobic rice cultivation and the rice root nematode (RRN), *Hirschmanniella oryzae* in submerged conditions. Few economically important rice nematode species under Indian condition are discussed below.

Nematodes of major economic importance

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

This nematode is reported from Madhya Pradesh, Jharkhand, West Bengal, Assam, Tripura, Kerala, Andhra Pradesh, Gujarat, Haryana, Karnataka, Himachal Pradesh, Odisha, Eastern Uttar Pradesh, Delhi, Punjab and Gujarat, infecting mainly the upland and direct sown medium land paddy. Other than



Fig.1 Hook shaped galls caused by *Meloidogyne graminicola*

rice, this also infects wheat, onion, banana and weeds like *Echinochloa colona*, *E. crusgalli*, *Cyperus compressus*, *Cyanotis axillaris*, *C. rotundus*, *Brachiaria ramosa*, etc. It causes more damage to upland rice and the seedlings in nursery beds. The nematode larvae enter the roots just above the root cap and cause root galls, which in turn disturbs the uptake of water and nutrients by roots. Thereby, it reduces the rice plant's ear-head number, panicle length and grain weight causing yield loss to the tune of 15-25%. In the nurseries they may enhance the effect of other seed/soil borne diseases and cause complete mortality of seedlings. Another nematode species (*Meloidogyne triticoryzae*) from the same genus is reported as major problem in rice-wheat cropping system, as they can attack both rice and wheat.

Symptoms: The typical symptom is the appearance of fish hook shaped galls in the root tip (fig 1). The visible symptom above ground is too mild but heavy infestation may lead to stunting, yellowing and loss in vigour of plants in patches.

Rice root nematodes (*Hirschmanniella* spp.)

This nematode is prevalent in all rice growing states and assumes its importance under submerged / waterlogged condition. In India prevalence of *H. oryzae*, *H. gracilis*, *H. mucronata* and *H. spinicaudata* has been reported from



Fig.2 *Hirschmanniella* spp. inside Rice Roots

irrigated, semi-deepwater and deepwater rice environments. Other host crops include cotton, sugarcane, finger millet, maize, wheat, pearl millet, okra, tomato and weeds viz., *Cyperus rotundus*, *Oryza nivara*, *Echinochloa crus-galli*, *E. colona*, *Panicum milliaceum*, *Cynodon dactylon*, *Cyanotis axillaris*, *Dactyloctenium aegyptium*, *Eclipta alba* and *Brachiaria ramosa*. They infest the root cortex region and cause extensive tunneling (fig 2) by feeding upon the cells. Direct seeded rice under submerged condition is more prone to nematode damage than transplanted rice.

Symptoms: Brown discoloration on the root surface and necrosis. Heavier damage to roots causes retardation of growth, stunting of plants, chlorosis, reduction in the tiller number, earheads number and weight of grains.

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

It causes white tip disease of rice in all rice ecosystems both in *Kharif* and *Rabi* seasons. It is reported from states of Tamil Nadu, Karnataka, Maharashtra, West Bengal, Andhra Pradesh, Madhya Pradesh, Gujrat, Uttar Pradesh and Himachal Pradesh. In addition to rice, strawberry and tuberose are the major hosts of the white-tip nematode. It also infests

other crops and weeds belonging to Poaceae family. The nematode feeds on the growing apical bud inside the leaf whorl during nursery and early tillering stages. Later they enter into the glumes of the floral primordia and go up with the earhead.

Symptoms: The top one cm to 1/3rd of the emerging leaf becomes whitish or whip like (fig 3) and extensive feeding causes atrophied panicle, chaffy or shrunken grains.



Fig.3 Symptoms of white-tip Nematode

Stem or Ufra nematode (*Ditylenchus angustus*, Butler 1913, Filipjev 1936)

This nematode is specific to rice and found in submerged or deepwater fields in UP, Bihar, West Bengal, Maharashtra, Andhra Pradesh and Assam. Presently, the nematode distribution is limited to North Lakhimpur District of Assam. In addition to rice, it survives on weeds like *Leersia hexandra* and wild rices. The first sign of the disease in the field is chlorotic streaks on the upper leaves. During ripening of the crop, the nematodes (both adult and juveniles) coil up and enter quiescence. They can be found as nematode wool at the base of the stubbles. These nematodes revive when the field is irrigated or gets rain water.



Fig.4 Symptoms of Stem or Ufra nematode

Symptoms: Yellowing and mottling of the leaves with contorted margins, blackening of the inter nodes, crinkled earheads with sterile spikelets and sometimes 3-4 ear heads in a single leaf sheath may also be seen. 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) are two kinds of symptoms of infestation by this nematode in rice (fig 4).

Nematodes of minor economic importance

Cyst nematodes (*Heterodera* spp.)

The rice cyst nematode has been reported from Trivandrum, Quilon, Alleppy and Trichur districts in Kerala, Haryana, West Bengal, and Madhya Pradesh. Different species of cyst nematode associated with rice crop are *Heterodera oryzicola*, *H. oryzae*, *H. sachhari* and *H. skohensis*. Browning, leaf chlorosis, stunting, and early flowering by 10-13 days are common symptoms of cyst nematodes infested plants. The root does not show any gall formation. However, cysts and egg masses are seen in areas where roots turned brown to black. The yield losses are due to reduction in number of ear-heads and grain weight.