

BURROWING NEMATODE A POTENTIAL THREAT TO AGRICULTURE

P.K. KOSHY, P. SUNDARARAJU and V.K. SOSAMMA
Central Plantation Crops Research Institute, Regional Station,
Krishnapuram, Kayangulam, Kerala

THE burrowing nematode, *Radopholus similis* occupies the second position only to the root-knot nematode among the economically important plant parasitic nematodes in the tropical and sub-tropical regions. The nematode is notorious as the cause of spreading decline of citrus in Florida, Pepper yellows in the Bangka island of Indonesia and root and rhizome rot of banana in all banana growing tracts of the world except in Israel and Taiwan. In India the nematode was first recorded only in 1966 from banana roots in Kerala. Recent surveys have shown its widespread occurrence in Kerala, Karnataka and Tamil Nadu on coconut, arecanut, banana and pepper. *R. similis* may be indigenous to Kerala as various varieties of banana are known to be cultivated here since long. The possibility of its introduction along with the cavendish type of banana also cannot be ruled out. The nematode was first described by Nathan Augustus Cobb from banana roots from Fiji in 1893 as *Tylenchus similis*. Subsequently the nematode was reported causing extensive root lesions and cavities in the roots of coffee in Java and in sugarcane in Hawaii. *Radopholus* is considered to be indigenous to Australia and New Zealand because nine of the eleven species of the genus are found in these areas.

Significance

The nematode is known to parasitize more than 250 species of plants throughout the tropical and sub-tropical regions which makes *R. similis* the most significant pest of agricultural crops. Parasitization by this nematode causes gross reduction in the quality and quantity of yield. It has wiped out over 20 million pepper vines of Bangka Island over a short period of two decades. More than 15 thousand acres of citrus in Florida are reported to be infested with *R. similis*. Reduction in yield from 50

to 80 per cent for grape fruit and from 40 to 70 per cent for oranges are reported. At an average fruit value of £2/box the grower incurs a loss of \$19,549/ha. In Surinam, where there was 100 per cent infestation on banana, the yield was 37 tons/ha/year but when the infestation was less, the yield was 73 tons/ha/year.

In India no data is available on loss due to *R. similis* infestation on any crop, though the nematode was recorded in 1966 and known to parasitize several crops such as black pepper, cardamom, ginger, turmeric, sweet potato, sugarcane, groundnut, coconut, arecanut and banana and has also been reported in association with diseases such as slow wilt of pepper, coconut root (wilt) and arecanut yellow leaf.

Dissemination. The nematode is disseminated mainly through infested planting materials, floods, irrigation water, farm implements and bulk transport of soil. The nematode is known to spread in Florida downhill at the rate of 66 metres and uphill at the rate of less than 8 metres within a year.

Morphology and Biology

The nematode is known for its sexual dimorphism. The female nematodes vary in length from 0.520 to 0.880 (0.690) mm, with an average width of 25.6 μ and a spear of about 18 μ with well developed basal knobs. Males vary in length from 0.590 to 0.670 (630) mm with degenerated oesophagus and spear and an elevated non-striated lip region.

R. similis is a migratory endoparasite, capable of a soil phase in adverse conditions. The life cycle is completed in 20-25 days at 24-32°C. Egg, four larval and an adult stage are the different phases in its life history. All larval stages and females are infective. Fertilization is usual but parthenogenesis does occur. The nematode has two biotypes having no morphological differences (1) the 'banana race' attacking banana

but not citrus, and (2) the 'citrus race' pathogenic to both banana and citrus. The 'citrus race' is at present confined to Florida and has a wide host range compared to the 'banana race.' The coconut, arecanut and banana populations in Kerala have been identified as the 'banana race' and the coconut population is known to have a host range of over 41 species of plants. The host range of other populations has not been studied so far and the existence of other biotypes is very likely. The host range and race status of the black pepper population in Kerala and Karnataka needs immediate attention.

Studies on annual periodicity of *R. similis* populations in coconut and arecanut root revealed that the maximum population occurs during September to November and minimum during March to June. Hence, it is preferable to conduct regular surveys for detection during the peak season.

Symptoms

The most obvious symptoms of attack on banana is the toppling of plants especially those at the bearing stage. Other symptoms include lack of vigour, premature defoliation and reduction in bunch weight, size and number of leaves. In citrus, the declining trees have fewer and smaller leaves and more dead twigs than healthy trees with a tendency to wilt. The new growth flushes are weak, fruit set sparse and yields low, but death is not usual. In both banana and citrus *R. similis* occupies an intercellular position in the cortical parenchyma where they feed on the cytoplasm of nearby cells, destroying them and causing cavities to develop. These cavities coalesce and are continually enlarged by the nematode's feeding and tunnelling laterally and towards the endodermis, producing the characteristic reddish brown lesions in the cortex. When extensive cavities have formed, cracks with raised margins appear on the root surface. Nematodes enter the stele in citrus via endodermal passage cells and accumulate in the phloem and cambium secondary invasions of the lesions by other fungal organisms causes necrosis.

The first indication of slow wilt disease in pepper is the appearance of occasional yellowed leaves, which increase in number until within a year large portion, or even all, of the foliage may become involved. The growth is arrested and production of panicles rapidly declines. Severe die-back and death of the plants eventually follow. The young, fleshy feeder roots show lesions and develop extensive necrosis.

In coconut roots, *R. similis* produce small, elongate, reddish brown lesions which later coalesce and cause extensive root rotting and reduce lateral root production. The nematode population is found confined mostly to the cortical region of the root. The affected plant exhibits considerable reduction in growth and

vigour. Apart from these blackening of the root tips was another common symptom in arecanut.

Association with fungi. Incidence of panama wilt of banana caused by *Fusarium oxysporum* f. *cubense* gets doubled in Gros Michel banana when *R. similis* is added to the soil and wilt symptoms appeared faster on *R. similis* infected bananas as the fungus alone is unable to invade intact banana roots. The spreading decline of citrus also involves an interaction of *R. similis* with *Fusarium*, *Sclerotium* and other soil inhabiting organisms. The fungus *Cylindrocarpon musae* is found constantly associated with *R. similis* in banana. Recently *Cylindrocarpon effusum* and *C. lucidum* have been isolated from lesions caused by *R. similis* on coconut roots.

Control

Paring banana sets involving removal of all discoloured portions, followed by a dip in Bordeaux mixture and DBCP paste, the infection gets reduced from 89 per cent to 1 per cent after 8 months. Hot water treatment of banana sets at 55°C for 20 minutes is a standard practice in Central America and Australia. Flood fallowing is practised successfully in Surinam.

In Florida, push and treat method (DD at 100 gallons/acre) is practised for eradicating the burrowing nematode from commercial groves and with chemically treated buffers (EDB at 50 gallons/acre). To prevent the burrowing nematode from becoming established in healthy groves, bare-rooted citrus plants treated with hot water at 122°F for 10 minutes are planted.

The common coconut cultivars West Coast Tall, Dwarf Orange, Dwarf Green, Gangabondam, Laccadive Ordinary, Tall × Dwarf, Dwarf × Tall, and Tall × Gangabondam were found susceptible to *R. similis* on inoculation. Thirty-one Areca germplasm collections available at CPCRI, Vittal were screened against the arecanut population of *R. similis* and all of them were found susceptible.

To release burrowing nematode-free coconut seedlings from heavily infested nurseries in Kerala a dip treatment in 1000 ppm DBCP for 15 minutes was found effective and is recommended.

In India the nematode is at present known to exist only in Kerala, Karnataka and Tamil Nadu states. Recently the nematode was reported from a geographically isolated area like Lakshadweep also which might have been introduced through the several shipments of banana suckers from Kerala and Tamil Nadu to these islands. This brings out the necessity for an intensive survey of areas growing banana, coconut, pepper and other known hosts of the nematode at the earliest and adoption of strict quarantine measures against the movement of planting material from infested to non-infested areas, especially so in view of its wide host range, very high potential as a pathogen, association with other microorganisms as an incitant in complex diseases and their possible involvement in diseases of national importance.