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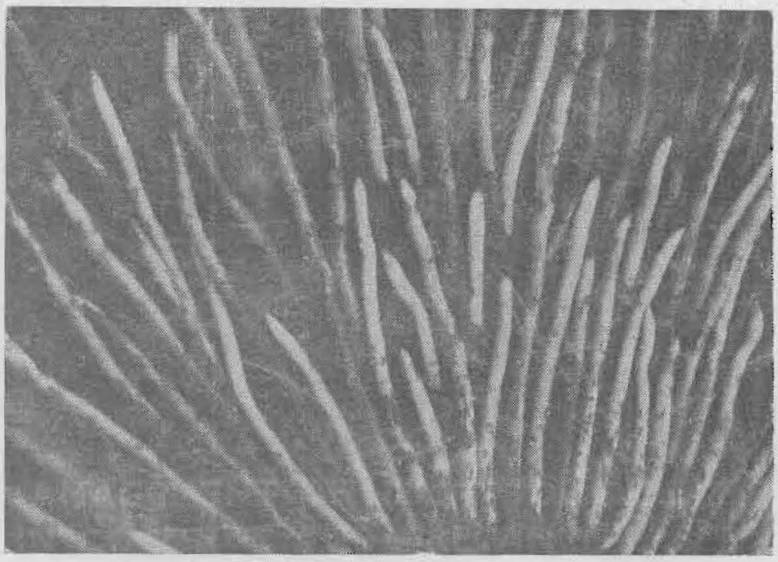
MANAGEMENT OF NEMATODE DISEASES IN COCONUT AND ARECANUT BASED FARMING SYSTEMS



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Cover: The tender roots with lesions caused by *Radophlus similis* and rotting at the base of a young coconut palm

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MANAGENENT OF NEMOTODE DISEASES IN COCONUT AND ARECANUT BASED FARMING SYSTEMS

Introduction

Coconut and arecanut being perennial in nature are committed to the land for a long duration and chances of mid-term corrections are very limited except in cases of inter crops that are annuals or biennials. Crops, cultlivars and cultivation techniques used in coconut and arecanut based farming systems are essentially based on the needs and preferences of the farmer family and community at large. The wide range of crops cultivated include vegetables, fruits like banana, cacao, pineapple, papaya, tubers like cassava, elephant foot yam, taros, tannia, yams, chinese potato, spices like black pepper, cardamom, ginger, termeric, cloves nutmeg, cinnamon, etc. and cash crops like coffee and betelvine. Apart from these, a number of fruit trees like jack, mango, cashew, guava and sapota are also grown mostly along the boundaries. These crops are plagued by a number of pests and diseases. In addition to this, plant parasitic nematodes also cause considerable reduction in yield and quality of the produce. Many scientists, administrators, extension workers and farmers are not fully aware of these problems beecause of the non-specific symptoms of these on the above ground plant parts.

What are nematodes?

Plant parasitic nematodes are elongated more or less cylindrical worms 0.3-5.0 mm long, unsegmented and colourless. The anterior end tapers to a rounded lip region and the posterior end tapers to a terminus. Female of some species (root-knot and cyst nematodes) have greatly expanded bodies sometimes nearly spherical, but always with a distinct neck. The adult males are always slender worms. There are usually no external appendage. It moves with an undulating movements in a dorsoventral plane. Nematodes make their way through pore spaces of the soil. Nematode movement is possible only when water is present. They have well defined digestive system mouth cavity which is armed with a conspicuous protrusible spear or stylet used to puncture plant cells. The stylet is hollow and forms the path of food in take. They have well defined excretory, nervous and reproductivie systems. The life cycle of plant parasitic

nematodes consists of five distinct stages-adult, egg and four juveni stages with four moults. The first stage juvenile develops in the egg and the first moult occurs within the egg shell giving rise to the second stage juvenile which emerges free into the soil or plant tissue. On feeding the second stage juvenile grows, develops and moults thrice to become an adult. Upon maturity, the female deposits eggs and the life cycle is repeated. Nematodes exist as separate females and males. Some forms are parthenogenetic. Under optimum conditions the duration from egg to egg -producing females may be three or four weeks.

Plant parts generally damaged :

Several hundreds of specias of nematodes are known to infest crop plants. They infest plant parts including roots, trunks, buds, leaves, flowers and seeds. But majority of plant parasitic forms are root feeders spending most of their life in the soil (cetoparasites) or in roots or other underground plant parts (endoparasites). Some nematodes primarily infest and damages above ground plant parts like stem, leaf and seed.

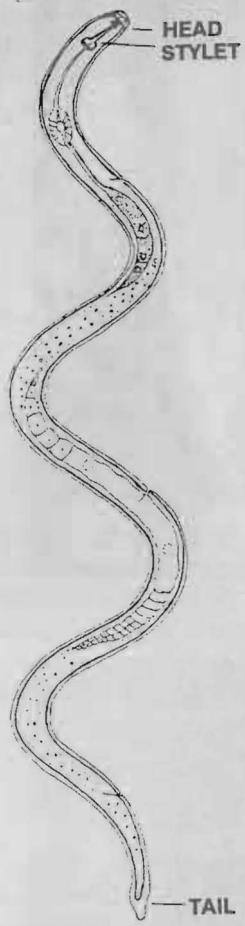
Spread:

They are spread to long distances primarily through seeds, seedlings, rhizomes and rooted cuttings of different plants. They are also spread through agricultural implements and irrigation water. Rapidly developing nematode diseases are very unlikely, but crop losses ocur after a gradual build up of population brought about by successive planting of susceptible crop cultivars over a period of years.

Major nematodes in coconut and arecanut systems:

The important neematodes in coconut and arecanut-based farming systems are the burrowing nematode, *Radopholus similis,* the root- knot nematode, *Meloidogyne incognita* and the lesion nematode, *Pratylenchus coffeae*.

The burrowing nematode is such a devasting pest that it has wiped out millions of black pepper vines in Indonesia within two decades. Similarly, spreading decline in citrus caused by *R. similis* has spread to 6000 ha within 35 years in U.S.A. (Fig. 1). It causes root rot, black head toppling diseases and decline in banana. Nearly 30% yield loss in coconut is caused by this burrowing nematode.



(Fig. 1)

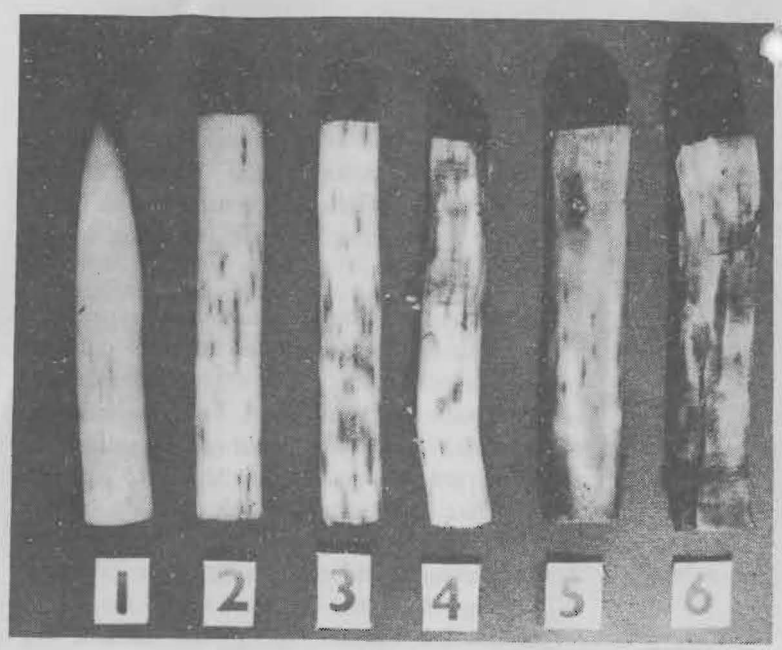
Application of nematicides to the infested plants for a period of five years resulted in ten-fold increase in the yield of arecanut. Nematode infestation of coconut seedlings can cause considerable reduction in production of inflorescences, nuts in latter years, apart from delay in flowering by six months.

Symptoms on diferent component crops:

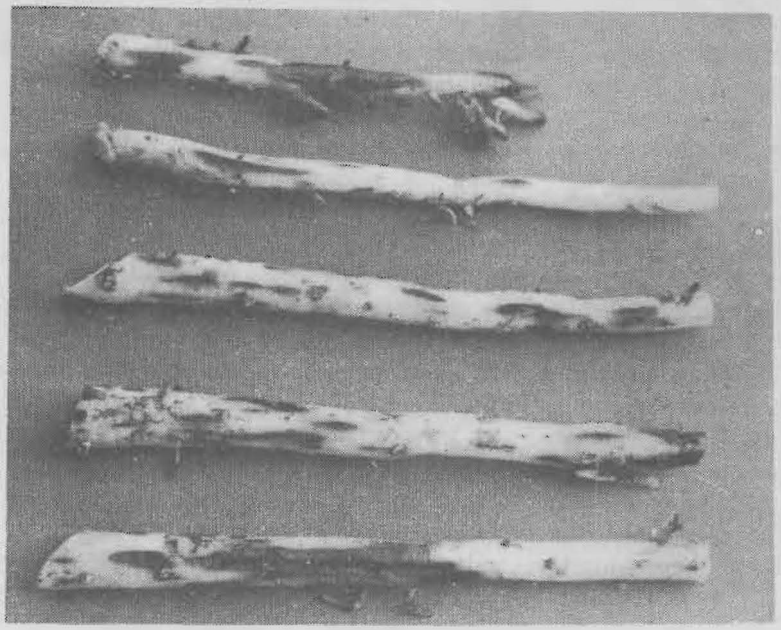
Burrowing nematode infested coconut and areca palms exhibit general decline, symptoms like yellowing, button shedding, reduction in leaf size, yield etc. Symptoms on roots are more specific exhibiting isolated elongate orange-coloured lesions on tender and semi-hard roots (Fig.2). These lesions later enlarge and coalesce to cause extensive rotting of roots. Tender roots on heavy infestation become spongy in texture. On semi-hard orange roots surface cracks are comonly seen. Lesions are not usually seen on the old, hard, dark brown roots. The nematode also attacks the plumule, leaf bases and haustoria of seedlings. The drastic reduction in number and mass of tertiary feeder roots limits plant growth. Unlike in coconut, in arecanut the tip of lateral and tertiary roots on infestation become black (Fig.3).

The thick primary roots produced from the bole region of the palm exhibit large, oval, sunken, dark lesions.

Primary symptom of *R. similis* infested or slow decline affected black pepper vines is the appearance of a few, pale yellow drooping leaves. The number of such leaves gradually increases and within a year or two the entire foliage may become yellow. This is followed by shedding of leaves, cessation of growth and die-back symptoms. In the early stage, the symptoms may disappear with the onset of South-West Monsoon and with the appearance of new flush.



(Fig. 2)



(Fig. 3)

However, within three to five years of initiation of yellowing all the leaves are shed and the vine dies.In bearing vines spike shedding takes place. In large plantations, affected patches are conspicuous with many barren standards. The tender, feeder roots show typical orange to purple coloured lesions. The root system exhibits extensive rotting with the main roots devoid of feeder roots. Extensive necrosis of large roots develops subsequently. Burrowing nematode infested betelvine exhibits similar sysmptoms of yellowing as on black pepper.

Black pepper and betelvines infested by root-knot nematodes show unthrifty growth and yellowing of leaves. The interveinal areas on new leaves of affected vines show dense yellowish discolouration. The roots show prominent galls which become brownish to black when old.

In the case of cardamom root-knot nematode infestation causes stunting, yellowing, reduced tillering, delay in flowering, immature capsule drop and reduction in yield. Roots do not show much galling. Instead, there will be excessive branching, but seedlings show galling, drying of leaf margin and tips. In nurseries germination is reduced by more than 50 per cent. Infested seedling fail to establish on transplantation to secondary nurseries and main fields.

Root-knot nematode infested ginger and turmerie show stunting, chlorosis and marginal necrosis of leaves. Roots and underground rhizomes exhibit galling and rotting.

Burrowing and lesion mematode infested ginger and turmeric plants exhibit stunting, reduced vigour and tillering; they mature and dry out faster than healthy plants. The topmost leaves become chlorotic with scorched tips. The infested rhizomes exhibit small shallow, sunken, water-soaked lesions. Infested turmeric rhizomes tend to lose their characteristic bright yellow colour and show brown rotting.

The problem of lesion nematode starts in the form of 'patch' in the main field, which gradually spreads through farm implements and rain water. Both young and bearing coffee plants become affected. In the former case the tap root gets severed and the number

of feeder roots greatly reduced. The plants tend to produce adventitous roots at the collar region giving a 'bearded' appearance. The plants become weak and get killed during dry periods. Infected bearing plants exhibit 'die back' symptoms. The plants become prematurely old calling for collar pruning or uprooting.

How to determine that nematode problems exist?

Symptoms caused by the parasitizing nematodes are not characteristically distinct from symptoms caused by other soil organisms as well as deficiencies. Therefore, when a farmer encounters plants that are stunted, chlorotic or yielding poorly, he may take soil and root samples and send to an approved nematology laboratory of the state agricultural university or an ICAR Institute.

The soil samples may be collected when the soil around the feeding roots is moist. Several cores around suspected nematode infested plants may be taken and mixed well and a composite sample of about 200 g soil devoid of bigger stones, clods, stubbles etc, may be put in plastic bags and fastened with rubber bands. They are properly labelled. For more details contact your nearest research centre.

The sampling areas and quantity and type of roots to be sampled for detection of *R. similiis* have been standardised for the following crops.

Crop	Distance from the base of the palm/plant/vine (cm)	Depth (cm)	Root samples	
			Quantity	Type
Coconut	100	50-100	50	Main
Arecanut	25-75	25-75	25	Lateral
Banana	25-50	20-40	25	Main
Black pepper	25-50	20-30	5	Feeder
Betelvine	25-50	20-30	5	Feeder
Coffee young	25-50	10	5	Feeder
Coffee-old	25-50	25-30	5	Feeder.

In the case of ginger, turmeric, vegetables and other annuals complete root system with surrounding soil should be taken. Samples should be kept out of the sun and stored at a moderate temperature, preferably less than 25°C. Send the samples to the nearest nematology laboratory as soon as possible for analysis and advice.

Management.

The objective of nematode management is to improve growth and yield of plants by keeping the population densities of nematodes as low as possible. It is not advisable to depend on a single method of control. Efficient management requires the careful integrated combinations of several practices. It may be dificult to suggest drastic changes in the cropping systems because of the need-based crops that are grown by the farmers under subsistance farming conditions. Hence the managenent strategies may be evolved to reduce the economic loss by following easily adoptible methods without disturbing the ecological balance. The important methods are chemical, cultural systems and biological.

Chemical control : Under the cropping systems as mentioned above involving several perennial and annual crops where harvesting is done allthrough the year from one crop or the other, control of nemmatodes using nematicides is to be avoided, as far as possible. Products of some crops like banana , papaya, pineapple, betel leaf etc. are generally consumed without any processing or cooking. Secondly, appplication of nematicides to the root zone of one component crop can lead to deposition of residues in the produce of adjoining crop as the roots of these crops are interwoven and the nematicides get carried through irrigation and rain water. Application of phorate @ 10 g a.i./ palm twice a year to coconut and 3 g a.i/ vine to black pepper and arecanut has been found beneficial in increasing yield of these crops substantially. Application of phorate to banana @ 3 g a.i./ sucker at planting and 90 days after planting is beneficial in the control of banana aphid, root grub, rhizome weevil apart from control of burrowing and other nematodes.

Cultural methods: It is relatively an inexpensive approach. Among the methods that are generally used viz. crop rotation, shifting of planting date, fallowing, flooding etc. are only of limited use in coconut and arecanut based farming systems, since most of the crops involved are perennial in nature. However, root-knot and

burrowing nematode susceptible inter-crops such as ginger, turmeric, papaya, elephant foot yam and chinese potato may be avoided and if grown, planting sites may be changed every year. The practice of keeping the cardamom nursery at the same site for many years consecutively helps in the population build up of root-knot nematodes. Preferences may be given to growing nematode-resistant crops such as cacao, pineapple, nutmeg, cinnamon, cloves, colocasia, tapioca and yams. Maximum care should be taken to avoid crop combinations that are susceptible to the same nematode species eg., avoiding root-knot succeptible dadaps (Erythrina lithosperma and E. indica) as shade trees, and subabul as standard for black pepper. Arecanut, banana and black pepper combination is a popular crop combination especially under irrigation. Black pepper isi usually wiped out in 10-15 years due to nematode infestation and banana (Kadali/Njalipoovan) continues to yield very poorly. Green manure crops like Crotalaria juncea, Pueraria Javanica and Mucuna sp. may be grown in basins and interspaces and ploughed back to soil. Increased use of organic amendments like Neem and Marotti (Hydnocarpus) oil cakes, farm yard manure and mulching with weeds, grass, straw, dry leaves etc. help in the build up of predatory nematodes and nematode parasitising fungi, while helping to improve the structure and water holding capacity of the soil.

Sanitational methods such as opening pits when the weather is dry and burning of trash in planting pits, avoiding running of water from infested to uninfested pits, paring of banana suckers and sundrying them, solarising nursery beds and potting mixture are some of the easiest and inexpensive methods to limit population build up of nematodes.

Nematodes introduced in host tissues are in an ideal environment for rapid development. Burrowing nematode infested seedlings of coconut and arecanut and rooted cuttings of black pepper do not establish easily and even if they get established initially they do not withstand the following drought conditions and more than 50 per cent of them are lost in the first year itself. In the case of banana, suckers may be pared, sun/ shade dried and treated with nematicides while planting or plant tissue culltured saplings wherever available. Seed rhizomes of ginger and turmeric may be raised in nematicide treated plots. Certified nematodee free seed rhizomes of ginger and turmeric need to be made available as in the

c of potato. It is one of the most stable means of managemer

In coconut Java Gianat x Malayan Dwarf Yellow, San R. Gangabondam, Kenthali, Klappawangi etc. in arecanut (Sumangala), VTL-17 (Sreemangala), Andaman-3, And Andaman-5 and VTI-11 x VTI- 17, in banana Yelkal Palayankodan and the cultivar P 812 has been found to be t the root-knot nematode. The arecanut cultivar Mangala susceptible to the burrowing nematode. In coffee the var. tolerant to Pratylenchus coffeae. Hence, the variety arabi on to robusta root- stock is recommended for replanting nematode infested areas and this has proved to be a ver measure for combating the problem.

Integrated Nematode Management

1. Avoid use of susceptible crop combinations
2. Use resistant/tolerant cultivars
3. Use nematode-free planting material
4. Inoculate biocontrol agents in to the nur mixture and in planting pits.
5. Increase use of green manure and o amendments
6. Follow sanitational methods.
7. Apply phorate/carbofuran judiciously.

Integrated nematode management system depending upon the species of nematodes and the the system, availability of resistant host plants, c practices, irrigation etc. Control of nematodes establishment of the transplants and uniform Nematode control also reduces damage ca inhabiting fungi, bacteria viruses etc. that caus presence of plant parasitic nematodes. Mo systemic chemicals protect the plants from th as well. Thus, reduction in nematode po development of healthy and fibrous r involved in coconut and arecanut base increasing the yield of crops and qu higher income to the farmers.