Root-knot nematode of cardamom and its control

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
KASARAGOD - 670 124, KERALA
INDIA
ROOT-KNOT NEMATODE OF CARDAMOM AND ITS CONTROL

Nematodes are a serious menace in many cultivated crops. Generally, the infestation caused by nematodes are not spectacular or of a sudden epidemic type but rather of slow decline in yield and spreading gradually but steadily in extent, year after year. Due to microscopic size of these pests and their hidden habitat in the soil, growers fail to recognise the importance of plant parasitic nematodes as a limiting factor in cardamom production. Moreover, nematode damage to cardamom was not identified till recently and was often attributed to nutritional deficiencies, lack of shade etc. The reported decline in yield of cardamom in recent years may be the result of wide spread incidence of root-knot nematodes in plantations.

In cardamom, the root-knot nematodes have assumed a serious problem in recent years. Root-knot nematode (*Meloidogyne* spp.) was found to occur in all fields of cardamom as well as in primary and secondary nurseries in Kerala, Karnataka and Tamil Nadu. The intensity varied from place to place. Among the species of root-knot nematodes recorded in cardamom, *Meloidogyne incognita* is most widely distributed. While *M. javanica* is prevalent in Calicut and Palghat districts, *M. arenaria* occurs in Ramnad district of Tamil Nadu only.

WHAT ARE NEMATODES?

Nematodes are group of round worms. They are also called eelworms, occurring in thousands of different species in soil as well as in living and dead plants. Plant parasitic nematodes are usually very small thread shaped and most of them measuring about less than one millimetre and cannot be seen with naked eyes.

HOW NEMATODES LIVE?

Plant parasitic nematodes are well adapted to life in soil. They are long and narrow and can navigate through soil pores. As their body surface is tough, flexible and oily, they can easily glide through films of water over the surface of soil particles. Broadly, plant parasitic nematodes can be divided into ectoparasites and endoparasites. The ectoparasites spend most of their
life outside the plant in moist zone of the soil while endoparasites inhabit in plant tissues of roots, stem, leaf, bulbs etc.

LIFE CYCLE OF ROOT-KNOT NEMATODES

It starts with an egg deposited by female, which is completely or partially embedded in root of host plant. The eggs are deposited with a gelatinous matrix which holds them together in a sac. More than 100 eggs are found in one such sac and it may be larger than the female body. Larvae hatch from the egg. The hatched second stage larvae move through the soil in search of a root on which it can feed. Longevity of hatched larvae varies from a few days to a few months. The larvae remain in the second stage until they enter a root and take up a position just above the root tip. Then the nematode enlarges to a sausage shape. In the swollen second stage, the juvenile stops feeding and undergoes three molts in the course of a few days and becomes an adult male or female. The male is elongated and vermiform, alive only for a few weeks. It leaves the root, mates and can be found free in soil or in proximity to adult females. The female swells to a characteristic shape with a narrow mobile head swollen immobile posterior, produce eggs and live for some time after egg production stops. The life cycle takes 3-4 weeks. Eggs in egg sac survive moisture stress and infected root can remain producing nematodes for long periods.

HOW NEMATODES CAUSE DAMAGE TO PLANT?

Millions of nematodes may be present at the same time on the roots of a single plant. When it is considered that such a heavily colonized plant is pierced millions of times and that millions of nematodes are simultaneously sucking out its vital juices, it is obvious that it will greatly weaken with the result that its growth and yield are very seriously affected.

While feeding, plant parasitic nematodes puncture cell walls with their stylet. This mechanical damage would probably be of no great significance if it is not accompanied by injection of secretions from oesophageal glands. The secretions have a digestive function as they liquify and prepare the cell contents for ingestion by the nematodes. Feeding on plant cells by nematodes may deprive the host of nutrients and water necessary for its growth. Root-knot nematodes after entering the roots produce root galls. They are the result of distinct enlargements of root tissue due to hypertrophy of cortical cells of the central cylinder of a root. The cells are also directly affected being transformed into giant cells by dissolution of common cell walls and coalescing of several cells. The conductive tissue responsible for translocation of nutrients and water to the top are often blocked.

2
NEMATODE DAMAGE IN NURSERY

1. Poor germination: Due to heavy infestation of root-knot nematodes, nurseries recorded 34 per cent of germination against 82 in sterile soil. The infestation results in delayed germination and stunted growth of seedlings with smaller and narrower leaves.

2. Poor establishment: When nematode infested primary seedlings were transplanted again to infested secondary nurseries, establishment is poor resulting in as high as 40% damage. Generally the nursery sites unchanged for years favour a build up of high inoculum of nematodes. When these heavily infested secondary seedlings are planted in the main field their establishment and growth are found to be very poor.

3. Indirect damage: Nematode infested seedlings are more prone to invasion by soil borne organisms. Nematode injury paves way for the entry of other secondary organisms. The altered metabolism induced by nematode parasitism makes the plant vulnerable to the attack of otherwise weak pathogens. Removal of cell content following stylet penetration usually results in collapse of tissue and death of cells.

NEMATODE DAMAGE IN CARDAMOM PLANTATIONS

1. Shedding of immature capsules is commonly observed in nematode infested cardamom fields. Fruit drops generally occur in localised areas or in patches where stunting of clumps are commonly observed. Fruit drops may vary from 20-80% depending upon the degree of infestation.

2. Heavy infestation of nematodes at times produces sterile tillers in masses.

3. Progressive reduction in yield is a common phenomenon due to nematodes. Total loss in yield may occur in course of time, when plants start drying due to infestation of nematodes and suckers become unproductive.

4. When population of nematodes is high, excessive branching of roots takes place. Vascular damage disturbs water and mineral uptake. Infected plants succumb to drought earlier than healthy plants.

HOW NEMATODE INFESTATION IN CARDAMOM LOOKS LIKE?

In nurseries: Seedlings harbouring root-knot nematode had poor tillering. In severe cases, the unopened leaf curls and fails to emerge forming a whip like structure. Stunting along with yellowing and drying of leaf margin and tips
are common aerial symptoms. Very young seedling had typical root knot appearance on root system while old seedlings exhibit excessive branching in addition to galling.

In field: 1. Infested plants exhibit excessive branching near the root tips or all along the entire root at different intervals. The bunch of rootlets emerging little above the root tips is readily discernible from other healthy roots as they are devoid of hairs and are milky white in colour.

2. The damage caused to cardamom plants by nematodes is manifested by stunted growth. Usually nematode infestation is not evenly spread over a field. Uneven growth in patches which spread gradually year after year appears where nematodes are rampant. Yellowing and drying of leaf margins and tips are associated with such plants.

HOW NEMATODES SPREAD?

It is a common practice to raise nurseries inside the plantation where perennial water source is readily available throughout the year. The site of these nurseries generally remains unchanged for years. The optimal growing conditions combined with repeated cropping under high fertility and irrigation favours the growth and multiplication of nematodes. These nurseries serve as a reservoir for nematodes.

Root-knot infested seedlings used for transplantation into the main field serve as an important source of inoculum in cardamom plantations. Once introduced, nematodes can spread rapidly throughout the field. Farm implements may carry nematode contaminated soil from infested spots in the field while depositing them in non-infested areas. Irrigation, drainage and run off water may pick up nematodes and their larvae and scatter them in the field.

Some shade trees like dadaps (Erythrina spp.) Vernonia sp, Ficus sp. and Cedrella sp. are naturally infested with root-knot nematodes. Among the shade trees Erythrina spp. are highly susceptible to root knot nematodes. Avoiding Erythrina spp. and clean weeding would help considerably in reducing the build up of root-knot nematode population at field level. Because spread of nematodes may occur through the weeds naturally occurring in cardamom plantations also.

CONTROL MEASURES

In nursery: 1. Methyl bromide fumigation can be taken up in pre-plant primary and in secondary nurseries. The effect of methyl bromide on
control of nematodes and on weeds in cardamom nurseries is very promising. Weeding in the early stages of growth is reported to cause disturbance to young cardamom seedlings and weeding is necessarily done after every 30 days. Fumigation with MBr results in complete control of weeds. Methyl bromide fumigation @ 500 gms/100 sq. ft. under polythene covering for 72 hr had controlled nematodes with an increase in germination. In the fumigated nursery beds the seedlings are vigorous and healthy with broader leaves. Because of increased vigour, seedlings raised in fumigated beds withstand transplanting shock hence the normal 30-40% gap filling in secondary nursery can be avoided. The increase in cost for fumigating both primary and secondary nursery will only be 50 paise per seedling at a treatment cost of 50 paise/sq. ft. The additional cost is negligible considering the advantage of control of weeds, nematodes and other diseases and cent per cent establishment of transplanted seedlings in secondary nursery and in the field.

2. Drenching the nursery beds with 2% formalin and covering with polythene for 72 hr and raking the soil to liberate the formalin gas followed by planting after 15 days of drenching may be adopted in case MBr fumigation is not possible.

3. In case the above two methods cannot be adopted, plants may be treated with aldicarb @ 5 Kg ai/ha i.e. 30 gms/6 x 1 M bed after 10 days of germination along the rows, repeated after 3 months. In the secondary nursery applications is done @ 10 Kg ai/ha i.e. 60 gms/6 x 1 M bed after transplanting and repeated after every three months around the individual plants. The cost of aldicarb per plant inclusive of treatment in primary and secondary nurseries is ten paise per seedling. Including the labour cost for application it may work out to 25 paise per seedling. The use of these nematicides has only limited advantage as none of the chemicals is effective in raising nematode free seedling.

In field: 1. Nematicides are expensive. They are profitable to use only if the land is heavily infested with nematodes. Usually nematode infestation is not uniformly spread over a field but occurs in patches. In such cases, control measures must be initiated without any delay in these infested patches. Granular nematicides can be applied after opening a basin of 3-5 cm deep to expose root system around the pseudostem and again covered with the same soil. Sufficient moisture may be ensured for release of the active ingredient from the nematicide granules. Plants may be treated with carbofuran/ophorate @ 5 kg ai/ha i.e. around individual plant preferably after few showers in May and repeated after 3 months. When nematicides are used at economic rate, they do not kill all the nematodes. The nematode population increases rapidly after 2-3 months. If nematicide application is not followed after 3 months, nematode infestation may be as severe as it was before.
2. "Katte" affected cardamom plant generally harbours more root-knot nematode population to an extent of 5-10 times compared to healthy plants. Hence 'Katte' plants should be regularly removed from plantations. Care should be taken to remove the entire root zone of the diseased plants, and nematicide (Aldicarb/phorate – 15 gms/pit) should be applied in the pits before taking up new planting.