

ROOT-KNOT NEMATODE

- i. *Meloidogyne javanica*
- ii. *M. arenaria*
- iii. *M. incognita*
- iv. *M. hapla* etc.

Family: Heteroderidae

Order: Tylenchida

These are among the most spread plant parasitic nematodes and cause heavy losses, particularly to vegetable, even more than all other diseases combined together.

Symptoms: The plant growth is reduced, unthrifty growth and tendency of plant to wilt during warm days. In case of high populations, young seedlings may be killed over large areas without any trace of gall formation. If the suspected plant is carefully lifted up with a shovel. The plant roots will show galls on them. The galls can be split open and white pearly, typically elongate pyriform females can easily be seen under a microscope.

Crop damage in warm and long season parts of the world is generally much more conspicuous than the cooler and short season areas. Nematode injury is usually associated with plant parasitic fungi, which find their way into the weakened roots. In 1955, Sasser showed that tobacco plants inoculated with Black Shank of Tobacco (*Phytophthora parasitica* var. *nicotianae*) fungus caused mortality 0-30% while other inoculated with nematode and fungus showed 75-100% mortality after 3 weeks of planting.

Life cycle: Elongate ovate eggs are laid in a gelatinous egg sac. On an average female lays 200-500 eggs. This nematode passes through 5 stages. 1st and 2nd stage develop within the egg. 2nd stage larvae come out. They are slender, worm like and move in soil in search of the host. The juvenile may find their way in the mother gall or somewhere else. In a single gall, all the stages of the nematode may be found. Larvae prefer root tips for penetration. They are unable to penetrate into large roots. Females remain near the cortex while juveniles penetrate to near about the central cylinder.

After the establishment of juveniles giant cells develop. Female juvenile become obese spindle shaped. 3rd and 4th stage cuticles are also produced without any moult. The larvae at this time are flask shaped. When gonads develop, final moult takes place and 2nd, 3rd, and 4th stage cuticles are shed simultaneously. After 3rd stage, male remains active, slender, with small spear, and bluntly tail without bursa. Reproduction can take place without males and a single larva may produce as many as seven generations.

Control:

1. Crop rotation: Not successful to a great extent. In case of cotton and peanut nematodes, a three years rotation of alfalfa has proved useful. Anyhow rotation of alfalfa, tobacco, corn, and cereals will produce satisfactory yield.
2. Fallowing of land: Dry fallowing with 2-3 deep ploughing during hotter summer months in long season areas, is an excellent measure. winter vegetable should be short season.
3. Soil fumigation: DD mixture @ 7 lbs/10,000 sq.ft. EDB+DD mixture @ 8 lbs/10,000 sq.ft. VAPAN @ 3 lbs/100 sq. ft. Nemagon (DBCP) 10 gl/acre; etc.
4. Root residues should be collected and removed or allow them to decay before the application is made, other wise, a large number of population will escape during fumigation.

CYST FORMING NEMATODE

Causal Organism: Sugarbeet cyst nematode: *Heterodera schachtii*,
Potato cyst nematode: *Globodera rostochiensis*
Family: Heteroderidae
Order: Tylenchida

Potato cyst nematodes were first found in 1881 in Germany and in 1941 in USA. Because of its yellow or golden phase during development it was named as golden nematode of potato.

Symptoms: Potato cyst nematodes do not cause distinctive above ground symptoms that are of diagnostic value. Because the nematodes attack root, infected plant exhibit typical symptoms of water or mineral stress. Plants show sickly yellow appearance the plants may die prematurely. High nematode densities cause stunting and in some cases stop growth completely. Close examination of the roots of infected plants at the time of flowering reveals minute pearly white bodies, which are immature females that have erupted the root epidermis. When the females mature they turn dark brown and most of them are dislodged from the roots when plants are lifted for examination. First sign of nematode attack appears in a field with patchy area of poor growth, which year after year enlarges and spread by cultivation to entire field. Yield of infested plants is drastically reduced in terms of number and size of potato. Damage is caused by disruption of the conducting tissues of the roots. This disruption is brought about by formation of feeding sites (synchytia) of phloem parenchyma through cell wall dissolution.

Life cycle:

During spring, 2nd stage juveniles emerge from the eggs after stimulation of substances

from host plant roots. They invade host root near the tip. Eventually they come to rest with then heads towards the stele and begin feeding on pericycle or cortical and endodermis cells. By injecting saliva, there is breakdown of the cell wall, which forms large "Syncytia transfer cell" with dense granular cytoplasm. The nematode continues feeding until its development is complete (a period of 2-3 months for completion the life cycle depending upon temperature). The juvenile after becoming sedentary undergoes a series of three molts through 3rd and 4th juvenile stages to the adult. Sex is distinguishable J3 stage and once the sex is determined, it is irreversible.

J4 males remain coiled within the sac like third stage cuticle and emerge from the roots after last molt. They are vermiform and live freely in soil. The J4 females enlarge as their gonads increases in size eventually rupturing the root cortex exposing spherical bodies outside the root with only head and neck embedded in the root. Later on females die and cuticle tends to form a tough leathery cyst protecting eggs and Juveniles within their bodies THE CYSTS. After harvesting of potatoes, these cysts are detached from the roots and become free in soil and overwinter.

CITRUS NEMATODE

Causal organism: *Tylenchulus semipenetrans*
Order: Tylenchida
Family: Tylenchulidae

This nematode is a serious pathogen of citrus orchards and is invariably present in all plantations with those trees which are in various stages of decline and dieback. It causes a disease named as SLOW DECLINE which is worldwide in distribution including Pakistan, India, Srilanka, Thailand, China, Philippines, Iraq, Lebanon, Egypt, South Africa, Australia, Brazil and United States. Losses are sometimes very high upto 40-50%.

Symptoms

Plantings at early stage produces excellent yield for 10-15 years before injury become evident.

If the populations are low at initial stage, no prominent symptom appear until population reaching to damaging level.

Competition is developed for fertility and moisture between roots and tree resultantly top growth is checked.

The first indicator of injury is a reduction in terminal growth accompanied by reduced vigour, yellowing & dying of leaves and twigs.

The trees are not killed but maintain life on a limited scale.

Such trees produce crop which is poor in quantity and quality.

Young nursery stock if planted on infested land, begin to show yellow leaves, followed by defoliation and production of under-sized fruits within two-three years.

Such plants fail to survive.

Roots of diseased plants show dirty appearance due to female's gelatinous secretions at the time of reproduction and egg laying.

Life Cycle

Females are found on thick, started rootlets to which a layer of soil particles is clinging.

These particles are held in place by gelatinous mucus secreted by the female, which protects the eggs.

Females can be observed clinging to the roots with their heads and necks buried in the cortical layer. J2 require 14 days to locate and feed on epidermal root cells. The J3 and J4 stages end in shorter immature female. Young female emerges later on after molting. Within a week, this female can penetrate to the pericycle of the root and develop into fully enlarged female. J2 males usually are formed before emerging from egg mass, after third molt. J4 male increases in size and male sex organs are developed. From this stage adult male emerges. The length of lifecycle is about six-eight weeks.

Control

1. Exclusion:
 - I. Use nematode-free nursery.
 - II. Avoid run off water from infested to non-infested field.
 - III. Contaminated equipment should be avoided.
2. Crop Management:

Soil problems like poor drainage, excessive salinity, drought stress should be properly managed. Weeding and hoeing is also necessary.
3. Direct Management:
 - I. Preplant nematicides should be used like methyl bromide, 1,3 dichloropropane and dibromochloropropane (DBCP) 5-10 gallons per acre.
 - II. Post plant nematicides like aldicarb, femaniphos, oxanil are recommended.
4. Use of resistant root stock.

