

Lecture 13 - Different methods of Nematode Control

Plant parasitic nematodes can be controlled by several methods. The nematode control aims to improve growth, quality and yield by keeping the nematode population below the economical threshold level. The control measures to be adopted should be profitable and cost effective. It is essential to calculate the cost benefit ratio before adopting control measures.

The nematode control methods are

1. Regulatory (Legal) control
2. Cultural control
3. Physical control
4. Biological control
5. Chemical control.

Regulatory control

Regulatory control of pests and diseases is the legal enforcement of measures to prevent them from spreading or having spread, from multiplying sufficiently to become intolerably troublesome. The principle involved in enacting quarantine is exclusion of nematodes from entering into an area which is not infested, in order to avoid spread of the nematode

Quarantine principles are traditionally employed to restrict the movement of infected plant materials and contaminated soil into a state or country. Many countries maintain elaborate organizations to intercept plant shipments containing nematodes and other pests. Diseased and contaminated plant material may be treated to kill the nematodes or their entry may be avoided. Quarantine also prevent the movement of infected plant and soil to move out to other nematodes free areas.

Plant Quarantine in India

The Destructive Insects and Pests Act, 1914 (DIP) was passed by the Government of India which restricts introduction of exotic pests and disease into the country from abroad.

The agricultural pests and disease acts of the various states prevent interstate spread of pests within the country. The rules permits the plant protection advisor to the government of India or any authorizes officer to undertake inspection and treatments.

Strict regulations have been made against *G. rostochiensis*, the potato cyst nematode and *Rhadinaphelenchus cocophilus*, the red ring nematode of coconut. Domestic quarantine

regulations have also been imposed to restrict the movement of potato both for seed and table purposes in order to prevent the spread of potato cyst nematode from Tamil Nadu to other states in India.

Cultural Control

Cultural nematode control methods are agronomical practices employed in order to minimize nematode problem in the crops.

Selection of healthy seed material

In plants, propagated by vegetative means we can eliminate nematodes by selecting the vegetative part from healthy plants. The golden nematode of potato, the burrowing, spiral and lesion nematodes of banana can be eliminated by selecting nematode free plant materials. The wheat seed gall nematode and rice white tip nematode can be controlled by using nematode free seeds.

Adjusting the time of planting

Nematode life cycle depends on the climatic factors. Adjusting the time of planting helps to avoid nematode damage. In some cases crops may be planted in winter when soil temperature is low and at that time the nematodes cannot be active at low temperature. Early potatoes and sugar beets grow in soil during cold season and escape cyst nematode damage since the nematodes are not that much active, to cause damage to the crop during cold season.

Fallowing

Leaving the field without cultivation, preferably after ploughing helps to expose the nematodes to sunlight and the nematodes die due to starvation without host plant. This method is not economical.



Deep summer ploughing

During the onset of summer, the infested field is ploughed with disc plough and exposed to hot sun, which in turn enhances the soil temperature and kills the nematodes.

For raising small nursery beds for vegetable crops like tomato and brinjal seed beds can be prepared during summer, covered with polythene sheets which enhances soil temperature by 5

to 10°C which kills the nematodes in the seed bed. This method is very effective and nematode free seedling can be raised by soil solarization using polythene sheets.



Summer ploughing

Manuring

Raising green manure crops and addition of more amount of farm yard manure, oil cakes of neem and castor, pressmud and poultry manure etc enriches the soil and further encourages the development of predacious nematodes like *mononchus* spp. and also other nematode antagonistic microbes in the soil which checks the parasitic nematodes in the field.

Flooding

Flooding can be adopted where there is an enormous availability of water. Under submerged conditions, anaerobic condition develops in the which kills the nematodes by asphyxiation. Chemicals lethal to nematodes such as hydrogen sulphide and ammonia are released in flooded condition which kills the nematodes.



soil

Trap cropping

Two crops are grown in the field, out of which one crops is highly susceptible to the nematode. The nematode attacks the susceptible crop. By careful planning, the susceptible crop can be grown first and then removed and burnt. Thus the main crop escapes from the nematode damage. Cowpea is highly susceptible crop can



Cowpea

be grown first and then removed and burnt. Cowpea is highly susceptible to root – knot nematode and the crop can be destroyed before the nematodes mature.

Antagonistic crops

- ✓ Certain crops like mustard, marigold and neem etc have chemicals or alkaloids as root exudates which repell or suppress the plant parasitic nematodes.
- ✓ In marigold (*Tagetes* spp.) plants the α – terthinyll and bithinyll compounds are present throughout the plant from root to shoot tips. This chemical kills the nematodes.
- ✓ In mustard allyl isothiocyanate and in pangola grase pryrocaterchol are present which kills the nematodes.
- ✓ Such enemy plants can be grown along with main crop or included in crop rotation.



Marigold

Removal and destruction of infested plants

Early detection of infested plants and removal helps to educe nematode spread. After harvest the stubbles of infested plants are to be removed. In tobacco, the root system is left in the field after harvest. This will serve as a inoculum or the next season crops. Similarly in *D. angustus* the nematode remains in the left out stubbles in the field after harvest of rice grains. Such stubbles are to be removed and destroyed and land needs to be ploughed to expose the soil.

Use of resistant varieties

Nematode resistant varieties have been reported from time to time in different crops. Use of resistant varieties is a very effective method to avoid nematode damage. Nemared, Nematex,

Hisar Lalit and Atkinson are tomato varieties resistant to *M. incognita* . The potato variety Kufri swarna is resistant to *G. rostochiensis*.

Physical control

It is very easy to kill the nematodes in laboratory by exposing the nematodes to heat, irradiation and osmotic pressure etc., but it is extremely difficult to adopt these methods in field conditions. These physical treatments maybe hazardous to plant or the men working with the treatments and the radiation treatments may have residual effects

Heat treatment of soil

Sterilization of soil by allowing steam is a practice in soil used in green house, seed beds and also for small area cultivation. Insects, weed seeds, nematodes, bacteria and fungi are killed by steam sterilization. In such cases steam is introduced into the lower level of soil by means of perforated iron pipes buried in the soil. The soil surface needs to be covered during steaming operation. Plastic sheets are used for covering. In the laboratory and for pot culture experiments autoclaves are used to sterilize the soil.



Soil solarisation

Hot water treatment of planting material

Hot water treatment is commonly used for controlling nematodes. Prior to planting the seed materials such as banana corms, onion bulbs, tubers seeds and roots of seedlings can be dipped in hot water at 50 – 55 °C for 10 minutes and then planted.

Irradiation

Irradiation also kills the nematode. Cysts of *G. rostochiensis* exposed to 20,000 Y contained only dead eggs and at 40, 000 Y exposure, the eggs lost their contents. *Ditylenchus*

myceliphagus in mushroom compost exposed to γ rays between 48,000 to 96,000 γ inactivated the nematodes. UV light also kill the nematodes. But these irradiation is not practically feasible under field conditions.

Osmotic pressure

Feder (1960) reported 100% nematode mortality when sucrose or dextrose were added to nematode infested soil @ 1 to 5% by weight. But these methods are not practical and economical.

Washing process

Plant parasitic nematodes are often spread by soil adhering to potato tubers, bulbs and other planting materials. Careful washing of such planting material helps to avoid the nematodes in spreading in new planting field. Washing apparatus for cleaning potato and sugarbeet tubers are commercially developed and are being used in many countries.

Seed cleaning

Modern mechanical seed cleaning methods have been developed remove the seed galls from normal healthy wheat seeds.

Ultrasonics

Ultrasonic have little effect on *Heterodera* spp. The use of this ultrasonics is not practically feasible.