Lecture 14 - Biological Control

Biological control aims to manipulate the parasites, predators and pathogens of nematodes in the rhizosphere in order to control the plantparasitic nematodes. Addition of organic amendments such as farm yard manure, oil cakes, green manure and pressmud etc encourages the multiplication of nematode antagonistic microbes which inturn checks the plant parasitic nematodes.

The addition of organic amendments acts in several ways against the plant parasitic nematodes. Organic acid such as formic, acetic propionic and butric acids are released in soil during microbial decomposition of organic amendments. Ammonia and hydrogen sulphide gases are also released in soil during decomposition. These organic acids and gases are toxic to nematodes.

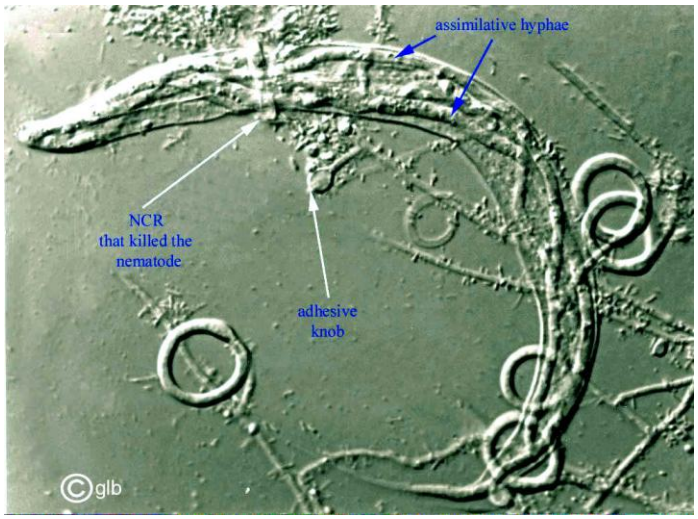
Nematode antagonistic microbes multiply rapidly due to addition of organic matter. Organic amendements improve soil conditions and helps the plants to grow. The organic matter also provides nutrition for the crps plants.

Predacious fungi

Most of the predacious fungi comes under the order Moniliales and Phycomcetes. There are two types of predacious activities among these fungi. They are nematode trapping fungi and endozoic fungi.

Non-constricting rings

The trap is formed similar to the constricting ring. It is a non – adhesive trap. The reing becomes an infective structure and kills the nematode eg. *Daclylaria candida*.



In addition to formation of traps and adhesive secretions, the predacious fungi may also produce toxin which kills the nematodes.

Endozoic fungi

The endozoic fungi usually enter the nematode by a germ tuber that penetrates the cuticle from a sticky spore. The fungal hyphae ramify the nematode body, absorb the contents and multiply. The hyphae then emerge from dead nematode. *Catenaria vermicola* often attacks sugarcane nematodes.

Pasteuria penetrans was found to be very effective against the root –knot nematodes in many crops. The *P. penetrans* infested J2 of root knot nematodes ca be seen attached with spores throughout the cuticle.

History of chemical control

Kuhn (1881) first tested CS2 to control sugarbeet nematode in Germany and he could not get encouraging results. In South Carolina State, U.S.A. Bessey (1911) treated CS2 or the control of root – knot nematodes but the method proved impractical. Latter on the chemicals like formaldehyde, cyanide and quick line were observed to have nematicidal properties, but all these chemical were found to be highly expensive.

Mathews (1919) observed the effect of chloropicrin (tear gas) against plant parasitic nematodes in England. Carter (1943) an entomologist of Hawai, Pineapple Research Institute, reported the efficacy of 1,3 dichoropropene 1,2 dichloropropane (DD) mixture@ 250 1b/acre, against the plant parasitic nematodes. In 1944, scientists from California and Florida states of USA reported the efficacy of ethylene dibromide (EDB). In the same year the Dow Chemical company, USA introduced the chemical as a soil fumigant for the management of nematodes. The introduction of these two nematicides viz., DD and EDB paved way for the chemical control of nematodes.

Description of some important nematicides

Ethylene dibromide (EDB) : 1.2 Dibromonehane. It is a colourless liquid and the gas in non-inflammable. It is available ad 83% liquid formulation containing 1.2 kg active ingredient per litre and as 35% granules. It is injected or dibbled into the soil for the control of nematodes at 60 to 120 1 or 200 kg ai/ha but it is not very effective against cyst nematodes. Heterodera spp. and soil fungi. Crops like onion, garlic and other bulbs should not be planted after soil treatment with EDB. It is available as Bromofume and Dowfume.

Dibromochloropropane : (DBCP) 1,2 – dipromo – 3 – chloropropane. It is a straw coloured liquid, a litre of it weighing 1.7 kg. It can be used s soil treatment before planting, at the time of

planting or as post when the soil temperature is above 20˚C. It is applied as a sprinkle depending upon the crop and stage. Certain crops like tobacco and potato are sensitive due to high bromine content in the chemical. It functions more efficiently than other fumigant at high soil temperature due to its high boiling point (195.6˚C). trade names are Nemagon and fumazone.

DD mixture It is the trade name of the mixture of compounds, chief of them contain thecis and the trans isomers in equal quantities of 1,3 – dichloropropene 30.35%, and a few other chlorinated compounds up to about 5%. Of these, dichloropropene is the most toxic compounent and among its two isomers, the transisomer is twice as toxic as the cis-isomer. It is a black liquid of 100% formulation and a litre of it contains approximately 1kg of technical compounds. It is used in the control of soil insects and nematodes and injected into the soil at a depth of 15 -20 cm at 25 x 30 cm spacing. It is a fungicide a very high diseases. Since it is highly phytotoxic, it is used for preplant soil application at least 2 -3 weeks before planting. It is used for preplant soil application at least 2 -3 weeks before planting. It is used as such at 225 – 280 1/ha, but in clay and peaty soils a higher dosage is required. It taints potato tubers and carrots grown in treated soil. Dichloropropence is available under the trade name Telone andin mixture with dibromoetane under the name Dorlane.

Methylbromide or Bromomethane It boils at 4.5˚C. At ordinary temperatures it is a gas and therefore, confined in containers under pressure as a liquid. The gas is 1.5 times as heavy as air. Its insecticidal properties were described by Le Goupil in 19 -32. Its power of penetration into packed foodstuffs such as flour is remarkable. As it kills insects slowly a longer period of exposure to gas may be required. For control of stored grain pests it is used at 24 – 32 $g.m^3$, exposure period being 48 h. In tent fumigation for the control of termites and powder post beetles, the dosage recommended is 32 0-64 g/ m^3. For fumigating live plants, the dosage is 16 - 32. Some plants are likely to be injured. In soil application for the control of nematodes.

Phorate : 0,0 – diethyl S – (ethylthiomethyl) phosphorodithioate. Trade name is Thimet. It is systemic insecticide cum nematicide, available as 10% granule. It has got both contact and fumigant action. It does not persist for a longer period and gets metabolically oxidized yielding for rat: oral 16 – 3.7; dermal 2.5 to 6.2.

Aldicarb : 2 – methyl – 2 (methilthio) propinaldehyde 0 (methylcarbomy) oxime. Trade name is Temik. The sulphur atom in the molecule is oxidized to sulfoxide and then to sulfone. It is a

systemic 10% granule. The residues remain in plants for 30 -35 days as a lethal dose. It also acts as repellent, contact nematicide and interferes with reproduction of the nematodes by way of sex reversal.

Carbofuran: C_{12} H_{15} No_3. It is 2,3 – dihydro – 2, 2, dimethyl 7 benzofuranyl methyl carbamate. Trade name Furadon. It is a systemic insecticide cum nematicide. It is formulated as 3% granule and also as 40F. The residual effect last for 30 – 60 days. It has also got phytotonic effect. This systemic chemical has got acropetal action and applied @ 1 -2 kg ai. /ha.

Resistant varieties

The use of resistant varieties provide an effective, economical and friendly means of nematode control.

Crop varieties identified/developed resistant to plant parasitic nematodes

Crop	**Nematode**	**Resistant varieties**
Tomato	Root-knot nematodes (*Meloidogyne javanica / M. incognita*)	PNR-7, NT-3, NT-12, Hisar Lalit
Chilli	Root-knot nematodes ((*Meloidogyne javanica / M. incognita*)	NP-46A, Pusa Jwala, Mohini
Cowpea	Root-knot nematodes (*Meloidogyne javanica / M. incognita*)	GAU-1
Mungbean	Root-knot nematodes (*Meloidogyne javanica / M. incognita*)	ML-30 and ML-62
Cotton	*Meloidogyne incognita*	Bikaneri nerma, Sharda, Paymaster
Grapevine	Root-knot nematodes (*Meloidogyne javanica / Meloidogyne incognita*)	Khalili, Kishmish Beli, Banquabad, Cardinal, Early Muscat, Loose Perlett
Potato	Potato cyst nematode (*Globodera rostochiensis*)	Kufri Swarna, Kufri Giriraj