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# Nematode Problem in Vegetable Crops and Their Management

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Although nematodes rarely kill plants, they can drastically reduce plant growth and yields. Damage is often more pronounced when plants are under other stresses such as lack of water or nutrients or when damaged by other diseases or insects. An IPM approach should attempt to monitor or scout fields for pest densities at critical periods of crop growth.

## Introduction

Nematodes are microscopic, wormlike animals too small to be seen with the unaided eye. The body of the nematode is elongate without any segment. It is cylindrical tapering at both the ends especially towards the tail. The females may swell to become spherical. The size of plant nematode ranges from 0.2 mm to 10 mm & commonly 0.5 to 1.5 mm range. The majority of plant parasitic nematodes live in the soil and damage plants by feeding in large numbers on the roots, impairing the plant's ability to take up water and nutrients. Severe root damage caused by nematodes typically results in above ground symptoms that may include stunting, yellowing of leaves loss of plant vigor and/or an overall general decline in plant performance. Damage is often more pronounced when plants are under other stresses such as lack of water or nutrients or when damaged by other diseases or insects. Although nematodes rarely kill plants, they can drastically reduce plant growth and yields. Nematodes are usually confined to localized areas in the fields spreading very slowly under their own power; however, nematodes may be dispersed more rapidly by movement of infested soil through cultivation, on soil clinging to garden tools and tillers, in water, or on roots of transplants.

## Plant Parasitic nematodes

Plant parasitic nematodes are microscopic roundworms that live in soil and plant tissue and feed on plants by puncturing and sucking the cell contents with a needlelike mouthpart called a stylet. The majority of Plant parasitic nematodes feed on roots, either within the root tissue as endoparasites or outside as ectoparasites. Some nematodes feed within leaves.

1. **Cucurbits:** Root-knot nemetodes (*Meloidogyne spp*.). Root knot nematodes feed on the root systems of cucurbit plants and create abnormal, knotty growths on the roots, called galls. The galls, which can grow to be 1 inch or more, make it difficult for the plant to transmit water and nutrients from the roots to the above-ground plant parts. As a result, cucurbit plants infested with nematodes are often stunted. They may have yellow leaves and tend to wilt easily in warm weather. Infested plants produce fewer leaves, flowers and fruits than healthy plants, and the fruit may be of poor quality.

**Management:** Long crop rotations are applied with non susceptible crops to eliminate or reduce nematode population. Deep ploughing, fallowing, and solarization can further reduce nematode population levels, especially root knot nematodes. Use of resistant varieties- Muskmelon- Hara Madhu is moderately resistant. Cucumber- Bikaner is resistant. Watermelon- Shahjanpuri is resistant. Ridge gourd- Meerut Special and Panipati are resistant. Pumpkin- Jaipuri and Dasna are resistant. Ash gourd- Agra and Jaipuri are resistant. Organic manures enhance nematophagous fungi & antogonistic bacteria & hence reduce the nematode infection. Soil fumigants like- Nemagon @ 120 kg/ha are also useful to reduce nematode population.

2. **Potato:** Cyst nematode (*Globodera rostochinensis, G. pallida*) and Potato tuber rot nematode (Ditylenchus *destructor*).

   **Management:** Crop rotation with French bean and peas. White mustard as an Enemy plant reduces potato cyst nematode. Grow resistant variety Kufri Swarna. Apply Carbofuran @ 60-70 kg/ha in split dose, half at planting time and half at earthing up. The infested soil can be sterilized with steam. Potato cyst nematodes are killed by passing the steam into the soil through perforated pipes in western countries. Hot water treatment will be useful to control cyst nematodes in potato tubers. Soil fumigants Methyl bromide (Dowfume MC-2) @ 400-900 kg/ha, dichloropropene (Telone) @ 500-900 kg/ ha also reduce nematode population. Nonfumigant nematicides- Mocap 6EC is labeled on potato can be used. Potato cyst nematode is a quarantine objective & strict quarantine prevents the movement of the nematode from one country to another.

3. **Beet root and Carrot:** Root-knot nemetodes (*Meloidogyne spp*.). Injury of the growing root tip by nematodes often causes forking of the taproot, stubbing, fasciculation (bunching) of the roots, and a predisposition to wilting. Typically this occurs within the first few weeks after seed germination. In addition, root knot nematodes induce characteristic galls on feeder roots.

   **Management:** Crop rotations are applied with non susceptible crops such as corn or cereals to reduce nematode problem or interplanting or rotating with marigolds will help to suppress populations. Apply neem cake @ 1 tonne/ha or phenamiphos and carbofuran at 4 and 6 kg *a.i.* /ha at sowing time. Organic manures are also reduced the nematode infection. Residues of broccoli, chicken manure and Trichoderma inoculant were incorporated into the soil artificially infested with root-knot nematodes. Telone-II preplant soil fumigation. Allow 2 to 3 weeks between application and planting or until odor has left soil.

4. **Tomato and Brinjal:** Root-knot nemetodes (*Meloidogyne spp*.). Root knot nematodes cause characteristic galls on roots; galls may be up to 1 inch in diameter, but are usually smaller. These galls interfere with the flow of water and nutrients to the plant; infected plants appear less vigorous than healthy plants, may be yellowed, are prone to wilt in hot weather, and respond poorly to fertilizer. Damage areas usually appear as irregular patches and are frequently associated with lighter-textured soils.

   **Management:** Apply neem/subabool leaves @ 0.5 kg/$m^2$ in nursery. Fumigants dichloropropene (Telone) @ 500-900 kg/ ha, dibromochloro propane, (Nemagon) @ 120 kg/ha are recommended to control. Integration of crop rotations with non host crop (*Capsicum annum*). Application of a nematicide Carbofuran/Phorate @ 1 kg *a.i.* /ha at 15 days after transplanting are helpful. Use of resistant variety- Tomato- Hisar Lalit, Pusa-120 (Sel.-120), Nematax, Roma II, VNF-8, Mangala, Arka Vardan. Brinjal- Giant of Banaras, Gola, Gulla, Black Beauty. Apply mustard/neem cake @ 2 tonnes/ha before planting. Nonfumigant

nematicides Vydate L can be injected through drip irrigation systems. Gourd crop like-Marigold as a Border/intercrop is also helpful to reduce nematode problem.

5. **Okra:** Root-knot nemetodes (*Meloidogyne spp*.). Foliar symptoms of nematode infestation of roots generally involve stunting and general unthrift ness, premature wilting, irregular growth, leaf chlorosis and large galls on the root system.

   **Management:** Seed treatment with Carbofuran @ 3% or soil treatment with Carbofuran/Nemacur @ 2 kg/ha at time of sowing. Use of Systemic nematicide, furadan (3G) was found to be quite effective in reducing root-gall and egg-mass. Crop rotation with nematode suppressive crops like clusterbean, sweet corn, millets and incorporation of organic amendment in to the soil also reduce nematode problems.

6. **Onion:** Stem and bulb nematode (*Ditylenchus dipsaci*) and Root knot nematode (*Meloidogyne spp*.). The stem and bulb nematode lives within the plant, feeding in stems, leaves, and bulbs resulting plants are stunted with shortened and thickened leaves, often with brown or yellowish spots. The bulb tissue begins softening at the neck and gradually proceeds downward. Infected bulbs are light in weight, may be malformed or produce sprouts and double bulbs. The stem and bulb nematode penetrates the germinating clove and destroys tissue as it moves through seeking food. Root knot nematodes can cause stunting and uneven stands of plants.

   **Management:** Seed/bulb treatment in hot water at $46^0$C for 1 hour. Use clean, uninfested cloves/bulbs. Growing non-host crops such as spinach, carrots and lettuce for several years is helpful in reducing populations of stem and bulb nematodes. OXAMYL (Vydate L) @ 2–4 qt/acre can be applied in-furrow, as a band, or in sprinkler or furrow irrigation. If the nematode is present in the soil, fumigation can give good control.

7. **Amaranthus:** Root-knot nemetodes (*Meloidogyne spp*.)

   **Management:** Use of resistant varieties Bhubaneswar Local and Kantei Khoda.

8. **Sweet potato:** Sweet potato are frequently damaged by root knot and reniform nematodes. Either may cause stunting and yield loss, root knot nematodes in the tubers may cause cracking or internal dark lesions the severely reduce the value of the sweet potato.

   **Management:** Selection of nematode and disease free propagating materials. Crop rotation. Do not plant sweet potato in the same field in successive years. Use resistant varieties like Cordner, Jewel, Garnet, Bienville, etc. Preplant soil fumigation with materials containing 1, 3-Dichloropropene (DD, Telone II) @ 9-12 gallons/acre or Aldicarb (Temik) at 11kg/ha & Oxamyl (vydate) @ 11kg/ha effectively control nematode. In general planting of cover crops in the season between harvestable crops like Sunn hemp (*Crotolaria juncea*), Doob Grass (*Cynodon dactylon*), Velvet Bean (*Mucuna pruriens*), are good control of the most common root knot nematodes.

**Conclusion**

Nematode control measures can be conveniently divided into two major categories including cultural and chemical control measures. Each management procedure should be considered for use in conjunction with all other available measures in an integrated mode of management. In addition to nematodes, many other pests can cause crop damage and yield losses that further enforce the development of an overall integrated pest management (IPM) program, utilizing all available chemical and nonchemical means of reducing pest populations to sub economic levels. An IPM approach should attempt to monitor or scout fields for pest densities at critical periods of crop growth.