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## PLANT PARASITIC NEMATODE MANAGEMENT STRATEGIES

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### Disease Diagnosis

Management of plant parasitic nematodes hinges on detection and population density estimation. Soil analysis for presence and quantity of plant parasitic nematodes from a lab with a trained nematologist is the first step prior to selecting a field for vegetable production. Root-knot nematodes (*Meloidogyne* spp.) and soybean cyst nematode (*Heterodera glycines*) are the most important nematode pests commonly found in the midwest. Predictive yield loss models are present for *Meloidogyne incognita* (root-knot) where basic biology information is known. Economic thresholds have been published for certain vegetable-nematode interactions.

### Disease-Resistant Varieties

Resistance to all species of *Meloidogyne* except *M. hapla* is available with the Mi gene in tomato, but few other vegetable crops presently have resistant genes for plant parasitic nematodes. Nematode resistance in tomatoes is indicated by the "N" designation. Resistant varieties should be used whenever possible to reduce yield loss. It is important to have multiple disease resistance genes when more than one important pathogen is present in a field, such as with tomatoes where root-knot nematodes, *Verticillium*, and *Fusarium* can interact.

### Crop Rotation

Plant parasitic nematodes survive overwinter in the soil or in association with plant material. Crop rotation and weed control are very important in managing plant parasitic nematodes. Root-knot spp. have a very wide vegetable, field crop, and weed host range. Soybean cyst nematodes have a much narrower host range, but when both nematode species are present a rotation ideal for soybean cyst nematode reduction may favor buildup of root-knot spp.

### Other Cultural Practices

Damage by plant parasitic nematodes can be minimized by adequate water and fertilizer. Plant parasitic nematodes reduce the plant root system's ability to take up water and nutrients, especially when nematode population density is high at planting. Adequate water and fertilizer does not reduce the nematode density but reduces plant stress and thus the symptoms of nematode damage.

Anything that moves soil can spread plant parasitic nematodes within fields and to other fields.

### Chemical Control

Seedling diseases, root diseases, and vascular wilts caused by soilborne fungi and nematodes can be destructive problems in the field and greenhouse. Soil-applied fumigants or nematicides may help prevent serious losses to soilborne disease when used in conjunction with long-term management practices.

Soil fumigants are chemicals that, when injected into the soil, emit toxic fumes that penetrate air spaces in soil in sufficient concentration to kill microorganisms. They must be sealed into the soil with water or a plastic tarp to ensure that a lethal concentration and exposure time are reached. Because fumigants are harmful to all living plants, a period of 2 weeks to 2 months must be allowed between treatment and planting in order to avoid crop damage. Several non-fumigant nematicides are available for several vegetable crops. These generally are systemic compounds that also may provide good insect control.

A number of different factors affect the performance of these products, including soil temperature soil moisture, soil tilth, organic matter, soil type, and time of application. Consult the product label for specific details on safe handling and application methods.

A brief description of several common soil treatments is given in the table on page 42.

## PLANT PARASITIC NEMATODE MANAGEMENT STRATEGIES (CONT.)

Chemical	Fumigant/- Nematicide	Application	Plant Back Time	Crops	Comments
Methyl Bromide	F	Preplant, tarped or mulched for 24 to 48 hours	10 to 14 Days	Most vegetables	Formulations with 98% methyl bromide and 2% chloropicrin are appropriate for nematode control.
Mocap ethroprop	N	Soil only. Applied with water by soil injection, sprinkler system, flood irrigation, over soil surface with sprinkling can.		Cabbage, sweet corn, cucumbers, potatoes, sweet potatoes, snap beans, lima beans	Mobile in sandy soil. Crop injury can occur if used in furrow.
SMDC; Sodium Methyldithio carbamate (Vapam, etc.)	F	Preplant Tarped. Don't enter within 48 hours.	14-21 days after treatment	General use fumigant	Vapam is more effective when applied with considerable water.
Vydate	N	Soil and foliage treatment	NA	Carrot, celery, cucurbits, eggplant, pepper, potato, sweet potato, tomato	Foliar applications are not effective for moderate and high populations of nematodes.
Telone	F	Soil treatment only	2 to 3 weeks	Most vegetables	Formulations with high percentages of chloropicrin are needed to control soilborne fungal diseases.
Nemacur, fenamiphos	N	Soil treatment only	NA	Cabbage, brussels sprouts, bok choy, okra, garlic	
F = Fumigant N = Nematicide					

## SLUG AND SNAIL CONTROL

Slugs and snails occasionally cause serious damage to seedlings, tender, low-growing leafy vegetables; or ripening fruit that are on the ground. Feeding damage, hollowed-out areas, can be found anywhere on fruit, but is usually concentrated near the stem. Slugs leave a telltale slime trail (silvery trail) behind on the surface of fruit or leaves. Slugs and snails are active at night or cloudy days.

Slugs and snails favor continuously moist soil and organic mulch. Their eggs are laid in groups in moist soil, and they use the organic mulch to overwinter. Slugs can complete their entire life cycle in a field.

If slugs are a problem, their hiding places, i.e., boards, stones, weedy areas, should be eliminated. Heavy mulching will also create a favorable habitat for slugs and should be

thinned so the soil can become warm and dry. This will reduce the number of slugs. Raised beds that can dry out more readily than flat beds reduce slug problems. Use of black plastic mulch will discourage slug build-up because it causes the soil to heat up and dry out.

As a last resort, metaldehyde bait (Clean Crop, 3.5G 30-40 lb./A or 7.5 G 15-20 lb./A) can be used and is usually very effective. Follow label instructions carefully for application methods for each particular vegetable crop. Apply bait in evening after a rain or irrigation. For an organic alternative, diatomaceous earth can be spread around plants (a 1 inch high x 3 inch wide band). Control of slugs with diatomaceous earth has been poor to fair.