

FACT SHEET

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CONTROL OF PLANT PARASITIC NEMATODES AROUND THE HOME AND GARDEN

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Plant parasitic nematodes, slender wormlike animals that move among soil particles and root surfaces, attack numerous ornamental and garden plants as well as lawn grasses. They are too small to be seen by the naked eye; however, their damage is apparent in stunted, unproductive plants.

Nematodes puncture plant cells and withdraw juices with a hollow stylet in their forepart. Enzymes (digestive juices) secreted into plant cells to predigest food often cause abnormal responses detected as root knot galling, the most common symptom observed by homeowners.

Root knot nematode damage is most noticeable to the observer, but other nematode types cause plant damage just as severe with less obvious symptoms. These include a stubby root condition, dead areas within roots, excessively branched roots or death of an entire root branch. Roots should be dug and not pulled from the soil when symptoms are sought. It may be necessary to wash soil from roots to see more definite symptoms.

After preparation for observation, suspected roots should be compared with healthy plant roots to enable clearer identification of nematode symptoms. If plants are legumes such as beans and peas, nitrogen nodules caused by nitrifying bacteria should not be confused with root knot nematodes. Nitrogen nodules, attached to the side of the root, can be removed by the thumbnail without destroying the root. However, root knot galls are formed within the root and cannot be removed without root destruction.

Nematodes are commonly introduced into a noninfested area by bringing in contaminated soil or adding infested transplants. Sterilization of soil or mulch before introduction into flower beds or gardens will prevent nematode occurrence. Transplants introduced into the area should have been grown in sterilized or pest-free soil.

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Soil may be sterilized physically or chemically. Small amounts may be treated in an oven at 160 degrees F. 3 to 4 hours. Higher temperatures cause release of toxic substances in the soil. Steam sterilization with steam generation equipment is satisfactory if soil is well tilled and covered with an airtight cover before steam exposure. Time required for adequate steam sterilization may be determined by placing a raw Irish potato under the cover at the beginning of the operation. When the potato is baked throughout, sterilization is complete.

Chemical and soil sterilization may be done with one of several non-selective chemicals designed for this purpose. These chemicals are detrimental to all living organisms in the soil and cannot be used around established plants. They are safe when used as directed and should be applied by a qualified pest control operator or nurseryman. Table 1 lists suggested materials along with use information.

Soil Sterilization Methods

Soil sterilant materials shown in Table 1 are gases and liquids. Application techniques for each include:

1. *Gas application*—Methyl bromide is liquid under compression, but rapidly forms a highly toxic gas under atmospheric conditions. For this reason, it must be applied under an airtight cover such as polyethylene film. Till soil to the depth of desired treatment. Place cans, crates or bottles over the area to be treated so that the airtight cover will be held off the ground to allow circulation of poisonous gas. Place some type of container such as a coffee can under the airtight cover to catch liquid methyl bromide as it comes from the pressurized can. This allows it to vaporize and become evenly distributed under cover.

Once the preceding procedures are accomplished and the airtight cover has been sealed on all sides, the delivery line from the application

device should be terminated in the vaporizing container. Then secure the application device to the pressurized methyl bromide container for material delivery. Enough material should be released to treat the area covered by the cover. Leave the cover in place 48 to 72 hours.

2. *Liquid application* — (A) Vapam or VPM form a toxic gas after application. They may be diluted with water and applied to the soil with a sprinkler can. This application must be followed with a "water seal" on an airtight cover. A water seal may be applied by sprinkling the area with water to near the point of runoff. Satisfactory results may be achieved with this method, but best results are obtained by using an airtight film. (B) Vorlex or Chloropicrin should be injected into the soil by specially constructed knives or similar devices. The treated area must be covered with an airtight cover when chloropicrin is used, but this step is optional with Vorlex. However, covering treated soil will give better control in the upper 2 inches of soil.

Less toxic materials, nematicides, are available if only nematode control is required. Some types must be applied before planting, while others may be used around established plants. Nematicides do not completely eradicate plant parasitic nematodes, but do lower their population so that plants may be grown satisfactorily. Population will build up again, requiring treatment on an annual or semi-annual basis.

Application methods are dependent upon the type of material used, along with conditions in the area requiring treatment. Most nematicides are

Spear used in puncturing plant cells

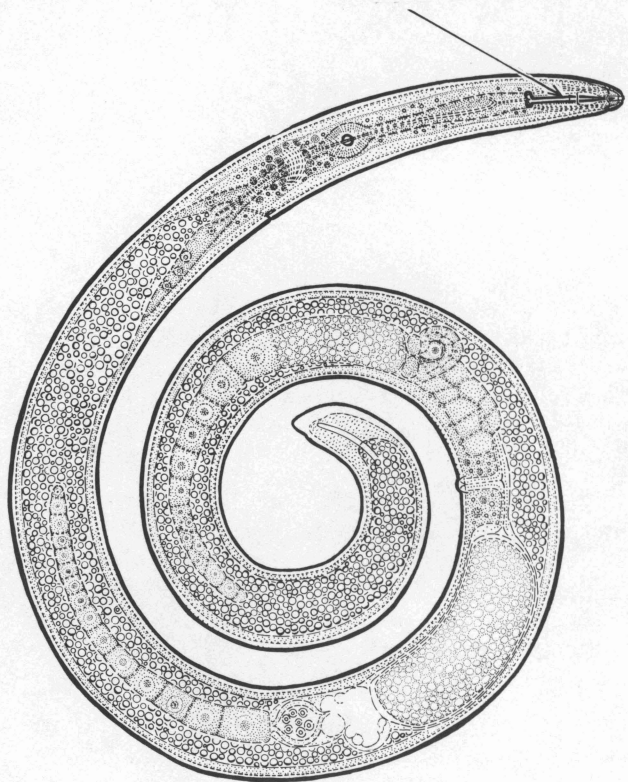


Fig. 1. General shape of a nematode. They may range in length from 0.2 mm to 10 mm, but most plant parasitic types range below 2 mm.

Table 1. Soil Sterilant Materials

Material*	Relative toxicity	Range of pest control	Must be used under airtight cover	Method of application	Suggested application rate per 100 sq. ft.	Waiting period
Methyl bromide	Very toxic	All	Yes	Release contents of pressurized can under an airtight cover.	1 to 3 lb.**	Allow plastic cover to remain in place for 48 hours after chemical application. Wait 10 days before setting transplants.
Vapam or -VPM-	Toxic	All, except nut grass	Yes, for best results	Sprinkle on soil in water and seal with an airtight cover or water seal.	1 to 2 qt.	Allow plastic cover to remain in place for 48 hours after chemical application. Wait at least 14 days before planting.
Vorlex	Toxic	All, except nut grass	No	Inject into soil to a depth of 8 to 12 inches.	2 1/2 to 7 1/2 fl. oz.	Allow 3 weeks before planting.
Chloropicrin	Toxic and very irritating to mucuous membranes	All	Yes	Inject into soil and cover with an airtight cover.	1 lb.	Wait at least 10 days or until all traces of the chemical have left the soil.

*All materials listed in this table are highly toxic to human beings if used improperly. Homeowners are encouraged to obtain professional assistance with application.

**This suggested rate pertains only to soils where non-food crops are to be grown. Check current recommendations for satisfactory use where food crops are to be grown.

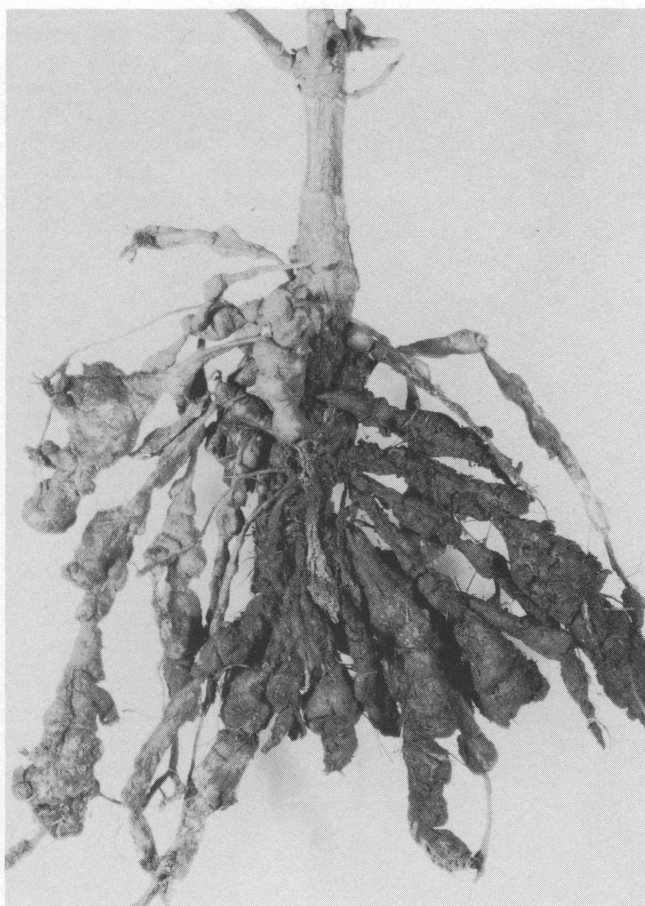


Fig. 2. Root knot galls on lima beans. Galls are produced as a result of feeding and presence of the nematode inside the roots.

either injected into the soil or washed in by a water drench.

Nematicides may be purchased in liquid or granular forms, with application directions dependent upon the type of plants growing or to be grown. When possible, nematode-infested soil should be treated before planting seed or setting transplants.

Nematicide Application Methods

1. *Preplant application* — First decide whether row or overall treatment is desired. If plants are to be cultivated in a row, treat only the potential root zone. Soil should be tilled deeply to prepare a good seedbed. Dig a trench 6 to 8 inches deep in the row and distribute liquid or granular material evenly in the trench at the prescribed rate. Cover immediately to prevent material loss. For best results, soil moisture conditions should be just right for cultivation or planting and the soil temperature should be between 60 and 85 degrees F.

If overall treatment is desired, till the soil deeply, dig trenches 12 inches apart and apply in the same way as described above. Nematicides diffuse approximately 6 inches from point of application to give a treated zone 12 inches wide and 12 inches deep. Applying materials on 12-inch centers results in overall or broadcast soil treatment.

2. *Side dressing nematode-infested plants* — Make sure the material on hand can be used around living plants without causing injury. Dig a trench to the side of the plants as directed on

Table 2. Nematicides For Soil Treatment

Material*	Formulation	Smallest container size	May be used around living plants	Suggested application rates per 100 sq. ft. or per 100 linear ft.**	Percent active ingredient	Aeration period before planting
Nematode Killer	Granule	1 lb.	Yes. Can be used on most plants. See label for specific information.	26 oz.	9.7 %	None***
Nema-X	Granule	1 lb.	Yes. "	13 oz.	5 %	None***
Nemagon	Liquid	1 gal.	Yes. "	4 tbsp. per 2 gal. water	84 %	None***
Fumazone-86E	Liquid	5 gal.	Yes. "	4 tbsp. per 2 gal. water	84 %	None***
Vorlex	Liquid	1 qt.	No. Preplant only.	2 1/8 to 7 1/2 fl. oz.	100 %	1 week or until all odor leaves soil****
Vapam or -VPM-	Liquid	1 qt.	No. Preplant only.	1/2 qt. to 1 1/2 qt.	31 %	2 weeks or until all odor leaves soil****

*Trade names listed as a convenience to the homeowner do not guarantee nor warrant the product's standard nor does it imply approval of the product to the exclusion of others.

**Rate suggestions are for plants intended for non-food uses such as ornamentals. Consult the label for rate recommendations on plantings for food use.

***Do not place seed in direct contact with the nematicide.

****For a positive determination, set a tomato transplant in treated soil and observe 3 days. If no damage is noted, the treated soil is safe for planting.

the label. Cover the material immediately and water to cause diffusion of the material into the root zone. If food-producing plants are to be treated in this manner, make sure all label precautions related to chemical rate and plant growth stage are followed carefully.

3. *Drench for established shrubs and trees* — Infested shrubs and trees may be treated by building a dike around the tree base that will contain water-diluted materials until they penetrate the root zone. The dike should be large enough in diameter to accommodate a majority of the feeder roots. The nematicide should be accurately measured and diluted in sufficient water to penetrate the root zone. After material penetration, add water to wash the nematicide down into the root zone.

4. *Treatment of established turf* — Liquid materials are more satisfactory for use on turf than granules. They may be watered into turf after application from a sprinkler can. Materials should be diluted in water first and then sprinkled only on an area that can be watered immediately. Apply

sufficient water to leach the material into the root zone.

Nematicides have been well accepted and given good economic returns. Treatment is sufficient for a year and retreatment usually will be required the following year if susceptible plants are to be grown.

Most common garden plants such as beans, cucumbers, okra and squash are highly susceptible. Most tomato varieties are susceptible, but resistant ones like Texas' popular Nematex have been developed.

Marigolds, like some other nematode-tolerant ornamentals, emit a substance from their roots that is toxic to the parasite. For this reason, some homeowners choose to grow marigolds in flower beds 2 to 3 years to reduce nematode populations rather than using nematicides.

While it is almost impossible to completely eradicate plant parasitic nematodes, they can be controlled by practicing methods listed in this publication.