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ROOT-KNOT NEMATODES (*MELOIDOGYNE INCOGNITA*)

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The Pathogen

Root-knot is the most widely distributed nematode pest of cotton worldwide. This nematode has been reported in every country where cotton is grown. The southern root-knot nematode, *Meloidogyne incognita,* is the predominant nematode species of concern in cotton.

The root-knot nematode is a microscopic worm that spends its entire life cycle either in the soil or inside cotton roots. In contrast to insect pests, nematodes are not very mobile and may move only a few feet during their life. However, nematodes are survivors and can survive tremendously harsh conditions for long periods of time. Root-knot nematodes also produce large numbers of progeny (up to 1,000 per female) in egg masses that are attached to roots in as little as 20 days.

Root-knot survives in the soil from crop to crop mainly in the egg stage. When soil temperature and moisture levels are favorable for crop growth, eggs hatch and the immature nematodes (juveniles) move through the soil to find a cotton root. The juvenile penetrates the root tissue and migrate deeply into the root where they establish a permanent feeding site. Once this feeding site is established, the nematodes go through two additional juvenile stages, reaching adulthood in about three weeks. During this time, cotton root cells near the nematode enlarge tremendously and form characteristic galls from which the name "root-knot" is derived.

Symptoms and Crop Damage

The most diagnostic symptom of root-knot damage is the presence of galls on lateral roots and the tap root (Figure 1). Plant symptoms vary according to the severity of the infection, the cotton cultivar, and the environment. Plant stunting, leaf discoloration that often mimics nutrient deficiency, and wilting or flagging of leaves during the heat of the day all may indicate a root-knot problem.

Yield suppression due to root-knot can be substantial. In the United States, about 4.5% of the potential yield is lost each year because of this pathogen (Figure 2). Because nematodes are relatively immobile, uniform infestation of a field virtually never occurs. Rather, some areas within the field may have very high populations while other areas nearby may have low population levels or no nematodes at all. This "patchy" distribution makes efficient nematode management with nematicides difficult.

Detection

The most accurate means of determining if a root-knot problem exists in a field is to dig up and examine a representative sample of cotton root systems in the field immediately after harvest. Root-knot galls are not easily confused with other problems. A system utilizing root galling information, called the Weighted Nematode Rating system (WNR) is used by many growers in the western United States to predict the severity of damage for the next season. In most other production regions, soil samples for nematode assay will be the main means of detecting root-knot in cotton fields and predicting future damage to the crop. Threshold levels vary from state to state. Contact local county Extension personnel for advice that is specific to your area.

Nematode assay from soil samples requires specialized laboratory equipment and expertise in nematode identification. Nematode assay services are available in all states and in most other regions where cotton is grown. The following is a general guide to proper sampling and handling techniques. More specific guidelines may be obtained from local nematode assay laboratories.

- ★ Sample during the crop season or shortly after harvest
- ★ Collect several small samples over the entire area and combine them into one composite
- ★ Sample to a depth of 6-8 inches
- ★ Sample when soil moisture is adequate for crop growth but not saturated
- ★ Limit the area represented by a single composite sample (5-20 acres)
- ★ Place composite sample into a non-vented container (plastic bag). Avoid allowing the soil to dry out, sit in direct sunlight, or get excessively hot or cold.

- ★ Transport samples in insulated containers to avoid radical changes in temperature and to keep them out of the sun.
- ★ Deliver the samples to the assay laboratory immediately.

Root-Knot Management

Root-knot management in cotton requires an integrated approach that is ongoing. Once the nematode has become established in a field, it is virtually impossible to eradicate. Root-knot can, however, be managed so that it has little adverse impact on crop yield. Three fundamental approaches can be effective in root-knot management. Crop rotation, particularly if a clean fallow period can be included in the sequence periodically, can lower nematode population densities substantially. Unfortunately, the southern root-knot nematode has a very broad host range that includes many common agronomic and vegetable crops. Crop and cultivar selection are, therefore, of critical importance when planning cropping sequences (Table 1). Nematicides (Table 2) are probably the most-often used management strategy for root-knot. Various nematicides, rates of application, and application approaches are used in different regions. Nematicides are relatively expensive and most pose a significant environmental and health risk if used improperly. They can, however, be a cost-effective means of suppressing nematode damage to the crop (Figures 3-4). Resistant cultivars have been used somewhat effectively in some areas. The cultivar Nem-X, which is adapted to the arid western United States, has been very effective in allowing cotton to be produced in fields with severe root-knot. A few root-knot resistant cultivars that are adapted for use in the middle and southeastern United States have been developed, but none are currently being grown commercially in the regions.

Table 1. Crops that may be effective in lowering southern root-knot nematode population densities.

Effective Crops	Moderately Effective Crops
Rice (flooded)	RKN resistant soybean
Peanut	RKN resistant cowpea
Certain species of *Crotalaria* and *Tagetes*	Grain sorghum*
Rye, Barley	Non-dormant alfalfa
Bahaia grass; Coastal bermuda grass	RKN resistant tomato

*Grain sorghum is moderately effective in the middle and southeastern U.S., but is a good host for root-knot in the western states.

Table 2. Nematicides frequently used in the United States for nematode control in cotton.

Nematicide	Remarks
Aldicarb (Temik 15 G)	Applied in-furrow at planting or both in-furrow and as a sidedress application at pinhead square
1,3-Dichloropropene (Telone II)	Injected into soil 2 wk prior to planting
Oxamyl (Vydate C-LV)	Applied as foliar spray at pinhead square for supplemental nematode suppression

Figure 1. Root-knot galls.

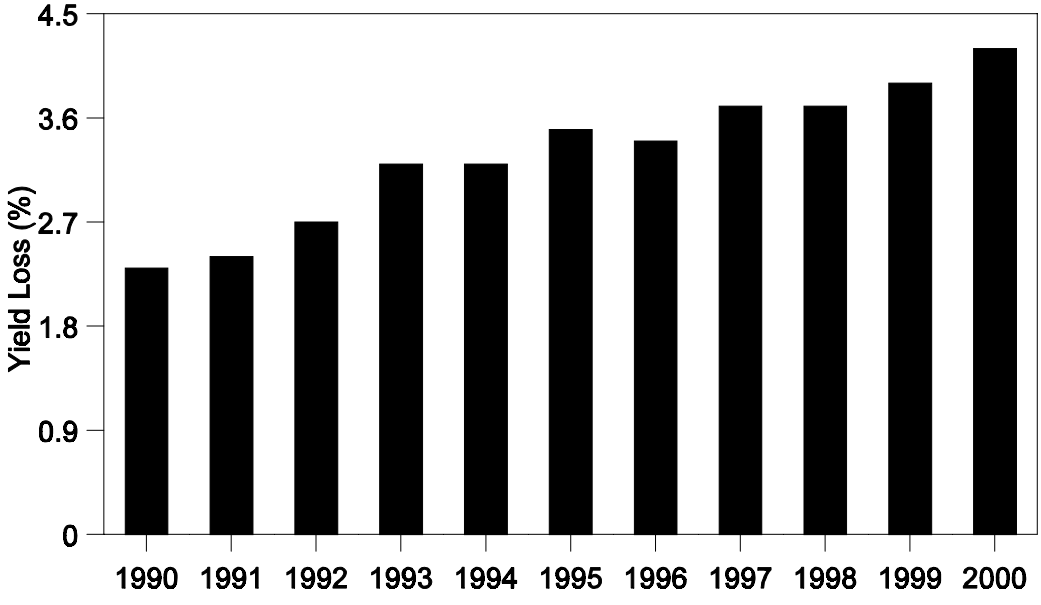

Figure 2. Estimated cotton yield loss in the USA (1990-2000) due to nematodes.

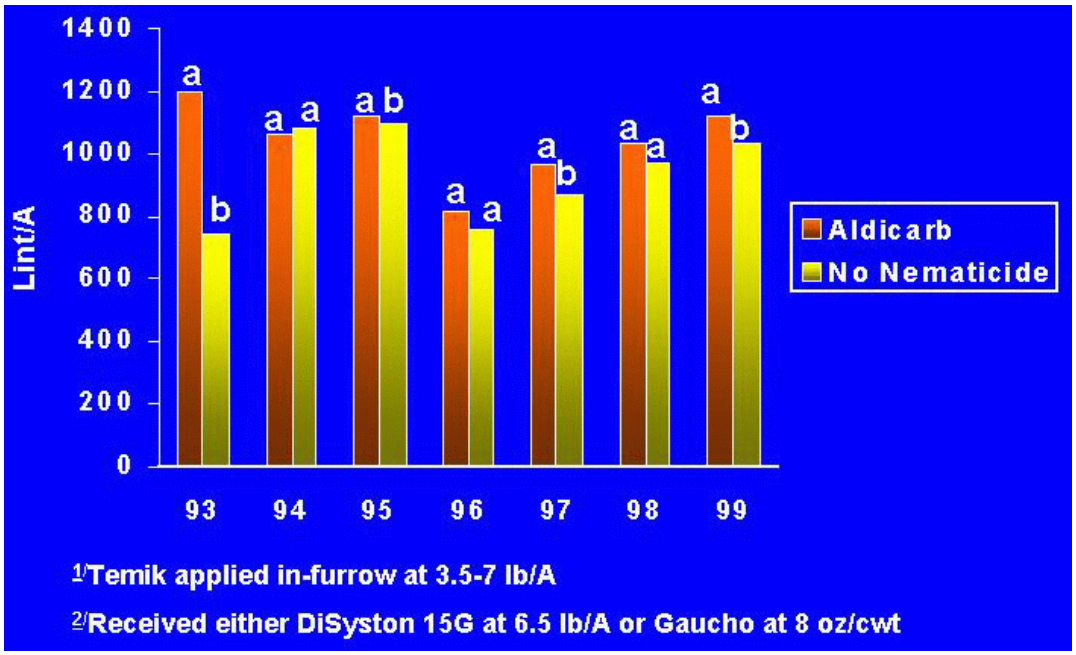

Figure 3. Average lint yield with[1] and without[2] Aldicarb in fields with a root-knot nematode population density >250/500 cm^3 soil, 1993-1999.

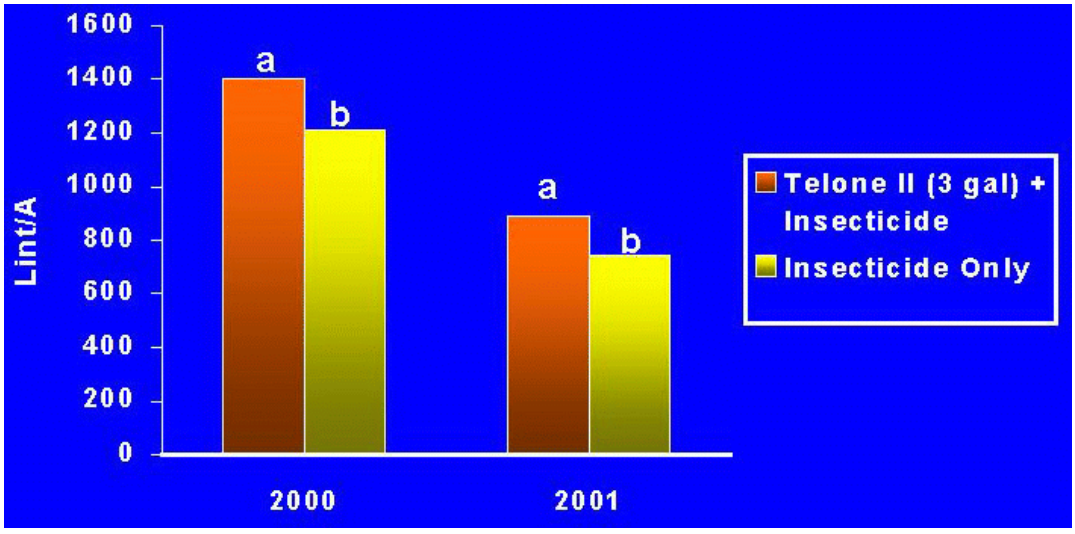

Figure 4. Cotton Lint Yield with and without Fumigation, Ashley County, Arkansas, 2000 and 2001.