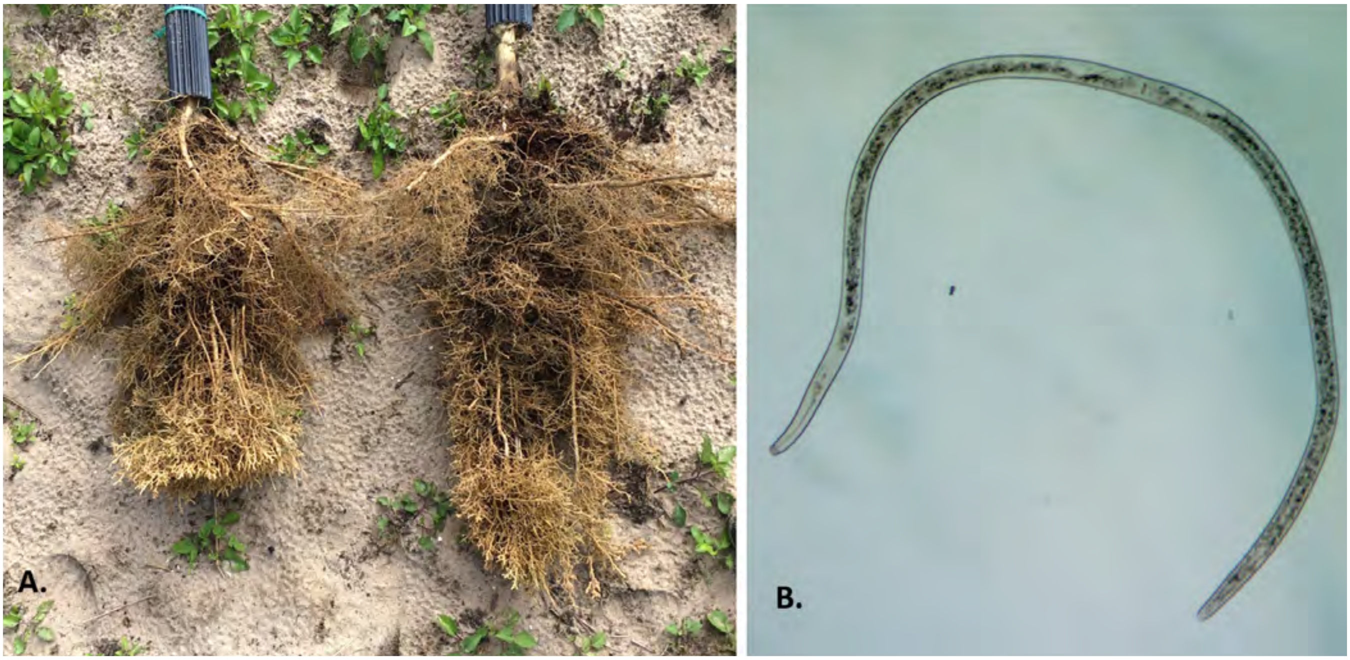


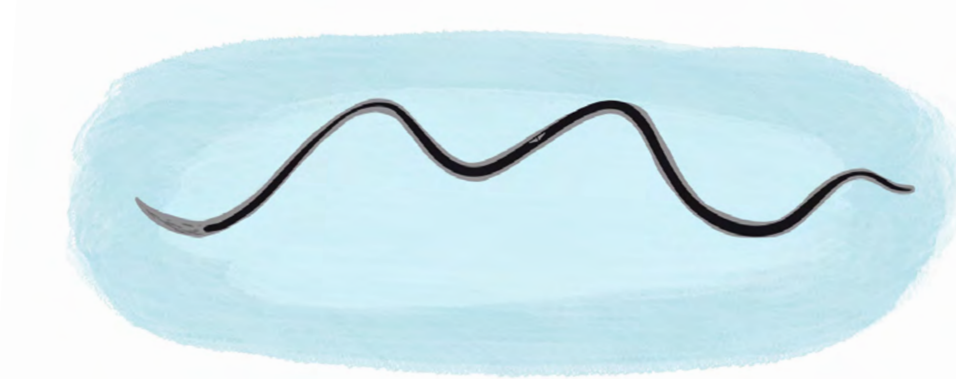
Figure 1. A) Sting nematodes caused stubby root symptoms on young citrus trees. Use of nematicide in the tree planting hole prevented damage to the shallow roots, but nematodes deeper in soil restricted the rooting depth. B) A female sting nematode

Sting nematodes: A growing problem for young trees

By Larry Duncan

Successive hard freezes in Florida in the late 1980s resulted in widespread replanting of citrus groves. Within a few years, many groves on the Central Ridge had discrete patches of poorly growing, chlorotic young trees amid patches of vigorously growing trees. Stubby root symptoms on the declining trees suggested damage by sting nematodes (*Belonolaimus longicaudatus*).

This nematode was confirmed to be the cause of the problem when it was found that large numbers of the pest were associated with the poorly growing trees with few fibrous roots. Few or no sting nematodes were recovered from soil beneath adjacent healthy trees with dense root systems.



NEW PRACTICES, MORE NEMATODES

Sting nematodes had not previously been considered a widespread, economically important problem in citrus. What had changed? And how did unthrifty trees with few roots support so many sting nematodes when neighboring, healthy trees growing in the same soil supported only non-damaging levels of the nematode?

In the decades just prior to the late-80s freezes, citricultural practices changed in major ways. Microjet irrigation replaced overhead or simple, rain-fed irrigation. Mowing largely replaced disking for weed management in row middles.

Sting nematodes respond rapidly to soil water deficit by moving deeper in the soil. As trees began to receive more frequent irrigation from low-volume systems, the nematode was able to remain in the moist soil near the soil surface where fibrous roots are most

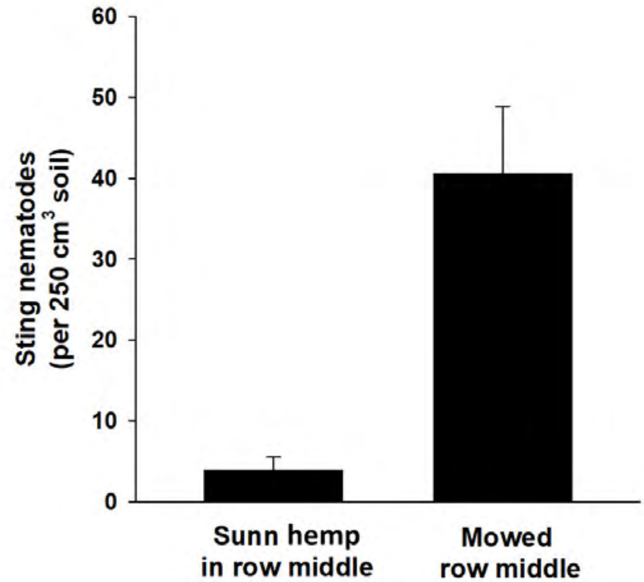


Figure 2. A) Sunn hemp is grown on one side of young citrus trees while native vegetation grown on the other side allows access for management. The two row-middle management regimes will be alternated from side to side of the trees as sunn hemp crops mature and are replanted. B) The graph shows population density of sting nematodes in this grove beneath the sunn hemp and the native vegetation.

abundant. When mowing replaced disking for weed management in citrus row middles, sting nematode populations increased. Thus, replanted groves now encounter more nematodes than was common previously.

Furthermore, sting nematodes have a very wide range of host plants. They are commonly found in coarse, sandy soil throughout the southeastern United States, where they are major pests of many crops, including turf and strawberry, in addition to citrus.

ROOT DAMAGE

Populations of soil-borne pests are highly patchy; thus, young tree damage in replanted groves is patchy as well. Unfortunately for trees that are stunted early by encountering large numbers of the nematode, irrigation scheduling corresponds to the needs of the larger, healthier trees with more abundant roots and higher transpiration rates. Periodic drying of soil beneath healthy trees during the irrigation cycle drives sting nematodes deeper in the soil, thereby affording the shallow root profile protection from the nematode. Smaller trees do not transpire quickly enough to dry the soil between irrigation events. So large numbers of nematodes are free to remain in the shallow profile where they continue to feed on the few remaining fibrous roots.

The damage caused to roots by sting nematodes is very distinctive, making it easy to determine if it may be involved in irregular growth of young trees (Figure 1A, page 24). Sting nematodes are large for plant parasitic nematodes (approximately 0.1 inch long; Figure 1B, page 24). They do not enter the roots as do burrowing nematodes (*Radopholus similis*) or citrus nematodes (*Tylenchulus semipenetrans*) but remain in the soil where they feed only at the tips of growing fibrous roots. When the root tip cells are damaged, growth stops, and roots appear stubby. What can be done to avoid excessive damage by sting nematodes?

MANAGEMENT RECOMMENDATIONS

Unlike the citrus nematode and burrowing nematode, there are no commercial rootstocks resistant to the sting nematode. Reducing the numbers of sting nematodes prior to replanting to levels similar to the days when middles were disked would be helpful.

Preplant soil fumigation of sites with known sting nematode problems was shown to be effective in promoting more vigorous growth of young trees. However, fumigants can no longer be used in many sites with coarse sand that lack a confining soil barrier to protect groundwater. Bare fallowing soil will have the same effect on populations as did disking of row middles, but the practice degrades the soil structure and quality.

Despite the sting nematode's wide host range, a number of non-host crops exist. Strawberry growers have traditionally rotated berries with non-host crops such as the leguminous velvet bean (*Mucuna pruriens*) and, more recently, sunn hemp (*Crotalaria juncea*) to improve the soil, increase levels of nitrogen and prevent buildup of sting nematode. Such crops could be used, prior to replanting groves, as alternatives to bare fallow.

Continued on page 28

There may also be good reason to grow non-host cover crops in row middles. As the young trees grow, roots that extend beyond the canopy toward the mowed vegetation can encounter large populations of sting nematodes that effectively bonsai the trees by restricting the lateral root growth. These nematodes are very mobile in sand and may also help to repopulate sting nematodes beneath the tree canopy that may have been reduced by use of nematicides.

Figure 2 (page 26) shows a cover crop of sunn hemp growing in the row middle on one side of young tree rows. When the crop is mature, it will be incorporated into the soil. The next crop will be grown in the opposite middle. Alternating the middles with sunn hemp allows necessary grove operations on the mowed side while nematode populations are declining on the sunn hemp side. Perennial peanut is another ground cover that is a non-host for sting nematode. While more difficult to establish, the crop provides a permanent cover that permits farm operation traffic.

Alternating the middles with sunn hemp allows necessary grove operations on the mowed side while nematode populations are declining on the sunn hemp side.

The use of nematicides in the tree rows can effectively reduce the size of sting nematode populations (Figure 3, page 29). Several products such as oxamyl (Vydate) and fluopyram (Velum Prime) are currently registered for use in citrus, with others likely in the near future. Most, if not all, of these products will require spring and fall applications because sting nematode populations rebound quickly following treatments. Use of soil-applied nematicides should be avoided during the summer months to reduce unintended movement by heavy rains that can reduce efficacy and increase risk of groundwater contamination.

Threshold levels for sting nematode have not been determined because population numbers change greatly over time without clear seasonality. However, the characteristic damage to root systems provides clear evidence when tree growth and condition are impaired by this nematode.

ONGOING RESEARCH

Nematicides and cover crops are expensive, and there is uncertainty whether HLB-affected trees are able to respond sufficiently to return the costs of reducing many of the other pests and pathogens of the root system. The Citrus Research and Development Foundation recently funded a project to answer the question with regard to sting nematode.

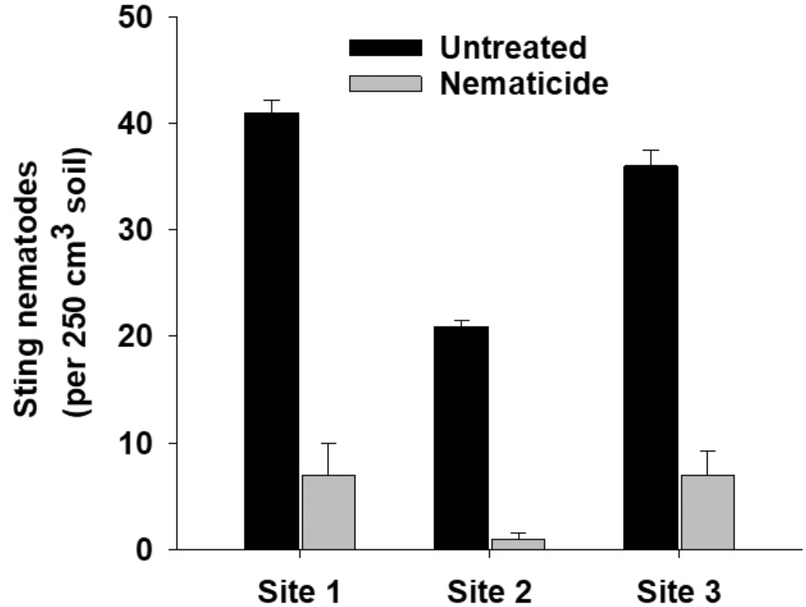


Figure 3. Sting nematode population density beneath young, HLB-affected trees in three groves with trees that were treated or not treated with the labeled rate of oxamyl. Yield is being monitored as trees come into production to determine the profitability of nematode management in trees with root systems already compromised by HLB.

Experiments at several locations will evaluate nematode and tree responses to various cover crops, nematicides and combinations of the two tactics. The growth and yield responses of trees to these treatments will be monitored and reported during the next three years. Additional properties of the cover crops — such as their contribution to increasing soil organic matter, nitrogen and beneficial insects — will also be assessed in an effort to develop effective integrated pest management for sting nematode.

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