Figure 1. Sting nematodes cause stubby root symptoms.

Cover crops and nematicides for sting nematode management

By Larry Duncan, Johan Desaeger and Sheng-Yen Wu

The citrus row middle habitat changed profoundly beginning in the 1970s as mowing replaced disking for weed management. This change ended the costly cycle of cutting and regrowing citrus roots near the soil surface and reduced soil erosion, among other benefits. Mowing also allowed a seasonal succession of native plants to flourish, providing a more stable and diverse habitat for both beneficial and harmful organisms.

Sting nematodes (*Belonolaimus longicaudatus*), which feed on the roots of most grasses and many broadleaf species, quickly exploited the new conditions to increase their numbers. When groves were repeatedly replanted following the series of hard freezes in the 1980s and early 1990s, sting nematodes emerged as a new problem for grove reestablishment. The economic importance of sting nematodes is again evident as groves are widely replanted, this time in response to huanglongbing (HLB).

Sting nematodes damage the fibrous root system by feeding at the root tip, killing the apical cells. This results in stubby, non-functional roots and a greatly reduced root system (Figure 1). Sting nematodes are large plant-parasitic nematodes that remain in soil rather than entering roots, as do burrowing, lesion and citrus nematodes.

Sandy soils are preferred by sting nematodes. They will migrate vertically to avoid dry conditions. By severely damaging the root systems of young trees, they cause stunting, canopy thinning and leaf yellowing, especially in winter. Diagnosis is by soil sampling, but more effective is root excavation because the damage is unmistakable. While stubby symptoms can be apparent in surface roots, the most severe damage often occurs deeper in the soil, where moisture fluctuates less.

There is no known resistance to the sting nematode. Use of preplant fumigants is now largely restricted in counties most affected by the nematode. Bare fallow and fallow combined with non-host/antagonistic cover crops such as sunn hemp will reduce sting nematodes prior to planting. After planting, nematicides can be applied via microjets to manage populations in the tree undercanopy. However, as roots of young trees extend into the row middle, they can be severely damaged by large populations supported by the native plants.

HLB is the driving force affecting all management decisions for citrus trees and pests in Florida. Because root systems of HLB-infected trees are severely compromised, the capacity of trees to respond profitably to nutritional, pest and disease management programs is often unknown.

We initiated two 3-year trials in a grove of 15-month-old Valencia on Khuharske trees in February 2019 to evaluate the profitability of sting nematode management in young orchards using cover crops and nematicides. Trial updates will be reported annually.

NEMATICIDE EVALUATION

Following several decades of soil fumigant and nematicide deregistrations without new products, companies are focused again on nematode control. Several recently registered and experimental products have new modes of action that are highly toxic to nematodes, but less toxic to mammals and birds by several orders of magnitude than existing carbamate products.

Recently registered products include fluopyram (Velum Prime, Bayer) and fluensulfone (Nimitz, Adama). Unregistered compounds include fluazaindolizine (Salibro, Corteva) and an unnamed compound.

We are also evaluating two longstanding carbamate nematicides, aldicarb and oxamyl. Aldicarb is no longer registered for use on citrus but is being evaluated for its effect on HLB-affected trees. Oxamyl (Vydate, Corteva) is widely used to manage nematodes in citrus and is considered a

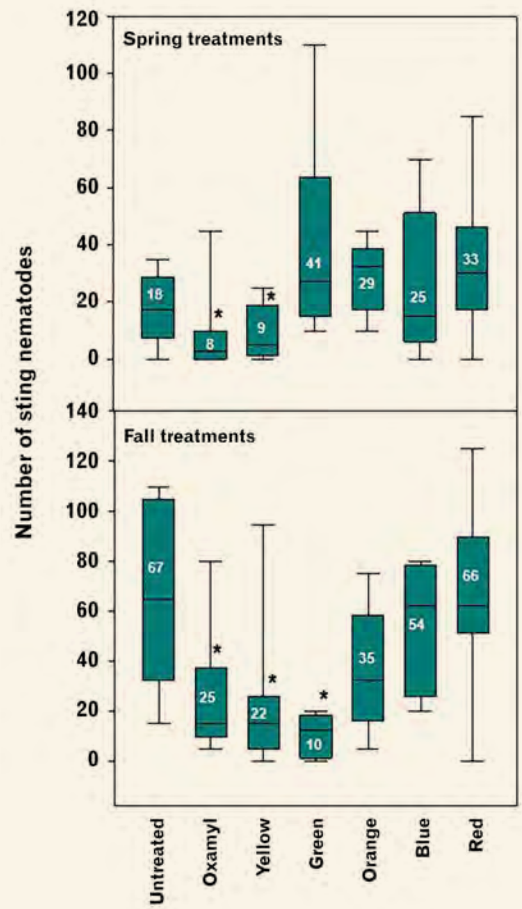

Figure 2. Effect of six nematicides on population densities (white numbers are means) of sting nematodes. Treatments with asterisks are significantly different than the untreated control.

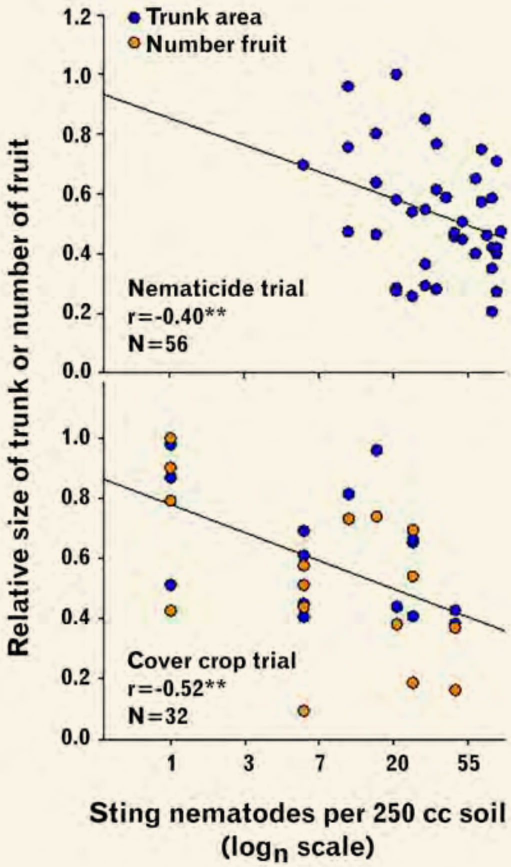

Figure 3. Annual growth of young citrus trees in the nematicide trial (top panel) is reduced at higher sting nematode population densities. The same trend is evident in the tree growth and the numbers of fruit per tree in the cover crop trial.

Figure 4. Perennial peanuts are being grown in citrus row middles on both sides of trees in a plot.

standard in this trial.

Each product is being applied according to label rates to eight plots of four young trees (32 trees/product), either once or twice in the spring and once or twice in the autumn, except aldicarb which is applied just once in the spring.

The four new compounds are applied via microjets and are rotated each season to avoid occurrence of resistance. Application times increased from one hour in the spring treatments to two hours in autumn. Treatment effects on nematodes were measured in June and November at least 30 days following the final treatment of the season.

Nematodes are highly aggregated in soil, limiting sampling accuracy and requiring repeated measurements over time and across sites to understand product performance with confidence. For this reason, we shall designate all treatments, except the untreated and the oxamyl standard, by a color until enough data are collected to understand their reliability.

Just two compounds, oxamyl and the yellow compound, reduced sting nematode populations compared to those in untreated plots in June (Figure 2, top, page 13). By November, oxamyl and both treatments containing combinations of the yellow and green compounds reduced sting nematodes by between 62 and 82 percent compared to controls (Figure 2, bottom, page 13).

There were no significant treatment effects on trunk growth or fruit per tree. However, the trunk growth was inversely related to the sting nematode population levels in 2019 (Figure 3, top). A highly significant negative relationship between the trunk growth rate and the number of fruits suggests that nematicide-induced vegetative growth differences in trees were real and came at the expense of fruit production.

ROW MIDDLE MANAGEMENT

Perennial peanut sod, a non-host for sting nematode, was established in middles on both sides of eight 4-tree plots, and native plants were managed routinely in eight other plots (Figure 4). Four of eight plots in each middle treatment were also randomly assigned to be treated under canopy with oxamyl twice in both spring and fall. Thus, the trial will evaluate the profitability of using a non-host cover crop, with or without nematode management in the tree row.

Despite having four-fold the quantity of roots in peanut middles compared to conventional middles, sting nematode numbers in peanut plots were just a third of those in conventional plots. However, oxamyl did not reduce the numbers of sting nematodes in the tree rows. Effects of oxamyl may have been masked by sampling error due to low sting nematode numbers in the tree rows, which averaged just a third of those in the adjacent nematicide trial.

Neither cover crop nor nematicide affected tree growth or fruit production. As in the nematicide trial, tree growth was inversely related to the number of sting nematodes in 2019 (Figure 3, bottom, page 14). However, unlike the nematicide trial, the fruit yield was positively related to the vegetative growth rate and was significantly lower at high sting nematode density.

AFTER ONE YEAR

Perennial peanut in row middles was slow to establish, requiring careful irrigation and weed management. Nevertheless, the cover crop performed as expected, reducing sting nematodes in the row middles by two thirds compared to those in conventional middles, similar to the reduction from nematicides in tree rows. The perennial habit and low height of the plant provides advantages lacking in other potential non-hosts of sting nematode such as sunn hemp and velvet bean, which rapidly grow to heights that would inhibit grove operations.

Increasing the injection time for some new nematicides may have increased the efficacy against sting nematodes to levels comparable to oxamyl. Some of the new products, reported to perform well in trials in other systems in Florida (e.g., turf, strawberry and vegetables) were ineffective here, possibly due to differences in application methods. Data collected here and during the next two seasons will provide a basis to understand the profitability of managing sting nematode in young trees affected by HLB.

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