Figure 1. Four-year-old Valencia on Kuharske trees are in a grove infested with sting nematodes. These trees illustrate the wide variation in conditions typical of trees affected by huanglongbing and sting nematodes. Note the large numbers of newly replanted, covered trees in the left photo.

Research update on cover crops and nematicides

By Larry Duncan, Johan Desaeger and Homan Regmi

Two field experiments were initiated in January 2019 to evaluate the efficacy of nematicides and cover crops for managing the sting nematode (*Belonolaimus longicaudatus*) in a replanted grove affected by huanglongbing (HLB). The trees were nearly two years old when perennial peanut (resistant to sting nematode) plots were established in row middles to compare to middles managed by mowing the native vegetation. Shortly thereafter, nematicides were applied beneath the trees in some of each of these two types of plots. A second trial in the same grove compared three registered and three non-registered nematicides for nematode control and tree response.

Results from one year of the trials were published in the August 2020 issue of Citrus Industry. The article also provided background information about the sting nematode and its impact on citrus trees, especially the uneven growth young, replanted trees experience from damage to feeder roots (Figure 1). This article focuses on the experimental results following two years of management and briefly looks ahead at additional work that may be warranted.

NEMATICIDE EVALUATION

As noted in the previous article, nematodes are highly aggregated in soil and are affected by many soil and climatic properties. This limits sampling accuracy and requires repeated measurements over time and across sites to confidently understand product performance. To help ensure their reliability, all treatments are designated by color except the untreated control and the oxamyl standard until the third (final) year of data is collected.

Figure 2 (page 17) shows the combined average number of sting nematodes in the various treatments during the summer and winter 2020 sampling times. The top panel indicates nematodes in the seven experimental treatments. In plots of four of these treatments, the chemicals

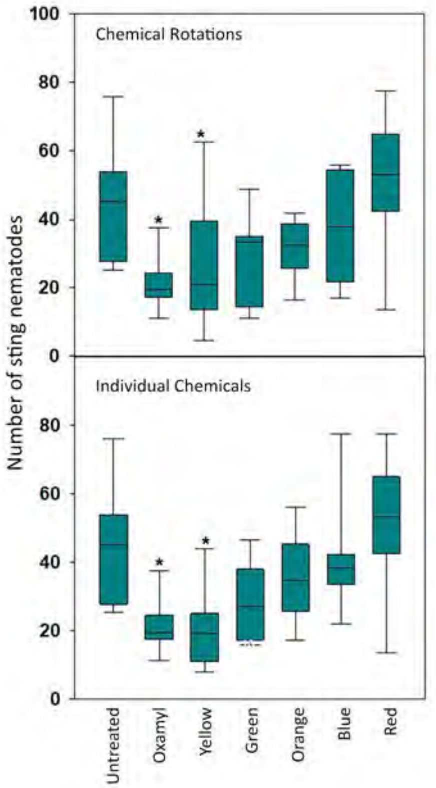

Figure 2. The numbers of sting nematodes per 250 cm^3 soil in the experimental plots are shown. Some were treated with alternating nematicides during spring and fall each year (top panel), and following the spring or fall treatment using specific, individual nematicides (bottom panel). The label colors represent treatments with recently registered or unregistered (experimental) nematicides for use in citrus.

used in the fall were different than those used in the spring. The rotations ensured that spring and fall management of nematodes occurred in all treatments, including those restricted to one annual application. Rotations also help avoid buildup of microorganisms in the soil that are capable of metabolizing and thereby reducing the effectiveness of the chemicals. All the plant measurements pertain to these plots. The three most effective treatments in these plots, on average, reduced nematodes by just 43%.

The bottom panel of Figure 2 shows average nematode numbers during 2020 in plots treated by a single chemical. In other words, for chemicals that were rotated, the nematode numbers shown were measured immediately after the spring or fall treatments of a given chemical. The average sting nematode reduction for the three best performing chemicals was 48%.

The initial tree size in February

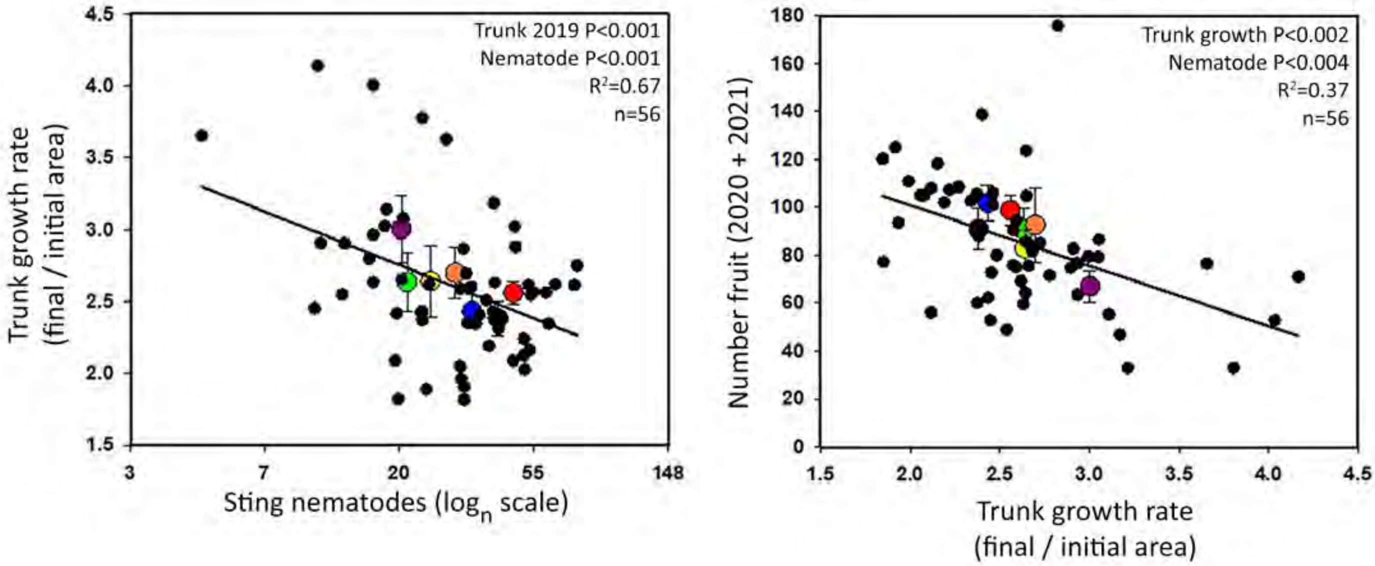

Figure 3. The trunk growth rate two years after the initiation of nematicide treatments is related to the size of trees before treatment and the population levels of sting nematodes during the two years (left panel). To date, fewer fruit have produced by rapidly growing trees (right panel). Small black circles represent average tree growth rates and fruit per tree in the individual, 4-tree plots. Larger colored circles represent the average growth and number of fruit of trees treated according to the color scheme assigned to the different treatments. Black represents the untreated control, and purple represents the oxamyl standard nematicide treatment.

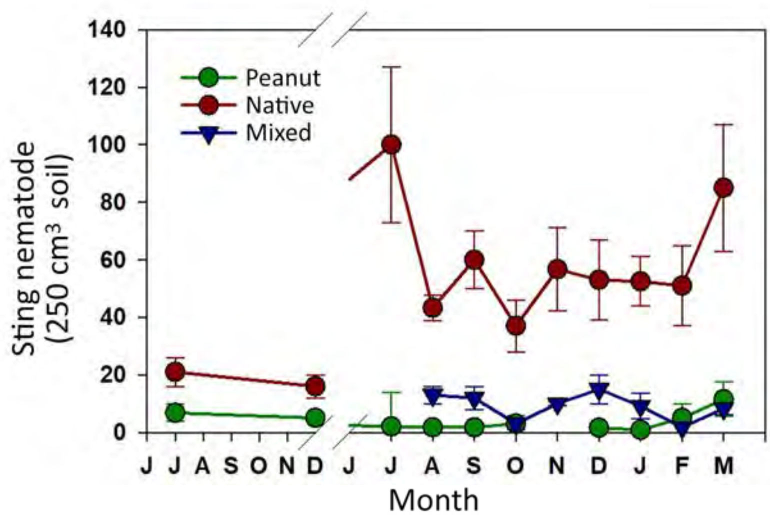

Figure 4. Sting nematode population density in row middles with native weed vegetation (red), perennial peanut (green) or perennial peanut with a small amount of weed incursion into the plots (blue).

2019, before nematicide treatments began, and the average numbers of sting nematodes during the past two years are both highly significantly related to the growth rate of trees to date (Figure 3, left panel). Although the average initial trunk size did not differ significantly between the treatments, those treatment averages varied as much as 30%. The oxamyl-treated trees tended to grow at a faster rate and produced significantly more (58%) feeder roots than the untreated controls during 2020. The average amount of fruit per tree was low, just 15% of a 90-pound box in these four-year-old trees. There were no treatment effects on the numbers of fruit per tree in 2021 or when combined with the 2020 numbers.

As noted previously, the most rapidly growing trees tend to produce the fewest fruit to date (Figure 3, right panel).

ROW-MIDDLE MANAGEMENT

The average number of sting nematodes in plots treated with oxamyl was 55% fewer than in plots of untreated trees when measured after the spring treatments in 2020. Nematodes were 23% fewer in winter following the autumn treatments, but the differences were not significant.

Sting nematodes in row middles were measured monthly in 2020. Several of the plots of perennial peanut had significant weed encroachment; these plots were sampled separately from plots with homogeneous stands of peanuts. In 2020, perennial peanuts reduced the sting nematode numbers in row middles by 94% compared to those in middles of native vegetation. In peanut middles with some weed encroachment, the nematode reduction was 85% (Figure 4).

There were no significant differences in the size of trees or fruit quantity between the treatments. Compared to untreated plots, there was a trend of increased citrus root density with applications of oxamyl (26% increase), peanut in row middles (32%), and the combination of oxamyl and peanut middles (37%). However, fruit yield tended to be lower where oxamyl was applied regardless of row-middle management. As previously reported, a significant inverse relationship between tree growth and fruit yield suggests that the young trees' response to nematode management may be an increase in vegetative growth.

FINDINGS AFTER TWO YEARS

Perennial peanut in row middles was increasingly effective at reducing sting nematode populations. During the first year after establishment, nematodes declined by about two-thirds in middles with peanut compared to native vegetation. During the past year, the suppression increased to 85 to 95% depending on the degree of weed infestation. The effectiveness of the cover crop should become increasingly important as the tree root systems colonize the row middles.

None of the nematicides have provided a comparable level of nematode reduction compared to the perennial peanuts. As noted in the first year of the trial, some of the new products that performed well in other cropping systems in Florida were ineffective here. To the degree that these products reduced sting nematodes, the tree root systems and trunk girth have responded with increased growth. However, the responses of these 4-year-old trees have been modest and would need to increase with time to merit the use of these products. With increasing size and maturity, the trees in plots with less nematode pressure may shift emphasis from growth to fruit production.

The results to date suggest the need to compare the management of sting nematode (and other root pests and pathogens) in replanted trees that are both affected by and free of HLB. The use of protective tree covers has shown such comparisons as feasible. If HLB-free trees can respond to nematode management with greater growth than those affected by HLB during the first few years, they are likely to better tolerate sting nematodes when the protective covers are removed.

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