Figure 1. Overview of the study site in Southwest Florida *(Left photo courtesy of Lucas Fideles Costa)*

Integrating use of organic soil amendments and weed management

By Ute Albrecht, Ankit Pokhrel, Sarah Strauss and Ramdas Kanissery

The soils in most Florida citrus production areas are sandy. They have less than 1% organic matter and a low cation exchange capacity (CEC). This makes them prone to nutrient leaching, especially after heavy rainfall events in the summer.

HUMIC SUBSTANCES

One way to improve soils is by amending them with humic substances. Humic substances can be derived from non-renewable sources, such as peat, volcanic soils and mineral deposits, or from renewable sources like compost. Although they are high in nutrients and organic matter, humic substances are not a replacement for fertilizers. Many of their positive effects come indirectly from their ability to change the physicochemical properties of the soil.

For example, humic substances are polyanionic, which can increase the CEC and prevent nutrients from leaching. Moreover, the increase in organic matter after adding humic substances can provide a more favorable environment for plant-beneficial soil microbes inhabiting the zone around the roots.

Reported effects of both beneficial microbes and humic substances on crop plants range from improvements of the root structure and the plant water- and nutrient-use efficiency to inhibition of soil-borne pathogens and increased disease resistance. Fibrous root decline has been noted as one of the adverse effects of HLB, so improving root structure and enhancing nutrient-use efficiency of citrus trees may ultimately help trees cope better in an HLB-endemic environment.

STUDY DESIGN

In a previous University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) study published in the June 2022 issue of Citrus Industry magazine (pages 10-13), researchers found a significant increase in weed pressure in response to regular compost applications. More weeds competing with trees for nutrients likely negates any positive effects associated with the soil amendments.

Another study was initiated that integrates the use of soil amendments and weed management. In this study, two types of organic humic materials are compared against a negative control: 1) compost (derived from yard waste) and 2) a combination of humic and fulvic acids (derived from leonardite) in granular form. Both materials are spread twice a year under the tree canopy at a rate of 5 tons of compost per acre and 140 pounds humic/fulvic acids per acre.

For weed management, three different types of herbicides were compared: 1) glyphosate (post-emergence), 2) glufosinate-ammonium (post-emergence) and 3) flumioxazin (pre-emergence). An untreated check was also included

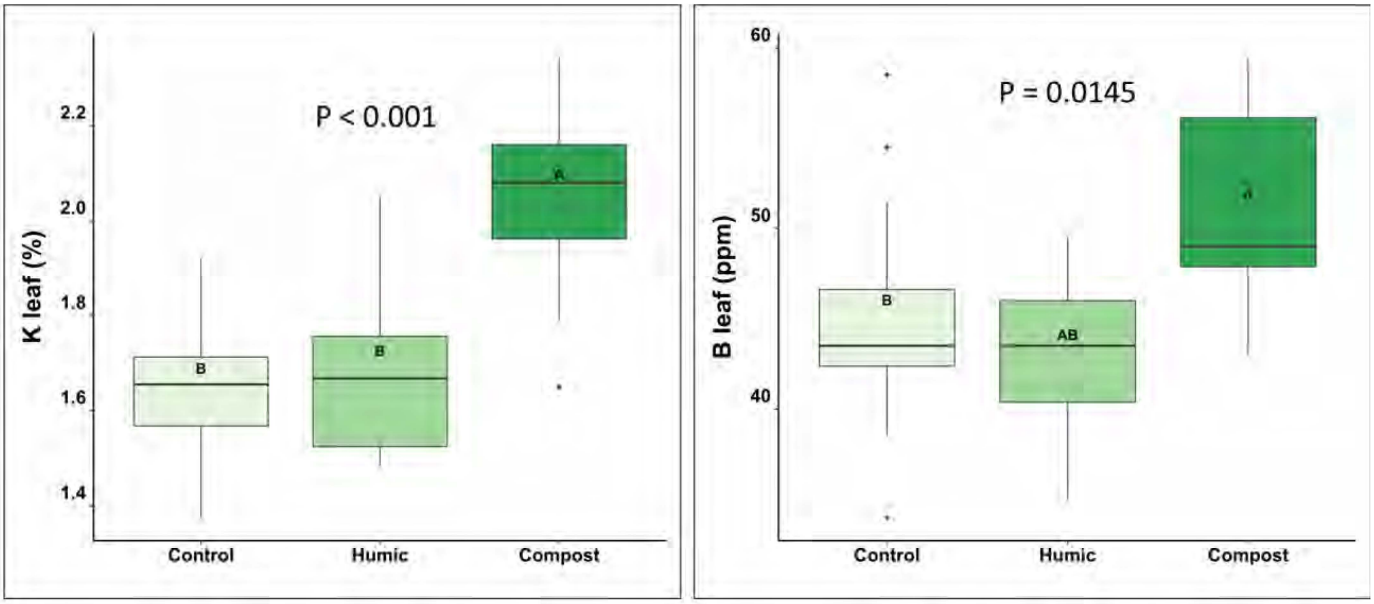

Figure 2. Compost effect on leaf potassium and boron content

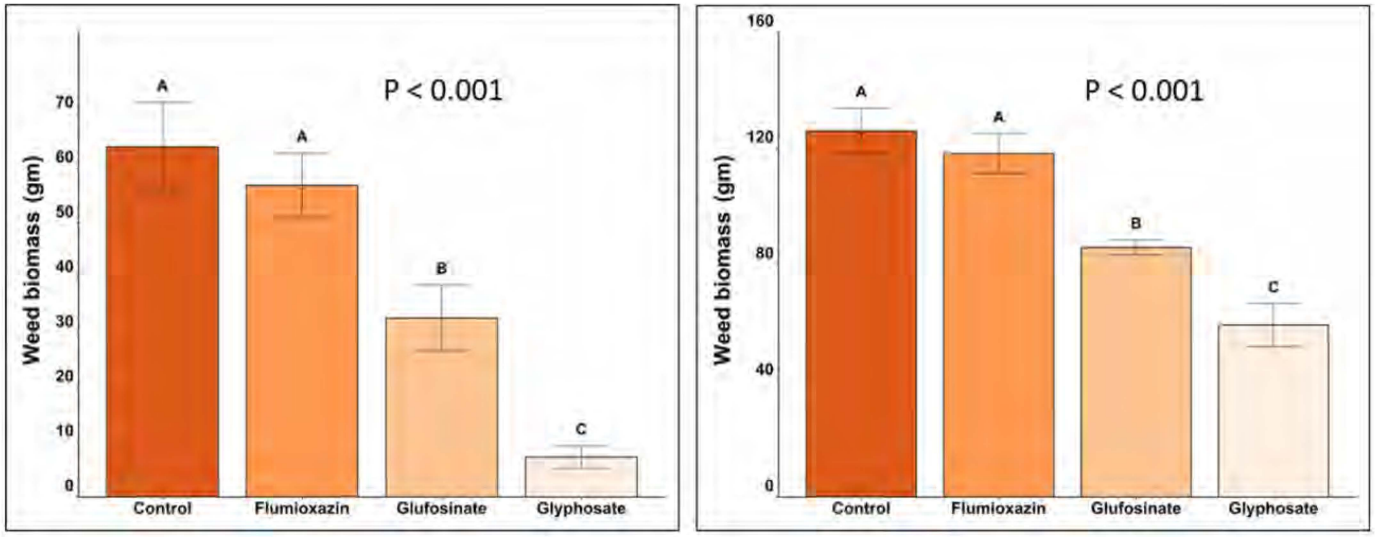

Figure 3. Herbicide effect on weed biomass in spring (left) and summer (right)

as a control. The weed pressure in the untreated check was maintained with post-emergence sprays utilizing selective herbicides not evaluated in this study. Glyphosate is applied at a rate of 3.8 pounds active ingredient (ai) per acre, glufosinate at 1.25 pounds ai per acre, and flumioxazin at 0.27 pounds ai per acre.

The trees were planted in 2019 on a 10-acre commercial citrus production site in Southwest Florida and are Valencia orange on US-802 rootstock (Figure 1, page 15). Treatments commenced in 2021.

RESEARCH RESULTS

After less than two years of study, the compost-amended plots were found to have a higher water-holding capacity than the non-amended control plots. The humic/fulvic acid plots were in between the two.

There were also differences in some of the soil nutrients. The compost-amended plots had higher soil potassium, calcium and boron levels than the control plots regardless of weed management. Thus far, no differences have been found between the humic/fulvic acid plots and the control plots. The compost also affected the leaves, which had a higher content of potassium and boron (Figure 2). Surprisingly, none of the humic amendments have measurably increased the soil organic matter or the CEC so far.

Of the three herbicides used in this study, glyphosate is the most effective at suppressing weed growth. This effect is more evident during spring than summer (Figure 3). Although glufosinate suppresses weed growth, its effect is more moderate compared to glyphosate. Flumioxazin does not appear to be effective in suppressing weeds at this location, which suggests that it needs to be combined with a post-emergence herbicide for effective weed control.

The most dominant weed species at the trial location are torpedo grass, Spanish needle, pusley

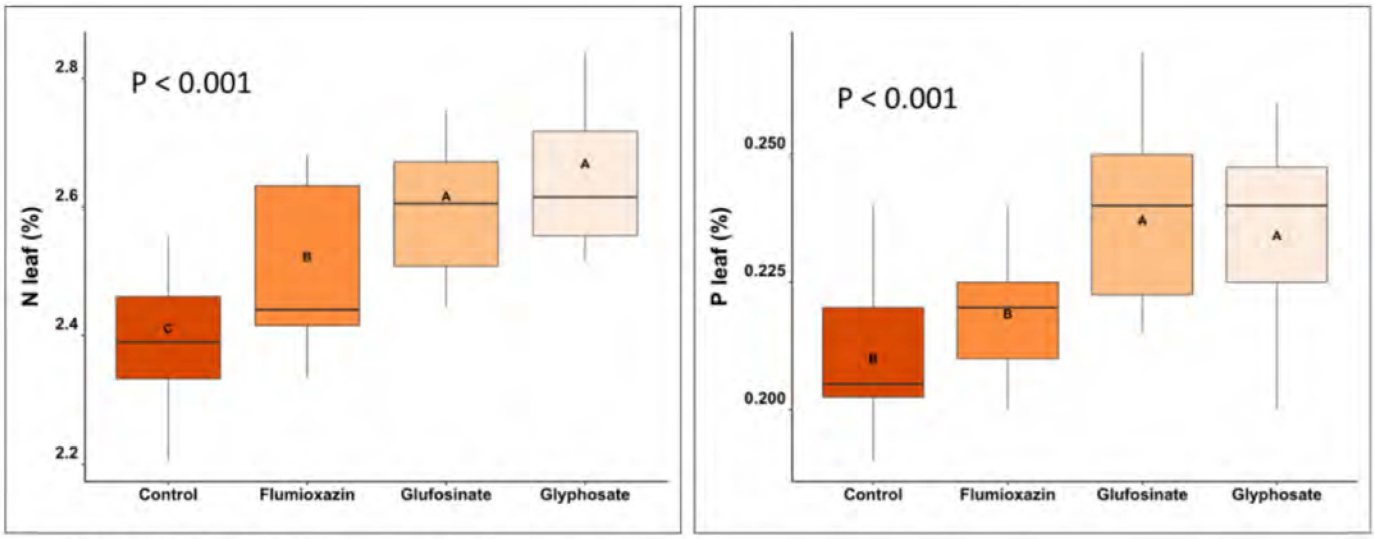

Figure 4. Herbicide effect on leaf nitrogen and phosphorus content

and ragweed. Although glyphosate was the most effective in suppressing weeds, it was more effective on grass species and less effective on broad-leaved weeds like Spanish needle.

While none of the herbicides appear to have any effect on the soil nutrients so far, significant differences were found for some of the leaf nutrients. In plots where glyphosate and glufosinate are being applied, the leaf nitrogen and phosphorus content of the trees are higher compared to the control and flumioxazin plots (Figure 4). Glyphosate also increased the zinc and sulfur content of the leaves relative to the control.

While organic amendments have not produced any measurable effect, weed management did affect tree growth. Trees grew more in plots managed with glyphosate or glufosinate compared to the control and flumioxazin-treated plots. This demonstrates the need for an effective weed management program to eliminate weed competition for macronutrients and micronutrients, especially in the early years of tree establishment.

The root health variables measured in this study included root density, specific root length (SRL) and root respiration. Although no differences were found in density and length, fibrous roots from trees in the compost-amended plots show a higher respiration rate, suggesting that they are metabolically more active. No such effect was measured for the herbicides, although fibrous roots from glyphosate-treated plots showed a trend for a higher SRL. Despite measured differences for weed suppression, soil nutrients, leaf nutrients and root respiration, none of the treatment combinations have shown any effect on productivity or fruit quality so far.

TAKE HOME MESSAGES

Regular compost amendments to the soil improved the water-holding capacity, increased nutrient content in soil and leaves, and increased the fibrous root respiration rate in less than two years of treatment. However, amended soils were more favored by weeds, and weed management practices need to be adjusted when using organic amendments.

Glyphosate was the most effective in suppressing grass weeds, but its use resulted in the selection of broad-leaved weed species. Nevertheless, more effective weed suppression resulted in significantly higher levels of several important macronutrients and micronutrients, which translated into significantly more tree growth. This demonstrates the importance of eliminating competition for nutrients in young trees during the early years of field establishment. Whether soil amendments will improve tree growth and health in the long term under Florida growing conditions remains to be seen.

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