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Effect of Silicon-Based Fertilizer Applications on Reproduction and Development of Arthropod Pests Associated with Horticultural Crops – Part 3

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BACKGROUND

Greenhouse producers are continually searching for and/or requesting alternative systems to control insect and mite pest populations. They do not want to rely solely on insecticides and/or miticides and, thus, can avoid resistance. A "potential pest management strategy" that has been discussed in trade magazines involves applying silicon-based fertilizers to improve plant tolerance to insect feeding and thus reduce feeding damage. Several articles have made claims that silicon applications may avoid insect outbreaks. However, there is minimal quantitative research to support these claims. The protective role of silicon associated with disease resistance is well documented whereas, there is relatively little information concerning silicon's affiliation with resistance to insect pests. Thus, we decided to determine if silicon-based fertilizer applications negatively impact the life history parameters of the phloem-feeding insect pest; the citrus mealybug (*Planococcus citri*).

MATERIALS AND METHODS

Fiddleleaf fig (*Ficus lyrata*) plants (cultivar Little Fiddle) were established from Oasis plugs for 35 days, before treatment with different rates of the silicon-based fertilizer. Plants were subject to a constant liquid feed program (200 ppm nitrogen). The silicon application treatments were different rates, applied as a drench to the growing medium, of the silicon-based fertilizer (as potassium silicate): 0, 100, 400, 800, and 1600 ppm.

Plants were inoculated with citrus mealybug first instar nymphs using a leaf disk transport procedure (Figure 1).

Figure 1. Leaf disk transport procedure.

Two weeks after inoculation, the fiddleleaf fig plants were inspected daily. Oviposition (egg-laying) by citrus mealybug females was assessed by the presence of a white, cottony egg mass underneath the abdomen (Figure 2). Egg masses and ovipositing citrus mealybug females were collected using a micro-spatula and placed into

Figure 2. Ovipositing citrus mealybug females.

vials containing 70% isopropyl alcohol (rubbing alcohol). Citrus mealybug ovipositing females were measured, and the eggs in the abdomen and external egg masses were dissected and counted.

There were two harvest dates to assess the silicon content in the leaves and stems of the fiddleleaf fig plants. The first harvest was 45 days after plants had received the initial silicon treatment. This was

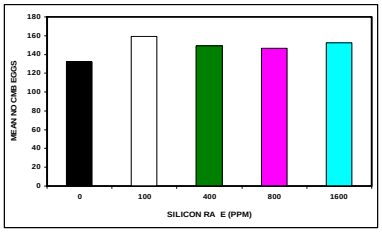
used to establish a silicon concentration baseline, and the final harvest was conducted at the conclusion of the study.

We evaluated the following citrus mealybug life history parameters: egg load of females and development time from 1st instar to egg-laying adult.

RESULTS

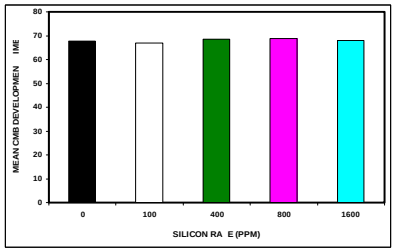
None of the different rates of the silicon-based fertilizer (0, 100, 400, 800, and 1600 ppm silicon) negatively affected the mean number of eggs laid (egg load) by citrus mealybug females and development time (days) from 1st instar to egg-laying adult when feeding on fiddleleaf fig plants. The mean egg load ranged from 132 to 160 eggs across all the silicon rates (Figure 3)

Figure 3. Mean number of citrus mealybug eggs laid by females for each silicon application rate.



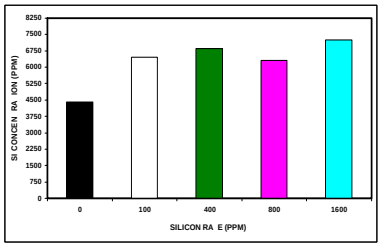
and the mean development time ranged from 67 to 69 days (Figure 4).

Figure 4. Mean citrus mealybug development time (days) from 1st instar to egg-laying adult for each silicon application rate.



However, the silicon concentrations present in fiddleleaf fig plants were between 6000 and 7500 ppm silicon (Figure 5).

Figure 5. Mean silicon concentration in fiddleleaf fig tissue for each of the silicon application rates.



This was substantially higher than those in coleus plant tissue (See AFE Special Research Reports #209 and #210), and would classify fiddleleaf fig as a silicon 'neutral' plant. In fact, the fiddleleaf fig plants that received the higher silicon-based fertilizer rates appeared to absorb and accumulate more silicon than those plants that did not receive any silicon (0 ppm). Nonetheless, these elevated concentrations of silicon did not negatively affect any of the citrus mealybug life history parameters measured [female egg load and development time (days)].

CONCLUSIONS

Silicon-based fertilizer applications may not be a viable alternative management strategy to alleviate problems with phloem-feeding insect pests such as the citrus mealybug. This is based on the fact that none of the treatments negatively affected any of the citrus mealybug life history parameters measured.

IMPACT TO THE INDUSTRY

This research has refuted the claims made that silicon-based fertilizer applications may be utilized as a pest management strategy to deal with insect pests of greenhouse-grown foliage crops. As such, greenhouse producers do not have to utilize this method to management insect pests feeding on greenhouse-grown foliage crops.

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