Special Research Report #210: Insect Management

Effect of Silicon-Based Fertilizer Applications on Reproduction and Development of Arthropod Pests Associated with Horticultural Crops – Part 2

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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

Green colored coleus plants were grown from cuttings prior to artificial inoculation with citrus mealybug (*P. citri*). 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, coleus 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. Egg masses and ovipositing citrus mealybug females were collected using a micro-spatula (Figure 2)

Figure 2. Collecting citrus mealybugs from coleus plants.

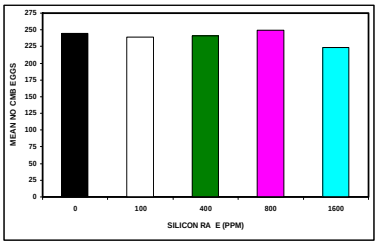
and placed into vials containing 70% isopropyl alcohol (rubbing alcohol). Citrus mealybug ovipositing females were measured, and the eggs in the abdomen and external egg masses were dissected and counted.

Coleus plants were harvested at the termination of the study (day 59) to assess the total silicon content in the leaves and stems. We evaluated the following citrus mealybug life history parameters: egg load of females and development time from 1st instar to egg-laying adult.

RESULTS

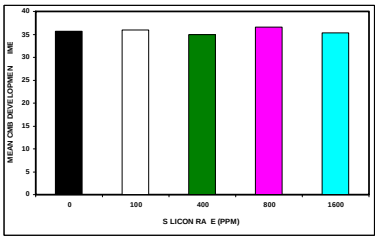
None of the different rates of the silicon-based fertilizer (0, 100, 400, 800, and 1600 ppm silicon) negatively affected the mean number of eggs laid (egg load) by citrus mealybug females and development time (days) from 1st instar to egg-laying adult. The mean egg load ranged from 223 to 249 eggs across all the silicon rates (Figure 3)

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



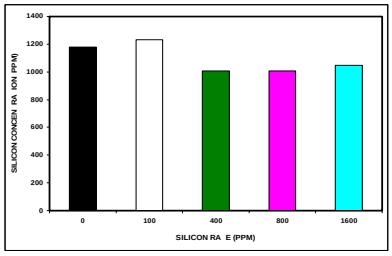
and the mean development time ranged from 35 to 37 days (Figure 4).

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



Although there were statistically significant differences in citrus mealybug female egg load and development time (days), these differences were neither consistent nor additive with the increasing silicon-based fertilizer rates. In addition, there were no correlations between the silicon-based fertilizer rates and concentrations of silicon in the plant tissue with concentrations ranging between 1000 and 1235 ppm silicon (Figure 5). None of the treatments inhibited citrus mealybug from feeding on the green coleus, and, subsequently, did not negatively influence any of the citrus mealybug life history parameters measured.

Figure 5. Mean silicon concentration in green coleus tissue for each of the silicon application rates.



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. In addition, the coleus plants did not appear to absorb and translocate supplemental silicon into plant tissues to exhibit a response, which is common among many dicot plants.

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 crops. As such, greenhouse producers do not have to utilize this method to management insect pests feeding on greenhouse-grown crops.

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