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Effect of Silicon-Based Fertilizer Applications on Reproduction and Development of Arthropod Pests Associated with Horticultural Crops – Part 1

B. K. Hogendorp, Graduate Student and R. A. Cloyd, Professor and Extension Specialist
Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL 61801 and Department of Entomology, Kansas State University, Manhattan, KS 66506

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Phone: 703/838-5211
Fax: 703/838-5212
E-mail: afe@endowment.org
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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: spray, drench, spray + drench combination, and control. The rate used was 50 ppm (as potassium silicate).

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.

There were three harvest dates to assess the total silicon content in the coleus leaves and stems. The first harvest was 15 days after inoculating coleus with citrus mealybugs, the second harvest was 38 days after having inoculated coleus with citrus mealybugs, and the third harvest was 60 days after inoculating coleus with citrus mealybugs.

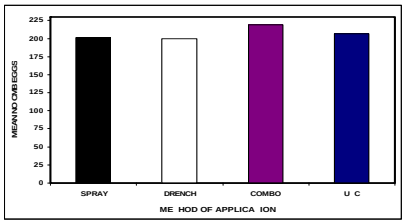
We evaluated the following citrus mealybug life history

parameters: egg load of females and development time from 1st instar to egg-laying adult.

RESULTS

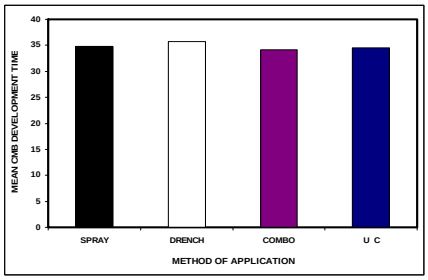
None of the silicon-based fertilizer application treatments (spray, drench, and combination) at 500 ppm silicon affected the mean number of eggs laid (egg load) by citrus mealybug females and development time (days) from 1st instar to egg-laying adult. The mean egg load ranged from 199 to 220 (Figure 3)

Figure 3. Mean number of citrus mealybug eggs laid by females per each application method.



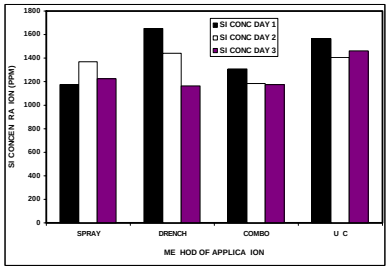
and the mean development time ranged from 34 to 36 days (Figure 4).

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



This suggests that applications of the silicon-based fertilizer, at 50 ppm potassium silicate, did not inhibit citrus mealybug feeding on this green coleus, and, subsequently, did not negatively influence any of the citrus mealybug life history parameters measured. It is possible that the manufacturers' label rate of 50 ppm silicon is too conservative for substantial quantities of silica to accumulate in coleus tissues. It is interesting to note that the untreated check plants had higher concentrations of silicon than most of the plants that did receive silicon (Figure 5).

Figure 5. Mean silicon concentration in green coleus tissue for each application method and harvest date.



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 waste time attempting this method to management insect pests feeding on greenhouse-grown crops.

For Additional Information Contact:
rcloyd@ksu.edu