Influencing Pest Populations with Silicate Fertilizer

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Abstract

Greenhouse production of many floriculture crops utilize soilless media. This media has limited available silicon compared with in ground growing. Supplementation of silicon in these systems has been shown to positively affect plant quality. Silicon fertilizer has also been shown to increase resistance to pathogens in many crops including rice, sugarcane and cucumbers. Little research has been done however on its effects on arthropod pests in ornamental crops. The goal of this study was to evaluate the effects of silicon supplementation on Liriomyza trifolii (Burgess) (Insecta: Diptera: Agromyzidae) (American serpentine leafminer) in chrysanthemums. Plants received potassium silicate for 47 days after planting at a rate of 500ppm silicon with every irrigation. Preliminary results indicate that leafminer damage can be reduced by potassium silicate application on chrysanthemum.

Background

Silicon and its impact on plant health has been the subject of research since 1917 when it was shown to protect rice from Magnathorpe grisea, a fungal pathogen (Onodera 1917). Plants are able to take up ionic silicon when it is combined with common plant essential nutrients such as potassium (Epstein 1993), but can differ in the total amount of silicon that they are able to accumulate (Hodgson, 2005). Several reviews of the effects of silicon application call attention to improved disease resistance, improved response to drought stress and salt stress, increased structural stability and negative effects on pest populations (Epstein 1993, Epstein 1999, Ma 2006, Parrella et al. 2007, Richmond 2003, Savant 1997). In some cases the accumulation of silicon can be seen through electron microscopy of plant trichomes (Epstein, 1999). Potassium silicate (K2SiO4) is commercially available as a micronutrient fertilizer and can be easily injected into irrigation systems. Experiments have also shown that plants treated with soluble silicon have improved resistance to several feeding guilds of insects (Kvedaras and Keeping 2008). In a 2000 study Ranger et al. found that green peach aphids reared on zinnias treated with potassium silicate had reduced feeding performance and reduced offspring production. Similar results have been found with various plant species and pests (Reynolds et al 2000). The effects on pests are caused by strengthening plant cells and in some cases inducing other plant defenses (Epstein 1993). The incorporation of silicon fertilizers into IPM programs has the potential to reduce the economic damage from a broad array of pests.

Results

- The leafminer damage was significantly reduced (p=.0065) by Si treatment. Both control treatments had an average of 5.1 mines per leaf and the Si treated leaves had an average of 2.75 a 54% reduction.
- Caliper was found to be the same across all treatments (p>.05).
- Height was reduced in the silicon treatment (p=.0065) by Si treatment. Both control treatments had an average of 34.9cm and 35.4cm for the control and potassium control respectively to 31.7cm.

Discussion

Silicon has the potential to be an important part of a comprehensive IPM system with the intention of giving other tactics, such as parasitoids, an advantage over pest populations. This will reduce the amount of pesticide used in nursery and floriculture production, answering the public’s increasing demand for organic and reduced risk plant products (CDEA, 2007). However due to the high variability among plant species in silicon uptake and accumulation, each commodity, needs to be considered individually.

Methods

- Chrysanthemums were grown from rooted cuttings and received three different treatments:
  1. 500ppm potassium silicate
  2. Untreated control + equivalent potassium
  3. Untreated control
- There were three treatments across 16 replicates (n=44) arranged in a completely randomized design.
- Plant height, caliper and leafminer damage were measured 47 days after planting.
- The assumptions of ANOVA were met by log10 transformation of data and was analyzed using ANOVA in JMP Pro 10. Tukey HSD was used for mean separation.

Citations

- Parrella, M. P., Costamagna, T. P., and Kaspi, R. 2007. The addition of potassium silicate to the irrigation has been found to increase the productivity of rice plants. Adv. Agro. 58: 151
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Acknowledgments

Thank you to Robert Starnes and Chris Durand for technical assistance. Thank you also to our many funding sources.