GROWING KNOWLEDGE

Series content is coordinated by Dr. Lloyd Nackley, associate professor of nursery production and greenhouse management at Oregon State University in Corvallis, Oregon.

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Focus on silicon

Researchers study using silicon-calcium supplementation on rhododendrons to reduce herbivores

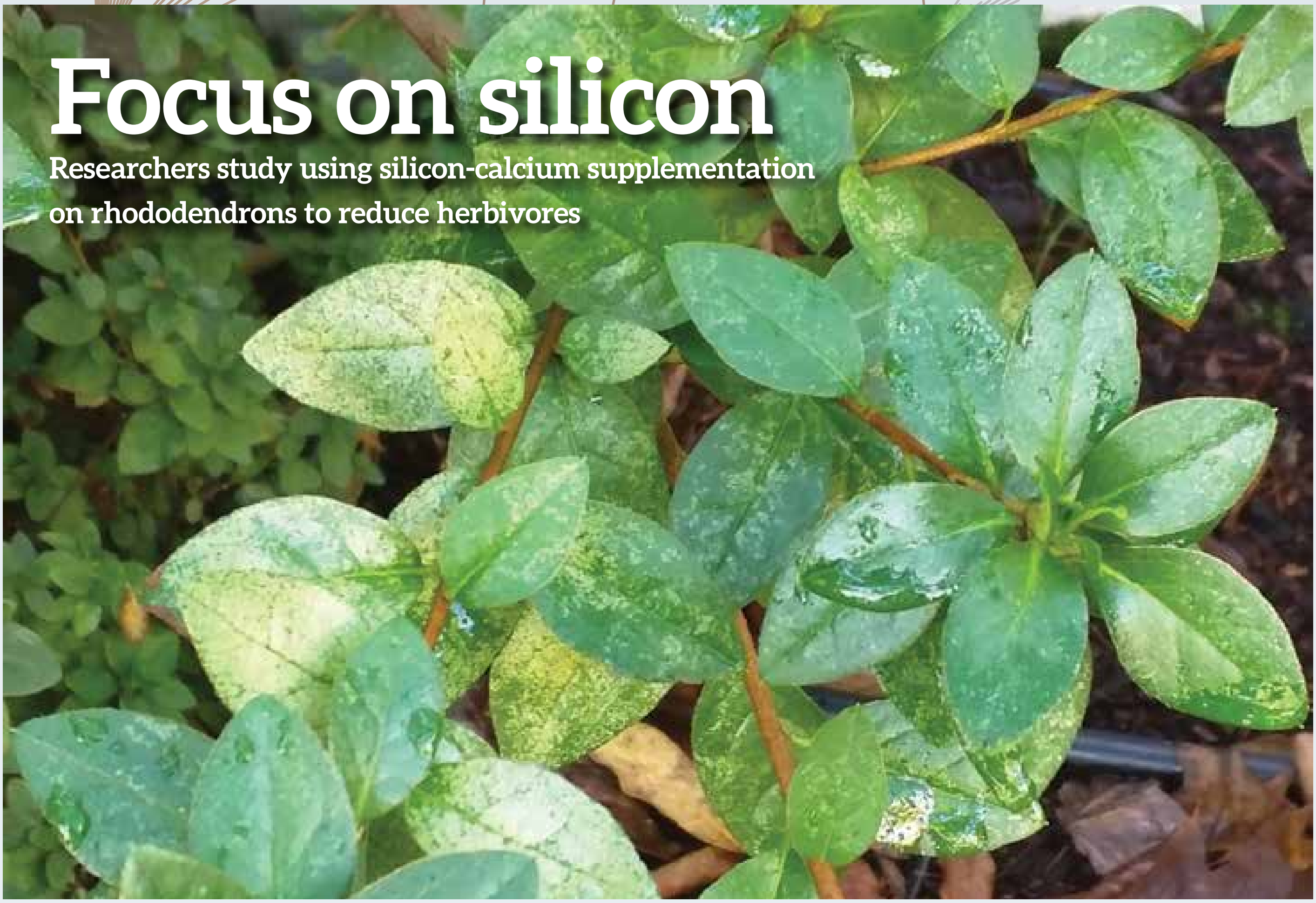

Figure 2a. As lace bugs drink up chlorophyll in the sap of rhododendrons, it causes unattractive white-yellowish stippling on the top side of leaves. This stippling makes potted plants unmarketable. PHOTO COURTESY OF OREGON STATE UNIVERSITY

BY JANA LEE, KATERINA VELASCO GRAHAM, ERIC JANASOV, RYAN PAUL, CAROLYN SCAGEL

Silicon is a convenient management tool to apply during fertigation to help plants maintain water and nutrient balance. Silicon can also protect plants from fungal pathogens and heavy metal toxicity.

Effectiveness of silicon

Applying silicon to plants has been shown to increase plant resistance to weevils in sweet potatoes, leaf miners in chrysanthemums and aphids in zinnias. Alternating between foliar sprays and soil drenches of silicon has reduced thrips damage and increased marketable yield of orchids.

Silicon supplementation can help protect plants against pests in several ways. First, it may result in deposits in the plant tissue. These can strengthen the cell wall, wear out the insect's mouthparts, or physically damage the insect's digestive system when the insect ingests plant tissue.

Second, silicon can change the plant's chemistry, thereby reducing the nutritional quality or digestibility of the plant.

Third, silicon may cause plants to emit odors when pests feed on them and attract more predators and parasitoids into the area.

Uses for rhododendrons and azaleas

Rhododendrons and azaleas are a staple of Pacific Northwest landscapes. Unfortunately, these plants are affected by the pretty and dainty azalea lace bug, Stephanitis pyrioides.

Originally from Asia, this pest has been present in the eastern United States for over a century and has been in Oregon for approximately 15 years.

Lace bugs have a straw-like mouthpart to drink plant sap from the underside of leaves (Figure 1, Page 36). As they drink up chlorophyll in the sap, it causes unattractive white-yellowish stippling on the top side of leaves (Figure 2a, above). This stippling makes potted plants unmarketable. »

Figure 2b. The lace bugs leave black spots on the underside of the rhododendron leaves. PHOTO COURTESY OF OREGON STATE UNIVERSITY

The underside of leaves become covered with black frass, or defecation spots (Figure 2b, above). Severe infestation on bushes in the landscape can also lead to plant death.

Oftentimes, azalea lace bugs are managed through the use of neonicotinoids and pyrethroids. However, there is concern about using these insecticides during bloom, because they may affect pollinators.

Biological control methods can help, such as releasing predatory lacewings. So can mechanical controls, such as using pressurized water sprays to knock off the delicate bugs on the leaves. Some cultivars are more resistant, such as the ones with more indumentum (fuzzy hairs) on the underside of leaves. While these alternatives have helped reduce lace bugs, they have not replaced insecticides.

Additional alternative controls are needed, and we tested whether silicon supplementation would be beneficial for lace bug control.

In a three-year study, we tested both foliar spray and drench application of silicon on potted rhododendrons. We examined whether treatments reduced lace bug feeding and egg laying under the leaf epidermis. The commercial silicon product already has calcium in the formulation, so both the silicon product and calcium-only applications were tested for impact (referred to as Si and Ca thereon). Solutions for ‘Si foliar’ and ‘Si soil’ were made by mixing 20 ml calcium silicate (22% SiO2, 10% Ca%, Mainstay Si, Redox Chemicals) per 7.57 liter of water, and the calcium only treatments of ‘Ca foliar’, and ‘Ca soil’ mixed 10 ml calcium carbonate (Ca 20%, Mainstay Ca, Redox Chemicals) per 7.57 liter of water. As the products were fertigated, the solution was agitated to prevent precipitation. Four or eight weekly applications were made as rhododendrons flushed out new growth.

Figure 1. Lace bugs have a straw-like mouthpart to drink plant sap from the underside of leaves. PHOTO COURTESY OF OREGON STATE UNIVERSITY

Our studies used rhododendron plugs transplanted into pots, or 1-year old plants. We tested on cultivars known to be susceptible to this pest: ‘Boule de Niege’, ‘Cunningham White’, ‘Florence Parks’, and ‘Nova Zembla’. Study 1 took leaves from variously treated rhododendron plants, immersed leaves in water cups, and placed them into cages. Adult lace bugs were released and allowed to choose between various leaves and feed for a week. Study 2 and 3 placed the entire potted rhododendron in large cages, released adult lace bugs, and allowed bugs a choice to move between plants for 3–4 weeks. At the end, leaves were taken to count the number of adults settled, frass spots (defecation), and eggs. Leaf area measured to standardize counts by leaf area.

Application of silicon/calcium sometimes reduced the number of settling adults at the end of the trial. Application more consistently reduced the number of frass spots and eggs laid on plants by 25-75% compared to the untreated control within the same cage (Figure 4a, Page 36). Fewer frass spots indicate less feeding on the leaves. No one treatment stood out as better, as improvement was seen with silicon applied via foliar spray or drench, and calcium-only applied via foliar spray or drench.

A final choice trial, Study 6, was done by allowing lace bugs to freely move between variously potted plants placed on greenhouse benches for 14 weeks. Stippling on the leaves was quantified to see if Si or Ca reduced visible damage. Though differences were not statistically different, fewer frass spots and stippling damage was seen on leaves, and fewer eggs were laid when plants were treated with silicon or calcium (Study 6, Figure 4a). Leaves that contained more frass spots had more eggs. As expected, if lace bugs feed more on the plant, they will reproduce more.

Silicone and calcium accumulation in plants

To investigate whether extra silicon/calcium accumulated in plants, rhododendron leaf samples were taken before and after the supplementation period. Neither silicon nor calcium content were observed to increase in leaves as expected. Though supplementation can benefit the plant, it did not lead to discernible accumulation in plant leaves to make the tissue tougher for herbivores. This suggests that supplementation somehow improved plant defense or made plants less attractive to lace bugs.

Regardless of treatments, Si and Ca levels increased at the end of the season. Our results also suggest that rhododendrons passively accumulate Si and Ca from root uptake. The ability of rhododendron leaves to absorb Si or Ca on leaves with the rates that were applied was not supported in our experiment.

Unfortunately, when lace bugs were confined in small cages with only one kind of treated plant in a no-choice test

Study 4 and 5, they laid more eggs on silicon-treated rhododendrons compared to untreated rhododendrons (Figure 4a). Insects may do this if they perceive low quality resources and overcompensate. In the nursery or landscape, the lace bug adult could fly to another plant. Potentially, an untreated plant can be used as a 'trap plant' that gets more lace bugs and then treated with insecticide.

During or after trials, the rhododendron plants were kept uncaged and in mixed arrangements on the greenhouse bench. Serendipitously, rhododendron aphids, *Illinoia lambersi*, colonized the plants. This aphid is from North America and is an occasional pest of rhododendrons and azaleas. After noticing the aphids, we recorded how many new rosettes or leaves were infested with aphids. A reduction in aphid colonization occurred 1 to 2 months after the last

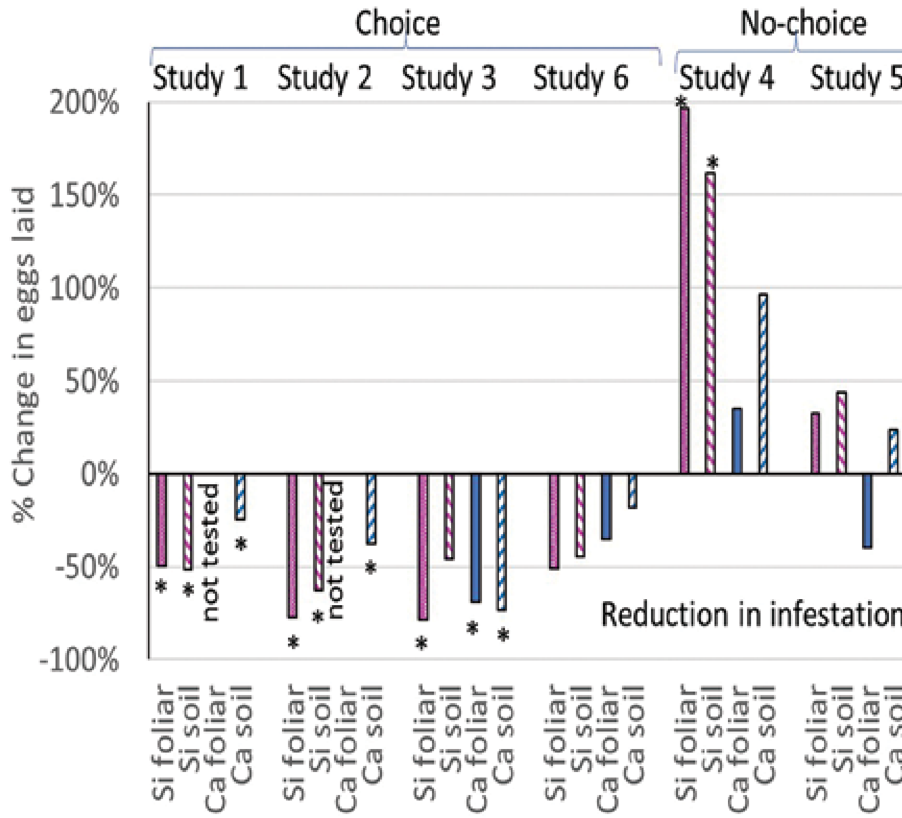

Figure 4a. Application more consistently reduced the number of frass spots and eggs laid on plants by 25-75% compared to the untreated control within the same cage. PHOTO COURTESY OREGON STATE UNIVERSITY

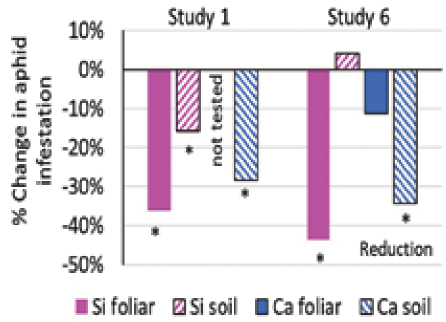

Figure 4b. About 16-37% fewer rosettes were infested with aphids compared to controls in the first case, and 34-44% fewer leaves were infested with aphids in the second case. PHOTO COURTESY OREGON STATE UNIVERSITY

application. About 16-37% fewer rosettes were infested with aphids compared to controls in the first case, and 34-44% fewer leaves were infested with aphids in the second case (Figure 4b).

Additional evaluation is needed to test how supplementation affects landscape plants. Given the benefits of silicon-calcium application to improve general plant health, enhanced pest resistance can be an added bonus.

Further information can be found in Graham KV, Janasov EG, Paul RL, Scagel CF, Lee JC. 2024. Silicon supplementation can reduce infestation by azalea lace bug. Journal of Economic Entomology 117(5): 1948-1958. **DOI.org/10.1093/Jee/Toae164**

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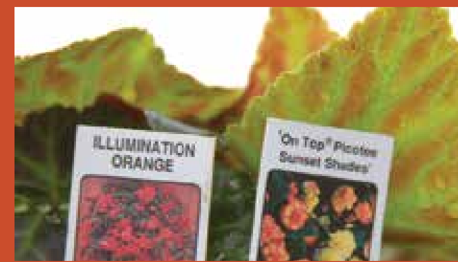

Digger MARKETPLACE