

Introduction

This research is part of a multidisciplinary project targeted at improving greenhouse production technology for floricultural crops. The relationship of plant nutrition with both biotic and abiotic stresses has been the initial focus. In addition to the essential plant nutrients nitrogen and potassium, the potentially beneficial element silicon is being studied because of its absence in soilless media culture, which predominates regional floricultural production. The ubiquitous fungal pathogen *Botrytis cinerea* was used to challenge plants grown under different nutrient regimes to determine if 1) fertilization levels with nitrogen or potassium would predispose plants to an increased level of *Botrytis* infection and 2) if supplemental fertilization with silicon would result in sufficient uptake to provide enhanced plant resistance to *Botrytis* infection.

Materials and Methods

In all trials, plants were planted in a soilless media mix containing 70:30 peat perlite (vol:vol). Plants were grown in a greenhouse and established with a modified Hoagland's solution containing 50 mg/L N. The pH was adjusted to 5.6 before the nutrient solution was applied to the plants. Plants were irrigated every 3 to 4 days for an additional four weeks. Flowers were removed to maintain vegetative growth. *Botrytis* inoculations were made by spraying a conidial suspension (2×10^5 /ml) to near runoff on the test plants. Relative humidity was maintained at approximately 80% for the first 12 hours.

SILICA ADDITIONS

New Guinea Impatiens 'Pure Beauty Purple' was used in this study. After 10 days, K_2SiO_4 was added to the nutrient solution for 10 plants at 0.0 mM Si (18 M Ω purity water plus 1/2x Hoagland's solution) and 2.0 mM Si (plus 1/2x Hoagland's solution). At the end of the growth period, control and treatment leaves were harvested, washed with deionized water, and sampled for analysis with a scanning electron microscope (SEM, Hitachi model S-4700, Figure 2). Beam voltage was 10.0 kV at a magnification between 30 and 300x, and raised to 20.0 kV for higher magnification. These voltages were used with the energy dispersive X-ray analysis (EDXA) for the respective images. Fresh cuttings of the edge of the plant leaf including the "teeth" were mounted on aluminum tabs with carbon sticky dots and viewed with the SEM. A total of 10 leaf samples were used for each treatment that included about 20 "teeth" on the edge of the leaf. Three stem samples from Si-treated plants were also prepared for analysis in the SEM and EDXA.

POTASSIUM ADDITIONS

The third experiment supplied 0, 3, 9, 21, 45, and 93 mM K (as K_2 -EDTA) to New Guinea Impatiens 'Electric Orange'

NITROGEN ADDITIONS

N concentrations of 2, 3.6, 7.1, 14.3, 28.6 or 42.9 mM was supplied to Begonia 'Barbara'. A ratio of 1:1 NO_3^- : NH_4^+ was used for all the N treatments.

Results



Figure 1. Reiger begonia showing (l to r) growth response and increased disease susceptibility with increasing nitrogen.

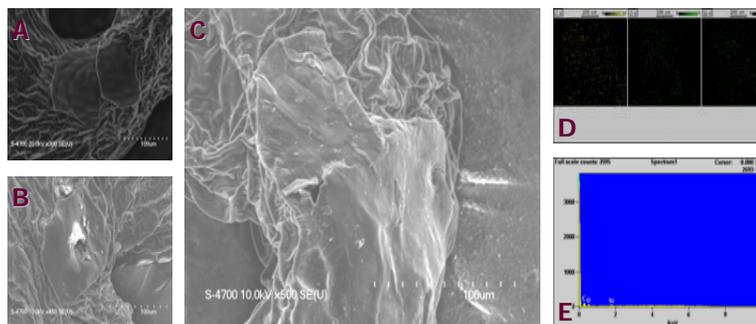


Figure 2. New Guinea impatiens leaf with Si added (A, B, and C). Based on EDXA maps of these images (D) and corresponding spectrograph (E), the deposits appear to contain Si. The presence of these deposits corresponds to the location of hydrathodes on the leaf margin.

Conclusions

- Silicon was demonstrated to be taken up, accumulated, and localized in unique cells of New Guinea impatiens leaves
- Further studies are needed to determine enhanced fungal resistance and the possibility of using silicon as an alternative to fungicides
- There was a trend for greater *Botrytis* susceptibility with more K, but further testing is needed.
- Nitrogen levels equal to or exceeding standard Hoagland's solution (15mM N) gave increasing levels of disease in Reiger begonia

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References

- Gillman, J.H., Zlesak, D.C., and Smith, J.A. 2003. Applications of Potassium silicate decrease black spot infection in *Rosa hybrida* 'Meipelta' (Fuschia Meidiland) HortScience 38(6):1144-1147.
- Ma, J.F., Miyake, Y., and Takahashi, E. 2001. Silicon as a beneficial element for crop plants. In *Silicon in Agriculture*. Edited by Datonoff, L., Korndorfer, G., and Snyder, G. Elsevier Science. New York. Pp. 17-39
- Marshner, H. 1995. Mineral Nutrition of higher Plants. 2nd Ed. Academic Press. New York.
- McAvoy, R.J. and Bible, B.B. 1996. Silica sprays reduce the incidence and severity of bract necrosis in poinsettia. HortScience 31(7):1146-1149.
- Nelson, P.V. 2003. Greenhouse Operation and Management. 6th Ed. Prentice Hall. New Jersey.