COMPARING STRAWBERRY SALT TOLERANCE USING A LOW VOLUME NEAR-CONTINUOUS GRADIENT DOSING SYSTEM

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Introduction

Traditional tolerance experiments are tedious and time consuming limiting replications and the number of treatments (DeMalach et al. 1996). Researchers have developed and adapted many automated systems over the years to overcome this tedious process (Aragues et al. 1999, DeMalach et al. 1996, and Levy el al. 1999). There is significant need to further develop new techniques for conducting rapid tolerance experiments. A previous system was adapted to provide a near-continuous gradient dosing system (NCGDS) to maximize the number of treatment levels and minimize labor in tolerance experiments..

FIG 1 – Before screening, a greenhouse was divided into sixteen blocks with two strawberry cultivars.

FIG 2 – The experimental blocks after screening with calcium chloride.

Objectives

1. To test the effectiveness and flexibility of the NCGDS treatment delivery system.
2. To use the NCGDS system to selectively screen two strawberry cultivars for their tolerance of saline, calcareous soil conditions in the semi-arid western U.S.

Summary

A near-continuous gradient, low-volume dosing system has been successfully created. All the parts for this system are readily available and relatively easy to install.

An increase in salinity treatments caused a decrease in leaf count and leaf mass for both cultivars. A significant difference was found in the ratio of injured to total leaf mass between the two cultivars. Ovation produced a greater mass of injured leaves. Allstar would be more tolerant than Ovation in Utah's calcareous, saline environments.

Methods

A drip irrigation system was assembled in a greenhouse with two supply laterals. Rain Bird emitters were coupled in combinations to provide an equal amount of nutrients but varying amounts of salinity to each plant. Cultivars and placed in separate blocks. Emitter liquid delivery was collected and the electrical conductivity (EC) was measured to monitor delivery accuracy. Plants were destructively harvested after 15 weeks of calcium chloride treatment. To normalize genetic differences, injury index ratios were created for leaf count and mass.

FIG 3 – Chemical injection pumps controlled the dosing process, providing nutrients and treatment to supply laterals.

FIG 4 – Solenoid valves were used in combination with a misting controller to initiate 30 second irrigation cycles daily.

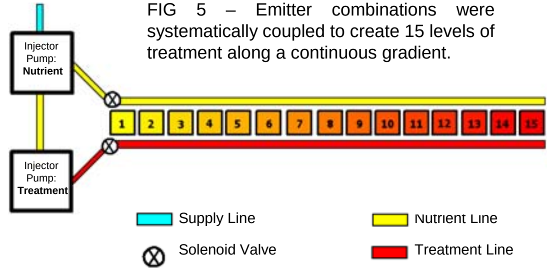


FIG 5 – Emitter combinations were systematically coupled to create 15 levels of treatment along a continuous gradient.

Results

System –
The actual emitter flow rates had a strong linear correlation with predicted flow rates (R^2 0.99). Similarly, the EC of the collected leachate mirrored the flow rate correlation (R^2 0.90). Approximately 0.44 L of solution was delivered to each treatment level per irrigation cycle.

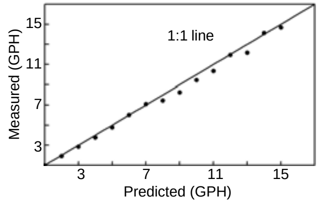


FIG 6 - Measured flow was positively correlated to the predicted flow rates.

FIG 7 – Leachate EC analyzed weekly from four randomly selected blocks.

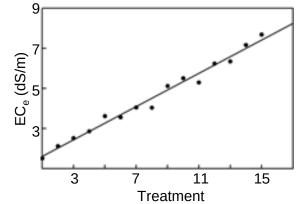


FIG 8 - Leachate EC readings increased with higher emitter rates.

Leaf Count-
There was a significant increase (P<0.0001) in the ratio of injured to non-injured leaves for both cultivars at every treatment level. The cultivars did not significantly differ (P 0.7434) in their response to the treatment.

At harvest Ovation had many small undeveloped leaves. Allstar had fully developed tri-foliate leaves.

Ovation →
—●—
← Allstar
—▲—

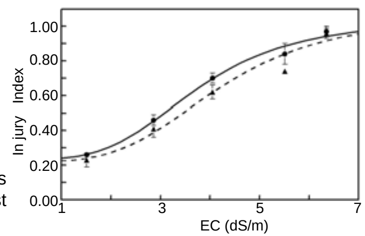
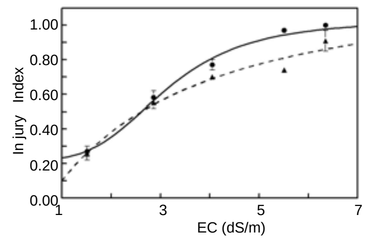


FIG 9 – Both varieties experienced death at the highest treatment.



Leaf Mass –
The injured to non-injured leaf mass index was found to be significantly different (P = 0.0092) between the two cultivars. An increase in salinity treatment resulted in a decrease of mean leaf weight for the two cultivars.

The leaf mass injury index comparison validates the leaf development observations.

FIG 10 – At the higher treatment levels Ovations leaves did not fully develop.

Additional Observations

The CGDS is not limited solely to salinity experiments. It can be an asset to researchers performing an assortment of tolerance experiments where low volume application and a range of treatment levels are desired. The dosing apparatus installed in this system allows the user to have an unlimited range of treatment concentrations.

Aragues, R., E. Playan, R. Ortiz, and A. Royo. 1999. A new drip- injection irrigation system for crop salt tolerance evaluation. Soil Sci. Soc. Am. J. 63:1397-1404.
DeMalach, Y., J. BenAsher, M. Sagih, and A. Alert. 1996. Double emitter source (DES) for irrigation experiments in salinity and fertilization. Agron. J. 88:987-990.
Levy, Y., D. Columbus, D. Sadan, and J. Lifshitz. 1999. Trickle linear gradient for assessment of the salt tolerance of citrus rootstocks in the orchard. Irr. Sci. 18:181-184.

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