

Weigela florida 'Alexandra', Wine & Roses™ weigela. Weigela has never looked so good. Dark burgundy-purple foliage blows 'Java Red' weigela away; leaf color intensifies to near black in mid summer. Intense rosy-pink colored flowers jump against the dark glossy foliage. Developed by Herman Geers of the Netherlands.

POSTER SESSION PAPERS

A New Computer-Controlled Multifertilizer Injector for Recycling Nutrients and Water Run-Off in Nurseries

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INTRODUCTION

Nursery production practices can cause pollution if nitrate and other nutrients leach into the groundwater and surrounding environment.

NEW AUTOMATED TECHNOLOGY

A new computer-controlled multifertilizer injector has been developed to monitor, control, and recirculate nutrients and irrigation water. This patented system was designed in the late 1980s by Climate Control Systems, Inc., Leamington, Ontario, Canada, and subsequently tested by scientists at Agriculture and Agri-Food Canada in Harrow, Ontario (Papadopoulos and Liburdi, 1989). The system was initially developed for the greenhouse vegetable industry, but shows promise for use in outdoor container nurseries.

The system described herein (Fig. 1), was specifically designed for research and is smaller than a typical commercial unit. The cost was \$25,000. The computer is an IBM compatible 486/66 MHz with 8 MB of RAM. A minimum of 100 MB of hard drive is required for data storage. The software is written in Quick Basic and contains 1.4 MB of code. The control panel uses plug-in Opto Modules, which facilitates ease of replacement.

Fertigation can be initiated manually or automatically by time or solar set point. A delay feature can postpone fertigation during rainfall. For each fertigation cycle, the computer stores and can graphically display all nutrients, electrical conductivity (EC), pH levels, and flow rates. The system is equipped with alarms to warn if nutrients, EC, and/or pH levels are too high or too low, or if there is a system malfunction.

A two-tiered (1.2 m long × 1.4 m high × 0.5 m wide) stainless steel frame contains 10 electrically driven, individually controlled, dosimetric pumps. Each pump is con-

nected to a separate fertilizer stock solution or an acid tank for pH control. Both the injection volume (0.1 to 1.0 ml) and stroke rate (up to 180 ml) of each pump can be adjusted. In-line EC, pH, and water flow sensors are housed within the central PVC manifold (2.5-cm diameter). An in-line blending tube thoroughly mixes the individual nutrients and acid. The system delivers up to 2000 liters of nutrient-charged irrigation water h^{-1} . Pumps in commercial units can deliver up to 5 liters of each stock solution per minute and have solution flow volumes up to 65,000 liters h^{-1} .

Fertigation and Recirculation. To fertilize a crop, the computer is programmed to deliver set levels of nutrients, EC, and acid. More than 50 different crops, grown at the same time, can each be given a different fertilizer formulation, without changing the stock solutions. Each formulation can be modified at any time to meet the crop's changing nutritional requirements.

If nutrients and water are recirculated, leachate run-off is collected from the containers and returned to the injector. The recirculated solution is then recharged to targeted nutrient levels, and returned to the crop.



Figure 1. The computer-controlled multifertilizer injector at the Horticultural Research Institute of Ontario showing the computer (far left), the control panels (on the wall), the injection pumps, and the solenoid valves and plumbing (far right). Each injection pump is connected to a separate fertilizer stock solution or an acid tank for pH control.

Research Trial. Results from preliminary experiments were promising (Purvis et al., 1997). Subsequently, we showed that containerized *Physocarpus opulifolius* 'Dart's Gold' grew best with nutrients recirculated by the multifertilizer injector, and least with nonrecirculated water soluble fertilizer (20N-8P-20K) delivered by a traditional dosimetric proportioner (Purvis et al., 1999). Growth was intermediate with incorporated controlled-release fertilizer (18N-6P-8K). The EC and pH of recirculated and nonrecirculated nutrient solutions supplied by the multifertilizer injector were accurate to within 6% of targeted levels. Recirculation reduced overall fertilizer use by 69% and run-off was completely eliminated.

LITERATURE CITED

- Papadopoulos, A. P. and N. Liburdi.** 1989. The "Harrow Fertigation Manager": A computer-controlled multifertilizer injector. *Acta Hort.* 260:255-265.
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