

NCERA-101
Committee on Controlled Environment Technology and Use
2012 Annual Station Report

State of Ohio, USA

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1. Impact Nugget: Virtual Grower 3.0 software was released to be compatible with Mac, Linux, and 64-bit processors; it includes plant scheduling, and dual heating systems. Over 12,000 copies have been distributed since the original release of the software.

2. New Facilities and Equipment. J. Frantz was reassigned to his former position in Toledo, OH effective 7-1-2011 following the closure of the Orono, ME USDA-ARS laboratory.

3. Unique Plant Responses. Irradiation with UV-A/UV-B mixed spectra induced variable plant growth regulation responses in seedlings of 10 crops including both floricultural and vegetable species. Some crops (petunia) showed little response to a 2-h exposure while others (e.g. spinach) were killed at the same dose. We are investigating the potential for UV exposure to serve as a non-chemical growth regulator.

Supplemental silicon helped alleviate drought in repeated dry-down experiments in zinnia. Plants fed with supplemental Si were larger and had greater water use efficiency than non-supplemented control plants.

4. Accomplishment Summaries. Virtual Grower software was developed to allow a user to easily build, in software, a greenhouse that closely matched their facility so that energy simulations could be run conveniently. Virtual Grower 3.0 was released in 2011, expanded the software to over 800 sites, included predictions of planting time or finish time, dual-system heating capabilities, and compatibility with more operating systems. These changes allow a user to see the impact that optimizing in one area (heating efficiency) may have on plant growth and scheduling. The software has enabled growers and engineers to more easily obtain energy audit information with which owners can seek funding for energy efficiency improvements. Over 12,000 copies of VG have been distributed, primarily through the website www.virtualgrower.net.

5. Impact Statements. Virtual Grower software continues to be developed by the USDA-ARS team in Toledo, OH. The software allows a user to design greenhouses and simulate heating and plant growth for 12 greenhouse crop species. Users can optimize management strategies to save energy and improve scheduling. Over 12,000 copies have been distributed, with typical, easy-to-implement savings of around 20% on average. Virtual Grower won the Excellence in Technology Transfer award from the Federal Laboratory Consortium in 2012.

6. Published Written Works.
Refereed Journal Articles

Adams, C., J. Frantz, and B. Bugbee. 2012. Macro- and micro-nutrient release characteristics of three polymer-coated fertilizer technologies: theory and measurement. *J. Plant Nutr. Soil Sci. In press.*

Andiru, G., C.C. Pasian, J.M. Frantz, and M.L. Jones. 2012. Greenhouse production of impatiens wallerana using a controlled release fertilizer produces quality finished plants with enhanced garden performance. *J. Hort. Sci. & Biotech. In press.*

Barnes, J., B. Whipker, I. McCall, and J. Frantz. 2012. Nutrient disorders of 'Evolution' mealy-cup sage. *HortTechnology. 22:502-508.*

- Rothrock, M.J. Jr., J.M. Frantz, and S. Burnett. 2012. Effect of volumetric water content and clover (*Trifolium incarnatum*) on the survival of *Escherichia coli* (O157:H7) in a soil matrix. *Current Microbiology*. DOI:10.1007/s00284-012-0142-3
- Frantz, J.M. 2011. Elevating carbon dioxide in a commercial greenhouse reduced overall fuel carbon consumption and production cost when used in combination with cool temperatures for lettuce production. *HortTechnology*. 21:647-651.
- Frantz, J.M., S. Khandahar, S. Leisner. 2011. Silicon differentially influences copper toxicity response in silicon-accumulator and non-accumulator species. *J. Amer. Soc. Hort. Sci.* 136:329-338.
- Mishra, S., S.A. Heckathorn, J.M. Frantz. 2011. Elevated CO₂ affects plant responses to variation in boron availability. *Plant & Soil*. 350:117-130.
- Barnes, J., B. Whipker, I. McCall, and J. Frantz. 2011. Characterization of nutrient disorders of *Lilium longiflorum* 'Nellie White' and *Lilium hybrid* 'Brunello'. *Acta Hort.* 900:205-211.
- Blanchard, M.G., E.S. Runkle, and J.M. Frantz. 2011. Energy-efficient greenhouse production of *Petunia* and *Tagetes* by manipulation of temperature and photosynthetic daily light integral. *Acta Hort.* 893:857-864.
- Krug, B.A., B.E. Whipker, W.C. Fonteno, I. McCall, and J. Frantz. 2011. Incidence of boron deficiency in bedding plants caused by drought stress or abscisic acid application. *Acta Hort.* 891:141-147.
- Krug, B.A., B.E. Whipker, I. McCall, and J. Frantz. 2011. Boron distribution and the effect of lime on boron uptake by pansy, petunia, and gerbera plants. *Acta Hort.* 891:135-140.
- Jeong, K.Y., P.V. Nelson, J. Frantz, and W. Brinton. 2011. Impact of composted dairy manure on pH management and physical properties of soilless substrate. *Acta Hort.* 891:173-180.
- Jeong, K.Y., B.E. Whipker, I. McCall, C.C. Gunter, and J. Frantz. 2011. Characterization of nutrient disorders of pot rose "Karina Parade." *Acta Hort.* 891:125-133.
- Barnes, J., B.E. Whipker, I. McCall, and J. Frantz. 2011. Characterization of nutrient disorders of *Primula acaulis* 'Danova Rose.' *Acta Hort.* 891:77-83.
- Barnes, J., B.E. Whipker, I. McCall, and J. Frantz. 2011. Characterization of nutrient disorders of *Pericallis x hybrida* 'Jester Pure Blue.' *Acta Hort.* 891:67-75.
- Omer, M., J. Locke, J. Frantz, C. Krause, and L. Horst. 2011. Interaction of *Calibrachoa* and selected root and foliar pathogens in greenhouse settings. *Acta Hort.* 893:1301-1307.
- Davis, K.I., C.E. Niedziela Jr., M.R. Reddy, B.E. Whipker, and J.M. Frantz. 2011. Nutrient disorder symptomology and foliar concentrations of *Clerodendrum thomsoniae*. *J. Plant Nutrition*. 34:1079-1086.

Trade Magazine Articles

- Frantz, J.M. 2011. Virtual Grower 3: A powerful decision support tool for greenhouse systems. *Greenhouse Product News (GPN)*, October, 2011, pp. 22-28.
- Andiru, G., C. Pasian, J. Frantz, and M. Jones. 2011. How much water and nitrogen is wasted when a hose is used? *OFA Bulletin*. 930:17-18.

Book Chapters

none

Poster Presentations

3 poster presentations throughout the fiscal year.

7. Scientific and Outreach Oral Presentations

12 scientific or outreach presentations throughout the fiscal year

8. **Other relevant accomplishments and activities.** None