NCERA-101 Station Report

Cornell University

Neil Mattson, nsm47@cornell.edu
Louis D. Albright, albright@cornell.edu
Michael B. Timmons, mbt3@cornell.edu
Davis S. de Villiers, dsd5@cornell.edu
Timothy J. Shelford, tjs47@cornell.edu
Tyler S. Anderson, tsa46@cornell.edu
Kale Harbick, kh526@cornell.edu
Ted N. Alhanti, tna9@cornell.edu

1. New Facilities and Equipment:

- A mini-chamber controlled environment growth apparatus and computer control program developed by D. de Villiers and T. Shelford has proven to be a reliable and consistent tool for plant growth experiments. This system allows for the concurrent operation of four separate enclosed environments with the capability to control and log hydroponic pond temperature, air temperature, relative humidity, CO_2 concentration and light. Nearly 6 months of continuous use has produced limited technical issues allowing for smooth execution of growth trials with baby leaf greens that can produce large amounts of data in a relatively short amount of time while requiring limited experimenter intervention. As the CO_2 and Daily Light Integral (DLI) experiment comes to an end, the mini chamber apparatus will be utilized by other members and associates of Cornell CEA for similar experiments with additional crops.

2. Unique Plant Responses:

- The investigation of CO_2 and DLI on baby leaf greens in mini-chambers is nearly complete, with 6 experimental runs fully processed. Experimental conditions included DLIs of 10, 15, and 20 moles crossed with CO_2 concentrations of 400, 1000 and 1600 ppm. Two replications of each experimental condition have been executed with the crops Spinach, Romaine Lettuce, and Arugula while rotating CO_2 concentrations and DLIs across four different mini chamber environments. Preliminary analyses show the possibility of a strong main effect of CO_2 on fresh and dry weight for all three crops when comparing 400 ppm to either 1000 or 1600 ppm. This result has been observed at all three light levels with average g/mol values of low light level and high CO_2 conditions consistently exceeding values in conditions of 400 ppm CO_2 and high DLI. These results could reinforce the value of CO_2 supplementation in commercial greenhouse operations for both environmental and economic interests. Currently in the data analysis and write-up phase, this work will soon be prepared for publication.
- Our group found that non-aerated vermicompost extract (VCE) (sourced from Worm Power LLC) was a viable nutrient solution replacement as well as supplement to a conventional Sonneveld's nutrient solution (SNS) for hydroponic baby leaf spinach production. In a USDA SBIR project we are also examining efficacy of VCE as a biological control agent for the suppression of *Pythium* root disease in hydroponic spinach. In early experiments, we assessed the concentration of zoospores necessary to reliably infect spinach seedlings. Interestingly we have observed that infection requires less zoospores in summer vs. winter conditions. We have found that VCE addition to trays in the seedling stage can, in some cases, reduce subsequent *Pythium* infection in hydroponic ponds.

3. Accomplishment Summaries:

- Work is continuing on the development of a user friendly program to predict the energy usage of a user defined greenhouse. A particular focus of this effort is the quantification of the amount and timing of electricity used for supplemental lighting under different lighting control strategies, designs and set points, in different geographical locations.
- A series of experiments are being conducted to investigate the performance of lettuce and tomatoes to aquaponic water and are compared to traditional hydroponic water quality conditions of pH 5.8 and a standard ½ Sonneveld nutrient solution. The first experiments were designed to isolate the effect of pH only and used ½ Sonneveld solutions for both the controls and the treatment. A second experiment then compared ½ Sonneveld at pH 7.0 for both the control and the treatment but the treatment tubs were also supplemented weekly with 200 L of water taken from a recirculating aquaculture system (RAS). Finally, we are conducting an experiment where the treatment tubs continuously circulate water from the fish RAS to the treatment tanks and are compared against a control of ½ Sonneveld and pH 5.8. The treatment tanks using the fish water are only supplemented with chelated iron and no other nutrients.

4. Impact Statements:

- The Cornell CEA group continues to meet with and provide scientific expertise to many external parties developing CEA production and technology related businesses. In the past year our group provided consultation to more than 20 businesses. In many cases these consultations led to improved production practices (yield) of existing operations and positive changes to business plans for potential operations.

5. Published Written Works:

Scientific

Shahid, M.A., R.M. Balal, M.A. Pervez, T. Abbas, M.A. Aqeel, A. Riaz and N.S. Mattson. 2015. Exogenous 24-Epibrassinolide elevates the salt tolerance potential of pea (*Pisum sativum* L.) by improving osmotic adjustment capacity and leaf water relations. Journal of Plant Nutrition: 38(7):1050-1072. doi:10.1080/01904167.2014.988354

Currey, C.J., R.G. Lopez and N.S. Mattson. 2014. Finishing bedding plants: a comparison of unheated high tunnels versus heated greenhouses in two geographic locations. HortTechnology. 24(5):527-534.

Villarino G.H., Bombarely, A., Giovannoni J.J., Scanlon M.J., and N.S. Mattson. 2014. Transcriptomic analysis of *Petunia hybrida* in response to salt stress using high throughput RNA sequencing. PLoS ONE 9(4): e94651. doi:10.1371/journal.pone.0094651.

Jandricic, S.E., N.S. Mattson, S.P. Wraight and J.P. Sanderson. 2014. Within-plant distribution of foxglove aphid, *Aulacorthum solani* (Kaltenbach) (Hemiptera: Aphididae), on various greenhouse plants with implications for control. Journal of Economic Entomology. 107:697-707.

Popular (Trade) Press

Mattson, N., L.D. Albright, D. de Villiers, M. Brechner, R. Langhans. 2015. Top misconceptions about CEA. Inside Grower. February:32-34.

Mattson, N. 2014. Comparing substrate fertilizer amendments for spring bedding plants. Greenhouse Grower Magazine. 32(13):48-54.

Mattson, N.S., M. Bridgen, and N. Catlin. 2014. Using controlled-release fertilizer to produce garden mums. Greenhouse Grower Magazine. 32(9):72-74.

Mattson, N., J. Sanderson, and E. Lamb. 2014. How cultural factors impact fungus gnat populations. Greenhouse Grower Magazine. 32(5).

Owen, G., R. Lopez, S. Beeks, and N. Mattson. 2014. Vermicompost Validity. GrowerTalks. 77(11):68-70.

Beeks. S., N. Mattson, and R. Lopez. 2014. Vermicompost 101. GrowerTalks. 77(10):66-71.

Mattson, N. and C. Peters. 2014. A Recipe for Hydroponic Success. Inside Grower. January:16-19.

Other extension publications

Mattson, N.S., S.A. Beeks Brace. 2014. Website: Substrates and fertilizers for organic vegetable transplant production. http://www.greenhouse.cornell.edu/crops/organic.html

6. Other relevant activities or information: