NCERA-101 Station Report March 2013

The University of Tennessee

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1) New Facilities and Equipment.

We installed wavelength specific LED lighting systems in four of our growth chambers and in one of our greenhouses. These LED systems provide us with the ability to conduct research on the impact of specific wavelengths on the development of phytonutrients and minerals of importance to plants and in human nutrition. We also obtained sensors for light, temperature and humidity to equip our greenhouses with upgraded technology to monitor and document the environment.

In 2012 the third phase of our Institute of Agriculture Greenhouse expansion efforts was completed. This complex included a new Head House equipped with soil Sterilization equipment, sterile media facilities and root cleaning equipment. This complex contains 10 bays that are individually isolated to support research on plant pathogens and insects.

2) Unique Plant Responses.

Growth chamber experiments focused on the application of narrow-band wavelengths from light-emitting diodes. Experiments conducted in 2012 included: 1) measuring the impacts of short-duration blue wavelengths just prior to harvest on the nutritional quality of sprouting broccoli microgreens, and 2) measuring the impacts of different percentages of blue light in a red/blue/green environment on the nutritional quality of sprouting broccoli and comparing results to regular incandescent/fluorescent lighting; Results from experiments in 2012 indicate that blue wavelengths have a significant impact on many different quality parameters in leafy specialty crops.

We have been conducting experiments with foliar applications of ABA to determine if this growth regulator can be used in tomato production to modify stress levels and regulate calcium disorders (Blossom End Rot or BER) in greenhouse tomatoes grown in hydroponic systems. Our early results indicate that ABA treatments can increase calcium uptake into fruits and decrease the occurance of BER.

3) Accomplishment Summaries.

Work continues to establish management techniques in protected culture that will result in specialty crops with higher nutritional values. Projects conducted in 2012 also included work to measure the impacts of different nutritional regimes, specifically Se, Ca, and Mg, on the nutritional quality of specialty leafy crops.

Growth chamber experiments focused on the application of narrow-band wavelengths from light-emitting diodes. Experiments included: 1) measuring the impacts of short-duration blue wavelengths just prior to harvest on the nutritional quality of sprouting broccoli microgreens; 2) measuring the impacts of different percentages of blue light in a red/blue/green environment on the nutritional quality of sprouting broccoli and comparing results to regular incandescent/fluorescent lighting; and 3) measuring the impacts of the narrow-band wavelengths on blue, red, green, red/blue, infrared, and ultraviolet on nutritional quality of sprouting broccoli when applied in single applications just prior to harvest. Early results from these experiments indicate that blue wavelengths have an impact on many different quality parameters in leafy specialty crops.

A trial was established in Sept. 2012 to evaluate the short day strawberry cultivars 'Strawberry Festival', 'Florida Radiance', 'Winterstar', 'Camarosa', and 'Camino Real' and two day neutral cultivars 'Albion' and 'San Andreas' for potential for greenhouse production. The cultivars were established in 15 by 11 cm pots, 12 plants per experimental unit and eight replications. The plants were spaced 11 cm apart in a double layered polyethylene covered greenhouse with heat and evaporative cooling pads. Data of first bloom date, yield, and mite susceptibility are being collected until mid-April.

In 2010-2011, 'Strawberry Festival' and 'Camarosa' were grown in the same greenhouse and same size containers at various plant populations. Plants were grown with six replications at populations of 9, 12, 15, to 18 plants per square yd (bench space) (or 7.5, 10.0, 12.5, 15.1 plants per square meter) As plant population increased from 9, 12, 15, to 18 plants per square yd (bench space), yields per plant declined from 365, 321, 287, to 249 g/plant, respectively. Yields per bench area increased from 3285, 3856, 4298 to 4482 g/square yard (or 2747, 3224, 3593, to 3748 g/square meter)

Trials were continued in 2012 to develop protocols for producing strawberries in low-tech greenhouses during the off-season (fall-winter) when prices are highest. Short-day and day-neutral cultivars have been identified that have acceptable yields, fruit size and quality for greenhouse production. Our research showed that hydroponically grown crops could produce nearly 0.9 kg/plant when grown in 1.7 liter pots. A protocol was developed for timing and propagation of strawberry plug plants for off-season greenhouse production. Bumblebees were shown to be more efficient than hand pollination of strawberry flowers. Bumblebees are sensitive to many pesticides, thus trials were conducted to evaluate biological pest control. Trials demonstrated that the IPM-managed introduction of the predatory mite Phytoseiulus persimilis could control two-spotted spider mites, the parasitoid wasp Encarsia formosa controlled white flies, and a combination the predatory bug Orius insidiosus and a predatory mite Amblyseius cucumeris controlled thrips. Thus, greenhouse strawberries can be produced in

polyethylene-covered greenhouses with greatly reduced pesticide usage and probably organically.

Greenhouse trials were conducted to evaluate the effects of ‘Emporador’, ‘Multifort’, ‘Maxifort’ and ‘DP-106’ rootstocks on growth and yield of ‘Mountain Fresh plus’ and ‘Tribute’ tomatoes grown in hydroponic systems. The results were compared to controls of non-grafted and self-grafted plants of each cultivar. Plants were transplanted in July 2012 and will be harvested until the end of June 2013. Preliminary data on early yields indicate that rootstocks are affecting marketable yield of both ‘Tribute’ and “Mountain Fresh Plus”. Marketable yields (preliminary) of plants grafted on ‘DP-106’ and 'Maxifort' are 15% and 41% higher, respectively, than non-grafted plants.

Our preliminary results from greenhouse experiments with hydroponic tomatoes indicate that foliar application of the plant growth regulator ABA improves tomato fruit quality and increased Ca partitioning into tomato fruit tissue, thereby decreasing the incidence of BER

4) Impact Nuggets:

• We developed Greenhouse production practices for several crops including strawberry, tomato, pepper, galea melon, and cucumber. Identified strawberry cultivars identified as promising for fall and winter greenhouse production. Continue to demonstrated that Biologicals controls can be used to control mite, thrip, aphid and white fly populations. Greenhouse tomato yields have been increased to over 24 pounds per plant on a short harvest spring crop. This yield should prove to be commercially successful for growers interested in greenhouse vegetable production. We continue to evaluated cultivars for quality and yield as a spring and fall crop for greenhouses in the mid-south.

• Our research in 2012 established that short duration exposure to blue light prior to harvest increased the concentration of several nutritionally important phytonutrients and minerals.

• Our results from greenhouse experiments with hydroponic tomatoes indicate that foliar application of the plant growth regulator ABA improves tomato fruit quality and increased Ca partitioning into tomato fruit tissue, thereby decreasing the incidence of BER

5) Published Written Works.

1. Amundson, S.*, D. E. Deyton, D. A. Kopsell, J. W. Hitch, A. Moore, and C. E. Sams. 2012. Optimizing plant density and production systems to maximize yield of greenhouse grown 'Trust' tomatoes. HortTechnology, 22(1):44-48.
2. Kopsell, D.A. and C.E. Sams. 2013. Increases in shoot tissue pigments, glucosinolates, and mineral elements in sprouting broccoli after exposure to short-duration blue light from light-emitting diodes. Journal of the American Society for Horticultural Science 138(1):31-37. [Accepted for publication in 2012]
3. Manion, L.K., D.E. Kopsell, D.A. Kopsell, C.E. Sams, and R.L. Rhykerd. 2012. Selenium fertilization influences biomass, elemental accumulations, and phytochemical concentrations in watercress. Journal of Plant Nutrition *In Press*.
4. Kopsell, D.E., D.A. Kopsell, T.C. Barickman, and C.E. Sams. 2012. Ratio of calcium to magnesium influences biomass, elemental accumulations, and pigment concentrations in kale. Journal of Plant Nutrition *In press.*.

6) Other relevant activities or information.

We are continuing to develop information on production practices to improve yield and quality of specialty crops in greenhouse protected culture. We are revising our web page on Protected Agriculture and will be adding information to it on a regular bases over the next few years.