<u>Title of Project:</u> Identifying symptoms of micronutrient toxicity under low pH rhizosphere in blueberry (*Vaccinium spp.*) through high quality imaging**.**

<u>Progress Report</u>

<u>Grant Code</u>
SRSFC Project # 2014-16

Research

Dharma S. Pitchay
Assistant Professor
Department of Agricultural and Environmental Sciences
3500 John A. Merritt Blvd.
Tennessee State University
Nashville, Tennessee 37209
Ph. 615-963-4890
Email: dpitchay@tnstate.edu

Erick D. Smith
Assistant Professor
Department of Horticulture
The University of Georgia – Tifton Campus
Ph. 229-386-3119
Email: ericks@uga.edu

<u>Objectives:</u>

1. To document and photograph the chronological development of micronutrient toxicity symptoms of Southern Highbush (*V. corymbosum* L.) and Rabbiteye (*v. ashei* Reade) in response to a growth medium supplied with supraoptimal concentrations of a range of micronutrients (Fe, Cu, Mn, Zn, and B).
2. To establish the foliar critical excess and toxicity values for levels of micronutrients of supra-optimal supply for blueberry

<u>Justification and Description:</u>

In 2012, blueberry production from the reporting southeastern states (AL, AR, FL, GA, MS, and NC) produced 32% of the total national production at 62,220 metric tons, which was 37% of the total acreage. The farm gate value for the region was $245M, totaling 29% of the total national blueberry market (USDA ERS, 2013). With the southeast participating in one third of the national production of blueberry, the agents and specialists of extension and research need to have quality tools for diagnosis, especially in the area of nutrient analysis to make conclusive recommendations for blueberry growers.

Blueberry (*Vaccinium sp*.) is a calcifuge (lime avoiding plant) and thrives well in an acidic soil medium of pH 4.5 – 5.5. Therefore, at low pH levels, soil nutrient availability of macronutrients such as nitrogen (N), calcium (Ca), magnesium (Mg), and molybdenum (Mo) can be a challenge for this crop. On the other hand, the availability of micronutrients iron (Fe), manganese (Mn), boron (B), copper (Cu), and zinc (Zn) could be in excess at low pH levels for this crop. Much work has been focused on identifying nutrient deficiency and toxicity (Eck, 1988, Retamales and Hancock, 2012) and there are good physical descriptions of the symptoms. However, few mineral discrepancies have high quality photographic images to correspond to the descriptions of deficiencies.

Whenever a county extension agent or specialist is asked to identify a critical problem in a grower's field, there are many resources for that individual may draw from e.g. experience, training, and a web search on a smartphone. In more difficult assessments, the agents will photograph the malady and send it to a specialist or research from a smartphone. Utilizing the web, there are many sites with good descriptions and few images for the agent to diagnose nutrient toxicities. Commonly, an agent may use a search engine like Google *images* which gives the user many options for information that may have nothing to do with the crop or deficiency/toxicity.

An important aspect of diagnosis of nutrient deficiencies is the location on the plant where the symptom is expressed (Gibson et al 2007). In blueberry, nitrogen deficiency can cause stunting, low vigor and have pale green to chlorotic leaves (Hart et al, 2006). Generally, the matured leaves will take on a fall color and abscise. Initial chlorotic symptoms will occur on the older/lower leaves while the young leaves may appear pale green and or reddish in tint. This is a response of translocation of nitrogen and is an important knowledge for identifying the deficiency. However, blueberry being a calcifuge is efficient at uptake of calcium. This also means that blueberry has a much lower demand (0.3-0.8%) for calcium than *Rubus* (0.6-2.5%) (Mills and Jones, 1996). Considering blueberry is seldom deficient in the leaf sample, when calcium deficiency does manifest it appears in the younger plant tissue as interveinal chlorosis and /or browning in the edges (Hirschi, 2004). Calcium is considered immobile and symptoms develop in young tissue (Gibson et al 2007). This information is readily available through many sources, however good quality photographic information will help the individual be confident in diagnosing the symptom. Of course, the diagnostic process should include soil and tissue sampling to validate the field analysis.

Tennessee State University presently has a greenhouse space and facility to investigate this study and deliver the results by growing blueberry hydroponically in mineral excess solutions. In the past, the principal investigator has conducted research on N-forms and ratios for blueberry and has delivered the information to the International Plant Nutrition Institute, the funding agency for this particular project.

<u>Materials and Methods:</u>

Varieties:
Two commercial varieties a) *Vaccinium* 'Legacy' Northern Highbush and b) *Vaccinium* 'Ochlockonee' Rabbiteye Blueberry seedlings of uniform size were selected with the consultation of growers.

Treatments:
It is a factorial design with five micronutrients (Fe, Mn, Cu, Zn and B) each element will be delivered at four different concentrations as the main factor. The pH of nutrient solution will be adjusted to two pH levels (5.0 and 5.5) as the sub-factor. Therefore, this study consists of 40 treatments (5 elements x 4 concentrations x 2 pH levels) with four replications and three per replication. For each micronutrient toxicity treatment, the element will be supplied with four concentrations and the solution pH will be adjusted to 5.0 and 5.5. Each treatment solution will consist of specially formulated macro and micronutrients using reagent grade chemicals dissolved in 18 mega-ohms deionized water.

Pictorial Analyses:
Images of blueberry plants toxicity symptoms including the shoot and roots will be photographed together with a detail description of the treatment response over a period of time.

<u>Results</u>
Currently, the plants are at growing stage supplied with optimal control nutrient solution (Figure 1) because the plants need to be large enough to start the treatments so that sufficient tissue biomass can be obtained for foliar analysis and other measurements.

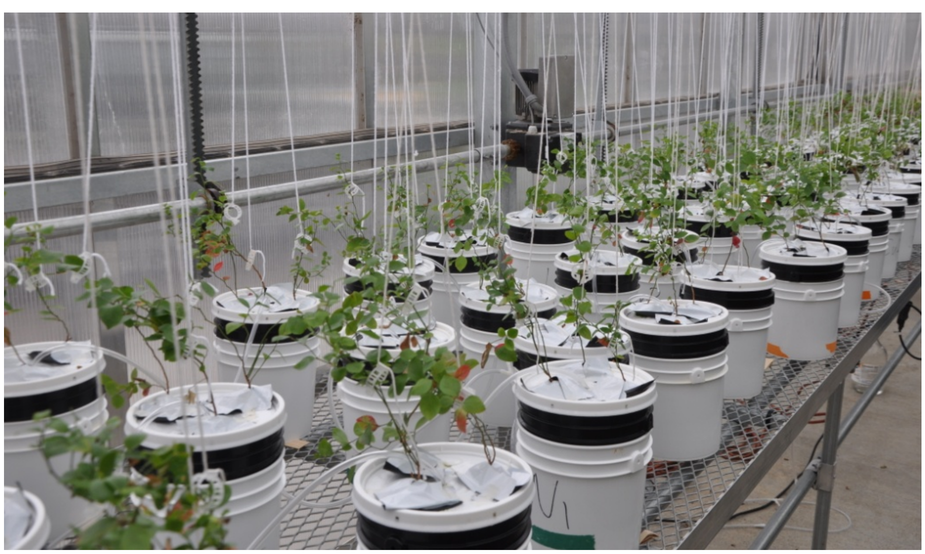

Figure 1: Experimental layout of the project showing six weeks old blueberry seedlings grown under hydroponic system.

Impact Statement:

With this study, we expect to produce a pictorial portfolio of excess and toxicity symptoms of micronutrients in blueberry with corresponding foliar tissue values. The portfolio will be available on the Southern Region Small Fruit Consortium (SRSFC) web site.

The practical benefit of this study is the readily available comprehensive data base of excess/toxic range micronutrients in blueberry. This data could be used as a diagnostic tool by growers, county extension agents, or stakeholders with an interest in abiotic plant disorders. The foliar tissue values will be valuable to the Plant Analysis laboratories across the southern regions and nationwide in support of precision nutrient management in blueberry production.

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USDA ERS, US Blueberry Industry http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1765