CDFA Fertilizer Research and Education Program 2013 Proposal

Project Title:
PHOPHOROUS AND BORON FERTILZER IMPACTS ON SWEETPOTATO PRODUCTION AND LONG-TERM STORAGE

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CDFA Funding Request:
One year: $8,576

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B. Executive Summary:

Sweetpotatoes present a growing industry in the U.S. They have received much positive publicity in the last few years regarding their nutritional benefits; additionally the production of sweetpotato fries has been a consumer success that is growing each year. In 2012, California was the second top producing state, harvesting approximately 21% of the national production from 18,500 acres. The estimated farm value of the sweetpotato crop in 2011 was nearly $130 million. This proposal addresses two issues currently facing the industry in California: 1) very little information regarding phosphorous requirements for this crop; and 2) a skin discoloration problem in the main cultivar that Extension Specialists in other states have suggested appears to be boron deficiency. A small plot fertilizer trial in a commercial field is proposed to address these issues, with extensive sampling of soil, leaves, and roots to determine the efficacy of the treatments. The information will be directly applicable to growers and consultants to improve nutrient management for this crop.

C. Justification:

Multi-year fertilizer trials conducted with sweetpotatoes, including one such FREP sponsored trial in 2001 – 02, with nitrogen and potassium have provided information regarding rates, timing, source, and impacts on storage quality (the most recent report is in the 2009 Sweetpotato Research Progress Report, available online at http://cemerced.ucdavis.edu). Since that first work ten years ago, the industry has changed substantially, with increased use of compost, new varieties, and much greater emphasis long-term storage in order to meet customer expectations of having availability to sweetpotatoes year-round. Additional issues within the industry include:

- Phosphorous rate determination and nutrient removal in the stored crop. The last documented fertilizer trial conducted in California for P on sweetpotatoes was in 1974. No yield response was observed, however, soil P levels were not determined. In the Fertilizer Guide for California Vegetable Crops[2], the suggested phosphorous rate for sweetpotatoes is 60 – 120 lbs P_2O_5 per acre. Based on root analyses from my own work, phosphorous is removed at the rate of 1.0 lb P_2O_5 per 1000 pounds of harvested roots. Average yields are about 31,000 lbs/A; high yielding fields are 60,000 lbs/A. Thus the current recommendation may be too high.
- Boron impacts on root quality and long-term storage. A new variety, Covington, now the dominant variety used in California, has problems after 6 months of storage with darkening of skin ("tea staining") and dark spot formation that suggests boron deficiency (figures below).

Left: dark spots on the left suggest B deficiencies, though the biotic pathogen Scurf may also be involved. Right: though subtle, these roots are turning dark and becoming unmarketable in storage.

The objective of this trial would be to evaluate the affect of different rates of boron and phosphorous fertilizers on Covington sweetpotato tissue and root yield, long-term (8 month)

[2] Tyler, K.B., and O.A. Lorenz. 1981. Department of Vegetable Crops, University of California.

storability, and incidence of "tea staining" or darkening on the root surface. The project would be conducted in a commercial field, using different rates of pre-plant applied boron (as Borax or Solubor) and phosphorous (e.g. 10-34-0) using a replicated, factorial design. In-season soil, plant, and water samples will be taken for B and P analysis. Plant canopy, root yields, and root nutrient content will also be measured to determine whole-plant partitioning and nutrient removal. Roots will be stored in a standard shed and weighed and evaluated for 8 months after harvest.

The target audience for this research would be the growers and crop consultants who work with sweetpotatoes. It is hoped that such information would help with specific storage and production issues currently impacting the industry.

This project addresses two of FREPs priority research areas: Demonstrating agronomically sound uses of fertilizing materials at the field scale, and developing best management practices and education materials.

D. Objectives:

1. Evaluate different rates of soil applied phosphorous on sweetpotato crop response in soil, leaves, and roots to determine P rate recommendations for this crop.
2. Evaluate different rates of boron fertilizer on sweetpotato roots to determine impacts on yield and skin color after long-term storage.

E. Work Plan:

Task 1. April 2014. Establish field location, take pre-plant soil samples at 1 and 2 ft depth. Field site will be in a commercial field in the Livingston – Turlock area of California. Samples will be sent to ANR labs at UC Davis for complete nutrient analysis to determine baseline soil fertility levels at the site.

Task 2. May 2014. Set up experimental trial as a completely randomized block split-plot design with 4 replications by applying phosphorous and boron fertilizers to established beds, with P rate (0, 40, 80, 120 lbs P2O5/A) as the main plot and B rate (0, 0.5, 1.0, 1.5 lbs B/A) as the split plot. Suggested plot size is 1 bed x 35 feet. Fertilizers will be applied to the center of the bed and mechanically incorporated. A uniform application of K, and if necessary Zn, will be made to the plot area at this time.

Task 3. May 2014. Transplant sweetpotato cultivar 'Covington' at standard plant spacing. Irrigation and field management, including N applications, will be done by the grower cooperator throughout the season.

Task 4. June 2014. Irrigation water sampling and analysis. ANR Lab.

Task 4. June 2014. First leaf sampling from all plots, submit to ANR labs for P and B analysis.

Task 5. July 2014. Second tissue sampling (leaves, 6th from the growing point, 12 from each plot).

Task 6. August 2014. Late season soil sampling, all P rates and two (low & high) for Boron, 0 – 12". Send to ANR labs for analysis.

Task 7. Sept 2014. Canopy biomass measurements to determine the weight and plant partitioning of nutrients. Take a 5-ft sample from each plot, weigh, and dry to determine dry matter content.

Task 8. Sept or Oct, 2014. Harvest. Measure root yield and size, take 30 lb subsample for root nutrient analysis, take 30 lb subsample for long-term storage test. Samples for analysis will have a center slice cut from each root, mashed, and freeze dried for ANR Labs. Storage samples will be weighed at harvest, then placed within totes and put into a typical sweetpotato storage building for long-term monitoring. Temperature and relative humidity monitors will be placed with the sample.

Task 9. Monitor weight loss and skin color on samples by weighing at 3, 6, and 8 months after harvest.

F. Project Management

Scott Stoddard will be responsible for implementation of the treatments, experimental design, sampling, and data analysis. The cooperator will be responsible for the day-to-day farming of the crop and maintaining roots in storage.

Outreach activities include the annual winter sweetpotato meeting, a harvest field day, and the sweetpotato Tips newsletter, which is sent out 2 – 3 times per year. Other activities could include presentations at CCA/PCA continuing education meetings and the annual National Sweetpotato Collaborators meeting.

G. Budget Narrative

Personnel expenses are for the assistance of one student assistant to help with plot establishment and preparation, plant and soil sampling, harvest, and data recording. I estimate this project will require ~~15~~ 19.4 days of work and a pay rate of $10.50 per hour. Benefits are calculated at ~~37%~~ 5.9 and 6.9% of pay.

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The bulk of the requested funds are for sample analysis, based on ANR Lab rates for 2012 – 13, and are listed under the supplies category. Other supplies are those needed for plot work, such as stakes, markers, sampling bags, courier fees, etc.

No travel is anticipated in the first year. If funded for more than one year, I anticipate travel funding would be needed.

Supplies ~~Equipment~~. Hobo temperature, CO_2, and RH monitors for stored equipment. The CO2 monitor is listed on the web for $465.00.