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Can a Better Tool for Assessing 'Hass' Avocado Tree Nutritional Status be Developed? – A Feasibility Study

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INTRODUCTION

California avocado growers must increase yield, including fruit size, and/or reduce production costs to remain competitive in the U.S. market, which now receives fruit from Mexico, Chile, New Zealand, Australia, Dominican Republic, Peru and Ecuador (Figure 1) and soon South Africa and Brazil.

Optimizing the nutrient status of the 'Hass' avocado (*Persea americana* Mill.) is a cost-effective means to increase yield, fruit size and quality, but the California avocado industry has no reliable diagnostic tool relating tree nutrient status with yield parameters. For the 'Hass' avocado of California, experiments for only N, Zn and Fe have been conducted to determine the optimal leaf concentration for maximum yield (Crowley, 1992; Crowley and Smith, 1996; reviewed in Lovatt and Witney, 2001). Alarmingly, leaf N concentration was not related to yield (Lovatt and Witney, 2001). Optimum ranges for nutrients other than N, Zn and Fe used for interpreting leaf analyses for the 'Hass' avocado are borrowed from citrus and, thus, are not related to any avocado yield parameter. Moreover, since optimal ranges for most nutrients are not known, current ranges for N, Zn and Fe are likely inaccurate, since they were determined under conditions where availability of one or more nutrients might have limited yield.

The project's objective is to test the feasibility of using tissues that have frequently proven more sensitive and reliable than leaves to diagnose deficiencies of the 'Hass' avocado sufficiently early that corrective measures would have a positive effect on yield parameters during the current year, not just the following year. Based on results obtained by avocado researchers in Chile (Razeto and Granger, 2001; Razeto et al., 2003; Razeto and Salgado, 2004), it is highly likely that peduncle and/or inflorescence tissue will meet the criteria essential for an effective diagnostic tool for 'Hass' avocado fertility fertilizer management in California.

However, it must be noted that additional research would be required to develop the broader database required to have confidence in the relationship between nutrient concentrations in peduncle and/or inflorescence tissue and yield or fruit size than would be provided by the two data sets that will be obtained in this proposed two-year study. Hence, this is a feasibility study designed to determine whether a better tool for assessing 'Hass' avocado tree nutrient status can be developed.

OBJECTIVES

The specific objectives of this project are as follows:

1. To determine the sensitivity of the flower, entire inflorescence, and fruit peduncle to differences in tree nutrient status.
2. To determine if the nutrient concentrations of the tissues above are related to fertilizer rate and to yield parameters.
3. To determine if differences in tissue nutrient concentrations related to yield can be detected sufficiently early to be corrected before they impact yield, fruit size or fruit quality in the current year.

DESCRIPTION

Tissues will be collected as follows: Entire inflorescence at the cauliflower stage and at full bloom; flowers at full bloom; and peduncle of young fruit in June-July (which is before exponential increase in fruit size and June drop of the current crop, start of mature fruit drop and transition from vegetative to reproductive growth), in November at the end of the fall vegetative flush. Sample collection is repeated the following year. Standard leaf collection will be in September each year. Samples will be collected from 16 individual 'Hass' avocado trees on the diagonal across orchards (with different but known rootstocks) located in Pauma Valley, Irvine, Santa Paula (high N and B site),

San Luis Obispo and from trees receiving best management practice (BMP) N vs. BMP NPK and 0.8x N vs. 0.8x NPK in both July and August at a new research site in Santa Barbara. Tissue will be analyzed for N, S, P, K, Mg, Ca, Fe, Zn, Mn, B, Cu, and Cl. At harvest, yield (number and kilogram of fruit), fruit size distribution, and fruit quality will be determined per tree.

The project is a success if one, or more, tissue a) is sensitive to differences in tree nutrient status, b) has a nutrient content related to fertilizer rate and yield, fruit size and quality, and c) reveals nutrient deficiencies sufficiently early that correction will improve yield in the current year.

RESULTS AND CONCLUSIONS

The research was initiated with the start of funding in July 2007. Due to the freeze, orchards that we had planned to use had to be replaced with new ones. The first sampling date was September, the standard time for collecting avocado leaves for analysis. At this time, we also collected fruit peduncles for nutrient analysis for comparison with leaf analyses.

Due to the number of research sites, sampling dates and different tissues sampled, we have a huge and complex set of data. Different statistical analytical techniques are being used to mine this data set. For simplicity, results from one of our research orchards are presented here to provide an example of the information obtained. In this example, we used harvest data and peduncle tissue and standard leaf samples (Embleton et al., 1973) nutrient analyses. Using correlations and regression analyses, we determined which nutrients in each tissue significantly positively or negatively influence each yield parameter, i.e., total yield in kilograms and number of fruit per tree, and fruit size distribution based on packing carton fruit sizes. Packing carton fruit sizes are based on grams per fruit, as follows: size 84 (99 to 134 grams); size 70 (135 to 177 grams); size 60 (178 to 212 grams); size 48 (213 to 269 grams); size 40 (270 to 325 grams); size 36 (326 to 354 grams); and size 32 (355 to 397 grams).

For significant relationships, an equation predicting how the yield parameter will change with a change in the tissue concentration of the nutrient was generated. Using stepwise regression analyses, we can predict the most important combination of nutrients for each yield parameter. In this statistical analysis of the data, we found no significant relationships between leaf nutrient concentrations and total yield or fruit size. In contrast, there were significant relationships between the nutrient concentrations in peduncle tissue and yield parameters. For example, 98% of the variation in total yield for the trees in this orchard was explained by peduncle concentrations of four nutrients (in order of importance) Cu + N + Mn + B ($P = 0.0002$). Similarly, 86% of the variation in the yield of commercially valuable fruit of packing carton sizes 60 + 48 + 40 could be explained by four different nutrients (in order of significance) Ca + Zn + Mg + N ($P = 0.0233$). For small size fruit of packing cartons size 84 + 70, 98% of the variation in yield was due (in order of significance) to Cu + P + B + Mn ($P = 0.0002$). As suspected, 'Hass' avocado tree nutrient status related to high total yield is also related to a high yield of small size fruit. Keep in mind examples are from only two tissues sampled on one date in a single orchard.

It is anticipated that the results of our research will identify a tissue(s) and a time(s) of analysis that is responsive to fertilizer treatment, related to tree growth and yield parameters and predictive of yield. With these results, an annual tissue sampling strategy can be developed to provide avocado growers with a more sensitive tool to better manage their fertilizer inputs and reduce costs, while increasing yield, fruit size, fruit quality and net profit and protecting the environment from fertilizer over-use.

LITERATURE CITED

Crowley, D.E. 1992. Soil fertility and the mineral nutrition of avocado: the physical, chemical, and biological properties of soil and their importance in the culture of avocado. California Avocado Development Organization and The California Avocado Society, Circular No. CAS-92/1, 26 p.

Crowley, D.E. and W. Smith. 1996. Zinc fertilization of avocado trees. HortScience 31:224-229.

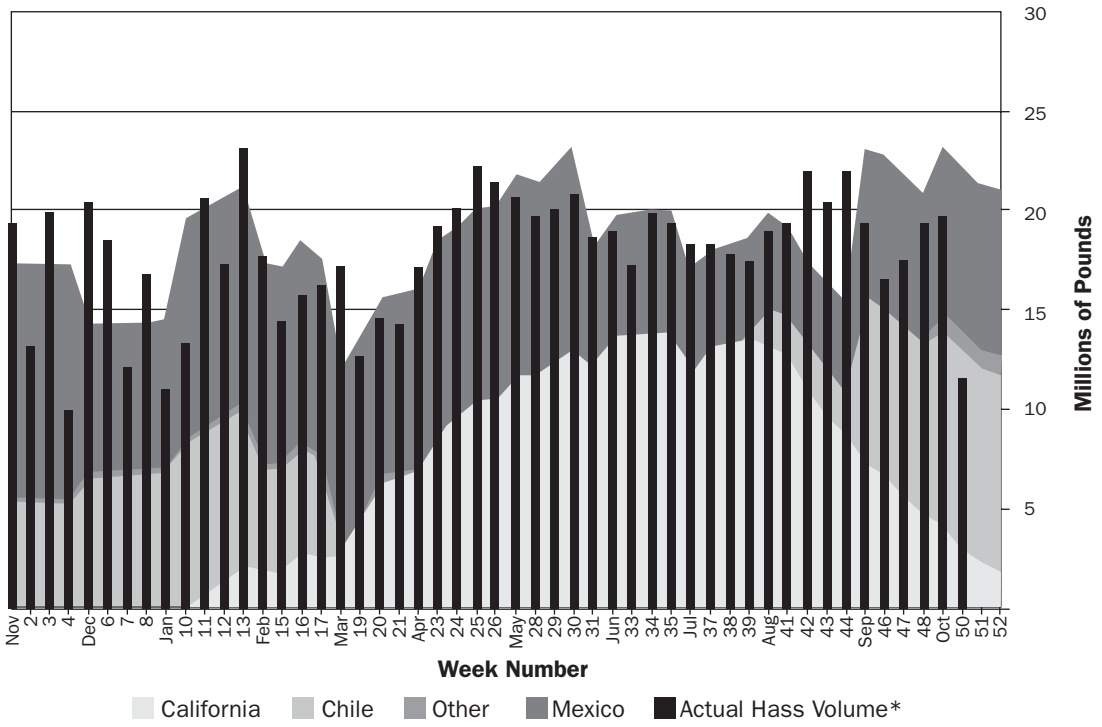
Lovatt, C.J. and G. Witney. 2001. AvoResearch 1(3):1-4, 11.

Razeto, B. and C. Granger. 2001. Análisis químico del pendúnculo del fruto y la inflorescencia, posibles herramientas de diagnóstico nutricional en palto (*Persea americana* Mill.), p. 73. In: Resúmenes. 52º Congreso Agronómico de Chile, Quillota, Chile.

Razeto, B., C. Granger, and T. Fichet. 2003. Análisis de diferentes tejidos como indicadores del nivel de boro en el árbol de aguacate (*Persea americana* Mill.). (Analysis of different tissues as indicators of boron level in avocado [*Persea americana* Mill.]). Proceedings, V World Avocado Congress 1:359–363.

Razeto, B. and J. Salgado. 2004. The influence of fruit peduncle as indicators of nitrogen status of the avocado tree. HortScience 39(6):1173–1174.

Figure 1
'Hass' avocado fruit (in millions of pounds) arriving weekly from Chile, Mexico and other countries into the U.S. and competing with California grown avocados in the U.S. markets.



**Chile and Mexico figures represent arrivals into U.S. market. All other figures reflect Avocado Marketing Research and Information Center (AMRIC) shipment volume.*

Data designed by Gwen Peterson, AMRIC