

Developing nutrient management recommendations for organic blueberry production systems

Dr. Bernadine Strik¹, Amanda Vance¹, Dr. Dave Bryla², Dr. Dan Sullivan³, Javier Fernandez-Salvador¹

¹Dept. Of Horticulture, OSU; ²USDA-ARS, HCRU, Corvallis; ³Dept. Of Crop and Soil Science, OSU



Introduction

Organic blueberry production in the USA has increased from about 480 acres in 2003 (Strik and Yarborough, 2005) to 4,090 acres in 2011 (Strik, 2014). Presently, certified organic blueberry land accounts for about 5% of total acreage in the country while organic blueberry acreage in Oregon and Washington accounts for 15% to 20% of the total acreage planted in these states. Growers commonly ask how organic production practices, particularly differences in soil fertility or pH, might affect tissue nutrient concentrations and thus fertilizer practices. There is a lack of information on the relationship between soil and leaf nutrient levels and yield and how to use soil and leaf tissue testing results to manage fertility programs in organic blueberry production. Growers wish to develop efficient fertilizer programs that optimize plant health and yield, and reduce risk of negative environmental impact or adverse economic effects that may be caused by fertilizing with an incorrect rate of product or at the wrong time.

Objectives

- 1) Determine the relationship between soil and plant nutrient levels and yield for various production systems
- 2) Use leaf nutrient concentration data to develop leaf nutrient standards specific to organic blueberry production systems
- 3) Determine the impact of nutrient management treatments on plant nutrient uptake and losses
- 4) Develop recommended soil properties and nutrient standards for cultivars grown in organic production systems

Materials & Methods

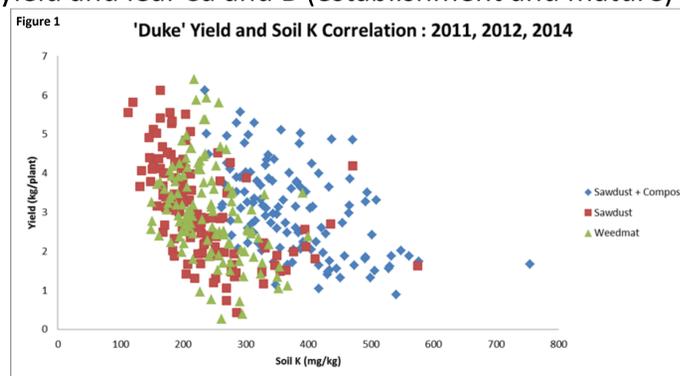
A long-term trial was established in Oct. 2006 at NWREC in Aurora, OR and certified organic in May 2008. Treatments include two planting configurations (flat ground and raised beds), four fertilizer treatments (low and high rates of feather meal and fish emulsion), two cultivars ('Duke' and 'Liberty'), and three mulch treatments (sawdust, compost + sawdust, and weed mat). Yield, leaf tissue, and soil samples were collected annually and used for correlation analysis. In 2013 and 2014, data were collected on leaf sampling time for six blueberry cultivars grown in two organic production systems to determine what factors influenced leaf nutrients and the best sampling time. In 2015 and 2016, whole plants are being excavated from select treatments to determine plant growth, nutrient allocation, and a total nutrient budget.



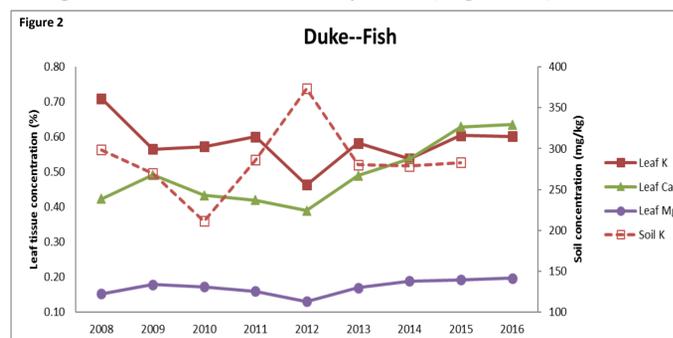
Results

Objective 1:

- Yield peaked in 2014 and leveled out in 2015-16. Years 2007-2013 are considered "establishment years" and 2014-2016 are considered "mature."
- More relationships were found between yield and leaf nutrient concentration in 'Duke' than 'Liberty'
- 'Duke': Yield and leaf and soil K negatively correlated in establishment (Figure 1); positive correlation between yield and leaf Ca and B (establishment and mature)



- Little impact of leaf N on 'Duke' or 'Liberty' during establishment. Mature years show negative correlation with yield in 'Duke' and positive in 'Liberty'
- Negative correlation between leaf K and leaf Ca and Mg in both cultivars (establishment years). Soil K in plots fertilized with fish is high and accumulated K may have antagonistic effect on Ca uptake (Figure 2)

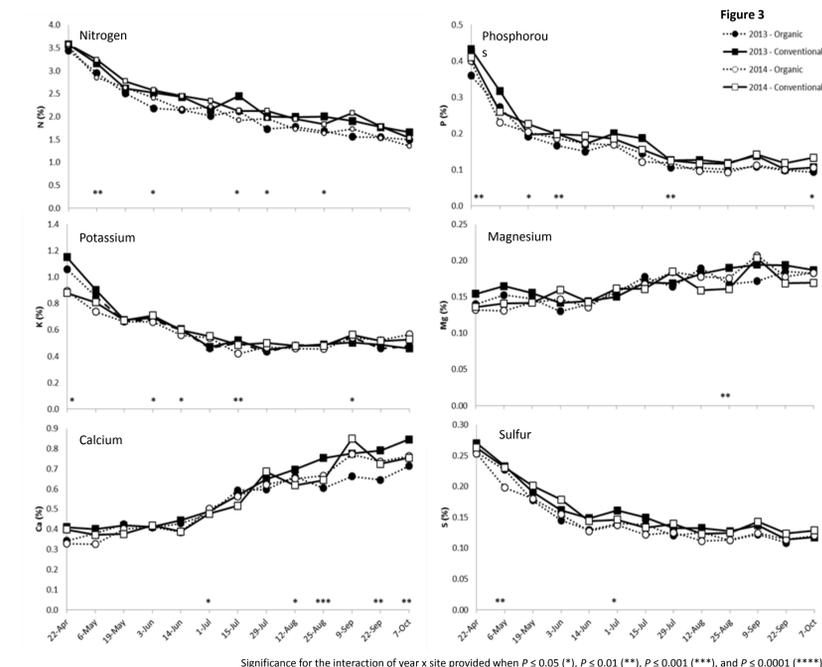


- In 'Duke,' leaf N negatively correlated with leaf Ca
- Soil and leaf P negatively correlated with yield in 'Duke' but opposite found in 'Liberty' (all years)
- Leaf Mn in 'Duke' correlated with lower yield, likely because of sensitivity to soil pH
- Leaf B positively correlated with yield in 'Duke' but negative in 'Liberty' (establishment years) despite consistently lower leaf B in 'Liberty'
- Leaf Cu positively correlated with yield in both cultivars; possible indirect effects through other nutrients being investigated

Results

Objective 2:

- Key differences found between leaf nutrient concentrations in organic compared to conventional production found, suggesting a need for revised nutrient standards
- Leaf N and P consistently lower in organic, despite commercially acceptable yields and healthy looking plants
- Patterns of change in nutrients similar between organic and conventional (Figure 3)
- See Strik and Vance (2015) for more details



Significance for the interaction of year x site provided when $P \leq 0.05$ (*), $P \leq 0.01$ (**), $P \leq 0.001$ (***), and $P \leq 0.0001$ (****).

Objective 3:

- Plants excavated 3x in 2015, final dig in December 2016
- Treatments being studied: 'Duke' and 'Liberty', feather meal and fish fertilizer, sawdust and weedmat mulches
- Year, cultivar, fertilizer, and mulch all impacted fruit nutrients (Table 1)
- Fish fertilized plots had higher K and lower Ca than feather meal, either because of higher Ca in feather meal fertilizer or increased K uptake from fish competing with Ca
- Further analysis underway and will be completed in 2017

Table 1	Nutrients removed (lbs/ton of fresh fruit) 2015						Nutrients removed (oz/ton of fresh fruit) 2015					
	N	P	Mg	K	Ca	S	B	Fe	Mn	Cu	Zn	Al
High Feather	1.65	0.22	0.11	1.68	0.18	0.16	0.04	0.09	0.11	0.01	0.03	0.66
High Fish	1.91	0.22	0.10	1.68	0.13	0.16	0.04	0.09	0.11	0.01	0.03	0.60
Sawdust	1.66	0.21	0.10	1.64	0.17	0.15	0.04	0.09	0.11	0.01	0.03	0.65
WeedMat	1.91	0.22	0.10	1.73	0.14	0.17	0.04	0.09	0.11	0.01	0.03	0.61
Duke	2.04	0.21	0.11	1.57	0.13	0.17	0.04	0.08	0.09	0.01	0.03	0.44
Liberty	1.49	0.23	0.10	1.80	0.19	0.16	0.04	0.10	0.13	0.01	0.02	0.84

Objective 4:

Recommendations based on results from Objectives 1-3 will be made at the conclusion of the study after comprehensive analysis.

Literature Cited

- Strik, B.C. 2014. Organic blueberry production systems – Advances in research and industry. Acta Hort. 1017:257-267.
- Strik, B.C. and A. Vance. 2015. Seasonal variation in leaf nutrient concentration of northern highbush blueberry cultivars grown in conventional and organic production systems. HortScience 50: 1453-1466.
- Strik, B.C. and D. Yarborough. 2005. Blueberry production trends in North America, 1992 to 2003 and predictions for growth. HortTech 15: 391-398.