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Annual Grower Summary for 2016

Project Overview

The primary objectives of the current project are to observe the effects of foliar-applied calcium (Phyta-Cal QC™) and boron (Solubor®) on: 1) fruit-set, weight, yield, and berry firmness; and 2) to observe a rate response to treatments varying in rate and composition. A secondary objective included observation of premature fruit drop incidence reported to occur in 'Draper' blueberry. Trials occurred in four fields (two in Skagit County and two in Whatcom County). Plant material trialed included established highbush blueberry cultivars, 'Bluecrop' and 'Draper'. Products were applied starting at the "Early Pink Bud" stage in 2015 and continued every 7-10 days for a total of six applications. Treatments included: untreated control; low and high boron (Solubor® 2.4 and 4.8 g/gal, respectively); low and high calcium (Phyta-Ca QC™ 37 and 74 mL/gal, respectively); low and high combination product of boron and calcium (Phyta-Set QC™ at 50 and 100 mL/gal) (Table 1). In 2016, the low Ca and B treatments were dropped and replaced with an alternative Ca product (LiberateCa™, 20 mL/gal), a micro nutrient blend (MicroLink Mangenese & Boron, 13 mL/gal). Mature fruit was collected 1-2 days prior to commercial harvest. Fruit samples were counted, weighed, and tested for firmness and processed for nutrient composition. Foliar nutrient samples were also collected and analyzed for nutrient content. This report provides a review of results from the first year of this project, as well as preliminary results for the second and final year of this project in 2016. This project is partially funded by the Washington Blueberry Commission.

Recap of First Year Results (2015)

The results are given in the context of abnormal seasonal weather for the 2015 growing season. Weather data for 2015 revealed higher than average temperature and solar radiation and lower than average relative humidity and precipitation. Early season soil samples confirmed soil nutrients were within an expected range with little to no abnormality. Fruit set was consistent across all sites at 85% or more (85%+ of flowers set fruit). An overall statistically insignificant trend of increased fruit set with the combination (calcium plus boron) treatment was observed. Significant differences in yield between treatments within a site were not detected, regardless of cultivar. Fruit firmness was not impacted by the application of calcium or boron in the 2015 growing season. Leaf tissues sampled in early August showed no significant differences between nutrient contents of untreated and treated leaf tissues. However, fruit tissue analyses of harvested fruit showed up to 60% more boron from plants treated with the high concentration of boron and an average increase of ~25% in fruit boron concentrations across boron treated sites. The increase in

fruit calcium concentrations was more modest, being raised by as much as 22% from plants treated with the high concentration of calcium, with an average increase of ~7% across all calcium treated sites. Despite the promising increase of fruit tissue nutrient levels, which demonstrates that some of these applied nutrients were being taken up by the plant, it remains to be determined if foliar supplementation with calcium and boron under more typical and marginal environmental conditions during the bloom time will increase overall fruit set, yield, and attributes of berry quality.

Second Year Results (2016)

The weather in 2015 and 2016 were very different; 2015 was hot and dry and 2016 was cool with more precipitation. This difference in weather allows for a side-by-side comparison of fruit set under the two distinct environmental conditions. The information we have indicates that, due to low air temperatures and precipitation, it is possible that inadequate foraging of honey bee pollinators during crucial stages of pollen viability led to decreased fruit set compared to 2015 (Figs. 1 and 2). Additionally, the cooler temperatures could have slowed plant metabolism and the rates of biological reactions, such as pollen growth. Treated plants were segregated by cultivar and analyzed for significant differences across the treatments. Initial analyses of the data do not indicate a significant difference in fruit set between treated and untreated (control) 'Draper' or 'Bluecrop' plots. Pollen growth rates, yield estimates, fruit firmness, and berry weight data were also collected and also showed no significant treatment effect. Leaf and fruit tissue nutrient analysis (which will be forwarded to you individually in the coming weeks) were sampled in late July. Tissue analyses showed no significant increase in boron or calcium levels in treated leaves, but a clear trend of elevated boron in leaf material is apparent. Fruit tissue analyses, similar to 2015, showed a significant increase in boron levels in the fruit, but no significant elevation of calcium. Despite the statistically insignificant differences in calcium levels in the leaves and fruit, we saw a reduction in fruit drop in calcium treated 'Draper' plants across all sites in 2016 (Fig. 3). We will be discussing these results with cooperative BC researcher, Eric Gerbrandt, who has been leading research on reducing fruit drop in 'Draper'. Our expectation is that there will be recommendations on ways to reduce premature fruit drop in 'Draper' based on work done by Mr. Gerbrandt and our trials in Washington.

Project Outlook

Our foliar nutrient project, whereby we focused on the potential impacts of boron and calcium on reproductive (flowering and fruiting) processes in western Washington blueberry, is coming to a close. With two years of results, we clearly see that under our experimental conditions, supplemented boron and calcium did not increase fruit set nor pollen viability in 'Bluecrop' and 'Draper' blueberry. At this point, we are not prepared to make recommendations for the use of foliar-applied boron or calcium for increasing fruit set in blueberry given we have not observed clear increases in fruit set nor subsequent yields.

However, we did see positive results in reducing 'Draper' drop with foliar applied calcium in 2016 (Fig. 3). These nutrients should, however, be considered if there is a documented and defined nutritional deficiency in a planting. The umbrella project for reducing 'Draper' drop with calcium is headed by Eric Gerbrandt and we have been collaborating with him. Expect more information in the near future regarding reducing 'Draper' drop through supplementation with foliar nutrients. We will also have additional information concerning hive density and supplemental pollinators from our 2016 projects in the next couple months. We are extremely grateful for the cooperation and aid of our grower cooperators, who make these research projects possible by sacrificing their time and energy.

If you have any questions, please email Matt Arrington at matthew.arrington@wsu.edu and/or Lisa DeVetter (PhD Advisor) at lisa.devetter@wsu.edu.

Table 1. Description of foliar treatments applied to Washington blueberry, 2015 and 2016. Treatment names are on the far left, followed by the year of treatment application, the trade name, chemical name, rate in mL/gal (Solubor is a powdered product and units are in g/gal), and the parts per millions of target element in the mix.

Treatment	Year Treated	Product Name	Form	Rate	ppm
				(mL/gal)	
Untreated	2015/2016	-	-	-	-
Boron Low	2015	Solubor	Disodium Octaborate Tetrahydrate	2.5	125
Boron High	2015/2016	Solubor	Disodium Octaborate Tetrahydrate	5	250
Calcium Low	2015	Phyta Cal	Calcium Chloride	37	750
Calcium High	2015/2016	Phyta Cal	Calcium Chloride	74	1500
Alt Calcium	2016	Liberate Ca+	Calcium Sulfate	20	150
B+Ca Low	2015/2016	Phyta Set	Calcium Chloride and Sodium Tetraborate	50	125/750
B+Ca High	2015/2016	Phyta Set	Calcium Chloride and Sodium Tetraborate	100	250/1500
B+Mn	2016	MicroLink	Sodium Borate and Manganese Sulfate	13	165/130

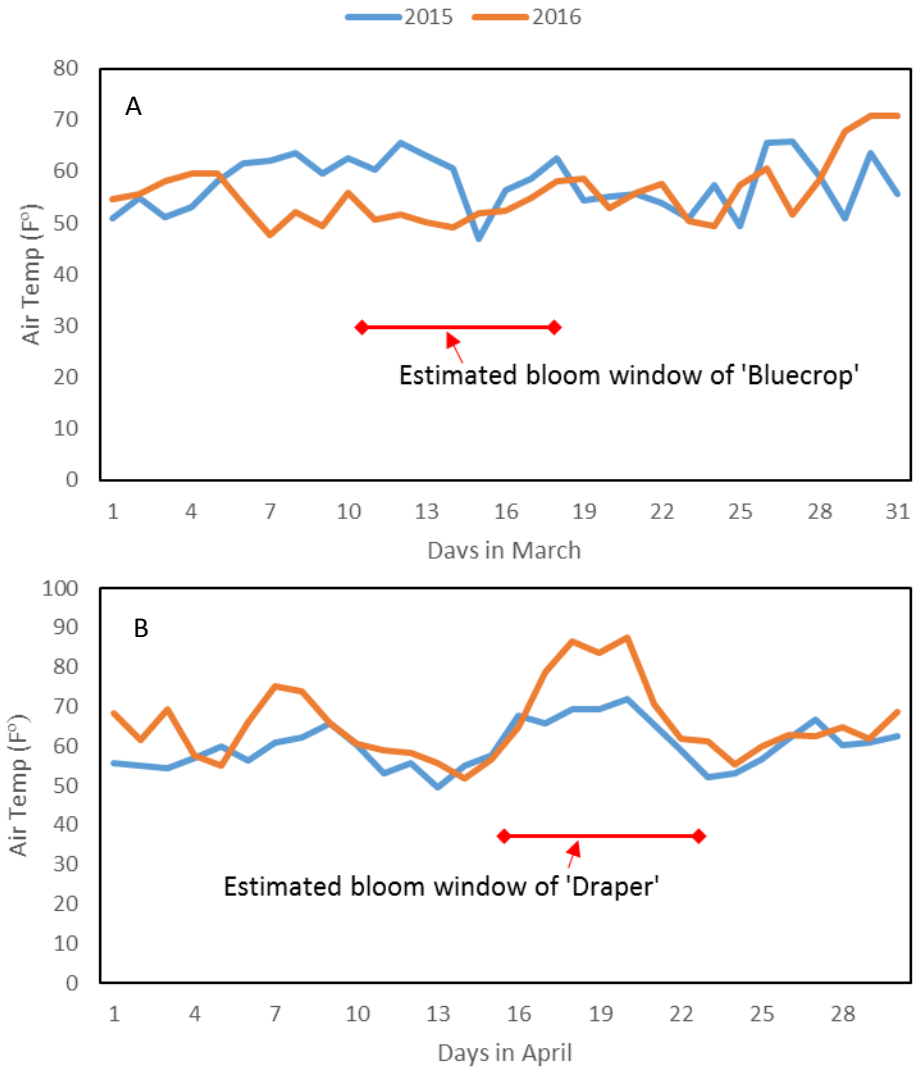

Figure 1: AgWeatherNet data from March through April of 2015 and 2016. (A) shows March air temperatures in 2015 and 2016, with the estimated bloom window of 'Bluecrop' plants in Skagit County. (B) shows April 2015 and 2016 air temperatures, with the bloom window for Whatcom County 'Draper' plants. Data are copyright of Washington State University.

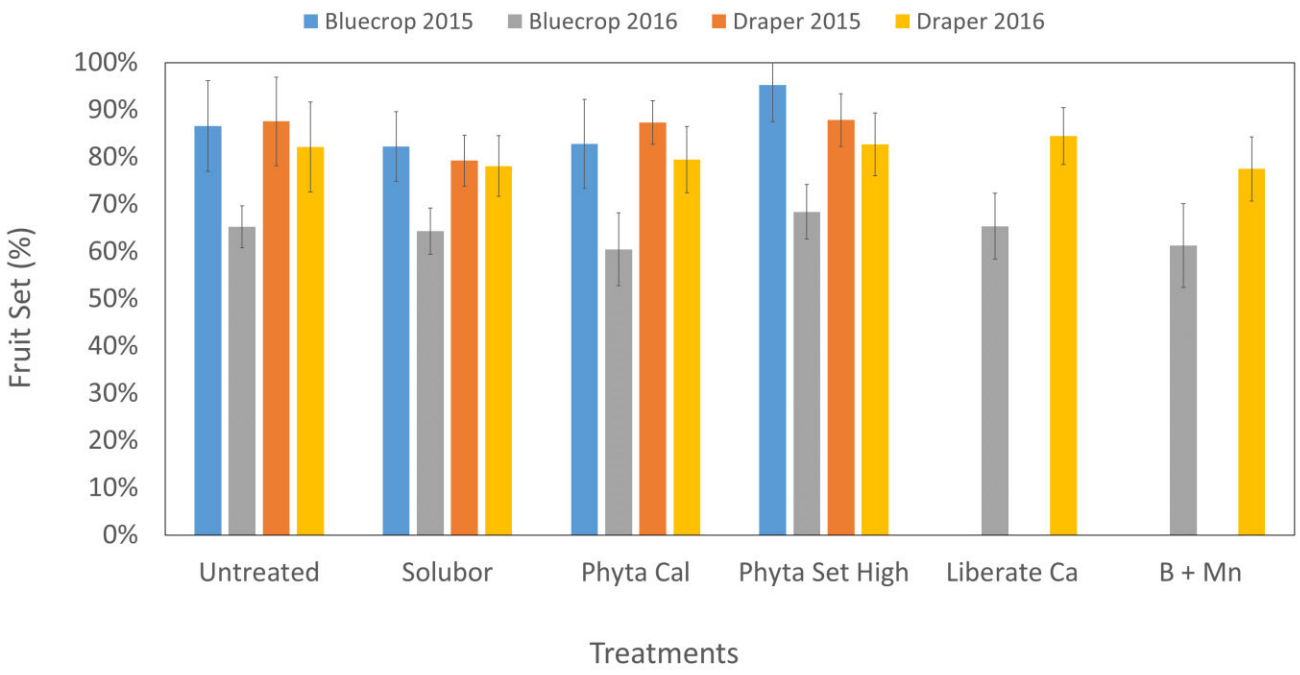

Figure 2: Percent of 'Bluecrop' and 'Draper' flowers that set fruit by treatment, 2015 and 2016. Treatments included in both years of the project are: untreated (control), and "high" boron, calcium, and boron+calcium (Solubor, Phyta Cal, and Phyta Set High, respectivley). Liberate Ca and MicroLink B+Mn were included in 2016 only.

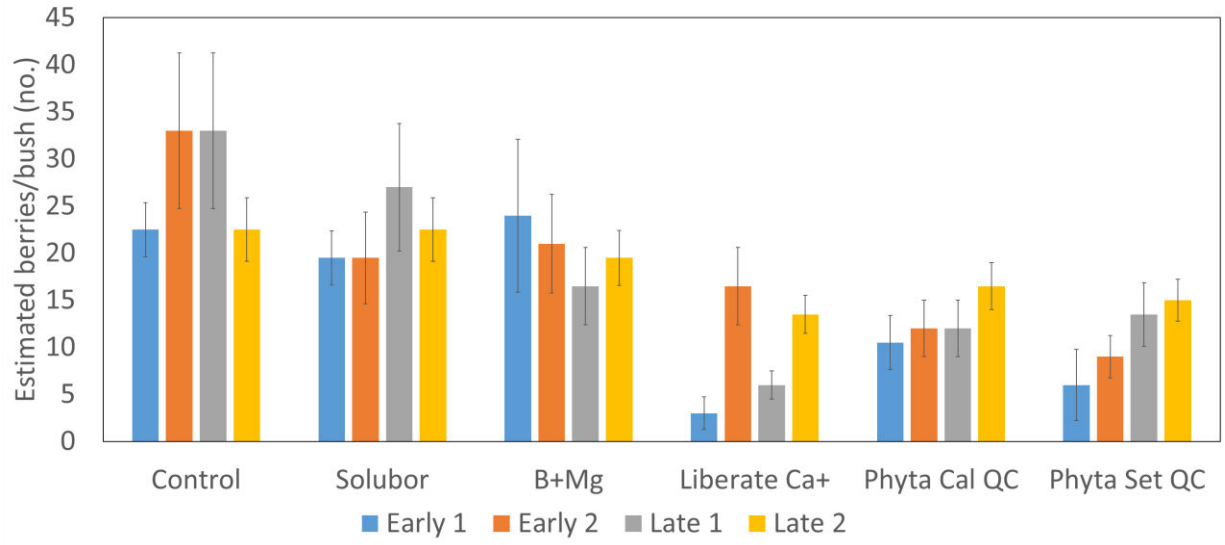

Figure 3: 'Draper' fruit drop measured as berries dropped per 1.5ft x 1ft grid square [two random samples per plot, measured twice per site (i.e, "Early" and "Late")] in two experimental sites located in Whatcom County, Washington. Treatments included: untreated (control), "high" boron (Solubor), MicroLink B+Mn, Liberate Ca, "high" calcium (Phyta Cal QC), and "high" boron+calcium (Phyta Set QC). Figure representes 2016 data, as limited fruit drop was observed in 2015.