Organic Zinc Foliar Products on Apple Tissue Nutrition

Research Summary for

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Background and Objective

The United States is the second largest producer of apples worldwide, and Washington state by far leads the nation in apple production. About 6 of every 10 apples consumed in the United States were grown in Washington. 2016 state yield was 132.9 million 40-pound boxes, and 2017 was forecasted to result in 130.9 million boxes. More than 175,000 acres of the state are developed apple orchards, and they contribute well over $1 billion to the state's economy.

Zinc is one of the most common foliar nutrient sprays applied to tree fruit in Washington state, typically sprayed twice in the early spring. Zinc is a regulatory, functional, or structural component of many cofactors and enzymes that drive metabolic reactions. The objective of this study was to quantify and compare nutrient assimilation resulting from foliar applications of Soil Basics' Helix Zinc and several competitive organic products.

Materials and Methods

The study was placed within a 10-acre block of V-trellised, non-bearing, second-year organic Ambrosia apples in Wenatchee, Washington (figure 1). Four treatments were replicated four times each, with a replicate consisting of three consecutive trees (table 1). The experiment was arranged in a randomized complete block design with three trees as buffers between each plot. Rates were designed to apply equivalent amounts of active ingredient.

Treatment	Manufacturer	Product Zinc Content	Product Rate
Untreated	N/A	N/A	N/A
Helix Zinc	Soil Basics	6.5%	1 qt/100 gal
Biolink Zinc	Westbridge	8.0%	0.81 qt/100 gal
PolyAmine Zinc	Verdesian	5.8%	1.12 qt/100 gal

Table 1. Treatment products, manufacturer, zinc percentage, and rate.

The treatments were applied June 16, 2017. A backpack sprayer with a single Teejet stainless steel flat fan 8003 nozzle was used to apply products, and the solution was sprayed to runoff. Tissue samples were taken 3, 5, 7, and 14 days post-application.

Each treatment sample was composed of at least 75 leaves taken 6-8 inches from shoot tips in each plot. Leaves were acid washed: rinsed with distilled water, soaked in 0.5% solution of phosphorus-free detergent for five minutes, rinsed with distilled water, soaked in 0.1 molar HCl acid solution for five minutes, and soaked in distilled water. Samples were air dried and then taken to a commercial laboratory for nutrient analysis.

Figure 1. Orchard where organic zinc foliar products trial placed.

Results and Discussion

The range of tested zinc values in untreated plots was very small, 15 to 18 ppm (figure 1). Every product appeared effective at increasing tissue zinc levels on treated leaves within three days after application. However, zinc concentration decreased and remained fairly constant when sampled 5 through 14 days after application. Zinc levels remained between 15 and 20 ppm for all treatments at sampling days five, seven, and fourteen. Due to the small magnitudes of difference, fluctuations at these later sampling times were likely caused by variation. A minimum of 15 ppm zinc is desired for adequate nutrition, so these trees were close to academically-defined deficiency (except for the treated trees three days after application).

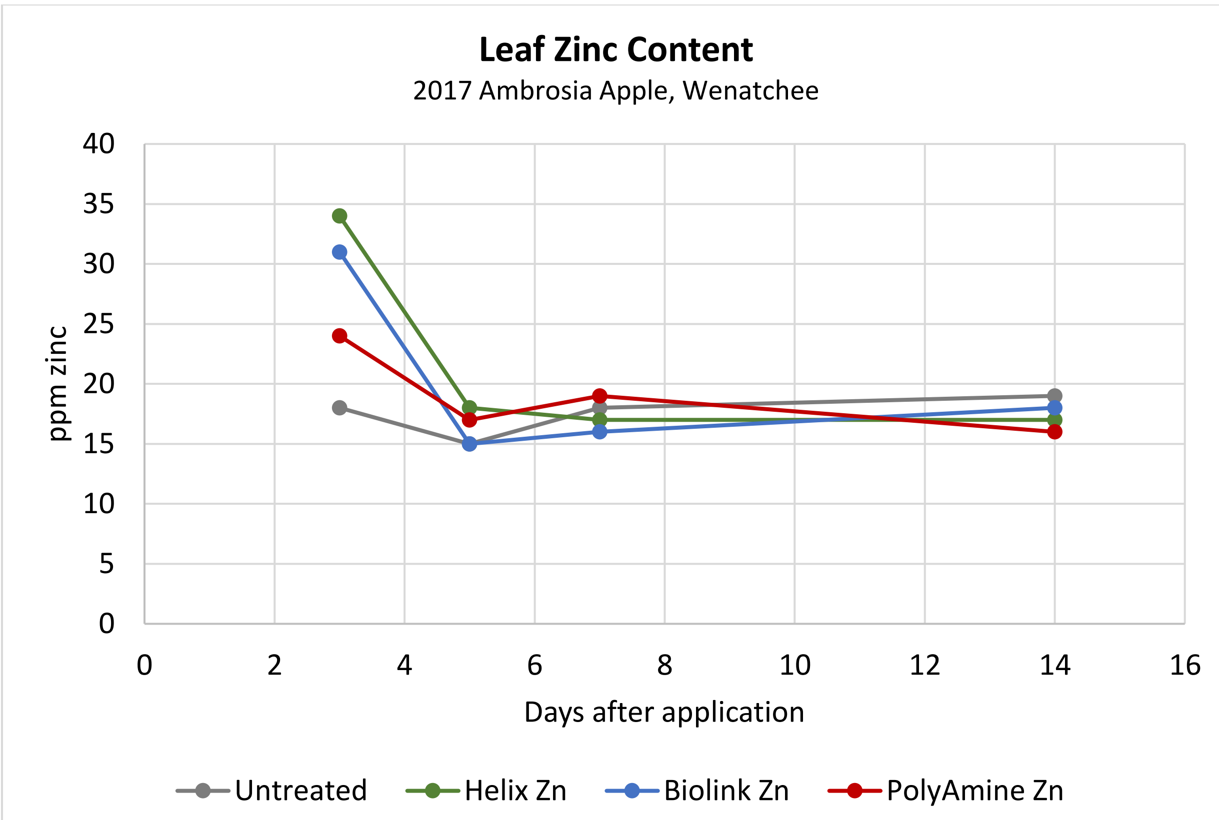

Figure 2. Parts per million zinc in leaves at 3, 5, 7, and 14 days post-application for each of the products and untreated.

Three days after application, Helix Zinc yielded the greatest increase in zinc levels relative to untreated leaves – nearly doubling the zinc concentration – followed by Biolink Zinc and PolyAmine Zinc (figure 3). After five days, the applications appeared ineffective at maintaining higher zinc levels. In fact, all treated foliage zinc contents were slightly less than the zinc concentration of the untreated leaves by day 14.

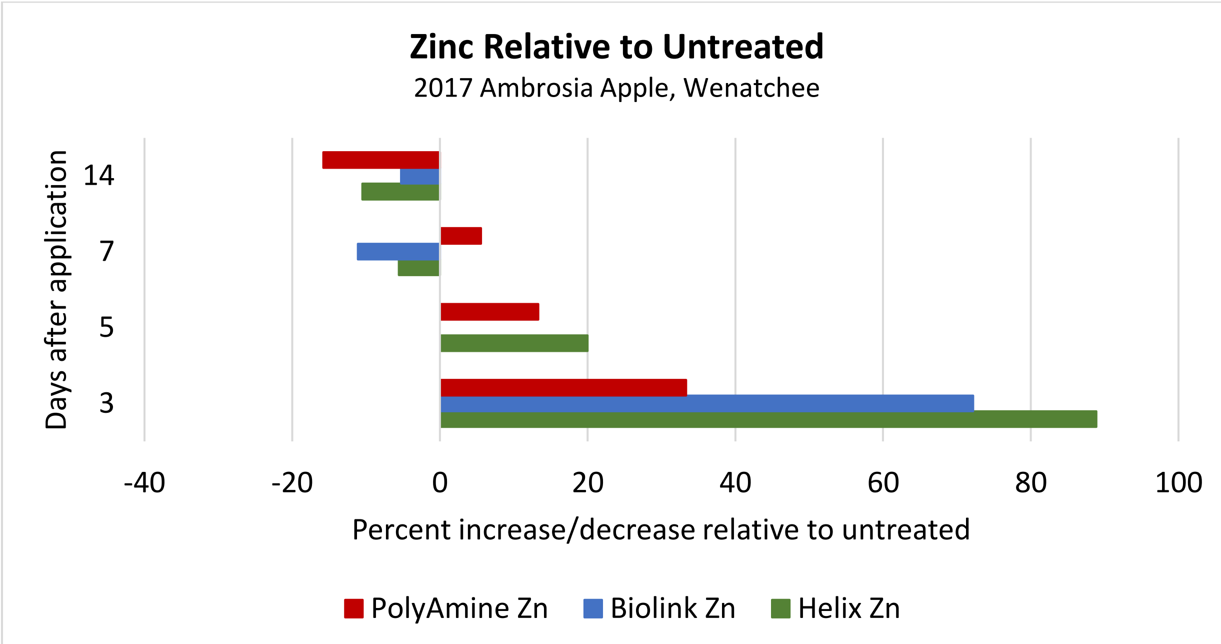

Figure 3. Percent increase or decrease of leaf zinc content for each product relative to untreated at 3, 5, 7, and 14 days post-application.

Between treatments, other nutrient levels were very similar. Iron concentrations tended to fluctuate; for example, iron under Helix Zinc was lower than untreated at day three but higher at day seven (appendix). Interestingly, calcium and manganese were higher than untreated five days after treatment. Zinc has been linked to better calcium nutrition in apples, by enhancing IAA biosynthesis and therefore IAA/calcium counter transport. By seven days after treatment, this calcium increase faded to approximately equal untreated (figure 4).

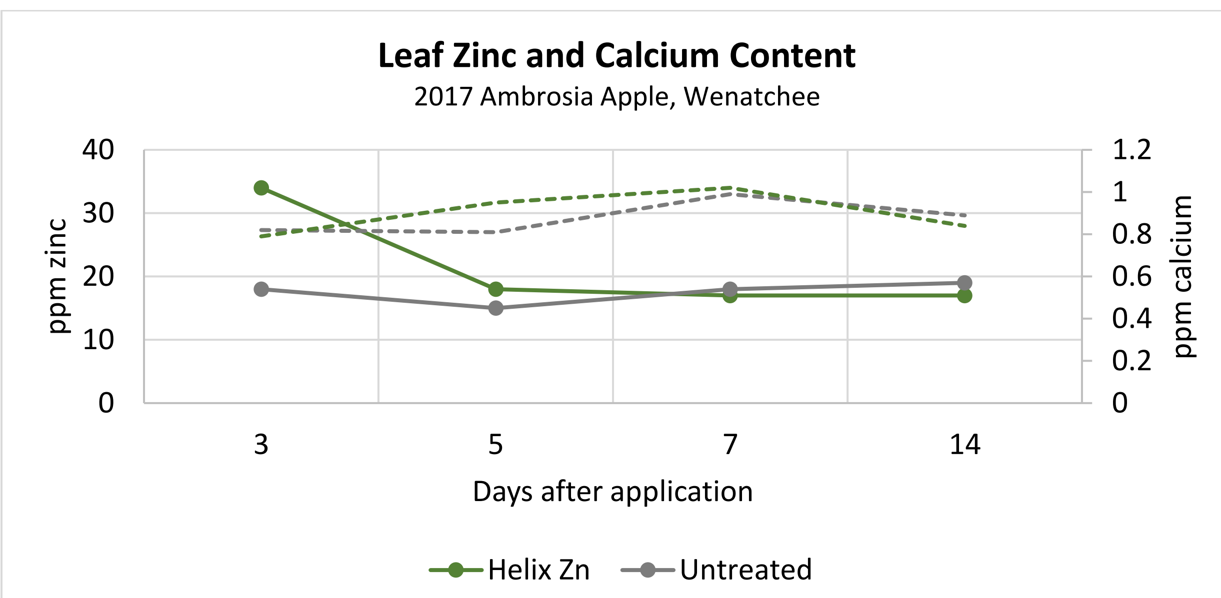

Figure 4. Zinc (solid lines, left hand axis) and calcium (dashed lines, right hand axis) in leaf tissue at 3, 5, 7, and 14 days post-application for Helix Zinc and untreated.

Appendix: Tissue nutrient analyses

3 days post-application

	Untreated	*Helix Zinc*	*Biolink Zinc*	*PolyAmine Zinc*
N (%)	2.69	2.67	2.78	2.67
P (%)	0.3	0.3	0.3	0.31
K (%)	2	1.99	1.96	2
S (%)	0.17	0.18	0.19	0.19
Ca (%)	0.82	0.79	0.8	0.85
Mg (%)	0.22	0.23	0.24	0.23
B (ppm)	11	11	11	12
Zn (ppm)	18	34	31	24
Mn (ppm)	43	40	49	49
Cu (ppm)	10	10	10	11
Fe (ppm)	91	78	93	90
Na (%)	0.02	0.01	0.02	0.02

5 days post-application

	Untreated	*Helix Zinc*	*Biolink Zinc*	*PolyAmine Zinc*
N (%)	2.82	2.78	2.82	2.68
P (%)	0.28	0.28	0.27	0.29
K (%)	1.9	2.06	1.98	2.11
S (%)	0.16	0.18	0.18	0.19
Ca (%)	0.81	0.95	0.93	0.94
Mg (%)	0.24	0.27	0.25	0.27
B (ppm)	27	29	28	31
Zn (ppm)	15	18	15	17
Mn (ppm)	44	49	52	49
Cu (ppm)	9	9	9	1
Fe (ppm)	83	77	76	91
Na (%)	0.02	0.02	0.02	0.02

7 days post-application

	Untreated	*Helix Zinc*	*Biolink Zinc*	*PolyAmine Zinc*
N (%)	2.65	2.6	2.54	2.71
P (%)	0.31	0.3	0.31	0.32
K (%)	2.39	2.43	2.41	2.46
S (%)	0.19	0.19	0.19	0.21
Ca (%)	0.99	1.02	1.04	0.99
Mg (%)	0.27	0.28	0.28	0.28
B (ppm)	33	30	29	32
Zn (ppm)	18	17	16	19
Mn (ppm)	48	46	55	52
Cu (ppm)	10	9	10	10
Fe (ppm)	77	95	84	90
Na (%)	0.02	0.02	0.02	0.02

14 days post-application

	Untreated	*Helix Zinc*	*Biolink Zinc*	*PolyAmine Zinc*
N (%)	2.75	2.66	2.74	2.67
P (%)	0.31	0.29	0.3	0.28
K (%)	2.59	2.48	2.58	2.56
S (%)	0.16	0.16	0.17	0.16
Ca (%)	0.89	0.84	1	0.94
Mg (%)	0.3	0.31	0.32	0.29
B (ppm)	31	31	31	29
Zn (ppm)	19	17	18	16
Mn (ppm)	47	45	54	51
Cu (ppm)	10	9	9	9
Fe (ppm)	161	193	218	149
Na (%)	0.02	0.02	0.02	0.02