Determining the growth effects of three rates of *AZOMITE®* Granulated Slow Release micronutrient fertilizer on first leaf almond and walnut.

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Objective:

1. To determine the growth benefits of *AZOMITE®* Granulated Slow Release micronutrient fertilizer applied at three different rates on first year almond and walnut orchards.

Methods: The trial, located near Merced, CA, is on sandy loam soil. Materials were applied to one year old almond (Nonpareil on Nemaguard) and walnut (Own rooted Chandler) trees that were planted April and January, 2011, respectively. Both blocks were previously planted as a vineyard. Four treatments were randomly assigned to achieve a randomized complete block design containing 8 blocks of six replicate trees for a total of 32 blocks and 192 trees total. Three treatments of *AZOMITE®* will be applied within the dripline of the tree and slightly incorporated as follows:

1. Base treatment of ½ lb *AZOMITE®* Granulated Slow Release + three 1/8 lb follow up treatments (397 g/tree applied),
2. Base treatment of 1 lb *AZOMITE®* Granulated Slow Release + three ¼ lb follow up treatments (794 g/tree applied),
3. Base treatment of 2 lbs *AZOMITE®* Granulated Slow Release + three ½ lb follow up treatments (1588 g/tree applied),
4. Untreated control (0 g/tree applied).

All trees, both treated and control crops, were on the grower's standard fertilization program. This program included four 6 ounce applications of triple 15 NPK blend fertilizer. Three applications of the treatments occurred, one in late June, August, and late September. Unwanted vegetation was controlled with paraquat herbicide, which was applied in mid-May, late June, and early September. Trees were irrigated using double line drip. Performance was evaluated through ratings and final growth caliper. Ratings were taken throughout the summer, and final height and caliper readings were taken in January 2012. Leaf tissues were sampled for both crops in mid-September, with leaves from the same treatment and block pooled for analysis. Analysis was performed by UC Davis's Analytical lab, with analysis of nitrogen, phosphorous, potassium, boron, calcium, magnesium, zinc, manganese, iron, copper, and sulfur.

Data was analyzed using JMP 9 software package. Differences in growth and leaf nutrient content among the treatments were determined using an analysis of variance. Within the ANOVA, the growth response was the dependent variable, and the applied treatment was the independent variable. Since the study was also established as a rate study, a regression showing the relationship of the applied material to growth was performed. In this analysis, both variables were described as continuous, and were compared to determine rate effect. All results were deemed significant if the error value was $p<0.05$.

Results:

Almonds:

Growth and Height Measurements:

The applied treatments of *AZOMITE®* at 0, 397, 794, and 1588 g/tree yielded an increase in caliper size of 22.32, 24.53, 23.43, and 25.4 mm, respectively (Table 1). The differences between treatments was not statistically different at $p<0.05$. The applied treatments of 0, 397, 794, and 1588 g/tree yielded an increase in height of 108, 108.7, 110.7, and 116.9 cm, respectively (Table 1). These differences were not statistical at $p<0.05$. There were no differences in mid- or end- season tree ratings.

There was a noted increase in the seasonal change in caliper and height as the amount of material applied increased. A regression was run to examine the relationship between the changes in caliper and height as the dependent variable and the applied treatment rates as the predictors. The regression equation predicted 12.4 percent of the variance within tree height. Tree height entered the regression equation of $y=(0.0058x(\text{grams applied}))+107.05$ ($p=0.0481$) (Figure 1). The regression for seasonal caliper change was not significant at ($p>0.05$).

Leaf Tissue Nutrient Analysis.
The application of 0, 397, 794, and 1588 g/tree of *AZOMITE®* did not increase any of the tested nutrient levels within almond leaf tissue ($p<0.05$) (Table 2).

Walnuts:
Growth and Height Measurements:
The applied treatments of *AZOMITE®* at 0, 397, 794, and 1588 g/tree yielded an increase in caliper size of 11.68, 12.05, 12.49, and 11.44 mm, respectively (Table 1). The differences between treatments was not statistically different at $p<0.05$. The applied treatments of 0, 397, 794, and 1588 g/tree yielded an increase in height of 269.67, 248, 275.52, and 230.34 cm, respectively (Table 1). These differences were not statistical at $p<0.05$. There were no differences in mid- or end- season tree ratings.

A regression was run to examine the relationship between the changes in caliper and height as the dependent variable and the applied treatment rates as the predictors. The regressions for both variables were not significant at ($p>0.05$).

Leaf Tissue Nutrient Analysis.
The application of 0, 397, 794, and 1588 g/tree of *AZOMITE®* did not increase any of the tested nutrient levels within walnut leaf tissue ($p<0.05$) (Table 2).

Discussion.
As determined in the regression, the varying rates did have a positive growth effect on almond tree height. The upward trend suggests that continual applications of *AZOMITE®* will increase the tree growth response, which could possibly lead to an increase in young tree yield. Tree height was more sensitive to change in comparison to the change in tree caliper. The increase in growth cannot be contributed to an increase in nutrient leaf content of the tested elements, suggesting that the added gain may be from an untested element or plant-nutrient response.

Within walnut, the results indicate no benefit of applying *AZOMITE®* in order to increase tree growth within the conditions of this trial. This difference in response versus almond may be due differences in root-nutrient uptake which may prevent or delay the benefit that may become evident as the trees age.

It is important to note that the almond trees were planted later than normal (early April v/s January) for the area. This date, however, is not necessarily unusual for a wet year and is common in higher rainfall areas such as Butte and Tehama County. Even with the late date, the application of *AZOMITE®* on almond yielded a positive growth response, which may become more apparent with a second year of product application.

Table 1: Analysis of variance of the growth response due to four treatments of *AZOMITE®* within almond and walnut.

Crop	Rate (g/plot)	Change in Caliper (mm)	Change in Height (cm)
Almonds	0	22.32	108
	397	24.53	108.7
	794	23.43	110.7
	1588	25.4	116.9
	DF	5	5
		p=0.1047	p=0.2121
Walnut	0	11.68	269.67
	397	12.05	248
	794	12.49	275.52
	1588	11.44	230.34
	DF	5	5
		p=0.72	p=0.234

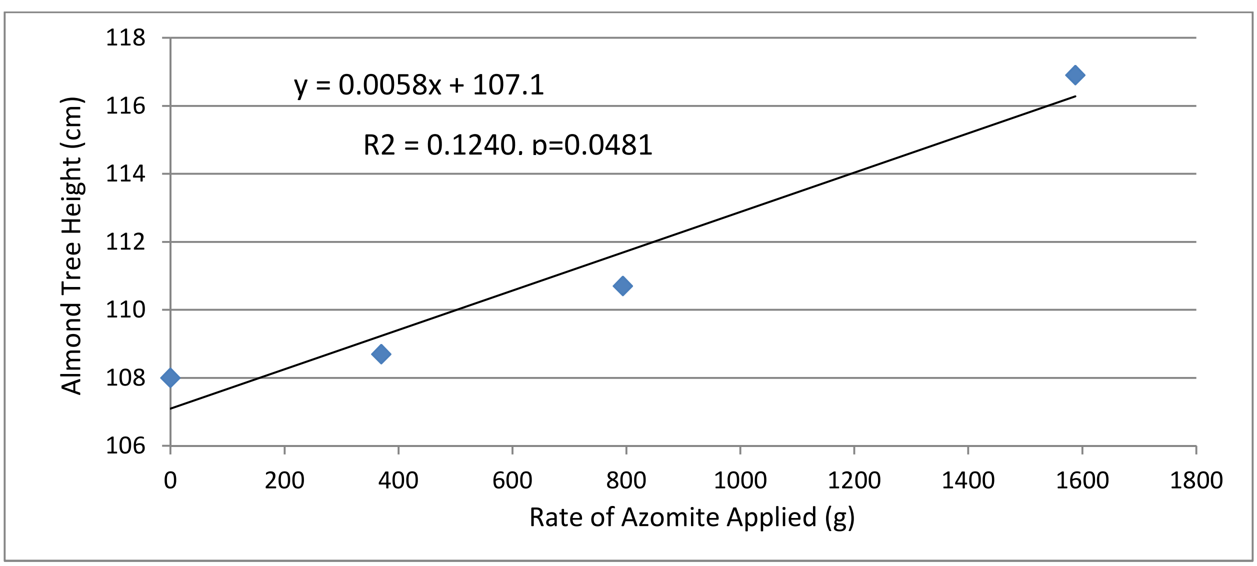

Figure 1: Linear regression of the relationship between almond tree height (cm) and rate of *AZOMITE®* applied (grams)

Table 2: Analysis of variance of the effect of four treatments of *AZOMITE®* on the tissue concentrations of nitrogen, phosphorous, potassium, boron, calcium, magnesium, zinc, manganese, iron, copper, and sulfur within almond and walnut.

Crop	Rate (g/plot)	Nitrogen (% of dry wt)	Phosphorous (% of dry wt)	Potassium (% of dry wt)	Boron (ppm)	Calcium (% of dry wt)	Magnesium (% of dry wt)	Zinc (ppm)	Manganese (ppm)	Iron (ppm)	Copper (ppm)	Sulfur (ppm)
Almonds	0	3.61	0.231	2.02	31.6	1.494	0.47	16.81	48.85	84.11	6.56	1881
	397	3.61	0.235	2.03	31.8	1.497	0.47	16.54	48.65	85.3	6.41	1886
	794	3.64	0.231	2.08	31.58	1.516	0.46	16.81	43.33	84.4	6.56	1880
	1588	3.54	0.224	2.05	30.85	1.616	0.48	15.78	47.91	83.41	6.32	1896
	DF	5	5	5	5	5	5	5	5	5	5	5
		p=0.429	p=0.211	p=0.861	p=0.323	p=0.276	p=0.826	p=0.716	p=0.400	p=0.916	p=0.702	p=0.938
Walnut	0	3.47	0.23	1.03	132	1.61	0.61	44.41	194.26	180.4	7.25	1976
	397	3.53	0.25	1.23	115	1.47	0.53	41.48	162.15	163.7	7.04	2048
	794	3.48	0.24	1.1	126.7	1.69	0.62	47.2	175.52	173.26	7.25	2038
	1588	3.57	0.24	1.11	116.7	1.57	0.59	46.76	210.3	164.65	7.03	2031
	DF	5	5	5	5	5	5	5	5	5	5	5
		p=0.742	p=0.704	p=0.426	p=0.416	p=0.305	p=0.290	p=0.833	p=0.162	p=0.677	p=0.873	p=0.763