Evaluation of the Efficiency of Transit Silicate to Improve Pest Resistance and Yield of Almonds

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Applications of silicon to plants has been shown to have many benefits, including strengthening the cell walls of plants, improving plant resistance to pests and disease, playing a regulatory role in a number of physiological functions (for instance uptake of other nutrients), improving biotic and abiotic stress resistance of plants and also improving crop quality and yield[1]. Increasing the silicon not only can increase crop yields by also adequate concentrations of silicon in plant tissues is a viable element of integrated pest and disease management[2].

Key words: Silicon, pest and disease resistance, biotic and abiotic tolerance**,** plant tissue benefits

Introduction

Plants acquire silicon through the uptake of mono silicic acid (MSA)[3]. Transit Silicate is a formulation containing 33% potassium silicate, which is the potassium salt of silicic acid and is readily absorbable by plants. Transit Silicate also contains 7% Amino acids and 1.5% biologically active organic molecules. Apart from silicon, potassium is a major element required for optimum crop growth and yield. Thus, this study aimed to evaluate the efficacy of Transit Silicate application at the nut development stage with regards to improving pest resistance and yield of almonds.

Objectives

The specific objectives of this study are:

2. Evaluate the effect of fertigation with Transit Silicate on improving nutrient status of almonds.
3. Evaluate the effect of fertigation with Transit Silicate on the yield parameters of almonds: nut weight, hull weight, kernel weight, and total yield.
1. Evaluate the effect of Transit Silicate on improving pest resistance - particularly for *Carpophilus* beetle.

Materials and Methods

<u>Site Selection and Trial design</u>

This trial was conducted in an Almond orchard within the Sunraysia region of Victoria. The block selected in the orchard had severe pest pressure the previous season. The trial was conducted with a randomised blocked design with three replicates. Commercial Fertigation of Transit Silicate was applied across the block twice during plant development, once during the nut development stage and once during the nut maturing stage.

Ten trees from each of the control rows were isolated from the drip tapes, and were considered the control trees. Ten trees from the adjacent rows were considered as the treatment trees. This was replicated over three different sites on the same block.

Treatment and application rate

Table 1: Treatment rates of Transit Silicate applied to almond trees and the trial design used.

Treatment	Rate L/ha	Application timing
Control	0	
Transit Silicate	30 L/ha	Nut developing stage Nut maturing stage

Replicate Site 1

Control Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Treated Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Control Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Treated Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10

Replicate Site 2

Control Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Treated Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Control Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Treated Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10

Replicate Site 3

Control Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Treated Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Control Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10
Treated Row	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5	Tree 6	Tree 7	Tree 8	Tree 9	Tree 10

Observations

Leaf nutrient analysis

Twenty eight (28) days after the final application of Transit Silicate, twenty leaves per plant were collected from each tree in both the control and treatment groups. These leaves were washed and analysed at Analytical Laboratories and Technical Services Australia, Victoria for the presence of the listed elements: Nitrogen, Posphorus, Potassium, Sulfur, Calcium, Magnesium, Sodium, Alminium, Boron, Copper, Iron, Magnanese, Zinc, Silicon and Molybdenum.

Kernel Weight, Hull weight and Nut Weight.

A 0.50 metre transect of whole nuts was collected from each row, and the nut weight and kernel weight was measured and recorded.

Statistical Analysis

Analysis of variance was performed using Prism 7 (Graph Pad Software). Significant difference between the treatments was determined by comparing the replicate means using Tukey's test ($P<0.05$). A t-test was performed to determine the significant difference between the control Vs treated, a P value <0.15 was considered to be significant.

Results and Discussion

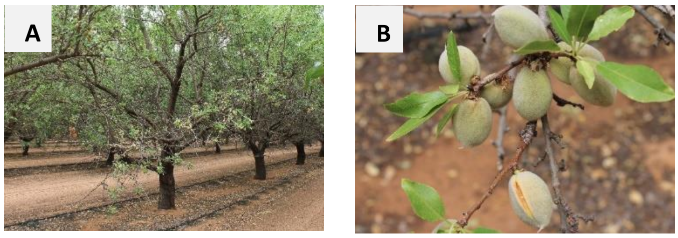

Figure 1. A) The control trees at harvest. B) The control almond nuts at harvest

Figure 2. A) The trees treated with Transit Silicate at harvest. B) The almond nuts of the plants treated with Transit Silicate at harvest

Figure 3 shows significantly higher levels of silicon was present in the leaves of the plants that had been treated with the Transit Silicate. The treated plants had 8.3% more silicon in the leaf tissue than the control plants.

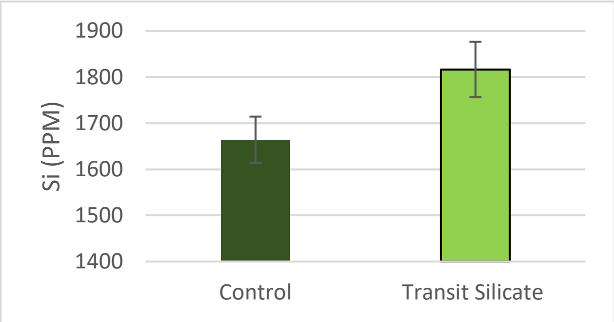

Figure 3. Analysis of Silicon (ppm) in almond leaves with reference to Control vs Transit Silicate. Each bar represents mean ± SE. A t-test was performed to determine the significant difference between the control vs treated, different superscripts show significant difference (P<0.15). The t-test was performed with Prism 7 (Graph Pad Software).

Figure 4. (A) The whole nut weight comparison shows an increase of 7.25% in weight of the treated almond trees compared to the untreated trees. (B) Shows that the kernel weight from the treated trees was significantly higher than those from the control trees, with an increase kernel weight of 37.6% compared to the plants not treated with Transit Silicate.

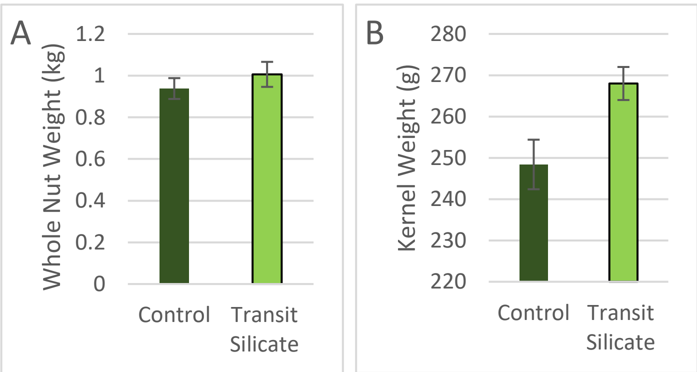

Figure 4. The weight of the whole nut collected from the treated and control trees (A) and the kernel weights from these nuts (B). Each bar represents mean ± SE. A t-test was performed to determine the significant difference between the control vs treated, different superscripts show significant difference (P<0.15). The t-test was performed with Prism 7 (Graph Pad Software).

Figure 5 shows that the Transit Silicate plants had a higher kernel weight, with 100 of the treated nuts weighing significantly more than 100 of the control nuts. The Transit Silicate nuts had a 5.8% increase in kernel weight compared to the nuts of the control plants, which were not treated with the Transit Silicate.

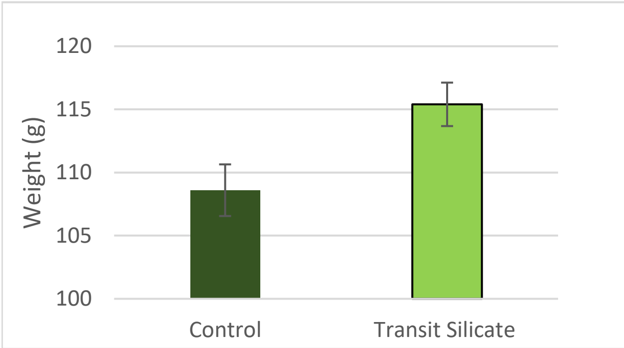

Figure 5. The weight of the 100 kernels collected from the treated and control trees. Each bar represents mean ± SE. A t-test was performed to determine the significant difference between the control vs treated, different superscripts show significant difference (P<0.15). The t-test was performed with Prism 7 (Graph Pad Software).

The outturn was calculated as the percentage of kernel weight to nut weight. Outturn was increased by 1.5% by the Transit Silicate treatment compared to the control (Figure 6).

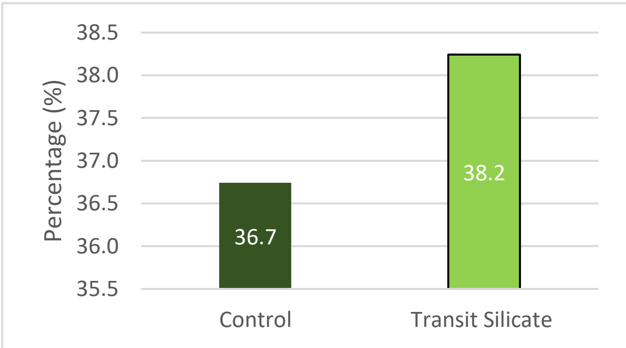

Figure 6. The outturn for the Transit Silicate compared to that of the control.

Figure 7 (A and B) shows the nutrient levels found in the leaves of almond trees treated with Transit Silicate vs control. With Potassium (12.49%), Calcium (92.83%), Sodium (20.89%), Aluminium (12.65%), Iron (13.30%), Manganese (23.77%) and Molybdenum (120.4%) all showing a significant increase in nutrient concentration in the leaves of almond trees treated with Transit Silicate. Copper showed higher concentration levels in the control (-41.25%) compared to the plants treated with Transit Silicate. There was no significant increase in levels on Nitrogen, Boron, Phosphorus, Sulphur, Magnesium or Zinc in the treated plants compared to that of the control.

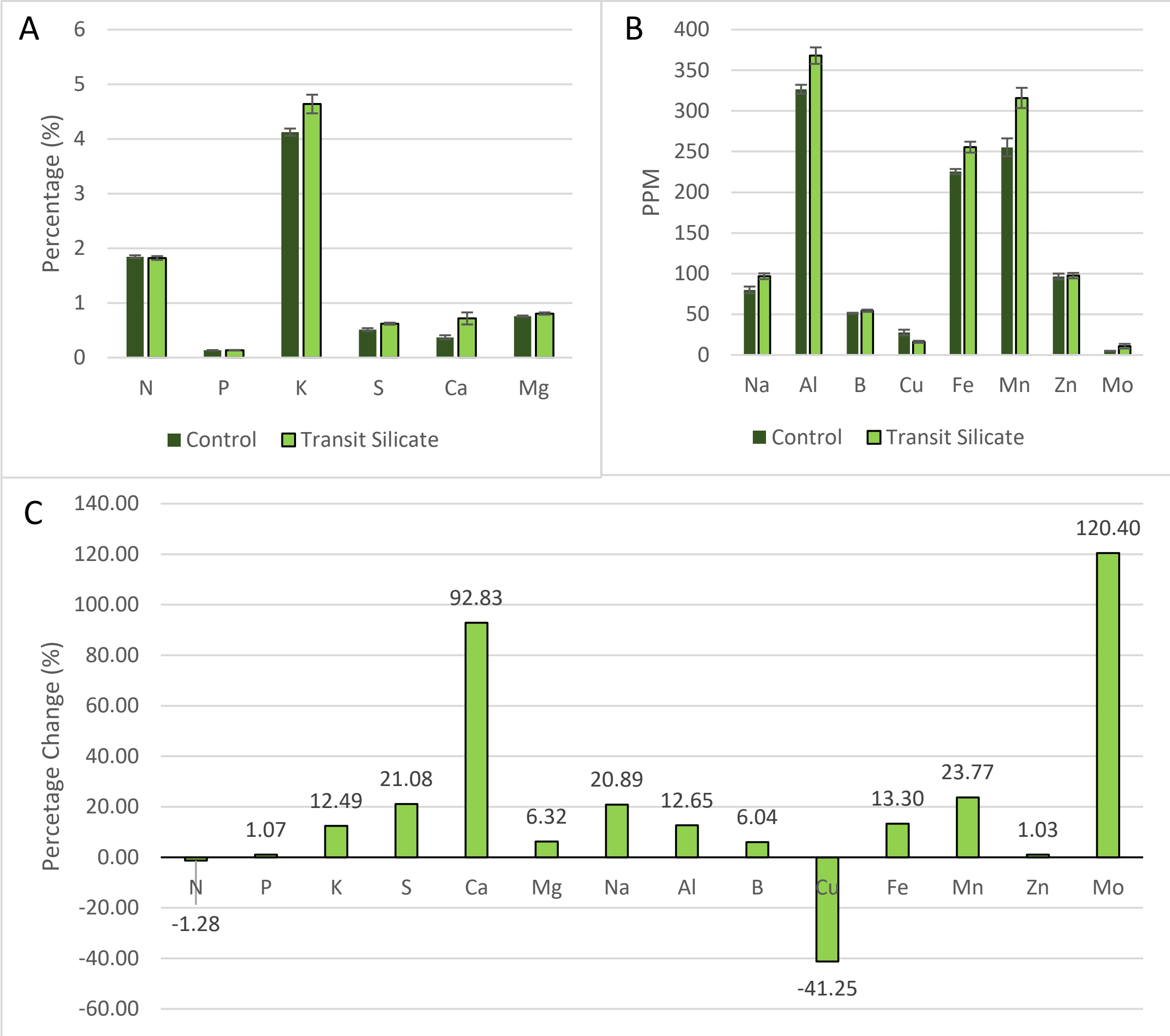

Figure 7. Shows the effected of Transit Silicate on the nutrient levels of elements in the leaves of treated plants compaired to the control plants (A and B) and the percentage change C. Each bar represents mean ± SE. A t-test was performed to determine the significant difference between the control vs treated, different superscripts show significant difference (P<0.15). The t-test was performed with Prism 7 (Graph Pad Software).

Figures 8 and 9 show a sample of nuts taken from control and Transit Silicate treated almond trees to look for insect damage. Only one nut with insect damage was found in the control group, and none were found in the nuts taken from plants treated with Transit Silicate. It should be noted that this year there was a low insect pressure in the orchard as reported by the orchard's agronomist.

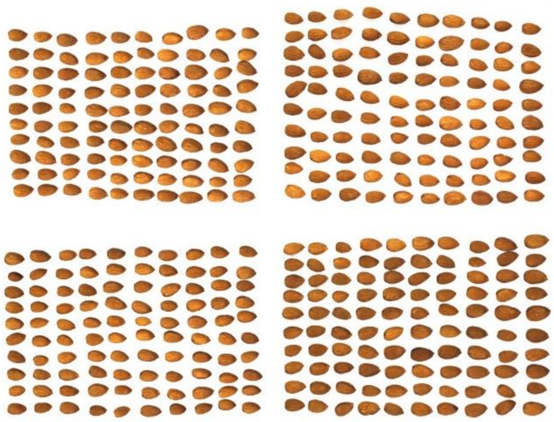

Figure 8. A sample of 400 nuts from the plants treated with Transit Silicate were examined for insect damage. No insect damage was found.

Figure 9. A sample of 400 nuts from the control plants were examined for insect damage. Only one nut with insect damage was found.

Conclusion

The results from this study clearly show that Transit Silicate applied as fertigation increases the yield of almonds and increases plant foliar nutrient concentrations. Transit Silicate effectively demonstrated that:

- Plants treated with Transit Silicate had increased nutrients in their leaves.
- Yields can be improved by the application of Transit Silicate through an increase in kernel weight.
- Transit Silicate increases outturn and was calculated to be an increase of 1.5% in the almond trees treated with Transit Silicate compared to the control.

The effect of Transit Silicate in improving pest resistance is unable to be determined from this study, due to the low levels of pests found during this season, so further study is needed to assess this factor.

References

1. Wang, S. Y., and G. J. Galletta. "Foliar application of potassium silicate induces metabolic changes in strawberry plants." *Journal of Plant Nutrition* 21.1 (1998): 157-167.
2. Glare, Travis R., and Maurencoaut O'callaghan. Bacillus thuringiensisbiology, ecology and safety. No. 632.951 G5. 2000.
3. Lewin, Joyce, and Bernard EF Reimann. "*Silicon and plant growth*." Annual Review of Plant Physiology 20.1 (1969): 289-304.