Evaluation of the efficiency of Complete Blend 10 DC for improving plant nutrient status and yield in almonds

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Maintaining macro and micro nutrients at the ideal level is critical to achieving the best yield for almond crops[1]. Correct nutrient levels are vital during the active growth and nut development stages, ensuring maximum productivity from every plant[2], [3]. Combinations of both macro and micro nutrients are necessary for a large handful of plant processes. Chlorophyll biosynthesis and photosynthesis is increased through nitrogen, magnesium and iron. Enzyme activation, protein synthesis and plant hormone production such as auxin are also increased through copper, boron and zinc elements. Levels of energy storing molecules and macro molecules such as sugars, starches, oils, fats and vitamins are all heightened with correct macro and micro nutrient availability. Together, these micro and macro nutrients enhance yields and overall growth.

Key Words: Macronutrients, micronutrients, increased productivity and yields, enhance overall growth.

Introduction

Macro and micro nutrients play significant roles in increasing plant production and overall health. Complete Blend 10 DC is a fertilizer formulation containing: Nitrogen (12%), Phosphorus (8%), Potassium (1.4%), Sulfur (5%), Manganese (1.7%), Magnesium (2%), Zinc (1.7%), Copper (0.8%), Boron (0.2%), Iron (1%) and biologically active organic molecules (BAOM) 1%. This study aims to evaluate the effectiveness of a single application (soon after fruit set) of macro and micro nutrients through Complete Blend 10 DC, towards improving plant nutrient status and almond crop yield.

Objectives

The specific objectives of this study are:

1. Evaluate the effect of fertigation with Complete Blend 10 DC on the nutrient status of almonds.
2. Evaluate the effect of fertigation with Complete Blend 10 DC on the yield parameters of almonds.

Materials and Methods

Site Selection and Trial design

This trial employed a randomized block design with three replications. Commercial fertigation was applied across the orchard with Complete Blend 10 DC soon applied after fruit set. The application of Complete Blend 10 DC was an addition to the orchard's usual fertigation program. Seven trees, each from two rows, were isolated using drip line taps and were considered as control trees. Seven trees, each from two adjacent rows, were considered as treated replicates. This was replicated at three different sites in the same block, and repeated in a total of four different blocks across the orchard.

Treatment and Application Rate

Table 1: Treatment rates of Complete Blend 10 applied to almond trees

Treatment	Rate/ha	Application timing
Control	0	
Complete Blend 10 DC	30 L/ha	Shortly after fruit set

Observations

Leaf nutrient analysis

At the 'hull split' development stage, twenty leaves per plant were collected from each almond tree in both the control and treatment groups. These leaves were washed and then analysed at Analytical Laboratories and Technical Services Australia, Victoria for the presence of: Nitrogen, Phosphorus, Potassium, Sulfur, Calcium, Magnesium, Sodium, Alminium, Boron, Copper, Iron, Magnanese, Zinc, Silicon and Molybdenum.

Kernel Weight, Hull weight and Nut Weight.

Fifty nuts from each of the seven trees in each row were collected (ie. 350 per row). This was done for every row in both the control rows and the rows treated with Complete Blend 10 DC.

A 0.50 metre transect of whole nuts was collected from each row and the resulting nut weight and kernel weight 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 with a P value <0.15 was considered to be significant.

Results

Figures 1 and 2 show the visual difference between the control and treated trees and nuts fertigated with Complete Blend 10 DC, shortly before harvest. It can be seen that the plants treated with Complete Blend 10 DC appeared to have greater canopy coverage and more nuts per tree.

Figure 1. A) control tree at harvest. B) control nut at harvest

Figure 2. A) Complete Blend 10 DC treated trees. B) Complete Blend 10 DC treated nuts at harvest

The whole nuts collected from the trees treated with Complete Blend 10 DC weighted 2.05% more than those collected from the control trees. This was found to be statistically significant (Figure 3).

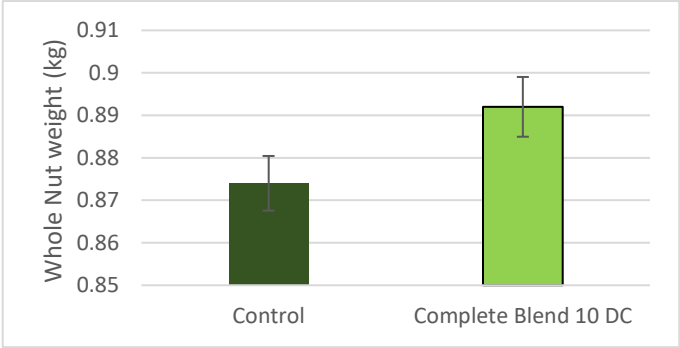

Figure 3. Whole nut weight collected from trees with reference to Complete Blend 10 DC vs Treatment. Each bar represents mean ± SE. A t-test was performed to determine the significant difference between the control Vs treated, different superscripts show significant difference ($P<0.15$). The t-test was performed with Prism 7 (Graph Pad Software).

Figure 4 shows the kernel weight from the nuts collected from the trees. The Complete Blend 10 DC treated trees had an increased kernel weight of 2.69% compared to that of the control tree kernels. This change was considered to be statistically significant.

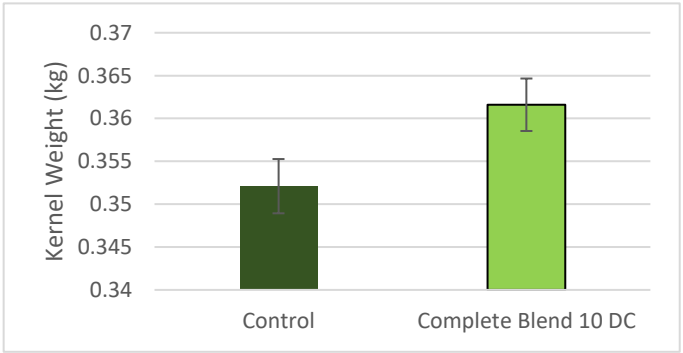

Figure 4. Kernel Weight collected from trees with reference to Control vs Complete Blend 10DC. Each bar represents mean ± SE.

A 50cm transect of whole nuts was collected from the ground to estimate yield. It was found that the transects from Complete Blend 10 DC had a 5.31% higher whole nut weight compared to the control (Figure 5). This change was considered to be statistically significant.

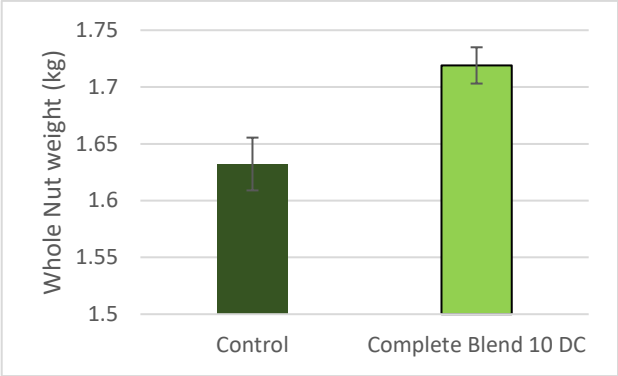

Figure 5. Whole nut weight collected from 50cm transect off ground with reference to Control vs Complete Blend 10 DC. Each bar represents mean ± SE. A t-test was performed to determine the significant difference between the control Vs treated, different superscripts show significant difference (P<0.15). The t-test was performed with Prism 7 (Graph Pad Software).

Outturn was increased by 1.9% with the application of Complete Blend 10DC, compared to the control (Figure 6). Outturn was calculated as the percentage of kernel weight to nut weight.

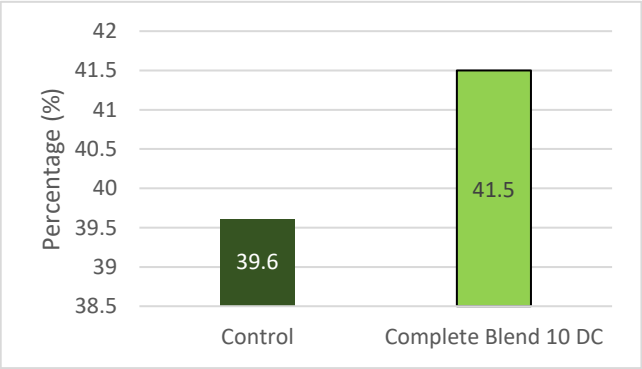

Figure 6. The outturn for Complete Blend 10 DC as compared to that of the control.

One hundred (100) kernels from both the control and Complete Blend 10 DC treated samples were weighed. It was found that, the Complete Blend 10 DC treated trees produced kernels which were 6.8% heavier than the control kernels (Figure 7). This difference was considered to be statistically significant.

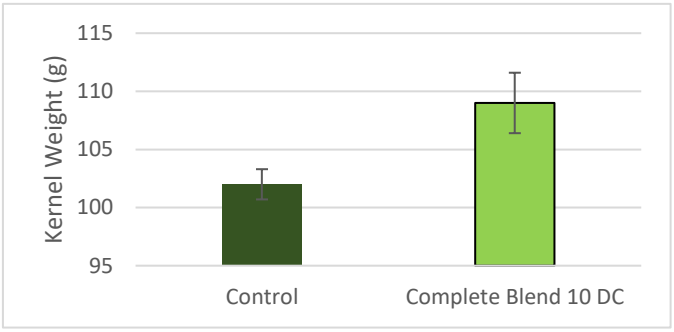

Figure 7. Weight of 100 kernel samples collected from trees with reference to Control vs Complete Blend 10 DC. Each bar represents mean ± SE. A t-test was performed to determine the significant difference between the control vs treated, different superscripts show significant difference (P<0.15). The t-test was performed with Prism 7 (Graph Pad Software).

Figure 8 shows the nutrient level percentage concentrations in the leaves for the Complete Blend 10 DC compared to the control. In general, the leaves treated with Complete Blend 10 DC had higher levels of nutrients in the leaves – with the results for Calcium, Carbon, Sulphur and Magnesium considered to be significant.

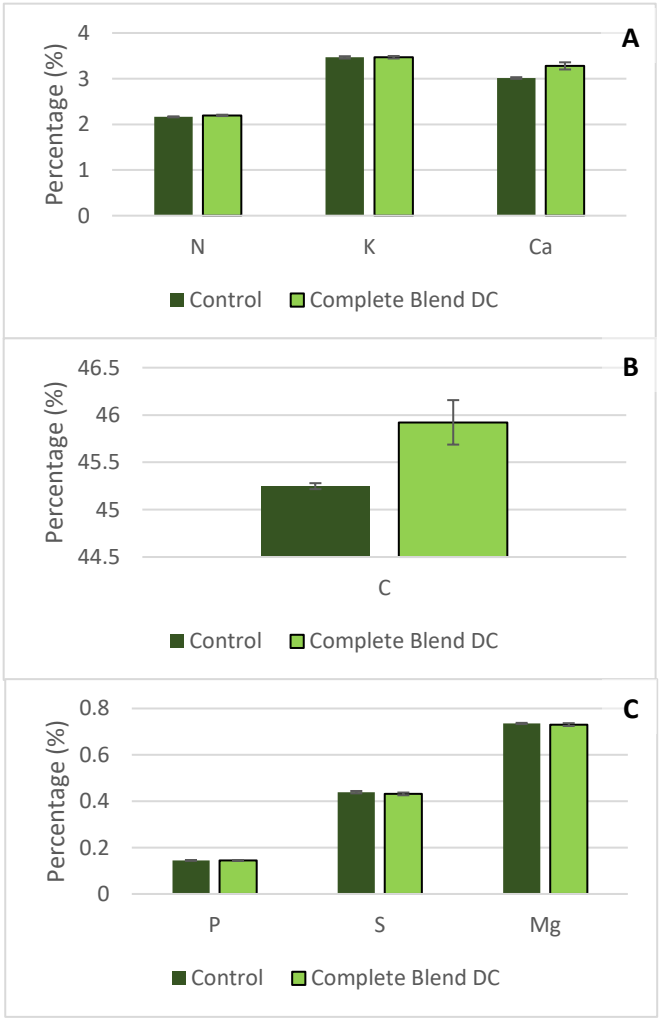

Figure 8. The effects of Complete Blend 10 DC on the nutrient levels in leaves compared to the control.

Figure 9 shows nutrients levels (in parts per million) found in the leaves of sampled almond trees. The results for Boron, Copper, Molybdenum, Manganese and Silicon were found to be significant. In general, leaves from trees treated with Complete Blend 10 DC had higher levels of nutrients than control trees - apart from Boron and Copper. Boron and Copper are both considered essential micronutrients for plant growth. Even though the levels where lower than the control they were still considered to be within the normal range for healthy plant growth.

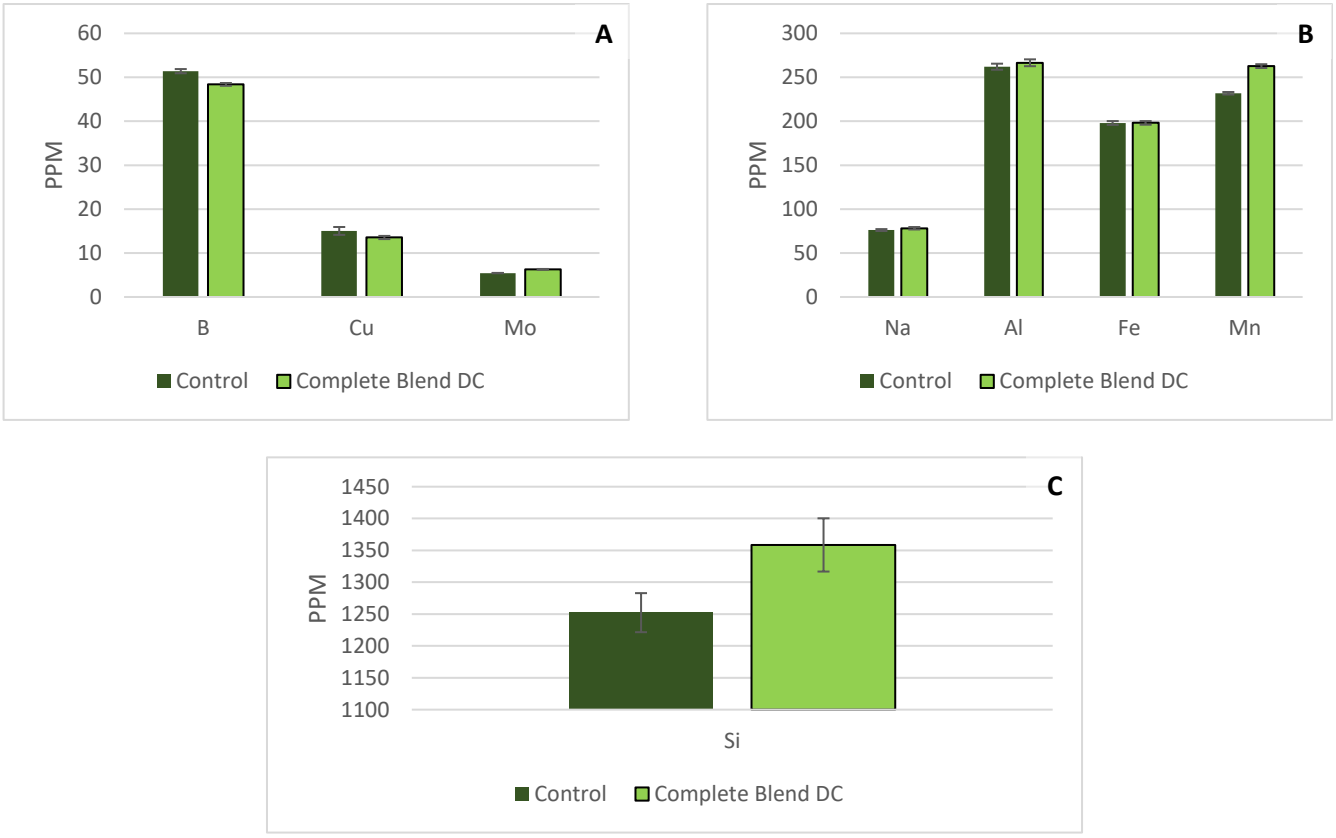

Figure 9. The effects of Complete Blend 10 DC of the nutrient levels in leaves compared to the control. A t-test was performed to determine the significant difference between the control vs treated, different superscripts show significant difference ($P<0.15$). The t-test was performed with Prism 7 (Graph Pad Software).

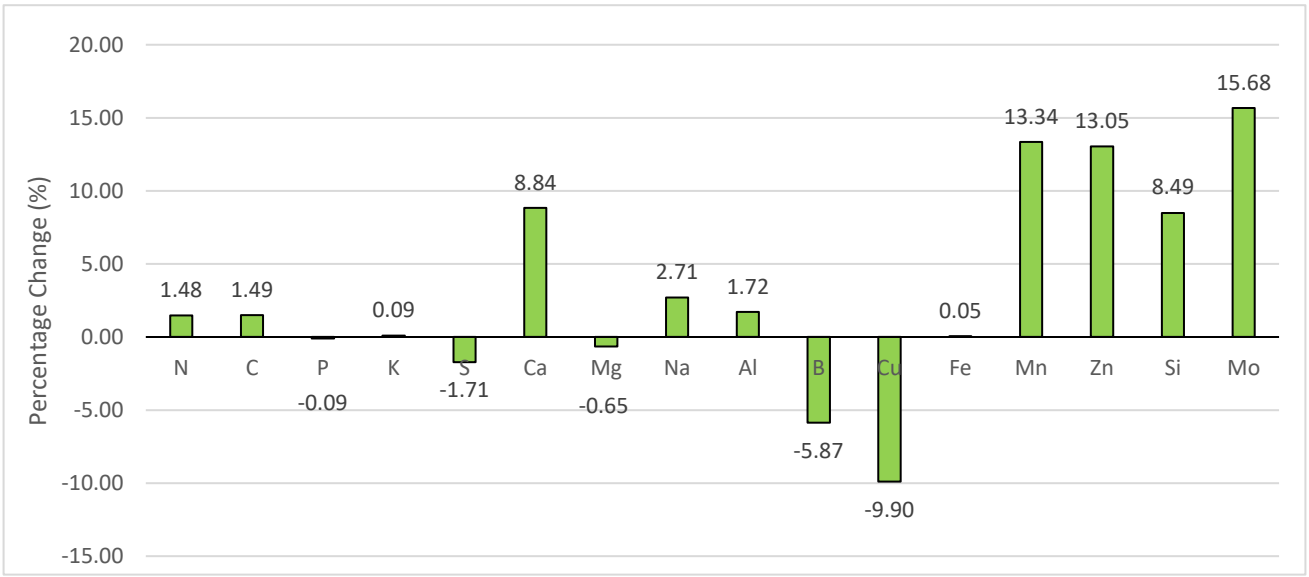

Figure 10. The percentage change the nutrient uptake in Complete Blend 10DC, compared to that of the control.

Canopy vigour could be seen to improve with the application of Complete Blend 10 DC, when compared to the control trees in adjacent rows (Figure 11). Control plants (column A) have less leaves on the trees and the leaves have begun turning yellow earlier compared to the trees treated with Complete Blend 10 DC (Column B). These pictures were taken post-harvest.

Figure 11. Post-harvest picture of almond tree canopies. Column A is the control trees and column B is the trees treated with Complete Blend 10 DC. These pictures were taken post-harvest in four different blocks – with control and treated pictures for each row matched from adjacent rows in the same block.

Discussion and Conclusion

This study into the efficiency of Complete Blend 10 DC in increasing almond yields and physiological growth shows that when applied to almonds soon after fruit set, via fertigation, Complete Blend 10 DC has the ability to increase almond yields and plant foliar nutrients. More specifically:

- Plants treated with Complete Blend 10 DC had increased nutrient concentrations in leaves, in particular micro elements such as Zinc, Iron, Molybdenum and Manganese.
- The nut yield over a 50cm transect was increased by 5.31% when Complete Blend 10 DC was applied.
- Outturn for trees treated with Complete Blend 10 DC increased by 1.9%.
- Trees treated with Complete Blend 10 DC had an increased canopy both during harvest and post-harvest compared to the control trees.

From this study it is clearly shown that complete Blend 10 DC is an effective way to increase orchard productivity, by increasing both the nutrient status of the plants and improving canopy vigour and to ensure plants achieve optimal nutrient during critical stages of growth, which leads to an increase in yield.

References

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