Consume-it

ProSol AGRI™

Water Additive

Effect on Avocado Nursery Tree Growth

First Research Report | 2019

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Schagen Nursery • Mpumalanga • 5-Month Trial • 'Hass' / Clonal 'Bounty' Rootstock

Study Overview & Methodology

Location	Schagen Nursery, ~20 km west of Nelspruit (Mpumalanga)
Plant material	'Hass' avocado grafted on clonal 'Bounty' rootstocks
Grafting date	Mid-May 2019
Container	7-litre black plastic bags, composted pine bark medium
Trial design	Randomized pseudo-block, 10 replicates × 6 data trees
Duration	5 months of continuous application
Application	Hand-watered 2× per week at 1:10 000 dilution ratio
Control	Clean water + standard nursery fertilizer

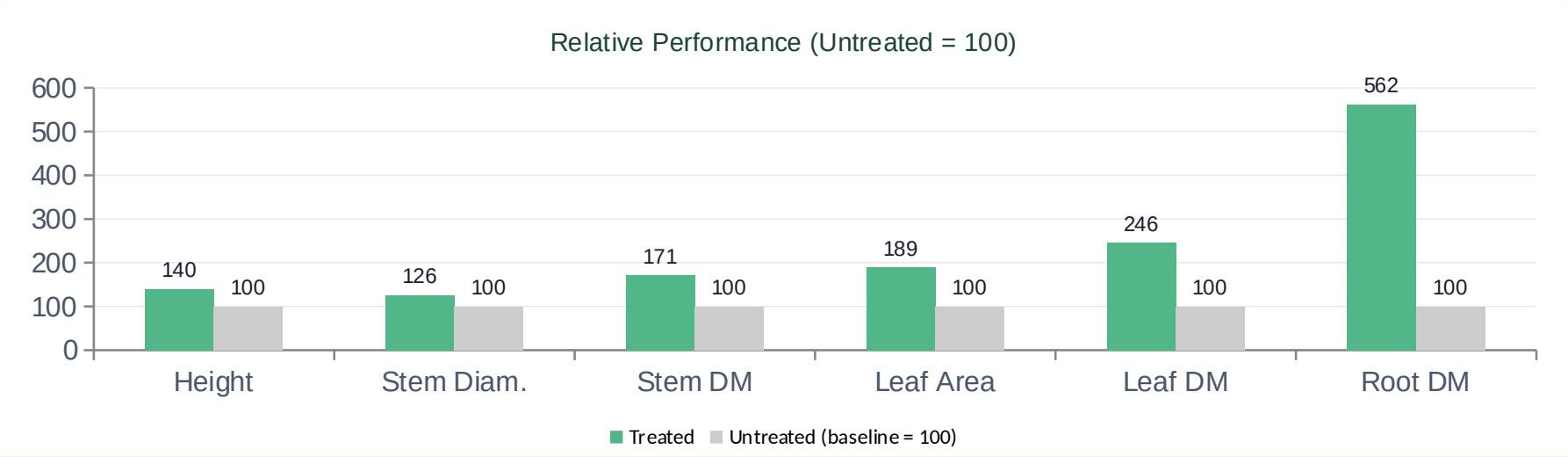
Statistical analysis: GenStat v14 (ANOVA); significance threshold $P < 0.05$

Measurements Taken

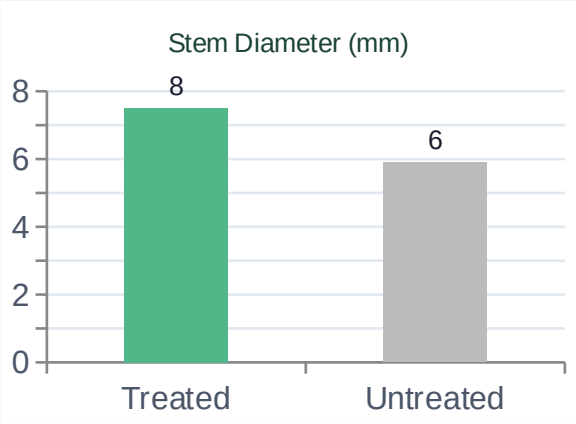
- Tree height
- Stem diameter
- Internode length
- Leaf size & area
- Leaf, stem & root dry mass
- Tree nutrient levels
- Growth medium nutrients

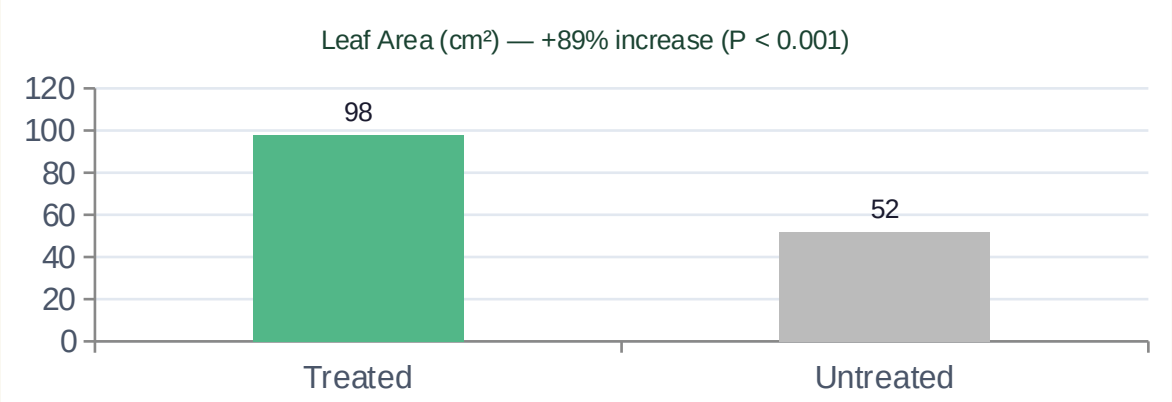
Key Results at a Glance

+40%	+26%	+71%	+89%	+146%	+462%
Tree Height	Stem Diameter	Stem Dry Mass	Leaf Area	Leaf Dry Mass	Root Dry Mass



Above-Ground Growth – Height, Stem & Leaves





Leaf Growth

+42%	Leaf Length
+35%	Leaf Width
+89%	Leaf Area
+146%	Leaf Dry Mass
+40%	More Leaves (14 vs 10 per tree)

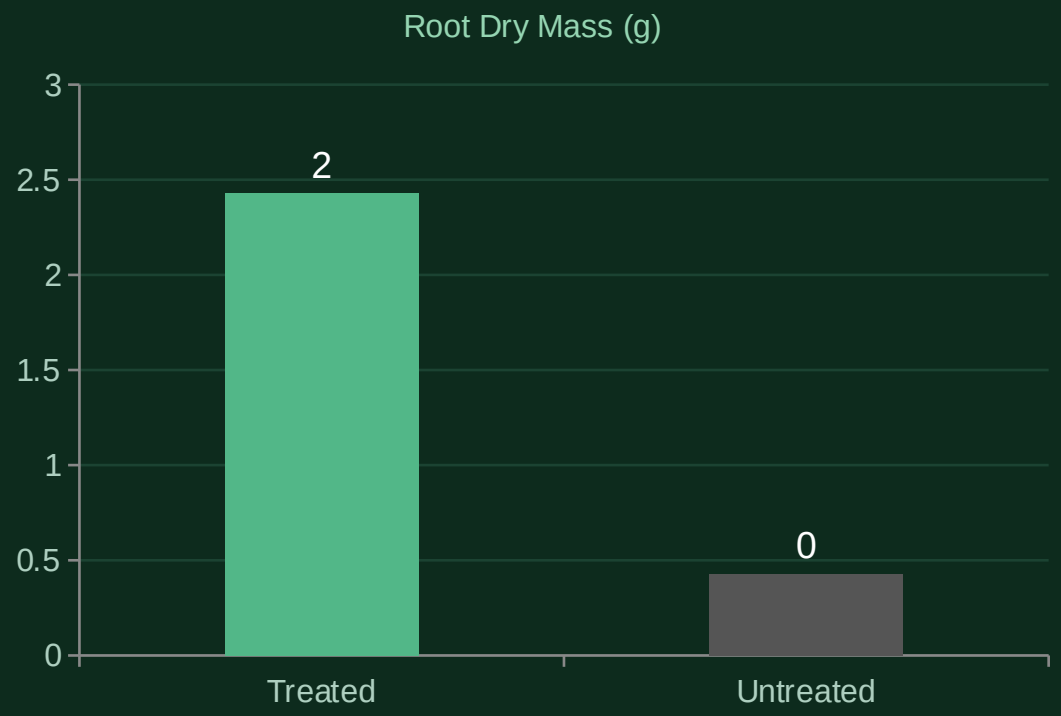
Root Growth — The Most Dramatic Effect

+462%

Root Dry Mass Increase

P < 0.001

~2.43g (treated) vs ~0.43g (untreated)



Root ball of treated trees fully filled the bag volume — visually confirmed before harvesting. Larger root mass improves establishment when transplanted to the field.

Nutrient Status — Plants & Growth Medium

Significant Nutrient Changes (P < 0.05)	
Stems – Nitrogen	Higher in treated
Stems – Boron	Higher in treated
Leaves – Boron	Lower in treated
Leaves – Manganese	Lower in treated
Roots – Boron	Higher in treated
Medium – Nitrogen	Higher in treated

Key Takeaways

Boron redistribution

Prosol Agrigrow altered boron translocation — higher in stems & roots, lower in leaves. Warrants further study.

No metal toxicity

All nutrient levels remain within safe norms for avocado. No risk of phytotoxicity.

No heavy metal build-up

Zinc, copper & iron trends higher in medium but not statistically significant. Low accumulation risk.

Zinc & copper effect

These Prosol Agrigrow components are known to boost photosynthesis, contributing to growth gains.

Conclusions & Future Research

Vigorous Growth

Prosol Agrigrow significantly improved overall nursery tree vigor: taller, thicker-stemmed trees with more leaves.

Photosynthetic Capacity

89% larger leaf area + more leaves per tree → greater carbohydrate production and energy for growth.

Exceptional Root Mass

462% increase in root dry mass is the standout result, suggesting dramatically improved establishment potential.

Safety Confirmed

No heavy metal toxicity or significant accumulation in the growth medium. Nutrient levels within safe norms.

Future Research Directions

• Test dilutions: 1:50 000 / 1:100 000 / 1:150 000 / 1:200 000 / 1:250 000 • Extend to other nurseries nationally • Test efficacy against Phytophthora cinnamomi and other nursery diseases • Evaluate as eco-friendly alternative to chlorine/peroxide disinfectants

PROSOL AGRIGROW

ADDENDUM

Original Research Report

The effect of Prosol Agrigrow (water additive)

on the growth of avocado trees in the nursery

N.J.R. Roets & I.J. Froneman | ARC Tropical & Subtropical Crops | 2019

The effect of Prosol Agrigrow (water additive) on the growth of avocado trees in the nursery

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Aim: To determine the effect of Prosol Agrigrow on the growth of avocado trees in the nursery

Materials and Methods

This trial was carried out at the Schagen Nursery of the Fruit Farm Group approximately 20 km west of Nelspruit (Mbombela) in Mpumalanga. This nursery is situated in one of the major avocado cultivation areas in the country. The planting material used for this study was 'Hass' avocado trees grafted on clonal 'Bounty' rootstocks. All trees were grafted during mid-May 2019. The trees were planted in 7 liter black plastic bags in a composted pine bark growth medium. This medium was tested prior to planting to be free of diseases. The trial was laid out in a randomized pseudo-block design, with two treatments, consisting of ten replicates per treatment and six data trees per replicate. The treatments were a Prosol Agrigrow water additive treatment and an untreated control. The treated trees were hand watered with Prosol Agrigrow two times a week. A dilution ratio of 1:10 000 (Prosol Agrigrow: water) was used. Untreated trees were watered with clean water and given the standard nursery fertilizer application. After five months of application, the following data was collected: tree height, stem diameter, internode length, leaf size and area, leaf, stem and root dry mass, tree nutrient levels and nutrient levels of the growth medium. For tree and growth medium nutrient levels, the leaf, stem and root material and the medium were first digested. Levels of all nutrients, except nitrogen, phosphorus and boron were determined using atomic absorption spectrometry. Levels of nitrogen, phosphorus and boron were determined colorimetrically. All data was analyzed using GenStat (version 14, 2010) statistical software, with the two treatments being compared using analysis of variance. Treatments were regarded as statistically significantly different when $P < 0.05$.

Results and Discussion

It was clearly evident that the Prosol Agrigrow significantly improved the vigour of nursery avocado trees (Figure 1). It can be seen in Figure 1 that the treated trees were substantially taller and had larger leaves. In this instance, the application of Prosol Agrigrow resulted in a

40% increase in tree height (Figure 2 A). Trees were not only taller, but had thicker stems as well, in which case the Prosol Agrigrow resulted in a 26% increase in stem diameter (Figure 2 B). Although the treated trees were taller, internode length was not significantly affected by the treatment (Figure 2 C), but treated trees had significantly more nodes (P = 0.01) and therefore significantly more leaves than the untreated trees. The mean number of leaves for the treated trees were 14 leaves per tree, while being 10 leaves for the untreated trees. As a result of the more vigorous growth of the treated trees, stem dry matter content was increased by 71% when compared to the untreated trees (Figure 2 D).

Figure 1: Visual effect of Prosol Agrigrow on the growth of nursery avocado trees (treated trees left and untreated trees right)

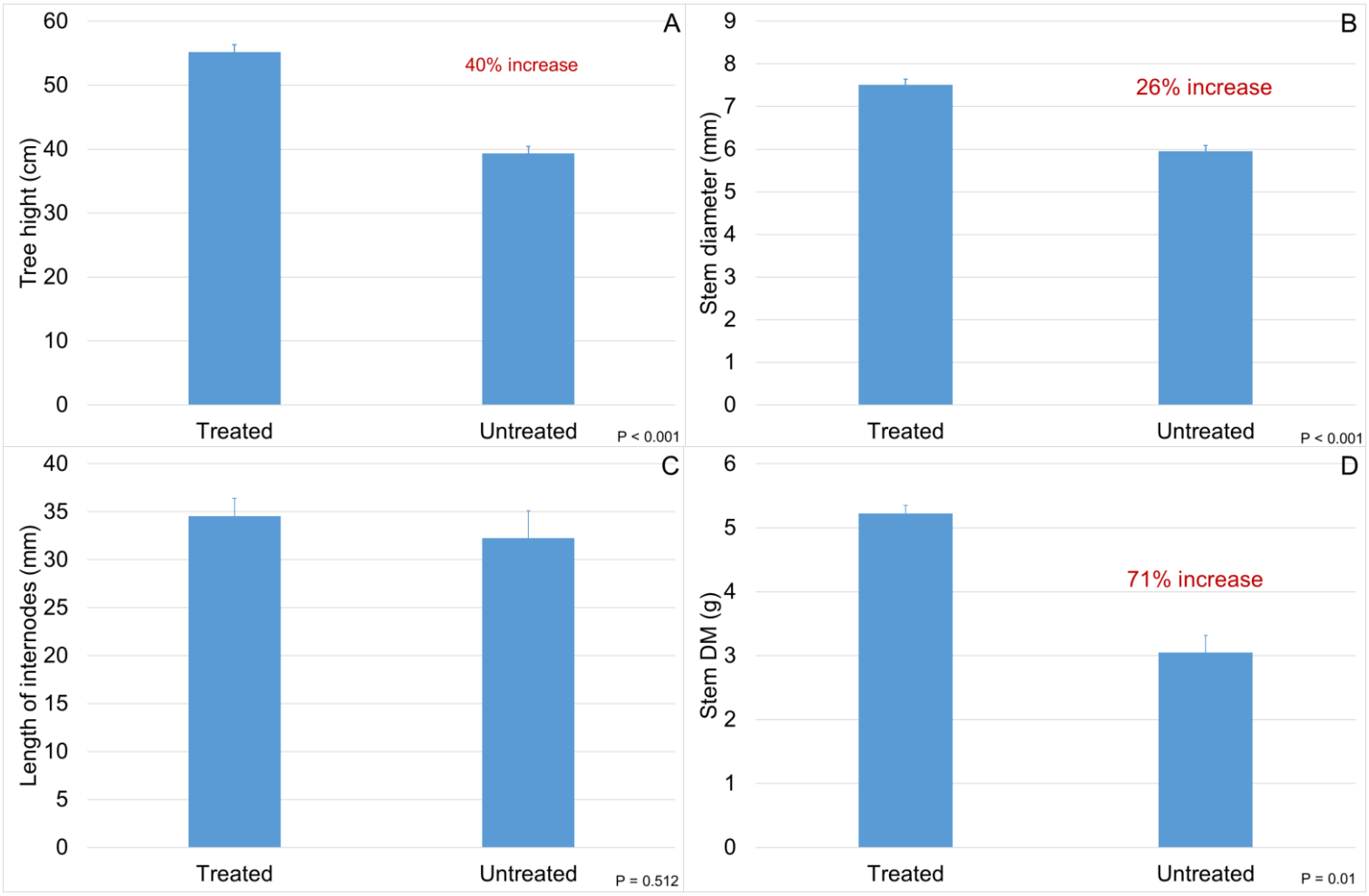

Figure 2: The effect of Prosol Agrigrow on the growth of avocado nursery trees, with A) tree height, B) stem diameter, C) internode length, and D) stem dry mass

As seen in Figure 1, the application of Prosol Agrigrow had a significant effect on leaf growth of avocado nursery trees. Both the length and the width of the leaves of the nursery trees were increased by 42 and 35% respectively (Figure 3 A and B). As a result of that leaf area was increased with 89% (Figure 3 C). The larger leaves resulted in a dry matter content increase of approximately 146% (Figure 3 D). Due to the larger leaf area and higher number of leaves per tree of the treated trees, it can be expected that the treated trees are more productive than the untreated trees. This is because of the higher photosynthetic area of the treated trees that may result in higher production of carbohydrates and energy for the treated trees. In addition, components in the Prosol Agrigrow (especially zinc and copper) is known to increase photosynthesis of the trees.

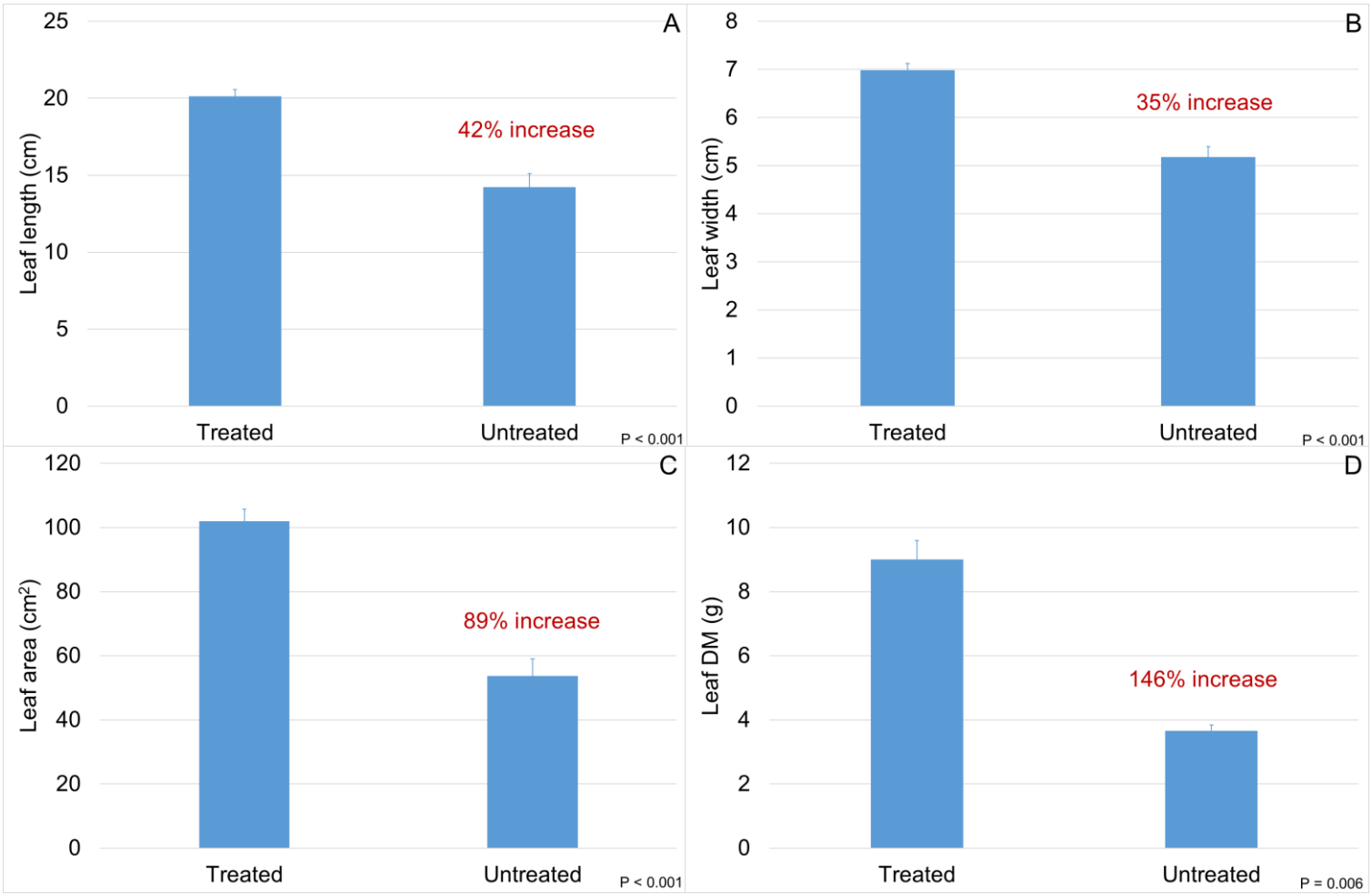

Figure 3: The effect of Prosol Agrigrow on leaf growth of nursery avocado trees, with A) leaf length, B) leaf width, C) leaf area, and D) leaf dry matter content

The Prosol Agrigrow had a significant effect on root growth of avocado nursery trees. It can be seen that the root mass was increased significantly by the Prosol Agrigrow treatment. It could visually be seen that the root ball of the trees treated with Prosol Agrigrow already filled the volume of the bag (Figure 4 A), while it was not the case for the untreated trees (Figure 4 C). Once the roots were removed from the trees and the growth medium, it could be seen that the root ball mass volume occurred much larger for the treated trees (Figure 4 B), compared to the untreated trees (Figure 4 D). Once all roots were dried and weighed, it was found that the increase in root dry mass was approximately 462% (Figure 5). It is therefore clear that Prosol Agrigrow caused much more vigorous growth of avocado trees in the nursery.

Figure 4: The visual effect of Prosol Agrigrow on root growth of nursery avocado trees (A and B: roots of treated trees, and C and D: roots of untreated trees

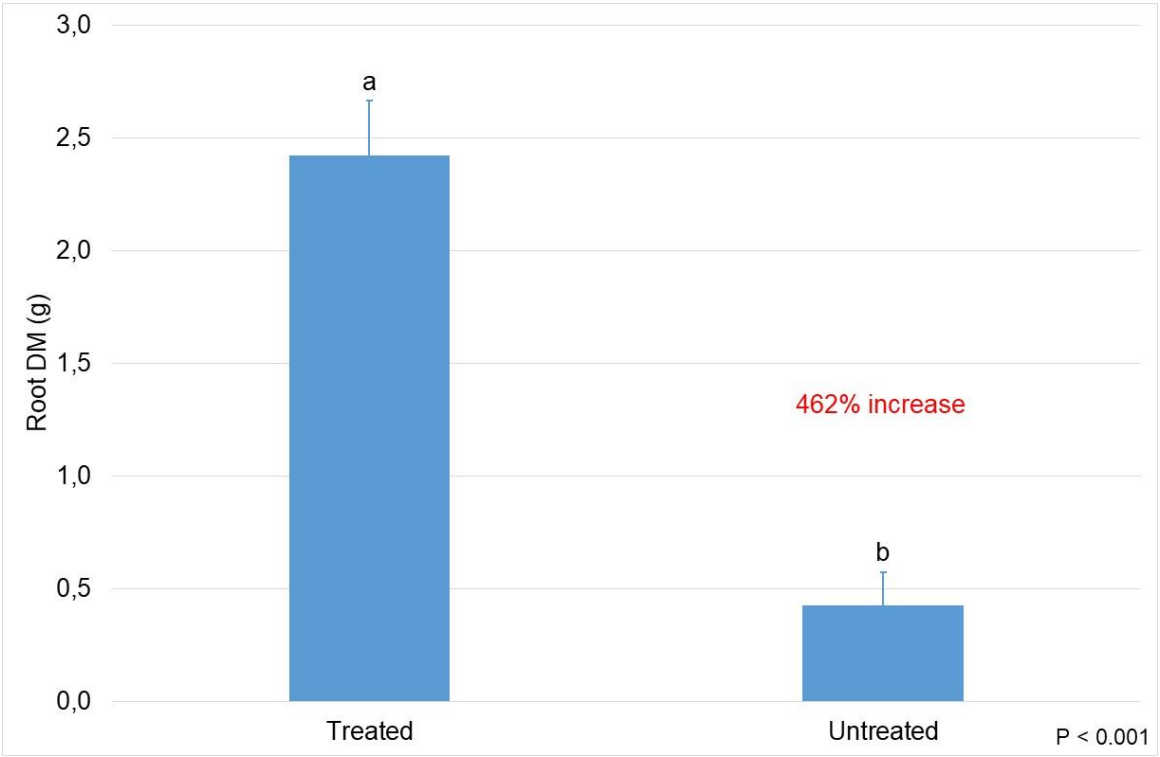

Figure 5: The effect of Prosol Agrigrow on root dry mass avocado nursery trees

Nitrogen and boron levels were found to be significantly higher in the stems of treated trees compared to stems of untreated trees (Table 1). Levels of other nutrients in the stem were not significantly affected by the Prosol Agrigrow treatment (Table 1). Boron and manganese content in the leaves were significantly affected by Prosol Agrigrow treatment. In this instance the boron and manganese levels in the leaves for the treated trees were significantly lower than the untreated trees (Table 2). The boron levels in the roots were affected by the Prosol Agrigrow treatment. In this instance, the boron levels in the roots of treated trees were significantly higher than in the roots of untreated trees (Table 3). The results clearly indicate that the Prosol Agrigrow treatment altered the translocation of boron in the plant, but this would need further investigation and clarification. It is also important to note that the levels of nutrients are well within the norms for avocado trees and that there is therefore no evidence of metal toxicity in the plants.

Table 1: The effect of Prosol Agrigrow on the nutrient status of the stems of nursery avocado trees

Nutrient	Treated	Untreated	P - value
Nitrogen (%)	1.60 ± 0.025	1.41 ± 0.013	0.037**
Phosphorus (%)	0.22 ± 0.018	0.21 ± 0.008	0.312
Potassium (%)	1.73 ± 0.113	1.88 ± 0.112	0.557
Calcium (%)	0.44 ± 0.032	0.51 ± 0.043	0.455
Magnesium (%)	0.36 ± 0.010	0.40 ± 0.010	0.130
Zinc (mg/kg)	40.0 ± 3.21	37.3 ± 2.40	0.589
Cu (mg/kg)	5.0 ± 0.58	9.3 ± 1.20	0.039**
Manganese (mg/kg)	286.3 ± 24.13	260.7 ± 30.80	0.575
Iron (mg/kg)	48.7 ± 0.67	68.3 ± 11.39	0.237
Boron (mg/kg)	106.3 ± 5.83	44.9 ± 1.79	0.015**

*** Indicate significant difference at the 95% confidence level*

Table 2: The effect of Prosol Agrigrow on the nutrient status of the leaves of nursery avocado trees

Nutrient	Treated	Untreated	P - value
Nitrogen (%)	2.83 ± 0.086	2.95 ± 0.114	0.157
Phosphorus (%)	0.28 ± 0.016	0.26 ± 0.016	0.091
Potassium (%)	1.51 ± 0.037	1.41 ± 0.059	0.214
Calcium (%)	0.73 ± 0.045	0.91 ± 0.055	0.050
Magnesium (%)	0.50 ± 0.029	0.61 ± 0.035	0.070
Zinc (mg/kg)	35.6 ± 1.40	37.8 ± 2.14	0.106
Cu (mg/kg)	13.4 ± 1.25	19.8 ± 3.20	0.058
Manganese (mg/kg)	862.6 ± 15.21	957.0 ± 24.59	0.006**
Iron (mg/kg)	91.2 ± 8.21	109.5 ± 10.84	0.076
Boron (mg/kg)	116.0 ± 4.45	123.8 ± 6.15	0.039**

*** Indicate significant difference at the 95% confidence level*

Table 3: The effect of Prosol Agrigrow on the nutrient status of the roots of nursery avocado trees

Nutrient	Treated	Untreated	P - value
Nitrogen (%)	3.03 ± 0.290	3.54 ± 0.520	0.642
Phosphorus (%)	0.18 ± 0.017	0.27 ± 0.027	0.297
Potassium (%)	2.97 ± 0.255	3.38 ± 0.175	0.515
Calcium (%)	0.20 ± 0.005	0.19 ± 0.005	0.500
Magnesium (%)	0.28 ± 0.006	0.51 ± 0.205	0.461
Zinc (mg/kg)	64.5 ± 0.50	72.5 ± 7.50	0.458
Cu (mg/kg)	7.0 ± 0.001	8.0 ± 1.00	0.500
Manganese (mg/kg)	853.5 ± 96.50	645.0 ± 9.00	0.298
Iron (mg/kg)	383.5 ± 24.50	354.5 ± 61.50	0.577
Boron (mg/kg)	122.0 ± 2.85	47.0 ± 15.70	0.015**

*** Indicate significant difference at the 95% confidence level*

Considering nutrient build-up in the growth medium, it is evident from Table 4 that higher levels of nitrogen occurred in the growth medium. For the treated growth mediums, nitrogen content was 23.36 mg/L, while 7.29 mg/L for the untreated growth mediums. Zinc, copper and iron also tended to be higher, but the differences were not statistically significant (Table 4). All other elements, conductivity and the pH of the growth medium were not affected by the

application of Prosol Agrigrow (Table 4). There is therefore a low risk of heavy metal accumulation and heavy metal toxicity when applying Prosol Agrigrow in the nursery.

Table 4: The effect of Prosol Agrigrow on the accumulation of heavy metals in the nursery growth medium

Element	Untreated	Treated	P
pH	4.39 ± 0.06	4.50 ± 0.08	0.576
Conductivity (mS/m)	54.40 ± 6.90	53.40 ± 2.60	0.933
Nitrogen (mg/L)	7.29 ± 1.78	23.36 ± 5.31	0.026**
Phosphorus (mg/L)	13.14 ± 1.74	9.12 ± 1.30	0.071
Potassium (mg/L)	58.20 ± 6.14	52.83 ± 5.78	0.041**
Calcium (mg/L)	14.03 ± 1.21	9.39 ± 1.80	0.365
Magnesium (mg/L)	6.89 ± 0.23	5.57 ± 1.10	0.374
Zinc (mg/L)	0.03 ± 0.00	0.07 ± 0.01	0.090
Copper (mg/L)	0.01 ± 0.00	0.02 ± 0.00	
Iron (mg/L)	1.10 ± 0.44	6.37 ± 2.68	0.339
Manganese (mg/L)	0.62 ± 0.03	0.56 ± 0.18	0.758
Boron (mg/L)	0.37 ± 0.22	0.28 ± 0.09	0.620
Sodium (mg/L)	9.48 ± 3.53	8.18 ± 0.66	0.760
Chlorine (mg/L)	8.29 ± 3.72	9.70 ± 0.50	0.796

*** Indicate significant difference at the 95% confidence level*

Conclusions and Future Research

This is the first report on Prosol Agrigrow demonstrating the potential of this product in the nursery to improve the growth and therefore the turnover of nursery trees. The use of Prosol Agrigrow in water resulted in a significant improvement in tree growth. Trees were larger, with larger leaves, thicker stems and larger root masses. With the exception of boron, Prosol Agrigrow did not have a major effect on nutrient levels and nutrient distribution in the plant and no heavy metal toxicity occurred. Heavy metals were also not found to accumulate in the growth medium. For this study the Prosol Agrigrow was applied at a relatively high concentration of 1:10 000. It is, however, not certain if this concentration is optimal. It might be possible to lower the ratio and future trials will include dilution ratios of 1:50 000, 1:100 000, 1:150 000, 1:200 000 and 1:250 000. It is further important to extend this study to other avocado nurseries in the country to gather sufficient data to enable accurate recommendations. The Prosol Agrigrow will further be tested for its efficacy to control *Phytophthora cinnamomi* and other diseases that might occur in the nursery as a possible

more environmentally friendly alternative to the chlorine and peroxide based products that are currently used in nurseries as disinfectants.