

## Case Study

### Trial of S-Chelate-O 12\* on growth of avocados

## Summary

The purpose of this trial was to test the efficacy of the S-Chelate biologically friendly chelation technology with a comprehensive package of 9 micro and secondary nutrients and the 3 main macronutrients <https://www.s-chelate.com/wp-content/uploads/2020/08/S-Chelate-O-12-Star-product-data.pdf>

Therefore the S-Chelate-O 12\* was compared with:

- 1. Product X** – A well known brand of NPK fertiliser, incorporating conventional, bio-accumulative chelated micronutrients
- 2. Product Y** – A second well known branded NPK fertiliser incorporating seaweed extracts
- 3. Tap water** – as a control

49 avocado stones were started over a 6 month period and the results showed S-Chelate-O 12\* to be measurably more effective in every aspect of growth:

- germination
- development of roots
- stem growth
- leaf growth

The results shown below are based upon the 22 trials that had emerged by the 30th May 2020. In fact a 7 further stones were trialled in distilled water, but in the absence of any nutrients none had emerged by 30th May.

## Background

As illustrated on the website <https://www.s-chelate.com/foiar-s-chelate-m-squared-potato-trials-2013/>, our S-Chelate product range has been shown to provide enhanced growth for a number of plant types. In particular they are being used commercially with great success for the amenity, mainly golf course, market.

Previously, various trials have combined conventional, commercially available nutrients with our S-Chelate products, as described on our website. This meant we could not control the whole package of nutrients being trialled and results were often hit and miss.

For this reason primarily we created a complete plant feed, **S-Chelate-O 12\***, to provide a controlled package of nutrients. However, this also has resulted in an 'all in one' plant nutrition and growth stimulus which we plan to offer to the amateur grower and horticultural markets.

We then required a small scale plant trial method to compare **S-Chelate-O 12\*** with established commercial products to test the efficacy of our new formulation and to guide further product development. To that end we elected to trial the product by measuring its effect upon the growth of avocado plants and comparing with the growth resulting from two well known competitor plant feed products, which we have called X and Y, and with tap water alone. Details of the declared nutrient analysis of each product are given in appendix A.

Avocados were selected for the trial because we had a ready supply of avocado stones and we knew that growing avocados from stones can be challenging.

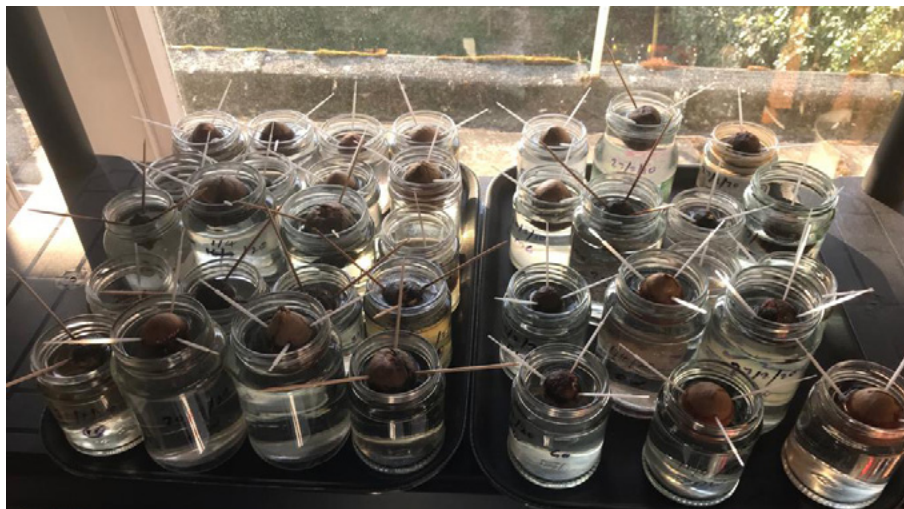
The start dates for each trial varied over a 6 month period from 1st October 2019 through to 11th April 2020 with our primary concern being the time taken to measure the various stages of growth for each nutrient medium used.

The **S-Chelate-O 12\*** is based on the original S-Chelate Cultiv-8 formula with the addition of S-Chelate Ca and NPK resulting in the 12 element **S-Chelate-O 12\*** complete feed. This was tested against tap water and two well established commercial products called here X and Y. Details of the declared nutrient analysis of each product are given in appendix A.

## The Experiment and Results

### STAGE 1 – THE START

Avocado stones were mounted with cocktail sticks and immersed in the various test media in small glass jars as shown below, and the start date noted. Details of all the dates associated with each trial are provided in the accompanying Excel file [<Link to Excel file>](#)



Avocado stones mounted in test media

Fungal growth appeared on the non-immersed parts of the stones so they were brushed clean every two weeks under tap water and the medium was renewed. They were also inspected at these times for stone splitting due to root germination.

## STAGE 2 – GERMINATION

Plants were checked regularly for any root growth and potted when germination was evident and the date noted. The average number of days from start to germination was significantly quicker for those products which were tested in the S-chelate solution than in the other product solutions:

Test Solution	Average Days
S-C	32.8
X	44.6
Y	48.0
Tap water	65.7
<b>AVERAGE</b>	<b>47.8</b>

A Chi-squared statistical test on these averages gives a value of 11.63 with 3 degrees of freedom, yielding a probability of less than 2% that this result could have been achieved by chance.

Details for all 22 trials are given below. Case # is the order in which the plants emerged from the soil in the pots.

Time from start to potting/germination		
Days	Feed in water	Case #
10	S-C	15
12	S-C	18
13	S-C	22
25	Tap water	20
25	X	21
33	S-C	14
36	Y	8
36	X	19
37	Tap water	4
37	S-C	5
39	X	16

Time from start to potting/germination		
Days	Feed in water	Case #
47	Y	9
50	S-C	6
50	S-C	7
52	Tap water	1
55	X	17
57	S-C	13
61	Y	11
68	X	10
69	Tap water	12
92	Tap water	2
119	Tap water	3

Experience showed that larger stones tended to grow faster so subsequent stones were allocated evenly according to size across the different feed media.

At the point of germination, when the stone had split to reveal initial root growth, they were washed and brushed in tap water and potted separately in 10 cm polypropylene pots stood on saucers, in a commercial general purpose peat based potting compost and then later in a commercial wood fibre based potting compost.



Potted and Tagged Avocados - feeding took place every two weeks. (The pots were 10 cm diameter at the top, 7 cm at the base and 9.5 cm tall).

The same volume of feed or water was added to each pot and feeding and watering was measured and kept constant for all cases. Initially, 80ml of the RTU solutions of each product were added each time and later, as the plants grew and had to be re-potted, 160ml and then 240ml were used.

### STAGE 3 – TIME FROM START TO EMERGENCE

The date was noted on the pot tag when the first shoot appeared through the soil and each pot was numbered according to order of emergence.

Case #	Days	Feed in water	Feed in pot
15	23	S-C	S-C
18	41	S-C	S-C
22	49	S-C	S-C
8	56	Y	Y
20	57	Tap water	Tap water
21	58	X	X
14	62	S-C	S-C
1	63	Tap water	Tap water
19	63	X	X
4	67	Tap water	S-C
5	69	S-C	S-C
6	82	S-C	S-C
7	85	S-C	S-C
16	85	X	X
17	86	X	X
11	87	Y	Y
13	92	S-C	S-C
10	94	X	X
12	95	Tap water	X
9	110	Y	Y
2	135	Tap water	S-C
3	149	Tap water	Y

Once again the Chi-squared test shows the difference in performance is significant at 2%.

Test Solution	Average Days
S-C	63.3
X	84.3
Y	80.2
Tap water	101.0
<b>AVERAGE</b>	<b>82.2</b>

## FINAL STAGES – GROWTH MEASUREMENTS

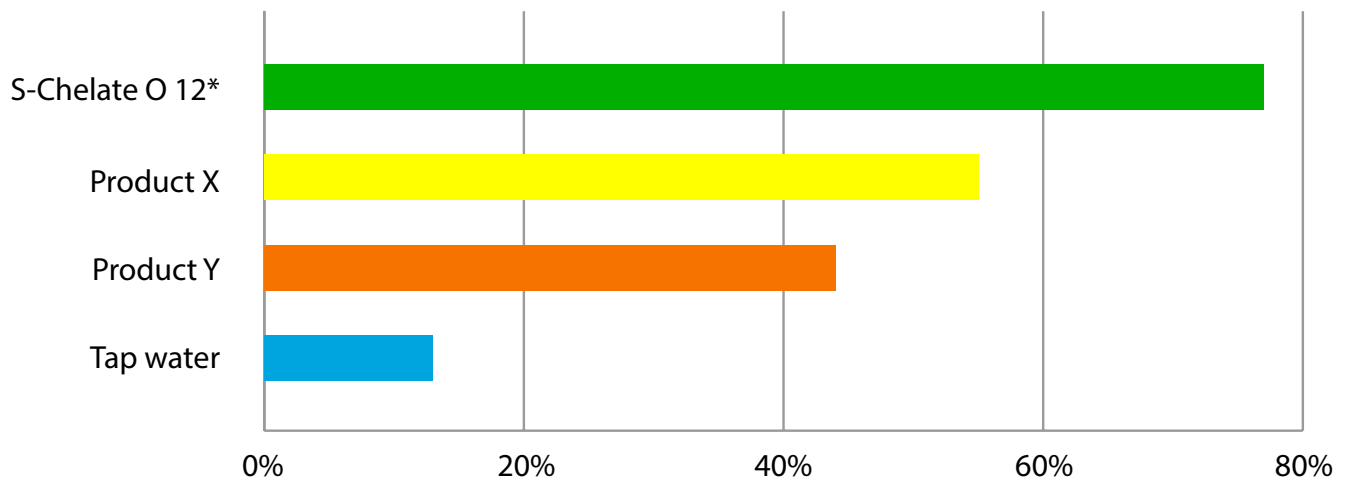
The plants were examined for root appearance at the base of the pots and stem height and leaf growth was measured at various intervals and the results noted.



## Analysis of Results

22 plants had emerged by 30th May out of 49 stones planted. Those fed with **S-Chelate-O 12\*** having the most robust response:

**% Stones Emerging by 30th May**



- 77% of the **S-Chelate-O 12\*** fed stones (10 out of 13)
- 55% of the **product X** fed stones (6 out of 11)
- 44% of the **product Y** fed stones (4 out of 9)
- 13% of the **tap water** fed stones (2 out of 16)

Stones using the S-Chelate medium were ahead of the others in every respect, germination and emergence as noted above and subsequently the **S-Chelate-O 12\*** plants also demonstrated more significant growth than the others:

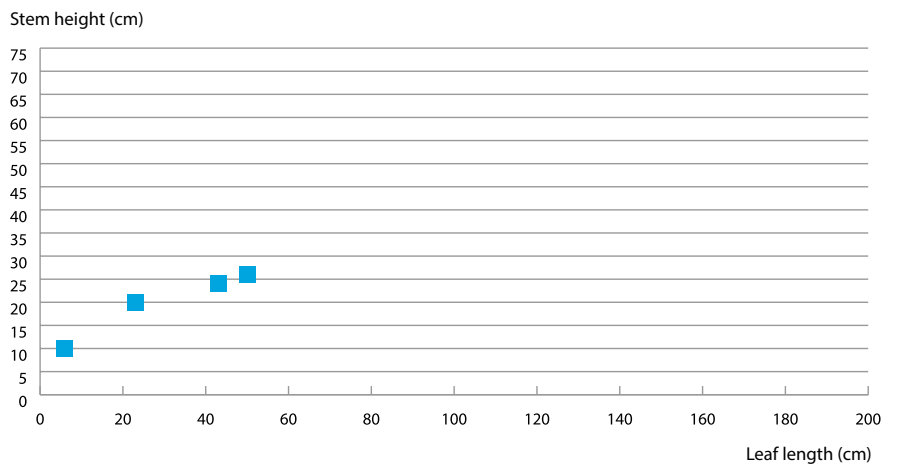
Trial Medium	50 cm height	100 cm height	150 cm height
S-Chelate	8	5	4
Product Y	4	2	0
Product X	1	1	0
Tap water	1	0	0



The S-chelate product also provides better leaf growth than product X as illustrated by the examples below showing the relative growth patterns for different media, including leaf growth. This is further evidence of the superiority of the **S-Chelate-O 12\*** over the other trial products:

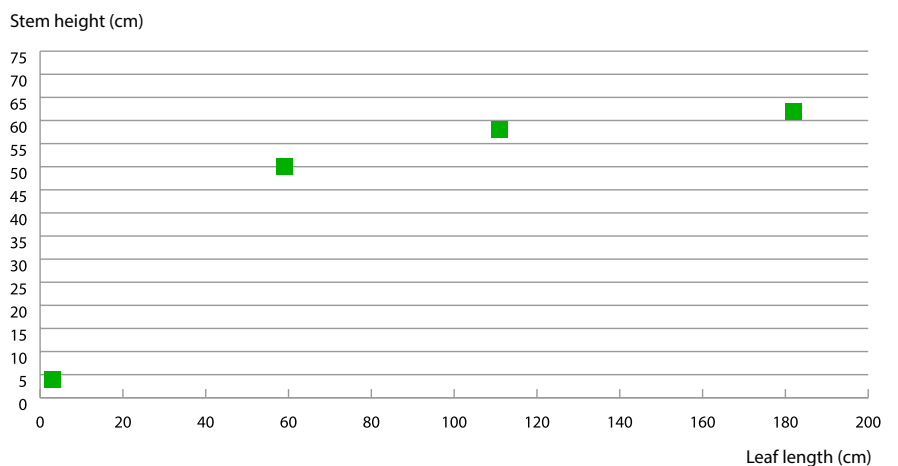
### Case 3: Tap water

Days from start	Leaf length	Stem height
154	6	10
167	23	20
174	43	24
189	50	26



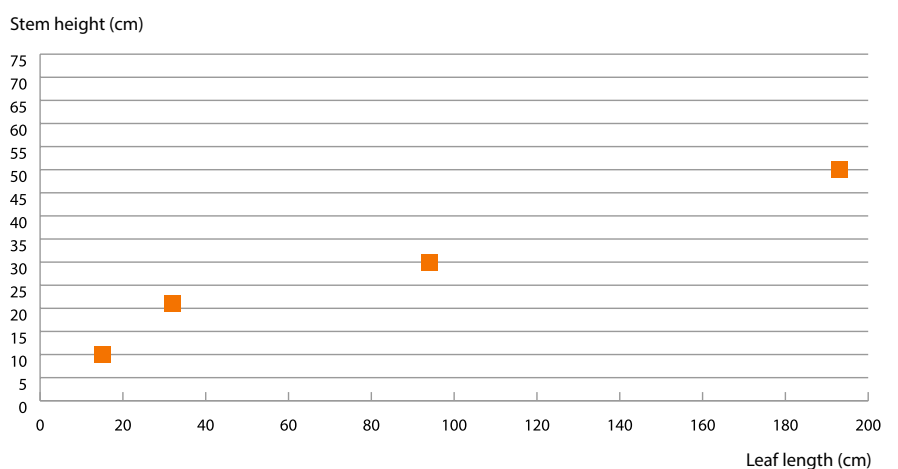
### Case 11: S-Chelate

Days from start	Leaf length	Stem height
74	3	4
92	59	50
107	111	58
137	182	62



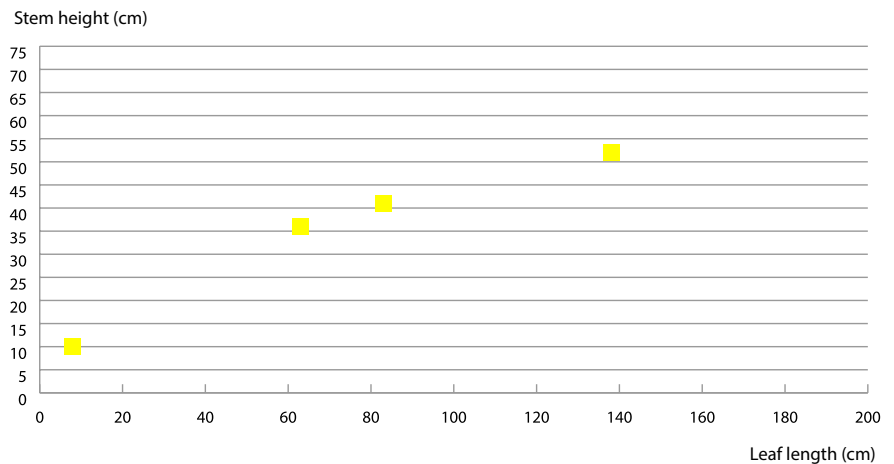
### Case 15: Product Y

Days from start	Leaf length	Stem height
69	15	10
84	32	21
115	94	30
146	193	50



## Case 15: Product X

Days from start	Leaf length	Stem height
104	8	10
124	63	36
149	83	41
180	138	52



## Discussion and Next Steps

This is an important step in our development of a more scientific approach to formulating the S-Chelate products. Avocados stones were chosen for the trial because we have a continuous supply and each one constitutes a test in its own right. Moreover they are not easy to grow in the UK climate, even indoors or in greenhouse conditions.

The micro and macro nutrient elemental make-up of the **S-Chelate-O 12\*** is based on a consensus of commercial product analyses but all of the cations are chelated with our proprietary S-Chelate technology and we are delighted with the results which support our results with other small scale trials.

We believe the **S-Chelate-O 12\*** can be used as a general purpose/complete feed for the hobby gardener and we would also recommend it for commercial growers who may be struggling to identify which nutrient or nutrients might enhance the quality or yield of their crop.

Meanwhile, we would strongly welcome any comments or questions about this trial and any suggestions you may have on nutrient make up for your crop and, specifically, any trials we may be able to perform with your crop.

To request further information or provide your comments please go to <https://www.s-chelate.com/contact/>

## Appendix A: Test Solutions Declared Contents

	<b>S-Chelate 12*</b>	<b>Product X</b>	<b>Product Y</b>
NPK	7 : 3 : 18	6 : 1.3 : 5	4 : 1.3 : 6.6
Total NPK	28%	12.3%	11.9%
Ready to use (RTU) solution	8.3 gm of powder (Two tea-spoons) of powder to 4.5 litres	20 ml to 4.5 litres	20 ml to 4.5 litres
NPK in RTU solution	0.053%	0.053%	0.053%
<b>NITROGEN</b>	<b>7.0%</b>	<b>6.0%</b>	<b>4.0%</b>
· Urea	-	3.3%	2.1%
· Nitric	6.0%	1.7%	-
· Ammoniacal	1.0%	1.0%	-
<b>PHOSPHORUS</b>	<b>3.0%</b>	<b>1.3%</b>	<b>1.3%</b>
<b>POTASSIUM</b>	<b>18.0%</b>	<b>5.0%</b>	<b>6.6%</b>
<b>MICRONUTRIENTS:</b>			
· Boron	0.1%		
· S-Chelated Calcium	2.1%	-	-
· S-Chelated Copper	0.1%	-	-
· Copper EDTA	-	0.002%	-
· S-Chelated Iron	0.7%	-	-
· Iron DPTA	-	0.03%	-
· S-Chelated Magnesium	0.4%	-	-
· S-Chelated Manganese	0.4%	-	-
· Manganese EDTA	-	0.01%	-
· Molybdenum	0.03%	0.001%	-
· S-Chelated Zinc	0.2%	-	-
· Zinc EDTA	-	0.002%	-
· Sulphur	1.4%	-	-
+ Seaweed enriched?	No	No	Yes

## Appendix B: Two Specific Case Histories



The original two plants started on 1st October 2019 were both begun in tap water with plant #1 germinating and then emerging quite quickly (63 days) compared with #2 which took 135 days to emerge. However #1 was not growing well and 90 days after emergence it was fed with product X and after a further 28 days without any real 'pick up' it was fed with the S-Chelate product. Although the plant started to respond, its development could not be sustained. At 175 days following emergence, all the leaves finally dropped and the test was stopped – see picture below. Even though roots had developed and the stem was still alive, the plant did not develop viable leaves.

However plant #2 was fed with **S-Chelate-O 12\*** following emergence leading to the extensive growth evident in the photos.

The experience with plant #1 showed that the plants needed to be fed after emergence so feeding with ready to use (RTU) solutions was started immediately after emergence for all subsequent tests. It was also decided to try immersing the stones from the start of mounting in RTU solutions which, as shown, then measurably accelerated germination.



Avocado plant #1 terminated 175 days after emergence



Avocado plant #2 at the end of May 2020, 8 months after starting

The same process of superior root, stem and leaf development with the S-Chelate became evident as the trial progressed and details of each plant can be seen in the results tables [<Download Excel file>](#)

The most advanced plants were transferred to one of Rothamsted Research Station's many glasshouses on 10th June 2020 where the trial continues.