AN EXTRACT FROM SEAWEEDS (SEASOL®) INCREASES ROOT GROWTH AND YIELD OF STRAWBERRY PLANTS

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A series of field trials conducted in the strawberry nursery and fruit sectors in Victoria showed that application of a seaweed extract increased the root growth of strawberry plants by 38%, runner and fruit yields by 8% and reduced fruit rots by 11%. These trials represent the most comprehensive research on seaweed extracts and biostimulants in strawberry crops in Australia. Research and information on the use of seaweed extracts in Australian horticulture was recently published in two articles in a high-ranking scientific journal, and are available to read on the internet:

https://link.springer.com/content/pdf/10.1007%2Fs10811-017-1387-9.pdf. https://link.springer.com/content/pdf/10.1007%2Fs10811-015-0574-9.pdf

Farmers have applied seaweeds to soil and plants since early Roman times. Initially, farmers regarded seaweed extracts (liquid forms of seaweed) as a tonic because of their medicinal-like properties for enhancing plant growth. These days there is a sophisticated and growing understanding of the active components in seaweed extracts, and the hundreds of plant genes that respond to the extracts resulting in increased plant growth and health. Seaweed extracts contain a wide range of active compounds, such as:

1. Growth regulators (including auxins, cytokinins, ethylene, gibberellins, abscisic acid, brassinosteroids, strigolactones, and more) that influence the growth of different parts (organs) of the plant.
2. Quaternary ammonium molecules, such as betaines and proline, that buffer against major osmotic changes and plant stress.
3. Polysaccharides, laminarins and alginates that trigger defence mechanisms in the plant and influence soil biology.

Seaweed extracts belong to a group of crop protectants called plant biostimulants. Scientists have defined plant biostimulants as 'organic materials that, when applied in small quantities, enhance plant growth and/or development such that the response cannot be attributed to the application of traditional plant nutrients.' Therefore, seaweed extracts generally do not contain high concentrations of plant nutrients and are not fertilisers, but may have a similar effect in stimulating plant growth as some fertilisers. Seaweed extracts are made using a range of different methods including alkaline or acid hydrolysis, cellular disruption under pressure, or fermentation. The way extracts are made can influence the active compounds they contain, and their effectiveness for use in different crops. Worldwide, the manufacture of seaweed extracts for crop protection is a billion-dollar industry. The adoption of seaweed extracts is growing rapidly on a global scale, due mostly to the increasing cost of synthetic fertilisers, the need to buffer against crop stress caused by climate variability, and the withdrawal of many agrichemicals, particularly in Europe.

The Victorian Strawberry industry Certification Authority (VSICA) conducted a series of field trials to independently test whether seaweed extracts can stimulate strawberry growth, yields and quality. We used a product called Seasol® in the trials, which is an extract from two seaweeds – Southern bull kelp (Durvillaea potatorum) and knotted kelp (Ascophyllum nodosum). The product is made in Australia (Seasol International, Bayswater, Victoria) from the seaweeds using an alkaline hydrolysis process. Every month, we applied the seaweed extract to strawberry crops as a combination of a soil drench (10 L/ha in a 1:400 solution) and as a foliar spray (1:400 concentration to the point of run-off). We compared strawberry crops in the seaweed treatment with those in a control treatment, which consisted of the same amount of water as applied in the seaweed treatment. We applied the treatments in addition to the standard nutrient and fungicide programs used by growers at the trial sites.

The trials were conducted at Toolangi, Vic in the nursery sector (2013/14 and 2014/15) and at Coldstream, Vic (2016) and Warburton, Vic (2017/18) in the fruit sector. During the trials, we measured runner yields, fruit yields (picked 2-3 times per week through the entire season), root growth, and fruit quality and rots post-harvest. The trials were conducted using a scientific design called randomised complete block, and we had up to 16 replications of the treatments in the trials. This design allowed us to analyse our data in a way that was scientifically robust, using a method called 'analysis of variance'.

We found that the application of the seaweed extract increased runner yields by 8%, depending on the variety in the trial. The extract had the greatest effect

Figure 1:
Four replicates of strawberry runners (Fortuna) treated with a seaweed extract (Seasol®) (top), or not treated with the extract (bottom) in a field trial at Toolangi, Victoria. The extract increased runner yields in the trial.

increasing the yields of early dug runners, such as the variety Fortuna (Figure 1). This was because the extract accelerated the root growth of daughter plants and resulted in fewer rejected runners at harvest. The effects of the seaweed extract on later dug runners such as the variety Albion, which had a longer time to develop roots, were still significant, but less pronounced. Harvested runners that were treated with the seaweed extract had a greater density of feeder roots (22% greater) than runners from the untreated control.

In separate experiments (see Figure 2), we examined the root growth of strawberry tips using time-lapse photography. The results showed that the seaweed extract increased the growth rate of roots from strawberry tips. A video of one of the replicates in the experiment is available to view at https://www.youtube.com/watch?v=zvw5l28FJ8g. VSICA use seaweed extracts in the commercial production of the early generations of Certified runners, especially to produce strawberry plug plants. This is because plugs rely on good root growth from tips to establish well.

In the fruit sector we found that application of the seaweed extract also increased commercial fruit yields by 8%. This was equivalent to an increase in revenue from fruit of $0.30 per plant, based on weekly wholesale prices for fruit (FreshLogic, Hawthorn, Victoria). There was a very strong, direct relationship between root growth and fruit yields. As root growth increased (specifically the root length per volume of soil, or the 'root length density'), fruit yields also increased. This relationship highlights the importance of a strong root system for good strawberry fruit yields. Use of the seaweed extract increased the root length density of strawberry plants by 38% compared with the control, and this probably contributed to the increased fruit yields. There was evidence that the seaweed extract increased the uptake of some nutrients (e.g. potassium) by strawberry plants, which may be attributed to their improved root growth. In addition, the improved root growth of plants treated with the seaweed extract probably increased their water-use efficiency, but this will require more research to confirm.

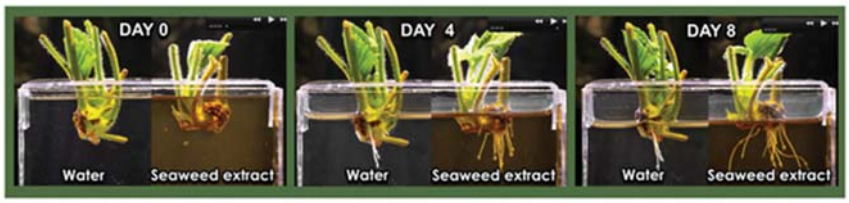

Figure 2: Time-lapse photography showing the increased root growth of strawberry tips (Albion) treated with a seaweed extract (Seasol®) compared with water.

Following harvest, strawberry fruit from the trials were stored in punnets for 7 days at 3-4°C (cold storage), and then incubated in the punnets at 20°C for 4 days (room temperature). Rots did not develop on the fruit during cold storage. Following storage at room temperature, however, rots caused by the fungi Botrytis cinerea and Rhizopus developed very quickly. Results showed that fruit from plants treated with the seaweed extract had significantly less rots (11% lower rot incidence) than fruit from the control treatment (Figure 3). This shows that the seaweed extract has potential to complement the fungicides currently applied in fruit sector for control of rots, and to improve post-harvest quality for consumers.

These trials represent the most comprehensive investigation of the effects of seaweed extracts and biostimulants across strawberry nursery and fruit sectors anywhere in the world. They highlight a strong potential for extracts as one component of future crop management systems in strawberry. Research is continuing in Australia and overseas to gain a better understanding of the ways that seaweed extracts can stimulate crop growth and health, and new discoveries of the compounds they contain. There is great focus on the ways seaweed extracts can complement and potentially offset the use of more costly synthetic fertilisers and agrichemicals for improved strawberry quality, health, and yields.

Scientific Sources:

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Figure 3: Fruit rots of strawberry following incubation for 7 days at 3-4°C, and then 4 days at 20°C. Treatment of strawberry plants with a seaweed extract (Seasol®) reduced the incidence of fruit rot by 11% (top punnets) compared with fruit from plants not treated with the extract (bottom punnets).