

Composted sea grass and seaweed as a soil substitute in the Seawater Greenhouse – a literature review

Author: Thomas Bjelkeman-Pettersson, GreenOcean, thomas@greenocean.org

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Introduction

The Seawater Greenhouse¹ (SWG) will be used in arid climates close to the sea. One of the characteristics of a typical location for the SWG is that there is often poor soil for growing crops typically found in a greenhouse, such as vegetables. The SWG can function quite well in a climate that will not normally allow anything at all to be grown due to water shortage. Hardly anything can grow in a climate like this, which results in a soil that contains very little humus and is therefore, often very sandy. This poses a problem if you want to use soil as a substrate inside the SWG, as it can be prohibitive to transport soil to the location or make soil from sand and manure. However, many prospective SWG locations have sea grass or seaweed in the nearby ocean, which could serve as a soil substitute when composted and mixed up with sand to give it a better structure.

The original purpose of this paper was to write a review of research papers available on using sea grass and seaweed as soil substitute. However, as it turns out, I have only found one research paper about using sea grass or seaweed as a soil substitute. Therefore most of the material reviewed here is about using sea grass or seaweed as a fertiliser instead of traditional manure or industrially manufactured nitrogen, phosphorus and potassium (NPK) fertiliser, and improving the soil structure.

Materials and methods

Research for this paper has consisted primarily of using the online search facilities at Stockholm University, which give access to a large number of research papers and abstracts databases as well as online journals. Papers were either downloaded from a web site or requested in hardcopy direct from the author.

Findings and discussion

Seaweed² has traditionally been used in many areas of the world as a fertiliser in agriculture. However, it has not until recently been considered as a viable fertiliser for modern high intensity farming. But interest in sustainable agriculture and efforts to minimise use of industrial fertiliser has increased the interest in using seaweed as fertiliser again [1]. Zemke-White & Ohno [2] claim that some 25 species of seaweed are used around the world in agriculture. They have specifically listed 18 different species of seaweed in use in 17 different countries in their worldwide overview. The use is as animal feed and fertiliser, but there is no data to show how this is distributed between the two uses. They note that it is difficult to get an overview of the use of seaweed, as the use is local and the farmers do not report their use to any central authority. It seems likely that one can find many farming communities close to the sea, that would have knowledge about the local use of seaweed.

As far as I can tell, seaweed as fertiliser for specific crops is quite successful, particularly if there is a shortage of other fertilisers. Traditionally it has been used in Spain to fertilise potato crops and López-Mosquera & Pazos [3] show results from potato growing using seaweed as fertiliser with the nearly the same yield as when using industrial NPK fertiliser. Other experiments, which resulted in good yields, were carried out with potatoes in Norway [4] and wheat in Finland and Sweden [5].

The use of seaweed as fertiliser not only provides a source of nutrients for the plants, but also improves the structure of the soil, which then can hold more water; it also increases activity by microorganisms in the soil in a positive way [6].

The main concern with using seaweed as fertiliser seem to be the added salinity from both the content of the seaweed itself as well as from salt deposits on the seaweed when the sea water evaporates. Indeed, some authors have washed the seaweed in fresh water (or even distilled water) before drying [6]. Washing the seaweed in fresh water before drying increased crop yields in experiments with seaweed and wheat crops in Sweden and Finland [5]. The yields were lower when not rinsing the

¹ The Seawater Greenhouse, see <http://www.seawatergreenhouse.com/>

² I will use the general term of seaweed for both sea grass and seaweed from this point onwards.

seaweed. It should be noted that Swedish and Finish waters have a lower salinity than from most other seas and oceans. López-Mosquera & Pazos [3] note high Na and Cl contents of the seaweed used, but didn't suffer salinisation in the soil the used. They warn that a covered crop that doesn't have the benefit from leaching by rain could have trouble salinity.

The plant nutritional content of seaweed can (unsurprisingly) vary quite significantly, depending on species of seaweed and location harvested from [1].

The experiments, which come closest to using seaweed as a soil substitute, are the experiments that Klock performed with *Salvia* growing in a mix of seaweed and garden waste [7]. The seaweed was mixed 1:1 with garden waste. The overall result was that the *Salvia* grew better in a traditional mix of garden compost (50% manure, 50% garden waste), vermiculite and perlite than it did in a compost that included seaweed. However, the plants were still healthy and of good quality in this seaweed compost (50% seaweed, 50% garden waste), even though the new growth of the plants was about halved. Other than saying it is possible to grow plants in a mix of garden waste and seaweed, it is not possible to draw any strong conclusions from this experiment with regards to raising vegetables, as different species of plants have very different optimum growing conditions. It should be noted that Klock did not mention whether she rinsed the seaweed in fresh water before using it in the compost, neither did she identify the seaweed species used.

Conclusion

Local seaweed can most likely be used, at least in part, as soil substitute or soil improver and fertiliser in the SWG. In the documented cases, seaweed used as a fertiliser is between half as good to equivalent to industrial fertiliser. Seaweed is clearly a good soil improver: beyond nutrition it increases activity of microorganisms in the soil as well as increases the water holding capacity of the soil. Local conditions will have to be investigated to see if local farmers have experience in using seaweed as soil improver and test will have to be performed to see which of the local seaweed work well.

One concern with use of seaweed as soil substitute or soil improver in the SWG is salinity of the soil. Considering that fresh water shortage is one of the main reasons for using the SWG, washing seaweed before composting may not be practical. However, as the water used in the SWG is effectively distilled water (with extremely low salt content) this may not be a big issue, but more research would need to be performed to know for certain.

Papers reviewed

[1] Tang og tare – aktuell som gjødsel for dagens bonde? [English: Seaweed and sea grass – suitable as fertiliser for the modern farmer?], Kirsty McKinnon, Norsk Centre for ecological farming, (2000?)

[2] World seaweed utilisation: an end-of-century summary, W. Lindsey Zemke-White, Masao Ohno. *Journal of applied phycology* (1999, Vol 11, pp 369-376)

[3] Effects of seaweed on potato yields and soil chemistry. M.E. López-Mosquera and P. Pazos. *Biological agriculture and horticulture* (1997, Vol. 14, pp 199-206)

[4] Effects of algal fibre and perlite on physical properties of various soils and on potato nutrition and quality on a gravely loam soil in southern Norway, Hugh Riley. *Acta Agric, Scandinavia* (2002, Vol. 52, pp 85-96)

[5] Alternativ användning av marina fintrådiga alger [English: Alternative use of marine sea grass], Ylva Melin. EU Life algae report series (2001, pp 4-10)

[6] Physical and biological effects of kelp (seaweed) added to soil, S.F.I. Haslam, D.W. Hopkins. *Applied soil ecology* (1996, Vol. 3, pp 257-261)

[7] Comparison of *Salvia* growth in seaweed compost and biosolids compost. Kimberly A. Klock-Moore. *Compost Science & Utilization* (2000, Vol 8, No. 1, pp 24-28)

Version history

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