Field lab: On-farm fermentation of sugar kelp seaweed to enhance seed establishment and to reduce powdery mildew progression.

Background to the field lab

The idea originated from David and Stuart Oates, organic farmers based on the Lizard Peninsula in Cornwall. Working to reduce the use of fossil fuel based fertilisers on their farm, they looked towards biostimulants to retain and improve crop productivity.

Seaweed extracts are proven, but often prohibitively expensive and not adapted to local conditions. A conversation with The Cornish Seaweed Company sparked an idea to create their own biostimulants on-farm. They contacted Hannah Jones at Farm Carbon Toolkit for her expert advice on the topic.

The Atlantic Vineyard, which aims to be an Earth Friendly vineyard, got involved following a conversation with Tim from the Cornish Seaweed Company. Vine cultivation in the UK, often referred to as 'cool climate viticulture', faces challenges of achieving grape ripeness, with plants highly susceptible to diseases caused by the good old British weather! Vineyards in the UK tend to leave grapes on the vines for longer into the autumn in an attempt to fully ripen them and improve the sugar content and acidity balance. These vines are susceptible to plant-health issues from the cooler, wetter and more humid 'cool climate' conditions such as mildew, mould, fungus, rot and other pest issues which can cause damage to, and decimate, the vines and grapes.

Why seaweed?

Seaweed extracts are classified as biostimulants because of their ability to enhance nutrition uptake efficiency, environmental stress tolerance, and crop yield and or quality without particular emphasis on just the nutrient content of the product (DuJardin, 2015).

Seaweed extracts (including *Durvillaea potarorum* and *Acophyhyllum nodosum*) have been shown to increase the nutrient density and flavour of apples (Yang et al, 2023) and yield of tomatoes (Hussain et al, 2021). Further advantages are associated with improved soil health relating to biological activity, water retention, soil aeration, nutrient availability and structure (Khan et al, 2009, Hussain et al, 2021; DuJardin, 2021). The seaweeds can have a bio-stimulation effect on crop plants through the hormones that they contain, which include cytokinins, auxins, abscisic acid, and gibberellins and can increase a plant's resilience to environmental stress (Boukari et al, 2020).

In summary, there is extensive evidence to support the use of Ascophyllum to enhance crop and soil health but the novel element of this work is to use sugar kelp (virtually all seaweed extracts are from *Ascophyllum nodosum*), on farm, with bespoke on-farm equipment to de-centralise costs and increase farm sustainability. Virtually no research has been done on the use of sugar kelp, which is a scalable and a sustainable alternative to Ascophyllum, as it can be farmed at sea without input.

Aims of the field lab

The main objective is to use a novel on-farm fermented extract of sugar kelp (*Saccharina latissimi*) as a foliar feed and seed treatment. Sugar kelp, as opposed to widely-used *Ascophyllum*, can be sustainably cultivated throughout the UK, requiring no input and enhancing marine biodiversity, creating floating reefs. However, the effects of a fermented extract on crops remain poorly understood due to the novelty of sugar kelp as an aquaculture industry. Sugar kelp contains bioactive compounds that influence plant growth and health dynamics differently

than the widely used *Ascophyllum* The local provenance of the seaweed and collaboration with the farm group would offer the opportunity to determine the agronomic merits of home-produced seaweed extract. The novel element of this work is to use sugar kelp with bespoke on-farm equipment to de-centralise production, reduce costs and increase farm sustainability.

On-farm seaweed processing for farms located close to suppliers offers potential benefits in terms of crop (1) seedling vigour (Thorsen et al, 2010); (2) crop quality (Yang et al, 2023; Saavedra del Aguila et al, 2024) (3) Disease resistance (Catlin, 2020); (4) soil health (DuJardin,2021) and (5) carbon footprint (Hofmann et al 2024). But although *Ascophyllum* extract is commonly used and the benefits are well- known, it is wild-harvested and production cannot be scaled sustainably. This project allows for localised management of seaweed which closes nutrient cycles, reduces input costs and improves on-farm economic and environmental sustainability.

Seaweed aquaculture is a fast-growing industry, but severely hampered by lack of applications. Proving that sugar kelp biostimulant has real crop benefits will significantly boost the viability of this fledgling industry. By providing farmers with both evidence that sugar kelp works and a cheaper way of making it the trial hopes to empower farmers to:

1. invest confidently in seaweed biostimulant, knowing it will be effective
2. potentially reduce the costs of purchase and transportation by showing how it can be made on farm. By decentralising the production of the ferment you reduce environmental impact / make it more flexible.

Part 1:

This is how the trial hopes to achieve the first aim: The project will test the effect of fermented sugar kelp seaweed compared to a control on:

1) Rate of establishment of autumn sown heritage wheat;
2) Wheat plant vigour;
3) Foliar disease progression on grape vines;

Part 2:

The second part of the trial will look at the costs and benefits: Produce a seaweed ferment lifecycle assessment to determine its carbon footprint and cost.

This project is very relevant for other farmers in the UK (and abroad). All seaweed farms are currently growing sugar kelp, and there are a number of seaweed farms spread out around the UK coast, with a lot of the coast suitable to grow this seaweed. So each region could have its own 'local' seaweed farm(s) to supply it.

What would be a successful field lab outcome?

Success would be evident from seaweed treatment with:

1) Enhanced seed establishment rate in wheat
2) Improved soil stability within 2 months of seed sowing in wheat fields
3) Enhanced wheat root development
4) Reduced mildew infestation on vines
5) Economically viable on farm process for handling locally harvested seaweed.