Initial trials of Kelp (*Macrocystis pyrifera*) as a fungicide and health promotor on grapes

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2. Introduction

The concept of using kelp seaweed (*Macrocystis pyrifera*) and other seaweeds as fungicides and general health promoters for crops is well established, for example (Elmer & Reglinski, 2006; Crisp *et al.*, 2007). With the increasing desire to move away from xenobiocides to eobiotic materials, there is renewed interest in materials, such as seaweed, to supply nutrients and control pests. It is therefore considered an opportune time to be exploring different uses for kelp. An experiment was undertaken for the preliminary evaluation of New Zealand Kelp as a fungicide and general health promotor on grapes. As there is a range of laboratory research indicating efficacy, and the often very poor correlation between the results of such laboratory field experiments, field trials were considered the best approach.

Grape vines suffer from two major 'types' of fungal pathogens in New Zealand: The mildews, both powdery (*Uncinula necator*) and downy (*Plasmopara viticola*) and botrytis (*Botrytis cinerea*). Mildews mostly infest and attack the leaves throughout the growing season creating the characteristic white sheen on the upper and/or lower leaf surfaces depending on the mildew species. *Botrytis*, also infests the plant throughout the season, but mostly remains non-pathogenic, i.e. it does not attack the plant, rather it lives saprophytically on the dead material on the plants surface. *Botrytis* only becomes a problem as the plant senesces (starts dying back) at the end of the season, attacking the ripening (i.e. dying) grape berries causing the characteristic grey mould on the grape bunches. This trial looked only at the effect of kelp on mildew and overall plant health due to the limited availability of suitable grape vines for bunch production in the time frame and within the resources available.

2.1. Method

Thirty six grape vines, approximately eight years old, situated at the Horticultural Research Area of Lincoln University, 43°38'51.43" S 172°27'20.82" E were used for the experiment. The vines had previously been used for a range of research projects and were known to be susceptible to and have a background level of powdery mildew (*Uncinula necator*) and downy mildew (*Plasmopara viticola*).

Vines were randomly selected for one of three treatments:

- No spray (control)
- Water (control)
- Kelp at 2 g/10 litres water.

Vines were sprayed to run-off via a hand held spay lance with the water and kelp solutions. Vines were sprayed from December 2011 (early leaf emergence) to March 2012 (ripe fruit) on the following dates, December 8, 11, 22, January 5, 12,19, February 2, 16, March 8, 22, i.e. approximately every two weeks and giving a total of 10 applications treatments . On 2012-03-29 the vines were visually inspected for both types of mildew and given a score of 1-5 with 1 being low mildew levels i.e. only a few older leaves with a small area of mildew and 5 being high mildew levels, i.e. most leaves showing significant mildew coverage. Overall vine health was also assessed with 1 being very healthy and 5 very unhealthy, the rating being based on the vigour of the vines and leaf colour. The assessment was 'single blind' i.e. the assessor knew what the treatments were but was **not** aware which vines has received which treatments. Results were analysed by Kruskall-Wallis test to compare multiple 'medians'.

2.2. Results

The average (n=12) scores (1-5, 1=good 5=poor) for the three grape treatments are presented in Table 1.

Table 1. Average (n=12) mildew and health scores (1-5, 1=good 5=poor) for the three grape treatments. P value is chi-square. ns = not significant

Treatment	Control	Water	Kelp	P value	Significance
Mildew score (1-5)	3.25	3.25	3.75	0.510	ns
Health score (1-5)	3.58	3.25	3.75	0.436	ns

2.3. Discussion

The results are unambiguous in that the results for the kelp treated and water and null control plants were practically, and in some cases exactly, the same. This was somewhat surprising as the literature indicates that seaweeds such as kelp, and various extracts, do have both a specific anti-fungal action and also can have a general 'tonic' effect, although, this effect will depend on the existing plant health and nutrient status.

The lack of effect is also not thought to be due to major problems with the experimental design, even though it was a 'basic' methodology. Both a null and water control were used, so the trial was fully controlled. While it did not have any fungicide treatments, this does not invalidate the method, it only fails to provide an industry standard reference point. A reasonably high rate of kelp was applied, both in terms of concentration and number of applications so if an effect was present this should have been more than ample to induce the effect. The measurement was conducted single blind, i.e. the person applying the treatments and therefore who knew which vines received which treatments, was different to the person who conducted the measurements, who did not know which treatment individual vines had received so could not be biased, either consciously or unconsciously, by that knowledge. There was a considerable variation among the vines (of all treatments) of both mildew and health status, i.e. vines with little mildew that were clearly growing vigorously, and vines that were covered with mildew and/or with very poor 'anaemic' growth. There was therefore plenty of natural variation for the treatment to modify.

3. Conclusions / recommendations

Within agricultural science experiments there can be large inter-experiment variability, because there are many variables, such as weather, cultivars, spray formulations, 'the season' etc. all of which can affect trials both positively and negatively. This is no different from real-world farming when a technique can work well on one occasion and poorly the next, due entirely to external factors. Therefore, the negative result of this single experiment, should not be considered definitive 'proof' that kelp has no potential as a grape fungicide, or as a management tool for other pathogens on other crops, rather it should be taken as an indicate that the likelihood of such effects are lower. What is does indicate is that a more extensive search and reading of the literature, especially the grey literature, than was possible for this report (due to resource constraints), and possibly glasshouse assays (halfway between laboratory and field experiments) would be worthwhile before proceeding with any more field experiments.

This research also illustrates the need for a more fundamental ('under the hood') understanding of using biological materials, such as kelp, within agriculture. An example of this comes from real-world farming in the 1990s: A new seaweed extract product was being promoted as a general foliar fertiliser and health promotor to farmers, backed up by solid research showing its potential to increase plant growth due to the presence of 'plant hormones' e.g., gibberellic acid. One processing pea producer decided to test it on his crop, by spraying a number of unconnected swaths up the field i.e. having treated and untreated / control areas. The visual difference in the crop was clear, with the spayed peas being darker green and much taller and more dense. At harvest the farmer reported that the viner was clearly requiring more power to harvest the treated peas, so he concluded that the product had worked exceptionally well and that he would use it over his entire crop in future. However, when manual samples were taken from the field, the yield from the treated swaths was dramatically lower than untreated areas, to the point of almost yielding nothing in some treated samples. The primary effect of the seaweed product, due to the plant hormones it contained, was to keep the peas in vegetative growth, i.e. growing large and green, and inhibit reproductive growth, i.e. setting flowers and producing peas. The product did exactly what it said on the tin, however, it was completely contrary to the general perception that it would 'improve the crop'.

So while kelp has probable value as a general plant health tonic and/or pesticide / fungicide, as do many other 'natural' (eobiotic) materials, it is not possible to make general claims about its value across a wide range of crops, as may have both negative and positive effects depending on the situation.

4. Acknowledgements

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5. References

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