SOIL AMENDING ATTRIBUTES OF SEAWEED

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Often, we only have to look to the past to relinquish clues that will help resolves today's problems. Modern man is now just beginning to rediscover the benefits of seaweed, which have been known for centuries. In fact seaweed was used by the ancient Greeks, Chinese and Vikings to enhance soil fertility as well as the health and well being of their animals.

The 1960's era gave birth to a barrage of synthetic compounds which now dominate agriculture. The excessive use of these chemical fertilisers, herbicides, insecticides, fungicides etc have attributed to the slow death of our soils.

Farmers world-wide were told to embrace these compounds because they would change the face of agricultural production forever. Unfortunately, thirty years on, we now realise that many of these products have a death grip on agriculture. To break free we need to look to past agricultural practices. Seaweed was commonly used in agriculture until the 1960's, but the advent of synthetic compounds vanquished it to a neglected realm. However it is one of the organic products which links the present to the past. By employing seaweed and other products I believe we can reverse our self-induced destructive path.

Two thirds of the earth's surface is covered with water, mostly salt water and marine algae. Commonly called seaweed or kelp, it is the most predominant vegetation found. Although numerous species of seaweed abound only a few are harvested for agricultural use.

Seaweed extracts are available as a liquid concentrate, which is derived through the process of alkaline hydrolysis, or as a seaweed or kelp meal – a non-soluble powder which is produced by drying (sun or geothermal) and chopping the seaweed into a granular consistency. The liquid concentrate is used as a foliar spray, as a drench and as a nutrient supplement when added to stock water troughs. Foliar spraying with seaweed supplied nutrients to plants via leaves – a method which has been shown to be 95% efficient, within an hour or so most of the nutrients have been translocated to the roots. Seaweed meal is used for soil amendment and as a livestock additive, either mixed with feed or put out as an ad-lib lick.

The average composition of *Ascophyllum nodosum*, the predominant seaweed in agriculture use today (*), typically contains over 60 minerals and elements, 12 vitamins, 21 amino acids, simple and complex carbohydrates plus several plant growth hormones.

Although the amounts of major elements contained in seaweed are small, there are significant levels of trace elements. Since these micronutirents are derived from plants, they are present in proportions which are conducive to absorption by plants. The micronutrients, through their involvement in enzyme systems, are part of the balance of plants nutrients regulating growth and development.

Enzymatic reactions are dependent upon the presence of metallic ions, which serve as catalysts. The micronutirents (Iron, Copper, Zinc, Magnesium, Boron, Manganese, and Cobalt) serve as catalysts which activate the enzymes. Even though plants only require small amounts of these micronutrients, they are just as essential as NPK (Nitrogen, Phosphorus, Potassium) and in some cases even more. If only our University and agronomist people would remember this! A lack of one of the above trace elements can upset the balance of one or more enzyme systems; although the

yield of the crop may not suffer because of a trace element deficiency, the quality can be adversely affected.

Unfortunately, the deficiency of one trace mineral may not always be corrected by the simple addition of this micronutrient. The perceived lack of one trace element may in fact be attributed to an excess of another. An excessive amount of iron will often display symptoms associated with a manganese and phosphorus deficiency. Excess copper and zinc reduce iron's availability. On grasslands, an excess of molybdenum produces a copper deficiency. It is therefore deemed prudent and sensible to provide a balanced micronutrient package, such as seaweed, rather than a single element.

Seaweed also contains alginic acid and mannitol, which are carbohydrates with chelating ability. Chelates are large organic molecules which encircle and hold trace elements enabling plants to effectively absorb micronutrients that are generally in "unavailable" forms. These chelating agents not only make trace elements from seaweed "available", they also make the trace elements more "available" to the plant.

Alginic acid accounts for about 25% of the dry weights of seaweed meal which mannitol comprises 10%. Since alginic acid and mannitol do not immobilise available Nitrogen, as does cellulose, they decompose more readily than cellulose. These organic compounds contribute greatly to the formation of humus by stimulating microbial activity. Seaweed contains only about 5% cellulose. Because it derives its mechanical strength from alginic acid whereas land plants, because of their rigid structure, are comprised primarily of cellulose, Alginic acid has been shown to have the ability to improve the crumb structure and water holding characteristics of soil. These are important features which are associated with fertile soils.

As a result of catalytic action, alginic acid acts as a binder of soil particles. The aggregation of soil particles results in better soil aeration with an accompanied increase in aerobic bacteria. The aggregation of soil particles also increases the soil surface area which greatly facilitates chemical and biochemical exchange, thereby promoting increased productivity.

Seaweed meal could be classified as a slow release fertiliser as it slowly decomposes and releases its nutrients.

Research in Russia has demonstrated that seaweed extracts enable plants to more efficiently utilise the major elements in the soil. This would seem to suggest that the seaweed either increased the uptake of previously "unavailable" nutrients or increased the utilisation of "available" nutrients. This is further supported by research that has shown that the addition of seaweed products reduced commercial fertiliser applications with no reduction in the yield or quality of the crop.

Seaweed also contains low but significant concentrations of plant growth hormones (*cytokinins, auxins, gibberellins*). These hormones are involved in the growth and development of roots, stem and leaves. A hormone is a substance which is produced in small quantities in one part of the plant and then translocated to another part, where it produces a special effect.

**Cytokinins* are manufactured in the areas of root cell division and translocated to the region of cell elongation of the stem. Cytokinins are necessary for cell formation to take place.

**Auxins* are produced in the regions of both roots and stem cell division and then transported to the region of cell elongation. Auxins give cell walls the ability to stretch – a very important factor.

*_Gibberellins_* are synthesised in active leaves and, via conducting vessels, are translocated to the region of cell elongation. Gibberellins along with auxins facilitate cell elongation.

If growth hormones are present on too large an amount they will inhibit plant growth. It is important that manufacturers' recommendations are followed when applying products either as a foliar spray or directly into the soil.

Recent research has also shown that vitamins, especially C and E which are classified as antioxidants, can help alleviate stress in plants. Stress can be in the form of drought, exposure to chemicals, insect infestation, fungal attack etc.

Oxygen's (O2) chemical structure consists of two orbiting electrons. Stress in plants or animals results in free radicals of oxygen. Simply put, oxygen loses one of its electrons and now a free radical seeking another electron. An agent responsible for the removal of an electron will attack plant and animal cells, causing damage and disease. The damage resulting from the attack of oxidants can be visually interpreted by reduced yield, and a failure of the plant to thrive.

The addition of vitamins C and E produce a more vigorous and durable plant. Research suggests that the vitamins simply stimulate plant and animal cells. The vitamins function as a catalyst, making the plant think it has a more stressful environment than it actually has. The plant reacts by increasing its defence mechanisms.

Decades of world-wide research, led by Dr. T.L. Senn, Virginia Clemson University's seaweed guru, have substantiated the benefits of seaweed. In 1959 Dr. Senn launched a research assault which, after three decades, has catapulted seaweed to the forefront of regenerative agriculture. His tireless efforts have unravelled many of the mysteries surrounding seaweed's rejuvenating properties.

The following benefits of seaweed extract have been observed:

1. Enhanced seed germination – Research conducted at Clemson University (Virginia) utilising a wide variety of seeds, showed an increase in germination, accompanied by accelerated seed emergence. In addition, the seedlings were stronger and displayed an increased survival rate. This translates into a significant advantage when planting under adverse climatic conditions.
2. Increased root and plant growth – Numerous trials have demonstrated enhanced root growth, which can not only be attributed to the chelated micronutrients in seaweed, but also to the chelating agents which enable previously unavailable nutrients in the soil to become more available.
Of major importance, plant growth hormones (*cytokinins, auxins and gibberellins*) are responsible for increased root growth and development. Increased root area accelerates nutrient and water uptake, which translates into increased plant growth. The growth and development of stems and leaves is also positively influenced by these same hormones.

Turf grass trials conducted at the Virginia Polytechnic Institute found that seaweed increased root mass from 67% to 175% when compared to the untreated plots. Plots treated with seaweed in autumn also exhibited a 38% increase in spring growth as well as a 52% increase in root mass over the untreated plots.

Research at the University of Portsmouth in England found that seaweed treated plants also had a fourfold increase in chlorophyll. An increase in chlorophyll causes an increase in photosynthetic activity which results in greater food production, which translates into increased plant growth. This dramatic increase in chlorophyll was also responsible for a more intense vibrant green colour.

3. Increased yield, protein and quality – The above-mentioned increases in plant growth would be expected to increase forage yield but it has also been shown to increase grain yields. Numerous trials in England have reported from 14% to 40% increases in cereal grain yields. Forage tests have also shown similar results.

Dr Senn and his cohorts found increases in tomatoes, sweet corn, sweet potatoes, sweet peppers, lima beans, peas, okra and soybeans. Increases in protein have also been observed in grasses and grains. Improved quality has also been reported, although it is difficult to quantify quality. However, grains with higher test weights (an indication of quality) have been recorded. Graziers have also reported livestock preference for seaweed treated pastures.

4. Increased resistance to insects and disease – There is experimental evidence which indicates the presence of antioxins in seaweed products. These antioxins appear to disrupt the reproductive cycle of some insects and repel others. Crops sprayed with seaweed have been found to have fewer incidences of pest and disease infestations such as fusarium, powdery mildew, botrytis, "damping-off" of seedlings, black bean aphid attack and red spider mite infestation etc. Several tests have also confirmed the reduction in nematodes when seaweed was applied to the soil.

Another theory is that insects are attracted to plants that are deficient in trace minerals. It is also believed that the addition of seaweed, because of its cytokinin content, results in increased disease resistance in plants. Apparently this increased resistance may be the result of plant structural changes or to physiological responses which stimulate the plant's natural defence mechanisms.

5. Increased resistance to drought and frost – Enhanced water uptake as a direct result of the increased root growth of seaweed treated plants increases a plant's drought tolerance. Drought tolerance is also increased by seaweed's ability to stimulate changes in the plant's metabolic pathways, allowing roots access to moisture not normally available to plants. Even under moisture-stress conditions, the use of seaweed products has been shown to stimulate root growth.

Cytokinins also retard plant senescence by slowing the rate of the plant's degradation processes and stimulating photosynthetic activity. Tests at Clemson University revealed that the addition of seaweed extract enabled tomatoes to survive to 29 deg F. At this temperature the untreated tomatoes were killed. This increased resistance to environmental stress could mean the difference between profit and loss to a farmer.

6. Increased shelf life – Studies at the Clemson University showed that fruits and vegetables grown and treated with seaweed products were able to resist decomposition much longer than those left untreated. Research at Rutgers University also found that seaweed delayed the onset of brown rot infection in ripening fruit. Evidently, seaweed delays the maturity of fruits and vegetables after harvest. This has major economic implications with such a perishable commodity.

In conclusion, let me state that seaweed is not a "cure-all-snake-oil"! Plants do not live by NPK alone. Micronutrients are essential for growth and development. Seaweed, being a rich source of available micronutrients, supplements and complements NPK.

Seaweed's effectiveness is due to the fact that it fulfils the basic needs of the soil and plants. If a soil contained all the needed humus, structure, tilth and nutrients, seaweed's contribution would be inconsequential. If a plant does not require additional trace minerals, plant growth hormones and vitamins, why add seaweed? Unfortunately, our plants are devoid of these much needed micronutrients because our soils are micronutrient deficient.

The crisis that we all face is that these micronutrient deficiencies are transferred from plants to animals and finally to humans. Many diseases in animals and man have been traced to micronutrient deficiencies. If man is to survive and flourish, we need to respect the soil and look to those products which can link the present to the past.

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(* In Australia, the predominant seaweed used in agriculture today is Southern Tasmanian bull kelp, *Durvillea potatorum***. It is very highly regarded throughout the world for its qualities – Gerhard Grasser.)**

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