SEAWEED EXTRACTS AND THEIR APPLICATION IN CROP MANAGEMENT PROGRAMS

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Seaweeds and seaplants make up an integral part of the coastal ecology and landscape. Seaweeds such as the brown algae *Ascophyllum nodosum* (commonly known as Norwegian Kelp) grow in abundance within the littoral zone, that area periodically covered by rising or receding tides. For centuries, agricultural areas close to these coastal zones have utilized seaweeds as a valuable source of organic matter for various soil types and for many different fruit and vegetable crops. Today, seaweed meals and soil amendments are available in ready-to-apply dry form for use in crop soils and home gardens alike. Moreover, high quality liquid and powder seaweed extract products can be found in pure form, or in recipe formulations with or without ingredients ranging from traditional (e.g. fertilizers, pesticides, etc.) to nontraditional products (e.g. humates, fish products, etc.). Of all the seaweeds and extract products currently on the market, *Ascophyllum nodosum* is the most widely used and researched seaweed species in agriculture. *Ascophyllum* is a recognized source of several natural plant growth regulators including cytokinins, auxins, betaines, oligosaccharides and other organic compounds such as macro- and micro-nutrients. Even in light of these properties and characteristics, seaweed extracts, being natural products, are often scrutinized moreso than single active ingredient products because of their various natural origins and complex composition. Of course, this information is also needed to identify specific crop benefits related to rates and timings on a number of crops

To this end, considerable evidence has been accumulated in recent years to support and identify the benefits associated with the use of seaweed extracts in crop production systems. In fact, published evidence shows an increase in plant anti-oxidant activity after the application of *Ascophyllum* extract. Anti-oxidant enzymes provide a degree of crop protection from free radical oxidants arising from normal metabolism and any number of biotic and abiotic stresses. Work at Virginia Tech demonstrated that superoxide dismutase activity in bentgrass increased 62.5% and up to 100% under low nitrogen and high nitrogen conditions, respectively. Also, at Texas Tech, ascorbate peroxidase levels were doubled in endophyte infected tall fescue while superoxide dismutase was found to increase by 19.5% in response to *Ascophyllum* extract treatments. Moreover, work at the University of Avignon corroborated these findings by showing an increase in peroxidase activity after two applications (640%) as well as increased levels of a known anti-fungal compound, the phytoalexin capsidiol (56% after 48 hours) in treated peppers. Interestingly, photosynthetic capacity and chlorophyll content were also higher by 22 and 28% in *Ascophyllum* treated grasses versus untreated controls, respectively.

Under field conditions, replicated trials on tomato showed significant increases in yield (8%). Similar results were found for pepper weight yield (30%) and fruit number (47%). Greenhouse results on fresh market tomatoes indicated an increase in overall yield by 14 and 49% (for recommended and double rate applications, respectively). Similar results were reported for potatoes (6%), bananas (2.5%), grapes (31%) and apples (7%). On a larger acreage, cooperative trials demonstrated significant increase in fruit firmness (cherries (5-15%), apples (8%), peaches (5-13%), and grapes (up to 23%)).

Seaweed extracts are often used in conjunction with other products, both traditional and nontraditional. The use of nontraditional products such as humates and fish emulsions have received tremendous attention in recent years. Although the nutrient content of these products is as varied as the sources from which they are derived, alternative products can be used to furnish primary and secondary nutrients, improve soil cation exchange capacity, increase the presence of plant growth hormones, and stimulate plant defense mechanisms against diseases and insects. In short, seaweed extracts, traditional and

nontraditional products serve to complement each other and can furnish a wide variety of chemical, physical or biological improvements to the crop and its growing environment.

In summary, Acadian Seaplants, in conjunction with several university, industry and government partners, provides significant, pertinent data support regarding product action on a variety of high value crops. This data is relevant to growers/practitioners, extension agents and academic researchers, alike. From a scientific standpoint, a large body of literature has been amassed to support the use of seaweeds and seaweed extracts in agricultural programs. Of course, seaweed extracts are not stand-alone fertilizer products and should be used within regular crop management programs to be most effective.

In summary, from a grower standpoint, field trial results have shown significant improvements in overall yields and/or fruit/vegetable quality for a variety of crops. It is the goal of current research programs to investigate and support these field observations with concrete data on what beneficial effects are being realized and why.

Table 1. Yield response to seaweed extract applications to several crops tested in commercial field trials.*

Crop	Variety	Year	Application rate**	Noted responses
Apples	Rome	1993	2 L/ha LSC foliar applied. 2 applications prebloom 3 applications post bloom	Improved yield Improved fruit quality Decreased insect pressure
Tomatoes	cv. 9174 cv. 8892	1992 1993 1994	3 L/ha LSC foliar applied at transplant, lay-by and fruit set	Increase in total and marketable yield. Slight increase in Brix.
Potatoes	Atlantic	1996	1 L/ha LSC as seed treatment	Increase in yield
	Chipeta	1996	2 L/ha LSC foliar applied at tuber set, 10-14 days later, and late bloom	Decrease in nematode and wireworm damage
Carrots	Bolero Nanda Maestro	1997	750 g/ha SSEP foliar applied 3 times up to pencil stage of development	Increase in yield Increase in carrot size
Grapes	Flame Thompson's	1993 1998	600 g/ha SSEP foliar applied at 20 and 50 cm cane (pre-bloom), early shattering, and sizing	Increase in yield Slight increase in Brix
Peppers	Emerald Green Bell	1992	600 g/ha SSEP foliar applied at seedling and approximately every 2-4 weeks thereafter	Improved yield Greater number of large fruit

* Research performed in commercial trials with independent research organizations as part of Acadian Seaplants Limited field trials product testing program

** Abbreviations: LSC, Liquid Seaweed Concentrate (29% solids); SSEP, Soluble Seaweed Extract Powder