Seaweed extracts as plant-biostimulants

- International seminar on fertilisers in Paris on the 9 th September 2009
- JF Morot-Gaudry
- INRA-Versailles
- Académie d'Agriculture de France

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Biostimulants are defined as materials, other than fertilisers, that promote plant growth when applied in small quantities; they are also referred to as metabolic enhancers.

Seaweed extracts are bioactive at **low concentrations**. Seaweed components also exhibit synergistic activity.

Seawwed extracts are sprayed on plants during vegetative and flowering stages.

Chemical components of seaweed that affect plant growth:

Carbohydrates (laminaran, fucoidan, sulfated fucose, andalginate), minerals and trace elements;

Growth hormones or plant growth-regulatory substances (cytokinins, auxins and auxin-like compounds;

Betaines, sterols, etc.;

Seaweed extracts and seaweed products

- **Increase root development and mineral absorption** (Jeannin et al 1991);

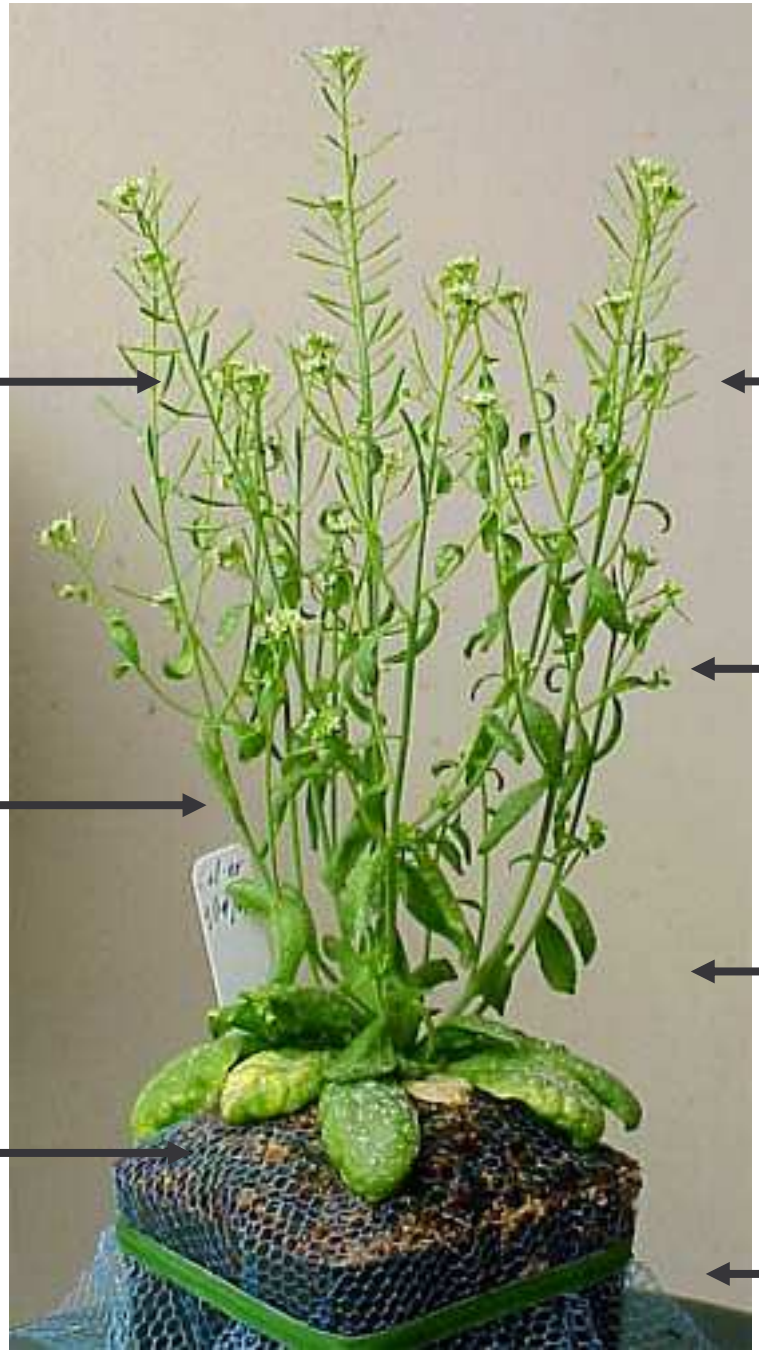
- **Enhance plant chlorophyll content** (Blunden et al 1997);

- **Trigger early flowering and fruit set in a number of crop plants** (Abetz and Young 1983; Arthur et al 2003); seaweed extracts probably encourage flowering by initiating robust plant growth;

- **Increase plant yield;** yield increases by seaweed extracts are thought to be associated with the hormonal substances present in the extracts, especially cytokinins (better mobilisation of photosynthates);

-**Improve fruit yield, size and quality**, especially in tomato (Crouch and van Staden, 1992);

- **Improve vegetative propagation** in many crop species (Crouch



Better résistance to environmental stresses

Improved shoot and root growth

Higher flowering and fruit set

Enhancement of plant defense against pest and deseases

Better yield

Improvement of nodulation

Better root development and mineral absorption

HARICOT : Variété S - 102

Traitement	Production totale de grains secs par lot de 42 pieds de haricot	Masse de mille grains secs
Témoin	100	100
GA 14	113	101
MZ 63	102	96

MAIS : Variété DEA

Traitement	Production totale de grains secs par lot de 14 pieds de maïs	Groupes homogènes déterminés par le test de Newman et Keuls au seuil de 5 %		
Témoin	100			C
GA 14 (3 ml/l)	117		A	
GA 14 (6 ml/l)	120		A	
MZ 63 sans GA 14	107		B	
MZ 63	118		A	
MZ 63 (deux applications)	115		A	

Effects of seawed extracts in alleviating environmental stresses as drought, salinity, and temperature extremes:

Seawed products elicite abiotic tolerance in plants. The bioactive substances derived from seaweeds impart stress tolerance and enhance plant performance;

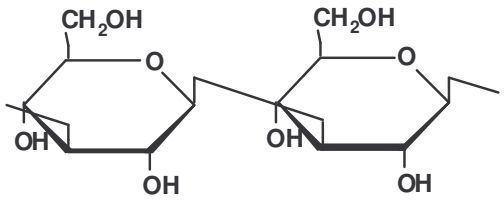
The beneficial antistress effects of seaweed extracts may be related to **cytokinine activity**. Cytokinins mitigate stress-induced free radicals by direct **scavenging and by preventing reactive oxygen species** (ROS) formation by inhibiting xanthine oxidation (Fike et al 2001).

Ascophyllum nodosum extracts contain betaines, glycine betaine, aminobutyrate, which can increase chlorophyll content in leaves (Blunden et al 1986).

Effects of seawed extracts in alleviating biotic stress:

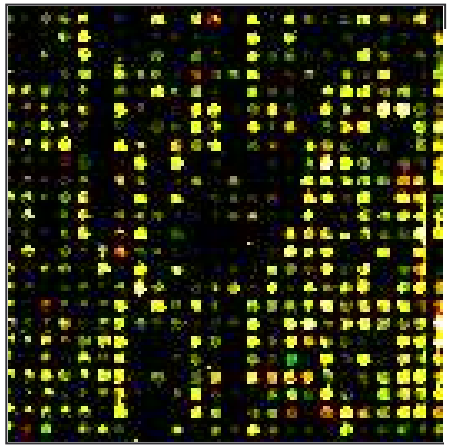
Sulfated fucans from brown algea elicite multiple defense responses in alfalfa and tobacco. Sulfated linear galactans are considered as effective elicitors of defense in tobacco plants (Mercier et al 2001).

Laminarin has been shown to stimulate natural defense responses in plants and is involved in the induction of gene encoding various pathogenesis–related proteins (PR) with antimicrobial properties (Fritig et al 1998; van Loon and van Strien 1999).

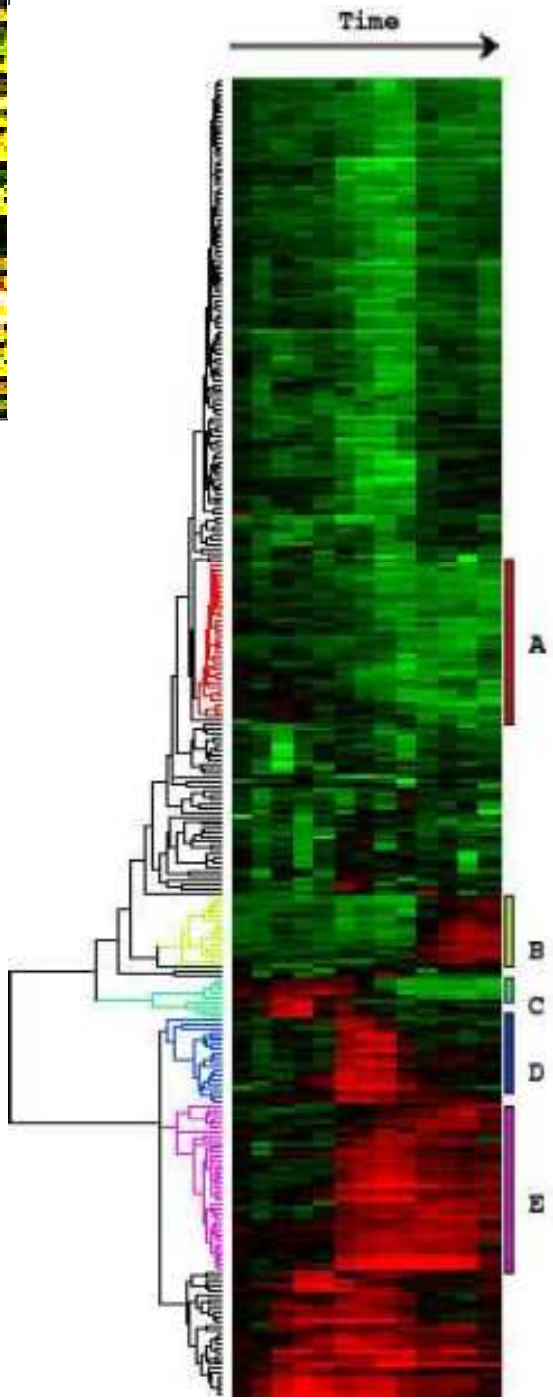


Laminarin β-1,3-glucan

The mechanisms of actions of seaweed extracts-elicited physiological responses are largely unknown.



As genomes of number of plants are now completely sequenced or nearing completion (*Arabidopsis thaliana, Medicago truncatula*, tomato, rice, poplar, etc.), it is possible to look at the effects of seaweed extracts and components of the seaweeds on the whole **genome/transcriptome** of plants to better understand the mechanisms of action of seaweed-induced growth response and stress alleviation.



The recent challenges to food production due to the increasing occurrence of biotic and abiotic stresses is likely due to climate change and will further reduce yields and/or will have an impact on crops in the 21st century (IPCC 2007). Therefore, research into developing **sustainable methods** to alleviate these stresses should be a priority.

Recent studies have shown that seaweed extracts protect plants against a number of biotic and abiotic stresses and offers **potential for field application**.

Seaweed and seaweed-derived products have been used in crop production systems due to the presence of a number of plant growth-stimulating compounds.

However, the biostimulatory potential of many of these products has not been fully exploited due to the lack of scientific data on growth factors present in seaweeds and their mode of action in affecting plant growth.

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Ouvrages de JF Morot-Gaudry INRA-Versailles-Académie d'Agriculture de France

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