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OPINION

Opinion: developments in the commercialisation of seaweed extract biostimulants

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Abstract

The market for seaweed extract biostimulants is experiencing rapid growth, driven by increasing awareness of their benefits and the need for sustainable agricultural practices. This opinion article reviews recent developments in the commercialization of seaweed extract biostimulants, including data on market value and geographical spread, and highlighting the emergence of new species in use. The author advances that recent market trends indicate the start of a gradual transition from wild-harvested to cultivated seaweed sources for biostimulants, while the current proliferation of products is setting the stage for future consolidation of the sector. Challenges to improve market uptake and strategies for companies looking to achieve primacy in the market are discussed.

Keywords Seaweed biostimulant · Market trends · Biostimulant market · Sustainable agriculture

Bajpai et al. (2024) write: "chemical fertilizers have been at the core of the agricultural production system in the last century, but their excessive usage poses a threat to the ecosystem (Del Buono, 2021). Additionally, only 18-49% of the applied fertilizer is used by the plants and the remaining is lost to runoff to aquatic bodies causing eutrophication and leaching (Gomiero et al. 2011). In the current scenario, there is an urgent requirement to develop a sustainable agricultural system to address fundamental issues related to economical agricultural production in an ecologically friendly manner (Tahat et al. 2020). Plant biostimulants are gaining interest as an alternative sustainable strategy to improve the innate ability of treated plants to cope with stress tolerance and efficiently utilize the available nutrients (Shukla et al. 2016; Nephali et al. 2020; Shukla and Prithiviraj 2021)."

The value of the seaweed biostimulant market was estimated at US$535 million for 2016, taking up around one third of the total biostimulants market (North Sea Farm Foundation 2018). According to The Nature Conservancy and Bain (2023), the seaweed biostimulants market was worth an estimated US$1 billion in 2023, implying a yearly growth rate of 9.3% in the past seven years. Seaweed extract biostimulants are produced in more than 40 countries (Fig. 1; Hermans n.d.); no other seaweed product can claim such a broad geographic production base. Despite this widespread production, some of the biggest seaweed producing nations are conspicuously absent: Japan and Chile are each represented by just one company, while South Korea and Indonesia have none.

Macroalgae have a wide range of commercial applications. The reason organizations prefer biostimulants as a product choice varies across regions. In Europe and North America, farmers are capable of growing larger volumes and are in search of markets outside of the currently dominant food sector to create more demand for their crops. Biostimulants based on wild-harvested seaweeds have already established a market presence. The hope is to expand this success to include products based on cultivated seaweeds. Conversely, in tropical regions, the focus is on value addition. Biostimulants offer a premium price point compared to carrageenan, providing a means to diversify revenue streams and mitigate the risks associated with market consolidation. Island states in the Caribbean, Indian Ocean, and Pacific are interested in using seaweed biostimulants to valorize strandings of harmful algal blooms, while nonprofit organizations are drawn to the potential of seaweed biostimulants to partially displace conventional fertilizers and their associated carbon emissions.

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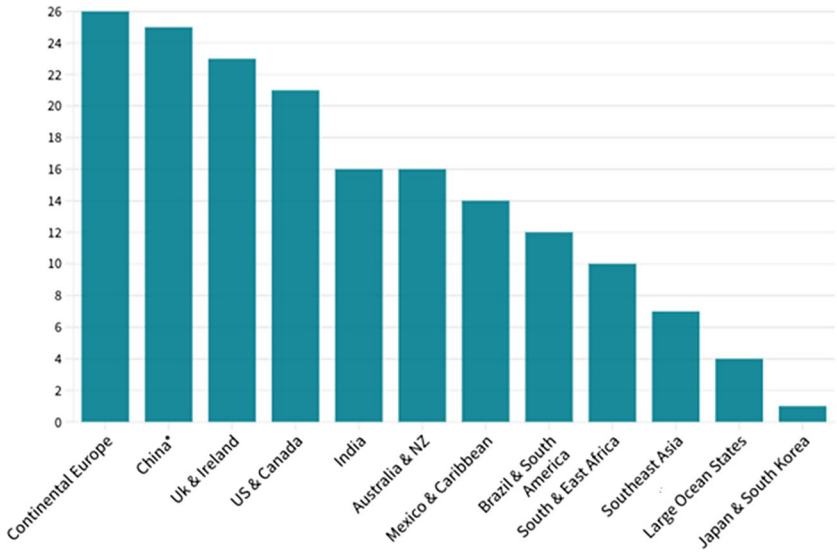

Fig. 1 Seaweed biostimulant companies by region (2024). *It is likely that not all companies in China have been captured as yet

This opinion article summarizes the latest developments in the commercialisation of seaweed extract biostimulants.

In the past year, several companies in the United Kingdom have introduced biostimulants derived from cultivated *Saccharina latissima* (Atlantic Mariculture 2024; Câr-y-Môr, n.d.), while in Norway, one company has begun marketing a biostimulant based on a blend of *S. latissima* and *Ascophyllum nodosum* (Kelpinor, n.d.). More *S. latissima*-based biostimulant trials are underway in the United States and the United Kingdom (GreenWave 2023; Kaly Group 2024; Algapelago n.d.). Effects and mode of action of *S. latissima* extracts on plant growth and soil health remain poorly understood. In a trial with drought-stressed tomatoes, a biostimulant using *S. latissima* extract demonstrated superior performance to a product using *A. nodosum* extracts (Top et al. 2023), while another found protection against microbial diseases, although with potential tradeoffs in growth (Jensen and Jorgensen 2022). Processing of *S. latissima* remains an engineering challenge, but progress has been reported in both cutting and process flow for biostimulants (SIRPUTIS 2024a, b).

Biostimulants using *Macrocystis pyrifera* extracts are not a new development. However, until recently, all supply was wild harvested. What is new is the use of cultivated supply to produce biostimulants (Kelp Blue 2023; Cascadia Seaweed, n.d.; Patagonia Biotecnologia, n.d.).

Biostimulants based on extracts from *Kappaphycus alvarezii* and *Eucheuma denticulatum* have been marketed for some time by Indian companies. Their success has inspired new entrants in India and Malaysia (ClimaCrew 2023; Sabah Publishing House 2023). Cultivation of *K. alvarezii* developed in Brazil with the intention to supply domestic carrageenan production. However, in 2022 the total harvest of 100 tonnes went instead into the production of biostimulants, which offers higher prices for less effort; because the biostimulants are processed fresh, no intermediate drying process is needed (Hayashi et al. 2024). New products based on stranded *Sargassum* spp. were recently launched by companies from the Dominican Republic and the United Kingdom (SOS Carbon 2024; AgroPages 2023), following in the footsteps of earlier entrants from Saint Lucia, Mauritius and Puerto Rico (Hermans, n.d.).

Other species that have shown strong potential as a basis for a biostimulant include *Ulva lactuca*, extracts of which boosted growth by 25% in a trial with salt-stressed potatoes (Wadzilt 2023), and *Galaxaura rugosa*, extracts of which led to improved CO_2 assimilation and water use efficiency among tomato seedlings subjected to water deficit (Morales-Sierra et al. 2023).

The seaweed biostimulants market is projected to grow at a rate of 13% per year (The Nature Conservancy and Bain 2023). If correct, it could be worth US$2.5 billion in 2030, with around 1% of global farmland treated. Beyond farming, sports pitches are a growing market for seaweed biostimulants (Davidson 2023). Consider the fact that the United States has more golf courses than McDonald's outlets: more than 16,000 golf courses use 5.6 billion liters of water a day and are collectively treated with 100,000 tonnes of fertilizer a year (Buckley 2024). While such statistics point to significant market potential for seaweed biostimulants, several challenges exist. One such challenge is the relatively long development time required to bring new products to market (Hermans 2024). Several years are needed to establish the scientific basis for products and demonstrate their efficacy in field trials.

Additionally, the diversity of seaweed biostimulants and their varying modes of action can make it difficult to provide clear and consistent information to potential customers (Merfield and Johnson 2020; Verplancken 2023).

The growing interest in biostimulants has led to a surge in commercial activity, with more than 100 producers of seaweed extracts biostimulants vying for market share (Hermans, n.d.). The current proliferation is predicted to lead to a shakeout, with those willing to invest in science, marketing, and education anticipated to be left standing (Jacobs 2024).

Suggested strategies to achieve primacy in the market include

- Increasing understanding of the mode of action of the biostimulant and delivering consistency across different crops, soils and climates (Sujeeth et al. 2022);
- broadening how performance is measured beyond crop growth to include soil physicochemical and biological properties and plant health markers (Mendes et al. 2023);
- coupling advanced soil testing with large datasets on the soil microbiome to recommend farm-specific tailored inputs (Jacobs 2022);
- retaining full bioactivity in powdered or granulated form to reduce the financial and environmental costs of shipping water-soluble biostimulants (Critchley 2024);
- convincing regulators to broaden the definition of a biostimulant to include biotic stress resistance, or taking the extra step to register as a pesticide (Anuar et al. 2023; Critchley 2024).

In conclusion, it could be argued that the developments outlined above point to two distinct trends. Firstly, that the market for seaweed extract biostimulants exhibits signs of a trend seen previously in seaweed markets for food, hydrocolloids and abalone feed where at first, products relied exclusively on wild harvested supply, while later on cultivated seaweeds took an increasing share of supply. Secondly, that the current lack of clear leaders in the market has led to a proliferation of products, suggesting consolidation of the sector lies ahead.

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References

AgroPages (2023) Bionema stimulates organic growth with a new range of biostimulants. Grainews. https://news.agropages.com/News/NewsDetail---47207.htm

Algapelago (n.d.) Products — algapelago.. https://www.algapelago.com/about. Retrieved June 17, 2024

Algas Organics (2023) Algas organics on linkedin: This under 30 founder is harvesting seaweed to save our coastlines. https://www.linkedin.com/posts/algas-organics_this-under-30-founder-is-harvesting-seaweed-activity-7055842206409994240-HJXE/

Anuar MSK, Hashim AM, Ho CL, Wong M-Y, Sundram S, Saidi NB, Yusof MT (2023) Synergism: Biocontrol agents and biostimulants in reducing abiotic and biotic stresses in crop. World J Microbiol Biotechnol 39:123

Atlantic Mariculture (2024) Organic seaweed & oyster farming. https://www.atlanticmariculture.co.uk/

Bajpai S, Shukla PS, Prithiviraj B, Nivetha N (2024) Editorial: development of next generation bio stimulants for sustainable agriculture. Front Plant Sci 15:1383749

Buckley C (2024) After shutting down, these golf courses went wild. The New York Times https://www.nytimes.com/2024/02/15/climate/golf-courses-conservation-nature.html

Cabello DF (2023) Compañía italiana compra el 51% de PatBio, startup chilena que creó bioestimulantes en base a algas. La Tercera. https://www.latercera.com/pulso/noticia/compania-italiana-compra-el-51-de-patbio-startup-chilena-que-creo-bioestimulantes-en-base-a-algas/CGIWMX2J7JHZXPDHDTVPESVMG4/

Câr-y-Môr (n.d.) Seaweed Biostimulant. https://www.carymor.wales/biostimulant. Retrieved June 17, 2024

Cascadia Seaweed (n.d.) Biostimulants. Cascadia Seaweed Products. https://www.cascadiaseaweed.com/cascadia-plant-health. Retrieved June 17, 2024

ClimaCrew (2023) ClimaCrew on linkedin: #marine #kappaphycus #maharashtra #gujarat #plant #growth #promoters. https://www.linkedin.com/posts/climacrew_marine-kappaphycus-maharashtra-activity-7097527896113623042-a0KG/

Critchley A (2024). Conversation in the margin of the opening of the Tropical Seaweed Research Center [Personal communication].

Davidson L (2023) Conversation at Seagriculture EU 2023 [Personal communication].

Del Buono D (2021) Can biostimulants be used to mitigate the effect of anthropogenic climate change on agriculture? It is time to respond. Sci Total Environ 751:141763

G.O.A.L. (2023). G.O.A.L. on LinkedIn: Sealife Organics is busy setting up its new production plant at Bel Ombre. https://www.linkedin.com/posts/goal23_sealife-organics-is-busy-setting-up-its-new-activity-7140318237757431808-mc-R/

Gomiero T, Pimentel D, Paoletti MG (2011) Is there a need for a more sustainable agriculture? Crit Rev Plant Sci 30:6–23

GreenWave (2023) Seaweed-Powered agriculture: Biostimulants bridge land and sea. GreenWave. https://www.greenwave.org/blog-who-farms-matters/agrisea-biostimulant

Hayashi L, dos Santos AA, Ventura TFB, Landuci FS, Gelli VC, Castelar B (2024) *Kappaphycus alvarezii* farming in Brazil: A brief summary and current trends. In: Critchley AT, Hurtado AQ, Neisch IC (eds) Tropical phyconomy coalition development: focus on eucheumatoid seaweeds. Springer, Cham, pp 113–120

Hermans S (n.d.) A database of seaweed organisations. Phyconomy https://phyconomy.net/database/. Retrieved June 17, 2024

Hermans S (2024). Sea6 Energy: Thinking big about tropical seaweeds. The Fish Site https://thefishsite.com/articles/sea6-energy-thinking-big-about-tropical-seaweeds

Jacobs D (2022) For the sake of the soil: How the perception of biostimulants has changed. CropLife. https://www.croplife.com/special-reports/for-the-sake-of-the-soil-how-the-perception-of-biostimulants-has-changed/

Jacobs D (2024) The biostimulants gold rush: What's driving demand in the plant health market? CropLife. https://www.croplife.com/special-reports/the-biostimulants-gold-rush-whats-driving-demand-in-the-plant-health-market/

Jensen A, Jorgensen TH (2022) Extracts of *Saccharina latissima* and *Ulva lactuca* affect the balance between growth and immunity in *Arabidopsis thaliana*. J Appl Phycol 34:2201–2209

Kaly Group (2024) Kaly Group on LinkedIn: this week Kaly Group have been distributing its first trial biostimulant. https://www.linkedin.com/posts/kaly-group_this-week-kaly-group-have-been-distributing-activity-7169321702936535040-4mK9

Kelp Blue. (2023). StimBlue+. Kelp Blue Biotech. https://biotech.kelp.blue/stimblue/

Kelpinor (n.d.) Plant health. https://www.kelpinor.no/plant-health. Retrieved June 17, 2024

Mendes R, de Barros I, D'Andréa PA, D'Andréa-Kühl MSC, Rodrigues GS (2023) A multi-attribute approach to evaluating the impact of biostimulants on crop performance. Front Plant Sci 14:1214112

Merfield C, Johnson M (2020) Understanding biostimulants, biofertilisers and on-farm trials. The BHU Future Farming Centre, Lincoln, NZ 13. https://www.bhu.org.nz/future-farming-centre/information/bulletin/2016-v1/understanding-biostimulants-and-biofertilisers

Morales-Sierra S, Luis JC, Jiménez-Arias D, Rancel-Rodríguez NM, Coego A, Rodriguez PL, Cueto M, Borges AA (2023) Biostimulant activity of *Galaxaura rugosa* seaweed extracts against water deficit stress in tomato seedlings involves activation of ABA signaling Front. Plant Sci 14:1241441

Nephali L, Piater LA, Dubery IA, Patterson V, Huyser J, Burgess K, Tugizimana F (2020) Biostimulants for plant growth and mitigation of abiotic stresses: a metabolomics perspective. Metabolites 10:505

North Sea Farm Foundation (2018) Identification of the seaweed biostimulant market

Patagonia Biotecnologia (n.d.) Patagonia Biotecnología SpA. Retrieved June 17, 2024, from https://www.patbio.com/

Sabah Publishing House (2023) Sabah to gain from bio-based initiatives. Sabah Publishing House Sdn Bhd. https://www.dailyexpress.com.my/news/216788/sabah-to-gain-from-bio-based-initiatives/

Shekhar DJ (2023) Sea6 Energy: Farming the ocean, and exploring the possibility of making crude oil from seaweed. ForbesIndia. https://www.forbesindia.com/article/innovation/sea6-energy-farming-the-ocean-and-exploring-the-possibility-of-making-crude-oil-from-seaweed/87569/1

Shukla PS, Prithiviraj B (2021) *Ascophyllum nodosum* biost imulant improves the growth of *Zea mays* grown under phosphorus impoverished conditions. Front Plant Sci 11:601843

Shukla PS, Borza T, Critchley AT, Prithiviraj B (2016) Carrageenans from red seaweeds as promoters of growth and elicitors of defense response in plants. Front Mar Sci 3:81

SIRPUTIS (2024a) SIRPUTIS on linkedin: #pumpingkelp #fillingibcs #biostimulantproduction. https://www.linkedin.com/posts/sirputis_pumpingkelp-fillingibcs-biostimulantproduction-activity-7184475866200956929-QO5-/

SIRPUTIS (2024b) SIRPUTIS on linkedin: #seaweedfinecutting #biostimulantsextraction #sirputis. https://www.linkedin.com/posts/sirputis_seaweedfinecutting-biostimulantsextraction-activity-7187073203893067777-buT1/

SOS Carbon (2024) SOS carbon on linkedin: #soscarbon #plansos #lcmsystem #lcm #seaweed #climateaction. https://www.linkedin.com/posts/soscarbon_soscarbon-plansos-lcmsystem-activity-7188624446713143296-dbzL/

Sujeeth N, Petrov V, Guinan KJ, Rasul F, O'Sullivan JT, Gechev TS (2022) Current insights into the molecular mode of action of seaweed-based biostimulants and the sustainability of seaweeds as raw material resources. Int J Mol Sci 23:7654

Tahat MM, Alananbeh KM, Othman YA, Leskovar DI (2020) Soil health and sustainable agriculture. Sustainability 12:4859

The Nature Conservancy & Bain & Company (2023) Analysis of farmed seaweed carbon crediting and novel markets to help decarbonize supply chains. https://www.nature.org/content/dam/tnc/nature/en/documents/SeaweedMarketsAnalysis.pdf

Top S, Vandoorne B, Pauwels E, Perneel M, Labeke M-CV, Steppe K (2023) Plant sensors untangle the water-use and growth effects of selected seaweed-derived biostimulants on drought-stressed tomato plants (*Solanum lycopersicum*). J Plant Growth Regul 42:5615–5627

Verplancken B (2023) Recent insights into the mode of action of seaweed-based plant biostimulants. European Biostimulants Industry Council. https://biostimulants.eu/wp-content/uploads/2023/01/20230116-EN-Seaweed-WhitePaper-v11.pdf

Wadzilt (2023). Biostimulant. WADZILT. https://www.wadzilt.nl/biostimulant-salivital/