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Biostimulants
2017

Markets; Companies; Products; Key Drivers; Legislation; Crops; Formulation; R&D

Contents

Figures & Tables

Executive Summary

Introduction

Plant biostimulants are a diverse group of substance and microorganisms, including seaweed extracts, humic acids and amino acids, which can be delivered as a foliar spray or to the seeds or roots of plants. They modify plant physiology to improve efficiency and resilience, which can lead to higher crop yield and quality. Confusingly, these products sometimes go by other names, such as elicitors, plant strengtheners and conditioners, phytostimulants, phytoprotectants, biofertilisers, bioactivators, or soil, yield, crop and plant growth enhancers.

The exact definition varies between countries. In the EU, biostimulants will be regulated for the first time on an EU-wide basis under the proposed legislation to update fertiliser Regulation 2003/2003. In the US, fertiliser is regulated at state, rather than federal, level.

In the past, many retailers sold products of dubious benefit and quality. However, in recent years, manufacturers have organised trade associations and invested in scientific research, while tougher regulations are ensuring that today plant biostimulants are winning a reputation for reliability.

The use of biostimulants may benefit plants, the soil and the environment. A great many beneficial effects to plants have been ascribed to biostimulants, leading to improved yield and crop quality. For the soil, humic substances improve soil structure, while biofertilisers add microflora.

Research into modes of action is still in its infancy, and molecular biology may open up the understanding of how these products work. Most products are derived from natural sources, and contain a mixture of substances, which may act synergistically to produce the biostimulant effect.

Types of biostimulants

Biostimulants can be split into: humic substances; seaweed extracts; free amino acids and other nitrogen containing substances; other complex organic materials; chitosan and chitosan derivatives; anti-transpirants; beneficial chemical elements; inorganic salts; and microorganisms. Some biostimulants might fit into more than one category. The most used plant biostimulants are humic substances, amino acids and kelp extracts.

Biostimulant market

Sales data is difficult to collect and variable for the burgeoning market for crop biostimulants. This is partly due to definitions varying from country to country; a lack of data from individual countries; and a fragmented

market. In comparison with the crop protection markets, sales of biostimulants are very much smaller, although the market is growing rapidly. Estimates typically put sales at around $1.5 billion in 2015, rising at a CAGR of between 10-12%, and reaching around $3 billion by 2022. With few real figures to go on, and with the tendency of researchers to move towards a common value to ensure credibility, it is hard to be certain.

Drivers of the market include: the growing population, particularly of middle-class consumers; growing interest in sustainability; ability of biostimulants to improve produce quality; new innovative products; better organisation of manufacturers; improved knowledge of farmers; and increased promotion of biostimulants. Factors impacting the market include a lack of knowledge and lack of legislation.

Regions

Europe is the largest market for plant biostimulants. EBIC estimates that biostimulants sales in the EU reached around €578 million ($640 million) in 2015, with an additional €250 million ($277 million) in exports. Sales were growing at an estimated CAGR of 12-13% (Michalopoulos, 2016). Mediterranean countries, particularly Spain, Italy and France, are leading the way for production and usage.

The North American market for biostimulants is dominated by the US, with perhaps three quarters of sales in the region. MicroMarketMonitor's claim that the US market for biostimulants is growing at a CAGR of 14.1% is a high estimate. Kline, for example, predicts the market will rise at less than 10% a year. It estimates mixtures of biostimulants and microbials comprise almost 80% of US biostimulant sales (Kline, 2016). The market is currently hampered by the lack of overarching biostimulant legislation in the US. The need to register biostimulants under fertiliser legislation at state level makes it difficult for companies to register easily these products across states.

The Latin American market crop protection market has been hit by low crop prices, unfavourable weather conditions and high distributor inventories. The first factor in particular may hit biostimulant sales. However, there is still plenty of growth potential. Brazil is generally agreed to dominate the biostimulant market in Latin America, followed by Argentina. The Brazilian government is promoting the switch to organics, which should boost biostimulant sales.

For the Asia/Pacific region, India and China are major markets, along with Japan. The Indian government's promotion of organic farming is one factor that is encouraging the uptake of biostimulants, particularly biofertilisers. Government investment has helped India to become one of the leaders in biofertiliser technology. While the emphasis is on the development of indigenous biofertilisers often using waste products, it does create a generally conducive environment for biostimulants.

In China, the market is fragmented. Food scandals have boosted demand for organic produce, although high costs put organics out of reach of many people. In addition, many lack confidence in certification scheme. Another factor that may encourage the use of biostimulants is the increasingly recognised problem of polluted soils. There is an opportunity for biostimulants to play a part in soil remediation. Some overseas companies operate solely through distributors. Others have chosen to operate closer to the market, opening offices or forming joint ventures.

Crops

Initially, biostimulants were used mainly in organic farming, or confined to the higher-value fruit and vegetable markets. Their use is now expanding, to conventional agriculture and to a broader range of crops.

However, organic farming accounts for only a small proportion of total agricultural land – estimated at just 0.99% in 2014 (IFOAM, 2016). With the emphasis now on sustainability across the whole agricultural sector, the scope is increasing to promote biostimulants on non-organic crops, as part of integrated crop management, aiming at cutting back on the use of other chemical inputs, while increasing crop yield and quality. Therefore, there is huge potential for growth.

Field crops are generally considered to be the largest market for plant biostimulants. While their use is less established than for the fruit and vegetable sector, field crops cover a much larger area. For example, some 186 million ha of maize were harvested in 2013, compared with just 7 million ha of grapes (FAOSTAT). The market has huge potential for growth. However, so far biostimulants are generally seen as an option rather than as a necessity, unlike fertilisers and crop protection products.

For fruit and vegetables, potential benefits include higher yields and better quality produce. For fruit specifically, setting may be improved, along with uniformity. Quality is a major issue for fruit and vegetable growers, particularly as supermarkets have increasing power, and are only willing to accept high-quality uniform specimens. The high value of the produce means growers have more leeway to experiment, as a small increase in yield can pay for the cost of the biostimulant, while an insurance spray may also be worth considering. Globally, the EU is the largest market for biostimulants on fruit and vegetables.

The global turf and ornamentals market for biostimulants is dominated by Europe. Some estimates suggest the market is growing with a CAGR of over 10%. For turf, sports areas, particularly golf, is driving this growth. The market for biostimulants on turf is fragmented, with many companies selling low-turnover products, many of which are aimed primarily at other crops and ornamentals.

Formulations

Biostimulants are typically applied to the crop or soil at very low concentrations alongside crop protection products, fertilisers or other plant inputs, or applied as part of a seed treatment. Therefore, the formulator has to consider the mode of application to ensure the formulation fits into the grower’s existing regime.

Liquids are often specifically formulated for use as a tank mix with liquid fertilisers. The label may also specify an option to tank mix with pesticides. One caveat is that living microorganisms found in biofertilisers must generally be kept apart from fungicides.

While most biostimulants are used as foliar or soil treatments, some are used as seed treatments. The advantage is that they can encourage fast early growth and root development, improving germination, and enabling plants to survive adverse conditions.

R&D

In the past, many biostimulants were sold without the backing of sound scientific research and evidence. As a result, many end users lost confidence in the products. It is only recently that a more scientific research-based approach has developed, backed up by comprehensive evidence from the field.

It takes around two to five years to bring a new biostimulant product to market from the first concept. One of the companies at the forefront of research has been Valagro, with its GeaPower platform to develop biostimulants.

In recent years, the leading agrochemical companies have also realised the potential of biologicals, and many have made acquisitions or forged partnerships in this sector, particularly for R&D. While often driven by biopesticides, much of the technology also benefits the biostimulants sector. For example, recent deals include: Syngenta's partnership with DSM Food Specialties; Bayer's strategic research collaboration with Forschungszentrum Jülich; BASF's agreement with Plant Advanced Technologies; Dow AgroSciences's agreements with bio-engineering company Synthace; genomics company Radiant Genomics and biotech company TeselaGen Biotechnology; and Monsanto's multi-year research agreement with Second Gene.

Plant biostimulants are typically based on extracts of natural products, and contain naturally occurring combinations of chemicals, so are generally not eligible for product patents, although the manufacturing process may be patentable. The potential lack of product patents means that companies may invest in R&D without the assurance of patent protection to prevent copies/reverse engineering of biostimulant products.

Legislation

While plant biostimulant products are traded internationally, regulations vary widely between countries, and even between states within the US and EU. This has acted as a barrier to the nascent industry. Generally, humic acids and amino acids tend to be treated as fertilisers, while seaweed extracts, with their high levels of growth regulators, are sometimes registered as PGRs under pesticide regulations.

In the EU, proposals are afoot to revise Fertiliser Regulation 2003/2003, extending its scope to include, among other things, plant biostimulants.

In the US, fertiliser is registered at state level rather than federal level. There are therefore a number of different, and often conflicting, standards for managing fertilisers, plant or soil amendments and/or biostimulants. This makes it difficult for many companies to register biostimulants in a number of US states.

For a comprehensive report about biostimulant legislation, see Agrow's Global Biostimulant Regulations 2016, published by Informa UK (Guest, 2016).

Companies – background information

The biostimulants sector is dominated by many small and medium-sized enterprises (SMEs). These have been encouraged by the lack of registration requirements, and resulting low barriers to entry. Companies come from various backgrounds. These include: agrochemical companies; fertiliser companies; research organisations; companies that have a ready supply of raw materials; and biopesticide companies.

The nascent biostimulant industry has only recently begun to establish effective industry associations. This is particularly notable in the EU – propelled by the impending changes to fertiliser legislation – and the US. The US Biostimulant Coalition and EBIC are discussed below, as is the AAPFCO, which regulates fertiliser legislation in the US.

Companies – profiles

This section profiles some of the main companies involved in the biostimulants sector: Acadian Seaplants, Agrinos, Arysta LifeScience, BASF, Biostadt, Isagro, Italpollina, Koppert Biological Systems, Leili Group, Tradecorp International, and Valagro.

a frequently reported benefit is increased plant uptake of nutrients (including nitrogen, phosphorus, potassium, iron, calcium and magnesium).

- Amelioration of abiotic stress – such as tolerance to salinity stress and drought stress.
- Plant physiology and metabolism – humic substances improve soil structure and fertility. Some humic acids can be absorbed by the root to exert direct effects on plant metabolism. This may be through auxin-like effects, or through an antioxidant role.

For further information and references to research, see Calvo et al, 2014.

While increasingly popular in organic farming, humic products are also starting to be used in conventional systems. They may be used alone or blended with fertilisers. The main formulations are granules, liquids and powders. Broadly speaking, some manufacturers claim that fulvic acid, due to its small size, penetrates the leaves and roots, making it more suitable for foliar sprays and root drenches, while humic acid is best used as a soil conditioner. However, others disagree. Examples of formulations of humic products are shown in Table 1.

Table 1: Formulations of humic substances used in agriculture

Formulation	Product	Application Method
Granules	Humate, Leonardite, Oxidized Lignite, Humalite	Broadcast or in-row
	Coated, prilled or combined products	Broadcast or in-row
	Blended fertilisers with humic products	Broadcast or in-row
Liquids	Liquid Humic Acids	In-row or foliar, with or without other inputs
	Liquid Fulvic Acids	Foliar with nutrients
Powders	Soluble Humic or Fulvic Acids	In-row or foliar
	Suspendable Humic Substances	In-row or foliar

Source: www.humictrade.org/crops-and-soil

Manufacturers of humic products tend to be located where there is a good source of raw material, particularly the US, China and Russia.

Sales of humic products are expected to rise, particularly where they are seen as an environmentally friendly way to boost crop yields and improve the soil. A major barrier has been a lack of consistency of definitions and standards. In North America, the industry association has been working with regulators to develop these. This means that products can be tested and compared. Manufacturers will be able to supply an analysis of the levels of active substances in their products to back up efficacy claims.

This compares with the early days of the industry, where some producers made exaggerated claims for their products. Some based these claims on the colour of the product – a deep brown or black colour being compared with rich fertile soils and lush plant growth. This, however, was not always backed up by evidence, and many products had few or no humic acids.

Non-protein amino acids may play roles in stress responses and other responses. Many of these are specific to certain types of plants, and are also toxic to herbivores. Vranova reviewed the literature, listing those that had been shown to have some activity in plants, including anti-herbivory and plant protection activity. Some are shown in Table 6 alongside their biostimulant effects.

Table 6: Some non-protein amino acids and their potential use as biostimulants

Non-protein amino acid	Activity
Beta-aminobutyric acid	Protection against stress
Dopamine	Inhibition of auxin oxidation and sugar metabolism, stress protectant, growth stimulator
Glycine betaine	Metal uptake, protection against stress, inducer of nod gene expression
Homoserine	Signalling
Hydroxyproline	Structural
Homoarginine	Inhibitor of arginine decarboxylase
Methionine sulfoximine	Inhibitor of photosynthesis, nitrate and ammonium assimilation, plant growth
Ornithine	Protection against stress, intermediate of primary metabolism
Pipecolic acid	Flower inducing activity, osmoprotectant
Serotonin	Flowering, morphogenesis, growth regulation, adaptation to environment changes, retardation of leaf senescence
Alpha-amino butyric acid	Inductor (ethylene production), activator (malate dehydrogenase)
Beta-alanine	Protection against stress
Gamma-amino butyric acid	Role in metal uptake, plant growth and development, signalling, pH regulation, protection against oxidative stress, energy production and maintenance of carbon/nitrogen balance, alternative pathway for glutamate utilization, fruit ripening, role in guidance of pollen through female tissue

Source: Vranova, V et al, 2011.

Free amino acids and peptides can be produced by chemical synthesis. Alternatively, chemicals (acids or alkalis), enzymes or other methods (eg microwaves) are used to break down protein substrates, including industrial by-products, such as crop residues, and animal collagen and epithelial tissues. These by-products can be variable, leading to a variable end product.

The main amino acid biostimulants tend to be of animal origin.

Nitrogen containing biostimulants are mainly used as foliar application, although some are used as soil applications and seed treatments. In soil applications, this will affect the microbial flora and improve soil structure. They are also often used in mixtures.

Notable companies in this sector include SICIT 2000.

Table 8: Microorganisms etc in Lebanon Seaboard's ironROOTS product	
Ingredient	**Concentration**
Microorganisms	**Viable propagules/gram**
23.3% Mycorrhizal fungi	
Pisolithus tinctorius	1,600,000
Rhizopogon amylopogon	80,000
Rhizopogon fulvigleba	80,000
Rhizopogon luteolus	80,000
Rhizopogon villosulus	80,000
Scleroderma cepa	40,000
Scleroderma citrinum	40,000
Laccaria bicolor	16,000
Laccaria laccata	16,000
Glomus intraradices	21
Glomus mosseae	20
Glomus aggregatum	20
Glomus clarum	1
Glomus monosporum	1
Glomus deserticola	1
Glomus brasilianum	1
Glomus etunicatum	1
Gigaspora margarita	1
Other ingredients	**Percentage**
Humic acids (derived from Leonardite)	18%
Vitamin C (ascorbic acid)	7.3%
Amino acid (glycine)	4.5%
Myo-Inositol	2.0%
Surfactant (polyalkylene oxide modified siloxane)	2.0%
Vitamin B1 (thiamine mononitrate)	1.3%
Vitamin E (alpha-tocopherol)	0.6%
Source: Lebanon Seaboard	

2.12 References

Websites:

Acadian Seaplants: www.acadianseaplants.com

- Foltron is aimed at the vegetative stage, and supplies NPK, iron, zinc, magnesium, manganese, boron, copper, molybdenum and folcystein. It can be used on: fruit (apple, citrus, cucumber, melon, peach, pepper, strawberry, tomato, walnut, watermelon); cereals (barley, maize, oats, rice, sorghum, wheat); legumes (alfalfa, beans, peas, soybeans); and other field crops (cotton, potato).
- Biozyme is a plant extract mainly for fruit and vegetables for use at the flowering and fruiting stage, which supplies the trace elements, magnesium, sulfur, manganese, iron, zinc and boron. It can be used on: fruit (citrus, cucumber, eggplant, grape, melon, pepper, pomegranate, strawberry, tomato, watermelon); vegetables (mustard); cereals (rice, wheat); legumes (beans); and ornamentals (roses).

Yield and quality benefits are key factors across most crops

While yield is always an important driving factor for growers to use biostimulants, quality characteristics are also important, particularly for fruit and vegetables. These characteristics include homogeneity, colour and increased size, as farmers can often achieve higher prices for larger fruit of uniform size. In addition, some biostimulants claim better fruit setting, and produce may be more tolerant of storage and handling.

The range of benefits is illustrated by Arysta's product range (see Table 12). Yield and quality are the two most claimed benefits, as these are often the overriding criteria when developing a product. As companies carry out more research, the range of benefits claimed will increase. Better nutrient uptake may also be a factor in improved vegetative growth. Improved plant establishment is increasingly seen as an important benefit, particularly where plants are under stress.

Table 12: Biostimulant benefits claimed for Arysta's products

	Yield	Fruit set	Flowering	Establish-ment	Vegetative growth	Abiotic stress	Qua-lity	Nutrient uptake
Fruit and vegetables								
Apple	X	X	X			X	X	X
Strawberry	X	X	X	X	X	X	X	X
Grape	X	X	X	X			X	X
Tomato	X	X	X	X	X	X	X	X
Pepper	X	X	X	X	X	X	X	X
Cucumber	X	X	X	X	X	X	X	X
Row crops								
Beans	X	X	X		X		X	X
Maize	X				X			X
Wheat	X				X	X	X	X
Rice	X				X		X	X
Oilseed rape	X		X	X		X	X	X
Potato	X			X	X		X	X
Sugarcane	X						X	
Sugar beet	X					X	X	
Ornamentals								
Roses	X		X	X		X	X	X

Source: www.cropbenefits.com, November 2016

Table 14: EBIC survey – company business areas			
Type of enterprise	**Home market (%)**	**Other EU countries (%)**	**Non-EU countries (%)**
Large	20	30	50
	15	18	67
	1	2	98
Medium	75	10	15
	70	25	5
	40	50	10
	35	25	40
	35	25	40
	25	50	25
Small	50	30	20
	30	0	70
	20	20	60
Source: Arcadia International, 2014			

As an illustration to the types of company involved, a study in 2016 considered biostimulant products available for use on cereal and/or OSR crops in the UK (Storer, 2016). Although not claiming to be an exhaustive list of the biostimulants available for those crops, it does illustrate the range of companies involved.

- **Companies with crop protection interests** – these included Arysta, a market leader in plant biostimulants, which sells Atonik (phenolate-based product), and two seaweed extracts, Multoleo and Rooter. FMC was represented by its UK subsidiary, Headland Crop Nutrition. French company De Sangosse was also present with its Radiate seed treatment.
- **Manufacturing and formulation specialists** – These were Biotechnica, part of the Stan Chem group of companies that manufactures specialist materials for many industries. Established in 1993, Biotechnica offers one of the most comprehensive ranges of agricultural biostimulants and biofertilizers, and is the UK's largest manufacturer of seaweed extract. Another company, Micromix, formulates and produces own-label products for customers. It concentrates on micronutrients and foliar applied fertilisers. A third, Omex, specialises in fluid dynamics, allowing it to manufacture complex liquid formulations for use in many industries, including agriculture.
- **Microbe specialists** – Symbio is an environmental biotechnology company that specialises in selecting and applying mycorrhizae, soil bacteria and fungi. PlantWorks, which has pioneered the international licensing of manufacturing know-how and equipment for the production of mycorrhizal fungi.
- **Humic acid specialist** – Neotech-Agri supplies products based on humic acids, including biostimulants, and is the exclusive distributor in the UK and Ireland for Humintech products.

Companies various backgrounds are discussed in the following sections.

Table 18: Agrinos Group revenues, 2014-2015					
	NOK million			$ million	
	2014	2015		2014	2015
Total operating revenue	44.9	54.7		7.2	6.7
Comprising:					
a) Sales revenue	39.4	52.9		6.3	6.4
b) Other operating revenue	5.5	1.9		0.9	0.2
Total operating expenses	-266.2	-317.1		-42.4	-34.8
Net loss after tax	-185.3	-243.5		-29.5	-26.2
Source: http://agrinos.com/sites/default/files/Agrinos_Annual_Report_2015.pdf					

In 2015, Asia/India accounted for 47.9% of sales revenues, thanks to a doubling of turnover. China is a key target market. In 2011, Agrinos formed a joint venture there with Beijing Sinagri Co Ltd. It holds a 60% stake in the joint venture, Beijing Agrinos Biotech Co Ltd. Sales and marketing were initially directed towards the retail sector, governments and large institutions. In July 2014, Agrinos formed a cooperation agreement with Kingenta (see below).

North America accounted for a further 32.6% of sales revenue, with the US the major market, and Latin America 11.6%. In Brazil, Agrinos operates through its wholly owned subsidiary, Agrinos do Brasil Ltda. The company's key strategic crops are sugar cane, maize, cotton, soybean and degraded land. The first commercial sales were in 2013.

Agrinos also has subsidiaries in: Spain (Agrinorway Iberica SL), UK (Agrinos UK), Malaysia (84.7% holding in Agrinos Malaysia Sdn Bhd), and Indonesia (55% holding in PT Agrinos Indonesia). In Mexico, the company operates through Agrinos Corporate Services, Bioderpac, and Agrinos Mexico. In 2014-5, Agrinos closed its business units in Colombia, Peru and Ghana.

10.2.2 Products

The company's main products are based on its proprietary HYT. This strengthens the soil-based microbial ecosystem, stimulates crop development at key points in the growth cycle, and boosts natural plant resistance to pathogens and threats. It acts synergistically with conventional fertilisers to improve nutrient delivery to the plant. Application methods vary from handheld sprayers to large-scale industrial liquid fertiliser projects. The system is made up of three components (A, B and C) that function together. How they are used depends on the crop type, soil, farm management practices and goals of the farmer. All are suitable for organic systems, and have Organic Materials Review Institute (OMRI) certification in the US.

HYT A – a prototype invented in the 1980s, and tested internationally in the 1990s. It was first produced in the US, then later Mexico. It is a liquid concentrate containing naturally occurring soil-based microbes, and is also sold as iNvigorate. Agrinos reports that it improves: plant growth and development; plant and produce quality; and soil structure and fertility. This is achieved because it:

10.5.2 Products

Biostadt's flagship product is the biostimulant, Biozyme, available in granular and liquid formulations. This is produced from *Ascophyllum nodosum* by fermenting dried granulated seaweed powder using a special process acquired from a US company. Described as Biostadt Induced Lacto-fermentation Technology (BILT), the process involves fermentation with Lactobacilli. Biozyme is rich in cytokinins and auxin precursors, enzymes and hydrolysed protein.

The company started selling Biozyme in 1986. By 2003, Biozyme was used on a wide range of crops. In Asia, the Middle East and Europe, the company used the Wokozim brand name. In 2014, the company said that Biozyme was India's top-selling plant growth stimulant. It made annual sales of Rs150 crores (Rs 1,500 million – around $26 million), and was one of the few Rs100 crore-plus brands in the Indian agro chemical industry (Singh, undated).

The company's main biostimulants are shown in Table 21. All are based on seaweed extracts, and some have additional plant and animal extracts.

Table 21: Biostadt's main biostimulants

Brand	Ingredients
Amaze-X	Seaweed extract, micronutrients, amino acids, and humic acid
Biocane	Seaweed extract in a granular formulation for use on sugar cane
Biozyme	Seaweed extract; available in liquid and granular formulations, some with animal extracts, for a variety of crops
HiTone	Seaweed extract for flowers, lawns and gardens
Hy-Zyme	Seaweed extract; available in liquid and granules for a variety of crops
Maxigrain	Seaweed extract with plant and animal extracts in a liquid formulation for rice and maize, sold in the Philippines
Maxizyme	Seaweed extract; available in liquid and granules for a variety of crops
Multicote	Granular formulation for sports turf, sold in the Philippines
Nanozim	Seaweed extract; available in liquid and granules, and is aimed mainly at horticultural crops; some formulations have additional plant and animal extracts
Rejoice	Seaweed extract, amino acid, carbohydrates and potassium in a wettable granule formulation
Techzyme Granules	Seaweed extract in a granular formulation, and certified organic by Ecocert
Wokozim	Seaweed extract; available in liquid and granules for a variety of crops, the brand is aimed mainly for exports; some formulations have additional plant and animal extracts

Source: Biostadt.

Amaze-X

In 2013, the company launched the novel seaweed extract Amaze-X in India. Amaze-X is a granule formulation that contains seaweed extract, organic nitrogen, potassium, micronutrients (magnesium, calcium and silica), proteins, amino acids, carbohydrates, and humic acid. It dissolves in water and can be mixed with fertilisers. It is used on fruit and other crops.

10.7.2 Products

Italpollina offers a broad portfolio of liquid fertilisers and biostimulants containing amino acids and peptides from plants, extracts from the Amazonian rainforest and beneficial microbials. Many, including Trym, Trainer, Auxym, Condor, TIFI and Coveron (see table below), are certified for use in organic farming. Italpollina's products are split into:

- Specialties, which include biostimulants, such as plant strengtheners, beneficial microbials, amino acids and liquid fertilisers used for fertigation (see Table 23)
- Altea, which sells products for the garden, professional turf and hydroseeding (applying a slurry of seed and mulch over prepared ground). Products include biostimulant Attiva (based on plant extracts) and mycorrhizal inoculants for home and professional gardeners
- Organics and organic minerals

Table 23: Italpollina's main biostimulants falling under specialties

Brand	Ingredients
Plant strengtheners	
Phosphit-One	Foliar liquid feed containing NPK + amino acids from plants, promoting cell wall thickening and lignification
Trym	Trace elements (boron, zinc, manganese) + extracts from tropical plants, increasing plant enzyme activity
Beneficial microbials – containing rhizosphere bacteria, plus:	
Aegis range	*Glomus intraradices* + *G mosseae*
Condor	*Trichoderma atroviride* (Italpollina strain)
TIFI	*Trichoderma atroviride* (Italpollina strain) + *Glomus* spp
Seed inoculants – containing *Glomus intraradices*, *G mosseae*, *Trichoderma atroviride* and rhizobacteria	
Coveron	Liquid formulation for commercial seed treatment of winter cereals. It increases resistance to abiotic stress, lodging and drought, improves nutrient absorption and increases yields.
Team	Formulated as a micronized powder for dry application directly to the seed in the hopper, it is for use on cereals.
Biostimulants	
Auxym	Liquid fertiliser with plant extracts + trace elements (boron, iron, manganese, copper and zinc), it promotes fruit set, increases production and fruit quality
Click Fruit, Click Horto	*Glomus intraradices* + *Trichoderma atroviride* + rhizosphere bacteria.
Amino acids of plant origin	
Trainer	Amino acids + plant peptides
Fertigation with humic acids	
Oasi range	Plant extracts + macro/micro nutrients + organic matter

Source: Italpollina.

Table 26 Tradecorp's main biostimulants and humectants	
Trade name	**Description**
Biostimulants	
AlgaeGreen	Seaweed extract from OGT acquisition
Aton range	Range based on L-α amino acids with micronutrients for stress conditions and critical periods of crop development
Phylgreen range	Range of solutions based on Gentle and Low Temperature (GLT) extract of *Ascophyllum nodosum* to activate plant metabolism in all development stages – see OGT acquisition
Boramin Ca	Solution of L-α-amino acids and active and mobile calcium, enriched with boron
Ruter AA	Complete activator of enzymatic processes and stimulant for root growth
Delfan Range	Range of anti-stress solutions for adverse climatic conditions and critical periods of crop development, containing 17 amino acids
Humectants	
Humistar, Humifirst	Humic amendment to improve crop yield and quality, based on American Leonardite, and available as liquid and WG
Humical	Liquid humic amendment with calcium chelated by EDTA
Turbo Root	Soil conditioner and rooting agent assimilated rapidly by the crop
Source: Tradecorp	

AlgaeGreen

With the OGT acquisition, Tradecorp has acquired the seaweed extract sold under the AlgaeGreen brand. AlgaeGreen is also available in liquid lawn feed mixtures sold to the home and garden market in shop brands in Ireland and overseas. OGT's products are sold mainly for use on golf courses, football fields and other sports grounds, and also in horticulture and the lawn and garden market. AlgaeGreen improves a crop's ability to resist stress such as drought or freezing. It also gives enhanced resistance to pathogens such as viruses and nematodes. Harvested products such as cut apples or strawberries, also last longer.

Humectants

This range improves soil fertility and structure, and increases microbial activity. It favours root development, increases the absorption of nutrients and encourages vegetative development. A major product is Humifirst, a liquid concentrate based on humic and fulvic acids from American Leonardite. Its use can improve the physical, chemical and biological condition of the soil. This leads to increased root development, better absorption of nutrients and higher yield. The product has a website, www.humifirst.fr.

Biostimulants

These improve the absorption of nutrients and their effectiveness, improving crop tolerance to abiotic stress. This range includes biostimulants based on GLT (Gentle and Low Temperature) extract of seaweed and/or L-α free amino acids enriched with essential nutrients.