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Mini Review

Bioestimulantes in the Agriculture

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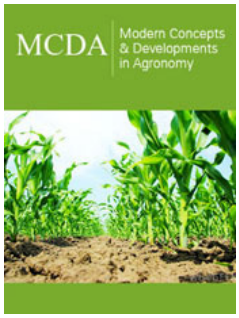
Abstract

The great challenge of modern agriculture is in the sustainable production of food without compromising natural resources. Various technologies to increase productivity have been used in agriculture, biostimulants are increasingly available in a variety of formulations and with varied ingredients on the market, therefore, there is a need for studies on agronomic benefits to ensure the viability of use in the most diverse cultures.

Keywords: Biofertilizers; Seaweed extracts; Humic substances

ISSN: 2637-7659



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Submission: April 27, 2019

Published: August 07, 2020

Volume 7 - Issue 1

How to cite this article: Josilaine Gonçalves da Silva. Bioestimulantes in the Agriculture. Mod Concep Dev Agrono. 7(1). MCDA. 000652. 2020. DOI: 10.31031/MCDA.2020.07.000652

Introduction

Biostimulants are associations that can present two or more substances that promote plant growth of a different biochemical nature, such as amino acids, nutrients, vitamins, humic substances, algae extract and microbial inoculants, and that when used in small quantities in seed treatment, applications in soil, aerial part and / or leaf, which can improve crop growth and confer tolerance to biotic and abiotic stresses [1-4]. In the scientific literature, the word biostimulant has been used widely without drawing a border between biostimulants and other widely used categories of substances applied to plants and crops: such as fertilizers and pesticides.

Market

The use of these products has grown in agriculture and our understanding of their use has been expanding considerably. The global market for biostimulants is projected to increase 11.24% per year and reached more than US $ 2.6 billion in 2019, reaching a total of US $ 4.9 billion by 2025, according to data released by the North American consultancy Markets and Markets [5].

Mechanisms of action

These products increase the water and nutrient absorption capacity, as well as the resistance to water stresses, allowing the best development of plants in suboptimal conditions [6,7]. Several studies have shown positive results from the use of these substances. The use of biostimulant had a positive effect on the speed of germination in soybean [8]. Biostimulants based on A. nodosum and Brevibacterium sp result in positive effects in most phytotechnical characteristics, being that they provided the best increase in the dry mass of the corn roots [9], and in bean seedlings were effective in promoting the initial growth [10]. Main biostimulant classes The main categories of plant biostimulants used in agriculture are:

A. humic substances,

B. complex organic materials,

C. beneficial chemical elements,

D. inorganic salts (including phosphite),

E. seaweed extracts,

F. chitin and chitosan derivatives,

G. antiperspirants and

H. free amino acids and other substances that contain N [3].

Some important categories are widely recognized by scientists and farmes, Table 1 shows the main sources of "biostimulants" and examples available on the agricultural market. Humic substances (SHs) are humidified and recalcitrant organic compounds found in soil, water, sediments and organic residues [3,11] acting on the physical, physicochemical, chemical and biological properties of the soil. Bioregulator is an organic, non-nutrient compound that, when applied to the plant in low concentrations, promotes, inhibits or modifies its physiological processes [2] Seaweed extract: Seaweeds are single-celled or multicellular beings that do photosynthesis.

Table 1: Main sources "biostimulants" and examples available in the agricultural market.

Bioestimulant Class	Example
Humics substances	Acidos húmicos, ácidos fulvicos
Biorregulators	Auxina, giberilina e citocina
Microorganisms bioactive	*Trichoderma asperellum, Bacillus methilotrophicus*
Seaweed extracts	*Ascophyllum nodosum, Ecklonia maxima*

They are nourished by the active elements of the sea and contain good concentrations of mineral salts, being a natural source of macro and micronutrients and amino acids [12]. The characteristic fertilizing potential of macroalgae has been explored for many centuries, mainly by people living in coastal areas around the world [13,14]. In plants, the nutritional effects through supply and micro and macronutrients indicate that they act as fertilizers, in addition to other roles [1,15,16]. Microbial-based biostimulants have been important since the beginning of agriculture (the use of the genus Rhizobium in legumes) and current expectations include its commercialization as a way to complement crop nutrition. The beneficial effects of microorganisms on plants depend on sophisticated nutritional and chemical signaling, as well as soil and climate factors. Plant roots release sugars, organic acids, amino acids and phenolics, which affect the composition of rhizospheric communities, leading to beneficial relationships [16].

Final considerations

Biostimulants are products with the potential to improve the resistance of plants to biotic and abiotic stresses, however little is known about its mechanism of action. There is still much to be done in this field, since a good understanding of these mechanisms can result and a more efficient generation of biostimulants for the farmer.

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