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Review Article

Potential Macroalgae Bacteria for "Plant Growth Promotion"

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Abstract

Macroalgae plays an important function for marine environment. Algal bacteria degrade algal polysaccharides, like fucoidan and alginate. Plant growth promotion (PGP) through plant growth promoting bacteria is a well-known observable fact and the growth enhancement due to certain behaviour of bacteria. These types of bacteria also gave beneficiary effect on pest, another toxic organism. PGP bacteria are a good alter native of chemical fertilizer by increasing the soil fertility.

Keywords: Macroalgae; Organism; Plant Growth Promotion (PGP)

Introduction

Macroalgae plays an important function for marine environment. It is mainly used in universal prime creation and make available food and shelter for many of microorganisms. Macroalgae exterior supplies shelter and nutrient rich components for the development of organism (Armstrong., *et al*. 2000) [1]. Macroalgae are associated with a large group of organisms and these types of organisms may be beneficial or harmful to the macroalgae. Organism that lives outer cell of macroalgae have been reported as critical for morphological growth of macroalgae. Bacteria have antibacterial assets are protect the macroalgae from pathogens and the other harm full organisms (JanakiDevi., *et al*. 2013) [2]. Many bacterial species have host specificity and bactericidal action beside specific pathogens. These activities connect the complex biochemical exchanges between macroalgae and organisms (Strobel, 2003) [3]. Algal bacteria degrade algal polysaccharides, like fucoidan and alginates (Brown and Preston, 1991) [4]. Algae produces organically active multifarious that may be capable for killing bacteria or interfere in bacterial growth (Susilowati., *et al*. 2015) [5].

Plant growth promotion through plant growth promoting bacteria is a well-known observable fact and the growth enhancement due to certain behaviour of bacteria. There have been a number of methods used by PGP bacteria that involve in plant growth and give beneficial improvement in variety of environmental circumstances. Kloepper and Schroth, (1981) [6] discussed that plant growth promoting bacteria settled for plant growth promotion and done the alteration of the microbial culture in rhizosphere position by producing the varieties of compounds. However, plant growth promoting bacteria promote plant growth openly by using their ability to provide nutrient (nitrogen, phosphorus, potassium and essential minerals) and adjust plant hormone stage, or ultimately declining the inhibitory property of many pathogens during plant growth and also involved in development of biocontrol agents, root colonizers, and environmental protectors (Gupta., *et al*. 2015) [7].

Macroalgae have been use from earliest times directly or in fertilizer form as a soil adjustment to enhance the output of crops in coastal area and for recovery of alkaline soils, which may have nutrient deficiencies. It is also discussed that in the middle of the

first century, macroalgae had been in widely use (Craigie, 2011, [8] Dixit., *et al*. 2020 [9]). That reported the many benefits of macroalgae as resource organic bioactive compound and as fertilizer these wider purpose in the agricultural field (Van Alstyne, 2003) [10]. The purpose of micronutrients from different macroalgae, which have increases plant biomass due to high amount of zinc (Tuhy., *et al*. 2015, [11] and Spalding., *et al*. 2019 [12]). In new generation macroalgae fertilizer, it is use as organic fertilizers which are rich in nutrients and also promote faster generation of seeds, increase crop yields and stimulate pathogen resistance of many crops (Sathya., *et al*. 2010 [13]). The liquid fertilizers based on seaweed extracts, initially established are now successfully used as fertilizers in agriculture (Ciepiela., *et al*. 2016) [14].

Recently, marine macroalgae are not only applied as bio fertilizers but also for soil stabilizers (Arioli., *et al*. 2015) [15]. Temple and Bomke (1988) [16] noticed that fresh kelp has an excellent effect in fine-textured soil on crop growth and nutritional response. Fertilizers from macroalgae (Fucus, Laminaria, Ascophyllum, Sargassum etc.) are biodegradable, non-toxic, non-polluting and non-hazardous for human, animals and birds (Dhargalkar and Pereira, 2005) [17].

Mishra., *et al*. (2019) [18] reported a mixture of macroalgae released high quantities of organic compound and verities of nutrients especially they are very rich in NH4-, NO3 - and NO2-, and phosphate. Their growth incentive of okra was found after foliar function (Abbasi., *et al*. 2010), induction of amylase acitivity in barleywas reported by Rayorath., *et al*. (2008) [19], effect of *Ulva* on seed germination, growth parameters, pigment and carbohydrate content of wheat studied by Shahbazi., *et al*. (2015) [20], improvement of rice and maize growth by seaweed liquid (Singh., *et al*. 2015) [21], and also development of root and shoot span with enlarged numbers of leaves. Overall growth promotion was found of *Vigna* sp. by using different macroalgae as biofertilizers (Gopalakrishnan and Binumol, 2016) [22]. Treatment with a industrial extract from *Ascophyllum nodosom* pretentious the regulation of phytohormone biosynthesis and growth in *Arabidopsis* (Wally., *et al*. 2013) [23]. The initiation of cytokinin- activity in *Arabidopis thaliana* due to the application of extracts from brown macroalgae *Aqcophylum nodosum* reported by Khan., *et al*. (2011) [24]. Many diverse of macroalgae were studied as sources of bio fertilizers (Jayasinghe., *et al*. 2016) [25].

Recently, various cases have reported on antimicrobial compounds of macroalgae (Widowati., *et al*. 2014) [26]. Marine organisms are closely associated with algae. Many studies prove that bacteria linked with algae having the antibacterial activity reported by (Ali., *et al*. 2012) [27]. throughout the world, resistance bacteria have been clinically significant that antibiotics is a major factor of macroalgae.

Several studies have exposed the anti-bacterial properties in different macro-algae (Vandeplassche., *et al*. 2017) [28]. Algae living near the sea exterior are continually showing to ultraviolet rays and oxidation air that frequently direct to the development of free radicals and other oxidants. No damage has been seen because of oxidation in the arrangement of macroalgae and also proposed that they possess defence system against oxidation (Nabti and Hartmann, 2017) [29].

However, algae have the surface of many dissimilar strains of organisms which produce potentially active compounds. It would be an equally valuable association between algae and bacteria in which this associations based on the capability of algae to generate organic materials and oxygen that was used by organism and it is called then "symbiotic bacteria." In part of resistance the bacteria engage in significant role in preserve the strength of the host organism by the creation of bioactive secondary metabolites (Bhardwaj., *et al*. 2014) [30]. Macroalgae considered as source of bioactive multifarious, which produce a great range of secondary metabolites that characterized by a broad spectrum of biological actions. Complex with cytostatic, antiviral, antihelminthic, antifungal and antibacterial manners have been investigated in green algae, brown algae and red algae (Mohammadi and Hajeb, 2013) [29]. Macroalgae have been monitored widely for isolate which are used for life saving drugs or biologically dynamic substances all over the world (Nabti and Hartmann, 2017) [27].

Conclusion

The chemical fertilizers intensification yield in agriculture and that are affluent and harm the environment. They reduce non-renewable energy via side effects, such as discharge out, and contaminating water basins, extinguishing micro-organisms and friendly insects, making the crop more susceptible to the attack of diseases, reducing soil fertility, thereby causing irretrievable damage to the overall system. The use of PGPR could be a better alternative to

chemical fertilizers. They are cost-effective, not detrimental to the environment and could easily be found.

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