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Effect of sea weed extract on growth and yield of rice

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Abstract
The major Sources of bio stimulants are Humic acid, chitosan, algae, beneficial bacteria and seaweed extract and found that the application of this bio stimulants improved the metabolic processes such as photosynthetic activities, respiration, ion absorption, leaf pigmentation, plant vigor and delayed fruit maturity. Seaweed (macro algae) are the marine plants (most under used bio resources) which belongs to the plant kingdom Thallophyta. Seaweed extracts are environmentally friendly, biodegradable, and non-toxic. It was anticipated that using seaweeds as a bio fertilizer would make up for soils that had lost or had insufficient nitrogen, phosphate, and potassium (N,P,K). Seaweed extracts like *Ascophyllum nodosum, kelp, Kappaphycus and Gracilaria* are good for rice growth and yield.

Keywords: Seaweed, Yield, bio stimulants, Ascophyllum Nodosum, kelp, Kappaphycus and Gracilaria

Introduction
The majority of people consume rice, an essential food crop that is extensively cultivated worldwide. Population of India is 136.64 crores (GoI 2019) and increasing year by year to feed the whole population farmers need to adopt new cultivation techniques which are affordable and gives high yield bio stimulants can replace the commercial fertilizers and helps to gain more yield to farmer Bio stimulants are the natural organic compounds in low quantities
which promote plant growth, nutrient availability, stress resistance, and boost the quality of the crop Rice is the world's most essential and oldest cereal food crop, and more than half of the world's population relies on it as their main source of sustenance. *Oryza sativa*, the cultivated plant, is said to have originated in Southeast Asia. Other rice species include *O. glaberrima* and *O. perennis.* Rice used for agriculture which can reach a height of 1.2 metres (4 feet). Hollow stalks support the long, flattened leaves. Large, spreading root systems are typical of fibrous plants. The panicle, which is another name for an inflorescence (flower cluster), is made up of spikelets that bear flowers and develop into fruit or grain. There are significant differences between types in the size, shape, and weight of the panicle as well as the overall yield of a plant.Seaweeds are multicellular, macroscopic creatures found in coastal and marine habitats that are high in polysaccharides, polyunsaturated fatty acids (PUFAs), enzymes, and bioactive peptides. (Courtois, 2009; Shukla *et al.,* 2016; De Jesus Raposo *et al.,* 2013; Ahmadi *et al*., 2015; Okolie *et al.,* 2018). Shallow marine seaweeds may be subjected to adverse circumstances such as excessive temperature, salt, and light. Seaweeds create different stress-related chemicals than terrestrial species, which are necessary for their survival in these conditions (Shukla *et al*., 2016). As a result, several types of seaweed are key sources of plant bio stimulants and are commonly utilized to boost agricultural production. (Khan *et al*., 2009; Sharma *et al*., 2014 [27]; du Jardin, 2015; Van Oosten *et al.,* 2017). The brown, costal seaweed Ascophyllum nodosum is the most observed seaweed and used as a source for industrial and commercial plant bio stimulants. Several commercial extracts from A. nodosum have been demonstrated to support plant development, lessen various abiotic and biotic stressors, and enhance plant defences through influencing molecular, physiological, and biochemical processes. The biostimulants made from A. nodosum are possibly the best investigated of all the seaweed-based biostimulants, with numerous modes of resistance being reported. The goal of this study is to collect modern knowledge of the bioactive compounds contained in A. nodosum extracts, as well as their mechanisms of action in boosting plant development in the face of abiotic and biotic stresses.
Seaweed extracts have been shown to boost plant growth and yield by including major and minor minerals, amino acids, vitamins, cytokinins, auxin, and abscisic acid-like growth stimulating compounds (Mooney & Van Staden, 1986). Most seaweed fertilizers are derived from kelp, a type of seaweed that may grow to be over 50 meters long. Magnesium, potassium,

zinc, iron, and nitrogen are all trace minerals present in organic seaweed fertilizers, and they are all good to plants. Nitrogen, for example, is required for the formation of nitrate, a fundamental component of plant photosynthesis.

The impact of seaweed on growth characteristics

Chetna *et al*. 2015 [7] organized a field experiment to study the effect of Seaweed Derived from Enteromorpha intestinalis as a Bio stimulant in Glycine max. Results showed that significantly higher growth was recorded maximum at a concentration of 60% SLF as compared to control. A field experiment was conducted by Shankar *et al*. (2015) [26] to study the influence of seaweed extracts on Sesame growth, yield attributes, and nutrient uptake (*Sesamum indicum* L.) found that foliar applications of seaweed extracts (*Kappaphycus and Gracilaria*) significantly enhanced the growth and nutrient uptake of sesame (Sesamum indicum L.) when plants are treated with foliar spray of seaweed extract thrice at seedling, pre-flowering, and flowering stages with different concentration where 15 per cent seaweed extract, showed the maximum plant height, dry matter, LAI, and CGR were also recorded. Akash *et al.,* (2017) [3] conducted a field experiment to study The influence of various quantities of commercial seaweed liquid extract of Ascophyllum nodosum as a plant bio stimulant on onion growth, yield, and biochemical components (*Allium cepa* L.) T3 (0.55%), had the highest average number of leaves (9.08/plant), the highest plant height (55.20cm/plant) at 80 days after transplanting, and the highest crop growth rate (33.65 g/m2/day) at 80 to 100 days after transplanting among the assessed treatments (0.55 percent) in onion.

A field experiment was conducted by Dilvarnaik *et al.* (2017) to study the effect of seaweed saps on germination, growth and yield of hybrid maize result revealed that the application of seaweed sap at a 15% concentration of either *Kappaphyccus or Gracilara* sap boosted plant height considerably. However, when the concentration is either reduced to 2.5 percent or increased to 20 percent, germination is significantly reduced in Germination percentage reductions at greater concentrations of Kappaphyccus or Gracilara seaweed sap could be owing to germination inhibition caused by high salt concentrations in seaweed saps. Al-Ghamdi *et al.* (2018) [4] conducted a field experiment to study the effect of *Ascophyllum nodosum* seaweed extracts on *Asparagus* and found that The total chlorophyll content, plant height, photosynthetic rate, transpiration rate, and stomatal conductance of asparagus plants treated with a 7 mL.L1 *Ascophyllum nodosum* seaweed extract increased significantly when compared to control. The length of the branches and the dry weight per plant per plant increased by 11.55 percent and 6.45 percent, respectively. Abbas *et al.* (2020) [1] conducted a field experiment to study the influence of seaweed extract on the growth, quality and productivity parameters of four onion cultivars. Among different concentration of seaweed extract (0% (control), 0.5% 1%, 2% and 3%), significantly higher growth paraments were recorded with application extract at the rate of 0.5 per cent compared to control.

The impact of seaweed on yield characteristics

Jadhao, *et al.*, (2014) conducted field experiment to study the effects Seaweed as bio stimulant to enhance productivity and quality of black gram results revealed that application of Seaweed extracts derived from *Kappaphycus alvarezii and Gracilaria edulis* to plants twice during the crop season at various concentrations (0, 2.5, 5, 10, and 15%). Both extracts were shown to be quite beneficial in increasing production, growth, and improving produce quality. When treated at 10% concentration, *K. alvarezii and G. edulis* extracts improved seed production by 47.52 percent and 42.52 percent, respectively. Not only that, but other yield-related characteristics such as number of pods/plant, pod weight, seed weight/plant, and seed test weight have also been improved. Pramanick *et al.,* (2014) [20] conducted a field experiment on the influence of seaweed saps on green gramme growth and yield results revealed that Foliar application of seaweed extract increased growth, yield parameters considerably. The maximum grain production was obtained with applications of 15% *Kappaphykus* sap + recommended dose of fertiliser (RDF), followed by 15% Gracilaria sap + RDF extract, which increased grain yield by 38.97 and 33.58 percent, respectively, as compared to the control. The use of 15% seaweed extract also resulted in the highest straw yield. Satapathy *et al.,* (2014) [25] conducted a field experiment to study The effect of liquid seaweed sap on summer rice yield and economics results revealed that application of seaweed (5% K sap+ RDF and 5% G sap+ RDF,) increased rice grain yield by 13.8% and 10.3% respectively, as compared to control.

A field experiment was conducted by Pal, A. *et al.* (2015) [21] to study the effect of seaweed saps on yield, economics and growth of maize (sweet corn) result revealed that significantly higher yield parameters was recorded when plants treated with 15 percent G Sap in combination of RDF produced the maximum green cob production (189.97 q ha-1) and fodder yield (345.19 q ha-1). (Akash *et al*., 2017) [3] conducted a field experiment to study The effect of seaweed (*Ascophyllum nodosum*) as a bio stimulant on growth and yield of onion. The 0.55 per cent treatment was found to be the best in terms of leaf number (9.08/plant), plant height (55.20cm/plant), crop growth rate (33.65g/m2 /day), fresh bulb diameter (5.13cm/plant), bulb fresh weight (120.21g/plant), harvest index (77.44 per cent) over control, While the extract's greater concentration indicates a declining trend. Basavaraja *et al.*, 2018 conducted a field experiment to investigate the effects of seaweed extract on hybrid maize growth, yield result revealed that Grain yield improved considerably by 18.54 percent and 26.04 percent over control for plants receiving 10% concentrations of K. alvarezii and G. edulis sap, respectively. The increase in yield was linked to an increase in the number of rows per cob, cob length, and grain weight per 100 grain. This experiment reveals that treatment of both the saps at 10 per cent boosted the nutrient absorption, grain, and stover production above control. A field experiment was conducted by Trivedi *et al.,* (2018) [32] to study the Differential growth, yield, and metabolic responses of maize following foliar spray of Kappaphycus alvarezii seaweed extract during grain-filling stage under normal and drought circumstances were studied. Result revealed that application of *Kappaphycus alvarezii* seaweed extract increase in all yield parameters, particularly cob length, grain number per cob, and grain fill length; however, the 100-seed weight remained unchanged. Campobenedetto *et al.,* (2021) conducted a field experiment the effect of concentrated seaweed on the development and mineral nutrition of nutrient-stressed lettuce and found that Kelpak considerably enhanced the yield as well as the concentrations and quantities of Ca, K, and Mg in the leaves

of lettuce that had a sufficient supply of nutrients, but had no effect on nutrient stressed plants.

The impact of seaweed on economics

Pramanick *et al.,* (2014) [20] conducted a field experiment to study effect of seaweed saps on growth and yield improvement of transplanted rice in old alluvial soil and found that treating sesame crops with 75 per cent RDF with 15 per cent *Kappaphyscus alvarezii* sap resulted in significantly greater yield, nitrogen absorption, net returns (Rs. 28650/ha), and BCR (1:99) than the control (100 percent RDF). Satapathy *et al.,* (2014) [25] conducted a field experiment to study the effect of liquid seaweed sap on summer rice yield and economics significantly higher Net return (27749.00) and BCR (1.70) was recorded when treated with 5 per cent G Sap along with RDF. A field experiment was conducted by Nayak *et al.,* (2020) [22] to study the effects of seaweed extracts on kharif rice growth, yield, and economics (*Oryza sativa* L.) significantly higher net return (26,614) and BCR (1.59) was recorded when plants are treated with 75% RDF in combination with Bio zyme granule @ 15 kg/ha along with Proventus DS legacy spray @ 625 ml/ha, over control.

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