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SEAWEED EXTRACT'S USE IN AGRICULTURE

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When the world's population increases, so does the demand for food and fibre per unit area. As a result, the demand for chemical fertilisers rises in order to generate higher yields from a smaller area. Excessive use of chemical fertilisers is harmful to one's health and pollutes the atmosphere. As a result, many plant extracts have been used in agriculture in recent years. The use of natural seaweeds as fertiliser has enabled traditional synthetic fertilisers to be gradually phased out (Hong *et al.*, 2007).

The macroscopic marine algae are known as “Seaweeds”. They are used as human food, cattle feed, a chemical fertiliser substitute, and a source of various fine chemicals. Aside from that, it's used to make a variety of agricultural goods like agar and alginate (Khan *et al*., 2009). Since they contain several growth regulators such as, Cytokinins (Durand *et al.*, 2003), Auxins (Sahoo *et al.*, 2000), Gibberellins (Strik *et al.*, 1997 and Staden *et al.*, 1997) and various macro and micronutrients needed for plant growth and development, seaweed extracts are marketed as liquid fertilisers and bio-stimulants. It aids in the production of beneficial soil microorganisms (Khan *et al.*, 2009), develops tolerance against environmental stress (Zhang *et al.*, 2003), increases nutrient uptake from soil (Turan *et al.*, 2004 and Kose *et al.*, 2004) and enhances antioxidant properties (Verkleij *et al.*, 1992).

Around 700 species of marine algae are present in both the intertidal and deep-water regions of the Indian coast, with approximately 60 of them being commercially important. Tamil Nadu, Gujarat, Maharashtra, Goa, Lakshadweep, Andhra Pradesh, and Karnataka are the leading seaweed producers. A few species can also be found in West Bengal and Orissa, as well as the Andaman and Nicobar Islands (Tandel *et al.*, 2016).

Significance in Agriculture

Seaweed extracts are currently used in agricultural practices and have already been commercialised.Sea weed is available in a number of types, including LSF (Liquid Seaweed Fertilizer), granular, and powder. The whole or finely chopped driven algal manure has been used, and all of them have been shown to support cereals, pulses, and a number of flowering plants. Seaweed manure has the advantage of being free of weed seeds and other pathogenic fungi.

The foliar spray of liquid extract from seaweed causes cereals, vegetables, fruit plants, and horticultural crops to grow faster and produce more (Elansary *et al.,* 2016).In many commercial crops, foliar spraying with seaweed extract is a popular practice to increase yield (Khan *et al.,* 2009). The aim of recent research is to implement new methods for preparing various seaweeds, such as mixed consortiums, for use in agricultural fields and to increase yield. Brown algae liquid extracts are sold under different brand names as bio-stimulants or biofertilizers. Seaweed extracts have been commercially available in recent years under various names as Maxicrop (Seaborn), Cytex, and Seacrop 16 (Gandhiyappan *et al.*, 2001 and Perumal *et al.*,2001) etc.

Effect on Germination

Many researchers have recorded the beneficial effects of seaweed on agricultural crop germination. Higher germination percentage, shoot and root length, and seedling vigor index was observed when rice seeds were soaked in lower concentrations of seaweed extracts (Layek *et al.*, 2018). In the case of maize, a similar result was also published. Seeds soaked in lower concentrations (5%) of both seaweed saps (*Kappaphycus* and *Gracilara* species) displayed a higher rate of germination, while seeds soaked in higher concentrations (15%) of extracts inhibited germination (Layek *et al.*, 2016).At low concentrations of seaweed extracts, an increase in germination and seedling vigor may be due to the presence of growth-promoting substances such as auxins, gibberellins, and phenylacetic acid (Sivasankari *et al.*, 2006) and other micro-nutrients (Layek *et al.,* 2014). The use of seaweed sap at a 15% concentration of either *Kappaphyccus* or *Gracilara* sap improved wheat germination significantly. However, when the concentration is either decreased to 2.5 percent or increased to 20 percent, germination is greatly reduced (Dilvarnaik *et al.*, 2017). The reduction may be due to high salt concentration in seaweed saps. Development promoting factors such as IAA

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and IBA Gibberlins (A & B), micronutrients, vitamins, and amino acids, which have a significant impact on crop germination, could explain the higher germination percentage at lower concentrations.

Effect on Crop Growth

With higher concentrations of seaweed extract, rice yield attributing characters such as the number of panicles hill^{-1} and number of effective grains panicle^{-1} increased, and the highest value was obtained for 15% K sap, which was statistically comparable to 10 and 5% K sap concentrations (Layek *et al.*, 2018). Furthermore, the application of both *Kappaphyccus* sap and *Gracilaria* sap at the same concentration improved the absorption of N and P by grain (Pramanick *et al.*, 2014).

When compared to a control, seaweed application increased crop growth while also increasing the number of active nodules. This may be because many cytokinins found in brown algal extracts, such as trans-zeatin riboside and its dihydro derivatives, are present (Saravanan *et al.*,2003). Due to increased plant height, number of pods plant^{-1}, number of grains plant^{-1}, number of branches, and improved nutrient uptake by plant, 15% seaweed extract from *Kappaphycus alvarezii* resulted in a 57% increase in grain yield in soybean (Rathore *et al.*, 2009).

Effect on Yield

In rainfed soybean production, foliar applications of seaweed extracts could be a promising choice for yield enhancement (Rathore *et al.*, 2009). The addition of seaweed to sunflower seed significantly increased oil content, oil yield, K, Na, and crude protein. It was confirmed that applying 0.6% concentrations of *Gracilaria dendroides,* and *Ulva lactuca* to sunflower resulted in higher oil content of 34.05 and 30.55%, respectively (Hannan *et al*., 2011 and Salem *et al.*, 2011).

To increase potato growth and yield, supplementing the prescribed fertiliser dose with extracts of either *Kappaphycus alvarezii* (K sap) *or Gracilari aedulis* (G sap) at a 10% concentration could be used (Prajapati *et al.*, 2016). Spraying seaweed extract on potato tubers 30 and 60 days after planting resulted in higher tuber yield, increased nitrogen, total soluble solids, and protein content (Haider *et al*., 2012).

In the case of rice, a 15% *Kappaphyccus* (K) or *Gracilaria* (G) sap application resulted in an 18.0% increase in rice grain yield as compared to control (Layek *et al.,* 2018). The application of 7.5% and 5.0% concentrations of *K. alvarezii* and *G. edulis* sap, respectively, increased wheat grain yield by 19.74% and 13.16%, respectively, over the control (Shah *et al.*, 2013).

Conclusion

In crop production, seaweeds and seaweed products are becoming more common. The mechanism(s) of action of seaweed extract-elicited physiological responses, on the other hand, is largely unknown. Since the genomes of a variety of plants have now been sequenced or are close to being sequenced, researchers will investigate the effects of seaweed extracts and components on the whole genome/transcriptome of plants to better understand the mechanisms of action of seaweed-induced growth response and stress alleviation. Climate change is likely to blame for the recent challenges to food production caused by an increase in the incidence of biotic and abiotic stresses, which would further reduce yields and/or have an effect on crops in the twenty-first century (IPCC 2007). As a result, research into finding long-term solutions to these stresses should be prioritised. Recent research has found that seaweed extracts protect plants from a range of biotic and abiotic stresses and that they may be used in the field.

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