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Efficacy of Seaweed Liquid Fertilizer on *Vigna mungo* L. Seedlings

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Abstract: **Use of marine microalgae as fertilizer in crop production has a long tradition in coastal areas all over the world. Marine algae are classified into three types, namely green (Chlorophyceae), brown (Phaeophyceae) and red (Rhodophyceae) algae based on their pigments like Chlorophyll, Carotenoids and Phycobiliproteins. In the present study, an attempt has been made to investigate the effect of seaweed liquid fertilizer (SLF) of two seaweeds. SLFs obtained from the brown seaweed *Padina tetrastromatica* and green seaweed *Ulva lactuca* were tested on the important pulse plant, black gram (*Vigna mungo*). The seven day old seedlings were used for the estimation of chlorophyll a, b, total chlorophyll and carotenoid. The dry weight is more than that in the control at all the concentrations, i.e., 0.25% to 2.0% of *Padina* SLF, with the highest record in 0.75 % concentration. While enhanced dry weight of these seedlings over the control was recorded at 0.75 and 1.5% concentrations of *Ulva* SLF. Present investigation indicates that *Padina* SLF yielded better results than *Ulva* SLF.**

Keywords: **Seaweed, fertilizers, effect, study, liquid.**

I. INTRODUCTION

Use of seaweeds as manure in farming practice is very ancient and common among the Romans and also practiced in Britain, France, Spain, Japan and China. The use of marine microalgae as fertilizer in crop production has a long tradition in coastal areas all over the world. Seaweeds usually grow vertically away from the substratum which brings them close to light. Temperature, salinity, water motion and nutrient availability are related to seaweed growth. Water uptake and photosynthesis take place throughout the entire surface of the algal thallus in contrast to vascular plants. Sea weeds are classified into three types namely, green (Chlorophyceae), brown (Phaeophyceae) and red (Rhodophyceae) algae based on their pigments like chlorophyll, carotenoids and phycobiliproteins.

The growing agricultural practices need more fertilizers to boost yield to satisfy food requirements for man. The sea weed extracts contain plant growth hormones, regulators, promoters, carbohydrates, amino acids, antibiotics, auxins, gibberellins and vitamins which will consequently enhance seed germination, yield and quality of the crop plants such as resistance to frost, fungal and insect attacks.

Seaweed cast continued to be so valuable to farmers, even in the early 1990s (Weibull, *et al.*, 1919). In many countries seaweed and beach cast are still used in both agricultural and horticultural practices (Verklij *et al.*, 1992; Zopade *et at.*, 2001). Sea weeds can be used in many ways to increase soil fertility. Indian coastal area is about 7000 km long and harbors about 844 marine algal species belonging to different families and genera.

The merits of sea weed manure include easy availability of macronutrients and trace elements. Sea weeds were used along with farmyard manure as soil conditioners in European countries during 1950s (Rama Rao, 1992). Sea weeds contain all the trace elements and plant growth hormones required by plants. Many plant growth hormones, regulators and promoters are available to enhance yield attributes (Crouch and Van Staden *et al.*, 1991, 1992). In recent years, the use of natural seaweed products as substitutes to synthetic fertilizers has assumed importance. In agriculture, the applications of seaweeds are so many: as soil conditioners, fertilizers and green manure, due to the presence of high amounts of potassium salts, micronutrients and growth substances. Beneficial effects from the use of seaweed extracts as natural regulators include increase in crop yield, delay of fruit senescence, improved overall plant vigour, improved yield quantity and quality and increased ability to withstand adverse environmental conditions. Crop cultivation using organic fertilizers has contributed to deposition of residues, improving physical and chemical properties of soil that is important for biological development.

II. MATERIALS AND METHODS

The test plant used in this present study is black gram, *Vigna mungo*, one of the most important pulse crops of South India especially in Tamil Nadu and cultivated in an area of 1.8 lakhs hectare with a production of 75,920 tones and records an average yield of only 409 kg per hectare. Identification of organic sources for yield enhancement will be advantageous and the seaweeds have become major importance for research, as the seaweed resources in shallow and deep waters remain underutilized for enhancing crop production (Kaliaperumal and Kalimuthu, 1997). SLFs obtained from the brown seaweed *Padina tetrastromatica* and green seaweed *Ulva lactuca* were tested on black gram.

Collection of Seaweeds:

Two commonly available seaweeds *Padina tetrastrmatica* and *Ulva lactuca* (Fig.1) were collected from Hare's Island, Thoothukudi, Tamil Nadu located 4.83 km away from Thoothukudi at 8.53°N 78.36°E. The collected seaweeds were brought to the laboratory in plastic bags containing sea water, washed thoroughly to remove all the epiphytic debris using tap water. After thorough washing, these two seaweeds were dried under shade, powered separately in a blender and stored in HDP bags (High Density Polythene) for further use.

Preparation of SLF using Ethanol:

Powered seaweeds were mixed with 100 ml of ethanol and stirred well and filtered. The filtrate was considered as 100% concentration of SLF and then made into 0.25. 0.50, 0.75, 1.5 and 2.0 percent concentrations

Experimental Plant:

Certified seeds of *Vigna mungo* were procured from Tamil Nadu, Agricultural Research College, Killikulam. The healthy seeds of uniform size, colour, and weight and free from visible infection were segregated and stored in a metal tin container.

Seed Treatment:

The seeds were sterilized using 0.1% mercuric chloride for 1-2 minutes and rinsed with distilled water. The seeds were then soaked in different concentrations of the algal extracts for 24 hours. Control was maintained by soaking one set of seeds in distilled water.

A **B**

Figure 1: Thalli of *Ulva lactuca* (A) and *Padina tetrastromatica* (B).

Seed Germination and Seedling Growth Studies:

The soaked seeds were washed with distilled water and sown in growth towels (modified from old news paper roll placed on a plastic sheet). These modified growth towels were kept in plastic troughs filled with water. The seed germination percentage and seedling growth parameters on 7 day old seedlings were measured.

Pigment Analysis:

The seven days old seedling were used for the analysis Chlorophyll a, Chlorophyll b, total Chlorophyll, Carotenoid .

Table I: Effect of *Padina* SLF on Black Gram germination Seedling Growth

Sl. No.	Growth parameters	Control	Concentrations of *Padina* SLF				
			0.25	0.50	0.75	1.50	2.0
1	% of germination	80±3.21	80±2.89	90±4.22	100±5.12	100±5.14	85±3.01
2	Shoot length(cm)	21.5±0.38	25.6±0.53	23.1±0.4	26.3±0.62	22±0.46	15.5±0.3
3	Root length(cm)	22±0.2	24±0.39	22.3±0.32	27.5±0.51	23.5±0.37	22±024
4	No of lateral roots	30±0.22	45±0.31	45±0.35	47±0.38	52±0.41	30±0.24
5	Fresh weight	3.1±0.033	3±0.031	3.1±0.035	3.4±0.046	3±0.042	3.3±0.041
6	Dry weight	0.28±0.006	0.29±0.006	0.28±0.005	0.28±0.006	0.27±0.005	0.27±0.005

Table II: Effect of *Ulva* SLF on Black Gram germination and seedling growth.

Sl. No.	Growth parameters	Control	Concentration of *Ulva* SLF				
			0.25	0.50	0.75	1.50	2.0
1	% of germination	80±4.31	80±3.34	80±3.12	90±4.18	100±5.36	80±4.5
2	Shoot length (cm)	14±0.3	20.4±043	21.2±0.51	26.1±0.6	19.5±0.4	17±0.39
3	Root length (cm)	10.5±0.16	17.5±0.23	21.2±0.41	23.3±0.5	23.3±0.32	10±0.1
4	No of lateral roots	9±0.1	30±0.32	32±0.35	37±0.41	27±0.28	22±0.25
5	Fresh weight	1.7±0.032	3.06±0.07	1.95±0.034	2.43±0.041	2.12±0.038	2.5±0.043
6	Dry weight	0.38±0.005	0.24±0.004	0.26±0.004	0.4±0.006	0.29±0.005	0.28±0.004

Table III: Effect of *Padina* SLF on chlorophyll a, chlorophyll, total chlorophyll , carotenoids on black gram

Sl. No.	Concentrations	Chlorophyll a (mgg^{-1})	Chlorophyll b (mgg^{-1})	Total chlorophyll (mgg^{-1})	Carotenoids (mgg^{-1})
1	control	0.5979 ±0.05	0.5145±0.001	1.023±0.05	0.769±0.02
2	0.25	0.6347±001	0.5427±0.005	1.1979±0.01	0.9021±0.01
3	0.50	0.6601±0.001	0.5710±0.01	1.294±0.002	0.966±0.007
4.	0.75	0.61±0.005	0.521±0.005	1.722±0.002	0.926±0.012
5	1.5	0.586±0.008	0.5593±0.05	1.1603±0.003	0.790±0.012
6	2.0	05725±0.003	0.503±0.005	0.985±0.007	0.771±0.51

Table IV: Effect of *Ulva* SLF on chlorophyll a, chlorophyll b, total chlorophyll and carotenoids on black gram

Sl. No.	Concentrations	Chlorophyll a (mgg^{-1})	Chlorophyll b (mgg^{-1})	Total chlorophyll (mgg^{-1})	Carotenoids (mgg^{-1})
1	Control	0.50649 ±0.001	0.561±0.005	1.123±0.017	0.694±0.019
2	0.25	0.6988±0.008	0.6012±0.004	1.301±0.006	1.003±0.017
3	0.50	0.697±0.006	0.5756±0.007	1.1903±0.011	0.932±0.013
4	0.75	0.5929±0.004	0.5474±0.014	1.1402±0.020	0.792±0.020
5	1.50	0.5388±0.006	0.469±0.010	1.008±0.016	0.765±0.011
6	2.0	0.4654±0.006	0.3923±0.010	0.881±0.016	0.700±0.03

III. RESULTS

Growth Parameters:

The effect of different concentrations of alcohol extracts of seaweeds treated on the growth of *Vigna mungo* was studied. The parameters such as seed germination, shoot length, number of lateral roots, fresh weight, dry weight and pigment analysis were recorded.

Effect of Padina SLF on Black Gram Seedling Growth

(Table: I) All the concentrations of *Padina* SLF enhanced shoot length and root length when compared with the control, the optimum concentration being 0.75%. At this concentration, the number of lateral roots are found to be more than that of control. Fresh weight of the black gram seedlings was found to exceed over the control at higher concentrations of 0.25, 0.50 and 0.75 %. The dry weight showed an increase over the control at all the concentrations 0.25% to 2.0% of *Padina* SLF, with the highest record at 0.75 % concentration.

(Table: III)Enhanced amount of chlorophyll a, chlorophyll b and total chlorophyll was recorded at 0.25 & 0.50 *Padina* SLF. The amount of carotenoids was found to be more than the control of 0.75% *Padina* SLF.

Effect of Ulva SLF on Black Gram Seedling Growth

(Table: II) 0.50 & 0.75 concentrations if *Ulva* SLF showed enhanced shoot length when compared to the control. All the concentrations except 10% SLF of *Ulva* triggered increased root length over the control. The number of lateral roots was found to be more than in the control at 0.235, 0.50, & 0.75 concentrations of *Ulva* SLF. *Ulva* SLF treated black gram seedlings showed increased fresh weight at 0.25, 0.50, 1.50 and 2.0 % concentrations, while dry weight got enhanced in these seedlings over the control at 0.75 and 1.5 % concentrations of *Ulva* SLF.

(Table: IV) An increase in the amount of chlorophyll a, chlorophyll b, total chlorophyll and carotenoids was registered in the cotyledons of black gram seedlings obtained from the seeds treated with 0.50% SLF extracted from *Ulva.*

IV. CONCLUSION

Commercial exploitation of seaweeds has met with varying degrees of success owing to conflicting views on their effect on productivity. However, the adverse effects of synthetic fertilizers upon environment necessitated identification of biostimulants and organic manures for usage as foliar and soil amendments for enhancement of yield in agricultural crops (Meeting *et al,* 1990).

In the present study SLFs extracted from both *Padina* and *Ulva* were found to be effective in promoting seedling growth of black gram in terms of root length, shoot length, number of lateral roots, fresh weight and dry weight at almost all the concentrations. The reasons for the growth enhancement activity of these SLFs could be the fact that seaweeds contain many growth hormones and organic substances like amino acids, antibiotics, and vitamins apart from micro and macro nutrients (Tay *et al*., 1985; Booth., 1965).

Seaweeds were widely used in the field of agriculture from ancient times by people living near the coasts. As there was advancement in new technologies, seaweeds were utilized in a highly refined manner; liquid seaweed fertilizer was one that comes out of the new technology. Liquid seaweed fertilizer is prepared by different methods and it has varied applications (Sylvia *et al.*, 2005).

Vigna mungo seeds soaked with low concentrations of both the seaweed extracts showed higher levels of germination, while the higher concentrations of the extracts inhibited germination. The increased germination percentage at low concentration may be due to the presence of some growth promoting substances such as IAA, IBA, Gibberellins (A and B), cytokines, micro nutrients (Fe, Cu, Zn, Co, Mo, Mn, Ni) (Challen and Hemingways, 1965). The germination percentage decreased with increase in concentrations of both the SLFs. Present findings coincide with those of earlier studies made in *Cajanus cajan* (Mohan *et al.,* 1994), maize, ragi, and kambu (Rajkumar Immanuel and Subramanian, 1994) and *Vigna catajung* and *Dolichos biflorus* (Anantharaj and Venkatesalu, 2001). Statistically significant differences were observed for shoot length, root length fresh and dry weight. A positive response was observed at both the SLF's at 0.75%.

The increased seedling growth may be due to the presence of phenyl acetic acid (PAA) and other closely related compounds in the SLF (Taylor and Wilkinson, 1977). The growth enhancing potential of seaweeds might be attributed to the presence of micro and macro nutrients (Challen and Hemingways, 1965). Among the two seaweed liquid fertilizers, *Padina* SLF yielded better results. The higher concentration showed a decreasing trend. Similar results were recorded in *Padina* which enhanced maximum seedling growth at low concentrations in *C.cajan* (Mohan *et al.*1994), *Vigna radiata* and *C.cajon* (Venkataraman Kumar *et al.*, 1993) .

The lower concentrations of these two seaweed liquid fertilizers (*Padina* and *Ulva*) also increased chlorophyll content of *Vigna mungo* up to 0.50 when compared to control. Similar observations was made in *Scytoema sp* (Venkataraman Kumar and Mohan., 1997) and in *Vigna mungo* (Venkataraman Kumar and Mohan, 1997). The seaweed extract applied as foliar spray enhanced the chlorophyll level in plants (Blunden *et al.*, 1996). Mostafa and Sheekh (1909) reported that the plant growth substances present in seaweed liquid fertilizer enhance the chlorophyll contents in the leaves.

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