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Effect of Seaweed Liquid Fertilizer of *Dictyota dichotoma* on growth and yield of *Abelmoschus esculantus* L.

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ABSTRACT

The effect of Seaweed Liquid Fertilizer (SLF) of Dictyota dichotoma was tested at different concentrations (12.5%, 25%, 50%, 75% and 100%) on growth and yield parameters of Abelmoschus esculantus. The seaweed extract was found effective in increasing the biomass, growth of roots and shoots, number of roots, leaves, flowers, and fruits, leaf area index, fruits length, fresh and dry weight of fruits, maturity time and yield. The findings of the present study showed that the low level of SLF enhances the growth and yield than that of higher concentration.

Keywords: *Abelmoschus esculantus, Dictyota dichotoma*, Seaweed Liquid Fertilizer, Growth and Yield.

INTRODUCTION

Seaweeds are marine macro algae which form an important component of the marine living resources of the world. The plant growth hormone's effect of seaweed is advantageously made use of to stimulate germination and growth, thereby increasing the yield and resistance ability of many crops [1] and [2]. Seaweeds represent an alternative to conventional chemical fertilizers. Commercial use of liquid extracts, obtained from seaweeds is successfully used as foliar sprays for several crops [3]. In the present investigation, an attempt has been made to study the influence of SLF prepared from *Dictyota dichotoma* on the growth and yield characteristics of Okra (*Abelmoschus esculantus*).

MATERIALS AND METHODS

Collection of seaweeds

The marine algae *Dictyota dichotoma* was freshly collected from the Rameshwaram coastal region and washed thoroughly with seawater to remove all the unwanted impurities, adhering sand particles and epiphytes. Samples were washed thoroughly using fresh water to remove the surface salt and then blotted to remove excess water.

Preparation of seaweed liquid extract

Seaweeds were shade-dried for four days, followed by oven-drying for 24 hours at 60°C. The dried seaweeds were used for the preparation of Seaweed Liquid Fertilizer (SLF) following the method of Rama Rao [4]. The filtrate thus obtained was considered as 100% SLF, from which different concentrations (12.5%, 25%, 50%, 75% and 100%) were prepared by adding distilled water. As the liquid fertilizer contained organic matter, it was refrigerated between 0-4^{o}C until use.

Selection of crop plants

The crop plant, selected for the present study was *Abelmoschus esculantus* belonging to the family of Malvaceae. The seeds were collected from the SPIC Bio-technology Division, Chennai, Tamil Nadu. The seeds with uniform size, color and weight were chosen for the experimental purpose and surface sterilized with 0.1% $HgCl_2$ for 1 minute and thoroughly washed with distilled water 3-5 times. Seeds were presoaked for 12 hours in distilled water and were sown in sterilized vermiculate, moistened with distilled water.

Seaweed liquid fertilizer treatment

After 20 days of germination, the seedlings which were of uniform length (15±2cm) were transferred to pots containing garden soil. After 20, 40, 60 and 90 days, selected concentrations of SLF were sprayed on the leaves (20 seedlings/concentration) @ of 2ml /seedling. One batch of seeds were kept as control and treated with distilled water. Plants that were hundred days old were taken for observation. Different parameters namely fresh and dry weight of whole plant, root and shoot length, number of lateral roots, leaf area, number of leaves, flower and fruits, fruit length, fresh and dry weight of fruits and yield were recorded.

Physiochemical analysis of SLF

The color was observed visually and the pH was measured using the pH meter. Nitrogen Phosphorus, Potassium, Calcium, Magnesium, Iron, Manganese, Copper and Zinc content were analyzed in the extract following the method of Humphries [5]. Plant growth hormones like auxin and cytokinins were also estimated.

RESULTS AND DISCUSSION

The physicochemical properties of the extract of seaweed *Dictyota dichotoma* have been analyzed. The extract was brown in color and the pH recorded was 6.8 at room temperature. The extract contained macronutrients like Nitrogen, Phosphorous, Potassium, Magnesium, Calcium and micronutrients like Iron, Manganese, Zinc and Copper and growth hormones like cytokinin, auxin and their values are given in Table 1.

Table 1 Mineral compositions of seaweed extract *Dictyota dichotoma*

Macro nutrients (mg/g dry weight)		Micro nutrients (mg/g dry weight)		Plant growth hormones (µg/g dry weight)	
Nitrogen	175.02	Iron	8.64	Cytokinin	360.76
Phosphorus	44.56	Manganese	5.69	Auxin	264.52
Potassium	71.84	Zinc	1.91		
Magnesium	65.71	Copper	1.82		
Calcium	85.25				

The results obtained from the present study on growth and yield parameters of *Abelmoscus esculentus* treated with different concentrations of SLF *Dictyota dichotoma* and control are presented in Table 2 and 3.

Table 2 Effect of seaweed extract, *D. dichotoma* on the growth of *A. esculantus*

Parameters	Seaweed Extract Concentration (%)					
	Control	12.5	25	50	75	100
Whole plant fresh wt. (g)	143.71±0.669	144.18±0.190	150.13±0.455	143.36±0.386	138.16±0.730	134.13±0.400
Whole plant dry wt. (g)	21.14±0.466	25.64± 0.32	28.50± 0.416	23.17±0.25	21.67± 0.407	19.12± 0.261
Shoot length (cm)	70.45±0.325	76.9± 0.568	86.3± 0.251	78.02± 0.110	73.24± 0.708	69.58± 0.440
Root length (cm)	19.5± 0.3	28.1± 0.1	30.4± 0.305	27.4± 0.264	23.1± 0.1	20.4± 0.208
Leaf area index (cm^2)	36.6±0.378	38.6± 0.321	46.8± 1.819	36.2± 0.251	34.8± 0.3	30.2± 0.650
Lateral roots (no.)	64.0± 2.081	72.0± 1.527	85.0± 3.055	70.0± 2.645	65.0± 2.516	62.0± 3.0
No. of leaf (n)	15± 1	17.0± 1	22.0± 1.527	18.0± 1.527	15.0± 1.0	12.0± 0.577
No. of flowers (n)	8.0± 1	12.0± 0.577	14.0± 1	11.0± 0.577	10.0± 1	8.0± 0.577

Table 3 Effect of seaweed extract, *D. dichotoma* on the yield of *A. esculantus*

Parameters	Seaweed Extract Concentration (%)					
	Control	12.5	25	50	75	100
No. of fruits (n)	8.0 ± 1	12.0 ± 0.577	14.0 ± 0.577	10.0 ± 0.577	10.0 ± 1	7.0 ± 0.577
Fruit length (cm)	9.0 ± 0.763	11.5 ± 0.503	14.3 ± 0.360	9.4 ± 0.305	8.7 ± 0.2	8.2 ± 0.503
Fruit girth (cm)	1.21 ± 0.049	1.29 ± 0.030	1.37 ± 0.041	1.27± 0.03	1.23 ± 0.047	1.15 ± 0.025
Fruit dry wt. (g)	1.13 ± 0.060	1.30 ± 0.020	1.39 ± 0.015	1.28 ± 0.025	1.11 ± 0.030	1.10 ± 0.057
Yield (kg/ha)	9.8 ± 0.251	12.91± 0.591	13.89 ± 0.55	11.8 ± 0.529	11.0 ± 0.763	8.9 ± 0.152

The highest shoot length (86.3cm), root length (29.4cm), fresh weight of shoot (70.64g), dry weight of root (29.51g), number of lateral root (89.0), leaf area index (56.8), number of leaf (19) and number of flowers (11) were recorded in the plants with 25% SLF. The SLF treatment increased the growth parameters significantly when compared to the control. Similar results were obtained at 1.5% concentration of *Enteromorpha clathrata* on green gram [6]. Vijayanand [7] reported that lower concentration of SLF from *Stoechospermum marginatum* promoted the growth of brinjal and Sivasankari [8] also reported similar effect in cowpea. Stephenson [9] recorded that lower concentration of SLF prepared from *Ascophylum* and *Laminaria* accelerated the growth of maize. The seedlings treated with low concentration of SLF (25%) showed better results in growth parameters which may be directly attributed by the presence of essential macro, micro nutrients, phenyl acetic acid (PAA) and other closely related compounds like growth regulators at an optimum level. Promotive effects of SLF application might also be because of increased root proliferation and establishment, thereby, plants were able to mine more nutrients even from distant places and deeper soil horizon, in a balanced proportion. Besides SLF regulates plant bio-physiological activities, which collectively resulted in maintaining higher photosynthetic activity [10].

The growth parameters showed a decreasing trend at higher levels employed. Similar results were reported in *Cajanus cajan* [11] and *Vigna radiata* [12]. Dhargalkar and Untawale [13] also reported similar findings with *Hypnea musciformis*, *Spathoglossum asperum*, *Stoechospermum marginatum* and *Sargassum* on the growth of crops such as green chillies, turnips and pineapple which may be due to very high salt index observed in seaweed extracts which in turn affected the growth and yield.

In terms of yield parameter, maximum number of fruits (9.0), Fruit length (21.3cm), Fruit dry weight. (16.2g) and Yield (15.0kg/ha) were recorded in the plants treated with lower SLF concentration (25%). This observation is in conformity with the earlier report on the promotional effect of length, breadth and weight of fruits of *Zizyphus mauratiana* with crude extract of seaweed [14]. Increased yield in banana, potato and oranges were obtained by giving them seaweed treatment [15]. Similar trend was also observed in bhendi [16], *Lycopersicon lycopersicum*, *Abelmoscus esculantus* [17] and cowpea [8].

The present investigation shows that the foliar treatments using extract from *Dictyota dichotoma* exhibits promising effects on growth and yield characteristics of the test plant *Abelmoscus esculantus*. The growth promoting properties of the seed treatment using seaweed extract improves the quality of the soil and increases the crop yield. This study also confirms that use of SLF is a wise ecofriendly technique to enhance crop production.

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