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Effect of Seaweed Liquid Fertilizer on Growth and Pigment Concentration of *Abelmoschus esculentus* (l) medikus

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Abstract: The present study an attempt has been made to investigate the effect of Seaweed Liquid Fertilizer of *Rosenvigea intricata* with or without chemical fertilizer on seed germination, growth, yield, pigment content and soil profile of *Abelmoschus esculentus* was analyzed. The seed germination, shoot length, root length, number of lateral roots, number of leaves, number of vegetables, length of vegetables, weight of vegetables, chlorophyll 'a', chlorophyll 'b', total chlorophyll and carotenoids was found maximum at 20% SLF with or without chemical fertilizer. Hence the present study found that 20% SLF with or without chemical fertilizer shows the higher growth, yield, chlorophyll pigment and soil profile compared to other concentration.

Key words: Seaweed Liquid Fertilizer · Growth · Yield · Pigment concentration

INTRODUCTION

The use of seaweeds as manure in farming practice is very ancient and common practice among the Romans and also practiced in Britain, France, Spain, Japan and China. The use of marine macro algae as fertilizer in crop production has a long tradition in coastal areas all over the world. Seaweed cast continued to be so valuable to farmers, even in the early 1900s. In many countries seaweed and beach cast are still used in both agriculture and horticulture [1]. Many studies in the past three decades have found wide application in modern agriculture for the use of marine macroalgae as fertilizer. They are used as whole or finely chopped powdered algal manure or aqueous extracts. In recent years the use of these marine macroalgae in modern agriculture has been investigated by many [2-6].

Seaweeds contain all the trace elements and plant growth hormones required by plants. It was also reported that seaweed manure is rich in potassium but poor in nitrogen and phosphorus then the farm manure [7]. There are many plant growth hormones, regulators and promoters available to enhance yield attributes [8-10]. Seaweed liquid fertilizers will be useful for achieving higher agricultural production, because the extract contains growth promoting hormones (IAA and IBA), Cytokinins, Gibberellins, trace elements, vitamins, aminoacids, antibiotics and micronutrients [11]. Booth, 1969 [12] also observed that the value of seaweeds as fertilizers was not only due to nitrogen, phosphorus and potash content, but also because of the presence of trace elements and metabolites. The higher amount of water soluble potash, other minerals and trace elements are present in seaweeds and are readily absorbed by plants and they control deficiency diseases [10]. The carbohydrates and other organic matter present in seaweeds alter the nature of soil and improve its moisture retaining capacity [10].

In the present day world, the seaweed fertilizers are often found to be more successful than the chemical fertilizers [13]. In India, large quantity of macroscopic marine algae has been utilized directly as manure or in the form of compost by coastal peoples [14,15]. Besides their application as Farm Yard Manure (FYM), Liquid extract obtained from seaweeds popularly known as SLF/LSF has recently gained much interest as foliar spray for inducing faster growth and yield in cereal crops, vegetables, fruits, orchards and horticultural plants [16, 17, 13].

India is an agricultural country; nearly 70% of the population thrives in rural areas, engaged in agriculture making the backbone of our economy. The fast growing population is mounting tremendous pressure in food production in the country. To meet out this increasing demand, farmers use chemical fertilizers to enhance the crop production. The toxic chemicals (arsenic and cadmium) from the chemical fertilizers accumulate in plant products causing health problems in human by biomagnifications [18]. In recent years the use of natural

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seaweed products as substitutes to the conventional synthetic fertilizers has assumed importance. In agriculture, the application of seaweeds are so many, as soil conditioners, fertilizers and green manure, due to the presence of high amount of potassium salts, micronutrients and growth substances.

The growing agricultural practices need more fertilizers for higher yield to satisfy food for human beings. There are many growth hormones, regulators and promoters available to enhance yield attributes. The developed countries utilized such growth hormones in cultivation of crops. In India utilization of seaweeds and their extracts, seaweed liquid fertilizers will be useful for achieving higher agricultural production.

Kannan and Tamilselvan, 1990 [19] observed that the soil application of SLF of *Enteromorpha clathrata* and *Hypnea musciformis* increased the growth characteristics of green gram, black gram and rice. Seaweed concentrate (Kelpak) increased the growth and yield significantly in potassium stressed wheat. These result suggested that the mineral elements with in Kelpak are partly responsible for its effect [20]. Aqueous extract of *Sargassum wightii* when applied as a foliar spray on *Zizyphus mauritiana* showed an increased yield and quality of fruits [3]. Whapham *et al*., 1993 [5] observed that the application of SLF of *Ascophyllum nodosum* increased the chlorophyll levels of Cucumber cotyledons and tomato plants. The present study intends to investigate the effect of Seaweed Liquid Fertilizer (SLF) prepared from *Rosenvingea intricata* on the growth, yield, seed germination and pigment concentration of *Abelmoschus esculentus*.

MATERIALS AND METHODS

Rosenvingea intricata was collected from Chunnambar estuary, Pondicherry (Union Territory). Seaweed sample was picked with hand and immediately washed with seawater to remove the foreign particles, sand particles and epiphytes. Then it was kept in an ice box containing slush ice and immediately transported to the laboratory and washed thoroughly using tap water to remove the salt on the surface of the sample. Then the seaweeds were spread on blotting paper to remove excess water. SLF was prepared by following the method of [21]. One kg of seaweed was cut into small pieces and autoclaved for 1 hour and the hot extracts were filtered through a double-layered cheese cloth and allowed to cool at room temperature. The filtrate was then centrifuged at 10,000rpm for 30 minutes at 4°C and the resulting supernatant was taken as 100% seaweed extract and was stored in refrigerator for further studies.

Test Crop Plant: The crop plant, selected for the present study was *Abelmoschus esculentus* (L) Medikus is an important plant cultivated throughout Indian subcontinent. The seeds for the study purpose were collected from regional pulses research station, Tamil Nadu Agricultural University, Vamban, Pudukottai District, Tamil Nadu, India. Healthy seeds free from visible infection with uniform size, colour and weight were segregated and then stored in metal tin containers as suggested by [22] and used for the experimental purpose.

Seed Soaking: The seaweed liquid fertilizer was prepared with different doses viz., 10%, 20%, 30%, 40%, 50%, 100%. Then the sowing seeds were soaked in particular doses of SLF for 12hrs. Then the seeds were sowed and observed for germination and early growth.

Plant Culture: In the present investigation, polythene bags [32x24cm] were used for raising the crops. The bags were filled with 5kg of garden soil, which was evenly mixed with recommended level of chemical fertilizer (N 0.080: P 0.101: K 0.060)g/kg in one set up of experimental bags. Ten seeds were sown at a depth of 1.5 cm in each bag. They were kept in the net house to prevent damages caused by birds, rats, squirrels and other animals. The polythene bags were labeled in particular doses and rearranged at regular intervals so as to ensure uniform environmental impact on the plants growth. The weeds were removed regularly and watering was done once in 2 days for the test plants. All the experiments were conducted in triplicates.

Details of Treatments: The crop plants [*Abelmoschus esculentus*]was treated with or without chemical fertilizers at different doses.

I. Seaweed liquid fertilizer alone [without chemical fertilizer]

1) Control: only water; 2) 10% SLF; 3) 20% SLF; 4) 30% SLF; 5) 40% SLF; 6) 50% SLF; 7) 100% SLF

II. Seaweed liquid fertilizer with recommended level of Chemical fertilizer.

1) Control: only water; 2) 10% SLF+Chemical fertilizer [N 0.080: P 0.101: K 0.060]g/kg; 3) 20% SLF+Chemical fertilizer [N 0.080: P 0.101: K 0.060]g/kg; 4) 30% SLF+Chemical fertilizer [N 0.080: P 0.101: K 0.060]g/kg; 5) 40% SLF+Chemical fertilizer [N 0.080: P 0.101: K 0.060]g/kg; 6) 50% SLF+Chemical fertilizer [N 0.080: P 0.101: K 0.060]g/kg; 100% SLF+Chemical fertilizer [N 0.080: P 0.101: K 0.060]g/kg

Analyses: Plants from each treatment were randomly drawn for various analyses. Plants from the bags were uprooted carefully and washed in tap water. They were then processed for different analyses.

All the parameters such as growth and yield characters, Chlorophyll content and soil profile (N,P,K) were analysed only at the end of 45th days after seed sowing. Soil analysis was done before seed sowing and after harvest. Triplicate samples were used for all the parameters and the mean values were presented.

Pigment Analysis:
Chlorophylls were estimated by Arnon, 1949 [23].
Carotenoids were analyzed by Kirk and Allen, 1965 [24]

RESULT

Seed Germination: The seed germination was found to be maximum at 20% (98.66±1.87; 98.33±1.24), 30% (99± 0.81; 98.66±0.84) SLF with or without chemical fertilizer and all other doses of SLF treatment shows decreasing trends of seed germination and the control plant was recorded 91.66±1.22% Fig. (1).

Growth Parameters: The effect of SLF of *Rosenvingea intricata* on growth parameters such as shoot length, root length, number of lateral roots, number of leaves were recorded from *Abelmoschus esculentus* plant. The maximum shoot length recorded was 38.7±0.655 cm in the plants that received from 20% concentration of SLF with recommended level of chemical fertilizer and where as 38.26±0.45 cm was obtained from 20 % SLF alone. The minimum shoot length was 29.3±0.60 cm and 30.76±1.001 cm in plants received 100 % SLF with chemical fertilizer and 100 % SLF alone respectively Fig (2). Root length was observed maximum 15.26±0.60 cm in 20% concentration of SLF with recommended level of chemical fertilizer and where as 14.83±0.15 cm in the plants that was received from 20 % SLF alone. The minimum root length was 10.36±0.45 cm and 12.33±0.45 cm in plants received 100 % SLF with chemical fertilizer and 100 % SLF alone respectively Fig. (3).

The highest level of lateral roots recorded were 27.66±0.47 in the plants that received from 20% SLF with recommended level of chemical fertilizer and where as 26±0.81 in the plants that received 20 % SLF alone. The minimum lateral roots were 11.66±1.24 and 12.33±0.47 in plants received 100 % SLF with chemical fertilizer and 100 % SLF alone respectively Fig (4). The maximum number of leaves recorded was 8.33±0.47 in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 7.33±0.47 in the plants that received 20 % SLF alone. The minimum number of leaves was 3±0.81 in plants received 100 % SLF with chemical fertilizer and 100 % SLF alone respectively Fig. (5).

Yield Parameters: In *Abelmoschus esculentus* maximum number of vegetables was recorded 7.66±0.41 in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 7.33±0.47 in the plants that received 20 % SLF alone. The minimum number of vegetables was obtained 1.66±0.47 from 100 % SLF with chemical fertilizer and 100 % SLF alone respectively Fig. (6). The maximum length of vegetables was recorded 14.93±0.35 cm in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 14.2±0.4 cm in the plants that received 20 % SLF alone. The minimum length of vegetables was 7.9±0.62 cm and 8.43±0.30 cm in plants received 100 % SLF with chemical fertilizer and 100 % SLF alone respectively Fig. (7). The maximum weight of vegetables recorded was 12.76±0.41 g in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 12.43±0.56 g in the plants that received 20 % SLF alone. The minimum weight of vegetables was 1.66±0.47 g in plants received from both 100 % SLF with chemical fertilizer and 100 % SLF alone respectively Fig. (8).

Pigment Content: In lady's finger the maximum chlorophyll'a' content obtained was 0.698±0.003 mg in plants that received 20% SLF with recommended level of chemical fertilizer and whereas 0.678±0.001 mg in plants that received 20% SLF alone. The minimum chlorophyll content obtained recorded was 0.454±0.004 mg and 0.501±0.002 mg in plants that received 100% SLF with recommended level of chemical fertilizer and 100% SLF alone respectively Fig. (9). In lady's finger the maximum chlorophyll'b' content obtained was 0.613±0.002 mg in plants that received 20% SLF with recommended level of chemical fertilizer and whereas 0.585±0.004 mg in plants that received 20% SLF alone. The minimum chlorophyll 'b' content obtained recorded was 0.378±0.002 mg and 0.476±0.002 mg in plants that received 100% SLF with recommended level of chemical fertilizer and 100% SLF alone respectively Fig. (10). The maximum total chlorophyll content obtained was 1.321±0.006 mg in plants that received 20% SLF with recommended level of chemical fertilizer and whereas 1.351±0.005 mg in plants

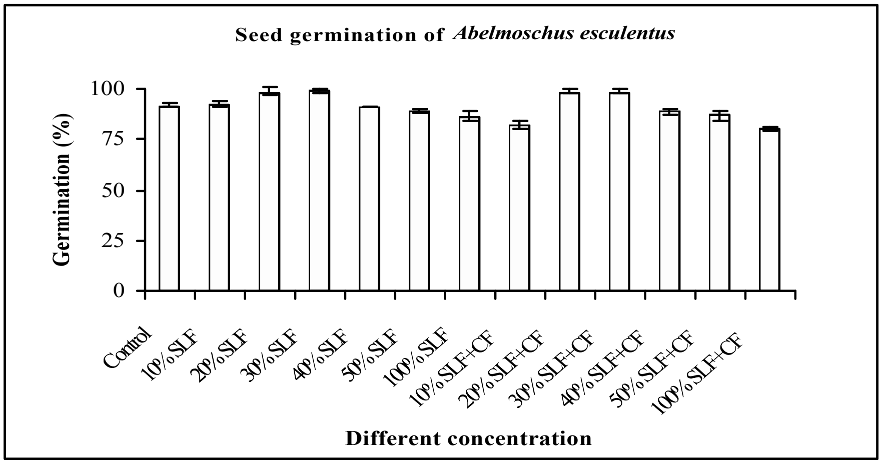

Fig. 1: Shows the seed germination of *Abelmoschus esculentus*

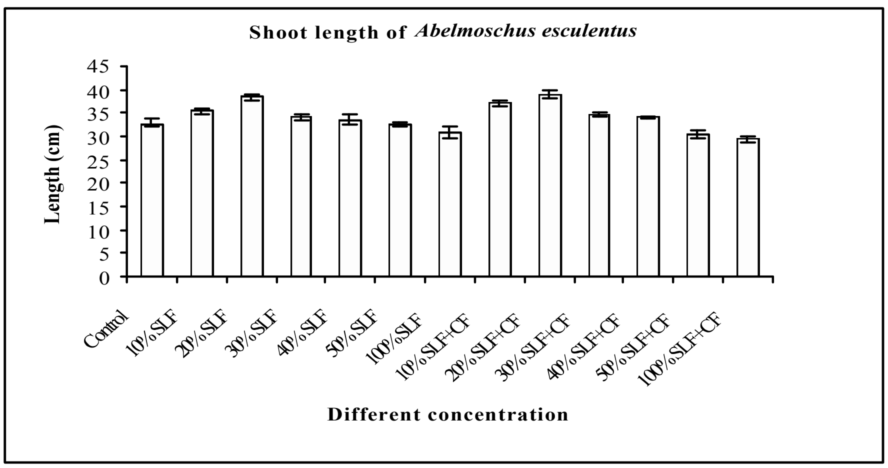

Fig. 2: Shows the Shoot length of *Abelmoschus esculentus*

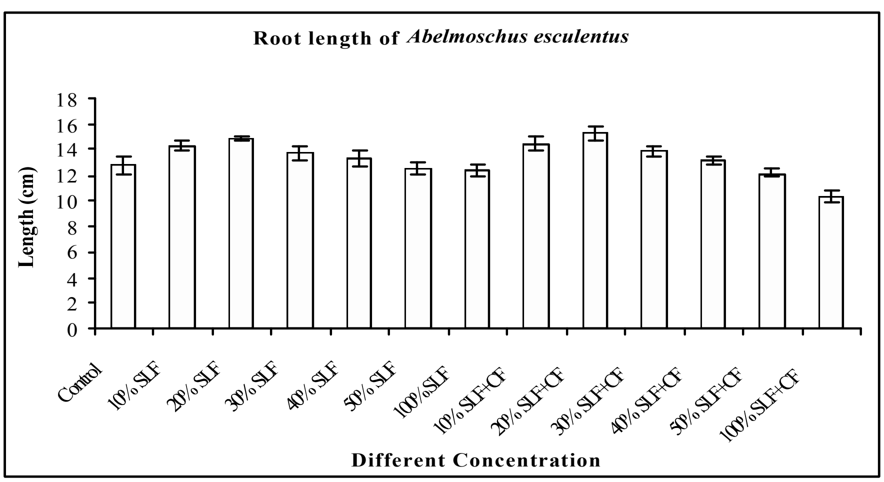

Fig. 3: Shows the Root length of *Abelmoschus esculentus*

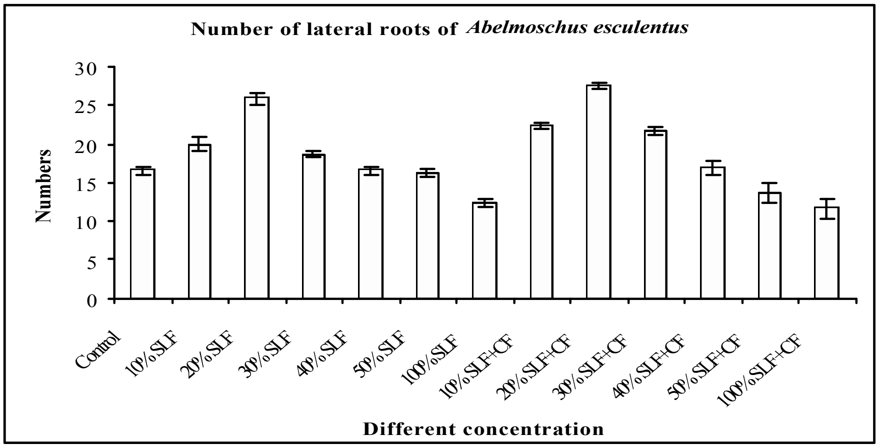

Fig. 4: Shows the number of lateral roots of *Abelmoschus esculentus*

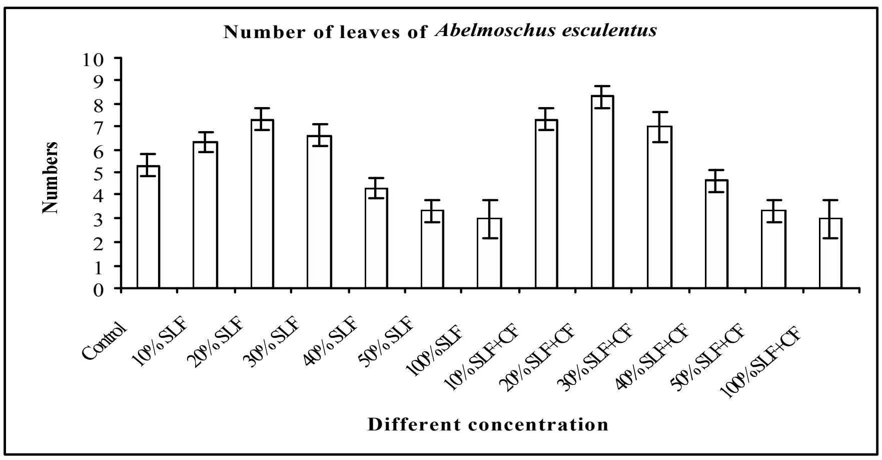

Fig. 5: Shows the number of leaves of *Abelmoschus esculentus*

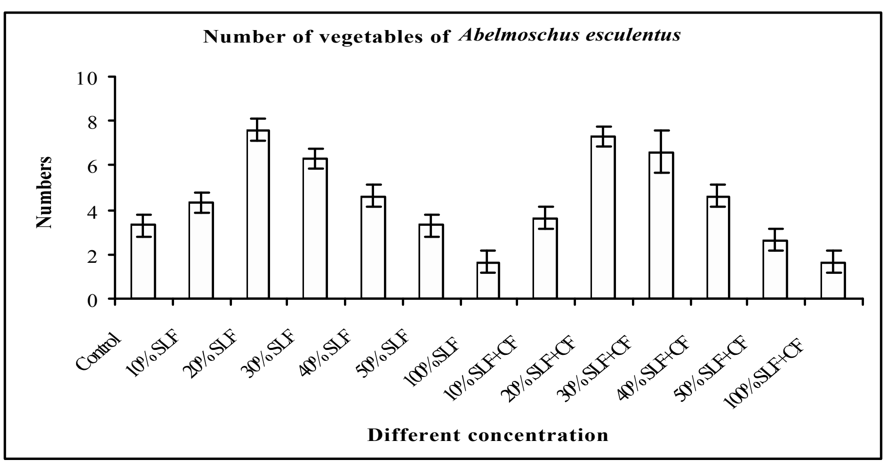

Fig. 6: Shows the number of vegetables of *Abelmoschus esculentus*

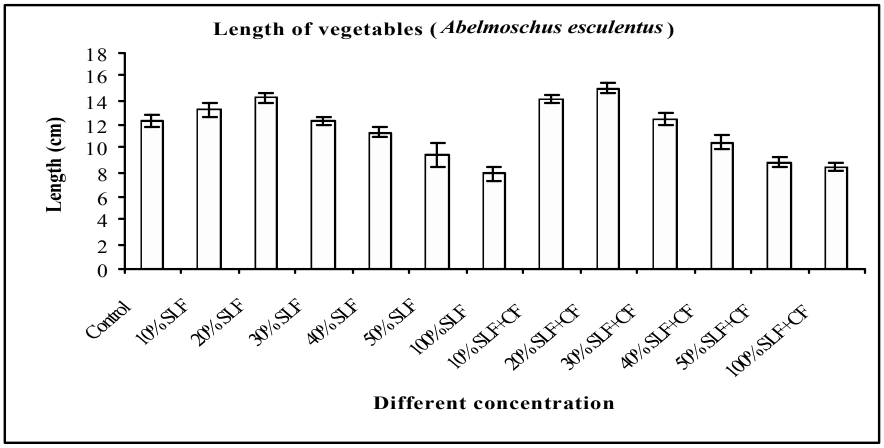

Fig. 7: Shows the length of vegetables of *Abelmoschus esculentus*

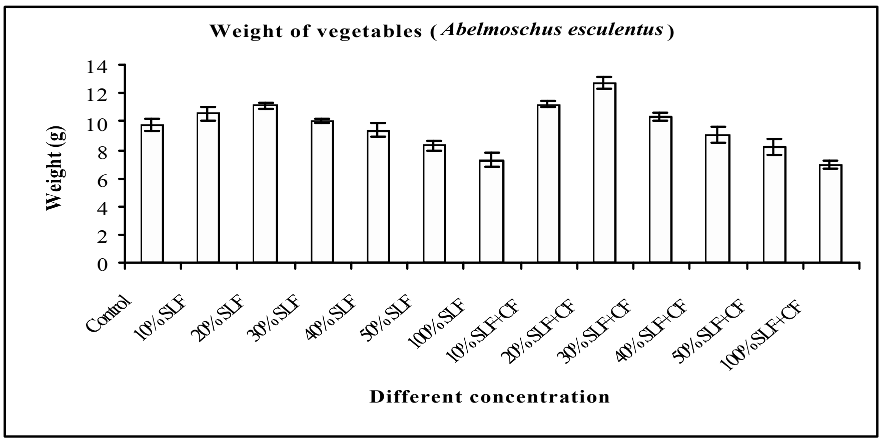

Fig. 8: Shows the weight of vegetables of *Abelmoschus esculentus*

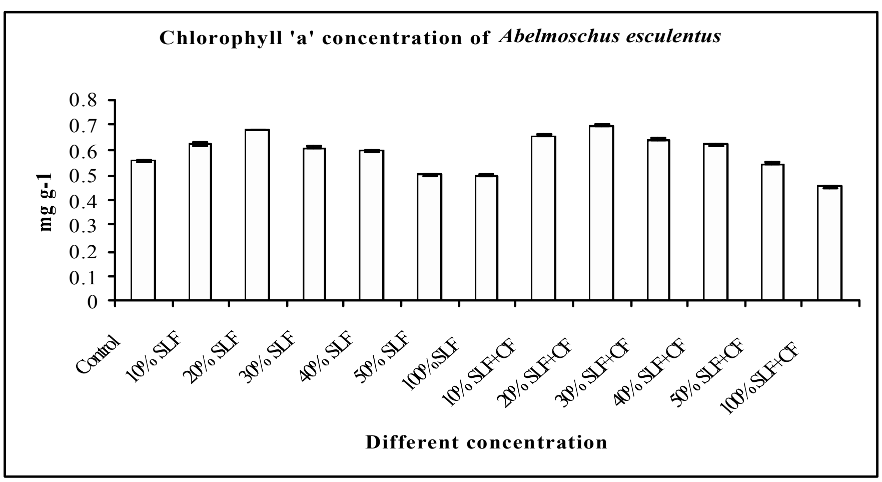

Fig. 9: Shows the Chlorophyll ‘a’ concentration of *Abelmoschus esculentus*

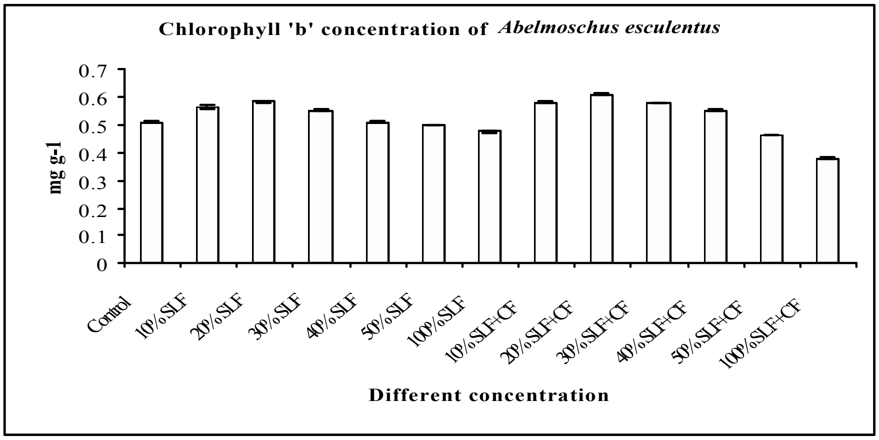

Fig. 10: Shows the Chlorophyll ‘b’ concentration of *Abelmoschus esculentus*

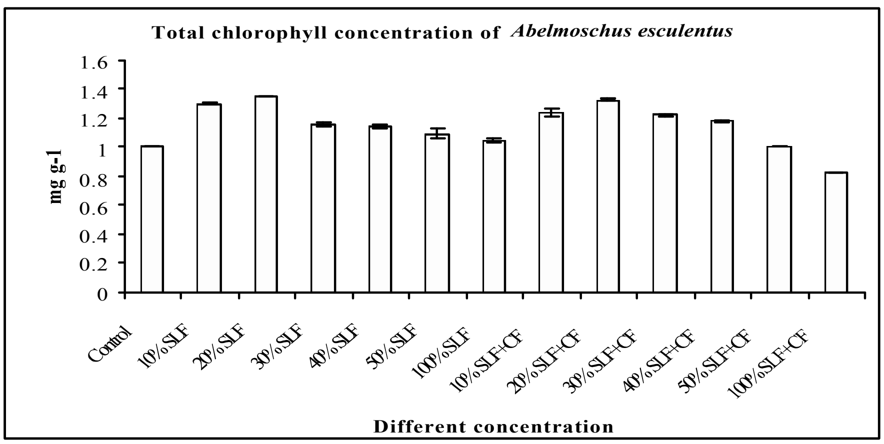

Fig. 11: Shows the Total Chlorophyll concentration of *Abelmoschus esculentus*

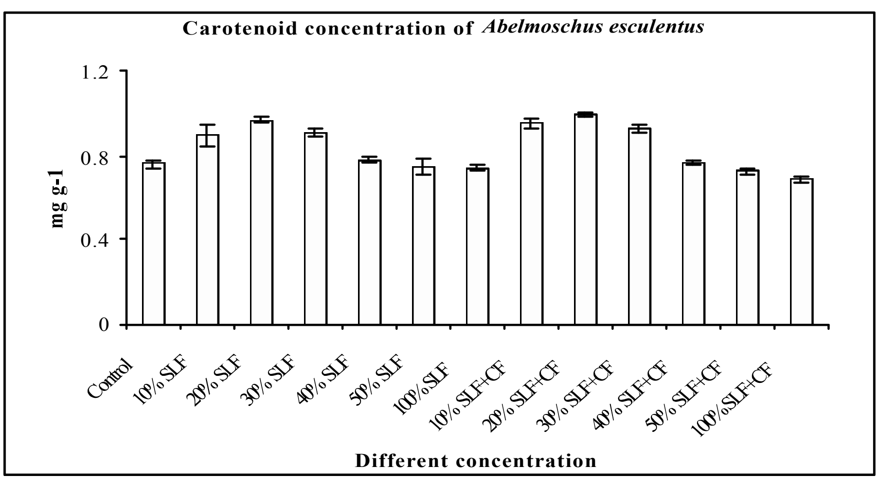

Fig. 12: Shows the Carotenoid concentration of *Abelmoschus esculentus*

that received 20% SLF alone. The minimum total chlorophyll content obtained recorded was 0.832±0.002 mg and 1.045±0.005mg in plants that received 100% SLF with recommended level of chemical fertilizer and 100% SLF alone respectively Fig. (11).

In *Abelmoschus esculentus* the maximum carotenoids content obtained was 0.999±0.006 mg in plants that received 20% SLF with recommended level of chemical fertilizer and whereas 0.968±0.012 mg in plants that received 20% SLF alone. The minimum carotenoids content obtained recorded was 0.687±0.013 mg and 0.742±0.11 mg in plants that received 100% SLF with recommended level of chemical fertilizer and 100% SLF alone respectively Fig. (12).

DISCUSSION

Seaweeds show great promise as a source of seaweed liquid fertilizer [SLF] for raising food crops. The present study highlights the efficiency of SLF obtained from the brown seaweed, *Rosenvingea intricata*. The time has come to produce a large quantity of food to the rapidly increasing world population. It an expected that there will be great deficiency of food materials in future. It is necessary to avoid this fast approaching disaster; also the production of various type of crop production is to be increased adequately.

In the present investigation seeds treated with lower concentration (20%) with or without chemical fertilizer shows better response in terms of shoot and root length, number of lateral roots and number of leaves. Similar observation was made by some earlier workers. Stephenson, 1974 [25] recorded that lower concentration of SLF prepared from *Ascophyllum* and *Laminaria* accelerated the growth in maize. Blunden and wildgoose, 1977 [26] reported a marked increase in lateral root development in potato plants as a result of treatment with seaweed extract. Similar results were recorded in *Padina*, which induced maximum growth in *Cajanus cajan* [27]. Thirumaran *et. al.,* 2006 and 2007 [28,29] reported with *Chaetomorpha antennina* and *Rosenvingea intricata* on the growth of *Abelmoschus esculentus* and *Raphanus sativus*. *Stoechosperum marginatum* and *Sargassum* on the growth of green chillies, turnips and pineapples and Cluster bean [30] and SLF of *Stoechospernum marginatum* at low concentration promoted the growth of brinjal [31] and Cowpea [32]. Taylor and Wilkinson, 1977 [33] the increased seedling growth may be due to the presence of Phenyl Acetic Acid (PAA) and other closely related compounds.

Dhargalkar and Untawale, 1980 [34] reported that SLF treatment enhanced the rate of seed germination in green chilies and turnip and found that lower concentrations of SLF increase the germination percentage than the higher concentration. Similar observation was made in *Cajanus cajan* [27], maize, ragi and Kambu [35], *Vigna catajung* and *Dolichos biflorus* [36,37], *Sesamum* [38] *Oryza sativa* [39]. According to Challen and Hemingway, 1965 [40] the growth promoting factors like IAA and IBA, Gibberlins(A&B),micronutrients,vitamins and aminoacids have a marked influence on the germination rate whereas retarded growth effects at higher concentration can be attributed by excessive hormones or high concentration of minerals present.

In the present study the seeds treated with low concentration like 20% concentration of both SLF added and SLF with chemical fertilizer showed better results in growth parameters such as shoot length (38.26±0.45; 38.7±0.65 Cm), root length (14.83±0.152; 15.26±0.602 Cm), number of lateral root (26±0.81; 27.6±0.47) and number of leaves (7.33±0.47; 8.33±0.47) of the plant. The obtained results were coinciding with previous studies of *Sargassum tenerrimum* algal extracts at low concentration promoted the crop growth [21]. Stephenson, 1974 [25] recorded that lower concentration of SLF prepared from Brown algae *Ascophyllum* and *Laminaria* accelerated the growth in maize. Similar results were recorded in *Padina*, which induced maximum growth in *Cajanus cajan* [27]. The higher seedling growth was found at 1.5% concentration of *Enteromorpha clathrata* on green gram [41]. Dhargalkar and Untawale, 1980 [34] also reported similar findings with *Hypnea musciformis, Spatoglossum asperum, Stoechosperum marginatum* and *Sargassum* on the growth of green chilies, turnips and pineapples.

The SLF treatment also increased total chlorophyll and carotenoids content of both the test plants at lower concentration (20%) SLF with or without chemical fertilizer. Our findings coincide with some earlier findings. Whapham *et al.,* 1993 [5] observed that the application of SLF of *Ascophyllum nodosum* increased the chlorophyll of Cucumber cotyledons and tomato plants. *Gracilaria edulis* extract on *Vigna unguiculata* and *Phaseolus mungo* [42], *Caulerpa scalpelliformis* and *Gracilaria corticata* extract on *Cyamoposis tetragonoloba* [30].

The present study, seaweed liquid fertilizer prepared from the brown alga *Rosenvingea intricata*, applied to crop plant showed better results in all aspects of growth, yield and pigment concentration when compared to the seaweed fertilizer of green alga [43,44]. It is probably due to the presence of growth promoting hormones and nutrients in more quantities in the brown alga than in other groups of algae, seaweed liquid fertilizer can be applied to various crop plant in order to enrich the nutrient content of the soil and intern to increase the growth and yield of cultivable plants.

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