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Effect of Seaweed Liquid Fertilizer on Growth and Pigment Concentration of *Cyamopsis tetrogonolaba* (L) Taub

G. Thirumaran, M. Arumugam, R. Arumugam and P. Anantharaman

CAS in Marine Biology, Annamalai University, Parangipettai-608 502, Tamil Nadu, India

Abstract: The present investigation an attempt has been made to study the effect of SLF from Rosenvigea intricata with or without chemical fertilizer on seed germination, growth, yield, pigment content and soil profile of *Cyamopsis tetragonoloba* (L) Taub were analyzed. The seed germination, growth and yield parameters such as shoot length, root length, number of lateral roots, number of leaves, number of vegetables, length of vegetables, weight of vegetables, photosynthetic pigment concentration such as chlorophyll 'a', chlorophyll 'b', total chlorophyll and carotenoids was found to be maximum at 20% concentration of 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 % *Rosenvingea intricata* % *Cyamopsis tetragonoloba* % Growth % Yield % Pigment concentration

INTRODUCTION

Seaweeds are the macroscopic marine algae found attached to the bottom in relatively shallow coastal waters. They grow in the intertidal, shallow and deep sea areas up to 180 meter depth and also in estuaries and backwaters on the solid substrate such as rocks, dead corals and pebbles. Seaweed zone is one of the conspicuous and wide-spread biotope in the shallow marine environment. The Seaweeds are totally different from higher plants as they neither have true leaves, stems and roots or vascular systems none specialized sex organs.

The use of seaweeds as manure in farming practice is very ancient and was prevalent among the Romans and also practiced in Britain, France, Spain, Japan and China. There are also records of culture of seaweeds for manure in Ireland and South Africa. The Seaweeds are used either directly or after compositing or burning is being made into a meal. Case of seaweeds, especially species of *Sargassum* has been used in parts of coastal Kerala as manure for coconut plantation. Experiments on the use of seaweeds as manure have been carried out by [1], who showed higher rate of growth and higher yield in crop plants. Bhosle *et al.* [2] prepared a seaweed liquid fertilizer (SLF) and studied its effect on *Phaeseolus vulgaris*. Rama Rao [3] reported good yields of *Zizyphus rugosa* fruits, where leaf spray of SLF obtained from *Sargassum* was used.

Seaweed liquid fertilizer (SLF) contained macro nutrients, trace elements, organic substances like amino acids and plant growth regulators such as auxin, cytokinin and gibberellins. They are particularly suitable content [4], it has been proved that SLF promoted, the growth and yield of crop plants [5-8]. The SLF obtained from brown, red and green seaweeds are now available commercially in trade names such as Maxicrop (sea born), Algifert (Manure), Golmar, GA 14, Kelpak 66, Seaspray, Seasol SM3, Cytex and Sea Crop 16 for use in agriculture [9]. Verklejj [10] stated that application of SLF enhanced the water retention capacity of soil. Seaweed extracts are known to enhance seed germination and plant growth [2, 11-13]. They have been also shown to increase crop yield, improve growth and induce resistance to frost, fungal and insect attack and increase nutrient uptake from soil.

At Present we use chemical fertilizers in great quantities to compensate the deficiency of nutrient in soil. It is observed that the abundant use of chemical fertilizers affects soil and plants in due course. Recent researches proved that seaweed fertilizers are preferred not only due to their nitrogen, phosphorus and potash content but also because of the presence of trace elements and metabolites

Corresponding Author: G. Thirumaran, CAS in Marine Biology, Annamalai University, Parangipettai-608 502, Tamil Nadu, India

similar to plant growth regulators. In India, as a step towards the expansion of native sources of natural manures, the seaweed fertilizers application will be useful now for achieving higher production. Recently, seaweed extracts as liquid fertilizers (SLF) has come in the market, for the simple reason that they contain many growth promoting hormones like auxin, gibberellin, trace elements, vitamins, amino acids and micronutrients. Dhargalkar and Untawale [14] studied the effect of seaweed extracts on grown chillies and turnip to found that lower concentrations of SLF enhanced the rate of seed germination.

The application of seaweed fertilizer for different crop was of great importance to substitute the commercial chemical fertilizers and to reduce the cost of production. Liquid fertilizers derived from seaweeds are found to be superior to chemical fertilizers due to high level of organic matter, micro and macro elements, vitamins and fatty acids and also rich in growth regulators [15]. The growth promoting effect of extract of seaweeds on seed germination [11,16], Vegetative growth [13] and biochemical characteristics [17] in agriculture crops has been reported. Seaweed extract have been marketed for several years as fertilizer additives and beneficial result from their use have been reported [18]. The carbohydrates and other organic matter present in seaweeds alter the nature of soil and improve its moisture holding capacity [15].

Marine macro algae serve as an excellent source of food, fodder, fertilizer and as production of phycocolloids such as agar-agar, carrageenan and algin. Historical records show that the use of seaweed in agriculture is ancient and wide spread wherever there are abundant resources in the coastal regions of Iceland, Norway, Great Britain, Ireland and France. Seaweeds as manure, dates back to fourth century as a partial substitute for manure. Thivy [1] reported that the seaweeds particularly brown algae improve the fertility of soil in cultured fields as their algin content helps in conditioning the soil, facilitating aeration, moisture retention and adsorption of nutrient elements. The present study was undertaken to assess the effect of seaweed extract of *Rosenvingea intricata* on seed germination, growth and yield characters, chlorophyll content and soil fertility of *Cyamopsis tetragonaloba*(L) Taub.

MATERIALS AND METHODS

The seaweed *Rosenvingea intricata* was collected from Chunnambar estuary, Pondicherry. The algal sample was hand picked and washed thoroughly with seawater to remove all the impurities, sand particles and epiphytes. It was kept in an ice box containing slush ice, transported to the laboratory and washed thoroughly using tap water to remove the salt on the surface of the sample. The water was drained off and the algal material was spread on blotting paper to remove excess water. SLF was prepared by following the method of [2]. 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 test plants selected for the present study was *Cyamopsis tetrogonolaba* (L) Taub which is widely cultivated in India.

Seeds: Viable seeds were obtained from the Agricultural College, Govt. of Tamil Nadu, Madurai. Care was taken in selecting the seeds of uniform size and they were stored in metal tins as suggested by Rao [19].

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 [*Cyamopsis tetragonolaba*] was treated with or without chemical fertilizers at different doses.

- Seaweed liquid fertilizer alone [without chemical fertilizer]
- Control: only water; 2) 10% SLF; 3) 20% SLF; 4) 30% SLF; 5) 40% SLF; 6) 50% SLF; 7) 100% SLF
- Seaweed liquid fertilizer with recommended level of Chemical fertilizer.
- 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 [20].
Carotenoids were analyzed by Kirk and Allen [21].

RESULT

Seed Germination: In cluster bean (*Cyamopsis tetragonaloba*) the 100% seed germination was found to be at 20%, 30% SLF with or without chemical fertilizer. The effect of SLF of *Rosenvingea intricata* on growth parameters such as shoot length, root length, number of lateral roots, number of leaves and pigment concentration of Cluster bean was showed in Table (1and2).

Shoot Length: The maximum shoot length recorded was 34.89 cm in the plants that received 20% SLF with recommended level of chemical fertilizer and where as

Table 1: Growth and pigment concentration of *Cyamopsis tetragonaloba*

Parameters	Control	10% SLF	20% SLF	30% SLF	40% SLF	50% SLF	100% SLF	10% SLF+CF	20% SLF+CF	30% SLF+CF	40% SLF+CF	50% SLF+CF	100% SLF+CF
Shoot length	30.46	32.01	33.96	32.85	30.78	29.64	29.53	33.51	34.89	32.57	31.91	29.26	26.46
	±1.3	±1.56	±3.70	±1.68	±1.25	±0.65	±1.15	±1.49	±2.18	±1.13	±1.88	±0.32	±2.01
Root Length	14.73	16.63	17.23	15.83	15.32	14.2	10.21	17.43	18.26	17.26	15.5	12.7	11.56
	±0.50	±1.25	±0.80	±1.10	±0.75	±0.45	±0.70	±0.76	±0.40	±0.86	±0.65	±0.85	±0.66
Chlorophyll	0.5974	0.6347	0.6601	0.61	0.586	0.5725	0.5625	0.6649	0.6988	0.6147	0.5929	0.5388	0.4654
"A"	± 0.05	±0.01	±0.001	±0.005	±0.008	±0.003	±0.005	±0.001	±0.008	±0.004	±0.006	±0.006	±0.006
Chlorophyll	0.5145	0.5427	0.5710	0.521	0.5593	0.503	0.4785	0.561	0.6012	0.5756	0.5474	0.4697	0.3923
"b"	±0.001	±0.005	±0.001	±0.005	±0.005	±0.007	±0.004	±0.005	±0.004	±0.007	±0.014	±0.010	±0.010
Total	1.023	1.1974	1.294	1.1722	1.1603	0.985	0.896	1.123	1.301	1.1903	1.1402	1.008	0.8581
chlorophyll	±0.05	±0.01	±0.002	±0.002	±0.003	±0.007	±0.006	±0.017	±0.006	±0.011	±0.020	±0.016	±0.016
Carotenoids	0.769	0.9021	0.966	0.926	0.790	0.771	0.749	0.968	1.003	0.932	0.792	0.765	0.700
	±0.02	±0.01	±0.007	±0.012	±0.012	±0.051	±0.018	±0.019	±0.017	±0.013	±0.020	±0.011	±0.030
Length of	12.66	14.26	14.83	13.43	11.16	8.56	8.02	14.63	15.63	13.23	10.66	8.96	8.59
vegetables	±0.60	±0.40	±0.25	±0.45	±0.25	±0.65	±0.30	±0.50	±0.20	±0.50	±0.20	±0.50	±0.25
Weight of	4.933±	6.113	6.466	5.916	4.85	4.306	3.856	6.223	6.763	5.796	4.92	3.903	3.71
vegetables	0.15	±0.20	±0.55	±0.10	±0.34	±0.31	±0.19	±0.27	±0.51	±0.35	±0.55	±0.25	±0.31

Table 2: The Yield of *Cyamopsis tetragonaloba*

Seed germination	90%	90%	100%	100%	90%	90%	80%	90%	100%	100%	90%	90%	80%
No. of lateral roots	17	24	27	20	19	17	15	28	32	23	19	16	14
No. of leaves	14	17	20	16	14	14	12	19	23	20	16	13	10
No of vegetables	9	11	13	12	10	9	8	11	13	12	11	9	8

33.96 cm in the plants that received 20% SLF alone. The minimum shoot length was 26.46 cm and 29.53 cm in plants received 100% SLF with chemical fertilizer and 100% SLF alone respectively. The observed value was 30.46 cm in the control plant.

Root Length: The maximum shoot length recorded was 18.26 cm in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 17.23 cm in the plants that received 20% SLF alone. The minimum root length was 10.21 cm and 11.56 cm in plants received 100% SLF with chemical fertilizer and 100% SLF alone respectively. The observed value was 14.73 cm in the control plant.

Number of Lateral Roots: The maximum lateral roots recorded were 32 in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 27 in the plants that received 20% SLF alone. The minimum lateral roots was14.and 15 in plants received 100% SLF with chemical fertilizer and 100% SLF alone respectively. The observed value was 17 in the control plant.

Number of Leaves: In cluster bean the maximum number of leaves length recorded was 23 in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 20 in the plants that received 20% SLF alone. The minimum number of leaves was 10 and 12 in plants received 100% SLF with chemical fertilizer and 100% SLF alone respectively. The observed value was 14 in the control plant.

Number of Vegetables: The maximum number of vegetables recorded was 13 in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 13 in the plants that received 20% SLF alone. The minimum number of vegetables was 8 and 8 in plants received 100% SLF with chemical fertilizer and 100% SLF alone respectively. The observed value was 9 in the control plant.

Length of Vegetables: The maximum length of vegetables recorded was 15.63 cm in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 14.83 cm in the plants that received 20% SLF alone. The minimum length of vegetables was 8.6 cm and 8.1 cm in plants received 100% SLF with chemical fertilizer and 100% SLF alone respectively. The observed value was 4.7 cm in the control plant.

Weight of Vegetables: In cluster bean the maximum weight of vegetables recorded was 6.76 g in the plants that received 20% SLF with recommended level of chemical fertilizer and where as 6.46 g in the plants that received 20% SLF alone. The minimum weight of vegetables was 3.97 g and 3.92 g in plants received 100% SLF with chemical fertilizer and 100% SLF alone respectively. The observed value was 2.62 g in the control plant.

Chlorophyll'a': In cluster bean the maximum chlorophyll'a' content obtained was 0.698 mg in plants that received 20% SLF with recommended level of chemical fertilizer and whereas 0.562 mg in plants that received 20% SLF alone. The minimum chlorophyll content obtained recorded was 0.454 mg and 0.501 mg in plants that received 100% SLF with recommended level of chemical fertilizer and 100% SLF alone respectively. The observed value was 0.555 mg in the control plants.

Chlorophyll'b': In cluster bean the maximum chlorophyll'b' content obtained was 0.601 mg in plants that received 20% SLF with recommended level of chemical fertilizer and whereas 0.571 mg in plants that received 20% SLF alone. The minimum chlorophyll 'b' content obtained recorded was 0.392 mg and 0.478 mg in plants that received 100% SLF with recommended level of chemical fertilizer and 100% SLF alone respectively. The observed value was 0.514 mg in the control plants.

Total Chlorophyll: In cluster bean the maximum total chlorophyll content obtained was 1.301 mg in plants that received 20% SLF with recommended level of chemical fertilizer and whereas 1.294 mg in plants that received 20% SLF alone. The minimum total chlorophyll content obtained recorded was 0.858 mg and 0.896 mg in plants that received 100% SLF with recommended level of chemical fertilizer and 100% SLF alone respectively. The observed value was 1.023 mg in the control plants.

Carotenoids: In cluster bean the maximum carotenoids content obtained was 1.003 mg in plants that received 20% SLF with recommended level of chemical fertilizer and whereas 0.966 mg in plants that received 20% SLF alone. The minimum carotenoids content obtained recorded was 0.700 mg and 0.749 mg in plants that received 100% SLF with recommended level of chemical fertilizer and 100% SLF alone respectively. The observed value was 0.769 mg in the control plants.

DISCUSSION

As a step toward the expansion of nature source of other manures seaweed fertilizer application will be useful in enriching the soil and achieving higher production in the place of costly chemical fertilizer. In the developing world, the use of seaweed liquid fertilizer should be urged to avoid environmental pollution by heavy doses of chemical fertilizer in the soil. The beneficial effect of SLF on terrestrial plants include improving the over all growth, yield and the ability to with stand adverse environmental conditions [5]. The seaweed extracts obtained from *Ecklonia maxima* a when applied as soil drench to tomato seedlings significantly increased the growth and reduced infestation by *Metoiclogyne incognita*. However, foliar application was less effective when compared with soil drench [8]. The earlier work has similar to our present study, here growth, yield, pigments were rich in SLF foliar spray treated plant and soil profile like N,P,K were also higher in our investigation.

In the present study the percentage of seed germination found to be 100% in plants received 20% and 30% SLF with or without chemical fertilizer. Aitkin and Senn [22] recorded lower concentration seaweed extract showed increased seed germination on ornamental plants, tobacco, pea and cotton. Dhargalkar and Untawale [14] 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* [12], maize, ragi and Kambu [23], *Sesmum* [24] *Oryza sativa* [25] and Cowpea [26].

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 [27] recorded that lower concentration of SLF prepared from *Ascophyllum* and *Laminaria* accelerated the growth in maize. Blunden and Wildgoose [28] 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* [12]. Thirumaran *et al*. [29-30] reported with *Chaetomorpha antennina* and *Rosenvingea intricata* on the growth of *Abelmoschus esculentus* and *Raphanus sativus*. Dhargalkar and Untawale [14] also reported similar findings with *Hypnea musiformis, Spatoglossum asperum, Stoechosperum marginatum* and *Sargassum* on the growth of green chillies, turnips and pineapples and Cluster bean [17].

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.* [31] observed that the application of SLF of *Ascophyllum nodosum* increased the chlorophyll of Cucumber cotyledons and tomato plants.

In the present investigation seeds treated with lower concentration (20%) of SLF with or without chemical fertilizer increased number of vegetables per plant, length of the vegetable and weight of single vegetable. This observation is agreement with the earlier reports that promotional effect in terms of length, breadth and weight of the fruit of *Zizyphus mauratiana* while experimenting with crude extract of seaweed [7]. Rama Rao [6] reported that the dry powder and liquid formulators of the seaweed *S.wightii* increased the fresh weight of tomato plants; further the dry powder was effective at a low dose.

In general, it was observed in the present study, that the seaweed liquid fertilizer prepared from the brown alga, *Rosenvingea intricata*, applied to crop plant gave better results in all aspects of growth to yield and soil nutrient content when compared to the seaweed fertilizer of green alga [32-33]. 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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