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Influence of Seaweed Liquid Fertilizer on Growth and Biochemical Characteristics of *Arachis hypogea* L. under field trial

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Abstract
In the present study, an attempt has been made to investigate the effect of Seaweed Liquid Fertilizer (SLF) of the brown seaweed *Sargassum wightii* Grev. on the growth, biochemical and pigment characteristics of *Arachis hypogea*. The 1.0% concentration of water extract showed better results of growth parameters, biochemical and pigments constitutions. Combined effect of 1.0% SLF plus different proportions of recommended rate of chemical fertilizers were also made on *A. hypogea*. Among the different concentrations of SLF investigated, the plants that received with 1.0% SLF showed maximum fresh weight, dry weight, root and shoot length, number of branches, leaf area and content of total chlorophyll, chlorophyll a and b, protein, carbohydrate and lipid. Similarly the plants that applied with 1.0% SLF plus 25% recommended rate of chemical fertilizers showed enhanced characteristics. *Arachis hypogea* treated with 1.0% SLF of *S. wightii* plus 25% recommended rate of chemical fertilizers showed an increased the above parameters.

Keywords: Seaweed Liquid Fertilizer, SLF, *Arachis hypogea*, *Sargassum wightii*, Chlorophyll

INTRODUCTION

Seaweeds are one of the most important marine resources of the world and being used as human food, animal feed and raw material for many industries. They are also used as manure for agricultural and horticultural crops [1] due to the presence of minerals, trace elements and plant growth regulators which occur in water soluble form [2] and enhances the disease resistance in field crops [3]. Different forms of seaweed preparation such as LSF (Liquid Seaweed Fertilizer), SLF (Seaweed Liquid Fertilizer) LF (Liquid Fertilizer), and either whole or finally chopped powered algal manure have been used and all of them have been reported to produce beneficial effects on cereals, pulses, and flowering plant. Seaweed manure has the advantage of being free from weeds and pathogenic fungi. Liquid extracts of brown algae are being sold as biostimulants or biofertilizers in various brand names. Promising increased crop yield, nutrient uptake, resistance to frost and stress, improved seed germination of reduced incidents of fungal and insect attack have been resulted by application of seaweed extracts. Seaweeds are known to contain appreciable quantities of plant growth regulators [4], cytokinin [5], IAA [6], gibberellins and gibberellins-like substances [7, 8].

The application of seaweed extract for different crops was a great importance due to containe high levels of organic matter, micro elements, vitamins and fatty acids and also rich in growth regulators such as auxins, cytokinin and gibberellins [9]. The beneficial effect of seaweed extract application is as a result of many components that may work synergistically at different concentrations, although the mode of action still remains unknown [10].However, application of seaweed extract increased chlorophyll content [11, 12]. Hence the present study was conducted to find out the effect of seaweed (*Sargassum wightii*) on the growth and biochemical parameters of *Arachis hypogea* L.

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MATERIAL AND METHODS

The specimens of brown seaweed *Sargassum wightii* Grev. was collected from Mandapam coast, Tamil Nadu. The collected seaweeds were washed with seawater initially to remove macroscopic epiphytes and sand particles and finally with fresh water to remove adhering salt. They were shade dry for four days followed by oven dry at 60°C for 12h. Then the materials were hand crushed and made as coarse powder using a mixer grinder. This was added with distilled water in a ratio of 1 : 20 (w/v) and autoclaved at 121°C, 15lbs/sq.inch for 30 minutes. The hot extract was filtered through cheese cloth and allowed to cool at room temperature [13]. Its concentration was calculated by keeping a known volume of (100 mL) in a hot air oven at 60° C until it showed a constant dry weight.

Field trial was conducted on *Arachis hypogea* L. at Kumminipet near Arakkonam, Tamil Nadu. Each plot covered an area of 12m^2 (4m x 3m). Bunds were raised up to a half a feet. Three duplicates in randomized plots were maintained for each experiment.

The experimental area was (ca. 600m^2) spread with ca 200 Kg Farm Yard Manure and ploughed thoroughly for two times followed by a final ploughing accompanied by sowing ground nut seeds along the furrows at an interval of one foot and leveled off. Then the field was separated into plots.

Effect of SLF(s) on *Arachis hypogea*

Different concentrations of 1.2 L of *S. wightii* SLF namely 0.25,

0.5, 1.0 and 1.5% w/v were prepared and diluted to 12L using the irrigating well water. It was applied uniformly to the respective plots by distributing 1L of diluted SLF/m^2 or 100ml SLF/m^2. The plots were irrigated every week.

The 1.2L of 1.0% SLFwas made up to 12L with well water and dissolved the different proportions of recommended rate of chemical fertilizers viz., 75%, 50% and 25%. Plants were also applied only with 100% recommended rate of chemical fertilizers as well as with 1.0% SLF and treated them as controls

Thirty day old plants were taken for the observations. Different parameters namely, total plant height, shoot height, root height (cm), total fresh and dry weight, shoot fresh and dry weight, root fresh and dry weight (g), number of branches and leaf area of third young leaf (cm^2) were recorded. The biochemical parameters of the third young leaf namely total chlorophyll, chlorophyll a and b [14], total carbohydrate [15], total protein [16] and lipid content [17] (mg/g fresh weight) were recorded.

RESULTS

The groundnut (*Arachis hypogea*) treated with four different concentrations of *S. wightii* SLF viz., 0.25%, 0.5%, 1.0% and 1.5% showed that the SLF enhanced the concentrations of photosynthetic pigments. The plant received with 1.0% SLF contained a maximum of 1.85 mg/g fresh weight of Chlorophyll *a* on 30 day old plants. Further, the concentration of Chlorophyll *b* was 0.48 mg/g fresh weight. At this condition, the increments of Chl *a* and Chl *b* on 30th day were more than 105.0% and 45.0%, respectively, when compared to control (Fig.1a).

The accumulation of total carbohydrate, total protein and total lipid content also increased due to the SLF treatment. A maximum accumulation of the above parameters was recorded when the plant applied with 1.0% SLF on 30th. At this condition, the 30 day old plants showed an increment of more than 61.0%, 83.0% and 73.0%, towards the accumulation of total carbohydrate, total protein and total lipid content, respectively, when compared to control (Fig.1b).

The physical parameters like total plant height, shoot and root height (cm), total fresh weight, shoot and root fresh weight, total dry weight, shoot and root dry weight (g), number of branches and leaf area (cm2) were also recorded a maximum when the plants received with 1.0% *S. wightii* SLF. The one way ANOVA of total plant height and total fresh weight showed significant each at 1% level (Table 1).

Effect of different proportions of recommended rate of chemical fertilizers + 1.0% *S. wightii* SLF

Interestingly 30 day old plants that received with 25% recommended rate of chemical fertilizers + 1.0% SLF showed maximum values of different physical parameters. The one way ANOVA calculated between parameters and different concentrations of SLF showed highly significant at 1% level (Table 2).

The number of branches and leaf area were also increased significantly when the plants applied with the 25% recommended rate of chemical fertilizer + 1.0% SLF on 30th day. The ground nut received with 25% of recommended rate of chemical fertilizers + 1.0% SLF showed a maximum accumulation of total carbohydrate, total protein and total lipid content in the third young leaf on 30 day old plants when compared to the plants that received with 100% recommended rate of chemical fertilizer (control 2). The concentration of total Chlorophyll, Chlorophyll a and Chlorophyll b also showed a maximum when the plants treated with 25% recommended rate of chemical fertilizers + 1.0% SLF on 30th day. At this condition, the plants contained a maximum of 2.17 mg/g fresh weight of total Chlorophyll, 1.67 mg/g fresh weight of Chlorophyll *a* and 0.50 mg/g fresh weight of Chlorophyll *b*. Their increments were more than 40.0%, 36.0% and 56.0%, respectively, when compared to control 2 (100% recommended rate of chemical fertilizer) (Fig.2a, 2b).

Table 1. Effect of *Sargassum wightii* SLF on the growth of *Arachis hypogea* under field trial on 30th day

Parameters	F-value	P-value	SLF Concentrations				
			Control	0.25%	0.5%	1.0%	1.5%
Total plant height (cm)	9.55	0.00**	16.00 ± 1.90^{a}	18.80 ± 2.56^{ab}	21.00 ± 0.80^{bc}	23.20 ± 2.61^{c}	21.50 ± 1.58^{bc}
Shoot height (cm)	5.41	0.00**	11.00 ± 2.09^{a}	13.00 ± 2.68^{ab}	14.80 ± 0.79^{b}	16.00 ± 2.07^{b}	15.00 ± 1.22^{b}
Root height (cm)	9.46	0.00**	5.00 ± 0.49^{a}	5.80 ± 0.22^{ab}	6.20 ± 0.82^{bc}	7.20 ± 0.79^{c}	6.50 ± 0.41^{bc}
Total fresh weight (g)	12.62	0.00**	19.31 ± 0.88^{a}	24.45 ± 2.14^{b}	25.87 ± 3.88^{b}	28.09 ± 0.98^{b}	26.27 ± 0.73^{b}
Shoot fresh weight (g)	11.64	0.00**	18.15 ± 0.95^{a}	23.10 ± 2.05^{b}	24.43 ± 3.84^{b}	26.41 ± 0.89^{b}	24.76 ± 0.72^{b}
Root fresh weight (g)	15.89	0.00**	1.16 ± 0.08^{a}	1.35 ± 0.09^{ab}	1.44 ± 0.13^{b}	1.68 ± 0.11^{c}	1.51 ± 0.10^{bc}
Total dry weight (g)	56.79	0.00**	3.71 ± 0.08^{a}	4.71 ± 0.12^{b}	4.97 ± 0.08^{b}	5.40 ± 0.17^{c}	5.05 ± 0.34^{bc}
Shoot dry weight (g)	59.21	0.00**	3.49 ± 0.08^{a}	4.45 ± 0.12^{b}	4.70 ± 0.09^{b}	5.08 ± 0.14^{c}	4.76 ± 0.32^{bc}
Root dry weight	3.80	0.01*	0.22 ± 0.04^{a}	0.26 ± 0.05^{ab}	0.27 ± 0.04^{ab}	0.32 ± 0.03^{b}	0.29 ± 0.03^{ab}
Number of branches	0.61	0.65^{NS}	3.00 ± 1.22	4.00 ± 0.70	4.00 ± 1.22	3.80 ± 1.30	4.00 ± 1.58
Leaf area (cm^2)			10.2	12.0	13.3	15.8	14.1

Note: *denotes significant at 5% level
**denotes significant at 1% level
Different alphabets between concentration denotes statistically significant based on multiple range test (Tukey -HSD test).
^{NS} denotes not significant

Table 2. Effect of different proportions of recommended rate of chemical fertilizers + 1.0% *Sargassum wightii* SLF on *Arachis hypogea* under field trial 30th day

Parameters	F-value	P-value	Concentrations					
			CST1	CST2	CST3	CST4	CST5	CST6
Total plant height (cm)	7.34	0.00**	14.40 ± 2.07^{a}	16.00 ± 1.87^{ab}	18.40 ± 1.51^{bc}	20.00 ± 2.00^{c}	17.60 ± 1.34^{abc}	18.00 ± 2.00^{bc}
Shoot height (cm)	3.30	0.03*	10.20 ± 1.48^{a}	11.00 ± 1.00^{ab}	12.20 ± 1.64^{ab}	13.20 ± 1.64^{b}	11.60 ± 1.14^{ab}	12.40 ± 3.78^{ab}
Root height (cm)	6.08	0.00**	4.20 ± 0.83^{a}	5.00 ± 1.00^{ab}	6.20 ± 0.83^{bc}	7.00 ± 1.00^{c}	6.00 ± 1.22^{abc}	6.00 ± 1.00^{ab}
Total fresh weight (g)	559.67	0.00**	23.76 ± 1.20^{a}	28.26 ± 0.97^{b}	33.50 ± 0.58^{c}	49.70 ± 0.91^{d}	26.80 ± 1.07^{b}	20.70 ± 0.89^{a}
Shoot fresh weight (g)	604.15	0.00**	22.70 ± 0.99^{a}	26.60 ± 1.14^{b}	31.60 ± 0.54^{c}	47.20 ± 0.82^{d}	25.10 ± 0.85^{b}	20.00 ± 0.40^{a}
Root fresh weight (g)	90.42	0.00**	0.98 ± 0.11^{a}	1.59 ± 0.13^{b}	1.85 ± 0.21^{c}	2.55 ± 0.07^{d}	1.67 ± 0.07^{bc}	0.72 ± 0.05^{a}
Total dry weight (g)	213.58	0.00**	4.57 ± 0.22^{a}	5.44 ± 0.20^{b}	6.46 ± 0.16^{c}	9.59 ± 0.51^{d}	5.17 ± 0.28^{b}	3.99 ± 0.14^{a}
Shoot dry weight (g)	86.71	0.00**	4.39 ± 0.50^{a}	5.14 ± 0.29^{a}	6.11 ± 0.27^{b}	9.10 ± 0.65^{c}	4.85 ± 0.43^{a}	3.86 ± 0.33^{a}
Root dry weight	72.76	0.08**	0.18 ± 0.007^{a}	0.30 ± 0.02^{b}	0.30 ± 0.04^{b}	0.49 ± 0.02^{c}	0.32 ± 0.03^{b}	0.13 ± 0.007^{b}
Number of gynophore	30.08	0.00**	2.20 ± 1.18^{a}	2.80 ± 1.64^{a}	5.20 ± 1.78^{a}	16.00 ± 3.80^{b}	6.00 ± 1.78^{a}	3.20 ± 1.09^{a}
Number of branches	3.92	0.00**	4.40 ± 1.14^{a}	5.80 ± 1.30^{ab}	6.40 ± 1.14^{ab}	7.00 ± 1.30^{b}	5.80 ± 0.83^{ab}	4.60 ± 0.89^{a}
Leaf area (cm^2)			12.3	12.4	15.5	17.8	12.5	10.7

Note:*denotes significant at 5% level
**denotes significant at 1% level
different alphabets between concentration denotes statistically significant based on multiple range test (Tukey -HSD test).

S- *Sargassum wightii* T - Treatment C - Chemical fertilizer
CST1- 100% recommended rate of chemical fertilizer
CST2 - 75% recommended rate of chemical fertilizer + 1.0% SLF
CST3 - 50% recommended rate of chemical fertilizer + 1.0% SLF
CST4 - 25% recommended rate of chemical fertilizer + 1.0% SLF
CST5 - 1.0% SLF only
CST6 - Water only

Fig.1a Effect of different concentrations of *Sargassum wightii* SLF on the pigments of *Arachis hypogea* on 30th day

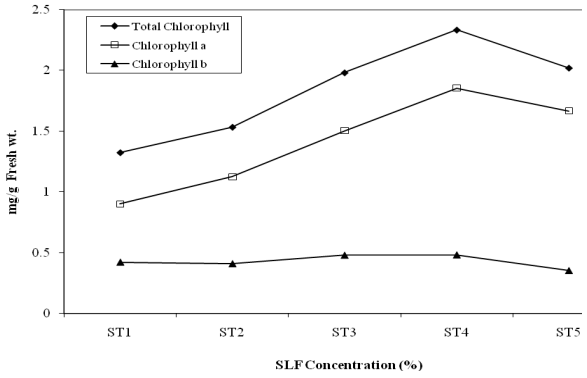


Fig.1b Effect of different concentrations of *Sargassum wightii* SLF on the total protein, total carbohydrate and total lipid content of *Arachis hypogea* on 30th day

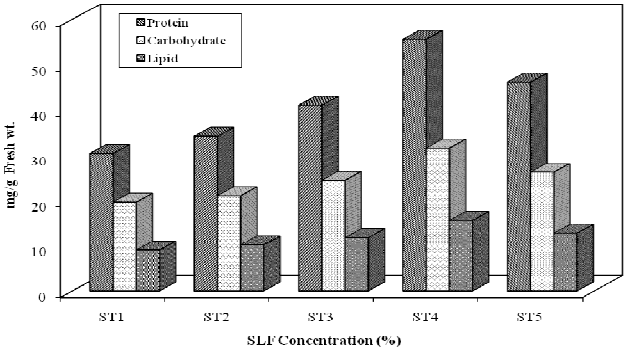


Fig.2a Effect of different concentrations of recommended rate of chemical fertilizers + 1.0% *Sargassum wightii* SLF on the pigments of *Arachis hypogea* on 30th day

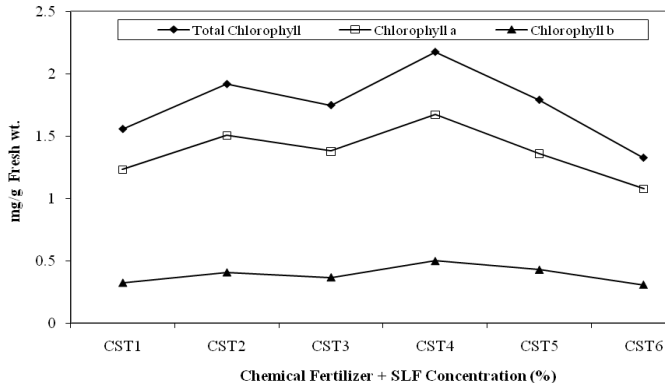
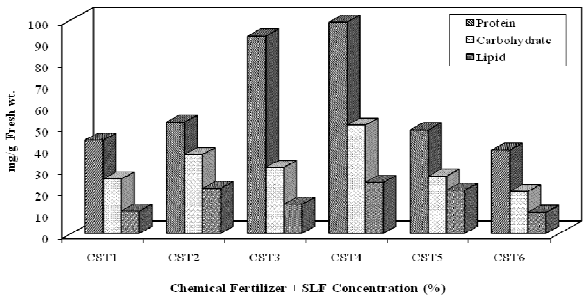


Fig.2b Effect of different concentrations of recommended rate of the chemical fertilizers + 1.0% *Sargassum wightii* SLF on the total protein, total carbohydrate and total lipid content of *Arachis hypogea* on 30th day



CST1 - 100% recommended rate of chemical fertilizer
CST2 - 75% recommended rate of chemical fertilizer + 1.0 % SLF
CST3 - 50% recommended rate of chemical fertilizer + 1.0 % SLF
CST4 - 25% recommended rate of chemical fertilizer + 1.0 % SLF
CST5 - 1.0 % SLF only CST6 - water only

DISCUSSION

Seaweed treatment of crops has grown in popularity and led to development of a large number of processed seaweed products. These can be placed into three groups: meals for supplementing soil in large volumes or for blending into defend rooting media for glasshouse crops, powered or liquid extracts, and concentrates employed as root dips, soil drenches and foliar sprays [18, 19, and 20].

Magnesium, forms an important component of Chlorophyll, which increased by 66.0% and 96.0% in the shoot under the influence of extracts obtained from *Ulva* and *Enteromorpha* [21]. The concentrations of total Chlopohyll, Chlopohyll *a* and Chlopohyll *b* of *Vigna ungiculata* were increased up to 140%, 160% and 110%, respectively, when the plant received with of 0.25% of *U. lactuca* SLF [8]. *Vigna catajung* when treated with 10% *Caulerpa racemosa* extract contained highest protein and amino acid contents [22]. The amount of protein content was found highest in the shoot system under the treatment of *Enteromorpha* and *Jania* extracts [21]. In the present study concentration of different pigments and total protein content of the test crop showed increased levels when treated with SLF as in agreement with the findings of earlier workers. The pigments and total protein content were increased with SLF treatment as well as with the combined effect of chemical fertilizers + 1.0% SLF for the crop.

Seaweed extracts of Laminariaceae and Fucaceae when applied as a foliar application on banana showed that the time of fruiting decreased while the average bunch weight of the fruits increased [23]. Further, the soil application of seaweeds increased significantly the average corn weight. Increased crop yields were also obtained in commercial trials with potato, sweet corn, pepper, tomato, and orange. Crouch *et al*. [24] also observed that the seaweed extract, Kelpak significantly increased the yield of lettuce plants.

In this study, The length of shoot and root, fresh and dry weight of both shoot and root, number of branches and the leaf area were found increased due to the application of SLF individually as well as in the combination with different proportions of recommended rate of chemical fertilizers + 1.0% SLF. Among the different concentrations tested the crops preferred 1.0% SLF of seaweed for their maximum growth characteristics. Similarly, among the different proportions of chemical fertilizers + 1.0% SLF the crops preferred 25% of recommended rate of chemical fertilizers + 1.0% SLF for their maximum growth parameters.

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REFERENCES

[1] Chapman, V. J and D. J. Chapman. 1980. Seaweeds and their uses, Third Editions. Chapman and Hall, New York.

[2] Moller, M. and M. L. Smith. 1999. The effect of pruning treatments using seaweed suspensions on the water sensitivity of Barley (*Hardeum vulgare* L.) caryopses. *Annals of Appl. Biol.* 135:515-522.

[3] Verkleij, F.N. 1992. Seaweed extracts in agriculture and Horticulture. *A Review. Biol. Agricul. and Horticul.* 8: 309-324.

[4] Mooney, P. A. and J. Van Staden. 1985. Effect of seaweed concentrate on the growth of wheat under conditions of water stress. *South Afr. J. Sci.* 81: 632 -633.

[5] Smith, F. B. C. and J. Van Staden. 1984. The effect of seaweed concentrate and fertilizer on growth and exogenous cytokinin content of *Phaseolus vulgaris.* South *Afr. J. of Bot.* 3: 375-379.

[6] Abe, H., M. Vchiyams and R. Sato. 1972. Isolation and identification of nature action in marine algae. *Agro. Biol. Chem.* 36: 2259 - 2260.

[7] Bentley, J. A. 1960. Plant hormones in marine planktons, zooplanktons and sea water. *J. Mar. Biol. Ass. U.K.* 39: 433- 444.

[8] Sekar, R., N. Thangaraju and R. Rengasamy. 1995. Effect of seaweed fertilizer from *Ulva lactuca* on *Vigna unguiculata* (L.) *Walp. Phykos.* 34: 49-53.

[9] Crouch, I. J. and J. Van Staden. 1994. Commercial seaweed products as Biostimulants in horticulture. *J. of Home and Consumer Horticul.* 1:19–76.

[10] Fornes, F., M. Sánchez-Perales, J. L. Guadiola. 2002. Effect of a seaweed extract on the productivity of 'de Nules' Clementine mandarin and navelina orange. *Bot. Mar*. 45:486–489.

[11] Whapham, C. A., G. Blunden, T. Jenkins and S. D. Wankins. 1993. Significance of betaines in the increased chlorophyll content of plants treated with seaweed extract. *Appl. Phycol.* 5: 231 -234.

[12] Thirumaran, G., M. Arumugam, R. Arumugam and P. Anantharaman. 2009. Effect of seaweed liquid fertilizer on growth and pigment concentration of *Cyamopsis tetrogonolaba* L. Taub. Am. Euras. *J. Agron.* 2 (2): 50 -56.

[13] Rama Rao, K. 1990. Preparation of liquid seaweed fertilizer from *Sargassum*. In: Seaweed Research and Utilisation Association Workshop on Algal products and Seminar on Phaeophyceae in India. 4th - 7th June at Madras. p.16.

[14] Mackinney, G. 1941. Absorption of light Chlorophyll solution, *J. Biol. Chem.* 140: 315-322.

[15] Dubois, M., K. A. Gillies, J. K. Hamilton, P. A. Robbers and F. Smith. 1956. Calorimetric method for determination of sugar and related substances. *Anal. Chem.* 28: 350-352.

[16] Bradford, M. M. 1976. A Rapid and sensitive method for the quantification of microgram quantities of protein utilizing the principle of protein-dye binding. *Anal. Biochem.* 72: 248-254.

[17] Folch, J., M. Less and G. Solune Stanley. 1957. A simple method for the isolation and purification of total lipids from animal tissues. *J. Biol. Chem*. 226: 497-509.

[18] Booth, E. 1969. The manufacture and properties of liquid seaweed extracts. In: Proc. Int. Seaweed Symp. 6 : 655-662.

[19] Senn, T. L. 1987. Seaweed and plant growth. Faith printing Co., ed. Taylor, South Carolina, p.166.

[20] Metting, B., W. R. Rayburn and P. Raynand. 1988. Algae and agriculture: In: Algae and human affairs. Eds. Lembi, C. A. and R. A.Waaland, Cambridge Univ. Press, Campridge, pp.335-370.

[21] El-Sheekh, M. M. and A. E. F. El-Saied. 1999. Effect of seaweed extracts on seed germination, seedling growth and some metabolic processes of fabe beans (*Vicia faba* L.). *Phykos.* 38: 55-64.

[22] Anantharaj, M. and V. Venkatesalu. 2001. Effect of seaweed liquid fertilizer on *Vigna calajung*. *Seaweed Res. Utiln.* 23: 33-39.

[23] Blunden, G. 1972. The effects of aqueous seaweed extracts as a fertilizer additive. In: *Proc. Int. Seaweed Symp.* 7 : 584-589.

[24] Crouch, I. J., R. P. Beckett and J. Van Staden. 1990. Effect of seaweed concentrate on the growth and mineral nutrition of nutrient - stressed lettuce. *J. Appl. Phycol.* 2: 269-272.