Seaweed Res. Utiln., 38(2) : 111 - 116, 2016

Seaweed extract as a biostimulant for *Lycopersicum esculentum* - a field trial

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ABSTRACT

The present study was made on the effect of seaweed powder (*Sargassum wightii*), organic manure (*S. wightii*) and coconut cake with seaweed powder (*S. wightii*) on the growth and biochemical constituents of *Lycopersicun esculentum*. The main objective of the study was to enhance the growth and biochemical constituents of *L. esculentum*. The above three fertilizer were prepared in 10, 25, 50 and 75%. The lower percentage of these fertilizer showed increase in germination, root length and shoot length when compared to higher percentage. Further among them, the organic manure (*S.wightii*) showed better growth parameters such as fresh weight, dry weight, total height, root and shoot length. The chlorophyll 'a' and chlorophyll 'b' were also found to increase in the lower percentage when compared to higher level organic manure treated plants. The study also showed that the seaweed powder, organic manure and coconut cake contain high amount of macro and micronutrients, which make them potential biofertilizer. The eco-friendly *S. wightii* powder and organic manure are recommended to the farmer for attaining better growth of plants and also in improvement of soil fertility.

Introduction

Seaweeds are one of the most important marine resources of the world. Seaweed extracts have been marketed for several years as fertilizer additives and beneficial results from their use have been reported (Booth, 1965). The possibilities of using seaweed in modern agriculture have been investigated by many (Thivy, 1961; Aitken and Sen, 1965; Boney, 1965). Different forms of seaweed preparation such as LSF (Liquid Seaweed Fertilizer), SLF (Seaweed Liquid Fertilizer) LF (Liquid Fertilizer) and either whole or finely chopped powder 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, reduced incidents of fungal and insect attack have been resulted by application of seaweed extracts. Seaweed are known to contain appreciable quantities of plant growth regulators (Mooney and Van Staden, 1985), cytokinin (Smith and Van Staden, 1984), IAA (Abe *et al.,* 1972), gibberellins and gibberellins – like substance (Bentley, 1960; Sekar *et al.,* 1995).

Seaweed extract as organic biostimulant is fast becoming accepted practice in horticulture due to its beneficial effects (Verkleij, 1992). SLF treatment increased the number of branches and concentration of photosynthetic pigments (Sridhar and Rengasamy, 2010). Seaweed extracts are reported to improve seed germination in several species such as table beet (Wilczek and Ng, 1982), Lettuce (Moller and Smith, 1998) and Fababean (El-Sheekhg and EL-Saled, 2000). Seaweed in general constitutes one of the best renewable resources for food, fodder, fertilizer, medicine process development and could help in meeting the food and nutritional security and health measure of Indian population. Eco friendly seaweed liquid fertilizers to crops may be useful for the growers for attaining better germination, growth and yield (Pise and Sabale, 2010). Crop cultivation using organic fertilizers has contributed for deposition of residues, improving physical and chemical properties of soil which is important for biological development (Galbiattia *et al.,* 2007). In the present study, the application of three fertilizers. Seaweed powder (*Sargassum wightii*), Organic manure (*S. wightii*) and Coconut cake +

Received : Sep. 2016; Revised : Oct. 2016; Accepted : Nov. 2016

Seaweed powder (*Sargassum wightii*) were made on the stimulation of seed germination, growth parameters and photosynthetic pigments of the *Lycopersicum esculentum* (Tomato).

Materials and Method

Collection of seaweeds

For the present study, the seaweed *Sargassum wightii* belonging to the Family Sargassaceae and class Phaeophyceae was collected from the intertidal region of Nochiyurani Coast, Gulf of Mannar during June 2016. The material collected was washed thoroughly with seawater to remove all the impurities like sand particles and ephiphytes. They were transported to the laboratory in polythene bags. Finally, the seaweeds were washed thoroughly with tap water to remove, the surface salt and then plotted to excess water.

Preparation of seaweed extract

The seaweeds was shade dried for five days followed by one dry for 12 hours 60°C centigrade. Then the material was hand crushed and made as coarse powder and again the powder was crushed in the mixie (Preethi, Eco-chef).

Selection of crop plant

Lycopersicum esculentum was selected as the experiment crop plant in the study. The seeds of *L. esculentum* having uniform size, shape, colour and weight were selected from the seeds obtained from Tamil Nadu Agriculture Vegetable Research Station in Palur, Cuddalore. The selected seeds were stored in metal tin as a suggested by Rao (1976). The seeds were surface sterilized with 0.1% $HgCl_2$ mercuric chloride washed thoroughly 3-5 times sterilized distilled water and then the sowing seeds were soaked in different doses of seaweed. Powder mixed with soil, organic manure, coconut cake mixed with soil in different combinations. The seaweed *Sargassum wightii* – Organic manure obtained from SNAP Natural & Alginate Products Pvt. Ltd., Sipcot Industrial Complex, Ranipet, Tamil Nadu.

Experimental design and plant treatment

The paper teacup of about 6 cm diameter and 4 cm height were used for growing the test plants for germination and growth experiments. The paper teacups were filled with seaweed powder, organic manure and coconut cake in three different combinations prepared in different percentage (10, 25, 50 and 75%). The above different set of experiment took in the ratio level seaweed powder, organic manure and coconut cake mixed with soil. Above the three combinations the control set were maintained by giving soil and water alone. For the crop plant 10 seeds were sown in each paper cup. The seed to seed distance maintained in each paper cup was was 2 cm. The tea cups were arranged in completely randomized block design with triplicate for each treatments. The paper cups were watered regularly to cup capacity. All tea cups experiments were done in the Experimental Garden, Department of Botany, Annamalai University, Tamil Nadu, India. Growth parameters including the percentage of germination, root length, shoot length, fresh weight, dry weight and total height were estimated. Seedling capped at 60 ± 5°C for 48 h and weight for determination of the dry weight. The chlorophyll content were also estimated by the method of Arnon (1949). Estimation of physico-chemical properties of red soil were also analysed.

Results and Discussion

The physico-chemical properties of red soil are given in (Table-1). The present study, the three different fertilizer Seaweed powder (*Sargassum wightii*), Organic manure (*Sargassum wightii*) and coconut cake with seaweed powder tested on *Lycoperiscum esculentum* seeds in the present study are shown in Plate-1. Aitken and Senn (1965) reported that lower concentration of seaweed extract increased seed germination in ornamental plants, tobacco, pea and cotton. Dhargalkar and Untawale (1983) reported that SLF treatment enhanced the rate of seed germination in green chillies and turnip and found that lower concentration of SLF increased the germination percentage than the higher concentration. In the present study, the lowest germination percentage (40%) was found at 75% coconut cake with seaweed powder (*S. wightii*) (Plate-4). The highest germination (95%) of the tomato was recorded with 10% organic manure with seaweed powder (*S. wightii*) (Plate-3). Similar observation was also made on higher concentration of seaweed extract causing a drop in biological activity leading to sticky brown cotyledons, either due to loss of chloroplast integrity (Wu and Lin, 2000) or because of interplay of other compounds in the seaweed extract. Maximum root length (6.6 ± 0.20) of the *L. esculentum* was observed in 10% in

Table 1. Physico chemical properties of red soil

Air temperature (°C)	33 ± 1.2
Soil temperature (°C)	31 ± 1.3
Soil pH	7.9 ± 1.5
EC (mm/cm)	8.1 ± 1.8
Salinity (‰)	2.3 ± 1.5
Dissolve/Oxygen (mg/L)	2.7 ± 1.5

Sargassum wightii (Powder) | *Sargassum wightii* (Organic Mannaure) | *Sargassum wightii* (Coconut cake)

Plate-1. *Different fertilizers used in the equipments*

Plate-2. *Growth of* Lycopersicum esculentum *treated with* Sargassum wightii *powder in different concentration*

Plate-3. *Growth of* Lycopersicum esculentum *treated with* Sargassum wightii *powder with organic manure in different concentration*

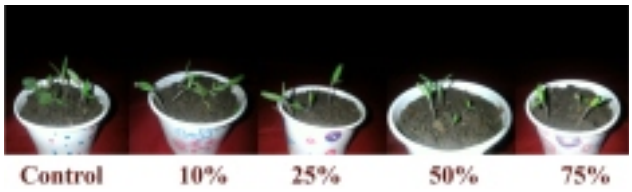

Plate-4. *Growth of* Lycopersicum esculentum *treated with* Sargassum wightii + *coconut cake in different concentration*

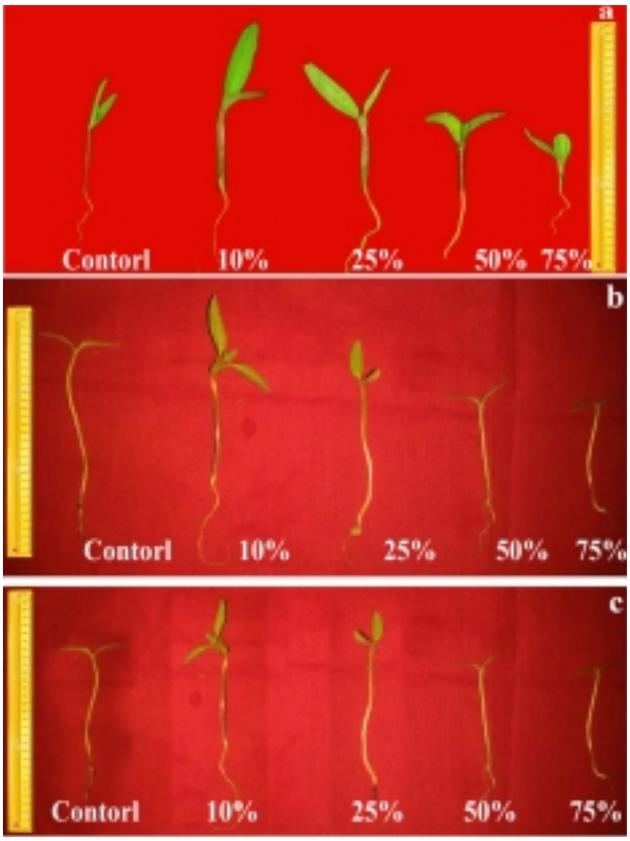

Plate-5.

a. *Germination studies of Root and shoot length on* Lycopersicum esculentum *seedlings treated with* Sargassum wightii *with the organic manure*

b. *Germination studies of Root and shoot length on* Lycopersicum esculentum *seedlings treated with seaweed powder* (S. wightii)

c. *Germination studies of Root and shoot length on* Lycopersicum esculentum *seedlings treated with coconut cake + seaweed powder* (S. wightii)

of organic manure with seaweed powder treatment (Plate-5). The lowest root length (40 ± 0.15 cm) (Plate-5) was observed in seaweed powder with coconut cake (75%). Similar observation on the rooting response was attributed to endogenous in doles which were positively identified in the seaweed concentrate (Stirke *et al.,* 2004). The increased supply of nutrients provided by the aqueous seaweed extract resulted in healthy root and shoot. Similar findings were reported in *H. musciformis, Spatoglossum asperum* and *S. wightii* on the growth of crops such green chillies, trumps and pine apple (Dhargalkar and Untawale, 1983). The maximum shoot length of the tomato was observed at 10% (Plate-5) of organic manure with seaweed powder treatment among the three fertilizers tested (6.5 ± 0.57 cm) (Table-3). The lowest shoot length (4.1±0.05 cm) (Table-3) was found at 75% coconut cake with seaweed powder (Plate-5). As observed by Sekar *et al.* (1995), in the present study, the freshwater of tomato seedlings tested with seaweed extracts treatment gradually decreased with increasing concentration of seaweed extract from *S. wightii.* Kamaladhasan and Subramanian (2009) also reported similar effect in red gram and Lingakumar *et al.* (2002) and Thevanathan *et al.* (2005) reported linear growth of both shoots and roots in *Vigna unguiculata* and *Phaseous mungo*. Similar typical growth promotions was observed in the study at lower concentration of the *Sargassum plagiophyllum* extract. The increased seedling growth may be due to presence of some growth promoting substances such as IAA and IBA, Gibberellins, Cytokinins, Micronutrients and Amino acid (Challen and Hemingway, 1966).

The maximum observation of chlorophyll a content was observed in 10% organic manure with seaweed powder

Plate-6. *Number of lateral roots observed in the organic manure with seaweed powder treated plants*

Table-2. *Germination of* Lycopersicum esculentum *seeds treated with seaweed powder, organic manure and coconut cake*

Treatment		Control	10%	25%	50%	75%
Sargassum wightii (powder)	a	80	90	80	65	50
	b	85	85	75	60	45
	c	70	80	70	70	40
		76%	85%	75%	65%	45%
Organic manure with seaweed powder	a	80	100	80	70	55
	b	75	95	75	65	45
	c	70	90	85	75	45
		76%	95%	80%	70%	48%
Coconut cake with seaweed powder	a	80	85	60	50	40
	b	70	80	75	55	35
	c	80	80	65	45	45
		76%	81%	66%	50%	40%

Table-3. *Shoot length of treated plants cm/seedlings on 20th day*

Treatment		Control	10%	25%	50%	75%
Sargassum wightii (powder)	a	4.7	5.9	5.4	4.8	4.4
	b	4.9	5.8	5.2	4.5	4.2
	c	5.0	6.3	5.1	4.6	4.0
		5.0 ± 0.43	6.3 ± 0.54	5.4 ± 0.47	4.8 ± 0.41	4.4 ± 0.37
Organic manure with seaweed powder	a	5.0	6.4	5.6	4.4	4.2
	b	4.8	6.5	5.5	4.7	4.5
	c	4.8	6.2	5.3	4.3	4.3
		5.0 ± 0.43	6.5 ± 0.57	5.6 ± 0.49	4.7 ± 0.40	4.5 ± 0.39
Coconut cake with seaweed powder	a	4.7	5.7	4.9	4.3	4.0
	b	5.0	5.4	5.1	4.2	4.1
	c	4.9	5.5	5.0	4.5	4.1
		5.0 ± 0.43	5.7 ± 0.51	5.0 ± 0.45	4.5 ± 0.39	4.1 ± 0.36

Table-4. *Root length of treated plants cm/seedlings on 120th day*

Treatment		Control	10%	25%	50%	75%
Sargassum wightii (Powder)	a	4.4	5.9	5.4	4.5	4.0
	b	4.3	5.8	5.2	4.6	4.2
	c	4.5	5.5	4.9	4.4	4.2
		4.5 ± 0.39	5.9 ± 0.51	5.4 ± 0.46	4.6 ± 0.40	4.2 ± 0.37
Organic manure with seaweed powder	a	4.5	6.5	5.2	4.6	4.5
	b	4.3	6.6	5.0	4.4	4.4
	c	4.4	6.8	5.3	4.9	4.0
		4.5 ± 0.39	6.9 ± 0.59	5.3 ± 0.46	4.9 ± 0.41	4.5 ± 0.38
Coconut cake with seaweed powder	a	4.4	5.6	5.0	4.2	4.0
	b	4.5	5.3	4.8	4.1	3.7
	c	4.3	5.5	4.5	4.0	3.9
		4.5 ± 0.39	5.6 ± 0.49	5.0 ± 0.42	4.2 ± 0.36	4.1 ± 0.34

(0.592 ± 0.053) (Table-8). The minimum chlorophyll a content (0.293 ± 0.026) was observed in coconut powder with seaweed powder 75%. The maximum content (0.529 ± 0.047) was observed in 10% organic manure with seaweed powder (Table-9). The Minimum chlorophyll b content was observed in coconut powder with seaweed powder 755 of the (0.287 ± 0.025) Table 9. The maximum fresh weight (0.98 ± 0.02) was observed in 10% organic manure with seaweed powder (Table-5). The minimum fresh weight 0.17 ± 0.01 observed in 75% seaweed extract (Table-7). The maximum dry weight (0.26 ± 0.015) was observed in 10% organic manure with seaweed powder (Table-6). The minimum dry weight (0.02 ± 0) was recorded in 75% organic manure with seaweed powder (Table-7). The maximum number of lateral roots (28 ± 1.52) was registered in organic manure with seaweed powder (Table-6). The minimum number of lateral roots (7 ± 1) was observed in coconut cake with

Table-5. *Seaweed extract of* Sargassum wightii *on growth parameters of* Lycoperiscum esculentum *on 20th day seedlings*

Parameter	Control	10%	25%	50%	75%
Fresh weight (mg/g FW)	0.55 ± 0.045	0.65 ± 0.056	0.57 ± 0.049	0.35 ± 0.03	0.17 ± 0.01
Dry weight (mg/g FW)	0.12 ± 0.03	0.17 ± 0.014	0.12 ± 0.010	0.07 ± 0.005	0.04 ± 0.003
Total height (cm)	9.5 ± 0.83	11.8 ± 1.056	10.8 ± 0.93	9.3 ± 0.82	8.4 ± 0.75
Number of lateral roots	14 ± 1.1	21 ± 1.7	18 ± 1.5	10 ± 0.9	8 ± 0.6

Table-6. *Organic manure with seaweed powder* (Sargassum wightii) *on growth parameters of* Lycoperiscum esculentum *on 20th day seedlings*

Parameter	Control	10%	25%	50%	75%
Fresh weight (mg/g FW)	0.55 ± 0.045	0.98 ± 0.086	0.78 ± 0.068	0.40 ± 0.03	0.22 ± 0.01
Dry weight (mg/g FW)	0.12 ± 0.03	0.26 ± 0.022	0.15 ± 0.012	0.11 ± 0.009	0.06 ± 0.004
Total height (cm)	9.5 ± 0.20	13.1 ± 1.14	10.8 ± 0.95	9.2 ± 0.81	8.9 ± 0.77
Number of lateral roots	14 ± 1.11	28 ± 2.3	24 ± 1.9	13 ± 0.9	10 ± 0.7

Table-7. *Coconut cake with seaweed powder* (Sargassum wightii) *on growth parameters of* Lycoperiscum esculentum *on 20h day seedlings*

Parameter	Control	10%	25%	50%	75%
Fresh weight (mg/g FW)	0.55 ± 0.045	0.55 ± 0.047	0.40 ± 0.033	0.29 ± 0.024	0.19 ± 0.014
Dry weight (mg/g FW)	0.12 ± 0.03	0.14 ± 0.01	0.10 ± 0.008	0.09 ± 0.01	0.02 ± 0.00
Total height (cm)	9.5 ± 0.83	11 ± 0.99	9.5 ± 0.87	8.5 ± 0.75	8 ± 0.7
Number of lateral roots	14 ± 1.1	11 ± 1.0	13 ± 1.0	8 ± 0.6	7 ± 0.5

Table-8. *Chlorophyll 'a' content of treated plants in 20th day*

Treatment		Control	10%	25%	50%	75%
Sargassum wightii (powder)	a	0.488	0.535	0.415	0.347	0.318
	b	0.492	0.538	0.418	0.349	0.321
	c	0.495	0.541	0.422	0.352	0.324
		0.495 ± 0.044	0.547 ± 0.048	0.422 ± 0.037	0.352 ±0.03	0.324 ± 0.028
Organic manure with seaweed powder	a	0.489	0.586	0.437	0.369	0.333
	b	0.493	0.589	0.439	0.31	0.336
	c	0.494	0.592	0.441	0.374	0.339
		0.495 ±0.044	0.592 ±0.053	0.441 ± 0.039	0.374 ± 0.03	0.339 ± 0.030
Coconut cake with seaweed powder	a	0.486	0.534	0.392	0.344	0.288
	b	0.487	0.539	0.394	0.346	0.291
	c	0.492	0.541	0.398	0.349	0.293
		0.495 ± 0.044	0.541 ± 0.048	0.398 ±0.035	0.349 ± 0.031	0.293 ± 0.026

seaweed powder (Table-7). Similar observation was made in *Sytonema* sp. by Venkataraman Kumar and Mohan (1997). The seaweed extract applied as foliar spray enhanced the leaf chlorophyll level in plants (Bhundell *et al.,* 1996). The enhanced levels of photosynthetic pigments in leaf tissues with the application of seaweed extracts from *Ascophyllum nodosum* either as a soil drench or as foliar spray have been reported earlier in tomato (Whapham *et al.,* 1993).

The using of seaweed as manure in farming practice is very ancient and common practice among the Romans and also in Japan and China. In organic manure treated plants more number of lateral root branches formed. The first Indian study on the seaweed as a manure for vegetable and field crops was by Thivay (1961) using *Hypnea* compost with cow dung on bhendi which showed increased yield. The seaweed fertilizer was found to be superior to chemical fertilizer because of high level of organic matter retaining moisture and minerals in the upper soil level available to the root. The increase in the yield of black gram, potato, coconut, palms and citrus was reported by Mehta *et al.* (1967) and Mehta and Gaur (2001). The seaweed extract from *S.wightii* gradually decreased the growth of *L. esculentum* with increasing concentration. Kamaladhasan and Subramanian (2009) also reported similar effect in red gram. Lingakumar *et al.* (2002) and Thevanathan *et al.* (2005) reported linear growth of both shoots and roots in *Vigna unguiculata* and *Phaseous mungo*. Similar typical growth promotions was observed in the study at lower concentration of the *Sargassum plagiophyllum* extract. The increased seedling

Table-9. *Chlorophyll 'b' content of treated plants in 20th day*

Treatment		Control	10%	25%	50%	75%
Sargassum wightii (powder)	a	0.431	0.477	0.386	0.302	0.274
	b	0.434	0.479	0.388	0.305	0.276
	c	0.438	0.481	0.389	0.307	0.279
		0.438±0.039	0.481±0.043	0.389±0.082	0.307±0.027	0.279±0.024
Organic manure with seaweed powder	a	0.431	0.524	0.415	0.323	0.287
	b	0.438	0.526	0.419	0.326	0.289
	c	0.434	0.529	0.421	0.329	0.301
		0.438±0.039	0.529±0.047	0.421±0.037	0.329±0.029	0.301±0.026
Coconut cake with seaweed powder	a	0.431	0.445	0.346	0.296	0.287
	b	0.438	0.4	0.346	0.298	0.285
	c	0.434	0.449	0.349	0.303	0.281
		0.438±0.039	0.449±0.040	0.349±0.031	0.303±0.026	0.287±0.025

growth may be due to presence of some growth hormones.

The alginate derivatives from seaweeds are occurring in the cell wall as mixed salt with the major cations. Salt of alginic acid combined with the metallic ions in the soil form high molecular weight complexes that absorb moisture, swell, retain soil moisture and improve crumb structure. This results in better soil aeration and capillary activity of soil pores which in turn simulate the growth of the plant root system as well as boost soil microbial activity (Moore, 2004). The coconut cake is one of the organic fertilizers with high nitrogen contents and should be used for growing vegetables or ornamental plants. It swells by absorbing enough water applied to the plants. This results mixing with the soil and releasing of nutrients after their decomposition and Leaching and volatilization losses can be reduced by following improved method of preparation of manure. After the plant parasites nematodes and fungi are controlled to some extent by altering to the balance of microorganisms in the soil. Considering the above important findings that the Seaweed powder, Organic manure and coconut cake are effective in increasing the growth promoting hormones and nutrients in more quantities *Sargassum wightii* can be applied to fruit crop Tomato. It is recommended to the growers for attaining better germination growth and yield of cultivate plants.

References

Aitken, J. E. and J.I. Senn 1965. Seaweed products as fertilizers and soil conditioners. *Bot. Mar.,* 8: 144-148.

Boney, A. D. 1965. A biology of marine algae. Hutchinson Educational Limited. London.

Challen, S. B. and J.C. Hemingway 1966. Growth of higher plants in response to feeding with seaweed extracts. *Proc. Fifth Int. Seaw. Symp.,* 359 - 367.

Dhargalkar, V. K. and A.G. Untawale 1983. Some observations on the effect of SLF, on higher plants. *Indian J. Mar. Sci.,* 12: 210-214.

El-Sheekh, M. M. and A. El. D. El-Saled. 2000. Effect of crude seaweed extracts on seed germination, seedling growth and some metabolic processes of *Vicia faba* L. *Cytobios.,* 101: 23-35.

Galbiattia, J.A., I.H.L. Cavalcantea, A.G. Ribeiroa and T.C.T. Pissarraa 2007. Nitrate and Sodium contents on lettuce and drained water as function of fertilizing and irrigation water quality in Brazil. *Int. J. Plant Prod.,* 1: 205–214.

Kamaladhasan, N. and S. K. Subramanian 2009. Influence of seaweed liquid fertilizers on legume crop, red gram. *Journal of Basic and Applied Biology.* 21-24.

Lingakumar, K., R. Jeyaprakash, C. Manimuthu and A. Haribaskar 2002. *Gracilaria edulis*- an effective alternative source as a growth regulator for legume crops. *Seaweed Res. Utiln.,* 24 (1): 117-123.

Moller, M. and M.L Smith 1998. The applicability of seaweed suspensions as priming treatments of Lettuce (*Lactuca sativa* L.) seeds. *Seed Sci. Technol.,* 26: 425 - 438.

Mooney, P. A. and J. Van Staden 1985. Effect of seaweed concentrate on the growth of wheat under condition of water stress. *S. Afr. J. Sci.,* 8: 632-633.

Pise, N.M. and A.B. Sabale 2010. Effect of seaweed concentrates of *Trigonella foenm* L. *J. Phytol.,* 2(4): 50-56.

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

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 African Journal of Botany.* 3: 375-379.

Sridhar, S. and R. Rengasamy 2010. Effect of seaweed liquid fertilizers on the growth, biochemical constituents and yield of *Tagetes erecta, under field trial. Journal of Phytology, 2(6): 61-68.*

Thevanathan, R., D.S. Anjanadutta, Dinamani and I.L.G. Bhavani 2005. Studies on the impact of application of marine algal manure and liquid fertilizer on the linear growth of the seedlings of some pulses. *Seaweed Res. Utiln.,* 27 (1&2): 125 - 133.

Thivy, F. 1961. Seaweed manure for perfect salt and smiling field. *Salt Res. Ind.,* 1: 1-4.

Verkleij, F. N. 1992. Seaweed extracts in agriculture and horticulture. A review - *Biol. Agri. and Horti.* 8: 37-48.

Wilczek, C. A. and T. Ng. 1982. The promotion of seed germination in table beet by an aqueous seaweed extract. *Hort Science,* 17: 629-630.