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SIGNIFICANCE OF SEAWEED LIQUID FERTILIZERS FOR MINIMIZING CHEMICAL FERTILIZERS AND IMPROVING YIELD OF *ARACHIS HYPOGAEA* UNDER FIELD TRIAL

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Abstract

Efficacy of different concentrations of Seaweed Liquid Fertilizers (SLFs) obtained from the brown seaweed *Sargassum wightii* Grev. and green seaweed *Ulva lactuca* L, was made on *Arachis hypogaea* under field trial. Combined effect of 1.0% SLF(s) plus different proportions of recommended rate of chemical fertilizers was also made on *A. hypogaea*. Among the different concentrations of SLF(s) 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, lipid and yield. Similarly the plants that applied with 1.0% SLF(s) plus 50% recommended rate of chemical fertilizers showed enhanced characteristics. *Arachis hypogaea* treated with 1.0% SLF of *S. wightii* / *U. lactuca* plus 50% recommended rate of chemical fertilizers showed an increased yield up to ca. 4.1Kg fresh weight which was more than 11% to that of the plants received with 100% recommended rate of chemical fertilizers. The two SLFs were also analyzed for micro and macro elements and the plant growth regulators like auxin and cytokinin.

Keywords: *Sargassum wightii*, *Ulva lactuca*, Seaweed liquid fertilizer, *Arachis hypogaea*, auxin, cytokinin

Introduction

The importance of seaweeds as manure has been recognized for a long time in other countries. However, in India very little information is available on the beneficial effects of seaweeds to improve the crop growth Bhosle *et al.* (1975), Vijalakshmi and Lakshmanan (1988). Newton (1951) reviewed the use of seaweeds as manure by ancient Romans and the method of seaweed application from whole and chapped seaweeds as well as liquid supplement and extracted preparations. The first Indian to study the seaweeds as manure for vegetable and field crops was Thivy (1961). Seaweed meals provide an approximately equivalent amount of N, less P but more K, total salts and readily available micronutrients compared to most animal manures Simpson and Hayes (1958). Apart from macro and micronutrients, seaweed contains many growth promoting hormones like cytokinin, gibberellin and auxins Tay *et al.* (1987), Stirk and Van Staden (1997). The responses of plants to seaweed application are many and varied. These include higher yield, increased nutrient uptake, changes in plants tissue composition, increased resistance to frost, fungal diseases and insect attack, longer shelf life of fruit and better seed germination. It has been suggested that numerous benefits of seaweed are derived from the chelating properties of certain constituents Lynn (1972). Seaweed as fertilizers was not only due to nitrogen, phosphorus and potash content but also because of the presence of trace elements and metabolites similar to plant growth regulators Booth (1969). Seaweed extracts are now available commercially labelled as Maxicorp (sea born), Algifert (marinure), Goemar GA14, Seaspray, Seasol, SM3, Cylex and Sea crop 16 Jeanin *et al.* (1991). The present study was aimed to investigate the significance of SLFs obtained from the brown seaweed *Sargassum wightii* Grev. and green seaweed *Ulva lactuca* L, for reducing the amount / cost of the chemical fertilizers for enhanced yield under field trial.

Material and Methods

The specimens of brown seaweed *Sargassum wightii* Grev. and green seaweed *Ulva lactuca* L. were collected from Mandapam coast, Tamil Nadu during November 2002. 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

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was filtered through cheese cloth and allowed to cool at room temperature Rama Rao (1990). Its concentration was calculated by keeping a known volume of (100 mL) in a hot air oven at 60º C until it showed a constant dry weight. The 1.0% seaweed liquid fertilizer was analyzed for different macro and microelements Humphries (1956) as well as plant growth regulators namely auxin Gordon and Paleg (1957) and cytokinin Syono and Torrey (1976).

Field trial was conducted on *Arachis hypogaea* L. at Kumminipet near Arakkonam, Tamil Nadu. Each plot covered an area of 12m2 (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. 600m2) 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 feet and leveled off. Then the field was separated into plots. Randomized soil samples prior to sowing were also collected and analyzed for different macro and microelements.

Effect of SLF(s) on *Arachis hypogea*

Different concentrations of 1.2 L of *S. wightii* SLF and *U. lactuca* 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/m2 or 100ml SLF/m2. They were applied on 0 day and 45th day after sowing (corresponding the days of chemical fertilizer application). The plots were irrigated every week.

Effect of 1.0% SLF(s) plus different proportions of chemical fertilizers

100% Recommended rate of chemical fertilizers for *Arachis hypogaea*

Days	Chemical fertilizers (per ha)	
0 day (basal)	Urea	- 17Kg
	Super Phosphate	- 34Kg
	Potash	- 54Kg
45th day	Calcium Sulphate	- 200Kg

e.g. 240g Calcium Sulphate per plot on 45th day

The 1.2L of 1.0% SLF(s) was 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(s) and treated them as controls

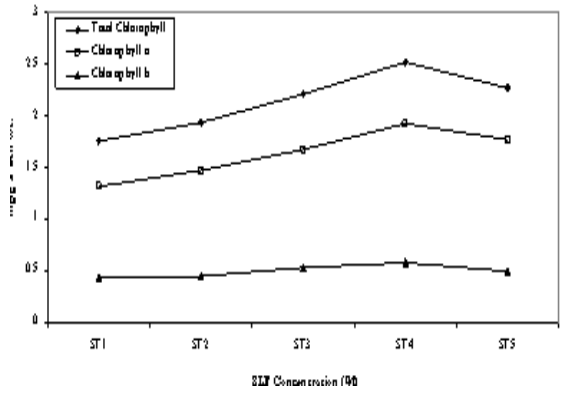
Sixty day old plants were taken for the observations. Different parameters namely, total plant height, shoot height, root height (cm), total fresh and dry weight, shoot fresh and dry weight, root fresh and dry weight (g), number of branches and leaf area of third young leaf (cm^2) were recorded. The biochemical parameters of the third young leaf namely total chlorophyll, chlorophyll a and b Mackinney (1941), total carbohydrate Dubois et al. (1956), total protein Bradford (1976) and lipid content Foleh et al. (1957) (mg/g fresh weight) were recorded. The plants were uprooted at the end of 105th day and separated the pods by hand picking and the yield (fresh weight) was also recorded (Kg).

Results

The groundnut treated with *S. wightii* SLF showed enhanced concentrations of photosynthetic pigments. The plants that received with 1.0% SLF contained a maximum of 1.92 mg/g fresh weight of Chlorophyll a on 60th day old plants. (Fig.1)

The accumulation of total carbohydrate, total protein and total lipids content of the third young leaf also increased due to the SLF treatments.(Fig. 2) The physical parameters like 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 (cm2) were also showed higher values when the plants received with 1.0% *S. wightii* SLF (Tables 1).

Fig.1. Effect of different concentrations of *Sargassum wightii* SLF on the pigments of *Arachis hypogaea* on 60th day



ST1 - Water only, ST2 - 0.25% SLF, ST3 - 0.5% SLF, ST4 - 1.0% SLF, ST5 - 1.5% SLF.

Fig. 2. Effect of different concentration of *Sargassum wightii* SLF on the total protein, total carbohydrate and total lipid content of *Arachis hypogaea* on 60th day

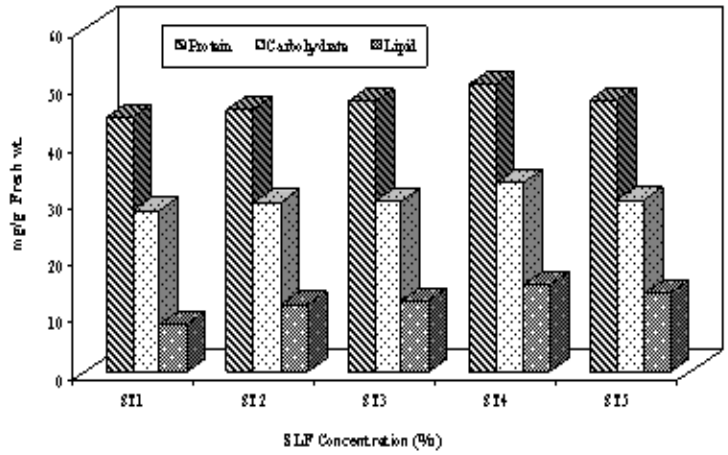


Table 1 : Effect of *Sargassum wightii* SLF on the growth of *Arachis hypogaea* under field trial on 60th day

Parameters	F-value	P-value	SLF Concentrations				
			Control	0.25%	0.5%	1.0%	1.5%
Total plant height (cm)	45.98	0.00**	18.60 ± 1.59^{a}	24.40 ± 1.98^{b}	26.60 ± 1.07^{b}	29.30 ± 0.83^{c}	26.90 ± 0.78^{bc}
Shoot height (cm)	16.41	0.00**	13.00 ± 1.44^{a}	16.60 ± 2.05^{b}	17.50 ± 0.64^{bc}	19.10 ± 0.58^{c}	17.40 ± 0.87^{bc}
Root height (cm)	35.30	0.00**	5.60 ± 0.47^{a}	7.80 ± 0.47^{b}	9.10 ± 0.85^{c}	10.20 ± 0.96^{c}	9.50 ± 0.47^{c}
Total fresh weight (g)	40.85	0.00**	131.64 ± 8.22^{a}	144.14 ± 8.53^{a}	169.91 ± 6.10^{b}	191.66 ± 9.22^{c}	179.4 ± 10.7^{bc}
Shoot fresh weight (g)	40.17	0.00**	130.90 ± 8.24^{a}	143.10 ± 8.46^{a}	168.70 ± 6.05^{b}	190.30 ± 9.22^{c}	178.20 ± 10.82^{bc}
Root fresh weight (g)	24.07	0.00**	0.74 ± 0.14^{a}	1.04 ± 0.11^{b}	1.21 ± 0.10^{bc}	1.36 ± 0.06^{c}	1.26 ± 0.11^{c}
Total dry weight (g)	24.95	0.00**	25.10 ± 1.72^{a}	27.59 ± 1.44^{a}	32.41 ± 2.32^{b}	36.56 ± 1.02^{c}	34.21 ± 3.30^{bc}
Shoot dry weight (g)	25.08	0.00**	24.96 ± 1.73^{a}	27.29 ± 1.27^{a}	32.18 ± 2.36^{b}	36.30 ± 1.00^{c}	33.99 ± 3.29^{bc}
Root dry weight	7.40	0.08**	0.14 ± 0.03^{a}	0.20 ± 0.03^{ab}	0.23 ± 0.05^{b}	0.26 ± 0.03^{b}	0.24 ± 0.01^{b}
Number of pods	17.78	0.00**	10.00 ± 4.47^{a}	14.00 ± 3.16^{ab}	19.00 ± 3.16^{bc}	26.00 ± 2.55^{d}	22.00 ± 3.16^{cd}
Number of branches	2.50	0.07^{NS}	5.00 ± 1.58	6.00 ± 1.87	6.00 ± 1.22	8.00 ± 1.22	7.00 ± 2.00
Leaf area (cm^{2})			9.1	10.5	12.0	15.1	13.2

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 hypogaea* under field trial on 60th day

Parameters	F-value	P-value	Concentrations					
			CST1	CST2	CST3	CST4	CST5	CST6
Total plant height (cm)	33.08	0.00**	22.40 ± 2.30^{a}	32.80 ± 3.27^{b}	38.00 ± 3.67^{c}	35.80 ± 2.04^{bc}	27.20 ± 1.48^{a}	24.40 ± 0.89^{a}
Shoot height (cm)	31.86	0.00**	10.40 ± 1.14^{a}	20.00 ± 2.34^{cd}	23.60 ± 2.70^{d}	23.60 ± 2.30^{d}	18.00 ± 1.58^{bc}	15.60 ± 1.51^{b}
Root height (cm)	15.42	0.00**	12.00 ± 1.22^{b}	12.80 ± 1.30^{ab}	14.40 ± 1.67^{d}	12.20 ± 1.30^{b}	9.00 ± 0.83^{a}	8.80 ± 0.83^{a}
Total fresh weight (g)	414.22	0.00**	136.90 ± 4.49^{a}	137.60 ± 5.17^{a}	246.74 ± 5.28^{c}	157.61 ± 6.27^{b}	149.29 ± 4.49^{b}	131.55 ± 1.76^{a}
Shoot fresh weight (g)	393.41	0.00**	135.30 ± 4.52^{a}	134.60 ± 5.33^{a}	243.62 ± 5.34^{c}	154.20 ± 6.35^{b}	146.20 ± 4.74^{b}	128.87 ± 1.67^{a}
Root fresh weight (g)	68.63	0.00**	1.60 ± 0.11^{a}	2.99 ± 0.17^{bc}	3.12 ± 0.17^{cd}	3.41 ± 0.12^{d}	3.09 ± 0.27^{cd}	2.68 ± 0.13^{b}
Total dry weight (g)	374.60	0.00**	26.41 ± 0.85^{a}	26.54 ± 1.18^{a}	47.61 ± 0.84^{c}	30.42 ± 0.92^{b}	28.80 ± 0.88^{b}	25.37 ± 1.08^{a}
Shoot dry weight (g)	367.08	0.00**	26.11 ± 0.84^{a}	25.97 ± 1.16^{a}	47.01 ± 0.88^{c}	29.77 ± 0.91^{b}	28.21 ± 0.85^{b}	24.87 ± 1.13^{a}
Root dry weight	29.82	0.00**	0.30 ± 0.03^{a}	0.57 ± 0.04^{bc}	0.60 ± 0.04^{bc}	0.65 ± 0.03^{c}	0.59 ± 0.04^{bc}	0.51 ± 0.07^{d}
Number of pods	59.46	0.00**	14.00 ± 1.41^{bc}	10.80 ± 0.83^{ab}	26.40 ± 1.94^{d}	25.40 ± 3.71^{d}	15.40 ± 2.07^{c}	9.40 ± 1.51^{a}
Number of gynophore	52.12	0.00**	18.00 ± 0.70^{a}	11.40 ± 2.79^{a}	37.00 ± 7.17^{c}	32.00 ± 2.91^{c}	27.80 ± 3.34^{b}	11.60 ± 2.07^{a}
Number of branches	21.78	0.00**	4.66 ± 1.14^{ab}	9.00 ± 1.00^{cd}	10.60 ± 1.34^{d}	6.80 ± 1.64^{bc}	6.20 ± 0.83^{ab}	4.40 ± 0.89^{a}
Leaf area (cm^2)			10.4	9.8	14.3	13.9	11.1	8.7

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

At the above condition a maximum yield of 3.6 Kg pods fresh weight /plot was recorded when compared to only 1.5 Kg/plot in control (only water). The increment of the former was more then 1 ½ folds to that of control (Table 3).

Among the treatments, the plants that received with 1.0% SLF plus 50% recommended rate of chemical fertilizers recorded a maximum yield of 4.1 Kg fresh weight of pod/plot when compared to only 3.7 Kg/plot in 100% recommended rate of chemical fertilizers. The increment of the former was more than 11.0% to that of latter (Table 3).

Table 3: Effect of different concentrations of *Sargassum wightii* SLF and different proportions of recommended rate of chemical fertilizers + 1.0% SLF on the yield of *Arachis hypogaea*

Concentrations	Yield (Kg/Plot)	Proportions	Yield (Kg/Plot)
Control	1.5	100% recommend rate of chemical fertilizers	3.7
0.25% SLF	1.8	75% recommend rate of chemical fertilizers + 1.0% SLF	3.9
0.5% SLF	2.5	50% recommend rate of chemical fertilizers + 1.0% SLF	4.1
1.0% SLF	3.6	25% recommend rate of chemical fertilizers + 1.0% SLF	3.8
1.5% SLF	2.8	SLF only	3.7
		Water only	1.5

Arachis hypogaea applied with different concentrations of *U. lactuca* SLF revealed that the physical parameters namely total plant height, shoot and root height, total fresh weight, shoot and root fresh weight, total dry weight, shoot and root dry weight, number of branches and leaf area showed higher values when the plant applied with 1.0 % SLF. The total fresh weight and dry weight of plants were the maximum of 106.29 g and 20.5 g, respectively at 1.0 % SLF treatment on 60th day. The concentration of total chlorophyll, chlorophyll a and chlorophyll b and the accumulation of total carbohydrates, total protein and total lipid content were found maximum at this condition. The accumulation of total protein,

carbohydrate and lipid content was also found maximum due to the application of 1.0% SLF (Figs. 3-4). *Arachis hypogaea* received with 1.0% *U. lactuca* SLF showed a maximum of 2.5 Kg fresh weight of pods / plot, which was more than 72.0% when compared to control (received only with water) (Table 6). The values on different parameters of *A. hypogaea* on 60th day with reference to the effect of 1.0% *U. lactuca* SLF plus different proportions of recommended rate of chemical fertilizers are presented in the Tables 4, 5. Thirty day old plants applied with 1.0% SLF plus 25% recommended rate of chemical fertilizers exhibited maximum values of different parameters except leaf area. Among the treatments, the plants that received with 1.0% SLF plus 50% recommended rate of chemical fertilizers exhibited a maximum yield of 4.0 Kg fresh weight / plot as against 3.6 Kg / plot recorded in 100% recommended rate of chemical fertilizers (Table 10).

Fig. 3. Effect of different concentrations of *U. lactuca* SLF on the pigments of *Arachis hypogaea* on 60th day

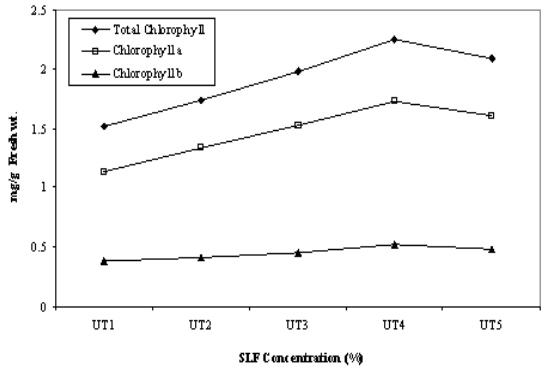
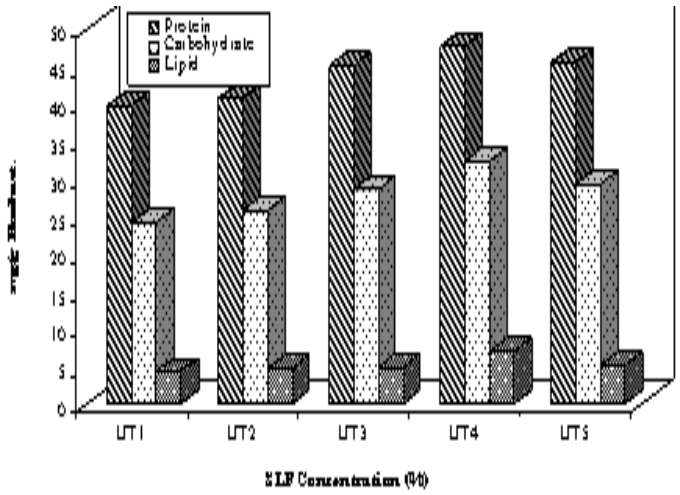


Fig. 4. Effect of different concentration of *U. lactuca* SLF on the total protein, total carbohydrate and total lipid content of *Arachis hypogaea* on 60th day



UT1 - Water only, UT2 - 0.25% SLF, UT3 - 0.5% SLF, UT4 - 1.0% SLF, UT5 - 1.5% SLF

Table 4: Effect of *Ulva lactuca* SLF on the growth of *Arachis hypogaea* under field trial on 60th day

Parameters	F-value	P-value	Concentrations				
			UT1	UT2	UT3	UT4	UT5
Total plant height (cm)	140.90	0.00**	23.40 ± 0.54^{a}	25.50 ± 0.67^{b}	30.40 ± 1.15^{c}	33.70 ± 0.67^{d}	30.86 ± 0.77^{c}
Shoot height (cm)	40.83	0.00**	18.70 ± 0.45^{a}	20.10 ± 0.25^{b}	21.60 ± 0.67^{c}	23.80 ± 0.49^{d}	22.08 ± 1.15^{c}
Root height (cm)	141.31	0.00**	4.70 ± 0.31^{a}	5.40 ± 0.46^{a}	8.80 ± 0.51^{b}	9.90 ± 0.35^{d}	8.70 ± 0.48^{b}
Total fresh weight (g)	92.13	0.00**	66.76 ± 3.46^{a}	77.49 ± 3.10^{b}	89.52 ± 1.74^{c}	106.29 ± 4.71^{d}	93.28 ± 3.91^{c}
Shoot fresh weight (g)	86.95	0.00**	65.82 ± 3.49^{a}	76.40 ± 3.15^{b}	87.75 ± 1.86^{c}	104.30 ± 4.68^{d}	91.53 ± 3.81^{c}
Root fresh weight (g)	73.16	0.00**	0.94 ± 0.11^{a}	1.09 ± 0.10^{a}	1.77 ± 0.12^{bc}	1.99 ± 0.10^{c}	1.75 ± 0.14^{b}
Total dry weight (g)	25.39	0.00**	12.87 ± 2.02^{a}	14.94 ± 1.17^{ab}	17.26 ± 1.24^{bc}	20.50 ± 0.32^{d}	17.98 ± 1.13^{c}
Shoot dry weight (g)	23.78	0.00**	12.69 ± 2.02^{a}	14.73 ± 1.18^{ab}	16.92 ± 1.25^{bc}	20.12 ± 0.35^{d}	17.65 ± 1.13^{c}
Root dry weight (g)	21.19	0.00**	0.18 ± 0.03^{a}	0.21 ± 0.02^{a}	0.34 ± 0.04^{b}	0.38 ± 0.05^{b}	0.33 ± 0.03^{b}
Number of pods	15.39	0.00**	5.00 ± 1.58^{a}	7.00 ± 3.08^{ab}	10.00 ± 2.00^{bc}	15.00 ± 2.23^{d}	12.00 ± 2.12^{cd}
Number of branches	4.37	0.01**	4.00 ± 1.00^{a}	4.00 ± 0.70^{ab}	5.00 ± 1.22^{ab}	6.00 ± 0.70^{b}	5.00 ± 0.70^{ab}
Leaf area (cm^2)			8.2	9.3	10.8	13.5	12.1

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).

U - *Ulva lactuca* T - Treatment
UT1 - Control
UT2 - 0.25 % SLF
UT3 - 0.5% SLF
UT4 - 1.0% SLF
UT5 - 1.5% SLF

Table 5 : Effect of different proportions of recommended rate of chemical fertilizers + 1.0% *Ulva lactuca* SLF on *Arachis hypogaea* under field trial on 60th day

Parameters	F-value	P-value	Concentrations					
			CUT1	CUT2	CUT3	CUT4	CUT5	CUT6
Total plant height (cm)	153.61	0.00**	25.60 ± 1.14^{b}	31.40 ± 1.34^{c}	45.20 ± 2.28^{e}	39.20 ± 2.28^{d}	29.20 ± 1.09^{c}	20.40 ± 1.14^{a}
Shoot height (cm)	77.76	0.00**	16.20 ± 1.64^{b}	18.80 ± 0.83^{bc}	25.80 ± 1.92^{d}	25.40 ± 1.67^{d}	19.40 ± 1.14^{c}	11.00 ± 1.00^{a}
Root height (cm)	72.99	0.00**	9.40 ± 1.14^{a}	12.60 ± 1.14^{b}	19.20 ± 0.83^{e}	13.80 ± 0.83^{b}	9.80 ± 0.83^{a}	9.40 ± 1.14^{a}
Total fresh weight (g)	332.35	0.00**	130.62 ± 1.74^{b}	150.08 ± 0.85^{c}	170.33 ± 4.41^{e}	162.51 ± 1.80^{d}	127.94 ± 2.74^{b}	122.28 ± 1.29^{b}
Shoot fresh weight (g)	291.00	0.00**	128.60 ± 1.67^{b}	146.82 ± 0.95^{c}	166.91 ± 4.64^{e}	159.60 ± 1.97^{d}	125.90 ± 2.75^{b}	120.26 ± 1.30^{a}
Root fresh weight (g)	77.14	0.00**	2.02 ± 0.09^{a}	3.26 ± 0.21^{b}	3.62 ± 0.23^{c}	2.91 ± 0.23^{b}	2.04 ± 0.12^{a}	2.02 ± 0.14^{a}
Total dry weight (g)	143.84	0.00**	25.19 ± 0.19^{a}	28.95 ± 0.75^{b}	32.90 ± 0.58^{d}	31.36 ± 0.76^{c}	25.61 ± 0.74^{a}	24.75 ± 0.65^{a}
Shoot dry weight (g)	14.45	0.00**	24.81 ± 0.17^{a}	28.33 ± 0.77^{b}	32.21 ± 0.61^{d}	30.80 ± 0.73^{c}	25.22 ± 0.72^{a}	24.17 ± 0.49^{a}
Root dry weight (g)	33.30	0.00**	0.38 ± 0.03^{a}	0.62 ± 0.03^{bc}	0.69 ± 0.10^{c}	0.56 ± 0.04^{b}	0.39 ± 0.04^{b}	0.38 ± 0.02^{a}
Number of nuts	123.20	0.00**	6.80 ± 0.83^{a}	11.00 ± 1.00^{b}	21.40 ± 1.67^{d}	17.20 ± 1.48^{c}	11.20 ± 1.30^{b}	5.00 ± 1.00^{a}
Number of Branches	36.73	0.00**	5.00 ± 0.70^{a}	8.80 ± 0.83^{b}	10.40 ± 1.14^{b}	5.80 ± 0.83^{a}	5.20 ± 0.83^{a}	5.40 ± 0.54^{a}
Leaf area (cm^2)			11.7	14.9	22.4	17.5	14.8	9.8

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).

U - *Ulva lactuca* T - Treatment C - Chemical fertilizer
CUT1 - 100% recommended rate of chemical fertilizer
CUT2 - 75% recommended rate of chemical fertilizer + 1.0% SLF
CUT3 - 50% recommended rate of chemical fertilizer + 1.0% SLF
CUT4 - 25% recommended rate of chemical fertilizer + 1.0% SLF
CUT5 - 1.0% SLF only
CUT6 - Water only

Table 6: Effect of different concentrations of *Ulva lactuca* SLF and different proportions of recommended rate of chemical fertilizers + 1.0% SLF on the yield of *Arachis hypogaea*

Concentrations	Yield (Kg/Plot)	Proportions	Yield (Kg/Plot)
Control (Water only)	1.4	100% recommend rate of chemical fertilizers	3.6
0.25% SLF	1.7	75% recommend rate of chemical fertilizers + 1.0% SLF	3.6
0.5% SLF	1.9	50% recommend rate of chemical fertilizers + 1.0% SLF	4.0
1.0% SLF	2.5	25% recommend rate of chemical fertilizers + 1.0% SLF	3.5
1.5% SLF	2.1	SLF only	3.4
		Water only	1.4

The 1.0% *Sargassum wightii* SLF was contained N-21.2, P-11.6, K-469, Ca-120, Mg-146, Fe-1.5, Cl-219, and F-0.15 mg/L and auxin 92μg/L and cytokinin 186μg/ whereas, the seaweed extract of *U. lactuca* contained maximum content of Mg (398mg/L) followed by K (329mg/L), Ca (200mg/L), P (24.45mg/L) and N (20.16mg/L). Among the micronutrients Cl (179mg/L) was recorded a maximum followed by Fe (6.7mg/L) and F (0.42mg/L). The amount of plant growth regulators like auxin and cytokinin contents was recorded up to 150 μg/L and 235μg/L, respectively.

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 Both (1969), Senn (1987) and Metting et al. (1988). Seaweed liquid fertilizers were found superior than chemical fertilizer because of the presence of high levels of organic matter Aitken and Senn (1965). In present study the seaweed extract obtained from *S. wightii* contained a maximum amount of K compared to the other macro nutrient N and P. Whereas, Mg was found maximum to that of N, P and K in *U. lactuca* extract.

The seaweed extract obtained from *Ecklonia maxima* when applied as soil drench to tomato seedlings significantly increased the growth. Crouch and Van Staden (1993) described that foliar application was less effective when compared to soil drench. The present study indicated that the growth characteristics like plant height, fresh weight and leaf area of *Arachis hypogaea* enhanced due to the SLFs treatments individually as well as along with chemical fertilizers. Whaphan et al. (1993) observed that application of *Ascophyllum* extract increased the chlorophyll content of cucumber cotyledons and tomato plants. Appreciable increase in the amounts of chl. a and chl. b content recorded in the present plant. This may be the consequence of uptake of magnesium content from the SLF, a constituent of chlorophyll. Tay et al. (1985) showed the presence of cytokinins in the extract of *Durvillea potatorium*. Seker et al. (1995) detected cytokinins in the extract of Ulva lactuca. Among the two plant growth regulators investigated in the present attempt the amount of cytokinin was found high compared to auxin in both SLFs. Stephenson (1974) while experimenting with *Ascophyllum* and *Laminaria* liquid fertilizers on potatoes, corns, peppers, tomatoes, pineapples and oranges found that lower concentrations of liquid fertilizers accelerated growth than higher concentrations. In the present study, greater height and leaf area were observed in the plants that applied with 1.0% of both SLFs as well as with 50% recommended rate of chemical fertilizer plus 1.0% SLF. These treatments further enhanced their yield. The plants received with 100% recommended rate of chemical fertilizers showed an increment of yield up to 147% when compared to control (only water). Whereas, the plants that received with 50% recommended rate of chemical fertilizers plus 1.0% SLF of *S. wightii* and *U. lactuca* SLF increased the yield further up to 175% and 185%, respectively. Thus, proving the synergistic effect of chemical fertilizer and SLF towards the yield of crop. It may be attributed that the enhancement in the latter could be due to utilization of micronutrients (as well as macro nutrients) and PGRs in the SLFs by the crop, since the soil was being suffered for those nutrients.

The plants that received only with SLF always showed less yield when compared to the plants received with 100% recommend rate of chemical fertilizers. This indicating that the amount of macronutrients in the SLFs could not able to meet the demand of the crop. Whereas, the plants that received with 1.0% SLFs plus 50% recommend rate of chemical fertilizers showed more yield than at 100% recommend rate of chemical fertilizers inferring the combined effect of these two components for maximum yield. Among the two SLFs investigated the SLF obtained from *S. wightii* found superior than *U. lactuca* SLF towards groundnut yield.

The present study revealed that 50% recommend rate of chemical fertilizers plus 1.0% SLF supported a maximum yield of ground nut, thus accounting the

reduction of 50% cost for chemical fertilizer. Between the two seaweeds *S. wightii* could be an ideal candidature for the preparation of SLF since it occurs through out the year in the Indian Coasts whereas, *U. lactuca* is found scarce during summer.

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