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EFFECT OF SEAWEED LIQUID FERTILIZER (SLF) ON THE GERMINATION AND GROWTH OF SEEDLING OF SOME AGRICULTURAL CROPS

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ABSTRACT

Seaweeds are among the important renewable marine living resources with tremendous commercial application of the world. The effect of Seaweed Liquid Fertilizer (SLF) of *Sargassum wightii* was studied on the growth parameters of five different agricultural crops viz. *Amaranthus roxburghinus***,** *Amaranthus tricolor***,** *Arachis hypogaea***,** *Capsicum annum* and *Tagetes erecta* . The seeds were soaked in different concentrations of SLF viz. 0.25%, 0.5%, 1.0% and 1.5% for 6h, 12h and 24h of durations. The maximum growth was recorded at 1% concentration Viz., shoot length, root length in cm and fresh weight in gram when compared to control. It was concluded that differential response was noticed in the crops to the seaweed extract treatment. In spite of these differential responses, *Sargassum wightii* was found to be an effective seaweed liquid fertilizer (SLF) in the crops.

Key words: Seaweed Liquid Fertilizer, SLF, *Sargassum wightii, Amaranthus roxburghinus, Arachis hypogaea, Capsicum annum*

INTRODUCTION

Algae have lots of economical uses. The seaweed suspensions or extracts obtained from algae gain a commercial importance. The seaweed suspensions can be an alternative treatment especially for organic farming. Numerous papers have been published on the foliar application, evaluation of seaweed extracts on horticultural or agricultural plants (Abetz, 1980, Crouch *et al*., 1990). The brown algae, like *Ascophyllum nodosum* (L.) Le Jolis and *Laminaria* hyperborean (Gunn.) Foslie are generally used for the commercial seaweed extracts. However, in experimental studies it was shown that growth of seedlings was stimulated by the crude extracts of green (*Cladophora dalmatica*, *Entromorpha intestinalis*, *Ulva lactuca*, *Caulerpa chemnitzia*), brown (*Sargassum wightii*) and red algae (*Corallina mediterranea*, *Jania rubens*, *Pterocladia pinnate*) (El-Sheekh and El- Saled, 2000; Sivasankari *et al*., 2006). The presence of minerals, trace elements and plant growth regulators which occur in water soluble form (Moller *et al*., 1999) and enhances the disease resistance in field crops (Verkleij, 1992). Aqueous extract of *Sargassum wightii* when applied as a foliar spray on *Zizyphus mauritiana* showed an increased yield and quality of fruits (Rama Rao, 1991). Growth promoting effect of seaweed liquid fertilizer (*Enteromorpha intestinalis*) on the sesame crop plant (Gandhiyappan and Perumal, 2001). Seaweed foliar applications increased harvestable bean yields by an average of 25% (Temple and Bomke, 1989), staked tomato yields by up to 99% (Csizinszky, 1984), early yield of one variety of greenhouse cucumber (Passam *et al*. , 1995), and greenhouse tomato total fruit fresh weights by 17% (Crouch and Van standen, 1992). Moverover, they function as plant conditioners. These extracts when applied to seeds or when added to the soil, stimulate growth of the plants (Blunden, 1991). Hence the present study was conducted to find out the effect of seaweed (*Sargassum wightii*) on the growth of five different agricultural crops.

MATERIALS AND METHODS

The specimens of brown seaweed *Sargassum wightii* Grev. was collected from Mandapam coast, Tamil Nadu. The collected seaweed 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 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. Different concentrations of SLF namely 0.25, 0.5, 1.0 and 1.5% w/v were prepared from the known concentration of SLF stock by adding distilled water. The effect of SLF on the seed germination and early growth of seedlings of five different crops was made under laboratory conditions at $30\mu Em^{-2}s^{-1}$light intensity, 12h/12h light dark cycle and 24 ±1°C. Twenty seeds of each crop were surface sterilized with 0.1% mercuric chloride for one minute and washed thoroughly in sterilized distilled water. Then they were soaked in

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Table 1: Effect of *Sargassum wightii* SLF on the seedling growth of *Amaranthus roxburghinus*

Parameters	Duration of soaking	F-value	P-value	SLF Concentrations				
				Control	0.25%	0.5%	1.0%	1.5%
Length of plumule (cm)	6 h	4.39	0.010**	2.95 ± 0.30^{a}	3.70 ± 0.20^{a}	3.76 ± 0.43^{a}	3.76 ± 0.27^{a}	3.28 ± 0.16^{ab}
	12 h	5.23	0.004**	2.98 ± 0.28^{ab}	3.38 ± 0.57^{b}	3.20 ± 0.14^{ab}	3.54 ± 0.28^{b}	3.18 ± 0.37^{a}
	24 h	3.07	0.03*	2.74 ± 0.23^{a}	2.56 ± 0.28^{a}	2.80 ± 0.25^{ab}	3.28 ± 0.25^{b}	2.76 ± 0.23^{a}
Length of radical (cm)	6 h	3.82	0.018*	3.16 ± 0.31^{a}	4.06 ± 0.83^{ab}	3.46 ± 0.32^{ab}	4.34 ± 0.89^{b}	3.28 ± 0.16^{ab}
	12 h	0.78	0.54NS	2.40 ± 0.46	2.64 ± 0.19	2.92 ± 0.25	2.96 ± 0.29	2.46 ± 0.15
	24 h	7.99	0.0005**	2.12 ± 0.22^{a}	2.28 ± 0.19^{ab}	2.48 ± 0.14^{b}	2.54 ± 0.11^{b}	2.28 ± 0.44^{a}
Fresh weight (g)	6 h	7.30	0.001**	0.0073 ± 0.0004^{a}	0.0087 ± 0.0011^{bc}	0.0089 ± 0.001^{b}	0.0094 ± 0.0007^{c}	0.0076 ± 0.0004^{ab}
	12 h	8.36	0.000**	0.0071 ± 0.001^{ab}	0.0071 ± 0.0008^{ab}	0.0077 ± 0.0008^{ab}	0.0087 ± 0.0012^{b}	0.0064 ± 0.0005^{ab}
	24 h	5.67	0.003**	0.0058 ± 0.0003^{a}	0.0057 ± 0.0005^{a}	0.0065 ± 0.0005^{ab}	0.0073 ± 0.0006^{b}	0.0063 ± 0.001^{a}

Note: *denotes significant at 5% level; **denotes significant at 1% level; Different alphabets between concentrations denotes statistically significant based on multiple range test (Tukey -HSD test). NSdenotes not significant

Table 2: Effect of *Sargassum wightii* SLF on the seedling growth of Amaranthus tricolor

Parameters	Duration of soaking	F-value	P-value	SLF Concentrations				
				Control	0.25%	0.5%	1.0%	1.5%
Length of plumule (cm)	6 h	8.91	0.00**	3.00 ± 0.46^{a}	4.00 ± 0.37^{b}	3.34 ± 0.32^{ab}	4.02 ± 0.49^{c}	3.94 ± 0.08^{bc}
	12 h	16.02	0.00**	2.72 ± 0.13^{a}	3.12 ± 0.27^{abc}	2.94 ± 0.15^{a}	3.60 ± 0.15^{c}	3.36 ± 0.23^{bc}
	24 h	3.70	0.02*	2.70 ± 0.21	3.00 ± 0.27	2.82 ± 0.19	3.48 ± 0.16	3.20 ± 0.2
Length of radical (cm)	6 h	9.71	0.00**	2.80 ± 0.21^{a}	3.38 ± 0.38^{bc}	3.76 ± 0.20^{a}	3.86 ± 0.35^{c}	3.56 ± 0.26^{bc}
	12 h	63.32	0.00**	2.78 ± 0.19^{a}	3.50 ± 0.07^{b}	3.20 ± 0.25^{ab}	3.60 ± 0.10^{b}	3.42 ± 0.19^{b}
	24 h	1.55	0.22NS	2.58 ± 0.14	3.10 ± 0.20	2.64 ± 0.15	3.54 ± 1.04	3.10 ± 0.26
Fresh weight (g)	6 h	0.97	0.44NS	0.009 ± 0.0008	0.028 ± 0.03	0.010 ± 0.001	0.013 ± 0.001	0.012 ± 0.0007
	12 h	0.67	0.61NS	0.008 ± 0.001	0.009 ± 0.001	0.008 ± 0.002	0.010 ± 0.001	0.009 ± 0.004
	24 h	0.46	0.76NS	0.008 ± 0.001	0.0088 ± 0.0005	0.0087 ± 0.001	0.010 ± 0.001	0.0089 ± 0.004

Note: *denotes significant at 5% level; **denotes significant at 1% level, Different alphabets between concentrations denotes statistically significant based on multiple range test (Tukey -HSD test). NSdenotes not significant

Table 3: Effect of *Sargassum wightii* SLF on the seedling growth of Arachis hypogaea

Parameters	Duration of soaking	F-value	P-value	SLF Concentrations				
				Control	0.25%	0.5%	1.0%	1.5%
Length of plumule (cm)	6 h	2.54	0.07NS	3.74 ± 0.55	4.94 ± 0.43	5.26 ± 0.43	5.50 ± 0.18	4.78 ± 0.56
	12 h	44.23	0.00**	2.80 ± 0.15^{a}	2.84 ± 0.15^{a}	3.82 ± 0.13^{bc}	3.88 ± 0.25^{c}	3.54 ± 0.15^{b}
	24 h	153.96	0.00**	1.06 ± 0.05^{a}	1.58 ± 0.08^{b}	2.70 ± 0.13^{d}	3.00 ± 0.20^{e}	2.10 ± 0.17^{c}
Length of radical (cm)	6 h	13.80	0.00**	4.68 ± 0.21^{a}	5.70 ± 0.43^{b}	6.02 ± 0.35^{bc}	6.58 ± 0.45^{c}	5.34 ± 0.59^{ab}
	12 h	59.96	0.00**	3.22 ± 0.08^{a}	4.16 ± 0.29^{bc}	4.50 ± 0.10^{c}	5.30 ± 0.33^{c}	3.90 ± 0.15^{b}
	24 h	97.28	0.00**	2.70 ± 0.10^{a}	3.60 ± 0.11^{b}	3.98 ± 0.14^{c}	4.12 ± 0.21^{c}	2.92 ± 0.09^{a}
Fresh weight (g)	6 h	1.68	0.19NS	2.18 ± 0.20	2.56 ± 0.32	2.38 ± 0.28	3.03 ± 0.12	2.36 ± 0.26
	12 h	81.95	0.00**	1.51 ± 0.06^{b}	1.33 ± 0.02^{a}	1.50 ± 0.04^{b}	2.00 ± 0.08^{d}	1.85 ± 0.09^{c}
	24 h	5.41	0.00**	1.02 ± 0.07^{a}	1.18 ± 0.05^{ab}	1.19 ± 0.08^{ab}	1.28 ± 0.12^{b}	1.10 ± 0.11^{a}

Note:* denotes significant at 5% level;** denotes significant at 1% level; Different alphabets between concentrations denotes statistically significant based on multiple range test (Tukey -HSD test). NSdenotes not significant

Table 4: Effect of *Sargassum wightii* SLF on the seedling growth of *Capsicum annum*

Parameters	Duration of soaking	F-value	P-value	SLF Concentrations				
				Control	0.25%	0.5%	1.0%	1.5%
Length of plumule (cm)	6 h	119.49	0.00^{**}	3.00 ± 0.11^{a}	3.94 ± 0.14^{b}	3.80 ± 0.19^{b}	4.98 ± 0.10^{c}	4.06 ± 0.14^{b}
	12 h	17.43	0.00^{**}	4.20 ± 0.12^{b}	3.80 ± 0.15^{a}	4.28 ± 0.14^{bc}	4.52 ± 0.16^{c}	4.06 ± 0.11^{ab}
	24 h	3.10	0.03^{*}	4.50 ± 0.73^{ab}	4.94 ± 0.54^{ab}	5.22 ± 1.01^{ab}	5.54 ± 0.59^{b}	4.04 ± 0.77^{a}
Length of radical (cm)	6 h	53.93	0.00^{**}	5.98 ± 0.17^{b}	5.22 ± 0.28^{a}	7.25 ± 0.39^{c}	7.18 ± 0.33^{c}	5.64 ± 0.06^{ab}
	12 h	40.03	0.00^{**}	4.90 ± 0.10^{b}	4.18 ± 0.31^{a}	5.28 ± 0.22^{bc}	5.60 ± 0.10^{c}	4.32 ± 0.24^{a}
	24 h	6.62	0.00^{**}	4.60 ± 0.87^{b}	3.74 ± 0.62^{ab}	4.84 ± 0.52^{b}	4.86 ± 0.54^{b}	3.22 ± 0.56^{a}
Fresh weight (g)	6 h	10.33	0.00^{**}	0.04 ± 0.004^{b}	0.03 ± 0.004^{a}	0.04 ± 0.006^{b}	0.05 ± 0.006^{c}	0.04 ± 0.003^{b}
	12 h	9.10	0.00^{**}	0.03 ± 0.004^{ab}	0.02 ± 0.001^{a}	0.03 ± 0.002^{ab}	0.04 ± 0.002^{c}	0.03 ± 0.002^{ab}
	24 h	0.91	0.47^{NS}	0.033 ± 0.007	0.036 ± 0.003	0.035 ± 0.002	0.092 ± 0.13	0.026 ± 0.008

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

Table 5: Effect of *Sargassum wightii* SLF on the seedling growth of *Tagetes erecta*

Parameters	Duration of soaking	F-value	P-value	SLF Concentrations				
				Control	0.25%	0.5%	1.0%	1.5%
Length of plumule (cm)	6 h	2.71	0.05^{NS}	4.56 ± 0.75	5.06 ± 0.43	4.96 ± 0.53	5.56 ± 0.44	4.14 ± 0.50
	12 h	12.09	0.00^{**}	4.30 ± 0.67^{bc}	4.16 ± 0.43^{a}	4.82 ± 0.46^{bc}	4.92 ± 0.37^{c}	4.10 ± 0.27^{a}
	24 h	2.78	0.05^{NS}	3.86 ± 0.25	3.22 ± 0.23	3.72 ± 0.40	4.36 ± 0.20	3.32 ± 0.32
Length of radical (cm)	6 h	4.06	0.01^{*}	4.40 ± 0.54^{ab}	4.68 ± 0.41^{b}	4.84 ± 0.67	5.10 ± 0.65^{c}	4.18 ± 0.10^{a}
	12 h	25.84	0.00^{**}	3.90 ± 1.08	4.62 ± 0.63	4.78 ± 0.68^{b}	4.92 ± 0.39^{b}	3.84 ± 0.54^{a}
	24 h	2.70	0.05^{NS}	2.96 ± 0.16^{a}	3.84 ± 0.28^{b}	4.30 ± 0.18^{b}	4.90 ± 1.02	3.46 ± 0.39
Fresh weight (g)	6 h	2.20	0.10^{NS}	0.037 ± 0.002	0.042 ± 0.001	0.045 ± 0.002^{c}	0.053 ± 0.004	0.043 ± 0.004
	12 h	19.95	0.00^{**}	0.036 ± 0.005^{ab}	0.035 ± 0.002^{a}	0.043 ± 0.005	0.046 ± 0.009^{d}	0.038 ± 0.004^{bc}
	24 h	1.15	0.35^{NS}	0.034 ± 0.006	0.033 ± 0.002	0.037 ± 0.001	0.037 ± 0.004	0.033 ± 0.005

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

different concentrations of SLF: 0.25%, 0.5%, 1.0% and 1.5% for 6h, 12h and 24h of duration in *Sargassum wightii* SLF. After the treatment the seeds were placed on a sterilized moist handmade filter paper in a petriplate and kept under laboratory conditions for germination except *Arachis hypogaea*. The seed germination and early growth of seedlings of *Arachis hypogaea* was carried out in acid washed coarse sand. The growth characteristic namely, the length of radicle and plumule and fresh weight of seedlings were recorded on 5th day of the plants namely; *Amaranthus roxburghinus***,** *Amaranthus tricolor***,** *Arachis hypogaea* and *Tagetes erecta*. These features were recorded on *Capsicum annum* on 10th day since it showed a delayed germination and growth.

RESULTS

Germination

The percentage seed germination of *Amaranthus roxburghinus***,** *A. tricolor***,** *Arachis hypogaea***,** *Capsicum annum* and *Tagetes erecta* showed 100, 100, 100, 90 and 80%, respectively, of SLF treatment.

Early growth of seedlings

Amaranthus roxburghinus

The fresh weight and the length of radicle and plumule of *A. roxburghinus* seedlings were increased due to *S. wightii* treatment. Amoung the treatments a maximum of 4.3cm and 3.7cm length of radicle and plumule was recorded when the seeds were soaked in 1.0% SLF for 6h duration of soaking compared to 3.1cm and 2.95cm in control, respectively. The fresh weight of the seedlings was also increased by 20% due to the above SLF treatment. The seeds treated with 0.25% and 1.0% *S. wightii* SLF were found highly significant at 1% level based on multiple range tests. Tukey –HSD test (Table 1).

Amaranthus tricolor

The seeds treated with different concentrations and duration of soakings in *S. wightii* SLF showed increased growth characteristics of seedlings when compared to control. Among the treatments, the seeds soaked in 1.0% SLF for 6h duration showed maximum growth characteristics. The length of radicle and plumule increased to 38% and 34%, respectively. The fresh weight of the seedlings was also increased to 44.5% more than the control. The seedlings grown at 1.0% SLF showed highly significant at 1% level (Table 2).

Arachis hypogaea

The data recorded on the effect of *S. wightii* SLF on *A. hypogaea* are presented in the Table 3. The seeds soaked at four different concentrations and three durations in *S. wightii* SLF showed enhanced growth characteristics of seedlings. The seedlings obtained at 6h duration in 1.0% SLF concentration showed maximum growth characteristics. At this condition, the length of radicle and plumule increased to 40.5% and 47.0%, respectively, over control. The total fresh weight of seedlings was 3.03g against only 2.18g in control. The one way ANOVA revealed that SLF concentrations were not found significant towards the length of plumule but different from each other. In the case of length of radicle the SLF concentration of 0.25%, 0.5% and 1.0% was found significantly different at 1% level.

Capsicum annum

The growth of seedlings of chilli was enhanced when the seeds were treated with different concentrations and duration of *S. wightii* SLF. Among the treatments, the seedlings grown at 1.0% SLF for 6h duration showed maximum growth characteristics. The one way ANOVA showed highly significant at 1% level between 1.0% SLF concentration and seedling parameters studied (Table 4).

Tagetes erecta

The seeds of marigold when treated with different concentrations and duration in the *S. wightii* SLF showed enhanced growth characteristics. The seedlings grown at 1.0% SLF for 6h duration showed maximum growth in terms of the length of radicle and plumule increased to 23% and 22%, respectively, when compared to control. There was a significantly difference between the concentrations of SLF and the length of radicle based on multiple range test (Table 5).

DISCUSSION

Seaweed products are known to enhance the germination of seeds, increase the uptake of plant nutrients, impart a degree of frost resistance and make the plants better to withstand phytopathological fungi and insect pests (Booth, 1969). The extracts obtained from *Spathoglossum asperum*, *Ulva lactuca* and *Entromorpha intestinalis* were found to promote seed germination and the growth of seedlings of gram, groundnut and maize. Dilute extracts were found to be more effective than the concentrated extracts (Bukhari and Untawale, 1978). Seaweed liquid fertilizer promoted seed germination and enhanced early seedling growth up to a concentration of 0.75% in black gram and up to 1.5% in green gram. Whereas, highest concentration of SLF (2.0%) inhibited both shoot length and number of lateral roots in black gram. The commercial seaweed extract SM3 promoted seedling growth up to 0.75% in black gram and up to 1.0% in green gram (Venkataraman Kumar *et al.*, 1994). In present study, also the seaweed extract of *S. wightii* accelerated the seed germination and early growth of all the five plants investigated. The seeds of *Amaranthus roxburghinus***,** *A. tricolor***,** *Arachis hypogaea***,** *Capsicum annum* and *Tagetes erecta* when soaked in 1.0% concentration for 6h duration showed higher growth in terms of length in both radicle and plumule.

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