Research Paper

Volume : 2 | Issue : 10 | October 2013 • ISSN No 2277 - 8179

Potentials of Seaweed Liquid Fertilizers on the Growth and Biochemical Characteristics of *Solanum lycopersicum* - A field trial.

Agriculture

KEYWORDS : Seaweed Liquid Fertilizer, Chlorophyll, Biofertilizer, Eco-friendly, Soil fertility.

N.Karthick	Department of Biotechnology, Manonmaniam Sundaranar University, Tirunelveli-627012, Tamil Nadu, India.
V.Prasanth Kumar	Department of Biotechnology, Manonmaniam Sundaranar University, Tirunelveli-627012, Tamil Nadu, India.
V.V.Divya	Department of Biotechnology, Manonmaniam Sundaranar University, Tirunelveli-627012, Tamil Nadu, India.
S.Umamaheswari	Department of Biotechnology, Manonmaniam Sundaranar University, Tirunelveli-627012, Tamil Nadu, India.

ABSTRACT

The present was undertaken to monitor the effect of three different Seaweed Liquid Fertilizers (SLF) from Caulerpa scalpelliformis, Sargassum wightii, Cheilosporum spectabile and Chemical Liquid Fertilizer (CLF) on the growth and biochemical constituents of Solanum lycopersicum. The main objective of the study was to enhance the growth, biochemical constituents and nutraceutical values of S. lycopersicum. Different concentrations (10%, 20%, 30%, 40%, 50%) of the three different SLF and CLF were used and growth was observed over a period of 4 months. A statistically significant increase in the three different SLF were observed with regard to seed germination, Shoot length, Root length than the CLF treated plants. The biochemical constituents (Chlorophyll, Cartenoid, Protein) were also found to increase in the SLF treated plants than the CLF plants. The study also shows that the seaweed liquid extract contains high amount of macronutrients and micronutrients which makes it a potential biofertilizer. The eco-friendly seaweed liquid fertilizers are recommended to farmers for attaining better growth of plants and also in improvement of soil fertility.

Introduction

India is mainly an agricultural country with approximately 70% of the population are located in rural areas and directly engaged in agriculture. The growing population is placing pressure on food production and to meet this increasing demand, farmers are using chemical fertilizers to enhance their crop production. Chemical fertilizers are mixed with pesticides which get accumulated in plant leading to health problems in human due to biomagnifications (Hansra 1993). Seaweeds are important marine renewable resource. They are used as food, feed, fodder, fertilizer, agar, alginate, carrageenan and source of various fine chemicals. (Sahoo 2000). Soil is a main essential part of the terrestrial ecosystem. Soil is considered a store house of microbial activity. The long term application of inorganic fertilizers is to increase the productivity of crop and they lead to the ill-effect of the ecology of the agricultural systems. Commercial use of concentrated seaweed extracts as foliar spray, in seed treatments and root dips have increased far more rapidly than use of seaweed meals a soil additive (Metting et al.1990). Seaweed fertilizers is one of the natural organic fertilizers containing highly effective nutritious and promotes faster germination of seeds, increase yields and resistant ability of many crops. Biofertilizers enhance crop productivity through processes such as nitrogen fixation, phosphate solubilisation and plant hormone production (Pereira and Verlecar 2005). Recently researchers proved that the seaweed fertilizers are better than the other fertilizers and are very economical (Gandhiyappan and Perumal 2001). In the present investigation, efforts have been made to study the influence of three different seaweeds on the growth and biochemical characteristics of *S. lycopersicum*.

MATERIALS AND METHODS

Collection of seaweeds

The seaweeds are collected from the coastal area of Manapadu, Tuticorin district, Tamil Nadu, India. Fresh seaweeds were thoroughly washed with distilled water to get rid off their holdfasts and epiphytes. The water was drained off from the thallus and they were spread on blotting paper to remove the excess water.

Preparation of different concentration of SLF and CLF

The three different types of seaweeds were finely chopped into small pieces separately and mixed with one litre of distilled water and boiled for an hour and the extract was filtered through muslin cloth. The filtrate was allowed to cool at room temperature thereafter filtered through Whatman filter paper No 41 (Pore size 20-25μm). (Bhosle et al. 1975). Different concentrations of SLF (10%, 20%, 30%, 40%, 50%) were prepared by diluting this extract with distilled water. The SLF was stored at 4°C for further experimental analysis. The CLF was bought from the fertilizer shop and it was diluted as per the standard field dosage.

Selection of crop plant

Solanum lycopersicum was selected as the experimental crop plant in the present study. The seeds of *S.lycopersicum* having uniform size, shape, colour and weight were selected and collected from the Tamil Nadu Agricultural University, Coimbatore. The selected seeds were stored in a metal tin as suggested by Rao (1976). The seeds were pre-treated in SLF and CLF for 24 hrs.

Experimental study

In the field experiment, ten seeds were sowed per one set of experiment. The weeds were removed and watering was done regularly for the test plant. The experiment was carried out in triplicates. The growth parameters such as Seed germination, Root length, Shoot length of SLF and CLF treated plants were regularly monitored and tabulated. The biochemical parameters such as Chlorophyll content (Arnon 1949), Carotenoid (Mackinney 1941), and Protein content (Lowry et al. 1951) were analysed.

Results and Discussion

The germination effect of three different seaweed extracts and CLF were noted (Table 1 and Figure 1). The *C.scalpelliformis* exhibited highest germination percentage of 98±0.88 in 20% concentration and the lowest germination percentage was noted in *C.spectabile* in 50% concentration is 75±1.25. The increased germination percentage at low concentrations might be due to the presence of some growth promoting substance such as IAA, IBA, Gibberellins, CLF were increased in 50% concentration is 96±0.76. The control plant recorded a growth of 84±2.0 percentage of germination. Higher concentration of seaweed extract caused a drop in biological activity leading to sickly, brown cotyledons, probably either due to loss of chloroplast integrity (Wu and Lin 2000) or because of interplay of other compounds in the seaweed extract.

The maximum root length was recorded as 5.03±0.50 cm /seedlings in the plant that received with 30% SLF of *C.scalpelliformis*. The root length of CLF was maximum at 40% concentration and minimum at 10% concentration and the values of root length are tabulated (Table 2 and Figure 2). The rooting response was attributed to endogenous indoles which were positively identified in the seaweed concentrate (Strik et al. 2004). The increased supply of nutrients provided by the aqueous seaweed extract resulted in healthy root and shoot. The similar findings were reported in *H.musciformis, Spatoglossum asperum* and *S.wightii* on the growth of crops such as green chillies, turnips and pine apple (Dhargalkar and Untawale 1983). The shoot length of the plant was maximum (14.50±0.58 cm/ seedling) in 30% SLF of *C.scalpelliformis* and decreased shoot length (10.32±0.13cm/ seedling) was seen in 10% concentration of *C.spectabile.* In the CLF treated plant, the shoot length was maximum in 50% concentration of 12.32±0.23 and it was decreased in 10% concentration of 10.07±0.10. The values of shoot length of SLF and CLF treated plants were noted (Table 3 and Figure 3). The present study corroborates with the results of earlier studies made *Cajanus cajan* (Mohan et al. 1994).

The maximum chlorophyll content was observed in 40% SLF of *C. scalpelliformis* at the rate of 7.63±0.47 and the minimum was noted in the rate of 3.310±0.15 in 20% concentration and in CLF, the maximum chlorophyll content was seen in 40% and minimum in 10% respectively as 6.236±0.37 and 3.934±0.18 (Table 4 and Figure 4). A similar observation was made in *Scytonema sp.* by Venkataraman kumar and Mohan (1997 a). The seaweed extract applied as foliar spray enhanced the leaf chlorophyll level in plants (Blunden et al.1996). In another study, the enhanced levels of photosynthetic pigments in leaf tissues with the application of seaweed extracts from *A. nodosum* either as a soil drench or as foliar spray have been reported earlier in tomato (Whapham et al.1993). The highest level of carotenoid (1.64±0.50) was noted in 30% of *S. wightii* and the lowest value at the rate of 1.05±0.18 in 40% concentration of *S. Wightii.* But in CLF treated plants, the highest level was recorded in 20% concentration as 1.385±0.27 and lowest level was noted in 50% concentration of 0.865±0.15 respectively (Table 5 and Figure 5).

The protein content of the SLF treated plants was shown to be maximum in 40% of *C. scalpelliformis* in the rate of 0.54±0.1 mg g^{-1}f.w and minimum in 40% *S. wightii* at the rate of 0.21±0.01 mg g-1f.w whereas in CLF, the maximum was seen in 30% concentration (0.36±0.03) and minimum in 40% concentration (0.028±0.04) which is represented in Table 6 and Figure 6. A significant increase in the levels of protein content of *Sorghum vulgare* was recorded with 1.5% seaweed liquid extract prepared from *Hydroclathrus clathratus* (Ashok et al. 2004). The increase in protein content at lower concentrations of liquid extract may be due to the absorption of most of the necessary elements by the seedling (Anantharaj and Venkatesalu 2001).

Conclusion

In our present investigation, there is an overall assessment of the effect of SLF and CLF on *S. lycopersicum* in terms of shoot length, root length, concentration of photosynthetic pigments, proteins revealed that the green seaweed has the potential to be used as a biofertilizer. The chemical fertilizers are highly cost effective and they are available in great demand. The seaweed fertilizers seems a feasible substitute to chemical fertilizers.

Table 1 : Germination percentage of SLF and CLF treated *Solanum lycopersicum*

Treatments	10%	20%	30%	40%	50%	CONTROL
S. wightii	82±1.86	86±2.16	97±0.90	80±2.00	76±1.50	84±2.00
C.scalpelliformis	86±2.16	98±0.88	95±0.72	86±2.16	81±1.75	84±2.00
C.spectabile	78±1.77	79±1.9	83±1.90	76±1.50	75±1.25	84±2.00
CLF	91±1.50	95±0.72	89±2.32	92±1.62	96±0.76	84±2.00

Table 2 : Root length of SLF and CLF treated *Solanum lycopersicum*

Treatments	10%	20%	30%	40%	50%	CONTROL
S. wightii	1.85±0.12	2.45±0.30	3.06±0.37	4.03±0.43	3.56±0.40	3.49±0.36
C.scalpelli formis	1.89±0.17	3.01±0.35	5.03±0.50	5.01±0.48	4.76±0.50	3.49±0.36
C.spectabile	1.86±0.14	2.07±0.20	4.08±0.46	4.23±0.4	4.31±0.36	3.49±0.36
CLF	1.87±0.16	2.09±0.24	4.86±0.9	4.96±0.52	3.85±0.31	3.49±0.36

Table 3 : Shoot length of SLF and CLF treated plants

Treatments	10%	20%	30%	40%	50%	control
S. wightii	10.75±0.15	11.65±0.20	12.50±0.27	14.12±0.49	13.02±0.30	11.85±0.36
C.scalpelli formis	10.90±0.17	12.40±0.26	14.50±0.58	14.30±0.51	12.10±0.21	11.85±0.36
C.spectabile	10.32±0.13	11.90±0.23	13.32±0.41	13.90±0.47	11.29±0.14	11.85±0.36
CLF	10.07±0.10	11.34±0.19	12.79±0.29	12.90±0.32	12.32±0.23	11.85±0.36

Table 4 : Chlorophyll content of SLF and CLF treated *Solanum lycopersicum*

Treatments	10%	20%	30%	40%	50%	control
S. wightii	4.302±0.25	5.072±0.32	6.095±0.40	6.777±0.43	5.225±0.32	3.191±0.10
C.scalpelli formis	5.374±0.35	6.289±0.39	7.228±0.45	7.637±0.47	6.924±0.44	3.191±0.10
C. spectabile	4.204±0.20	3.310±0.15	4.227±0.21	5.119±0.34	5.231±0.35	3.191±0.10
CLF	3.934±0.18	5.232±0.35	5.956±0.37	6.236±0.37	4.617±0.26	3.191±0.10

Volume : 2 | Issue : 10 | October 2013 • ISSN No 2277 - 8179

Table 5 : Carotenoid content of SLF and CLF treated *Solanum lycopersicum*

Treatments	10%	20%	30%	40%	50%	control
S. wightii	1.465±0.20	1.370±0.16	1.640±0.25	1.050±0.18	1.436±0.21	1.365±0.14
C.scalpelliformis	1.523±0.17	1.504±0.19	1.464±0.17	1.520±0.32	1.166±0.21	1.365±0.14
C. spectabile	1.446±0.16	1.522±0.14	1.446±0.21	1.413±0.19	1.466±0.18	1.365±0.14
CLF	1.083±0.19	1.385±0.14	1.184±0.18	1.401±0.17	0.865±0.15	1.365±0.14

Table 6 : Protein content of SLF and CLF treated *Solanum lycopersicum*

Treatments	10%	20%	30%	40%	50%	control
S. wightii	0.25±0.02	0.27±0.04	0.32±0.05	0.21±0.01	0.23±0.05	0.25±0.02
C.scalpelliformis	0.29±0.03	0.28±0.03	0.31±0.07	0.54±0.1	0.32±0.03	0.25±0.02
C.spectabile	0.22±0.01	0.27±0.05	0.26±0.04	0.25±0.04	0.28±0.04	0.25±0.02
CLF	0.32±0.04	0.31±0.04	0.36±0.03	0.28±0.03	0.35±0.02	0.25±0.02

Figure 1: Germination percentage of Solanum lycopersicum

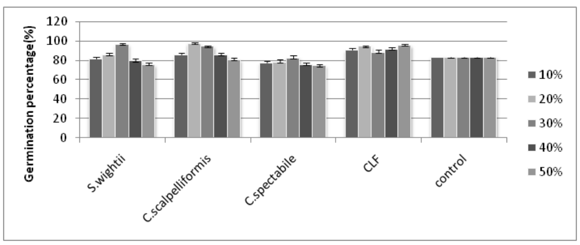


Figure 2: Root length of Solanum lycopersicum

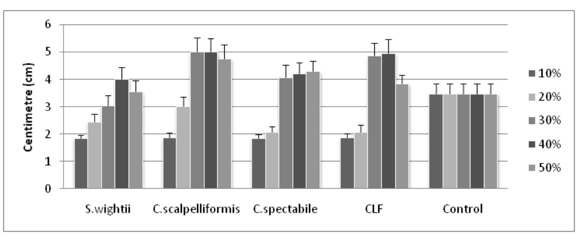


Figure 3: Shoot length of SLF and CLF treated plants

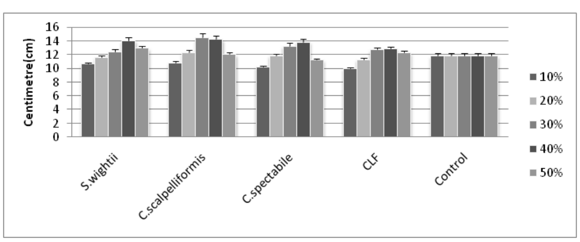


Figure 4 : Chlorophyll content of SLF and CLF treated Solanum lycopersicum

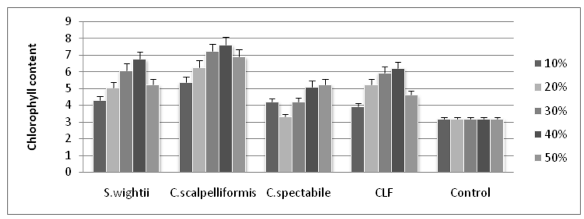


Figure 5 : Carotenoid content of SLF and CLF treated Solanum lycopersicum

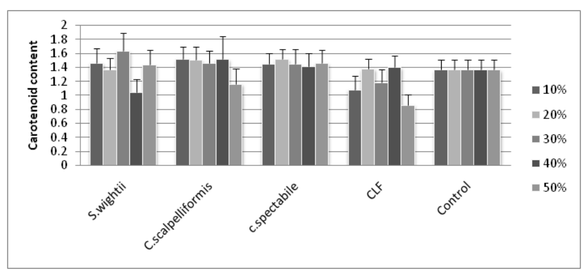
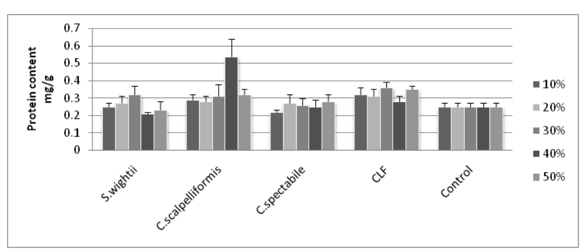


Figure 6 : Protein content of SLF and CLF treated Solanum lycopersicum



REFERENCE

Anantharaj, M. and Venkatesalu, V. (2001). Effect of seaweed liquid fertilizer on Vigna catajung.Seaweed Research Utilization, 23(1&2): 33-39. | Arnon D.I. (1949). Copper enzymes in isolated chloroplasts, polyphenol oxidase in Beta vulgaris. Plant Physiology, 2: 1-15. | Ashok, V., Vijay-anand, N and Rathinavel, S. (2004). Bio-fertilizing efficiency of seaweed liquid extract of Hydroclathrus clathratus on Sorghum vulgare. Seaweed Research Utilization, 26: 181-186. | Bhosle, N.B., Untawale, A.G and Dhargalkar V.K. (1975). Effect of seaweed extract on growth of Phaseolus vulgaris. Indian Journal of Marine Science, 4: 208-210. | Blunden, G., Jenkins, T and Liu, Y.W. (1996). Enhanced chlorophyll levels in plant treated with seaweed extracts. Journal of Applied Phycology, 8: 535-543. | Challen, S.B and Hemingway, J.C. (1965). Growth of higher plants in response to feeding with seaweed extracts.proc.5th Ind.seaweed symp. | Dhargalkar, V.K and Untawale A.G. (1983). Some observations of the effect of SLF on higher plants. Indian Journal of Marine Science, 12: 210-214. | Gandhiyappan, K and Perumal, P. (2001). Growth promoting effect of seaweed liquid fertilizer Enteromorpha intestinalis on the sesame crop plant. Seaweed Resource Utilization, 23: 23–25. | Hansra, B.S. (1993). Transfer of agricultural technology on irrigated agriculture. Fertilizer News, 38(4): 31-33. | Lowry, O.H., Rosenbrough, N.J., Farr, A.L and Randall R.J. (1951). Protein measurement with the folinphenol reagent. Journal of Biological Chemistry, 193: 265-275. | Mackinney, G. (1941). Absorption of light by chlorophyll solutions. Journal of Biological chemistry, 140: 315-322. | Metting, B., Zimmerman,W.J., Crouch, I.J and van Staden J. (1990). Agronomic uses of seaweed and microalgae. In: Akatsuka I(ed) Introduction to applied phycology. SPB Academic Publishing,The Hague, Netherlands, pp 269–627. | Mohan, V.R.,Venkataraman kumar, V., Murugaseswari, R and Muthuswami S. (1994). Effect of crude and commercial seaweed extracts on seed germination and seedling growth in Cajanus cajan L. Phykos, 33(1&2): 47-51. | Nelson, N. (1944). A photometric adaptation of somogyis method for the determination of reducing sugar. Analytical Chemistry, 31: 426-428. | Pereira, N and Verlecar, X.N. (2005). Role of marine algae in organic farming. Current Science, 89: 593-594. | Rao, R.S.N. (1976). Seed viability studies under different storage conditions. Patnagar, Journal of Research, 2: 253. | Stirk, W.A., Arthur, G.D., Lourens, A.F., Novak, O., Sternad, M and Van Staden J. (2004). Changes in cytokinin and auxin concentrations in seaweed concentrates when stored at an elevated temperature. Journal of Applied Phycology, 16: 31–39 | Venkataraman Kumar, V and Mohan, V.R. (1997a). Effect of seaweed extract SM3 on the cyanobacterium, Scytonema species. Seaweed Research Utilization, 19(1&2): 13-15. | Whapham, C.A., Blunder, G., Jenkins, T.,Wankins, S.D. (1993). Significance of betaines in the increased chlorophyll content of plants treated with seaweed extract. Journal of Applied Phycology, 5: 231-234. | Wu, Y.T and Lin, C.H. (2000). Analysis of cytokinin activity in commercial aqueous seaweed extract. Gartenbauwissenschaft 65:170-173.