Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 1861-1864
Received: 14-03-2019
Accepted: 18-04-2019

Iswarya S
M.Sc. Scholar, Department of Agronomy, TNAU, Coimbatore, Tamil Nadu, India

Latha KR
Professor (Agronomy), TNAU, Coimbatore, Tamil Nadu, India

Srinivasan K
Professor (Agronomy), TNAU, Coimbatore, Tamil Nadu, India

Correspondence
Latha KR
Professor (Agronomy), TNAU, Coimbatore, Tamil Nadu, India

Evaluation of seaweed extract on growth determinants, yield and biochemical parameters of greengram (*Vigna radiata*)

Iswarya S, Latha KR and Srinivasan K

Abstract
Seaweed extract or Seaweed Liquid Fertilizer (SLF) is referred as a new generation potential natural organic product that paves the way for crop improvement. A field experiment was conducted during *kharif* 2018 to find the effect of seaweed extract on the growth characters, yield components, yield and quality of greengram. Seed soaking in 0.1 % seaweed extract solution for 30 minutes + foliar application of seaweed extract (0.25%) twice on 25 DAS and 35 DAS recorded significantly the highest values in plant height (56.06 cm), root nodules (10.06), root volume (3.41 g/cc), number of branches at harvest (3.13), dry matter production (3795 kg ha^{-1}), chlorophyll content of the leaves (52.63), grain yield (1248 kg ha^{-1}), grain nitrogen per cent (3.95) and grain protein content (24.67%) followed by seed soaking in 0.1 % seaweed extract solution for 30 minutes + foliar application of seaweed extract (0.25%) on 25 DAS (single spray). The presence of micro and macro nutrients, trace elements, humic acid, amino acids, plant growth hormones, vitamins, antibiotics, carbohydrates, metabolite enhancers and other organic matters in seaweed extract enhanced the growth, yield and quality traits of greengram.

Keywords: greengram, seaweed extract, SPAD values, biochemical parameters

Introduction
Seaweeds are marine macro-algae that are renewable, non-hazardous, biodegradable, non-toxic, flexible, tenacious and prolific bioactive substances (Praminick *et al.*, 2013) [1]. Seaweed extracts (SWE) or liquid seaweed fertilizers are the new generation, eco-friendly liquid bioactive plant stimulants or fertilizers which have recently gained importance as foliar spray used in many crops to improve nutrient absorption and to usher crop productivity. Greengram is the fourth most predominant crop among the pulses which occupies an area of about 4.07 million hectares with an average production and productivity of about 1.90 million tones and of 467 kg per hectare respectively in India. Mung shares 13.86 % of area and 7.76 % of production to total pulse area under cultivation and production in India. Pulses show a declining trend in contribution to total food grain production for about 6-7 % from 1960-2018 due to its low productivity (Success Report, Ministry of Agriculture & Farmers Welfare, 2017-18). Besides all, the productivity of greengram is abysmally low in India. Cultivation in marginal and sub marginal areas with inadequate fertilization, the unfavorable weather conditions, abnormal soil conditions with high pH, non-availability of region-specific production technology, varietal constraints are the major drawbacks in pulse productivity. The suitable input and method of supplying nutrient play a vital role in enhancing crop productivity and quality which ensures both the food and nutritional security (Anil Kumar *et al.*, 2015) [2]. Seaweed extracts has the potential to improve the growth and yield of greengram.

Materials and Methods
A field research was conducted during *kharif* season (July - October) of 2018 at Wetland farm, Tamil Nadu Agricultural University, Coimbatore. Greengram variety CO 8 was sown in the main field after the respective seed treatments at 30×10 cm spacing in beds and channels. The natural liquid seaweed fertilizer (purity-100%, patent no. IN 224938; US 6893479 EP 1534757) comprises the blend of red seaweed (*Kappaphycus alvarezii*) and brown seaweed (*Sargassum sp.*) algal extracts and the liquid biofertilizer NPK consortia (100%) that contains the consortium *of Rhizobium, Azotobacter and Acetobacter*, phosphorous solubilising bacteria (PSB) and potassium mobilizing bacteria (KMB) were used as the material for seed treatment and foliar application. The trail was laid out in RBD with seven treatments and three replications. The treatments comprised of T_1 - Seed treatment (ST) with *Rhizobium*, T_2 - NPK microbial consortia ST @ 10ml / kg of seed, T_3 - T_2 + SWE spray (0.25%) on 25 DAS, T_4 - T_2 + SWE spray (0.25%) on 25 DAS and 35 DAS, T_5 - T_1 + seed soaking in SWE (0.1%) for 30

minutes, T_6 - T_5 + SWE spray (0.25%) on 25 DAS, T_7 - T_5 + SWE spray (0.25%) on 25 DAS and 35 DAS, respectively. All the treatments received equal amount of recommended dose of fertilizer (25:50:25 kg of NPK/ha) as basal application. The total chlorophyll content was estimated by using SPAD chlorophyll meter. Fifteen physiologically active leaves from five randomly selected plants were used for recording chlorophyll content at 45 and 60 DAS. The grain nitrogen per cent was estimated by di-acid digestion of plant sample with micro kjeldhal's method suggested by Humphries (1956). The other growth observations were recorded at 45 DAS, 60 DAS and at harvest stage to infer the effect of seaweed extract.

Results and Discussion

Seaweed extract on growth of greengram

The results on growth characters, *viz.*, plant height, dry matter production, number of root nodules, root volume, number of branches at harvest were recorded at respective intervals are presented in Table 1. The results revealed that increase in plant height up to 49.67 cm on 45 DAS and 56.06 cm at 60 DAS were observed in T_7 followed by T_6. This might be due to the presence of auxin in seaweed extract which played an effective role in cell growth and enlargement (Dilavarnaik *et al.,* 2017) [3] and altered the cell wall plasticity making the shoot tip to move upwards leading to increased plant height (Anonymous) [4]. The dry matter production gradually increased from pod development stage to maturity stage which ranged from 1160 kg ha^{-1} to 2174 kg ha^{-1} at 45 DAS and 2005 kg ha^{-1} to 3896 kg ha^{-1} at 60 DAS. Among the treatments T_7 shown significant improvement over the control. Seaweed Liquid Fertilizers (SLF) are the excellent source of micro and macro nutrients, trace elements, amino acids, plant growth promoting hormones, vitamins, antibiotics, carbohydrates, proteins and other organic matters exhibits plant growth stimulating property under diluted condition (Moshe *et al.,* 2015) [5] which increased the chlorophyll content (John and Mahadevi, 2014) [6] and nutrient uptake in plants (Dwivedi *et al.,* 2015) [7] and altogether lead to better dry matter accumulation (Pramnick *et al.,* 2017) [8]. The data on root nodules ranged from 7.70 to 10.06 among the treatments and the variations did not attain the level of significance. The maximum values in root nodules at 30 DAS were recorded in T_7 followed by T_6 and T_5 which might be due to the increased activity of nitrogenase enzyme in root nodules induced by the seed treatment and foliar application of seaweed extract. The data on observation further revealed that the treatment T_7 recorded higher values in number of branches (3.13) at harvest and root volume (3.41 g/cc) at harvest. Similar significant response to foliar spray of SWE were also observed in soybean (Rathore *et al.,* 2008) [9]. In general the foliar spray of seaweed extract along with RDF showed increased growth and development stimulations significantly improving the growth determinants over the control (Pramnick *et al.,* 2013).

Seaweed extract on yield and biochemical characters of greengram

The yield performance of greengram was positively influenced by the foliar application of seaweed extract and treatment T_7 recorded the highest yield of 1242 kg ha^{-1} followed by T_6 with 1145 kg ha^{-1} (Table 2). The percentage of yield increase was 26.2% and 15.8% for the treatments T_7 and T_6, respectively over control. Seaweed liquid fertilizers are the source of versatile plant nutrients and hormones positively which influenced the growth and physiological parameters and increased the yield of the crops (Pramnick, 2013). Zodape *et al.* (2010) [10] observed the same trend of results with foliar application of *Kappaphycus spp* extract that had significantly increased the yield by 30.11%, 26.30 %, 16.78 % over the control, respectively in greengram.

The results obtained on biochemical constituents are presented in Table 2. Significant differences were observed in chlorophyll content on leaves and T_7 recorded the highest values at 45 DAS (58.47) and 60 DAS (52.63). There was an incremental increase in chlorophyll content of leaves at flowering stage and declined thereafter. The presence of beneficial amounts of cytokinins, auxins and betaines and inorganic salts in seaweed extracts increased the number and size of chloroplasts, development of grana of chloroplasts and enhanced the chlorophyll concentration in leaves (Laura *et al*., 2017) [11]. The increase in green pigment concentration was observed in blackgram by Venkatraman and Mohan (1997) [12] and also in greengram (Shri Devi and John, 2014) [13] due to seaweed extract application. At maturity stage the decrease in chlorophyll content may be due to addition of fibrous material in plant tissue and breakdown of chlorophyll or chlorophyll degradation due to senescence inducing enzymes (Bokari, 1983) [14]. Foliar application of seaweed extracts at varying days after sowing improved the grain nitrogen per cent and protein content considerably over the control, however in both the case, significantly higher values were recorded in T_7 followed by T_6, T_4, T_3 and the lowest value was recorded in control (T_1). The increase in grain nitrogen per cent directly increased the grain protein per cent, as both are interrelated parameters. The results are in confirmation with the previous findings of Raverkar *et al.* (2015) [15] who noted that foliar spray of seaweed extracts along with RDF increased the grain nitrogen uptake and higher protein content. This might be due to increased availability and absorption of necessary inorganic elements such as Ca, Na, K, Mg, N and Zn present in the seaweed extracts.

Table 1: Effect of seaweed extract of red algae and brown algae on growth parameters of greengram

Treatments	Plant height (cm)		Dry matter production (kg ha $^{-1}$)		Root nodules at 30 DAS (Nos.)	Root volume at harvest (g/cc)	No. of branches at harvest
	45 DAS	60 DAS	45 DAS	At harvest			
T 1	35.69	39.00	1160	2005	7.70	1.13	1.33
T 2	38.82	41.46	1242	2150	9.02	1.45	1.53
T 3	40.95	43.32	1580	2785	9.38	1.93	2.20
T 4	42.37	46.83	1710	3030	9.45	2.33	2.47
T 5	39.41	42.07	1540	2685	9.62	1.34	1.80
T 6	45.16	51.66	1990	3545	9.83	2.90	2.60
T 7	49.67	56.06	2174	3896	10.06	3.41	3.13
SEd value	1.179	1.874	82.7	156	0.639	0.131	0.239
CD (P=0.05)	3.746	4.083	180	339	NS	0.287	0.521

Table 2: Effect of seaweed extract of red algae and brown algae on yield and biochemical constituents of greengram

Treatments	SPAD value of total chlorophyll content of leaves		Grain nitrogen per cent	Grain protein per cent	Grain yield (kg ha $^{-1}$)	Per cent yield increase over the control
	45 DAS	60 DAS				
T 1	39.29	29.18	3.40	21.25	989	-
T 2	40.88	31.61	3.42	21.38	1018	2.9
T 3	43.69	37.29	3.46	21.63	1078	9.0
T 4	48.03	43.51	3.52	22.00	1118	13.0
T 5	40.85	32.62	3.43	21.44	1037	4.9
T 6	53.69	48.17	3.58	22.35	1145	15.8
T 7	58.47	52.63	3.95	24.67	1248	26.2
SE.d value	1.955	1.998	0.136	0.974	45.46	-
CD (P=0.05)	4.261	4.354	0.339	2.122	99.05	-

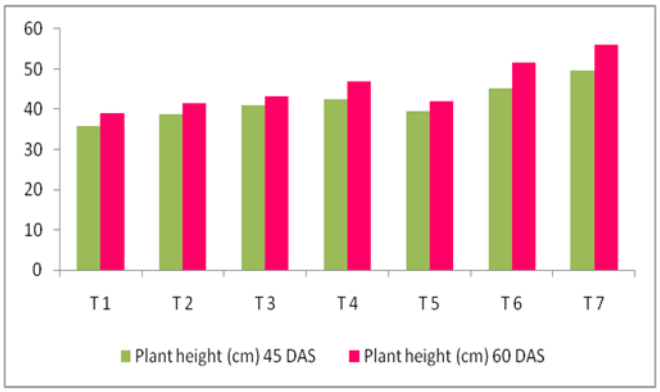

Fig 1: Effect of SWE on plant height of greengram

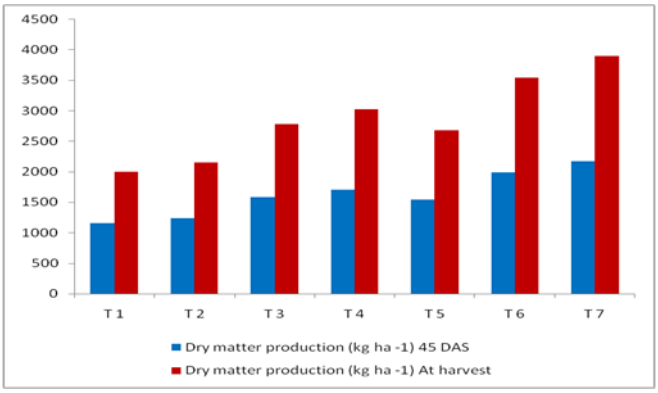

Fig 2: Effect of SWE on dry matter production of greengram

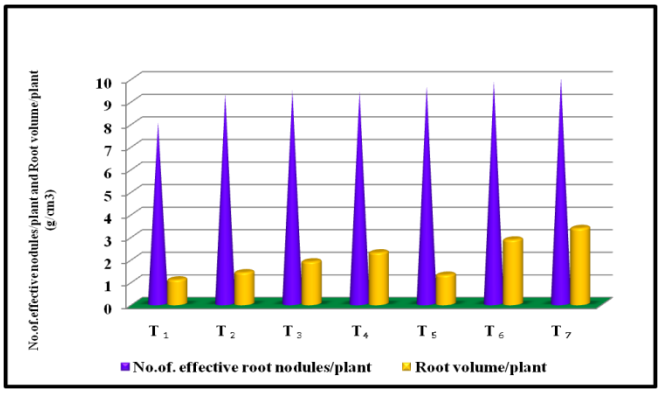

Fig 3: Effect of SWE on effective root nodules volume of greengram

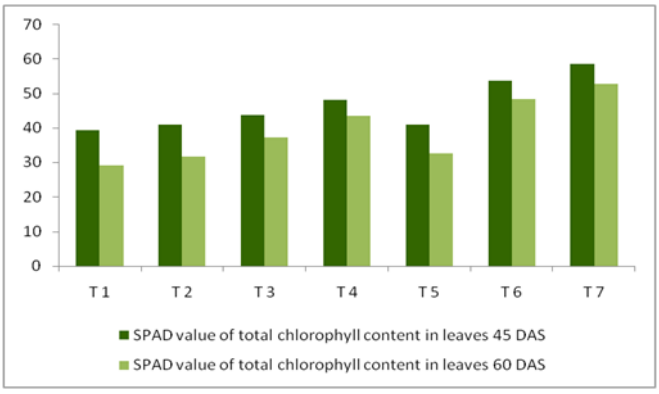

Fig 4: Effect of SWE on cholorophyll content of greeengram

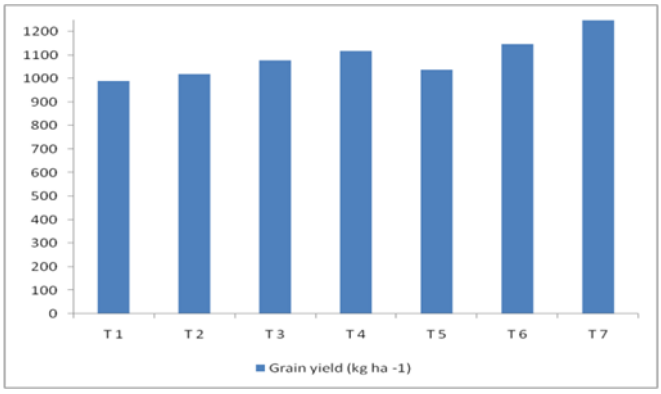

Fig 5: Effect of SWE on grain yield of greengram

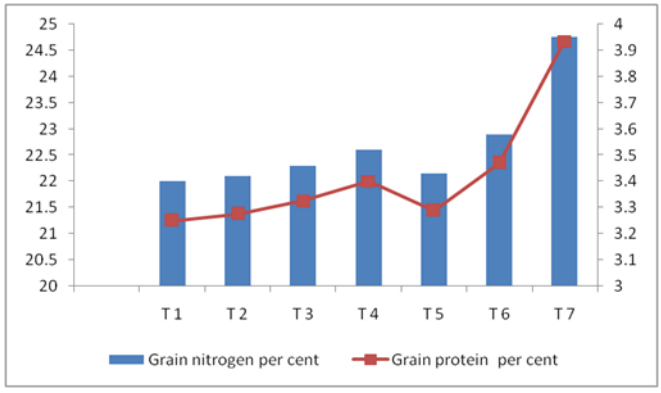

Fig 6: Effect of SWE on grain nitrogen and grain protein per cent of greengram

Conclusion

In this present investigation, it could be concluded that seaweed liquid extract play a prominent role in increasing the growth determinants, yield and biochemical parameters of greengram. The plants which received foliar application of 0.25% seaweed extract combined with seed soaking for 30 minutes in 0.1 % seaweed extract along with recommended dose of fertilizer were found be significantly superior over other treatments. This implies that usage of seaweed extract at lower concentration stimulated the morphological and

biochemical characters of greengram eventually has a great scope and potential in improving the production status and quality traits of greengram.

Acknowledgments
I would like to thank the Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 641003, members of my advisory committee for their valuable suggestions during my research work and IFFCO for providing the samples for testing.

References

1. Pramanick B, Koushik B, Arup G. Effect of seaweed saps on growth and yield improvement of green gram. African Journal of Agricultural Research. 2013; 8(13):1180-1186.
2. Anil KS, Ved P, Santosh K, Dwivedi SK. Pulses production in India: present status, bottleneck and way forward. Journal of Agrisearch. 2015; (2):75-83.
3. Dilavarnaik S, Basavaraja PK, Yogendra ND, Arup G. Influence of seaweed saps on germination, growth and yield of hybrid maize under Cauvery command of Karnataka, India. International Journal of Current Microbiology and Applied Sciences. 2017; 6(9):1047-1056.
4. Anonymous. Michael Place. Auxin: the functions, effects, and applications of a plant growth hormone. http://ndusu.edu.htm.
5. Moshe H, Asher B, Maya O, Dror M, Torsten M, Uri Y. The use of bio-stimulants for enhancing nutrient uptake. Advances in Agronomy. 2015; 130:143-167.
6. John JPP, Mahadevi B. Effect of seaweed liquid fertilizer of *Caulerpa peltata* lamour (Green seaweed) on *Vigna radiata* (l.) r. wilczek, in Idinthakarai, Tamil Nadu, India. World Journal of Pharmacy and Pharmaceutical Sciences. 2014; 3(6):1000-1007.
7. Dwivedi SK, Ashok PK. Impact of natural organic fertilizer (seaweed saps) on productivity, nutrient uptake and economics of greengram (*Phaseolus radiata* L.). International Journal of Environmental Sciences. 2015; VII:461-466.
8. Pramanick B, Brahmachari K, Mahapatra BK, Arup G, Ghosh D, Sudeshna K. Growth, yield and quality improvement of potato tubers through the application of seaweed sap derived from the marine alga *Kappaphycus alvarezii.* Journal of Applied Phycology. 2017; 29:3253-3260.
9. Rathore SS, Chaudhary DR, Boricha GN, Ghosh A, Bhatt BP, Zodape ST *et al.* Effect of seaweed extract on the growth, yield and nutrient uptake of soybean *(Glycine max)* under rainfed conditions. South African Journal of Botany. 2009; 75:351-355.
10. Zodape ST, Mukhopadhya S, Eswaran K, Reddy MP, Chikara J. Enhanced yield and nutritional quality in green gram (*Phaseolus radiata* L) treated with seaweed (*Kappaphycus alvarezii*) extract. Journal of Scientific and Industrial Research. 2010; 69:468-471.
11. Laura G, Fernando S, Gustavo H, Ernesto R, Rosalba M. Effect of seaweed liquid extracts from *Ulva lactuca* on seedling growth of mung bean (*Vigna radiata*). Journal of Applied Phycology. 2017; 29:2479-2488.
12. Venkataraman K, Mohan VR. The effect of seaweed liquid fertilizer on black gram. Phykos. 1997; 36(1-2):43-47.
13. Shri Devi SDK, John PP. Influence of seaweed liquid fertilizer of *Gracilaria dura* (ag.) J ag. (red seaweed) on *Vigna radiata* (l.) R. Wilczek., in Thoothukudi, Tamil Nadu, India. World Journal of Pharmaceutical Research. 2014; 3(4):968-978.
14. Bokari UG. Chlorophyll, dry matter, and photosynthetic conversion-efficiency relationships in warm-season grasses. Journal of Range Management. 1983; 36(4):431-434.
15. Raverkar KP, Navneet P, Ramesh C, Swati C, Zodape ST, Ghosh A. Impact of foliar application of seaweed saps on yield, nodulation and nutritional quality in green gram (*Vigna radiata* L). Legume Research. 2016; 39(2):315-318.