International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(3): 799-802

Received: 12-03-2020
Accepted: 13-04-2020

Amalesh Ghosh
[a] Palli Siksha Bhavana, Visva-Bharati, Sriniketan, Birbhum, West Bengal, India
[b] Assistant Director of Agriculture, Department of Agriculture, Govt. of West Bengal, , India

Tanmoy Shankar
Assistant Professor, Department of Agronomy, M.S. Swaminathan School of Agriculture, Centurion University Technology and Management, Paralakhemundi, Odisha, India

GC Malik
Palli Siksha Bhavana, Visva-Bharati, Sriniketan, Birbhum, West Bengal, India

Mahua Banerjee
Palli Siksha Bhavana, Visva-Bharati, Sriniketan, Birbhum, West Bengal, India

A Ghosh
Central Salt and Marine Chemicals Research Institute, Bhavnagar, Gujarat, India

Corresponding Author:
Amalesh Ghosh
[a] Palli Siksha Bhavana, Visva-Bharati, Sriniketan, Birbhum, West Bengal, India
[b] Assistant Director of Agriculture, Department of Agriculture, Govt. of West Bengal, India

Effect of seaweed extracts on the growth, yield and nutrient uptake of black gram (*Vigna mungo* L.) in the red and lateritic belt of West Bengal

Amalesh Ghosh, Tanmoy Shankar, GC Malik, Mahua Banerjee and A Ghosh

DOI: https://doi.org/10.22271/chemi.2020.v8.i3j.9300

Abstract
A field experiment was conducted at the Agricultural farm of Visva-Bharati University, Birbhum, West Bengal during *Pre-kharif* (Summar) season of 2012, to study the effect of foliar spray of seaweed extracts (prepared from *Kappaphycus alvarezii* & *Gracilaria crassa*) on the growth and productivity of black gram. The foliar spray was applied thrice at different concentrations (0, 5.0, 7.5, 10.0 and 15.0% v/v) of seaweed extracts. Foliar applications of seaweed extracts significantly enhanced the growth and yield attributes. The highest grain yield was recorded with applications of 15% *Kappaphykus* + recommended dose of fertilizer which at par wth 15% *Gracilaria* extracts + RDF resulting in an enhanced by 51 and 44% grain yield, respectively compared to the water applied plots. The highest straw yield was also achieved with the application of 15% seaweed extracts. The nutrient uptake (N, P and K) which influenced due to the application was also with seaweed extract.

Keywords: Seaweed extracts, *Kappaphycus (K)*, *Gracilaria (G)*, recommended dose of fertilizer, black gram

Introduction
Seaweeds are one of the important marine living resources which are renewable. Several species of green, brown and red algae are used as manure in coastal areas throughout the world. They are rich in potassium but poor in nitrogen and phosphorus. Seaweed concentrates are beneficial effects on plants as they contain growth promoting hormones (IAA, IBA and Cytokinins) and different trace elements, vitamins and amino acids (Khan *et al.* 2009) [4]. A wide range of beneficial effects have been reported from the use of liquid seaweed extracts, including increased crop yields, increased uptake of inorganic constituents from the soil, more resistance to stress conditions. Seaweed species were reported to be potential sources of fertilizer. Integrated use of sea weed liquid fertilizer in combination with the chemical fertilizer and their proper management for better growth and yield is very essential. Keeping, these facts in perspective, the present investigation were taken up. Sea weeds are marine algae, saltwater dwelling, and simple organisms that fall into the rather. A positive effect of several species of algae on the growth, development and, consequently yields of field crops have been proved so far. Seaweed liquid extract could serve as an alternative bio-fertilizer as is eco-friendly, and substantial economic with environmental benefits. So the main objective of this study is to evaluate the application of different concentrations of seaweed extracts in enhancing the growth, yield and nutrient uptake of black gram (*Vigna mungo* L.) grown in fields, in the red lateritic belt.

Materials and methods
A field experiment was conducted during *pre-kharif* season of 2012 at the agricultural farm, Palli Siksha Bhavana, Visva-Bharati, Sriniketan, Birbhum, West Bengal. The farm is situated at $23^0$39' N latitude and $87^0$42' E longitude with an average altitude of 58.90 m above mean sea level (MSL) under sub-humid, semi arid region of West Bengal. The soil of the experimental site was sandy loam in texture with pH 5.76, organic carbon 0.39%, available nitrogen 146.20 kg/ha, available phosphorus 31.1 kg/ha and available potassium 139.1 kg/ha.

The experiment comprised of 13 treatments and the treatments were distributed in randomized block design with three replications. The details of the treatments are T_1- 100 % RDF + Water, T_2- 5 % K + 100 % RDF, T_3- 7.5 % K + 100 % RDF, T_4-10 % K + 100 % RDF, T_5-15 % K + 100 % RDF, T_6- 5 % G+ 100 % RDF, T_7- 7.5 % G + 100 % RDF, T_8 - 10 % G + 100 % RDF, T_9-15 % G + 100 % RDF, T_{10} - 7.5 % K + 75 % RDF, T_{11} -7.5 % G + 75 % RDF, T_{12} -7.5 % K + 50 % RDF and T_{13} -7.5 % G+ 50 % RDF (K = Kappaphycus, G = Gracilaria and RDF = Recommended Dose of Fertilizer). Three sprays of Kappaphycus and *Gracilaria* extract were applied one at the seedling stage [20 days after sowing (DAS)] second at the pre-flowering stage (40 DAS) and third at the pod development stage (60 DAS). The recommended dose of fertilizer (RDF) for black gram @ 20:40:40 kg ha^{-1} N, P_2O_5 and K_2O, were applied as basal. Data of plant samples were taken through random sampling at 40 DAS and60 DAS to measure plant height, dry matter accumulation, crop growth rate (CGR) and leaf area index (LAI). Data on yield attributes were taken randomly before harvesting. At maturity, black gram seeds and stick samples were collected from each plot, oven dried at 70°C to constant weight and ground to pass through a 0.5 mm sieve for chemical analysis. Data were analyzed using analysis of variance (ANOVA) following randomized block design (Gomez and Gomez, 1984). Differences were considered significant at 5% level of probability.

Result and discussion

Growth attribute

Foliar application of different sea weed liquid fertilizer along with 100% RDF increased growth attributes of black gram significantly over water applied plot (Table 1). In general, a gradual increase in plant growth attributes was observed with increasing seaweed extract application. The result of the experiment indicated that plant height and dry matter accumulation of Black gram at 20 DAS had no significant effect while 40 DAS and 60 DAS were significantly influenced by the different levels. Because first spraying should be done at 20 DAS. The increasing trend in plant height, dry matter accumulation, crop growth rate (CGR) and leaf area index (LAI) was noticed with the advancement levels of growth of the crop up to 60 DAS. Maximum plant height and dry matter accumulation was recorded with 15% *Kappaphycus* extract + 100% RDF (T_5) and was statistically at par with 15% *Gracilaria* extract + 100% RDF (T_9) treated plot regarding all the observations taken at different DAS. In case of CGR during 20-40 DAS and 40-60 DAS, the best result was recorded with the treatment T_5 (15% *Kappaphycus* + 100% RDF) which was closely followed by T_9 (15% *Gracilaria* extract + 100% RDF). Highest value of LAI was recorded with T_5 (15% *Kappaphycus* extract + 100% RDF) for all the observations. Higher growth attributes of black gram occurred probably due to, presence of growth promoting hormones (IAA and IBA, Cytokinins) trace elements (Fe, Cu, Zn, Co, Mo, Mn, and Ni), vitamins and amino acids (Ferreira and Lourens, 2002) [2]. Similar results were reported on soybean (Rathore *et al*., 2009) [9], cowpea (Lakshmi and Sundaramoorthy, 2010) [5], green gram (Pramanick *et al*, 2012) [8] and sesame (Shankar *et al*., 2015) [10].

Table 1: Effect of treatments on plant height (cm), dry matter accumulation (g m^{-2}), CGR (g m^{-2} day^{-1}) and LAI of black gram.

Treatment	Plant height (c.m)			Dry matter accumulation (g m^{-2})			Crow growth rate CGR (g m^{-2} day^{-1})		Leaf area index (LAI)		
	20DAS	40DAS	60DAS	20DAS	40DAS	60DAS	20-40DAS	40-60DAS	20DAS	40DAS	60DAS
T_1	14.3	36.5	44.8	21.1	143.5	316.4	6.12	8.65	0.89	2.85	3.22
T_2	14.4	38.9	46.2	21.1	150.3	331.3	6.46	9.05	0.86	3.07	3.38
T_3	14.3	40.6	46.9	20.9	156.3	340.5	6.77	9.21	0.88	3.14	3.52
T_4	14.2	44.3	49.1	21.2	173.6	361.7	7.62	9.40	0.84	3.60	3.76
T_5	14.2	46.0	52.9	21.1	191.8	391.7	8.53	9.99	0.86	3.86	4.04
T_6	14.6	38.3	45.5	21.2	146.3	321.9	6.26	8.78	0.79	3.05	3.34
T_7	14.4	40.3	47.2	20.9	154.2	334.7	6.67	8.86	0.82	3.12	3.47
T_8	14.3	43.1	49.1	20.8	172.2	355.1	7.57	9.15	0.91	3.58	3.60
T_9	14.4	45.2	50.8	21.1	185.7	379.1	8.23	9.67	0.81	3.74	3.92
T_{10}	14.1	39.1	46.7	20.5	155.6	337.7	6.66	9.21	0.76	3.12	3.43
T_{11}	14.1	38.7	46.4	20.4	152.2	334.3	6.59	9.11	0.71	3.04	3.38
T_{12}	13.5	38.0	45.5	20.2	145.4	327.2	6.26	9.09	0.67	3.01	3.29
T_{13}	13.63	37.87	45.13	20.27	144.49	322.18	6.21	8.88	0.64	2.93	3.25
SE.m (±)	0.44	1.82	1.63	0.53	6.57	14.28	0.28	0.23	0.03	0.13	0.16
CD at 5%	N.S	5.3	4.76	N.S	19.18	41.7	0.83	0.67	0.1	0.38	0.47

DAS= Days After Sowing, CGR=Crop Growth Rate, LAI=Leaf Area Index.

Yield attributes and Yields

The use of seaweed extract increased all the yield attributes measured for black gram (Table 2). The maximum numbers of branches per plant, pods per plant, seeds/pod and test weight were observed under the treatment T_5 (foliar application of 15% *Kappaphycus* extract along with 100% RDF) which was closely followed by 15% *Gracilaria* extract + 100% RDF (T_9), T_4 (10% *Kappaphycus* extract +100% RDF), T_8 (10% *Gracilaria* extract + 100% RDF). The maximum increase in seed yield over water to the extent of 51% and this treatment was followed by the treatments T_9 (15%*Gracilaria* extract + 100% RDF), T_4 (10% *Kappaphycus* extract +100% RDF), T_8 (10% *Gracilaria* extract + 100% RDF), T_3 (7.5% *Kappaphycus* extract + 100% RDF) and T_7 (7.5%*Gracilaria* extract + 100%RDF) recording 44.03, 39.79, 32.84, 28.87 and 25.03 % yield increase, respectively over water applied plots. Strover yield was observed highest at T_5 (15% *Kappaphycus* + 100% RDF) which was Statistically at par with T_4 (10% *Kappaphycus* extract +100% RDF) and T_9 (15%*Gracilaria* extract + 100% RDF) But in case of harvest index the highest value was found in treatment T_9 where 15% *Gracilaria*+ 100% recommended dose of fertilizer was applied, and which was statistically at par with T_5 (15% *Kappaphycus* + 100% RDF), T_8 (10% *Gracilaria* + 100% RDF), T_3 (7.5% *Kappaphycus* + 100% RDF). Presence of Cytokinin and Gibberelin in seaweed extracts increased yield attributes and yield probably due to their effect on reduced flower and pod drop, delayed fruit senescence, increased size of flower and fruit. And also improves ability due trace elements (Fe, Cu, Zn, Co, Mo, Mn, and Ni), vitamins and

amino acids. Similar kind of results were reported on (Bai *et al*., 2008; Pramanick *et al*., 2012 and Shankar *et al*., 2015) [1, 8, 10] are reported with the foliar application of seaweed extract.

Table 2: Effect of treatments on yield components, seed and stover yield of green gram.

Treatment	No of branches plant^{-1}	No of pods plant^{-1}	No of seed pod^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
T_1	6.01	21.40	5.65	32.93	1148	3478	22.39
T_2	6.86	26.64	6.31	34.43	1297	3642	25.03
T_3	7.17	33.92	6.66	36.67	1481	4092	26.60
T_4	7.84	37.61	6.81	36.87	1607	4717	25.75
T_5	8.17	52.34	7.15	36.97	1733	5016	27.68
T_6	6.85	25.68	6.18	34.47	1263	3642	26.03
T_7	7.02	31.60	6.51	36.54	1435	3919	26.19
T_8	7.34	33.74	6.71	36.74	1525	4297	27.29
T_9	8.01	47.10	6.96	36.92	1653	4464	27.94
T_{10}	7.01	30.97	6.40	35.24	1401	3990	26.00
T_{11}	7.00	28.71	6.33	35.11	1343	3863	23.97
T_{12}	6.83	24.14	5.91	33.97	1251	3618	24.14
T_{13}	6.34	23.45	5.70	33.50	1228	3564	23.30
SE.m (±)	0.29	1.20	0.24	0.89	59.91	494.78	0.91
CD at 5%	0.85	3.51	0.71	2.60	174.89	7.30	2.65

Nutrients content and uptake

The use of the seaweed extracts significantly increased N, P and K uptake by grains at higher concentrations (10% and above) and reached maximum at 15% seaweed extract compared with control (Table 3). The highest N and K uptake by grain was recorded with the treatment T_5 (15% *Kappaphycus* extract + RDF) which was statistically at par with 15% *Gracilaria* extract + RDF (T_9), 10% *Kappaphycus* extract + RDF (T_4) and 10% *Gracilaria* extract + RDF (T_9). 15% *Kappaphycus* extract + RDF showed the maximum uptake of P by grain. In case of nutrient uptake by stover, 15% *Kappaphycus* extract + RDF was observed to be the best and it was closely followed by 15% *Gracilaria* extract + RDF and 10% *Kappaphycus* extract + RDF. Our results confirm those findings previously reported by Pramanick *et al*. (2012) [8] in green gram noted an increased uptake of magnesium (mg), K and calcium (Ca) in lettuce with seaweed concentrate application. Mancuso *et al*. (2006) [6] and Zodape *et al*. (2009) [11] also observed.

Table 3: Effect of treatments on nutrient uptake by seed and stover of black gram.

Treatment	Nutrient uptake by seed (kg ha^{-1})			Nutrient uptake by stover (kg ha^{-1})		
	N	P	K	N	P	K
T_1	44.0	1.5	8.4	44.9	3.5	31.7
T_2	53.0	2.1	10.6	52.8	4.7	39.0
T_3	61.4	2.7	12.4	60.2	6.6	44.6
T_4	67.0	3.1	14.3	70.3	8.0	52.4
T_5	72.9	4.0	16.1	79.3	10.0	59.7
T_6	51.2	2.0	10.0	49.2	5.1	38.2
T_7	58.9	2.4	11.6	54.5	5.9	41.6
T_8	63.3	3.2	13.3	62.7	7.3	48.6
T_9	69.1	3.3	15.0	68.7	8.0	51.3
T_{10}	54.4	2.7	11.1	57.1	6.0	41.9
T_{11}	52.3	2.3	10.5	54.5	5.4	39.4
T_{12}	48.5	2.0	9.4	49.6	4.7	35.5
T_{13}	47.4	1.8	9.3	47.0	4.6	33.8
SE.m (±)	2.31	0.11	0.46	2.85	0.28	1.82
CD at 5%	6.75	0.31	1.35	8.32	0.83	5.31

Conclusion

Thus, it can be concluded that the seaweed extracts are effective in increasing the growth attributes, yield attributes and yield of black gram. The extracts also enhance nutrient content and uptake by this grain crop. Presence of micro-elements and plant growth regulators, especially cytokinins in *Kappaphycus* and *Gracilaria* extracts is responsible for the increased growth, yield and quality of black gram receiving by the foliar application of the dfferent extracts.

References

1. Bai NR, Banu NRL, Prakash JW, Goldi SJ. Effect of seaweed extracts (SLF) on the growth and yield of *Phaseolus aureus* L. Journal of Indian Hydrobiology. 2008; 11:113-119.
2. Ferreira MI, Lourens AF. The efficacy of liquid seaweed extract on the yield of Canola plants. South African Journal of Plant and Soil. 2002; 19:159-161.
3. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. John Wiley and Sons, New York, 1984.
4. Khan W, Rayirath UP, Subramanian S, Jithesh MN, Rayorath P, Hodges DM *et al*. Seaweed extracts as biostimulants of plant growth and development. Journal of Plant Growth Regulator. 2009; 28:386-399.

5. Lakshmi S, Sundaramoorthy P. Response of *vigna unguiculata* on liquid seaweed fertilizer. International Journal of Current Research. 2010; (2):039-042.
6. Mancuso S, Azzarello E, Mugnai S, Briand X. Marine bioactive substances (IPA extract) improve foliar ion uptake and water tolerance in potted *Vitis vinifera* plants. Journal of Advanced Horticulture. Science. 2006; 20:156-161.
7. Nelson WR, Van SJ. The effect of seaweed concentrate on the growth of nutrient-stressed, greenhouse cucumbers. Journal of Horticulture Science. 1984; 19:81-82.
8. Pramanick B, Brahmachari K, Ghosh A. Effect of seaweed saps on growth and yield improvement of green gram. African Journal of Agricultural Research. 2012; 8(13):1180-1186.
9. Rathore SS, Chaudhary DR, Boricha GN, Ghosh A. 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. Shankar T, Malik GC, Banerjee M, Ghosh A. Effect of Sea Weed Extracts on the Growth, Yield Attribute and Nutrient Uptake of Sesame (*Sesamum indicum* L.). International Journal of Bio-resource and Stress Management. 2015; 6(3):420-423.
11. Zodape ST, Mukherjee S, Reddy MP, Chaudhary DR. Effect of *Kappaphycus alvarezii* (Doty) Doty ex silva. extract on grain quality, yield and some yield components of wheat (*Triticum aestivum* L.). International Journal of Plant Production. 2009; 3:97-101.