ISSN: 2347-4688, Vol. 12, No.(2) 2024, pg. 858-864

Current Agriculture Research Journal

www.agriculturejournal.org

Influence of Seaweed Extracts on Growth and Seed Yield in Green Gram (*Vigna radiata* L.) Cv. Vbn 2

G. GOWRISANKER, S. PADMAVATHI, S. ARUNKUMAR* and A. PRAVEEN RAJASIMHAN

Department of Genetics and Plant Breeding, Annamalai University, Tamil Nadu, India.

Abstract

With the aim to assess the effectiveness of seaweed extracts, specifically *Kappaphycus alvarezii* and *Gracilaria*, on seed yield in green gram (*Vigna radiata* L.) cv. VBN 2. The Department of Genetics and Plant Breeding at Annamalai University's Experimental Farm served as the site for the field trial. The results revealed that seeds soaked with *Kappaphycus alvarezii* (2.5%) exhibited higher value for the growth attributes, physiological traits, pod characters and seed yield attributes of green gram VBN 2. It also recorded days to first flowering in earlier days. The results of the present investigation suggest that in order to enhance growth and yield characteristics under difficult environmental conditions, green gram seeds should be treated with 2.5% *Kappaphycus alvarezii* seaweed extract for 12 hours.

Article History
Received: 03 March 2024
Accepted: 28 June 2024

Keywords
Gracilaria;
Green Gram;
Growth;
Kappaphycus alvarezii;
Seaweed;
Yield Parameters.

Introduction

Green gram, a significant pulse crop in India, offers high-quality protein. It belongs to the family "Leguminosae". Green gram is a short-duration crop that is typically grown as a rain-fed, rice-fallow crop that is also irrigated. A significant concern is ensuring food security, which can only be achieved by raising agricultural output. Higher yields can only be achieved by utilizing macro and micronutrients, which play a crucial role in crop nutrition.[1] The primary factor limiting the crop growth and productivity is the deficiency of essential nutrients. With its preference for technology and accuracy, modern agriculture expects every seed to emerge quickly and develop into healthy seedlings, assuring a high yield. For mechanized cultural activities, synchronization in development and uniformity of growth are extremely desirable attributes. There are several uses for seaweed extract as a seed treatment. Seaweed extract contains an abundance of nutrients and hormones that promote growth. Seaweed liquid fertilizers can act us effective means for raising agricultural output.[2]

Seaweed fertilizer, sometimes referred to as Liquid Seaweed Fertiliser (or) Seaweed Liquid Fertiliser

CONTACT S. Arunkumar arunkumaragri97@gmail.com Department of Genetics and Plant Breeding, Annamalai University, Tamil Nadu, India.

Doi: http://dx.doi.org/10.12944/CARJ.12.2.28

(or) Liquid Fertiliser, together with powdered algal manure that has been diced or whole and then mixed in, can be applied to grains, pulses, and flowering plants. The absence of weeds and pathogenic fungus in seaweed manure is a benefit. Brown algae liquid extracts are sold as biostimulants or biofertilizers under a variety of brand names. Because seaweed extracts reduce the frequency of disease and insect attack, they have been shown to increase crop output, nitrogen uptake, resistance to cold and stress, and enhance seed germination. Coastal farmers applied seaweed manure on a range of crops to alter the soil's composition and improve its capacity to retain moisture because seaweeds are rich sources of N, K, other minerals, trace elements, carbohydrates, and other organic materials.[3] Seaweed extracts are also known to stimulate nutrient uptake, improve seed germination and growth, confer a degree of cold resistance, and increase plant resistance to phytopathological fungi and insect.[4]

Kappaphycus alvarezii extract, abundant in plant growth regulators and nutrients, demonstrates favorable effects across various crops. Its rich composition of micro and macronutrients contributes to enhanced crop performance and yield responses. Numerous study areas are primarily concerned with the utilization of seaweed extracts in plants as foliar sprays, seed treatments, or soil treatments. With this background, the current study aimed to determine whether different quantities of seaweed extracts (*Kappaphycus alvarezii* and *Gracilaria*) could improve the parameters associated with the growth and yield of green gram (*Vigna radiata* L) VBN 2.

Materials and Methods

Seaweeds *Kappaphycus alvarezii* and *Gracilaria* were collected at Ramanathapuram, India, south coastal Pudhumadam region. The obtained sample was properly cleaned with sea water to get rid of any last bits of sandy material, debris, gravel, and the epiphytes before being carefully rinsed with water.

Preparation of Seaweed Extract (SWE)

Following a four-day period of shade drying, the seaweeds were dried in the oven for a period of twelve hours at 60˚C. Following a manual grinding of the mixture into a coarse powder, distilled water was then added in a 1:20 (w/v) ratio. The combination was then sterilised at 121˚C and 151bs/sq.inch for a duration of thirty minutes. Following their passage through a double-layered cheesecloth, the heated extracts were allowed to come down to room temperature.[5] The fifteen minutes were spent centrifuging the filtrate at 10,000 rpm. 100% liquid seaweed extracts were consumed from the resulting supernatant. The extract was used to create different quantities of liquid seaweed fertilizer by mixing it with distilled water. Five different concentrations of the seaweed *Kappaphycus alvarezii* were prepared: 1.0%, 1.5%, 2.0%, 2.5%, and 3.0%. In contrast, four different concentrations of *gracilaria* were prepared: 2.5%, 5.0%, 10%, and 15%.

Treatment details

T_0 - Control
T_1 - *Kappaphycus sap* @ 1.0% + Soaking + RDF + Foliar spray.
T_2 - *Kappaphycus sap* @ 1.5% + Soaking + RDF + Foliar spray.
T_3 - *Kappaphycus sap* @ 2.0%+ Soaking + RDF + Foliar spray.
T_4 - *Kappaphycus sap* @ 2.5%+ Soaking + RDF + Foliar spray.
T_5 - *Kappaphycus sap* @ 3.0%+ Soaking + RDF + Foliar spray.
T_6 - *Gracilaria sap* @ 2.5%+ Soaking + RDF + Foliar spray.
T_7 - *Gracilaria sap* @ 5%+ Soaking + RDF + Foliar spray.
T_8 - *Gracilaria sap* @ 10%+ Soaking + RDF + Foliar spray.
T_9 - *Gracilaria sap* @ 15%+ Soaking + RDF + Foliar spray.

Three replications of the field experiment were conducted employing a Randomized Block Design, consisting of ten treatments, with dried seeds serving as the control. Field trials were conducted at the Experimental Farm with soaking and foliar spray. Foliar spray was given at three times viz., 30 days, 45 days and 60 days of crop growth. All the trails were maintained along with the control. The total number of branches from each of the chosen plants was counted, and the average number of branches per plant was noted. Ten uprooted plants' roots were cleaned, and the number of nodules found in the lateral and tap roots was recorded and represented as a whole number. In each plot, the number of days

from sowing to the first flowering at each plant node was noted, and the mean value was reported as the number of days to the first flowering. The number of clusters per plant at maturity was noted for the five randomly chosen plants, and the mean value was computed and presented as a numerical value. When the pods in each plant reached maturity, their lengths were measured on a scale. The longitudinal splitting of the pods employed to measure the length of the pods allowed for the counting of the seeds within each pod and the recording of the mean number of seeds per pod as a number. Hand shelling was done on the pods of the ten tagged plants in each treatment. After the seeds were washed, their mean weight was measured using an electric balance and reported in grams. Panse and Sukhatme procedure were used to statistically analyze the data from field experiments.[6]

Results

The results were recorded under field conditions. The green gram seeds treated with 2.5 percent *Kappaphycus alvarezii* showed higher values of parameters related to growth and yield viz., plant height (cm) (42.06), no. of leaves per plant (44.85), no. of branches per plant (9.77), chlorophyll (mg/g^{-1}) 'a' & 'b' (1.296 & 1.253), total chlorophyll (mg/g^{-1}) (1.578), no. of nodules per plant (10.48), days to first flowering (26), no. of clusters per plant (8.47), no. of pods per plant (29.75), pod yield per plant (22.02), pod length (8.55), no. of seeds per pod (12.88), seed yield per plant (5.71) and hundred seed weight (3.76).

The minimum plant height, no. of leaves per plant, no. of branches per plant, chlorophyll 'a' & 'b', and total chlorophyll was 29.71 cm, 31.33, 5.80, 0.676 mg/g^{-1}, 0.762 mg/g^{-1} and 1.037 mg/g^{-1} recorded in Control (T_0), respectively. The maximum days to first flowering was recorded in T_0 (30 days). The minimum no. of nodules per plant, no. of clusters per plant, no. of pods per plant, pod yield per plant, pod length, no. of seeds per pod, seed yield per plant and hundred seed weight was 6.37, 5.14, 20.34, 11.62 g, 4.81 cm, 6.41, 1.21 and 2.00 was recorded in T_0, respectively. When compared to control, nearly 29.36% increase in plant height was observed for T_4 treatment. Also, 31.63% increase in no. of pods per plant was observed.

Discussion

This study reports on the impact of seaweed extract seed soaking and foliar spraying on growth parameters such as plant height (cm), the number of leaves, branches, and nodules per plant were all considerably greater in T_4 compared to T2 (Fig 1). Treatment T_4 showed earlier flowering (Table 1). In T0, the lower values were noted. The rise in first node height that results from an increase in hypocotyl size. The heightened growth characteristics observed may be attributed to the presence of plant growth promoters (PGR) like cytokinin, as well as macro and micro elements found in seaweed extract. Due to the use of foliar spray of seaweed liquid fertilizer, which is the richest source of macro and macro nutrient, other growth parameters also demonstrated an upward trend. Seaweed extract applied during crucial stages of the crop was quickly and efficiently absorbed through the leaves, translocated to the vegetative and reproductive part. Several authors have reported similar conclusions.[7-10]

Table 1: Impact of seed soaking+foliar spray of seaweed extracts on growth parameters in green gram cv. VBN 2

Treatment details	Plant height (cm)	No. of leaves per Plant	No. of branches per Plant
T_0	29.71	31.33	5.80
T_1	37.47	35.55	7.23
T_2	39.88	42.07	7.02
T_3	32.93	37.30	8.41
T_4	42.06	44.85	9.77
T_5	36.49	38.83	6.83
T_6	35.07	36.48	7.94
T_7	33.77	34.74	7.70
T_8	34.61	38.06	6.92
T_9	34.10	35.69	7.32
MEAN	35.60	37.49	8.00
SED	1.3359	1.8937	0.3921
CD (p=0.05)	2.8054	3.9768	0.8234

Table 2: Impact of seed soaking+foliar spray of seaweed extracts on physiological traits in green gram cv. VBN 2

Treatment details	Chlorophyll 'a' (mg/g^{-1})	Chlorophyll 'b' (mg/g^{-1})	Total Chlorophyll (mg/g^{-1})
T_0	0.676	0.762	1.037
T_1	0.989	1.001	1.296
T_2	1.252	1.174	1.442
T_3	0.973	1.067	1.302
T_4	1.296	1.253	1.578
T_5	1.029	1.009	1.258
T_6	0.845	0.989	1.141
T_7	1.035	1.066	1.179
T_8	1.067	1.012	1.293
T_9	0.954	1.081	1.179
MEAN	1.012	1.041	1.272
SED	0.1365	0.055	0.080
CD (p=0.05)	0.2744	0.1123	0.1620

Table 3: Impact of seed soaking+foliar spray of seaweed extracts on no. of nodules per plant, days to first flowering and no. of clusters per plant in green gram cv. VBN 2

Treatment details	No. of nodules per plant	Days to first Flowering	No. of clusters per Plant
T_0	6.37	30	5.14
T_1	7.52	30	7.25
T_2	9.43	27	7.58
T_3	8.29	30	6.86
T_4	10.48	26	8.47
T_5	7.98	30	6.62
T_6	8.15	29	6.92
T_7	7.49	28	7.03
T_8	7.05	30	7.38
T_9	7.29	30	6.55
MEAN	8.00	29.42	6.89
SED	0.3921	1.5258	0.4785
CD (p=0.05)	0.8234	3.2042	1.0048

The physiological traits i.e. Chlorophyll content showed significantly higher values in T_4 followed by T_2 (Table 2). These parameters have positively contributed towards yield. Increased levels of chlorophyll 'a' & 'b' and total chlorophyll could be due to the attributed seaweed extracts cytokinin and magnesium content, which are thought to be crucial components that promote growth in chlorophyll biosynthesis, may have had a significant impact on the physiological characteristics of green gram. The potassium from *Kappaphycus alvarezii* that are abundant in the seaweed utilised in this work are known to have a growth-promoting effect on plants. One of the essential nutrients for plants, potassium is necessary for numerous physiological functions such chlorophyll, photosynthesis, and enzyme activity. Several authors have reported findings that are similar.[11-13]

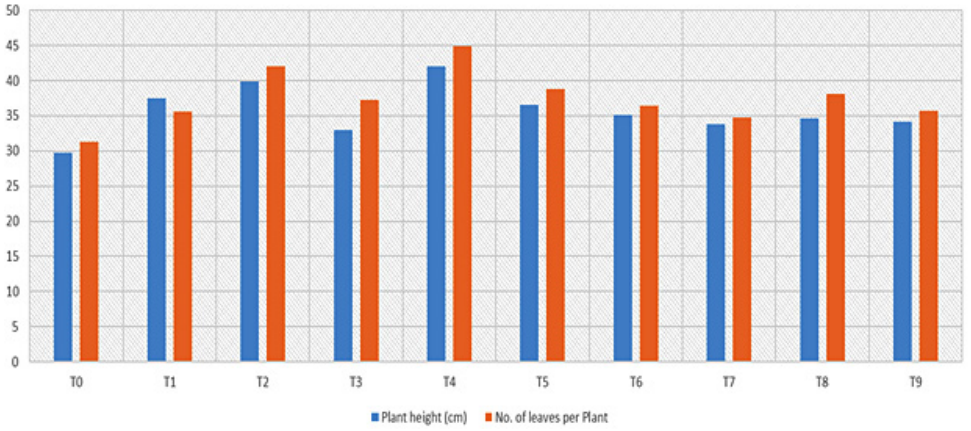

Fig. 1 : Effect of foliar application on seed soaking + foliar spray on seaweed extracys on plant height (cm) and number of leaves per plant in green gram cv. VBN 2

Early flowering observed in T_4 treatment. The formation of flowers will be delayed in other concentrations of seaweed extract due to toxicity if the seaweed extract dosage is increased or decreased due to its hormonal action. Similar findings were made by author.[14] In the present investigation yield parameters viz., no. of clusters per plant, no. of pods per plant, pod yield per plant, pod length, no. of seeds per pod, seed yield per pod and hundred seed weight expressed similar hike in T_4 followed by T_2, while lower values were recorded in T_0 (Table 3, 4 & 5).

Table 4: Impact of seed soaking+foliar spray of seaweed extracts on pod characters in green gram cv. VBN 2

Treatment details	No. of pods per Plant	Pod yield per plant (g)	Pod length (cm)
T_0	20.34	11.62	4.81
T_1	22.61	14.43	6.51
T_2	27.87	19.32	7.57
T_3	26.96	15.97	5.97
T_4	29.75	22.02	8.55
T_5	26.91	16.74	6.93
T_6	24.44	15.55	6.65
T_7	25.21	17.77	6.99
T_8	23.22	16.01	6.19
T_9	25.08	15.04	6.12
MEAN	25.24	16.44	6.63
SED	0.4933	0.3465	0.1268
CD (p=0.05)	1.0360	0.7276	0.2663

Table 5: Impact of seed soaking+foliar spray of seaweed extracts on seed yield attributes in green gram cv. VBN 2

Treatment details	No. of seeds per pod	Seed yield per plant	Hundred seed Weight
T0	6.41	1.21	2.00
T_1	7.64	2.43	2.42
T_2	10.11	4.32	3.20
T_3	8.64	2.91	2.65
T_4	12.88	5.71	3.76
T_5	9.10	3.39	2.51
T_6	8.12	3.33	2.70
T_7	7.99	3.44	2.21
T_8	8.89	3.01	2.88
T_9	7.44	3.71	2.55
MEAN	8.72	3.34	2.68
SED	0.16	0.2497	0.0528
CD (p=0.05)	0.35	0.5244	0.1108

Increase trend of yield contributing characters were observed T_4 followed by T_2. Among the two different seaweed extracts Kappaphycus performed well compared to *Gracilaria* nearly 80% increase was noticed by the seeds soaked and foliar spray with kappaphycus and 66% increased with *Gracilaria* treated seeds. The quality and yield potential of seeds have been enhanced by the presence of critical amino acids, trace minerals, vitamin supplements, and plant growth regulators including gibberellins and cytokines in seaweed. The number of seeds per pod and seed yield per pod were the main contributing elements to the yield increase. This might be because the growth promoting harmones (IAA and IBA), cytokinins, iron, copper, zinc, manganese, vitamins and amino acids which in turn increased the yield parameters. A number of authors presented reports that were comparable.[15-17]

Conclusion

The study reveals that the field experiment, VBN 2 seeds treated with seaweed *Kappaphycus alvarezii* (2.5%) showed improvement in growth and yield characters was due to the presence of bioactive substances, cumulative effect of nutrition of *Kappaphycus alvarezii* (2.5%) when compared to the action of two sea weed extract Kappaphycus performed better than *gracilaria*.

Acknowledgement

The staff and students of GPB department extended their support during the study, has our deepest gratitude.

Funding Sources

There was no external support for this study.

Conflicts of Interest

The contributors declare that they have no conflicts of interest.

Authors Contribution

GG - Data collection and analysis, SP - Manuscript finalizing and review, SA–Manuscript preparation and editing, APR - Field experiment conducted.

Data Availability Statement

All datasets produced or examined throughout this study are included in this manuscript.

Ethics Approval Statement

Not applicable

References

1. Arif M., Ali S., Khan A., Jan T., Akbar M. Influence of farm yard manure application on various wheat cultivars. *Sarhad Journal of Agriculture.* 2006;22:27-29.
2. Zodape S. T., Kawarkhe V. J., Patolia J. S., Warade A. D. Effect of liquid seaweed fertilizer on yield and quality of okra (*Abelmoschus esculentus* L.). *Journal of Scientific and Industrial Research.* 2008;67:1115-1117.
3. Simpson K., Hayes S. F. The effect of soil conditioners on plant growth and soil structure. *Journal of the Science of Food and Agriculture.* 1958;9(3):163-170.
4. Bhosle N. B., Dhargalkar V. K., Untawale A. G. Effects of seaweed extract on the growth of *Phaselous vulgaris L. Indian Journal of Geo-Marine Sciences.* 1975;4(2):208-210.
5. Rama Rao K. Preparation of liquid fertilizer from sargassum. In: Seaweed Research and Utilization Association Work shop on Algal products and seminar on Phaeophyceae in India, Madras, India. 1990;6:4-7.
6. Panse V. G., Sukhatme P. V. Statistical methods for agricultural workers. Statistical methods for agricultural workers. 1954;361.
7. Chouliaras V., Tasioula M., Chatzissavvidis C., Theriosa I., Tsabolatidoub E. The effects of seaweed extract in addition to nitrogen and boron fertilization on productivity, Fruit maturation, leaf nutritional status and oil quality of the olive (Olea europaea L.) cultivar Koroneiki. *Journal of the Science of Food and Agriculture.* 2009;89(6):984-988.
8. Nedumaran T., Perumal P. Effect of seaweed liquid fertilizer on the germination and growth of seedling of mangrove – *Rhizophora mucronate boir. Journal of Phytology.* 2009;1(3):142-146.
9. Pramanick B., Brahmachari K., Ghosh A. Effect of seaweed saps on growth and yield improvement of green gram. *African Journal of Agricultural Research.* 2013;8(13):1180-1186.
10. Mahajan R. V., Bhale V. M., Deshmukh J. P., Patil S. P., Shingrup P. V. Significance of marine algal sap as foliar nutrition on seed quality and nutrient uptake of Black gram *(Vigna mungo). International Journal of Pure and Applied Bioscience.* 2017;5(5):1042-1047.
11. Sathya B., Indu H., Seenivasan R., Geetha S. Influence of seaweed liquid fertilizer on the growth and biochemical composition of legume crop. (*Cajanus cajan* L.) Mill sp. *Journal of Phytology.* 2010;2(5):50-63.
12. Selvam G. G., Sivakumar K. Effect of foliar spray form seaweed liquid fertilizer of Ulva reticulata (Forsk.) on *Vigna mungo* L. and their elemental composition using SEM-energy dispersive spectroscopic analysis. *Asian Pacific Journal of Reproduction.* 2013;2(2):119-125.
13. Flora G., Vishnu Priya R. Effect of *Ulva lactuca* and *Padina tetrastromatica* concentrate on growth and yield of *Momordica charantia. Seaweed Research and Utilisation.* 2016;38(2):117-123.
14. Chaudhary F. M., Loneregan J. F. Zinc absorption by wheat seedling. I. Inhibition by macronutrient ions short term studies and its relevance to long term zinc nutrition. Soil Science Society of America Proceedings. 1972;36:323-327.
15. Zodape S. T., Mukherjee S., Reddy M. P., Chaudhary D. R. 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(2):1735-6814.
16. Deshmukh P. S., Phonde D. B. Effect of seaweed extract on growth, yield and quality of sugarcane. *International Journal of Agricultural Sciences.* 2013;9(2):750-753.
17. Mahajan R. V., Bhale V. M., Deshmukh J. P. Potential effect seaweed sap on nutrient uptake of green gram. *International Journal of Science and Nature.* 2016;7(4):740-743.