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Evaluating the Impact of Combined Application of Seed Dressing and Foliar Application of Sea Weed Extracts on Growth Attributes of Black Gram (*Vigna mungo*)

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ABSTRACT

A field experiment was conducted to assess the impact of combined application of seed dressing and foliar administration of sea weed on growth attributes of black gram. The crop was raised in Annamalai University Experimental Farm, Faculty of Agriculture, Annamalai nagar. The experiment consisted of seven treatments and was laid out in Randomized Block Design with three replications. Seed treatment and foliar application @ 5% seaweed extract (*Sargassum* sp.) + RDF excelled the other treatments in recording the highest growth attributes viz., plant height, LAI, DMP and number of branches per plant. The diverse mix of micro and macro nutrients, trace elements, humic acid, amino acids, plant growth hormones, vitamins, antibiotics, and organic matter in seaweed extract significantly enhanced black gram's growth parameters like plant height, leaf area, and root biomass.

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INTRODUCTION

Black gram (*Vigna mungo*) is a vital player in the Indian agricultural landscape and culinary scene. Black gram, like other legumes, possesses a unique ability to fix atmospheric nitrogen into the soil. This natural fertilizer enriches the soil, promoting the growth of other crops and reducing the requirement of synthetic fertilizers. It packs a powerful nutritional punch. With a protein content of around 26%, nearly three times that of cereals, it serves as a crucial source of plant-based protein in the predominantly cereal-based Indian diet. Additionally, it is rich in essential minerals and vitamins, making it a well-rounded dietary supplement. Beyond human consumption, black gram serves as a nutritious and affordable feed for livestock. Its high protein content and essential nutrients contribute to healthy animal growth and development. India reigns supreme in the world of black gram, holding the titles of both largest producer and consumer. With a mean yield of 501 kg ha^{-1} in 2020-21, the country produces roughly 23.4 lakh tonnes annually from 46.7 lakh hectares of land. This translates to 15.7% the total acreage of pulses in India and 9.09% of its total pulse production being dedicated to black gram. Seaweed, a treasure trove from the ocean depths, offers a powerful and natural

way to enhance plant growth. This remarkable marine resource, brimming with organic content, essential nutrients, vitamins, and plant growth hormones like cytokinins and auxins, has earned a well-deserved place in agriculture (Xinyi *et al.* 2019). Seaweed extracts stimulate the natural production of key hormones like cytokinins and auxins. These hormones orchestrate a symphony of growth, promoting stronger roots, lusher leaves, vibrant flowers, and higher growth attributes. The suitable input and method of supplying nutrient play a crucial part in enhancing crop productivity and quality which ensures both the food and nutritional security (Anil *et al.* 2015). Furthermore, it is well recognized that liquid seaweed formulations protect plants from disease and pests and improve their ability to with stand abiotic conditions like drought and cold. Seaweed extracts contain secondary metabolites including terpenes that have antibacterial properties that promote plant growth. Seaweeds have a broader range of applications in agriculture that can be utilized to maximize crop productivity while using less fertilizer.

MATERIALS AND METHODS

A field investigation was carried out at Annamalai University, Experimental Farm, Annamalai Nagar, Cuddalore District in Cauvery Delta Zone of Tamil Nadu to study the effectiveness of seed dressing and foliar implementation of seaweed liquid fertilizer on growth of black gram ADT-5 during February-April, 2020. The Experimental Farm is geographically situated at 11° 24' North latitude and 79° 44' East longitude and with an altitude of + 5.79 m above mean sea level (MSL). The climate of experimental site is moderately warm with hot summer months. The soils of the experimental field were clay loam. The soil was low in available nitrogen (229 kg ha^{-1}), medium in available phosphorus (13.90 kg ha^{-1}) and high in available potassium (287 kg ha^{-1}).

The field trail was conducted in Randomized Block Design in three replications. The treatments comprised of T_1 - 100% RDF 25:50:25 N P_2O_5 kg ha^{-1}, T_2 - Seed treatment and foliar usage of sea weed extract (*Kappaphycus* sp.) @ 5% at pre flowering and post flowering stage + RDF, T_3 - Seed treatment and foliar application of seaweed extract (Kappaphycus sp.) @ 10% at pre flowering and post flowering stage + RDF, T_4 - Seed treatment and foliar spray of seaweed extract (*Kappaphycus* sp.) @ 15% at pre flowering and post flowering stage + RDF, T_5 - Seed treatment and foliar application of seaweed extract (*Sargassum* sp.) @ 5% at pre-flowering and post-flowering stage + RDF, T_6 - Seed treatment and foliar application of sea weed extract (*Sargassum* sp.) @ 10% at preflowering and post-flowering stage + RDF and T_7 - Seed treatment and foliar usage of seaweed extract (*Sargassum* sp.) @ 15% at pre flowering and post flowering stage + RDF.

Biometric observations on growth attributes viz., plant height, LAI, DMP and number of branches $plant^{-1}$ were recorded at respective stages of crop growth. In each plot, five representation plants were selected by simple random sampling method and the plants were tagged. These randomly tagged plants from each treatment of each replication were used as a sample for this study. Plant height of black gram was recorded at by measuring from the plants base to the top most leaf and expressed in cm. The leaf length was measured in cm and recorded at the time of flowering stage. From the sampling area in each plot, five plants were removed randomly at harvest stage. These samples were first air dried in shade and then dried in a hot air oven at 80°C for 48 hrs. The mean dry weight of the sample plants from each plot was recorded and dry matter production was calculated and expressed in kg ha^{-1}. The numbers of branches $plant^{-1}$ were counted at harvest stage from five randomly selected plants in each plot. The different growth components observed during the course of investigation were analyzed statistically as per the procedure suggested by Gomez and Gomez (1984). Wherever the results were found significant ('F' test), the critical differences (CD) were arrived at 5% probability level (p=0.05).

RESULTS AND DISCUSSION

The growth parameters such as plant height, dry matter production, leaf area index, and number of branches $plant^{-1}$ of black gram crop were significantly impacted by the various treatments of seed dressing and foliar application of sea weed extract. Numerous studies have revealed the remarkable growth-promot-

Table 1. Effect of seed treatment and foliar application of seaweed extract on growth attributes of black gram.

Treatments	Plant height (cm)		LAI	DMP (kg ha^{-1})		Number of branches plant^{-1}
	45 DAS	At harvest		45 DAS	At harvest	
T_1 100% RDF 25:50:25 N P_2O_5 kg ha^{-1}	30.27	35.58	3.58	1510	2422	7.20
T_2 Seed treatment + foliar application @ 5% seaweed extract (*Kappaphyus* sp.) + RDF	32.73	38.64	3.89	1582	2568	7.89
T_3 Seed treatment + foliar application @ 10% seaweed extract (*Kappaphyus* sp.) + RDF	24.99	29.35	2.90	1360	2187	5.39
T_4 Seed treatment + foliar application @ 15% seaweed extract (*Kappaphyus* sp.) + RDF	19.68	23.09	2.23	1209	1748	5.05
T_5 Seed treatment + foliar application @ 5% seaweed extract (*Sargassum* sp.) + RDF	35.47	41.68	4.23	1646	2694	8.05
T_6 Seed treatment + foliar application @ 10% seaweed extract (*Sargassum* sp.) + RDF	27.60	32.65	3.24	1424	2311	6.66
T_7 Seed treatment + foliar application @ 15% seaweed extract (*Sargassum* sp.) + RDF	22.24	26.16	2.57	1303	2023	4.75
SEd ±	30.27	35.58	0.13	22.68	32.41	0.17
CD (p=0.05)	32.73	38.64	0.29	45.37	64.82	0.35

ing effects of applying seaweed extracts to plants. From rice paddies in Asia to maize fields in Africa, a diverse range of crops like rice, maize, and legumes have responded positively to this natural growth enhancer (Singh *et al*. 2016).

The results on growth characters, viz., plant height, leaf area index, dry matter production and number of branches at harvest were recorded at respective intervals are presented in Table 1. The results concluded that increase in plant height of 41.68 cm at harvest were observed in T_5 Seed treatment and foliar application of seaweed extract (*Sargassum* sp.) @ 5% at pre flowering and post flowering stage + RDF. This is because seaweed extracts are rich in plant hormones like cytokinins, auxins, and gibberellins. These hormones directly stimulate cell division and expansion, leading to increased internode elongation and ultimately, taller plants (Dilavarnaik *et al.* 2017). More over presence of auxin and growth promoting substances in seaweed extract which plays an effective role in cell growth and enlargement, making the shoot tip to move upwards leading to increased plant height. This finding was similar with Ambika and Sujatha (2017). Research by Ghaderiardakani *et al*. (2019) highlights this hormonal influence, demonstrating how seaweed extracts directly promote cell growth and stem elongation. Seaweed fertilizers not only nourish plants directly but also improve soil characteristics, enhancing nutrient availability and uptake. This improved access to essential nutrients fuels vigorous growth, allowing plants to reach their full height potential. Additionally, seaweed help plants to take in and apply nutrients more efficiently, further optimizing resource allocation for height gain. This enhanced energy production translates to increased vigor and growth, directly influencing plant height. For instance, Pramanick *et al.* (2012) observed a notable rise in plant height (8.1% to 13.5%) in black gram treated with seaweed sap, highlighting the link between improved photosynthesis and taller plants.

The optimum availability of the nutrients with seed treatment and foliar application of seaweed extract (*Sargassum* sp.) @ 5% at pre flowering and post flowering stage + RDF (T_5), might have promoted

higher acceptance and application of essential plant nutrients for enhanced photosynthates production and further crop canopy establishment. This might be the probable reason for resultant enhanced values of leaf area index with this treatment. Leaf area is an important factor determining the dry matter production of a crop and subsequently the yield. The study observed a remarkable increase in dry matter production as black gram plants moved from the pod development stage to maturity. At 45 days after sowing (DAS), dry matter accumulation ranged from 1209 kg ha^{-1} to 1646 kg ha^{-1}. This impressive growth continued till harvest, with dry matter values soaring from 1748 kg ha^{-1} to a staggering 2694 kg ha^{-1}. This shows the rapid biomass accumulation during the crucial pod filling and seed development stages. There is a significant increase in chlorophyll content by sea weed extract application (John and Mahadevi 2014). This enhanced chlorophyll production translates to improved photosynthesis and energy capture, higher nutrient uptake powering further growth and altogether lead to better dry matter accumulation. Pramanick *et al.* (2017) stated that seaweed extract foliar application resulted in increased dry matter accumulation in plants. This signifies efficient conversion of nutrients into plant biomass, contributing to greater overall yield and productivity.

The data on number of branches (8.05) at harvest of black gram showed distinct increase with treatment (T_5). Seaweed application induces more profuse vegetative branching which is highly beneficial for harvesting more solar energy, optimizing plant architecture, enhancing productivity and resilience in agricultural crops. Seaweeds are also rich in cytokinins which induce growth of axillary buds leading to initiation of more secondary and tertiary branches in dicot plants resulting in bushier growth (Shri Devi and Paul 2014). The growth hormones in seaweeds promote the early development of axillary buds and side shoots well before flowering/fruiting. This early branching ability allows more vegetative biomass accumulation before the reproductive stage. With more primary and secondary branches being formed after seaweed treatment, the number of sites for flower bud formation in the leaf axils of those branches also increases significantly. This leads to a greater flowering capacity. The rest of the treatments viz., T_2, T_1, T_6, T_3 and T_7 were next in descending order. The seed treatment and foliar application of seaweed extract (*Kappaphycus* sp.) @ 15% at pre flowering and post flowering stage + RDF (T_4) registered the lowest values of the growth attributes. This might be because of the fact that concentrated seaweed extracts create very high osmotic pressure due to the existence of polysaccharides like alginates, fucoidans. This leads to loss of turgor and plasmolysis damage in plant cells, affecting metabolic functions. Also, some research indicates concentrated seaweed liquids can physically clog stomata and coat leaf surfaces, hindering gaseous exchange through respiration and photosynthesis vital for plant growth. This is supported by Pise and Sabale (2010) who noted that 6% concentration caused severe retardation of symbiotic fixation of nitrogen and related growth. Sivasankari *et al.* (2006) also recorded a steep decline in leaf area index total dry matter production and relative growth rate in rice when sprayed with *Kappaphycus* sp. extract beyond 6% concentration, attributable to osmotic and ion-specific stress effects.

CONCLUSION

In this present investigation, it is in conclusion that seaweed liquid extract holds immense potential for boosting black gram growth parameters. Notably, the mixture of seed soaking in 5% *Sargassum* sp. Seaweed extract along with foliar spraying of 5% *Sargassum* sp. seaweed extract along with the recommended fertilizer dose, delivered the most impressive results. This suggests that low-concentration approach proved highly effective in enhancing black gram's morphological characteristics, demonstrating the immense potential of seaweed extract as an eco-friendly growth promoter. These findings open doors for sustainable agricultural practices that can significantly improve black gram yield and support healthier, more resilient crops.

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