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Effect of Foliar Nutrition of Seaweed Sap on Growth and Yield of Greengram

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Abstract: *Present research was conducted at the Research farm of Department of Agronomy, Dr. PDKV, Akola. (MS) during the* kharif *season 2013-14 to study the effect of foliar nutrition of seaweed sap on growth and yield of grengram. Experiment comprised of seven treatments of marine algal sap (Kappaphycus and Gracilaria spp.) combination of recommended dose of fertilizer with three levels of seaweed sap concentrations i.e. 5%, 10% and 15% and replicated thrice. Treatments consist, $T_{1:}$ control (No application of marine algal sap), T_2:K-sap @ 5%, T_3:K-sap @ 10%, T_4:K-sap @ 15%, T_5:G-sap @ 5%, T_6:G-sap @ 10% and T_7:G-sap @ 15%. The data indicated that, foliar application of seaweed saps significantly influenced various growth parameter, yield attributes and yield of blackgram. The results revealed that foliar spraying G-sap @ 15% (T_7), recorded highest growth parameter i.e. plant height, number branches, leaf area, root length, rood nodule and dry matter production. Yield attributes i.e. number of pods (14.98), pod weight (7.35 g), grain weight per plant (3.93 g) were found significantly highest with foliar spraying of G-sap @ 15% (T_7) compared to other treatments. Similarly, maximum biological yield i.e. grain yield (1150 kg ha^{-1}) and straw yield (2255 kg ha^{-1}) were recorded with same foliar applied treatment i.e. G-sap @ 15% (T_7) followed by K-sap @ 15% (T_4), G-sap @ 10% (T_6) and K-sap @ 10% (T_3). Percent increase of grain yield was (38.72%) over control.*

Keywords: *Greengram, Kappaphycus and Gracilaria spp, Growth, Grain yield.*

INTRODUCTION

Pulses are the cheapest and main source of dietary vegetable protein for majority of Indians. Pulses are next to cereals in terms of their economic and nutritional importance as human food. The ability of pulses to fix atmospheric nitrogen in the soil-crop system is their unique and beneficial characteristics among all plant species. Inclusion of pulses in crop needs to be viewed as long term benefit for resource conservation because of their intrinsic virtues like nitrogen fixation ability, less dependence on external inputs like water, fertiliser and power, per day productivity and higher protein content and its role in ecological security (Ali and Venkatesh, 2009). Green gram (Vigna radiata L.) is the third most important pulse crop grown in India next only to gram and pigeon pea. It is a favorable pulse crop since it will thrive better in all seasons as sole and intercrop or fallow crop. In India, the name greengram is more commonly used than mungbean (Chatterjee and Randhawa, 1952). Greengram contains about 24 per cent protein, this being about two third of the protein content of soybean, twice that of wheat and thrice that or deficient cereal grains but, cereals are rich in methionine, cystine and cystein, the sulphur bearing amino acids. So, a diet combining mungbean and cereal grains form a balanced amino acid diet. Productivity of green gram in India is much lower than the world's average as the crop is mainly concentrated in rainfed conditions with poor management practices. Several steps were made to boost the productivity of green gram. One among and the cheapest way is application of growth promoters for increasing and

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exploiting the genetic potential of the crop. Source-sink relationship in green gram is very wider (Sujatha, 2001). So physiological manipulation is needed to improve this assimilates partitioning.

Seaweeds, one of the important marine living resources could be termed as the futuristically promising plants. Seaweed could be exploited for its multi-functional properties in the form of food, energy and fertilizer. An adequate amount of growth promoting hormones and micronutrients present in seaweed makes them an excellent fertilizer. Unlike chemical fertilizer, seaweed extract are biodegradable, non-toxic, non-polluting and nonhazardous to human (Dhargalkar and Pereia 2005). Seaweed manures have the advantage of being free from weeds and pathogenic fungi. Liquid extracts of brown algae are being sold as biostimulants or biofertilizers in various brand names. Seaweed extract is a new generation of natural organic fertilizer containing macronutrients, trace elements, and organic substances like carbohydrates, amino acids and plant growth regulators such as auxin, IAA, kinetin, zeatin, cytokinin and gibberellins. Seaweeds are biodegradable, non-toxic, non-polluting and non-hazardous to the environment (Mooney and Van Staden, 1986).

MATERIAL AND METHODOLOGY

Field experiment was conducted during *kharif* season of 2013 at the Research farm of Department of Agronomy, Dr. PDKV, Akola. The soil of experimental site was clayey in nature, low in organic carbon, available nitrogen, available phosphorus and high in potassium. The experiment was laid in Randomised block design with seven treatments and replicated three times. Greengram cultivar Kopargaon was sown during the *kharif* season and was fertilized with recommended dose. (20:40:00 NPK kg ha^{-1}). The treatments were comprised of six concentrations of seaweed sap, *i.e.* $T_{1:}$ control (No application of marine algal sap), T_2:K-sap @ 5%, T_3:K-sap @ 10%, T_4:K-sap @ 15%, T_5:G-sap @ 5%, T_6:G-sap @ 10% and T_7:G-sap @ 15%. Intercultivation was carried out as and when required and crop was harvested at its physiological maturity. The seaweed sap *i.e. Kappaphycus* and *Gracilaria* spp. having 100% concentration was procured from Central Salt and Marine Chemical Research Institute, Bhavnagar, Gujarat. Then it was converted in foliar application liquid by adopting serial dilution technique and finally the foliar spray of 5, 10 and 15% concentration was applied to greengram at 20 and 35 days after sowing. The crop was sown during 19 June 2013 and harvested in 21 August 2013.

RESULT

Growth Parameters

The data on growth parameter viz. Plant height, number of branches, number of trifoliate leaf, leaf area, root length and total dry matter production (Table 1) increased with crop age (Table 1). An evaluation of the seaweed sap treatments indicated that, foliar application of G-sap @ 15% (T_6) recorded highest growth parameter *i.e.* plant height (54.46 cm), number of branches (5.80), number of functional leaf (15.05), leaf area (10.85 dm^2) and total dry matter production (19.45 g) and it was statistically at par with K-sap @ 15 (T_3), G-sap @ 10(T_5) and K-sap @ 10% (T_2). Lowest growth parameter recorded in control with respective value (49.13 cm, 3.38, 10.09, 8.02 dm^2, 17.83 cm 13.63 g of plant height, number of branches, number of functional leaf, leaf area, root length and dry matter production.

Increased the plant height due to enhancement in the cell division and cell elongation at shoot apex and such effect was due to increase plant height. Similar results were reported by Rathore *et al.* (2009) and Sujatha and Vijayalakshmi (2013). Highest number of branches could be due to the suppression of apical dominance as a result of increase in the auxin activity, leading to more number of nodes per plant resulting in increased number of primary and secondary branches per plant. The results are in agreement with those reported by Rathore *et al.* (2009) and Shanker *et al.* (2014). Increased number of leaf and leaf area may be due to positive effects on cell division and cell elongation leading to, increased plant height thereby increased number of functional leaves and ultimately leaf area plant. Similar results were also reported by Renuka Bai *et al.* (2010) and El-Yazied *et al.* (2012). The higher concentration auxin promote the elongation of roots but as compare to stem higher concentration of auxin induces more lateral branch roots and root length when applied exogenously. The enhanced dry weight of vegetative and reproductive parts may be due to increased translocation of assimilates from leaf, stem, root to the reproductive parts (pod) and may be attributed to the retention of more number of leaves, leaf area, number of branches and number of pod ultimately increase the total dry matter. The above results were in agreement with those obtained previously by Sujatha and Vijayalakshmi (2013).

Chlorophyll Content Index (%)

As revealed from data presented in Table 1, the chlorophyll content index (CCI) did not changed to a level of significance when measured before spraying of seaweed sap. After the foliar spray application of seaweed sap (K-sap and G-sap) at 25 and 40 DAS, significant rise in the value of CCI were recorded with treatments.

Data revealed that, foliar application of seaweed sap *i.e.* G-sap @ 15% (T_6) significantly recorded highest chlorophyll content index *i.e.* 27.01% at 25 DAS and 32.16% at 40 DAS. However it was statistically at par with foliar application of seaweed sap treatment K-sap @ 15% (T_3) and G-sap @ 10% (T_5). Cumulatively it was observed that percent increased of chlorophyll content index at 25 and 40DAS were 27.82% and 39.34% respectively. Lowest chlorophyll content index (%) was noted in control. Increase the chlorophyll content index might be due to presence of high amount of potassium salts, micronutrients and growth substances in this seaweed sap and their absorption in plant leaves at an accelerated rate resulting in greater formation of chlorophyll pigments. Cytokinin inhibits degradation of chlorophyll, breakdown of protein molecules and aids in the increase of chlorophyll level. The results obtained in this regard are in close accordance with those of Shanker *et al*. (2014) and El-Yazied *et al.* (2012).

Yield and Yield Attributes

Foliar application of seaweed sap *i.e.* (K-sap and G-sap) found significant effect on yield attributes and yield of greengram. Results on yield attributes revealed that, treatments differed significantly as influenced by seaweed sap it could be seen from the data (Table 3) that mean number of pod, pod weight per plant and grain weight were 13.06, 6.46 g and 3.36 g respectively. Foliar spraying of seaweed sap G-sap @ 15% (T_6) recorded highest number of pod (14.98), pod weight per plant (7.35 g) and grain weight (3.93 g) and it may statistically at par with K-sap @ 15% (T_3), G-sap @ 10% (T_5) and K-sap @ 10% (T_2). Lowest yield attributes observed in control.

Table 1
Effect of foliar nutrition of seaweed sap on growth attributes of greengram

Treatment	*Plant height at Harvest (cm)*	*Number of branches at Harvest*	*Number of leaf at 45 DAS*	*Leaf area at 45 DAS (dm^2)*	*Root length at Harvest (cm)*	*Root nodule at 45 DAS*	*Dry matter at Harvest (g)*	*CCI before (%)*	*CCI after at 25 DAS (%)*	*CCI CCI after at 40 DAS (%)*
T_1: control	49.13	3.38	10.09	8.02	17.83	29.58	13.63	20.44	21.13	23.08
T_2:K-sap @ 5%	51.05	4.22	12.40	9.11	19.16	30.93	15.34	21.29	23.39	26.51
T_2:K-sap @ 10%	52.62	5.23	13.97	9.91	20.41	32.54	17.34	22.09	25.28	29.32
T_3:K-sap @ 15%	53.93	5.57	14.62	10.67	21.34	33.82	18.75	22.00	26.44	31.11
T_4:G-sap @ 5%	51.45	4.53	12.71	9.38	19.54	31.40	15.95	21.53	24.05	27.48
T_5:G-sap @ 10%	53.13	5.45	14.46	10.24	20.93	32.83	18.07	22.06	25.73	30.08
T_6:G-sap @ 15%	54.46	5.80	15.05	10.85	21.74	34.43	19.45	21.94	27.01	32.16
SE(m)	0.72	0.23	0.45	0.35	0.51	0.70	0.75	0.38	0.64	1.04
CD at 5%	2.24	0.73	1.40	1.10	1.58	2.16	2.32	NS	2.00	3.23
GM	52.25	4.88	13.33	9.74	20.13	32.22	16.93	21.62	24.72	28.54

Table 2
Effect of foliar nutrition of seaweed sap on yield attributes and yield of greengram

Treatment	*No of Pod per plant*	*Pod Wt./ plant (g)*	*Grain wt./plant (g)*	*Grain yield (kg ha^{-1})*	*Grain yield (kg ha^{-1})*
T_0K_0-0%	10.33	5.27	2.54	829	1749
T_1K_1-5%	11.92	5.89	3.00	906	1887
T_2K_2-10%	13.35	6.61	3.51	1029	2070
T_3K_3-15%	14.47	7.11	3.75	1082	2189
T_4G_4-5%	12.41	6.12	3.12	935	1924
T_5G_5-10%	13.84	6.84	3.65	1062	2117
T_6G_6-15%	14.98	7.35	3.93	1150	2255
SE(m)	0.61	0.30	0.18	42.73	74.90
CD at 5%	1.89	0.93	0.58	131.66	230.66
GM	13.04	6.46	3.36	999	2027

Pod number is a major yield determining factor in pulses and it was greatly influenced by the nutrients and marine algal sap as growth promoter. Increased photosynthetic efficiency of greengram which lead to producing higher amount of metabolites and carbohydrates and their successful diversion towards the final plant product, *i.e.* pods and the grains. This result was in close confirmation with the finding Rathore *et al.*(2009), Zodape *et al.* (2010), Renuka Bai *et al.* (2011) and Sujatha and Vijayalakshmi (2013).

Effect of seaweed sap on seed and straw yield of greengram was significant (Table 3). It is apparent that treatment consisting of G-sap @ 15% (T_6) posed a great impact than other treatments in respect of grain and straw yield 1150 and 2250 kg ha^{-1}, while it was at par with foliar application of K-sap @ 15% (T_3), G-sap @ 10% (T_5) and K-sap @ 10% (T_2). The approximately numerical increment of grain and straw yield over control by these treatments was in the range of 38% and 28%, respectively.

The greengram crop gave better response to the higher doses of seaweed liquid fertilizer which stimulate the diversion of food material from leaves in acropetal and basipetal direction that resulted into improvement from the source to sink relation of greengram crop and eventually more number of pods, pod weight and grain yield per plant, ultimately resulted into increased grain and straw yield. The increased grain yield could be attributed to higher chlorophyll content, dry matter production, net assimilation rate, biomass duration, leaf area duration and its accumulation in reproductive parts, as result increased the grain and straw yield. These results are in confirmation with Rathore *et al.* (2009), Sharma *et al.* (2011), Raverkar *et al.* (2012) and Shankar *et al.* (2014).

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