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Significance of Marine Algal Sap as Foliar Nutrition on Seed Quality and Nutrient Uptake of Blackgram [*Vigna mungo*]

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ABSTRACT

Field experiments were conducted during 2012 at Research farm, Department of Agronomy Dr. PDKV, Akola (Maharashtra) to study the "Significance of marine algal sap as foliar nutrition on quality and nutrient uptake of blackgram". The foliar spray marine algal saps were applied twice at different concentrations (0, 5, 10 and 15% v/v) of (Kappaphycus and Gracilaria sap). Foliar applications of marine algal sap significantly enhanced the highest protein yield, vigour index macro and micro nutrients. Highest protein yield (340.43 kg ha^{-1}) and vigour index (3529.03%) were recorded with foliar application of Gracilaria sap + recommended dose of fertilizer (RDF). The protein yield increment was computed 31.67% and 25.75% respectively compare to the control. The highest macro nutrients uptake i.e. nitrogen, 54.47 and 27.59, 7.46 and 4.49 kg ha-^{1} phosphorus and 14.34 and 17.56 kg ha-^{1} potassium in grain and straw were observed by foliar application of 15% G-sap + RDF. Similarly, highest uptake of micronutrients (Cu, Fe, Mn and Zn) was registered with 15% G-sap + RDF. Presence of some macro and microelements and growth promoter, especially cytokinins, IAA, GA in Kappaphycus and Gracilaria extracts responsible for enhancing protein yield and improving nutrients uptake of blackgram.

Key words: *Blackgram, Kappaphycus sap, Gracilaria sap, macronutrients and micronutrients.*

INTRODUCTION

Marine bioactive substances extracted from marine algae are used in agricultural and horticultural crops, and many beneficial effects may be achieved in terms of enhancement of yield and quality. Seaweed extract is a new generation of natural organic fertilizers containing highly effective nutritious and promotes faster germination of seeds, increase yield, seed quality and resistant ability of many crops. Unlike, chemical fertilizers, extracts derived from seaweeds are biodegradable, non-toxic, non-polluting and non-hazardous to humans, animals and birds[4]. Seaweeds are the macroscopic marine algae found attached to the bottom in relatively shallow coastal waters.

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They grow in the intertidal, shallow and deep sea areas up to 180 meter depth and also in estuaries and backwaters on the solid substrate such as rocks, dead corals and pebbles. Seaweeds are one of the most important marine resources of the world. Seaweed extracts have been marketed for several years as fertilizer additives and beneficial results from their use have been reported[3] Liquid seaweed fertilizer is a unique combination of N, P, K, trace elements, alginates and simple sugars that are in dissolved form. These are easily absorbed through roots and leaves, besides releasing trace elements bound to the soil. Liquid extracts obtained from seaweeds have recently gained importance as foliar sprays for many crops including various cereals, pulses and different vegetable species.

Seaweed liquid extract (SLE) which contains macro nutrients, trace elements, organic substances like amino acids and plant growth regulators such as auxin, cytokinin and gibberellins are applied to improve nutritional status, vegetative growth, yield and fruit quality in some plants. In recent years, the use of seaweed extracts have gained in popularity due to their potential use in organic and sustainable agriculture[13] especially in rainfed crops, as a means to avoid excessive fertilizer applications and to improve mineral absorption. At present, the use of natural seaweed products as substitutes to conventional inorganic fertilizers has gained importance. Seaweed fertilizers are better than other fertilizers and are very economical. Recent, research demonstrated that seaweed fertilizers can compete with other fertilizers and are very economical. Hence, there is a need for popularizing the use of seaweed as health food and liquid organic fertilizer through mass scale trials and organization of public awareness programmes[7]. This study was undertaken to investigate the "Significance of marine algal sap as foliar nutrition on seed quality and nutrient uptake of blackgram".

Blackgram is third important pulse crops of India and Maharashtra state in particular. Among all the pulses, blackgram (*Vigna mungo (*L.) Hepper) is a highly prized pulse for its biological protein value and rich in phosphoric acid. Being, a leguminous crop, blackgram fulfills major part of nitrogen requirement by symbiotic nitrogen fixation with the help of bacterium called Rhizobia. Blackgram is used as green mannuring crop and helps for preventing soil erosion. Being a short duration crop and adaptability to off season it fits well in many intensive crop rotation. In Maharashtra, the growing of pulses in the cropping system is now a days not a common practice, but it is well known that inclusion of any pulse crop in the sequence has all-round advantages. Blackgram is commonly known as uradbean is a main source of dietary protein (24%) carbohydrates 67%, fiber 3.5%, fat 1.74% and major portion of lysine in vegetarian diet. Foliar fertilization is gaining importance in plant nutrition these days. The productivity of blackgram is declined due to inadequate plant stand, heavy flower drop and immature pod abscission leading to poor seed setting besides unfavourable environment, water and nutrient deficiencies at critical periods. Therefore, the solution to increase the productivity is to develop a method by which improve vegetative growth, flowering and pod filling could be maintained. Biological inputs through seed and foliar nutrition are ideal for improving crop yield and environmentally safe. Hence, it is important to find out the organic sources for seed and foliar treatments, for effective maintenance of vigour and viability.

Therefore, the objective has been taken towards the balancing fertilization of blackgram for the securing the highest productivity of crop by foliar nutrition of marine algal sap to increased the protein yield, seed quality and uptake of nutrients of blackgram.

MATERIAL AND METHODS

Field experiment was conducted during *kharif* season of 2012 at the Research farm of Department of Agronomy, Dr. Panjabro Deshmukh Krishi Vidyapeeth, Akola (Maharashtra). The experiment was laid in

Randomised block design with seven treatments and replicated three times. The details of treatments are T_1 Control (No application of seaweed sap, RDF applied), 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%. Two sprays of Kappaphycus and Gracilaria saps extract were applied at different growth stages vegetative stage (20-25 days) and flowering stage (35-40 day) through knapsack sprayer. Spraying of sea weed saps was done in the field as per the treatment. The quantity of water used was 500-600 liter ha^{-1} with adjuvant. Weekly average meteorological data during the span of experimentation, recorded at meteorological observatory, Dr. PDKV, Akola. The total rainfall of 639.3 mm was received during *Kharif* season (11 June to 30 September). The soil of experimental site was clayey in nature, pH 7.7, EC 0.27 dSm^{-1}, organic carbon 0.39%, available N 194.58 kg ha^{-1}, P 14.29 kg $ha-^{1}$ and K 315.73 kg ha^{-1}. The recommended nutrient dose of N, P_2O_5, and K_2O was applied @20:40:00 kg ha^{-1} for the blackgram crop.

The observations, for protein yield, seed quality and uptake of nutrients were recorded as per the standard method from each plot of each replication separately. Soil and plant samples were drawn from the treated plots and analyzed. The analysis was done by micro kjeldahl, Vanadomolybdo phosphoric yellow color and flame photometric methods for nitrogen, phosphorus and potassium, respectively. The uptake of Nitrogen (N), Phosphorus (P) and Potassium (K) by greengram crop was computed on the basis of dry matter accumulation and expressed as kg ha-1. The field experiment was laid out in randomized block design (RBD) replicated thrice to evaluate the effect of a seaweed saps. The data was analyzed by the method of analysis of variance as described by Gomez and Gomez.

PREPARATION MARINE ALGAL SAP

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 blackgram at 20-25 and 35-40 days after sowing.

RESULT AND DISCUSSION

UPTAKE OF MACRONUTRIENTS (N, P AND K)

Nitrogen, phosphorus and potassium uptake in blackgram was differed significantly due to different doses of foliar spray along with RDF (Table 1). The higher dose of *Gracilaria* seaweed sap i.e. G-sap@15%+RDF (T_7) recorded significantly higher uptake of nutrient over other treatments. Contrary to comparable performance of foliar spray G-sap@15%+RDF (T_7) and K-sap@15%+RDF (T_4) in respect to grain and dry matter of the crop which removed higher amount of nutrient when compare with other treatments. In blackgram, higher nitrogen, phosphorus and potassium uptake was recorded in application of foliar spray G-sap@15%+RDF (T_7) but, being at par with foliar spray of K-sap@15 (T_4), G-sap@10% (T_6) and K-sap@10% (T_3) in case of grain and straw nutrient uptake of nitrogen, phosphorus and potassium. Lowest uptake was noticed with control.

The foliar application of seaweed *Kapphphycus spp*. and *Gracilaria spp*. to crop plant gave better result in all aspect of protein yield, quality of seed and nutrient uptake after harvest when compared with control (T_1). It is probably due to presence of growth promoting hormones and nutrient in marine algal sap is more and in easily available form. Uptake was found to be higher in grain than straw indicating higher demand of nutrients by seeds and translocation of nutrients from vegetative to reproductive system i.e. pod, seed and other. Presence of trace element and plant growth regulators, especially cytokinin, GA, etc in marine algal sap is effective in plant nutrition for the synthesis of plant hormones and balancing intake of N, P and K inside the plant cells. These opinions are also supported by Zodape *et al.*[24], Sharma *et al.*[16] and Abou El-Yazied *et al*[1].

QUALITY PARAMETER OF BLACKGRAM

Foliar application of marine algal saps significantly influenced seed quality parameter. Protein yield (kg ha^{-1}) and vigour index (%) progressively increased with increasing levels of marine algal sap up to 15%. The data pertaining to seed quality parameter was recorded and embodied in table 1. Highest protein yield (340.43 kg ha^{-1}) and vigour index (3529.03%) was recorded with foliar application of marine algal sap i.e. G-sap@15%+RDF (T_7), which was 46.35% and 34.68% higher than the control treatment. However it was at par with K-sap@15+RDF (T_4), G-sap@10%+RDF (T_6) and K-sap@10%+RDF (T_3). Lowest quality parameter noted in control.

The numeric increase in protein yield might be due to increased grain yield and availability and higher uptake of nitrogen. These marine algal saps are involved in carbohydrate and protein metabolism and help the formation of aminoacids, cystein and methionin which influence protein content in grain of blackgram. These views are also supported by Zodape *et al.*[24] and Pramanick *et al.*[8]. Presence of growth promoting substances and trace element in marine algal sap increased the seed germination, root and shoot length ultimately increased the vigour index.

Table 1: Effect of marine algal sap on macronutrients uptake (N, P and K) and seed quality of blackgram

Treatment	Nitrogen uptake (kg ha^{-1})		Phosphorus uptake (kg ha^{-1})		Potassium uptake (kg ha^{-1})		Protein Yield (kg ha^{-1})	Vigor Index (%)
	Grain	Straw	Grain	Straw	Grain	Straw		
T_1 :Control 0%	37.22	19.59	4.42	3.02	9.57	12.43	232.60	2620.15
T_2 :K-sap@5%	43.33	22.37	5.52	3.75	11.21	14.10	270.81	2979.52
T_3 :K-sap@10%	49.42	25.30	6.27	4.78	12.91	15.91	308.84	3244.82
T_4 :K-sap@15%	52.83	26.85	6.96	5.28	13.95	17.05	330.17	3435.02
T_5 :G-sap@5%	44.48	23.07	5.65	3.93	11.62	14.37	278.00	3051.12
T_6 :G-sap@10%	51.28	26.31	6.72	5.11	13.53	16.74	320.48	3345.00
T_7 :G-sap@15%	54.47	27.59	7.46	5.49	14.34	17.56	340.43	3529.03
SE(m)	2.04	0.91	0.47	0.27	0.53	0.60	12.79	107.49
CD at 5%	6.31	2.82	1.45	0.83	1.66	1.88	39.43	331.23
GM	47.57	24.44	6.14	4.48	12.45	15.45	297.33	3171.10

UPTAKE OF MICRONUTRIENTS (Cu, Fe, Mn and Zn)

Micronutrients uptake i.e. copper, iron, manganese and zinc in blackgram crop were influenced significantly due to foliar application of marine algal sap along with RDF was increased with increasing doses of marine algal sap (Table 2).

Highest uptake of copper, iron, manganese and zinc were recorded with foliar application marine algal sap i.e. G-sap@15%+RDF (T_7) with respective value (11.24 and 9.18 g ha^{-1}), (309.04 and 253.42 g ha^{-1}), (90.47 and 76.83 g ha^{-1}) and (63.58 and 57.08 g ha^{-1}) in grain and straw respectively. However this treatment was at par with K-sap@15 (T_4), G-sap@10% (T_6) and K-sap@10% (T_3). Percent increase of total uptake of copper, iron, manganese and zinc of blackgram was 52%, 36%, 47% and 43% observed with G-sap@15%+RDF (T_7) over control.

Table 2: Effect of marine algal sap on microutrints uptake (Cu, Fe, Mn and Zn) of blackgram

Treatment	Zn (g/ha)			Cu (g/ha)			Fe (g/ha)			Mn (g/ha)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
T_1 Control 0%	42.72	39.08	81.81	7.17	6.20	13.36	217.69	194.19	411.88	61.15	55.55	116.70
T_2 K-sap@5%	50.94	45.45	96.39	8.54	7.27	15.81	251.11	215.09	466.20	71.61	61.89	133.50
T_3 K-sap@10%	57.89	50.99	108.88	10.03	8.30	18.33	285.05	237.13	522.18	82.15	69.81	151.95
T_4 K-sap@15%	61.58	54.65	116.23	11.13	8.81	19.94	300.72	248.49	549.21	87.88	74.50	162.38
T_5 G-sap@5%	52.11	46.57	98.67	8.78	7.58	16.36	256.63	220.28	476.91	74.13	64.12	138.25
T_6 G-sap@10%	59.66	52.81	112.47	10.46	8.58	19.04	292.73	243.33	536.06	85.14	72.20	157.34
T_7 G-sap@15%	63.58	57.08	120.66	11.24	9.18	20.43	309.04	253.42	562.46	90.47	76.83	167.31
SE(m)	2.70	2.37	4.49	0.50	0.36	0.84	12.17	7.00	15.04	2.74	2.87	6.45
CD at 5%	8.33	7.33	13.85	1.57	1.13	2.61	37.51	21.57	46.36	8.44	8.87	19.89
GM	55.50	49.52	105.02	9.62	7.99	17.61	273.28	230.28	503.56	78.93	67.84	146.77

Presence of trace element in marine algal sap which enhanced the uptake and strongly supported movement of nutrients within the plant. Copper, iron, manganese and zinc uptake was found to be higher in grain than straw indicating higher demand of nutrients by seeds and translocation of nutrients into reproductive parts from vegetative parts. The significant enhancement in uptake of micronutrients due to presence of trace element, primary element and growth regulating substance in marine algal sap. Similar result was observed by Zodape *et al*[24].

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