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Effect of Foliar Spraying Seaweed Sap on The Phenolgical, Biochemical and Yield of Blackgram

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Abstract: *Experiment was conducted to find out effect of foliar spraying seaweed sap on phenological, biochemical and yield of blackgram at Research farm of Department of Agronomy, Dr. PDKV, Akola. (MS) during the kharif season 2013-14. The experiment was conducted by adopting randomized block design with three replications. Treatments consisted of six combinations of seaweed sap i.e. Kappaphycus spp. (K-sap) and Gracilaria spp. (G-sap) and one control, namely* FS_0*: (No application of seaweed sap, RDF common is applied),* FS_1*:K-sap @ 5% + RDF,* FS_2*:K-sap @ 10% + RDF,* FS_3*:K-sap @ 15% + RDF,*FS_4*:G-sap @ 5% + RDF,* FS_5*:G-sap @ 10% + RDF and* FS_6*:G-sap @ 15% + RDF. Chosen treatments were imposed at peak vegetative stage (20-25 DAS) and ten days after the first foliar spray (35 DAS) at different concentration (0, 5%, 10 % and 15%). Investigations were undertaken to document the foliar application of G-sap @ 15% (*F_6*) recorded highest phenological parameter viz., plant height, number of branches, leaf area, root length and dry matter production. Similarly, maximum value of biochemical constituent i.e. chlorophyll content (a, b and total) and carotenoids content noted in foliar application of G-sap @ 15% (*F_6*) at flowering, fruiting and pod development stage of blackgram over control. Yield attributes i.e. number of pods, pod weights and grain weight and grain yield also be recorded with foliar application of G-sap @ 15% (*F_6*). The grain yield was enhanced by 25.53% with foliar spraying of G-sap @ 15% (*FS_6*) (1218 kg/ha) than the control. However it was at par with K-sap @ 15% + RDF (*FS_3*), G-sap @ 10% (*FS_5*) and K-sap @ 10% + RDF (*FS_2*) at flowering, fruiting and pod developments stage.*

Keywords: *Blackgram, Kappaphycus and Gracilaria spp, Carotenoid, Chlorophyll and Grain yield.*

INTRODUCTION

Pulses are one of the important segments of Indian agriculture after cereals and oilseeds. These pulses constitute chickpea, pigeonpea, lentil, mungbean, urdbean and field pea. The split grains of these pulses called *dal* are excellent source of high quality protein, essential amino and fatty acids, fibers, minerals and vitamins. These crops improve soil health by enriching nitrogen status, long-term fertility and sustainability of the cropping systems. India is the largest producer of pulses, accounting for about 25 per cent of the global share. Being an inseparable ingredient in the diet of the vast majority of population and mainstay of sustainable crop production, pulses continue to be an important component of the rainfed agriculture since time immemorial, (Satya Sundaram, 2010). Blackgram (*Vigna mungo* (L.) Hepper) is one of the highly priced pulses of India. Its seeds are highly nutritious with protein (25-26%), carbohydrate (60%), fats (1.5%) and significant amount of mineral, amino acid and vitamins.

The importance of this crop among the other pulse crop is by virtue of its high nutritional value, short duration, adaptability to all season and suitability to various cropping systems. Blackgram is also used as green mannuring crop being a leguminous crop it has capacity to fix atmospheric

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nitrogen. It also helps in preventing soil erosion. Being a short duration crop and adaptability to off season it fits well in many intensive crop rotation. 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 (Booth, 1969). Seaweeds are biodegradable, non-toxic, non-polluting and non-hazardous to the environment. (Renuka Bai *et al.*, 2011). Different forms of seaweed preparation such as LSF (Liquid Seaweed Fertilizers) and SLF (Seaweed Liquid Fertilizers) either whole or finally chopped powered algal manure have been used and all of them have been reported to produce beneficial effects on cereals, pulses and flowering plants. Seaweeds are rich source of growth promoting substances such as IAA, kinetin, zeatin and gibberellins, auxins and cytokines, macro and micro elements amino acid and vitamins. Beneficial results from their use in crop plants like early seed germination and establishment, improved crop performance and yield, elevated resistance to biotic and abiotic stress.

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. Blackgram cultivar TAU-1 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.* FS_0-(No application of seaweed sap, RDF is applied), FS_1:K-sap @ 5% + RDF, FS_2:K-sap @ 10% + RDF, FS_3:K-sap @ 15% + RDF, FS_4:G-sap @ 5% + RDF, FS_5:G-sap @ 10% + RDF and FS_6:G-sap @ 15% + RDF. 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 blackgram at 20 and 35 days after sowing.

RESULT AND DISCUSSION

Effect of Seaweed Sap on Growth of Blackgram

Foliar application of different seaweed saps along with RDF increased growth attributes of blackgram significantly over control (Table 1). In general,

Table 1
Effect of seaweed sap on phenological parameters of blackgram

					Dry matter partitioningAt Harvest stage (g)				
Treatment	*Plant height at harvest (cm)*	*Number of branches*	*Leaf area (dm^2)*	*Root length (cm)*	*Leaf*	*Stem*	*Root*	*Pod*	*Drymatter production (g)*
FS_0	47.67	4.16	6.66	17.86	2.25	4.02	1.087	5.05	12.60
FS_1	50.45	4.85	7.69	19.94	2.62	4.62	1.203	6.54	15.04
FS_2	52.61	5.62	8.36	21.36	2.99	5.39	1.270	7.41	17.07
FS_3	53.97	6.06	8.90	22.28	3.31	5.81	1.321	7.95	18.40
FS_4	50.94	5.04	7.92	20.43	2.77	4.83	1.223	6.63	15.45
FS_5	53.26	5.84	8.52	21.82	3.18	5.68	1.295	7.80	17.96
FS_6	54.78	6.31	9.21	22.77	3.43	6.00	1.333	8.17	18.95
SE (m)±	0.84	0.28	0.31	0.54	0.16	0.22	0.024	0.35	0.77
CD (P = 0.05)	2.60	0.87	0.96	1.69	0.50	0.69	0.077	1.10	2.40
GM	51.95	5.22	8.18	20.92	2.94	5.19	1.248	7.08	16.49

increase in plant height, number of branches, leaf area, root length, dry matter partitioning and total dry matter production was observed with increasing seaweed extract application.

Maximum plant height (54.78 cm), number of branches (6.31), leaf area (9.21 dm^2) root length (22.27 cm), dry matter partitioning of leaf (3.43 g), stem (6.0 g), root (1.333 g), pod (8.17 g) and total dry matter accumulation (18.95 g) was recorded with foliar application of G-sap @ 15% + RDF (FS_6) being statistically at par with K-sap @ 15% + RDF (FS_4), G-sap @ 10% + RDF (FS_5) and K-sap @ 10% + RDF (FS_3) respectively. However, the foliar spraying of K-sap @ 15 + RDF (FS_3) registered the next best treatment on higher phonological parameters. Lowest growth parameter noticed with no foliar application of seaweed liquid fertilizer (control).

Seaweed liquid fertilizer 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). Increase in the 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 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 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).

Effect of Seaweed Sap on Photosynthetic Pigment

Apart from phenological characters seaweed liquid fertilizer also improve the different biochemical parameters (Table 2). Increase in the seaweed liquid fertilizer concentration levels to blackgram from 0 to 15% of both sap (K-sap and G-sap) progressively increased the biochemical parameters *i.e.* chlorophyll content (chl. *a*, *b* and total) and carotenoids content at flowering, fruiting and pod development stage. Foliar spraying of seaweed sap *i.e.* G-sap @ 15% + RDF (FS_6) significantly enhanced the chlorophyll '*a*', '*b*' and total content at flowering stage (1.357, 0.559 and 1.919 mg g^{-1} fr wt), fruiting stage (1.553, 0.669

Table 2
Effect of seaweed sap on photosynthetic pigment of blackgram

	Flowering			*Fruiting*			*Pod Development*			*Carotenoids contents*		
Treatment	*Chl 'a'*	*Chl 'b'*	*Total*	*Chl 'a'*	*Chl 'b'*	*Total*	*Chl 'a'*	*Chl 'b'*	*Total*	*Fl.*	*Ft.*	*Pd.*
FS_0	1.211	0.402	1.612	1.301	0.484	1.785	1.067	0.447	1.514	0.486	0.553	0.387
FS_1	1.245	0.457	1.702	1.393	0.545	1.938	1.113	0.489	1.602	0.520	0.619	0.423
FS_2	1.294	0.504	1.798	1.474	0.598	2.072	1.174	0.547	1.721	0.575	0.692	0.463
FS_3	1.343	0.544	1.887	1.536	0.654	2.190	1.220	0.593	1.813	0.621	0.739	0.496
FS_4	1.256	0.468	1.724	1.408	0.559	1.967	1.087	0.506	1.593	0.538	0.641	0.438
FS_5	1.310	0.520	1.830	1.491	0.617	2.108	1.200	0.564	1.764	0.601	0.722	0.482
FS_6	1.357	0.559	1.916	1.553	0.669	2.223	1.232	0.605	1.837	0.640	0.769	0.519
SE(m)	0.0255	0.0219	0.0457	0.0303	0.0281	0.0587	0.0267	0.0238	0.0465	0.029	0.039	0.023
CD at 5%	0.0784	0.0676	0.1407	0.0933	0.0867	0.1807	0.0837	0.0733	0.1433	0.090	0.122	0.073
GM	1.288	0.493	1.781	1.451	0.589	2.040	1.156	0.536	1.692	0.569	0.676	0.458

Table 3
Effect of seaweed sap on yield attributes and yields of blackgram

Treatment	*No of Pod per plant*	*Pod Wt. Per plant (g)*	*Grain wt. Per plant (g)*	*Test Wt. (g)*	*Grain yield (kg ha^{-1})*	*Straw yield (kg ha^{-1})*
FS_0	12.04	5.05	2.62	48.03	907	1884
FS_1	13.87	6.54	3.06	48.14	1012	2059
FS_2	15.63	7.41	3.48	49.06	1116	2196
FS_3	17.02	7.95	3.73	49.45	1184	2304
FS_4	14.24	6.63	3.18	47.75	1042	2102
FS_5	16.39	7.80	3.62	48.93	1146	2244
FS_6	17.95	8.17	3.88	49.78	1218	2354
SE(m)	0.84	0.35	0.15	0.66	38.73	59.51
CD at 5%	2.60	1.10	0.47	NS	119.33	183.34
GM	15.31	7.08	3.37	48.74	1089	2163

and 2.223 mg g^{-1} fr wt) and pod development stage (1.232, 0.605 and 1.837 mg g^{-1} fr wt) and it was statistically at par with K-sap @ 15 + RDF (FS_3), G-sap @ 10 + RDF (FS_5) and K-sap @ 10 + RDF (FS_2). Similarly highest carotenoids content was observed with foliar spraying of G-sap @ 15% + RDF (FS_6) with respective values *i.e.* (0.640, 0.769 and 0.519 mg g^{-1} fr wt) at flowering, fruiting and pod development stage. Among the all growth stages, highest photosynthetic pigment *i.e.* chl. 'a' chl. 'b' total chl (1.553, 0.669 and 2.223 mg g^{-1} fr wt) and carotenoids content (0.769 mg g^{-1} fr wt) noted at fruiting stage. Significantly lowest photosynthetic pigment recorded with control plant. Percent increased of total chlorophyll content were 19.04% 24.53% and 21.33% respectively.

Seaweed liquid fertilizer rich source of potassium and cytokinin, Potassium protect the chlorophyll molecule from photo-oxidation and increased chlorophyll synthesis, maintains turgor, reduces water loss and wilting which lead to increase the food formation and photosynthesis. Cytokinins inhibit degradation of chlorophyll, breakdown of protein molecules and increase the chlorophyll level soybean. The results obtained in this regard are in close accordance with those of Shanker *et. al* (2014) and El-Yazied *et. al* (2012). The highest carotenoids contents of blackgram were observed at higher concentration of seaweed liquid fertilizer of *Gracilaria sap* @ 15%. Such a rise in leaf protein contents may be attributed to the increased availability and absorption of necessary elements (Ca, Na, K, Mg, N and Zn) present in the seaweed extracts. This is in agreement with the work of Anantharaj and Venkatesalu (2001), Sivasankari Ramya *et al.* (2011) and Erulan *et.al.* (2009).

Effect of Seaweed Sap on Yield Attributes and Yield

Yield and yield attributing characters of blackgram were influenced significantly by the foliar spraying of seaweed liquid fertilizer (Table 3). Foliar spraying of seaweed liquid fertilizer *i.e.* G-sap @ 15% + RDF (FS_6) significantly recorded highest number of pods/plant (17.95), pod weight/plant (8.17g) and grain weight/plant (3.88g) as compared to control. However it may at par with K-sap @ 15% + RDF (FS_3), G-sap @ 10% + RDF (FS_5) and K-sap @ 15% + RDF (FS_2).

Lowest yield attributes noted in control. Increased spraying of seaweed liquid fertilizer (*Kappaphycus* and *Gracilaria spp*) from 0 to 15% also significantly increased the grain yield and straw yield of blackgram than the control (Table 3). Foliar spraying of seaweed liquid fertilizer G-sap @ 15% + RDF (FS_6) registered maximum grain yield (1218 kg ha^{-1}) and straw yield (2354 kg ha^{-1}) and it was at par with K-sap @ 15% + RDF (FS_3), G-sap @ 10% + RDF (FS_5) and K-sap @ 15% + RDF (FS_2). The percent increased the grain yield of blackgram was (34.28%) as compared to control. Minimum grain yield and straw yield of blackgram noted in control *i.e.* 907 and 1884 kg ha^{-1}.

The blackgram 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 blackgram crop and eventually more number of pods, pod weight and grain yield per plant, ultimately resulted into increased grain yield. The increased seed yield could be attributed to higher dry matter production and its accumulation in reproductive parts, higher net assimilation rate, biomass duration and enhanced chlorophyll content. These results are in confirmation with results obtained by Rathore *et al.* (2009), Zodape *et al*. (2010), Renuka Bai *et al.* (2011), Sharma *et al.* (2011), Raverkar *et al.* (2012) and Shankar *et al.* (2014).

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