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Research Paper

Effect of Seaweed Liquid Fertilizers on Productivity of *vigna radiata* (L).Wiliczek

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Abstract: *A field experiment was conducted at Regional Agricultural Research Station, Lam, Guntur during rabi seasons of 2012-2013 and 2013-2014 to study the effects of seaweed liquid fertilizers on growth and yield of greengram on deep black clay loam soils. The foliar application was done twice at different concentrations (0, 2.5, 5.0,7.5,10.0 and 15.0 % v/v) of seaweed liquid fertilizers (namely Kappaphycus and Gracelaria). Control plot was sprayed with water. Foliar application of either kappaphycus and gracilaria @10 % sap at flowering stage and pod development stage resulted in increased plant height, branches per plant, number of pods per plant, test weight (100 grain) and grain yield (19.3% and 25.4% respectively) over the control. The presence of micro and macro nutrients, vitamins, growth hormones and other constituents in the seaweed extract might be very much useful to the crops but their level should be appropriate to enhance growth and productivity. It may be concluded that liquid seaweed extracts could serve as cost effective eco-friendly product for sustainable agriculture.*

Keywords: Greengram, Kappaphycus, Gracelaria, seaweed extract, productivity

Introduction

The use of seaweeds as manure in farming practices is very ancient and common practice among the Romans and also practiced in Britain, France, Spain, Japan and China. Organic fertilizers have contributed for deposition of crop residues, physical and chemical properties of soil[1]. Among the organic sources as supplemental fertilizers, seaweed extract have been used[2].

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. Liquid extracts obtained from seaweeds have recently gained importance as foliar sprays for many crops including various cereals, pulses and different vegetable species. Seaweed extracts contain major and minor nutrients, amino acids, vitamins, cytokinins, auxins and abscisic acid like growth promoting substances and have been reported to stimulate the growth and yield of plants, develop tolerance to environmental stress[3], increase nutrient uptake from soi[4] and enhance antioxidant properties[5]. Seaweed Liquid Fertilizers treatment increased the number of branches and concentration of photosynthetic pigments[6].

The extracts derived from seaweeds are biodegradable,nontoxic, non-polluting and non-hazardous to humans, animals and birds[7]. With the advancement of modern agricultural technologies, we somehow achieved food security for our country to feed its ever escalating population. But so far, unfortunately, we could not achieve nutritional security for our people. Seaweed extract is a new generation of natural organic fertilizers containing highly effective nutritious and fast germination of seeds and increase in yield. Greengram or mungbean is the third most important legume crop grown and consumed in India and is a good source of carbohydrates, proteins and minerals. India is the largest producer and consumer of pulses in the world contributing around 25-28 % of the global production. This study presents application of seaweed liquid fertilizer as a foliar spray to greengram to determine improvement in growth and yield.

Material and Methods

A Field experiment was conducted for 2 years from 2012-2013 and 2013- 2014 during *rabi* seasons at Regional Agricultural Research Station, Lam, Guntur (A P), India to find out the effect of seaweed liquid fertilizers on productivity of *Vigna radiata* L (greengram). The soil of the experimental site was clay loam in texture with soil pH was neutral in reaction (6.8) and an electrical conductivity of 0.45 dSm^{-1}. The soil organic carbon content was low (0.61%). The soil was low in available nitrogen (203 kg ha^{-1}), medium in available phosphorus (22.4 kg ha^{-1}) and available potassium (412 kg ha^{-1}).

Table 1: **Details experimental treatments**

Treatment	Details	Time of application
T_1	2.5 % *Kappaphycus* sap spray	Flower initiation and pod formation
T_2	5.0 % *Kappaphycus* sap spray	,,
T_3	10 % *Kappaphycus* sap spray	,,
T_4	15 % *Kappaphycus* ap spray	,,
T_5	2.5 % *Gracilaria* spray	,,
T_6	5.0 % *Gracilaria* spray	,,
T_7	10 % *Gracilaria* spray	,,
T_8	15 % *Gracilaria* spray	,,
T_9	Water spray	,,
T_{10}	7.5 % *Kappaphycus* spray	,,

The experiment comprised of ten treatments, the details of the treatments are mentioned Table 1. Two sprays of *Kappaphycus* and *Gracilaria* extracts were given, one at the flowering stage and the other at the pod development stage. These seaweed extracts were collected from Central Salt and Marine Chemicals Research Institution (Council of Scientific and Industrial Research), G.B. Marg, Bhabnagar, Gujarat-364002, India. For proper adherence, extracts were mixed with proper surfactant (Active 80 at 0.5 ml l^{-1} of water) at the time of spraying. The total spray volume was 500 L ha^{-1} in each application. The treatments were distributed in a randomized block design with three replications. The plot size was 5 × 6 m. The recommended dose of fertilizer (RDF) for green gram was 20-50-0 kg ha^{-1} N, P_2O_5 and K_2O, respectively and all fertilizers were applied as basal through Urea and Single Super Phosphate (SSP). Date of sowing was 13th and 15th of November, 2012 and 2013 and the crop was harvested on 1st February, 2013 and 5th February, 2014, respectively. The crop was grown with standard packages of practices for the region.

Plant height at harvest was recorded for randomly selected five plants. Data on yield components viz., branches per plant, pods plant and test weight (100 grain) was also recorded. All data were analyzed using analysis of variance (ANOVA) following randomized block design (Gomez and Gomez) [8]. Differences were considered significant at 5% level of probability.

Results and Discussion

Growth and yield attributes: Plant height was measured at recorded at harvesting stage and the data presented in table 2. The plant height increased up to 10 % concentration of both extracts during 1st year, but in second year the increase was up to 15% concentration of *gracelaria* sap only and the increase was significantly superior over control. The maximum mean plant height recorded with 10% concentration of *kappaphycus* sap (47.9 cm) and was statistically on a par with *gracelaria* sap at same concentration. The increase in plant height with seaweed liquid fertilizer may be due to its stimulation effect on growth and development resulting in good health of plants, while deliberating the effect of seaweed liquid fertilizer on crops the aspects of root development and mineral absorption, shoot growth and photosynthesis of the plant system. These findings are in agreement with those of Pramanick *et al*. [9], Gurusaravanan *et al*. [10] and Zodape *et al*. [11].

The maximum number of branches per plant and pods per plant were recorded with foliar application of 10% k*appaphycus* which was closely followed by 15 % *gracelaria* sap. The mean maximum number of branches per plant (3.5) was recorded with 10 % *kappaphycus* or at higher concentration of 15 % *gracelaria* liquid fertilizer sap which was superior over control. Similarly, the highest number of pods per plant, 32.8 and 31.5 were recorded with respective levels of both seaweed liquid fertilizers. This is in conformity with the findings reported for *Capsicum annum*[12], blackgram [13], canola plants [14] and greengram[11]. Significant increase in test weight was observed with 10 % foliar spray of both seaweed liquid fertilizers over control during 2013-14, however, among the treatments the difference was not significant. This is in conformity with the results obtained for greengram[11].

Yield: Foliar application of seaweed liquid fertilizers (10%) resulted in higher grain yields over control to the extent of 19.3% (*kappaphycus*) and 25.4% (*gracilaria*) which was the highest and significantly superior when compared to control plot (water spray). The increase in grain yield was mainly due to increase in number of branches per plant, as well as number of pods per plant and test weight. The beneficial effects of seaweed extract may be due to presence of some growth promoting substances (IAA, IBA, Gibberelins, Cytokinins, micronutrients, vitamins and aminoacids). Our results confirm those findings previously reported by Pranamick *et al*.[9], Bai *et al*.[15], Zodape *et al*.[16] and Gurusaravanan *et al*. [10]. The yields of several crops like blackgram[13], *Capsicum annum*[12], canola plants [14] and *Abelmoschus esculentus*[17] were increased with foliar application of seaweed liquid fertilizers.

Conclusion

Foliar application of seaweed liquid fertilizers of *kappaphycus* and *gracelaria* increased growth and yield of greengram due to the stimulation effect of growth promoting substances such as IAA,IBA, gibberellins, cytokinins, vitamins, aminoacids and micronutrients. It may be concluded that liquid seaweed extracts could serve as cost effective eco-friendly product for sustainable agriculture, but their level should be appropriate to enhance growth and productivity.

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Table 1: Effect of sea weed liquid fertilizer on growth and yield of Greengram during 2013and 2014

Treatments	Plant Height (cm)			No. of branches /plant			No. Pods/ plant			100 seed weight (g)			Seed Yield (kg/ha)		
	2013	**2014**	**Mean**	**2013**	**2014**	**Mean**	**2013**	**2014**	**Mean**	**2013**	**2014**	**Mean**	**2013**	**2014**	**Mean**
T_1	57.3	32.7	45.0	3.1	3.1	3.1	31.9	24.7	28.3	3.2	3.2	3.2	583	711	647
T_2	60.0	35.2	47.6	3.1	3.2	3.1	33.8	26.2	30.0	3.3	3.3	3.3	604	711	658
T_3	60.0	35.8	47.9	3.3	3.6	3.5	37.7	27.8	32.8	3.4	3.4	3.4	741	800	771
T_4	60.0	34.5	47.3	3.3	3.3	3.3	34.1	26.7	30.4	3.3	3.4	3.4	684	756	720
T_5	55.7	31.7	43.7	3.4	2.9	3.2	31.4	24.0	27.7	3.3	3.3	3.3	673	667	670
T_6	56.7	34.1	45.4	3.4	3.1	3.3	33.1	24.7	28.9	3.3	3.4	3.4	693	667	680
T_7	57.7	35.6	46.7	3.3	3.2	3.3	33.1	28.1	30.6	3.4	3.5	3.5	763	856	810
T_8	54.0	37.1	45.6	3.4	3.6	3.5	31.8	31.2	31.5	3.3	3.5	3.4	731	878	805
T_9	54.7	31.8	43.3	3.2	2.7	3.0	27.5	22.9	25.2	3.3	3.1	3.2	670	622	646
T_{10}	57.7	35.0	46.4	3.1	3.3	3.2	33.1	24.1	28.6	3.4	3.5	3.5	686	744	715
SEM+	1.3	1.13		0.2	0.16		1.1	1.48		0.04	0.09		14.8	27.35	
CD (P=0.05)	3.9	3.3		NS	0.5		3.5	4.4		NS	0.26		43.9	81	

T_1- 2.5 % *kappaphycus* sap spray, **T_2**- 5.0 % *kappaphycus* sap spray, **T_3**- 10 % *kappaphycus* sap spray, **T_4-15** % *kappaphycus* sap spray, **T_5**- 2.5 % *gracilaria* sap spray, **T_6**- 5 % *gracilaria* sap spray, **T_7**- 10 % *gracilaria* sap spray, **T_8**- 15 % *gracilaria* sap spray, **T_9**- Water spray, **T_{10}**-7.5 % kappaphycus sap spray.