Effect of Seaweed Extract and Compost Treatments on Growth, Yield and Quality of Snap Bean

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Abstract: The study was carried out during 2009 and 2010 seasons, on snap bean, (Phaseolus *vulgaris* L.). cultivars. Bronco, fine type. at Brnashat village, Giza governorate, Egypt. In order to investigate effect of seaweed extract and compost treatments. The experiment which carried out to study the effect of four different seaweed compost levels (0, 1, 2 and 3 m^3 seaweed compost/feddan) and four concentration of seaweed extract (0, 250, 500, 750 ppm) as a foliar application on vegetative growth, flowering characteristics, yield parameters and chemical composition. Results indicated that spraying the plants with seaweed extract at higher rate significantly increase Number of leaves per plant, Average leaf area, Leaf and stem fresh weight per plant, Leaf and stem dry weight per plant, Percentage of fruit set, compared to control. Seaweed extract at 750 ppm tested concentrations exhibited the highest significantly pods yield compared to those of untreated check and other treatments. Spraying seaweed extract at higher rate tended to have the highest values from photosynthetic pigments, N, P, K and Mg content of leaves whereas, protein content in pods, free amino acids percentage in leaves, carbohydrates in leaves and pods and carbohydrates fraction in leaves both rates (500 and 750 ppm seaweed extract) gave the highest value with significance over the 250ppm and control plants. But fiber percentages in pods have no significance difference between treatment and control. Seaweed compost treatments showed that using $3m^3$ or 2 m^3 per feddan gave the highest value on vegetative growth, flowering characteristics, yield parameters and chemical composition (minerals and biochemical values). It was concluded that reproductive, pods yield characteristics and chemical composition of snap bean responded positively to $3m^3$ or $2m^3$ seaweed compost combined with foliar application 750 ppm seaweed extract.

[Abou El-Yazied, A.; A. M. El-Gizawy; M. I. Ragab and E. S. Hamed. **Effect of Seaweed Extract and Compost Treatments on Growth, Yield and Quality of Snap Bean.** J Am Sci 2012;8(6):1-20]. (ISSN: 1545-1003). http://www.sciencepub.net/american. 1

Key words: Snap bean, *Phaseolus vulgaris*, Seaweed extarct, Seaweed compost, Growth, Yield.

1. Introduction

Snap bean (*Phaseolus vulgaris*, L.) is one of the most important members of leguminous crops in Egypt grown for either local consumption or exportation, it is known as green bean or snap bean it is important source for protein and energy for many developing countries. It's Rich in protein, dietary fibres, minerals (Ca, P, Fe, K, Mg & Mn) and vitamins (A, B1, B2 & C) with high amino acids **(Şehirali, 1988).** The cultivated area with snap beans in Egypt is about 64045 feddan according to Horticultural Central Administration and Agricultural Crops (Ministry of Agriculture and Land Reclamation, 2011).

Growers have always sought new methods to control the growth of plants; seaweed appears some of the qualities of efficient plant growth regulators which would justify its use as a soil additive. The use of seaweed in agriculture is not new, since ancient Greeks, Chinese and Viking applied seaweed mulches to the soil. Authentic records of the use of seaweed for plant growing date back many centuries. France, in 1681 issued a royal degree regulating the condition under which seaweed could be collected; the degree also specified the type and location of seaweed and for what it was to be used. Although seaweed has been used as mulch for certain crops for centuries, investigation into the response of plants in growth and development have been initiated only in recent years, Seaweed liquid fertilizers were found superior than chemical one because of the presence of high levels of organic matter, thus accounting a reduction of 50% cost for chemical fertilizer **(Aitken and Senn 1965).** Seaweeds are one of the most important marine resources of the world and being used as human food, animal feed and raw material for many industries, they are also used as manure for agricultural and horticultural crops **(Chapman and Chapman1980).** The importance due to the presence of minerals, trace elements and plant growth regulators which occur in water soluble form **(Moller and Smith., 1998, 1999)** and enhances the disease resistance in field crops **(Verkleij,1992).** The chemistry of seaweed (*Ascophyllum nodosum*) is complex, it has a very high content of organic carbon (particularly carbohydrates such as alginic acid, laminaren and mannitol), seaweed is also high in polysaccharides but yet very low in N. P. K, seaweed is well known for its trace mineral content and the presence of a range of biologically active, growth promoting substances (**Crouch, and van Staden 1993).** Seaweed concentrates are known to cause many beneficial effects on plants as they contain growth promoting hormones (IAA and IBA, Cytokinins), trace elements (Fe, Cu, Zn, Co, Mo, Mn, and Ni), vitamins and amino acids **(Challen and Hemingway 1965; Khan *et al*. 2009).** Several investigators have been made a lot of researches to know how seaweed works including morphological and chemical development in plants since 1965 till now. Seaweed extract is a new generation of natural organic fertilizers containing highly effective nutritious and promotes faster germination of seeds and increase yield and resistant ability of many crops, unlike the chemical fertilizers, extracts derived from seaweeds are biodegradable, non-toxic, non-polluting and non-hazardous to humans, animals and birds **(Dhargalkar and Pereira, 2005).** Seaweed treatment of crops has grown in popularity and led to develop large numbers of processed seaweed products. These can be placed into three groups, meals for supplementing soil in large volumes or for blending into defend rooting media for glasshouse crops, powered or liquid extracts, and concentrates employed as root dips, soil drenches and foliar sprays (**Both,1969; Senn, 1987).** Seaweed extracts are known to enhance seed germination and plant growth **(Bhosle *et al* 1975; Sekar *et al.* 1995).** All the crude extracts of seaweed increased protein content in root and shoot systems; total soluble sugars and chlorophyll content in leaves. **(El-Sheekh and El-Saied 1999).** As for application of seaweed to the soil (**Zodape, *et. al.* 2010; Hamblin, 1991 and Ouedraogo*, et. al. 2001)*** show that organic matter improves physical and chemical properties of soil (porosity, structure, and water- holding capacity). Among organic sources as supplemental fertilizer, seaweed extract has been used (**Zodape, 2001**). More than 15 million tons of seaweed products are used annually as nutrient supplements and biostimulants in agriculture and horticulture crop production; application of seaweed extracts enhances seed germination and seedling vigour **(kambayashi and wanata, 2005; Economou et al 2007**). Then we agreement with **(Kumar and Sahoo 2011)** when they demonstrated that seaweed liquid extract could serve as an alternative bio fertilizer as is eco-friendly, cheaper, deliver substantial economic and environmental benefits to farmers.

Hence the aim of study was conducted to find out the effect of seaweed extract and compost treatments on growth, yield and biochemical parameters of green bean.

2. Materials and Methods

This investigation was carried out through 2009 and 2010 seasons, on snap bean, (Phaseolus *vulgaris* L.). cultivars. Bronco, fine type. at Brnashat village, Giza governorate, Egypt. The soil texture was clay, the chemical and physical properties of the soil are shown in Table (A).

Table A: Chemical and physical properties of the soil at Brnashat village, Giza governorate, during 2009 and 2010 seasons.

Chemical properties

Seasons	EC m. mhos/cm	PH	Cations (Meq. L^{-1})				Anions (Meq. L^{-1})		
			Ca^{++}	Mg^{++}	K^{+}	Na^{+}	Cl^{-}	$Hco3^{-}$	$SO4^{-}$
2009	0.93	8.0	4.5	5.3	0.72	1.2	1.1	5.3	4.8
2010	0.89	8.1	5.3	4.8	0.56	1.3	0.9	6.5	3.8

Physical properties

Seasons	Sand %	Silt %	Clay %	Organic matter %	Texture
2009	21.6	20.2	58	2.2	clay
2010	20	23	57	1.87	

Soil samples were analyzed by Soil Water and Environment Res. Inst. Agric. Res. Center.

The analysis of regular and seaweed compost are shown in Table (C) about 20 m^3 / feddan of regular plant compost was used as control treatment , while seaweed compost was partly replacement instead of the regular plant compost with three levels to applied as compost treatments on planted beans, the four compost mixture levels was,

- Regular plant compost at 20 m^3 + 0 m^3 seaweed compost / feddan.
- Regular plant compost at 19 m^3 + 1 m^3 seaweed compost / feddan.
- Regular plant compost at 18 m^3 + 2 m^3 seaweed compost / feddan.
- Regular plant compost at 17 m^3 + 3 m^3 seaweed compost / feddan.

Combined with four concentrations of seaweed extract (0 - 250 - 500 – 750 ppm) as a foliar application for three times (the first before flowering, 15 and 30 days after the first one). The chemical and biochemical analyses of seaweed extract are shown in table (B).

Seeds of snap bean "Bronco cultivar" were sown on the 1st of September 2009 and 2010 seasons. The experimental plot was 14 m^2 consisted of five rows; each row was 4 m length and 0.7 m width. The planting distance was 7 cm apart on one side, an alley (1 m wide) was left as boarder between compost treatments. Harvesting pods was carried out for three times. All replicates received similar agricultural practice such as fertilization, irrigation management also disease and pest control programs according to the recommendations of the Egyptian Ministry of Agriculture.

Table (B) Chemical and biochemical analyses of seaweed extract during 2009 and 2010 seasons.

Organic matter	Growth regulators	Macro and micro elements
Total amino acid 6% Carbohydrates 35% Alginic acid 10% Manitol 4% Betaines 0.04%	IAA 0.03% Cytokinins (Adenine)0.02%	Organic (N) 3.12 % P_2O_5 2.61 % K_2O 4.71 % Ca 0.25 % S 3.56 % Mg 0.58 % Fe 150 ppm Zn 70 ppm Mn 13 ppm B 60 ppm I 30 ppm

The experiment layout:

The experiment was laid out in a split plot design with four replicates. the levels of seaweed compost were assigned in the main plots and foliar application of seaweed extract were distributed in the sub-plots.

Table (C): Chemical and biochemical analyses of seaweed and regular plant compost.

Seaweed compost	Regular plant compost	Characteristics
30.4	27.5	moisture %
6.2	7.4	PH
1.5	4	EC (ds/m)
2.1	1.6	Total nitrogen %
33	44	Organic matter %
19.12	25.5	Organic carbon %
01:13	01:15	C/N ratio
0.9	0.6	Total phosphor %
1.6	1.3	Total potassium %
0.11	0.7	Calcium %
0.10	0.09	Magnesium %
1.1	0.23	Sulphur %
1400	1750	Fe ppm
160	125	Mn ppm
90	60	Zn ppm
130	200	Cu ppm
15	-	I ppm
non	non	Weed seeds
		Nematodes
		Parasitic
125	26	Growth regulators total auxin ppm
80	15	Cytokinins (Adenine) ppm
2.1	0.3	Total amino acid %

Studied characteristics:

Vegetative characteristics:

Five Plants per each experimental plot were chosen randomized from four replications (from the inner rows).

$$\text{Leaf area (cm}^2\text{)} = \frac{\text{Disk area} \times \text{No. Disks} \times \text{Leaf FW}}{\text{Disk FW}}$$

Leaf and stem fresh weight per plant, Leaf and stem dry weight per plant. (A.O.A.C., 2005), Percentage of fruit set.

Fruit characteristics: Five plants were used to determine the following characters

Number of pods per plant, pod fresh weight per plant, total pods yield per plant, estimated pod yield (ton/ fed.), marketable pod yield (ton/ fed.).

Chemical analyses:

Leaf chlorophyll reading (SPAD), Total nitrogen in leaves (mg/ 100 mg DW) according to **(black 1965)**. Total phosphorus in leaves (mg/ 100 mg DW), it was determined as reported by (**Troug and Meyer 1939**).Total potassium in leaves (mg/ 100 mg DW) it was determined as reported by Brown and (**lilleland 1946**). Total magnesium in leaves (mg/ 100 mg DW). It was measured according to (**A.O.A.C. 2005**). Fiber percentage in pods: it was determined according to (**Rai and Mudgal 1988**) Total soluble protein (mg/100mg DW) in pods: it was determined according to (**Bradford 1976**). Free amino acid percentage in leaves: it was determined according to **(Rosen 1956)**. Total sugars, reducing sugars, non reducing sugars (mg/100 mg DW.) in leaves. Total carbohydrates (mg/100 mg DW.) in leaves and pods: It was measured according to **(A.O.A.C. 2005**).

Statistical analysis:

Data of the two seasons were arranged and statistically analyzed using M static (M.S.) software. The comparison among means of the different treatments was determined, as illustrated by **Snedecor and Cochran (1982).**

3. Results and Discussion

Vegetative characteristics:

Data presented in Tables (1-6) show the influence of different levels of seaweed as compost treatments and different concentration of seaweed extract as foliar application during 2009 and 2010 seasons on leaf number, leaf area, leaf fresh weight, leaf dry weight, stem fresh weight and stem dry weight of snap bean and we found that, In general, the vegetative growth of snap bean responded positively to levels of seaweed compost. Using seaweed compost $2m^3$ or $3m^3$ per feddan increased plant length, leaf number, leaf dry weight, stem fresh weight and stem dry weight. However using $3m^3$ per feddan was better on leaf area and leaf fresh weight in the two seasons as compared with the other studied levels treatments.

Concerning the foliar application of seaweed extract in the two tested seasons, the obtained data showed that the foliar application of seaweed extract 750 ppm concentration increased significantly leaf number, leaf area, leaf fresh weight and stem fresh weight as compared with the other studied levels of the treatments and there is no significant difference between 500 and 250 ppm seaweed extract for these measurements. However, the measurements (leaf dry weight and stem dry weight), have no significance differences detected for the treatments, with slight increasing for concentration 750 ppm foliar application of seaweed extract in the two tested seasons.

Respecting the interactions, the studied combination between adding seaweed compost at different concentration of foliar application of seaweed extract, indicated that plants treated with seaweed compost 3m^3 and foliar application of 750ppm concentration showed the highest leaf number, leaf area, leaf fresh weight, leaf dry weight, stem fresh weight and stem dry weight, in the two seasons as compared with the other combination treatments. These results in harmony with **Temple *et al* 1988** studying the effects of two kelp (*Macrocystis integrifolia* and *Ecklonia maxima*) concentrates, when prepared as foliar sprays, on bean (*Phaseolus vulgaris*) growth and N nutrition found that shoot/root ratio, leaf area ratio and specific leaf area positively responses. Also **Ramya *et al* 2010** used liquid extracts of marine as soil drench to cluster bean plant and noticed maximum influence on growth parameters such as shoot length, root length, total fresh and dry weight and leaf area. The growth enhancing potential of seaweed might be attributed to the presence of carbohydrate, micro and macro elements. And **Sangeetha and Thevanathan 2010** when studying the seedling leaves area on pulses and rice plants found that Apart from the large number of leaf or leaflet production, the leaf area or the lamina of the leaves in plants grown in soil amended with panchagavya was always larger than those of the control plants. Similar results obtained by **Kumar and Sahoo 2011** a 6.7% increase in shoot length over control was measured 25 days after germination and a 46.15% increase in the number of branches plant−1 for the same 20% treatment and due this to seaweed extracts are known to enhance the growth of vegetables, fruits, and other crops as they are reported to contain growth regulators such as auxins (IAA and IBA), gibberellins, cytokinins, betaines, and major macro- and micronutrients. **Sridhar and Rengasamy 2010** assure our result**,** the groundnut treated with *S. wightii* SLF showed in physical parameters like total plant height, shoot height, root height (cm), total fresh and dry weight, shoot fresh and dry weight, root fresh and dry weight (g), number of branches and leaf area of third young leaf (cm2) were also showed higher values when the plants received with 1.0% *S. wightii* SLF and explain these by the seaweed extract obtained from *S. wightii* contained a maximum amount of K compared to the other macro nutrient N and P. Also **Thirumaran *et al* 2009** investigat an attempt has been made to study the effect of SLF with or without chemical fertilizer on growth of *Cyamopsis tetragonoloba* (L) Taub. Result showed that shoot length**:** The maximum shoot length recorded was 34.89 cm in the plants that received 20% SLF with recommended level of chemical fertilizer compared with the observed value was 30.46 cm in the control plant. And number of leaves in cluster bean the maximum number of leaves length recorded was 23 in the plants that received 20% SLF with recommended level of chemical fertilizer compared with the observed value was 14 in the control plant. It is probably due to the presence of growth promoting hormones and nutrients in more quantities in brown alga that increase growth. **Sultana *et al* 2011** study the application of seaweed as soil amendment on soybean, showed slightly better effect on plant growth than urea or potash by producing taller plants. Similar effect obtained by **Pise and Sabale 2010** fresh and dry weights of fenugreek were found maximum with 50% treatment of *Ulva* and almost had similar values by **Shehata *et. al.* 2011** investigate the effect of amino acid and seaweed extract compared to control on celeriac plants and results indicated that spraying the plants with amino acids and seaweed extract at higher rate significantly increased plant height and fresh and dry weight of leaves compared to control. And due growth enhancing potential of the seaweed extract might be attributed to the presence of macro and micronutrients and may be due to the presence of some growth promoting substances present in the seaweed extract. And **Nour *et al* 2010** elucidate the effect of foliar spray with seaweed extracts (without, 1g/ l and 2g/ l) on growth, dry weight and physical characters of tomato plants, resulted showed; It is obvious from the data that increasing the dose of applied seaweed extracts from 0.0 up to2g/l led to a marked stimulative effect on growth parameters as compared with the control treatment in both seasons, with the exception of number of shoots per plant. These results might be attributed to the beneficial effect of seaweed extracts contain naturally occurring supplying nutrients, plant growth hormones (auxins, cytokines and gibberellins) as well as other plant bio stimulants; e.g. amino acids, vitamins that could maintain photosynthetic rates, improve plant resistances, delay plant senescence and control cell division. Then **Kumar and Sahoo 2011** also mentioned that the application of SLE-enhanced root length, number of lateral roots, shoot length and number of branches increased maximum for the 20% treatment. Equal results found by **Sridhar and Rengasamy 2011** the plants that received 1.0% concentration showed a maximum plant height of 51.0cm, which was more than 54.0% when compared to control. Further, SLF treatment showed maximum plants height, fresh weight, dry weight and number of branches. And **Zodape *et al* 2008** study the effect of liquid seaweed fertilizers applied as a foliar spray with different concentration on yield and nutrition quality of okra and found that plants sprayed with LSF showed a significant increase in growth parameters such as height, fresh weight and dry weight of plants. **Zahid B. P. 1999; Reitz and Trumble 1996** noticed the similar result when applied seaweed as a manure and foliar application then found that foliar application and seaweed manure increased plant size, wet mass, dry mass, leaf area and stem dry mass compared to control. These results strongly suggest that cytokinins are a biologically active component of this seaweed concentration.

Table 1: Effect of seaweed extract foliar application and compost treatments on leaf number of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0 ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	16.25 e	18.38 cde	20.00 b-e	21.75 a-d	19.09 C'
1 m^3	17.38 de	21.25 a-d	22.88 de	22.13 a-d	20.91 BC '
2 m^3	22.75 a-c	23.00 a-c	22.75 a-c	24.25 ab	23.19 AB'
3 m^3	22.50 a-c	24.38 ab	24.38 ab	25.13 a	24.09 A'
Mean	19.72 B	21.75 AB	22.50 AB	23.31 B	
	2nd seasons				
0.0 m^3(control)	15.63 f	17.25 ef	19.38 c-f	20.63 b-f	18.22 C'
1 m^3	18.50 def	22.13 a-e	23.50 a-d	22.88a-d	21.75 BC'
2 m^3	23.50 a-d	23.88 a-d	23.88 a-d	25.13 ab	24.09 AB'
3 m^3	24.75 a-c	26.25 a	26.13 ab	26.88 a	26.00 A'
Mean	20.59 B	22.38 AB	23.22 AB	23.88 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 2: Effect of seaweed extract foliar application and compost treatments on leaf area (cm^2) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0 ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	142.22 i	148.66 hi	160.09 fg	177.04 cd	157.00 C'
1 m^3	157.23 gh	168.81 def	176.46 cd	189.89 b	173.10 B'
2 m^3	166.70 ef	167.82 def	176.33 cd	191.51 b	175.59 B'
3 m^3	174.77 cde	183.78 bc	192.85 b	211.37 a	190.69 A'
Mean	160.23 C	167.27 BC	176.43 B	192.45 A	
	2nd seasons				
0.0 m^3(control)	149.41 i	156.29 hi	164.50 gh	183.04 de	163.31 C'
1 m^3	163.70 gh	172.53 fg	183.13 de	202.08 b	180.36 B'
2 m^3	173.46 efg	174.99 ef	186.71 cd	202.97 b	184.53 B'
3 m^3	179.12 def	186.11 cd	194.41 bc	214.57 a	193.55 A'
Mean	166.42 C	172.48 BC	182.19 B	200.66 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 3: Effect of seaweed extract foliar application and compost treatments on leaf fresh weight (g) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0 ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	43.33 h	43.83 h	48.00 fgh	54.00 def	47.29 D'
1 m^3	46.56 gh	49.79 efg	53.08 def	58.73 bcd	52.04 C'
2 m^3	53.28 def	54.43 cde	58.26 bcd	63.76 ab	57.43 B'
3 m^3	58.56 bcd	60.43 bc	63.68 ab	69.05 a	62.93 A'
Mean	50.43 C	52.12 C	55.75 B	61.38 A	
	2nd seasons				
0.0 m^3(control)	46.05 h	46.93 gh	50.88 e-h	56.40 cde	50.06 D'
1 m^3	47.93 fgh	51.48 e-h	54.18 def	61.09 bc	53.67 C'
2 m^3	52.91 d-g	53.52 def	56.97 cde	62.71 bc	56.53 B'
3 m^3	58.45 cd	61.94 bc	65.04 b	71.44 a	64.22 A'
Mean	51.34 C	53.47 BC	56.76 B	62.91 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 4: Effect of seaweed extract foliar application and compost treatments on leaf dry weight (g) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	9.01 b	9.61 b	10.18 ab	11.15 ab	9.99 B'
1 m^3	9.10 ab	11.44 ab	12.30 ab	12.31 ab	11.29 AB'
2 m^3	11.97 ab	11.33 ab	11.70 ab	12.42 ab	11.85 AB'
3 m^3	11.15 ab	12.60 ab	12.88 ab	13.48 a	12.52 A'
Mean	10.31 A	11.24 A	11.76 A	12.34 A	
	2nd seasons				
0.0 m^3(control)	9.13 c	9.91 bc	10.41 bc	11.11 abc	10.14 B'
1 m^3	9.93 bc	12.22 abc	12.78 ab	12.79 ab	11.93 A'
2 m^3	12.40 abc	12.22 abc	12.63 abc	13.27 abc	12.63 A'
3 m^3	11.69 abc	12.75 ab	13.25 ab	14.10 a	12.95 A'
Mean	10.79 A	11.77 A	12.27 A	12.81 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 5: Effect of seaweed extract foliar application and compost treatments on stem fresh weight (g) of snap during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	36.03 c	36.00 c	36.98 bc	38.28 a-c	36.82 B'
1 m^3	36.53 c	37.08 bc	38.42 a-c	39.46 a-c	37.87 B'
2 m^3	38.37 a-c	39.88 a-c	40.26 a-c	42.13 ab	40.16 A'
3 m^3	38.71 a-c	39.90 a-c	41.13 a-c	42.49 a	40.56 A'
Mean	37.41 B	38.21 AB	39.20 AB	40.59 A	
	2nd seasons				
0.0 m^3(control)	36.68 c	37.10 bc	38.86 a-c	40.20 a-c	38.21 B'
1 m^3	38.75 a-c	39.30 a-c	40.76 a-c	41.63 a-c	40.11 AB'
2 m^3	40.15 a-c	40.74 a-c	41.80 ab	43.36 a	41.51 A'
3 m^3	40.95 a-c	41.44 a-c	42.21 a	43.67 a	42.06 A'
Mean	39.13 B	39.64 B	40.91 AB	42.21 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 6: Effect of seaweed extract foliar application and compost treatments on stem dry weight (g) of snap during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	5.10 c	5.50 bc	6.25 a-c	7.35 a-c	6.05 B'
1 m^3	5.58 bc	7.61 a-c	8.48 a-c	8.36 a-c	7.51 AB'
2 m^3	8.08 a-c	7.17 a-c	7.88 a-c	8.49 a-c	7.91 A'
3 m^3	7.32 a-c	8.48 a-c	8.93 a	9.51 a	8.56 A'
Mean	6.52 A	7.19 A	7.89 A	8.43 A	
	2nd seasons				
0.0 m^3(control)	5.34 b	5.29 b	6.51 ab	7.62 ab	6.19 B'
1 m^3	6.26 ab	8.21 ab	9.06 ab	8.94 ab	8.12 AB'
2 m^3	8.34 ab	7.46 ab	8.06 ab	8.88 ab	8.18 A'
3 m^3	7.54 ab	8.94 ab	9.39 ab	9.96 a	8.96 A'
Mean	6.87 A	7.47 A	8.25 A	8.85 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Fruit setting percentage:

Table (7) and Figure (1) present the effect of seaweed extract foliar application and compost treatments on fruit set percentage during 2009 and 2010 seasons of study. The results showed that the highest percentage of fruit set was obtained by increasing seaweed compost levels with insignificance difference among compost levels. In addition to that application of seaweed extract as foliar spray increased percentage of fruit set significantly with increasing concentration of seaweed extract. As to the interaction among seaweed compost levels and seaweed extract, it was noticed that the most effective treatments for stimulating the percentage of fruit set were using seaweed compost 3m^3 per feddan combined with 500 or 750 ppm seaweed extract In this respect, we agreed with **Sridhar and engasamy 2010** he noticed that the plants that received with 1.0% *U. lactuca* SLF showed a maximum yield of 132 flowers per 10 plants per row when compared only 93 flowers per 10 plants per row in control. And also **Nour, *et. al.* (2010)** found that fruit set percentage affected by foliar spray with seaweed extracts and reflected a significant effect on setting percentage. While **(Crouch and van Staden 1992)** said that For example, tomato seedlings treated with SWC set more flowers earlier than the control plants. And **(Featonby-Smith and van Staden 1983a, b)** due the same results to association with the hormonal substances present in the extracts, especially cytokinins. Also **Khan *et al* 2009** found that in many crops treated with seaweed extracts, yield is associated with the number of flowers at maturity. As the onset and development of flowering and the number of flowers produced are linked to the developmental stage of plants, seaweed extracts probably encourage flowering by initiating robust plant growth. Similar result found by **Nour *et al* 2010** he elucidate the effect of foliar spray with seaweed extracts (without, 1g/ l and 2g/ l) on flowering and fruit setting of tomato plants, resulted indicate the effect of foliar spray with seaweed extracts on flowering, fruiting and fruit setting. In general, it is clear from the obtained results that, increasing the dose of applied seaweed extracts was associated with marked stimulative effect on number of fruits. On the other hand, foliar spray with seaweed extracts reflected a significant effect on setting percentage. **Sultana *et al* 2011 s**tudy the application of seaweed as soil amendment on soybean, results showed slightly better effect on number of flowers per plant.

Fruit characteristics, pod yield and quality:

Data presented in Tables (8 - 11) show the influence of different levels of seaweed compost treatments and different concentration of seaweed extract as foliar application during 2009 and 2010 seasons on number of pods per plant, total pods yield (gm) per plant, estimated pods yield (ton / feddan) and marketable pods yield (ton / feddan) of snap bean and we found that, In general, the pods yield of snap bean responded positively to levels of seaweed compost. Using seaweed compost 2m^3 or 3m^3 per feddan increased number of pods per plant, estimated pods yield (ton / feddan) and marketable pods yield (ton / feddan). However using 3m^3 per feddan was better on total pods yield (gm) per plant in the two seasons as compared with the other studied levels treatments.

Concerning the foliar application of seaweed extract in the two tested seasons, the obtained data showed that the foliar application of seaweed extract increased significantly number of pods per plant, total pods yield (gm) per plant, estimated pods yield (ton / feddan) and marketable pods yield (ton / feddan) as compared with the control treatment; there is no significant difference between concentrations of seaweed extract for these measurements. However, no significance differences were detected for concentration of seaweed extract treatments, with slight increasing for concentration 750 ppm of seaweed extract foliar application in the two tested seasons for these measurements.

Table 7: Effect of seaweed extract foliar application and compost treatments on fruit set percentage of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	32.66 c-e	33.41 c-e	32.06 de	34.23 b-e	33.09 C’
1 m^3	31.68 e	34.29 b-de	35.05 a-e	37.00 a-e	34.50 BC’
2 m^3	35.88 a-e	37.79 a-de	37.93 a-e	38.84 a-c	37.61 AB’
3 m^3	38.05 a-e	38.36 a-d	41.00 a	40.35 ab	39.44 A’
Mean	34.56 B	35.96 AB	36.51 A	37.60 A	
	2nd seasons				
0.0 m^3(control)	30.61 e	32.41 c-e	30.79 de	32.58 b-e	31.60 C’
1 m^3	32.24 c-e	35.69 a-e	36.83 a-c	37.86 a-c	35.65 B’
2 m^3	36.28 a-e	39.13 a	40.27 a	40.59 a	39.07 AB’
3 m^3	36.69 a-d	38.41 ab	40.96 a	41.58 a	39.41 A’
Mean	33.95 B	36.41 AB	37.21 A	38.15 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

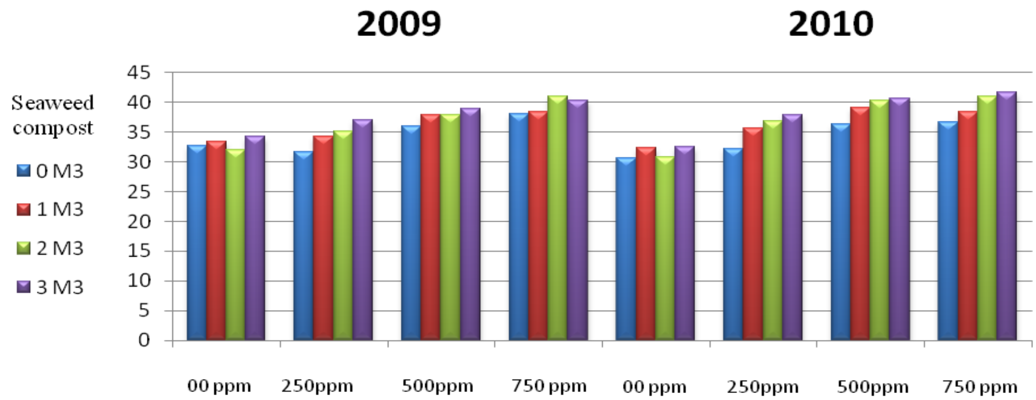

Figure (1): Effect of interaction of seaweed extract foliar application and compost treatments on fruit set percentage of snap bean during 2009 and 2010 seasons.

Respecting the interactions, the studied combination between adding seaweed compost with different concentration of foliar application of seaweed extract, indicated that the plants treated with seaweed compost 3m^3 or 2m^3 combined with foliar application of 500ppm or 750 ppm concentrations showed the highest number of pods per plant, total pods yield (gm) per plant, estimated pods yield (ton / feddan) and marketable pods yield (ton / feddan) as compared with other combination treatments the control treatment; in the two seasons as compared with the. These results are in harmony with those obtained by **Kumar and Sahoo 2011; Temple and Bomke 1989** the pod yield for beans increased after foliar spray with crude extracts of Macrocystis integrifolia and E. maxima. also **Sridhar and Rengasamy 2011** found that the plants that received with 1.0% *U. lactuca* SLF showed a maximum yield of 132 flowers with 1.76 Kg fresh weight per 10 plants per row when compared only 93 flowers with 1.24 Kg per 10 plants per row in control. Similar results found by **Zodape *et al* 2010** foliar application of seaweed extract on green gram gave significant increase in yield as compared to increase in control. Increase in yield was due to increase in number of pods as well as weight of pods per plant. And **Nour *et al* 2010** elucidate the effect of foliar spray with seaweed extracts (without, 1g/ l and 2g/ l) on yield and yield components of tomato plants, results indicate that foliar spray with seaweed at a rate of 2g/l gave the highest results on yield and yield components, but without reaching to the statistical level, the increases occurred on yield and its components might be attributed to the increasing in vegetative growth parameters. Similar result obtained from **Sridhar and Rengasamy 2010** that the plants that received with 1.0% SLF plus 50% recommended rate of chemical fertilizers recorded a maximum yield of 4.1 Kg fresh weight of pod/plot when compared to only 3.7 Kg/plot in 100% recommended rate of chemical fertilizers. and Seaweed liquid fertilizers were found superior than chemical fertilizer because of the presence of high levels of organic matter and these seaweed extract obtained from *S. wightii* that used in this study contained a maximum amount of K compared to the other macro nutrient N and P. **Ramya *et al* 2010** used liquid extracts of marine as soil drench to cluster bean plant and noticed maximum enhancement in yield parameters such as number of pods per plant, pod weight, pod length. **Thirumaran *et al* 2009** investigat an attempt has been made to study the effect of SLF with or without chemical fertilizer on growth and yield content of *Cyamopsis tetragonoloba* (L) Taub. Result showed that Weight of Vegetables in cluster bean the maximum weight of vegetables recorded was 6.76 g in the plants that received 20% SLF with recommended level of chemical fertilizer compared with the observed value was 2.62 g in the control plant. It is probably due to the presence of growth promoting hormones and nutrients in more quantities in the brown alga than in other groups of algae. Seaweed liquid fertilizer can be applied to various crop plants in order to enrich the nutrient content of the soil and intern to increase the growth and yield of cultivable plants. **Rathore *et al* 2009** study the effects of foliar applications of different concentrations of seaweed extract on yield of soybean, so foliar applications of seaweed extract significantly enhanced yield parameters. The highest grain yield was recorded with applications of 15% seaweed extract, followed by 12.5% seaweed extract that resulted in 57% and 46% increases respectively compared to the control. **Khan *et al* 2009** found that treatment with seaweed extracts on yield has enhancement effects due to improved chlorophyll content in leaves of various crop plants have been attributed to the betaines present in the seaweed, yield increases in seaweed-treated plants are thought to be associated with the hormonal substances present in the extracts, especially cytokinins; cytokinins in vegetative plant organs are associated with nutrient partitioning, whereas in reproductive organs, high levels of cytokinins may be linked with nutrient. These results are in harmony with those obtained by **(Zodape et al 2008; Crouch and van Staden 1992; Featonby-Smith and van Staden 1983a, b, 1984).** Seaweed extract increased fruit yield when sprayed on tomato plants during the vegetative stage, producing large sized fruits (30% increase in fresh fruit weight over the controls) with superior quality and explain these to the effects of the application of seaweed fertilizers in improving total fruit production may be related to the effect of cytokinins**.** Foliar application of seaweed liquid extract (Kelpak 66) enhanced bean yield by 24% **Nelson and van Staden 1984.**

Table 8: Effect of seaweed extract foliar application and compost treatments on number of pods of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	16.25 d	17.50 cd	18.25 b-d	20.38 a-d	18.09 C’
1 m^3	17.50 cd	19.13 a-d	20.13 a-d	21.50 a-c	19.56 B’
2 m^3	20.38 a-d	22.13 a-c	22.63 ab	24.00 a	22.28 A’
3 m^3	21.25 a-d	23.13 ab	23.50 a	24.13 a	23.00 A’
Mean	18.84 B	20.47 AB	21.13 AB	22.50 A	
	2nd seasons				
0.0 m^3(control)	17.63 d	18.88 cd	19.13 cd	21.75 a-d	19.34 C’
1 m^3	19.50 b-d	20.50 a-d	21.88 a-d	22.88 a-c	21.19 B’
2 m^3	21.50 a-d	22.63 a-c	23.25 a-c	24.75 a	23.03 A’
3 m^3	21.25 a-d	22.50 a-c	23.25 a-c	24.13 ab	22.78 A’
Mean	19.97 B	21.13 AB	21.88 AB	23.38 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 9: Effect of seaweed extract foliar application and compost treatments on total pod yield / plant (g) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons (2009)				
0.0 m^3(control)	66.65 ef	69.73 d-f	72.21 c-f	79.18 a-e	71.94 C’
1 m^3	65.29 f	73.96 b-f	76.89 a-f	81.11 a-d	74.31 BC’
2 m^3	73.25 c-f	80.19 a-d	81.23 a-d	83.25 a-c	79.48 AB’
3 m^3	76.78 b-f	81.43 a-d	86.25 ab	89.38 a	83.46 A’
Mean	70.49 C	76.33 BC	79.14 AB	83.23 A	
	2nd seasons (2010)				
0.0 m^3(control)	71.58 e	75.93 c-e	77.41 c-e	83.51 a-d	77.11 C’
1 m^3	75.35 de	79.31 b-e	83.24 a-d	86.02 a-d	80.98 BC’
2 m^3	77.60 b-e	83.74 a-d	86.20 a-d	86.99 a-c	83.63 B’
3 m^3	84.10 a-d	88.87 ab	92.61 a	94.38 a	89.99 A’
Mean	77.16 B	81.96 AB	84.87 A	87.72 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 10: Effect of seaweed extract foliar application and compost treatments on estimated pod yield (ton/ fed.) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	5.17 cd	5.41 b-d	5.60 a-d	6.14 a-d	5.58 C'
1 m^3	5.06 d	5.74 a-d	5.96 a-d	6.29 a-d	5.76 BC'
2 m^3	5.68 a-d	6.22 a-d	6.30 a-d	6.46 a-c	6.16 AB'
3 m^3	5.95 a-d	6.31 a-d	6.69 ab	6.93 a	6.47 A'
Mean	5.47 B	5.92 AB	6.14 AB	6.45 A	
	2nd seasons				
0.0 m^3(control)	5.55 d	5.89 cd	6.00 b-d	6.48 a-cd	5.98 B'
1 m^3	5.84 cd	6.15 a-d	6.46 a-d	6.67 a-d	6.28 B'
2 m^3	6.02 b-d	6.49 a-d	6.68 a-d	6.75 a-c	6.49 AB'
3 m^3	6.52 a-d	6.89 a-c	7.18 ab	7.32 a	6.98 A'
Mean	5.98 B	6.36 AB	6.58 A	6.80 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 11: Effect of seaweed extract foliar application and compost treatments on marketable pod yield (ton/ fed.) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	4.22 e	4.65 c-e	4.79 b-e	5.27 b-e	4.73 C'
1 m^3	4.50 de	5.07 b-e	5.26 a-e	5.47 a-d	5.08 BC'
2 m^3	5.01 b-e	5.56 a-d	5.79 a-c	5.62 a-d	5.50 AB'
3 m^3	5.55 a-d	5.88 ab	6.27 a	6.31 a	6.00 A'
Mean	4.82 B	5.29 AB	5.53 A	5.67 A	
	2nd seasons				
0.0 m^3(control)	4.68 e	5.07 de	5.17 c-e	5.56 a-e	5.12 B'
1 m^3	5.33 c-e	5.50 b-e	5.68 a-e	5.88 a-d	5.60 B'
2 m^3	5.42 c-e	5.80 a-e	6.01 a-d	6.06 a-d	5.82 AB'
3 m^3	6.06 a-d	6.26 a-c	6.56 ab	6.63 a	6.38 A'
Mean	5.37 B	5.66 AB	5.85 A	6.03 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Chemical Component:

Mineral Component (N, P, K, Mg)

Tables (12 – 15) presented the influence of different levels of seaweed compost treatments and different concentration of seaweed extract as foliar application during 2009 and 2010 seasons on Mineral component [Nitrogen, Phosphor, Potassium and Magnesium in leaves (mg/ 100 mg DW)] of snap bean and we mentioned that, In general, the mineral component in leaves of snap bean responded positively to levels of seaweed compost. Using seaweed compost $3m^3$ per feddan increased percentage of nitrogen, phosphor, potassium and magnesium in leaves with insignificance differences with $2m^3$ seaweed compost as compared with control. However using 1m^3 seaweed compost per feddan give the highest percentage of minerals under study over the control in the two seasons.

Concerning the foliar application of seaweed extract in the two tested seasons, the obtained data showed that nitrogen in the first season hasn't significance difference over the treatment. Although, the second season give significance differences as compared to control and the same result had obtained in percentage of magnesium in the two tested seasons. But percentage of phosphor and potassium in leaves affected by the foliar application of seaweed extract, increased significantly by increasing concentration of seaweed extract, as compared with the control treatment; but no significance differences were detected for concentrations of seaweed extract.

Respecting the interactions, the studied combination between adding seaweed compost with different concentration of foliar application of seaweed extract on Nitrogen, Phosphor, Potassium and Magnesium in leaves indicated that the plants were reflect increasing in percentage of mineral by increasing levels of seaweed compost combining with increasing in seaweed extract foliar application as compared with other combination treatments with the control treatment in the two seasons. These results are in harmony with those obtained by **Pise, N.M. and A.B. Sabale (2010)** that investigated the effect of seaweed extract on growth and biochemical constituents of fenugreek and found that it has been observed that total nitrogen activity increased at lower to higher concentrations of both the treatments of seaweeds. All values are compared to control then total nitrogen content in leaves (8.89 g 100-1g dry wt) and control was (2.29 g 100-1g dry wt). Similar result obtained by **Shehata *et. al.* 2011** investigate the effect of amino acid and seaweed extract compared to control on celeriac plants and results indicated that spraying the plants with amino acids and seaweed extract at higher rate tended to have the highest values from P and K content of leaves compared with control. The enhancing potential of seaweeds might be attributed to the presence of potassium as a main component in the seaweed extract. Also **Nour *et al* 2010** elucidate the effect of foliar spray with seaweed extracts (without, 1g/ l and 2g/ l) on chemical constituents of tomato plants, resulted showed that, in general, it is evident that spraying tomato plants with seaweed extracts at a rate of 2g/l significantly increased T.S.S. and gave the best results of N, P, K and protein (%) but without reaching to the statistical level. And assure our result by **Rathore *et al* 2009** when he study the effects of foliar applications of different concentrations of seaweed extract on nutrient uptake of soybean and indicated that improved nutrient uptake (N, P, K and S) was observed with seaweed extract application. Application of seaweed extract increased mineral content (N content) of beans in all concentration compared to control plants obtained these result by **Beckett, R P, Mathegka A. D. and J.Van Staden 1994.** And disagree with **Zahid B. P. 1999** used seaweed manure on three plants to study its effect on magnesium and some other minerals and found that seaweed manure equal in results on control and the magnesium content in the three plants of study.

Table 12: Effect of seaweed extract foliar application and compost treatments on nitrogen in leaves (mg/ 100 mg DW) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	21.03 c	23.37 bc	25.27 a-c	26.69 a-c	24.09 B'
1 m^3	23.22 bc	27.25 ab	29.42 a	28.59 ab	27.12 AB'
2 m^3	25.28 a-c	25.41 a-c	25.46 a-c	26.85 a-c	25.75 AB'
3 m^3	25.60 a-c	27.57 ab	27.60 ab	29.01 ab	27.44 A'
Mean	23.78 A	25.90 A	26.94 A	27.78 A	
	2nd seasons				
0.0 m^3(control)	20.54 e	21.87 e	24.46 c-e	25.79 b-e	23.17 C'
1 m^3	23.23 de	27.25 a-d	28.87 a-c	28.36 a-d	26.93 B'
2 m^3	28.16 a-d	28.75 a-c	28.61 a-c	30.26 ab	28.94 AB'
3 m^3	28.74 a-c	30.38 ab	30.46 ab	31.41 a	30.25 A'
Mean	25.17 B	27.06 AB	28.10 AB	28.95 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 13: Effect of seaweed extract foliar application and compost treatments on phosphorus in leaves (mg/ 100 mg DW) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	11.14 b	12.14 ab	13.15 ab	14.11 ab	12.63 B'
1 m^3	12.54 ab	14.68 ab	15.99 a	15.32 ab	14.63 A'
2 m^3	12.59 ab	12.49 ab	12.16 ab	13.16 ab	12.60 B'
3 m^3	13.12 ab	13.94 ab	13.99 ab	14.41 ab	13.87 AB'
Mean	12.35 B	13.31 AB	13.82 A	14.25 A	
	2nd seasons				
0.0 m^3(control)	10.45 c	11.65 bc	12.38 a-c	13.16 a-c	11.91 B'
1 m^3	12.35 a-c	14.47 ab	15.41 ab	14.96 ab	14.30 A'
2 m^3	14.32 a-c	14.47 ab	14.42 a-c	15.06 ab	14.57 A'
3 m^3	14.84 ab	15.73 a	15.60 ab	15.95 a	15.53 A'
Mean	12.99 B	14.08 AB	14.45 A	14.78 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 14: Effect of seaweed extract foliar application and compost treatments on potassium in leaves (mg/ 100 mg DW) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	37.71 e	41.99 c-e	44.72 a-d	47.15 a-c	42.89 B'
1 m^3	40.04 de	46.49 a-c	50.01 a	48.55 ab	46.27 A'
2 m^3	42.74 b-e	43.39 b-e	43.47 b-e	45.85 a-e	43.86 AB'
3 m^3	43.91 a-e	46.81 a-c	47.37 a-c	49.85 a	46.99 A'
Mean	41.10 B	44.67 A	46.39 A	47.85 A	
	2nd seasons				
0.0 m^3(control)	38.65 f	40.18 d-f	44.42 c-f	47.09 a-c	42.58 C'
1 m^3	39.90 ef	46.73 bc	48.87 a-c	48.26 a-c	45.94 BC'
2 m^3	45.67 c-e	46.71 bc	46.42 b-d	49.04 a-c	46.96 B'
3 m^3	49.86 a-c	52.39 ab	52.66 ab	53.14 a	52.01 A'
Mean	43.52 B	46.50 AB	48.09 A	49.38 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 15: Effect of seaweed extract foliar application and compost treatments on magnesium in leaves (mg/ 100 mg DW) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	10.21 c	10.74 bc	11.55 a-c	12.40 a-c	11.22 B'
1 m^3	11.27 a-c	12.97 a-c	13.82 ab	13.76 ab	12.96 A'
2 m^3	13.45 ab	13.19 a-c	13.31 a-c	13.76 ab	13.43 A'
3 m^3	13.12 a-c	13.87 a	13.98 a	13.93 a	13.72 A'
Mean	12.01 A	12.69 A	13.17 A	13.46 A	
	2nd seasons				
0.0 m^3(control)	9.82 d	9.95 cd	10.57 b-d	11.24 a-d	10.40 C'
1 m^3	10.99 a-d	12.88 a-d	13.72 ab	13.31 ab	12.73 B'
2 m^3	13.07 a-c	13.21 ab	13.16 ab	13.75 ab	13.30 AB'
3 m^3	13.66 ab	14.16 a	14.17 a	14.02 a	14.00 A'
Mean	11.89 A	12.55 A	12.91 A	13.08 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Bio-chemical component:

Data presented in Tables (16 - 21) show the influence of different levels of seaweed compost treatments and different concentration of seaweed extract as foliar application during 2009 and 2010 seasons on chlorophyll reading, fiber percentage in pods, total soluble protein (mg/100mg DW) in pods, free amino acid percentage in leaves and total carbohydrates (mg/100 mg DW.) in leaves and in pods of snap bean and the result was in general, biochemical component of snap bean responded positively to levels of seaweed compost compared with control. Using seaweed compost 1m^3, 2m^3 or 3m^3 per feddan increased total soluble protein in pods, free amino acid percentage in leaves and total carbohydrates in leaves without significance difference between treatments but using seaweed compost 2m^3 or 3m^3 per feddan increased total carbohydrates in pods with significance difference as compared with the other studied levels of treatments. However increasing seaweed compost levels there was no significance difference about fiber measurements in pods over the control. On the other hand, increased seaweed compost levels increased chlorophyll reading in leaves with significance difference about treatments.

Concerning the foliar application of seaweed extract in the two tested seasons, the obtained data showed that the measurements (chlorophyll reading, total soluble protein (mg/100mg DW) in pods, free amino acid percentage in leaves and total carbohydrates (mg/100 mg DW.) in leaves) increased by increasing foliar application of seaweed extract concentration; increased significantly when compared with control. On the other side there were no significance differences detected for the fiber percentage in pods and total carbohydrates in pods as compared with the other studied levels of the treatments.

Respecting the interactions, the studied combination between adding different levels of seaweed compost with different concentration of foliar application of seaweed extract, on chlorophyll reading, fiber percentage in pods, total soluble protein (mg/100mg DW) in pods, free amino acid percentage in leaves and total carbohydrates (mg/100 mg DW.) in leaves and in pods indicated that plants treated with seaweed compost 3m^3 combined with seaweed extract foliar application of 750ppm concentration showed the best of chlorophyll reading, total soluble protein (mg/100mg DW) in pods, free amino acid percentage in leaves and total carbohydrates (mg/100 mg DW.) in leaves and in pods. The opposite were noticed in table (28) and figure (4), fiber percentage in pods, the highest percentage found in 0 m^3 of seaweed compost combined with 0.0 ppm seaweed extract foliar application and the lowest percentage found in 3m^3 of seaweed compost combined with 750 ppm seaweed extract foliar application, in the two seasons as compared with the other combination treatments. This result in agreement with **Sridhar and Rengasamy 2011** *Tagetes etecta* treated with four different concentrations of *U. lactuca* SLF 0.25%, 0.5%, 1.0% and 1.5% showed enhanced values on different physical and biochemical features than the plant received only water, SLF treatment increased concentration of photosynthetic pigments. At 1.0 % concentration, the plants contained maximum concentrations of total chlorophyll, chlorophyll *a* and chlorophyll b. their increments were more than 41.0%, 42.0% and 37.0% respectively, when compared to control and due this to this may be the consequence of uptake of magnesium content from the SLF; SLF can improve the accumulation of total carbohydrate, total protein and total lipid contents was also found maximum when the plants received with 1.0% SLF on marigold. At this condition their increments were more than 37.0%, 58.0% and 60.0% respectively and due this to the analysis of seaweed extract of *U. lactuca* revealed that amongst macronutrient the values of total nitrogen were maximum followed by potassium, sulphur, magnesium, calcium and phosphorus. And similar result obtained by **El-Sheekh, and El-Saiedh (1999).** the analysis of protein content of root and shoot system of *Vicia faba* showed that seaweed extracts increased protein content in both root and shoot system. The height amount of proteins was obtained in shoot system under the treatment seaweed extracts. It was implied that α- naphthalenacetic acid may induced some specific proteins during germination including the acidic lipoxygenases in bean embryos and they was suggested the possible role of plant growth regulators like auxin and cytokinin as well as macro and micro elements present in the SLFs for the appearance of those induced proteins, and **(Liu *et al.* 1991)** said so that auxins may act either by turning on the expression of certain genes or by being involved in the modification of key gene products. Also **Shehata *et. al.* 2011** investigate the effect of amino acid and seaweed extract compared to control on celeriac plants and results indicated that spraying the plants with amino acids and seaweed extract at higher rate significantly increased values from photosynthetic pigments content of leaves compared with control. And due to Seaweed extracts contain significant amounts of cytokinins, auxins and betaines, which enhance chlorophyll concentration in the leaves. These results was in harmony with **Ramya *et al* 2010; Atzmon and Van Staden, 1994** used liquid extracts of marine as soil drench to cluster bean plant and noticed there was a significant increase in biochemical parameters such as photosynthetic pigments, protein content and amino acids. Increase in the photosynthetic pigments of cluster bean may be due to the presence of magnesium which is the chief constituent for chlorophyll synthesis or due the increase in photosynthetic pigments to increase in number and size of the chloroplast and better grana development. Similar records by **Pise, N.M. and A.B. Sabale 2010** the biochemical constituents of fenugreek increased with concentration levels up to 50%. The highest values of total chlorophyll content (142.6±0.12 mg/100g fr. wt.), carotenoid (13.16±0.05 mg/100g fr. wt.), protein content of leaves (3.31 mg/100g fr. wt.), amino acid content of leaves (4.68 g 100-1g dry wt.), total carbohydrate content of leaves Photosynthetic pigments were enhanced by both the treatments of SWC when compared to the control values. *Sargassum* treatment (50%) was equally effective as that of Hoagland while that of *Ulva* was found less promotive. The increase in the protein content at lower concentration of SLF might be due to absorption of most of the necessary elements by the seedlings. **Thirumaran *et al* 2009** investigat an attempt has been made to study the effect of SLF with or without chemical fertilizer on pigment content of *Cyamopsis tetragonoloba* (L) Taub. Result showed that chlorophyll'a', chlorophyll'b' and total chlorophyll in cluster bean the maximum content obtained plants that received 20% SLF with recommended level of chemical fertilizer. It is probably due to the presence of growth promoting hormones and nutrients in more quantities in the brown alga than in other groups of algae. This result was in harmony with **Christobel, G. J. 2008** in the present study higher amount of chlorophyll a, b and total chlorophyll were found in the leaves of *Phaseolus aureus* treated with low concentration of SLF (1% and 5%) than that of higher concentration of SLF (10% and 25%). The minimum chlorophyll a and b content was observed in control plant. The high chlorophyll content in the plant treated with low concentration of seaweed liquid fertilizer may be due to the presence of betaines as reported by **Blunden *et al.,* 1997** who assure that the seaweed extract applied as foliar spray enhanced the leaf chlorophyll level in plants. In the study high Mg and Fe content in *Sargassum* might have influenced the synthesis of chlorophyll and add that in all cases, soil application of the seaweed extract resulted in significantly higher chlorophyll contents of the treated plants than foliar application. And they explain these results by higher chlorophyll concentrations in the leaves resulting from soil application of the seaweed extract could be achieved also by using the solution of betaines. These data strongly indicate that the effects on leaf chlorophyll contents produced by the use of seaweed extracts are due to the betaines contained in them. It appears probable that the activity of the seaweed extract and the betaines is the result of slowing down the degradation of leaf chlorophyll rather than increasing its content. The possible role of betaines in producing this result was considered and the effect on leaf chlorophyll content was investigated using a cucumber bioassay procedure devised for cytokinins reported by **(Fletcher, 1982). Khan *et al* 2009** agree with us that they found treatment with seaweed extracts enhancing leaf chlorophyll content of plants, this increase in chlorophyll content may be due to a decrease in chlorophyll degradation and (**Whapham *et a*l 1993)** assure that results, that this increase in chlorophyll content was a result of reduction in chlorophyll degradation, which might be caused in part by betaines in the seaweed extract. It has been indicated that betaine may work as a nitrogen source when provided in low concentration and serve as an osmolyte at higher concentration. Also (**El-Sheekh and el-Saied 2000; Mostafa and Zheekh 1999; Whapham et al. 1992; Featonby-Smith BC, van Staden J 1984)** found that foliar application of seaweed extract has increased chlorophell content of *phaseoulus vulgarise* and enhance the chlorophyll contents in the leaves, either to the soil or to the foliage of tomato plants produced leaves that, after 34 days, were visually more green than those of control plants. **Zodape *et al* 2008** study the effect of liquid seaweed fertilizers applied as a foliar spray with different concentration on nutrition quality of okra and found that plants sprayed with LSF showed a significant increase in nutrition quality of okra as carbohydrate, protein and dietary fiber. This result was in harmony with **Zahid B. P. 1999** used Seaweed manure on three plants to study its effect on fiber and found that there is slight different between seaweed manure treatments and control but this different was not significant.and these result was the same with **Zodape *et al* 2010** foliar application of seaweed extract on green gram plants not only increased seed yield but also improved nutrition quality of seeds compared to control , carbohydrate content has increased and protein content and **Christobel, G. J. 2008** it was significantly noticed that the protein content of green gram plants was at higher level in the pods of *Phaseolus aureus L* treated with the SLF of low concentration (1% and 5%) than control, so these results Also reported by **Sivasankari *et al* 2006** when used different concentration of seaweed extract of *S. wightii*, found that there was significant difference in biochemical status of different concentration levels so that the biochemical constituents increased with concentration up to 20% and thereafter it declined . The highest value of chlorophyll content , protein content of shoot and amino acids content of shoot, were recorded at 20% *S. wightii* extract of soaked seedlings compared with control and other treatments and due these result to the presence of some growth promoting substances such as IAA and IBA, gibberellins, cytokinins, micronutrients, vitamins and amino acids.

Carbohydrate fraction (mg/100 mg DW.) in leaves:

Data presented in Tables (22) and figure (2)show the interaction of the four levels of seaweed compost treatments and four different concentration of seaweed extract as foliar application during 2009 and 2010 seasons on carbohydrate fraction (mg/100 mg DW.) in leaves and the result presented that using seaweed compost 3m^3 per feddan combined with 750ppm of seaweed extract foliar spray increased significantly total carbohydrates, total sugars and non reducing sugar and the opposite result found with reducing sugar in control plants in the two tested seasons. This result was in harmony with **Ramya *et al* 2010** used liquid extracts of marine as soil drench to cluster bean plant and noticed maximum influence on reducing sugar. Similar result obtained by **Shehata *et. al.* 2011** investigate the effect of amino acid and seaweed extract compared to control on celeriac plants and results indicated that either amino acids or seaweed extract increased total sugar content compared to check treatment and such effect were more distinct and significant via using the higher rate with no significant differences between them. Also **Sivasankari *et al* 2006** used different concentration of seaweed extract of *S. wightii* by soaking seedling of *vigna sininses* and found that there was significant difference in biochemical status of different concentration levels so that the biochemical constituents increased with concentration up to 20% and thereafter it declined . The highest value of reducing sugar content of shoot and total sugars content of shoot were recorded at 20% *S. wightii* extract compared with control and other treatments and due these result to the presence of some growth promoting substances such as IAA and IBA, gibberellins, cytokinins, micronutrients , vitamins and amino acids. Assure that total soluble sugars increased in both root and shoot system under the treatment of green and red algal extract **(El-Sheekh and El- Saied, 1999).** Also **Blunden *et al* 1979; Aitken and Senn 1965** foliar application of seaweed extract increased sugar content of sugar beet due the increasing sugar content to seaweed component of laminarin and manitol that's take place of sugar in seaweed.

Table 16: Effect of seaweed extract foliar application and compost treatments on chlorophyll reading (SPAD) of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	35.95 cd	37.82 a-d	39.05 a-d	40.58 a-d	38.35 B'
1 m^3	35.87 d	37.35 b-d	39.33 a-d	40.79 ab	38.33 B'
2 m^3	38.25 a-d	39.60 a-d	41.48 ab	41.13 ab	40.11 AB'
3 m^3	40.67 abc	41.15 ab	42.16 a	42.58 a	41.64 A'
Mean	37.68 B	38.98 A	40.50 A	41.27 A	
	2nd seasons				
0.0 m^3(control)	35.25 d	37.20 b-d	38.63 a-d	41.15 a-c	38.06 C'
1 m^3	36.27 cd	37.44 b-d	39.48 a-d	41.74 ab	38.73 BC'
2 m^3	38.38 a-d	40.48 a-c	41.84 ab	41.99 ab	40.67 AB'
3 m^3	40.97 a-c	41.59 ab	42.70 a	43.13 a	42.10 A'
Mean	37.72 B	39.18 AB	40.66 AB	42.00 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 17: Effect of seaweed extract foliar application and compost treatments on fibre percentage in pods of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	1.41 a	1.40 ab	1.35 a-c	1.35 a-c	1.38 A'
1 m^3	1.36 a-c	1.37 a-c	1.33 a-c	1.28 a-c	1.34 A'
2 m^3	1.35 a-c	1.27 a-c	1.23 a-c	1.18 bc	1.26 A'
3 m^3	1.33 a-c	1.28 a-c	1.24 a-c	1.17 c	1.25 A'
Mean	1.36 A	1.33 A	1.29 A	1.24 A	
	2nd seasons				
0.0 m^3(control)	1.36 a	1.35 a	1.33 a	1.30 a	1.34 A'
1 m^3	1.34 a	1.33 a	1.28 a	1.23 a	1.29 A'
2 m^3	1.32 a	1.26 a	1.20 a	1.16 a	1.24 A'
3 m^3	1.30 a	1.23 a	1.19 a	1.16 a	1.22 A'
Mean	1.33 A	1.29 A	1.25 A	1.21 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 18: Effect seaweed extract foliar application and compost treatments on total soluble protein (mg/100mg DW) in pods of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	1.71 g	1.77 fg	1.74 g	1.95 ef	1.79 B'
1 m^3	2.14 c-e	2.17 b-d	2.36 a	2.13 c-e	2.20 A'
2 m^3	2.10 de	2.09 de	2.47 a	2.32 a-c	2.25 A'
3 m^3	2.35 ab	2.13 de	2.32 a-c	2.39 a	2.30 A'
Mean	2.08 AB	2.04 B	2.22 A	2.20 A	
	2nd seasons				
0.0 m^3(control)	1.67 h	1.72 h	1.71 h	1.76 gh	1.72 B'
1 m^3	1.89 f-h	1.97 g-e	2.01 d-f	2.30 a-c	2.04A'
2 m^3	2.22 cd	2.17 c-e	2.27 bc	2.35 a-c	2.25A'
3 m^3	2.23 c	2.27 bc	2.45 ab	2.52 a	2.37 A'
Mean	2.00 B	2.03 AB	2.11 A B	2.23 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table19: Effect of seaweed extract foliar application and compost treatments on free amino acid percentage in leaves of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	0.62 e	0.68 e	0.66 e	0.74 d	0.68 B'
1 m^3	0.80 cd	0.82 bc	0.89 a	0.81 c	0.83 A'
2 m^3	0.80 cd	0.79 cd	0.94 a	0.88 ab	0.85 A'
3 m^3	0.89 a	0.81 c	0.88 ab	0.91 a	0.87 A'
Mean	0.78 B	0.78 B	0.84 A	0.84 A	
	2nd seasons				
0.0 m^3(control)	0.63 h	0.65 h	0.65 h	0.67 gh	0.65 C'
1 m^3	0.72 f-h	0.75 e-g	0.76 def	0.87 a-c	0.78 B'
2 m^3	0.84 cd	0.82 c-e	0.86 bc	0.89 a-c	0.85 AB'
3 m^3	0.85 c	0.86 bc	0.93 ab	0.95 a	0.90 A'
Mean	0.76 B	0.77 AB	0.80 AB	0.85 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 20: Effect seaweed extract foliar application and compost treatments on total carbohydrates (mg/100 mg DW.) in leaves of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons				
0.0 m^3(control)	23.32 f	24.58 f	24.72 ef	25.40 c-e	24.51 B'
1 m^3	25.03 de	25.33 de	25.83 b-e	25.99 b-e	25.55 A B'
2 m^3	26.87 a-c	26.31 a-d	26.49 a-d	26.33a-d	26.50 A'
3 m^3	27.69 a	26.90 a-c	27.57 a	27.14 ab	27.33 A'
Mean	25.73 B	25.78 B	26.15 A	26.22 A	
	2nd seasons				
0.0 m^3(control)	21.03 d	21.53 d	21.97 d	25.07 c	22.40 B'
1 m^3	25.34 bc	25.69 a-c	25.99 a-c	25.80 a-c	25.71 A'
2 m^3	25.74 a-c	26.36 a	26.11 ab	26.65 a	26.22 A'
3 m^3	26.36 a	26.56 a	26.68 a	26.62 a a	26.56 A'
Mean	24.62 B	25.04 AB	25.19 AB	26.04 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 21: Effect of seaweed extract foliar application and compost treatments on total carbohydrates (mg/100mg DW) in pods of snap bean during 2009 and 2010 seasons.

Compost	Seaweed extract concentration				Mean
	0.0ppm(control)	250 ppm	500 ppm	750 ppm	
	1st seasons (2009)				
0.0 m^3(control)	20.22 f	20.40 ef	20.92 d-f	21.95 b-f	20.87 B’
1 m^3	21.29 d-f	21.62 d-f	21.77 c-f	23.71 a-f	22.10 B’
2 m^3	25.08 a-f	23.93 a-f	25.35 a-d	25.54 a-d	24.98 A’
3 m^3	25.49 a-d	26.48 a-c	26.88 a	26.72 ab	26.39 A’
Mean	23.02 A	23.11 A	23.73 A	24.48 A	
	2nd seasons (2010)				
0.0 m^3(control)	21.00 d	21.31 d	21.93 d	22.41 cd	21.66 B’
1 m^3	21.88 d	21.41 d	23.91 b-d	24.15 a-d	22.84 B’
2 m^3	25.68 a-c	26.52 ab	25.92 a-c	26.17 ab	26.07 A’
3 m^3	27.58 a	27.22 ab	26.17 ab	26.55 ab	26.88 A’
Mean	24.03 A	24.12 A	24.48 A	24.82 A	

Means followed by different letters are significantly different at P≤ 0.5 level; Duncan's multiple range test.

Table 22: Effect of interaction of seaweed extract foliar application and compost treatments on carbohydrate fraction (mg/100 mg DW.) in leaves of snap bean during 2009 and 2010 seasons.

Treatments	2009				2010			
	Total carbohydrates	Total sugars	reducing sugars	non reducing sugars	Total carbohydrates	Total sugars	reducing sugars	non reducing sugars
C1S1	23.32 f	16.96 d	11.53 ab	5.43 e	21.03 d	15.63 d	10.59 a	5.03 e
C1S2	24.58 f	17.51 cd	11.81 a	5.70 e	21.53 d	15.71 d	10.18 ab	5.54 e
C1S3	24.72ef	17.54 cd	10.74 b-d	6.80 cd	21.97 d	16.01 cd	10.07 bc	5.94 de
C1S4	25.40 c-e	17.90 bc	11.72 a	6.18 de	25.07 c	16.77 a-d	10.00 bc	6.77 c-e
C2S1	25.03de	18.15 a-bc	11.19 a-c	6.96 cd	25.34 bc	16.54 b-d	9.86 b-d	6.68 c-e
C2S2	25.33de	18.29 a-c	10.69 b-e	7.60 bc	25.69 a-c	16.60 b-d	9.74 b-de	6.86 b-e
C2S3	25.83b-e	18.67 ab	10.38 c-e	8.28 ab	25.99 a-c	17.29 a-d	9.63 c-g	7.66 a-cd
C2S4	25.99b-e	18.65 ab	10.11 de	8.55 ab	25.80 a-c	17.51 a-d	9.80 b-d	7.71 a-d
C3S1	26.87a-c	18.59 ab	10.29 c-e	8.31 ab	25.74 a-c	17.99 ab	9.77 b-d	8.22 a-c
C3S2	26.31a-d	18.55 ab	10.39 c-e	8.16 ab	26.36 a	17.76 a-c	9.67 c-f	8.09 a-c
C3S3	26.49 a-d	18.42 ab	10.32 c-e	8.11 ab	26.11 ab	17.81 a-c	9.46 d-h	8.35 a-c
C3S4	26.33 a-d	18.71 a	10.46 c-e	8.25 ab	26.65 a	17.85 a-c	9.16 h	8.69 ab
C4S1	27.69 a	18.80 a	10.65 b-e	8.15 ab	26.36 a	18.17 ab	9.29 e-h	8.88 a
C4S2	26.90 a-c	18.30 a-c	9.94 de	8.36 ab	26.56 a	18.26 ab	9.21 gh	9.05 a
C4S3	27.57 a	18.85 a	10.00 de	8.85 a	26.68 a	18.42 ab	9.27 h	9.15 a
C4S4	27.14 ab	18.81 a	9.80 e	9.01 a	26.62 a	18.61 a	9.14 h	9.47 a

C = compost treatment (0.0 [control] – 1 – 2 – 3 m^3) S = seaweed extract foliar application (0.0 [control] – 250 – 500 – 750 ppm)

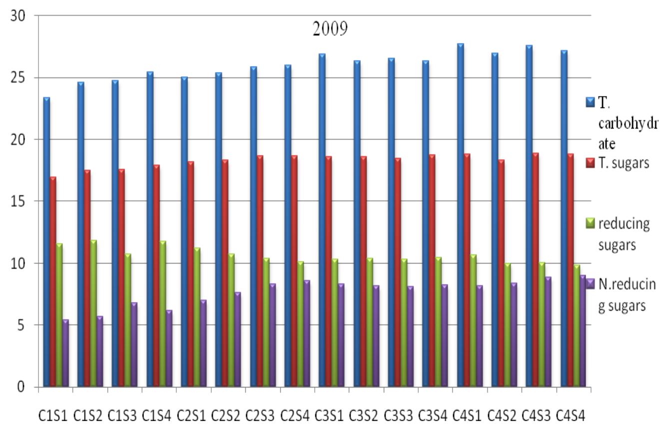

Figure (2): Effect of interaction of seaweed extract foliar application and compost treatments on carbohydrate fraction (mg/100 mg DW.) in leaves of snap bean during 2009

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References

1. **A.O.A.C. (2005).** Official methods of analysis. 15th ed. Association of Official Agricultural Chemists. 12th Ed., Washengton, D.C., USA.
2. **Aitken, J. B. and T. L. Senn (1965).** Seaweed products as a fertilizer and soil conditioner for horticultural crops. Botanica Marina. Vol. 8, Issue 1, Pages 144–147.
3. **Atzmon N, van Staden J (1994)** The effect of seaweed concentrate on the growth of Pinus pinea seedlings. New For 8:279–288
4. **Beckett, R P, Mathegka A. D. and J.Van Staden 1994.** Effect of seaweed concentrate on yield of nutrient stressed tepary bean (*Phaseolus acutifolius* Gray) , J. Appl Phycol (6) 429-430.
5. **Bhosle, N. B.; Dhargalkar, V. K. and A. G. Untawale (1975).** Effect of seaweed extract on the growth of *Phaseolus vulgaris* L. Indian J. Mar. Sc., 4 : 208-210.
6. **Black, C. A. (Ed). (1965)**. Methods of soil analysis . partz. American Society of Agronomy, I N C. publisher, Madison, Wisconsin, USA.
7. **Blunden, G, Wildgoose P. B and F E Nicholson (1979).** The effect of aqueous seaweed extract on sugar beet, Bot Mar,(22)539-541.
8. **Blunden, G.; T. Jenkins, Y. Liu (1997).** Enhanced leaf chlorophyll levels in plants treated with seaweed extract. Journal of Applied Phycology. 8:535–543
9. **Booth, E. (1969).** The manufacture and properties of liquid seaweed extracts. Proc. Int. seaweed symp. 6 : 622-655.
10. **Bradford, M. M. (1976).** A rapid and sensitive method for the quantification of microgram quantities of protein utilizing the principle of protein-dye binding. *Anal. Biochem.*, 72 : 248.
11. **Brown, J.D. and Lilleland (1946)**. Rapid determination of potassium and sodium in plant material and soil extracts by flame photometry. Proc. Amer. Soc. Hort. Sci., 48: 341-346.
12. **Challen, S.B. and J.C. Hemingway (1965).** Growth of higher plants in response to feeding with seaweed extracts. Proc. 5th Int. Seaweed Symp. 5:359–367
13. **Chapman, V.J and D.J. Chapman (1980).** Seaweeds and their uses. Third Editions. Chapman and Hall, USA, p. 334
14. **Christobel, J. G. (2008).** Effect of seaweed (*SARGASSUM WIGHTII* L.) on the germination and growth of green gram (*Phaseolus Aureus* L.) *Journal of Basic and Applied Biology,* 2(1), 2008, pp. 105-108.
15. **Crouch, I. J. and J. Van Staden (1992).** Effect of seaweed concentrate on the establishment and yield of greenhouse tomato plants. Journal of Applied Phycology, 4: 291-296.
16. **Crouch, I.J. and J. Van Staden (1993)**. Evidence for the presence of plant growth regulators in commercial seaweed products. *Plant Growth Regulation,* 13: 21-29.
17. *Economou, G*.; *D. Lyra*; K. Sotirakoglou; K. Fasseas and P. Taradilis (*2007*) Stimulating Orobanche ramosa seed germination with an Ascophyllum nodosum extract. Phytoparasitica Volume 35, Number 4, 367-375.
18. **El-Sheekh, M. M. and A. E. F. El-Saiedh (1999).** Effect of seaweed extracts on seed germination, seedling growth and some metabolic processes of faba beans (*Vicia faba*L.), Phykos, 38 : 55-64.
19. **Featonby-Smith BC, van Staden J (1983a)**. The effect of seaweed concentrate on the growth of tomato plants in nematode-infested soil. Sci Hortic 20:137–146
20. **Featonby-Smith BC, van Staden J (1983b).**The effect of seaweed concentrate and fertilizer on the growth of Beta vulgaris. Z Pflanzenphysiol 112:155–162.
21. **Featonby-Smith BC, van Staden J (1984)** The effect of seaweed concentrate and fertilizer on growth and the endogenous cytokinin content of *Phaseolus vulgaris*. S Afr J Bot 3:375–379.
22. **Fletcher RA (1982)** an improved bioassay for cytokinins using cucumber cotyledons. Plant Physiol. 69: 675-677
23. **Hamblin, A.P. (1991)**. Sustainable agricultural systems: what are the appropriate measures of soil structure? Australian Journal of Soil Research 29: 709-15
24. **Kambayashi, M.; K. wanata (2005)** effect of kelp on riceseedling growth, tohoku j crop sci. 48 27-29
25. **Khan, W.; U.P. Rayirath; S. Subramanian; M. N. Jithesh; P. Rayorath; D. M. Hodges; A. T. Critchley; J. S. Craigie; J. Norrie; B. Prithiviraj (2009)** Seaweed extracts as biostimulants of plant growth and development.J Plant Growth Regul 28:386–399
26. **Kumar, G. and D. Sahoo (2011).** Effect of seaweed liquid extract on growth and yield of Triticum aestivum. Pusa Gold. Journal of Applied Phycology. 23 :251–255.
27. **Liu, W., Hildebrand, D. F., Scott Grayburm, W., Phillips, G. C. and Collins, G. B. 1991.** Effects of exogenous auxins on expression of Lipoxygenases in cultured soybean embryos. *Plant Physiol.,* 97 : 969-976.
28. **Mostafa, M.E., and Zheekh, L. 1999.** Effect of seaweed extracts on seed germination, seedling growth and some metabolic process of Vicia faba L. *Cytobios*,100: 23 – 25.
29. **Moller, M. and M.L. Smith (1998).** The significance of the mineral component of seaweed suspension on lettuce (*Lactuca sativa* L) seedling growth. *Journal of Plant Physiology*, 153: 658 – 663.
30. **Moller, M. and M.L. Smith (1999).** The effect of pruning treatments using seaweed suspensions on the water sensitivity of Barley (*Hardeum vulgare* L.)caryopses. Annals of Applied Biology, 135:515-522.
31. **Nelson WR, van Staden J (1984)** the effect of seaweed concentrate on wheat culms. J Plant Physiol 115:433–437
32. **Nour, K. A. M.; N. T. S. Mansour and W. M. Abd El-Hakim (2010).** Influence of foliar spray with seaweed extracts on growth, setting and yield of tomato during summer season, J. Plant Production, Mansoura University, Vol. 1 (7): 961 – 976.

33. *Ouedraogo, E.; A. Mando and N.P. Zombre (2001).* Use of compost to improve soil properties and crop productivity under low input agricultural system in West Africa , Agric. Ecosyst environ 84 259-266.
34. **Pise, N.M. and A.B. Sabale (2010).** Effect of seaweed concentrates on the growth and biochemical constituents of *Trigonella Foenum- Graecum* L. Journal of Phytology, 2(4): 50–56.
35. **Rai, S. N. and V.D. Mudgal (1988).** Synergistic effect of sodium hydroxide and steam pressure treatment on compositional changes and fibre utilization of wheat straw. Biological waster , vol. 24 : 105- 114.
36. **Ramya, S. S.; S. Nagaraj and N. Vijayanand (2010).** Biofertilizing efficiency of brown and green algae on growth, biochemichal and yield parameters of Cyamopsis (L.) Taub. Recent Research in Science and Technology, 2(5): 45-52.
37. **Rathore, S. S.; D. R. Chaudhary; G. N. Boricha; A Ghosh; B. P. Bhatt; S.T. Zodape and J. S. Patolia (2009).** Effect of seaweed extract on the growth, yield and nutrient uptake of soybean (Glycine max) under rainfed conditions. South African Journal of Botany **75**(2):351-355.
38. **Reitz, S.R. and J.T. Trumble. (1996).** Effects of cytokinin-containing seaweed extract on *Phaseolus lunatus* L. Influence of nutrient availability and apex removal. Botanica Marina 39:33-38
39. **Rosen, H. (1956).** A modified ninhydrin colorimetric analysis for amino acids arch. Biochem. 67 : 10- 15
40. **Sangeetha, V and R. Thevanathan (2010).** Biofertilizer potential of traditional and panchagavya amended with seaweed extract. The Journal of American Science, 6(2):61-67.
41. **Şehirali, S. (1988).** Yemeklik tane baklagiller Ders Kitabı. (Seed Legumes, Lecture Notes), Publication No. 1089 pp. 314. Faculty of Agriculture, University of Ankara, Turkey.
42. **Sekar, R.; N. Thangaraju and R. Rengasamy (1995).** Effect of seaweed liquid fertilizers form *Ulva lactuca* on *Vigna unguiculata* L. (walp.), Phykos, 38: 49-53.
43. **Senn, T. L. (1987).** Seaweed and plant growth. Faith printing co. Taylor, South Corolina, 166pp.
44. **Shehata, S. M.; H. S. Abdel-Azem; A. Abou El-Yazied; A. M. El-Gizawy (2011).** Effect of foliar spraying with amino acids and seaweed extract on growth chemical constitutes, yield and its quality of celeriac plant. European Journal of Scientific Research. 58. (2), pp.257-265.
45. **Sivasankari, S.; V.Venkatesalu; M. Anantharaj and M. Chandrasekaran (2006).** Effect of seaweedextracts on the growth and biochemical constituents of Vigna sinensis. Bioresource Technology. 97 1745–1751.
46. **Snedecor, G.W. and W.G. Cochran (1982).** Statistical methods 7th ed. Iowa state Unv. , press, lowa, U.S.A
47. **Sridhar, S. and R. Rengasamy (2010).** Efeect of seaweed liquid fertilizer on the growth, biochemical constituents and yield of *Tagetes erecta,* under field trial**.** Journal of Phytology, 2(6): 61–68
48. **Sridhar, S. and R. Rengasamy (2010).** Significance of seaweed liquid fertilizers for minimizing chemical fertilizers and improving yield of *Arachis* under field trial**.** Recent Research in Science and Technology, 2(5): 73-80.
49. **Sridhar, S. and R. Rengasamy (2011).** Potential of seaweed liquid fertilizers (SLFS) on some agricultural crop with special reference to protein profile of seedling. International Journal of Development Research; Vol. 1, Issue, 7, pp.055-057.
50. **Sultana, V.; G. N. Baloch; Ambreen; J. Ara; M. R. Tariq AND S. E. Haque (2011).** Comparative efficacy a red aga *Solieria Robusta*, chemical fertilizers and pesticides in managing the root diseases and growth of soybean. *Pak. J. Bot*., 43(1): 1-6, 2011.
51. **Temple, W. D.; A. A. Bomke; R. A. Radley and F. B. Holl (1988).** Effects of kelp (*Macrocystis integrifolia* and*Ecklonia maxima*) foliar applications on bean crop growth and nitrogen nutrition under varying soil moisture regimes Plant and Soil. 117 (1), 75-83.
52. **Temple, W. P. and A. A. Bomke (1989).** Effect of kelp (*Macrocystis integrifolia*) on soil chemical properties and crop response. Plant and Soil, 105: 213-222.
53. **Thirumaran, G.; M. Arumugam; R. Arumugam and P. Anantharaman (2009).** Effect of seaweed liquid fertilizer on growth and pigment concentration of cyamopsis tetrogonolaba (L) Taub. American-Eurasian Journal of Agronomy 2 (2): 50-56.
54. **Trough, E. and A.H. Meyer (1939)**. Improvement in denies colorimetric method for phosphorus and arsenic Ind. Eng. Chem. Anal. Ed., 1: 136-139.
55. **Verkleij, F.N. (1992).** Seaweed extracts in agriculture and Horticulture. *A Review Biological Agriculture and Horticulture*, 8: 309-324.
56. **Whapham CA, Blunden G, Jenkins T, Hankins SD (1993)** significance of betaines in the increased chlorophyll content of plants treated with seaweed extract. J Appl Phycol 5:231–234.
57. **Whapham CA, Jenkins T, Blunden G, Hankins SD (1992)** Increased chlorophyll content of tomato leaves treated with seaweed extracts. 3r. phycol. J. 27: 102.
58. **Zahid, P. B. (1999).** Preparation of organic fertilizer from seaweed and its effect on the growth of some vegetable and ornamental Plants**.** Pakistan Journal of Biological Sciences 2(4) 1274- 1277.
59. **Zodape, S. T**. ***(*2001*)*** Seaweeds as a biofertilizer, J Sci Ind Res, 60. 378-382. 8.
60. **Zodape, S.T.; V. J Kawarkhe; J S Patolia and A.D Warade (2008).** Effect of liquid seaweed fertilizer on yield and quality of okra (*Abelmoschus esulentus* L.) Journal of Scientific and Industrial Research Vol. 67, December , pp. 1115 – 1117.
61. **Zodape, S.T.; S. Mukhopadhyay; K. Eswaran, M.P. Reddy and J. Chikara (2010).** Enhanced yield and nutritional quality in green gram (*phaseoulus radiata* L) treated with seaweed (kappaphycus alvarezii) extract , journal of scientific & industrial research vol. 69 pp. 468 – 471.

3/3/2012