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EFFECT OF ALGAE AND YEAST EXTRACTS AS FOLIAR APPLICATION ON THE PRODUCTIVITY OF SNAP BEAN GROWN UNDER SANDY SOIL CONDITIONS

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ABSTRACT: ***A field experiment was carried out during the two successive summer seasons of 2017 and 2018 under sandy soil conditions at El-Khattara Experimental Farm, Fac. Agric., Zagazig University, to study the effect of algae extract at 0, 1 and 2 ml/l, and yeast extract at 0, 5 and 10 g/l as foliar application and their interactions on growth, chemical constituents, yield and pod quality of snap bean cv, Bronco. The most important findings could be summarized as follows: The interaction treatment between spraying snap bean with algae extract at 2 ml/l, and yeast extract at 10 g/l increased plant height, number of leaves, number of branches, shoot dry weight , chlorophyll a, b and total chlorophyll (a+b) in leaf tissues, N,P and K contents in shoots and its uptake by shoots, average pod length , pod weight , yield / plant, and total pods yield/fed., total carbohydrates, TSS and total protein in green pods and lowest total fiber content in green pods. However, this treatment recorded a high relative increases in total yield/fed. were about ١١.٥ % over the control as average of two seasons.***

Key word: ***Snap bean, algae, yeast extract, chemical constituents, yield and pod quality.***

INTRODUCTION

Snap bean (*Phaseolus vulgaris* L.) is one of the important vegetable crops in Egypt for both local consumption and exportation. As well as It is one of the important food crops in Egypt and consumed as a cooked vegetable either as dry seeds or green pods. It plays an important role in human nutrition as a cheap source for protein, carbohydrates, vitamins and minerals.

Algae are natural bio active materials rich in minerals, protein, lipids, carbohydrates, vitamins and microelements (B, Mo, Zn, Cu). In addition, seaweed fertilizer aunique combination of N, P, K, trace elements and simple sugar that are in dissolved forms that are easily absorbed through roots and leaves, besides releasing trace elements bound to the soil and it is safe to human, animals and the environment (Sathya *et al*., 2010).

The beneficial effect of seaweed extract spraying on plants was demonstrated in terms of increase in growth (Salah El Din *et al*., 2008 on broad bean, Boghdady *et al*., 2016 on chickpea and Salama *et al*., 2019 on snap bean), leaf pigments and mineral contents (Byan 2014 and Abu Seif *et al*., 2016 on snap bean), yield and its components (Fawzy *et al*. 2010, Abou El-Yazied *et al*., 2012 on snap bean, Latique *et al*. 2013 on snap bean, Nawar and Ibraheim 2014 on pea , Kocira *et al*., 2017 and Salama *et al*. 2019 on snap bean) and pod quality (Salah El Din *et al*., 2008 on broad bean).

Yeast is a natural source of cytokinins and has stimulatory effects on bean plants (Amer, 2004). It has a beneficial role during vegetative and reproductive growth through improving the flower formation and their set in some plants due to its high auxin and cytokinins

contents and enhancement the carbohydrates accumulation. In addition, it participates in a beneficial role during stress due to its cytokinins content (Barnett *et al*., 1990).

Many researchers showed that spraying plants with yeast extract increased plant growth (Shokr and Fathy, 2009, Nassar *et al.,* 2011 , Abdel-Hakim *et al*., 2012, Kamal and Ghanem 2012, Abd-Elrhem 2017 on snap bean) , plant chemical constituents (El-Tohamy and El-Greadly, 2007 on snap bean, Shokr and Abd El- Hamid 2009 on pea and Abd-Elrhem 2017 on snap bean), yield and its components (El-Desuki and El-Gereadly 2006 , Ali and Abd-Allah, 2010, Nassar *et al.,* 2011 , Marzauk *et al*., 2014 and Khattab *et al*., 2015 on broad bean) and Marhoon *et al*., 2018, pod quality (Abou El-Yazied and Mady, 2012 and Abd-Elrhem, 2017 on snap bean and Al-Ashry, 2019 on sugar pea).

The objective of this study was to evaluate the effect of algae and yeast extracts at different concentrations as foliar application on growth, yield and pod quality of snap bean plants grown in sandy soil.

MATERIAL AND METHODS

A field experiment was carried out during the two successive summer seasons of 2017 and 2018 under sandy soil conditions at El-Khattara Experimental Farm, Fac. Agric., Zagazig University, to study the effect of algae and yeast extracts rates as foliar spray on growth, chemical constituents , yield and pod quality of snap bean cv, Bronco.

The soil physical and chemical of the used experimental properties site in sandy soil for the two experimental seasons, had 0.14 and 0.15 % organic matter, 8.01 and 7.99 pH, 2.05 and 2.16 mmhos/cm EC, 3.93 and 3.71 ppm available N, 3.92 and 3.97 available P and 12.15 and 13.12 available K in the 1st and 2nd seasons, respectively.

This experiment included 9 treatments, which were the combination between three rates of algae extracts (0, 1 and 2 ml/l) and three rates of yeast extract (0, 5 and 10 g/l). These treatments were arranged in a split plot design with three replications. Algae extract rates were randomly assigned in the main plots, while, yeast extract rates were devoted in sub plots.

Algae extract was produced at the Algae Production Station of the National Research Centre (NRC, Giza, Egypt). Major components of algae extract is shown in Table, (1).

Yeast extract was prepared from active dry yeast (*Saccharomyces cerevisiae*), dissolved in water, followed by adding sugar at a ratio of 1: 1 and kept 24 hours in a warm place, for reproduction according to the methods described by Morsi *et al.* (2008). Chemical analysis of activated yeast extract is shown in Table (2).

Table (1). Major constituents of the used algae extract

Constituents (D.W)	(%)	Macronutrients (%)		Micronutrients (ppm)	
Crude protein	50.56	N	8.09	Fe	2057
Ether extract	7.39	P	2.69	Zn	722
Crude fiber	9.83	K	0.65	Mn	747

Ash	**9.18**	**Cu**	**93**
Moisture	**4.51**		

Table (2): Chemical analysis of yeast extract according to Morsi *et al.* (2008).

Amino acids mg/100g dry weight		Mineral mg/100g dry weight		Vitamins mg/100g dry weight	
Arginine	**1.99**	**Total N**	**7.23**	**Vit.B_1**	**2.23**
Histidine	**2.63**	**P_2O_5**	**51.68**	**Vit.B_2**	**1.33**
Isoleucine	**2.31**	**K_2O**	**34.39**	**Vit. B_5**	**19.56**
leucine	**3.09**	**MgO**	**5.76**	**Vit.B_6)**	**1.25**
Lysine	**2.95**	**CaO**	**3.05**	**Vit. B_7**	**0.09**
Methionine	**0.72**	**SiO_2**	**1.55**	**Vit. B_8**	**0.26**
Phenyl alanine	**2.01**	**SO_2**	**0.49**	**Vit. B_9**	**4.36**
Threonine	**2.09**	**NaCl**	**0.30**	**Vit B_{12}**	**0.15**
Tryptophan	**0.45**	**Fe**	**0.92**	**Nicotinic acid**	**39.88**
Valine	**2.19**	**Ba**	**157.5**	**Pamino benzoic acid**	**9.23**
Glutamic acid	**2.00**	**Pd**	**438.6**	**Carbohydrates**	**23.2**
Serine	**1.59**	**Mn**	**81.3**	**Glucose**	**13.33**
Aspartic acid	**1.33**	**Zn**	**335.6**		
Cystine	**0.23**				
Proline	**1.53**				
Tyrosine	**1.49**				

The experimental unit area was 10.8 m^2 (three drippers lines with 6m length for each and 60cm width), and the distance between drippers was 25cm. The middle dripper line was used for data collection and others were used for yield determination. One dripper line were left between spraying treatments, and 50cm was left between plots as a guard space to avoid the overlapping of spraying concentrations.

Seeds of snap bean were obtained from the Hort. Res. Instit., Agric. Res. Center, Egypt. Seeds were sown on 1st and 4th March in the 1st and 2nd seasons, respectively, in hills 15 cm apart on one side of dripper and two seeds per hill and then thinned after completely emergency to leave one plant/ hill.

The plants were sprayed with algae and yeast extracts using hand pressure sprayer three times at 15, 30 and 45 days after sowing in both growing seasons

All plots received equal amounts of nitrogen, phosphorus and potassium and added in the form of ammonium sulphate (20.5 % N), calcium superphosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O) at the rates of 80 kg N, 37 kg P_2O_5 and 50 kg K_2O, respectively. On third of N, K and all P fertilizers were added at the time of soil preparation with 20 m^3/fad. FYM (farmyard manure). The rest two third of N and K were divided

into 10 equal portions and added through water irrigation (fertigation) 3 days intervals, beginning 15 days after sowing. The other normal agricultural treatments for growing snap bean plants were practiced.

Data Recorded

A random sample of ten plants from every plot was taken after 60 days from sowing and plant height (cm), number of leaves/plant, and number of branches/plant were recorded.

1. **Dry weight:** the shoots of plant were oven dried at 70 ^{o}C till constant weight, and then dry weight of shoots were recorded.
2. **Photosynthetic pigments:** Disk samples from the fourth upper leaf were obtained after 60 days from sowing in all plots to determined chlorophyll a and b, as well as carotenoids in both seasons according to the method described by Wettestein (1957).
3. **Plant chemical composition:** The dry matter of branches and leaves which taken at 60 days after sowing in the both seasons were finely ground and wet digested with sulfuric acid and perchloric acid (3:1). Nitrogen, phosphorus and potassium contents were determined according to the methods described by Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively. Nitrogen, phosphorus and potassium uptake (mg/plant) were calculated by element (%) in shoot x dry weight /shoot x 10.
4. **Pod yield and its components:** Green pods of each plot were harvested at the proper maturity stage, counted and weighted in each harvest and number of pods/ plant , yield / plant and total pod yield (ton /fed.) were determined. Ten plants were randomly marked from each plot for determining the number of pods/plant. Twenty pods were randomly chosen from each treatment to determine; pod length (cm) and average weight of pod (g) .
5. Pod quality; Randomly samples of pods from each treatment were taken to assay the following characters: Total carbohydrate (%): was determined in pods dry matter according to the method described by Dubois *et al.* (1956). Total soluble solids contents (TSS) as brix^{o}: total soluble solids content using the hand refractometer. Total crude fibers were determined as percentage according to Maynard (1970). Pod protein: pod protein percentage, pod total N was determined and a factor of 6.25 was used for conversion of total N to protein percentage (Kelly and Bliss, 1975).

Statistical analysis:

The data of these experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1980) and the differences among treatments were compared using LSD at 0.05 level.

RESULTS AND DISCUSSION

1. Plant growth

1.1. Effect of algae extract

Data in Table (3) revealed that foliar application of algae extract at different rates (1 or 2 ml/L) had a significant effect on plant growth, i.e., plant height, both number of leaves and branches, as well as dry weight of shoots of snap bean compared with unsprayed plants, in both seasons, however spraying snap bean plants with 2 ml/l recorded the highest values of all plant growth parameters, in both seasons.

The relative increases in dry weight of shoots due to spraying with algae extract at 2 ml/l were about 21.00 and 18.00 over

Table (3): Effect of spraying with algae and yeast extracts and their interactions on plant growth of snap bean plants during summer seasons of 2017 and 2018

Treatments		Plant height (cm)		Number of leaves/ plant		Number of branches/ plant		Dry weight of shoots (g)		Relative increases in dry weight of shoots (%)	
		2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season
Effect of algae extract											
0		33.44	33.55	21.22	27.77	6.22	5.89	11.62	12.08	00.0	00.0
1 ml/L		34.78	36.77	21.78	22.33	6.66	6.33	11.88	12.49	02.2	03.4
2 ml/L		38.47	40.49	26.48	26.81	7.02	7.09	14.06	14.25	21.0	18.0
L SD at 0.05 level		1.30	1.74	1.01	0.87	0.43	0.29	0.57	0.49	--	---
Effect of yeast extract											
YE 0		32.89	33.22	18.88	20.55	6.00	5.78	11.32	11.82	00.0	00.0
YE at 5 g/l		35.72	37.10	25.32	26.95	6.83	6.46	13.07	13.38	15.5	13.2
YE at 10 g/l		38.08	40.50	25.26	29.42	7.08	7.07	13.16	13.62	16.3	15.2
L SD at 0.05 level		1.02	1.36	0.79	0.68	0.34	0.22	0.43	0.38	---	----
Effect of interaction											
0	YE 0	30.66	26.66	14.66	23.66	5.00	5.00	10.83	11.13	00.0	00.0
	YE at 5 g/L	33.00	35.33	23.66	29.66	6.33	5.66	11.7	12.42	08.0	11.6
	YE at 10 g/L	36.66	38.66	25.33	30.00	7.33	7.00	12.32	12.69	13.8	14.0
1 ml/L	YE 0	32.00	33.66	17.33	24.00	6.33	6.33	11.19	11.84	03.3	06.4
	YE at 5 g/L	36.00	36.00	26.00	19.00	7.00	6.33	11.74	12.23	08.4	09.9
	YE at 10 g/L	36.33	40.66	22.00	24.00	6.66	6.33	12.7	13.39	17.3	20.3
2 ml /L	YE 0	36.00	39.33	24.66	14.00	6.66	6.00	11.93	12.48	10.2	12.1
	YE at 5 g/L	38.15	39.96	26.31	32.18	7.15	7.38	15.78	15.5	45.7	39.3
	YE at 10 g/L	41.25	42.18	28.46	34.25	7.26	7.89	14.46	14.77	33.5	32.7
L SD at 0.05 level		1.77	2.37	1.38	1.18	0.59	0.39	0.78	0.67	--	--

YE= Yeast extract

the unsprayed treatment in the 1st and the 2nd seasons, respectively.

The enhancement snap bean plant growth characteristics due to algae extract spraying may be attributed to the auxins content of the algae extract which

has an effective role in cell division and enlargement, this leads to increase the shoot growth, leaves number, and plant dry weight (Gollan and Wright 2006). It also contains macronutrients (N, P and K) which are very essential for growth and development of the plant (Attememe, 2009).

These results are harmony with those reported by Salah El Din *et al.* (2008) on broad bean, Boghdady *et al*. (2016) on chickpea and Salama *et al*. (2019) on snap bean

1.2. Effect of yeast extract

Data in the same Table (3) illustrated that plant height, both number of leaves and branches, as well as dry weight of shoots were significantly increased with increasing yeast extract rates up to 10 g/ L, in both seasons without any significant differences with the treatment of 5 g/L as respect to both number of leaves and branches/ plant in the 1st season and dry weight of shoots in both seasons.

The relative increases in total dry weight / plant were about 16.3 and 15.2 for the treatment of 10g /l and 15.5 and 13.2 % for the treatment of 5g/ l yeast extract over the control treatment (unsprayed) in the 1st and the 2nd seasons, respectively.

The superiority of plant growth as response to the foliar application of yeast extract may be attributed to its contents of different nutrients, i.e. P, K, Mg, Ca, Fe, Ba, Mn and Zn, higher percentage of proteins, higher values of free amino acids and vitamins (Table 1) which may play an important role in improving growth parameters.

These results are in agreement with those reported by Shokr and Fathy (2009), Nassar *et al. (*2011) , Abdel-Hakim *et al*. (2012), Kamal and Ghanem (2012) and Abd-Elrhem (2017) on snap bean, they concluded that, application of yeast extract caused a significant increase in plant growth characters of snap bean.

1.3. Effect of interaction

The interactions between algae extract and yeast extract had a significant effect on plant growth of snap bean, i.e., plant height, both number of leaves and branches as well as dry weight of shoots (Table 3). Spraying snap bean plants with algae extract at 2 ml/L and yeast extract at 10 g/L recorded the highest values of plant height, both number of leaves and branches / plant, while the interaction between algae extract at 2 ml/L and yeast extract at 5 g/L recorded the highest values of dry weight of shoots, in both seasons.

The relative increases in total dry weight / plant were about 45.7 and 39.3 % for the interactions between 2 ml/L algae extract and 5 g/L yeast extract over the control treatment (unsprayed) in the 1st and the 2nd seasons, respectively.

2. Leaf pigments

2.1. Effect of algae extract

Data in Table (4) indicated that, The algae extracts rates had a significant effect on chlorophyll a, total chlorophyll and carotenoides in leaf tissues and had insignificant effect on chlorophyll b, in both seasons.

Spraying snap bean plants with algae extract at 2 ml/L recorded the highest

Table (4): Effect of spraying with algae and yeast extracts and their interactions on leaf pigments (mg/g DW) of snap bean leaves tissues during summer seasons of 2017 and 2018

Treatments		Chl. a		Chl.b		Total (a+b)		Carotenoides	
		2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season
		Effect of algae extract							
Effect of algae extract		2.99	3.14	1.17	1.24	4.15	4.38	1.17	1.19
0		3.28	3.37	1.20	1.34	4.48	4.71	1.30	1.36
1 ml/L		3.47	3.63	1.37	1.51	4.84	5.14	1.64	1.51
2 ml/L		0.06	0.08	N S	N S	0.1 7	0.20	0.12	0.09
L SD at 0.05 level		Effect of yeast extract							
Effect of yeast extract		3.00	3.13	1.09	1.27	4.10	4.40	1.31	1.32
YE 0		3.32	3.43	1.28	1.41	4.60	4.84	1.25	1.28
YE at 5 g/l		3.41	3.59	1.37	1.41	4.78	4.99	1.55	1.45
L SD at 0.05 level		0.04	0.06	0.08	0.07	0.13	0.16	0.09	0.07
Effect of interaction									
0	YE 0	2.82	2.73	1.05	1.19	3.87	3.92	1.04	1.07
	YE at 5 g/L	3.00	3.19	1.19	1.29	4.19	4.48	1.07	1.08
	YE at 10 g/L	3.14	3.51	1.26	1.23	4.4	4.74	1.39	1.42
1 ml/L	YE 0	3.06	3.25	1.12	1.21	4.18	4.46	1.29	1.38
	YE at 5 g/L	3.11	3.31	1.10	1.37	4.21	4.68	1.10	1.21
	YE at 10 g/L	3.66	3.56	1.39	1.43	5.05	4.99	1.50	1.48
2 ml /L	YE 0	3.13	3.42	1.11	1.40	4.24	4.82	1.59	1.52
	YE at 5 g/L	3.86	3.79	1.55	1.56	5.41	5.35	1.58	1.55
	YE at 10 g/L	3.42	3.69	1.46	1.56	4.88	5.25	1.76	1.46
L SD at 0.05 level		0.08	0.11	0.15	0.12	0.23	0.28	0.17	0.12

YE= Yeast extract

2.2. Effect of yeast extract:

concentrations of chlorophyll a, total chlorophyll and carotenoides in leaf tissues, in both seasons.

Algae extract have a great role in cell division and enlargement and induce the photosynthesis, consequently in turn reflected on a great shoot growth (Lopez *et al*. 2008).

These results are in accordance with those obtained by Byan (2014) and Abu Seif *et al*. (2016) on snap bean.

Data in Table (4) showed that, concentrations of chlorophyll a, b, total chlorophyll and carotenoides in leaf tissues were significantly increased due to plants foliar spray with yeast extract compared with the unsprayed plants in both seasons. The highest values of all leaf pigments concentration were produced by the plants received 10 g/L yeast extract in both seasons.

These results could be attributed to the great role of yeast extract in stimulate the cell division, elongation, enlargement, protein and nucleic acid synthesis and chlorophyll formation (Spencer *et al*., 1983).

These results are agree with Abd-Elrhem 2017) on snap bean. He showed that foliar spray of plants with yeast extract increased photosynthetic pigments in the leaf tissues.

2.3. Effect of interaction

The interactions between spraying snap bean plants with 2 ml/L algae extract and 5g/L yeast extract significantly increased chlorophyll a, b, total chlorophyll (a+b) and carotenoides in leaf tissues than the other interactions treatments, in both seasons (Table, 4).

3. N, P and K contents and its uptake

3.1. Effect of algae extract

The obtained results in Table (5) showed that spraying snap bean plants with algae extract at 2 ml/L significantly increased N,P and K contents and its uptake in shoots without significant differences between algae extract at 1ml/L for N and P content in shoots in the 2nd season and K content in both seasons.

This increase in N content in shoots may be due to that the high protein content (50.56 % on dry basis of the algae extract which split natural plant amino acids involved directly in the metabolism (Table 1). Also, algae extract is a rich source of potassium and contains considerable amounts of Ca, Cu, Fe, Mg, Mn, P and Zn. These results may explain the great benefits of algae extract on supplementing pea plants with their requirements from organic and mineral nutrients (Marrez *et al*., 2014).

These results are in harmony with those reported by Abou El-Yazied *et al*. (2012) on snap bean.

3.2. Effect of yeast extract

Data in Table (5) showed clearly that foliar spray with yeast extract at different rates had a significant effect on N, P and K contents and its uptake by shoots compared to the control treatment (sprayed with tap water), in both seasons.

Spraying snap bean plants with yeast extract at 10 g/l recorded the maximum values of N,P and K contents in shoots and its uptake in both seasons , with no significant differences as a result of yeast extract of 5 g/l in P content of shoot in the 1st season.

These results are in accordance with those obtained by y El-Tohamy and El-

Table (5): Effect of spraying with algae and yeast extracts and their interactions on N, P and K contents and its uptake by snap bean shoots during summer seasons of 2017 and 2018

Treatments		Contents (%)						Uptake (mg/ plant)					
		N		P		K		N		P		K	
		2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season
Effect of algae extract													
0		2.38	2.76	0.310	0.330	1.99	2.18	278.99	334.57	35.89	39.77	232.62	265.39
1 ml/L		3.08	3.16	0.400	0.450	2.49	2.70	366.80	395.86	47.78	56.95	297.62	338.36
2 ml/L		3.27	3.18	0.450	0.470	2.55	2.69	461.85	453.70	63.50	67.13	360.83	384.73
L SD at 0.05 level		0.10	0.20	0.039	0.030	0.13	0.20	7.41	8.72	1.30	0.95	3.49	4.36
Effect of yeast extract													
YE 0		2.60	2.80	0.340	0.370	2.05	2.31	295.95	331.79	38.94	44.13	233.14	273.93
YE at 5 g/l		2.96	3.03	0.400	0.420	2.36	2.52	392.33	406.85	52.73	56.81	312.50	340.12
YE at 10 g/l		3.17	3.27	0.420	0.460	2.62	2.75	419.36	445.49	55.51	62.91	345.42	374.43
L SD at 0.05 level		0.08	0.15	0.030	0.024	0.10	0.16	5.82	6.84	1.02	0.76	2.73	3.42
Effect of interaction													
0	YE 0	2.01	2.46	0.260	0.270	1.65	1.89	217.68	273.80	28.16	30.05	178.70	210.36
	YE at 5 g/L	2.25	2.73	0.290	0.310	1.91	2.05	263.25	339.07	33.93	38.50	223.47	254.61
	YE at 10 g/L	2.89	3.08	0.370	0.400	2.40	2.61	356.05	390.85	45.58	50.76	295.68	331.21
1 ml/L	YE 0	2.78	2.89	0.320	0.390	2.18	2.55	311.08	342.18	35.81	46.18	243.94	301.92
	YE at 5 g/L	3.24	3.19	0.440	0.483	2.52	2.70	380.38	390.14	51.66	59.07	295.85	330.21
	YE at 10 g/L	3.22	3.40	0.440	0.490	2.78	2.86	408.94	455.26	55.88	65.61	353.06	382.95
2 ml /L	YE 0	3.01	3.04	0.443	0.450	2.32	2.48	359.09	379.39	52.85	56.16	276.78	309.50
	YE at 5 g/L	3.38	3.17	0.460	0.470	2.65	2.81	533.36	491.35	72.59	72.85	418.17	435.55
	YE at 10 g/L	3.41	3.32	0.450	0.490	2.68	2.77	493.09	490.36	65.07	72.37	387.53	409.13
L SD at 0.05 level		0.14	0.27	0.053	0.041	0.18	0.28	10.08	11.86	1.77	1.29	4.74	5.93

YE= Yeast extract

Greadly (2007) on snap bean and Shokr and Abd El- Hamid (2009) on pea, they stated that spraying plants with yeast extract increased N, P and K contents and uptake by plants.

3.3. Effect of interaction

The interactions between algae extract and yeast extract rates had a significant effects on N, P and K in shoots and its uptake, in both seasons, except P and K contents in leaves in the 1st season only (Table 5).

Regarding N, P and K contents in shoots data showed that spraying plants with the combinations of 2 ml/L algae extract and 10 g/L yeast extract increased N and P contents in shoots in both season. While the interactions between the treatment of algae extract at 1 ml/l and yeast extract at 10 g/l increased K content in shoots in both seasons. As for N, P and K uptake by shoots, the same data showed that the interactions between spraying bean plants with algae extract at 2 ml/l and yeast extract at 5 g/l increased N, P and K uptake by shoots, in both seasons.

4. Yield and its components

4.1. Effect of algae extract

Data in Table (6) showed that, pod yield and its components of snap bean plants had significantly affected by the two rates of algae extracts than unsprayed plants, in both seasons.

Spraying plants with algae extract at 2 ml/L increased pod length, number of pods / plant, average pod weight, yield/ plant and total green yield of pods/fed., in both seasons, without any significant differences with the treatment of algae extract at 1ml/L regarding pod length and number of pods / plant, in both seasons and average pod weight in the 2nd season.

The relative increases in total yield /fed. were about 24.6 and 32.6 % for algae extract at 2 ml/L and 14.9 and 21.4 % for algae extract at 1 ml/L over the control treatment (unsprayed plants) in the 1st and the 2nd seasons, respectively.

The increases of total yield /fed might be due to the increases in average pod weight (Table 6). Also, this might be due to the favorable effect of algae extract on dry weight (Table 3), leaf pigments (Table 4) and mineral uptake (Table 5).

These results are in harmony with those obtained by Fawzy *et al*. (2010), Abou El-Yazied *et al*. (2012) on snap bean, Latique *et al*. (2013) on snap bean, Nawar and Ibraheim (2014) on pea, Kocira *et al.* (2017) and Salama *et al*. (2019) on snap bean

4.2. Effect of yeast extract

Data in Table (6) indicated that, the foliar application of yeast extract increased pod traits and yield components comparing to the control treatment. Pod length, number of pods/ plant, average pod weight, yield/plant and total green yield /fed. were significantly increased with increasing yeast extract up to the highest rate, i.e. 10 g/L, in both seasons without any significant differences with the treatment of 5g/L concerning average pod length in the 1st season and number of pods/ plant in both seasons.

The relative increases in total yield /fed. were about 33.2 and 31.2 for 10g /L and 18.7 and 17.3 % for 5g/ L yeast extract over control treatment in the 1st and the 2nd seasons, respectively.

These results may be attributed to yeast extract containing amino acids and vitamins (Table 2). Also, yeast extract naturally (contains many compounds, i.e. cytokinins and proteins that enhance cell division and its enlargement which are

Table (6): Effect of spraying with algae and yeast extracts and their interactions on yield and its components of snap bean plants during summer seasons of 2017 and 2018

Treatments		Pod characterizes						Yield and its components					
		Pod length (cm)		Number of pods / plant		Average pod weight (g)		Yield / plant (g)		Total yield (.ton/fed.)		Relative increases in total yield	
		2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season
Effect of algae extract													
0		8.43	8.81	11.06	10.91	5.49	5.84	61.11	63.94	2.844	2.991	00.0	00.0
1 ml/L		10.78	10.17	11.91	11.91	6.08	6.89	70.26	78.11	3.267	3.632	14.9	21.4
2 ml/L		11.15	10.56	11.67	11.90	6.31	6.97	76.18	84.64	3.545	3.965	24.6	32.6
L SD at 0.05 level		0.51	0.44	0.07	0.10	0.09	0.21	3.05	3.66	0.130	0.200	--	---
Effect of yeast extract													
YE 0		9.72	9.48	11.32	11.24	5.76	6.31	59.11	65.11	2.743	3.038	00.0	00.0
YE at 5 g/l		10.21	9.75	11.67	11.92	5.94	6.56	69.95	76.56	3.257	3.565	18.7	17.3
YE at 10 g/l		10.43	10.31	11.64	11.56	6.18	6.82	78.48	85.02	3.655	3.985	33.2	31.2
L SD at 0.05 level		0.40	0.34	0.06	0.08	0.07	0.17	2.39	2.87	0.102	0.157	----	----
Effect of interaction													
0	YE 0	7.18	7.48	10.18	10.25	4.93	5.10	50.17	52.18	2.320	2.460	00.0	00.0
	YE at 5 g/L	8.20	8.30	11.03	11.26	5.22	5.44	57.58	61.25	2.687	2.858	15.8	16.2
	YE at 10 g/L	9.90	10.66	11.96	11.23	6.32	6.98	75.59	78.39	3.524	3.655	51.9	48.6
1 ml/L	YE 0	11.23	10.96	12.53	12.00	6.37	7.23	59.72	67.41	2.769	3.125	19.4	27.0
	YE at 5 g/L	11.50	10.73	12.13	12.40	6.48	7.50	72.46	81.68	3.371	3.800	45.3	54.5
	YE at 10 g/L	9.60	8.83	11.06	11.33	5.40	5.95	78.60	85.24	3.660	3.970	57.8	61.4
2 ml /L	YE 0	10.75	10.00	11.26	11.46	5.99	6.61	67.45	75.75	3.141	3.528	35.4	43.4
	YE at 5 g/L	10.92	10.23	11.86	12.10	6.11	6.75	79.82	86.76	3.713	4.036	60.0	64.1
	YE at 10 g/L	11.78	11.45	11.89	12.13	6.82	7.54	81.26	91.42	3.780	4.331	62.9	76.1
L SD at 0.05 level		0.69	0.60	0.10	0.14	0.13	0.29	4.15	4.97	0.177	0.272	---	---

YE= Yeast extract

safe and non-pollutant (Barnett *et al*., 1990).

The increase of total yield /fed. might be due to the increase in average pod weight (Table 6). Also, this might be due to the favorable effect of yeast extract on dry weight of shoots (Table 3) , leaf pigments (Table 4) and mineral contents and its uptake (Table 5).
The obtained results are in accordance with those of Ali and Abd-Allah (2010), Nassar *et al.* (2011), Marzauk *et al*. (2014) and Marhoon *et al*. (2018) on snap bean. They stated that yield and its components were increased with increasing yeast extract rates.

4.3. Effect of the interaction

It is clear from data in Table (6) that the interactions between spraying snap bean plants with algae extract at 2ml/l and yeast extract at 10 g/l was the best effective interactions treatment for increasing the average pod length, number of pods/ plant average pod weight, yield / plant and total yield /fed., followed by the interaction between 2 ml/L algae extract and 5 g/L yeast extract

The increases in total yield/fed., were about 62.9 and 76.1 % for the interaction between spraying with algae extract at 2 ml/L, and yeast extract of 10 g/L and 60.0 and 64.1 % for the interaction between spraying with algae extract at 2 ml/l and yeast extract at 5 g/L over the control (sprayed with tap water) in the 1st and the 2nd seasons, respectively.

5. Pod quality

5.1. Effect of algae extract

Data in Table (7) illustrated that, total carbohydrates %, TSS %, and total protein (%) in pods were significantly increased due to spraying the plants with algae extract at 2 ml/L in both seasons, with no significant differences with algae extract at 1 ml/L with respect to total protein in both seasons, on the other hand, unsprayed plants gave the highest percentage of total fiber in pods, in both seasons.

The stimulative effect of algae extract on total protein in bean pods might be due to the increases in TSS in its pods (Table 7). These increases might be ascribed to the fact that yeast extract contains proteins and amino acids (Table 1).

These results are in harmony with those reported by Salah El Din *et al.* (2008) on broad bean.

5.2. Effect of yeast extract

Data in Table (7) evidently showed that the yeast extract as foliar application had a significant effect on total carbohydrates %, TSS %, and total protein % in bean pods than unsprayed plants, in both seasons. All tested pervious parameters were significantly increased with increasing the yeast extract up to 10g/L, while total fiber (%) was decreased, in both seasons.

The stimulative effect of yeast extract on total carbohydrates in pods might be due to the increases in TSS in pods (Table 7). These increases might be ascribed to the fact that yeast extract contains sugars, proteins and amino acids, as well as several vitamins (Eata, 2001).

Similar results were obtained by Abou El-Yazied and Mady (2012) on broad bean and Abd-Elrhem (2017) on snap bean and Al-Ashry (2019) on sugar pea.

5. 3. Effect of interaction

It is clear from data in Table (7) that, there were a significant effect between algae extract and yeast extract as foliar application on pods quality, in both seasons. The interactions between 2 ml/ L algae extract and 10 g/L yeast extract recorded the maximum total

Table (7): Effect of spraying with algae and yeast extracts and their interactions on pod quality of snap bean during summer seasons of 2017 and 2018.

Treatments		Total carbohydrates (%)		TSS (brix)		Total fiber (%)		Total protein (%)	
		2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season
Effect of algae extract									
0		41.62	44.02	3.59	3.83	7.69	8.77	13.92	16.92
1 ml/L		47.26	52.06	4.16	4.70	6.83	8.39	16.69	18.78
2 ml/L		50.46	55.44	4.65	4.91	6.74	7.90	16.81	18.64
L SD at 0.05 level		0.56	0.53	0.12	0.16	0.49	0.18	0.65	0.52
Effect of yeast extract									
YE 0		44.04	47.81	3.67	4.01	7.58	8.56	14.38	17.09
YE at 5 g/l		46.58	51.25	4.30	4.46	7.19	8.28	15.88	18.09
YE at 10 g/l		48.72	52.46	4.43	4.97	6.49	8.22	17.16	19.16
L SD at 0.05 level		0.47	0.40	0.08	0.11	0.38	0.12	0.53	0.38
Effect of interaction									
0	YE 0	38.15	39.45	3.12	3.22	8.35	9.27	12.31	15.14
	YE at 5 g/L	41.22	44.58	3.42	3.47	7.56	8.65	14.06	17.01
	YE at 10 g/L	45.48	48.04	4.22	4.79	7.17	8.39	15.38	18.61
1 ml/L	YE 0	45.44	50.60	3.89	4.17	7.36	8.37	15.32	18.04
	YE at 5 g/L	47.82	53.38	4.59	5.01	6.99	8.18	16.82	18.37
	YE at 10 g/L	48.52	52.20	4.00	4.92	6.15	8.61	17.94	19.93
2 ml /L	YE 0	48.52	53.38	4.00	4.65	7.04	8.03	15.51	18.08
	YE at 5 g/L	50.70	55.78	4.89	4.89	7.02	8.01	16.76	18.88
	YE at 10 g/L	52.17	57.15	5.07	5.19	6.15	7.65	18.15	18.95
L SD at 0.05 level		0.82	0.69	0.14	0.20	0.67	0.21	0.92	0.67

YE= Yeast extract

carbohydrates, TSS, in both seasons and total protein (%) in the 1st season and recorded the minimum total fiber contents in these pods.

CONCLUSION

It could be concluded that, under the same conditions, spraying snap bean plants cv, Bronco with both of algae extract at 2 ml/L and yeast extract at 10 g/L three times after 15, 30 and 45 days from sowing was the best treatment for improving snap bean plants productivity and its pods quality and this treatment recorded highest values of total yield/fed. were about ٦٩.٥ % over the control (sprayed with water).

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تأثير الرش الورقى بمستخلصات الطحالب والخميره على إنتاجية نباتات الفاصوليا تحت ظروف الأراضى الرمليه

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الملخص العربى

أجريت هذه التجربة خلال موسمى صيف 2017 ، ٢٠١٨ تحت ظروف الأراضى الرمليه وذلك بمزرعة التجارب بالخطارة– كلية الزراعة – جامعة الزقازيق بهدف دراسة تأثير الرش الورقى بمستخلصات الطحالب (٠، ١ ، ٢ مل /لتر) ومستخلص الخميرة (٠، ٥، ١٠ جم / لتر) والتفاعل فيما بينهما على النمو ، المحتوى الكيماوى للعرش ، محصول القرون ، وجوده القرون للفاصوليا صنف برونكو . ويمكن تلخيص أهم النتائج كمايلى:

سجل التفاعل بين رش نباتات الفاصوليا بمعدل ٢سم٣/لتر من مستخلص الطحالب مع رش النباتات من مستخلص الخميرة بمعدل ١٠ جم / لتر الى زيادة إرتفاع النبات، عدد الأوراق والأفرع على النبات ، الوزن الجاف للعرش وزياده محتوى الورقة من كلوروفيل أ ، ب ، الكلورفيل الكلى (أ+ب) فى أنسجه الورقة ، محتوى العرش من النيتروجين والفوسفور والبوتاسيوم والممتص منهم بواسطه العرش ، متوسط طول ووزن القرن ، محصول النبات ومحصول الفدان الكلى من القرون ، وكذلك محتوى القرون من المواد الكربوهيدراتية ، المواد الصلبه الكليه والبروتين الكلى ،أقل محتوى للقرون من الالياف. علاوة على ذلك كانت الزيادة النسبية فى المحصول الكلى لهذه المعاملة هى ٦٩.٥ % متوسط موسمى الدراسة أعلى من معاملة المقارنة (الرش بالماء فقط) .

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