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Response of Some Varieties of Faba bean to Yeast and Algae and Their Impact on Yield and its Components

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ABSTRACT

Faba bean (*Vicia faba* L.) is one of the major leguminous crops grown in the world. It is important source of protein for humans and animals. Two field experiments were conducted in the Experimental Farm Station of National Research Centre, at Nubaria station in Behara Government, Egypt, during the two consecutive seasons 2012/2013 and 2013/2014. Field bean plants at 30 days from sowing were sprayed with the following treatments fresh water (Control), Yeast (5 g/L), Alga extract (0.1%). The plants were collected after 90 days from sowing to determine the growth and yield parameters and some minerals. The growth of plants was increased except in dry weight of the alga extract treated plants. On the other hand, these treatments significantly increased plant height, number of teller, number of leaves and number of pods, plant of weight, weight of 100grain/g, grain yield /ton and straw yield. Protein, nitrogen, phosphors, potassium, magnesium, ferric and zinc.

Key words: Faba bean, yeast and algae, growth, minerals, yield and yield components.

Introduction

Grain legumes are major crops cultivated in the Northern and the Delta Nile of Egypt. Faba bean (*Vicia faba* L.) is produced in an average area of 69,720 ha., with an average yield of 1896 kg/ha (AOAD, 2007). Grain legumes play an essential role in human nutrition balancing the deficiencies of cereal-based diet (Dart and Krantz, 1977). Faba bean (*V. faba* L.) is an annual legume that is consumed as plant foods for human and animal nutrition, because it is rich in protein. Faba bean has a nitrogen fixation symbiosis in relation with *Rhizobium Leguminosarum*bv. *Viciae* (Dashadi *et. al*., 2011).

Bio fertilizers are biological preparations embodying, essentially, sufficient densities of potent strains of microorganisms, having a tangible beneficial role in filleting a proper rhizosphere for plant growth (Saber, 2001). Dinitos, (2006) demonstrate that the health benefits of fruits and vegetables are largely due to the antioxidants and vitamins supported by the large number of phytochemicals, some with greater antioxidant properties. Also, Abd El-Moniem, and Abd-allah, (2008) reported that algae extract is a new biofertilizer containing N, P, K, Ca, Mg, and S as well as Zn, Fe, Mn, Cu, Mo, and Co, some growth regulators, polyamines, natural enzymes carbohydrates, proteins and vitamins applied to improve vegetative growth and yield. Safinaz and Ragaa (2013) reported that, using marine algae as biofertilizers improved the vegetative characters of maize plants. Al-Shakankery *et al*., (2014) stated that there is a significant increase in total phenol, ascorbic acids and nitrogen content of maize grains of plants treated with algae as a biofertilizer compared to that of the controlmaize plants. Using combination of marine algae and cyanobacteria as bioferrtilizers agents improved the growth and phenol content of faba bean (*V. faba* L.) (Hamouda and Farfour, 2013). Cyanobacteria are one of the major components of the nitrogen fixing biomass in paddy fields, due to the important characteristic of nitrogen fixation. A cyanobacterium plays an important role to build up soil fertility consequently increasing in the yield, (Sahu *et al*., 2012 and Song *et al*., 2005).

The aim of the present study is effect of yeast and alga on growth and contents of minerals and yield for faba bean (*Vicia faba* L.).

Materials and Methods

Two field experiments were conducted in the Experimental Farm Station of National Research Centre, at Nubaria, Beheria Governorate, Egypt, during the two consecutive seasons 2021/2013 and 2013/2014. Field bean plants at 30 days from sowing were sprayed with the following treatments. Water (Control), Yeast (5 g/L), Algal extract (0.1%). The plants were collected after 90 days from sowing to determine the growth parameters. The physical and chemical properties of the soil of the experiment are shown in Table 1.

The soil was well prepared were added at the rate of 8 kg/m^2 as well as calcium superphosphate (15.5% P_2O_5) at the rate of 150 k/feddan (hectare = 2.4 feddan) during the preparation of the soil. Seeds were sown in

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hills 30cm apart on rows 60 cm in between and covered with a thin layer of the soil, then irrigated. Three weeks later, the developed plants were thinned to leave one plant per hill.

Table 1: The physical and chemical properties of the soil in the experiment.

Parameters	First season	Second season
Sand (%)	49. 6	48.8
Silt (%)	27.3	27.6
Clay (%)	23.1	23.6
Soil texture	Sandy loam	Sandy loam
pH	8.23	8.14
E.C. (mmohs/cm)	0.54	0.76
Soluble ions (soil paste) meq/litre		
Ca++	1.10	1.19
Mg++	0.89	0.76
Na+	2.22	2.31
K+	0.18	0.21
Co_3^{--}	0.15	0.21
HCo_3^{--}	0.68	0.66
Cl-	2.00	2.32
So_4^{--}	1.12	1.14
Available elements (ppm)		
Total N	130	160
P	20.1	38.2
K	222.4	223.8
Fe	80	71
Mn	7.1	8.9
Zn	0.95	1.10
Cu	2.02	1.91

Yeast Extract Manitol "YEM" medium and incubated in a water bath shaker at 25°C±1 for 72 hrs. Yeast was applied as foliar sprays on foliageat two times at the rate of 5 g/liter, the first after one month from sowing, the other two months later.

After collection, algae were washed with fresh tap water to remove the epiphytes, sand and other extraneous matter then they were dried in shadow open air and completing the drying process in the oven at 60ºC for 5 hours. Then, dried algae were ground to fine powder by mechanic grinder. The algae were applied as a soil treatment at the rate of 3 gm. powdered algae/Kg soil seven days before planting and watered twice daily. Isolation and purification of algae were done according to the method described by Rippka, (1988).

The layout of the experiment was split plot design with three replications, where varieties were devoted to the main plot and biofertilizers in the subplots. While the analysis of the two bio stimulants are shown in Table 2:-

Table 2: The analysis ofchemical properties of the twobio stimulants.

Parameters	YEM	Algae
Weight of one m^3 (kg)	618	507
Weight (%)	35	33.8
O.M. (%)	72.8	63.2
pH	7.18	7.68
C/N ratio	23.4	19.5
Organic carbon (%)	28.9	26.7
N %	1.6	1.2
P %	0.86	1.58
K %	0.41	0.70
Mg %	0.02	0.00
Fe ppm	651	872
Mn ppm	117.3	198.4
Cu ppm	31.8	45.7
Zn ppm	56.8	77.4

Total protein content: protein content was determined by the Kjeldahl method for the calculation of all proteins which equal nitrogen content multiplied by 6.25 (A.O.A.C., 1990).

Statistical analysis

The responses of the treatments were compared by analysis of variance (ANOVA) (Sokal and Rohlf, 1995). Significant differences between the means of parameters were determined using Duncan's multiple range tests ($P \leq 0.05$). All analysis was carried out with SPSS software.

Results and Discussion

Effects of the Treatments on Vegetative Growth:

The effects of yeast, algae and varieties on growth and yield of Faba bean plants are shown in Table (3). The results showed that all treatments significantly increased vegetative growth as indicated by plant height, number of teller, number of leaves and number of pods. These effects were more obvious especially at higher concentrations of these treatments. Amer, (2004) indicated that the application of yeast increased common bean growth.

On the other hand, the application of algae promoted bean growth and productivity and these effects agreed with the findings of El Bassiouny *et al*. (2005) who found that foliar application of algae significantly increased plant height, number of leaves and branches and number of pods of faba bean. They attributed these effects to the fact that it is a low molecular weight lipophilic antioxidant which protect membrane from oxidative damage. Hess (1993) also indicated that algae is highly effective antioxidant at the membrane site.

On the other hand, Giza 3 had a significant effect on growth under application of yeast and algae more than Sakha 2. Karaman *et al*. (1999) showed that dry matter production increased with increasing yeast and algae applied to bean plants.

Table 3: Effect of yeast, algae and interaction between them on some growth characters.

Treatments	Plant height		Number of teller		Number of leaves		Number of pods	
	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3
Yeast 1g/l	80.1	80.45	2.16	3.21	34.33	33.66	14.10	14.26
Yeast 2g/l	81.19	81.11	3.15	4.26	35.66	34.66	14.60	15.16
Yeast 4g/l	82.16	82.16	3.33	4.32	36.33	36.66	15.07	14.79
Algae extract 1 ml/l	81.33	81.51	2.37	3.91	33.33	34.00	15.00	14.28
Algae extract 2 ml/l	82.19	92.16	2.58	4.15	34.66	35.66	15.16	14.36
Algae extract 3 ml/l	83.15	83.91	3.16	4.95	35.33	36.56	15.29	15.10
Control	80.01	80.19	2.05	2.65	28.66	32.00	14.06	14.13
LSD treatment	16.2		1.22		18.2		4.5	
LSD variety	12.8		1.1		16.4		3.8	
LSD T. X V.	11.4		0.81		12.4		2.4	

Effects of the Treatments on Yield:

The effects of yeast, algae and varieties on yield of Faba bean plants are shown in Table (4). The results showed that all treatments significantly increased yield as indicated by plant of weight, weight of 100grain/g, grain yield /ton and straw yield. These effects were more obvious especially at higher concentrations of these treatments. Amer, (2004) indicated that the application of yeast increased common bean growth, green pods yield and its component. Yeast is considered as a natural source of cytokinins that stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll (Kraig and Haber, 1980; Spencer *et al* 1983; Castelfranco and Beale, 1983 and Fathy and Farid, 1996). It also contains sugar, proteins, amino acids and vitamins (Shady, 1978).

On the other hand, the application of algae promoted bean growth and productivity and these effects agreed with the findings of El Bassiouny *et al.* (2005) who found that foliar application of algae significantly increased plant of weight, weight of 100grain/gm, grain yield /ton and straw yield of faba bean. They attributed these effects to the fact that it is a low molecular weight lipophilic antioxidant which protect membrane from oxidative damage. Hess (1993) also indicated that algae is highly effective antioxidant at the membrane site.

On the other hand, Giza 3 had high response to yeast and algae from Sakha 2 under sandy soil conditions (Gobarah, *et al*., 2006). Karaman *et al*. (1999) showed that dry matter production increased with increasing Zn concentrations applied to bean plants. Similar results were obtained by Abd-El-Lateef *et al.* (1998) who found that foliar application of either Fe and Zn alone or urea in combination with Zn or Cu on Mungbean gave the tallest plants and the application of urea or Zn increased the number of branches per plant. They concluded that beneficial effects were attained from the combination of urea with Zn on pod-number and with all trace elements on pod-weight per plant.

Table 4: Effect of yeast, algae and interaction between them on some yield characters.

Treatments	Plant of weight		Weight of 100grain/gm		Grain yield /ton		Straw yield/ton	
	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3
Yeast 1g/l	1.5	1.53	65.2	66.8	0.97	1.13	0.75	0.76
Yeast 2g/l	1.62	1.61	66.4	67.1	1.24	1.37	0.76	0.77
Yeast 4g/l	1.77	1.69	66.8	67.2	1.45	1.46	0.78	0.78
Algae extract 1 ml/l	1.59	1.74	67.4	67.6	1.09	1.16	0.74	0.75
Algae extract 2 ml/l	1.87	1.85	67.5	68.4	1.28	1.48	0.76	0.77
Algae extract 3 ml/l	1.97	2.10	67.8	69.2	1.43	1.55	0.79	0.80
Control	1.36	1.52	62.4	63.5	0.82	0.94	0.72	0.74
LSD treatment	0.12		2.4		0.07		0.06	
LSD variety	0.1		2.1		0.09		0.08	
LSD T. X V.	0.09		1.5		0.05		0.06	

Effects of the Treatments on Chemical Characters of Pods and Leaves

Table (5) and Figure (1) shows the chemical characters measured including Protein, nitrogen, phosphors, potassium, magnesium, ferric and zinc. Although all the treatments increased N, P and K content of grains, these effects were not significant except for yeast treatments which significantly increased N, P and K content in both seasons.

Yeast is considered as a natural source of cytokinins that stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid and chlorophyll (Kraig and Haber, 1980; Spencer *et al.,* 1983; Castelfranco and Beale, 1983). It also contains sugar, proteins, amino acids and vitamins (Shady, 1978). The improvement of snap bean growth in response to the foliar application of active dry yeast may be attributed to its contents of different nutrients, higher percentage of proteins, higher values of vitamins, especially B which may play an important role in improving growth and controlling the incidence of fungi diseases as mentioned by Meyer and Phaff, (1969) and Subba Rao, (1984). The improvement of growth of bean plants in response to foliar application of the treatments may result in improving quality of pods such as increased protein, carbohydrates and decreased fiber content. The treatments also increased chlorophyll content. These results agreed with results found by Amer, (2004) who found that applying yeast to bean plants significantly increased chlorophyll content. Also, Fathy and Farid, (2000) indicated that the application of yeast to tomato plants resulted in an increase in nitrogen, potassium and Ca contents of leaves. The tomato plants may have more pronounced effect compared to bean plants considering nutrient contents.

Vitamin E had also positive effects on chlorophyll content of bean plants as indicated by Schmitz and Noga, (1998). Moreover, it is concluded that foliar sprays of urea combined with Fe or Zn increase seed yield and improve the quality of seeds of Mungbeans (Abd-El-Lateef *et al.*, 1998).

Table 5: Effect of yeast, algae and interaction between them on some macro and microelements in grains.

Treatments	Protein		N%		P%		K%		Mn ppm		Fe ppm		Zn ppm	
	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3	Sakha 2	Giza 3
Yeast 1g/l	23.12	23.75	3.7	3.8	0.74	0.75	1.9	2.0	3.4	3.4	639	647	142	147
Yeast 2g/l	23.75	25.62	3.8	4.1	0.78	0.76	2.0	2.2	3.5	3.5	645	658	154	158
Yeast 4g/l	26.25	26.25	4.2	4.2	0.82	0.78	2.3	2.3	3.7	3.7	682	692	162	169
Algae extract 1 ml/l	23.75	24.37	3.8	3.9	0.73	0.74	2.0	1.9	3.4	3.4	643	654	145	148
Algae extract 2 ml/l	24.37	25.00	3.9	4.0	0.74	0.75	2.1	2.1	3.5	3.5	672	671	156	151
Algae extract 3 ml/l	25.62	25.625	4.1	4.1	0.76	0.76	2.2	2.3	3.6	3.7	695	685	164	168
Control	22.50	23.125	3.6	3.7	0.72	0.73	1.7	1.8	3.3	3.2	632	635	134	138
LSD treatment	7.9		2.14		0.091		1.24		0.9		62		22	
LSD variety	6.8		2.01		0.092		1.02		0.6		57		18	
LSD T. X V.	4.9		1.58		0.085		0.89		0.07		45		13	

Fulfill Plantago

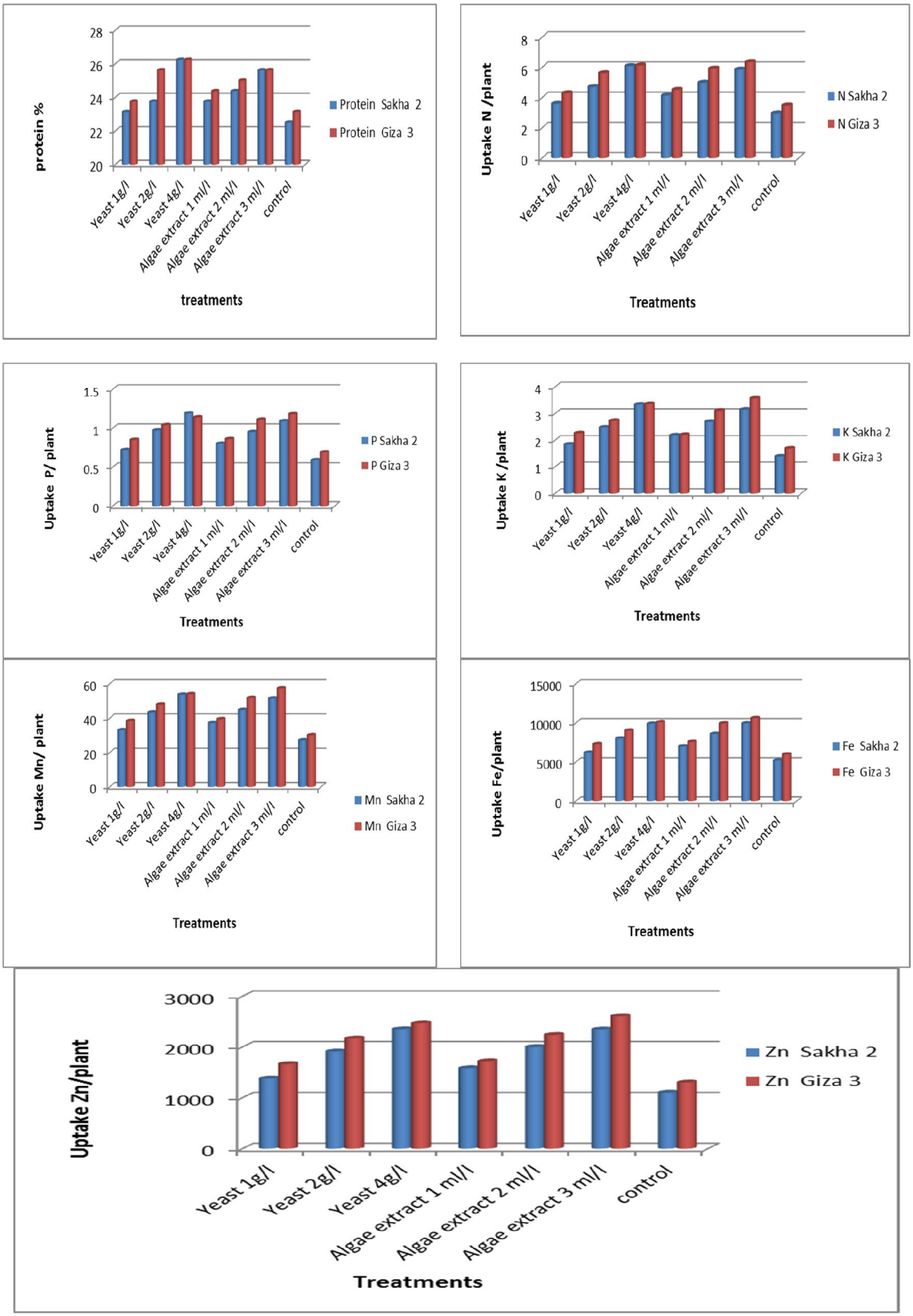

Fig. 1: Effect of yeast and algae and interaction between them on some macro and micro elements in grains.

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