J. Agric. Sci. Mansoura Univ., 31 (4): 1847 - 1860, 2006

INTEGRATED BROAD BEAN AGRICULTURE UNDER CALCAREOUS SOIL CONDITIONS

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ABSTRACT

Three field experiments were carried out at Desert Research Center, Experimental Station of Maryout in the North Western Coastal Zone of Egypt during 2000/2001, 2001/2002 and 2002/2003 winter growing seasons, respectively to study the effect of (*Burkholderia*) *B. cepacia*, gibberellins (GA_3, 200 ppm) compost at the rate 25 kg/fed (accompanied with or without sulphur at the rate 200 kg/fed), and their interactions on broad bean (*Vicie faba* L. var. Giza 776). Growth characters i.e.{plant height/cm, fresh and dry weights /g of shoots and roots, leaf area /cm^2}, chemical compositions i.e. {endogenous gibberellins as (GA_3) and cytokinines, total pigments ,total chlorophyll (a+b) as μ mole m^{-2}}and yield and its components{biological and seed yield ton/fed, No. of branches/ plant, No. of pods/ plant and 100 seed weight/g} were studied.

B. cepacia as bio-agent showed highly positive significant effects on broad bean growth characters, chemical compositions, yield and its attributes comparing with the control treatment.

Gibberellins (GA_3) as a seed soaking treatment increased significantly all studied growth characters, chemical compositions, and yield attributes of faba bean compared with the untreated seeds.

Applied compost to the experimental soil as soil amendment improved significantly all studied characters including plant growth, chemical composition and yield attributes. Compost with sulphur had greater positive effects on all studied characters as well as reducing the probability of soil borne infection rather than compost unaccompanied.

First and second order interactions between *B. cepacia*, gibberellins and compost treatments showed highly significant positive effects on plant growth, chemical composition, and yield and its attributes. The interaction between *B. cepacia*, gibberellins and compost accompanied with sulphur surpassed that of the other treatments on faba bean growth and its productivity under Maryut conditions.
Keywords: Faba bean, *B. cepacia*, gibberellins, compost, sulphur, growth parameters, chemical composition , biological and seed yield.

INTRODUCTION

Broad bean (*Vicia faba* L.) plays an important role in the farming systems of the Mediterranean Sea countries. Besides being an important food crop, it contributes to feed and fodder supply for livestock and affects positively the soil productivity for the cereal crops grown in rotation especially in the new reclaimed soils. In Egypt, it is a fundamental legume filed crop. The annual seed Egyptian production is 401,000 tons while the total consumption estimates 450,000 tons through the year 2007. (Anonymous, 2002). Therefore, efforts should be made to overcome the gap between production and consumption by growing it in the new reclaimed areas, where several challenges are facing as attacking by the crop numerous soil bome diseases as *Fusarium solani* and root-rot diseases as indicated by (Gowily,1987 ; Bondok *et al.*, 1993 and Beshir,1999). Moreover, low fertility(Anonymous, 2002).

Using the bio-control agents as a biological control of damping-off diseases have been reported by several investigators. (Weller, 1988 ; Zaki, 1997 and Zaki *et al.*, 1998), They reported that using such agents led to control the associated soil bome diseases beside promoting all growth characters hence yield and its attributes.

Application of Gibberellins effectively promotes plant growth, chemical composition and consequently yield and its attributes. It also increases plant resistance to soil borne diseases. (Saeed, 1983; Gowily & Abdel-Rahman, 1989; Gowily, 1991 and Bondok *et al.*,1993).

Compost (complete fermented organic materials) is an eco-friendly fertilizer. It is positively improve soil chemical and physical properties. Many investigators reported that using compost with several crops including legume crops almost duplicated the observed yields besides controlling numerous of soil born diseases. (Logsdon, 1993; McElroy, 1993 and Hoitink *et al.*. 1993).

Sulphur has essential role in promoting growth and N fixation by legume plants. Adding sulphur as a soil amendment to the calcareous soils improved soil properties and increased plant growth. Moreover it helped significantly in reducing some disease incidence after application. (Mengel & Kirby, 1978; Salem *et al.*, 1988, Krol & Kobus, 1992; Arthur, 1993; Behera and Roul, 1995 and Beshir and Zaki ,2000) .

MATERIALS AND METHODS

Three field experiments were carried out at Desert Research Center, Experimental Station of Maryout in the North Western Coastal Zone of Egypt during 2000/2001, 2001/2002 and 2002/2003 winter growing seasons, respectively. During soil preparation, calcium superphosphate (15.5 % P_2O_5) was added at the rate of 200kg / fed. potassium sulphate (48 % K_2O) was added into the soil just after thinning in the rate of 50 kg/fed., while nitrogen fertilization was added at two equal doses, i.e. 48 kg/fed. in the form of ammonium nitrate (33.5 % N) after thinning (21 days after sowing), and after the second irrigation.

The experimental soil mechanical and chemical properties from 0- 30 cm depth are presented in tables (1 and 2).

Table1: Mechanical properties of the soil of Maryout Experimental Station from 0-30 cm. depth (means of 2000-2003 seasons).

$CaCo_3$	% of Particle size distribution (mm)					Class Texture
	Course sand	Fine Sand	Total Sand	Silt	Clay	
38.1	2.3	47.7	50	26.9	23.1	Sandy Clay Loam

Table 2: Chemical properties of the soil of Maryout Experimental Station from 0-30 cm. depth (means of 2000-2003 seasons).

pH	EC dS m^{-1}	Organic Matter %	Saturation soluble extract							
			Soluble anions (meq/L)				Soluble cataions (meq/L)			
			$Co_3^{=}$	HCo_3^-	$So4^-$	Cl^-	Ca^{++}	Mg^{++}	Na^+	K^+
8.01	4.10	0.65	—	2.4	5.0	32.0	20.7	2.7	26.3	1.05

Burkholderia cepacia applied as soil drench treatment at sowing. 1.5 liter of a suspension (10^8 cfu/ml) of the tested bacteria was sprayed into the furrows of each plot shortly after sowing according to Zaki *et al.*, (1998), while the control treatment sprayed with water. Gibberellins (GA_3) was applied as 200 ppm seed soaking for 12 hrs just before sowing , while non-treated control seeds were soaked in water for the same time period. Compost treatments were applied as 25 kg/fed of Maryut compost alone, or accompanied with 200 kg/fed of sulphur element, while the control treatment remained without treating. Compost treatments were added and mixed with the soil in the treated plots according to (El-Sersay *et. al.*1993). Maryut compost chemical properties were presented in table (3).

Faba bean (*Vicia faba* L. vGiza 776) was cultivated on 4th November in 2000/2001, 2001/2002 and 2002/2003 winter growing seasons, respectively at the rate 60 kg seeds/ fed., using 2-3 seeds/ hill, with 25cm apart in between, and were thinned to one plant/hill after 3 weeks from sowing date.

Table 3: Chemical analysis of Maryout compost

Moisture Content	Organic Matter	C/N Ratio	pH	Available %			ppm			S%
				N	P	K	Z	Mn	Fe	
8.3%	30.2%	18.1	7.3-7.1	2.15	1.14	1.25	2.1	3.9	4 2	0.25

Treatments were arranged in split-split plot design in three replicates, where the bio-agent treatments occupied the main plots, gibberellins treatments occupied the sub-plots and compost lied in the sub-sub plots. The plot area was 10 m^2 (3 x 3.5 m) including 5 ridges at 60 cm in hills 25 cm distances.

Weed control was carried out after 2 weeks from cultivation by hand pulling and by hoeing 3 weeks later. However the common agricultural practices for growing faba bean were applied.

Samples were taken from 10 guarded plants per each plot after 60 days from sowing to study some growth characters i.e.: {plant height/cm, fresh and dry weights /g of shoots and roots, leaf area /cm^2 using "Li-3000A" portable leaf area meter}. Chemical compositions were also determined i.e. {endogenous gibberellins as GA_3 following the method described by (Grham 1965), cytokinines referring to the method described by (Fletcher and Mccullach 1971) after extraction using (Lenton *et al.*,1975) method, total pigments using SPDA-502 leaf chlorophyll meter, then converted into total chlorophyll (a+b) as μ mole m^{-2} referring to the equation published by (John *et al.*, 1988). At harvest, yield and its components were evaluated {biological and seed yield (ton/fed), no. of branches/ plant, no. of pods/ plant and 100 seed weight/g}.

Data obtained of the three seasons were exposed to the combined statistical analysis of variance following the method described by (Steel and Torrie 1960), and (Duncans' 1955) new multiple range test was used to differentiate between means.

RESULTS

1-Effect of Bio-agent :

Result^ in table (4) illustrate that comparing with the control treatment, using *Burkholdaria cepacia* as a bio-agent significantly increased all the studied growth characters of faba bean i.e., plant height/cm, root fresh and dry weights, shoot fresh and dry weights and leaf area/ cm^2. Moreover it significantly increased the endogenous content of gibberellins (GA_3), cytokinines (CKs), total pigments and chlorophyll content as presented in table (5). Thus, it increased significantly both biological and grain yields in addition to all yield attributes as indicated in table (6).

Table 4: Effect of *B. cepacia* on faba bean growth characters (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	Plant height/cm	Fresh weight / g		Dry weight / g		Leaf Area/cm^2
		Shoot	Root	Shoot	Root	
Control	67 97 b	61.69 b	10 93b	5.82 b	1.27b	5 96 b
Burkholderia cepacia	74.64 a	69.54 a	11.95a	6 82 a	1.66a	6.35 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 5: Effect of *B. cepacia* on faba bean chemical composition (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	GA_3 ppm	Cks ppm	Total Pigments	Chlorophyll μ mole m^{-2}
Control	19.2b	37.6b	47 1b	601.7b
Burkholderi cepacia	22.3a	44.6a	49 4a	652.2a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 6: Effect of *B. cepacia* on faba bean yield and its attributes (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	Biological yield Ton/fed.	Seed yield Ton/ fed.	No. of Branches / plant	No. of Pods / plant	No. of Seeds / pod	00 seed weight/ g
Control	2.7 b	0.94 b	5.0 b	7.6 b	4 b	87.2 b
Burkholderi cepacia	3.2 a	1.1 a	6.0 a	8.6 a	4.5 a	96.6 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

2- Effect of Gibberillins (GA_3):

Results in table (7) indicated that, comparing with the control treatment, treating faba bean with 200 ppm. gibberellins as seed soaking, led to increase significantly all studied growth characters i.e. plant height/cm, root fresh and dry weights, shoot fresh and dry weights and leaf area/ cm^2. Therefore enhanced plant accumulation of (GA_3), (CKs), total pigments and chlorophyll content as indicated in table (8), which led to increase the yield and its components as presented in table (9).

Table 7: Effect of gibberillins (GA_3) on faba bean growth characters (combined analysis of 2000, 2001 & 2002 growing seasons).

GA_3	Plant height/cm	Fresh weight / g		Dry weight / g		Leaf Area /cm^2
		Shoot	Root	Shoot	Root	
-	66.36 b	53.7 b	10. b	5.7 b	1.13 b	5.96 b
+	76.25 a	77.6 a	12.8 a	6.9 a	1.79 a	6.35 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 8: Effect of gibberillins (GA_3) on faba bean chemical composition (combined analysis of 2000, 2001 & 2002 growing seasons).

GA_3	GA_3 ppm	Cks ppm	Total Pigments	Chloro-phyll µ mole m^{-2}
-	18 b	34.6 b	46.6 b	590.4 b
+	23.5 a	47.6 a	49.9 a	663.4 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 9: Effect of gibberillins (GA_3) on faba bean yield and its attributes (combined analysis of 2000, 2001 & 2002 growing seasons).

GA_3	Biological yield Ton/fed.	Seed yield Ton/ fed.	No. of Branches / plant	No. of Pods / plant	No. of Seeds / pod	100 seed weight/g
-	2.6 b	0.89 b	4.8 b	7.3 b	3.9 b	84.6 b
+	3.3 a	1.1 a	6.3 a	8.8 a	4.6 a	99.3 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

3- Effect of Compost:

As indicated in table (10) comparing with the control treatments or compost application, the combination of compost and sulphur increased significantly all the studied growth characters i.e. plant height/cm, root fresh and dry weights, shoot fresh and dry weights and leaf area/ cm^2. Similar responses were realized in chemical composition as indicated in table (11).

Table 10: Effect of compost treatments on faba bean growth characters (combined analysis of 2000, 2001 & 2002 growing seasons).

Compost	Plant height/cm	Fresh weight / g		Dry weight / g		Leaf Area /cm^2
		Shoot	Root	Shoot	Root	
Control	63.2 c	43.8 c	9.4 c	5.48 c	0.9 c	5.36 c
Compost	74.04 b	73.6 b	12 b	6.3 b	1.7 b	6.48 b
Compost+ S	76.6 a	79.5 a	12.9 a	7.19 a	1.8 a	6.61 a

- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table (11): Effect of compost treatments on faba bean chemical composition (combined analysis of 2000, 2001 & 2003 growing seasons).

Compost	GA_3 ppm	Cks ppm	Total Pigments	Chloro-phyll µ mole m^{-2}
Control	14.5 c	18.3 c	42.3 c	498.9 c
Compost	23.2 b	50.2 b	50.5 b	673.5 b
Compost+ S	24.4 a	54.9 a	52 a	708.5 a

- Means having similar letters in same column are not significantly differed at P≥ 0.05

Consequently, yield and its attributes were increased significantly by applying the combination of compost and sulphur as presented in table (12).

Table 12: Effect of compost treatments on faba bean yield and its attributes (combined analysis of 2000, 2001 & 2002 growing seasons).

Compost	Biological yield Ton/fed.	Seed yield Ton/ fed.	No. of Branches / plant	No. of Pods / plant	No. of Seeds / pod	100 seed weight/g
Control	2 c	0.69 b	3 1 c	6.9 c	3.3 c	73.7 c
Compost	3 4 b	1.2 a	6.7 b	8.3 b	4.3 b	99.9 b
Compost+ S	3 5 a	1 1 a	6 8 a	9 1 a	4.7 a	102.2 a

- Means having similar letters in same column are not significantly differed at P≥ 0.05

4- Effect of the interaction between bioagent and gibberellins treatments:

As indicated in table (13) the interaction between *B. cepacia* and GA_3 increased significantly all studied growth characters in addition to improve significantly broad bean chemical composition (table, 14). The increments happened in both growth characters and chemical composition had positive effects on yield and its components comparing with either the control treatment or the compost application alone as indicated in table (15).

Table 13: Effect of the interaction between the bioagent and gibberillins (GA_3) treatments on faba bean growth characters (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	GA_3	Plant height/cm	Fresh weight / g		Dry weight / g		Leaf Area /cm^2
			Shoot	Root	Shoot	Root	
Control	-	65 c	49.9 d	9.9 c	5.5 b	1 c	5.7 d
	+	70.9 b	73.5 b	12 b	6.1 b	1.5 b	6.3 b
Burkholderia	-	67.7 bc	57.5 c	10.2 c	5.9 b	1.2 c	5.9 c
cepacia	+	81.6 a	81.7 a	13.7 a	7.8 a	2.1a	6.8 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 14: Effect of the interaction between the bioagent and gibberillins (GA_3) treatments on faba bean chemical composition (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	GA_3	GA_3 ppm	Cks ppm	Total Pigments	Chloro-phyll µ mole m^{-2}
Control	-	16.3 d	30.7 d	45.4 d	564.4 d
	+	22 b	44 5 b	48 8 b	639 b
Burkholderia	-	19 7 c	38.6 c	47 8 c	616 5 b
cepacia	+	24.9 a	50.7 a	51 a	687 9 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 15: Effect of The interaction between the bioagent and gibberillins (GA_3) treatments on faba bean yield and its attributes (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	GA_3	Biological yield Ton/fed.	Seed yield Ton/ fed.	No. of Branches / plant	No. of Pods / plant	No. of Seeds / pod	100 seed weight/g
Control	-	2.2 d	0 9 b	3 9 c	7 c	3.5 d	77 c
	+	3.2 b	1 b	6.1 a	8.2 b	4.4 b	97.5 ab
Burkholderia cepacia	-	2.9 c	0.9 b	5.6 b	7.7 b	4.3 c	92.1 b
	+	3.5 a	1.2 a	6.5 a	2.5 a	4.7 a	101 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

5- Effect of the interaction between bioagent and compost treatments:

Results in tables (16, 17 and 18) indicated that the interaction between *B. cepacia* and compost accompanied with sulphur is the best treatment to enhance all growth characters through improving the plant chemical composition, thus yield and its components compared either with the control or the other interaction treatments.

Table 16: Effect of the interaction between the bioagent and compost treatments on faba bean growth characters (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	Compost	Plant height/cm	Fresh weight / g		Dry weight / g		Leaf Area/cm^2
			Shoot	Root	Shoot	Root	
Control	Control	63 6 c	41 7 d	9.2 c	5.3 c	0 8 c	5 3 c
	Compost	68.8 bc	69.7 c	11.5 b	5.9 bc	1.5 b	6.2 b
	Compost+ S	72.3 b	73.7 bc	12.1 b	6.2 bc	1.5 b	6.4 b
Burkholderia cepacia	Control	62.8 c	45.9 d	9.6 c	5.6 c	1.0 c	5.5 c
	Compost	79.3 a	77.6 b	12.5 ab	6.7 b	1.9 a	6 75 a
	Compost+ S	81 a	85.3 a	13.[illegible] a	8.2 a	2.1 a	6.85 a

- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 17: Effect of the interaction between the bioagent and compost treatments on faba bean chemical composition (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	Compost	GA_3 ppm	Cks ppm	Total Pigments	Chloro-phyll µ mole m^{-2}
Control	Control	13.2 e	16.4 e	41.4 e	481.3 e
	Compost	21 9 c	45.3 c	49.0 c	640.0 c
	Compost+ S	22.4 c	51.2 b	51.0 b	683.6 b
Burkholderia cepacia	Control	15.8 d	20.2 d	43.2 d	516 5 d
	Compost	24.5 b	55.2 a	51.9 b	706.9 b
	Compost+ S	26.5 a	58.6 a	53.1 a	733.3 a

- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 18: Effect of the interaction between the bioagent and compost treatments on faba bean yield and its components (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	Compost	Biological yield Ton/fed.	Seed yield Ton/ fed.	No. of Branches / plant	No. of Pods / plant	No. of Seeds / pod	100 seed weight/g
Control	Control	1.68 e	0.6 c	2.9 c	6.6 c	3.0 d	65.6 c
	Compost	3.13 c	1.13 a	6 b	8 b	4.4 b	96.4 a
	Compost+ S	3.32 bc	1.12 a	6.2 b	8.2 b	4.5 b	99.8 a
Burkholderia cepacia	Control	2.38 d	0.8 b	3.2 c	7.2 c	3.6 c	81.9 b
	Compost	3.58 ab	1.27 a	7.4 a	8.6 b	4.9 a	103.3 a
	Compost+ S	3.63 a	1.08 a	7.5 a	9.9 a	4.9 a	104.5 a

- Means having similar letters in same column are not significantly differed at P≥ 0.05

6- Effect of the interaction between gibberellins and compost treatments:

The interaction between GA_3 and compost treatments had significant positive effects on the studied growth characters of faba bean as presented in table (19). Such positive effects materialize the encouragement occurred in faba bean chemical composition (table,20). This demonstrates the significant increment happened in both biological and grain yields, in addition to their attributes as presented in table (21).

Table 19: Effect of the interaction between gibberillins (GA_3) and compost treatments on faba bean growth characters (combined analysis of 2000, 2001 & 2002 growing seasons).

GA_3	Compost	Plant height/cm	Fresh weight / g		Dry weight / g		Leaf Area /cm^2
			Shoot	Root	Shoot	Root	
-	Control	62.5 c	38.8 f	9 d	5.33 c	0.8 d	4.87 d
	Compost	67.9 b	58.7 d	10.5 c	5.82 c	1.2 bc	6.17 b
	Compost+ S	68.7 b	63.7 c	10.7 c	5.97 bc	1.38 b	6.3 b
+	Control	63.9 bc	48.8 e	9.9 c	5.63 c	1.03 c	5.87 c
	Compost	80.17 a	88.6 b	13.5 b	6.78 b	2.12 a	6.8 a
	Compost+ S	84.6 a	95.4 a	15.2 a	8.42 a	2.22 a	6.93 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 20: Effect of the interaction between gibberillins (GA_3) and compost treatments on faba bean chemical composition (combined analysis of 2000, 2001 & 2002 growing seasons).

GA_3	Compost	GA_3 ppm	Cks ppm	Total Pigments	Chloro-phyll µ mole m^{-2}
-	Control	12.8 e	14.4 f	41.4 f	480.2 f
	Compost	20.4 c	42.4 d	48.2 d	621.2 d
	Compost+ S	20.8 c	47.1 c	50.4 c	669.9 c
+	Control	16.3 d	22.2 e	43.3 e	621.2 d
	Compost	26 b	58 b	52.7 b	725.8 b
	Compost+ S	28.1 a	62.6 a	53.7 a	746.9 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 21: Effect of the interaction between gibberillins (GA_3) and compost treatments on faba bean yield and its components (combined analysis of 2000, 2001 & 2002 growing seasons).

GA_3	Compost	Biological yield Ton/fed.	Seed yield Ton/ fed.	No. of Branches / plant	No. of Pods / plant	No. of Seeds / pod	100 seed weight/g
-	Control	1.55 d	0.5 d	2.5 d	6.4 d	2.9 d	60.9 d
	Compost	3 b	1.2 ab	5.8 b	7.7 c	4.4 b	94.6 b
	Compost+ S	3.18 b	1.0 bc	6.0 b	7.9 c	4.4 b	98.1 b
+	Control	2.52 c	0.9 c	3.6 c	7.4 c	3.7 c	86.5 c
	Compost	3.7 a	1.2 a	7.5 a	8.9 b	4.9 a	105.1 a
	Compost+ S	3.8 a	1.18 ab	7.7 a	10.2 a	5 a	106.2 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

7- Effect of the interaction between bioagent, gibberellins and compost treatments:

The interaction between the three main factors in the presence of sulphur with compost is known as the overall promising treatment to enhance all the studied characters tables (22, 23 and 24). This interaction treatment can be called as the recommended treatment to increase significantly broad bean growth, chemical composition and yield under Maryot conditions.

Table 22: Effect of the interaction between bioagent, gibberillins (GA_3) and compost treatments on faba bean growth characters (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	GA_3	Compost	Plant height/cm	Fresh weight/g		Dry weight / g		Leaf Area /cm^2
				Shoot	Root	Shoot	Root	
Control	-	Control	61.9 k	38 l	8.6 i	5.1 i	0.7 h	4.8 j
		Compost	66.2 h	54.9 h	10.5 f	5.7 g	1.2 f	6 g
		Compost+ S	67 g	56.8 g	10.6 f	5.8 f	1.3 e	6.2 f
	+	Control	63.8 i	45.4 j	9.9 g	5.6 h	0.9 g	5.8 h
		Compost	71.4 d	84.4 d	12.5 d	6.1 d	1.8 c	6.4 d
		Compost+ S	77.6 c	90.7 c	13.6 c	6.6 c	1.8 c	6.6 c
Burkholderia cepacia	-	Control	63.1 j	39.7 k	9.3 h	5.6 h	0.9 g	5 i
		Compost	69.7 f	62.4 f	10.6 f	5.9 e	1.3 e	6.3 e
		Compost+ S	70.4 e	70.5 e	10.8 e	6.1 d	1.5 d	6.4 de
	+	Control	64.2 i	52.1 i	9.9 g	5.7 g	1.17 f	5.9 g
		Compost	88.9 b	92.8 b	14.5 b	7.4 b	2.5 b	7.2 b
		Compost+ S	91.6 a	100.1 a	16.7 a	10.2 a	2.7 a	7.3 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 23: Effect of the interaction between bioagent, gibberillins (GA_3) and compost treatments on faba bean chemical composition (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	GA_3	Compost	GA_3 ppm	Cks ppm	Total Pigments	Chloro-phyll µ mole m^{-2}
Control	-	Control	11.6 k	14.3 j	40.8 k	469.1 k
		Compost	18.6 g	35.6 g	46.1 h	575.4 h
		Compost+ S	18.8 g	42.2 f	49.5 g	648.6 g
	+	Control	14.7 i	18.5 i	42 j	493.5 j
		Compost	25.3 d	54.9 c	51.9 d	704.8 d
		Compost+ S	26 c	60.1 b	52.5 c	718.6 c
Burkholderia cepacia	-	Control	13.9 j	14.4 j	41.9 j	491.2 j
		Compost	22.3 f	49 e	50.3 f	667.1 f
		Compost+ S	22.8 e	52 d	51.3 e	691.2 e
	+	Control	17.8 h	25.9 h	44.5 i	541.8 i
		Compost	26.7 b	61.1 b	53.6 b	746.7 b
		Compost+ S	30.2 a	65.2 a	54.8 a	775.3 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

Table 24: Effect of the interaction between bioagent, gibberillins (GA_3) and compost treatments on faba bean yield and its components (combined analysis of 2000, 2001 & 2002 growing seasons).

Bioagent	GA_3	Compost	Biological yield Ton/fed.	Seed yield Ton/fed.	No. of Branches / plant	No. of Pods / plant	No. of Seeds / pod	100 seed weight/g
Control	-	Control	0.9 k	0.9 k	2.3 j	5.8 k	1 i	46.4 l
		Compost	2.8 g	1 e	4.6 f	7.4 h	4.1 f	89.4 h
		Compost+ S	3 f	1 e	4.5 e	7.7 g	4.1 f	95.2 g
	+	Control	2.5 i	0.9 f	3.5 h	7.3 i	3.7 g	84.8 j
		Compost	3.5 c	1.2 c	7.3 c	8.5 d	4.8 d	103.4 d
		Compost+ S	3.6 b	1.2 c	7.5 b	8.8 c	4.5 c	104.5 c
Burkholderia cepacia	-	Control	2.2 j	0.7 g	2.7 i	7 j	3.5 h	75.5 k
		Compost	3.2 e	1.1 d	7 d	7.9 f	4.6 e	99.8 f
		Compost+ S	3.3 d	1.1 d	7.1 d	8.1 e	4.6 e	101 e
	+	Control	2.6 h	0.9 f	3.7 g	7.4 h	3.7 g	88.2 i
		Compost	3.9 a	1.3 b	7.8 a	9.3 b	5.1 b	106.8 b
		Compost+ S	3.9 a	1.5 a	7.9 a	11.6 a	5.2 a	108 a

- (-) = without seed soaking in GA_3 (+) = with seed soaking in 200 ppm GA_3
- Means having similar letters in same column are not significantly differed at P≥ 0.05

8- Pathogenic studies:

The pathogenic studies of the first season only of this work was published separately by (Zaki 2002), who reported that *B. cepacia* could control significantly the associated soil borne diseases .The interaction between the three main factors in the presence of sulphur with compost was recommended to control significantly soil bome diseases more than the other treatments.

recommended to control significantly soil borne diseases more than the other treatments.

DISSCUSSION

Generally, using *Burkholdaria cepacia* as a bio-agent had a significant positive effects on broad bean growth and yield, which came as a result of producing some growth promoters by the microorganism itself. Therefore, increase the plant accumulation of the endogenous promoters' such as gibberellins and cytokinines. (Zaki *et al.*,1998). This increase in the endogenous level of phytohormones led to enhance photosynthetic pigments accumulation including chlorophyll, which led to increase the photosynthesis rate, thereby increased plant growth characters therefore, yield and its attributes (Devieln and Williams, 1985). Nevertheless *B. cepacia* controlled significantly the associated soil borne diseases of faba bean thus increased growth and yield as indicated by (Windham, *et al.*, 1986 and Kleifeld & Chet, 1992).

Gibberellins is a plant growth regulator has positive effects on increasing the endogenous plant content of growth promoters, and reducing the endogenous content of growth inhibitors. Therefore, it enhances the photosynthetic pigments accumulation in plants which led to increase the photosynthesis rate, and encourage the source to sink assimilates transportation pathway to materialize the increment of yield and its attributes as a result of gibberellins application.(Deiveln, 1985 and Bondok *et al.*, 1993). Beside the positive effects of gibberellins application on plant growth and yield as well, it has an impact in controlling some plant diseases. This impact may come indirectly through encouraging the plant metabolism consequently; increase the plant capability to overcome the bad effect of presence of the pathogen. Yet, gibberellins direct impacts of controlling the pathogens is not well known. (Gowily, 1991 and Zaki, 2002).

Compost has direct impacts on plant growth, chemical composition, thus yield and its attributes, these direct impacts come from providing the plants by the important nutrients for growth and metabolism. Adjacent to the direct impacts, there are two indirect ones; the first is out of compost hydrolysis in soil, humic acid is produced and played an important role in reducing soil pH and increasing soil nutrient availability to the plans, beside the role of humic acid as a rich fertilizer itself. The second indirect impact is the preferable consequence of compost on the soil mechanical properties to improve soil physical properties including water holding capacity and reduce the probability of soil borne disease infection. (Logsdon, 1993; McElroy, 1993 and Hoitink *et.al;* 1993).

As compost applied in combination with sulphur, it has greater capability of reducing soil pH when sulphur is oxidized as described by (Mengel and Kirby, 1978 and Arthur, 1993). Meanwhile sulphur itself has an important role in N fixation by leguminous plants as well as improving soil chemical and physical properties also controlling soil borne disease. These tended to an increase in plant growth and productivity. (Salem *et al.*, 1988 ; Soubeih, 1998 and Zaki , 2002)

Consequently, as the studied main factors had highly significant effects on the studied characters in this work, all first and second order interactions between the main factors led to increase plant growth and productivity as well, through controlling the soil bome diseases in a direct or indirect way, besides improving the plant metabolism, nevertheless soil physical and chemical properties. (Zaki, 2002)

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الزراعة المتكاملة للفول البلدي تحت ظروف الأراضي الجيرية

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أقيمت ثلاث تجارب حقلية بمحطة بحوث مريوط بالساحل الشمالي الغربي خلال الموسم الشتوي للأعوام ٢٠٠٠/٢٠٠١ ، ٢٠٠١/٢٠٠٢ ، ٢٠٠٢/ ٢٠٠٣ علي التوالي ، وذلك لدراسة تأثير بكتيريا بيركولداريا (سيدوموناس) سباسيا و الجبرلين بتركيز ٢٠٠ جزء في المليون و الكمبوست (مضافا إلية الكبريت أو بدون) وتفاعلاتهم علي صفات النمو (ارتفاع النبات /سم، الوزن الغض والجاف لكل من الأفرع و الجذور/جم ، مساحة الورقة /سم٢) ، بعض الصفات الكيماوية (التركيز الداخلي لكل من الجبريلين والسيتوكاينين، الصبغات الكلية ، الكلوروفيل) إضافة إلي المحصول و مكوناتة (المحصول البيولوجي، محصول البذور ، عدد الأفرع/ نبات، عدد القرون/نبات ، وزن الـ ١٠٠ حبة) ، وذلك علي نبات الفول البلدي صنف جيزة ٧٧٦.

أظهرت المعاملة بالبكتيريا بيركولداريا (سيدوموناس) سباسيا كعامل حيوي تأثيرات إيجابية معنوية علي صفات النمو والتركيب الكيميائي و بالتالي المحصول و مكوناتة مقارنة بمعاملة المقارنة.

أدي نقع التقاوي في الجبريلين بتركيز ٢٠٠ جزء في المليون إلي زيادة نمو النبات و تحسين التركيب الكيميائي و كذلك زيادة المحصول و مكوناتة معنويا مقارنة بمعاملة البذور الغير منقوعة في الجبريلين.

أدت إضافة الكمبوست سواء مضافاً إلية الكبريت أو بدون إلي تفوق معنوي في جميع صفات النمو المدروسة ، وتحسين التركيب الكيماوي ، وزيادة معنوية في المحصول ومكوناتة مقارنة بتلك الغير مضاف إليها الكمبوست.

أدت جميع التفاعلات الثنائية و الثلاثية لبيركولداريا سباسيا، والجبريلين ، والكمبوست إلي تفوق معنوي في جميع الصفات المدروسة ، ولقد كانت معاملة التفاعل الثلاثي لبيركولداريا سباسيا، والجبريلين ، والكمبوست المصحوب بالكبريت من أكثر المعاملات تفوقا والموصي بها لزيادة إنتاج الفول البلدي تحت الظروف المشابهة لظروف الدراسة.