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EFFECT OF FARMYARD MANURE (FYM) DOSES AND DIFFERENT BIO-FERTILIZERS ON VEGETATIVE GROWTH, SEED YIELD AND ACTIVE CONSTITUENTS OF *Plantago ovata* FORSK PLANTS

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ABSTRACT

The present investigation was carried out in the Experimental Station and Laboratory of the Vegetable Crops and Ornamental Plants Department, Faculty of Agriculture, Mansoura Univ., Egypt, during the two successive seasons of 2002/03 and 2003/04 to study the effect of farmyard manure (10, 20 and 30 m^3 /fed.) and bio-fertilizers (Microbein, Phosphorein and Rhizobacterein) on *Plantago ovata* Forsk plants.

The results indicated that FYM doses had a positive effect on plant height, number of tillers and spikes, dry weight per plant, seed yield per plant and plot as well as mucilage content and percentage when compared with each other. The best results were of plants which received the medium FYM dose (20 m^3 /fed).

The inoculating with Rhizobacterein bio-fertilizer gave the tallest plants, while the inoculating with Microbein gave the highest number of tillers and spikes, dry weight per plant, seed yield per plant and plot as well as mucilage content and percentage.

The combined treatment of the medium FYM dose and Rhizobacterein inoculating gave the tallest plants, while the combined treatment of the medium FYM dose and Microbein gave the highest number of tillers and spikes, dry weight per plant, seed yield per plant and plot as well as mucilage content and percentage. Also, the combined treatment of the medium FYM dose and Phosphorein gave the heaviest 1000 seed weight.

INTRODUCTION

Plantago ovata Forsk (Isabgol) belongs to family *Plantaginaceae* is an annual herb and is the main source of isabgol seed and husk for use in medicine.

Isabgol seeds and husks are very rich in mucilage and have numerous pharmaceutical uses as, laxative drug (Marlett *et al.*, 2000), as cosmetic products, e.g. face masks to soften the skin (Deters *et al.*, 2005), as anti-inflammatory activity in the intestine and beneficial effect in ulcerative colitis (Langmead and Rampton, 2001 and Rodriguez *et al.*, 2003), beneficial effect in treatment of premenstrual constipation (Davies *et al.*, 1998) and beneficial effects in male sterility (Jamwal *et al.*, 1998).

The intensive use of chemical nutrition to plants in recent years resulted in environmental pollution and more human health problems.

Farmyard manure (FYM) added to soils to improve their physical and chemical properties. It increases the soil fertility by its composition from macro and micro elements, amino acids, organic acids, sugars and organic matter. Also it is a considerable useful habitat for several beneficial microorganisms. In the presence of organic materials the number of N_2 fixes

bacteria, mycorrhizae and phosphate solubilizing microorganisms increases in the soil as well as plant production (EL-Mahrouk, 2000).

Bhaskar *et al.* (2001) suggested that the application of farmyard manure (FYM) produced significantly higher number of shoots of geranium. The highest number of shoots and the highest fresh herbage yields were obtained with 30 t FYM /ha.

EL-Ghawwas (2002) reported that farmyard manure at (18 m^3 /fed.) was significantly improved plant height, number of fruits, seed weight per plant and the yield of volatile and fixed oils per plant and per plot in both seasons.

EL-Ghawwas *et al.* (2002) on fennel applied three levels of FYM (14, 21 and 28 m^3/fed.). They found that 28 m^3/fed. FYM significantly produced the tallest plants. The level 21 m^3 /fed. FYM significantly produced the highest number of branches, the highest value of fruit yield per plant and plot and the highest volatile oil percentages.

Mohamed (2003) found that supplying periwinkle plants with 20-30 m^3 /fed., turkey manure or 40-60 m^3/fed. cattle manure increased total alkaloids percentage in herb and roots, total alkaloids yield as well as N, P, Zn, Mn and Fe contents in herb and roots. Also, total carbohydrates content in herb and roots was increased compared to those of the untreated plants.

Yuonis *et al.* (2004) mentioned that FYM significantly increased vegetative growth. Treating plants with different rates of FYM increased seed weight per plant and plot. Active ingredient of *Ammi visnaga* (Visnagin & Khlein) significantly increased by increasing the rate of FYM.

Bio-fertilizers are the most reliable tools to reduce the rate of chemical fertilizers applied for medicinal plants production in all types of soil and hence decreasing environmental pollution (EL-Mahrouk, 2000).

The significant effect of bio-fertilizers may be due to the effect of different strain groups and nutrients mobilizing microorganisms which help in availability of metals and their forms in the composted material and increased levels of extractable minerals (EL-Kramany *et al.*, 2000).

Abd EL-Latif (2002) showed that the mixture of 1 kg/fed. nitrobein + 1 kg/fed. phosphorein with caraway seeds before sowing immediately gave the best results for the plant height, number of branches and fresh , dry weights per plant and the highest fruit yield .

Hafez (2003) stated on borage, that nitrobein (55 % *Azotobacter chroococcum* and 45 % *Azospirillum lipoferum* containing one gram on 10^7 cell) at 600 g/kg seeds enhanced greatly plant height, number of branches, leaves fresh and dry weights and branches fresh and dry weights, compared with control.

Eisa (2004) reported that microbein and nitrobein bio-fertilizers increased the essential oil content per plant and oil yield per fed. of *Salvia officinalis* plants.

Massoud *et al.* (2004) showed that nitrobein plus phosphorein gave significant increase in plant height, number of branches, and plant fresh and dry weight of thyme plants.

Yousef (2005) concluded that the highest essential oil percentage of lemon balm was obtained when treated with 100 kg N /fed., and 4 kg nitrobein/ fed.

The present work was planned to achieve the best growth, seed yield and mucilage content of isabgol through studying the optimum dose and best biofertilizer of farmyard manure.

MATERIALS AND METHODS

The present study was conducted during the two successive seasons of 2002/2003 and 2003/2004 at the Experimental Station and Laboratory of the Vegetable Crops and Ornamental Plants Dept., Faculty of Agriculture, Mansoura Univ., Egypt.

Seeds of isabgol (*Plantago ovata* Forsk), were secured from Müggenburg Firm, Hamburg, Germany and sown at the rate of 10 kg /fed (5 g /plot) on October 15 in both seasons.

Field was ploughed and after the last ploughing, the field was divided into 2 m^2 (1 x 2 m) plots and each plot contained 5 raws spaced at 15 cm apart.

All plots received chemical NPK fertilization as an activation dose at the rate of the quarter of the recommended rate of EL-Gamal, (2000).

In both seasons, NPK fertilizers were mixed and applied as one dose after one month from sowing.

The experimental field received farmyard manure (FYM) at three doses (m^3 /feddan) as (10, 20 and 30)

FYM analyses in both seasons are shown in Table (1).

Table (1): Chemical analysis of the added FYM (farmyard manure) in both seasons (2002/03 and 2003/04).

Properties %	2002/2003	2003/2004
Organic matter	65.42	67.97
Total carbon	38.03	39.52
Total nitrogen	1.79	1.83
C/N ratio	1:21.25	1:21.59
Total phosphate	1.04	0.92
Total potassium	0.98	0.89
pH (in 1 : 5)	8.19	8.17

Bio-fertilizers were provided by the General Organization for Agriculture Equalization Fund (G.O.A.E.F.), Ministry of Agriculture, Egypt. The examined bio-fertilizers were Rhizobacterein, [it contains live cells of efficient bacteria strains for N-fixation (*Azotobacter* sp.)], Phosphorein, [it contains live cells of efficient bacteria strains as phosphate solubilizing bacteria (*Bacillus megaterium*)] and Microbein, [it contains live cells of efficient bacteria strains for N-fixation and phosphate solubilizing (*Azotobacter* sp., *Azospirillum* sp., *Pseudomonas* sp. and *Bacillus* sp.)]

All the bacterial growth media were used at a rate of 400 g /fed (0.2 g /plot/season).

Treatments:

1- The dose of 10 m^3 FYM /fed:
- + 0 bio-fertilizers as (control).
- + Rhizobacterein.
- + Phosphorein.
- + Microbein.

2- The dose of 20 m^3 FYM /fed:
+ 0 bio-fertilizers as (control).
+ Rhizobacterein.
+ Phosphorein.
+ Microbein.

3- The dose of 30 m^3 FYM /fed:
+ 0 bio-fertilizers as (control).
+ Rhizobacterein.
+ Phosphorein.
+ Microbein.

Data recorded:

A. Vegetative growth:

Thirty plants were chosen randomly for each character recorded after about 90 days from sowing as the following:

1. Plant height (cm):
2. Number of tillers per plant.
3. Number of spikes per plant.
4. Dry weight per plant (g).

B. Seed yield (g):

1. per plant.
2. per plot.
3. Weight of 1000 seed.

C. Analysis:

1- Constituents of seeds:

Mucilage content (g per 10 g seeds) according to EL-Mahdy and EL-Sebaiy method (1984).

2- Chemical analysis of NPK : was determined according to Peter Burgski, (1968); Pregle, (1945); Jackson, (1967) and Black, (1965).

3- Experimental design and statistical analysis:

A factorial experiment in a randomized complete block design with 3 replicates was adapted, according to Cochran and Cox, (1957). The treatment means were compared using the least significant differences (L.S.D) at 0.05 procedures as mentioned by Gomez and Gomez, (1984).

Table (2): Mechanical and chemical analysis of experimental soil before the application of any fertilizers for the first seasons (2002/03).

Mechanical analysis %		Chemical analysis			Soluble cations and anions meq /100 g soil	
Coarse sand	0.98	Available (ppm)	N	55	Cation	
Fine sand	23.50		P	2.8	Ca^{++}	0.49
Silt	30.96		K	590	Mg^{++}	0.37
Clay	44.56	Organic matter (%)		1.15	Na^{+}	0.39
		EC* %		0.08	K^{+}	0.03
		pH**		8.25	Anion	
		$CaCO_3$		0.84	$CO_3^{=}$	0.02
					HCO_3^{-}	0.52
					$SO_4^{=}$	0.48
					Cl^{-}	0.26

* 1: 5 Soils: water extraction ** 1: 2.5 soils: water extraction

Table (3): Mechanical and chemical analysis of the experimental field after the application of farmyard manure, bio and chemical fertilizers in the end of the first season (2003).

FYM doses / Properties		m³/fed 10	20	30
Mechanical analysis (%):				
Coarse sand		0.74	1.19	1.30
Fine sand		21.26	19.15	18.94
Silt		29.72	29.49	24.75
Clay		48.28	51.50	58.38
Chemical analysis :				
Available (ppm)	N	75	88	93
	P	5.4	5.4	6.0
	K	710	745	812
Organic matter (%)		1.49	1.75	2.03
EC* %		0.07	0.08	0.09
pH**		8.03	7.89	7.90
$CaCO_3$		1.68	1.47	1.26
Soluble cations and anions (meq /100 g soil):				
Cation				
Ca++		0.38	0.44	0.42
Mg++		0.25	0.25	0.32
Na+		0.45	0.53	0.63
K+		0.04	0.06	0.07
Anion				
$CO_3^=$		0.00	0.00	0.04
HCO_3^-		0.42	0.40	0.33
$SO_4^=$		0.41	0.52	0.55
Cl^-		0.29	0.36	0.56

* 1: 5 soil: water extraction. ** 1: 2.5 soil: water extraction.

RESULTS AND DISCUSSION

A. Effect of farmyard manure and bio-fertilizers on vegetative growth of isabgol :

A.1. Plant height (cm):

A.1.1. Effect of farmyard manure (FYM) :

The results presented in Table (4) indicated the effect of FYM treatments on plant height of isabgol. The tallest plants (36.05 cm) were of plants fertilized with the medium FYM dose (20 m^3/fed).

The pre-mentioned increase in plant height was due to the organic manure which provided the plant with necessary demanded nutrients as well as improving the soil structure and drainage.

Similar results were obtained by Abd EL-Raouf (2001) on *Ocimum basilicum* and EL-Ghawwas (2002) on *Nigella sativa*.

A.1.2. Effect of bio-fertilizers:

The tallest plants were those inoculated by Rhizobacterein bio-fertilizer (34.91 and 35.68 cm), but the shortest plants (33.09 and 33.89 cm) were of control plants in the two seasons, respectively (Table 4).

Supplying isabgol plants with Microbein gave increases in plant height, but less than Rhizobacterein (34.42 and 35.51 cm).

The plant height increase may be due to that biofertilizers (Rhizobacterein and Microbein) supplied isabgol with nitrogen which is a precursor of protein synthesis and a vacuolar osmoticum. The osmotic compounds in the cell sap are important in order to allow cell enlargement.

The above mentioned results followed the same manner as those obtained by Ibrahim (2000) on *Ammi visnaga* and *Foeniculum vulgare*, Attia and Saad (2001) on *Catharanthus roseus* and Sakr (2005) on *Cassia acutifolia* found that bio-fertilizers caused a significant increase in plant height.

Table (4) Effect of farmyard manure (FYM) and bio-fertilizers on the plant height (cm) of *Plantago ovata* Forsk during the two seasons of 2002/2003 and 2003/2004.

Treatments	Plant height (cm)	
	2002/2003	2003/2004
FYM doses(m^3/fed)		
10	31.28	32.02
20	36.05	36.53
30	34.77	35.87
L.S.D at 5 %	0.16	0.14
Bio-fertilizers		
Control	33.09	33.89
Microbein	34.42	35.51
Phosphorein	33.71	34.66
Rhizobacterein	34.91	35.68
L.S.D at 5 %	0.19	0.16

A.1.3. Effect of interaction between FYM and bio-fertilizers:

Table (5) showed that the plants fertilized with the medium FYM dose and inoculated with Rhizobacterein gave the tallest plants (37.83 and 39.86 cm) while the shortest plants were of the low biofertilizers (control) (30.68 and 31.26 cm) in the two seasons, respectively.

These results agreed in general, with the findings reported by Hafez (2003) on borage and Sakr (2005) on senna, showing the positive effect of either organic or biofertilization in this respect.

Table (5): Effect of interaction between farmyard manure (FYM) and bio-fertilizers on the plant height (cm) of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Treatments FYM (m^3/fed)		Plant height (cm)	
		2002/2003	2003/2004
10	Control	30.68	31.26
	Microbein	31.79	32.88
	Phosphorein	30.97	31.73
	Rhizobacterein	31.96	32.96
20	Control	34.85	35.39
	Microbein	37.19	38.08
	Phosphorein	35.72	36.59
	Rhizobacterein	37.83	39.86
30	Control	33.75	35.01
	Microbein	35.77	36.35
	Phosphorein	34.43	35.61
	Rhizobacterein	36.13	37.46
L.S.D at 5 %		N.S	N.S

A.2. Number of tillers and spikes per plant:

A.2.1.Effect of FYM doses:

Data presented in Table (6) detected that the FYM fertilization doses promoted the growth of tillers and spikes per plant during both growing seasons. The largest number of tillers (4.43 and 6.83) and spikes (13.73 and 15.79) per plant were of plants fertilized with the medium FYM dose, but the least number of tillers (2.40 and 3.63) and spikes (7.33 and 9.91) per plant were of plants fertilized with the low FYM dose in the two seasons, respectively. Farmyard manure was important in maintenance of soil fertility and structure.

EL-Ghawwas *et al.* (2002) on fennel and Abd EL-Latif (2006) on sage who found that organic manure at 20 m^3/fed gave the best results in plant growth, dry weight, dry yield and essential oil yield.

Table (6): Effect of farmyard manure (FYM) and bio-fertilizers on the number of tillers and the number of spikes per plant of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Characters / Treatments	Number of tillers /plant		Nurnber of spikes /plant	
	2002/2003	2003/2004	2002/2003	2003/2004
FYM doses (m^3/fed)				
10	2.40	3.63	7.33	9.91
20	4.43	6.83	13.73	15.79
30	3.89	5.67	11.89	13.72
L.S.D at 5 %	0.14	0.16	0.22	0.46
Bio-fertilizers				
Control	3.04	4.54	8.94	11.28
Microbein	4.17	6.24	13.08	15.42
Phosphorein	3.32	4.99	10.19	11.98
hizobacterein	3.77	5.73	11.73	13.87
L.S.D at 5 %	0.16	0.18	0.26	0.53

A.2.2. Effect of bio-fertilizers:

It was obvious from data in Table (6) that biofertilizer increased number of tillers and spikes per plant in the two seasons as compared with the untreated ones. The largest number of tillers (4.17 and 6.24) and spikes (13.08 and 15.42) per plant were of plants inoculated by Microbein followed by Rhizobacterein inoculating (3.77 and 5.73) tillers and spikes (11.73 and 13.87) per plant. The least number of tillers (3.04 and 4.54) and (8.94 and 11.28) spikes per plant were of the untreated plants. The differences were significant in both seasons when the biofertilizers were compared with each other the control.

Herein results followed the same manner as those obtained by Ibrahim (2000) on *Ammi visnaga* and *Foeniculum vulgare*, Mahfouz (2003) on marjoram, Yadav *et al.* (2004) on isabgol and Sakr (2005) on senna.

A.2.3. Effect of interaction between FYM doses and bio-fertilizers:

The plants fertilized with the medium FYM dose and inoculated with Microbein had the largest number of tillers (5.23 and 7.93) and spikes (16.47 and 19.10) per plant, while the least number of tillers (2.03 and 2.86) and spikes (5.30 and 7.72) per plant were of plants which received the low FYM dose and 0 bio-fertilizer, in the two seasons, respectively (Table 7).

Table (7): Effect of interaction between FYM and bio-fertilizers on the No. of tillers and spikes per plant of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Characters / Treatments		No. of tillers /plant		No. of spikes /plant	
		2002/2003	2003/2004	2002/2003	2003/2004
FYM (m^3/fed)					
10	Control	2.03	2.86	5.30	7.72
	Microbein	2.87	4.43	9.17	11.53
	Phosphorein	2.17	3.33	6.60	8.93
	Rhizobacterein	2.53	3.90	8.26	11.43
20	Control	3.71	5.73	11.30	13.66
	Microbein	5.23	7.93	16.47	19.10
	Phosphorein	4.13	6.36	12.63	14.33
	Rhizobacterein	4.63	7.30	14.53	16.06
30	Control	3.36	5.03	10.23	11.46
	Microbein	4.40	6.02	13.60	15.63
	Phosphorein	3.68	5.23	10.93	12.67
	Rhizobacterein	4.13	6.00	12.40	14.10
L.S.D at 5 %		N.S	N.S	0.44	0.92

A.3. Plant dry weight (g):

A.3.1 Effect of FYM :

The data in Table (8) revealed that the different FYM doses gave variable results for plant dry weight (g) in both seasons. The heaviest plant dry weight (4.28 and 4.70 g /plant) was of plants which received medium FYM dose, while the lightest plant dry weights (3.47 and 3.87 g /plant) were of plants that received low FYM dose. The differences were significantly between FYM doses in both seasons.

Table (8): Effect of farmyard manure (FYM) and bio-fertilizers on the plant dry weight (g) of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Treatments	Plant dry weight (g)	
	2002/2003	2003/2004
FYM rates(m^3/fed)		
10	3.47	3.87
20	4.28	4.70
30	4.10	4.50
L.S.D at 5 %	0.04	0.06
Bio-fertilizers		
Control	3.68	3.92
Microbein	4.40	4.67
Phosphorein	3.88	4.18
Rhizobacterein	4.06	4.45
L.S.D at 5 %	0.05	0.07

The obtained results agreed with those obtained by Sakr (2005) on senna and Abd EL-Latif (2006) on sage.

A.3.2. Effect of bio-fertilizers:

The heaviest plant dry weights (4.40 and 4.67 g /plant) were of plants inoculated with Microbein biofertilizer, but the lightest plant dry weights (3.68 and 3.92 g /plant) were of uninoculated plants (control) in the two seasons, respectively (Table 8).

The bio-fertilizers supplied plants with N and P which might play a direct role in plant metabolism through activating the photosynthesis process as well as accumulation of their products in plant organs resulting in more plant growth. In other words, they enable the plant to build up organic materials (Mengel and Kirkby, 1982). Also, nitrogen increase growth and this in turn increase the carbohydrate formed by plant, thus dry weight increase.

The obtained results agreed with those obtained by Eid and EL-Ghawwas (2002) on marjoram, Hafez (2003) on borage, EL-Fawakhry and EL-Tayeb (2004) on *Euphorbia pulcherrima*.

A.3.3. Effect of interaction between FYM doses and different bio-fertilizers:

The heaviest plant dry weight was obtained when isabgol plants were applied with medium FYM dose and inoculated with Microbein biofertilizer (4.89 and 5.22 gm/plant) while the least plant dry weight (3.22 and 3.58 gm/plant) was obtained when isabgol plants were supplied with low FYM dose and no biofertilizer applied in the two seasons, respectively (Table 9).

Table (9): Effect of interaction between farmyard manure (FYM) and biofertilizers on the plant dry weight (g) of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Treatments		Plant dry weight (g)	
		2002/2003	2003/2004
FYM (m^3 /fed)			
10	Control	3.22	3.58
	Microbein	3.77	4.25
	Phosphorein	3.34	3.73
	Rhizobacterein	3.69	4.03
20	Control	3.97	4.04
	Microbein	4.89	5.22
	Phosphorein	4.05	4.24
	Rhizobacterein	4.59	4.99
30	Control	3.85	4.00
	Microbein	4.55	4.89
	Phosphorein	3.95	4.28
	Rhizobacterein	4.35	4.74
L.S.D at 5 %		0.07	0.11

B. Effect of farmyard manure (FYM) and bio-fertilizers on seed yield of isabgol:

B.1. Seed yield per plant and plot (g):

B.1.1. Effect of FYM doses:

Data of seed yield per plant as affected by FYM doses were presented in Table (10). The heaviest seed yield per plant (4.92 g) and plot (182.16 g) were obtained from plants fertilized by the medium FYM dose, while the lightest seed yield per plant (3.48 g) and plot (127.80 g) were of plants received the low FYM dose in the first season. The results of the second season followed the same trend.

The differences between FYM doses were significant when compared with each other in both seasons.

The obtained results were in line with those of EL-Ghawwas (2002) on *Nigella sativa* and Younis *et al.* (2004) on *Ammi visnaga*.

Table (10): Effect of farmyard manure (FYM) and biofertilizers on the seed yield per plant and plot (g) of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Characters / Treatments	Seed yield (g) per plant		Seed yield (g) per plot	
	2002/2003	2003/2004	2002/2003	2003/2004
FYM rates(m^3/fed)				
10	3.48	3.85	127.80	155.56
20	4.92	5.69	182.16	237.18
30	4.34	5.54	171.33	221.42
L.S.D at 5 %	0.05	0.02	2.98	2.86
Bio-fertilizers				
Control	3.70	4.00	139.91	168.40
Microbein	4.77	5.51	188.91	225.03
Phosphorein	4.00	4.69	160.17	189.33
Rhizobacterein	4.42	5.07	176.05	200.12
L.S.D at 5 %	0.05	0.03	3.45	3.30

B.1.2. Effect of bio-fertilizers:

Dealing with the effect of different biofertilizers on seed yield per plant and plot in both seasons was shown in Table (10).

The heaviest seed yield per plant (4.77 and 5.51 g) and plot (188.91 and 225.03 g) were of plants inoculated with Microbein bio-fertilizer followed by the inoculating with Rhizobacterein bio-fertilizer (4.42 and 5.07 g /plant) and plot (176.05 and 200.12 g /plot), while the lightest seed yield per plant (3.70 and 4.00 g) and plot (139.91 and 168.40 g) were of control plants in the two seasons, respectively.

The increase in seed yield per plant with bio-fertilizers may be due to the action of the bacteria in the biofertilizers resulting in an increasing effect on the vegetative growth and shortening the period required to reach flowering, thus increasing seed production (Sakr, 2005).

Moreover, the above results were in agreement with those obtained by Kandeel *et al.* (2001) on *Foeniculum vulgare*, Nofal *et al.* (2001) on *Ammi visnaga* and Abdel-Kader and Ghaly (2003) on coriander.

B.1.3. Effect of interaction between FYM and bio-fertilizers:

Results in Table (11) indicated that the seed yield per plant and plot were affected significantly as a result of interaction between FYM doses and the different bio-fertilizers. The heaviest seed yield per plant which reached (5.14 and 5.90 g) and plot (200.90 and 242.21 g) were of plants that received the medium FYM dose and inoculated with Microbein.

The tremendous increases may be due to the release of available nutrients from organic manure when combined with the favourable effect of bio-fertilization at the same time.

B.2. 1000 seed weight (g):

B.2.1. Effect of farmyard manure (FYM) :

The heaviest 1000 seed weight (1.83 g /1000 seed) was obtained from plants fertilized by the medium FYM dose, while the lightest 1000 seed weight (1.45 g /1000 seed) was obtained from plants fertilized by the low FYM dose in the first season. The results of the second season followed the

same trend. The differences were significant between all FYM doses in both seasons (Table 12).

Table (11): Effect of interaction between farmyard manure (FYM) and bio-fertilizers on the seed yield per plant and plot (g) of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Characters / Treatments		Seed yield (g) / plant		Seed yield (g) / plot	
		2002/2003	2003/2004	2002/2003	2003/2004
FYM (m^3/fed)					
10	Control	3.01	3.27	116.95	125.59
	Microbein	3.70	4.21	149.92	175.76
	Phosphorein	3.27	3.75	123.87	152.27
	Rhizobacterein	3.56	4.07	138.45	167.64
20	Control	3.91	4.29	175.07	198.78
	Microbein	5.14	5.90	200.90	242.21
	Phosphorein	4.16	4.73	188.17	212.08
	Rhizobacterein	4.97	5.81	194.49	230.63
30	Control	3.86	4.09	167.72	179.83
	Microbein	4.87	5.80	195.90	235.11
	Phosphorein	4.05	5.57	177.48	200.64
	Rhizobacterein	4.69	5.72	186.22	221.09
L.S.D at 5 %		0.09	0.04	5.97	5.72

Table (12): Effect of farmyard manure (FYM) and bio-fertilizers on the 1000 seed weight (g) of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Treatments	1000 seed weight (g)	
	2002/2003	2003/2004
FYM rates (m^3/fed)		
10	1.45	1.51
20	1.83	1.90
30	1.81	1.85
L.S.D at 5 %	0.01	0.02
Bio-fertilizers		
Control	1.62	1.66
Microbein	1.82	1.88
Phosphorein	1.85	1.94
Rhizobacterein	1.71	1.80
L.S.D at 5 %	0.03	0.02

These results were in agreement with those obtained by Ahmed (2005) on okra, who found that applying okra with 20 m^3/fed FYM gave the best growth, seed yield per plant and seed weight per pod and 1000 seed weight.

B.2.2. Effect of bio-fertilizers:

Data presented in Table (12) showed that, the heaviest 1000 seed weight (1.85 and 1.94 g /1000 seed) was of plants inoculated with Phosphorein bio-fertilizer, but the lightest 1000 seed weight (1.62 and 1.66 g /1000 seed) was of control plants in the two seasons, respectively.

The Microbein followed Phosphorein in affecting seed weight (1.82 and 1.88 g /1000 seed) in both seasons. These results may be due to that phosphate solubilizing might encourage plant to stimulate flowering and improving quality of seeds.

The obtained results were in agreement with those obtained by Tomar *et al.* (1996) on *Cicer arietinum*.

B.2.3. Effect of interaction between FYM doses and different bio-fertilizers:

The heaviest 1000 seed weight was of plants fertilized with the medium FYM dose and inoculated with Phosphorein biofertilizer (1.90 and 1.98 g /1000 seed). On the other hand, the lightest 1000 seed weight was of plants received the low FYM dose and no bio-fertilization in the two seasons, respectively (Table 13).

Table (13): Effect of interaction between farmyard manure (FYM) and bio-fertilizers on the 1000 seed weight (g) of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Treatments		1000 seed weight (g)	
		2002/2003	2003/2004
FYM (m^3 /fed)			
10	Control	1.44	1.49
	Microbein	1.79	1.83
	Phosphorein	1.80	1.86
	Rhizobacterein	1.64	1.68
20	Control	1.71	1.80
	Microbein	1.84	1.92
	Phosphorein	1.90	1.98
	Rhizobacterein	1.79	1.84
30	Control	1.65	1.78
	Microbein	1.82	1.87
	Phosphorein	1.85	1.93
	Rhizobacterein	1.75	1.82
L.S.D at 5 %		N.S	N.S

C. Effect of farmyard manure (FYM) and bio-fertilizers on isabgol constituents:

C.1. Mucilage content in seeds:

C.1.1. Effect of farmyard manure (FYM) :

The highest significantly mucilage content and percentage [3.48 g (34.8 %)] were of plants which received the medium FYM dose when compared with the lowest values attained of [2.97 g (29.7 %)] of plants that received the low FYM dose in the first season (Table, 13).

The results of mucilage content in the second season followed the same trend. The positive responses induced by suitable farmyard manure dose suggest the possibility of the promotive effects on photosynthetic activity and consequently photosynthetic products, mainly carbohydrates.

The obtained results were agreed with those of Yadav *et al.* (2004) on isabgol and Ahmed (2005) on okra.

C.1.2. Effect of different bio-fertilizers:

The highest mucilage content and percentage [3.42 g (34.2 %)] were of plants inoculated with Microbein biofertilizer followed by the inoculating with Phosphorein biofertilizer, then inoculating with Rhizobacterein. The lowest mucilage content and percentage in this respect were of control plants [3.07 g (30.7 %)] in the first season. The second season results followed the same trend of the first season results (Table 14).

Table (14): Effect of farmyard manure (FYM) and bio-fertilizers on the mucilage content (g) and percent in seeds of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Treatments	Mucilage			
	content (g)/10 g seeds		(%)	
	2002/2003	2003/2004	2002/2003	2003/2004
FYM rates (m^3/fed)				
10	2.97	3.10	29.7	31.0
20	3.48	3.51	34.8	35.1
30	3.32	3.40	33.2	34.0
L.S.D at 5 %	0.02	0.01		
Bio-fertilizers				
Control	3.07	3.10	30.7	31.0
Microbein	3.42	3.50	34.2	35.0
hosphorein	3.23	3.36	32.3	33.6
Rhizobacterein	3.18	3.22	31.8	32.2
L.S.D at 5 %	0.02	0.02		

The obtained results were in agreement with those obtained by Maheshwari *et al.* (2003) on blond psyllium and Ahmed (2005) on okra.

C.1.3. Effect of interaction between FYM and bio-fertilizers:

The highest values [3.43 g (34.3 %) and 3.69 g (36.9 %)] were obtained from plants fertilized with the medium FYM dose and inoculated with Microbein biofertilizer, followed by plants fertilized with the medium FYM dose and inoculated with Phosphorein [3.35 g (33.5 %) and 3.59 g (35.9 %)], while the lowest values were obtained from plants received the low FYM dose and not treated with biofertilizers [2.86 g (28.6 %) and 3.01 g (30.1 %)] in both seasons, respectively (Table 15).

C.2. N, P and K percentages:

C.2.1. Effect of FYM doses:

NPK percentage in the dry leaves of isabgol (Table 16) revealed that the application of FYM doses gave significant differences in both seasons when compared each other. The highest FYM dose gave the highest nitrogen (1.67 %), phosphorus (0.35 %) and potassium (2.36 %) compared to the medium and low dose in the first season. The results of nitrogen, phosphorus and potassium percentages in the second season followed the same trend.

Table (15): Effect of interaction between farmyard manure (FYM) and bio-fertilizers on the mucilage content (g) and percent in seeds of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Treatments		Mucilage			
		content (g)/10g seeds		(%)	
		2002/2003	2003/2004	2002/2003	2003/2004
FYM (m^3/fed)					
10	Control	2.86	3.01	28.6	30.1
	Microbein	3.16	3.29	31.6	32.9
	Phosphorein	3.09	3.26	30.9	32.6
	Rhizobacterein	2.99	3.14	29.9	31.4
20	Control	3.19	3.21	31.9	32.1
	Microbein	3.43	3.69	34.3	36.9
	Phosphorein	3.35	3.59	33.5	35.9
	Rhizobacterein	3.20	3.27	32.0	32.7
30	Control	3.07	3.19	30.7	31.9
	Microbein	3.40	3.48	34.0	34.8
	Phosphorein	3.28	3.39	32.8	33.9
	Rhizobacterein	3.14	3.24	31.4	32.4
L.S.D at 5 %		0.03	0.03		

Table (16): Effect of farmyard manure (FYM) and biofertilizers on the dry leaves NPK (%) of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Characters / Treatments	N (%)		P (%)		K (%)	
	2002/2003	2003/2004	2002/2003	2003/2004	2002/2003	2003/2004
FYM rates (m^3/fed)						
10	1.46	1.58	0.26	0.31	2.21	2.28
20	1.61	1.72	0.32	0.37	2.30	2.35
30	1.67	1.82	0.35	0.40	2.36	2.42
L.S.D at 5 %	0.02	0.03	0.01	0.01	0.03	0.02
Bio-fertilizers						
Control	0.98	1.10	0.26	0.31	2.24	2.31
Microbein	1.77	1.93	0.32	0.37	2.31	2.38
Phosphorein	1.09	1.12	0.37	0.42	2.33	2.39
Rhizobacterein	1.89	1.99	0.29	0.33	2.27	2.32
L.S.D at 5 %	0.023	0.441	0.016	0.012	N.S	N.S

Similar results were obtained by EL-Masry *et al.* (2002) on geranium, reported that significant response was observed in N, P and K contents with Urea + FYM. Sakr (2005) on senna, Abd EL-Latif (2006) on sage and Massoud (2007 b) on *Ocimum basilicum*, stated that application of cattle manure gave significant differences in the herb N, P and K content.

C.2.2. Effect of different bio-fertilizers:

As shown in Table (16) the inoculating of isabgol with Rhizobacterein bio-fertilizer gave the highest values of nitrogen percentage (1.89 and 1.99 %), while Phosphorein inoculating recorded the highest phosphorus (0.37 and 0.42 %) and potassium (2.33 and 2.39 %) in the two seasons respectively.

The results were agreed with those obtained by Massoud (2007 a) on marjoram.

C.2.3 Effect of interaction between FYM and bio-fertilizers:

The results presented in Table (17) indicated that all interaction treatments affected in the N, P and K percentages.

The high FYM dose combined with Rhizobacterein inoculating gave the highest percentages of N (1.99 and 2.13 %), while the same dose combined with Phosphorein inoculating gave the highest of P (0.43 and 0.46 %) and potassium (2.40 and 2.48 %) in the two seasons respectively.

On the other hand, the plants received the low FYM dose without bio-fertilizers gave the least values of nitrogen (0.88 and 1.00%), phosphorus (0.22 and 0.27 %) and potassium (2.15 and 2.25%) in the two seasons respectively. The differences were non-significant in both seasons.

Table (17): Effect of interaction between farmyard manure (FYM) and bio-fertilizers on dry leaves N, P and K percentages of *Plantago ovata* Forsk during the two seasons of 2002/03 and 2003/04.

Treatments		N (%)		P (%)		K (%)	
		2002/2003	2003/2004	2002/2003	2003/2004	2002/2003	2003/2004
FYM (m^3/fed)							
10	Control	0.88	1.00	0.22	0.27	2.15	2.25
	Microbein	1.65	1.80	0.27	0.31	2.23	2.30
	Phosphorein	0.91	1.04	0.32	0.37	2.26	2.31
	Rhizobacterein	1.72	1.80	0.25	0.29	2.19	2.26
20	Control	0.97	1.08	0.28	0.32	2.26	2.32
	Microbein	1.81	1.92	0.33	0.38	2.32	2.38
	Phosphorein	1.02	1.12	0.36	0.42	2.33	2.38
	Rhizobacterein	1.96	2.04	0.30	0.34	2.28	2.33
30	Control	1.08	1.21	0.29	0.35	2.31	2.36
	Microbein	1.86	2.06	0.36	0.41	2.38	2.45
	Phosphorein	1.16	1.27	0.43	0.46	2.40	2.48
	Rhizobacterein	1.99	2.13	0.32	0.38	2.34	2.37
L.S.D at 5 %		N.S	N.S	N.S	N.S	N.S	N.S

It can be recommended that, the application of farmyard manure at 20 m^3/fed combined with Microbein for the best results of growth, seed yield and mucilage content. Also, the application of farmyard manure at 20 m^3/fed combined with Phosphorein resulted in the heaviest 1000 seed weight. It may be noted that these treatments minimize the pollution of the agricultural environments.

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تأثير السماد البلدي والأسمدة الحيوية المختلفة على النمو الخضري والمحصول والمكونات الفعالة لنباتات القاطونة.

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أجرى هذا البحث بمحطة أبحاث ومعمل قسم الخضر والزينة – كلية الزراعة جامعة المنصورة خلال موسمي ٢٠٠٢/٢٠٠٣ ، ٢٠٠٣/٢٠٠٤ لدراسة تأثير السماد البلدي (بمعدل ١٠ ، ٢٠ ، ٣٠ م^3/ فدان) وبعض الأسمدة الحيوية المختلفة (ميكروبين وفوسفورين وريزوباكترين) وتفاعلاتهم على نباتات القاطونة.

١- أظهرت النتائج أن لمعدلات السماد البلدي الثلاثة تأثير موجب على كل من إرتفاع النبات وعدد الخلفات والسنابل والوزن الجاف للنبات وأعلى محصول للنبات والوحدة التجريبية من البذور وكذلك أعلى محتوى للبذور من المادة الفعالة (ميوسيلاج). وكان أفضل المعدلات لتحقيق أفضل النتائج هو المعدل الثاني (٢٠ م^3/ فدان).

٢- أدت المعاملة بسماد الريزوباكترين الحيوي إلى الحصول على أطول النباتات بينما أدت المعاملة بالميكروبين إلى الحصول على أكبر عدد من الخلفات والسنابل وكذلك الوزن الجاف للنبات بالإضافة إلى أعلى محصول للنبات والوحدة التجريبية من البذور وأعلى محتوى من المادة الفعالة (ميوسيلاج).

٣- أدى التفاعل (معدل السماد البلدي الثاني ٢٠ م^3/ فدان) والمعاملة بالريزوباكترين إلى الحصول على أطول النباتات بينما أدى التفاعل (معدل السماد البلدي الثاني والمعاملة بالميكروبين) إلى الحصول على أكبر عدد من الخلفات والسنابل وكذلك الوزن الجاف للنبات وأعلى محصول بذرى للنبات والوحدة التجريبية وأعلى محتوى من المادة الفعالة (ميوسيلاج) وأدى التفاعل (معدل السماد البلدى ٢٠ م^3/فدان والمعاملة بالفوسفورين إلى الحصول على أعلى وزن للألف بذرة.