Future of Egyptian Cotton Production in the Newly Reclaimed Desert Land of Egypt: 9- Use of Bio-fertilization to Decrease Requirements of Nitrogen and Phosphorus Fertilizers.

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ABSTRACT

Two field experiments were carried out in a highly calcareous sandy clay loam soil at Nubaria Agricultural Research Station during 2007 and 2008 seasons to evaluate the use of bio-fertilization on decreasing requirements of nitrogen and phosphorus fertilizer. Cotton growth, earliness, yield, its components and fiber properties of Egyptian cotton Giza 86 cultivar (*Gossypium barbadense L.,*) were evaluated under seven treatments, namely; 1- Control, recommended dose of 75 kg N + 31 kg P_2O_5/fed. without bio-fertilizers. 2- 37.5 kg N + 15.5 kg P_2O_5/fed. + Mycorrhizae. 3- 37.5 kg N + 31 kg P_2O_5/fed. + Mycorrhizae. 4- 75 kg N + 15.5 kg P_2O_5/fed. + Mycorrhizae. 5- 37.5 kg N + 15.5 kg P_2O_5/fed. + Microbein. 6- 37.5 kg N + 31 kg P_2O_5/fed. + Microbein. 7- 75 kg N + 15.5 kg P_2O_5/fed. + Microbein. The experimental design was a randomized completely blocks (RCBD) with four replicates. The most important results obtained could be given as follows: 1- The studied treatments had an insignificant effect on plant height at harvest, no. of sympodia/plant, earliness percentage, boll weight, no. of plants at harvest/fed., lint percentage, seed index and fiber properties in the two seasons, first sympodial position, boll age and number of open bolls/plant in one season only. 2- There was a significant effect ($P \leq 0.05$) to the studied treatments on days to first flower appearance as well as to first opened boll and seed cotton yield per plant as well as per fed. in both seasons. 3- Inoculation of cotton seeds with "Microbein" bio-fertilizer when conjugated with the recommended dose of 31 kg P_2O_5/fed. and half the amount of the recommended dose (37.5 kg N/fed.) produced the highest seed cotton yield/plant (51.73, 54.25 g) and consequently seed cotton yield/fed. (9.33, 11.24 kent./fed.) in both 2007 and 2008 seasons, respectively, as compared to the other studied treatments and the control. 4- Application of "Microbein" with half the amount of the recommended doses of N and P significantly increased yields of seed cotton (8.84, 10.58 kent./fed.) as compared to the control (8.84, 10.82 kent./fed.) in both 2007 and 2008 seasons, respectively. 5- Also, inoculation of cotton seeds with "Mycorrhizal" when conjugated with 75 kg N and 15.5 kg P_2O_5/fed. significantly increased yields of seed cotton (8.78, 10.89 kent./fed.) ($P \leq 0.05$) in 2007 and 2008 seasons, respectively. 6- The increase in seed cotton yield due to "Microbein" followed by "Mycorrhizal" under the low P and/or N doses, compared to the control, may be attributed to the decrease in position of first sympodium, days to first flower appearance as well as opened boll and boll age for the two bio-fertilizers in the two seasons. 7- The increase in yield of bio-fertilizers namely, "Microbein" and VA-Mycorrhizal is due to fact that those bio-fertilizers help in N_2-fixation and improving phosphate solubility bacteria that make it available for absorption by cotton plant roots.

INTRODUCTION

The intensive cultivation depletes the Egyptian soil of some plant nutrients, which could be compensated for mineral fertilizer application. Recently, it was believed that bio-fertilization should take place in the Egyptian agriculture not only to minimize the use of large doses of mineral fertilizers, which causes environmental pollution, but also to increase seed cotton yield and decrease the cost of production (Amberger, 1993.; Mitkees *et al.*, 1996; Hamissa *et al.*, 2000; El-Haddad *et al.*, 2001; El-Shazly and Darwish, 2001; Abou-Zaid *et al.*, 2002a and 2002b and Awad, 2006). Also, bio-fertilization becomes an important factor to increase the availability of N, P and micronutrients to correct their deficiencies in Ca CO_3 rich soils.

With regard to bio- and mineral N fertilization effect, Hamissa *et al.*, (2000) reported that inoculation of cotton seeds with "Rhizobactrein" + 60 Kg N/fed. gave the highest yield, its components and net income/fed. while El-Shazly and Darwish (2001) found that the addition of 30 Kg N/fed. with "Microbein" bio-fertilizer significantly increased seed cotton yield/fed. and gave the highest net income/fed. In $CaCO_3$ rich soils, Abou-Zaid *et al.*, (2002a) using cotton cultivar Giza 70, found that application of Nitrobein followed by Rhizobactrein bio-fertilizers significantly increased seed cotton yield, its components and net return compared with non-inoculation treatment. They added that the treatment of Nitrobein + 60 kg N/fed. gave the highest yield. Finally, Dawood (2006) using Giza 70 and 88 Egyptian cotton cultivars, in calcareous soil, reported that inoculation of cotton seeds with Mycorrhizal fungi conjugated with half the amount of the recommended dose of N gave the highest seed cotton yield (8.55 kent./fed.) as an average of the two seasons compared to other treatments, i.e., Microbein, the mixture of Mycorrhizal and Microbein bio-fertilizers and the control (75 kg N/fed.). Information available on N requirements of cotton plants showed better response to moderate dose of N application, i.e., 60-80 kg/fed. (Makram *et al.*, 1982; Abou-Zaid and El-Haddad, 1997; Darwish and Hegab, 2000; Hamissa *et al.*,2000; El-Beily *et al.*,2001; Abou-Zaid *et al.*, 2002a; Khalifa and Abou-Zaid, 2002 and Dawood, 2006).

As for bio- and mineral P fertilization effect, some studies have reported that phosphate solubilizing bacteria (PSB) and vesicular arbuscular mycorrhizal (VAM) can solubilize P and enhance its absorption by plant roots (Azcon *et al.*, 1976; El-Attar *et al.*,1979; Fawaz *et al.*, 1980; Kucey, 1988; Koreish *et al.*, 1998; Abou-Zaid *et al.*, 2002b, Awad 2006, Badr *et al.*, 2006 and Han et al., .T, 2006). They also found that increased yield response of crop plants have been observed following seed inoculation with PSB or/and VAM. Information available on P requirements for cotton plants showed better response to moderate dose of P application namely; 15.5 - 31.0 kg P_2O_5/fed. (Hamissa *et al.*, 1980; Hosny *et al.*, 1989; Abdel-Aal *et al.*,1996; Ali *et al.*,1996; Abou-Zaid *et al.*, 2002b and Awad, 2006).

The aim of this work was to study the effect of bio-fertilizers (VAM and Microbein) under the different doses of N and P fertilization on growth, earliness, yield, its components and fiber quality of Giza 86 cultivar grown in calcareous soil at west Nubaria.

MATERIALS AND METHODS

The present work was carried out in a sandy clay loamy soil at west Desert Road village, Mariut region beside Nubaria Agricultural Research Station, which located at 47 Km Alexandria-Cairo Desert Road in the two summer growing seasons of 2007 and 2008 to evaluate the use of bio-fertilization on decreasing requirements of nitrogen and phosphorus fertilizers. Cotton growth, earliness, yield, its components and fiber properties were evaluated under seven treatments, namely;

1- Control, recommended dose of 75 kg N + 31 kg P_2O_5/fed. without bio-fertilizers.
2- Mycorrhizae + 37.5 kg N + 15.5 kg P_2O_5/fed.
3- Mycorrhizae + 37.5 kg N + 31 kg P_2O_5/fed.
4- Mycorrhizae + 75 kg N + 15.5 kg P_2O_5/fed.
5- Microbein + 37.5 kg N + 15.5 kg P_2O_5/fed.
6- Microbein + 37.5 kg N + 31 kg P_2O_5/fed.
7- Microbein + 75 kg N + 15.5 kg P_2O_5/fed.

Treatments were arranged in a randomized completely blocks design (RCBD) in four replicates. The soil in which the experiments were performed was calcareous soil (loam, mixed, calcareous, hyper thermic, typic calciorthids). The mechanical and chemical soil properties were determined according to the method described by Page *et al.*, (1982) and presented in Table (1). In both seasons, the texture was sandy clay loam with calcareous, hyper thermic, typic calciorthids and low content of organic matter. The available amounts of macro elements were poor for nitrogen (<20 ppm), lower for phosphorus and potassium. Regarding, available amounts of micro-nutrients Fe, Cu and Mn were at higher levels in the soil, while Zn was existed in moderate amount.

The plot area was 16.25 m^2 (1/258.5 fed.), which consisted of five ridges, each 5 m long, 0.65 m apart and the distance between hills was 25cm. Cotton seeds of Egyptian cotton long staple Giza 86 cultivar (*Gossypium barbadense L.,*) were planted on 16 and 23 April after Egyptian clover (*Trifolium alexandrinum L.,*) in 2007 and 2008 seasons, respectively. Cotton was irrigated, during the growing season, eight times in addition to planting irrigation. Hand hoeing was carried out three times during the growing season before the first irrigation, second and third irrigations, respectively. Average yearly fertilizer rate for cotton was 48 Kg K_2O/fed. as potassium sulphate (48% K_2O). Nitrogen, as ammonium nitrate (33.5% N), was side-dressed, one half of it before the second irrigation and the other half before the third irrigation. All potassium sulphate (48% K_2O) was added before the second irrigation. The calcium superphosphate (15.5% P_2O_5) was added within planting. Before the second irrigation, the plants were thinned to two plants/hill. The standard commercial management practices for west Nubaria region were followed.

Arbiscular mycorrhizal fungi (*Glomus monihtus*), obtained from Götting University, Germany, was added the rate of 250 spores for each seed which were mixed with soil and decanting technique as described by Radwan (1998). The spores were added with the seeds at sowing time.

Table 1. Mechanical and chemical analysis of soil samples for the experimental site in 2007 and 2008 seasons.

Soil properties		Mean	
		2007	2008
Mechanical analysis:			
Clay	**(%)**	24.30	24.71
Silt	**(%)**	21 11	21.18
Sand	**(%)**	54.59	54.11
Texture class		**Sandy clay loam**	**Sandy clay loam**
Chemical analysis:			
Ph		8.11	8.05
E.C.	**(m.moh)**	0.62	0.69
Ca CO_3	**(%)**	28.82	28.63
HCO_3^-	**(%)**	12.87	13.22
Organic matter	**(%)**	0.77	0.82
Available N	**(ppm)**	13.02	15.28
Available P	**(ppm)**	7.92	8.26
Available K	**(ppm)**	208.14	205.33
Available B	**(ppm)**	0.85	0.97
Available Zn	**(ppm)**	0.96	1.05
Available Fe	**(ppm)**	9.0	8.3
Available Cu	**(ppm)**	3.9	3.7
Available Mn	**(ppm)**	9.0	11.0

Microbein is a commercial multi-strains bio-fertilizer produced by the General Organization for Agricultural Equalization Fund in Egypt (GOAEF), Ministry of Agriculture. It consists of a mixture of P-solubilizing and N_2-Fixing bacteria, i.e., Azospirillum, Azotobacter, Klebsiella, and Bacillus... etc (Abou El-Naga, 1993). Seeds inoculated with Microbein were not dressed by either fungicide or pesticides. The inoculation was performed by coating seeds at the rate of 900 g/fed., using a sticking substance (Arabic gum 5%) just before sowing. Seeds were sown in dry soil and then immediately irrigated.

The first pick of cotton yield was performed on 5 and 18 October, while the second pick was on 30 October and 10 November during 2007 and 2008 seasons, respectively. Ten random guarded plants were taken from each plot to determine days from sowing to the first flower appearance (DFF) as well as to first opened boll (DFB), plant height (PH), first sympodial position (FSP), number of sympodia/plant (NSP), number of open bolls/plant (NOB), boll weight (BW), seed cotton yield/plant (SCYP), earliness percentage (E %), lint percentage (L %), seed index (SI) and fiber properties measured by HVI according to (A.S.T.M. D-4605.,1986) upper half mean length (UHM) in mm, uniformity index (UI), Fiber strength in g/tex. (FS), fiber elongation percentage (FE %), micronaire reading (MR), reflectance (Rd %) and yellowness (+b). Also, number of plants/fed. at harvest (NPF) was determined. Seed cotton yield/plot was calculated from the three inner ridges in each plot and was converted to kentar/fed. (SCYF).

The collected data of the two seasons were subjected to statistical analysis according to Gomez and Gomez (1984), L.S.D. values at 5% level of significance were used for comparison between means.

RESULTS AND DISCUSSION

The present investigation was conducted to study the effect of nitrogen, phosphorus levels and bio-fertilization treatments on growth attributes, earliness parameters, yield, its components and fiber properties.

1. Growth attributes and earliness parameters:

Data presented in Table (2) showed that the seven treatments had significant effects on first sympodial position (FSP), boll age (BA) for one season, days to first flower appearance (DFF) and days to first opened boll (DFB) for the two seasons. While, plant height at harvest (PH), no. of sympodia/plant (NSP) and earliness percentage (E%) were not significantly affected by the studied treatments in the two seasons. It was obvious that the lowest FSP (6.77, 6.43 node), DFF (74.48, 72.30 days), DFB (119.38, 117.80 days) and BA (44.9, 45.5 days), in both 2007 and 2008 seasons, respectively, were produced with cotton seed inoculation by Microbein bio-fertilizer when conjugated with the recommended dose of 31 Kg P_2O_5/fed. and half the amount of the recommended dose of (37.5 Kg N/fed.) as compared to the other treatments (Table 2). Similar results were obtained by Darwish and Hegab (2000); Abou-Zaid *et al.*, (2002a and 2002b); Awad (2006) and Dawood (2006). Also, Kucey (1988) reported that increasing growth attributes and earliness parameters; i.e., increase E % and decrease DFF, DFB, BA and FSP due to inoculation with PSB were attributed to the reduction of media pH and hence the solubility of phosphates.

Table 2. Means of growth attributes and earliness parameters as affected by nitrogen, phosphorus levels and bio-fertilization for Giza 86 cotton cultivar during 2007 and 2008 seasons.

Treatments	Mineral fertilizer (kg/fed.)		Plant height at harvest (cm)		No. of sympodia/plant		First sympodial position (Node)		Days to first flower appearance		Days to first opened boll		Boll age (Day)		Earliness percentage (%)	
Bio-fertilizer	+ N	+ P_2O_5	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
1- Without	+ 75.0	+ 31.0	120.9	146.8	13.53	14.13	7.45	6.65	75.5	74.2	121.5	121.0	45.9	46.9	51.8	59.8
2- Mycorrhizae	+ 37.5	+ 15.5	117.3	131.1	13.00	13.48	7.95	6.93	78.3	78.0	124.9	128.2	46.6	50.2	53.8	57.7
3- Mycorrhizae	+ 37.5	+ 31.0	118.4	133.6	13.07	13.60	7.65	6.78	77.2	76.8	124.6	126.7	47.4	49.8	50.4	57.9
4- Mycorrhizae	+ 75.0	+ 15.5	118.5	137.8	13.37	13.78	7.57	6.45	76.9	72.9	124.4	118.8	46.5	45.9	51.1	59.9
5- Microbein	+ 37.5	+ 15.5	121.1	135.1	13.70	13.70	7.13	6.75	75.4	74.9	124.3	122.8	45.9	47.9	54.2	59.3
6- Microbein	+ 37.5	+ 31.0	121.1	142.4	14.35	14.15	6.77	6.43	74.5	72.3	119.4	117.8	44.9	45.5	53.2	60.8
7- Microbein	+ 75.0	+ 15.0	117.1	129.0	12.70	13.05	8.25	7.15	79.3	80.1	126.8	132.7	47.5	52.6	53.6	57.1
L.S.D. at 5 % level			N.S	N.S	N.S	N.S	1.08	N.S	1.15	2.64	1.55	2.18	N.S	0.91	N.S	N.S
Grand mean			119.2	136.5	13.39	13.70	7.54	6.73	76.7	75.6	123.1	123.9	46.4	48.4	52.6	58.9

2. Yield and its components:

The results recorded in Table (3) showed that number of opened bolls/plant (NOB) for one season, boll weight (BW), lint percentage (L %) and seed index (SI) for the two growing seasons, were not significantly affected by treatments. The studied treatments, also, did not exhibit any significant effect on number of plants/fed. at harvest (NPF) in both seasons. This result was expected since the same planting method and management practices were followed for all studied treatments. On the contrary Table (3), also, illustrated that seed cotton yield/plant (SCYP) and seed cotton yield/fed. (SCYF) were significantly affected by the treatments in the two seasons. The data given in Table (3) showed that inoculation of cotton seeds with Microbein bio-fertilizer when conjugated with the recommended dose of (31 Kg P_2O_5/fed.) and half the amount of the recommended dose of (37.5 Kg N/fed.) produced the highest values for SCYP (51.73, 54.25 g) and consequently SCYF (9.33, 11.24 Kent./fed.) in 2007 and 2008 seasons, respectively. The increase in yields of SCYP as well as SCYF due to (Microbein + 31 Kg P_2O_5/fed.+ 37.5 Kg N/fed.) treatment compared to the other studied treatments may be attributed to the decrease in FSP, DFF, DFB and BA for this treatment. These results were in agreement with Hamissa *et al.*,(2000); El-Shazly and Darwish, (2001); Abou-Zaid *et al.*. (2002a) and (2002b); Awad, (2006) and Dawood (2006). Also table 3 showed that the same trend was obtained for the two treatments of (Microbein + 15.5 Kg P_2O_5/fed. + 37.5 Kg N/fed.) and (Mycorrhizal + 15.5 Kg P_2O_5/fed + 75 Kg N/fed.) on seed cotton yield and its components in the two seasons. Mitkees *et al.*, (1996) and Radwan, (1998), assured that the increase in yield of Microbein followed by Mycorrhizal was due to the fact that those bio-fertilizers help in N_2-fixation and improving phosphate solubilizing bacteria that make it available for absorption by plant roots. Also, Mitkees *et al.*, (1996) reported that the positive effect of using "Microbein" bio-fertilizer compared to the control (non-inoculation with Microbein) may be due to that "Microbein" consists of a mixture of PSB and N_2-fixing bacteria, i.e., *Azospirillum, Azotobacter, Klebsiella.* and *Bacillus....* etc. Also, Zakhia and Lajudie (2001) assured that increasing N uptake with inoculation with *Bacillus sp.* may be related to the fact that *Bradyrhizobium sp.*, a genus which fixes atmospheric N in symbiosis with legume, is phyllogentically closer to *Bacillus* than to other rhizobial genera. Therefore, *Bacillus* strain in Microbein bio-fertilizer, i.e., *Bacillus megaterium* var. *Phosphaticum,* used in this study might have the capacity to fix atmospheric nitrogen.

Table 3. Means of yield and its components as affected by nitrogen, phosphorus levels and bio-fertilization for Giza 86 cotton cultivar during 2007 and 2008 seasons.

Treatments	Mineral fertilizer (kg/fed.)		No. of opened bolls/plant		Boll weight (g)		Seed cotton yield/plant (g)		No. of plants (1000 plants/fed.)		Seed cotton yield (Kentar/fed.)		Lint percentage (%)		Seed index (g)	
Bio-fertilizer	+ N	+ P_2O_5	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
1- Without	+ 75.0	+ 31.0	19.78	20.35	2.54	2.61	50.21	53.10	44.01	43.62	8.84	10.82	40.11	39.41	10.79	11.86
2- Mycorrhizae	+ 37.5	+ 15.5	17.66	18.55	2.61	2.58	46.08	47.86	44.07	43.61	8.43	9.69	40.02	38.99	10.90	11.97
3- Mycorrhizae	+ 37.5	+ 31.0	18.42	19.76	2.56	2.59	47.16	51.19	43.82	43.74	8.56	10.37	40.70	39.30	10.96	11.80
4- Mycorrhizae	+ 75.0	+ 15.5	18.56	20.22	2.56	2.66	47.50	53.78	44.46	43.81	8.78	10.89	40.28	39.21	10.94	11.67
5- Microbein	+ 37.5	+ 15.5	19.37	19.75	2.63	2.68	50.95	52.93	43.62	43.62	8.84	10.58	40.32	38.94	10.98	11.67
6- Microbein	+ 37.5	+ 31.0	19.97	19.73	2.59	2.75	51.73	54.25	44.59	43.63	9.33	11.24	40.71	39.70	10.96	11.32
7- Microbein	+ 75.0	+ 15.0	17.57	18.46	2.52	2.55	44.28	47.08	43.17	43.68	7.39	9.10	40.39	38.97	10.81	11.82
L.S.D. at 5 % level			0.55	N.S	N.S	N.S	1.79	3.61	N.S	N.S	0.89	0.81	N.S	N.S	N.S	N.S
Grand mean			18.78	19.57	2.57	2.63	48.27	51.46	43.96	43.67	8.59	10.37	40.36	39.22	10.91	11.73

Table 4. Means of fiber quality properties as affected by nitrogen, phosphorus levels and bio-fertilization for Giza 86 cotton cultivar during 2007 and 2008 seasons.

Treatments			Fiber Length parameters				Fiber bundle tinsel				Micronaire reading		Colour			
	Mineral fertilizer (Kg/fed.)		Upper half mean (mm)		Uniformity index (%)		Fiber strength (g/tex)		Fiber elongation (%)				Reflectance (Rd %)		Yellowness (+b)	
Bio-fertilizer	+ N	+ P_2O_5	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
1- Without	+ 75.0	+ 31.0	33.1	34.1	85.5	89.7	42.8	42.0	6.10	8.00	4.70	5.20	77.5	77.5	8.9	9.4
2-Mycorrhizae	+ 37.5	+ 15.5	32.7	33.8	85.4	88.8	43.4	41.4	6.06	7.70	4.66	5.20	78.6	76.5	9.0	9.6
3-Mycorrhizae	+ 37.5	+ 31.0	32.0	34.6	85.6	89.4	44.0	41.3	6.26	7.93	4.76	5.06	78.4	77.4	9.3	9.6
4-Mycorrhizae	+ 75.0	+ 15.5	33.0	34.2	86.8	89.6	43.8	42.4	6.43	8.00	4.76	5.10	78.7	76.9	8.8	9.7
5- Microbein	+ 37.5	+ 15.5	33.4	34.5	86.0	89.7	44.8	41.9	5.96	7.86	4.86	5.36	78.4	76.3	8.9	9.6
6- Microbein	+ 37.5	+ 31.0	32.9	34.5	85.4	88.9	44.1	41.3	6.66	7.90	4.63	5.10	76.9	76.1	9.1	9.6
7- Microbein	+ 75.0	+ 15.0	33.0	33.9	86.7	88.9	44.5	42.5	6.26	8.00	4.60	5.13	77.9	76.6	8.6	9.8
L.S.D. at 5 % level			N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Grand mean			32.9	34.2	85.9	89.3	43.9	41.8	6.25	7.91	4.71	5.16	78.1	76.8	8.9	9.7

3. Fiber properties

All studied treatments did not exhibit any significant effects on all fiber properties in both seasons (Table 4). This may be attributed to the realization that these characteristics were less affected by the environmental factors. These results agreed with those obtained by Hamissa *et al.*,(2000); Abou-Zaid *et al.*, (2002a) and (2002b); Awad, (2006) and Dawood (2006).

As a conclusion of the above results, it is advisable to inoculate cotton seeds with "Microbein" followed by Mycorrhizal bio-fertilizers when conjugated with using the low N and/or P levels to obtain the highest yield of seed cotton. That treatment saved about 50% of the recommended dose of the mineral N and P fertilizers and this treatment is promising for growing cotton in calcareous soils.

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الملخص العربي

مستقبل إنتاج القطن المصري في الأراضي الصحراوية المستصلحة حديثاً بمصر.

٩- أستخدام المخصبات الحيوية لتقليل الاحتياجات السمادية الآزوتية والفوسفاتية.

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أجريت هذه التجربة بمحطة البحوث الزراعية بالنوبارية – في أرض جيرية – خلال موسمي النمو ٢٠٠٧، ٢٠٠٨ وذلك لدراسة أستجابة صنف القطن المصري جيزة ٨٦ للتلقيح بالمخصب الحيوي "الميكروبين" وكذلك فطر "الميكوريزا" تحت مستويين مختلفين من الأزوت والفوسفور الأرضي وذلك مقارنة بمعاملة الكنترول. وأثر ذلك علي دلائل النمو، قياسات التبكير، المحصول ومكوناته وجودة التيلة. وقد إستخدم في هذه التجربة تصميم القطاعات كاملة العشوائية في أربع مكررات.

وكانت معاملات التجربة السبع كالتالي:

١) الكنترول (بدون مخصب حيوي + ٧٥ كجم ازوت + ٣١ كجم فو٢أ٥/فدان) وهو المعدل الموصي به.
٢) المخصب الحيوي "ميكوريزا" + ٣٧,٥ كجم ازوت + ١٥,٥ كجم فو٢أ٥/فدان).
٣) المخصب الحيوي "ميكوريزا" + ٣٧,٥ كجم ازوت + ٣١ كجم فو٢أ٥/فدان).
٤) المخصب الحيوي "ميكوريزا" + ٧٥ كجم ازوت + ١٥,٥ كجم فو٢أ٥/فدان).
٥) المخصب الحيوي "ميكروبين" + ٣٧,٥ كجم ازوت + ١٥,٥ كجم فو٢أ٥/فدان).
٦) المخصب الحيوي "ميكروبين" + ٣٧,٥ كجم ازوت + ٣١ كجم فو٢أ٥/فدان).
٧) المخصب الحيوي "ميكروبين" + ٧٥ كجم ازوت + ١٥,٥ كجم فو٢أ٥/فدان).

أهم النتائج المتحصل عليها كما يلي:

١) لم تختلف معاملات التلقيح بالميكروبين والميكوريزا - مقارنة بالكنترول - معنوياً في صفات طول النبات عند الجني، عدد الأفرع الثمرية/نبات، نسبة التبكير، متوسط وزن اللوزة، عدد النباتات/فدان عند الجني، تصافي الحليج، دليل البذرة وخواص التيلة في كلا الموسمين.

٢) أعطت صفات ارتفاع أول عقدة ثمرية، عمر اللوزة وعدد اللوز المتفتح/نبات فروقاً معنوية بين معاملات التجربة السبع في موسم واحد فقط.

٣) أعطت معاملات التجربة فروق معنوية لصفات عدد الأيام من الزراعة وحتي ظهور أول زهرة، تفتح أول لوزة، محصول النبات الفردي ومحصول الفدان من القطن الزهر في كلا الموسمين.

٤) أدي تلقيح بذور القطن بالمخصب الحيوي "الميكروبين" مع التسميد الفوسفوري الموصي به (٣١ كجم/فدان) ونصف الجرعة الموصي بها من الأزوت (٣٧,٥ كجم/فدان) إلي زيادة معنوية هي الاعلي مقارنة بالكنترول والمعاملات الاخري في محصول النبات الفردي (٥١,٧٣ و ٥٤,٢٥ جم/نبات) وبالتالي أعطت أقصي إنتاجية للفدان (٩,٣٣ و ١١,٢٤ قنطار/فدان) خلال موسمي الدراسة ٢٠٠٧ و ٢٠٠٨ علي الترتيب.

٥) ازداد محصول القطن الزهر/فدان للمعاملة بالميكروبين مع نصف الجرعة الموصي بها من الأزوت والفوسفور (٨,٨٤ و ١٠,٥٨ قنطار/فدان) والمعاملة بالميكوريزا مع ٧٥ كجم ازوت/فدان + ١٥,٥ كجم فوسفور/فدان (٨,٧٨ و ١٠,٨٩ قنطار/فدان) بصورة معنوية، كما لم تختلف هذه المعاملات معنوياً عن معاملة الكنترول (٨,٨٤ و ١٠,٨٢ قنطار/فدان) وذلك في كلا من موسمي الزراعة ٢٠٠٧ و ٢٠٠٨ علي الترتيب.

٦) الزيادة في المحصول والراجعة لاستخدام الميكروبين تليه الميكوريزا ربما ترجع إلي انخفاض أول فرع ثمري علي النبات، عدد الأيام من الزراعة وحتي ظهور أول زهرة، وتفتح أول لوزة وقصر عمر اللوزة في كلا الموسمين لهذين المخصبين الحيويين، وهذه القياسات تُعد مؤشراً للتبكير في نضج اللوز في القطن.

٧) الزيادة في الإنتاجية والراجعة لاستخدام المخصبين الحيويين الميكروبين والميكوريزا قد ترجع إلي حقيقة أن استخدام هذين المخصبين الحيويين يساعد في تثبيت الآزوت وتيسير إذابة الفوسفور الصالح للامتصاص في التربة في آن واحد.