Future of Egyptian Cotton Production in the New Reclaimed Desert Land of Egypt: 7- Response of Cotton to Bio- and Mineral- Nitrogen Fertilization

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ABSTRACT

This is the seventh part in a series of articles aiming at helping the cotton growers to optimize the cotton production in the desert regions. Two field experiments were conducted on a sandy loam soil at Nubaria Agric. Res. Stn. during the summer season of 1999 and 2000 to study the response of Egyptian cotton cultivar Giza 70 to inoculation with Rhizobactrein or Nitrobein as commercial biofertilizers compared to non inoculation treatment on some plant growth attributes, earliness parameters, seed cotton yield/fed,its components, fiber properties and net return/fed under the three levels of N fertilizers (30,45 and 60 kg N/fed).The results indicated that application of 60kgN/fed significantly increased plant height, number of sympodia/plant, earliness parameters, seed cotton yield/plant,its components, consequently seed cotton yield/ fed in the two seasons. While, N fertilizer levels had insignificant effects on first sympodial position, number of plants/fed at harvest, fiber length in both seasons, fiber strength and fineness in one season only. Application of Nitrobein followed by Rhizobactrein biofertilizers significantly increased plant height, earliness parameters, seed cotton yield/ fed and its components compared with non-inoculation treatment. On the contrary, biofertilizer treatments had insignificant effect on first sympodial position , days to first flower , number of plants/fed at harvest , lint percentage ,fiber length and fineness in the two seasons and fiber strength only in one season. All the studied characteristics were insignificantly affected by the first - order interactions, N fertilizer level x biofertiiizer, except plant height in one season only, boll weight and seed cotton yield/fed in the two seasons. Nine polynomial quadratic equations were established to express the relation between yield values of cotton and N rates under different biofertilizers. The following parameters were calculated from the equation: the optimum yields (Y opt) of seed cotton were 5. 79 , 6. 37 and 7. 02 kentar/fed in the first season and 6. 07, 6. 11 and 6.71 kentar/fed in the second season, when non-inoculation, Rhizobactrein and Nitrobein, respectively were applied. Also, the net returns of N fertilizer under Rhizobactrein and Nitrobein were calculated, where the data indicated that Nitrobein had the graetest value of net return for the two seasons.

INTRODUCTION

The use of N-fixing bacteria for cotton plants can help conserving soil system and reduce both of the costs of cotton production and environmental pollution (Abd El – Ghani *et al.*,1993;Amberger,1993;Nassar and Salama, 1995). Also, inoculation with N - fixing bacteria increases yield of seed cooton, its components and increases the net income/fed (Hamissa *et al.*, 2000; El - Shazly and Darwish, 2001). They also found that biofertilization improved cotton productivity and reduced the need for the mineral N fertilizer at the Delta of Egypt. In this respect, Mitkees *et al.*(1996) found that inoculation of cotton seeds

with biofertilizer compensate considerable parts of mineral N fertilizers. It saves about 50 kg N/fed in old lands and about 40 kg N/fed in new lands. Hence there will be a decrease in production costs and minimizing environmental pollution. In West Nubaria region, some field experiments were conducted to study the effect of biofertilization on some field crops such as soybean (El-Fayoumy *et. al.*,1996), barley (Said, 1998), forage sorghum (Mahmoud *et al.*, 1999), wheat (Ahmed, 2001 and El - Aggory *et al.*, 2001)and faba bean and wheat (Koreish *et al.*,2001). Their results showed that inoculation with biofertilizers significantly increased yield, yield components and net income/ fed.

Information available on N requirements of cotton plants showed better response to moderate rate of N application; i. e., 45 - 60 kg N/ fed (Abou - Zaid, 1991; Abou - Zaid and El - Haddad, 1997; Hamissa *et al.*, 2000 and El - Beily *et al.*, 2001).

With regard to N fertilizer rate x biofertilizer interaction, Hamissa *et al.* (2000) found that inoculation of cotton seeds with Rhizobactrein when conjugated with N dose of 60 kg/fed gave the highest yield, its components and net income/fed. While El-Shazly and Darwish (2001) reported that the addition of 30 kg N/fed x Microbein biofertilizer significantly increased seed cotton yield/fed and gave the highest net income/fed.

The objectives of the present study were to examine the effect of three biofertilizer treatments under three N fertilizer levels and their interactions on seed cotton yield, its components, fiber properties and net return/fed under the newly reclaimed desert land of West Nubaria region.

MATERIALS AND METHODS

Two field experiments were conducted on a sandy loam soil (loam , mixed , calcareous , hyper thermic , typic calciorthids)at Nubaria Agricultural Research Station during 1999 and 2000 summer seasons,to study the effect of N fertilizer levels, biofertilizer treatments and their interaction on growth attributes,earliness parameters, seed cotton yield,its components, fiber properties and net return/fed of Giza 70 Egyptian cotton cultivar.The physical and chemical soil properties were determined according to the method described by Page *et al.*,(1982) and presented in Table(1).

The experimental design was split plot with four replicates.The nitrogen fertilizer levels(30,45and 60kgN/fed) as ammonium sulphate (20.5%N) were allocated at random in the main plots.The biofertilizer treatments(non-inoculation,Rhizobactrein and Nitrobein)randomly distributed in the sub plots.

The biofertilizer (Rhizobactrein)is a mixture of nitrogen fixing bacteria-*Azotobacter chroococcum* and *Azospirillum brasilense*. The biofertilizer (Nitrobein) containing of *Azospirillum spp* and *Azotobacter chroococcum*.

Table 1. Some initial soil physical and chemical properties of the experimental site.

Parameter	Mean	
	1999	2000
Mechanical analysis :		
Sand, %	56	57
Silt, %	26	28
Clay, %	18	15
Texture	Sandy loam	Sandy loam
Chemical properties		
EC,dS/m(soil paste ext.)	1.87	1.66
PH(1:2.5 soil:water)	8.23	8.14
$CaCO_3$, %	23.10	22.18
O.M., %	0.57	0.66
NH_4 OAC ext. K , mg / kg soil	201.00	212.15
Na HCO_3 ext. P, mg / kg soil	4.20	5.18
Total N ,%	0.12	0.16

Such products are produced by the General Organization for Agricultural Equalization Fund, Ministry of Agriculture , Egypt (Abou-El-Naga,1993). The inoculation was performed by coating cotton seeds at the rate of 0.80 kg/fed with each product individually using a sticking substance (Arabic gum 5%) just before sowing.

Each sub - plot consisted of five ridges, 0.75 m apart and 5 m long (plot area = 18.75 m^2) and the distance between hills was 20 cm. Seeds were sown on 3 and 10 April after Egyptian clover in 1999 and 2000 seasons, respectively. Before the first irrigation, the plants were thinned to two plants/hill. A preplant application of 30 kg P_2O_5/fed, as superphosphate(15.5%P_2O_5),was incorporated into the soil surface each year. Nitrogen was side-dressed one,half of it before the first irrigation and the other half before the second irrigation. All potassium sulphate (48%K_2O) was added, at the rate of 48 kg K_2O/fed, before the second irrigation. Other recommended cultural practices were followed in both seasons.

At harvesting, ten random guarded plants were taken from each sub plot to determine plant height, number of sympodia/plant, first sympodial position,days from sowing to the first flower appearance as well as to first open boll, earliness percentage ,number of open bolls/plant, boll weight, seed cotton yield/plant, fiber length at 2.5% span length, fiber strength(g/tex),fiber fineness (micronaire reading) and net return/fed. Also, the number of plants/ fed. at harvest was determined. Seed cotton yield was calculated from the three inner

ridges in each sub plot and was converted into kentar/fed. The agronomical data of the two seasons were statistically analyzed at 0.05 probability level for a split plot design according to SAS-GLM procedure out lined by (SAS,1988).Duncan multiple range test was used for the separation of the means(Duncan,1955).

RESULTS AND DISCUSSION

1- Main effects:

1.1- Nitrogen fertilizer level effect:

1.1.1- Growth attributes and earliness parameters:

Data in Table (2) show that increasing the level of N fertilization from 30 to 60 kg/fed significantly increased plant height and number of sympodia /plant in the two seasons. On the contrary, increasing the N fertilization levels significantly decreased number of days from sowing to first flower appearance as well as to first open boll, consequently significantly increased earliness percentage in both seasons (Table 2).Meanwhile, nitrogen application had no significant effect on first sympodial position in the two seasons. Nitrogen plays an important role in plant growth and its considered as an indispensable element for several vital functions.Similar results were obtained by Abou-Zaid and El-Tabbakh(1996), Abou-Zaid and El-Haddad(1997),El-Razaz *et al.*(1997), Abd El-Malik and El-Shahawy(1999)and Darwish and Hegab (2000).They attributed this increase to the increase in the meristematic activity as well as production of auxin which encourage cell division and elongation .

1.1.2- Seed cotton yield/fed and its components:

The data in Table (2) show also that the 60 kg N/fed treatment gave the largest numbers of open bolls/plant (8.75,10.78),the heaviest boll weights (2.30,2.27g), consequently the highest yields of seed cotton/plant (20.22,24.50g) in 1999 and 2000 seasons, respectively. The previous results explained the highest yields of seed cotton/fed (5.85 and 6.09 kentar) in favour of the high N fertilizer level (60 kg N/fed) in 1999 and 2000 seasons, respectively (Table2).Nubaria represents the newly reclaimed calcareous soil (Table1), which is poor in soil texture and fertility as well as in biological activity. Therefore, raising N application from 30 to 60 kg/fed increased seed cotton yield/fed and its components. These results are in accordance with findings of Abd El- Malik and El - Shahawy (1999),Darwish and Hegeb (2000),Hamissa *et al.*(2000),El- Beily *et al.*(2001)and El-Haddad *et al.*(2001).Nitrogen fertilization did not exhibit any significant effect on number of plants/ fed at hervest in the two seasons (Table 2).This result was expected since the same planting method and management practices were followed for all N fertilization levels .

Table 2. Means of growth attributes, earliness parameters, seed cotton yield/fed and yield components as affected by nitrogen levels and some commercial biofertilizers during 1999 and 2000 seasons.

Character	Season	N level kgN/fed. (N)			L.S.D (0.05)	Biofertilizers(B)			L.S.D (0.05)
		30	45	60		Non.[1]	Rhz.[2]	Nit.[3]	
Plant height (cm)	1999	76.07c	92.47b	119.72a	3.71	85.74b	99.39a	103.12a	3.82
	2000	74.88c	90.39b	125.31a	9.90	88.78c	96.83b	104.98a	96.86
No.of sympodia / paint	1999	11.20c	13.78b	14.44a	0.61	12.19b	13.41a	13.82a	0.62
	2000	10.88c	12.05b	13.45a	1.14	11.46b	12.15ab	12.78a	0.83
First sympodial position	1999	5.36	5.35	5.37	N.S.	5.38	5.32	5.38	N.S.
	2000	5.80	5.78	5.82	N.S.	5.65	5.74	6.02	N.S.
Days to first flower	1999	78.57a	74.33b	70.42c	1.44	74.75	75.26	73.31	N.S.
	2000	80.65a	78.78a	73.60b	3.11	77.62	78.75	76.67	N.S.
Days to first open boll	1999	129.28a	122.63b	116.97c	2.04	123.84a	123.74a	121.28b	1.70
	2000	132.39a	129.07a	120.21b	3.75	127.57ab	128.75a	125.35b	2.76
Earliness%	1999	60.64c	67.32b	73.45a	1.08	63.52c	67.09b	70.80a	2.24
	2000	61.58c	66.52b	73.52a	1.46	64.91b	66.70b	70.01a	1.95
No. of open bolls/plant	1999	6.27b	8.30a	8.75a	0.81	7.01c	7.69b	8.62a	0.65
	2000	6.18c	9.02b	10.78a	1.09	8.08b	8.43b	9.47a	0.83
Boll weight(g)	1999	1.85c	2.03b	2.30a	0.06	1.98c	2.04b	2.16a	0.05
	2000	1.85c	2.00b	2.27a	0.10	1.95c	2.04b	2.13a	0.06
Seed cotton yield/plant(g)	1999	11.56c	16.84b	20.22a	1.71	14.01c	15.82b	18.79a	1.40
	2000	11.46c	18.06b	24.50a	2.59	15.99b	17.51b	20.51a	1.79
No.of plants/fed.[4]	1999	52569	52565	52664	N.S.	52567	52618	52614	N.S.
	2000	51870	51770	51837	N.S.	51770	51870	51837	N.S.
Seed cotton yield/fed.(kentar)[5]	1999	4.52c	5.56b	6.09a	0.09	4.68c	5.49b	6.00a	0.15
	2000	3.95c	5.14b	5.85a	0.27	4.51b	4.85b	5.58a	0.35

All the first-order interactions were not siginficant, except plant height in 1999 season, boll weight and seed cotton yield/fed in both seasons. For symbols see Table3.

1.1.3- Lint percentage and fiber properties:

Table(3)shows that increasing the level of N fertilization from 30 to 60 kg/fed significantly increased lint percentage in both seasons, while, lint percentage was not affected by the two lower of N fertilization levels (30 and 45 kg N/fed) only in the second season. These results agreed with those obtained by Abou-Zaid and El-Tabbakh (1996),Abou-Zaid and El-Hadded(1997),and Hamissa *et al.*(2000).

Data in Table (3) also show that N fertilizer levels had insignificant effects on fiber length in the two seasons, fiber strength and fineness only in one season. This may be attributed to the realization that these characters were less affected by the environmental factors (Makram *et al.*,1982;Abou-Zaid and El-Tabbakh,1996). Generally, The highest values of these traits were obtained from plants receiving 60 kg N/fed followed by those receiving 45kg N/fed. However, the plants receiving 30 kg N/fed produced the lowest values (Table 3).

1.2- Biofertilizer effect :

1.2.1- Growth attributes and earliness parameters :

It is obvious that the tallest plants and the highest number of sympodia/plant were produced with cotton seed inoculation by biofertilizers,i.e., Nitrobein and Rhizobactrein compared to the non-inoculation treatment(Table 2).In this concern, Hamissa *et al.*(2000),found that final plant height was significantly increased due to cotton seed inoculation with biofertilizers, while number of sympodia/plant did not respond to biofertilizers.

As for earliness parameters, results in Table(2)also show that first sympodial position and days to first flower appearance were not affected by the biofertilizers in the two seasons. While, biofertilizer treatments had significant effects on days to first open boll and earliness percentage in both seasons.

The lowest mean values of days to first open boll, consequently the earliest cotton plants were obtained when cotton seeds were inoculated with the commercial biofertilizer Nitrobein followed by the Rhizobactrein compared with non-inoculation treatment (Table 2). On the other hand, El-Shazly and Darwish (2001) found that biofertilizer treatments had insignificant effect on earliness percentage in the two seasons.

1.2.2- Seed cotton yield / fed and its components:

Data presented in Table (2) show that biofertilizers had significant effects on seed cotton yield / fed and its components, while number of plants/fed was insignificantly affected in the two seasons. Number of open bolls / plant, boll weight and consequently seed cotton yield / plant tended to increase when cotton seeds were inoculated with Nitrobein followed by Rhizoboctrein biofertilizers compared with the non-inoculation treatment (Table 2). These

Table 3 . Means of lint percentage and fiber properties as affected by nitrogen levels andsome commercial biofertilizers during 1999 and 2000 seasons.

Character	Season	N level kgN/fed (N)			L.S.D	Biofertilizers(B)			L.S.D
		30	45	60	(0.05)	Non.[1]	Rhz.[2]	Nit.[3]	(0.05)
Lint%	1999	37.37c	37.80b	38.91a	0.42	37.98	37.98	38.12	N.S.
	2000	36.32b	36.48b	37.64a	1.03	36.47	36.80	37.18	N.S.
Fiber length at	1999	33.63	33.65	33.67	N.S.	33.62	33.65	33.68	N.S.
2.5%S.L.(mm)	2000	33.54	33.58	33.60	N.S.	33.55	33.58	33.60	N.S.
Fiber strength	1999	34.53	34.56	34.58	N.S.	34.51b	34.56ab	34.60a	0.06
(g/tex)	2000	34.38b	34.44ab	34.53a	0.10	34.42	34.45	34.48	N.S.
Micronaire reading	1999	3.25b	3.28b	3.33a	0.04	3.25	3.30	3.32	N.S.
	2000	3.28	3.31	3.35	N.S.	3.28	3.31	3.34	N.S.

All the first-order interactions were not significant.
N.S.:Not significant at 0.05 level .
1 - Non: Non-inoculation treatment.
2 – Rhz.:Rhizobactrein biofertilizer.
3 – Nit.:Nitrobein biofertilizer.
4 – fed.: Feddan = 4200m^2
5 – kentar = 157.5 kg.

results clearly indicate that seed cotton yield / plant depends mainly on number of open bolls / plant and boll weight. Also, Table (2) shows that the highest yield of seed cotton / fed was obtained when cotton seeds were inoculated with the Nitrobein commercial biofertilizer giving 6.00, 5.58 kent / fed in 1999 and 2000 seasons, respectively. Both Rhizobactrein and non-inoculation treatments gave significantly lower yield. Rhizobactrein biofertilizer gave higher yields (5.49,4.85 kent/fed) than non-inoculation treatment (4.68,4.51 kent / fed) in 1999 and 2000 seasons, respectively, but the difference in yield between the two treatments was not significant in the second season. This may be due to no significant difference was obtained in number of open bolls / plant due to Rhizobactrein addition compared with non-inoculation treatment in the same season (Table 2). On the other hand, Hamissa *et al.*, (2000) found that the highest yield and its components were obtained when cotton seeds were inoculated with Rhizobactrein or Microbein compared with Nitrobein or non-inoculation treatments. Also, El-Shazly and Darwish(2001)show that biofertilizer addition gave significant effects on number of open bolls / plant, seed cotton yield / plant and consequently seed cotton yield / fed in one season only, but no significant difference was obtained in boll weight due to this addition, in both seasons.

The significant increases in yield and its components due to biofertilizer treatments compared to non-inoculation treatment could be concluded that the role of biofertilizer in increasing the indigenous level of plant phytohormones like IAA, GAs and CKs which promote plant growth, cell division, break the apical dominance, encourage the photosynthesis and assimilates accumulation (Said, 1998). Also, the role of these microorganisms in increasing the nitrogen, phosphorus and potassium uptake which promote plant development through the expected increase in the root extension (Hamissa *et al.*, 2000).

1.2.3. Lint percentage and fiber properties:

Biofertilizer treatments did not exhibit any significant effect on lint percentage, fiber length, fineness in the two seasons and fiber strength in the second season only (Table 3). The highest mean values of these traits were obtained when cotton seeds were inoculated with Nitrobein followed by Rhizobactrein. However, the control (non-inoculation) produced the lowest values. In this respect, Hamissa *et al.*,(2000) and El-Shazly and Darwish (2000) found that biofertilizer treatments had insignificant effect on lint % only in one season.

2. The interaction :

Regarding the interaction between N fertilizer levels (N) and biofertilizer treatments(B),it had insignificant effects on all of the studied characteristics in both seasons, except plant height in the first season, boll weight and seed cotton yield/fed in both seasons(Table 2). The insignificant N x B interaction for these traits indicating that the response to N fertilization level was similar at each biofertilizer treatment. Concerning boll weight, data in Table (4), cleared

that boll weight markedly increased by increasing N fertilizer levels from 30 to 60 kg/fed at any biofertilizer treatments in the two seasons. Inoculation of cotton seeds with Nitrobein at the high N level of 60 kg / fed produced the heaviest boll weights (2.48, 2.42g), while the lowest boll weights (1.79, 1.81g) were obtained from the combination between 30 kg N / fed and non-inoculation treatment in 1999 and 2000 seasons, respectively . The treatment of Nitrobein X 60 kg N /fed gave the highest yields of 6.67and 6.40 kent / fed in the two seasons ,respectively , indicating the great effect of boll weight on the yield (Table 4). In this respect , Hamissa *et al.* , (2000) found that the highest boll weight was obtained from the combination between the low N level of 30kg /fed and inoculation of cotton seeds with Rhizobactrein. Also,El-Shazly and Darwish(2001) showed that The most studied characteristics were not affected by N x B interaction .

3. Establishing quantitative relations:

3.1. The polynomial equations:

In an attempt to evaluate the cotton response quantitatively to applied nitrogen under different biofertilizers, the polynomial equations expressing the response to rates of nitrogen application were established using the least squares method.

The experimental values of seed cotton yields of the two seasons were used to calculate the values of B0, B1 and B2 in the following polynomial quadratic equation:

$$Y = B_0 + B_1X - B_2X^2$$

Where the term " Y " stands for the obtainable yield of seed cotton when rates of nutrient " X " are applied.The values of " B_0 " and " B_1 " are of the same significance as in the rectilinear equation , the term " B_2 " expresses the rate of plant response in the upper curved part of the response curve .

The equations expressing the response of seed cotton yield to nitrogen rates under different biofertilizers are presented in Table (5) .

3.2. Maximum and optimum yields:

The maximum yields for each biofertilizer were calculated using the following relationship :

$Y_{max} = B_o - [(B_1)^2 / 4B_2]$, Capurro and Voss (1981). The values of Ymax were calculated using the values of equations 1- 9 and presented in Table (6). Data in Table (6) show that the Y_{max} values were 5.79, 6.37 and 7.02 kentar of seed cotton yield / fed in the first season and 6.07, 6.11 and 6.71 kentar of seed cotton /fed in the second season, when non-inoculation, Rhizobactrein and Nitrobein,respectively were applied. In the polynomial equation(Table 5), the optimum rates of fertilizers application were calculated by differenting " Y " in the polynomial equations 1-9 with regard to " X " (dy / dx) and equating with ratio of the price of fertilizer unit and the price of the crop unit (kentar seed cotton) and presented in Table (6).Substitution for " X " by the

Table 4. Means of boll weight and seed cotton yield/fed as affected by N x B interaction during 1999 and 2000 seasons.

Character	Season	N Level kg/fed. (N)	Biofertilizers(B)			L.S.D. (0.05)
			Non.	Rhz.	Nit.	
Boll weight (g)	1999	30 kg.	1.79	1.87	1.89	0.08
		45 kg.	1.97	2.02	2.10	
		60 kg.	2.18	2.25	2.48	
	2000	30 kg.	1.81	1.86	1.89	0.10
		45 kg..	1.93	1.99	2.08	
		60 kg.	2.10	2.28	2.42	
Seed cotton yield/fed.[1] (kentar)[2]	1999	30 kg.	3.75	4.65	5.16	0.22
		45 kg.	4.86	5.67	6.16	
		60 kg.	5.43	6.17	6.67	
	2000	30 kg.	3.41	3.78	4.67	0.39
		45 kg.	4.66	5.07	5.68	
		60 kg..	5.47	5.69	6.40	

1-fed=feddan=4200 m^2
2-Kentar =157.5kg.

corresponding values of optimum rate of application (Y_{opt}) in equations 1-9, presented in Table (6).

Table 5. The polynomial equations expressing seed cotton yields – rates of nitrogen relations under different biofertilizers in 1999 and 2000 seasons.

Treatments	The polynomial equations	Eq. No.
	(1999 season)	
Non-inoculation	$Y = 0.804 + 1.842X - 0.170X^2$	(1)
Rhizobacterein	$Y = 1.475 + 1.984X - 0.201X^2$	(2)
Nitrobein	$Y = 2.494 + 1.658X - 0.152X^2$	(3)
	(2000 season)	
Non- inoculation	$Y = 0.522 + 1.837X - 0.152X^2$	(4)
Rhizoacterein	$Y = 1.071 + 1.785X - 0.158X^2$	(5)
Nitrobein	$Y = 2.099 + 1.658X - 0.149X^2$	(6)
	(1999 + 2000 seasons)	
Non- inoculation	$Y = 0.661 + 1.844 - 0.162X^2$	(7)
Rhizobacterein	$Y = 1.278 + 1.872 - 0.177X^2$	(8)
Nitrobein	$Y = 2.297 + 1.656 - 0.150X^2$	(9)

X_o = Control
X_1 = 15 kg N fed^{-1}
X_2 = 30 kg N fed^{-1}
X_3 = 45 kg N fed^{-1}
X_4 = 60 kg N fed^{-1}
Y = Seed cotton yield,kentar/fed.

The returns /fed from the applied optimum rates of nitrogen under the different biofertilizers were calculated and presented in Table (6). The results indicated that return /fed by using Nitrobien (2776.44 L.E.) was greater than that obtained by Rhizobactrein (2485.64 L.E.) or by non-inoculation treatment (2226.17 L.E.) in the first season. In the second season, the return by Nitrobein (2781.21 L.E.) was greater than that obtained by Rhizobactrein (2511.10 L.E.) or by non-inoculation treatment (2493.09 L.E.).

Regarding the net returns of nitrogen fertilizers under different biofertilizers , Table (6) shows that Nitrobein biofertilizer had the greatest value of net return for the two seasons .

The same Table shows, also, the returns per each Egyptian pound (L.E.) spent on each of the applied optimum rate of N under biofertilizer. In case of Nitrobein, the returns were 17.54 and 19.28 L.E. /1 L.E. for the first and second seasons, respectively. For Rhizobactrein, these returns were 17.14 and 17.00 L.E. / 1 L.E. for the two seasons, respectively. In case of non- inoculation, these returns were 14.73 and 16.70 L.E./1L.E. for the two seasons, respectively.It should be pointed out that the returns per feddan and net returns per feddan or per one L.E. spent to fertilization, presented in Table (6),are calculated by using the obtainable yield,i.e., the yield due to the soil and that due to the applied fertilizer with differentiation between both biofertilizers.

Table 6. The maximum (Ymax), optimum (Yopt) yield of seed cotton, the optimum rate of nitrogen fertilizer, values of returns and net returns in 1999 and 2000 seasons.

Treatments	Xmax unit / fad.	Ymax kentar / fad.	Xopt unit/ fad.	Yopt kenter / fad.	Seed cotton price L.E./ Kentar	Price of fert. L.E./ unit	Total value of yield L.E. / fad.	Total value of yield at control L.E./ fad.	Return of fert L.E. / fad.	Fert cost L.E./ fad.	Net return of fert. L.E. / fad.	L.E. / 1L.E.
						(1999 season)						
Non-inoculation	5.42	5.79	5.24	5.78	447.38	27.00	2585.85	359.69	2226.17	141.48	2084.69	14.74
Rhizobactrein	4.95	6.37	4.78	6.36	447.38	27.00	2845.33	359.69	2485.64	137.06	2348.58	17.14
Nitrobein	5.45	7. 02	5.25	7.01	447.38	27.00	3136.13	359.69	2776.44	149.75	2626.69	17.54
						(2000 season)						
Non-inoculation	6.04	6.07	5.87	6.06	450.18	24.00	2728.09	235.00	2493.09	140.88	2352.21	16.70
Rhizobactrein	5.65	6.11	5.48	6.10	450.18	24.00	2746.10	235.00	2511.10	139.52	2371.58	17.00
Nitrobein	5.56	6.71	5.38	6.70	450.18	24.00	3016.21	235.00	2781.21	137.12	2644.09	19.28
						(1999 + 2000 seasons)						
Non-inoculation	5.69	5.92	5.52	5.90	448.78	25.50	2647.80	296.64	2351.16	140.76	2210.40	15.70
Rhizobactrein	5.29	6.23	5.13	6.22	448.78	25.50	2791.41	296.64	2494.77	138.81	2355.96	16.97
Nitrobein	5.52	6.87	5.33	6.86	448.78	25.50	3078.63	296.64	2781.99	143.92	2638.07	18.33

1 Unit of Nitrogen = 15 kg N / fad.

REFERENCES

Abd El-Ghani, M.B,M.S.Abd El-Dayem,A.A.El-Sayed, and M.M.El-Fouly. 1993. Importance of protecting the environment and water resources from pollution with fertilizers. Proceedings of German/Egyptian/Arab Workshop in Cairo and Ismailia,Egypt. 6-17 June: 91-103

Abd El-Malik, R.R. and M.I.M.El-Shahawy.1999. Impact of plant population density through row and hill spacings under different nitrogen levels on Giza 89 cotton cultivar. Egypt.J.Agric.Res., 77(3):1287-1300.

Abou-El-Naga, S.H.1993. Production of biofertilizer in Egypt.General Organization for Agriculture Equalization Fund in Egypt (GOAEF). Biological Nitrogen fixation Non-legumes,6th International Symp,6-10 Sept.,Ismailia, Egypt, 158 .

Abou-Zaid, M.K.M.1991. Effect of planting date, plant density and nitrogen fertilization on growth and production of cotton .Ph.D.Thesis,Fac.of Agric.,Alex.Univ.

Abou-Zaid, M.K.M. and E.H. El-Haddad.1997. Future of Egyptian cotton productin in the new desert land of Egypt . 3.Yield and yield components of Giza 70 cultivar as affected by nitrogen and potassium fertilization . Alex . J . Agric . Res. 42 (1) : 73- 80.

Abou-Zaid, M.K.M. and S.Sh. El-Tabbakh.1996. Evaluation of the skip-row pattern in Egyptian cotton .Proc.7th Conf. Agronomy, Fac. of Agric.,Mansoura Univ.,9-10 Sept.,295-304.

Ahmed, E.G.G.2000. Effect of some biofertilizers on wheat (*Triticum aestivum*,L.) production in newly reclaimed soils.M.Sc.Thesis, Fac. of Agric. (Saba Basha),Alex. Univ.

Amberger, A.1993. Dynamics of nutrients and reactions of fertilizers applied on the environment . Proc. of German/Egyptian/Arab Workshop in Cairo and Ismailia,Egypt.6-17 June: 41-60.

Capurro,E. and R.Voss.1981. An index of nutrient efficiency and its application to corn yield response to fertilizer nitrogen.1.Derivation,estimation and application. Agron.J.73:128-135.

Darwish, A.A. and S.A.M. Hegab. 2000. Effect of foliar application of zinc under different levels of nitrogen fertilization on growth, yield and seed quality of cotton cultivar Giza 89. Minufiya J.Agric. Res., 25 (4): 987-997.

Duncan, D.B.1955. Multiple range and multiple F-tests. Biometrics.11: 1-42.

El-Aggory, E.M.,Y.M.Y. Abido,M.N.A. Omar, M.H.El-Kholy, M.Y. Gbraiel,H.G. Abu El - Fotoh, K. G. Aasi, G.M. El – Shebiny , M. R. Dardiry and

E.Y. Kabany.2001. Effect of using some Egyptian biofertilizers on wheat response to N-fertilizer.Egypt.J.Appl.Sci.,16(3):138-152.

El-Beily,M.A.A.,W.M.O.El-Shazly,S.A.Aly, and K.A.Ziadah. 2001. Response of cotton cultivar Giza 85 to nitrogen rates and hill spacings under levels of growth regulator (Pix).Minufiya J.Agric.Res.26(1):51-84.

El-Fayoumy,M.E.,H.M.Ramadan and E.A.Koreish.1996. Soybean biomass, N_2 – fixation and water use efficiency as affected by frequency of irrigation, soil salinity and inoculation with *Bradyrhizobium*. Alex.J.Agric.Res.,41(1): 313-326.

El-Haddad, E.H., M.K.M.Abou- Zaid, and S.Sh.El-Tabbakh. 2001. Future of Egyptian cotton production in the new reclaimed desert land of Egypt. 5-Response of cotton to fertilization in calcareous soils of the Northwest Coast of Egypt. Minufiya J.Agric Res., 26(6):1533- 1545.

El-Razaz, M.M, I.A.I.Mousa and F.M.Ghaly. 1997. Nitrogen and potassium rates as affected yield, yield components and fiber properties of two extra-long staple cotton varieties under drip irrigation system. J.Agric. Sci., Mansoura Univ., 22(9): 2759-2768.

El-Shazly, W.M.O. and A.A.Darwish. 2001. Response of cotton (Giza 89 cultivar) to nitrogen level and biofertilization with Microbein. Minufiya J.Agric.Res., 26(3): 635-658.

Hamissa, A.M., K.A.Ziadah, and M.F.El-Masri.2000. Response of cotton to biofertilizer and nitrogen fertilization, Minufiya J.Agric. Res., 25(2): 371-388.

Koreish,E.A.,H.M.Ramadan,M.E.El-Fayoumy,andH.M. Gaber.2001. Response of faba bean and wheat to bio- and mineral fertilization in newly-reclaimed soils. J. Adv. Agric. Res., 6(4):903-921.

Mahmoud,T.A,G.M.El-Shebiny, and H.S.Oshy .1999. Biofertilization of forage sorghum in calcareous soil. Annals of Agric. Sci. Moshtohor, 37(4):2243-2257.

Makram,E.A.,A.A.Sallam, and A.A.El-Gohary.1982. Effect of hill spacing under different nitrogen rates on yield components, yield and fiber properties of Egyptian cotton cultivar, Giza 75. Ann.Agric.Sci.,Fac. of Agric.,Ain Shams Univ., Bull.1731:1-18.

Mitkees, R.A, I. M. Sadek, M. K. Eissa, and S. K. Mahmoud. 1996. Use of N_2-biofertilizers to decrease N_2–fertilizers requirements. Nile Valley and Red Sea Regional Program, 8th Ann. Coordination Meeting .Egypt, 15-19Sept.,140-146.

Nassar, S.and O.Salama.1995. Effect of privatization process on fertilizers handling and their ues in cotton. Proc. FAO-IRCRNC,Joint Meeting of the working groups 4 and 3.Cotton Nutrition and growth regulators use in cotton. 20-23 March, 1995, Cairo, Egypt:13-20.

Page, A.L.,R.H.Miller, and D.R.Keeney (eds.).1982. Methods of Soil Analysis part - 2: Chemical and microbiological properties. Amer .Soc. Agron.,Madison,Wisconsin.

Said,M.A.1998."Studies on productivity of barley". Response barley to mineral and bio-fertilizer in the newly reclaimed lands.M.Sc. Thesis,Fac. of Agric.,Alex. Univ.

SAS Institute.(1988).SAS/STAT Users guide, Version 6.03 ed. SAS Inst., Cary, NC.

الملخص العربي

مستقبل إنتاج القطن المصري في الأراضي الصحراوية المستصلحة حديثا بمصر

٧- استجابة القطن للتسميد الآزوتي الحيوي والمعدني

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هذه الحلقة السابعة في سلسلة البحوث التي تهدف إلى مساعدة مزارعي القطن بالأراضي الجديدة من خلال استخدام تقنيات حديثة مع المحافظة على نظافة البيئة وفي إطار تعظيم صافي العائدمن وحدة المساحة الأرضية. وقد أجريت هذه التجربة بمحطة البحوث الزراعية بالنوبارية خلال موسمي الصيف ١٩٩٩ ، ٢٠٠٠ ميلادية وذلك لدراسة استجابة صنف القطن المصري الفائق طول التيلة "جيزة ٧٠"للتلقيح بالأسمدة الآزوتية الحيوية التجارية(ريزوباكترين ، نترو بين مقارنة بعدم التلقيح) مع معستويات مختلفة من التسميد الآزوتي المعدني (٣٠ ، ٤٥ ، ٦٠ كجم آزوت / فدان) وتفاعلهما على دلائل النمو وقياسات التبكير ومحصول القطن الزهر للفدان ومكوناته وخواص التيلة وصافي العائد للفدان .وقد استخدم في هذه التجربة تصميم القطع المنشقة بأربع مكررات ، وكانت النتائج الموجزة كما يلي :١ – أدت إضافة الآزوت بالمستوى المرتفع ٦٠ كجم للفدان إلى زيادة جوهرية في طول النبات وعدد الأفرع الثمرية على النبات ، قياسات التبكير ، محصول القطن الزهر / نبات ومكوناته (عدد اللوز المتفتح / نبات ، متوسط وزن اللوزة) وبالتالي أعطت هذه المعاملة أعلى زيادة جوهرية للقطن الزهر / فدان في كلا الموسمين ، بينما لم تؤثر مستويات التسميد الآزوتي جوهريا على موضع أول فرع ثمري ، عدد النباتات للفدان ، طول التيلة في كلا الموسمين ومتانة ونعومة التيلة في موسم واحد فقط . ٢ –أعطت المعاملة بالمخصبات الآزوتية الحيوية (النتروبين يليها الريزوباكترين) زيادة جوهرية في طول النبات ، قياسات التبكير ، محصول القطن الزهر للنبات ومكوناته ومحصول القطن الزهر للفدان وذلك مقارنة بالكنترول (بدون تلقيح) بينما لم

تختلف معاملتي التسميد الحيوي الآزوتي جوهريا عن الكنترول فى صفات موضع أول فرع ثمـري ، عدد الأيام لظهور أول زهرة ، عدد النباتات / فدان ، تصافى الحليج ، طول ونعومة التيلة فى كـــلا الموسمين ومتانة التيلة فى الموسم الثاني فقط .

٣ - لم يكن للتداخل من الدرجة الأولى (التسميد الآزوتي المعدني × التسميد بالمخصبات الحيوية) أي تأثير جوهري على معظم الصفات المدروسة فيما عدا طول النبات فى موسم واحد فقـــط ومحصول القطن الزهر للفدان ومتوسط وزن اللوزة فى كلا الموسمين .٤ -أدى تلقيح بـــذور القطن بالمخصب الحيوي الآزوتي " نتروبين " مع التسميد بالمستوى المرتفـع مـن السـماد الآزوتي المعدني " ٦٠ كجم / فدان " الى الحصول على اثقل اللوزات (٢,٤٨، ٢,٤٢جم) وكان ذلك مرتبطا بأعلى إنتاجية من محصول القطن الزهر/ فدان(٦,٦٧، ٦,٤٠ قنطـــار) لـــهذه المعاملة لموسمي ١٩٩٩،٢٠٠٠ ميلادية على الترتيب وذلك مقارنة بباقي المعاملات الأخرى.

٥ - حسبت تسعة معادلات من الدرجة الثانية للتعبير عن العلاقة بين قيم الانتاجية من القطن الزهر ومستويات السماد الآزوتي تحت أنواع مختلفة من المخصبات الحيوية وكانت أهم المؤشـــرات التى حسبت من المعادلات :

- قيم المحصول الأمثل فى القطن الزهر : كانت ٥,٩٧، ٦,٣٧ ، ٧,٠٢ قنطار /فـــدان فى الموسم الأول، وكانت قيم المحصول الأمثل في الموسم الثاني ٦,٠٧ ، ٦,١١ ، ٦,٧١ قنطار / فدان فى حالة عدم التلقيح ، التلقيح بالريزوباكترين ، التلقيح بالنتروبين ، علـــى الترتيب .
- قيمة صافى العائد : أعطى المخصب الحيوي " النتروبين " أعلى القيم من حيث قيمـة صافى العائد يليها الريزوباكترين واقل قيمة صافى عائد كانت لمعاملة الكنترول (بـــدون تلقيح) .