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STATISTICAL MODELS FOR PREDICTING YIELD RESPONSE OF ONION (*Allium Cepa* L.) TO APPLIED NITROGEN AND BIOFERTILIZERS

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ABSTRACT

Two field experiments were conducted during the two successive winter seasons of 1999/2000 and 2000/2001 to evaluated the effect of three commercial biofertilizers: microbein(a mixture of *Azotobacter* , *Azospirillum* , *Pseudomonas* , *Rhizobium* and *Bacillus*), Rhizobacterin (a mixture of *Azotobacter* and *Azospirillum*) and Halex-2 (a mixture of *Azotobacter*, *Azospiillum* and *Kebsiella*) with different nitrogen fertilizer levels (0,18,36,54,72 and 90 kg N fed.$^{-1}$) on bulbs yield of onion (*Allium cepa* L.) cv. giza 20 and its component (total bulb yield ton fed^{-1}, marketable bulb weight (g), Average bulb weight (g), and average bulb diameter (cm).

Generally, addition of 72 kg N fed.$^{-1}$ combined with Halex-2 biofertilizer was sufficient and adequate to produce maximum and economic yield in both seasons. Four polynomial quadratic equations were established to express the response of onion bulbs yield to N fertilization and biofertilizers inoculation. The experimental yield values and the corresponding calculated values were not significantly different as tested by the standard error of estimates SE and high values of correlation coefficient (R). $N_{opt.}$ and corresponding $Y_{opt.}$ were calculated for both years and the data revealed that the N fertilization application was more profitable when applied to onion seedlings with the biofertilizer Halex-2 as indicated by highest values of net returns compared with the other treatment combinations.

INTRODUCTION

Onion (*Allium cepa. L.*) is one of the oldest vegetable crops. It has been cultivated for thousands of years for its religious significance, medical properties and for its pungency and characteristic flavor (Hanly and Fanwick, 1985). It is considered one of the most important vegetable crops in Egypt for local consumption and export.

Nitrogen is an important element, which affect yield and quality of onion bulbs. Nitrogen nutrition can also influence onion bulb development and flavor, (Brewster and Butler, 1989; El-Oksh *et al.* 1993; Khalil et al. 1988 and El-Gamili and Abd El-Hadi 1996) and maximize marketable yields and percentage of large-sized onion bulbs (Vachhani and Patel, 1996; El-Gamili, 1996 and El-Gamili *et al.* 2000).

Recently, mineral fertilization became a target of criticism because of heavy use in the developing countries, where, it was suspected of having an adverse impact on the environment through nitrate leaching, and heavy metal uptakes by plants. This has led to a call for rational use of chemical fertilizers combined with organic and bio-sources to increase productivity and protect environment.

Biofertilizers are natural mini fertilizer factories that are economical and safer source of plant nutrition and they can be used as alternatives for chemical fertilizers. Remarkable effects of biofertilizers on yield of some crops have been reported by several investigators (Mishustin and Shilinkova, 1996; Iman and Badawy, 1978; Azad and Aslam, 1984 and Ashour *et al.*, 1997) working on Potato, and Barakat , Gabr, 1998 on Tomato and Elkhatib 2003 on peas.

The objectives of this study were:(1) to evaluate the effect of N fertilization with different levels and inoculation with various biofertilizer types on the bulbs yield and its components in order to explore the possibility of reducing amount of artificial N fertilizer by adding biofertilizers for the purpose of reducing the environmental pollution and production cost and (2) to quantify onion yield response to nitrogen fertilization with different types of biofertilizers using polynomial quadratic equations.

MATERIALS AND METHODS

Two field experiments were carried out at the experimental station farm, El-Bostan region, faculty of agriculture Alexandria university in Damanhour, Behira Governorate in the two winter seasons of 1999/2000 and 2000/2001. The physical and chemical characteristics of the soil (Table 1) were determined according to the methods reported by Black (1965). The experimental layout was split plot in a randomized complete blocks design with four replicates. Six nitrogen rates (0,18,36,54,72 and 90 kg N Fed^{-1}) were occupied the main plots; whereas 4 biofertilizer treatments: microbein(a mixture of *Azotobacter* , *Azospirillum* , *Pseudomonas* , *Rhizobum* and *Bacillus*), Rhizobacterin (a mixture of *Azotobacter* and *Azospirillum*) and Halex-2 (a mixture of *Azotobacter*, *Azospiillium* and *Kebsiella*) with different nitrogen fertilizer levels were assigned at random in the sub-plots. Each experimental unit contained 5 ridges, 4m long and 70 cm wide. Calcium super-phosphate (15.5% P_2O_5) at a rate of 300 kg fed^{-1} was broadcasted during soil preparation. Potassium sulfate (48% k_2O) was added at a rate of 150 kg $fed.^{-1}$ at three equal parts 35, 55 and 75 days after transplanting.

Table (1): Physical and chemical characteristics of the experimental site in 1999/2000 and 2000/2001 seasons.

Soil Properties			
Physical:			
Sand	84.24		(%)
Silt	11.00		(%)
Clay	4.76		(%)
Soil texture	Sandy		
Chemical:	1999	2000	
E.C.	2.16	2.34	(dsm^{-1})
PH	8.11	8.16	
Total N	0.22	0.30	gkg^{-1}
Total P	0.80	0.90	gkg^{-1}
Total K	0.90	0.11	gkg^{-1}
Organic matter	1.4	1.9	gkg^{-1}

Nitrogen fertilizer levels as ammonium nitrate (33.5% N) were side banded at four equal doses15, 35, 55 and 75 days after transplanting. Onion transplants cv. Giza 20 (60 days old) were inoculated with the aqueous solution of a single biofertilizer at a rate of 400g fed.$^{-1}$(according to the Agricultural Ministry Lab. recommendations) just before transplanting whereas, uninoculated seedlings were soaked in distilled water. Uniform onion transplants were transplanted 10 cm a part on both sides of the ridges in the 9th and 14th of December of 1999 and 2000 respectively.

At harvesting time (170 days after transplanting) plants were harvested and cured for 10 days under traditional field conditions, then data were recorded for total yield (ton fed^{-1}), marketable bulb yield (bulb diameter more than 3.5 cm) ton fed^{-1}, Average bulb weight (g) and average bulb diameter (cm). All obtained data were statistically analyzed using Costat software program (1985) and the revised L.S.D. test was used to compare the differences among treatment means as illustrated by Snedecor and Cochran (1980).

RESULTS AND DISSCUSSION

Total bulb yield and its components:

Total bulb yield, marketable yield and average bulb weight reflected significant differences among the different nitrogen levels used in both seasons (Tables 2 and 3). Fertilizing onion plants significantly increased bulb yield and its components in comparison with the unfertilized treatment. In addition, increasing nitrogen levels caused a significant increase in bulbs yield and its component up to 72 kg N fed^{-1}. However the responses of increasing nitrogen level up to 90 kg N fed appeared to be insufficient to express a significant effect in both seasons. At 72 kg N fed^{-1} the increments in total bulb yield, marketable yield, average bulb yield and bulb diameter over the control were 44.9, 41.4, 27.5 and 59.5% in 1999/2000, whereas the corresponding values in 2000/2001were 35.9, 44.0, 18.6 and 45.9% respectively. These increments may be related to the role of N in enhancing vegetative growth, which lead to produce more photosynthetic material required for bulb production. These results are in agreement with those of El-Gamili et. al. (2000); and Abd El-Maksoud and Swaff 2000 and Batal *et al.* 1994.

Regarding the effects of biofertilizer on bulbs yield and its components, results in (Table 2) indicated high significant increments in total yield, marketable yield, average bulb weight and bulb diameter as a result of inoculation of onion plants with the tested biofertilizers in both seasons. Moreover, Halex-2 gave significantly the highest values for marketable bulbs yield in both seasons (Table 2) whereas; there were no significant differences between Halex-2 and Rhizobacterin on total yield and Avg. bulb diameter in both seasons. The beneficial effect of biofertilizers was due to improving N nutrition (Lazarovit and Nowak 1997), producing phytohormones which responsible for root hair branching and an eventual increase in nutrient uptake, (Noel *et al.*, 1996 and Jagnow *et al.* 1991) and/or biocontrol of plant disease through production of antibiotics, antibacterial and antifungal compounds (Baker, 1987; Pandy and Kumar, 1989 and Ottow *et al.* 1982). These results agreed to a great extent with those reported by Iman and Badawy (1978); Azad and Islam (1984); Barakat and Gabr (1998) and Gabr *et al.* (2001).

Table (2): The main effect of nitrogen fertilizer rate and biofertilizer types on total bulbs yield of onion plants and its component during the winter seasons of 1999/2000 and 2000/2001.

Treatments	Total bulb yield (ton fed^{-1})		Marketable bulb yield (ton fed^{-1})		Average bulb weight (g)		Average bulb diameter (cm)	
	1999	2000	1999	2000	1999	2000	1999	2000
N rate (kg fed^{-1})								
0	5.35 D*	5.40 D*	4.47 D	4.32 D	63.55 E	69.42 C	4.40 D*	4.90 D
18	6.37 C	6.52 C	4.75 C	5.02 C	66.90 D	71.10 BC	5.32 C	5.40 C
36	6.97 B	6.85 B	5.25 B	5.30 BC	71.02 C	73.27 B	5.70 C	5.75 BC
54	6.90 B	6.85 B	5.45 B	5.42 B	74.82 B	80.95 A	6.30 B	6.02 B
72	7.75 A	7.95 A	6.32 A	6.22 A	81.02 A	82.32 A	7.02 A	7.02 A
90	7.50 A	7.65 A	6.45 A	6.30 A	81.00 A	82.35 A	7.22 A	7.15 A
Biofertilizer type								
Unincculated	6.28 C	6.42 B	4.88 C	4.93 D	68.35 D	70.38 B	5.30 C	5.37 C
Microbein	6.73 B	6.58 B	5.45 B	5.35 C	71.63 C	78.01A	6.05 B	6.02 B
Rhizobacterin	6.98 A	7.05 A	5.60 B	5.56 B	74.88 B	78.08 A	6.13 A	6.32 A
Halex-2	7.15 A	7.10 A	5.87 A	5.86 A	77.60 A	79.72 A	6.50 A	6.47 A

*** Values marked with the different alphabetical letter(s), within particular comparable group of means, are statistically different using revised L.S.D. test at P=0.05.**

The effects of different interactions among the various levels of the nitrogen and different biofertilizers type on yielding ability of onion plants in two seasons are shown in (Tables 3 and 4). The results revealed that the highest mean values for total and marketable bulbs yield, average bulb weight and bulb diameter in the two seasons were obtained from the plants that were previously inoculated with the biofertilizer Halex-2 and given either 72 or 90 kg N fed^{-1}. Therefore the treatment combination of Halex-2 plus 72 kg N fed^{-1} appears to be sufficient and adequate to produce maximum and economic bulb yield. These results might be explained on the basis that the interactive effects of the two studied factors were additive. A large number of reports emphasized the beneficial effects of the interaction between mineral N fertilizer and inoculation with biofertilizer on productivity of different vegetable crops as Ashour *et al.* (1997), Barakat and Gabr (1998), Abd El-Mouty (2000) and Elkhatib (2003).

Table (3): The interaction effects of nitrogen fertilizer rates and biofertilizer types on bulbs yield of onion plants and its components during the winter season of 1999/2000.

Biofertilizer type	N rate (kg^{-1})					
	0	18	36	54	72	90
Total bulb yield (ton fed^{-1})						
Uninoculated	5.00k*	5.90g-k	6.10f-j	6.40a-e	7.30a-e	7.00b-f
Microbein	5.20jk	6.40e-i	6.50d-l	6.90b-g	8.00a	7.40a-e
Rhizobacterin	5.70h-k	6.50d-i	7.10a-f	7.10a-f	7.80ab	7.70a-c
Halex-2	5.50l-k	6.70c-h	7.40a-e	7.50a-d	7.90ab	7.90ab
Marketable bulb yield (ton fed^{-1})						
Uninoculated	4.40ij	3.90k	4.70hi	4.30j	5.80ef	6.20b-d
Microbein	4.50ij	4.70hi	5.00h	5.70fg	6.40a-c	6.40a-c
Rhizobacterin	4.50ij	5.00h	5.40g	5.70fg	6.50ab	6.50ab
Halex-2	4.50ij	5.40g	5.90d-f	6.10c-e	6.60a	6.70a
Average bulb weight (g)						
Uninoculated	55.90l	60.70k	67.50ij	72.00e-h	77.10d	76.90d
Microbein	61.00k	65.20j	69.70f-l	75.10de	77.30d	81.50bc
Rhizobacterin	67.90ij	68.20h-j	72.20e-g	75.50de	84.50a-c	81.00c
Halex-2	69.40g-i	73.50d-f	74.70de	76.70d	85.20ab	85.50a
Average bulb diameter (cm)						
Uninoculated	3.60l*	4.70jk	4.50jk	5.40gh	6.60cd	7.00a-c
Microbein	4.50jk	4.90ij	6.10ef	6.50de	7.10ab	7.20ab
Rhizobacterin	4.30k	5.60gh	5.80fg	6.50de	7.30a	7.30a
Halex-2	5.20hi	6.10ef	6.40de	6.80b-d	7.10ab	7.40a

*** Values marked with the same alphabetical letter(s), within a particular comparable group of means, are statistically different using revised L.S.D. test at P=0.05.**

Table (4): The interaction effects of nitrogen fertilizer rates and biofertilizer types on bulbs yield of onion plants and its components during the winter season of 2000/2001.

Biofertilizer type	N rate (kg^{-1})					
	0	18	36	54	72	90
Total bulb yield (ton fed^{-1})						
Uninoculated	4.80k*	6.50h-j	6.20j	6.40ij	7.20d-f	7.40b-e
Microbein	4.80k	6.50h-j	6.70g-i	6.60h-j	7.30c-f	7.60a-d
Rhizobacterin	6.00f-h	6.50h-j	7.30c-f	7.30c-f	7.50a-e	7.70a-c
Halex-2	6.00f-h	6.60h-j	7.20d-f	7.10e-g	7.80ab	7.90a
Marketable bulb yield (ton fed^{-1})						
Uninoculated	3.90j	4.70hi	4.30ij	4.80gh	6.00cd	5.90cd
Microbein	4.00j	5.10f-h	5.40ef	5.20fg	6.10b-d	6.30a-c
Rhizobacterin	4.00j	5.10f-h	5.70de	6.00cd	6.30a-c	6.30a-c
Halex-2	5.40ef	5.20fg	5.80de	5.70de	6.50ab	6.60a
Average bulb weight (g)						
Uninoculated	63.80l	64.40l	66.90kl	71.40h-j	77.10d-f	78.70c-e
Microbein	69.70jk	74.70f-h	74.20f-i	84.90ab	83.90ab	81.20b-d
Rhizobacterin	70.40h-j	72.30g-j	76.20e-g	83.30ab	81.60bc	84.70ab
Halex-2	73.80f-j	73.00f-j	75.80e-g	84.20ab	86.70a	84.80ab
Average bulb diameter (cm)						
Uninoculated	3.90n	4.80m	5.00lm	5.10k-m	6.60e-g	6.80d-f
Microbein	5.30j-l	5.30j-l	5.30j-l	5.90hi	6.90c-e	7.40ab
Rhizobacterin	5.50ik	5.80l	6.30gh	6.30gh	6.90c-e	7.10b-d
Halex-2	4.90lm	5.70ij	6.40fg	6.80d-f	7.70a	7.30a-c

*** Values marked with the same alphabetical letter(s), within a particular comparable group of means, are statically different using revised L.S.D. test at P=0.05.**

Polynomial Quadratic Models:

Onion bulbs yield responded positively to N fertilizer application rate and different biofertilizer types. The response to nitrogen increments was expressed by polynomial quadratic equation:

$$Y_i = B_o + B_i x_i + B_{ii} X_i^2 \qquad (1)$$

Where Y_i is the predicted yield corresponding to nutrient rate x_i.
B_o is the intercept, represents the yield without N fertilizer application, B_i and B_{ii} are the linear and quadratic coefficients respectively.
Four equations were established using the least squares methods described in Snedecor and Cochran (1980), to express the response of onion bulbs yield to nitrogen fertilizer at different biofertilizer types for each season. (Table 5 and Figs 1& 2).

Table (5): The polynomial quadratic equations expressing onion bulbs yield as affected by N fertilization and different biofertilizer types in 1999/2000 and 2000/2001 seasons.

Treatment	The polynomial Quadratic Equations		Determination Coefficient R^2
Season 1999 / 2000			
Uninoculated	$Y_1 = -0.065x^2+0.70X+5.06$	(2)	0.92
Microbein	$Y_2 = -0.097x^2+0.91X+5.28$	(3)	0.88
Rhizobacterin	$Y_3 = -0.065x^2+0.76X+5.75$	(4)	0.96
Halex-2	$Y_4 = -0.130x^2+1.09X+5.64$	(5)	0.97
Season 2000 / 2001			
Uninoculated	$Y_1 = -0.065x^2+0.715X+5.14$	(6)	0.81
Microbein	$Y_2 = -0.097x^2+0.913X+5.12$	(7)	0.86
Rhizobacterin	$Y_3 = -0.065x^2+0.676X+6.0$	(8)	0.96
Halex-2	$Y_4 = -0.032x^2+0.559X+6.05$	(9)	0.95

Onion bulbs yield was quadratically related to N rate in the two seasons studied. The experimental yield values and the corresponding calculated values from equations 2-9 were not significantly different as tested by the standard error of estimates SE, (Table 6) also both of the experimental and predicted yield have shown highly significant values of correlation coefficients (R) (Table 6).

The Economical Optimum Rate of N Fertilizer Application ($N_{opt.}$):

The optimum rates of N fertilizer applied ($N_{opt.}$) at each biofertilizer type (Table 7) was calculated by differentiating "Y" in eqs. 2 - 9 with regard to "x" (dy / dx) and equating with the ratio of price of fertilizer unit to price of crop unit (Capurro and Voss 1981).
The local price of unit N fertilizer (18 kg / fed) was 45 Egyptian pound (EP) and the local price of 1 ton of onion bulbs yield was 500 EP. The optimum N application rates ($N_{opt.}$) were 4.7, 4.2, 5.2, and 3.8 units of N fed^{-1} from the eqs. 2 - 5 (1999) and 4.8, 4.2, 4.5 and 7.3 unit of N $fed._{1}$from the polynomial eqs. 6-9 (2000) for uninoculated, Microbein, Rhizobacterin and Halex-2 respectively.

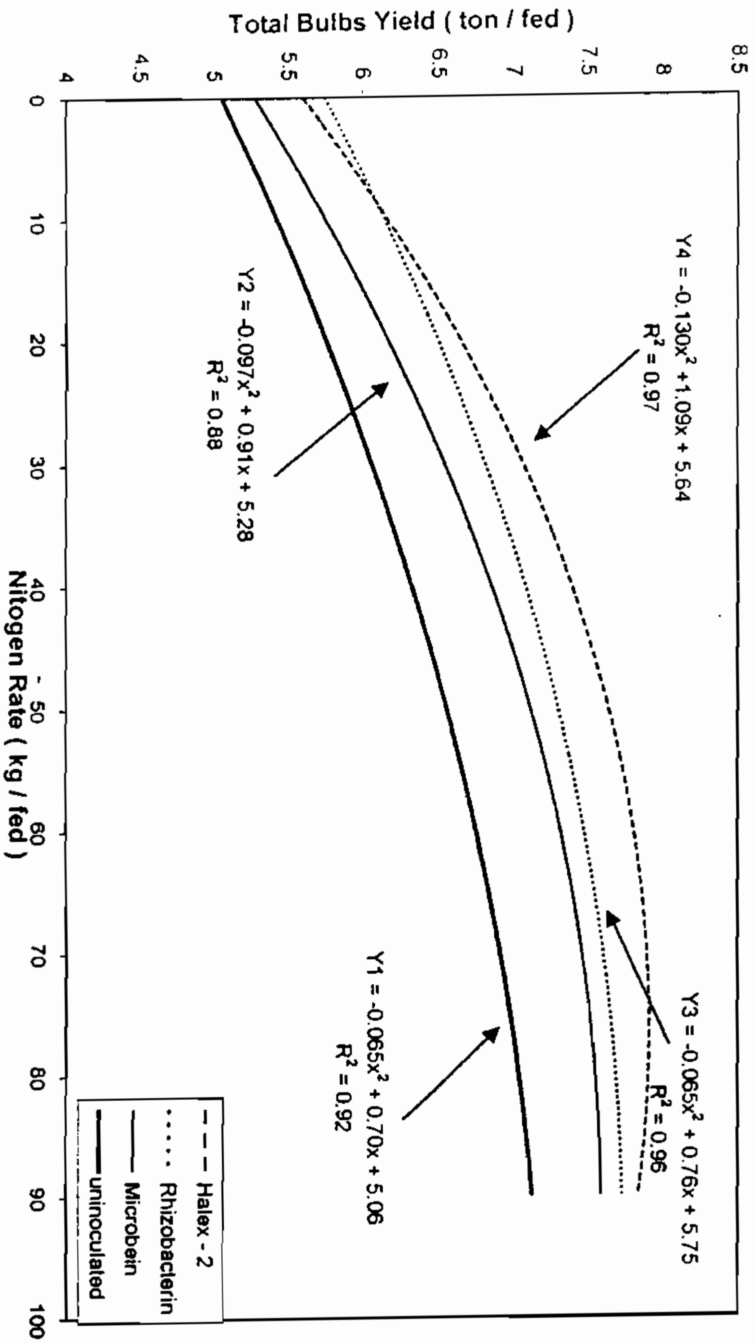

Fig (1): Total bulbs yield response curve of onion cultivar (giza 20) as a function of nitrogen application rate and different biofertilizer types during the season of 1999 / 2000

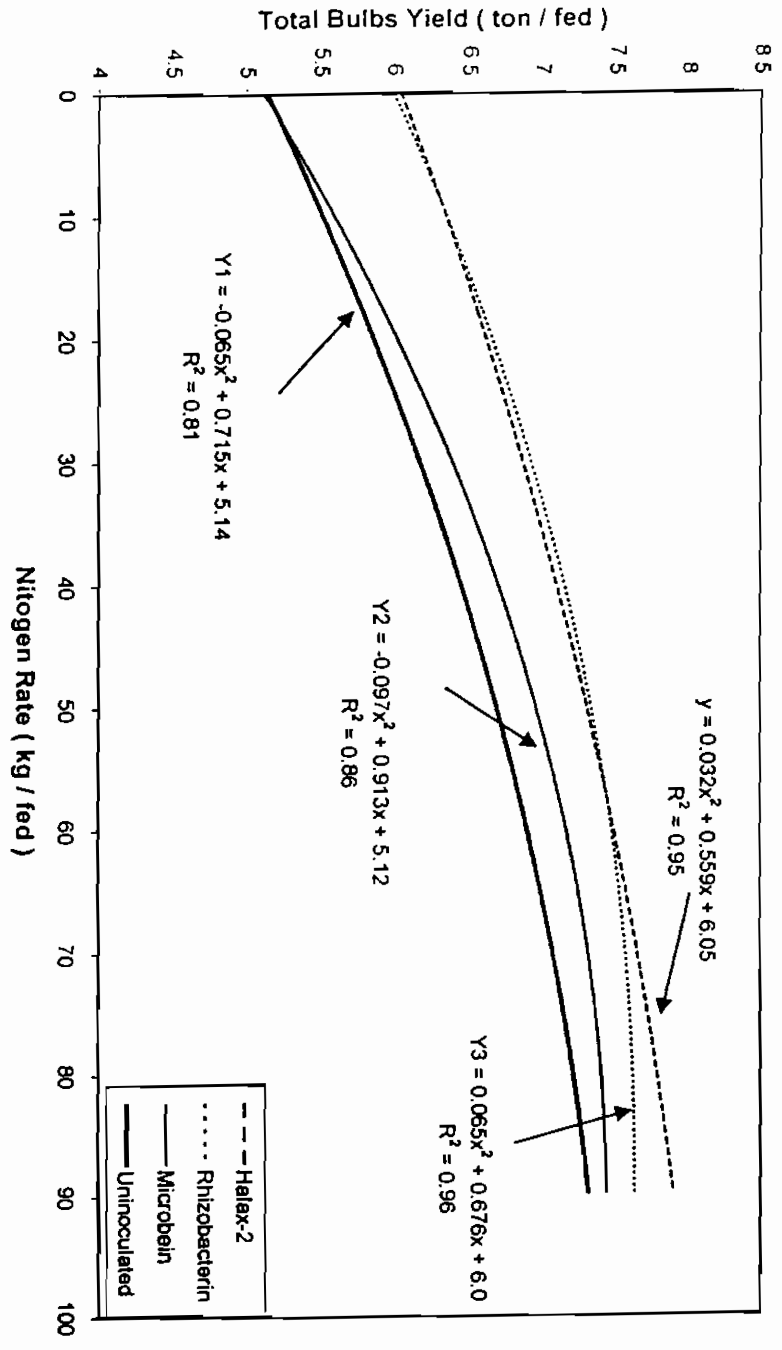

Fig (2): Total bulbs yield response curve of onion cultivar (giza 20) as a function of nitrogen application rate and different biofertilizer types during the season of 2000/ 2001

Table (6): Experimental and predicted bulbs yield of onion as affected by rates of N application and biofertilizer types in 1999/2000 and 2000/2001 seasons.

Season 1999/2000															
Yield (ton/fed.)				Yield (ton/fed.)				Yield (ton/fed.)				Yield (ton/fed.)			
Treatments		Exp	Pre	Treatments		Exp	Pre	Treatments		Exp	Pre	Treatments		Exp	Pre
Uninoculated	N_0	5.0	5.1	Microebein	N_0	5.2	5.3	Rizobacterin	N_0	5.7	5.8	Halex-2	N_0	5.5	5.6
	N_1	5.9	5.7		N_1	6.4	6.1		N_1	6.5	6.4		N_1	6.7	6.6
	N_2	6.1	6.2		N_2	6.5	6.7		N_2	7.1	7.0		N_2	7.4	7.3
	N_3	6.4	6.6		N_3	6.9	7.1		N_3	7.1	7.4		N_3	7.5	7.7
	N_4	7.3	6.8		N_4	8.0	7.4		N_4	7.8	7.8		N_4	7.9	7.9
	N_5	7.0	6.9		N_5	7.4	7.4		N_5	7.7	7.9		N_5	7.9	7.8
R= 0.954** SE= 0.233				R= 0.945** SE= 0.302				R= 0.980** SE= 0.181				R= 0.991** SE= 0.137			
Season 2000/2001															
Yield (ton/fed.)				Yield (ton/fed.)				Yield (ton/fed.)				Yield (ton/fed.)			
Treatments		Exp	Pre	Treatments		Exp	Pre	Treatments		Exp	Pre	Treatments		Exp	Pre
Uninoculated	N_0	4.8	5.1	Microebein	N_0	4.8	5.1	Rizobacterin	N_0	6.9	6.0	Halex-2	N_0	6.9	6.0
	N_1	4.5	5.8		N_1	6.5	5.9		N_1	6.5	6.6		N_1	6.6	6.6
	N_2	6.2	6.3		N_2	6.7	6.6		N_2	7.3	7.1		N_2	7.2	7.0
	N_3	6.4	6.7		N_3	6.6	7.0		N_3	7.3	7.4		N_3	7.1	7.4
	N_4	7.2	7.0		N_4	7.3	7.2		N_4	7.5	7.7		N_4	7.8	7.8
	N_5	7.0	7.1		N_5	6.7	7.3		N_5	7.7	7.8		N_5	7.9	8.1
R= 0.907* SE= 0.361				R= 0.925** SE= 0.366				R= 0.825* SE= 0.437				R= 0.874* SE= 0.406			

*, ** Significant at $P< 0.05$ and 0.01 levels, respectively

The optimum yield (Y_{opt}.)

Substitution for "n" by the values of N_{pot}. in the eqs. 2-9 (Table 7), the corresponding optimum yields Y_{opt}. of onion bulbs were 6.9 , 7.4 , 7.9 and 7.9 Ton fed^{-1} in the first season at uninoculated, Microbein, Rhizobacterin and Halex-2, respectively whereas the optimum yield in the second season were 7.1 , 7.2 , 7.7and 8.4 at uninoculated, Microbein, Rhizobacterin and Halex-2, respectively.

Net Returns of Onion Bulbs Yield Under Nitrogen Application and Biofertilization:

Net returns from optimum yield of onion bulbs yield received optimum levels of N fertilization in the two seasons were calculated and are presented in Table 7.

Table (7): Values of optimum rates of N fertilizer, optimum yields and net returns for onion cultivar's (Giza 20) as affected by different biofertilizer types in 1999/200 and 2000/2001 seasons.

Treatments	N_{opt} (units fed^{-1})	Y_{opt} (ton fed^{-1})	Net returns EP fed^{-1}
1999/2000			
Uninoculated	4.7	6.9	3228
Microbein	4.2	7.4	3501
Rhizobacterin	5.2	7.9	3706
Halex-2	3.8	7.9	3769
2000/2001			
Uninoculated	4.8	7.1	3324
Microbein	4.2	7.2	3401
Rhizobacterin	4.5	7.7	3637
$Halex_2$	7.3	8.4	3861

Avg. price of 1 ton of onion bulbs = 500 EP EP = Egyptian pounds
Avg. price of a unit of nitrogen fertilization (18 kg N) = 45 EP.
Avg. price of a package of biofertilizer inoculation for 1 fed = 10 EP.

The results indicated that, the inoculation of onion seedlings with any of the biofertilizer used was associated with higher values of net returns than the uninoculated seedlings in both seasons. The net returns were, 3228, 3501, 3706 and 3769 in the first season for uninoculated, microbein, Rhizobacterin and Halex-2 treatments respectively, whereas, the corresponding values in the second season were 3324, 3401, 3637 and 3861 at uninoculated, Microbein, Rhizobacterin and Halex-2, respectively. Thus, it is clear that Halex-2 was the most effective biofertilizer and mineral N application was more profitable when coupled with the Biofertilizer Halex-2 than to the other biofertilizers. These results are in agreement with those of Ghoneim and Abd El-Razik (1999); Abd El-Fattah and Arisha (2000) and Gabr *et al.* (2001).

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استخدام المعادلات الرياضية في التنبؤ باستجابة محصول البصل للتسميد النيتروجيني والحيوى

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أجريت تجربتان حقليتان فى شتاء موسمى النمو ١٩٩٩/٢٠٠٠ و ٢٠٠٠/٢٠٠١ لدراسة تأثير ثلاثة أنواع مختلفة من السماد الحيوى ;ميكروبين(*Azotobacter* و *Azospirillum* و *Pseudomonas* و *Rhizobium* و *Bacillus*) رايزوبـــــاكتيرين (*Azotobacter* و*Azospirillums*)هاليكس-٢(*Aztobacter* و*Azospirillum* و*Klebsiella*) مـــع ستــه مستويات مختلفة من التسميد النيتروجيني (صفر ، ١٨ ،٣٦ ، ٥٤ ، ٧٢ ، ٩٠ كجم نيتـــروجين / فدان) على محصول وجودة البصل صنف "جيزة ٢٠" وقد أظهرت النتائج أن إضـــافة ٧٢ كجـــم نيتروجين مع إستخدام هالكس-٢ كسماد حيوى كان كافياً للحصول على أفضل إنتاجية للمحصـــول الكلى والمحصول الصالح للتسويق ومتوسط وزن البصلة ومتوسط قطر البصلة.

أمكن الحصول على علاقة كمية لدراسة استجابة الأبصال للتســميد النيتروجينـــى مـــع التسميد الحيوى وتم التعبير عنها رياضيا بأربع معادلات من الدرجة الثانيةولم يوجد اى اخـــتلاف معنوى بين النتائج التجريبيه وبين النتائج المتنبأ بها باستخدام هذه المعادلات ومنها أمكـــن تقـــدير معدلات التسميد النيتروجيني المثلى والمحصول الأمثل لكل المعاملات المدروسة. وقد أوضـــحت هذه الدراسة فى كلا موسمى النمو أن أعلى إستجابة تم الحصول عليها عنـــد إســـتخدام معـــدلات النيتروجين المثلى كانت مع إستخدام هالكس-٢ كسماد حيوى حيث أظهرت النتائج أن العائد المادى (الربح) من هذه المعاملة كان أعلى المعدلات مقارنة بالمعاملات الأخرى.