J. Agric. Sci. Mansoura Univ., 30 (10): 5765 - 5779, 2005

MAIZE YIELD POTENTIALITY IN RESPONSE TO BIO AND MINERAL NITROGEN FERTILIZERS UNDER DRIP IRRIGATION REGIMES IN THE NEWLY RECLAIMED SOIL.

Abd- Alla, A. A.

Desert Environment Research Institute, Minufiya University, Egypt.

ABSTRACT

The present investigation was carried out during the two successive seasons 2003 and 2004 at the Experimental Farm of Desert Environment Research Institute, Minufiya University, El-Sadat City to evaluate maize (*zea mays L.*) CV 30 K 8 productivity affected by four irrigation regimes i.e. Ir_1(40 minutes at morning daily – 3360 m^3 /season), Ir $_2$ (50 minuets at morning daily – 4176 m^3 /season), Ir $_3$ (40 minutes daily (20 minutes morning + 20 minutes before sun set) – 3360 m^3 / season) and Ir $_4$ (60 minutes day and day – 2544 m^3 /season), three chemical nitrogen levels (N1-60, N2- 100 and N3- 140 Kg N / fad) and four biofertilization treatments *(Bio1- untreated, Bio2- Nitrobin, Bio3- Microbin* and Bio4- mexture of Nitrobin + Microbin). The following results were recorded :-

Increasing nitrogen levels up to 140 kg N /fad led to significantly increase plant height, ear height, stem diameter, LAI, ear length, seed index, number of rows /ear, number of grains / row, grain yield plant (g), grain yield /fad and N% in grains compared with other N levels (60, and 100 kg /fad.

The effect of biofertilizer could be arranged as the mixture, Microbin, Nitrobin and then untreated, where the highest values of all growth criteria, yield attributes, grain yield /fad and grain nitrogen percentage were achieved by application of the mixture of Nitrobin and Microbin.

The highest values of plant height, number of rows /ear, number of grains / row,seed index, grain yield plant (g), grain yield /fad and N% in grains were achieved by application of Ir 3 followed by Ir 2, Ir 1 and then Ir4. Application of N3 (140 Kg N) together with Bio 4 produced the highest values of plant height, seed index and grain yield / fad, also, Bio 3 with 140 Kg N /fad significantly produced the highest LAI and No. of grains /row. Grain yield / fad produced by (Bio 4 X N 2) exceeded that obtained by N3 without inoculation . Nitrogen fertilizer level N 3 combined with Ir 3 produced the highest values of ear length, ear diameter, grain yield per plant and per faddan (19.22 ardab), while N 3 X Ir 1 produced the highest ear position and LAI. Biofertilizer treatment (Bio 4) as a mixture of both Nitrobin and Microbin produced the maximum values of ear height (with Ir 2), seed index, grain yield /plant and per faddan (with Ir 3). Application of 140 Kg N /fad (N 3) with Bio 4 and irrigated by Ir3 produced the highest value of grain yield / fad 22.89 ardab and the highest value of water use efficiency (0.95 kg grain / m3 water).

This study recommended to use biofertilizer as the mixture of both Nitrobin and Microbin combined with 100 to 140 Kg N / fad and drip irrigation with 3360 m^3 water in frequent irrigations two times daily in full plant life to produce good production of maize grain yield in this region (El-Sadat city).

Keywords: Maize, Biofertilizer, Nitrogen levels and Irrigation regimes.

INTRODUCTION

Egypt lies in arid and semi–arid regions. Field crops production in such soils is faced by the prevalence of a number of rather extreme and detrimental conditions i.e limited water supply, drought conditions and very poor sandy soil deficient in nutrients. Irrigation regimes or water requirements are one of the most important factors affecting growth and yield of maize (*zea mays L.*). El–Saidi *et al* (1979) indicated that high quantity of water supply (3200 m^3 / fad.) improved the values of growth and yield and its attributes of maize compared with 800, 1600 and 2400 m^3 / fad. Nour El–Dein *et al* (1986) found that decreasing available moisture content in root zone significantly impaired maize yield, El-Refaie *et al* (1988) concluded that seasonal water consumptive use values for maize were 58.3,54.9 and 46.1 cm, when irrigated at 25.50and 75% deficit from the available water, respectively. Diab (1994) found that most of maize growth characters, yield and its components decreased when water supply of drip irrigation decreased from 3300 to 1800 m^3 / fad. Haikel and El-Badry (1995) and Haikel and Bassal (1996) found that drip irrigation system with 2688 m^3 or 3160 m^3 / fad were more effective to produce higher values of maize grain yields and its components as well as the value of water use efficiency. El–Mowelhi *et al* (1999) reported that increasing drip irrigation intervals from 4 to 7 days decreased growth and yield characters of maize as well as the value of water use efficiency. Hussein *et al* (2000) increased maize yield and its attributes using 3360 m^3 water / fad with drip irrigation comparing with 1680 m^3 or 5040 m^3/ fad. Monthly water consumptive use reached its peak during July and August which represented the period of maximum demand for water by maize (Khedr *et al* 1996 and Khalil 2001).

Intensive use of traditional sources of mineral fertilizer increase the cost of maize production, and some of this elements are either fixed in the soil or leached to pollute the under ground water. Integration with mineral and bio fertilizer will the future management to produce agricultural products. Zeidan *et al* (1988) Mabrouk and Aly (1998) and El-Bana and Gomaa (2000) indicated that most of grain yield and its attributes as well as protein and oil contents of maize responded to N increments up to the highest level tested (120, 160 and 175 kg N /fad), respectively. Also, Tantawy (1994) and Soliman *et al* (1995) recorded considerable increasing in maize grain yield and most of its attributes by raising nitrogen fertilizer levels from 90 to 150 kg N /fad.Haikel *et al* (2000) recommended to applied 130 kg N /fad as organic manure to produce higher yield of maize in new sandy soil. Atta–Allah (1998) recorded that increasing nitrogen level led to increase maize grain yield and application of bio fertilizer treatments significantly increased growth and yield components, and reduced the cost of production and pollution which be occurred by excessive use of chemical fertilizers. Also bio fertilizer agents varied in their effect on maize characters. Many investigators showed that inoculation with some species as *Azospirillum, Azotobacter* and *Bacillus spp* can save up to half of the field rate of in-organic nitrogen fertilizer, and at the same time, increase yield of grain and straw yields of cereal crops (Rai and Gaur 1988 and El–Howeity 2004). Shahby *et al* (2000) indicated that application of 120 Kg N / fad did magnify maize plant vigorousness with percentage increases of up to 213 % in biomass production. *Rhizobacterin supported* 230% higher plant N yield over N fertilizer alone. Salem (2000) found that the highest grain yield and its components were resulted from application of 120 Kg N without inoculation or 100 kg N + 0,5 Kg Biogen / fad. The interaction between chemical nitrogen and inoculation with Biogen and phosphorus fertilizer levels had significant effect on most studied characters. El–Nagar (2003) reported that chemical nitrogen up to 130 kg / fad increased maize yield and its attributes comparing with 70, 100, 160 and 190 kg N / fad, he also added that inoculation with *Azospirillum brasilense* was more effective under various irrigation regimes. The effect of interaction among nitrogen levels, bio fertilizer and irrigation regimes on grain yield was found to be significant on grain yield and some of studied traits.

This study aimed to evaluate the response of maize cultivar 30 K 8 to some nitrogen fertilizer levels and inoculation with Nitrobin,Microbin and their mixture under different irrigation regimes in order to increase maize grain yield and decrease the chemical nitrogen uses.

MATERIALS AND METMHODS

The present investigation was carried out during the two successive seasons 2003 and 2004 at the Experimental Farm of Desert Environment Research Institute, Minufiya University, El-Sadat city to evaluate maize (*zea mays L.*) productivity as affected by four irrigation regimes (Table 1), three chemical nitrogen levels (N1-60, N2- 100 and N3- 140 Kg N / fad) and four biofertilization treatments (Bio1-untreated, Bio2- Nitrobin (*Azospirillum sp. & Azotobacter sp.*), Bio3-*Microbin Azospirillum sp Bacillus megatherium & Pseudomonase sp & Mycorrhizae sp*) and Bio4-mexture of Nitrobin + Microbin). Soil chemical and physical analysis of the experimental site are presented in Table (2).

Table (1): The four irrigation regimes schedule for maize plants with drip irrigation.

Symbols	Germination M^3	Full season	No.of irrigations	Water quantity m^3
Ir1	96	40 minutes at morning daily	51	3360
Ir 2	96	50 minutes at morning daily	102	4176
Ir 3	96	40 minutes daily{20min morning + 20 minutes before sun set }	204	3360
Ir4	96	60 minutes every two days	102	2544

Water quantity of irrigation /hour / faddan =48 m^3

Table (2): Soil physical and chemical analysis of the experimental site at El-Sadat city (average of the two seasons).

Texture Grade	Clay %	Silt %	Sand %	W.H.C %	CEC Mmol. kg-1	$CaCO_3$ %	OM	EC MS. Cm1	pH	K ppm	P ppm	N ppm
Sandy Loam	6.73	20.	73.27	48	139.2	4.51	0.36	1.82	7.39	248	40.33	10.6

The preceding crop was *faba bean* in both seasons. The experimental design for each irrigation water regime was randomized complete block in split plot with three replications. Mineral nitrogen fertilizer levels were assigned to the main plot, while the four biofertilizer treatments occupied the sub plots. Each sup plot consisted of 6 rows –70 cm apart and 5 m long. Maize grains were thoroughly washed in water prior to treatment to get ride of any pesticides added for pest control during storage, then the grains were inoculated immediately before sowing with the appropriate biofertilizer at the rat of one kg inoculums / 15 Kg maize grains and irrigation took place. Irrigation regimes started after the germination stage (8 days after sowing). Phosphorus fertilizer at the rate of 31 kg P_2 O_5 and potassium fertilizer at the rate of 48 kg K_2O/fad were added. Mineral nitrogen fertilizer as ammonium sulphate (20, 6 % / N) was added at the studied rates in eight equal doses. Maize grains (C.V 30 K 8) were sown in hills 25 cm apart and rows 70 cm apart on may 22 in both seasons. Thinning took place 15 days after sowing to secure one healthy plant per hill. Other cultural practices were performed as recommended for maize production. Random samples of ten plants were measured from each sub – plot, 7 days after silking to determine leaf area index (L A I) according to Winter and Ohlrorgge (1988) as follows :

L A I = leaf area per plant / land area per plant.

At harvest, ten guarded plants were randomly taken from the third row, in each sub plot to measure plant height (cm), ear height (cm), stem diameter (cm), number of rows /ear, number of grains / row,seed index (g) (100- grain weight) and grain yield plant (g). Grain yield was determined from the yield of the four inner rows from each sub plot (containing the sample of ten plants), adjusted to 15.5 % moisture and converted to record grain yield (Ardab /fad -one ardab = 140 kg). Nitrogen content percentage was determine according to Black et al (1965).

Water use efficiency (W.U.F.) was defined as kilograms of maize grain yield per one cubic meter of water according to Vites 1965 .

W.U.F. = grain yield (kg / fad) / consumptive water use (m^3 / fad).

A combined analysis of variance was done for irrigation regimes, Barttlet test illustrated homogeneity of the experimental error.The combined analysis of variance was performed on the data of the four irrigation regimes for each of the two seasons, according to Gomez and Gomez (1984) using computer program M Stat statistical Analysis Package by Freed *et al* (1985).Comparison of means are done using the lest significant difference test (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Effect of nitrogen levels

As shown in Table (3) all growth criteria, yield attributes and grain yield / fad of maize significantly increased by increasing nitrogen levels up to the highest does (140 Kg N / fad) except ear diameter in both seasons and rows number / ear in the first one. Plant height, ear height, stem diameter and leaf area index positively responded to the increments of nitrogen. Such result was expected on such sandy soil that is very poor in available nitrogen content (10.6 pp m), and this result led to more photosynthesis activity and more dry matter accumulation from the sink to the source. Consequently, more increases in most of yield attributes characters such as ear length, seed index (100 – grain weight (9)), number of grains / row and number of ears / plant. With regard to grain yield / plant and grain yield / fad, positive and significant increases were achieved by increasing nitrogen levels from 60 Kg N to 100 and 140 Kg N / fad. The increase in grain yield might be attributed to the increase in number of ears / plant, seed index and number of grains / ear. As expected, nitrogen percentage in grains was increased by increasing nitrogen fertilizer levels up to the highest dose (140 kg). In this respect, El–Nagar (2003) stated that, in cereals, the size of leaf area available for photosynthesis is roughly proportional to the amount of nitrogen supplied, also the increase in number of grains / row could be principal attributed to increasing in the ratio of the vitality of fertilized terminal ovules as a result of increasing nitrogen, increasing pollen grains / tassel, silking maturity period and translocation available carbohydrate to the ears. Zeidan *et al* (1988), Mabrouk and Aly (1998) and El-Bana and Gomaa (2000) indicated that maize plants responded to nitrogen increment up to the highest tested level (120,160 and 175 Kg N / fad), Tantawy (1994) and Soliman *et al* (1995) registered considerable increasing in maize grain yield and most of its attributes by increasing nitrogen levels from 90 to 150 Kg N / fad, and Haikel et al (2000) up to 130 kg N / fad.

Effect of biofertilizer

Data in Table (4) represented the values of growth criteria, grain yield of maize and its attributes as affected by biofertilizer over all other treatments. It is evident from Table (4) that all biofertilizer treatments resulted in advantage in plant height, ear height, stem diameter and leaf area index comparing with the un-inoculated plants. Tendency increases were observed by inoculation with Nitrobin and Microbin especially when maize grains were inoculated with the mixture of them. This enhancement of growth could be due to the fixed nitrogen by the used bacteria. With regard to maize yield attributes i.e., ear length, ear diameter, seed index, number of grains / row, and number of ears / plant, all of these characters were significantly affected by inoculation with biofertilizer and their mixture except seed index in the first season. The values of all these traits as affected by biofertilizers could be arranged as the mixture > Microbin > Nitrobin > control (un-inoculated).

The superiority of inoculation especially with the mixture resulted in more grain yield / plant and more grain yield / fad as well as more nitrogen content in grains. In this respect, Atta Allah (1998) reported that the superiority in maize grain yield with inoculation may be attributed to the nitrogen fixation by non–symbiotic bacteria present in Serealen and Microbin for their ability to fix free molecular nitrogen, stimulate germination, improve plant stand, synthesis of chlorophyll, secretes growth hormones and consequently increase uptake of nutrients by maize plants. The relative increases in grain yield / fad were estimated by (7.8, 16.37 and 34.62 %) in the first season and (9.4, 21.36 and 32.48 %) in the second one for Nitrobin, Microbin and their mixture compared with un-inoculated plants, respectively. Rai and Gaur (1988) and El–Nagar (2003) indicated that inoculation with *Azospirilium, Azotobucter* and *Bacillus spp* increase yield of grain and straw yields of cereal crops and can save up to half of the field rate of in –organic nitrogen fertilizer.

Table (3): The effect of nitrogen fertilizer levels on growth criteria, yield attributes and grain yield of maize during 2003 and 2004 seasons.

Character / N. levels	plant height cm	Ear height cm	Stem diameter cm	L.AI	Ear length cm	Ear diameter cm	Rows No.	Seed index g	No. of grains/ row	No. of ears/ plant	Grain yield /plant g	Grain yield/fad (Arda)	N% in grain
						2003 season.							
N1	203.33	106.57	1.96	5.09	17.74	2.22	12.00	26.27	34.37	1.061	117.20	10.55	1.73
N2	230.64	109.69	2.07	5.50	19.29	2.29	12.47	29.53	36.57	1.10	149.30	13.44	1.98
N3	260.84	112.71	2.16	5.95	21.33	2.38	12.66	31.88	38.26	1.14	177.70	15.99	2.14
LSD at 0.05	22.16	2.07	.035	0.21	1.43	NS	NS	2.36	3.61	0.03	18.93	1.81	0.22
						2004 season.							
N1	223.72	104.46	1.96	4.96	17.59	2.10	11.70	26.92	30.92	1.11	109.00	9.86	1.83
N2	232.49	111.31	2.05	5.65	19.68	2.35	12.40	30.35	34.09	1.16	149.00	13.5	1.99
N3	240.37	112.62	2.11	5.83	20.57	2.43	13.09	31.99	37.82	1.23	193.00	17.4	2.17
LSD at 0.05	12.43	3.14	0.13	0.19	1.15	NS	1.02	2.54	2.46	0.05	27.78	1.62	0.25

Table (4): The effect of biofertilizer on growth criteria, yield attributes and grain yield of maize during 2003 and 2004 seasons.

Characters / Biofertilizer	plant height cm	Ear height cm	Stem diameter cm	L.AI	Ear length cm	Ear diameter cm	Rows No.	Seed index g	No. of grains/ row	No.of ears/ plant	Grain yield/ plant g	Grain yield/fad (Ardab)	N% in grains
						2003 season.							
Bio 1	203.28	100.25	2.01	5.29	18.85	4.19	12.17	28.16	35.00	1.06	129.70	11.67	1.79
Bio 2	235.50	110.33	1.99	5.48	19.40	4.27	12.28	28.71	35.74	1.09	139.80	12.58	1.97
Bio 3	240.15	113.33	2.10	5.59	19.50	4.36	12.29	29.30	36.90	1.10	148.10	13.33	2.00
Bio 4	247.48	114.73	2.16	5.70	20.07	4.38	12.77	30.74	37.96	1.16	174.60	15.71	2.04
LSD at 0.05	6.24	2.16	0.11	0.18	1.02	0.09	NS	NS	2.14	0.02	19.36	1.03	0.18
						2004 season.							
Bio 1	206.28	100.93	1.97	5.28	18.83	4.20	12.19	32.82	38.28	1.08	171.25	15.41	1.78
Bio 2	234.27	110.5	2.03	5.44	19.14	4.24	12.29	33.20	39.06	1.16	191.07	17.20	1.90
Bio 3	241.30	112.03	2.05	5.56	19.34	4.34	12.44	33.64	39.86	1.19	206.46	18.58	2.15
Bio 4	246.93	114.39	2.12	5.65	19.82	4.40	12.67	33.98	40.34	1.25	224.47	20.20	2.20
LSD at 0.05	15.93	3.21	0.08	0.12	0.67	0.11	NS	0.53	1.32	0.08	18.71	1.16	0.23

El–Howeity (2004) recorded that inoculation with *Azotobacter,Azospirillum sp* and *Bacillus* gave significant increases in maize plant growth,yield and its components comparing with single inoculum and un –inoculated ones.

The effect of irrigation regimes.

Table (5) represented the effect of water regime on maize growth criteria, grain yield and its attributes. Data indicated that the lowest irrigation water quantity (2544 m^3 /season) resulted in the lowest values of growth criteria (plant height, ear height stem diameter and L.A.I., while the highest values of plant height and L.A.I. were achieved by application of irrigation treatment (Ir_3) { 3360 m^3 /season divided in two irrigations daily, morning & before sunset} and exceeded the other treatments Ir_1 (3360 m^3 in one morning irrigation daily) , Ir_2 (4176 m^3, one morning irrigation daily. The same irrigation treatment (Ir_3) increased yield attributes i.e. ear length , ear diameter, seed index number of grains /row and number of ears /plant. The excess of all these traits led to increase grain yield /plant and nitrogen % in grains. Consequently, the maximum grain yield /fad was obtained by application of (Ir_3) treatment. The success of any irrigation method, particularly drip irrigation depends to a large degree on the management of any irrigation system. Management of drip irrigation system is unique in many respects. Irrigation by small, frequent quantities is quite different from traditional methods, where large, infrequent applications are normally applied. The management strategy changes from an extraction dominance of the soil water balance to one where water infiltration and redistribution are of primary importance (Nacayama and Bucks 1986).

These results may be due to the frequency of the small amount of water (morning & before sunset) which can allow water to move beneath the crop root zone, where it became largely available to crop.In the same time (Ir_3) may be decreased water infiltration, saved nutrients from leaching and prepared a suitable environment for biofertilizer agents activity, then resulted in dramatic increase in maize crop production. The relative increases for Ir_1, Ir_2, Ir_3 comparing with Ir_4 were (18.61 % & 17.27 %), (26.85 % & 33.64 %) and (47.96 % & 40.00 %) for the first and the second season, respectively. In this respect, Schussier and Westgate (1991) and El–Nagar (2003) reported that water stress decreased the capacity of source to assimilate metabolites translocation to developing growth traits and grain yield and its attributes and depressed the storage capacity of the sink. Hussein *et al* (2000) indicated that grain yield reduction due to excess of irrigation water may be attributed to that excess moisture content in soil which reduced soil aeration, O_2 and consequently root system efficiency. Similar results were recorded by Nour El–Dein *et al* (1986), El–Saidi *et al* (1979) Deiab (1994), Haikel and El –Badry (1995), Haikel and Bassel (1996), El–Mowelhi *et al* (1999), Khedr *et al* (1996) and Khalil (2001).

Table (5): The effect of irrigation regimes on growth criteria, yield attributes and grain yield of maize during 2003 and 2004 seasons.

Characters / Irrigation regime	plant height cm	Ear height cm	Stem diameter cm	L.AI	Ear length cm	Ear diamter cm	Rows No.	Seed index g	No. of grains/ row	No. of ears/ plant	Grain yield/ plant g	Grain yield/fad (Ardab)	N % in grains
2003 season													
IR1	230.5	110.9	2.17	5.48	19.53	435	12.44	33.98	34.70	1.08	142.30	12.81	2.08
IR2	230.7	112	2.08	5.68	19.31	4.34	12.27	33.21	37.90	1.13	152.20	13.70	1.95
IR3	239.8	110.6	2.11	5.86	20.35	4.38	12.63	33.97	39.30	1.14	177.60	15.98	2.09
IR4	225.5	105.1	1.92	5.03	18.62	4.13	12.17	27.34	33.60	1.058	120.00	10.80	1.68
LSD at 0.05	4.20	2.16	0.15	0.32	1.17	0.08	NS	1.04	2.26	0.03	17.83	1.34	0.26
2004 season													
IR1	231.5	109	2.03	5.42	19.1	4.28	12.3	33.40	35.50	1.1	140.00	12.90	2.10
IR2	233.6	110	2.07	5.63	19.3	4.3	12.4	34.00	36.20	1.18	160.00	14.70	2.01
IR3	238.38	112	2.12	5.84	20.1	4.45	12.7	33.60	32.8	1.31	169.00	15.40	2.17
IR4	225.3	107	1.95	5.04	18.6	4.15	12.2	32.60	33.00	1.10	121.00	11.00	1.71
LSD at 0.05	4.23	2.03	0.09	0.25	1.04	0.12	NS	1.15	2.01	0.02	19.63	1.76	0.29

Water use efficiency.

The data in Table (6) indicated that application of 3360 m^3 water in two irrigation daily (Ir $_3$) achieved the highest value of water use efficiency (0.67 kg grain / m^3) compared with the other water regimes. Data, also revealed that water use efficiency tended to increase with increasing nitrogen levels and application of biofertilizer, where maize plants fertilized with 140 bkg / fad combined with the mixture of biofertilzers (Nitrobin + Microbin) and irrigated with Ir $_3$ achieved the highest value of water use efficiency over all treatments. Khalil (2001) found that water use efficiency was 0.93 and 0.82 kg grain / m^3 for S.C. 10 and T.W.C.310, respectively.

Table (6): The effect of irrigation regimes on water use efficiency under application of chemical nitrogen and biofertilizer treatments as combined data.

Water use efficiency		Kg grain / m3 water			
Biofertilizer	N. levels	Ir 1	Ir 2	Ir 3	Ir 4
Bio 1 (control)	N 1	0.27	0.35	0.45	0.42
	N 2	0.48	0.41	0.58	0.54
	N 3	0.60	0.48	0.73	0.60
Bio 2	N 1	0.32	0.36	0.55	0.46
	N 2	0.47	0.43	0.61	0.54
	N 3	0.72	0.52	0.73	0.67
Bio 3	N 1	0.39	0.39	0.53	0.43
	N 2	0.62	0.46	0.65	0.61
	N 3	0.59	0.55	0.77	0.77
Bio 4	N 1	0.59	0.44	0.65	0.51
	N 2	0.70	0.50	0.79	0.71
	N 3	0.66	0.62	0.95	0.87
mean		0.53	0.46	0.67	0.59

LSD at 0.05 for irrigation regimes 0.09
LSD for intertaction (N X Bio x Ir) 0.012

The effect of the interaction.

The first order interaction between nitrogen levels and biofertilizer treatments had significant effects on plant height, LAI, seed index, No. of grains /row and grain yield /fad (Table 7). Maize plants fertilized with the mixture of biofertilizers and received 140 kg N /fad produced the highest values of plant height, seed index and grain yield /fad , while that plants which fertilized with Microbin and received 140 kg N /fad produced the highest LAI and No. of grains /row. Maize plants without inoculation and received 60 kg N/fad produced the lowest values of all these traits. It was evident that inoculation together with 100 kg N/fad produced grain yield /fad (15.88 ardab) was higher than that obtained by full nitrogen fertilizer without inoculation (14.38 ardab). In this respect, Shahaby *et al* (2000) indicated that inoculation with biofertilizer together with half of the recommended dose of N almost approached the proper development obtained by full fertilization regime. Salem (2000) found that the highest grain yield and its components were resulted from application of 120 Kg N without inoculation or 100 kg N + 0,5 Kg Biogen / fad.He also added that the interaction between chemical nitrogen and inoculation with Biogen and phosphorus fertilizer levels had significant effect on most studied characters. El–Nagar (2003) reported that chemical nitrogen up to 130 kg / fad increased maize yield and its attributes comparing with 70, 100, 160 and 190 kg N / fad. He added that the interaction among nitrogen levels, biofertilizer and irrigation regimes was found to be significant on grain yield and some of studied traits.

Table (7): The effect of the interaction between biofertilizer and nitrogen fertilizer on some maize characters (combined data).

Characters		Plant Height cm	L.A.I	Seed index (g)	No. of grain /row	Grain yield/fad ardab
N. levels	Biofertlizer treatment					
N1	Bio 1	**194.43**	**4.56**	25.53	31.28	8.57
	Bio 2	214.66	5.04	26.09	32.51	9.72
	Bio 3	220.96	5.18	26.66	32.66	10.22
	Bio 4	224.04	5.32	28.11	34.13	12.30
N2	Bio 1	201.23	5.37	28.95	33.58	11.58
	Bio 2	233.85	5.52	29.20	34.85	12.37
	Bio 3	243.86	5.62	30.27	35.82	13.96
	Bio 4	247.33	5.80	31.34	37.06	15.88
N3	Bio 1	222.63	5.68	31.05	36.69	14.38
	Bio 2	256.15	5.81	31.66	36.75	16.03
	Bio 3	257.35	5.93	32.18	38.51	17.09
	Bio 4	270.24	5.90	32.28	38.77	18.63
LSD at 0.05		15.06	0.33	3.62	5.43	2.09

Regarding to the interaction between nitrogen levels and irrigation regimes Table (8), it had significant effects on ear height, LAI, ear length, ear diameter, grain yield /plant and grain yield/fad.

Table (8): The effect of the interaction between nitrogen fertilizer and Irrigation regimes on some maize characters (combined data).

Characters		Ear.height cm	L.A.I	Ear length cm	Ear diameter cm	Grain yield /plant g	Grain yield/fad ardab
N. levels	Irrigation regimes						
N 1	Ir 1	104.36	4.75	17.83	2.10	106	9.51
	Ir 2	107.80	5.15	17.71	2.19	122	10.98
	Ir 3	107.57	5.48	18.64	2.32	137	12.37
	Ir 4	102.32	4.70	16.48	2.06	88	7.96
N 2	Ir 1	110.21	5.43	19.12	2.37	148	13.30
	Ir 2	112.36	5.85	19.59	2.35	155	13.92
	Ir 3	111.89	5.91	20.06	2.42	172	15.51
	Ir 4	107.52	5.12	19.18	2.15	123	11.06
N 3	Ir 1	115.57	6.17	21.04	2.48	175	15.71
	Ir 2	113.36	5.97	20.61	2.44	197	17.76
	Ir 3	113.69	6.16	21.98	2.50	214	19.22
	Ir 4	108.02	5.26	20.17	2.20	156	14.04
LSD at 0.05		3.24	0.72	1.08	0.13	32.26	3.43

Application of 140 kg N with Ir $_3$ produced the highest values of ear length , ear diameter ,grain yield /plant and grain yield /fad, and the same level of nitrogen with Ir $_1$ produced the highest ear position and the highest LAI. On the other hand, the lowest values of all these traits were obtained using Ir 4 with the lowest N level (60 kg). El-Saidi *et al* (1979)indicated that high quantity of water supply (3200 m3 /fad) with high nitrogen level raised the values of growth ,yield of maize and some of its components. El-Refaie *et al* (1988) recorded the same trend when investigated the effect of water regime and nitrogen fertilizer on maize.

The interaction between biofertilizer and irrigation regimes significantly affected ear height, seed index, grain yield /plant and grain yield /fad as a combined data (Table 9).The mixture of Nitrobin and Microbin (Bio 4) with Ir 2 expressed the highest ear position, also the same treatment (Bio 4) with (Ir 3) achieved the heavier seed index and the highest grain yield per plant and per faddan. While the lowest values of all these characters were obtained using the lowest irrigation quantity (Ir4) without inoculation. It was obvious that (Ir 3) provided the soil and plants with adequate and essential water to improve bacterial activity and N uptake which reflected in more grain yield. El–Nagar (2003) reported that inoculation with *Azospirillum brasilense* was more effective under various irrigation regimes.

Table (9): The effect of the interaction between irrigation regimes and biofertilizer treatments (combined data).

Characters		Ear height cm	Seed index g	Grain yield/plat g	Grain yield/fad ardab
Bio	**Irrigation**				
Control	Ir 1	99.90	28.7	118.96	10.82
	Ir 2	*101.85*	*27.91*	*134.38*	*12.22*
	Ir 3	104.05	30.65	156.29	14.24
	Ir 4	96.55	26.91	105.10`	9.55
Bio 2	Ir 1	111.70	28.6	134.29	12.26
	Ir 2	*113.35*	*29.05*	*153.61*	*13.94*
	Ir 3	112.30	30.73	161.43	14.6
	Ir 4	104.30	27.53	110.16	10.03
Bio 3	Ir 1	113.10	29.28	146.46	13.32
	Ir 2	*113.30*	*30.03*	*160.63*	*14.65*
	Ir 3	112.90	30.99	174.71	15.87
	Ir 4	111.40	28.52	123.30	11.24
Bio 4	Ir 1	115.50	31.17	166.21	15.00
	Ir 2	*116.20*	*30.18*	*176.83*	*16.07*
	Ir 3	114.95	31.82	200.55	18.10
	Ir 4	111.58	29.18	145.14	13.24
L. S. D. at 5%		1.53	1.07	12.38	2.11

The second order interaction among nitrogen (N) X biofertilizer (Bio) X irrigation regimes had significant effect on grain yield /fad (Table 10). Generally, 140 gk N together with the mixture of biofertilizer (Microbin +

Nitrobin) and combined with Ir $_3$ achieved the highest values of most studied characters of maize, consequently the greatest grain yield / fad (22.89 ardab). On the other hand, the lowest grain yield / fad (6.49 ardab) was obtained when maize plants received 60 kg N without inoculation and irrigated with Ir 1 or (6.70) with Ir 4, as a combined data. El–Nagar (2003) reported that the effect of the interaction among nitrogen levels, bio fertilizer and irrigation regimes was found to be significant on grain yield and some of studied traits.

Table (10): The effect of the interaction among the nitrogen levels, biofertilizer treatment ad irrigation regimes on grain yield/fad (combined data).

Character		Grain yield /fad (ardab)			
Biofertilizer	N. levels	Ir 1	Ir 2	Ir 3	Ir 4
Bio 1 (control)	N 1	6.49	10.33	10.89	7.60
	N 2	11.63	12.29	13.85	9.80
	N 3	14.31	14.32	17.56	10.97
Bio 2	N 1	7.70	10.70	13.09	8.36
	N 2	11.37	12.68	14.73	9.75
	N 3	17.24	15.63	17.51	12.2
Bio 3	N 1	9.31	11.77	12.74	7.90
	N 2	14.81	13.87	15.61	11.00
	N 3	14.13	16.32	18.50	14.04
Bio 4	N 1	14.05	13.04	15.52	9.26
	N 2	16.86	14.85	18.90	12.95
	N 3	15.82	18.62	22.89	15.81
LSD at 0.05		5.93			

REFERENCES

Atta-Allah,S.A.A (1998):Response of maize to nitrogen and biofertilizer. Assiute, J. Agric.Sci. 29 (1) : 59 -73.

Black , C. A., D. D., Evans and L. E. ,Esminger (1965) : Methods of soil analysis, series. No. 9 Amer. Soc., Agron.Inc. Puplisher , Madison, Wisconsin , U S A.

Diab , M.T (1994) : Water requirements of maize under drip irrigation system. Egypt. J. Appl. Sci. , 9 (12) : 392 – 398

El–Bana, A. Y. A. and , M. A. , Gomaa (2000) :Effect of N and K fertilization on maize growth in different populations under newly reclaimed sandy soil. Zagazig J. Agric. Res. 27 (5) : 1179 – 1190.

El-Howeity, M.A.A. (2004) : colonization patterns of diazotrophs associated with some legume and non-legume crops. Ph D thesis , fac. Agric. Minufiya Univ.

El–Mowelhi, N. M. , S A. Abd El – Hafez , A. A. El Sabagh and A. I. Abo – Ahmed (1999) : Evaluation of drip irrigation maize in North Delta Egypt. proc. The 3rd conf. of field irrigation and Agrometeorology, Giza Egypt , : 223-231.

El–Nagar, G. R. (2003) : Integrating of mineral and bio – fixed nitrogen fertilization in maize production under different irrigation regimes. Assiut J. Agric. Sci. 34 (5) : 53 – 76.

El–Refaei, M. M. A. Y. Badawi , H.W. Tawadros , M. Hassanien and A. El Sabbagh (1988) : Effect of water regime and nitrogen fertilizer on maize production. Soil and water Res. Ins. , Agric Res. Center Conf. Field irrigation and Agroclimatology , 20 – 23 June , Giza , Egypt.

El–Saidi, M. T , D. M. El – Mariri and M. M Hussein (1979) : Influence of irrigation and nitrogen on yield of corn in calcareous soil. Egypt. J. Agron. 4 (1) ;73 –82.

Freed, R.,S , P. Eisensmith , S. Goetez , D. Reicosky , V. W. Smail and P. Wolbery (1985) : (M S T A T) software program for the design , management and analysis of agronomic research experiments. Michigan State University U.S.A.

Gomez, K. A. and A. A. Gomez (1984) : Statistical procedures for agriculture research. A wiley – inter – science publication. John wiley & Sons. Inc. New York.

Haikel, M. A. and Ola , Z. El Badry (1995) : Response of corn to different irrigation system s in newly reclaimed soil. Annals Agric. Sci., Moshtohor , 33 (3) : 1025 – 1034.

Haikel, M. A. and S. A. Bassal (1996) : Effect of irrigation systems , plant density and methods of nitrogen application on growth and yield of soybean under sandy soil conditions J. Agric. Sci. Mansoura Univ. 21(4) :1229-1240.

Haikel, M. A , Samira M. A Hussein and A. M. El –Melegy (2000): Effect of organic and mineral nitrogen on maize and its residual effect on wheat as a successive crop in sand soil under new irrigation systems. J. Agric. Sci. Mansoura Univ. , 25 (7) : 3803 – 3816.

Hussein, Samira , M. A. M. A. Haikel and A.M. El – Melegy (2000) : Effect of water requirements and plant densities on yield and its attributes of corn (*Zea mays , L*) under drip irrigation system in newly reclaimed soil in North Sinai. J. Agric. Sci. Mansoura Univ. , 25 (5) : 2439 – 2448.

Khalil, F. A (2001) : Scheduling irrigation of maize by using the evaporation pan method. Ph. D. Thesis.Fac. Agric. Moshtohor , Zagazig Univ. , Egypt.

Khedr, E. A. F , S. E. G. Matta , M. F. Wahba and M ;. M. El – Koliey (1996): Effect of water regime on yield of some maize cultivars and water relation. Bull. Fac. Agric. , Univ. Cairo , 47 : 87 –98.

Mabrouk, S.S.and A.A. Aly (1998): Maize growth and production on a sandy soil treated with organic and mineral N sources. Proc.8th Conf. Agron.,Suez Canal Univ.,Ismailia ,Egypt ,28-29 Nov.Pag :222-229.

Nakayama, F. S. and D. A.Bucks (1986) :Trickle Irrigation for Crop Production , and design operation Management ,U.S. Department of Agric. Agric. Res.Service , U. S. Water Conservation Laboratory Phoenix , Arizona ,U.S.A.

Nour El-Dein, N. A. ,. M. A. Ragab and E. R. Abou Gabal (1986) : Defferential response of maize plants to soil drought specific in growth stages. Proc. 2nd Conf Agron. Alex. Egypt , 1 : 309 – 320.

Rai, S. N. and A. C. Gaur (1988) : Characterization of *Azotobacter spp* and effect of *Azotobacter* and *Azospirillum* as inoculation on the yield and N – Uptake of wheat crop. J. plant and soil , 109 : 131 – 134.

Salem, M. A. (2000) : Response of maize (*Zea mays* L) growth and yield to chemical and bio fertilization. Zagzig J. Agric. Res. 27 (4): 845 – 858.

Schussier, J. R. and M. E. Westgate (1991) : Maize Kernels sit at low water potential. 1.Sensitivity to reduced assimilates during early Kernels growtn. Crop Sc. 31 : 1189 –1195.

Shahaby, A. F. ,. M. Fayez ,. M. N. Omar and Heba , Sh.Shehata (2000) : Integration of Diazotrophs inoculation with organic and inorganic fertilization to improve wheat and maize productivity in sandy soils. Egypt. J. Agric. Res. , 78 (2) : 499 – 519.

Soliman, F. H. ,. R. L. L. Faisal and A. Sh. A. Gouda (1995) :Response of some local and exotic maize hybrids to nitrogen levels under different environmental condition , Egypt. J. Appl. Sci , 10(8) : 556 – 570.

Tantawy, A. A. (1994) : Response of some maize genotypes to nitrogen fertilizer levels. Minia J Agric. Res. and Dev. 16(3) : 99- 113.

Vites, F.G. (1965) : Increasing water use efficiency by soil management in plant environment and efficient water use efficiency. American Society of Agronomy.

Winter, S. R. and A , J. Ohlrogge (1988) : Leaf angle , leaf area and corn (*Zea may L.*) Yield. Agron. J. 65. 395.

Zeidan, E.M., R.M.Aly, H.A.Basha and I.M.Abd El-Hameed (1998): Effect of nitrogen and farm yard manure fertilization on yield attributes ,yield and quality of maize. Proc.8th Conf. Agron.,Suez Canal Univ.,Ismailia , Egypt, 28-29 Nov.Pag :211-221.

جهد محصول الذرة الشامية واستجابته للتسميد الحيــوى والنتــروجين المعــدنى تحت نظم ري مختلفة فى الأراضي حديثة الاستصلاح.

عادل عبد الهادي عبد الله
معهد بحوث البيئة الصحراوية- مدينة السادات -جامعة المنوفية. مصر

أجريت هذه الدراسة في موسمي ٢٠٠٣ و٢٠٠٤ بالمزرعة البحثية لمعهد بحوث البيئة الصحراوية بمدينة السادات -جامعة المنوفية لدراسة مدى استجابة صنف الدرة الشامية ٣٠ ك ٨ لأربعة نظم ري بالتنقيط (Ir_1- ٤٠ دقيقة يوميا صباحا (٣٣٦٠م٣ ماء) و (Ir_2- ٥٠دقيقة يوميا صباحا (٤١٧٦ م٣)) و(Ir_3- ٤٠دقيقة يوميا على فترتين صباحا وقبل الغروب(٣٣٦٠ م٣)) و (Ir_4- ٦٠ دقيقة يوميا صباحا يوم ويوم (٢٥٤٤ م٣) وثلاثة مستويات من التسميد الآزوتي (٦٠ كجمN_1 و ١٠٠ كجمN_2 و ١٤٠ كجم أزوت للفدان N_3) وأربعة معاملات تسميد حيوي (بدون تلقيح Bio_1 -نتروبين Bio_2-و ميكروبينBio_3 ومخلوط السماد ين Bio_4) وفيما يلي أهم النتائج المتحصل عليها : -

أدت زيادة التسميد الآزوتي إلى ١٤٠ كجم للفدان إلى زيادة معنوية فى صفات النمو والمحصول ومكوناته (ارتفاع النبات وارتفاع الكوز وقطر الساق ودليل مساحة الأوراق وطول الكوز ومعامل البذرة وعدد الحبوب للسطر وعدد الكيزان للنبات ومحصول الحبوب للنبات والفدان والنسبة المئوية للنيتروجين فى الحبوب وذلك مقارنة بالمستويات الأخرى (٦٠و١٠٠ كجم أزوت للفدان).

أدى استخدام التسميد الحيوي بشكل عام إلى زيادة معنوية فى معظم صفات النمو والمحصول ومكوناته سواء باستخدام النتروبين او الميكروبين او مخلوطهما مقارنة بالكنترول.وقد تم الحصول على اعلى القيم فى صفات النمو والمحصول ومكوناته ومحتوى الحبوب من النيتروجين باستخدام خليط من كل من النتروبين والميكروبين ، كما تفوق الميكروبين على النتروبين فى معظم الصفات المدروسة.

تم الحصول على اعلى القيم فى ارتفاع النبات وعدد السطور / الكوز وعدد الحبوب / سطر ومعامل البذرة ومحصول الحبوب للنبات والفدان والنسبة المئوية للنيتروجين فى الحبوب باستخدام نظام الرى Ir 3 يليه Ir2 و Ir1 واخيرا Ir4.

كان للتفاعل بين العوامل تحت الدراسة أثرا على بعض صفات الذرة الشامية المدروسة ، وقد أدي التسميد بمعدل ١٤٠ كجم ازوت للفدان مع مخلوط النتروبين والميكروبين الى الحصول على أعلى القيم فى ارتفاع النبات ومعامل البذرة ومحصول الحبوب للفدان.وأدى استخدام الميكروبين مع ١٤٠ كجم أزوت الى الحصول على اكبر قيمة لدليل مساحة الأوراق وعدد الحبوب للصف – وتفوق محصول الحبوب عند التسميد بمخلوط الأسمدة الحيوية مع ١٠٠ كجم ازوت للفدان على التسميد بأكبر معدل للازوت (١٤٠ كجم) بدون معاملة بالأسمدة الحيوية ، مما يشير الى التوافق فى لستخدام هذه الأسمدة ويؤدى الى توفير جزء من السماد الكيماوي اللازم.

أدى استخدام ١٤٠ كجم أزوت للفدان مع نظام الري Ir_3 الى الحصول على أعلى القيم فى طول الكوز وقطر الكوز ومحصول الحبوب للنبات والفدان (١٩,٢٢ اردب).فى حين أعطى N_3 Ir X_1 أعلى القيم فى ارتفاع الكوز ودليل مساحة الأوراق.

أدى استخدام مخلوط النتروبين والميكروبين الى الحصول على أعلى القيم فى ارتفاع النبات (مع Ir_2) ومعامل البذرة ومحصول الحبوب للنبات والفدان مع Ir_3. كما كان للتفاعل بين العوامل الثلاثة أثرا معنويا على محصول الحبوب للفدان ،حيث أدى استخدام ١٤٠ كجم أزوت مع مخلوط كل من النتروبين والميكروبين والرى بنظام Ir_3 الى الحصول على أعلى قيمة لمحصول الحبوب وكفاءة استخدام الماء.

وتوصى الدراسة باستخدام مخلوط الأسمدة الحيوية مثل النتروبين والميكروبين مع معدلات من الأسمدة الأزوتية من ١٠٠ الى ١٤٠ كجم للفدان والرى بالتنقيط بمقنن ٣٣٦٠ م^3 ماء للفدان بنظام ريتين يوميا طوال فترة حياة النبات لانتاج محصول جيد فى منطقة مدينة السادات.