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RESPONSE O F SOME SUNFLOWER CULTIVARS TO SOME BIO-NITROGEN FERTILIZATION UNDR HILL SPACES

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ABSTRACT

Two field experiments were conducted at Sids agricultural Research Station to study the response of three sunflower cultivars, namely Maik, Vedoc and Eroflour to some bio-nitrogen fertilization treatments, i.e. control, inoculation with Rhizobacterien, inoculation with Rhizobacterien plus 10 kg N/ fed, inoculation with Rhizobacterien plus 20 kg N/ fed and 30 kg N/ fed under three hill spaces (20, 25 and 30 cm between hills) and their effects on some growth characters, yield and yield components as well as oil content and oil yield per fed.

Results showed that, cultivars significantly differed in all characters under study. It was clear that Eroflour cultivar surpassed the other two varieties in most studied parameters, except plant height (cm) and 100- seed weight (gm) where Maik cultivar gave the tallest sunflower plant, while 100- seed weight (gm) was not affected by cultivars.

Decrease the plant distances (20 cm between hills) led to a significant increase in plant height and both seeds and oil yields per fed, while both stem and head diameter, 100- seed weight and seeds weight per head had a reverse trend. Oil content was not affected by plant density.

As for bio- nitrogen fertilization, all studied characters significantly increased by increasing nitrogen levels up to 30 kg N/ fed. Inoculation of sunflower seeds with Rhizobacterien plus application of 20 kg N/ fed gave seeds yield per fed. equal to that of fertilization with 30 kg N/ fed, where no significance differences between them.

In general, the interactions among the three studied cultivars was significant on all traits studied herein.

It could be concluded that using Eroflour cultivar under 20 cm between hills. Also, seed inoculate the seed with Rhizobacteries as bio-fertilizer plus 20 kg N/ fed produced the highest seeds and oil yields/ fed.

INTRODUCTION

Egypt now is suffering from a great shortage in edible oils, so the Egyptian government is pressing hard to close up the increasing gab between the production and consumption of seed oil.

Sunflower (Helianthus annus, L.) is one of the four most important annual crops in the world grown for edible oil. Its seeds contain 24-49 % of oil and the cake contains 25-35 % of protein, which is mostly feeded to livestock because its high biological value. Furthermore, sunflower seeds are eaten as salted whole seeds as roasted nut meats (dehulled). Moreover sunflower oil is characterized by its high content of unsaturated fatty acids such as oleic and lenoleic which represent 90 % of the total acids of sunflower oil.

The sunflower productions is affected by the cultivars, abd el- Gawad *et al* ; (1987) Dimato *et al* ; (1990); Rashed, (1990) and Saleh, (1990) and by some environmental conditions such as plant density and nitrogen fertilization. Gubbles and Dedio (1990) found that plant height and oil content of achenes were increased with increasing plant density, while achene weight decreased. Also, Khargakharate and Nirwal (1991) sown sunflower in rows (30, 45 and 60 cm apart). They found that plant height, leaf area, 1000- seed weight (gm), seed yield and oil yield were highest at 60 cm. Moreover, Saleh (1994) reported that the best treatments to obtain maximum seeds and oil yields with Miak sown 20 cm apart.

On the other hand, microbial inoculation of some crops by certain free- living N_2- fixing bacteria had a great importance as a new technology. This method of microbial inoculation aims to minimize chemical fertilizer and reduces the costs of production and pollution which can be occurred by the excessive use of chemical fertilizers.

Recently, many investigators have reported that using N_2- fixing bio-fertilizer should help in this connection, such as El- Khawas, (1990); Radwan, (1998); Hamissa et al ; (1999); Sobhi et al ; (2000); El- Shazly and Darwish, (2001) and Galat, (2000).

This trial was conducted to find out the appropriate hill spacing and to study the effect of seed inoculation with free living- fixing bacteria (Rhizobacterien) in the presence of different levels of nitrogen fertilization under three sunflower cultivars to give highest sunflower yield and best quality.

MATERIALS AND METHODS

This study was conducted at the Experimental field of Sids Agricultural Research Station (ARC) during the two summer of seasons 2002 and 2003 to study to the effect of some sunflower cultivars, namely Maik (A1), Vedoc (A2) and Eroflour (A3), with different hills spaces 20 (B1), 25 (B2) and 30 (B3) cm between hills and five bio-nitrogen fertilization; without nitrogen or bio-fertilization (C1), bio-fertilization only (C2), bio-fertilization plus 10 kg N/ fed (C3), bio-fertilization plus 20 kg N/ fed (C4) and 30 kg N/ fed without bio-fertilization (C5) on some growth characters; plant height (cm), stem and head diameter (gm), yield components, i.e. seeds weight/ head and 100- seed weight (gm), seed yield/ fed and both oil content and oil yield/ fed.

Sunflower seeds were planted on may 20^{th} and may 24^{th} in the first and second season, respectively. Treatments were arranged in split- split plot design with four replications. Each plot contained 6 ridges, 6 m long and 0.60 m wide. The main plots represented sunflower cultivars, while sub-plots represented hill spacing treatments and bio- nitrogen fertilization doses were located in the sub-sub-plots.

Nitrogen fertilization was added in the form of ammonium sulphate (20.6 %) to the soil in three equals doses. The first portion was added before planting irrigation, while the second and third portions were added before the first and second irrigation, respectively. Rhizobacterien inoculations were used as N- bio-fertilizers, which are produced by General Organization for Agriculture Equalization, Ministry of Agriculture and Land Reclamation, Egypt.

Abou El-Naga, (1993) reported that the inoculation was performed by coating sunflower seeds with Rhizobacterien inoculation using a sticking substance (Arabic gum, 5%) just before sowing.

A surface soil sample (0-30 cm) was collected before planting to identify some chemical and physical properties according to the official methods described by Page et al; (1982) and Kluta (1982), respectively (Table,1). All other cultural practices were conducted as recommended for cultivating sunflower in the district. Oil percentage in sunflower seeds was determined using Soxhelt apparatuse according to the A.O.A.C. (1975).

Statistical analysis of variance was done according to Snedecor and Cochran (1980). Significance of difference among treatments was compared using the least significant differences (L.S.D) at 0.05 level probability.

Table (1): some physical and chemical analysis of the experimental soil.

Soil properties	First season	Second season
Particle size distribution (%)		
Coarse sand	1.1	1.3
Fine sand	11.6	10.4
Silt	36.0	38.0
Clay	50.9	50.0
Clay Textural class	Clay	Clay
Chemical analysis		
Organic matter (%)	1.1	1.2
$CaCo_3$ %	2.5	2.7
Ec (dsm^{-1} at 25 °C)	0.25	0.28
PH (1= 2.5 suspension)	8.1	8.1
Available N (ug/ g)	9.0	10.0
Available P (ug/ g)	12.5	11.3
Available K (ug/ g)	180	230

RSULTS AND DISCUSSION

Growth characters:

Data in tables (2, 3 and 4) indicate that Miak cultivar significantly surpassed the other two cultivars in plant height in the two studied seasons. Whereas, Vidoc cultivar was the shortest plant height. On the other hand, Eroflour cultivar significantly surpassed the other two cultivars in both stem and head diameter in the two seasons.

As for hill spacing, obtained data in Tables (2, 3 and 4) showed that hill spacing had significant effect on plant height, stem and head diameters, where the plant height increased by decreasing the distance between hills. This increase could be explained as a result of excessive shade which increases gibberilin content in plant height (Makram et al; 1994). These results are in a good agreement with those obtained by Gubbles and Dedio (1990). Whereas, decreasing plant density significantly increased both stem and head diameters. This trend of result could be explained on the basis that root size and leaf surface became larger as well as each plant receives more sunlight, water and nutrients in less dense stand.

With respect to bio-nitrogen fertilization, the data in the above mentioned Tables show that, regardless of Rhizobacterin inoculation, increasing nitrogen level up to 30 kg N/ fed caused a remarkable increase in all studied growth characters in the two seasons, which may be attributed to the stimulatory metabolic effects of nitrogen fertilization in acceleration of early vegetative and cumulative effect of greater dry matter production, thus, increasing the length as well as the diameters of both stem and head of sunflower plant. On the other hand inoculated sunflower seeds with Rhizobacterien increased the plant growth as compared with control. El-Khawas (1990), attributed the increase in plant growth due to bio-fertilization to the principle mechanism that bio-fertilizer could benefit the plant growth through fixing gaseous nitrogen and its transfer to the plant as a direct effect on growth hormons that released in root media by bacteria and affect positively its growth and extension. It is worthy to mention that application of mineral nitrogen fertilizer at its recommended rate, i.e. 30 kg N/ fed exceed the other bio-fertilization in both seasons. These results are in harmony with those of many investigators such as El-Shaly and Darwish (2001) and Galal (2003).

The obtained data revealed that interaction between any two of the three studied factors or among them on the studied growth characters are significant in both growing seasons. Miak cultivar planted at 20 cm between hills and received 30 kg N/ fed recorded the tallest plant. While, the highest values of both stem and head diameters of Eroflour cultivar were recorded due to less plant density and fertilization rate of 30 kg N/ fed.

Table (2): Effect of cultivars, hill spacing and nitrogen fertilization on plant height (cm).

Cultivars (A)	Hill spacing (B)	Fertilization (c)											
		First season						Second season					
		C1	C2	C3	C4	C5	Mean	C1	C2	C3	C4	C5	mean
A1	B1	260.8	271.1	280.3	289.1	298.3	279.9	254.1	266.2	271.1	282.0	290.3	272.7
	B2	256.2	270.4	277.1	285.2	292.5	276.3	257.1	262.4	269.2	278.7	284.9	270.5
	B3	255.1	268.2	272.4	276.1	280.2	270.4	249.1	261.4	264.9	270.1	273.1	263.7
Mean		257.4	269.9	276.6	283.5	290.3	275.5	253.4	263.3	268.4	276.9	282.8	269.0
A2	B1	221.7	23.3	241.9	249.2	260.0	240.6	215.4	225.9	234.6	246.6	255.3	235.6
	B2	219.2	228.7	237.2	245.3	256.8	237.4	210.8	221.7	232.2	242.7	251.5	231.8
	B3	214.8	224.7	233.9	242.5	253.4	233.9	204.8	213.4	224.7	235.5	247.0	225.1
Mean		218.6	228.9	237.7	245.7	256.7	237.3	210.3	220.3	230.5	241.6	251.3	230.8
A3	B1	242.5	251.1	259.4	271.2	279.1	260.7	238.8	247.9	252.8	268.0	271.3	255.8
	B2	239.9	248.7	256.6	268.5	277.4	258.2	232.8	241.4	251.2	261.7	269.9	251.4
	B3	237.6	245.7	254.5	264.7	273.7	255.2	243.7	232.3	250.2	260.0	268.5	250.9
Mean		240	248.5	256.8	268.1	276.7	258.0	238.4	240.5	251.4	263.2	269.9	252.7
Mean B	B1	241.7	250.8	260.5	269.8	279.1	260.4	236.1	246.7	252.8	265.5	272.3	254.7
	B2	238.4	265.9	257.6	266.3	275.6	257.3	236.4	241.8	250.9	261.0	268.8	251.2
	B3	235.8	246.2	253.6	261.1	269.1	253.2	232.5	235.7	246.6	255.2	262.9	246.6
Mean C		238.7	249.1	257.0	265.8	274.6	256.9	234.0	241.4	250.1	260.6	268.0	250.8

L.S.D at (0.05)	First season	Second season
A	1.38	2.51
B	2.58	2.06
C	3.91	3.74
AxB	4.40	3.58
Axc	6.77	6.48
BxC	6.77	6.48
AxBxC	11.77	11.22

Table (3): Effect of cultivars, hill spacing and nitrogen fertilization on stem diameter (cm).

Cultivars (A)	Hill spacing (B)	Fertilization (c)											
		First season						Second season					
		C1	C2	C3	C4	C5	mean	C1	C2	C3	C4	C5	mean
A1	B1	2.1	2.4	2.6	2.9	3.3	2.7	3.0	3.2	3.4	3.5	3.7	3.4
	B2	2.2	2.5	2.8	3.1	3.8	2.9	2.4	2.6	3.0	3.4	3.8	3.0
	B3	2.3	2.6	2.9	3.2	3.5	2.9	2.6	2.7	3.0	3.3	3.7	3.1
Mean		2.2	2.5	2.8	3.1	3.5	2.8	2.7	2.8	3.1	3.4	3.7	3.1
A2	B1	2.4	2.6	2.8	3.0	3.2	2.8	2.5	2.7	2.9	3.7	3.4	3.0
	B2	2.5	2.6	2.9	3.2	3.3	2.9	2.6	2.8	3.0	3.3	3.5	3.0
	B3	2.6	2.7	2.9	3.3	3.5	3.0	2.7	2.9	3.1	3.4	3.7	3.2
Mean		2.5	2.6	2.9	3.2	3.3	2.9	2.6	2.8	3.0	3.5	3.5	3.1
A3	B1	2.6	2.8	3.0	3.2	3.4	3.0	3.0	2.9	3.1	3.4	3.5	3.1
	B2	2.3	2.8	3.0	3.3	3.5	3.0	2.8	3.0	3.1	3.4	3.7	3.2
	B3	2.7	2.9	3.0	3.4	3.5	3.1	2.8	3.0	3.2	3.5	3.8	3.3
Mean		2.5	2.8	3.0	3.3	3.5	3.0	2.9	3.6	3.1	3.4	3.7	3.3
Mean B	B1	2.4	2.6	2.8	3.1	3.3	2.8	2.8	2.8	3.1	3.5	3.5	3.1
	B2	2.3	2.6	2.9	3.2	3.5	2.9	2.6	2.8	3.0	3.4	3.6	3.1
	B3	2.5	2.7	2.9	3.3	3.5	3.0	2.7	2.9	3.1	3.4	3.7	3.2
Mean C		2.4	2.6	2.9	3.2	3.4	2.9	2.7	3.1	3.1	3.4	3.6	3.2

L.S.D at (0.05)		
A	0.14	0.18
B	0.07	0.05
C	0.14	0.19
AxB	0.13	0.26
Axc	0.24	0.33
BxC	0.24	0.33
AxBxC	0.24	0.58

Table (4): Effect of cultivars, hill spacing and nitrogen fertilization on head diameter (cm).

Cultivars (A)	Hill spacing (B)	Fertilization (c)											
		First season						Second season					
		C1	C2	C3	C4	C5	mean	C1	C2	C3	C4	C5	Mean
A1	B1	12.2	15.4	16.3	17.2	18.4	15.9	12.1	14.7	15.8	17.0	18.1	15.5
	B2	13.2	16.2	18.3	19.2	20.1	17.4	13.0	16.0	18.1	19.0	20.0	17.2
	B3	14.2	16.2	18.3	20.0	21.1	18.0	14.0	16.0	18.1	20.0	21.0	17.8
Mean		13.2	15.9	17.6	18.8	19.9	17.1	13.0	15.6	17.3	18.7	19.7	16.8
A2	B1	13.7	15.2	16.7	17.1	19.0	18.0	13.6	15.0	16.5	12.0	18.5	15.1
	B2	14.1	16.6	18.7	19.4	21.1	18.0	14.0	16.4	18.5	19.2	21.0	17.8
	B3	15.1	17.0	19.2	20.3	21.9	18.7	14.5	16.6	19.0	20.1	21.6	18.4
Mean		14.3	16.3	18.2	18.9	20.7	18.2	14.0	16.0	18.0	17.1	20.4	17.1
A3	B1	14.1	16.6	17.3	18.4	18.8	17.0	14.6	16.4	17.1	18.1	19.5	17.1
	B2	14.9	17.7	19.9	20.8	22.0	19.6	14.7	17.5	19.8	20.6	21.8	18.9
	B3	15.7	17.8	20.1	21.4	22.7	18.5	17.7	15.5	20.0	21.3	22.6	19.4
Mean		14.9	17.4	19.1	20.2	21.2	18.7	15.7	16.5	19.0	20.0	21.3	18.5
Mean B	B1	13.3	15.7	16.8	17.6	18.7	16.4	13.4	15.4	16.5	15.7	18.7	15.9
	B2	14.1	16.8	19.6	19.8	21.1	18.3	13.9	16.6	18.8	15.6	20.9	18.6
	B3	15.0	17.0	19.2	20.6	21.9	18.8	15.4	16.0	19.0	20.5	21.7	18.5
Mean C		14.1	16.5	18.3	19.3	20.6	18.0	14.2	16.0	18.1	18.6	20.5	17.5

L.S.D at (0.05)		
A	081	1.67
B	0.38	0.72
C	0.85	1.08
AxB	0.66	1.24
Axc	1.49	1.87
BxC	1.49	1.87
AxBxC	2.55	3.24

Yield components:

Results presented in tables (5 and 6) show that all studied cultivars significantly differed in the studied yield components. The cultivar Eroflour had the highest weight of head seeds in the two growing seasons, while the lower weight of head seeds was obtained for the cultivar Vedoc in the first season and cultivar Miak in the second season. On the other hand the results showed non significant differences among the three cultivars for 100- seed weight. Similar results were obtained by Rashed (1990) who found that 1000- seed weight was not affected by varieties in the second season.

With regard to hill spacing, the data show that yield components, i.e. seeds weight per head and 100- seed weight were significantly affected by hill spacing in the two studied seasons. The highest yield components were obtained by sunflower planted at 30 cm between hills. This could be attributed to the fact that high plant density created a high competition between plants for nutrient elements, water and light. These results are in line with those obtained by Kharagakhrat and Nitrwl (1991) and Saleh (1994). They found that the yield components of sunflower plant were highest at the low plant density.

Table (5): Effect of cultivars, hill spacing and nitrogen fertilization on seeds weight /head (gm).

Cultivars (A)	Hill spacing (B)	Fertilization (c)											
		First season						Second season					
		C1	C2	C3	C4	C5	mean	C1	C2	C3	C4	C5	mean
A1	B1	60.3	71.1	78.3	88.2	95.3	78.6	57.3	68.4	72.5	84.1	91.0	74.7
	B2	62.3	75.1	80.1	93.2	101.8	83.9	60.1	71.2	77.3	89.7	92.8	78.2
	B3	63.5	78.2	81.2	95.3	102.3	84.1	60.5	76.1	78.4	91.9	99.9	81.4
Mean		64.4	74.8	79.9	92.2	99.8	82.2	59.3	71.9	76.1	88.6	94.6	78.1
A2	B1	65.0	73.1	81.1	89.2	94.5	80.6	63.3	70.1	80.1	85.2	91.2	78.0
	B2	67.1	77.6	83.2	95.0	63.2	77.2	64.8	75.1	80.1	91.9	101.0	82.6
	B3	68.0	81.2	84.2	98.3	104.1	87.2	64.7	77.4	81.1	96.2	100.2	83.9
Mean		66.7	77.3	82.8	94.2	87.3	81.7	64.3	74.2	80.4	91.1	97.5	81.5
A3	B1	67.1	77.3	83.2	94.7	99.3	83.3	65.9	75.0	80.3	92.0	96.1	81.9
	B2	68.1	81.1	85.3	98.7	106.2	87.9	65.9	77.3	82.7	95.1	10.7	84.5
	B3	68.4	83.2	86.1	100.1	107.9	89.1	65.2	79.8	83.8	97.9	102.3	85.8
Mean		67.9	80.5	84.9	97.8	104.5	86.8	65.7	77.4	82.3	95.0	100.0	84.1
Mean B	B1	64.1	73.8	80.9	90.7	96.4	80.8	62.2	71.2	77.6	87.1	92.8	78.0
	B2	65.8	77.9	82.9	95.6	90.4	83.0	63.6	74.5	80.0	92.2	98.5	81.8
	B3	66.6	80.9	83.8	97.9	104.8	86.8	63.5	77.8	81.1	95.3	100.8	83.7
Mean C		66.3	77.5	82.5	94.7	97.2	83.6	63.1	74.5	79.6	91.6	97.4	81.2

L.S.D at (0.05)	First season	Second season
A	0.50	2.45
B	1.38	2.13
C	2.21	2.64
AxB	2.40	3.70
Axc	3.39	4.56
BxC	3.39	4.56
AxBxC	6.63	7.90

As for bio-nitrogen fertilization, the data obtained clearly show that, the effect of mineral nitrogen fertilizer on the yield components of sunflower plants was significant in both seasons. Increasing nitrogen fertilization up to 30 kg N/ fed significantly increased both seeds weight per head and 100- seed weight in both seasons. On the other hand, using bio-fertilization led to a significant increase in the weight of both seeds per head and 100- seed weight (gm), compared to with control. It could be noticed that the application of 30 kg N/ fed gave the highest values of the yield components as comparing with any combination between Rhizobacterien and mineral fertilizer. The interactions among the three variables were significant in both seasons, where the heaviest weight of both seeds per head and 100- seed weight were produced by cultivar Eroflour when planted at 30 cm between hills and supplied with 30 kg N/ fed.

Table (6): Effect of cultivars, hill spacing and nitrogen fertilization on 100 -seeds weight (gm).

Cultivars (A)	Hill spacing (B)	Fertilization (c)											
		First season						Second season					
		C1	C2	C3	C4	C5	mean	C1	C2	C3	C4	C5	mean
A1	B1	5.1	5.3	6.7	6.3	6.7	6.0	5.1	5.2	5.6	6.1	6.4	5.7
	B2	5.3	5.5	7.0	6.4	6.9	6.2	5.2	5.4	5.8	6.3	6.6	5.9
	B3	6.3	5.5	6.1	6.7	7.0	6.3	5.1	5.4	6.0	6.5	6.9	6.0
Mean		**5.6**	**5.4**	**6.6**	**6.5**	**6.9**	**6.2**	**5.1**	**5.3**	**5.8**	**6.3**	**6.6**	**5.9**
A2	B1	5.2	5.4	5.8	6.4	6.5	5.9	5.1	5.2	5.6	6.2	6.6	5.7
	B2	5.3	5.6	6.0	6.5	7.0	6.1	5.2	5.4	5.9	6.4	6.8	5.9
	B3	5.4	5.6	6.2	6.7	7.0	6.2	5.2	5.5	6.0	6.6	6.9	6.0
Mean		**5.3**	**5.5**	**6.0**	**6.5**	**6.8**	**6.1**	**5.2**	**5.4**	**5.8**	**6.4**	**6.8**	**5.9**
A3	B1	5.3	5.4	5.9	6.4	6.8	6.0	5.2	5.3	5.7	6.3	6.7	5.8
	B2	5.4	5.7	6.2	6.7	7.0	6.2	5.3	5.6	6.0	6.4	6.9	6.0
	B3	5.5	5.8	6.3	6.9	7.2	6.1	5.3	5.7	6.1	6.7	7.0	6.2
Mean		**5.4**	**5.6**	**6.1**	**6.7**	**7.0**	**6.1**	**5.3**	**5.5**	**5.9**	**6.5**	**6.9**	**6.0**
Mean B	B1	5.2	5.4	6.1	6.4	6.7	6.0	5.1	5.4	5.6	6.2	6.6	5.7
	B2	5.3	5.6	6.4	6.5	7.0	6.2	5.3	5.5	5.9	6.4	6.8	6.0
	B3	5.7	5.6	6.2	6.8	7.1	6.2	5.2	5.5	6.0	6.6	6.9	6.1
Mean C		**5.4**	**5.5**	**6.2**	**6.6**	**6.9**	**6.1**	**5.2**	**5.4**	**5.9**	**6.4**	**6.8**	**5.9**

L.S.D at (0.05)	First season	Second season
A	N.S	N.S
B	0.15	0.13
C	0.19	0.18
AxB	0.25	0.23
Axc	0.33	0.31
BxC	0.33	0.31
AxBxC	0.57	0.54

Seed yield per feddan:

Average seeds yield per fed for the tested sunflower cultivars under different plant densities and bio-nitrogen fertilization is presented in Table (7). The data of both seasons showed that there were significant differences among the, three studied cultivars. It was clear that Eroflour cultivar surpassed the other cultivars in seeds yield. Meaning, there by that cultivars differed according to growth characters (except plant height) and yield components (Tables 3, 4, 5 and 6). These results agree well with that of seed yield. So, the superiority of Eroflour cultivar may be attributed to its high values of stem and head diameter as well as it had the heaviest both of seeds weight per head and 100-seed weight. On the other hand, Miak cultivar produced the lowest seeds yield in both seasons. Similar results were obtained by Saleh (1994) who found that Miak cultivar had the lowest seeds yield when compared with the other studied cultivar (Giza 1).

With regard to hill spacing, corresponding data reveal that, although the yield components of sunflower, i.e. seeds weight per head and 100- seed weight increased with increasing the distance between hills, the higher plant population compensated the low values of the weight of both seeds per head or 100- seed, so the total seed yield per fed increased with decreasing hill spacing to 20 cm in both growing seasons. The increase of seeds yield per fed due to decreasing hill spacing from 25 to 20 cm and from 30 to 20 cm reached to 2.2 % and 11.8 % in the first season and 3.2 % and 8.2 % in the second season, respectively. These results are in good agreement with those of Saleh (1994) who reported that decreasing spaces from 30 to 20 cm significantly increased seeds yield per fed.

It is evident that mineral nitrogen fertilization had significant effects on seed yield of sunflower per fed, where increasing nitrogen levels up to 30 kg N/ fed significantly increased seed yield in the both growing seasons with percent of 39 % over control in the two seasons. It is worthy to note that the seed yield for sunflower plants fertilized with 20 kg N/ fed combined with Rhizobacterien inoculation was equal to those supplied with complete recommended rate of nitrogen (30 kg/ N fed), where the difference between them was not significant in the two seasons. Thus, it could be concluded that the 20 kg N/ fed combined with seed inoculation by bio-fertilizer Rhizobacterien satisfied the demands of plant nutrition avoided excessive fertilizer application and reduced both the costs of chemical fertilizers and the environmental pollution. Similar results were obtained by Hamissa et al ; (1999) for cotton plants who concluded that the economic nitrogenous fertilizer use can be obtained through combination between N fertilizer at rate of 60 kg N/ fed and seeds inoculation with bio-fertilizer (Rhizobacterien).

Concerning the interactions among the three factors, the data in Table (7) show that the highest seed yield for sunflower plant was obtained for Eroflour cultivar when planted at 20 cm between hills and supplied with either 30 kg N/ fed at 20 kg N/ fed combined with seed inoculation with Rhizobacterien.

Oil content and yield:

Data presented in tables (8 and 9) show the effect of three sunflower cultivars, different hill spaces and bio-nitrogen fertilization and their interactions on oil percentage and oil yield per fed. Data reveal that the differences between the three cultivars were significant in oil content and yield. The superiority of Eroflour cultivar in oil yield per fed could be attributed to its superiority in seeds yield per fed (table 7) and oil content (Table 8). The increase in oil yield due to cultivar Eroflour reached to about 7 % and 18 % as compared with cultivar Vedoc and Miak, respectively in both seasons.

With regard to plant density, the data indicated that hill spacing did not significantly affected oil content in both growing seasons. Whereas, oil yield per fed significantly was affected by plant density. Using higher plant density (20 cm between hills) gave higher oil yield. It could be noticed that the effect of hill spacing on oil yield was parallel to its effect on seeds yield)Table

7). Lower oil yield at relatively wider plant distance confirmed the finding of saleh (1994).

For fertilization treatments, data revealed significant increase in oil percentage of sunflower plant as a result of mineral and/ or bio-nitrogen fertilization as compared with control, however, there was no clear trends could be observed among them. These results in agreement with those obtained by Radwan (1998) for cotton plant. On the other hand, increasing nitrogen level significantly and gradually increased oil yield per fed. Rhizobacterien inoculation alone or in combination with /or 20 kg N/ fed.increased oil yield only when compared with control, but did not reach the value due to application of 30 kg N/ fed.

The analysis of variance indicates, in general, significant interactions among the three factors. The highest both oil content or yield per fed were obtained by Eroflour cultivar when planted at 20 cm between hills and received 30 kg N/ fed., while the lowest values were recorded for Miak cultivar under thick stand and without nitrogen fertilization.

Finally, it could be concluded that in order to maximize sunflower production, it could be recommended to use Eroflour cultivar under higher population (20 cm between hills) and fertilization with 20 kg N/ fed with combined by Rhizobacterien inoculation to reduce environmental pollution.

Table (7): Effect of cultivars, hill spacing and nitrogen fertilization on seeds yield (kg/ fed).

Cultivars (A)	Hill spacing (B)	Fertilization (c)											
		First season						Second season					
		C1	C2	C3	C4	C5	mean	C1	C2	C3	C4	C5	mean
	B1	1588	1772	1924	2076	2232	1918	1524	1696	1876	2002	2172	1855
	B2	1536	1688	1824	1972	2136	1831	1484	1648	1764	1916	2076	1778
	B3	1449	1580	1748	1900	2044	1744	1404	1528	1692	1832	2000	1691
Mean		1524	1680	1832	1983	2137	1231	1471	1624	1777	1919	6248	1775
A2	B1	1684	1868	1992	2132	2328	2001	1628	1804	1920	2072	2264	1938
	B2	1612	1764	1864	2048	2276	1913	1584	1732	1828	2000	2204	1870
	B3	1548	1688	1804	1964	2128	1967	1484	1600	1756	1908	2080	1766
Mean		1615	1773	1887	1881	2244	1960	1565	1712	1835	1993	2183	1858
A3	B1	1792	1964	2148	2312	2452	2134	1744	1896	2116	2268	2400	2085
	B2	1728	1876	1992	2164	2328	2018	1684	1824	1928	2108	2268	1962
	B3	1652	1756	1994	2088	2289	1946	1604	1704	1880	2040	2232	1892
Mean		1724	1865	2028	2188	2356	2033	1677	1808	1975	2139	2300	1980
Mean B	B1	1688	1868	2021	2173	2337	2018	1632	1799	1971	2116	2279	1959
	B2	1625	1776	1893	2061	2247	1974	1584	1735	1840	2008	2183	1870
	B3	1550	1675	1832	1984	2154	1805	1497	1611	1776	1927	2104	1783
Mean C		1621	1773	1916	2073	2246	1941	1571	1715	1862	2017	2189	1871

L.S.D at (0.05)

A	190.10	94.34
B	105.5	59.72
C	183.2	182.98
AxB	182.74	77.98
Axc	285.91	143.73
BxC	285.91	143.73
AxBxC	511.62	248.94

Table (8): Effect of cultivars, hill spacing and nitrogen fertilization on oil content (%).

Cultivars (A)	Hill spacing (B)	Fertilization (c)											
		First season						Second season					
		C1	C2	C3	C4	C5	mean	C1	C2	C3	C4	C5	mean
A1	B1	41.2	41.0	41.8	42.2	41.8	41.6	40.3	42.4	42.9	42.7	42.1	42.1
	B2	42.1	42.3	42.4	42.6	42.9	42.5	42.1	42.9	42.7	42.7	43.1	42.4
	B3	41.5	41.5	40.8	41.6	44.6	41.4	41.7	42.2	41.0	42.0	42.4	41.9
Mean		41.6	41.6	41.7	42.1	42.1	41.8	41.4	42.5	42.2	42.5	42.5	42.1
A2	B1	43.3	43.9	44.4	44.3	44.2	44.0	43.5	44.2	44.7	44.2	44.4	44.2
	B2	44.1	44.5	44.5	44.4	44.1	44.3	44.0	45.0	44.3	44.2	43.6	44.2
	B3	44.8	44.3	43.7	44.7	44.9	44.5	44.4	44.4	43.4	44.4	44.8	44.3
Mean		44.1	44.2	44.2	44.5	44.3	44.3	44.5	44.5	44.1	44.3	44.3	44.2
A3	B1	44.6	44.6	45.4	44.5	44.7	44.8	44.1	43.3	45.3	44.5	44.2	44.3
	B2	44.4	44.5	44.9	44.3	44.3	44.5	44.4	44.9	44.6	44.2	44.7	44.6
	B3	43.8	45.9	44.7	44.4	43.9	44.5	45.0	45.2	44.2	44.5	45.3	44.8
Mean		44.3	45.0	45.0	44.4	44.3	44.6	44.5	44.5	44.7	44.4	44.7	44.6
Mean B	B1	43.3	43.2	43.9	43.7	43.6	43.5	42.6	43.3	44.3	43.8	43.6	43.5
	B2	43.5	43.8	43.9	43.8	43.8	43.8	43.5	44.3	43.9	43.7	43.9	43.7
	B3	43.4	43.9	43.1	43.6	43.5	43.5	43.7	43.9	42.9	43.6	44.2	43.7
Mean C		43.3	43.6	43.6	43.7	43.6	43.5	43.3	43.8	43.7	43.7	43.8	43.6

L.S.D at (0.05)	First season	Second season
A	0.49	0.56
B	N.S	N.S
C	0.24	0.28
AxB	N.S	N.S
Axc	0.58	0.71
BxC	N.S	N.S
AxBxC	1.01	1.22

Table (9): Effect of cultivars, hill spacing and nitrogen fertilization on oil yield (kg/ fed).

Cultivars (A)	Hill spacing (B)	Fertilization (c)											
		First season						Second season					
		C1	C2	C3	C4	C5	mean	C1	C2	C3	C4	C5	Mean
A1	B1	654	725	803	875	933	798	614	718	805	857	915	782
	B2	647	715	774	839	915	778	623	705	751	817	894	758
	B3	600	656	715	792	857	723	584	645	694	770	846	708
Mean		634	699	764	835	900	766	607	689	750	815	885	749
A2	B1	730	819	883	944	1026	880	707	796	856	917	1003	856
	B2	711	785	830	909	1002	847	695	780	808	883	961	825
	B3	695	749	787	876	957	813	658	711	761	845	930	781
Mean		712	784	833	910	995	847	687	762	808	882	965	821
A3	B1	798	876	976	1026	1096	954	771	820	957	1010	1061	924
	B2	765	835	896	958	1030	897	746	817	857	933	1011	873
	B3	725	807	868	927	1004	866	722	771	831	908	1010	848
Mean		763	839	913	970	1043	906	746	803	882	950	1027	882
Mean B	B1	727	807	887	948	1018	877	697	778	873	928	992	854
	B2	707	778	833	902	982	841	688	767	805	878	955	819
	B3	673	737	790	865	938	801	655	709	762	841	929	779
Mean C		702	774	837	905	979	840	680	751	813	882	959	817

L.S.D at (0.05)	First season	Second season
A	93.7	56.4
B	21.2	15.8
C	45.9	52.8
AxB	72.6	38.2
Axc	171.1	103.2
BxC	171.11	103.2
AxBxC	480.3	323.7

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استجابة بعض أصناف عباد لشمس إلي التسميد النيتروجيني الحيوي تحت ثلاث مسافات زراعية

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****معهد بحوث الأراضي والمياه والبيئة - مركز البحوث الزراعية**

أقيمت تجربتان حقليتان بمحطة البحوث الزراعيـة بسدس موسمي ٢٠٠٢ و ٢٠٠٣ لدراسة استجابة ثلاث أصناف من عباد الشمس (مياك - فيدوك - ايروفلور) إلي بعض معاملات التسميد النيتروجيني الحيوي وهي معاملة المقارنة و معاملة البذور بالريزوباكترين فقط و معاملة البذور بالريزوباكترين + ١٠كجم نتروجين /فدان) ومعاملة البذور بالريزوباكبترين + ٢٠كجم نتروجين / فدان) وذلك تحت ثلاث مسافات زراعية (٢٠ ، ٢٥ ، ٣٠ سم بين الجور) وتأثيراتهم علي بعض صفات النمو والمحصول ومكوناته ونسبة الزيت بالبذور ومحصول الزيت . **وكانت أهم النتائج كما يلي :-**

اختلفت الأصناف في كل الصفات المدروسة وقد تفوق صنف ايروفلور عن الصنفين الاخرين في معظم الصفات ما عدا طول النبات ووزن مائة حبة حيث أعطى الصنف مياك أطول النباتات بينما لم يتأثر وزن المائة حبة بالأصناف .

بالنسبة لمسافات الزراعة فأنة كلما قلت مسافات الزراعة بين الجور كلما ازداد كل من طول النبات ومحصول البذور والزيت - بينما قل قطر الساق والقرص ووزن المائة حبة ووزن بذور القرص - ولم تتأثر نسبة الزيت في البذور بمسافات الزراعة .

بالنسبة لمعاملات التسميد فان كل الصفات المدروسة قد زادت بزيادة التسميد النيتروجيني حتى ٣٠كجم نتروجين للفدان . وقد أدت معاملة بذور عباد الشمس عند الزراعة بلقاح الريزوباكترين بالإضافة إلي التسميد النيتروجيني بمعدل ٢٠ كجم نتروجين للفدان إلـي الحصول علي أعلي محصول من البذور مساويا للتسميد النيتروجيني بمعدل ٣٠كجم نتروجين / فدان حيث كان الفرق بينهما غير معنوي .

وقد كان تأثير التفاعل بين الثلاث عوامل معنويا علي الصفات المدروسة .

واخيرا يمكن التوصية بزراعة الصنف ايروفلور علي مسافات ٢٠سم بين الجور وإضافة ٢٠كجم نتروجين للفدان ومعاملة البذور بلقاح الريزوباكترين كسماد حيوي لتفادى التلوث البيئى.