

RESPONSE OF SUNFLOWER (HELIANTHUS ANNUUS, L.)
TO IRRIGATION AND NITROGEN FERTILIZER

by

El-Naggar, H.M.M.

Department of Agronomy, Faculty of Agriculture, Moshtohor,
Egypt.

ABSTRACT

Two field experiments were conducted to study the effect of irrigation intervals (without irrigation, 7, 14 and 21 days) and nitrogen levels (0, 15, 30, 45 and 60 kg N/fad.) on growth characters, yield components, yield and chemical composition of sunflower (Helianthus annuus, L.) var. Mayak. Irrigation every 14 days significantly effect increased all characters studied. Application of nitrogen at 60 kg N/fad. increased significantly, plant height, number of leaves, stem diameter, leaf area, head diameter, weight of head, weight of 100-seed, seed yield/plant seed yield ton/fad. as well as oil yield kg/fad. but oil content was significantly decreased.

The highest seed yield of sunflower could be achieved by applying 60 kg N/fad. to the soil and/or irrigation every 14 days.

INTRODUCTION

In Egypt, there is a big gab between annual consumption and production of edible oil, where the production does not exceed about 20% of our needs. Sunflower is the most suitable crop which can grow in the newly reclaimed soils and plays an important role in increasing oil production.

Jana et al. (1982) and Attia (1985), reported that head diameter and 100-seed weight increased with the increase of irrigation. Attia (1985), indicated that both oil content and oil yield kg/fad. were increased by increasing the available soil water. Abd El-Gawad et al. (1987), found that reducing the irrigation interval to 10 days increased plant height, number of leaves/plant and stem diameter. Attia et al. (1988), mentioned that plant height, stem diameter, 100-seed weight, seed yield kg/fad., seed oil content and oil yield kg/fad. were increased by increasing the available soil moisture.

Daulay and Singh (1980) and Sharma & Gaur (1988), reported that seed yield increased by increasing the nitrogen levels up to 90 kg N/ha. El-Mohandes (1984), found that applying nitrogen to sunflower with levels from 30 to 60 kg N/fad. resulted in increasing plant height, stem diameter, leaf area/plant, head diameter, seed weight/head, 500-seed weight, seed yield/fad. and oil yield/fad. On the contrary, seed oil content decreased by increasing nitrogen rate up to 90 kg N/ha. Hegab *et al.* (1987), revealed that plant height, head diameter and 100-seed weight were not significantly affected by the application of nitrogen fertilizer. While, fertilized plants with 30 kg N/fad. gave greater head weight. But, the seed weight/head was significantly increased by the increasing level of nitrogen application up to 60 kg N/fad. Singh *et al.* (1987), found that the number of green leaves did not differ significantly by nitrogen rates. El-Mesilhy (1989), found that the highest seed yield was obtained by application of the rate of 20 and 40 kg N/fad.

The present investigation was achieved to study the effect of irrigation intervals and nitrogen levels on sunflower plants.

MATERIALS AND METHODS

Two field experiments were conducted at the Research and Experiment Station of the Faculty of Agriculture at Moshtohor, Zagazig University during 1989 and 1990 seasons, to study the effect of irrigation intervals levels on yield and yield components of sunflower (*Helianthus annuus*, L.) variety Mayak. The soil of the experimental areas was clay with pH value of 7.8 and O.M. 2.1%. The preceding crop was Egyptian clover (berseem) in both seasons. Each experiment included twenty treatments which were four irrigation intervals after the first irrigation, i.e., without irrigation, irrigation every 7 days, 14 days and 21 days and five nitrogen levels, i.e., without nitrogen (control), 15, 30, 45 and 60 kg N/fad. Nitrogen (urea 46%) was applied after thinning and before the first irrigation. The experiments were designed according to split-plot design with four replications. The irrigation intervals were arranged at random in the main plots, while the nitrogen levels were assigned at random in sub-plots. The area of the sub-plot was 1/400 fad. Each sub-plot consisted of five ridges of 3 m. length and 60 cm. width. Hills were spaced by 30 cm. between hill. The sowing dates were carried out on 22 and 27 June in the first and second seasons,

respectively. The normal culture practices for growing sunflower were followed as recommended in the region.

The following data were recorded: plant height (cm.), number of leaves/plant, head diameter (cm.), stem diameter (cm.), leaf area dm²/plant, 100-seed weight (gm.) seed yield/plant (gm.), weight of head/plant (gm.), seed yield ton/fad., oil percent and oil yield kg/fad. by using the method of A.C.A.O. The data were analyzed statistically according to the procedure outlined by Snedecor and Cochran (1967). For comparison between means, Duncan's multiple range test was used (Duncan, 1955). Means followed by the same alphabetical letters are not statistically differed at the 5% level of significance.

RESULTS AND DISCUSSION

A- Effect of irrigation:

1- Growth Characters:

Results in Table (1) show that differences between the averages of plant height, number of leaves/plant, stem diameter as well as leaf area were significant. The highest values of growth characters were obtained from irrigation every 14 days in both seasons. There was no significant differences between irrigation every 14 and 21 days on plant height in both seasons. But there was significant differences between effect of irrigation every 14 and 21 days on number of leaves/plant, stem diameter and leaf area in the two successive seasons. On the other hand, increasing irrigation every 7 days significantly decreased the previous characters in the two seasons. The increase in growth characteristics due to irrigation every 14 days might be attributed to the increase in photosynthetic ability and meristemic activity in sunflower tissues. These results are in agreement with those obtained by Pal (1981); Jana *et al.*, (1982) and Attia *et al.*, (1988).

Table (1): Effect of irrigation treatments on growth characters of sunflower.

Irrigation	Plant height cm	No. of leaves /plant	Stem diameter cm	L.A. dm ² /plant
1989 season				
Without	194.7a	17.78a	2.014a	34.18a
Every 7 days	202.1b	18.88b	2.151b	42.64b
Every 14 days	217.4d	20.61c	2.291c	51.93d
Every 21 days	206.7c	19.43b	2.200b	45.49c
1990 season				
Without	186.1a	17.31a	1.965a	32.07a
Every 7 days	198.2b	18.18b	2.096b	39.35b
Every 14 days	210.2c	20.06d	2.236d	49.79c
Every 21 days	204.9c	18.85c	2.170c	43.48b

2- Yield, yield components and oil percent:

Data in Table (2) indicated that irrigation significantly increased, head diameter, weight of 100-seed, seed yield/plant, weight of head/plant, seed yield t/fad., oil percent and oil yield kg/fad. in both seasons.

Irrigation every 14 days gave the highest values whereas the irrigation every 7 and 21 days significantly decreased the previous characters in both seasons than without irrigation. The increase of seed yield/fad. with irrigation every 14 days may be due to the increase of dry matter accumulation, head diameter, weight of head/plant, weight of 100-seed, seed yield/plant. These results are in harmony with those obtained by Herman *et al.*, (1982); Rawson & Turner, (1983) and Attia *et al.*, (1988).

In both seasons, seed oil percent as well as oil yield kg/fad. were significantly affected by irrigation (Table 2). Irrigation every 14 days gave the highest values of yield, yield components and oil percent. On the other hand, irrigation every 7 and 21 days reduced significantly oil percent in the two successive seasons than the highest one. Oil yield kg/fad. had similar trend of oil percent in both seasons. These increases in oil yield resulted from irrigation every 14 days were quite expected, since the seed and oil percentage were significantly increased in the same trend. These results are in harmony with those obtained by Attia *et al.*, (1988).

Table (2): Effect of nitrogen, phosphorus and potassium fertilizer levels on growth characters of sunflower .

Fertilizer Kg/Fad.	Plant height cm.	No. of leaves / plant	stem diameter cm.	L.A. dm2 / plant
1988 Season				
N (0)	195.2 a	19.72 a	1.85 a	43.45 a
N (20)	203.5 b	20.95 b	1.91 b	51.62 b
N (40)	208.4 bc	21.38 bc	1.96 bc	54.73 bc
N (60)	213.1 c	21.74 c	1.98 c	58.27 c
P ₂ O ₅ (0)	198.9 a	20.27 a	1.85 a	49.05 a
P ₂ O ₅ (16)	211.3 b	21.62 b	1.99 b	54.97 b
K ₂ O (0)	201.2 a	20.54 a	1.87 a	50.94 a
K ₂ O (24)	208.9 b	21.35 b	1.97 b	53.09 a
1989 Season				
N (0)	190.3 a	18.24 a	1.56 a	39.46 a
N (20)	204.8 b	19.34 b	1.72 b	43.43 b
N (40)	210.7 c	19.52 b	1.74 bc	47.71 c
N (60)	212.8 c	19.74 b	1.78 c	51.95 d
P ₂ O ₅ (0)	199.9 a	18.76 a	1.65 a	42.60 a
P ₂ O ₅ (16)	209.4 b	19.66 b	1.76 b	48.68 b
K ₂ O (0)	202.1 a	18.96 a	1.67 a	44.61 a
K ₂ O (24)	207.2 b	19.46 b	1.73 b	46.67 a

B- Effect of Nitrogen:**1- Growth characters:**

The averages of plant height, number of leaves/plant and stem diameter as affected by nitrogen levels are presented in Table (3). The highest values of all characters were obtained by applying 60 kg N/fad.

Data indicated that the plant height, increased significantly as N-level increased up to 60 kg N/fad. in the both seasons. The increases in the plant height of sunflower with higher doses of nitrogen fertilizer may be due to the effect of nitrogen in increasing the number and/or the size of cells, increasing the number and length of internods. Similar results were obtained by Singh *et al.*, (1987) and El-Mesilhy, (1989).

Table (3): Effect of nitrogen levels on growth characters of sunflower.

Treatment	Plant height cm	No. of leaves /plant	Stem diameter cm	L.A. dm ² /plant
1989 season				
NO	190.2a	17.87a	2.037a	32.38a
N15	199.9b	18.58b	2.145b	41.37b
N30	205.6c	19.15c	2.176bc	45.06bc
N45	212.6d	19.94d	2.215cd	48.29cd
N60	217.8e	20.32d	2.247d	50.71d
1990 season				
NO	189.5a	17.18a	1.986a	28.60a
N15	195.0b	18.60b	2.063b	38.38b
N30	201.1c	18.77bc	2.142c	43.01c
N45	204.1c	18.98bc	2.174cd	46.16cd
N60	209.2d	19.48c	2.218d	49.72d

Concerning number of leaves per plant, increasing nitrogen levels from control to 60 kg N/fad. increased number of leaves/plant in both seasons. It could be concluded that N fertilizer showed a positive effect on number of leaves/plant. These results indicate the important role of nitrogen elements for plant growth. These results are in agreement with those reported by Shabana (1978) and Simon (1986).

Results show that the stem diameter increased significantly as the N-level increased up to 60 kg N/fad. in both seasons. These results were expected since nitrogen fertilizer increases the vegetative growth of sunflower plants. These results are in agreement with those obtained by Daulay & Singh (1980); El-Mohandes, (1984) and Simon (1986).

With respect to the leaf area dm^2/plant , the maximum values were observed in both seasons when 60 kg N/fad. was applied. The increase in leaf area of sunflower may be due to the stimulating effect of N fertilizer on metabolic process in sunflower. Similar results were obtained by El-Mohandes, (1984); Simon, (1986) and El-Mesilhy, (1989).

2- Yield, yield components and oil percent:

Table (4) show the averages of head diameter, 100-seed weight, seed yield/plant, weight of head, seed yield/fad. oil percent and oil yield/fad. in both seasons.

With the exceptional of oil percentage, weight of head in both seasons and seed yield ton/fad. in the first season the highest values of yield and its components were obtained by applying 60 kg N/fad., but without significant superiority over 45 kg N/fad. in both seasons.

Concerning head diameter, it was significantly increased as the nitrogen level increased up to 60 kg N/fad. in both seasons. These results might be attributed to the effect of nitrogen in increasing the metabolites translocated to the head. The effect of nitrogen on head diameter of sunflower plants was studied by many investigators (Daulay & Singh, 1980; El-Mohandes, 1984 and El-Mesilhy 1989). They reported that head diameter significantly increased by the application of nitrogen levels.

Concerning 100-seed weight, it significantly increased as the nitrogen level increased from zero to 60 kg N/fad. in both seasons. These results might be attributed to the increase in the metabolic components synthesized in the plants. These results are in agreement with those obtained by Moursi *et al.*, (1983) and El-Mesilhy (1989).

The head weight/plant significantly increased with increasing nitrogen level up to 60 kg N/fad., but without significant superiority over 30 kg N/fad. in both seasons. These results suggest that a positive relationship between head diameter and head weight of sunflower exists. These results agree with those obtained by Moursi *et al.*, (1983) and El-Mesilhy (1989).

Table 4: Effect of nitrogen, phosphorus and potassium fertilizer levels on yield, yield components, oil content and oil yield of sunflower.

Fertilizer Kg/Fed	Head diameter cm.	Height of 100 - seed gm.	Seed yield /plant gm.	Height of head gm.	Seed yield ton / fed.	Oil %	Oil yield Kg / fed.
N (0)	18.46 a	7.138 a	57.5 a	85.37 a	0.993 a	44.23 c	440.29 a
N (20)	19.86 b	7.620 b	68.01 b	98.69 b	1.224 b	44.02 bc	539.27 b
N (40)	20.42 bc	8.108 bc	71.90 bc	102.11 bc	1.294 bc	43.66 ab	565.37 bc
N (60)	20.94 c	8.495 c	75.28 c	105.12 c	1.355 c	43.31 a	587.07 c
P205(0)	19.22 a	7.455 a	64.73 a	91.71 a	1.150 a	43.12 a	495.82 a
P205(16)	20.61 b	8.226 b	71.65 b	103.91 b	1.282 b	44.49 b	570.18 b
K20(0)	19.47 a	7.662 a	66.26 a	94.65 a	1.178 a	43.49 a	512.68 a
K20(24)	20.37 b	8.019 b	70.12 a	100.97 b	1.255 b	44.11 b	552.32 b
N (0)	17.08 a	6.154 a	50.43 a	80.13 a	0.899 a	44.16 c	397.84 a
N (20)	18.37 b	6.818 b	62.02 b	94.10 b	1.116 b	43.73 bc	488.59 b
N (40)	18.74 bc	7.267 bc	66.14 bc	97.90 bc	1.178 bc	43.42 ab	512.01 bc
N (60)	19.08 c	7.605 c	69.17 c	101.20 c	1.239 c	43.13 a	534.63 c
P205(0)	18.01 a	6.628 a	58.93 a	86.84 a	1.042 a	42.92 a	446.82 a
P205(16)	19.13 b	7.294 b	64.95 b	99.82 b	1.174 b	44.30 b	519.72 b
K20(0)	18.21 a	6.790 a	60.30 a	90.17 a	1.069 a	43.32 a	463.29 a
K20(24)	18.93 b	7.132 b	63.58 a	96.49 b	1.147 b	43.90 b	503.25 b

Seed yield/plant, seed yield/fad. and oil yield/fad. significantly increased by the highest level of nitrogen (60 kg N/fad.). The application of 60 kg N/fad. significantly increased the seed yield/plant and per fad. and oil yield/fad. by 37.08%, 65.18% and 77.05% in the first season and 57.74%, 71.62% and 52.87% in the second season, over control treatment. It could be concluded that nitrogen had a significant effect on the seed and oil yield in sunflower plant. These results are expected since nitrogen significantly increased head diameter, 100-seed weight, weight of seed yield/plant and leaf area. In addition, these increases in oil yield resulted from the increases in N-fertilizer may be due to high seed yield. These results are in harmony with those obtained by El-Mohandes (1984) and El-Mesilhy (1989) for seed yield/plant and Moursi *et al.*, (1983) and Sorour & Attia (1988), for seed yield ton/fad. and by El-Mohandes (1984) and Sorour & Attia (1988) for oil yield kg/fad.

Seed oil percent in sunflower seeds was significantly decreased by application of nitrogen in both seasons.

The decrease in seed oil percent by nitrogen fertilizer may be due to the increase in seed protein content at the expense of oil concentration. Similar results reported by El-Mohandes (1984) and Singh *et al.*, (1987).

C- Interaction Between Irrigation and Nitrogen Fertilizer:

It this study it was not significant for all studied traits in both seasons. This result indicates that the separately effect of irrigation treatments and nitrogen levels. Consequently the data were excluded.

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استجابة عباد الشمس للرى والتسميد النتروجيني

هارون محمد محمد موسى النجار

أقيمت تجربتان حقليتان بمزرعة كلية الزراعة بمشتهر في
موسمى ١٩٨٩، ١٩٩٠ لدراسة تأثير الرى والنتروجين على صفات النمو
- مكونات المحصول والمحصول ونسبة الزيت لمحصول عباد الشمس
صنف ميك.

وتضمنت التجربة ٢٠ معاملة عبارة عن التوافق بين أربع
معاملات للرى (بدون رى - رى كل أسبوع - رى كل أسبوعين - رى كل
ثلاثة أسابيع) وخمس مستويات للنتروجين (صفر، ٣٠، ٤٥، ٦٠ كجم
نيترات/فدان) أضيفت بعد الخف وقبل رية المحياة. واستخدم
تصميم القطع المنشقة مرة واحدة حيث خصمت القطع الرئيسية
لمعاملات الرى والقطع المنشقة لمعاملات النتروجين.

وتتلخص أهم النتائج فى النقاط التالية:

أدى الرى كل ١٤ يوم الى زيادة معنوية فى طول النبات - عدد
الأوراق للنبات - سمك الساق - مساحة الأوراق للنبات - عرض
القرص - وزن ١٠٠ بذرة وزن بذور النبات - وزن القرص للنبات -
نسبة الزيت فى البذور - محصول الزيت كيلو جرام/ فدان وحصول
البذور طن/ فدان.

أدى اضافة النتروجين حتى ٦٠ كيلوجرام نتروجين/ فدان الى
زيادة معنوية فى طول النبات وعدد الأوراق فى كلا الموسمين.

أدى اضافة النتروجين حتى ٦٠ كجم نتروجين/ فدان الى زيادة
معنوية فى سمك الساق ومساحة الأوراق وعرض القرص ووزن بذور
النبات ولكنها لا تتفوق على تأثير الاضافة بـ ٤٥ كيلو جرام
نتروجين فى كلا الموسمين.

أدى اضافة النتروجين حتى ٣٠ كيلو جرام نتروجين/ فدان الى
زيادة معنوية فى وزن ١٠٠ بذرة فى الموسم الأول وحتى ٤٥ كيلو
جرام نتروجين/ فدان فى الموسم الثانى وكانت هناك زيادة
للمستويات الاعلى ولكنها غير معنوية.

زاد وزن القرص باضافة النتروجين حتى ٦٠ كيلو جرام/
نتروجين - فدان ولكن هذه الزيادة غير معنوية بينها وبين كل من
المعاملتين ٣٠، ٤٥ كيلو جرام نتروجين/ فدان فى كلا الموسمين.

أدى إضافة النتروجين حتى ٤٥ كيلو جرام نتروجين/ فدان الى نقص نسبة الزيت معنويا في موسمي الزراعة .

أدى إضافة النتروجين حتى ٤٥ كيلو جرام نتروجين/ فدان الى زيادة معنوية في محصول الزيت كيلو جرام/ فدان وكانت الزيادة الناتجة عن إضافة ٦٥ كيلو جرام نتروجين/ فدان غير معنوية في كلا الموسمين .

وبناء على النتائج السابقة يمكن استنتاج أن الري كل ١٤ يوم أو التسميد بمعدل ٦٥ كيلو جرام نتروجين/ فدان للمنف مياك من أهم المعاملات التي تزيد محصول البذرة والزيت في عباد الشمس .

INTRODUCTION

This information is available regarding the use of fertilizer with the aim to obtain maximum yield and quality of the crop. The present study was conducted to identify the best practice for fertilization of cotton. The results of the study are presented in this paper. The study was conducted in the experimental station of the Ministry of Agriculture, Baghdad, Iraq. The study was conducted during the growing season of 1977. The results of the study are presented in this paper. The study was conducted in the experimental station of the Ministry of Agriculture, Baghdad, Iraq. The study was conducted during the growing season of 1977. The results of the study are presented in this paper.