EFFECT OF NITROGEN, PHOSPHORUS AND POTASSIUM FERTILIZER LEVELS ON SUNFLOWER (HELIANTHUS ANNUAS, L.)

BY

El-Naggar, H.M.M. and Allam, S.A.H.

Depart. of Agron., Faculty of Agriculture Moshtohor, Egypt.

ABSTRACT

Two field experiments were conducted at the Research and Experimental Station of Moshtohor, Faculty of Agriculture during 1988 and 1989 seasons to sutdy the effect of nitrogen, phosphorus and potassium fertilizer levels on growth characters, yield, yield components, oil content and oil yield of sunflower (Helianthus annuus, L.) var. Mayak. Application of nitrogen increased plant height, number of leaves/plant, stem diameter, leaf area dm^2/plant, head diameter, weight of head, weight of 100-seed, weight of seeds/plant, seed yield and oil yield/fad. However, oil content was significantly decreased. Phosphorus (16 kg P_2O_5/fad.) showed a significant increase in all previous characters. All the studied characters were affected significantly by application of potassium fertilizer (24 kg K_2O/fad.) except L.A. dm^2/plant and seed yield/plant. The interaction effect of nitrogen x phosphorus, nitrogen x potassium, phosphorus x potassium and nitrogen x phsosphorus x potassium were not significant for all traits under study in both seasons. The highest seed yield of sunflower under study was obtained by applying 60 kg N/fad., 16 kg P_2O_5/fad. and 24 kg K_2O/fad to the soil.

INTRODUCTION

Sunflower is one of the important oil crops grown in the world. In Egypt there is a big problem concerning edible oil proudction. The local production satisfies 20% only of the total requriements. To increases the total production of the edible oil the area of oil crops such as sunflower should be increased in the newly reclaimed soils and/or apply the best cutlural practices, i.e., nitrogen, phosphorus and potassium fertilizers. Ahmed, (1977) and El-Emam (1984), found that plant height, head diameter, 200-seed weight, seed yield and oil yield were increased by increasing nitrogen fertilizer but seed oil

content was decreased. El-Mohandes (1984), showed that increasing nitrogen fertilizer levels for 30 to 60 kg/fad to sunflower resulted in an increase in stem diameter, and L.A./plant. Simon (1986), reported that the number of leaves/plant was consistently higher by giving 200 kg N/ha compared with no application of nitrogen. El-Mesilhy (1989), pointed out that highest seed yield was obtained by the application of 20 and 40 kg N/fad.

Blamey and Chapman (1981), showed that phosphorus fertilizer increased seed oil content and oil yield of sunflower. Diab (1981), found that phosphorus application caused a significant increase in plant height, seed yield per head and 100-seed weight. Tripathi and Kalra (1981), reported that application of 60 kg P_2O_5/ha to sunflower increased head diameter and seeds/head. El-Emam (1984) and Popescu et al. (1986), found that phosphorus fertilizer significantly increased L.A./plant, plant height, head diameter, seed oil content, seed yield/fad. and oil yield/fad. Kadar and Vass (1988), showed that application of 120 kg each of N.P.K. increased plant height, head diameter and seed yield.

Kamel et al. (1985), found that K-fertilizer affected oil percentage and oil yield. Sarkar et al. (1987), showed that K-fertilizer had a significant effect on leaf area index. Al-Nawas (1988), found that K-rate had an effect on 1000-seed weight, total seed, oil yield and seed oil content.

The present investigation was achieved to study the effect of nitrogen, phosphorus and potassium fertilizer levels on sunflower.

MATERIALS AND METHODS

This investigation was carried out at the Research and Experimental Station of Moshtohor, Faculty of Agriculture during 1988 and 1989 seasons. Soil type is clay. The chemical analysis of the soil is shown in Table (1).

Table (1): The chemical analysis of the experimental soil.

soil sample	O.M%	PH	N PPm	P PPm	Soluble cations and anions meg./L							
					K+	Na+	Ca++	Mg++	Co= 3	Hco- 3	Cl-	So= 4
Moshto-hor	1.72	7.8	47	29	0.9	8.12	3.72	8.20	4.01	4.99	9.0	3.69

The preceding crop was Egyptian clover in both seasons. The experimental design used was a randomized complete block one with four replications. Sixteen treatments were used in this investigation. These treatments were combinations of four nitrogen levels (0, 20, 40 and 60 kg N/fad.), two phosphorus levels (0 and 16 kg P_2O_5/fad.) and two potassium levels (0 and 24 kg K_2O/fad). Each plot included 5 ridges 60 cm apart and 3 m length comprising 1/400 fad. Seeds were planted in hills spaced 30 cm. apart within each ridge. Sunflower variety Mayak was used in this investigation and sown on June 21st an 27th in 1988 and 1989, respectively. The normal culture practices for growing sunflower were followed as recommended in the region.

Phosphorus fertilizer (calcium superphosphate 15.5% P_2O_5) and potassium fertilizer (potassium sulphate 48% K_2O) were added before sowing but nitrogen fertilizer (Urea 46% N) was added after thinning.

The characters under study were, plant height (cm), number of leaves/plant, stem diameter (cm), leaf area (dm^2)/plant, weight of 100-seed (gm), seed yield (gm)/plant, head diameter (cm), weight of head/plant (gm), seed yield (ton/fad), seed oil content and oil yield kg/fad. Data of the two seasons were analysed according to Snedecor and Cochran (1967). Comparison between means was carried out by using Duncan's multiple range test (Duncan, 1955). Means followed by the same alphabetical letters are not statistically different at the 5% level of the significance.

RESULTS AND DISCUSSION

A- Growth Characters:

1- Effect of nitrogen fertilizer levels:

The growth characters of sunflower as influenced by nitrogen fertilizer levels are presented in Table (2). The data indicated that the levels of nitrogen fertilizer had a significant effect on all traits studied in the two seasons. It could be noticed that increasing nitrogen from 0 to 60 kg N/fad increased plant height, stem diameter and leaf area (dm^2)/plant in both seasons, and number of leaves/plant in the first season. On the other hand, the number of leaves/plant in the second season increased with the application of 20 kg N/fad. It could be suggested that the increase in growth due to the application of N-fertilzier may be attributed to increasing the capacity of plants in building metabolites and consequently growth characters.

Table (2): Effect of irrigation treatments on yield, yield components, oil percent and oil yield of sunflower.

Irrigation	Head diameter cm	Weight of 100-seed. gm.	Seed yield /plant gm.	Weight of head gm	Seed yield ton/fad	Oil%	Oil yield kg/fad.
			1989 Season				
Without	14.72 a	5.32 a	45.33 a	94.66a	0.742 a	41.08 a	303.96 a
Every 7 days	16.86 b	5.99 b	56.25 b	115.27b	1.002 b	42.55 b	425.54 b
Every 14 days	18.79 d	6.71 c	63.85 c	131.24c	1.235 d	43.80 d	540.28 d
Every 21 days	18.01 c	6.32 bc	60.20 bc	126.51c	1.137 c	43.20 c	490.48 c
			1990 Season				
Without	14.06 a	5.07 a	39.49 a	88.95 a	0.610 a	40.90 a	249.01 a
Every 7 days	15.93 b	5.85 b	51.58 b	110.38 b	0.919 b	42.29 b	388.09 b
Evey 14 days	17.90 c	6.63 c	61.14 c	126.94 c	1.122 d	43.60 d	488.60 d
Every 21 days	17.13 c	6.22 b	56.37 bc	121.89 bc	1.038 c	42.93 c	445.17 c

These results are in agreement with thsoe obtained by El-Mohandes, (1984); Simon, (1986) and El-Mesilhy, (1989).

2- Effect of phosphorus fertilizer levels:

The data in Table (2) showed that there was a gradual increase in all traits studied by the application of phosphorus fertilizer at 16 kg P_2O_5/fad. in the two successive seasons. Such results were expected since phosphorus is known to be essential for cell division and development of roots growth. Similar results were obtained by Diab, (1981); El-Emam, (1984) and Kadar & Vass, (1988).

3- Effect of potassium fertilizer levels:

The data shwon in Table (2) indicated that increasing level of K-fertilization from 0 to 24 kg K_2O/fad. significantly increased plant height, number of leaves/plant and stem diameter. On the other hand K had no significant effect on L.A. (dm^2)/plant in both seasons. The positive effect of K-fertilization on the vegetative growth of plant was reported by Watson (1956), who mentioned that K-deficient plants might have smaller leaf surface as well as lower photosynthetic rates per unit area of leaf surface. In addition Hartt (1969), stated that K promotes translocation of newly synthesized photosynthates to different plant organs. These results are in agreement with those reported by Kadar and Vass (1988).

B- Yield, Yield Components, Oil Content and Oil Yield:

1- Effect of nitrogen fertilizer levels:

Table (3) shows that the differences between the averages of yield components, i.e head diameter, weight of 100-seed, seed yield/plant and weight of head/plant were significant with regard to N-levels in the two seasons. The highest values of previous characters were obtained from 60 kg N/fad. Whereas, the lowest ones for the respective charcters were obtained from the control treatment. Also, the data indicated that there was a gradual increase in seed yield (ton/fad) by increasing N-fertilizer up to 60 kg N/fad. in both seasons. Percentages of increase in seed yield/fad. were 36.46%, 10.70% and 4.71% for the first season and 37.82%, 11.02% and 5.18% for the second season due to application of 60 kg N/fad. over each of control, 20 and 40 kg N/fad. respectively.

These results are expected since nitrogen significantly increased head diameter, 100-seed weight and weight of seeds/plant. In addition, increases in oil yield resulted from the increases in N-fertilizer may be due to high seed yield. Percentages of increase in oil yield/fad. were 33.34%,

Table (4): Effect of nitrogen levels on yield, yield components, oil percent and oil yield of sunflower.

Treatment	Head diameter cm.	Weight of 100-seed. gm.	Seed yield /plant gm.	Weight of head gm.	Seed yield ton/fad.	Oil%	Oil yield kg/fad.
			1989 Season				
N0	15.74 a	5.02 a	41.68 a	92.94 a	0.693 a	43.18 c	300.86a
N15	16.49 b	5.81 b	52.09 b	100.69 b	0.968 b	43.07 c	418.99b
N30	17.13 bc	6.31 bc	59.27 c	122.34 c	1.097 c	42.75 bc	471.03c
N45	17.90 cd	6.56 bc	62.57 cd	127.86 c	1.160 d	42.35 ab	493.05cd
N60	18.21 d	6.74 c	66.25 d	130.77 c	1.227 e	41.93 a	516.41d
			1990 Season				
No	14.93 a	4.89 a	37.46 a	88.07 a	0.691 a	42.92 c	298.43a
N15	16.01 b	5.69 b	48.09 b	105.82 b	0.849 b	42.85 c	365.92b
N30	16.40 bc	6.16 c	54.91 c	117.47 c	0.955 c	42.59 bc	408.67c
N45	16.77 cd	6.42 cd	58.39 cd	122.99 c	1.026 cd	42.12 ab	434.34cd
N60	17.21 d	6.59 d	61.88 d	125.87c	1.090 d	41.66 a	456.22d

8.86% and 3.83% for the first season and 34.38%, 9.42% and 4.42% for the second season due to application of 60 kg N/fad. over each of control, 20 and 40 kg N/fad. respectively. These results are in harmony with those obtained by El-Mohandes (1984) and El-Mesilhy (1989). Whereas, seed oil content in sunflower seeds was significantly decreased by application of nitrogen in both seasons. The decrease in seed oil content by N-fertilizer application may be attributed to the increase in seed protein content at the expence of oil concentration. Similar results were reported by El-Mohandes (1984).

2- Effect of phosphorus fertilizer levels:

The effect of phosphorus fertilizer levels on the studied characters in the two seasons are presented in Table (3). Evidently, P-levels had a significant effect on head diameter, weight, of 100-seed, seed yield/plant, weight of head, seed yield, oil content and oil yield. The maximum values for these characters were recorded when 16 kg P_2O_5/fad. was applied. Applying P-fertilizer at 16 kg P_2O_5/fad. increased seed yield/fad. by 11.48% and 12.67% compared with control in 1988 and 1989 seasons, respectively. Applying P-fertilizer up to 16 kg P_2O_5/fad. increased oil yield/fad. by 14.99% and 16.32% compared with control in 1988 and (1989) seasons, respectively. This could be attributed to the role of P as a constituent of phospholipides. These results are in harmony with those obtained by Diab (1981) and El-Emam (1984).

3- Effect of potassium fertilizer levels:

It is shown in Table (3) that K-fertilizer increased significantly head diameter. Weight of 100-seed, weight of head/plant, seed yield (ton/fad.), oil content and oil yield (kg/fad) in the two seasons. However, seed yield/plant was not affected. The highest values of the previous characters were obtained from 24 kg K_2O/fad. Seed yield/fad. significantly increased as K-levels increased up to 24 kg K_2O/fad. in both seasons.

This superiority in seed yield amounted to 6.53% and 7.29% in 1988 and 1989 seasons, respectively as comapred to control. Oil yield/fad. significantly increased as K-levels increased up to the level of 24 kg K_2O/fad. in both seasons. Percentages of increase of oil yield/fad. were 7.93% and 8.63% compared with control in 1988 and 1989 seasons, respectively. The increase in average values of seed yield/fad. resulted from the increase in head diameter, weight of 100-seed and weight of head/plant. These results are in agreement with those obtained by El-Nawas (1988) and Kadar & Vass (1988).

C- Effect of Interaction:

Statistical analysis of the data on all studied traits showed that the interaction effects of nitrogen x phosphorus, nitrogen x potassium, phosphorus x potassium and nitrogen x phosphorus x potassium were not significant in both seasons. Consequently, interaction data were excluded.

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تاثير مستويات التسميد النتروجيني والفوسفاتي والبوتاسي على عباد الشمس

هارون محمد موسى النجار صلاح عباس حسن علام

أجريت تجربتان حقليتان بمزرعة كلية الزراعة بمشتهر خلال موسمي ١٩٨٨، ١٩٨٩ وذلك لدراسة تاثير مستويات مختلفة من التسميد النتروجيني (صفر، ٢٠، ٤٠، ٦٠ كجم نتروجين/ ف) والفوسفور (صفر و ١٦ كجم فو٢٥٩٢/ ف) والبوتاسيوم (صفر و ٢٤ كجم بو٢ ٦/ ف) على صفات النمو، المحصول، مكونات المحصول، نسبة الزيت ومحصول الزيت/ ف في عباد الشمس صنف مياك وكان التصميم المستخدم قطاعات كامله العشوائية في أربع مكورات.

وتم دراسة الصفات الاتية: طول النبات - عدد الاوراق - سمك الساق - مساحة الورقه - قطر القرص - وزن القرص - وزن ١٠٠ بذرة - وزن بذور النبات - محصول البذور والزيت/ف - نسبة الزيت في البذور وتتخلص أهم النتائج فيما يلي:

زاد معنويا كل صفات النمو ومكونات المحصول ومحصول البذور والزيت بالتسميد النتروجيني بينما نقصت معنويا نسبة الزيت.

وكانت نسبة الزيادة في محصول البذور للفدان ٣٦,٤٦٪، ١٠,٧٠ و ٤,٧١٪ في السنة الأولى و ٣٧,٨٢٪، ١١,٠٢٪ و ٥,١٨٪ في السنة الثانية وذلك عند اضافة ٦٠ كجم نتروجين/ ف بالمقارنة بالكنترول و ٤٠,٢٠ كجم نتروجين/ ف.

زاد معنويا كل صفات النمو ومكونات المحصول ومحصول البذور والزيت للفدان ونسبة الزيت باضافة معدل ١٦ كجم فو٢٥/٦٢ف مقارنة بالكنترول.

وكانت الزيادة فى محصول البذور للفدان ١١,٤٨٪، ١٢,٦٧٪ مقارنة بالكنترول فى موسمى الزراعة على الترتيب.

وقد تاثر طول النبات، عدد الاوراق وسمك الساق بالزيادة معنويا باضافة ٢٤ كجم بو٢ ٦/ف مقارنة بالكنترول ولم تتاثر مساحة الورقة للنبات معنويا.

بينما تاثر قطر القرص، وزن القرص، وزن ١٠٠ بذرة ومحصول البذور للفدان معنويا ولم يتاثر محصول بذور النبات باضافة البوتاسيوم.

زاد معنويا كل من نسبة الزيت ومحصول الزيت/ف وذلك باضافة ٢٤ كجم بو٢٦/ف مقارنة بالكنترول.

وكانت نسبة الزيادة فى محصول البذور للفدان ٦,٥٣٪، ٧,٢٩٪ عند اضافة ٢٤ كجم بو٢٦/ف بالمقارنة بالكنترول فى موسمى الزراعة على الترتيب ويمكن الاستنتاج ان التسميد النتروجينى بمعدل ٦٠ كجم نتروجين/ف، ١٦ كجم فو٢٥/٦٢ ف و ٢٤ كجم بو٢٦ من اهم التوصيات التى يمكن استخلاصها من هذه الدراسة.