EFFECT OF TIME OF N APLICATION WITH AND WITHOUT P ON SUNFLOWER

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INTRODUCTION

Sunflower is one of the most important oil crops in the world. However, it is a new oil crop in Egypt. Therefore, the research work on sunflower, in Egypt, commenced recently. Consequently, the available information about sunflower husbandry are still scarce. The results of some studies which carried out in Egypt revealed that the response of sunflower yield to N fertilization was relatively low. The highest seed yield of sunflower was obtained by adding of 40-45 kg N/feddan one faddan = 0,42 ha. at plant age of 30 days (El-Sawaby and Omran 1976, Ahmed 1977, Shabana 1978 and 1979, and El-Mohandes 1979). Also, Massey (1971), in USA, found that the highest seed yield of sunflower was obtained by application of 56 kg N/ha.

Regarding, phosphorus fertilization, El-Sawaby and Omran (1976) in Egypt and Zubriski and Zimmerman (1974) in USA reported that application of phosphorus alone had no significant effect on seed yield of sunflower. However, many workers stated that the best yield of sunflower could be obtained by application of N, P and K in combinations together (Saric *et al.* 1972, Hera 1974 and El-Sawaby and Omran 1976).

The objective of this investigation is to find the proper time for application recomended N level (95 kg/ha) with and without P on yield, yield components, and other agronomic characteristics of sunflower.

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MATERIALS AND METHODS

The experiment was carried out at the Agricultural Experiment and Research Centre, Faculty of Agriculture, Cairo University, Giza, Egypt, during 1977 and 1978 seasons. The soil type is loamy clay in texture, Ph range 7.1 to 7.8. The soil contained 0.10-0.12% total N, and 0.18-0.20% total P. Giza 1 variety was used in both seasons. The following treatments were used in both seasons:

1. Phosphorus fertilizer (super phosphate 15% P_2O_5) was applied at rates of 0 and 71.4 kg P_2O_5 per hectare at planting.
2. 95 kg N/ha was applied according the following system:

plant age (days)	Growth stage	Corresponding irrigation
at planting	at planting	Planting irrigation
at 30	3-4 Pairs of leaves	*2nd* irrigation
at 45	6-8 Pairs of leaves	*3rd* irrigation
at 60	at budding	*4th* irrigation

Planting date was April 26 in 1977 and March 30 in 1978. A split plot design with four replications was used. Main plots were devoted to phosphorus fertilizer (0 and 71.4 kg P_2O_5), while sub plots were assigned to time of N application. Each sub plot had 6 ridges, 6 meters long and 60 cm apart. Sunflower seeds were planted in hills spaced by 30 cm within ridges. One month after planting hills were thinned to secure one plant per hill. Plants were irrigated at 15-day intervals. At the end of pollination, a guarded 10 plants from the *2nd* row of each sub plot were taken to estimate stem diameter (cm), plant height (cm), number of leaves and leaf area per plant (LA) in dm^2 according to Terhan *et al.* (1975) and leaf area index (LAI) according to Watson (1958).

At harvest, ten heads were randomly taken to determine head diameter, number and weight of seeds per head and 1000 seed weight. The plants of a two inner ridges were harvested in August 13 in 1977 and July 20 in 1978 and seed yield per hectare was calculated. Seed yield was adjusted to to 13% moisture content. Seed oil content was estimated according to comstack and Culbertson (1958). Oil yield was calculated.

All data were subjected to analysis of variance according to

Snedecor and Cochran (1967) and the treatment means compared according to Duncan's multiple range test (Duncan 1955). In Tables 1, 2, 4 and 5 the averages which followed by the same letter(s) are not significantly different.

RESULTS AND DISCUSSION

1. Morphological Characters

1.1. Effect of Phosphorus Fertilization:

The data of Table 1 show that stem and head diameter, plant height, number of leaves and leaf area per plant, LAI and days to flowering (appearance of ray flowers of 50% of sub plot plants) were not significantly affected by application of 71.4 kg P_2O_5/ha in both seasons. Such results could be explained as the natural reserves of P in the soil was enough to satisfy the requirements of sunflower plants. This explanation in general agreement with the conclusion of Hera (1974) who concluded that the reduced effect of fertilizers on sunflower was due mainly to the capacity of its radicular system to draw the nutritive elements from less soluble forms in the soil. These results also are in harmony with those obtained by Zubriski and Zimmerman (1974), and El-Sawaby and Omran (1976).

TABLE 1

Effect of P fertilization on some morphological characters in 1977 and 1978 seasons

Character	P_2O_5,Kgl/ha			
	0	7,14	0	7,14
	1977		1978	
1.— Days to heading	80.7aa	79.5a	79.0a	79.5a
2.— Stem diameter (cm)	2.0a	2.1a	2.1a	2.1a
3.— Leaf number/plant	23.7a	25.2a	25.7a	28.0a
4.— LA/Plant (dm^2)	505.0a	542.0a	745.0a	737.0a
5.— LAI	2.8a	3.0A	4.3a	4.1a
6.— Plant height (cm)	259.0a	257.0a	267.0a	266.0a
7.— Head diameter (cm)	13.7a	13.6a	14.6a	14.5a

1.2. Effect of Time of Nitrogen Application

Table 2 shows that when N application was delayed until the 45 days plant age the plants were significantly delayed in flowering in 1978 season only. Also, the plants became shorter in 1977. However, delayed N application until plant age of 30 or 60 days in 1977 and 1978 seasons, respectively, significantly increased leaf number and LA/plant, and LAI. Such increase in leaf characters may be due to the important effect of N on the leaf longevity and also its direct effect on the formation of the new leaves.

On the other hand, greatest head diameter was obtained when N was applied at planting in both seasons, and tended to decrease by delaying N application (Table 2). The superiority of early time of N application may be due to the stimulation effect of N on metabolism processes which reflected on an increased in dry matter formation which migrated at heading to form greater heads.

1.3. Effect of Interaction

The interaction between P fertilization and time of N application had a significant effect on number of leaves per plant, LAI and head diameter in 1977 season only. The results obtained showed that the greatest head diameter was observed when N was applied at planting for the plants which fertilized by 71.4 kg P_2O_5/ha (Table 3). However, the greatest leaf number/plant and LAI value were recorded from the plants which fertilized by 71.4 kg P_2O_5/ha when N was applied at 45 and 30 days after planting, respectively (Table 3).

2. Yield and yield components

2.1. Effect of Phosphorus Fertilization

The results presented in Table 4 show that addition of 71.4 kg P_2O_5/ha caused a significant increase in number of seeds/head and oil yield/ha, only in 1977 season. The increase in oil yield was estimated by 11.5% (a 2-year average). In context, seed yield was insignificantly increased due to P fertilization by 9% (average of two seasons). Therefore, the increase in oil yield may be due to the increase in seed yield rather than the increase in oil content which estimated by 0.6% in both seasons. Zubriski and Zimmerman (1974), and El-Sawaby and Omran (1976) stated that phosphorus fertilization had no significant effect on sunflower seed yield.

TABLE 2

Effect of time of N application on some morphological characters 1977 and 1978 seasons.

Characters	Time of N application							
	At planting	30 days after planting	45 days after planting	60 days after planting	At planting	30 days after planting	45 days after planting	60 days after planting
	1977 season				1978 season			
1. Days to heading	81.0a	79.0a	81.5a	79.5a	77.5a	78.5ab	80.5b	80.5b
2. Stem diameter (cm)	2.0a	2.2a	2.2a	1.9a	2.0a	2.2a	2.2.a	2.2a
3. Plant height (cm)	275.0b	262.0b	244.0a	250.0a	278.0a	274.0a	268.0a	269.0a
4. Number of leaves/plant	22.5a	25.0b	25.0b	25.5b	25.0a	25.5a	24.5a	32.5b
5. (LA)/plant (dm^2)	383.0a	644.0b	487.0ab	582.0ab	593.0a	724.0a	671.0a	1034.0b
6. (LAT)	2.1a	3.6b	3.2b	3.2b	3.2a	4.0a	3.7a	5.7b
7. Head diameter (cm)	14.1b	14.1b	13.0a	13.2a	15.8b	13.8a	14.7ab	13.9a

TABLE 3

Leaf number per plant, LAI and head diameter as affected by P fertilization and time of N application in 1977 season

P_2O_5, kg/ha	Time of N application			
	at planting	30 days after planting	45 days after planting	60 days after planting
	1.— Leaf number/plant			
0	23.0	24.0	23.0	25.0
71-4	22.0	26.0	27.0	26.0
	2.— LAI			
0	2.4	3.4	2.4	3.0
71-4	1.8	3.8	3.0	3.5
	3.— Head diameter (cm)			
0	13.0	14.2	13.0	14.5
71-4	15.3	14.0	13.0	12.0

TABLE 4

Effect of P fertilization on yield and yield components in 1977 and 1978 seasons

Character	P_2O_5, kg/ha			
	0	71.4	0	71.4
	1977		1978	
1.— Number of seeds/head	743.0a	870.0b	665.0a	728.0a
2.— 1000-seed weight (gm)	66.7a	66.2a	79.0a	74.5a
3.— Seed weight/head (gm)	49.3a	55.9a	52.5a	53.9a
4.— Seed yield/ha (kg)	2572.0a	2987.0a	2685.0a	2775.0a
5.— Oil content (%)	27.9a	28.5a	28.6a	29.2a
6.— Oil yield/ha (kg)	711.6a	837.7b	749.7a	804.4a

TABLE 5

Effect of time of N application on yield and yield components in 1977 and 1978 seasons

Characters	Time of N application							
	At planting	30 days after planting	45 days after planting	60 days after planting	At planting	30 days after planting	45 days after planting	60 days after planting
	1977 Season				1978 Season			
1. Number of seeds/head	994.0b	870.b	761.0a	660.0a	705.0a	661.0a		
2. 1000-seed weight (gm)	61.5a	70.0b	68.5b	66.0b	73.5a	80.5a	74.0a	70.0a
3. Seed weight/head (gm)	61.2b	58.0b	47.3a	43.9a	55.5a	53.0a	52.2a	52.0a
4. Seed yield/ha (kg)	3258.0b	2889.0b	2672.0b	1587.0a	3134.0b	2646.0ab	2629.0ab	2511.0a
5. Seed oil content (%)	28.4a	28.8a	28.5a	27.2a	28.7a	28.3a	29.2a	28.4a
6. Oil yield/ha (kg)	911.0b	823.0b	747.0ab	618.0a	875.0b	740.0ab	761.0ab	702.0a

2.2. Effect of Time of Nitrogen Application:

The data tabulated in Table 5 indicated that the highest number and weight of seeds per head were obtained when N was applied at planting. Howerer they significantly decreased by delaying N application in 1977 only. In context, delaying N application until plant age of 30 days gave the highest 1000-seed weight in both seasons.

The highest seed and oil yields were obtained when N was applied at planting in both seasons. Seed and oil yields were significantly decreased when N application was delayed until the 60 days plant age. These reductions were estimated by 52 and 32% in 1977 and by 20 and 18% in 1978, respectively. The superiority of N which added early at planting may be due to the greater heads, greater number and weight of seeds per head than that of the plants which fertilized later on. However, seed oil content, was not significantly affected by the time of N application in both seasons.

2.3. Effect of interaction:

The interaction between P fertilization and time of N application had a significant effect on oil yield, only in 1977 season (Table 6).

The highest oil yield (1063 kg/ha) was obtained when N was applied at planting for the plots which fertilized by 71.4 P_2O_5/ha. These results are in harmony with those obtained by Saric *et al.* (1972), Hera (1974) and El-Sawaby and Omran (1976). They stated that the best yield of sunflower could be obtained by application of N, P and K in combination together.

TABLE 6

Oil yield (kg/ha) as affected by P fertilization and time of N application in 1977 season

P_2O_5, kg/ha	Time of N application			
	At planting	30 days after planting	45 days after planting	60 days after planting
0	729	721	735	635
71.4	1063	925	759	602

These results cleared that the best oil yield (1063 hg/ha), which resulted in form the combination of 71.4 kg P_2O_5 + 95 kg N/ha applied at planting, outyielded the usual treatment of sunflower fertilization (95 kg N only/ ha applied just before *2nd* irrigation) in Egyptian forming by 37% in 1977 (Table 6) and by 25.5 a 2-year average.

ABSTRACT

Application of 71.4 kg P_2O_5/ha significantly increased seed number/plant and oil yield/ha by 6 and 16% over the unfertilized treatment in one season. The morphological characters, seed yield and other yield components were not significantly affected by P fertilization in both seasons.

Delaying N application decreased seed and oil yields. Addition of N at planting increased seed and oil yield by 15.5 and 14.5% (a 2-year average) compared to the usual time of N application in Egipt, i.e. one month after planting. The highest oil yield was obtained from the combination of 71.4 kgP_2O_5 + 95 kg N/ha applied at planting. This treatment surpassed the common treatment which use in Egypt (application of 95 kg N/ha just before the 2nd irrigation, one month after planting) by 25.5% (a 2-year average).

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