EFFECT OF RATS AND APPLICATION TREATMENTS OF NITROGEN FERTILIZER ON SUNFLOWER (Helianthus annuus, L.) II- Yield and yield components.

BY

Mohamed, M. Kasem and El-Mesilhy, M.A.

Dept. of Agronomy, Fac. of Agric., Moshtohor, Zagazig Univ.

ABSTRACT

Results of the two-year experiment at Mit-Ghamr, Dakahlia, showed that N had a significant effect on major yield components. The highest head diameter, weight of seed per head, weight of seeds per plant were obtained with 40 kg/fad. in both seasons. The 100-seed weight character showed the highest increase with 20 kg/fad. shelling percentage was not affected by rate of N. The highest seed yield/fad. was favored in both seasons with 40 kg N/fad. However, straw and biological yields were the highest with 20 and 40 kg N/fad. in the first and the second season, respectively. N affected oil percent adversely but had no effect on oil acidity or saponification value. Protein content of seeds was increased by increasing up to 40 kg/fad. None of the characters included was affected by the application treatment. Rate X application treatments was not significant for all traits and thus considered negligible.

INTRODUCTION

There is some discrepancy over the rate of the fertilizer N required for sunflower and the when-how application treatment is highly beneficial. Rates in the range of 20-40 kg/fad. were considered by many as sufficient to effect good yields of seeds.

Shabana (1978), El-Ahmer et al (1980) and Nour El-Din et al (1983) reported that the highest yields were obtained by 40 kg/fad. Also, most of the investigators are of the view that the rate of 30 kg N/fad. is optimal for yield and yield contributing characters, El-Ahmer et al (1980) and Hefni et al (1985), Nonetheless, Hegab et al (1987) mentioned that 30 kg N/fad. did not affect major yield component which, on the contrary, responded favorably to the higher rate of 60 kg/fad. Likewise, Moursi et al (1983) and El-Agamy et al (1985) reported that the rate of 60 kg/fad. increased both of the economic and the biological yields significantly. And increasing the rate over the 60 kg N/fad. resulted in noneconomical increases of yields.

As for oil content of seeds, results reported ranged from no effect of N rate on oil percent, Gomaa et al (1987) and Nour El-Din et al (1983) to slight increases in percent oil, El-Mohandes (1984) and Rao et al (1982), to reductions in oil percent El-Ahmer et al (1980) and Hefni et al (1985). Protein yield was on the contrary, increased by increasing the rate of N, El-Mohandes (1984) and El-Agamy et al (1985).

Concerning the application treatment, Kandil (1980) reported that the highest number and weight of seeds/head was obtained when N was applied at planting time. Too, yield of seeds and oil yield were significantly decreased when application time was adjourned until plants reached the age of 60 days. Rao et al (1976) found that the highest yield was obtained by the application of 50 % of the N rate at sowing and the remainder 50 % was given in two equal doses at 21 and 45 days after sowing. Singh and Quadri (1984) reported that the way N was administered, that is single dose or 2-3 doses had the same effect. Satyanarayana et al (1985) found that adding 50 % of the N rate at sowing and the remainder 50 % at the button and the flowering time gave the highest yield. In addition, rate of N and time of application had no effect on oil content of seeds. Apparently, from the review that a single recommendation as to rate and treatment application of N for sunflower to fit all areas of production is not possible. In the first paper of this series, it was concluded that increasing the rate of N fertilizer over 20 kg/fad. is not justifiable. Thus, this research was pursued with the aim to shed light on the N requirement of the crop in that area.

MATERIALS AND METHODS

Two field experiments were carried out at the Extension Fields at Mit-Ghamr, Dakahlia Governorate. Soil is clay-loamy alluvial, fertile, well drained of normal pH 8 and poor in organic matter (< 2%)> The experiments were run as complete randomized block design with four replications each. Plot size was 21 m^2 (1/200 fad.) of 10 rows 3.5 m. long and 60 cm wide. Sunflower variety Florida 328 (introduction from USA) was sown on the 14th and the 29th of June in the first and the second season, respectively. Hill spacings were 30 cm within the ridge. Before planting all experimental units were given the same amount superphosphate (P^2O^5 15.5 %). Plants were thinned to one plant/hill after

19 days from sowing and before the first irrigation. both seasons the preceding crop was wheat.

Each experiment included 24 treatments. These were the four N rates: 0, 20, 40 and 60 kg N/fad. applied in six dose-time combinations as follows:

1) The rate was applied in a single dose before sowing (T_1).
2) The rate was applied in a single dose before the first irrigation (T_2).
3) The rate was applied in a single dose before the second irrigation (T_3).
4) The rate was applied in two separate doses, one before sowing and the second before the first irrigation (T_4).
5) The rate was applied in two separate doses, one before sowing and the second before the second irrigation (T_5).
6) The rate was applied in two separate doses, one before the first irrigation and the second before the second irrigation (T_6).

Data pertaining to this work included the following measurements:

1- Head diameter in cm. and head weight in g. were determined from 10-head samples taken from each plot at random.
2- Weight of seeds/head and weight of seeds/plant were determined from the weight of seeds/plot adjusted to 13% moisture content divided by the number of heads/plot to obtain weight of seeds/head and by the number of harvested plants to obtain weight of seeds/plant.
3- Shelling percentage was calculated from the adjusted seeds/plot divided by the weight of heads/plot times 100.
4- Seed, straw and biological yields in kilograms/faddan were determined using conversions of per plot values to their per faddan equivalents.
5- Harvest index (H.I.) was determined as seed yield percentage from biological yield using plot values.
6- Total N was determined by Micro-Kjeldahal according to Anonymous (1975). N conversions to protein equivalents were performed using a factor of 6.25.
7- Oil percentage was determined after extraction with Soxhelt apparatus using N-hexane as solvent. After wards acidity and saponification values were determined according to Anonymous (1975).

All data were analysed using the ordinary ANOVA according to Sendecor and Cochran (1967). F.L.S.D. at the 5 % level of probability was used to compare among means.

RESULTS AND DISCUSSION

Effect of rates:

I) Yield components:

Data in Tables (1 and 2) show that head diameter, weight per head, seed weight per plant were markedly increased by the fertilizer N in both seasons, in comparison to the control treatment. The highest increase in head diameter and weight/head occurred with the rate of 40 kg/fad. in the first season and with 60 kg/fad. in the second season. However, the highest weight of seeds/head occurred with 40 kg/fad. in both seasons. Shelling percentage character was apparently unaffected by N and remained unchanged over all rates. The highest 100-seed weight obtained by 20 kg/fad. in both seasons. The results reported here are similar to those reported by Hussein et al (1980), Kamel et al (1980), El-Mohandes (1984), El-Gazzar (1987) and Gomaa et al (1987). On the other hand, Hegab et al (1987) reported that head diameter was not significantly affected by N application. Also, Monotti (1975) reported that N did not affect both of the weight of seeds/head and the 100-seed weight.

II) Seed yield/faddan:

Data in Tables (1 and 2) show that seed yield/fad. was increased significantly by N fertilizer and by rates. Results indicate clearly that the increase was not same with all rates. The highest increase was that occurring with 40 kg/fad. Data in Table (3) represent increments in yield per kilogram of added N for the three utilized rates. Apparently, the highest increase occurred with the first 20 kg in both seasons, followed by a drastic reduction of the rate of increase with the second 20 kg. Thus under the conditions of this experiment the optimal rate of N is somewhere between 20 and 40 kg/fad. Increasing the rate of N over 40 kg is not economically advisable because of the decrements occurring with the third 20 kg/fad. The response is similar to a mitcherlictype response.

Table (1): Effect of N rates on yield, yield components of sunflower plant, season 1987.

N rates	Head diameter	Weight of head	Weight of seeds/ head	Weight of 100 seeds	Shelling	Weight of seeds/ plant	Yield of seeds/ fed.	Yield of straw/ fed.	Biol. yield/ fed.	Harvest index	Oil	Protein	Acid value
	cm	g			%	g		Kg			%		
00 kg	15.30	89.70	52.32	7.03	56.93	52.08	1126	1042	2168	59.1	50.37	25.93	1.2
20 kg	18.04	119.20	70.42	7.71	56.91	70.77	1608	1614	3221	49.9	47.56	30.30	1.3
40 kg	17.94	123.70	72.03	8.00	58.22	72.38	1683	1642	3325	50.6	47.71	33.22	1.1
60 kg	18.22	125.23	71.98	8.04	57.49	72.42	1653	1743	3396	48.7	46.97	32.44	1.0
L.S.D. 5%	0.73	8.98	5.16	0.40	N.S.	5.26	150	131	243	2.3	1.60	1.80	N.S.

Table (2): Effect of N rates on yield and yield components of sunflower, season 1987.

N rates	Head diameter	Weight of head	Weight of seeds/ head	Weight of 100 seeds	Shelling	Weight of seeds/ plant	Yield of seeds/ fed.	Yield of straw/ fed.	Biol. yield/ fed.	Harvest index
	cm	g			%	g	Kg			
00 kg	16.03	101.70	54.83	7.65	52.13	54.80	1097	1333	2430	45.1
20 kg	18.10	125.10	67.36	8.34	54.12	67.36	1347	1810	3157	42.7
40 kg	18.71	139.50	74.05	8.56	53.47	74.05	1481	2080	3561	41.6
60 kg	18.47	133.10	68.47	8.63	51.36	68.46	1389	1972	3361	41.2
L.S.D.5%	0.49	7.51	4.88	0.43	N.S.	4.87	103	137	250	1.9

Table (3): Response of seed yield in kg of added nitrogen.

N levels	1987 season	1988 season
1 - 20	24.10	12.50
21 - 40	3.75	6.70
41 - 60	-1.50	-4.60

III) Straw yield, biological yield and harvest index:

Data in Tables (1 and 2) show that straw yield were significantly increased by N in both season. In one season, the highest straw yield was obtained from 60 kg/fad. and in the second season from 40 kg/fad.

The biological yield, apparently shows the same trend as straw yield in both seasons. In contrast, the harvest index was significantly reduced by the application of N. Reductions in harvest index increased with increasing the rate of N. The higher the rate, the more the decrement in the biological yield, seed oil and oil characters.

The results in Tables (1 and 2) show that N fertilizer reduced oil percent of sunflower significantly in comparison with the control. No apparent difference between the three rates on percent oil could be detected. Protein content of seeds, on the contrary, was increased by N fertilizer. The increase in percent protein occurred with all rates, however, the highest increase was that occurring with 40 kg/fad. The data indicate a clear interplay between both percentages of oil and protein in seeds, i.e., a reduction in oil percent was followed by an increase in protein. Oil characters as could be seen from Tables (1 and 2) were almost stable over all N rates.

Effect of the application treatment:

Data of both seasons Tables (4 and 5) show the application treatment of N had no effect on most of the studied traits. The two exceptions were yield of straw/fad. and the biological yield of the first season, which were increased significantly by T_5. This, however was not confirmed in the second season.

CONCLUSIONS

Results reached in this two-year experiment in a location near Mit-Ghamr, Dakahlia Governorate show clearly that

Table (4): Effect of application treatment of N fertilizer on yield, yield components of sunflower, season 1987.

Treatments of application (dose-time)	Head diameter	Weight of head	Weight of seeds/ head	Weight of 100 seeds	Shelling	Weight of seeds/ plant	Yield of seeds/ fed.	Yield of straw/ fed.	Biol. yield/ fed.	Harvest index	Oil	Protein	Acid value
	cm	g			%	g	Kg				%		
T_1	17.30	113.80	67.38	7.37	58.97	67.54	1555	1476	3032	53.1	49.42	28.10	1.2
T_2	17.20	115.40	66.85	7.79	57.00	67.00	1549	1508	3057	52.6	47.38	32.57	1.2
T_3	16.98	108.70	62.75	7.94	57.36	63.10	1403	1353	2756	52.7	47.47	30.30	1.1
T_4	17.15	112.30	65.43	7.56	57.90	65.68	1496	1256	3012	51.7	48.42	31.48	1.3
T_5	17.56	116.20	69.17	7.64	58.51	69.11	1583	1653	3236	51.0	58.00	29.36	0.9
T_6	18.04	120.60	68.55	7.87	54.59	69.05	1518	1555	3073	51.4	48.21	30.62	1.2
L.S.D. 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	161	297	N.S.	N.S.	N.S.	N.S.

Table (5): Effect of application treatment of N fertilizer on yield, yield components of sunflower, season 1988.

Treatment of application (dose-time)	Head diameter	Weight of head	Weight of seeds/ head	Weight of 100 seeds	Shelling	Weight of seeds/ plant	Yield of seeds/ fed.	Yield of straw/ fed.	Biol. yield/ fed.	Harvest index
	cm	---------- g	----------	----------	%	g	----------	Kg	----------	
T_1	17.58	120.40	64.04	8.19	52.85	64.03	1281	1798	3079	41.8
T_2	18.07	126.70	65.04	8.19	51.11	65.03	1330	1815	3144	42.4
T_3	17.71	120.90	64.70	8.43	53.46	64.69	1295	1732	3026	42.9
T_4	17.86	128.90	68.66	8.24	52.86	68.65	1374	1847	3220	42.9
T_5	18.50	130.40	68.08	8.29	51.91	68.07	1362	1812	3173	43.2
T_6	17.70	121.70	66.54	8.42	54.41	66.52	1331	1790	3121	42.8
L.S.D. 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N fertilizer is important for sunflower productivity. A rate in the vicinity of 20-40 kg was about right to obtain good yields and excessive amounts of the fertilizer (> 40 kg/fad.) are not justifiable. This conclusion has also been reached in the first paper of this work on growth characters. Results also, show clearly that the application treatment is not important. Thus rates could be added at convenience starting before sowing till prior to the second irrigation either in a single dose or in two split doses. In addition there was no relevance between rate and the application treatment, inasmuch as all the interactions were not significant.

REFERENCES

Anonymous (1975): Official Methods of Analysis of the Association of Official Agriculture Chemist. Published by Association of Official Agriculture Chemists, Washington D.C.

El-Agamy,A.I.; Fayed, M.H.; El-Gharib, E.A. and Attia, S.A (1985): Effect of irrigation regime, nitrogen fertilization level and distance between hills on yield and quality of sunflower. Annals of Agric. Sci., Moshtohor 23: 1557-1571.

El-Ahmer, B.A.; El-Rayes, F.M.; Omran, A.O. and Ali. A. (1980): Effect of NPK and their different combinations on seed yield, oil content and other economic characters of sunflower (Helianthus annuus L.). Agric. Res. Rev. Ministry of Agric. 58: 117-134.

El-Mohandes, S.I. (1979): Some agronomic studies on sunflower. M.Sc. Thesis, Fac. Agric., Cairo Univ.

El-Mohandes, S.I. (1984): Effect of plant population density and nitrogen fertilization on sunflower. Ph.D. Thesis, Fac. Agric., Cairo Univ.

Gomaa, M.A.; Fayed, E.H. and Mohamed, M.A. (1987): Effect of nitrogen fertilization and inter-row spacing on yield and its attributes of sunflower. Annals of Agric., Sc. Moshtohor 25: 29-42.

Hefni, El-S.; Shokr, El.; El-Ahmar, B.A.; El-Deepah, H.R. and El-Emam, M. (1985): Effect of P and N fertilizers on yield and its components of sunflower under Noubaria conditions. Zagazig J. Agric. 12: 85-110.

Hegab, M.I.; El-Gayar, M.A.; El-Wakil, A.M. and Ali, S.A. (1987): Effect of N-fertilizer rates on seed and oil yields of some sunflower varieties under calcarous soil conditions. Annals of Agric. Sc., Moshtohor 25: 1183-1198.

Moursi, M.A.; El-Bagoury, O.H. and Behairy, T.G. (1983): Harvest index in sunflower plant to some cultural treatments. Proc. 1st Conf. of Agron. 2:625-636.

Nour El-Din, N.A.; Hamada, M.A. and Abdrabu, R. (1983): Effect of distance between plants and N fertilizer on sunflower yield and its components. Proc. 1st Conf. Agron. 2: 615-624.

Rao, A.M.; Rao, Y.Y. and Reddy, G.H. (1978): Investigation on the optimum spacing and time of N application for sunflower. Indian J. Agric. Res. 10: 79-100.

Rao, N.N. and Reddy, S.N. (1982): Effect of plant density and time of application of N and P on growth and yield of sunflower. Indian J. of Agron. 27: 475-477.

Shabana, R. (1978): Effect of nitrogen application on seed yield, oil content and other characteristics of sunflowers. Third General Con. and 10th Anniv. of the Assoc. for the Advancement of Agric. Prod. ion Africa, Problems and Solutions, 9-15 April, Ibadan, Nigeria, Vol. III: 113-124.

Singh, C.M. and Quadri, S.J.S. (1984): Note on response of sunflower to rates and time of nitrogen application. Himachal J. of Agric. Res. 10: 76-77.

Snedecor, G.W. and Cochran, W.G. (1967): Statistical methods 6th Ed. Iowa State Univ. Press Iowa, USA.

تأثير معدلات التسميد النيتروجين وكيفيه الاضافة على عباد الشمس
٢- المحصول ومكوناته

د. محمدقاسم محمد
محمود أمين المصيلحي
قسم المحاصيل - كلية الزراعة بمشتهر

أظهرت نتائج الدراسة للعامين مايلى:-

١) كان للتسميد النيتروجينى أثرا فعالا على مكونات المحصول الرئيسيه حيث زاد محيط القرص ووزن القرص ووزن بذور القرص معنويا عند مستوى ٤٠ كجم/ للفدان .

٢) تفوق وزن ١٠٠ بذرة معنويا عن مستوى ٢٠ كجم / للفدان عنه فى المستويات الاخرى .

٣) لم يكن لمستويات التسميد النيتروجينى تأثيرا يذكر على معدل التفريط فى موسمى الزراعة .

٤) زاد محصول الفدان من البذور معنويا باضافة ٤٠ كجم / للفدان بينما زاد محصول القش والمحصول البيولوجى معنويا باضافة ٢٠ ، ٤٠ كجم / للفدان فى الموسم الاول والثانى على الترتيب .

٥) تأثر محصول الزيت سلبا للتسميد النيتروجينى ولم يكن للتسميد النيتروجينى أو مستوياته تأثير يذكر على رقم الحموضه أو التصبن .

٦) زاد محتوى البذور من البروتين عند مستوى ٤٠ كجم / للفدان فى موسمى الزراعة .

٧) لم يكن لكيفية الاضافه أى تأثير يذكر على الصفات السابقة .

٨) لم يكن تأثير تفاعل معدل التسميد x كيفية الاضافة معنويا لموسمى الزراعة .