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Response of sunflower genotypes Helianthus annuus L. to amounts of nitrogen fertilizer on growth characteristics and components

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***Abstract*---**The field experiment was carried out during the spring and fall season of 2021 in Basra Governorate, Al-Haritha area. The study aimed to studying the response of 6 genotypes of the sunflower which symbolized by the symbol (V) V1 = local, V2 = moons, V3 = Ishaqi 1, V4 = Ishaqi 2, V5 = Turki Tarzan , V6 = shmoos, And four levels of nitrogen fertilizer symbolized by the symbol (N0) (N = 0 without fertilizer (control), N1 = (N 100 kg. ha-1) , N2 = (N 200 kg. ha^{-1}) , N3 = (N 300 kg. ha^{-1}). According to the complete randomized block design, R.C.B.D. With three replicates and in the order of Split Plot Design (the levels of nitrogen fertilization were distributed in the main plots and the cultivars in the sub-plot). The results have shown superior to the genotypes shmoos, Moons, and Ishaqi2 compared to other cultivars in the studied traits, and most of the yield components as; plant height, leaf area, weight of 1000 seeds total seed yield. In comparison, the study showed the superiority of the fertilizer level 300 kg N. ha^{-1} Significant in the traits mentioned earlier. The interaction between cultivars and fertilizer led to the N level exceeding 300 kg. ha^{1} with cultivar shmoos in plant height, leaf area, the weight of 1000 seeds, and total grain yield were significant compared to the treatment of no addition of fertilizer (control) for all treatments of the experiment.

***Keywords*---**sunflower, genetic structures, nitrogen fertilizer.

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Introduction

The sunflower crop Helianthus annuus L is one of the most important oil crops in the world due to its short growth period and high economic returns. The percentage of oil in its seeds reaches high rates, which may reach up to 55% in some varieties. It is a healthy oil because it contains Omega- 3 fatty acids and unsaturated fatty acids such as Oleic. And Linoleic with its low sensitivity to oxidation in the period of packing and storage (Pand and Srivestance,1988).

Sunflower seeds contain vitamins A, D, E, and K. They also have approximately 27% protein and 60% polyunsaturated fatty acids, which are the best for heart patients to reduce the level of cholesterol in the blood (Ahuja and Bhatia, 2003). The estimated cultivated area in Iraq for the 2019 season for the sunflower crop is 450 ha with an average yield of 2333. 2 t .ha -1 (Central Statistics Organization., 2019). Sunflower oil is the first in use in Iraq, and its productivity is still limited due to the failure to follow the correct scientific methods in serving the soil and the crop because it is determined by factors of genetic structures and environmental conditions and the interaction between them (Al-Rawi, 1998). Studies have shown that the growth and productivity of sunflowers are affected by many factors, including genetic structures, environmental factors, and pre-and post-cultivation processes such as plowing and fertilization, especially nitrogen fertilization, which plays a significant role in increasing quantitative and qualitative production (Killi, 2004).

Studies have indicated that phenotypic traits in general and yield components, in particular, are good criteria for selecting plants from different genotypes, whether to improve quality or yield and its components represented in diameter of the disc, seeds number in the disc, and seeds weight (Elsahookie and others, 1999). Schoeman (2003) showed in his study that the stability of the productivity of genotypes in different environments has become of great importance to plant breeders because the production of stable varieties is one of the important things in modern agriculture. After all, it leads to an understanding of environmental and genetic interference and thus can know their behavior and response to various environmental conditions. Moghaddasi et al. (2011) indicated that nitrogen fertilizer at different levels had a significant effect on the yield and components of the number of seeds per disc and the weight of 1000 seeds. Due to the lack of high-yield varieties of seeds and the reliance on the cultivation of local cultivars, which requires the study of compositions with high yield and good quality under the conditions of the southern region.

Therefore, this study was conducted to evaluate the performance of different genotypes of sunflower under conditions under the conditions of the Basra region, determining the level of nitrogen fertilizer that gives the highest yield, and studying the interaction between the genotypes and nitrogen fertilizer levels.

Materials and Methods

The field experiment was carried out in the year 2021 for the spring and autumn seasons in silty clay soil at Al-Hartha Research Station of Basra University, College of Agriculture, which is located at E44/47° N 40/30°, to study the response of genotypes of sunflower *Helianthus annuus* L. to quantities of nitrogen fertilizer for the characteristics of Growth and its components. Under the influence of the conditions of the area and determining the best fertilizer level. The soil was plowed by two orthogonal plows using the inverted plow and smoothed with disc harrows; then, it was leveled at the rates and divided into three equal replications with a distance between one repeater and another 2 m; each repeater was divided into 72 experimental units with an area of 12 m^2 (4 * 3 m) the distance between one experimental unit and another 1 m The genotypes were randomly distributed in the experimental units.

The experimental unit included 4 harrows, the distance between one harrow and another 75 cm and between one plant and another 25 cm. The planting was done on the meadow side to achieve a plant density of 53,333 plants ha-1 by designing the complete random block design and arranging splintered plots (RCBD). The experiment included two factors; the first factor was six genotypes of Sunflower (Local, Aqmar, Ishaqi 1, Ishaqi 2, Tarzan, and Shmoos. The source of the seeds is the Agricultural Research Department in Baghdad. The second factor included levels of nitrogen fertilizer in the form of urea (46%N) at a rate (0,100, 200, 300 kg N.ha-1) added in two batches. The first was in the emergence of four true leaves, and the second batch was at the beginning of the emergence of flower buds (AlRawi, 2001). Phosphorous and potassium fertilization operations were carried out according to the fertilizer recommendation. Phosphate fertilizer was added in the form of P2O5) 110 kg. ha^{-1} and potassium sulfate 120 kg.ha^{-1} in the form of K2O. Add it all at once when planting.

The experimental field was planted in the spring season on the spring season 16.02.2021 (Al-Obaidi, 2000) and the fall season on 27.07.2021 by placing 3-4 seeds in one hole at a depth of 3-5 cm. The process of thinning the plants to one plant in the hole after two weeks from planting. Manual weed control, hoeing, and weeding were performed when needed. The data were analyzed using an analysis of variance (ANOVA) spreadsheet using GenStat procedure Library release PL 18.2 software.

Table (1) some properties of the study soil before planting

Adjective		Quantity		Unit
PH		spring season	Autumn season	–
		7.24	7.80	
EC		6.6	6.3	dSm^{-1}
	sand	46.50	44.30	
	silt	535.80	418.00	

Minute volume analysis	clay	417.70	418.00	g Km $^{-1}$ soil
soil texture	Silty clay loam			

Studied traits

1- Plant height (cm): according to the height of the plant from the soil surface to the base of the disc, an average of ten plants (Al-Sahoki, 1996).
2- Leaf area (cm^2): It was calculated from the following equation: sum of squares of the maximum width of plant leaves x 0.65 (EL-Sahooki and ELDabas, 1982).
3- Seeds number in the disc: It was calculated from the average number of seeds in the disc for ten plants from each experimental unit.
4- Weight of 1000 seeds (g): It was calculated by taking 1000 seeds at random from the yield of each experimental unit and then weighed with a sensitive scale.
5- Total seed yield, t. ha^{-1} was calculated from the harvest of the discs of the two middle lines of the experimental unit and the addition of the yield of the ten random discs taken to measure other characteristics after adjusting the weight based on the moisture content of 8%. After neglecting the discs, the seeds were weighed, and the weight of the harvested area was converted to a t. ha^{-1}.

Results and Discussion

From the results of Table (2), it is clear that there are significant differences between the genotypes and nitrogen levels and the interaction between them for plant height traits. The lowest averages for this trait were (115.54 and 127.40) cm for the two growing seasons in the spring and fall sequence of 2021. The difference may be attributed to the nature of the genotypes of this trait, as this trait is highly responsive to the heterogeneity of sunflower cultivars (Aliwi, 2020). These results are in agreement with the findings of Hassan, Ahmed, and Ozturk (2017) et al. (2017) and Bjaili et al. (2019).

As for the effect of nitrogen, the table indicates that the level of 300 kg N t ha^{-1} gave the highest plant height averages, which amounted to (148.22 and 163.51) cm, compared with not adding fertilizer, which gave the lowest averages of (121.15 and 109). 82) cm. This can be explained by the role of nitrogen, which enters into all vital processes and is the basis for building proteins and nucleic acids and encouraging rapid growth as well as the process of cell division and thus positively reflected on the height of the plant, Karim et al. (2012), and this agrees With what was mentioned by Abd EL-Satar and others (2017), Hassan and Ahmed (2017), Akpojotor and others (2019).

The effect of the interaction, the genotype Shmoos at the fertilizer level 300 kg N t ha^{-1} gave the highest averages for plant height, reaching (188.40 and 197.48) cm compared with the local cultivar when not added. The nitrogen fertilizer gave the lowest averages of (94.60 and 108.10) cm, respectively, for the spring and autumn planting seasons of 2021, consistent with what Bjaili et al. (2019) mentioned; and Al-haidary (2018) mentioned.

Table (2) Effect of genotypes and nitrogen fertilizer levels and their interaction on plant height (cm)

spring season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
	0	100	200	300	
Local	94.60	110.40	124.96	132.20	115.54
Aqmar	114.13	128.26	142.90	158.60	135.97
Ishaqi 1	103.47	117.76	129.40	136.00	121.66
Ishaqi**2**	120.33	134.29	147.36	145.87	136.96
Tarzan	97.60	113.78	123.99	128.27	115.91
Shmoos	127.00	136.71	158.13	188.40	152.56
average	109.52	123.53	137.79	148.22	
Lsd $_{0.05}$	N= 3.362		V= 3.510		N*V= 6.957
Autumn season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
Local	108.10	119.05	135.65	146.80	127.40
Aqmar	127.41	141.50	156.04	178.33	150.82
Ishaqi 1	118.89	130.93	136.93	152.19	134.74
Ishaqi**2**	127.28	145.62	153.68	162.07	147.16
Tarzan	111.19	123.13	134.45	144.17	128.24
Shmoos	138.03	146.00	171.47	197.48	163.24
average	121.15	134.37	148.04	163.51	
Lsd $_{0.05}$	N= 0.921		V= 1.141		N*V= 2.209

The results of Table (3) showed significant differences between the genotypes and nitrogen levels and the interaction between them for the characteristic of leaf area in the plant. The genotype gave Shmoos the highest averages (4375.04 and 5022.68) cm compared with the local genotype, which showed the lowest averages (2898.42 and 3379.19). The reason for the superiority of the cultivar Shamus may be attributed to having the most number of upper leaves (2020). These results agree with what was reached by Hassan and others (2014) and Kandil and Odam (2017).

As for the effect of nitrogen, table (3) indicates that the fertilizer level 300 kg N t ha^{-1} gave the highest averages (4518.88 and 5067.25) cm compared with not adding fertilizer, which gave the lowest averages (2681.79 and 3017.13) cm. This may be because nitrogen works to activate and multiply cells, Its elongation and tissue differentiation, and that sufficient amounts of nitrogen lead to making the plant long. Its positive effect is reflected in the functional performance of the leaves with their chlorophyll content, thus increasing the efficiency of photosynthesis, which leads to an increase in the leaf area. Abd et al. (2019) are consistent with what was mentioned by Yakout et al. (2014). and Kandil and Odam (2017) and Al-haidary (2018).

The effect of the interaction, the table indicates that the genotype Shams at the fertilizer level 300 kg N ha^{-1} gave the highest averages in leaf area (6001.47, 6690.16) cm compared with the local cultivar when nitrogen fertilizer was not added, which gave the lowest averages (2874.29,2525.42). (Name the two growing seasons, respectively, and these results agree with Al-haidary (2018).

Table (3) Effect of genotypes and nitrogen fertilizer levels and their interaction on leaf area (cm)

spring season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
	0	100	200	300	
Local	2525.42	2471.35	2854.35	3742.56	2898.42
Aqmar	2627.36	3418.55	3849.43	5056.67	3738.00
Ishaqi 1	2610.31	2668.76	3400.76	3885.17	3141.25
Ishaqi**2**	2858.73	3147.22	3514.36	4617.43	3534.44
Tarzan	2514.28	2825.85	3193.46	3809.98	3085.89
Shmoos	2954.63	3871.72	4672.33	6001.47	4375.04
average	2681.79	3067.24	3580.78	4518.88	
Lsd $_{0.05}$	N= 65.2		V= 75.5		N*V= 147.4
Autumn season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
Local	2874.29	3153.36	3666.43	3822.66	3379.19
Aqmar	2927.34	3931.98	4621.67	5872.87	4338.47
Ishaqi 1	2856.89	3298.37	4044.33	4478.23	3669.46
Ishaqi**2**	3099.54	3642.53	3986.43	5304.12	4008.16
Tarzan	2941.56	3319.63	3586.22	4235.48	3520.72
Shmoos	3403.16	4520.64	5476.76	6690.16	5022.68
average	3017.13	3644.42	4230.31	5067.25	
Lsd $_{0.05}$	N= 84.3		V= 84.7		N*V= 169.0

The results of Table (4) it is showed that there are significant differences between the genotypes and nitrogen levels and the interaction between them in the character of seeds number, as the genotype gave Shmoos the highest averages (980.9 and 1108.1) seeds compared with the local genotype, which showed the lowest averages (718.9 and 845. 3) seed.

The reason may be due to the increase in the leaf area, which was reflected in addition in the diameter of the disc and thus the increase in seeds number in the disc and to the nature of the genetic structure of it in this trait, as each component has a different genetic ability, as the number of seeds is related to the number of origins of the ovaries in them, which is linked by nature to the genetic structure during The composition of nutrients (Alawi, 2020). These results were in agreement with the findings of Abd Elrahman et al. (2014) and, Al Ahbabi (2015, Abd et al. (2019), as they found a difference in the genotypes of sunflower in the number of seeds per disc.

The effect of nitrogen fertilizer, the table indicates that the fertilizer level of 300 kg N t ha-1 gave the highest averages (1016.3 and (1154.6) seeds compared with not adding fertilizer, which gave the lowest averages (806.8 and 687.6) grains, perhaps the reason for this is that nitrogen works on Cell activation, proliferation, elongation, and tissue differentiation, and that sufficient amounts of nitrogen have a positive effect on the functional performance of the leaves with their chlorophyll content, thus increasing the efficiency of photosynthesis, which leads to an increase in the number of seeds in the disc. This is consistent with what was mentioned by Abd Elrahman et al. (2014), Al-haidary (2018), and Akpojotor et al. (2019).

Regarding the effect of the interaction, the table indicates that the Shmoos genotype was significantly superior at the fertilizer level 300 kg N t ha^{-1}, which gave the two highest averages in the number of seeds in the disc (1343.3,1300.2) cm compared with the local variety when nitrogen fertilizer was not added, which gave the lowest two averages (619.8 and 763.7) seeds for the two planting seasons, respectively.

Table (4) Effect of genotypes and nitrogen fertilizer levels and their interaction on seeds number

spring season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
	0	100	200	300	
Local	619.7	683.4	753.0	816.7	718.2
Aqmar	785.7	811.9	1018.0	1154.0	917.2
Ishaqi 1	638.8	754.7	822.3	953.0	803.5
Ishaqi**2**	716.6	780.6	959.0	1079.9	884.0
Tarzan	684.0	725.1	912.7	881.3	789.5
Shmoos	685.0	87878.8	1046.3	1213.0	980.9
average	688.3	772.4	5ز918	1016.3	
Lsd $_{0.05}$	N= 11.42		V= 9.81		N*V= 20.19
Autumn season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
Local	763.7	805.0	865.7	94 947.0	845.3

Aqmar	829.0	982.0	1109.7	1218.0	1034.7
Ishaqi 1	794.0	861.0	952.7	1145.3	938.2
Ishaqi**2**	824.0	942.0	1077.0	1225.3	1017.1
Tarzan	744.6	843.0	1022.3	1015.1	906.2
Shmoos	885.7	1026.3	1143.7	1376.7	1108.1
average	806.8	909.9	1028.5	1154.6	
Lsd $_{0.05}$	N= 11.97		V= 9.88		N*V= 20.53

Table (5) shows significant differences between the genotypes and nitrogen levels and the interaction between them for the 1000-seed weight trait (55.08 and 61.42) g. This may be due to the different transformative nature of foodstuffs as a result of different genotypes, Abd et al. (2019).

The effect of nitrogen, the table indicates that the fertilizer level of 300 kg N ha^{-1} gave the highest averages (71.83 and 88.00)g compared with not adding the fertilizer, which gave the lowest averages (51.28 and 56.83) seeds. The reason for this may be attributed to the increase in the leaf area in Table (2), which led to raising the efficiency of the plant, including increasing the concentration of nutrients inside the plant and converting them into carbohydrates and protein materials that are transferred to the seeds in the phase of filling the seeds of AlJubouri and Al-Ahba'i (0776); and Abro et al8 (0707)8

As for the effect of the interaction, the table indicates that the genotype Shmoos at the fertilizer level 300 kg N t ha^{-1} gave the highest averages (71.83 and 78.22) g compared with the local cultivar when nitrogen fertilizer was not added, which gave the lowest averages (55.08 and 61.42) g for two growing seasons, respectively.

Table (5) Effect of genotypes and nitrogen fertilizer levels and their interaction on the weight of 1000 grains (g)

spring season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
	0	100	200	300	
Local	42.67	50.00	59.67	68.00	55.08
Aqmar	52.00	60.33	71.67	72.33	64.08
Ishaqi 1	52.33	57.00	69.00	68.33	61.67
Ishaqi**2**	49.33	61.33	64.67	67.67	60.75
Tarzan	48.00	57.00	69.00	74.00	62.00
Shmoos	63.33	70.00	77.33	80.67	72.83
average	51.28	59.28	68.56	71.83	
Lsd $_{0.05}$	N= 1.716		V= 2.211		N*V= 4. 091
Autumn season					

genetics	Nitrogen fertilization levels kg ha^{-1}				average
Local	49.67	57.33	66.00	72.67	61.42
Aqmar	57.33	67.00	77.33	80.00	70.42
Ishaqi 1	54.60	63.67	75.67	74.33	67.07
Ishaqi**2**	55.67	67.00	71.00	74.00	66.92
Tarzan	52.00	62.00	74.00	80.33	67.18
Shmoos	70.67	76.00	85.67	88.00	80.08
average	56.63	65.50	74.94	78.22	
Lsd $_{0.05}$	N= 0.969		V= 1.721		N*V= 3.234

The results of Table (6) show significant differences between the genotypes and nitrogen levels and the interaction between them for the characteristic of the total seed yield t ha^{-1}. The genotype Shmoos gave the highest two averages (3189.98 and 3944.27) t ha^{-1} compared with the local genotype, which showed the lowest averages (2318.54 and 2919.25) t ha^{-1}.

The reason may be attributed to the superiority of the genotype Shamus in this trait by having the highest number of seeds according to Table (4), as well as the weight of 1000 seeds according Table (5), which was reflected positively in the total yield t ha^{-1}.

As for the single effect of nitrogen, the table indicates that the fertilizer level 300 kg N t ha^{-1} gave the highest averages (3436.36 and 4471.91) t ha^{-1}, compared with not adding fertilizer, which gave the lowest averages (1567.32 and 2125.35) t ha^{-1}. The reason for this is that the addition of nitrogen increases vegetative growth in terms of the number of leaves, leaf area, and components of the yield from the number of seeds in the disc and the weight of 1000 seeds, which is reflected in the total yield positively by Al-Jubouri and Al-Ahbai (2015).

The effect of the interaction, the table indicates that the genotype Shmoos at the fertilizer level 300 kg N t ha^{-1} gave the highest averages (3189.98 and 3944.27) t ha^{-1} compared with the local cultivar when nitrogen fertilizer was not added, which gave the lowest averages (2318.54 and 2919). .25) t ha^{-1} for the two growing seasons, respectively.

Table (6) Effect of genotypes and nitrogen fertilizer levels and their interaction on total yield seed t ha^{-1}

spring season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
	0	100	200	300	
Local	1345.44	2074.63	2646.92	3207.02	2318.54
Aqmar	1525.72	2669.85	2981.32	3535.52	2678.15
Ishaqi 1	1419.11	2351.44	2693.64	3272.56	2434.26
Ishaqi**2**	1472.80	2421.22	3015.05	3383.33	2573.18

Tarzan	1398.72	2405.91	2761.42	3320.95	2471.73
Shmoos	2242.10	3056.46	3562.46	3898.71	3189.98
average	1567.32	2496.53	2943.48	3436.36	
Lsd 0.05	N= 82.48		V= 60.09		N*V=129.30
Autumn season					
genetics	Nitrogen fertilization levels kg ha^{-1}				average
Local	1728.87	2544.28	3378.32	4025.51	2919.25
Aqmar	2065.68	3373.69	3835.47	4554.93	3457.44
Ishaqi 1	2017.21	3078.73	3613.54	4377.95	3271.86
Ishaqi**2**	2099.34	3095.88	3624.17	4499.37	3329.69
Tarzan	1983.36	3164.15	3624.22	4315.92	3271.91
Shmoos	2857.62	3598.83	4262.88	5057.76	3944.27
average	2125.35	3142.59	3723.1	4471.91	
Lsd 0.05	128.48= N		72.01=V		171.15=N*V

Conclusions

Shmoos and Aqmar's genotypes were significantly superior in growth characteristics (plant height and leaf area) and yield characteristics (number of seeds per disc, weight of 1000 seeds, and total seed yield). The fertilizer level 300 kg N t ha^{-1} gave positive results in the growth and yield characteristics mentioned above. It was found through the study that the genotypes of Shmoos and Aqmar and the fertilizer level 300 kg N t ha^{-1} gave the highest averages for the studied traits.

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