



## Response of Growth, Yield and Yield Components of two Sunflower Varieties (*Helianthus annuus* L.) to Nitrogen Fertilization

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### Abstract

A field study was conducted at spring 2013 in the experimental farm of the Faculty of Agricultural Science, University of Sulaimany at Bakrajo, to evaluate the response of some growth characters, yield and yield components of two varieties Flame and Sirena and three Nitrogen fertilization on growth and yield sunflower (*Helianthus annuus* L.). The experiment comprised of two varieties of sunflower (Flame and Sirena) and Nitrogen fertilization levels (0, 100 and 200) Kg (urea) ha<sup>-1</sup>. Arranged as Split-Plot in Randomized Completely Block Design with three replications. performances in term of plant height, leaves number and stem diameter were evaluated. The important character of yield, yield components and growth were also evaluated. The Nitrogen fertilizer levels were implemented in the main plots and varieties implemented in the sub-plots. The results showed no significant differences between varieties in growth characters with exception of stem diameter, while it was found to be significant on all yield characters with exception of disk diameter, there were no significant differences of nitrogen levels on growth characters with exception of number of leaves plant<sup>-1</sup>, while it was found to be highly significant on all yield characters. The effect of interaction between varieties and Nitrogen levels were no significant for all growth characters, yield and yield components continue.

The highest percentage of oil represented in the variety (Flame) under the treatment of control.

### Introduction

Sunflower (*Helianthus annuus* L.) is an important crops among oil seeds and as a source of the oil production in the world, following soy, cotton and rape seed [1]. The native of this crop is central areas of America continent, and seemingly it is Peruvian or Mexican in origin [2]. Although Sunflower is generally regarded as a temperate zone crop than the tropical, because it is widely adaptable for drought tolerant than most other grain crops [3]. The major goal of growing sunflower is for its seed (achene) that contains (36–52%) oil and (28–32%) protein [4].

Fertilizer is one of the important factors for agriculture production [5]. Nitrogen is an essential major mineral for growth, development and yield quality of the crop, because it enhances the metabolic processes that based on protein [6]. Rapid leaf area development, prolong life of leaves, improves leaf area duration overall crop assimilation obtained by the application of maximum level of nitrogen, thus resulting to increase in seed yield [7, 8, and 9]. The risk of disease and lodging also increases by using excess N application, thus due to reduction in oil content, and may aggravate ground- and surface-water pollution.

There are many problems regarding to the sunflower production in Kurdistan regions, particularly unavailability and high prices of inputs, old traditional methods of sowing, low plant population per unit area, use old and less potential varieties and improper uses of fertilizers.

The present study was to investigate the influence three nitrogen fertilizer levels on growth, yield and yield components of two sunflower varieties.

### **Materials and Methods**

A field experiments was carried out at spring 2013, at Experimental Farm of the Faculty of Agriculture, University of Sulaimany at Bakrajo located in the southwest of Sulaimany city (Latitude: 35° 33' N; Longitude 45° 27' E at altitude of approximately 830 m).The experimental area plots were ploughed twice, harrowed and well leveled. The experiment conducted on a silty clay loam soil [10]. A brief account of some physical and chemical properties of the experimental soil is given in Table (1). Moreover, the average temperature and monthly rainfall precipitation at Bakrajo is presented in Table (2).The experiment was Arranged as Split-Plot in RCBD with three replicates. Three levels of nitrogen (0, 100, and 200) kg (Urea) ha<sup>-1</sup> were implemented in main plots and two varieties of sunflower (Flame and Sirena) were implemented in subplots. Each main plot consisted of two subplots with 2 m width by 2 m length. Each subplot consisted of four rows of 2 m long and 0.5 m between, and 0.25 m within plants in the row thus, corresponding 80000 plant ha<sup>-1</sup>. Seeds cultivated on April 4, 2013. Mechanical weed control was carried out three times to keep the experimental plots free from weeds and plots were irrigated as required through the growing season. Five plants in each plot were randomly sampled and labeled for data collection. Statistical analyses were conducted using JMP, version 7 [11]. The LSD test was done to find the significant differences between treatments at 5% probability level .The mature plants were harvested on 25 of July, 2013 for estimating seed yield and yield components.

Table (1): Physical and chemical properties of the studied soil:

<i>Soil properties</i>	<i>Values</i>
Soil texture (P.S.D)	Silty Clay
Sand ( g.kg <sup>-1</sup> )	48.5
Silt ( g.kg <sup>-1</sup> )	449.8

Clay ( g.kg <sup>-1</sup> )	501.7
E.C. ( dS.m <sup>-1</sup> )	0.33
pH	7.44
O.M. ( g.kg <sup>-1</sup> )	21.02
CaCO <sub>3</sub> ( g.kg <sup>-1</sup> )	337.6
Total N (ppm)	19.93
K <sup>+</sup> ( g.kg <sup>-1</sup> )	2.67
Na <sup>+</sup> (ppm)	27.66
Ca <sup>++</sup> ( Meq.l <sup>-1</sup> )	2.66
Mg <sup>++</sup> ( Meq.l <sup>-1</sup> )	1.98

Table 2: Average air temperature and rainfall during the season of 2013 at Bakrajo location.

<i>Month</i>	<i>Bakrajo</i>		
	<i>Average temperature oC</i>		<i>Rain fall mm</i>
	<i>MAX</i>	<i>MIN</i>	
<i>April</i>	31.79	7.5	14
<i>may</i>	37.5	12	48.1
<i>June</i>	39.5	19.5	0.00
<i>July</i>	43.7	23.3	0.00

## Results and Discussion

Data in Table (3) explain the effect of varieties on growth characters. It was noticed that this effect was no significant for all growth characters exception of stem diameter. Flame variety superior significantly Sirena variety in the stem diameter by 21.96%.

Table 3: The effect of varieties on growth characters:

<i>Varieties</i>	<i>Plant height (cm)</i>	<i>Stem diameter (cm)</i>	<i>No. of leaves plant<sup>-1</sup></i>
<i>Flame</i>	140.91	2.11	35.16
<i>Sirena</i>	128.85	1.73	32.15
<i>LSD (0.05)</i>	N.S	0.299	N.S

Data in Table (4) shows significant differences between nitrogen applications on all growth characters except No. of leaves plant<sup>-1</sup>. Regarding the plant height in cm, the highest plant height was (145.84 cm) shown by the treatment of 200 Kg ha<sup>-1</sup>, while the lowest plant height value was (121.76 cm) shown by the control treatment.

Our research data concur with the literature reporting that increasing N rates increased plant height [12, 13, 14 and 15].

Nitrogen via improving vegetative growth led to increase of plant height [16, 17].

Data recorded on stem diameter illustrates significant differences between nitrogen applications levels in stem diameter. The treatment of 200 Kg N. ha<sup>-1</sup> shows the maximum stem diameter (2.394 cm). While the smaller stem diameter observed control (1.50 cm).

High rate of nitrogen application leads to more rapid leaf area development, increases leaf area duration after flowering and enhance the whole crop assimilation consequently contributing to increase in seed production [7, 8].

Table 4: The effect of nitrogen applications on growth characters:

<i>Nitrogen levels (N) Kg ha<sup>-1</sup></i>	<i>Plant height (cm)</i>	<i>Stem diameter (cm)</i>	<i>No. of leaves plant<sup>-1</sup></i>
<i>0</i>	121.76	1.50	30.11
<i>100</i>	137.05	1.91	34.53
<i>200</i>	145.84	2.34	36.33
<i>LSD (0.05)</i>	11.79	0.04	N.S

Table (5) confirms that there were no significant interaction between varieties and nitrogen applications levels on all growth characters.

Table 5: The effect of interaction of varieties and nitrogen applications on growth characters

<i>variety</i>	<i>Nitrogen levels Kg ha<sup>-1</sup></i>	<i>Plant height (cm)</i>	<i>Stem diameter (cm)</i>	<i>No. of leaves plant<sup>-1</sup></i>
<i>Flame</i>	<i>0</i>	129.36	1.67	31.20
	<i>100</i>	140.60	2.11	35.73
	<i>200</i>	152.78	2.55	38.56
<i>Sirena</i>	<i>0</i>	114.16	1.34	29.03
	<i>100</i>	133.30	1.70	33.33
	<i>200</i>	138.90	2.14	34.100
<i>LSD (0.05)</i>		N.S	N.S	N.S

As shown in Table (6) there were significant differences between varieties in yield and yield components in all traits except disk diameter. These varieties had the same response to nitrogen fertilizer levels. The results indicated that the disk dry weight, seed weight and weight of 1000 seed of Flam variety superiority Sirena by 41.16%, 47.05% and 3.41 %, respectively.

Table 6: The effect of varieties on yield and yield component:

<i>variety</i>	<i>Disk diameter (cm)</i>	<i>Disk dry weight Kg ha<sup>-1</sup></i>	<i>seed weight Kg ha<sup>-1</sup></i>	<i>1000 - seeds Weight (g)</i>
<i>Flame</i>	19.42	11846.2	6305.16	55.78
<i>Sirena</i>	14.93	8392.3	4287.82	53.94
<i>LSD (0.05)</i>	N.S	2218.8	1206.62	0.67

Data in Table (7) shows highly significant differences between nitrogen applications in all yield and yield components.

Data recorded on disk diameter illustrates significant differences between nitrogen applications levels. The treatment of 200 Kg N. ha<sup>-1</sup> shows the maximum disk diameter of 21.75 cm. While the smaller disk diameter observed by control treatment 12.70 cm.

These results validate the findings [18] that have also the evidence regarding to positive effects of nitrogen on head diameter.

Some researches [12, 19] have also shown that nitrogen fertilizer increased head diameter of the sunflower.

Regarding the disk dry weight, the maximum value was 11597.3 Kg ha<sup>-1</sup> shown at 200 Kg ha<sup>-1</sup>, while the minimum disk dry weight value was 8281.7 Kg ha<sup>-1</sup> shown by the control treatment.

Data recorded on seed weight illustrates highly significant differences between nitrogen applications levels in seed weight Kg ha<sup>-1</sup>. The treatment 200 Kg N. ha<sup>-1</sup> shows the maximum seed weight 6060.00 Kg ha<sup>-1</sup>. While the minimum seed weight is observed by the Control treatment 4288.13 Kg ha<sup>-1</sup>. This result agrees with [20]. It has been well documented that increasing N rates produced sunflower plants with higher seed weight [13, 21].

These findings are supported by [22] who reported increase in achene's weight with increasing fertilizer dose.

Regarding the 1000-seed weight, the maximum weight was 55.61g shown by the treatment of 100 Kg N. ha<sup>-1</sup>, while the minimum value of 1000-seed weight was 53.90 g shown by control treatment.

Application of N lead to increase head diameter, 1000-seed weight, biological yield, seed yield per head and seed yield per plant, but Application of N contributed to decreased harvest index and seed oil concentration [23]. These results are in confirmatory with those of [15,22 and 24].

Table 7: The effect of nitrogen application on yield and yield components:

<i>Nitrogen Levels (N) Kg ha<sup>-1</sup></i>	<i>Disk diameter (cm)</i>	<i>Disk dry weight Kg ha<sup>-1</sup></i>	<i>Seed weight Kg ha<sup>-1</sup></i>	<i>1000- seed Weight (g)</i>
<i>0</i>	12.70	8281.7	4288.13	53.90
<i>100</i>	17.08	10478.7	5541.33	55.61
<i>200</i>	21.75	11597.3	6060.00	55.05
<i>LSD (P≤ 0.05)</i>	105.	1199.25	578.06	0.75

Table( 8) confirms that there were no significant interaction between varieties and nitrogen applications levels on all yields and yield components characters in the experiment.

Table 8: The effect of interaction between varieties and nitrogen applications on yield and yield components :

<i>Variety</i>	<i>Nitrogen levels (N) Kg ha<sup>-1</sup></i>	<i>Disk diameter (cm)</i>	<i>Disk dry weight Kg ha<sup>-1</sup></i>	<i>Seed weight Kg ha<sup>-1</sup></i>	<i>1000 - seed weight (g)</i>
<i>Flame</i>	<i>0</i>	14.03	10181.33	5406.13	55.18
	<i>100</i>	19.90	12413.33	6654.93	56.23
	<i>200</i>	24.33	12944.00	6854.40	55.92
<i>Sirena</i>	<i>0</i>	11.36	6382.13	3170.13	52.62
	<i>100</i>	14.26	8544.00	4427.73	55.00
	<i>200</i>	19.166	10250.66	5265.60	54.19
<i>LSD (0.05)</i>		N.S	N.S	N.S	N.S

Table (9) shows that seed oil percentage significantly affected by both nitrogen applications and varieties.

Data in Table (9) shows highly significant differences between nitrogen applications on seed oil percentage; the maximum seed oil percentage value recorded by the control treatment 39.05% while the minimum seed oil percentage were 30.20% which produced by the 200kg N h<sup>-1</sup>.

Increased N rates led to declines in oil concentrations of the sunflower plants. Similar responses have been reported in other studies [25, 26, and 27].

There were significant differences between varieties in seed oil percentage. Flame variety significantly superior Sirena variety by 19.28 %.

Nitrogen application enhanced the seed yield, however, reduction of seed oil content percentage was relatively small (2-5%) and was overcompensated by the seed yield increase at the approachable site [28].

Table (9): Seed oil percentage (%) at maturity as influenced by nitrogen applications and varieties:

<i>Nitrogen Levels (N)</i> <i>kg ha<sup>-1</sup></i>	<i>varieties</i> <i>(V)</i>		<i>Avg.of</i> <i>Seed oil</i> <i>%</i>	<i>LSD (0.05) for</i> <i>(V)</i>
	<i>Flame</i>	<i>Sirena</i>		
<b>0</b>	43.06	35.03	39.05	1.85
<b>100</b>	37.10	31.76	34.43	
<b>200</b>	32.63	27.76	30.20	
<i>Avg.of Seed oil %</i>	37.60	31.52		
<i>LSD (0.05)</i> <i>for (N)</i>	3.01			
<i>LSD (0.05) for (V *N)</i>	N.S			

## References

- [1] Bogataj, A. “ *Vpliv roka setve na pridelek petih izbranih hibridov sončnice (Helianthus annuus L.)*” na laboratorijskem polju Biotehniške fakultete. Diplomsko delo, Univerza v Ljubljani, Biotehniška fakulteta (mentorica: Darja Kocjan Ačko), 32 str., (2007).
- [2] Rahimiyan, H., M. Banayian,. “ *Plant Breeding fiziology*”, Mashhad Jahade Daneshgahi publication. (1997).
- [3] R. Ahmad, N. Hussain, T. Mahmood and M. Amjad, “*Growth and Yield Performance of Some Sunflower (Helianthus annuus L.) Hybrids Planted in Spring Sea-son,*” J. Agri. Sci., 29, (3): 288-291, (1992).
- [4] Rosa, P.M., Antoniassi, R., Freitas, S.C., Bizzo, H.R., Zanotto, D.L., Oliveira, M.F. Castiglioni, V.B.R., “*Chemical composition of Brazilian sunflower varieties*”. *Helia* 32,145-156,(2009).

- [5] Connor, D. J. and A. J. Hall. “*Sunflower physiology*”. In. A. A. Schneiter (ed.), “*sunflower technology and production*”, monograph no. 35, 113-182. ASA, CSSA, SSSA, Madison, (1997).
- [6] M. M. Zubillaga, J. P. Aristi and R. S. Lavado, “*Effect of Phosphorus and Nitrogen Fertilization on Sunflower Nitrogen Uptake and Yield*” J. of Agro. and Crop Sci 188 ( 4): 267-274, (2002).
- [7] Khaliq, T., A. Ahmad, A. Hussain and M. A. Ali, “*Impact of nitrogen rate on growth, yield and radiation use efficiency of maize under varying environments*”. Pakistan J. Agri. Sci., 45(3): 1-7, (2008).
- [8] Khaliq, T., A. Ahmad, A. Hussain, M and A. Ali, “*Maize hybrids response to nitrogen rates at multiple locations in semi arid environment*”. Pakistan J. Bot., 41(1): 207-224, (2009).
- [9] Nasim, W., A. Ahmad, A. Wajid, J. Akhtar and D. Muhammad , “*Nitrogen effects on growth and development of sunflower hybrids under agro-climatic conditions of Multan, Pakistan*” J. Bot., 43(4): 2083-2092, (2011).
- [10] Aziz, S. A. , “*Improving the performance and efficiency of drip/trickle irrigation system in Sulaimani governorate*”. College of agriculture. University of Sulaimani, (2008).
- [11] JMP, Version 7. “*SAS Institute Inc.*”, Cary, NC, (1989-2007).
- [12] Hussein M.A., El-Hattab A.H., Ahmed A.K., “*Effect of plant spacing and nitrogen levels on morphological characters, seed yield and quality in sunflower (Helianthus annuus L.)*. J. Agron. Crop Sci., 149, 148–156, (1980)
- [13] Mahal S., Uppal H.S., Mankotia B.S., “*Performance of spring sunflower (Helianthus annuus L.) under different levels of soil moisture regime and nitrogen*. Environ. Ecol., 16: 599–602, (1998).
- [14] Poonia K.L., “*Effect of planting geometry, nitrogen and sulfur on growth and yield of sunflower (Helianthus annuus L.)*. J. Ecol. Physiol., 3: 59–71, (2000).
- [15] Abdel-Motogally, F. M. F., and E. A Osman (2010). “*Effect of nitrogen and potassium fertilization combinations on productivity of two sunflower cultivars under east of Elewinate condition*. American Eurasian J. Agrica and Environmental. Sci, 8(4): 397-401.
- [16] Hasanzade A. , “*The effect of different amounts of Nitrogen fertilizer on yield and yield component and grain oil of sunflower*. Uremia. Agri. Sci. Research, 2 (1): 25-33, (2002).
- [17] Halvorson Ardell D, Akfred LB ,Joseph MK ,Stephen DM and Donald LT. , “*Sunflower response to tillage and nitrogen fertilization under intensive cropping in a wheat rotation*. Agron. J. 91, 637-642, (1999).
- [18] A. Ahmad, S. Iqbal, S. Ahmad, T. Khaliq, W. Nasim, A. Hussain, M. Zia-ul-Haq and G. Hoogenboom, , “*Seasonal Growth, Radiation Interception, Its Conversion Efficiency and Aerial Dry Biomass Production of Oryza sativa L. under Diverse Agro-Environments in Pakistan*,” J. Bot., 41, ( 3): 1241-1257 ,(2009) .
- [19] Massey J.H. , “*Effects of nitrogen rates and plant spacing on sunflower seed yields and other characteristics*”. Proc. 4th Int. Sunflower Conf. Memphis, Tennessee, Nat. Cottonseed Prod. Assoc., USA: 254–257, (1970).
- [20] A. Anwar-ul-Haq, A. Rashid, M. A. Butt, M. A. Akhter, M. Aslam and A. Saeed, , “*Evaluation of Sunflower (Helianthus annuus L.) Hybrids for Yield and Yield Compo-nents in Central Punjab*,” J. Agri. Re-search, 44 (4): 277-285, (2008)
- [21] Hoking, P.J. Ctal, “*Sulfur nutrition of sunflower as affected by nitroyers supply: effect on vegetative growth, the derelopment of yield componeats and seed yield and quality Field crop*” Res., 16(2): 157-175, (1987).

- [22] Ali, H., S. A. Randhawa and M. Yousaf , “ *Quantitative and qualitative traits of sunflower as influenced by planting dates and nitrogen application*”. Int. J. Agri. Biol.6 (2): 410-412, (2006).
- [23] Kasem M.M., El-Mesilhy M.A. , “ *Effect of rates and application treatments of nitrogen fertilizer on sunflower (Helianthus annuus L.)* ”. I. Growth characters. Ann. Agric. Sci. Moshtohor., 30, 653–663, (1992).
- [24]Al-Thabet, S.S., “*Effect of Plant Spacing and Nitrogen Levels on Growth and Yield of Sunflower (Helianthus annuus L.)*”. J. King Saud Univ. Agric. Sci. 19(1):1-11,(2006).
- [25]Steer B.T., Coaldrake P.D., Pearson C.J., Canty C.P. , “*Effects of nitrogen supply and population density on plant development and yield components of irrigated sunflower (Helianthus annuus L.)* ”. Field Crops Res., 13, 99–115,(1986).
- [26] Geleta S., Baltensperger D.D., Binford G.D., Miller J.F. , “*Sunflower response to nitrogen and phosphorus in wheat-fallow cropping systems*”. J. Prod. Agric., 10, 466–472,(1997).
- [27]Scheiner J.D., Gutierrez-Boem F.H., Lavado R.S. , “ *Sunflower nitrogen requirement and 15N fertilizer recovery in western Pampas, Argentina*”. Eur. J. Agron. 17, 73–79, (2002).
- [28] Javier, D.S., H. Flavio, Gutierrez-Boem and R.S. Lavado, “ *Sunflower nitrogen requirement and N fertilizer recovery in Western Pampas, Argentina*”. Eup. J. Agron., 17, 73-79, (2002).

