Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Annals of Biological Research, 2013, 4 (2):90-93
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0976-1233
CODEN (USA): ABRNBW

Effect of sowing date on yield and yield components of sunflower (*Helianthus annus* L.)

Moslem Fetri[1,3], Mohammad Eghbal Ghobadi[1,2], Ghassem Asadian[3] and Mohsen Rajabi[3]

[1]Department of Agronomy and Plant Breeding, Campus of Agriculture and Natural Resources, Razi University, Kermanshah, Iran
[2]Department of Biotechnology for Drought Resistance, Campus of Agriculture and Natural Resources, Razi University, Kermanshah, Iran
[3]Education Complex of Jahad-Agriculture, Hamedan, Iran

ABSTRACT

High yields of grain and sunflower oil need to match of vegetative and reproductive growth stages of the plant with favorable weather conditions by selecting appropriate sowing date. A split plot experiment, according a randomized complete block design (RCBD) with three replications was performed in the research field of Scientific and Practical Center, Education Complex of Jahad-Agriculture of Hamedan, Iran in 2012. Main plot were sowing date (20 May, 5 and 20 June) and sub-plots were six sunflower cultivars (Pomar, Euroflor, Master, Sirna, Azargol and Armaviruski). Results showed that between cultivars, was significant for grain yield, biological yield, head diameter, stem diameter, stem height, grain empty percent, head dry weight, dry weight of stems and leaves. Grain yield of Euroflor (556.3 g m^{-2}) was the most of the other varieties. The superiority of this variety was due to increased diameter and dry weight of head, stem diameter and biomass. Study planting dates showed that between cultivars was no significant for grain yield, but with delayed planting, decreased stem diameter. The effect of sowing date was significant difference for thousand-grain weight and number of grains per head, so that delays in planting increased grain weight. That was due to reduced number of grains per head.

Key words: Sunflower, Sowing date, Cultivars, Yield and yield components

INTRODUCTION

Among the crops, oil crops are great importance as one of the largest sources of energy. These are being cultivated mainly due to the use of food and non food oils. In Iran, due to the high consumption of oils and high import from other countries is considered, thus oilseeds production and study and research in this area has increased. Now, sunflower is as one of the world's annual oil plants. World production of oils in sunflower is next to soybean and canola [3, 13], but in Iran is after the canola. Oil sunflower cultivars mainly have the branches with a head. Branching and multi heading have the negative effect on yield, but times of ripening of heads are different. Cold and freezing on an early spring planting of sunflower may result in damage to the terminal bud and thus multiple branching that, thus the grain yield will decrease. In fact, the economic yield is the conversion of natural sources including light, water and nutrients into usable products by plant communities [12].

In sunflower, yield is determined by the proportions of the various components. Recognition the share and state of formation in each component are important in plant yield. Yield components of sunflower include number of heads per unit area, number of grains per head and average grain weight [3, 5]. Sowing date under irrigated and rainfed cultivation are one of the most important in farming operations, which affect on yield and other characteristics of the crop. Determine the sowing date for a crop depending on prevailing conditions and climatic region [2]. Ishida et al., [9] and Hadjichristodoulou [1] reported that in sunflower with delay in planting decreased grain yield. Tanimu et al., [2] and Dixon and Lutman [7] pointed out that delay in sowing reduced the morphological characteristics of the plant, including plant height, stem and head diameter, but its effect on grain yield is not significant.

Although many studies have been done on all sunflower cultivars particularly planting date, however, few studies on planting (especially in the case of studied cultivars) has been in the region. Therefore, this study carried out to determine the best sowing date of sunflower cultivars, according to the weather conditions in Hamedan, Iran.

MATERIALS AND METHODS

The experiment was performed in the research field at Education Complex of Jahad-Agriculture of Hamedan (48º 31´ N and 34º 52´E, 1730 m above sea level), in Iran, with temperature characteristics in table 1, on soils classed a Sandy loam (Table 2), during 2012. This location has cold and humid winters, moderate summers and with semi - arid and cold climate. Average annual evapotranspiration is 1408 mm, average rainfall of about 305 mm (meteorology office of Hamedan). Field of experiment was fallow before the sowing from two years ago. Before sowing, half of the nitrogen fertilizer (150 kg ha^{-1} with Urea source) and ammonium- phosphate (200 kg ha^{-1}) was used by hand broadcasting method. Residual urea fertilizer was used at 7 to 8 leaf stage of sunflower (150 kg ha^{-1}).
The test carried out a split-plot based on a randomized complete block design with 3 replications. Main plot were sowing date (20 May, 5 and 20 June) and sub-plots were six sunflower cultivars (Pomar, Euroflor, Master, Sirna, Azargol and Armaviruski). Lines spacing and between plants were 50 and 20 cm, respectively. Irrigation was during the growing season with siphon every 6 to 8 days. For measurements the various components of the plant including stems and leaves, and seed heads were ten plants of each plot. Samples were dried in oven at 70 °C for 72 h. Thousands grain weight was performed with using of seed counter. For data analysis was used SAS software and the Duncan test at 5% level.

Table 1. Average air temperature and rainfall during the seasons from 2006-2012 at Hamedan, Iran

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall (mm)	0.34	71.74	34.00	19.50	36.38	30.20	50.72	45.68	2.42	3.08	0.00	4.16
Average temperature (°C)	15.7	7.6	2.9	-1.0	-1.0	5.0	9.8	14.1	19.7	24.0	24.8	21.6

Table 2. Condition of physical and chemical of soil in farm

Soil texture	Sand	Silt	Clay	K_2O (ppm)	P_2O_5 (ppm)	N (%)
Sandy-loam	52.5	26.6	20.9	451	10.8	0.049

RESULTS AND DISCUSSION

The results showed that between genotypes there is a significant difference for the diameter of head (Table 4). Maximum and minimum of head diameter were Euroflor (18.8 cm) and Master (14.6 cm), respectively. This is consistent with results Dixon and Lutman [7] that reported the effect of genotype on the size of head diameter was the most compared to sowing date. Although Tanimu et al., [2] reported that delay in sowing date significantly reduces the head diameter. Probably due to the different cultivars and weather conditions the location of experiment. In between the grain yield with head diameter, thousands grain weight no. grain weight was positive correlation, and between thousands grain weight with no. grain weight was negatively correlated (Fig. 1). Reported that head diameter is positively correlated with grain weight per head [15]. Marinkovic [14] reported a significant and positive correlation between the number of grains and head diameter and thousands grain weight. Results showed that there is a significant difference in yield between cultivars (Table 4). The maximum and minimum of grain yield obtained at Euroflor (556.3 g m^{-2}) and master (375.9 g m^{-2}), respectively. It seems, superior varieties in terms of yield due to high leaf area duration of reproductive phase, fast Physiological grow, sending enough assimilate to reproductive organs and ultimately benefit from the environment.

Stem diameter between the sowing dates and the interaction of cultivars and varieties, sowing dates was a significant difference (Tables 3 and 4). The highest of stem diameter obtained at Euroflor compared to other cultivars.

Sowing date (20 May) has maximum for stem diameter compared to 5 and 20 June. Stem diameter was reduced with delay in planting. Ishida et al., [9] in their studies reported the stem diameter reduced with delay in planting. With delays in planting decreased stem diameter, Pomar, Master and Sirna, but increased Armaviruski cultivar. The results indicated that there are very significant differences between cultivars in plant height (Table 4). Stem height was highest at Azargol (149.6 cm) compared to other varieties. The results of the analysis indicated that there are significant differences between cultivars for biological yield (Table 4). Maximum and minimum of biological yield obtained at Euroflor (1394.4 g m^{-2}) and Master (949.1 g m^{-2}).

Table 3. The effects of sowing dates on yield and yield components of sunflower cultivars

Sowing date	Biological yield (g m^{-2})	Grain yield (g m^{-2})	Harvest index (%)	Head diameter (cm)	Grain empty (%)	No. grain /head	1000-grain weight (g)	Head dry weight (g)	Leaf+ stem dry weight (g/ plant)	Stem diameter (cm)	Plant height (cm)
20 May	**1163.0^{a}**	**468.4^{a}**	**39.65^{a}**	**15.87^{a}**	**6.21^{a}**	**976^{a}**	**44.53^{b}**	**28.67^{a}**	**41.3^{a}**	**2.48 ^{a}**	**130.5^{a}**
5 June	**1159.7^{a}**	**448.9^{a}**	**38.52^{a}**	**17.07^{a}**	**5.76^{a}**	**883^{b}**	**50.85^{a}**	**29.63^{a}**	**40.6^{a}**	**2.22 ^{b}**	**130.8 ^{a}**
20 June	**1114.6^{a}**	**406.6^{a}**	**37.19^{a}**	**16.33^{a}**	**6.75^{a}**	**876^{b}**	**51.27^{a}**	**29.02^{a}**	**41.8^{a}**	**2.13 ^{c}**	**134.8 ^{a}**
P value	**ns**	**ns**	**ns**	**ns**	**ns**	*****	*****	**ns**	**ns**	******	**ns**

*ns, * and ** : Not significant, significant at 5% and 1% probability levels, respectively.*
Within each column, mean followed by a different letter are significantly different at 5% level (DMRT).

Table 4. The effects of cultivars of sunflower on yield and yield components at different sowing dates

Cultivars	Biological yield (g m^{-2})	Grain yield (g m^{-2})	Harvest index (%)	Head diameter (cm)	Grain empty (%)	No. grain /head	1000-grain weight (g)	Head dry weight (g)	Leaf+ stem dry weight (g/plant)	Stem diameter (cm)	Plant height (cm)
Pomar	**1106^{abc}**	**375.5^{b}**	**36.99^{a}**	**16.12^{bc}**	**5.16^{b}**	**934^{a}**	**43.76^{a}**	**27.5^{b}**	**42.44^{abc}**	**2.52^{a}**	**137.1^{a}**
Euroflor	**1394^{a}**	**556.3^{a}**	**36.35^{a}**	**18.87^{a}**	**3.97^{b}**	**1010^{a}**	**52.18^{a}**	**38.9^{a}**	**47.5^{ab}**	**2.6^{a}**	**122.8^{b}**
Master	**949^{c}**	**382.9^{b}**	**40.30^{a}**	**14.67^{c}**	**5.67^{b}**	**841^{a}**	**45.71^{a}**	**26.3^{b}**	**30.26^{c}**	**1.92^{b}**	**120.3^{b}**
Sirna	**1030^{bc}**	**441.0^{b}**	**40.53^{a}**	**15.21^{bc}**	**6.10^{ab}**	**876^{a}**	**50.91^{a}**	**24.5^{b}**	**34.36^{bc}**	**1.97^{b}**	**119.4^{b}**
Azargol	**1130^{abc}**	**451.1^{b}**	**39.47^{a}**	**17.04^{ab}**	**8.30^{a}**	**922^{a}**	**50.88^{a}**	**27.7^{b}**	**40.17^{bc}**	**2.32^{a}**	**149.6^{a}**
Armaviruski	**1264^{ab}**	**441.1^{b}**	**36.07^{a}**	**16.64^{bc}**	**8.25^{a}**	**889^{a}**	**49.85^{a}**	**29.5^{b}**	**52.77^{a}**	**2.33^{a}**	**143.1^{a}**
P value	*****	******	**ns**	******	******	**ns**	**ns**	******	******	******	******
Interaction sowing date × cultivar											
P value	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	******	**ns**

*ns, * and ** : Not significant, significant at 5% and 1% probability levels, respectively.*
Within each column, mean followed by a different letter are significantly different at 5% level (DMRT).

Data analysis showed that there was no significant difference between the grain empty (Table 4). The lowest grain empty was in Euroflor (3.97) and the highest in Azargol (8.3%). Thousands grain weight was significantly different among the different sowing dates (Table 4). Thousand grain weight was less in 20 May (44.5 g) than 5 (50.8 g) and 20 June (51.2 g), respectively, and with delay in planting, thousands grain weight was increased. The number of grains per head was a significant difference between sowing dates (Table 3).

Sowing dates 20 May, 5 and 50 June produced 976, 883 and 876 grains per head, respectively. Vega and et al. [4] examined the role of grain number on yield of corn, soybean and sunflower and stated that grain number is the most important component of grain yield of cereals and oilseeds.

It also depends on heavily on the physiological factors, genotype, environmental factors and management factors (during the flowering period and grain filling). Zaffaroni and Schneider [5] showed that the grain number per head is an important component of the grain yield in sunflower. Roath and Miller [16] in their study to study the effects of the environment on grain set in sunflower expressed in the sunflower there is compensation state between yield components and reduce the number of grains in the head may have to be weight grain. The number of grains per head is influenced by environmental conditions during the pollination period [6]. The leaf and stem dry weight were a significant difference between genotypes (Table 4). Maximum and minimum of stem and leaf dry weights were obtained at Armaviruski (52.7 g $plant^{-1}$) and master (30.2 g $plant^{-1}$), respectively.

Thompson and Heenan [8] reported that dry matter production has been affected by sowing date. The results of the analysis of the data showed that there was no significant difference between treatments at harvest index (Tables 3 and 4). Sangoi and Silva [10] reported that with delayed planting declined harvest index. Bange et al., [11] in their study, also reported a similar trend in the harvest index. These researchers reported that growth and assimilate share increased to the grain to cause harvest index in the early planting, that are inconsistent with this results.

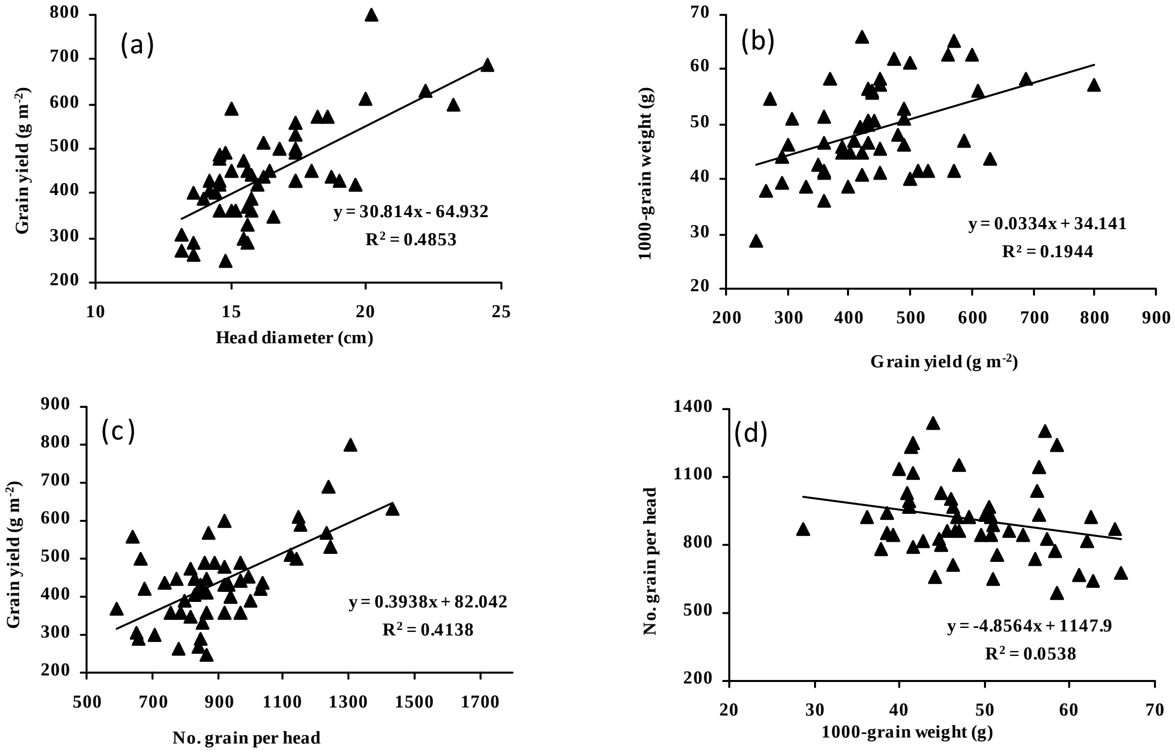

Fig. 1. Relationship between (a) grain yield and head diameter, (b) thousands grain weight and grain yield, (c) grain yield and no. grain per head and (d) no. grain per head and thousands grain weight.

CONCLUSION

In general, the results of this test showed that between sowing dates were no significant difference for yield and yield components (except grain per head, thousands grain weight and stem diameter). All of traits decreased with delay in planting. Between genotypes, head diameter, stem diameter, stem height, grain empty, head dry weight, leaf and stem dry weight, grain yield and biological yield were significant difference. Euroflor and master were maximum and minimum in grain yield and biomass, respectively. Interaction sowing date and cultivar was no significant difference (except stem diameter).

REFERENCES

[1] A. Hadjichristodoulou, *J. Agric. Sci. Camb*., **1993**, 720, 7-12.
[2] B. Tanimu, S. G. BAdo, S. A. Dadri, *Helia*., **1991**, 14, 29-36.
[3] B. J. Johnson, M. D. Jellum, *Agron. J.,* **1972**, 64, 747-748.
[4] C. R. C. Vega, V. O. Sadras, F. H. Andrade, S. A. Uhart, *Annals of Botany*, **2000**, 85, 461-468.
[5] E. Zaffaroni, A. A. Schneider, *Argon. J.,* **1991**, 81, 831-836.
[6] F. J. Villalobos, J. O. E. Hall, J. T. Ritchie, F. Orgaz, *Agron. J., **1996***, 88, 403-415.
[7] F. L. Dixon, , P. J. W. Lutman, *Agric. Sci. Camb.*, **1992**, 119, 197-204.
[8] J. Thompson, D. P. Heenan, *Aus. Exp. Agric*., **1994**, 32, 255-258.
[9] K. Y. Ishida, Ujinira, Hiramantsu, *Field Crop Abstr.*, **1991**, 44, 4, 25230.
[10] L. D. A. Sangoi, P. R. F. Silva, *Field Crop Abstr*., **1988**, 44, 10, 7548.
[11] M. P. Bange, K. G. Hammer, K. G. Rickert, *Aus. J. Agric. Ref.,* **1997**, 48, 231-240.
[12] O. R. Jones, *Agron. J.,* **1984**, 76, 229-235.
[13] R. G. Robinson, S. Troneme, R. Boniface, *Introduction Techn.,* **1975**, 47, 29-37.
[14] R. Marinkovic, *Euphytica.,* **1992**, 60, 201-205.
[15] S. K. Naskar, P. K. Hohwmik, K. Bhadra, *India J. Agric. Sci.,* **1988**, 58, 393-394.
[16] W. W. Roath, J. F. Miller, *Can. J. Plant Sci.,* **1982**, 62, 867-873.