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EFFECT OF SOWING DATES ON PERFORMANCE OF SUNFLOWER CROP UNDER NORTHERN OF SINAI CONDITIONS

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ABSTRACT

This study was conducted in the Eexperimental Farm, Faculty of Environ. Agric. Sci., EL-Arish city, Suez Canal University during two seasons of 2011 and 2012. Sunflower cultivar (Sakha53) was provided by Oil Crops Research Department, Field Crop Research Institute, ARC, Egypt. Seeds with rate of 4 kg fed.$^{-1}$ were planted under drip irrigation system. The experiment included 4 treatments in four replications. Plot area was 20 m^2 containing 5 rows each of 8 m length and 50 cm between rows. All of the other agricultural practices were carried out as recommended for sunflower growing under the conditions of North Sinai as a semi-arid region. Plants thinned to single plant per hill after 15 days and distance between hills was 25 cm apart. This study was aimed to study the influence of different sowing dates (15th April, 15th May, 15th June and 15th July) on growth and yield components of sunflower (Sakha53) cultivar under North Sinai condition. Results indicated that 15th April was the favorable sowing date and increased each of plant height (cm), number of green leaves/plant, head diameter (cm), head weight (g), seed weight/plant (head), 100- seed weight (g), number of seeds/head and seed yield/fed. of sunflower (Sakha53) cultivar.

Keywords: sowing dates, sunflower, planting date.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one of the most widely cultivated oil crops in the world and ranking fourth among all oilseed crops of the world **(Petcu *et al.*, 2010 and Arshad *et al.*, 2013).**

It is cultivated over an area of 1.83 million hectares with a production of 1.25 million tones with a productivity of 683 kg/ha in world. In Egypt total cultivated area is 9000 hectares and production amounted 22000 ton **(FAO, 2007)** .The two main sunflower seed varieties currently planted in Egypt are Sakha53 and Giza102 (**FAO, 2013).** Sowing date is one of very important abiotic factors promoted crop growth and yield such as sunflower **(Kolte, 1985 and Abdou *et al.*, 2011)**.

Environmental variables, especially temperature are playing important role in choice sowing dates, it is the key factor which affects plant growth, development and productivity of yield and oil **(Kaleem *et al.*, 2009; Kaleem *et al.*, 2010a)**.

North Sinai consider apart from semiarid region and it is promising region for cultivating sunflower crop. Differences of yield attributes in varying seasons might be due to the different climatic conditions that are based on temperature prevailing during the crop life cycle **(Kll and Altunbay, 2005)**.

Although, sunflower is a temperate zone crop, it can perform well under various climatic and soil conditions. Crop display and yield characteristics are influenced by environmental disparity **(Kaleem *et al.*, 2010b)**.

Quantitative parameters like stem diameter, plant height and biological yield of all sunflower hybrids were higher in spring when compared with autumn season where sunflower is sensitive to cold temperatures in autumn. Sunflower having higher physiological activity **(Brouder and Volenec, 2008; Kaleem *et al.*, 2009)** thus, the choice of suitable sowing dates may improve sunflower yield **(Bange *et al.*, 1997; Villalobos and Ritchie, 1992).**

This study aims to investigate the influence of different sowing dates (15^{th} April, 15^{th} May, 15^{th} June and 15^{th} July) on growth and yield components of sunflower (Sakha53) cultivar under North Sinai environments.

MATERIALS AND METHOD

This study was conducted at the Experimental Farm, Faculty of Environ. Agric., Sci., EL-Arish, Suez Canal Univ., during two seasons of 2011 and 2012.Sunflower cultivar (Sakha53) was provided by Oil Crops Research Department, Field Crop Research Institute, ARC, Egypt. Seeds with rate 4 kg $fed.^{-1}$ were planted under drip irrigation system.

The experiment included 4 treatments in four replications. Plot area was 20 m^2 containing 5 rows each of 8 m length and 50 cm between rows. All of the other agricultural practices were carried out as recommended for sunflower growing under the conditions of North Sinai as a semi-arid region.

Plants were thinned to a single plant per hill, 15 days after sowing and distance between hills was 25 cm apart. This study was aimed to study the influence of four sowing dates (15^{th} April, 15^{th} May, 15^{th} June and 15^{th} July) on growth and yield components of sunflower cultivar (Sakha53) under North Sinai condition.

Soil physical and chemical analysis as well as meteorological data of experimental site are shown in **Tables 1-a, 1-b and 2**.

Harvesting date and season duration (days) for plants of each sowing date treatment are shown in **Table (3)**.

Vegetative growth characters of sunflower:

Samples of five guarded plants from each experimental unit were randomly taken at 80 days after sowing for studying the effect of sowing dates on plant height (cm) and number of green leaves per plant.

Yield and yield components of sunflower:

At maturity (Table 3), five guarded plants were taken randomly from each experimental unit for measuring the following characters:

2.1. Head diameter (cm).

2.2. Head weight (g).

Heads of five plants of each experimental unit were lifted for two weeks after harvest until head and seeds were full dried by air at room temperature to determine the following head yield parameters:

2.3. Seed weight per plant (head).

2.4. 100- seed weight (g).

2.5. Number of seeds per head.

2.6. Seed yield per fed**:** Calculated on the basis of seed yield per the harvested three inner rows (8 m) in kg and then converted to seed yield per fed (kg.).

Statistical analysis:

Data of each of sunflower experiment was subjected to statistical analysis for two seasons and their combined using analysis of variance technique (MSTAT-C) computer software package **(Rusell, 1986)** with four replicates. Mean values of treatments were differentiated by using least significant range (Duncan's multiple range tests) at 0.05% level probability **(Duncan, 1955)**.

RESULTS

Data presented in Table (4) show significant differences in plant height and number of green leaves per sunflower plant due to ected between planting dates.

Under North Sinai climatical conditions combined results of the two experimental seasons cleared that the tallest sunflower plants (163.9 cm) were obtained from early sowing date (April, 15th) treatment.

Obviously, height of sunflower plants was significantly decreased as sowing date delayed. Therefore, the shortest plants (100.5 cm) were produced from the latest sowing date on 15th July. On the same trend, results show that early sowing date (mid-April) favored vegetative growth of sunflower plants and produced significantly more No. of leaves plant.

Sunflower yield components under investigation were: head diameter (cm); head weight (g.); seed number and weight (g.)/ plant and seed index (100-seed weight) in addition to seed yield (kg/fed.) and components were significantly affected by sowing dates. Such finding is true in both 2011 and 2012 seasons as well as their combined (Tables 5, 6 and 7). Obtained results indicate that head diameter (cm), head weight (g.), seed number and weight (g.)/ plant and seed index (100-seed weight) in addition to seed yield (kg/fed.) values were gradually decreased as sowing date was delayed.

The greatest yield components values were produced due to early sowing date (mid-April) but smallest values were recorded from plant sow lately mid-July.

DISCUSSION

Previous results showed that early sowing date (mid-April) gave the highest values of plant height and leaf number/plant. Average air temperature during growth season of mid-April sowed plants under El-Arish conditions were 23.0 and 23.5 ^{o}C in the 1st and 2nd seasons, respectively Table (2).

Table (1-a): Physical properties of the experimental site soil.

Depth (cm)	Clay (%)	Silt (%)	Sand (%)	Organic carbon (%)	Drained level		Saturation	Bulk density g/cm^3	Root growth factor 0.0 to 1.0
					Lower limit	Upper limit			
5	2	12	84	0.58	0.11	0.25	0.33	1.2	0.8
15	2	12	84	0.80	0.11	0.25	0.33	1.2	1.0
30	2	12	84	0.90	0.11	0.25	0.33	1.2	0.5

Table (1-b): Chemical analysis of the experimental site soil.

Depth (cm)	pH	EC (dS.m^{-1})	Cations Meq. l^{-1}				Anions Meq. l^{-1}			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	Co_3	So_4^{-}
5	7.8	2.1	4.6	9.2	3.6	1.7	3.3	4.5	-	11.3
15	7.8	1.5	3.6	4.9	5.1	0.52	6.2	3.2	-	4.7
30	7.8	1.7	3.4	8.4	3.9	0.5	5.3	2.9	-	8

Table (2): Meteorological data of El-Arish, North Sinai region during sunflower growing season of 2011 and 2012

Date	Air temp. [°C]						Solar radiation [MJ/m²]		Precipitation [mm]	
	Max.		Min.		Aver.					
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
April	25.2	25.8	13.2	13.2	19.2	19.5	11.0	10.8	0.60	0.80
May	27.6	27.6	16.3	16.3	21.9	21.9	12.0	12.0	0.20	0.20
June	28.9	29.2	19.4	19.9	24.1	24.5	13.5	13.0	0.00	0.00
July	31.4	32.8	21.8	23.2	26.6	28.0	12.6	8.9	0.00	0.20
Aug.	31.9	33.4	21.8	22.7	26.8	28.0	11.2	8.1	0.00	0.40
Sep.	30.7	30.7	20.5	21.1	25.6	25.9	9.3	6.3	0.00	0.00
Oct.	28.0	29.1	17.4	18.3	22.7	23.7	6.6	4.3	0.20	0.20
Nov.	21.9	25.4	11.4	15.0	16.6	20.2	4.2	2.7	0.40	6.20
Dec.	19.7	21.2	7.9	10.5	13.8	15.8	4.4	2.7	0.20	1.20

- **Source:** Central Laboratory for Agricultural Climate (CLAC, Egypt 2012).

Table (3): Harvesting date and season duration (days) for plants of each sowing date treatment.

Sowing date	2011 season		2012 season	
	Harvesting date	Season duration (day)	Harvesting date	Season duration (day)
15 April	05 August	112	05 August	112
15 May	16 August	93	16 August	92
15 June	15 September	92	15 September	92
15 July	10 October	87	10 October	87

Such temperature is optimum for germination and vegetative growth of sunflower plants. Climatic conditions prevailing growing of early planting sunflower plants Table (2) furnished favorable conditions for growth and hence produce the tallest sunflower plants (163.9 cm) having the highest number of leaves/ plant (28.3).

Delaying sunflower sowing date beyond mid-April was mostly concomitanted by a gradual depression in either height or number of leaves per sunflower plant.

Delaying sowing date conspicuously shorting growth season of sunflower plant Table (3) and diminished its capacity for elongation and for generate new leaf.

Moreover, delayed sowing plants faced at early vegetative stage with high temperature which reached to 31.9 and 33.1 ^{o}C in the 1st and 2nd season, respectively (Table 2). High temperature accelerates growth stages and constraint elongation of sunflower plant and hastened leaf senescence and death.

In this respect **El-Sadek, (2005)** stated that all growth criteria *i.e.* plant height, stem diameter, fresh and dray weight per plant, leaf area, LAI, SLW and SLA of sunflower plant were depressed by delaying the date of sawing from April 1st to May 1st. According to these results, he chose an earlier date of sowing (1-15 April) and omitted the later dates of sowing. He added that sowing sunflower delayer than April 15th exerted smaller growth criteria.

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Table (4): Effect of different sowing dates on sunflower plant height (cm) and number of leaves plant in 2011 and 2012 seasons and their combined analysis.

Season / Sowing date	Plant height (cm)			Number of leaves/ plant		
	2011	2012	Combined	2011	2012	Combined
April, 15th	159.40 a	168.40 a	163.90a	27.25 a	29.35 a	28.30 a
May, 15th	151.10 b	152.00 ab	151.55b	20.05 b	27.30 a	23.68 b
June, 15th	135.10 c	139.20 b	137.15c	21.70 b	24.55 ab	23.13 b
July, 15th	96.30 d	104.80 c	100.55d	19.75 b	19.80 b	19.78 c

- Mean values of treatments were differentiated by using Least Significant Range (Duncan's multiple range test) at 0.05 probability level

Table (5): Effect of different sowing dates on sunflower head diameter (cm) and head weight (g.) in 2011 and 2012 seasons and their combined analysis.

Season / Sowing date	Head diameter (cm)			Head weight (g.)		
	2011	2012	Combined	2011	2012	Combined
April, 15th	22.20 a	23.65 a	23.43 a	898.1a	926.8a	912.4a
May, 15th	16.15 b	23.08 a	19.62 b	754.2b	815.1b	784.6b
June, 15th	15.75 b	18.42 b	17.09 c	720.5c	788.5c	754.5c
July, 15th	13.45 c	14.43 c	13.94 d	601.7d	689.04	645.4d

- Mean values of treatments were differentiated by using Least Significant Range (Duncan's multiple range test) at 0.05 probability level

Table (6): Effect of different sowing dates on seeds number/ plant and seed weight/plant of sunflower in 2011 and 2012 seasons and their combined analysis.

Season / Sowing date	Seeds number/ plant			Seeds weight/ plant (g.)		
	2011	2012	Combined	2011	2012	Combined
April, 15th	1571.0 a	1799.2 a	1685.1 a	94.45 a	117.40 a	105.93 a
May, 15th	1322.5 b	1544.9 b	1433.7 b	73.90 b	93.47 b	83.69 b
June, 15th	1219.1 c	1461.3 c	1340.2 c	67.05 b	81.10 b	74.08 c
July, 15th	943.9 d	1081.6 d	1012.7 d	44.60 c	45.08 c	44.84 d

- Mean values of treatments were differentiated by using Least Significant Range (Duncan's multiple range test) at 0.05 probability level

Table (7): Effect of different sowing dates on seed index (100-seed weight g.) and seed yield (kg/fed.) of sunflower in 2011and 2012 seasons and their combined analysis.

Season / Sowing date	100-seed weight (g.)			Seed yield (kg/fed.)		
	2011	2012	Combined	2011	2012	Combined
April, 15	6.012 a	6.525a	6.270a	3022.4a	3756.8a	3389.6a
May, 15	5.550 b	6.050 b	5.800b	2348.8b	2991.0b	2669.9b
June, 15	5.500 b	5.550 c	5.530b	2145.6c	2595.2c	2370.4c
July, 15	4.725 b	5.000 c	4.860c	1427.2d	1730.5d	1578.8d

- Mean values of treatments were differentiated by using Least Significant Range (Duncan's multiple range test) at 0.05 probability level

The fruitful impacts of early sowing date on vegetative growth of sunflower late were also reported by **Barros *et al.* (2004), Kll and Altunbay (2005), Allinne *et al.* (2009), Abdou *et al.* (2011), Abd El-Mohsen (2013), Fetri *et al.* (2013), Hekmat (2013) and Soleymani *et al.* (2013).**

Accordingly, the smallest head diameter and head weight (g.) values in both seasons and the combined were recorded from sunflower plants sown lately on mid-July. High temperature during development of the later sown plants caused more rapid rate of leaf death and reduces canopy which diminished photosynthetes translocated from leaves to heads and seeds.

Similar results were obtained by **Hakoomat *et al.* (2004)**; **Kll and Altunbay (2005)**, **Shahbaz *et al.* (2005)**, **Lopes *et al.* (2007)**, **Arthanari *et al.* (2009**), **Abdou *et al.* (2011)**, **Abd El-Mohsen (2013)**, **Hekmat (2013)** and **Soleymani *et al.* (2013)**. In this respect **Arthanari *et al.* (2009**) showed that the significant higher yield components included head diameter, total seed head^{-1} and 100-seed weight was obtained due to sowing on April 9-15 than other sowing dates. Meanwhile **Abd El-Mohsen (2013)** indicated that the highest seed yield, oil yield, plant height, head diameter, 1000-seed weight and seed yield/ plant were obtained at the earliest planting date on 1st May.

When sowing date was delayed, for most genotypes, yield, 100-seed weight and head diameter were reduced **(Lopes *et al.* 2007)**. However,

Abdou *et al.* (2011) reported that the highest averages of head diameter, head weight, seed weight/head and 100 seed weight in the two seasons under El-Fayoum district conditions, were obtained from June 1st sowing date. Early sowing date (mid-April) furnished suitable climatic factors to sunflower plant to grow well and initiate high number of seeds per head (plant) and seeds weight per head (or per plant). While, Delaying sowing date, shorting the total growth duration of sunflower plant Table (3) and reduced number of leaves /plant Table (4) and consequently decreased photosynthetic efficiency of lately plants.

This finding agreed with those obtained by **Hakoomat *et al.* (2004), Barros *et al.* (2004)**, **Kll and Altunbay (2005)**, **Shahbaz *et al.* (2005), Arthanari *et al.* (2009**), **Fetri *et al.* (2013), Soleymani *et al.* (2013).** In this regard, **Kll and Altunbay (2005)** concluded that early sowing on 26th March resulted in the highest head diameter, total number of seeds head^{-1}, 1000-seed weight and seed yield. Likewise,

Arthanari *et al.* (2009) showed that the significant higher values of head diameter, total seeds head^{-1} and 100-seed weight were obtained due to sowing on April 9-15 than other sowing dates, whereas **Fetri *et al.* (2013)** suggested that delays in planting, increased grain weight due to reduced number of grains per head. Early sowing is accombined by long growth period (Table 3) that gives chance for plants to utilize efficiency all growth elements *i.e.* nutrient, water and light.

The environmental conditions during this period seemed to be suitable and favorable for growth Table (4) and reproduction stages of sunflower plant.

Longer growing season achieved with early sowing also increase photosynthetic area (Table 4) and period (leaf area duration) and consequently increase amount of photosynthates whom translocated to efficient sink of sunflower to face the requirement of greater number of seeds/head (Table 6), seed weight per plant (Table 6), 100-seed weight and seed yield (kg/fed.) (Table 7).

Moreover, early sowing date is obviously accompanied with a longer seed-filling period which permits to more accumulated metabolites to be stored in seeds.

Interpretation for the detrimental impact of delayed sowing on sunflower seeds was reported by **Caliskan *et al.* (2002)** whom deduced that poor seed-setting and development in the late sowing caused by a compination of high temperature and water stress during head initiation and seed setting were the reason for poor yield.

In this respect **Kll and Altunbay (2005)** in Turkey found that early sowing on 26th March resulted in the highest head diameter, total number of seeds head^{-1}, 1000-seed weight and seed yield.

Similarly, in Egypt **Abd El-Mohsen (2013)** concluded that the highest values of sunflower yield components included 1000-seed weight were obtained on the earliest planting date (1st May). Thereat, when sowing date was delayed, for most sunflower genotypes, yield, 100-seed weight and head diameter were reduced **(Lopes *et al*. 2007)**.

Delayed sowing dates were mostly coincide with significant reduction in sunflower productivity. Likewise, **Zheljazkov *et al.* (2011)** reported that later planting (20 June) may significantly decrease seed yield.

Withal, correlation studies indicated stronger association for yield components and yield with weather variables during flowering and seed-filling period, therefore **Parvender *et al.* (2014)** reveals a decisive factor to optimize sunflower yield by adjusting sowing time under changing climate scenario.

It is worthy to notice that values of all the studied yield attributes *i.e.* head weight; seed number and weight /plant and 100-seed weight as well as seed yield (kg/fed.) of sunflower were higher in the 2nd season of 2012 than in the 1st season of 2011.

Differences of yield components between the two experimental seasons might be due to the different climatic conditions that are based on temperature prevailing during the crop life cycle.

Average air temperature along summer season months (April, May, June, July, August, and September) was 23.9 ^{o}C in the first season, but amounted to 24.6^{o}C in the second one.

Warmer weather of the 2nd season may the favored growth and productivity of sunflower plants under El-Arish environmental conditions.

CONCLUSIONS

Finally, The 15th April was the suitable sowing date for growth and yield of sunflower cultivar (Sakha 53) under North Sinai condition.

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الملخص العربى

تأثيـــر مواعيد الزراعـــــة على سلــوك محصـــول دوار الشمـــس تحت ظروف شمال ســـيناء

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٣- المعمل المركزي للمناخ الزراعي- مركز البحوث الزراعية- مصر

أجريت هذه الدراسة بالمزرعة التجريبية بكلية العلوم الزراعية البيئية بالعريش، جامعة قناة السويس خلال موسمي الزراعة ٢٠١١ و ٢٠١٢. وتم الحصول على صنف دوار الشمس سخا ٥٣ من قسم بحوث المحاصيل الزيتية- معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية- مصر. زرعت البذور بمعدل ٤كجم/الفدان تحت نظام الري بالتنقيط. احتوت التجربة على ٤ معاملات وأربع مكررات. مساحة الوحدة التجريبية ٢٠م٢ احتوت على ٥ صفوف بطول ٨م بمسافة ٥٠سم بين الصفوف. تم إجراء جميع المعاملات الزراعية الموصى بها لزراعة دوار الشمس تحت ظروف شمال سيناء والمناطق شبه الجافة. وتم إجراء عملية الخف للنباتات الى نبات واحد فى الجورة بعد ١٥ يوم من الزراعة بمسافة ٢٥سم بين الجور. تهدف هذه الدراسة إلي دراسة أداء محصول دوار الشمس صنف سخا٥٣ في شمال سيناء تحت مواعيد مختلفة للزراعة (١٥ إبريل- ١٥ مايو- ١٥ يونيه و ١٥ يوليو) على النمو والمحصول، وأظهرت النتائج أن ميعاد الزراعة المبكر ١٥ إبريل يُعد الأفضل تأثيراً على إرتفاع النبات (سم)، عدد الأوراق الخضراء/النبات، قطر الرأس (سم)، وزن الرأس (جم)، وزن البذور/النبات (جم)، وزن الـ ١٠٠ بذرة (جم)، عدد البذور/الرأس ومحصول البذور/الفدان لنبات دوار الشمس صنف سخا٥٣ تحت الظروف المناخية لشمال سيناء.

الكلمات الإسترشادية: مواعيد الزراعة، محصول دوار الشمس،الصنف سخا ٥٣.

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المحكمون:

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