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# INFLUENCE OF SOWING DATE ON THE MORPHOLOGICAL CHARACTERS AND YIELD COMPONENTS ON SUNFLOWER HYHBRIDS

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***Abstract***

*Three sunflower hybrids: F708 (H1), HF 7104 (H2) and FD18E41 (H3) were sown at three different sowing dates (SD): 10 March (SD1), 25 March (SD2) and 10 April (SD3) in order to determine the influence of sowing date on the morphological characters and yield components. Research was performed in the field experiments in Tulcea county in 2020 under rainfed conditions. The highest values for head diameter, plant population, 1000-seed weight, seed yield and hectolitre mass were obtained at SD2. Between the hybrids H3 had the highest yield - 2029.67 kg ha$^{-1}$. At the interaction between sowing date and hybrid the highest no. of leaves/plant was for SD1H2 (17.8) while the great head diameter was for SD2H1 (16.61 cm). H1 and H2 had their high yield at SD2 (2288 kg ha$^{-1}$ and 1799.3 kg ha$^{-1}$) while H3 at SD3 (2566.3 ha$^{-1}$).*

***Key words****: sowing date, sunflower, hybrids, yield components.*

## INTRODUCTION

Sunflower (*Helianthus annuus* L.) is the main oil crop in Romania being cultivated on 1.17 million ha in 2020 (retrieved from: https://www.madr.ro/culturi-de-camp/plante-tehnice/floarea-soarelui.html). Sunflower is a temperate zone crop, which can behave well under different climatic and soil conditions (Canavar et al., 2010). In Dobrogea (Tulcea and Constanta counties) which is an arid region, sunflower is cultivated on about 1/5 of the total agriculture area of Romania (Manole et al., 2019).

Although sunflower is a better adapted crop to water stress than other crops, the main factors affecting sunflower production in rainfed conditions are irregular and inadequate amount of precipitation during the growing season (Agele, 2003; Olowe, 2013). The different growing factors (environmental and technological factors) influence strongly the yield and the yield components of the head for each sunflower hybrid (Ion et al., 2015).

One of the most important factors for a high and stabile yield is sowing date. An early sowing can avoid the dry atmosphere and water deficiency during flowering and seed filling stages but on the other hand the emergence can be extended and different weeds (*Poygonum convolvulus* L., *Sinapis arvenis* L., *Chenopodium album*) can cause problems (Vranceanu, 1974). When planting is delayed soil moisture gained during winter season can be inefficient valued due to evapotranspiration, the crop did not have enough time to fill achenes (Killi & Altunbay, 2005) and the yield decreased owing to high temperature during flowering (Ahmed et al., 2020).

Across the climatic regions it turns out that the optimum sowing time for sunflower vary really much, from February (El-Saied et al., 1989) – August (Lawal et al., 2011) to November (Ahmed et al., 2015). The results from one climatic region are not available to be implemented to a different one due to natural conditions. Thus studies like these have to carry out from time to time in all climatic

regions and provide the needed information for farmers.

Studies proved that beyond the influence over yield, sowing time influence also the emergence, flowering time, plant high, number of leaves, stem diameter, oil content (Petcu et al., 2010), dry matter (Sofield, 1977; Ahmed, 2015), fertile/infertile seeds (Baghdadi et al., 2014), or head diameter (Allam et al., 2003).

The aim of this research was to examine how different sowing dates influence morphological characters and yield components of different sunflower hybrids in the climatic conditions specific for Dobrogea area in 2020.

## MATERIALS AND METHODS

**Plant material and field trials.** The experiment was carried out in the field experiments in the South of Tulcea county (Beidaud - 44º42' N latitude and 28º34' E longitude) during 2020 on a chernozem argiloiluvial soil under rainfed conditions. The sunflower hybrids used were: F708 (H1), HF 7104 (H2) and FD18e41 (H3), bred at the National Agricultural Research and Development Institute Fundulea. They were sown at three different sowing dates (SD): 10 March (SD1), 25 March (SD2) and 10 April (SD3). Sowing density was 55,000 plants $ha^{-1}$. The space between rows was 70 cm. The plot size was 560 $m^2$ (5.6 m x 100 m). The previous crop was winter wheat. A hoeing was used to reduce weeds infestation before inflorescence being visible.

**Morphological characters and yield components.** At maturity from each plot a number of five representative sunflower heads (taken from average plants) in three replications were analysed for determining head diameter, number of seeds per head and 1000 - seeds weight (g). Number of green leaves was determined for 10 plants in three replications at the flowering stage. Plant density was determined by counting the plants within 28 $m^2$ (10 linear meters for 4 rows) in three replications. It was also determined hectolitre mass (kg $hL^{-1}$). The yield (kg $ha^{-1}$) was calculated using formula = no. of heads per ha*no. of seeds per head*1000 seeds weight (g)/1000*1000. The results were adjusted at 9% moisture content. The grain (achene) moisture was determined using a moisture analyser (Pfeuffer Helite).

**Weather conditions.** At Beidaud area for the sunflower growing period (March-August), the mean temperature has increased continuous from 7.7ºC (March) to 23.9ºC (August). The sum of rainfall for the same period was 115.2 mm insufficient for covering the sunflower water requirements for a good development which is over 400 mm (Pejic et al., 2009). Rainfall was irregular during the months of sunflower vegetative period (Figure 1).

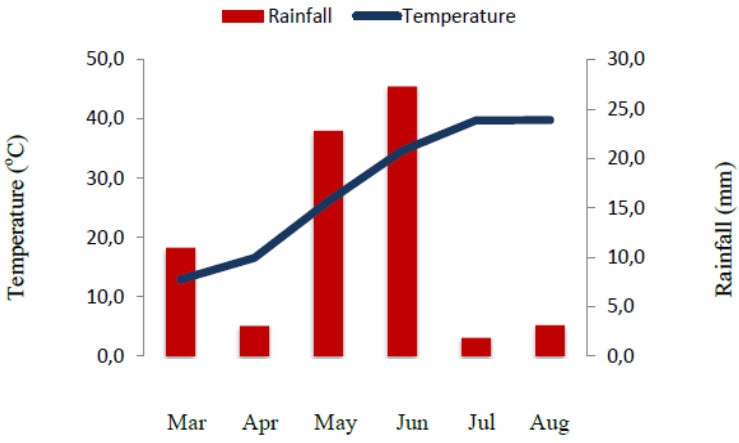


Figure 1. Average temperature (°C) and monthly distribution of rainfall (mm) during the sunflower growing season

**Statistical analysis.** Collected data were statistically analysed by ARM-9 software using Tukey's HSD (Honestly Significant Difference) test ($P< 0.05$).

## RESULTS AND DISCUSSIONS

Tukey's HSD test ($P< 0.05$) was performed in order to determine if there are significant differences between the sowing dates and sunflower hybrids (Table 1). Taking into account one by one the factors: sowing date and hybrid, there were not statistical differences for all traits assessed with one exception (no. of leaves/plant between hybrids).

The plants sowed at SD1 had the highest no. of leaves/plant. A possible explication for this is that an early sowing leads to a longer growing season. Similar results were obtained by Ahmed et al. (2015). Among hybrids, the average no. of leaves/plant varied from 15.47 (HF 7104) to 11.53 (FD18E41). This morphological character is influenced by the genetic potential same as head diameter.

Head diameter had higher values at SD2 (15.02 cm) followed by SD3 (14.76 cm). In most researches head diameter had the great values in SD1 (Miller, 1984; Allam, 2003; Lawal et al., 2011; Ozturk et al., 2017; Demir, 2019).

As in this experiment and other researches show that this character is directly proportional with the no. of seeds/head (Birck et al., 2016), yield (Lawal et al., 2011) and hectolitre mass.

Plant population can suffer in late sowing due to a less amount of rainfall available. In SD3 plant population was less with 6389 plants $ha^{-1}$ than in SD2 and less with 4841 plants $ha^{-1}$ than in SD1. Among hybrids it varied from 44642 plants $ha^{-1}$ (FD18e41) to 35992 plants $ha^{-1}$ (F708).

Between sowing dates no. of seeds/head increased constant alongside with the delay of sowing and between hybrids FD18E41 had the great no. of seeds/head (1207.33). This trait is influenced by the level of temperature and radiation conditions around anthesis, during and immediately after floral differentiation (Cantagallo & Hall, 2000; Chimenti et al., 2001).

Sowing on 25 March produced heavier seeds while sowing on 10 April produced lighter seed weight from 38.94 g (1000-seed weight) to 34.68 g (1000-seed weight).

Due to a lack of precipitations during the winter season the yield for SD1 had the lowest value - 1446.3 kg $ha^{-1}$. After 10 March the rainfall helped the plants to develop better thus for SD2 the yield was 2107.3 kg $ha^{-1}$. For SD3 the high temperature occurred during flowering stage lead to a decrease of the yield - 1816.7 kg $ha^{-1}$. In other studies the yield decreased when the sowing was delayed due to a shortened growing season (Allam et al., 2003; Lawal et al., 2011; Ahmed et al., 2020). Over the sowing dates FD18E41 seems to be the most suitable for this area with a yield of 2029.67 kg $ha^{-1}$ (Table 1).

The interaction between sowing date and hybrid showed that there were no statistic differences on plant population and hectolitre mass. The highest no. of leaves/plant was for SD1H2 (17.8) while the great head diameter was for SD2H1 (16.61 cm). According to Balalic et al. (2016) head diameter is influenced by the abiotic factors on the year of production (temperature, amount and distribution of rainfall) but it is mostly influenced by the hybrid.

The highest no. of seeds/head (1660.33) and yield (2566.3 kg $ha^{-1}$) was for SD3H3. H1 and H2 had their high yield at SD2 while H3 at SD3 (Table 2). In Romania for 2020 the average yield for sunflower was 1,880 kg $ha^{-1}$ (retrieved from: https://www.madr.ro/culturi-de-camp/plante-tehnice/floarea-soarelui.html).

## CONCLUSIONS

Plant population decreased once with the sowing delay from 41745.7 (plants $ha^{-1}$) to 36904.7 (plants $ha^{-1}$). Between sowing dates, sowing at 25 March has given the highest seed yield. FD18E41 hybrid behaved the best in Beidaud area due its genetic characteristics. The higher yield was obtained with FD18E41 hybrid sowed at 10 April. Similar researches have to be repeated at specific periods due climate change in all climatic regions.

Table 1. Effect of sowing date and hybrid on morphological characters and yield components during 2020 sunflower growing season

| | No. of leaves/plant | Head diameter (cm) | Plant population (plants ha$^{-1}$) | No. of seeds/head | 1000-seed weight (g) | Seed yield (kg ha$^{-1}$) | Hectolitre mass (kg hL$^{-1}$) |
|---|---|---|---|---|---|---|---|
| **SD1(10 March)** | 15.93- | 14.28- | 41745.7- | 800.57- | 36.48- | 1446.3- | 40.96- |
| **SD2 (25 March)** | 11.57- | 15.02- | 43293.7- | 1172.88- | 38.94- | 2107.3- | 43.36- |
| **SD3 (10 April)** | 11.40- | 14.76- | 36904.7- | 1246.66- | 34.68- | 1816.7- | 42.40- |
| **Tukey's HSD P< 0.05** | 4.90 | 4.55 | 10241.18 | 694.16 | 9.82 | 1239.84 | 8.90 |
| **Standard Deviation** | 1.68 | 1.56 | 3524.28 | 238.88 | 3.38 | 426.67 | 3.06 |
| **H1 (F708)** | 12.91b | 15.54- | 35992.00- | 1062.44- | 39.68- | 1753.00- | 39.68- |
| **H2 (HF 7104)** | 15.47a | 14.72- | 41309.34- | 950.36- | 34.10- | 1587.67- | 42.30- |
| **H3 (FD18e41)** | 11.53b | 13.82- | 44642.67- | 1207.33- | 35.71- | 2029.67- | 44.76- |
| **Tukey's HSD P< 0.05** | 2.49 | 4.55 | 10241.18 | 694.16 | 10.04 | 1239.84 | 8.90 |
| **Standard Deviation** | 0.85 | 1.56 | 3524.27 | 238.88 | 3.45 | 426.66 | 3.06 |

Different letters in columns differ at significant difference according to Tukey's HSD test; P< 0.05
"-": no significant difference

Table 2. Effect of interaction between sowing date and hybrid on morphological characters and yield components during 2020 sunflower growing season

| | No. of leaves/plant | Head diameter (cm) | Plant population (plants ha$^{-1}$) | No. of seeds/head | 1000-seed weight (g) | Seed yield (kg ha$^{-1}$) | Hectolitre mass (kg hL$^{-1}$) |
|---|---|---|---|---|---|---|---|
| **SD1H1** | 15.87ab | 15.94ab | 33214.3- | 821.00c | 43.30a | 1557.0ab | 41.93- |
| **SD1H2** | 17.80a | 14.95abc | 46190.3- | 749.73c | 34.40bc | 1493.3ab | 37.57- |
| **SD1H3** | 14.13bc | 11.95d | 45833.3- | 831.00c | 31.77c | 1288.0b | 43.40- |
| **SD2H1** | 12.73cd | 16.61a | 39404.7- | 1368.67ab | 40.10ab | 2288.0ab | 39.50- |
| **SD2H2** | 14.00bc | 14.68abc | 42023.7- | 1019.33bc | 37.80abc | 1799.3ab | 44.67- |
| **SD2H3** | 11.00de | 13.78cd | 48452.7- | 1130.67bc | 38.93abc | 2234.7ab | 45.93- |
| **SD3H1** | 10.13de | 14.06bc | 35357.3- | 997.67bc | 35.63abc | 1413.3b | 37.60- |
| **SD3H2** | 14.60bc | 14.51bc | 35714.3- | 1082.00bc | 32.00c | 1470.7b | 44.67- |
| **SD3H3** | 9.47e | 15.71abc | 39643.0- | 1660.33a | 36.43abc | 2566.3a | 44.93- |
| **Tukey's HSD P< 0.05** | 2.72 | 1.96 | 18243.72 | 417.63 | 7.83 | 1073.54 | 14.66 |
| **Standard Deviation** | 0.93 | 0.67 | 6280.61 | 143.77 | 2.69 | 369.58 | 5.047 |

Different letters in columns differ at significant difference according to Tukey's HSD test; P< 0.05
"-": no significant difference


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