

RESULTS ON THE FLOWERING STAGE IN THE ROMANIAN-GROWN SUNFLOWER HYBRIDS

REZULTATE PRIVIND FENOFAZA DE ÎNFLORIRE LA HIBRIZII DE FLOAREA-SOARELUI CULTIVAȚI ÎN ROMÂNIA

ION V.*, ȘTEFAN V.*, ION NICOLETA

* University of Agronomical Sciences and Veterinary Medicine of Bucharest, Romania

** Apiculture Research and Development Institute of Bucharest, Romania

The present paper presents the results of the research carried out on forty sunflower hybrids in southern Romania (15 km far from northeastern Bucharest), under the 2004 and 2006 climatic conditions, regarding the flowering stage, the period and the duration of flowering process within the crop, respectively. The studied hybrids were the following: Favorit, Festiv, Florina, Jupiter, Alcazar, Top 75, Venus, Alex, Saturn, Minunea, HS 2442, HS 2606, Milenium, Romina, Performer, Select, Justin, Splendor, Hercule, Felix, and twenty foreign hybrids cultivated in Romania: Huracan, Kasol, Lindor, Masai, Mateol, Podium, Saxo, Sunko, Fly, Rigasol, Rigasol OR, Fleuret OR, Arena, Melody, NK Armoni, Alexandra, NK Dolbi, NK Ferti, Opera PR, Sanay.

At the studied sunflower hybrids were performed the following determinations:

- *sum of growing degree days (GDD) from plant emergency (i.e. when 75% of the plants emerged) to the beginning of the flowering process within the crop (i.e. when 10% of the sunflower heads are flowered);*
- *date for the first sunflower heads flowering;*
- *date for the beginning of the flowering process, i.e. when 10% of the sunflower heads have flowered in the whole crop;*
- *date for the plain flowering phase, i.e. when 50% of the total sunflower heads have flowered;*
- *date for the full-flower phase, i.e. when all the sunflower head in the crop have flowered;*
- *date for the time when only 10% of the sunflower heads were still in flower;*
- *date for the end of flowering, i.e. when no sunflower heads are in flower in the whole crop;*
- *number of days between different flowering stages.*

Key words: sunflower hybrids, flowering stage.

Introduction

The climatic and soil conditions of Romania are favorable for growing sunflower, which represents one of the most important agricultural crops in Romania (800-950 thousand ha in the last few years, i.e. about 10% of the arable

land), as well as the most important oil crop. Thus, sunflower ranges third as cultivated surface, after maize and wheat.

The assortment of sunflower hybrids currently accepted for cultivation in Romania has become extremely diverse (118 hybrids registered in the Official Catalogue of crop varieties grown in Romania for the year 2006). In the last years, numerous foreign sunflower hybrids (58 hybrids) were added to the list of Romanian hybrids, which are already registered in the Romanian Official Catalogue.

From the melliferous point of view, sunflower flowers by the end of June and beginning of July, and provides the last important honey yield. In fact, sunflower is the most important melliferous cultivated plant for Romania.

Not only the foreign, but also the Romanian sunflower hybrids admitted for cultivation in Romania are less known or even unknown with respect to the biological characteristics of the flowering stage. For the beekeepers, it is very important to know their characteristics regarding the flowering stage, especially its period and duration.

Materials and Methods

Researches were carried out in field experiments between 2004 and 2006, on a reddish brown soil located 15 km far from northeastern Bucharest. The field experiments were located within the experimental farm of the Bucharest University of Agronomical Sciences and Veterinary Medicine – Faculty of Agriculture and they were part of two research projects financed by the AGRAL Research Programme (contract number 102/2001) and the CEEX Research Programme (contract number 106/2005).

The research objectives were to study the flowering stage in the sunflower hybrids cultivated in Romania, i.e. to establish the flowering period, the duration of this stage, and the duration of the different phases of the flowering process in the crop. The sunflower hybrids studied were twenty Romanian hybrids: Favorit, Festiv, Florina, Jupiter, Alcazar, Top 75, Venus, Alex, Saturn, Minunea, HS 2442, HS 2606, Milenium, Romina, Performer, Select, Justin, Splendor, Hercule, Felix, and twenty foreign hybrids cultivated in Romania: Huracan, Kasol, Lindor, Masai, Mateol, Podium, Saxo, Sunko, Fly, Rigasol, Rigasol OR, Fleuret OR, Arena, Melody, NK Armoni, Alexandra, NK Dolbi, NK Ferti, Opera PR, Sanay.

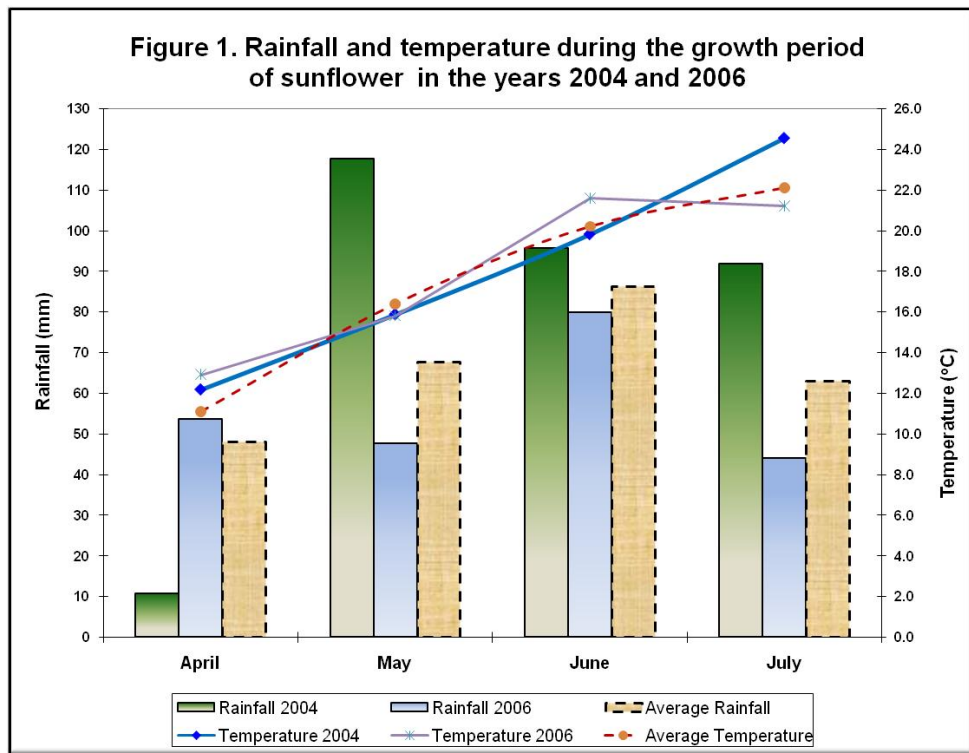
In 2004, as well as in 2006, the field experience had random plots with four replications. Each plot had a surface of 29.4 m², which meant six plant rows grown at a distance of 70 cm between rows and 7 m distance along the rows.

In each plot, the flowered heads were counted every two days. Also, the heads that completed the flowering process were counted. Thus, it was established the moment when the first sunflower heads flowered, the starting moment of the flowering process within the crop, i.e. the moment when 10% of the heads were flowered, the moment of plain flowering process, i.e. the moment when 50% of the heads were flowered, and the moment when all the heads were flowered. Also, it

was established the moment when 10% of the heads were still in flower within the crop (10% of the heads still had flowers), and the moment when all the heads within the crop finished the flowering process, respectively.

From the climatic point of view, the year 2004 can be considered as a favorable year for sunflower, considering that rainfalls exceeded the average specific for the experimental area, and temperature was moderate by the time the flowering process started. However, rainfalls were deficient in April, when sowing was performed, but the deficit was covered by the rains that fell during the May. The year 2006 was less favourable to sunflower because of the drought periods recorded in May, June and July, and the high temperature of June. The climatic data in the years 2004 and 2006 (Figure 1) were registered by an automatic weather station, which was positioned within the experimental field.

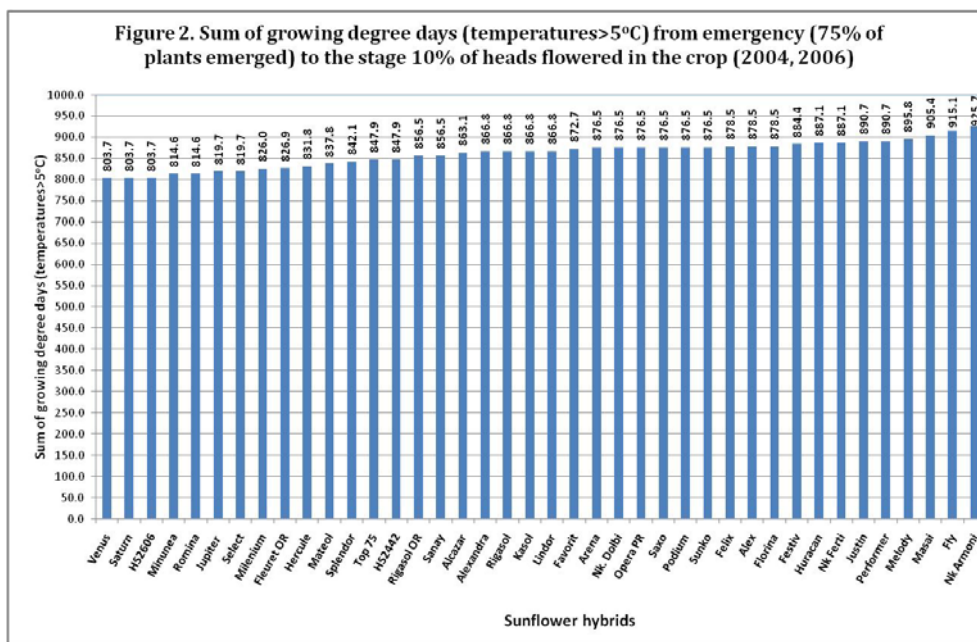
Sowing was performed on 6 April in 2004, and 11 April in 2006. The sowing density was 50,000 plants per ha.



Results and Discussions

The sum of growing degree days (GDD) from plant emergence (i.e. when 75% of the plants emerged) to the beginning of the flowering process within the crop (i.e. when 10% of the heads are flowered) ranges from 803.7 to 925.7 °C. The GDD was calculated as difference from the daily average temperature and the base

temperature (5°C). The earliest hybrids required about 800 of GDD (803.7 °C for the hybrids Venus, Saturn and HS 2606) to start the flowering process. The latest hybrids required more than 900 of GDD (905.4 °C for the hybrid Masai, 915.1 for the hybrid Fly and 925.7 °C for the hybrid NK Armoni) to start the flowering process (Figure 2).



The occurrence date for the first heads flowering in the studied sunflower hybrids varied between 24 June (in Rigasol OR, Fleuret OR and Sanay) and 01 July (in Performer, Justin, Festiv) (Table 1).

The beginning of the flowering process, i.e. when 10% of the heads have flowered in the whole crop, was recorded between 26 June (in Venus, Saturn and HS2606) and 2 July (in Performer, Justin and Festiv).

The plain flowering phase, i.e. when 50% of the total sunflower heads have flowered, was recorded between 29 June (in the hybrids Saturn and Fleuret OR) and 7 July (in the hybrid Performer).

The full-flower phase, i.e. when all the sunflower head in the crop have flowered, was recorded between 05 July (in the hybrid Saturn) and 16 July (in the hybrids Huracan and Opera PR).

The time when only 10% of the sunflower heads were still in flower was recorded between 05 July (in the hybrid Venus) and 18 July (in the hybrid NK Armoni).

The end of flowering, i.e. when no sunflower heads are in flower in the whole crop, was recorded between 06 July (in the hybrid Venus) and 20 July (in the hybrid NK Armoni).

Table 1

**Data regarding the flowering process in the sunflower hybrids grown in Romania
(2004, 2006)**

Nr. crt.	Sunflower hybrid	Flowering process in the crop				Calitides still flowered in the crop	
		First calitides flowering	Beginning of flowering process (10% of the heads flowered)	Plain flowering process (50% of the heads flowered)	All the heads flowered	10% of the heads are still in flower	End of flowering process (no any flowered heads)
1.	Favorit	30 June	01 July	06 July	12 July	13 July	15 July
2.	Performer	01 July	02 July	07 July	12 July	14 July	17 July
3.	Florina	30 June	01 July	06 July	12 July	13 July	15 July
4.	Jupiter	26 June	27 June	30 June	06 July	06 July	07 July
5.	Alcazar	29 June	30 June	04 July	09 July	10 July	11 July
6.	Top 75	28 June	29 June	03 July	09 July	10 July	11 July
7.	Venus	25 June	26 June	30 June	06 July	05 July	06 July
8.	Splendor	28 June	29 June	04 July	10 July	11 July	13 July
9.	Felix	30 June	01 July	05 July	10 July	10 July	11 July
10.	Justin	01 July	02 July	06 July	11 July	13 July	15 July
11.	Select	27 June	28 June	03 July	10 July	11 July	14 July
12.	Alex	30 June	01 July	05 July	10 July	11 July	12 July
13.	Saturn	25 June	26 June	29 June	05 July	06 July	07 July
14.	Hercule	27 June	28 June	03 July	10 July	10 July	11 July
15.	Minunea	26 June	27 June	02 July	09 July	10 July	12 July
16.	HS2442	28 June	29 June	03 July	08 July	10 July	12 July
17.	HS2606	25 June	26 June	01 July	06 July	08 July	11 July
18.	Festiv	01 July	02 July	06 July	11 July	13 July	13 July
19.	Milenium	27 June	28 June	03 July	09 July	10 July	13 July
20.	Romina	26 June	27 June	03 July	09 July	10 July	12 July
21.	Huracan	28 June	29 June	02 July	16 July	13 July	18 July
22.	Kasol	28 June	29 June	02 July	15 July	16 July	19 July
23.	Lindor	28 June	29 June	03 July	15 July	16 July	19 July
24.	Masai	28 June	01 July	04 July	15 July	17 July	19 July
25.	Mateol	26 June	28 June	01 July	15 July	14 July	18 July
26.	Podium	28 June	29 June	02 July	15 July	16 July	19 July
27.	Saxo	27 June	29 June	01 July	13 July	14 July	18 July
28.	Sunko	27 June	29 June	01 July	15 July	16 July	19 July
29.	Fly	28 June	01 July	04 July	15 July	16 July	18 July
30.	Rigasol	28 June	29 June	03 July	15 July	16 July	18 July
31.	Rigasol OR	24 June	28 June	01 July	11 July	13 July	18 July
32.	Fleuret OR	24 June	27 June	29 June	13 July	12 July	18 July
33.	Arena	28 June	29 June	01 July	11 July	12 July	18 July
34.	Melody	28 June	30 June	02 July	11 July	15 July	18 July
35.	NK Armoni	28 June	01 July	06 July	15 July	18 July	20 July
36.	Alexandra	27 June	29 June	01 July	13 July	14 July	18 July
37.	NK Dolbi	28 June	29 June	01 July	13 July	14 July	18 July
38.	NK Ferti	27 June	29 June	01 July	15 July	14 July	18 July
39.	Opera PR	28 June	29 June	02 July	16 July	14 July	18 July
40.	Sanay	24 June	28 June	01 July	11 July	15 July	18 July
<i>Limits of variation</i>		<i>24 June – 01 July</i>	<i>26 June – 02 July</i>	<i>29 June – 07 July</i>	<i>05 July – 16 July</i>	<i>05 July – 18 July</i>	<i>06 July – 20 July</i>

A period of 1-4 days was necessary between the occurrence of the first flowered heads and the beginning of the flowering process (10% of the sunflower heads have flowered), depending on the hybrid. Also depending on the hybrid, the period recorded between the beginning of the flowering process and the plain flowering phase (50% of the sunflower heads have flowered) was between 2 and 6 days. The hybrid also influenced the period from the plain flowering phase to the full-flower phase, which varied between 5 and 14 days (Table 2).

The sunflower heads flowering period ranged between 11 days in the hybrids Jupiter, Alcazar, Felix, Justin, Alex, Saturn, HS2442 and Festiv, and 20 days in the hybrids Mateol, Fleuret OR and NK Ferti. This shows that the flowering process is short in some sunflower hybrids, and longer in others.

From the melliferous point of view, the most interesting is the period between the beginning of flowering (10% of the sunflower heads have flowered) and the time when only 10% sunflower heads are still in flower, as this period marks the actual intense nectar gathering by the melliferous bees. This period varied between 10 days (in the hybrids Jupiter, Venus and Felix Arena) and 18 days (in the hybrids Kasol, Lindor, Podium, Sunko, Rigasol, NK Armoni and Sanay) (Figure 3).

The flowering period of the whole crop (since the occurrence of the first flowered heads to the end of the flowering process) ranged between 12 days in the hybrids Jupiter, Venus and Felix, and 25 days in the hybrids Rigasol OR, Fleuret OR and Sanay (Table 4).

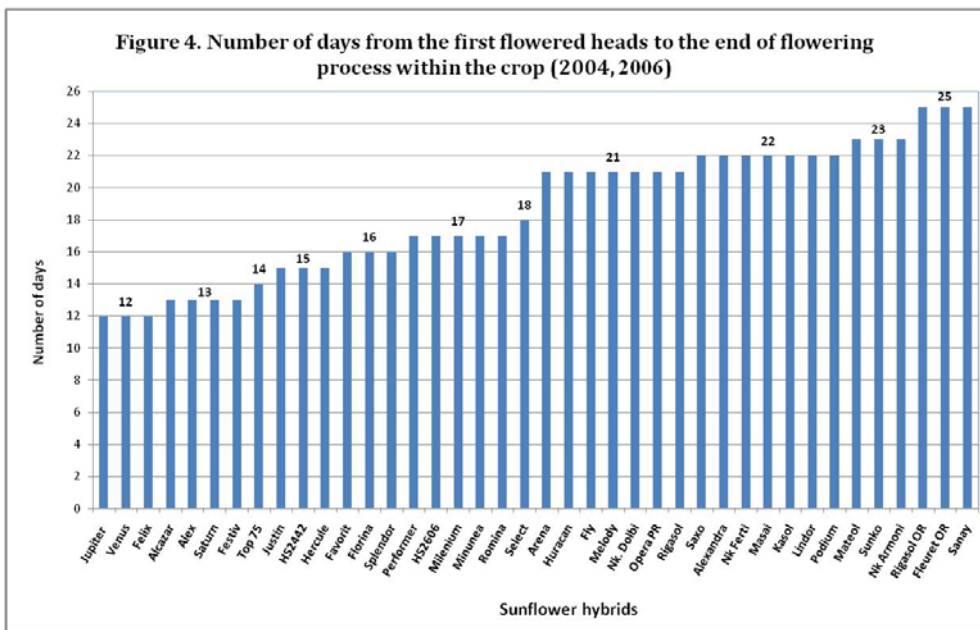
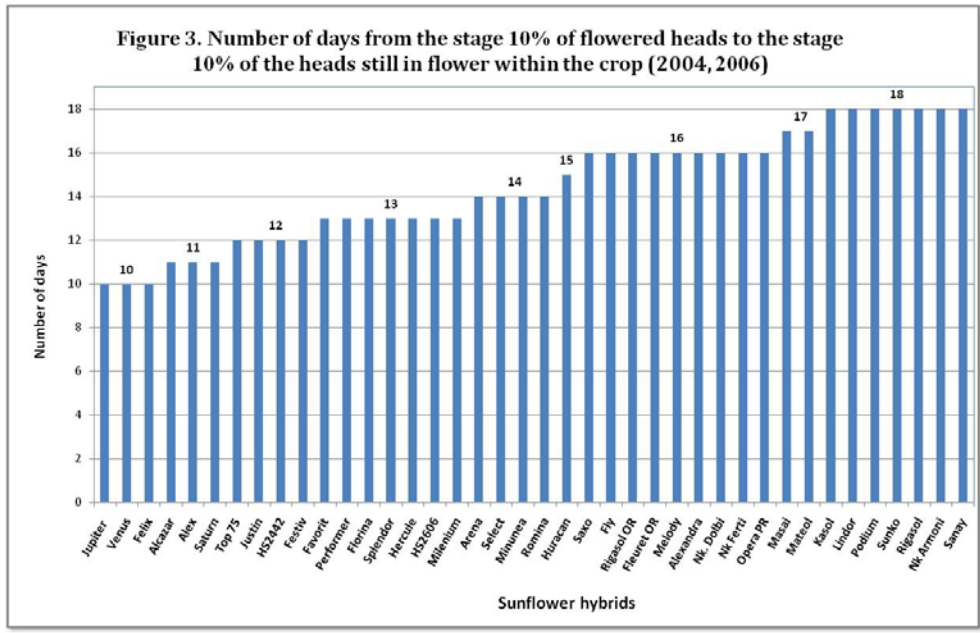
Conclusions

1. In the sunflower hybrids grown in Romania under the conditions of the years 2004 and 2006, the flowering process developed as follows:
 - a- the occurrence of the first flowered heads was recorded between 24 June – 01 July, according to hybrid;
 - b- the beginning of the flowering process (10% of the heads flowered) was recorded between 26 June and 02 July, according to hybrid;
 - c- the plain flowering phase (50% of the heads flowered) was recorded between 29 June and 07 July, according to hybrid;
 - d- the full-flower phase (all sunflower heads flowered) was recorded between 05 and 16 July, according to hybrid;
 - e- time when only 10% of the heads were still in flower within the crop was recorded between 05 and 18 July, according to hybrid;
 - f- end of flowering process (no any heads flowered) was recorded between 06 and 20 July.
2. The sum of growing degree days (GDD = sum of daily temperatures >5oC) from plant emergency to the beginning of the flowering process within the crop (10% of the calitides flowered) ranged from 803.7 to 925.7 oC.

Table 2

The flowering rate of sunflower hybrids grown in Romania (2004, 2006)

Nr. crt.	Sunflower hybrid	Number of days from the first heads flowering to the beginning of flowering process (10% of the heads flowered)	Number of days from the beginning of flowering process (10% of the heads flowered) to the plain flowering process (50% of the heads flowered)	Number of days from the plain flowering process (50% of the heads flowered) to all heads flowered	Day number of head flowering
1.	Favorit	1	5	6	13
2.	Performer	1	5	5	12
3.	Florina	1	5	6	13
4.	Jupiter	1	3	6	11
5.	Alcazar	1	4	5	11
6.	Top 75	1	4	6	12
7.	Venus	1	4	6	12
8.	Splendor	1	5	6	13
9.	Felix	1	4	5	11
10.	Justin	1	4	5	11
11.	Select	1	5	7	14
12.	Alex	1	4	5	11
13.	Saturn	1	3	6	11
14.	Hercule	1	5	7	14
15.	Minunea	1	5	7	14
16.	HS2442	1	4	5	11
17.	HS2606	1	5	5	12
18.	Festiv	1	4	5	11
19.	Milenium	1	5	6	13
20.	Romina	1	6	6	14
21.	Huracan	1	3	14	19
22.	Kasol	1	3	13	18
23.	Lindor	1	4	12	18
24.	Masai	3	3	11	18
25.	Mateol	2	3	14	20
26.	Podium	1	3	13	18
27.	Saxo	2	2	12	17
28.	Sunko	2	2	14	19
29.	Fly	3	3	11	18
30.	Rigasol	1	4	12	18
31.	Rigasol OR	4	3	10	18
32.	Fleuret OR	3	2	14	20
33.	Arena	1	2	10	14
34.	Melody	2	2	9	14
35.	NK Armoni	3	5	9	18
36.	Alexandra	2	2	12	17
37.	NK Dolbi	1	2	12	16
38.	NK Ferti	2	3	14	20
39.	Opera PR	1	3	14	19
40.	Sanay	4	3	10	18
<i>Limits of variation</i>		<i>1 – 4</i>	<i>2 – 6</i>	<i>5 – 14</i>	<i>11 – 20</i>



3. Between the different moments of the flowering process, the following days were necessary:
 - a- 1 – 4 days since the occurrence of the first sunflower heads flowered to the beginning of flowering process (10% of the heads flowered);
 - b- 2 – 6 days since the beginning of flowering to the plain flowering process (50% of the heads flowered);
 - c- 5 – 14 days from the plain flowering process to 100% of the heads flowered.
4. The flowering of all heads within the crop was achieved between 11 and 20 days, depending on the hybrid.
5. The intense nectar-gathering period, considered between the beginning of flowering (10% of the heads flowered) and the time when only 10% of the heads are still in flower within the crop varied between 10 and 18 days, depending on the hybrid.
6. The entire flowering process ranged between 12 and 25 days, according to the hybrid.

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ION V.*, ȘTEFAN V.*, ION NICOLETA

* University of Agronomical Sciences and Veterinary Medicine of Bucharest, Romania

** Apiculture Research and Development Institute of Bucharest, Romania

În cadrul acestei lucrări sunt prezentate rezultatele studiilor efectuate la un număr de 40 hibrizi de floarea-soarelui în condițiile din sudul României (15 km față de București, pe direcția nord-sud) și în condițiile climatic ale anilor 2004 și 2006, cu privire la fenofaza de înflorire, respectiv perioada și durata procesului de înflorire în cadrul culturii. Hibrizii de floarea-soarelui studiați au fost următorii: Favorit, Festiv, Florina, Jupiter, Alcazar, Top 75, Venus, Alex, Saturn, Minunea, HS 2442, HS 2606, Milenium, Romina, Performer, Select, Justin, Splendor, Hercule, Felix, and twenty foreign hybrids cultivated in Romania: Huracan, Kasol, Lindor, Masai, Mateol, Podium, Saxo, Sunko, Fly, Rigasol, Rigasol OR, Fleuret OR, Arena, Melody, NK Armoni, Alexandra, NK Dolbi, NK Ferti, Opera PR, Sanay.

La hibrizii de floarea-soarelui studiați au fost efectuate următoarele determinări:

- *suma temperaturilor biologic active (GDD) de la răsărirea plantelor (momentul în care 75% dintre plante au răsărit) până la începutul procesului de înflorire la nivelul culturii (momentul în care 10% dintre calatidii au înflorit);*
- *data apariției primelor calatidii înflorite;*
- *data când se realizează faza de început a procesului de înflorire la nivelul culturii (momentul în care 10% dintre calatidii au înflorit);*
- *data când se realizează faza de plin proces de înflorire la nivelul culturii (momentul în care 50% dintre calatidii au înflorit);*
- *data când se realizează faza de înflorire deplină la nivelul culturii (momentul în care toate calatidiile au înflorit);*
- *data când mai sunt înflorite 10% dintre calatidii la nivelul culturii;*
- *data afârșitului procesului de înflorire la nivelul culturii (momentul în care nu mai este niciun calatidiu înflorit);*
- *numărul de zile dintre diferitele faze ale procesului de înflorire.*

Cuvinte cheie: hibrizi de floarea-soarelui, fenofaza de înflorire.