FLOWERING DYNAMICS OF PARENTAL INBRED LINES OF SUNFLOWER HYBRIDS DEPENDING ON METEOROLOGICAL CONDITIONS

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ABSTRACT

Flowering dynamics of parental forms of sunflower hybrids Select, Turbo and Favorit was studied at Fundulea, in three succesive years differing in temperature and rainfall conditions. The inbred lines were sown in optimum period, when soil temperature reached 8-10°C, and in a second delayed period. The experimental data showed that the delayed sowing did not permit a good flowering coincidence of parental lines. In order to facilitate a good pollination, care should be taken to assure the adequate sowing disparity of parental inbred lines in crossing plots.

Key words*:* flowering coincidence, inbred lines, sunflower hybrids.

INTRODUCTION

Domestic sunflower hybrids produced on CMS basis are being cultivated in Romania on a large area. Hybrid seed production includes maintenance and multiplication of parental inbred lines, so that they preserve their biological and agronomic characteristics. In order to obtain high seed yield of superior quality, a special importance presents the flowering coincidence of parental forms in hybridization plots.

Differences in flowering and duration of certain growth phases are often attributed to photoperiodism, but sometimes they are rather affected by temperature than photoperiodism (Vrânceanu, 1974). The period between emergence and beginning of flowering is directly influenced by temperature and plants start to flower after having accumulated their specific useful temperature (Bonari et al., 1992; D'Amato and Giordano, 1992).

During anthesis, sunflower requires moderate temperatures of 18-22°C.

Temperatures higher than 30°C are very damaging, as they could lead to loss of pollen viability and increase the percentage of empty seeds.

In hybrid seed production, the photoperiodical reaction of parental lines should be determined for avoiding the lack of coincidence in flowering when crossing plots are placed in different areas or latitudes as well as when the sowing is performed in other different periods of time (Sandu et al., 1992).

The aim of the present study was to determine the thermal time required by different inbred lines during the growth phases: emergence to beginning of flowering, beginning of flowering to ending of flowering and emergence to technical maturity, and to find out the changes in flowering dynamics over three years, at two sowing dates. The paper could provide useful information for choosing the right sowing time and avoiding the lack of floral coincidence at the parental inbred lines.

MATERIALS AND METHODS

Four inbred lines, representing the parental forms of sunflower hybrids Select, Favorit and Turbo were studied in 1992, 1993 and 1994, at the Research Institute for Cereals and Industrial Crops of Fundulea, on cambic chernozem soil.

The first sowing was performed at the optimum time, when soil temperature reached 8-10°C. The second sowing was delayed with 14 days.

The sum of useful temperatures for different phenological phases was calculated as the sum of Celsius degrees equal to or higher than 7°C ($\sum$ ut $\geq$ 7°C). Data were recorded concerning flowering coincidence of parental forms and their reaction when sowing was delayed.

RESULTS AND DISCUSSIONS

Table 1 shows the sum of useful temperatures for certain phenophases required by each parental line of the hybrids Select, Turbo and Favorit. The small variation coefficients demonstrate the stability of these lines as regards the temperature needed for passing each phenophase.

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Table 1. The useful temperature (∑ ut ≥ 7°C) required by sunflower inbred lines for passing through different phenophases

Inbred lines	Year	Sowing date	A	B	C
LC-1004 A (♀ Select)	1992	May 1	805	183	1656
		May 15	831	163	1621
	1993	April 23	802	143	1630
		May 7	800	167	1627
	1994	April 14	828	186	1653
		May 4	828	170	1637
Coefficient of variation (s %)			1.5	9.5	1.2
LC-1064 C (♂ Select and Turbo)	1992	May 1	780	166	1590
		May 15	790	150	1585
	1993	April 23	785	143	1580
		May 7	795	152	1600
	1994	April 14	798	152	1575
		May 4	800	158	1583
Coefficient of variation (s %)			1.2	6.3	1.1
LC-1093 A (♀ Turbo and Favorit)	1992	May 1	780	175	1595
		May 15	800	170	1600
	1993	April 23	813	165	1605
		May 7	795	171	1608
	1994	April 14	816	175	1615
		May 4	828	179	1620
Coefficient of variation (s %)			1.7	2.9	1.1
LC-1066 C (♂ Favorit)	1992	May 1	798	183	1585
		May 15	805	160	1600
	1993	April 23	802	153	1596
		May 7	816	169	1600
	1994	April 14	810	169	1600
		May 4	805	150	1585
Coefficient of variation (s %)			1.1	6.4	1.1

A - Emergence to beginning flowering
B - Beginning to end of flowering
C - Emergence to technical maturity

One of the most important phenophases is that from beginning to the end of flowering. Select female line LC-1004 A requires a sum of useful temperatures comprised between 143 and 186°C, whereas Select male line LC-1064 needs 143-166°C for this phase. The female line of Turbo and Favorit LC-1093 A, needs 165-179°C during flowering, while their male parents, LC-1064 C and LC-1066 C, require 143-166°C and 150-183°C respectively.

From emergence to technical maturity, the four inbreds need a useful thermal time of 1575-1656°C.

Depending on meteorological conditions, the parental lines showed more or less adequate flowering coincidence. In 1992, the parental lines of Select (LC-1004 A and LC-1064 C) had the best flowering coincidence when they were sown at 8-10°C soil temperature (Figure 1). When sowing was delayed two weeks, the male flowered 4-5 days earlier than the female. In 1993 and 1994, the inbreds had a similar behaviour as in 1992; the best flowering coincidence was obtained by sowing them at the optimum time, when soil temperature reached 8-10°C. Flowering coincidence was reduced when they were sown 14 days later, because 30% of the female parent started flowering when the male already finished to flower in 1993 (Figure 2) and flowered two days earlier than the female in 1994 in 1994 (Figure 3).

In order to improve the flowering coincidence, even when sowing is not made in the optimum time, the parental lines of Select should not be sown at the same time, but 100% of female and 50% of male concomitantly and the rest of 50% of male when female seedlings emerge.

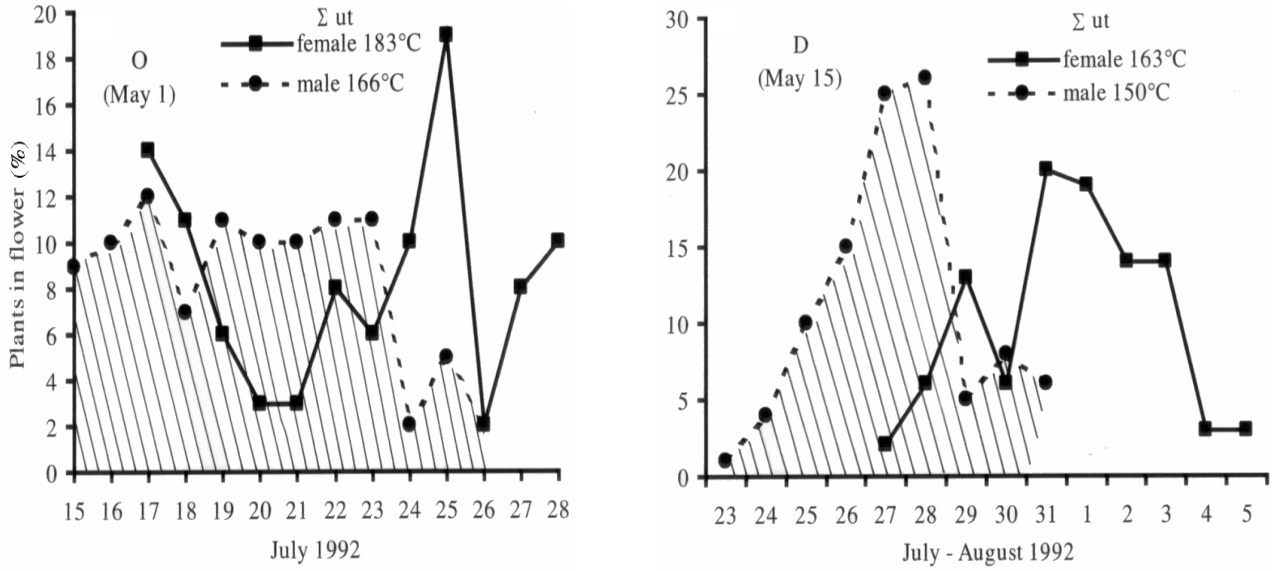

Figure 1. Flowering dynamics of parental lines of sunflower hybrid Select, sown concomitantly in optimum (O) and delayed (D) times in 1992

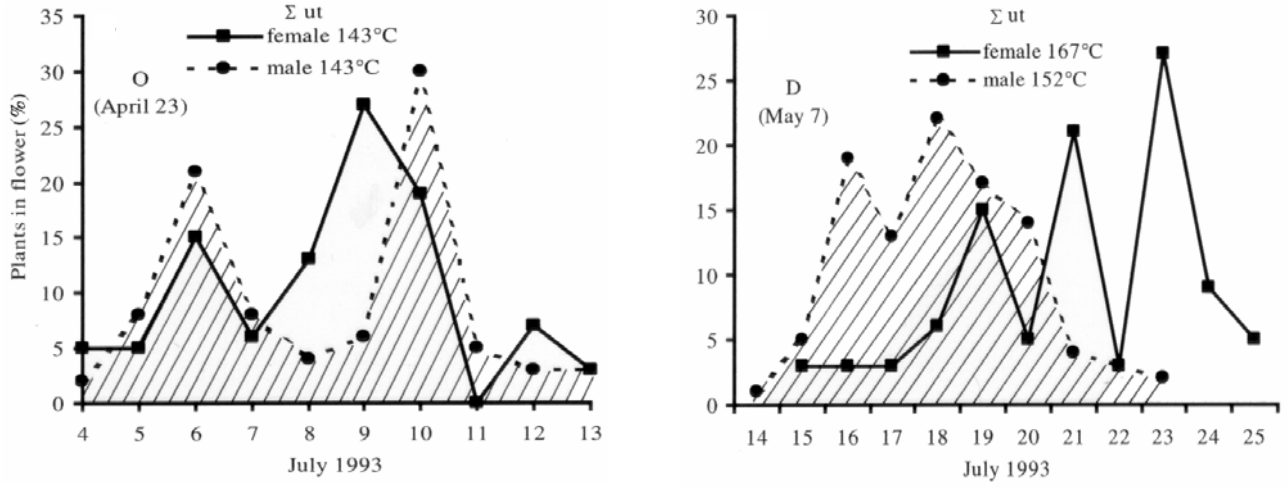

Figure 2. Flowering dynamics of parental lines of sunflower hybrid Select, sown concomitantly in optimum (O) and delayed (D) times in 1993

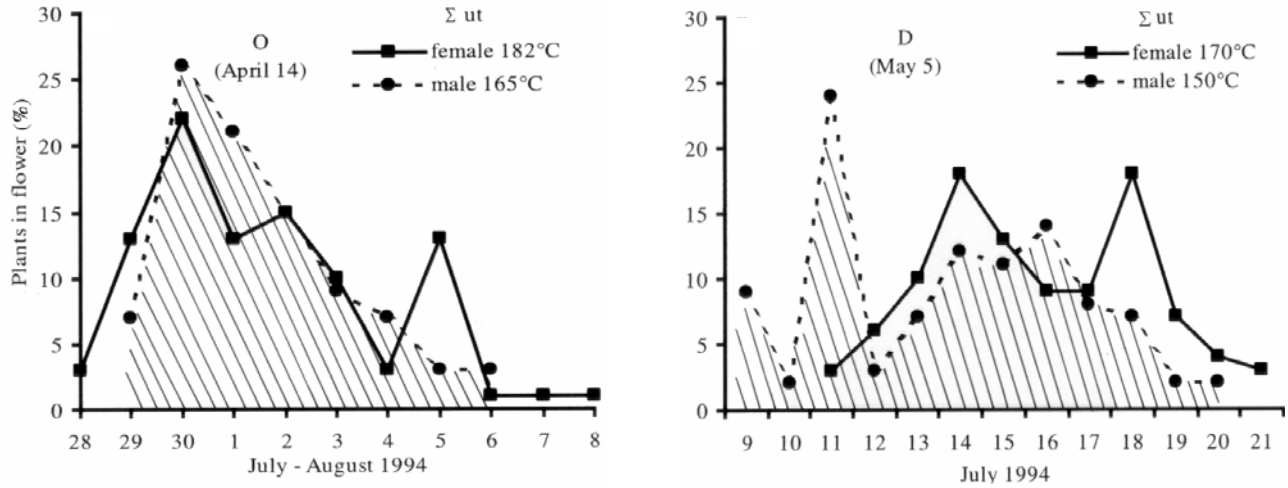

Figure 3. Flowering dynamics of parental lines of sunflower hybrid Select, sown concomitantly in optimum (O) and delayed (D) times in 1994

The parents of Turbo (LC-1093 A and LC-1064 C) showed a very good flowering coincidence in 1992 when sowing was performed at the optimum time but a great disparity in flowering when they were sown two weeks later. Similar results of 1993 showed that the best coincidence of male and female flowering could be obtained by sowing the two parents at the optimum time; when sowing was delayed, the male parent started flowering two-three days earlier than the female and ended flowering when the female parent had still 15-25% unopened flowers. In 1994, flowering started at the same day in both parental forms sown at the optimum time, with a maximum flowering of the male before the maximum flowering of the female, but pollen was enough for the most of female flowers. When sowing was delayed, the male produced pollen just for 80-85% of the female flowers. Flowering dynamics of parental lines of Turbo hybrid is presented in table 2.

These data indicate that the parental lines of Turbo should be sown, as in the case of Select's parents, 100% of female concomitantly with 50% of male, and the rest of male when the female seedlings have a coleoptyle of 5-6 cm.

The parental lines of Favorit (LC-1093 A and LC-1066 C) had good flowering coincidence at all sowing dates, because the male inbred line is a top-branching genotype, with the smaller heads of the branches flowering two-three weeks after that of the main head, so

Table 2. Flowering dynamics of Turbo parental lines

Years	Sowing time	Parental lines	Flowering duration		Flowering dynamics (% plants in flower per day)													
			beginning	ending														
1992	Optimum (May 1)	female	15.VII	28.VII	6	17	22	27	34	40	47	54	60	74	78	89	100	
		male	15.VII	26.VII	9	19	32	39	50	60	70	81	92	97	100			
	Late (May 15)	female	26.VII	5.VIII				2	3	11	17	41	65	70	80	90	96	100
		male	23.VII	31.VIII	1	5	16	31	56	82	87	94	100					
1993	Optimum (April 23)	female	5.VII	14.VII		4	5	10	30	49	59	74	90	93	100			
		male	4.VII	13.VII	2	10	31	38	42	54	87	94	98	100				
	Late (May 7)	female	17.VII	24.VII				10	15	38	54	69	72	96	100			
		male	14.VII	23.VII	1	6	26	40	52	68	82	87	89	100				
1994	Optimum (April 14)	female	29.VII	8.VIII	2	8	10	38	48	65	84	89	98	100				
		male	29.VII	6.VIII	7	33	53	67	74	86	94	100						
	Late (May 15)	female	11.VII	21.VII			4	14	24	44	54	71	77	84	94	99	100	
		male	9.VII	20.VII	9	12	36	39	46	58	69	82	89	97	99	100		

Table 3. Flowering dynamics of Favorit parental lines

Years	Sowing time	Parental lines	Flowering duration		Flowering dynamics (% plants in flower per day)													
			beginning	ending														
1992	Optimum (May 1)	female	15.VII	28.VII		6	17	22	27	34	40	47	54	60	74	78	89	100
		male	15.VII	26.VII	4	9	15	26	32	41	47	51	57	71	81	95	97	100
	Late (May 15)	female	26.VII	5.VIII	3	5	11	17	41	65	72	80	88	93	100			
		male	23.VII	31.VIII	7	19	35	61	72	94	100							
1993	Optimum (April 23)	female	5.VII	14.VII	4	6	12	32	51	62	78	95	96	100				
		male	4.VII	13.VII	6	24	38	52	76	91	95	98	100					
	Late (May 7)	female	17.VII	24.VII			10	16	40	55	69	72	96	100				
		male	14.VII	23.VII	3	15	27	32	49	61	69	72	96	100				
1994	Optimum (April 14)	female	29.VII	8.VIII		2	7	9	38	49	69	80	84	92	100			
		male	29.VII	6.VIII	5	21	37	52	67	77	86	94	100					
	Late (May 15)	female	11.VII	21.VII				4	14	24	44	53	69	72	78	89	94	100
		male	9.VII	20.VII	12	34	36	62	76	90	94	100						

pollen released was enough for all female flowers (Table 3).

The above mentioned data point out the good flowering coincidence of the parental lines of sunflower hybrids Select, Turbo and Favorit in all years when sowing was performed in optimum times (8-10°C in soil) and a variable disparity in inbred flowering when sowing is delayed. Due to the fact hybridization plots could be sown later, especially for providing a good isolation in time, care should be taken to assure the adequate sowing disparity of parental inbred lines that would facilitate a good pollination.

CONCLUSIONS

Flowering coincidence of parental lines represents the guarantee for obtaining superior hybrid seed yields, both quantitatively and qualitatively. In the case of inbred lines with a different vegetation period, a great importance as regards the achievement of flowering coincidence is played by their delayed and phased sowing depending on phenological development, correlated with the useful thermal degrees, specific to each inbred line.

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