

Vegetation period and hybrid sunflower productivity in breeding for earliness

Sergey Gontcharov¹, Maria Zaharova²

¹Kuban State Agrarian University, Kalinina, 13, Krasnodar, 350044, Russia,
E-mail: serggontchar@mail.ru

²All-Russia Oil Crops Research Institute, Filatova, 17, Krasnodar, 350038, Russia,
E-mail: marusya2002@inbox.ru

ABSTRACT

Development of a new cultivar combining short vegetation period with high productivity is a rather challenging problem. The aim of our work was to find out connections between duration of the vegetation period as a whole and its separate parts and seed yield, oil content and oil yield in sunflower hybrids. The study was done in the Hybrid Sunflower Breeding Department of All-Russia Oil Crops Research Institute (VNIIMK) in Krasnodar, Russia. Released, prospective and experimental sunflower hybrids of VNIIMK were used as a material. It was concluded that increasing the vegetation period itself does not lead to a high productivity. In each groups of earliness there were hybrids with high and low productivity. It was concluded also that seed yield is mainly determined by duration of the period from emergence to flowering (VE-R5.1), and oil content is mainly determined by duration of the period from beginning of flowering to maturity (R5.1-R8). Oil yield, being an integrated trait, it is determined by the whole vegetation period (VE-R8). As part of our study, a set of new hybrid combinations was produced and tested. One of them is recommended for release in the near future. Hybrid combination Kubanskiy 86 x VK 789 (tentative name is Aurora) is a three-way cross that throughout a 3-year trial showed better results than all tested open pollinated varieties and hybrids with a similar vegetation period.

Key words: breeding – earliness – sunflower – vegetation period.

INTRODUCTION

Development of a new cultivar combining short vegetation period with high productivity is a rather challenging problem. Many researchers report correlations between yield and duration of the vegetation period for different crops, including sunflower (Putt, 1943; Kovacik and Skaloud, 1972; Stoenescu, 1985; Merrien, 1992). At the same time, the possibility of a successful combination of these traits in one hybrid is not completely denied (Pustovoit, 1939). The aim of our work was to develop new ultra-early inbred lines and hybrids and also to find out relationships between duration of the vegetation period as a whole and its separate parts, and seed yield, oil content and oil yield in sunflower hybrids.

MATERIALS AND METHODS

The study was carried out during 2004–2006 in the Hybrid sunflower breeding department of All-Russia Oil Crops Research Institute (VNIIMK) in Krasnodar, Russia. Released, prospective and experimental sunflower hybrids of VNIIMK breeding were used as a material. The number of hybrids varied from 112 to 120 from year to year. In addition to the hybrids two open pollinated (OP) varieties (SUR and Enisey) were used as checks, because VNIIMK had not had such ultra-early hybrids before. The method described by Sheeiter and Miller (1981) was used for phenological observations. The main registered periods were VE-R1, VE-R5.1, R5.1-R8, R1-R5.1 and VE-R8. Among the agronomy characteristics only the most important ones were used: seed yield per hectare, oil content in the absolutely dry seed and oil yield per hectare. Experimental design was randomized blocks with three replications. Each replication had four rows and two central rows were analyzed only to exclude the border effect. Oil content was evaluated by NMR-analyzer.

RESULTS AND DISCUSSION

During the three years, correlation coefficients were calculated between duration of the main parts of vegetation period and the most important yield characters. The number of hybrid combinations studied varied from a minimum of 112 in 2006 to a maximum of 120 in 2004. The correlation coefficients obtained are presented in Table 1. As is clear from the table, no significant and (or) stable relationships for all the years were found.

Table 1. Correlations between duration of the main parts of vegetation period and yield characters in sunflower hybrids (Krasnodar, 2004-2006).

Character	Year	Duration of the parts of the vegetation period				
		V-E – R 1	V-E – R 5.1	R 5.1 – R 8	R1 – R 5. 1	V-E – R 8
Seed yield, t/ha	2004	- 0.11	0.12	0.05	0.12	0.17
	2005	0.11	0.09	0.00	0.01	0.08
	2006	-0.15	-0.11	0.34**	-0.04	0.12
Oil content, %	2004	0.11	-0.03	-0.05	-0.11	-0.07
	2005	-0.04	-0.04	0.12	-0.03	0.05
	2006	-0.35**	-0.53**	0.20*	-0.52**	-0.38**
Oil yield, t/ha	2004	-0.05	0.08	0.03	0.05	0.11
	2005	0.07	0.05	0.07	0.01	0.10
	2006	-0.26**	-0.28**	0.36**	-0.22*	-0.03

**P = 0,01; *P = 0,05

Correlation analysis were also calculated after dividing the data to include only high-yielding hybrids from each group of earliness. The number of studied hybrid combinations was 20 during the whole period. In this case we obtained results showing tight correlations between the studied traits (Table 2).

Table 2. Correlations between duration of the main parts of vegetation period and yield characters in high-yielding sunflower hybrids of different groups of earliness (Krasnodar, 2004-2006).

Character	Year	Durations of the parts of the vegetation period				
		V-E – R 1	V-E – R 5.1	R 5.1 – R 8	R1 – R 5. 1	V-E – R 8
Seed yield, t/ha	2004	0.21	0.59**	0.64**	0.37	0.88**
	2005	0.56*	0.66**	0.27	0.35	0.77**
	2006	0.50*	0.59**	0.27	0.54*	0.69**
Oil content, %	2004	0.14	-0.31	0.27	-0.51*	-0.01
	2005	-0.16	-0.36	0.42	-0.34	-0.04
	2006	-0.36	-0.60**	0.19	-0.67**	-0.48*
Oil yield, t/ha	2004	0.27	0.41	0.75**	0.11	0.83**
	2005	0.44*	0.37	0.48*	0.08	0.65**
	2006	0.33	0.29	0.41	0.20	0.49*

**P = 0,01; *P = 0,05

From these results it was concluded that increasing the vegetation period itself does not lead to high productivity. In each group of earliness there were hybrids with high and low productivity. It was concluded also that seed yield is mainly determined by the duration of the period from emergence to flowering (VE-R5.1), and oil content is mainly determined by the duration of the period from beginning of flowering to maturity (R5.1-R8). Oil yield, being an integrated trait, is determined by the whole vegetation period (VE-R8).

As a part of our study a set of new hybrid combinations was produced and tested. One of them is recommended for release in the near future (Table 3). Hybrid combination Kubanskiy 86 x VK 789 (tentative name is Aurora) is a three-way cross that during the whole 3-year trial showed better results than all tested OP varieties and hybrids with a similar vegetation period.

Table 3. Characteristics of the new ultra-early sunflower hybrid (Krasnodar, 2006)

Hybrid or OP variety	Period VE-R8, days	Seed yield		Oil content, %	Oil yield	
		t/ha	± to check		t/ha	± to check
Enisey (Chek OP variety)	76	3,09	-	42,2	1,17	-
SUR (OP variety)	78	3,19	+0,10	47,8	1,37	+0,20
Kubanskiy 86 x VK 789	74	3,41	+0,32	45,9	1,41	+0,24
LSD _{0,5}	-	-	0,20	-	-	0,09

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