

## SUNFLOWER BREEDING FOR HIGH PALMITIC ACID CONTENT IN THE OIL

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Depending on the meteorological conditions during ripening the fatty acid composition of sunflower oil varies in rather wide ranges. For our country's conditions this oil is characterized by comparatively high content of biologically active linolic acid (about 63%), containing yet oleic acid (25%), stearic acid (5%) and palmitic acid (7%). An essential difference between the varieties and hybrids tested and grown in the country, is not found. During the recent years a great interest is noticed to a special breeding conducting, directed to development of genetic materials with an increased content of oleic acid. It appears that the fatty acid composition of sunflower is easily changed under the influence of different mutagenic factors.

The mutant line 275HP was developed by the Soviet variety Zarya in 1973 after irradiation by gamma-rays of dry seeds at a dose of 1500 R, power dose of 1000 R/min. The initial material produced till  $M_4$  was self-pollinated and in 1977 a sister pollination was done, as the line had been morphologically well uniformed. The palmitic acid content in oil of line 275HP (Table 1) was comparatively high (13.9%) and because of that it was subjected to decomposition by self-pollination of single plants.

Table 1. Fatty-acid composition of OPV Peredovik and line 275HP (crop 1977).

Fatty acids (%)	Peredovik	Line 275HP
Linolic acid	63.2	55.9
Oleic acid	25.0	27.5
Stearic acid	4.8	2.7
Palmitic acid	7.0	13.9

The oil analyzes of the seeds originating from each single self-pollinated heads is indicated in Table 2.

Table 2. Fatty acid composition of the seeds from single self-pollinated heads of line 175HP (crop 1979).

No. of head	FATTY ACIDS				
	C <sub>18</sub> =2	C <sub>18</sub> =1	C <sub>18</sub> =0	C <sub>16</sub> =1	C <sub>16</sub> =0
2	56.2	29.4	5.8	-	8.5
3	54.2	32.6	7.5	-	5.7
4	67.8	19.4	5.8	-	7.0
5	56.8	30.3	7.3	-	5.6
6	61.3	25.1	4.1	-	9.5
7	64.7	22.5	6.5	-	6.3
8	54.8	15.5	2.7	2.9	24.1
9	51.6	28.8	4.0	1.9	13.7
10	57.0	22.2	4.3	2.8	14.7
11	55.8	10.5	1.7	6.9	25.1
12	56.4	10.6	4.3	3.6	25.1
13	50.7	28.1	6.3	-	5.9
14	52.6	12.5	4.3	6.1	24.5
Average	56.9	22.1	5.0	1.9	13.5

It is seen that the mean values of all 13 heads analyzed are quite close to these ones of the initial line. The individual composition of the single heads, however, is very different. That shows that in  $M_4$ , when the sister pollination of line 275 HP has been done in spite of its good morphological stability, this line has not been uniformed in relation to the oil fatty acid composition.

Four of the self-pollinated heads of 1979 crop showed a palmitic acid content about 25%. Besides in the fatty acid spectrum of these seeds a palmi-oleic acid appeared, which was not specific for the sunflower oil. During the subsequent years an attempt has been made for stability through selection of the high palmitic acid content. Four sub-lines were screened presenting their uniformity in Table 3. The differences observed in relation to the average palmitic acid content in the four sub-lines were statistically proved ( $F=9$ ) compared to 2.96 for a statistic level of 5%. In a broad sense the inheritance coefficient was 51.5%. In the years next the work with line was continued by self-pollination and selection of most high-palmitic plants. In 1984, as it was expected, 12 heads were selected with palmitic acid content on the average of 40.2%, four of these containing from 41.9 to 42.7%.

Table 3. Variation of palmitic acid content in the single plats from the four sub-lines isolated from the initial line 275HP (crop 1981).

Sub-lines	No. of plants analyzed	Mean content of $C_{16}=0$ (%)	Mean-square deviation
275HP/12/2	8	24.5	2.1
275HP/12/6	9	24.5	1.6
275HP/12/9	6	22.4	1.6
275HP/12/10	8	27.4	1.3

27 plants were produced from the seeds of these four parents in the subsequent 1985 and their content of palmitic acid averaged 35.1% and that of palmi-oleic one - 3.4% or totally fatty acids with  $C_{16}$ -39.1%. In 1986 26 plants were grown and their palmitic acid content averaged 39.7% and that of palmitoleic one - 3.6%, or totally - 43.3%.

In the last 1987 57 plants were grown. Their averaged content of palmitic acid was 28.4% and that palmit-oleic acid - 7.3%, or totally - 35.7%. It is seen that during the first two years the palmitic acid content has been higher than the last crop year by 7 and 11%. The amount of both the fatty acids with  $C_{16}$  chain, however, was decreased in a less degree by 3.3 and 7.5%, respectively. This, probably, is due to some genetic reasons, unknown for the time being, and to the different amounts of rainfalls in July and August in 1987 (Table 4).

Table 4. Palmitic and palmit-oleic acids content and rainfalls in July and August for the last three crop years.

YEAR	Palmitic acid	Palmit-oleic acid	Rainfalls, mm	
			July	August
1985	35.7	3.4	28.3	4.2
1986	39.7	3.6	59.5	3.6
1987	28.4	7.3	249.9	23.3

The inheritance of the high palmitic acid content was studied by crossing of sub-line 275HP/12/10 with four low palmitic lines according to complete diallel pattern in the period 1983-1984. The mother effect were studied on reciprocally

cross-pollinated  $F_1$  seeds from parent lines and from reciprocal  $F_1$  populations -  $F_2$  seeds (Table 5).

Table 5. Palmitic acid content in oil of self-pollinated seeds of parent populations of cross-pollinated seeds ( $F_1$  embryo) and of  $F_1$  plant seeds ( $F_2$  embryo) in crosses between line 275HP and other lines

PARENTS & CROSSES	Palmitic acid in %		
	1983	1984	d/a
1418	7.0	6.5	
1418 x 275HP	10.6	11.3	- 0.62
275HP x 1418	9.1	12.7	- 0.50
275HP	30.6	31.5	
MP		19.0	
1778	6.8	6.4	
1778 x 275HP	12.0	11.9	- 0.57
275 x 1778	10.3	13.1	- 0.47
275HP	30.6	31.5	
MP		19.0	
Pervenets-4	4.0	3.8	
Pervenets-4 x 275HP	7.4	10.4	- 0.53
275HP x Pervenets-4	8.5	10.6	- 0.51
275HP	30.6	31.5	
MP		17.7	
654cc	4.6	3.7	
654cc x 275HP	7.9	11.4	- 0.45
275HP x 654cc	9.0	10.6	- 0.50
275HP	30.6	31.5	
MP		17.6	

$F_1$  seeds of reciprocal crosses did not significantly differ for palmitic acid content but they were different from the self-pollinated seeds of mother parents. These results indicated a high embryo control for the content of that fatty acid with insignificant mother effects on the genotype.

The mean values for the palmitic acid content of the population  $F_1$  and reciprocal  $RF_1$  did not significantly differ (the differences were from 0.2 to 1.4%) in analyzed hybrid combinations. That showed the lack of considerable cytoplasmic effects on the content of that acid.

The values of the dominance degree index (d/a) were calculated on the base of mean values of the parent lines and their hybrid combinations in  $F_1$  generation in the single crosses responsible of the inheritance of the character palmitic acid content.

The mean values of the palmitic acid content of  $F_1$  and  $RF_1$  populations varied from 10.4 to 13.1% in all analyzed crosses, i.e. these were lower than the mid-parent values - 17.6-19.0%. Dominance degree character values were from 0.45 to 0.62. These data indicated a partial dominance of low palmitic acid content.

The analysis of the genetic components showed that the values of the additive component of the genetic variance ( $D=120.9$ ) was higher than that one of the dominant component ( $H_1=107.6$ ). Therefore, in inheritance of palmitic acid content the mean part of genetic variance is determined by the additive component. The mean dominance degree ( $H_1/D=0.89$ ), regarding the inheritance of that character, was less than 1 and showed incomplete dominance of genes controlling the low palmitic acid content which was in agreement with the results of Tab.5.

$\sqrt{H_1/D}=0.94$  shows again their incomplete dominance in each individual locus. This value is very close to 1 and because of that it could be assumed that a dominance exists in the larger part of the locuses, controlling this character. In our case the dominance decreased the expression of the character analyzed because the difference between the mean value for the crosses ( $\bar{F}_1$ ) and the mean value of parents ( $\bar{P}$ ) was negative  $\bar{F}_1 - \bar{P} = - 54.5$ . The results presented show that a line has been developed with palmitic acid content 4-5 times higher than the oil of sunflower varieties and hybrids grown at present.