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FREQUENCE OF OCCURRENCE AND RATE OF HETEROSIS WITH RESPECT TO PRODUCTIVITY OF SUNFLOWER

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Summary

In the period of 1974-1977, 100 sunflower hybrids have been tested each year on the basis of cytoplasmic sterility with the participation of 86 lines. The comparison is made with the zonated cultivar Peredovik, whose elite seed production is being carried out in the country.

The results obtained lead to the following conclusions:

1. The frequence of hybrids with a yield of over 8% more than that of Peredovik is 9%. The average outweighing in the yield from these hybrids comes to 11% and the maximum up to 27%.

2. When comparing the characters determining the rate of yield, the grain size plays a better expressed positive correlation; the diameter of the head -- a medium correlation; the height of the plant -- a low one.

3. The heterosis is best expressed in the height. If comparing the hybrids to cultivar Peredovik, only 3% of them are with a height of below 150 cm (20% lower than the height of Peredovik) in normal meteorological conditions.

In a period of more than 50 years an intensive sunflower breeding work has been conducted with the aim to increase the oil content in seeds and the seed yield/per unit area. In that direction Pustovoyt has achieved remarkable results and has brilliantly proved the po-sibilities for perfection of this plant.

At present our country has put the task to increase at a high rate sunflower yields above those obtained from modern cultivars and hybrids. Yields of wheat and sunflower in field conditions must not vary with more than 60% for the first crop.

Investigations on the productivity potential of sunflower from genetic aspect show the presence of rather a large interval that is still not used by breeding work.

Material and Methods

The aim of the present investigation is to study the productive abilities and the yearly manifestation of a group of lines and hybrids differing highly by their genetic origin. For that purpose 100 hybrids have been included in

trials in the course of 4 years (1974-1977) on the basis of CMS. A total of 51 lines, obtained by cultivars of different geographic origin have been used. Seed yield and oil content are reduced to the absolute dry matter. The Soviet cultivar Peredovik, whose seeds are produced in our country serves as a standard in the test.

Meteorological conditions in the investigated period varied. Most favorable was 1975, a year of large total rainfalls and their good distribution (284 lt from 1.04 to 30.08). In 1974 there was a very strong drought -- 150 lt for the period. In 1976 the trials were attacked by Botrytis during ripening time.

Results

The standard cultivar Peredovik yielded differently by years -- from 2170 to 3964 kg/ha, with oil content of seeds varying from 47.2 to 50.7% (Table 1). to make it possible to compare to Peredovik, all hybrids are divided into six groups, according to the rate of difference, expressed in percent (Table 2). The frequence of cases that exceed the standard with more than 15% is rather low. In that small group fall 2 to 6% of all tested materials.

Here one can come to the conclusion that the creation and investigation of hybrids has to be led on a wide scale in order to select a larger number of combinations, that are up to the requirements of productivity. Not less than 500-600 new hybrids have to be tested in our conditions each year. To obtain these hybrids we use 5 testers -- fertility restorers, resistant to Plasmopara.

TABLE 1. Results for Cultivar Peredovik

Indices	1974	1975	1976	1977	Average
Yield - c/ha	21.7	39.6	29.7	32.3	30.8
Oil content - %	47.2	48.8	50.7	47.6	48.6
Yield of oil - c/ha	10.2	19.3	15.1	15.4	15.0
Plant height - cm	123	205	159	207	173.5
Diameter of sunflower head - cm	17	21	21	23	20.5

TABLE 2. Distribution of hybrids according to their productivity.

Relative yield to Cultivar Peredovik	Percent of total number				
	1974	1975	1976	1977	Average
More than 120%	1.8	2	3	0	1.7
115-120	3.6	3	3	2	2.9
110-115	2.8	6	6	2	4.2
105-110	9.2	15	21	17	15.6
95-105	36.1	27	23	29	28.9
85- 95	17.8	27	27	33	26.2
Below 85	28.7	20	17	17	20.7

The rate of the heterosis effect and the frequence of more productive combinations are much higher when compared with the parents' lines. Out of the total number 81.8% give higher yield than the two parents, 12.2% are equal to the more productive one and only 6% are intermediary.

Breeding work at the Institute for increasing the productivity is directed mainly to:

- lowering the plant height and decreasing the thickness of heads;
- increasing the individual productivity of the plant by increasing the absolute weight and the number of seeds/1 head.
- improving the structure of plants with the aim to increase plant density while keeping the same individual yield.

To use more rationally the soil fertility at increasing productivity, the first task of our breeding work is to lower the plants' height. The heterosis effect with that character is very high (averagely for all cases, 29.7%). 91.5% out of the total number of hybrids are higher than both the parents, 6.7% are of the height of the higher parent and only 1.8% are intermediary. If measuring the character in absolute values, the hybrids are distributed in the following groups: from 140-155 cm, 16.9%; from 156-170 cm, 28.4%; from 171-185 cm, 36.0%, and above 186 cm, 18.7%.

The correlation coefficient between yield and height is o.206-0.379 in our trials. There is a positive but slightly expressed dependence, from which one can conclude that there exists a possibility of combining the high productivity with stem-height of 150-160 cm.

Out of all structural elements most important for the rate of yield is the 1000 seed weight. The dependence here is positive and well expressed , $r = 0.736$ to 0.791. The heterosis effect is manifested more weakly, so a strict selection has to be carried out as early as creating the lines. Hybrids that have displayed superiority to Peredovik with more than 15% have a 1000 seed weight of over 70 g.

A hybridization is now carried on for transferring the recessive gene for an erect-like disposition of leaves to lines of high combinative ability and valuable economical qualities.

Discussion

During the last four years more than 570 hybrids from Bulgaria, Romania, France, Yugoslavia, USA and Spain took part in the trials of our Institute.

Highest yields by years reduced to 0% moisture are as follows: 1974 - 2780 kg/ha; 1975 - 5260; 1976 - 3830; 1977 - 3960. If compared to the results from analogical tests with wheat for the same period, the latter about two times lower. As a criterion for a more precise evaluation one should have taken into account not the kgs of seeds, but the quantity of energy from the sun radiation and the soil fertility, that are factors related to the yield of both the crops.

Calculations on the basis of the chemical composition with average values (for wheat - protein - 15.0%; fats - 2.1%; hydrocarbons - 74.2%; for sunflower respectively 17.4%, 50.7%, 13.6%) and the quantity of calories for the separate components (5,500, 9,500 and 4,000) allow to establish more correctly the difference between the two cultures. If speaking of wheat, the trials at our Institute have given a record yield of 11,140 kg/ha, 3,930 kg/ha -- for the country, and 5,220 for Tolbuhin district. As for sunflower, these figures are 5,260, 1,890 and 2,520 kg/ha.

Results about the quantity of energy show (Table 3), that by its potential possibilities for formation of seed yield, sunflower is inferior to wheat with about 24%.

The available conditions of the country make it possible to form considerably higher sunflower yields, if some of the characters connected with seed formation can be perfected.

TABLE 3. Productivity expressed in calories.*

Record yield	Wheat kg/ha	Sunflower kg/ha	%	Wheat Great cal.	Sunflower Great cal.	%
In trials	11140	5260	47.2	43,370,880	33,401,000	77.0
For the country	3930	1890	47.7	15,690,520	12,001,500	76.5
For the district	5220	2520	48.2	20,840,850	16,002,000	76.8

* Wheat is used for 100%.