T1972BRE11

RESULTS OF SUNFLOWER BREEDING AND SEED GROWING

Mrs. T. G. PLYITNIKOVA (U.R.S.S.)

For the period of cultivation in the USSR, sunflower crop has suffered considerable changes and became a staple oil-bearing crop in the country.

Academician V.S. Pustovoit has developed and grounded genetically the method of sunflower improvement in the process of breeding based on individual selection of elite plants, estimation of their progenies and subsequent transpollination the best of them between themselves. The method allows to obtain gradual changes in population and at the same time to preserve genetic variability, necessary for further selection. Application of Academician V.S. Pustovoit's method favoured in breeding of high productive strain populations with unprecedent oil content.

Nowadays the most widely spread sunflower varieties have 50-52 % oil content on the absolute dry seed basis, compared with that of 32 % in the best initial varieties. Varieties with oil content 53-54 % are bred now and in current five years they will be introduced into production.

Modern sunflower varieties considerably exseed the old ones in seed yield per unit of area. This may be confirmed while comparing the productivity of the most widely distributed at one time variety Zhdanovskii 8281 with new widely spread variety Peredovik. Peredovik exseeds the old strain in seed yield by 4 c/ha and in kernel and oil yield 1.6 times as much.

It should be underlined that in their productivity all the basic modern sunflower varieties are similar to Peredovik, differing only in biological adaptability to different conditions of cultivation.

Introduction of high productive and high oil content varieties for late 20 years resulted in average increase of sunflower seed yield in the USSR (2.6 times as much) and in oil yield (4 times).

On large amount of areas varieties, bred in 1950 and even in 1938 are cultivated and have no considerable differences in productivity in comparison with Peredovik variety, bred in 1960. Longevity of these varieties is conditioned by their improvement in the process of seed growing. The method of sunflower varieties improvement in the process of seed growing developed by Academician V.S. Pustovoit is a continuation of breeding process and includes its elements.

The method allowed to increase seed yield of zoned sunflower varieties by 3.0 - 5.4 centners per hectare, oil content - by 3-10.7 % and yield of oil per hectare - by 22-51 %, i.e. it was

obtained such an effect that is not always possible in selection for heterosis. Main value of improving seed growing is the systematic rise of crop productivity in million hectares.

Since 1957 in the Soviet Union it has been accepted annual strain renovation of zoned sunflower varieties. It implies annual delivery last year yieldseed elite to collective and state farms seed plots. Due to the annual strain renovation, achievements in breeding and improving seed growing are introduced into production in the shortest terms.

For the period of renovation scheme being in action, oil content of commercial sunflower seeds has increased by 10 %. Such increase should mainly be related to sunflower zoned varieties improvement in the process of seed growing.

Use of the methods of improving seed growing complicates breeding work in creation of new varieties, having considerable differences from existing ones.

Nowadays sunflower breeding is conducted for many characters, and such of them as cropping power, seed oil content, immunity to diseases and pests, vegetative period and, at last, high yield of oil per hectare are of paramount importance for all zones of the USSR.

From perspective breeding material available in the USSR especial interest present early maturing varieties, ripening 10-12 days earlier than Peredovik type varieties. In this group separate numbers are isolated which in comparison with middle ripening varieties do not have considerable differences in productivity.

In the USSR sunflower breeding for immunity has been conducted since thirties of XX century and is completed with creation of varieties having higher resistance to the most dangerous crop parasite-broomrape (Orobanche cumana Wallr.) to verticilliose (Verticillium dahleae Kleb.) and to sunflower moth (Homoeosoma nebulella). Soviet sunflower varieties combine the most valuable characters of immunity with high oil content and yield of oil per hectare.

Since 1955-56 sunflower breeding for complex immunity on the basis of commercial sunflower varieties, crossing with wild species of Helianthus has been conducted under the guidance of Dr. G.V. Pustovoit.

Among 46 species of Helianthus studied, the most interesting was autohexaploid group consisting of H. tuberosus var. purpurellus, H. rigidus, H. subcanescens, H. macrophillus wich have immunity to downy mildew (Plasmopara helianthi) rust (Puccinia helianthi), Sclerotinia (Sclerotinia libertiana), Sclerotiorum bataticola, Foma sp., broomrape (Orbanche cumana Wallr.) and sunflower moth (Homoeosoma nebulella).

Some methods are developed in order to overcome the lack of combining ability between cultivated sunflower and wild Helianthus species and further sterility in hybrids of the first progenies. Thus for overcoming the sterility of interspecific hybrids it was proposed a combination of reciprocal crossings of hybrids F_1 and stress temperature while meiotic division of hybrids and, also, Michurin's method of preliminary vegetative rapproachment of crossing components. It has been developed and used in practice a complicated system of estimation of hybrids resistance to different pathogens in combination with high productivity.

Nowadays the institute has interspecific hybrids obtained in the result of crossings with 12 wild species of Helianthus. There are created interspecific hybrids (F_8 - F_{13}) having complex immunity to downy mildew (Plasmopara helianthi), rust (Puccinia helianthi), verticilliose (Verticilium dahleae), Sclerotinia (Sclerotinia libertiana), broomrape (Orobanche cumana), sunflower moth (Homoeosoma nebulella) and Brachicandus helichrise, which in many cases exceed modern sunflower varieties in productivity by 30-60 %. Preliminary estimation of hybrids immunity shows that they conceal in themselves a vast immunity, not limited to the above mentioned characters only, shows that research work in the field of sunflower interspecific hybridization is greatly perspective.

In connection with great importance of protein problem solving, not once the question

arose about the necessity to conduct selection for high protein content in sunflower seeds. Sunflower in the USSR is an important protein crop as it is mentioned in the paper by Dvoryadkin N.I., Director of VNIIMK.

However, researches conducted at VNIIMK by A.E. Dyakov showed that such trend in sunflower breeding is not quite perspective being in contradiction with physiological law of protein and oil accumulation in crop seeds.

It was proved experimentally that lowering of relative protein content in sunflower seeds in the process of selection for high oil content does not reduce gross yield of protein per hectare. At the same time, selection for high protein percentage in sunflower seeds does not raise gross yield of protein per hectare, but considerably reduces gross yield of oil. This may be explained by the fact that as high protein so low protein sunflower varieties absorb soil nitrogen identically. In conclusion it should be noticed that the methods of breeding and improving seed growing developed by Academician Pustovoit V.S. have proved their high efficiency. Sunflower varieties bred according to these methods occupy 59 % of sowed area in the USSR, posess unprecedent seed oil content, and are the richest national property of the country.

Table 1 - Characteristics of productivity of old and new sunflower varieties (According to the data of competitive strain testing)

Krasnodar, VNIIMK

Indices	Varieties		Percentage of Peredovik indices to variety Zhdanovskii 8281 indic.
	Zhdanovskii 8281 (average 1937-1944)	Peredovik (average 1966-1971)	
Seed yield, c/ha	23.7	27.7	117
Kernel yield, c/ha	14.0	21.8	156
Husk yield, c/ha	9.7	5.9	61
Oil yield, c/ha	7.8	12.5	160

Table 2 - Characteristics of the best zoned sunflower varieties. Average data : 1966-1971. Competitive strain testing VNIIMK.

Varieties	The year of zoning	Planted area 1969-71 average (thous.ha)	Vegetative period (days)	% of husk	Oil content absolute dry seed basis	Seed yield c/ha	Oil yield c/ha
Peredovik	1960	1 257	93	21,2	51,2	27,7	12,54
Armavirskii 3497	1953	1 204	94	21,3	51,4	27,7	12,58
VNIIMK 6540	1950	426	93	21,2	51,2	27,4	12,42
VNIIMK 1646	1938	223	92	21,6	50,6	27,0	12,07
VNIIMK 8931	1953	32	93	21,1	51,2	27,8	12,60

Table 3 - Change of sunflower productivity

Indices	Average in the USSR			Average in Krasnodar region		
	1946-1950	1966-1970	Percentage of 1966-1970 to 1946-1950	1946-1950	1966-1970	Percentage of 1966-1970 to 1946-1950
Seed yield c/ha	5.0	13.1	262	7.7	17.8	231
Kernel yield c/ha	3.0	10.0	333	4.1	13.7	327
Oil yield c/ha	1.5	6.0	400	2.1	8.4	386
Protein yield c/ha	0.7	1.9	271	1.0	2.5	250

Table 4 - Improvement of sunflower varieties in the process of seed growing. Competetive strain testing, VNIIMK.

Varieties	Year of zoning	Years of studying	Oil content (absol. dry seed basis %)	Seed yield c/ha	Oil yield c/ha
VNIIMK 1646	1938	1948-1950	40.4	19.9	7.6
		1967-1969	51.1	23.0	11.5
		Difference	+ 10.7	+ 3.1	+ 3.9
VNIIMK 6540	1950	1945-1948	41.2	23.3	8.8
		1966-1968	51.1	28.7	12.9
		Difference	+ 9.9	+ 5.4	+ 4.1
Armavirskii 3497	1953	1949-1951	45.2	24.3	9.8
		1966-1968	51.7	29.3	13.3
		Difference	+ 6.5	+ 5.0	+ 3.5
Zelenka 368	1953	1952-1954	44.4	22.7	8.8
		1966-1968	51.6	28.0	12.7
		Difference	+ 7.8	+ 5.3	+ 3.9
VNIIMK 8883	1955	1949-1952	42.5	22.2	8.6
		1966-1968	49.5	26.9	11.8
		Difference	+ 7.0	+ 4.7	+ 3.2
Peredovik	1960	1957-1959	48.8	24.4	10.4
		1966-1968	51.8	28.5	13.0
		Difference	+ 3.0	+ 4.1	+ 2.6

Table 5 - The best numbers of interspecific hybrids F_{15} (H. tuberosus x 8931) in nursery of the 1-st year study (1971)

Origin	Vegetative period (days)	Yield of achenes c/ha	Oil content (dry seed basis)	Oil yield	
				cent n/ha	%
13006	97	32.70	51.70	15.22	51.9
K-8931	97	22.11	50.37	10.02	
8486	98	35.18	52.26	16.55	40.9
K-8931	96	26.64	49.00	11.75	
1554	99	30.30	54.68	14.91	37.7
K-8931	96	26.98	48.09	11.68	
14534	97	33.35	52.31	15.70	31.1
K-8931	97	26.88	49.52	11.98	
8326	98	39.63	52.76	18.82	96.0
K-8931	95	22.43	47.55	9.60	