I.A. Gubin, USSR

NEW ACHIEVEMENTS IN SUNFLOWER INTERVARIETAL HYBRIDIZATION

A number of sunflower hybrids of the first generation was received in different years by means of intervarietal repollination, which significantly exceed initial varieties in terms of productivity (V.S. Pustovoit, 1939, 1946, 1951, 1952; L.A. Zhdanov, 1955; V.G. Volf,1954; Yu.P. Myakushko, 1954; K.I. Prokhorov, 1957; V.K. Morozov, 1970, etc.).

The present work is based on a new initial material and differs substantially from previous investigations. Its task was to find varieties-pollinators capable of raising the yield of a pollinated variety just during the year of intervarietal pollination, i.e. in F_0, together with receiving first generation hybrids.

The difficulty is that all modern sunflower breeding varieties are complex hybrid populations. As a rule, they are related to each other, which must probably decrease the effectivity of intervarietal hybridization.

Academician V.S. Pustovoit repeatedly turned to intervarietal sunflower hybrids and each time he managed to receive hybrids which considerably exceeded, in terms of productivity, even component varieties close in origin (3509x3519, 1646x6540, etc.).

He elaborated the classical methodology of sunflower breeding based on the principles of intervarietal hybridization.

The present work was also done under the leadership of Academician V. Pustovoit.

Pollinators were selected by paired crossings of sunflower varieties widespread in the Soviet Union under group and individual bag isolators, and the best of them were checked in the specific conditions of a production experiment.

The hybrid combinations were studied under group isolators during 3 years, the studies showed that in the year of repollination the seed yield of plants pollinated by other variety pollen was higher in most cases than that of pure varieties.

In some combinations this increase was not observed. At the same time there were hybrid combinations whose yield was lower than that of the check maternal varieties.

Similar results were obtained under individual bag isolators.

The analysis of experimental data revealed yield increases at intervarietal repollination largely thanks to greater numbers of setting seeds.

The higher seed yield during the year of intervarietal repollination was also borne out in production experiments by the example of the varieties Peredovik, VNIIMK 8931 and their mixture. Thus the seeds yield of the Peredovik + the VNIIMK 8931 variety mixture was annually higher than that of their components.

During the experimental years the yield of the varieties mixture was higher than the Peredovik variety yield by 18.1% and than the VNIIMK 8931 variety - by 8.6% (Table 1).

Phenological observations proved that the varieties mixture had more even flowering. The presence of pollen from different varieties facilitated quicker fecundation, owing to which the mixture matured two days earlier.

The phenological observations are in agreement with the seeds humidity measured during harvesting. Since the mixture matured a little earlier its seeds were drier by the time of harvesting.

Over 150 hybrid combinations were obtained during the years of work.

The first generation of hybrids was studied according to the A-AB-BA-B scheme. Parential varieties whose seeds were grown in similar conditions were checks. Such a scheme allowed to find the components of a given pair

which were more responsive to intervarietal repollination.

Table 1

The Influence of Sunflower Intervarietal Repollination on the Seeds Yield in F_o Production experiment

Years	Variants		VNIIMK 8931
	Peredovik + 8931 variety mixture	Peredovik	
1971	20.7	16.3	19.4
1973	20.4	17.2	18.8
1975	25.1	20.7	22.5
Average for 3 years	22.1	18.1	20.2
Difference relative to variety mixture, c/ha	-	-4.0	-1.9
%	-	-18.1	-8.6
m%	-1.48	HkS=1.2 c/ha	0.95

Many of hybrids studied exceed parental varieties in terms of productivity. The annual seed yield of all intervarietal hybrids was higher than that of the initial varieties by 1-2 c/ha on average or by 3-5%. The hybrids showed similar results in the oil yield per hectare (Table 2).

Mostly unsuccessful were hybrids between Soviet bred varieties and some foreign ones possessing fair combining ability according to literature data, but not perfect enough in terms of breeding. For this reason foreign bred varieties were not used in our work.

Table 2

Description of Sunflower Varieties in Terms of Oil Yield in F_1 at Intervarietal Repollination

Average for 3 years; VNIIMK, the city of Krasnodar

Varieties	Relation to components			
	maternal		paternal	
	amplitude, %	average, %	amplitude, %	average, %
Sputnik	111-118	113	99-116	107
Mayak	111-112	112	97-102	100
Peredovik	99-106	102	97-116	104
VNIIMK 6540	98-104	101	99-112	104
Voschod	93-105	99	92-116	105
Luch	97-102	100	101-112	107

Hybrids positively singled out and studied under the scheme described are reproduced on space isolators in the free flowering of parental varieties shown in rows.

Tow such hybrids, Nakhodka and Reserv, were passed on to the state variety trial in 1975 (Table 3).

The 1975 data on a number of state variety plots on these hybrids are favourable.

Despite the opinion that only the second generation hybrids should be selected from cross-pollinating plants we selected the best plants right in the hybrid plant nursery, i. e. in F_0. This enabled us to select plants whose progeny was more productive during the breeding process than the best entries of seed elite. Thus during hybridization of the Voskhod and the 309-10 varieties which were not very productive according to comparative tests, a big group of entries was singled out which exceeded the check both in the seed oil content and in the oil yield per hectare.

The subsequent crosspollination of the best hybrid entries according to the scheme (Voskhod x 309-10) F_1 x (309-10x Voskhod) F_1 helped identify a still more valuable hybrid material. According to the data of the first and second year nurseries, many hybrid numbers exceed the check by 3-4% in the seed oil content and by 25-94% in the oil yield per hectare (Table 4) after the second crosspollination.

The work we have done allows a conclusion that sunflower intervarietal crosspollination remains a progressive method both for breeding purposes and for obtaining intervarietal hybrids fit for the use in production.

Academician Pustovoit believed that sunflower intervarietal hybridization could be as effective as the inbreeding line method and involved considerably smaller costs. This idea has been borne out by our work.

Table 3

Description of Sunflower Intervarietal Hybrids

The VNIIMK contest trial, average for 1971, 1972, 1974, 1975

Hybrids and varieties	Vegetation period, days	Plant height, cm	Oil content of absolutely dry seeds, %	Seeds yield, c/ha	Oil yield, c/ha	
					absolute	+ - against control
Nakhodka	95	189	53.5	33.4	16.07	1.65
Reserv	97	196	53.4	32.7	15.72	1.30
VNIIMK 8931 check	95	198	52.2	30.7	14.42	-
m %						2.63
HSR 0.95						1.26

Table 4

The Best Entries of the Second Generation of Sunflower Hybrids According to the Hybrid Nursery Data of the First and Second Years of Studies

VNIIMK, average for 1974-1975

Hybrid entries and check	Vegetation period, days	Plant height, cm	Seed nature g/l	Oil content of absolutely dry seeds, %	Seed yield, c/ha	Oil yield, c/ha
Voskhod x 309-10$_1$	97	189	425	53.66	41.2	19.89
K-8931	97	196	421	50.91	32.3	14.79
Voskhod x 309-10$_2$	97	182	435	55.28	37.9	18.84
K-8931	96	180	410	51.25	32.3	14.90
309-10 x Voskhod$_3$	97	170	425	53.40	40.4	19.37
K-8931	96	184	411	49.20	34.9	15.41