T1972BRE14

BREEDING OF OIL SUNFLOWER IN POLAND

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The prevailing climatic conditions, especially temperature, are not as favourable for growing sunflower in Poland as they are in the main sunflower production regions in Europe, extending from the southern areas of the Soviet Union through Rumania, Bulgaria, Hungary and Yugoslavia. Naturally, the introducing of sunflower into the cultivation in Poland encounters much harder obstacles and much more difficult agrotechnical and breeding requirements. Thus, sunflower growing in this country can be considered on the condition that satisfactory yields of seed and oil are obtained. On this point of view, the Oil-Plant Deparment of Institute of Soil Science and Cultivation of Plants formulated the following principles of technology of sunflower cultivation in Poland :

a) point seeding by means of a pneumatic sower,

b) weed control by applying herbicides,

c) desiccation of maturing plants,

d) gathering and threshing by a combine harvester

the aim being to produce varieties with positive characteristics, namely :

1 - appropriate duration of vegetation period,

2 - adequate plant height,

3 - the highest possible oil yield per hectare,

4 - resistance to diseases and pests.

In our climatic conditions the vegetation period, from time of seeding to maturity should not exceed 120-125 days. With respect to desiccation by aeroplane as well as by tractor drawn sprayer the plant height is expected not to exceed 100 cm. The oil yield is assumed to be at least 700 kg per hectare.

Owing to the absence of sunflower cultivation in Poland the spreading of diseases and pests of this plant is slow and insignificant so far, yet extensive immunological breeding is provided for, attention being chiefly concentrated on Sclerotinia and Botrytis.

The breeding programm for sunflower varieties is realized at the Oil-Plant Department of the Institute of Plant Breeding and Acclimatization (IHAR) in Poznan :

1 - by breeding population varieties,

2 - by the use of heterosis in synthetic varieties and single crosses.

The Soviet Union developed most sunflower types and forms. Four relatively early Russian varieties : Woronezskij 64, Armavirec, Jenisej and Czernianka 66 were studied in field experiments at the Research Station of IHAR in Borowo in the years 1963-1966. Czernianka 66 succeeded best. Though maturing later than the others this variety distinguished itself by a small height, rich foliage and, first of all, by a higher yield. On the basis of inbred lines derived from this variety a new Polish variety, the Wielkopolski IHAR, has been developed and is being tested now, along with other varieties. The results obtained in 1970 are given in Table 1.

Table 1 - Mean values reached with sunflower varieties tested by the Research Centre for Varieties of Agricultural Crops

Variety	Vegetation period in days	Plant height in cm	Seed Yield in q/ha	Oil yield in q/ha
Borowski Prazkowany	121	108	19,7	5,6
Borowski Ulepszony	128	162	21,7	6,6
Pieredowik	130	160	18,6	7,7
Woronezski 109	126	144	16,4	6,4
Czernianka 66	125	102	20,0	8,2
Wielkopolski IHAR	125	110	21,4	8,3
Armawirec	122	127	13,9	5,5
Smiena	124	132	16,6	6,1

The mean values of seed yield obtained in 9 experiments with the Wielkopolski strains at the Research Station IHAR in Borowo in 1971 were as follows :

	Mean seed yield in q per ha
Czernianka - standard	23,1
Wielkopolski - standard	25,6
Wielkopolski selected strains	26,3

Intensive breeding work on the Wielkopolski variety tends to develop a uniform variety, reduce husk content in achenes, discard branched plants in addition to increasing the cropping power. In spring of this year about 150 hectares in different regions of Poland were sown with the seeds of this variety ; the area of the separate plantations ranged from 5 ha to 25 ha.

Studies on heterosis effects in sunflower were initiated in Poland in 1961. They enabled us to obtain our individual data as to frequency and rate of the heterosis effect as well as on crossing methods and tests of various forms. Inbreeding of many years resulted in a series of lines showing adequate morphological and physiological features. Their general combining ability is tested and, first of all, their usefulness as components of synthetic varieties is estimated.

In our experiments the general combining ability of lines revealed close correlation with their yield. This dependence justifies preliminary selection of lines to be made on the basis of their cropping power. Crossing of high-yielding lines (16-19 q per ha) provided definitely higher seed and oil yields both in the F_1 and in the theoretically calculated F_2 than crossing of low-yielding lines (10-11 q per ha). The results of crossing high-yielding with low-yielding lines and vice versa were approximately the same as those obtained in crossing of high-yielding forms.

In the evaluation of lines as components of a synthetic variety attention was given to the least selffertile of them ; this feature varied greatly between lines. Table 2 shows the mean selffertility in 10 lines inbred for 11 years (1960-1970) in per cent of full achenes in relation to the whole number of achenes per head.

Table 2 - Mean selffertility of 10 lines inbred in the years 1960-1970

Line	Degree of selffertility in %
1768/2	11,2
1767/3	12,9
1784/2	19,2
1766/2	21,8
1716/1	24,5
1787/1	23,6
1767/2a	31,6
1788/4	36,0
1759/1	43,5
1784/1	53,4

The tendency to selffertility increased with progressing inbreeding (I_0 - I_2 - 15,4 % ; I_6 - I_8 - 35,0 %) but pronounced differences were observed in the separate years. The heritability of this characteristic, expressed by the intraclass correlation coefficient x 100, was h^2 = 38.5 %. It shows that over 60 % variability of this feature was determined by environmental factors.

The vitality of F_1 and F_2 is affected also by the number of lines used to crossing. In our investigations 5 lines were used for intercrossing in the order of decreasing the combining ability. The mean vitality of the F_1 and the theoretical vitality of the F_2 were computed for reciprocal crossings of 2, 3, 4, 5, successive lines. Table 3 presents the results obtained in oil yield.

Table 3 - Oil yield of F_1 and F_2 hybrids in dependence of the number of crossed lines

N° of lines crossed	Yield of oil in q/ha		
	line	F_1	F_2 (theoret.)
2	6,0	12,3	9,1
3	5,1	11,7	9,5
4	4,6	10,1	8,8
5	4,3	9,0	8,0

The highest oil yield was noted for F_1 in a crossing of two best lines as well as for F_2 of 3 lines. This confirms some breeders' suggestion as to the possible development of a valuable synthetic variety of 3-5 genotypes.

Synthetic varieties are characterized by a greater variation than single crosses. Lines derived from very differentiated varieties increase undesirable variability in a new population. Therefore, it appears to be more purposeful to select from among the best lines and adequately numerous group, within which morphological differences (especially plant height) and physiological ones (duration of vegetation period) should not be too great. By crossing these lines a synthetic stock population would be created for the selection of second-cycle inbred lines, which already at the beginning of inbreeding would be used to create synthetic varieties. These are the goals in the programme realized at the Oil-Plants Department of the Institute of Plant Breeding and Acclimatization in Poznan.