CORRELATIONS OF SOME FEATURES IN THE BREEDING MATERIAL OF SUNFLOWER VARIETY WIELKOPOLSKI

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The Wielkopolski variety was derived from the Russian variety Czernianka 66. It is a low and rather early variety giving in Poland a good yield of oil reaching the level of some leading foreign varieties. Since 1966 its breeding has been conducted by the reserve method like that of Pustowojt. Single plants are selected from izolated nurseries and a year later they are compared one another in field experiments (incomplete blocs, 4 repetitions, plot area 3 m^2, the theoretical number of plants on a plot — 20, spacing of plants — 60 × 25 cm).

After the results of experiments are known, the best forms are choosen from reserves for mutual crossing.

Experiments with single plants and further reproduction were carried out through the years 1970 to 1972 in the Experimental Station for Breeding and Acclimatisation of Plants in Borowo, near Poznań, and, in addition only in 1972, in two other localities in different parts of Poland.

The mean values obtained were applied in the estimation of correlation of the features as follows : *A* — height of plants in cm, *B* — diameter of head in cm, *C* — yield of achenes in q/ha, *D* — yield of oil in q/ha, *E* — weight of 1000 achenes in g, *F* — content of oil in achenes in %, *G* — content of husk in achenes in %.

In Borowo the total number of different subjects compared was : in 1970 — 189, 1971 — 243, 1972 — 243, while in the three localities in tests performed in 1972, the total number of the same subjects taken for comparisons was 54.

The coefficients of correlation (r) of features were calculated from results obtained for each year and for every locality. Their homogeneity was estimated. In case of homogeneous correlations their mean value was calculated and tested at the level of $\alpha = 0.05$. The mean for heterogeneous coefficients, and correlations for mathematically dependent

features (yield of oil = yield of achenes x oil content in achenes), are given in brackets.

In the analysis of multiple regression as well as of multiple correlation, the yield of achenes and the yield of oil were compared separately as for the following : height of plants, diameter of head, weight of 1000 achenes and husk content. For some combinations the coefficient of partial correlation of the first order was calculated to define the degree of the relationship between two features, the influence of the third variable being eliminated.

Table 1 shows the mean values for features ($\bar{x}$), coefficients of variation (v) and intervals of variability in 3 years and in the 3 localities. The quoted values are similar except for the height of plants. The

Table 1

Mean values for features ($\bar{x}$), coefficients of variation ($\bar{v}$ %) and intervals of variability (w)

Years Localities	A Height of plants cm	B Diameter of head cm	C Yield of achenes q/ha	D Yield of oil q/ha	E Weight of 1000 achenes g	F Content of oil in achenes %	G Content of husk in achenes %
Progeny of various individual plants in years 1970—1972 $\bar{x}$	100	17	24	11	63	46	25
w	58—150	12—22	11—42	3—19	43—88	35—52	20—31
$\bar{v}$ %	8	8	16	17	9	3	5
Progeny of the same individual plants in 3 localities in 1972 $\bar{x}$	137	18	27	12	64	45	27
w	96—190	15—22	15—43	6—22	49—83	41—52	21—34
$\bar{v}$ %	7	6	20	20	8	3	6

same single plants in Borowo were low ($\bar{x}$ = 109 cm) while in other stations they were high (144—157 cm) what points to their reaction to different environmental conditions. The yields of achenes and of oil are the most variable features ($\bar{v}$ from 16% to 20%) whereas a mean relative variability was noticed in the height of plants, diameter of head, weight of 1000 achenes and sometimes in the husk content ($\bar{v}$ from 6% to 9%) and the least, however, in oil content in achenes ($\bar{v}$ =3%).

Table 2 gives mean values of the coefficients of correlation (r) of features. In 1970—1972, frequent different estimations of the degree and direction of correlation of features were expressed by a lack of homogeneity of the coefficient of correlation (mean values given in brackets). Of much greater frequency were consistent correlations for features of the same strains in 3 localities. In the breeding of oil sunflower those features are of importance which determine the yield.

Simple coefficients of correlation show, that in the materials tested the yield of achenes and of oil were clearly correlated with the height

Table 2

Mean values of coefficients of correlation for 3 years (I) and 3 localities (II)

Features		A Height of plants	B Diameter of head	C Yield of achenes	D Yield of oil	E Weight of 1000 achenes	F Content of oil in achenes
B Diameter of head	I	0.460**					
	II	(0.504)					
C Yield of achenes	I	(0.492)	(0.285)				
	II	0.476**	(0.254)				
D Yield of oil	I	(0.492)	(0.270)	(0.914)			
	II	0.481**	(0.200)	(0.985)			
E Weight of 1000 achenes	I	0.152**	(0.218)	(0.032)	0.038		
	II	0.308**	0.301**	0.179*	0.157*		
F Content of oil in achenes	I	(—0.021)	(—0.067)	0.150**	(0.237)	(—0.161)	
	II	—0.080	—0.397**	—0.041	(0.116)	—0.172*	
G Content of husk in achenes	I	(0.059)	(0.122)	(0.148)	(0.066)	0.009	—0.298**
	II	(—0.189)	(0.067)	—0.066	—0.124	—0.057	(—0.343)

of plants, less considerably with the head diameter, while a real correlation with the weight of 1000 achenes and the husk content was noted only sporadically.

The analyses of multiple regression and of multiple correlation (table 3) show that in almost all combinations there was clear positive correlation between the yield and height of plants after eliminating the influence of other features. Much rarer was (sometimes negative) the

Table 3

Coefficients of partial regression (b), coefficients of multiple correlation (R), coefficients of determination (R^2 x 100) in relation to features correlated with yield of achenes and of oil

Features	Years 1970, 1971, 1972 Localities I II III	A Height of plants $b_{(C)(D)\,A \cdot BEG}$	B Diameter of head $b_{(CD)B \cdot AEG}$	E Weight of 1000 achenes $b_{(C)(D)\,E \cdot ABG}$	G Content of husk $b_{(C)(D)\,G \cdot ABE}$	$R_{(C)(D)\,\cdot ABEG}$ (r)	$R^2 \times 100$
C Yield of achenes	1970	0.204				0.462	21.3
	1871	0.242	1.017		0.561	0.693	48.0
	1972	0.198		—0.091		0.423	17.9
	I	0.223				0.538	29.0
	II	0.455	—2.641			0.406	16.5
	III		3.641			0.690	47.6
D Yield of oil	1970	0.093				0.423	17.9
	1971	0.122	0.478		0.207	0.682	46.5
	1972	0.144		—0.036		0.444	19.7
	I	0.106				0.548	30.0
	II	0.225	—1.488			0.442	19.5
	III		1.534			0.648	42.0

correlation with the head diameter. There was hardly any influence of the weight of 1000 achenes and husk content on the yield both of achenes and of oil.

In the estimation of correlation of yield with a complete effect of all remaining features, the coefficients of multiple correlation for features clearly determining the yield were from $R = 0.40$ to $R = 0.69$ and were significant on the level of 0.01. In cases in wich only one feature clearly correlated with the yield, the coefficient of multiple correlation resolved into a single coefficient of correlation.

Low coefficients of determination (R^2) however show, that only a small part of variability of yield was caused by the influence of the features under study.

A fairly distinct correlation between the yield of achenes and of oil with the height of plants is very disadvantageous in Polish conditions, where an increase of height of plants over 120 cm is not desirable. The yield of oil is a function of yield of achenes and of oil content in them. In the breeding material of the Wielkopolski variety the correlation between the yield of oil and the yield of achenes was very high independent of oil content in achenes (r_{DC} and $r_{DC \cdot F} > 0.9$). However, the mean coefficients of correlation between the yield of oil and oil content were much lower ($\bar{r}_{DF} < 0.24$) what is dependent more on the yield of achenes but much less on lower variation in oil content. At an equal level of the yield of achenes the partial coefficient of correlation for most material fluctuated between $r_{DF \cdot C} = 0.65$ and $r_{DF \cdot C} = 0.86$.

At an equal yield of oil, there is a negetive correlation between the yield of achenes and the oil content.

A higher correlation between the yield of oil and the yield of achenes than between the yield of oil and the oil content in achenes speaks more in favour of breeding for high yield than for high oil content.

A weakly marked correlation between oil content and diameter of head as well as between oil content and weight of 1000 achenes shows, that intensive selection for high oil content can sometimes interfere with the trend to increase the yield of achenes.

A negative correlation between husk content and oil content in achenes makes possible to retain only selection for oil content by using the latest modern methods in its determination and to discard the extremely labor-consuming determination of husk content.