INHERITANCE OF PROTEIN CONTENT IN PEA. III. CORRELATION BETWEEN PROTEIN CONTENT AND SEED YIELD

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After several years of research work at Wiatrowo to breed cultivars with a higher protein content, our progress has been less than expected. The basic difficulty was the negative correlation between % protein content and seed yield, a difficulty discussed also by Jermyn and Slinkard (Canad. J. Pl. Sci., 1976, 56:427). To learn more about the problem we decided to subject the results of breeding tests to statistical analysis. First a preliminary analysis of correlation and regression was made. The analysis was based on the observations, from 1973-76, of seed yield and % protein content in four crosses: L 2813 x L 6003 (mean protein content 28.9%), L 3509 x L 2813 (30.6%), L 2815 x L 2813 (29.4%), and L 2813 x L 4318 (30.9%). In the first stage the significance of the coefficient of correlation between seed yield and % protein content for particular hybrids and for particular years was studied. There was a high, negative correlation always above (according to the absolute value) -0.95 between these factors.

Next the coefficients of correlation and regression were analyzed over all years. There was general lack of homoegeneity among the coefficients of correlation, reflecting differences in some or all of the variables studied. Crosses were also compared with respect to coefficients of correlation and regression. Three of these crosses showed substantially different correlation in all possible clusters of years whereas L 2813 x L 4318 showed a certain regularity (homogeneity of coefficients of correlation) over years.

From a breeding point of view, it was of interest to know if the negative correlation between seed yield and % protein content was equally strong at different levels of protein content. In order to study this problem, the cross L 3503 x L 2813 was chosen because the most data were available. Using a computer, the data were searched for those instances in which higher seed yield was not associated with lower protein content. This analysis showed that when protein content was not more than 27% a larger seed yield did not cause significant reduction of protein content. Since this conclusion was based on only one cross, we checked for verification in following years. Coefficients of correlation were analyzed and coefficients of equations of regression were compared for other crosses in which protein content was not more than 27% (1977 - 17 crosses, 1978 - 7 crosses, 1979 - 15 crosses). The results from 1979 (Table 1) are given as examples verifying the conclusions as stated.

The conclusions presented above show the possibilities of increasing the protein yield in cultivars, either by improvement of yield when protein content is not more that 27%, or by increase of protein content to the threshold level of 27% in high-yielding cultivars. For example, some varieties bred in Poland give a seed yield of about 3-4 tons/hectare, yet their protein content is only 22%. If, according to the above hypothesis, the protein content is increased to the theoretical 27%, protein yield would be greater by 150-200 kilos per hectare.

These observations demonstrate how difficulties faced in routine breeding inspire more detailed investigations.

Table 1. Correlation coefficients between yield of seeds and % protein for different cross-combinations.

No.	Cross-combination	Average		Correlation coefficient
		Yield in g	% protein	
1.	L 10207 x L 6025	15.4	24.6	-0.29*
2.	Sharma HP x L 10254	15.4	25.5	-0.18
3.	L 10222 x Sharma HP	12.0	27.1	-0.19
4.	L 10222 x L 2185	15.9	26.2	+0.15
5.	L 2185 x L 10254	16.2	24.9	+0.15
6.	L 10222 x India S.	9.5	23.5	+0.21
7.	L 6003 x L 9422	19.9	25.7	+0.06
8.	L 3026 x L 3518	14.2	24.7	-0.17
9.	L 3923 x L 3026	15.5	24.9	-0.28
10.	L 6025 x L 3527	23.7	25.7	-0.07
11.	L 6025 x L 3923	15.6	27.7	-0.33**
12.	L 6025 x L 3006	22.4	24.9	-0.10
13.	Lysima x L 3527	16.8	25.0	+0.19
14.	L 2185 x L 3527	23.4	25.9	0.00
15.	L 3923 x L 3026	31.6	23.6	-0.04