OIL AND PROTEIN CONCENTRATION IN SEED OF DIVERSE HIGH-PROTEIN INBRED LINES OF SUNFLOWER

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Abstract

Research results of numerous authors indicate that the concentrations of oil and proteins in sunflower seed are negatively correlated. However, some authors found these two characteristics to be positively correlated (e.g., BEDOV, 1982).

The objective of this investigation was to establish associations between oil and protein concentration in sunflower inbred lines of different origin. The investigation included five groups of lines which differed in geographic origin.

The results obtained indicated that the lines originating from Spain, Argentina, and Russia, as well as local population from Eastern Serbia had negative correlation coefficients (r): -0.87, -0.21, -0.18, and -0.05, respectively.

The lines from Bulgaria and the domestic protein variety Kolos had positive correlation coefficients (r): 0.38 and 0.21, respectively.

Introduction

Oil concentration in sunflower seed is a highly variable characteristic which depends largely on environmental factors. Average values of oil concentration in seed range from 20% to 55%. They depend on the ratio husk to kernel.

Oil concentration in seed is a qualitative characteristic and its expression is affected by several factors. In addition to the genotype, very important are environmental factors (temperature, humidity, length of the stage), especially at the stage of seed filling.

Within varietal populations, the variability in oil concentration in seed is large and fairly dependent on environmental factors (MOROZOV, 1947; NIKOLIĆ ET AL., 1971).

DUBLJANSKAYA AND MALISEVA (1963) found significant differences for protein concentration in the kernel of different varietal populations.

Studying breeding materials differing in genotypic origin, BEDOV AND ŠKORIĆ (1981) found the variation in protein concentration in the kernel from 16% to 29%.

BEDOV (1982) pointed out the importance of variability for protein concentration in sunflower lines for domestic breeding programs.

A large number of authors reported significant differences and negative correlations between oil and protein concentration in seed among sunflower genotypes, as well as an important effect of environmental factors on the expression of these two characteristics. This should be kept in mind when simultaneously breeding for high yields of oil and proteins.

Material and Method

We tested 230 sunflower inbred lines in the S_6 generation. The lines, which differ in the concentrations of oil and proteins, draw origin from various genetic materials (populations, varieties, and hybrids) collected at the Institute of Agricultural and Technological Research in Zaječar.

The source material for the development of inbred lines consisted of:

1. the protein variety Kolos (KOL.1),
2. the protein variety Kutuger (KUT.2),
3. a variety from Russia (RUS.3),
4. a local population from eastern Serbia (DUŠ.4)
5. a cultivar from Spain (SPA.5), and
6. a cultivar from Argentina (ARG.6).

For easier interpretation of the results obtained, each source was assigned an abbreviation and a number.

Oil concentration in seed was analyzed on a NMR analyzer, in samples with 5.5% moisture. Sample size was determined by volume and the mass of samples ranged from 3 to 6 g, in dependence of seed size and mass. Oil concentration was analyzed in two or more replications. Protein concentration was analyzed after the method of Kjeldahl.

Results

The results obtained for oil and protein concentration in the sunflower inbred lines tested indicated the presence of high variability which depended on the genotype, i.e., source material (Table 1).

The average concentration of proteins ranged from 17.51% to 20.18%. The maximum and the minimum value (24.65% and 9.27%, respectively) were registered in inbred lines derived from the protein variety Kolos. This group of lines had the highest values of standard deviation (SD = 3.41) and variation coefficient (Cv = 18.15%).

The average oil concentration in the tested lines ranged from 32.88% (the lines derived from Kolos) to 39.85% (the source material from Spain)(Table 2). The maximum average values of oil concentration were found for the groups of lines derived from the local population and the Russian variety, 50.82% and 50.95%, respectively. The largest variations in oil concentration in seed were found for the lines derived from the domestic population and those from Kolos, Cv = 25.08% and Cv = 22.51%, respectively.

The coefficients of simple correlation between oil and protein concentrations had different positive and negative values (Table 3). A high negative correlation (r = -0.872) was registered for the group of lines from Spain. Negative but non-significant correlations were found for the lines from the domestic population, Argentina, and Russia.

Positive correlations were established for the lines derived from the variety Kutuger and those derived from Kolos, r= 0.381 and r= 0.215, respectively.

Discussion

The results obtained are in agreement with the results of previous investigations on oil and protein concentration in sunflower seed. MOROZOV (1947), STOJANOVA ET AL. (1971), SCHUSTER (1964), etc., reported significant differences in oil concentration in seed, both between and among sunflower genotypes.

Our results are in agreement with an investigation of S. BEDOV (1982) which emphasized a considerable variability for protein concentration in sunflower seed and its importance in domestic breeding programs aimed at the development of protein sunflower hybrids.

In our investigation, the correlations between oil and protein concentration were both positive and negative, in dependence of the source material used. ZALI ET AL. (1978) found a non-significant negative correlation between oil and protein concentration. DJAKOV (1986) proved experimentally the absence of a negative correlation between oil and protein concentration in sunflower seed.

Conclusion

The following conclusions were drawn on the basis of the investigation on the variability and association between oil and protein concentration in sunflower inbred lines of different origin.

The highest variability in protein concentration was found for the group of lines derived from the variety Kolos (Cv = 18.15%), the lowest for the groups derived from Kutuger and the Spanish cultivar (Cv = 9.56% and Cv = 8.86%, respectively).

The highest variabilities in oil concentration in seed were found for the groups of lines derived from the local population Dušanovac and the variety Kolos, Cv = 25.08% and Cv = 22.51%, respectively.

Protein concentration was positively correlated with oil concentration in seed in the lines derived from the varieties Kutuger and Kolos.

A high negative correlation between the two characteristics was established for the lines derived from the Spanish cultivar.

Tab. 1 - Variability indicators for protein concentration in seed of sunflower inbred lines of different origin

Origin of line	X	Min.	Max.	Range	SC	Cv
KOL.1	18.79	9.27	24.65	15.38	3.41	18.15
KUT.2	20.18	17.94	23.68	5.74	1.93	9.56
RUS.3	17.50	11.06	22.31	11.25	2.96	16.90
DUS.4	18.19	13.75	21.86	8.11	2.44	13.41
SPA.5	19.26	16.82	22.41	5.59	1.71	8.86
ARG.6	18.27	11.42	23.55	12.13	3.01	16.48

Tab. 2 - Variability indicators for oil concentration in seed of sunflower inbred lines of different origin

Origin of line	X	Min.	Max.	Range	SC	Cv
KOL.1	32.88	14.34	48.75	34.41	7.40	22.51
KUT.2	33.80	24.84	41.35	16.51	4.58	13.55
RUS.3	37.85	24.95	50.95	26.00	5.43	14.35
DUS.4	34.40	14.75	50.82	36.07	8.36	25.08
SPA.5	39.85	34.85	45.29	10.45	4.09	10.26
ARG.6	37.22	29.75	43.51	13.76	4.17	11.20

Tab. 3 - Coefficient of simple correlation and determination between oil and protein concentration

Origin of line	Coefficient r	R^2
KOL.1	0.215	0.046
KUT.2	0.381	0.145
RUS.3	-0.185	0.034
DUS.4	-0.050	0.003
SPA.5	-0.872	0.760
ARG.6	-0.213	0.045

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