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APPLICATION OF GRIFFING'S METHODS IN DETERMINATION OF COMBINING ABILITY OF SUNFLOWER SELF-POLLINATED LINES

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SUMMARY

Six self-pollinated sunflower lines with a different origin are crossed to a complete diallel scheme. The parent lines and F_1 hybrids, including the reciprocal ones, are tested in a trial, conducted according to a randomized block method in three replications. Considerable heterotic effect registered for the seed yield from one plant. Proportional dependence is found between the productivity of the parent lines and hybrid combinations. The dispersion analysis of the combining ability to the four methods of Griffing shows that the additive and non-additive genic effects, in domination of additive ones, are of importance in the inheritance of the seed yield. The evaluations for the general and specific combining ability do not change essentially in different methods of analysis, as the succession of the lines arrangement is preserved in all cases.

INTRODUCTION

One of the most important preconditions for development of hybrid combinations wiht high prodoctive potential is the availability of parent lines with a good combining ability. According to some authors the diallel analysis is the most suitable method for evalution of this quality. Two models and four methods of diallel crosses developed by Griffing (1956), are differed in type of the initial material, the volume and the complexity of the crosses and the fullnes of the obtained information.
In a comparative study of the four methods in evaluation of self-pollinated maize lines Turbin et al.(1966) and Christova (1988) found that the effects of the general combining ability (GCA) are not affected by the applied method. The differences obtained in the variances of the specific combining ability (SCA) are depending on the participation or non-participation

of the parent forms in the analysis.

Fedin (1970) in a study in wheat and Turbin et al.(1974) - in maize, compared second and fourth methods and concluded that the parent forms have to be included in the analysis of GCA, while for the evaluation of SCA a testing of the hybrid combinations only is enough.

Data for studies in this direction in sunflower are not published. The objective of the present investigation is to make a comparison of Griffing's four methods in determination of the combining ability of self-pollinated sunflower lines for the character seed yield from one plant.

MATERIAL AND METHODS

In 1988 six self-pollinated sunflower lines with a different origin are crossed according to a complete diallel scheme. The parent lines and F_1 hybrids, including the reciprocal ones, are tested in 1989 at the field of the Institute for Wheat and Sunflower "Dobroudja", General Toshevo. The trial is conducted according to a randomized block method in three replications, with plots of 15 m^2. After threshing the seeds are weighed in a dry-air condition, the moisture is determined and the yield is calculated for absolute dry seeds.

Model I of Griffing (1956) is applied for determination of the combining ability, because a preliminary selection of the lines participating in the crosses has been carried out. Different number of components are includet in the analysis depending of the method used: Method I - the parent lines and all F_1 hybrids, including the reciprocal - p^2 entries; Method II - the parents and the one-way hybrids - $p(p + 1)/2$ entries; Method III - all hybrid combinations without the parents - $p(p - 1)$ entries; Method IV - only one-way hybrids - $p(p - 1)/2$ entries. The differences between the genotypes taking part in the study are found thrugh a dispersion analysis. The effects of GCA and the variances of SCA are determined according to the methods of Griffing (1956).

RESULTS AND DISCUSSION

The parent lines taking part in the study can be divided into two groups - lines with a relative higher productivity - 1234, 1607 and 3230, and lines with a relative lower productivity - 3004, 3041 and 3064 (Table 1). Heterotic effect for the seed yield per plant is registered in 93,3% of the hybrid combinations, and the heterosis level is from 18,5 to 119,6% toward the parent wiht a higher productivity. It has to be hoted that the high top limit of the heterosis is due mainly to the low productivity of the parent forms, than to the high hybrid productivity. In hybrids with higher yielding lines the level of the heterosis is not so well expressed, but the absolute values determinating the yield are higher.The hybrids between lines 1234 and 1607 are low productive, compared to the parent forms, which is due to the genetic incompatibility of these two lines. The differehces between the reciprocal hybrids are insignificant, and are statistically not proved in all the cases.

Table 1. Seed yield per plant of parent lines and hybrid combinations (g).

Parent lines	1234	1607	3004	3041	3064	3230
1234	48,1	39,7	57,9	66,4	67,9	66,6
1607	41,2	44,8	64,7	52,8	65,1	71,0
3004	57,5	59,6	28,5	62,6	63,7	71,2
3041	65,5	53,1	60,4	27,0	51,3	66,1
3064	67,1	63,8	51,8	56,0	32,2	66,6
3230	71,0	63,4	74,6	61,6	68,6	51,4

LSD 0,05 = 12,2 LSD 0,01 = 16,3

Regarding the determination of evaluations of the combining ability, the differences between the genitypes including in the study should be examined. The dispersion analysis shows a statistical authenticatin of the differences in the all four methods (Table 2). Higher values for the mean squares and F parameter are obtained for methods I and II, compared to those obtained for methods III and IV. It is due to the circumstance that the parent forms, yielding considerable lower than the hybrid combinations, are included in the investigation on the first two methods.
The next stage of the study requires conducting of a dispersion analysis of the combining ability. The results are presented in Table 3. Authentic values of the F parameter, both for GCA and SCA, are obtained also for the four methods used. Griffing (1956)

Table 2. Dispersion analysis for seed yield per plant.

Methods	MSv	MSe	Fexp.	F tab.	
				0,05	0,01
I	474,33	56,64	8,37	1,59	1,93
II	556,27	55,43	10,04	1,84	2,37
III	225,65	59,11	3,82	1,66	2,05
IV	212,65	62,42	3,41	2,06	2,80

determined the GCA as an indicator of the additive genetic variance, and the SCA as an indicator of the non-additive genetic variance, i.e. domination and epistasis. Therefore, the genes, both with additive and non-additive effects, play a substantial role in inheritance of the seed yield per plant in F_1 generation. The ratio of the mean squares GCA:SCA for the four methods is higher than one and is an evidence for a determinating role of the additive effects in inheritance of the character.

Table 3. Dispersion analysis of the combining ability.

Source of variation	Method I		Method II		F tab.	
	MS	Fexp.	MS	Fexp.	0,05	0,01
G C A	48,37	7,69	96,49	15,66	2,45	3,51
S C A	23,67	3,76	45,01	7,03	1,92	2,52
E	6,29		6,16			
	Method III		Method IV			
G C A	43,86	7,13	91,26	13,15	2,56	3,76
S C A	32,00	4,87	59,61	8,59	2,04	3,11
E	6,57		6,94			

The effects of GCA are indicated in Table 4. Considerable deviations of the values depending on the used method are not found. Lines 1234 and 3230 show highest values in all cases, and lines 3041 and 3064 exhibit the lowest. Lines 1607 and 3004 take an intermediate position showing a higher variation of the evaluations for the different methods, without a presence of a definite dependence.

The variances of SCA are presented in Table 5. Higher values are

Table 4. Effects of general combining ability.

Methods	Parent lines					
	1234	1607	3004	3041	3064	3230
I	5,33	0,78	0,27	-4,97	-2,39	3,97
II	6,17	-0,98	3,23	-4,50	-1,65	6,07
III	5,07	0,78	-2,48	-3,77	-1,79	4,20
IV	6,69	-0,99	-0,29	-2,12	-1,56	6,53

obtained in all parent lines for methods II and IV, than the values for methods I and III. This, probably, is due to the circumstance that in this two methods reciprocal hybrids are eleminated. Regardless of these differences there is a definite tendency in the succession of the arrangement of the parent forms. Lines 1234 and 1607 are distinguished by their high SCA even in the four methods. A certain variation of the values is found for the rest four lines, but it das not exert a substantial importance for the evaluation of the SCA of each of them.

Table 5. Variances of specific combining ability.

Methods	Parent lines					
	1234	1607	3004	3041	3064	3230
I	49,32	46,41	1,80	-0,48	4,43	6,29
II	105,76	83,54	20,92	0,98	12,83	27,44
III	33,16	29,51	5,06	-1,05	4,41	6,97
IV	53,22	50,33	22,33	0,99	6,97	31,76

CONCLUSIONS

Significant heterotic effect is expressed in inheritance of the seed yield per plant in F_1 generation. The productivity of the hybrid combinations depends proportionally by the productivity of the parent lines.

The additive and non-additive genic effects, with a domination of the additive ones, are of importance for the genetic control of the seed yield of sunflower hybrids.

The evaluation of the combining ability of sunflower inbred lines in a system of diallel crosses can be conducted according to the four methods of Griffing. The different methods do not effect on the succession of the lines arrangement, both on GCA and on SCA.

Parent lines 1234 and 3230 are with the highest effects of GCA for seed yield per plant, and lines 1234 and 1607 exhibited the highest variances of SCA.

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