MODE OF INHERITANCE OF SOME LEAF AREA PARAMETERS IN F_1 SUNFLOWER

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Abstract

The objective of this investigation was to gain knowledge on the mode of inheritance for the total number of leaves per plant and the dynamics of shedding of physiologically active leaves in the F_1 generation as compared with the parents' mean.

Thirteen inbred lines were used in the investigation, eight as females and five as testers. The obtained data were statistically processed by the method of line x tester analysis (KEMPTHORNE, 1979).

The lines and their hybrids differed in the GCA values. The hybrid combinations with high SCA values usually had one parent with a high GCA value and another with a low GCA value. The analysis of variance for the total number of leaves per plant indicated the predominance of the additive gene action over the dominant one.

Regarding the inheritance of the total number of leaves per plant, partial dominance was exhibited in 18 crosses, heterosis in 16 crosses, and dominance in six crosses.

Key words: Sunflower, leaf area, leaf number per plant, inheritance, F_1 generation.

Introduction

Leaf number and area determine total leaf area or assimilation area. Over 90% of total organic matter is formed in green plant parts. Numerous authors have established a highly significant positive correlation between yield and leaf area (SHABANA, 1974), while ŠKORIĆ

(1974) found a highly significant positive correlation between seed yield and oil concentration on one side and leaf area on the other.

Since most hybrids in the commercial production are single crosses, it is important to gain insight in the mode and principles of inheritance for the number of leaves in the F_1 generation. SINDAGI (1980) reported an increased number of leaves in the F_1 generation in relation to that of the parents. MARINKOVIĆ (1980) found heterosis, dominance, and intermediacy for the number of leaves in the F_1 generation.

The aim of this investigation was to gain information on the mode of inheritance for the total number of leaves per plant, the dynamics of shedding of photosynthetically active leaves in the F_1 generation, and the effect of parent lines on the trait examined in the F_1 generation.

Material and Method

Thirteen genetically diverse inbred lines were selected for the crossing scheme planned. Eight of them were used as females (L), five as testers (T). The lines differed in the average number of leaves per plant from 22.4 to 29.2. During the crossings, which were performed in 1990, the female lines were emasculated manually. The hybrid combinations obtained and their parents were sown in 1991 according to the system of random blocks in three replications, with 12 plants in each basic plot.

Total number of leaves and the number of green leaves were first checked at the stage of full flowering and then 10, 20, and 30 days after flowering.

Mode of inheritance was assessed by testing the significance of the mean values of the F_1 generation in relation to the parents' mean. When the average of the F_1 generation was equal to the parents' average, the inheritance was rated as intermediate. The hybrids' average close to that of either parent were considered as partial dominance, those equal to that of either parent as dominance. A significantly higher F_1's average in relation to the better parent, or a lower F_1's average in relation to the poorer parent were considered as the positive and the negative heterosis, respectively. To obtain full information on the mode of inheritance, GCA values were calculated for the lines and SCA values for their hybrid combinations, using the method of line x tester analysis (KEMPTHORNE, 1979).

Results and Discussion

Total number of leaves at the stage of flowering

The inbred lines used in this investigation differed considerably in the number of leaves per plant (Table 1). Among the female lines, the lowest average number of leaves was found for the line L-1, the highest for L-8 (22.4 and 29.2, respectively). Among the testers, the average number of leaves ranged from 22.9, in T-9, to 26.7, in T-13.

The hybrid combination L-5 x T-12 had the smallest number of leaves, 18.8. This value was significantly lower than that of the poorest parent. The largest number of leaves was found in the combination L-8 x T-10, 30.9, which was significantly higher than the value of the better parent, i.e., heterosis occurred in this combination. Partial dominance was exhibited in 45% of the cases, dominance in 15%, and heterosis in 40%.

The highest GCA value was found in the lines L-7 and L-8, the lowest in L-4 (Table 2).

Among the testers, the highest GCA value was found in T-12. It should be mentioned here that neither one of the testers had a higher GCA value than any other tester used. The highest SCA values were found in the combinations L-6 x T-12 and L-8 x T-10. Six hybrid combinations had significantly higher SCA values than the other combinations, while 18 combinations had negative values of this parameter.

The contributions of the female lines, testers, and crossing to the number of leaves per plant were 52.5%, 2%, and 45.5%, respectively.

The number of green leaves at the stage of flowering and 10, 20, and 30 days after flowering

At the stage of flowering, the number of photosynthetically active leaves differed slightly from the total number of leaves. Consequently, the contribution of the female line to the variance for the number of photosynthetically active leaves was increased to 64.5%, the contribution of crossing decreased to 33.5%, while that of the tester remained the same (2%).

The shedding of green leaves was fastest in the hybrid combination with the line L-4 (Table 3). Conversely, the combinations L-5 x T-11 and L-8 x T-10 maintained the mass of green

Tab. 1 - The average number of leaves in the parental lines and their cross combinations

Line▸ / Tester▾	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8
	22.4	23.5	23.8	25.1	26.5	27.0	27.8	29.2
T-9 22.9	26.0	26.4	23.7	24.2	25.2	26.1	26.4	28.1
T-10 23.9	22.6	24.0	24.8	23.3	24.0	23.9	29.5	30.9
T-11 24.8	24.8	27.1	24.0	25.0	26.0	26.0	27.1	26.7
T-12 25.3	25.7	25.9	24.7	23.7	18.8	30.0	29.1	27.5
T-13 26.7	25.3	27.8	24.8	23.3	25.4	25.1	27.9	27.1

Tab. 2 - Estimation of GCA effects

Lines:					
L-1	-0.790	-2.270	-1.826	-1.975	-2.388
L-2	0.557	1.490	0.501	0.412	0.586
L-3	-1.317	-0.277	0.154	0.672	0.726
L-4	-1.797	-2.837	-4.979	-4.142	-4.274
L-5	-1.790	-0.757	-0.013	-0.082	-0.294
L-6	0.563	1.510	0.494	0.525	1.252
L-7	1.817	0.737	1.574	0.945	1.206
L-8	2.757	2.403	4.094	3.652	3.186
Testers:					
T-9	0.058	-0.222	-0.332	0.132	-0.036
T-10	-0.588	-0.422	-0.623	-0.143	-0.128
T-11	0.129	0.428	0.422	0.098	0.643
T-12	0.275	0.312	0.406	0.140	0.422
T-13	0.125	0.097	0.127	-0.227	-0.902

leaves the longest. The characteristic was best maintained in the cross combinations of parents which differed in the GCA values for this characteristic. This is in agreement with the results of MARINKOVIĆ (1982).

Conclusion

1. Partial dominance, dominance, and heterosis were established for the inheritance of the total number of leaves in the F_1 cross combinations tested.

2. Additive gene effect was more important for the inheritance of the characteristic tested than the dominant one.

3. The cross combinations with high SCA values for the characteristic tested regularly included a parent with a high GCA value and a parent with a low GCA value.

4. High GCA values were found for the lines L-7 and L-8.

5. High SCA values were found for the combinations L-8 x T-10 and L-5 x T-11.

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