INFLUENCE OF SOME INFLORESCENCE CHARACTERISTICS ON SEED YIELD OF SUNFLOWER INBRED LINES

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ABSTRACT

Mutual relationships have been studied among several characteristics of the sunflower inflorescence (number of disk flowers, length of disk flowers, length of the disk flowers corolla, pollen viability, percentage of pollination) and their effect on seed yield per plant. The path coefficient analysis has provided information on the direct and indirect effects of the analyzed characteristics on seed yield. A significant positive correlation coefficient has been established between the number of disk flowers and seed yield per plant. The length of the corolla had the highest direct negative effect on seed yield. The length of disk flowers had a direct negative effect on seed yield.

INTRODUCTION

The sunflower is an open-pollinated plant which is tolerant to selfing. Due to a certain percentage of self-fertility (self-compatibility) it is possible to make inbred lines and, subsequently, hybrids. To mitigate the problems in the maintenance and production of parent lines and F_1 hybrids, it is necessary to develop inbred lines possessing a high degree of self-fertility (Fick, 1978). Seed yield is a complex characteristic because it is a resultant of a set of other characteristics (Marinković, 1992).

Being a melliferous plant, the attractiveness to insects is important for sunflower lines and hybrids. Insect foraging is essential for success of pollination, therefore, for the achievement of the desired yield level. Inflorescence characteristics that are attractive to insects (number and color of ray flowers, number and color of disk flowers, corolla length of the disk flower, etc.) have been extensively studied. Special attention has been given to the corolla length of the disk flower (Bailez and Bedascarrasbure**,** 1988; Golubović et al., 1992; Miklič, 1996) for which most authors believe to be negatively correlated with the number of bee visits. Flower morphology monitoring may be a useful screening method for the study of plant attractiveness to insects (Shein et al., 1980). Atlagić et al. (1996), Joksimović et al. (1996) and Miklič (1996) studied

the attractiveness of Novi Sad sunflower hybrids and inbred lines. Effects of the number of flowers and the percentage of pollination on seed yield were also investigated (Joksimović et al., 1997).

The objective of this paper was to establish mutual relationships between several characteristics of the sunflower inflorescence (pollen viability, length of the disk flower, corolla length of the disk flower, number of disk flowers, percentage of pollination) on one side and the seed yield of commercially important sunflower inbred lines on the other. Results of a long-term study were processed by the method of simple correlations and the path-coefficient analysis.

MATERIAL AND METHOD

Nine inbred lines were used in the study, 5 females in the form of B-analogues (CMS-V-8934-5-4, CMS-NS-GR-1, OCMS-22 (CMS-L-K-M), HA-26 and OD-3369) and 4 restorers (RHA-E ANN-65, RHA-SNRF (RHA-18), RHA-UMN-21 and RHA-RU-3). The inbreds were grown in conditions of spatial isolation.

Pollen viability was by the staining method of Alexander (Alexander, 1969). The lengths of disk flowers and disk flower corollas were measured by means of millimeter tracing paper at the stage of full flowering, taking samples from three areas of the head in 10 plants. The number of flowers and the total number of seeds after harvest (filled + empty) were counted. The percentage of pollination was calculated by the formula - number of filled seeds / total number of flowers x 100. Seed yield per head was determined as the mass of filled seeds per head expressed in grams.

Mutual relationships among the examined characteristics and the direct and indirect effects on seed yield were established by the path coefficient analysis, after the method designed by Wright (1921) and applied by Dewey and Lu (1952). Simple coefficients were tested after the method of Snedecor (1959) (according to Hadživuković, 1991).

RESULTS AND DISCUSSION

The established simple correlation coefficients (Table1) indicated the presence of a significant positive correlation between the number of flowers and seed yield

(0.691). A highly significant positive correlation existed between the length of the disk flower and the length of the disk flower corolla.

Table 1. Simple correlation coefficients between inflorescence characteristics and sunflower seed yield

Characteristic	Length of disk flower X_2	Length of disk flower corolla X_3	No. of flowers X_4	% of pollination X_5	Seed yield X
Pollen viability X_1	0.536	0.423	0.482	0.544	0.619
Length of disk flower X_2		0.919 **	- 0.016	0.183	0.227
Length of disk flower corolla X_3			- 0.243	0.120	- 0.096
No. of flowers X_4				0.117	0.691 *
% of pollination X_5					0.431

Significance threshold (n - 2 = 3) for 0.05 = 0.666
0.01 = 0.798

Marinković (1992) found a highly significant positive correlation between the number of flowers per head and seed yield. Influence of independent variables on the dependent variable was determined by the analysis of direct and indirect effects, i.e., by the path coefficient analysis. The obtained results showed that the length of the disk flower corolla had the highest negative direct effect on seed yield (-1.545) (Table 2), which could not be established by simple correlation coefficients. The true effect of this characteristic on seed yield was masked by the positive indirect effects of the disk flower length (1.318) and pollen viability (0.149). Bailez et al. (1988), Montilla et al. (1988) and Golubović et al. (1992) reported significant negative correlations between the length of disk flower corolla and bee visitation. The results of this paper confirm the importance of this characteristic for pollination, i.e., for final yield. The highest positive direct effect on seed yield was exhibited by the disk flower length (1.434), notwithstanding the high negative value of the indirect effect of the length of disk flower corolla (-1.420).

Table 2. Analysis of direct and indirect effects of several characteristics of the inflorescence on sunflower seed yield per plant

Characteristic	Direct effect	Indirect effect					Total
		Pollen viability	Length of disk flower	Length of disk flower corolla	No. of flowers	% of pollination	
Pollen viability	0.353	1	0.769	- 0.654	0.073	0.079	0.619
Length of disk flower	1.434	0.189	1	- 1.420	- 0.002	0.026	0.227
Length of disk flower corolla	- 1.545	0.149	1.318	1	- 0.037	0.017	- 0.096
No. of flowers	0.152	0.170	- 0.023	0.375	1	0.017	0.691
% of pollination	0.145	0.192	0.263	- 0.185	0.018	1	0.431

Residual effect = 0.373 Coefficient of determination = 0.861

The low positive values of the direct effects of pollen vitality (0.353), number of flowers (0.152) and the percentage of pollination (0.145) on seed yield (Table 2) were not expected. Particularly surprising was the low direct effect of the number of flowers, in view of the value of the simple correlation coefficient. This may be due to the indirect effects of the disk flower length and pollen vitality on seed yield. According to Miklič (1996), pollen viability had a significant effect on pollination in conditions of self-pollination. Our results do not support this statement. It should be taken into account that the method used for pollen viability determination gives a relative estimate, i.e., a probability that pollination might take place. This is why the effect of this characteristic on seed yield cannot be clearly expressed.

It is interesting to note that the simple correlation coefficients specially distinguished the effect of the number of flowers on seed yield (0.691* - Table1.), while the path coefficient analysis differentiated the effect of the length of disk flower corolla (-1.545 - Table 2.). Both characteristics are important for yield forming and they should be given due attention in sunflower breeding. Much higher effects of the percentage of pollination and pollen viability had been expected. The values of the indirect effects presented in Table 2 show that the indirect effects of some characteristics in fact concealed the direct effects of other characteristics.

REFERENCE

Atlagić, J., Joksimović, J., Miklič, V., 1996: Osobine cvasti inbred linije suncokreta. Zbornik radova Instituta za ratarstvo i povrtarstvo, Novi Sad, 25, 5-13.

Alexander, M. P., 1969: Differential staining of aborted and non-aborted pollen. Stain Technology, 13(3), 117-123.

Bailez, O. E. and Bedascarrasbure, E., 1988: Evaluacion de la preferencie de les abejes por lincas androesteriles de girasol. Proc. of 12th. Inter. Sunfl. Conf. 429-436, 25-29 July 1988, Novi Sad, Yugoslavia.

Dewey, D. R., and Lu, K. H., 1952: A correlation and path-coefficient analysis of components of grested wheat grass seed production. Agronomy Journal, 51, 515-518.

Fick, G. N., 1978: Selection of self-fertility and oil percentage in development of sunflower hybrids. Proc. of 8th. Inter. Sunfl. Conf., 418-422, 22-27 July 1978, Minneapolis, Minnesota, USA.

Golubović, M., Balama, J., Stanojević, D., 1992: Meliferne vrednosti sorata i hibrida suncokreta. Zbornik radova sa Savetovanja o unapredjenju uljarstva Jugoslavije, 34-40.

Hadživuković, S., 1991: Statistički metodi. Poljoprivredni fakultet u Novom Sadu.

Joksimović, J., Atlagić, J., Škorić, D. and Miklič, V., 1997: Oplodnja i prinos semena kod nekih inbred linija suncokreta u uslovima prostorne izolacije. Selekcija i semenarstvo, 4(1-2), 147-154.

Joksimović, J., Atlagić, J., and Miklič, V., 1996: Fenotipska i genotipska varijabilnost inbred linija suncokreta za dužinu cevastog cveta i dužinu krunice cevastog cveta. Zbornik radova sa 37. Savetovanja o proizvodnji i preradi uljarica., 458-468, 27-31.05.1996., Budva, Yugoslavia.

Marinković, R., 1992: Path coefficient analysis of some yield components of sunflower. Euphytica, 60, 201-205.

Miklič, V., 1996: Uticaj različitih genotipova i pojedinih klimatskih činilaca na posetu pčela i drugih polinatora i oplodnju suncokreta. Magistarski rad. Poljoprivredni fakultet, Univerzitet u Novom Sadu.

Montilla, F., Gomez-Arnau, J., Duhigg, P., 1988: Bee-attractiveness and self-compatibility of some inbred lines and their hybrids. Proc. of 12th. Inter. Sunfl. Conf., 423-428, 25-29 July, Novi Sad, Yugoslavia.

Shein, S. E., Sargent, S. J., Miko, J., 1980: An evoluation of differential attractiveness of sunflower genotypes to honey bees. Proc. of 9th. Inter. Sunfl. Conf., 216-220.

Wright, S., 1921: Correlation and causation. J. Adric., 1(20), 557-585.