SELECTION OF SUNFLOWER RESTORER INBRED LINES ACCORDING TO THE POLLEN AMOUNT

Elena Andrei - PhD.**,** Agricultural Research Station, Podu-Iloaiei, Iasi, Romania Fax : 40 32 740328

Carmen Doina Jitareanu, PhD.- Agricultural University of Iasi, 3, M. Sadoveanu Alee, Department of Plant Physiology, Fax. 4032141601, E-mail: gerardj@univagro-iasi.ro

Summary

The paper presents a few data concerning the amount of pollen released by sunflower restorer inbred lines and the correlation associations between this character and other specific features. In our study there have been analyzed in 22 inbred lines the amount of released pollen, number of ranges of tubular flowers, number of filled achenes per head and their weight, weight of 1000 grains, head diameter and oil content from achenes. The average pollen production per head registered values between 0.11g in the very early lines PI 110b, PI 153 and in the early line PI 66, and 0.50g in the very early line PI 92; this illustrated the possibility of selecting inbred lines, paternal forms, for increased amounts of pollen.

The correlation coefficients obtained have established the very close correlation between the number of range of tubular flowers per head and the number of tubular flowers (r = 0,710 ^{xxx}) and the number of filled achenes (r = 0.670 ^{xxx}); they also confirmed the importance of selection of pollen fertility restorer inbred lines according to the number of tubular flowers. The weight of achenes and the weight of 1000 grains, which pointed out the correlations with the amount of pollen, proved to be significantly distinctively, positively associated (r = 0.499 ^{xx}) and significantly positively associated, respectively (r = 0.388 ^{x}) and could be used as selection criteria for this important characteristic for sunflower inbred lines, paternal forms.

Keywords: sunflower, restorer inbred lines, tubular flowers, amount of polen, correlation

Introduction

The paternal inbred lines have to meet special objectives besides high specific combination ability. Excluding the pollen fertility restorer factors, the presence of a high amount of pollen and its phasing elimination (especially in the case of disturbance of coincidence at flowering caused by unfavourable weather conditions in that period) contributed to the achievement of a higher amount of seeds in experimental plots for hybridization in F_0; these factors represented selection criteria for paternal lines (Elena Andrea 1997 b).

The amount of pollen and the duration in which the pollen was released, depending directly on the dynamics of the appearance of tubular flowers, represent genetically conditioned characters, submitted to a strong influence of environment during the flowering (Elena Andrei 1997 a and 1998; Loublier et al.1990; Vidosava Secerov-Fiser et al. 1998). Voskoboinik et al. (1989 a) pointed out the importance of selection in paternal lines according to the number of tubular flowers per head.

The paper presents a few data on the amount of pollen released by pollen fertility restorer inbred lines and the correlation associations between that character and other characters.

Materials and Methods

In order to establish the variation of the pollen amount, according to the genetic base of inbred lines and to the influence of environment during flowering, the amount of pollen was determinate in 1998 and 1999 in 22 pollen fertility restorer inbred lines, created under ecological conditions of Moldova. In order to establish the amount of released pollen, in 10 plants from each inbred line, heads have been isolated before flowering, by using parchement bags. During flowering, the released pollen was gathered, weights were totalised and results were expressed in grams of pollen per head. The determination of number of ranges of tubular flowers and tubular flowers on different ranges of head was done daily, at the same hour, till the end of flowering.

Statistical indices (M, LSD and r) were computed by the help of the formulae created for this purpose (Falconer, 1969).

Results

Grouping inbred lines according to earliness at flowering allowed us to make a differentiation on the amount of pollen. The average amount of pollen produced by one head, according to the earliness at flowering, indicated variability among the inbred lines and more reduced variations within the same line, every year (table 1.).

The very early lines produced, on an average of two years 0.22g pollen per head, the early lines, 0.25g pollen per head and the semi-early ones, 0.27 g pollen per head; it results that amount of pollen increased at the same time with lateness flowering.

In 1998 the variation limits of the pollen amount were 0.10 g per head (in the very early lines PI 110b, PI 323, PI 327 and in the early line PI 6) and 0.45 g per head in the very early line PI 250 and in the semi-early lines PI 220. In 1999, the extreme values were 0.10 g per head in the very early line PI 153 and 0.66 g per head in the PI 92.

The great differences among pollen fertility restorer inbred lines pointed out the possibility of selection of paternal lines, according to the amount of released pollen, thus contributing to higher amount of seeds in experimental plots for hybridization in F_0 (especially, in the case of a disturbance of coincidence at flowering, determined by weather conditions during anthesis).

Table 1

The amount of pollen (g/head) produced by restorer sunflower inbred lines

IL	Very early inbred lines (opening of tubular flowers began between July 8 - July 11) Amount of pollen (g/head)			IL	Early inbred lines (opening of tubular flowers began between July 12 – July 15) Amount of pollen (g/head)			IL	Semi-early inbred lines (opening of tubular flowers began between July 16 - July 19) Amount of pollen (g/head)		
	1998	1999	Average		1998	1999	Average		1998	1999	Average
PI 16	0.12	0.14	0.13	PI 66	0.10	0.13	0.11	PI 70	0.37	0.27	0.32
PI 26	0.20	0.26	0.23	PI 101	0.30	0.22	0.26	PI 191	0.37	0.39	0.38
PI 92	0.34	0.66	0.50	PI 124	0.40	0.37	0.36	PI 211	0.18	0.20	0.19
PI 110b	0.10	0.12	0.11	PI 140	0.30	0.22	0.26	PI 212	0.30	0.20	0.25
PI 153	0.12	0.10	0.11	Average	0.27	0.23	0.25	PI220	0.45	0.23	0.34
PI 154	0.14	0.15	0.14	LSD 5%	0.17	0.14	0.15	PI 239	0.17	0.19	0.18
PI 210	0.28	0.33	0.30					PI 240	0.27	0.21	0.24
PI 250	0.45	0.27	0.36					Average	0.30	0.24	0.27
PI 253b	0.12	0.29	0.20					LSD 5%	0.09	0.06	0.07
PI 323	0.10	0.19	0.14	**IL= Inbred Line**							
PI 327	0.10	0.24	0.17								
Average of 11 lines	0.19	0.25	0.22								
LSD 5%	0.08	0.10	0.08								

According to the amount of pollen released by one head, the very early lines PI 92 (0.50 g), PI-210 (0.30 g), PI-250 (0.36 g), the early lines PI-101 (0.26 g), PI-124 (0,38 g), PI-140 (0.26 g) and the semi-early lines PI-70 (0.32 g), PI 191 (0.38 g) and PI 220 (0.34 g) were selected as valuable paternal forms for this characteristic.

Table 2 presents a few quantitative characters of the studied inbred lines. The survey of data showed that the head diameter had, on the average of two years, values between 14cm (PI 253b) and 25cm (PI-240). The average number of ranges of tubular flowers per head varied from 12 ranges (PI-110b) to 20.4 ranges (PI 140). The studied biological material presented great differences as concerns the number of tubular flowers per head, which registered values between 402 flowers in the very early line PI 110b and 1247 flowers in the semi-early line PI 212.

The selection directed to getting higher values of productivity in inbred lines, paternal forms, plus the selection according to the amount of pollen, represented an important objective of their breeding. The number of filled achenes per head and their weight, the weight of 1000 grains, major coefficients of productivity showed the differentiated production potential of the studied biological material. The number of the filled achenes had as extremes the PI 110b line with 217 achenes per head and the PI 140 line with 996 achenes per head. The weight of filled achenes varied between 6g in the very early lines PI 110b and 49.3g in the early line PI 140.The weight of 1000 grains showed significant differences at the material used; the two

year extreme average values were found in the PI 110b line (34g and in the PI 211 line (78.8g).

In order to establish some correlation associations between the amount of pollen produced by sunflower restorer inbred lines and their different characters, the corresponding correlation coefficients were calculated (table 3).

The 28 correlation coefficients obtained varied as size and degree of statistical assurance. The number of ranges of tubular flowers per head was very significantly positively associated with the number of tubular flowers ($r = 0.710^{xxx}$) and significantly positively associated with the number of filled achenes ($r = 0.394^{x}$).

The correlation associations between the number of tubular flowers and the number of filled achenes per head ($r = 0.670^{xxx}$) and their weight ($r = 505^{xx}$) confirmed the importance of selection of inbred lines, paternal forms, according to the number of tubular flowers.

Table 2

Variation of some characters in sunflower restorer inbred lines

Inbred lines	Head diameter (cm)	Range of tubular flowers (nr.)	Tubular flowers per head (nr.)	Filled achenes per head (nr)	Weight of filled achenes (g)	Weight of 1000 grains (g)	Oil content of seeds (%)
Very early lines (opening of flowers began between July 8 and July 11)							
PI 16	20	12.5	721	362	15.6	46.0	56.0
PI 26	22	18.6	1121	788	28.5	52.8	48.4
PI 92	22	14.0	655	541	39.5	70.0	52.6
PI 110b	16	12.0	402	217	6.0	34.0	52.2
PI 153	20	17.2	937	389	24.0	66.8	51.3
PI 154	22	19.6	956	439	24.0	70.0	47.5
PI 210	20	16.0	945	385	22.1	66.0	46.4
PI 250	23	19.6	970	519	26.6	56.0	49.5
PI 253b	14	15.4	490	267	7.5	35.6	52.4
PI 323	24	17.8	861	252	15.5	48.0	53.8
PI 327	20	17.6	803	230	17.0	54.0	50.9
LSD 5%	1.97	1.76	145.51	112.93	6.40	8.55	1.89
LSD 1%	2.74	2.49	205.69	159.64	9.05	12.08	2.67
LSD 0.1%	3.97	3.56	293.66	227.92	12.92	17.25	3.81
Early lines (opening of flowers began between July 12 and July 15)							
PI66	17	13.0	979	600	22.0	36.0	52.4
PI 101	23	14.2	419	377	22.0	66.0	52.8
PI 124	22	17.0	1007	811	33.2	48.8	52.0
PI 140	19	20.4	1229	996	49.3	70.0	53.3
LSD 5%	3.84	4.57	479.50	371.42	17.94	21.91	0.77
LSD 1%	6.34	7.54	793.42	614.58	29.69	36.25	1.28
LSD 0.1%	11.88	14.12	1485.07	1150.33	55.58	67.85	2.39
Semi - early lines (opening of flowers began between July 16 and July 19)							
PI 70	21	14.5	600	470	19.5	54.0	49.5
PI 191	18	18.2	1021	403	17.7	58.8	46.6
PI 211	20	17.0	893	613	42.0	78.8	48.4
PI 212	19	20.0	1247	604	18.5	36.0	46.4
PI 220	20	17.0	568	246	9.0	46.0	52.8
PI 239	22	16.5	892	382	16.0	48.0	47.6
PI 240	25	15.0	890	441	20.0	56.0	48.2
LSD 5%	2.04	1.66	210.19	115.18	9.15	11.92	1.94
LSD 1%	3.01	2.45	310.41	170.10	13.51	17.60	2.87
LSD 0.1%	4.65	3.79	479.81	262.44	20.88	27.21	4.44

Table 3

Correlation coefficients among the different characteristics of pollen fertility restorer sunflower inbred lines

Characters	Ranges of tubular flowers (nr)	Tubular flowers per head (nr)	Filled achenes per head (nr)	Weight of filled achenes (g)	Weight of 1000 grains (g)	Oil content from seeds (%)	Amount of pollen released by one head (g)
Head diameter(cm)	0.214	0.175	0.124	0.284	**0.425**^{x}	-0.126	0.150
Ranges of tubular flowers (nr)		**0.710**^{xxx}	**0.394**^{x}	0.351	0.297	-0.439^{0}	-0.012
Tubular flowers per head (nr)			**0.670**^{xxx}	**0.505**^{xx}	0.184	-0.455^{0}	-0.045
Filled achenes per head (nr)				**0.822**^{xxx}	0.283	-0.550^{00}	0.250
Weight of filled achenes (g)					**0.705**^{xxx}	-0.036	**0.499**^{xx}
Weight of 1000 grains (g)						-0.212	**0.388**^{x}
Oil content from seeds (%)							0.008
Amount of pollen released by one head (g)							1

P 5%=0.38; P 1%=0.58; P 0,1%=0.60

The weight of achenes and the weight of 1000 grains, which pointed out the correlations with the amount of pollen, were significantly distinctively positively associated (r = 0.499 ^{xx}) and significantly positively associated (r = 0.388 ^{x}), respectively, being used as selection criteria for this important characteristic for sunflower inbred lines, paternal forms.

Conclusions

1. The mean pollen amount per plant, on the average of two years, varied between 0.11g pollen per head (PI 110b, PI 153) and 0.50g pollen per head (PI 92), which proved the possibility of restorer inbred lines to produce different amounts of pollen.
2. The very early lines produced, on the average of two years, 0.22g pollen per head, the early lines 0.25g pollen per head and the semi-early lines 0.27g pollen per head, the pollen amount increasing at the same time with lateness.
3. The weight of achenes and the weight of 1000 grains, which pointed out the correlation with amount of pollen, were significantly distinctively positively associated (r = 0.499 ^{xx}) and significantly positively (r = 0.388 ^{x}) associated, respectively, and might be used as selection criteria for this important characteristic for sunflower inbred lines, paternal forms.
4. According to the amount of pollen per head, on the average of two years, the very early lines PI- 92 (0.50 g), PI-210 (0.30 g), PI-250 (0.36 g), the early lines PI- 101 (0.26 g), PI-124 (0.36 g), PI -140 (0.26 g) and the semi-early lines PI-70 (0.32 g), PI-191 (0.38 g) and PI-220 (0.34 g), were selected as valuable paternal forms.

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