THE USE OF EARLY GENERATIONS IN SUNFLOWER LINES EVALUATION

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ABSTRACT

The development of inbred lines that produce high heterosis effect in crossing is an important step in a breeding programme. A study was conducted with sunflower to compare the effect of lines on the S_3 and S_4 generations in the formation of hybrids. Twenty four hybrids were obtained by crossing among three male sterile lines with twelve lines in S_3 and S_4 generations derived from one single improved population. A randomized complete block design, with four replications, was used in the evaluations. The statistical analysis was accomplished by following the hierarchical classification model with hybrids within generations and mother, and generations within mother. There were no significant differences between generations for all traits evaluated. These results suggest that it should be possible to choose the best lines already in S_3 generation to continue the selfing generation process.

Key-words: *Helianthus annuus*, early selection, selfing, hybrid, male sterility.

INTRODUCTION

Sunflower (*Helianthus annuus*, L.) is a crop that shows easy adaptation in many environments. There is a large variability in relation the oil production and yield potential (Dedio, 1991; Kirsch & Miller, 1991, Chervet & Vear, 1990; Castiglioni et all., 1993). The sunflower oil is of high quality and the crop is important as a component in production systems and crop rotations. The expansion and establishment of sunflower, as an oleaginous crop, was possible by cultivar development and new agronomical technics. The genetic breeding represents about 60% of this progress, in particular the utilization of hybrids. The usual process to obtain lines for hybrid development needs six selfing generations. It is important to work with a number of lines that ensure efficiency associated with the availability of physical, financial and human resources. The evaluation in early generations is one of the methods

used in breeding programmes(Madupuri,1992). A study was conducted in Brazil to compare the behaviour of hybrids produced by crosses among male sterile lines with lines in the S_3 and S_4 generations.

MATERIAL AND METHODS

The experiment was carried out during the 1994/95 growing season, at the National Soybean Research Center, located in Londrina Country, Parana State, South Brazil. Twenty four hybrids were obtained by crossing among three male sterile lines (CMS HA 300, CMS HA303 79 NW22 and CMS HA302) with twelve lines in S_3 and S_4 generations. These S_3 and S_4 lines were obtained from a single improved population. A randomized complete block design with four replications was used in the hybrids evaluations. The statistical analyses was made according to the hiearchical classification model with hybrids within generations and mother, and generations within mother as follows:

$Y_{ijkl} = \mu + B_i + M_j + G_{k(j)} + H_{l(jk)} + \varepsilon_{ijkl}$, where

μ = grand mean,
B_i = effect of i^{th} block (i = 1,2,3,4),
M_j = effect of j^{th} mother (j = 1,2,3),
$G_{k(j)}$ = effect of k^{th} generation (k = 1,2) within j^{th} mother,
$H_{l(jk)}$ = effect of l^{th} hybrid (l = 1,2, ... 24) within j^{th} mother and k^{th} generation,
ε_{ijkl} = experimental error.

The following traits were evaluated: grain yield, oil content, oil yield, plant height, head height, stem diameter, head size, flowering date, physiological maturity and 1000 seed weight.

RESULTS AND DISCUSSION

The analysis of variance is shown on table 1. The effect of male sterile lines was significant to grain yield, 1000 seed weight, plant height, head height, flowering date, physiological maturity and oil yield. The S_3 and S_4 lines were randomly collected from a single improved population, thus being representative. Considering the grain yield and oil yield traits, the best hybrid combinations would be obtained with the lines CMS HA 302 and CMS HA 303 79 NW 22.

There was no significant effect of generation within mother for all traits evaluated. Therefore, the potential of the lines to show heterosis or not is the same using either the S_3 or the S_4 generation (table 2). These results suggest that it is possible to choose the best lines already in the S_3 generation, which is important for improving the efficiency of a breeding programme. The reduction in the number of lines at the first stages of the programme allows savings on physical, financial and human resources.

The effects of hybrid within generation and mother showed significance for oil content, 1000 seed weight, plant height, head height, head size, flowering date, physiological maturity and oil yield. Therefore, the lines from the population had a different behaviour among them , when crossed with the male sterile line. Special attention must be given to these traits during the selection of lines in the programme. On the other hand, no significant effects were detected on grain yield and stem diameter, suggesting lack of variability for these traits among the lines from the population.

CONCLUSIONS

The results obtained in this investigation suggest that it is possible to choose the best lines in S_3 generation and then to continue the process of selfing in order to obtain inbred lines or to introduce some gene of interest. In this particular study, some traits presented larger variability among lines, meaning that special attention must be given to these traits during line selection.

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Table 1: Mean squares from the analysis of variance for traits of sunflower in the study of S_3 and S_4 generations in hybrid combinations. EMBRAPA/CNPSo, Londrina, PR. Brazil. 1995.

SOURCE	D.F.	GRAIN YIELD	OIL CONTEND	OIL YIELD	1000 SEED WEIGHT	PLANT HEIGHT	HEAD HEIGHT	HEAD SIZE	Ø STEM	R4[1]	R6[2]	PHYS. MATURITY
BLOCK	3	44446.73	7.79	7106.54	60.73	2224.69	1455.85	17.10	79.07	3.54	2.98	21.45
MOTHER(M)	2	309041.08**	0.16	64930.71**	383.04**	6944.43**	3575.81*	8.59	1.69	36.30**	31.71**	64.33*
GENERATION(G)/M	3	7676.89^{ns}	1.77^{ns}	1013.28^{ns}	16.07^{ns}	20.69^{ns}	45.05^{ns}	0.63^{ns}	4.29^{ns}	0.70^{ns}	6.30^{ns}	9.06^{ns}
HYBRID/(GM)	18	29168.33	8.53**	7436.62*	41.46**	183.06**	215.11**	4.79**	5.80	5.00**	8.78**	17.84**
ERROR	69	18075.76	0.97	3860.52	8.18	78.85	78.11	1.41	5.19	0.78	3.72	3.45
AVERAGE		856.17	46.54	398.37	41.47	174.33	134.80	18.81	23.57	49.76	59.91	84.45
C.V.(%)		15.70	2.11	15.60	6.89	5.09	6.56	6.30	9.66	1.78	3.22	2.20

* significant at the 0.05 level of probability
** significant at the 0.01 level of probability
^{ns} not significant at the 0.05 level of probability
[1] initial flowering
[2] final flowering

Table 2: Mean values of S_3 and S_4 generations within three male sterile lines for different traits in sunflower. EMBRAPA/CNPSo, Londrina, PR. Brazil. 1995.

TRAITS	CMS HA 300		CMS HA 303 79 NW 22		CMS HA 302	
	S_3	S_4	S_3	S_4	S_3	S_4
GRAIN YIELD(g/plot)	722.67^{ns}	771.20	900.50^{ns}	900.98	1004.05^{ns}	958.28
OIL CONTENT(%)	47.00	46.22	46.57	46.41	46.43	46.69
OIL YIELD(g/plot)	339.80	357.04	418.81	418.39	465.64	447.50
1000 SEED WEIGHT(g)	40.97	41.77	39.62	40.79	52.39	48.93
PLANT HEIGHT(cm)	160.09	157.70	183.92	184.85	164.90	166.37
HEAD HEIGHT(cm)	128.49	127.71	140.67	142.31	118.18	111.38
HEAD SIZE(cm)	18.83	19.01	18.86	19.05	17.15	17.67
STEAM DIAMETER(mm)	23.16	24.32	23.69	23.40	23.35	22.70
INITIAL FLOWERING(days)	49.19	48.75	50.43	50.50	47.75	48.25
FINAL FLOWERING(days)	60.31	59.19	59.96	60.75	57.25	57.50
PHYS. MATURITY(days)	83.56	82.12	85.54	84.75	86.50	85.50

^{ns} differences between generations not significant at the 0.05 level of probability.