STUDIES OF ISOGENIC SUNFLOWER RESTORER LINES AND THEIR HYBRIDS.

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Résumé

Les objectifs de cette étude étaient de déterminer si les différences existant entre les lignées branchées (bb) et non branchées (BB) étaient transmises à leurs hybrids respectifs. Quinze pairs de lignées isogéniques bb et BB furent croisées avec trois lignées femelles. Les hybrides résultants et toutes les lignées parentales furent plantées dans un essai et vingt caractéres différents furent évalués. Les différences majeures entre les lignées isogéniques furent que les lignées bb présentèrent un diamètre de tête réduit de 4,3 cm et une période d'émission de pollen allongée de 5,3 jours. En outre elles atteignirent leur maturité physiologique avec une de 2,4 jours. Les lignées bb présentèrent aussi une réduction de poids de 12,4 gr pour une masse de 1 000 graines et leur teneur en huile était augmentée de 1,8%. Aucune de ces différences ne fut transmises à leurs hybrides. Comme plusieurs de ces caractéres sont des critéres important de sélection, on recommande que pour les deux premiéres générations de croisement des plantes non branchées (Bb et bb) soient choisies parmi des populations ségrégantes.

Abstract

The objectives of this study were to determine whether the differences between branched (bb) and unbranched (BB) lines were carried over to their respective hybrids. Fifteen pairs of isogenic bb and BB lines were crossed to three female lines. The resultant hybrids and all the parent lines were planted in a trial and 20 characters were measured. The major differences between the isolines were that the bb lines had: head diameter 4.3 cm smaller, total pollen shedding period 5.3 days longer and were 2.4 days quicker in reaching physiological maturity. The bb lines were also 12.4 g lighter in 1 000 seed mass and 1.8 percent higher in oil content. None of these differences were carried over to their hybrids. As several of these characters are important selection criteria, it is reçommended that for at least the first two generations of inbreeding unbranched plants (Bb and BB) be selected within segregating populations.

Introduction

The development of fertility restoring (Rf) inbred lines has been a major facet of sunflower breeding since the production of hybrids became a economic feasibility. Branched Rf lines and unbranched cytoplasmic male sterile (cms) lines are used to produce hybrids. The branched lines are used due to their extended pollen shedding period. The branching does not appear in the hybrid because this character is normally controlled by recessive genes (Fick, Zimmer & Zimmerman, 1974). Branching may be more complex in some populations, so for example Hockett & Knowles (1970) found four genes involving this character.

Branching reduces the yield and the heads do not mature uniformly. Ross (1939) also found a negative correlation (r= -0,709) between number of branches and yield. Differences between bb and BB near-isogenic lines 1 000 seed mass and oil content (6%) was reported by Dedio (1980). Concern has been expressed that these differences in branched lines may effect their hybrids. This study compares the characteres of branched and unbranched isogenic Rf lines and their hybrids.

Materials and Methods

Since 1976 Romanian hybrids Romsun 18 and Romsun 20, developed from cms and Rf lines, were used as the basic populations for the isolines. Heterozygous (Bb) plants were selected each year from segregating progenies until 1983 when 15 pairs of isolines were taken at random. Segregation for branching was caused by a single recessive gene in both populations. The 15 pairs of isolines were crossed to three unbranched cms lines, HA 60, HA 99 and H55-9-2-1-1 when in the S5 generation and they were at least 98% homozygous.

The parent lines and their hybrids were planted November 15, 1983 at Potchefstroom on a Westleigh sand clay soil. Six irrigations were applied during the growing season because the rainfall was not sufficient. Twenty-five plants were harvested in the two middel rows of the four row plots and a total of 20 characters were measured. Only the seven characters; flowering period, days to maturity, head diameter, 1 000 seed mass, yield, oil and protein content, showed major differences and will be discussed. The model 2 of Gardner and Eberhart (1966) was used to analyse the data. The effect of branching was firstly determined by comparison between the isolines, thereafter by comparison between their hybrids.

Results

All the characters showed significant differences between bb and BB lines but in their hybrids there were only small differences in the days to maturity, according to the variance analysis. The mean differences between the bb and BB lines are indicated in table 1 and the mean differences between their respective hybrids in table 3.

Table 1 Mean and mean differences between the characteristics of the branched and unbranched lines.

Type	Flowering period (days)	Days to maturity (days)	Head diameter (cm)	1 000 seed mass (g)	Seed yield (kg/ha)	Oil content (%)	Protein content (%)
bb	15.9	88.7	10.1	26.4	779	44.2	18.6
BB	10.6	91.1	14.4	38.8	1179	42.2	19.4
Dif.	5.3**	-2.4**	-4.3**	-12.4**	-400*	1.8*	0.8
Lsd 5%	1.19	1.58	1.41	4.3	283	1.43	0.88
Lsd 1%	1.69	2.23	2.00	6.08	422	2.00	1.24

*Significant at the 5% level of probability.
**Significant at the 1% level of probability.

The total pollen shedding period of the bb lines was extended by 5.3 days, while the days to maturity were 2.4 days less than their BB isolines. The oil content of the bb lines were 1.8% higher when it was determined with a NMR while the difference was 3.7% when it was determined with a NIR analyser. Linear regression analysis of bb and BB lines showed significant regression (Fb) between all the characters except the head diameter, as indicated in tabel 2.

Table 2 Linear regression and correlation between branched and unbranched lines.

Regression	Flowering period	Days to maturity	Head diameter	1 000 seed mass	Seed yield	Oil content	Protein content
Fb	13.29**	57.81**	0.49	38.09**	15.96**	52.64**	14.18**
b	0.69	0.43	0.24	1.15	1.06	0.93	0.67
y	-0.3+0.0.7X	50+0.0.4X	12+0.2X	8.4+1.2X	287+1.1X	1.3+0.9X	6.8+0.7X
r	0.71	0.76	0.19	0.86	0.74	0.90	0.72

** Significant at the 1% level of probability.

Both the oil content and seed mass of the pairs of isolines showed a high correlation coefficient (r) of r= 0.90 and r= 0,86, respectively. There are no differences in the means of the hybrids from the two isolines (table 3).

Table 3 Mean and mean differences between the characteristics of the hybrids from the branched and unbranched lines.

Type	Flowering period (days)	Days to maturity (days)	Head diameter (cm)	1 000 seed mass (g)	Seed yield (kg/ha)	Oil content (%)	Protein content (%)
bb	10.05	89.63	16.63	45.40	1468	44.35	18.14
BB	10.05	90.00	16.68	45.80	1441	44.23	18.05
Dif.	0.00	-0.36	-0.05	-0.04	27	0.12	0.09
Lsd 5%	1.19	1.58	1.41	4.3	283	1.43	0.88

Discussion

The data indicate major differences between the bb and BB isolines. Vermeulen (1985) found 5.8 and 4.8 days difference between isolines' flowering period under irrigation and dry land conditions, respectively. The period from the end of flowering to maturity of the bb lines was eight days shorter than their related BB isolines. The branching influenced the head diameter drastically, which caused differences in other seed characters. The higher oil, lower protein and lighter 1 000 seed mass of the bb plants were caused by the smaller seed size rather than by the branching gene itself (Fick et al, 1974). Dedio (1980) found 6% higher oil content and 26.3 gram lighter 1 000 seed mass in the bb lines. The difference of 2.5% in oil content which Fick et al (1974) found is more or less the same as in this trial. There were smaller differences in characters not discussed, like head type, stem bending, head attachment and diameter of the sterile centre area between the two pairs of isolines. In spite of all these differences between the bb and BB lines, none of them were found in their hybrids, as Dedio (1980) also reported. As several of these characters are important in selecting inbred Rf lines, effective evaluation in the early generations is essential for the breeder. By continual selection of the heterozygotes (Bb) in segregating progenies, the bb plants indicated the lines' pollen production ability, while the BB and Bb plants can be used to evaluate the lines for important characters. The determination of seed characteristics in the laboratory will be more accurate when using the BB and Bb lines. The best method in practice is to plant the selfed seed

from unbranched (BB or Bb) plants in a row in the next year and selecting the best segregating rows for further selection in the row. This procedure must be continued for at least the first two generations of inbreeding, then the best branched lines can be selected to test for combining ability. Admittedly this selection method is more time and labour consuming, but the improved response to selection should compensate.

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