CONVERSION OF SINGLE HEADED INBREDS INTO RECESSIVE BRANCHED RESTORES AND THEIR UTILIZATION IN SUNFLOWER BREEDING

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Abstract

An important number of single headed inbred lines with high combining ability were converted into recessive branched restorers, following a acheme with six backcrosses in alternation with a similar number of selfing generations. The comparative study of 16 isogenic for the b gene inbred lines crossed to the same cytoplasmic male sterile lines, put in evidence the analogy of both types of hybrids - via unbranched and branched restorers - with small significant morpho-physiological differences.

Introduction

The descovery of the recessive gene b (Putt, 1964) has permitted the development of the recessive branched restorers which release pollen over an extended period of time, allowing to produce hybrid seed with females that flower later than the male parent. This trait seems to improve the bee attractiveness and therefore the female pollination and seed set which results in higher hybrid seed yields.

The availability of such restorers is however quite limited, most of them having a common genetic background and being selected by self pollination within the present commercial hybrids produced by means of a small number of recessive branched male parents. This is the reason we initiated a programme of conversion of the best single headed inbred lines existing in our collection into recessive branched restorers containing the gene b.

In order to assess the influence of the recessive branching on the main agronomical characteristics of the F_1 hybrids, a comparative study with sunflower hybrids produced by using both isogenic lines i.e. unbranched and branched restorers, was conducted at Fundulea in 1983 and 1984 and the results are discussed in this paper.

Materials and Methods

Both unbranched normal B and fertility restorer C lines included in our conversion programme were advanced selection inbreds with high combining ability and superior morpho-physiological traits. Segregating F_2 progenies of single hybrids produced with recessive branched restorers were used as sources of Rf and b genes. Only fully branched with central head plants were chosen as donors of the b gene along the whole conversion scheme.

For converting the normal single headed lines into recessive branched restorers, fertile (Rf -) and branched (bb) plants of the nonrecurrent female parent were esmaculated in all crosses (Fig. 1). F_1 as well as each of the six generations of backcross was followed by a generation of selfing, in order to put in evidence the homozygous genotypes bb. Two or three generations per year were obtained under field, phytotron or greenhouses conditions.

The conversion of the unbranched restorers into recessive branched analogues (Fig. 2) was carried out using sterile (rf rf) and branched (bb) plants as female parents, avoiding thus the artificial emasculation.

The comparative study of hybrids produced by using both isogenic lines consisted of 32 entry randomized blocks with 3 replications, with plots of 6o harvested plants.

Results

Data presented in Table 1 show no significant mean differences between the agronomic performances of sunflower hybrids produced by means of the unbranched and branched restorers. The arithmetical means suggest however a bias in diminishing the seed size and increasing the oil content and the test weight. In these cases some hybrid combinations express significant mean differences, indicating perhaps that the conversion process was not completely performed.

Discussion and Conclusions

Other useful genes as those for disease resistance could be transferred into the branched genotypes along with the Rf and b genes. The genes Pl_1, Pl_2 and Pl_5 for resistance to Plasmopara

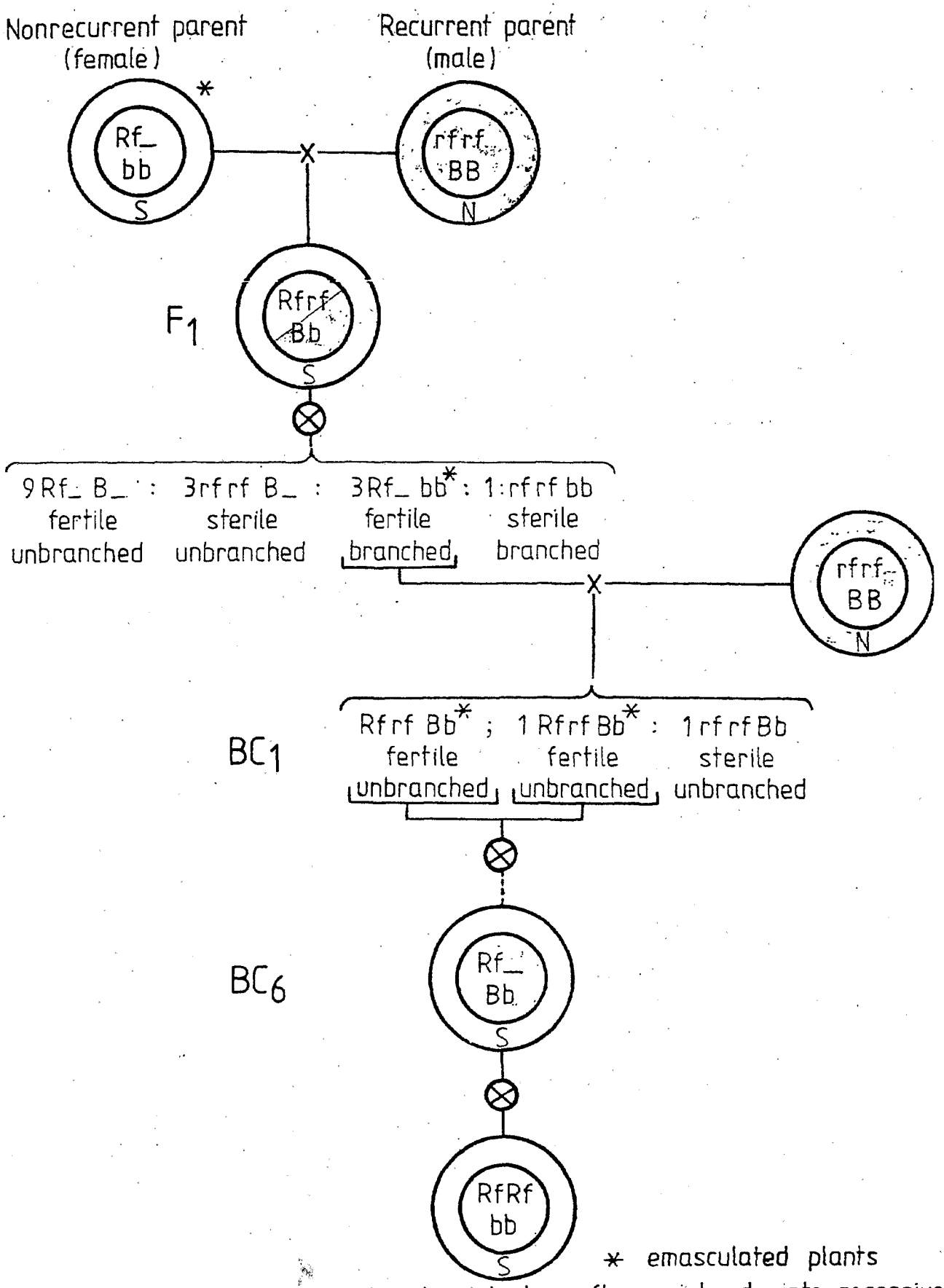

Fig. 1. Conversion of normal unbranched sunflower inbreds into recessive branched restorers

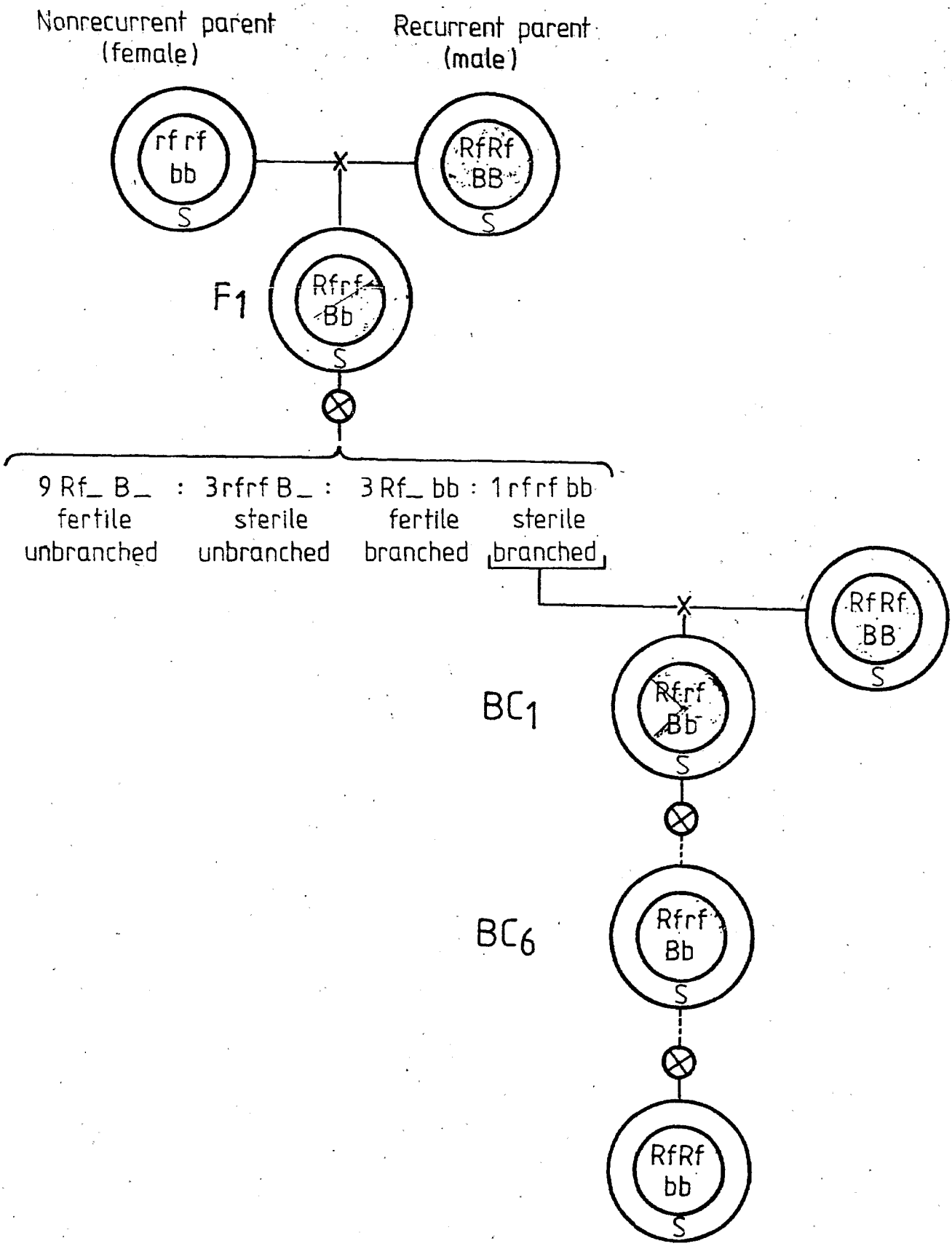

Fig. 2. Conversion of the unbranched sunflower restorers into recessive branched restorers.

Table 1. Mean differences between the agronomic performances of sunflower hybrids produced by crossing the same cytoplasmic male sterile lines with isogenic branched and unbranched restorers (Fundulea, 1983 and 1984)

Females	Males (BB and bb)	Seed yield (g/ha, o% moisture)	% oil in dry matter	1000 seed weight (g)	Test weight (kg/hl)	Vegetation period (days)	Plant height (cm)	Head diameter (cm)
AS-11o A	S-1358 Rf_2	-1.8	+o.9	-2.1	+1.8	-2	+6.2	+o.5
"	P-138o Rf_2	-2.4	+1.6	-6.4^x	+2.6	-2	+3.2	+1.2
ADV-946 A	V-874o Pl_2Rf_1	+o.6	-1.2	+4.o	-o.9	+2	-7.o	-2.3^x
P-138o A	C-1o2 Pl_1Rf_1	-1.3	+2.3^x	+2.8	+1.2	-4	+8.9^x	+o.8
V-1633 A	A-1566 Rf_1	-2.9	+1.1	-1.9	+3.2^x	+1	-1.5	+1.1
V-2612 A	SP-4559 Pl_2Rf_1	+1.8	+o.2	-3.4	+1.1	o	+6.1	+o.6
"	S-11-74-5566 Pl_5Rf_2	+o.9	+o.1	+4.4	+o.7	o	+4.8	-2.o
F-3oo4 A	V-1633 Pl_5Rf_2	-3.2^x	+2.7	-7.6^x	+3.o	-3	+2.9	-1.o
"	VF-1721 Pl_2Rf_1	-2.1	+2.4^x	-9.6^x	+2.o	-2	-2.6	+2.1
"	S-11-72-15 Pl_5Rf_2	+2.o	+o.5	-1.3	+o.8	+3	+9.8^x	+2.o
F-528o A	O-724o Pl_1Rf_2	-o.2	-2.6^x	+3.9	-2.2	-4	+5.5	-1.3
"	M-17o6 Pl_2Rf_1	-1.7	+1.8	-1.6	-o.4	-3	+3.2	-o.6
"	S-11-74-6688 Pl_5Rf_2	+3.3^x	-o.9	-2.o	-o.1	o	-o.8	+1.3
H-1o853 A	H-73-6874 R_{f_2}	-1.5	+1.6	-3.9	+3.8^x	-1	+6.7	-o.9
"	E1-8455 Pl_2Rf_1	-2.1	+2.3^x	-3.3	+1.5	-2	+3.6	-1.o
"	S-11-6446 Pl_5Rf_2	-1.o	+o.6	+5.3	-2.2	-4	-3.8	-o.4
Means	arithmetical	-o.7	+o.8	-1.4	+1.o	-1	+2.8	o
	absolute	1.8	1.4	4.o	1.7	2	4.8	1.2

The check was considered the hybrid produced with the unbranched restorer

x Significant at the o.o5 level

helianthi as well the gene O_5 for resistance to *Orobanche cumana* have been successfully used in the conversion programme developed at Fundulea. The second scheme permits to handle them easier because the *Rf* genes are already present in the recurrent parent.

When a valuable genotype is used as nonrecurrent parent, a part of the fertile (*Rf* -) and branched (*bb*) plants in the first backcross generations could be selfed and selected for developing new superior branched restorers.

The comparative study concerning the performances of the hybrids obtained with isogenic unbranched and branched restorers was intended also to evaluate the length of the linkage block associated with the *b* locus. The preliminary investigations carried out within the frame of this research work allow to foresee that the genes controlling the main plant traits are less associated with the *b* gene.

Although the conversion schemes presented in this paper require a double period of time for obtaining isogenic lines due to the recessiveness of the branching trait, it is worth using them in the advanced breeding programmes, when valuable lines are proposed for conversion.

References

PUTT, E.D. 1964. Recessive branching in sunflower. Crop Science, 4: 444-445.