5. <u>Cytoplasmic male sterility: genetics of fertility restorers</u>.

Restoration of pollen fertility by a fertility restorer (FR) inbred may appear to be inherited as a single gene, or as two or more complementary dominant genes, depending on the cytoplasmic sterile line used as a tester. This has been noted for four different FR lines. Table 1 illustrates the results of tests on one FR line.

Table 1.

Pedigree		Fertile %	Partially Sterile %	Sterile %	Total No. Plants
$K4^T$		0	0	100	
Kys^T		0	0	100	
$K4^T$ x Kys		0	0	100	
$WF9^T$		0	0	100	
F_1 ($K4^T$ x Kys) WG3		100	0	0	
F_1 $WF9^T$ x WG3		100	0	0	
F_2 ($K4^T$ x Kys) WG3	72	3	24	239	
F_3 ($K4^T$ x Kys) WG3	76	1	23	331	
(5 seg. progenies combined)					
F_2 $WF9^T$ x WG3	prog. 1	59	0	41	29
	prog. 2	44	4	52	27
	prog. 3	51	2	48	183
3 progenies combined		51	1	48	237
B.C. $WF9^T$($WF9^T$ x WG3)	rep. 1	21	1	78	96
	rep. 2	21	7	73	165
B.C. ($WF9^T$ x WG3) WF9	prog. 1	26	0	74	46
	prog. 2	29	0	1	28
3 progenies combined		22	3	75	335

As is shown in Table 1, WG3 completely restores fertility to $K4^T$ x Kys and to $WF9^T$. In F_2 and F_3 generations of ($K4^T$ x Kys)WG3, pollen restoration segregated as a clear 3:1 ratio of fertile : sterile plants. However, the F_2 of $WF9^T$ x WG3 shows a segregation which is closer to a 9:7 ratio of fertile : sterile plants than it is to a 3:1 ratio. Likewise, the backcross (B.C.) of $WF9^T$ x WG3 shows segregation of 1:3 for fertile : sterile plants, so that both F_2 and B.C. ratios of $WF9^T$ x WG3 indicate segregation of two dominant complementary genes for pollen restoration.

This apparent discrepancy between segregating populations of the two crosses may be resolved by assuming the following genetic compositions for the inbreds involved.

K4 –aaBB
Kys –aaBB
WF9 –aabb
WG3 -AABB

The genotype: A-B- would be required for pollen fertility (in sterile cytoplasm). The cross ($K4^T$ x Kys)WG3 would have the genotype: AaBB, and therefore Aa, alone, would segregate in further generations as a single gene. $WF9^T$ x WG3, on the other hand, would be heterozygous for both loci: AaBb. In either F_2 or B.C. to WF9 (aabb) it would therefore give 9:7 and 1:3 segregations, respectively.

It is apparent that several other crosses may be made among these four inbreds to test this hypothesis further. Since this effect was not expected they have not been made, but they will be made in the near future.

The possibility that some corn belt inbreds may be sterile (in sterile cytoplasm) as lines and in single crosses, out contain one or more dominant factors required for fertility restoration, is important from the point of view of producing commercial cytoplasmic male sterile double crosses. If a FR line of WG3 genotype (AABB) were used in a double cross in combination with three other lines of K4 and Kys genotype (aaBB), 50% of the plants in the double cross would have fertile tassels. If, however, the other three inbreds were of WF9 genotype (aabb) only 25% of the plants would have fertile tassels. This would be too small a percentage to insure complete pollination in the farmer's field.

It is not known what proportion of the inbreds used in double crosses today are similar to WF9, with respect to alleles of the WG3 FR, and what proportion are similar to K4 and Kys. However, if most of them should be like K4 and KyS, one might regard the WG3 FR as governed by a single gene, for all practical purposes. On the other hand, if most inbreds are like WF9, the WG3 restorer must be regarded as a two-factor restorer.

It would seem, therefore, that one cannot predict the general usefulness of any FR from a study of segregating populations resulting from any one cross.

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