

5. Restoration of fertility in double cross hybrids on sterile basis.

A theoretical possibility for development of double cross hybrids with two sterile lines has been reported by Duvick (Proc. 14th hybrid Corn Industry Research Conf. 1959, 42-52) and Galleev (Vestnik sel'skhoz. nauk, 1959, No. 6). These hybrids have the advantage of eliminating the need of detasseling during the development of their parent single cross hybrids also. However, we do not know anyone having observed so far to what extent their fertility becomes restored.

Making use of the large diversity of sterile and fertile analogues, maintainer and restorer lines (Dankov, T., Dissertation, 1972) we have developed all possible hybrids according to genotype (Table 1.). Restoration of fertility in 4 to 58 combinations has been studied in each genotype, and 50 to 60 plants from each combination were examined once or twice.

There are 108 possible genotypes and 88 of them are expected to give a certain percentage of fertile plants. They are presented in Table 1. All hybrids can be classified into two types according to the type of cytoplasm of the first mother line, namely T-type and S-type. The hybrids of the T-type are divided into two groups according to the type of cytoplasm in the second mother line, namely T- and S-type, and into 6 sub-groups according to the expected percentages of fertile plants, namely 0, 25, 37.5, 50, 75 and 100%. The S-type hybrids are also divided into two groups according to the type of cytoplasm of the second mother line, namely T- and S-type, and into 3 sub-groups according to the expected percentages of fertile plants, namely 0, 50 and 100%.

In hybrids with two mother sterile lines of the S-type, 91% of the plants are fertile although 50% is to be expected. This is due to the inviability of the male gametes with recessive rf-factors, namely Srf₃ (Buchert, Genetics, 44, 4, 1959). Besides this regularity, some other peculiarities and trends are observed which may be explained by the relationship between the cytoplasm and the nucleus. The environmental conditions have greater influence on the manifestation of fertility in double cross hybrids with two sterile lines than in single cross hybrids and F₂ generations on sterile basis. Taking into consideration these peculiarities,

Table 1

Restoration of fertility in double cross hybrids with two sterile mother lines (in % fertile plants).

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♂ single cross	sterile single cross	♂ single cross										sterile single cross							
		TRf ₁ rf ₁ Rf ₂ rf ₂ Rf ₃ rf ₃	Rf ₃ rf ₃	Rf ₃ Rf ₃	TRf ₁ Rf ₁ Rf ₂ rf ₂ Rf ₃ rf ₃	Rf ₃ rf ₃	Rf ₃ Rf ₃	TRf ₁ rf ₁ Rf ₂ Rf ₂ Rf ₃ rf ₃	Rf ₃ rf ₃	Rf ₃ Rf ₃	Srf ₁ rf ₁ rf ₂ rf ₂ Rf ₃ rf ₃	"	"	"	"	"	"	"	"
		7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Trf ₁ rf ₁ rf ₂ rf ₂	V. Ex.% Ob.%	10 25.0 24.7	13 25.0 41.6	9 25.0 37.4	10 50.0 56.1	9 50.0 60.1	11 50.0 53.1	10 50.0 49.3	9 50.0 55.3	10 50.0 57.0	- 0 -	- 0 -	- 0 -	- 0 -	- 0 -	10 25.0 31.0	12 50.0 53.4	12 50.0 54.4	12 100 96.9
2. TRf ₁ rf ₁ rf ₂ rf ₂	V. Ex.% Ob.%	14 37.5 42.7	16 37.5 51.5	9 37.5 56.2	8 50.0 52.4	12 50.0 63.7	10 50.0 63.1	11 75.0 55.4	12 75.0 58.2	8 75.0 58.4	- 0 -	- 0 -	12 25.0 18.2	- 0 -	14 50.0 36.9	10 37.5 50.6	11 50.0 53.9	12 75.0 57.3	9 100 78.1
3. Trf ₁ rf ₁ Rf ₂ rf ₂	V. Ex.% Ob.%	15 37.5 39.4	19 37.5 41.1	7 37.5 48.6	10 75.0 61.2	18 75.0 65.4	11 75.0 61.2	13 100 51.8	8 100 52.3	10 100 58.3	- 0 -	9 25.0 37.3	- 0 -	6 50.0 52.9	- 0 -	14 37.5 40.1	15 75.0 64.4	14 50.0 50.5	13 100 89.7
4. Trf ₁ rf ₁ Rf ₂ Rf ₂	V. Ex.% Ob.%	8 50.0 60.8	6 50.0 50.3	7 50.0 51.8	4 50.0 51.3	5 50.0 60.2	9 50.0 54.3	7 100 57.6	5 100 53.5	7 100 71.3	- 0 -	- 0 -	9 50.0 36.0	- 0 -	10 100 58.5	8 50.0 50.2	5 50.0 50.5	9 100 58.0	10 100 81.6
5. TRf ₁ Rf ₁ rf ₂ rf ₂	V. Ex.% Ob.%	12 50.0 53.7	22 50.0 52.6	8 50.0 54.5	10 100 61.3	13 100 66.4	10 100 63.4	14 50.0 54.4	13 50.0 58.9	11 50.0 59.0	- 0 -	10 50.0 30.3	- 0 -	8 100 72.3	- 0 -	11 50.0 51.5	13 100 66.5	17 50.0 54.2	14 100 82.5
6. Srf ₃ rf ₃	V. Ex.% Ob.%	- 0 -	58 50.0 58.2	26 100 94.5	- 0 -	28 50.0 57.0	22 100 86.4	- 0 -	31 50.0 54.9	20 100 87.1	19 50.0 93.6	15 50.0 93.4	30 50.0 89.9	17 50.0 94.0	26 50.0 84.5	30 50.0 90.8	25 50.0 91.6	41 50.0 88.0	29 50.0 92.6

restoration of fertility in double cross hybrids on sterile basis with two sterile lines may be predicted with a relative accuracy.

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6. An attempt for induction of mutation of normal cytoplasm into sterile cytoplasm by treatment with streptomycin.

According to Sager (Scient. Amer. 1965, 212, 1), Petrov et al. (Refer. jurnal, Rasteniev. 1969, 10, 55, 10), Yehuda and Dlana (Planta 1970, 91, 195) streptomycin appears to be a specific mutagen for cytoplasmic factors. The mutation of normal cytoplasm into a sterile one is of importance to the creation of new sources of sterile cytoplasm and for shortening of the period of development of sterile analogues.

We repeated the experiment of Petrov. 100 germinating seeds were taken from each line containing the genotypes Wf9-Nrf₁rf₁rf₂rf₂rf₃rf₃, VIR-75-Nrf₁rf₁rf₂rf₂Rf₃Rf₃, A-344-NRf₁Rf₁Rf₂Rf₂rf₃rf₃ and O570a-NRf₁Rf₁Rf₂Rf₂Rf₃Rf₃. The following concentrations of streptomycin in distilled water were used: 0.001Y/ml, 0.01Y/ml, 1Y/ml, 10Y/ml, 100Y/ml, 1 mg/ml and 10 mg/ml. The germinating seeds were soaked in this solution for 24 hours at temperature 22-24° C. Dry and soaked seeds served as controls in each experiment. Two progenies were observed after the treatment.

Male sterility was not found in any of the variants.

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1. Physiological investigations of the stature mutant nana-1.

Coleoptile elongation, seedling elongation, isoenzymes of peroxidase and peroxidase activity, respiration of coleoptiles and mesocotyls, protein synthesis, and changes in ribonucleic acid in seeds and seedlings of the stature mutant nana-1 were investigated.

Seedlings were treated with indoleacetic acid in various concentrations. Measurement showed a significant increase in growth by the treated