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SUNFLOWER'S IMMUNITY TO BROOM RAPE, DOWNY MILDEW AND RUST

Broom rape (Orobanche cumana Wallr), downy mildew (Plasmorpara helianthy Novot) and rust (Puccinia helianthy Schw.) infect sunflower and do a noticeable harm to marketable production expressed in lower seed yields and the worse quality of seeds.

The genetics of immunity to these phytopathogenes has been insufficiently studied, which makes it more difficult to use the immunity factor to protect marketable sunflower crops from these diseases. To solve these questions a series of crossings has been conducted between susceptible and immune constant inbred sunflower lines of the Odessa breeding. The immune lines, which have been selected from the F_6 interspecific hybrid H. tuberosus H. annuus L., have acquired their immunity to broom rape, downy mildew and rust from the Helianthus tuberosus L., while the susceptible lines have acquired that property from the Armavirsky 3497 sunflower variety. The type of inheritance was judged by the segregation of the F_1, F_2, BC_1P_1 and BC_1P_2 hybrids into susceptible and immune phenotypes.

Broom rape. The hybridological analysis conducted in 1973-1975 made it possible to find that in F_1 immunity to broom rape dominates over susceptibility (Table 1).

The dominant character of immunity inheritance has been observed both in direct and in back crosses. In F_2 the ratio of segregation relative to broom rape resistance is close on 3:1. Back crosses of F_1 plants with the line susceptible to broom rape have produced two classes of phenotypes one of which is susceptible and the other is immune to broom rape,

Table 1

Inheritance of Sunflower Immunity to Broom Rape

Hybrid formula, indices of parent lines	Generation	Phenotype segregation by resistance to broom rape		Theoretical segregation	χ^2	P
		immune	susceptible			
TA-3722 x L-3620	F_1	96	0			
L-3620 x TA-3722	F_1	64	0			
(TA-3722 x L-3620) x x L-3620	BC_2P_1	72	62	1:1	0.746	0.50-0.25
(TA-3722 x L-3620) x x TA-3722	BC_1P_2	64	0			
TA-3722 x L-3620	F_2	101	39	3:1	0.609	0.50-0.25
L-3620	P_1	2	35			
TA-3722	P_2	19	0			
Table χ^2 = 3.84	P<0.05					

the ratio between them being nearly 1:1. When F_1 is back-crossed with the line immune to broom rape, resistance to broomrape is restored on the phenotype level.

The data obtained suggest the conclusion that the immunity of the Odessa breeding sunflower lines to the local broom rape race "B" is explained by the action of one pair of the dominant genes.

Downy mildew. The hybridological analysis has shown that in F_1 immunity to mildew dominated over susceptibility (Table 2). In F_2 sunflower lines are segregated by their resistance into two phenotype classes in the ratio close on 3:1. When the lines are back-crossed with the line immune to mildew, resistance is restored on the phenotype level.

The data obtained show that the immunity of the Odessa breeding lines is explained by the action of one pair of dominant genes. This conclusion coincides with data obtained by American and Romanian researchers (D.E. Zimmer, M. S. Kinman, 1971; V. Vranceanu, F. Stoenescu, 1971).

Rust. Through the hybridological analysis of the segregation it was found that susceptibility to the excitant of rust dominates over immunity to it (Table 3). In F_2 the ratio of segregation into susceptible phenotypes has been close on 3:1. In the variants when F_1 was back-crossed with the immune inbred line the segregation ratio was 1:1.

When a susceptible line was used rust infecting was restored 100%.

The experiments have shown that sunflower's specific immunity to the local (Odessa) population of rust is inherited according to the monofactorial pattern and involves the action of one pair of recessive genes. On the other hand, on the American continent sunflower's resistance to rust is explained by the dominant factors (E.D. Putt, 1955, E.D. Putt, V.E. Sackston,

Table 2

Inheritance of Sunflower Immunity to Downy Mildew

Hybrid formula, indices of parent lines	Generation	Phenotype segregation by resistance to mildew		Theoretical segregation	χ^2	P
		immune	susceptible			
TA x 3722 x x L-3620	F_1	135	0			
L-3620 x TA-3722	F_1	66	0			
(TA-3722 x L-3620) x x L-3620	BC_1P_1	80	61	1:1	2.56	0.25-0.10
(TA-3722 x L-3620) x x TA-3722	BC_1P_2	112	0			
TA-3722 x L-3620	F_2	199	61	3:1	0.33	0.75-0.45
L-3620	P_1	0	33			
TA-3722	P_2	290	0			

Table χ^2 - 3.84; $P<0.05$

Table 3

Inheritance of Sunflower Immunity to Rust

Hybrid formula, indices of parent lines	Generation	Phenotype segregation by susceptibility to rust		Theoretical segregation	χ^2	P
		immune	susceptible			
TA-6030 x L-2621	F_1	0	127			
L-2621 x TA-6030	F_1	0	98			
(L-2621 x TA-6030)x x TA-6030	BC_1P_2	26	22	1:1	1.332	1.32-2.71
(TA-6030 x L-2621)x x L-2621	BC_1P_2	81	0			
TA-6030 x L-2621	F_2	28	114	3:1	2.112	1.32-2.71
TA-6030	P_1	62	0			
L-2621	P_2	0	82			

Table $\chi^2 = 3.84$; $P < 0.05$

1963). This points to certain specificities of the rust population in the USSR.

The establishment types of inheriting immunity to broom rape, downy mildew and rust and the identification of constant inbred lines by the immunity to these diseases make it possible to genetically regulate the resistance of hybrids and varieties, and to sharply raise the effective protection of marketable sunflower crops from these phytopathogenes.

The laws and patterns found as well as practical selection have helped us to create two interlinear hybrids - TA-3722 x L-3620 and L-340 x TA-1631, and one variety-population (Odessky 63). Their most valuable features are high resistance to the virulent complex of the B broom rape races and, in hybrids, also to downy mildew.