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INHERITANCE OF LOOSE SMUT RESISTANCE IN WHEAT CULTIVARS K309 AND CHRIS*

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Abstract

The inheritance of resistance to loose smut was studied under artificial inoculation field conditions in crosses involving two resistant (K309 and Chris) and two susceptible (Kalam and C271) wheat cultivars. In the F_1 progeny of the resistantxsusceptible crosses, the dominance of resistance to loose smut in both K309 and Chris appeared to be dominant. Segregation of the F_2 progeny of K309xKalam, KalamxK309, K309xC271 and C271xK309 into 3 resistant: 1 susceptible plant indicated the monogenic and dominant nature of resistance in K309. Segregation ratio of 15 resistant: 1 susceptible plant in F_2 progeny from the crosses involving Chris showed that there were two dominant and duplicate genes controlling resistance to loose smut in this cultivar.

Introduction

Loose smut disease, caused by *Ustilago tritici* (Pers) Rost., causes severe losses to wheat throughout the world. In Pakistan, an annual loss of 13 million rupees is reported (Hafiz & Sattar, 1950), 2 to 10 per cent loss being recorded from this disease in the North West Frontier Province of Pakistan (Bangash, 1965).

Resistance to loose smut in wheat has been reported in literature. It was dominant and monogenic in wheat cv. Hussar (Kohli & Nambisan, 1962). In N.P. 790 also this resistance was shown by a single dominant gene (Agrawal & Jain, 1965). However, two dominant and duplicate genes (R1R1R2R2) governed resistance in N.P. 798 (Agrawal *et al.* 1963). Similarly resistance against race 11 of *U. tritici* was controlled by two completely dominant genes in Todd and Kawvale (Richards, 1961).

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This study was therefore aimed at knowing the mode of inheritance of loose smut resistance in wheat cultivars K309 and Chris and to find out the number of genes conferring this resistance.

Materials and Methods

The study was made at the Agricultural Research Institute (ARI) Tarnab, Peshawar and Wheat Summer Nursery Station (WSNS) Kaghan, Hazara during 1972 to 1974. It included two resistant (K309 and Chris) and two susceptible (Kalam and C271) wheat cultivars. Crosses of resistantXresistant, resistantXsusceptible, susceptibleXresistant and susceptibleXsusceptible cultivars were made at the WSNS, Kaghan during summer 1972. Ten heads of each cross were inoculated at the anthesis time with the loose smut inoculum prepared according to Basit & Malik (1967). F_1 was raised and studied at the ARI, Tarnab during winter 1972-73. Some of the F_1 material was also used in getting eight back crosses (Table 1). The F_1 and back crosses were inoculated during the said winter season. Both F_2 and BC_1 were planted at the ARI, Tarnab during winter 1973-74. Loose smut intensity was recorded in the two populations following Bever (1953). The disease data were analyzed by Chi-Square method (LeClerg *et al,* 1962).

Results and Discussion

Results indicated that resistant plants dominated the susceptible ones in F_1 of different crosses (Table 1). This showed the dominance of resistance in wheat cultivars K309 and Chris. However, a few smutted plants appeared in F_1 where K309 was involved with Kalam or C271. Such type of reactions can fit a gene-for-gene model. It is assumed that K309 populations used in these crosses comprised of two genotypes: one homozygous for resistance and other heterozygous for resistance. The heterozygous component segregated into resistant (R) and susceptible (r) genotypes, resulting in the appearance of susceptible plants in F_1 of crosses involving K309 and a susceptible cultivar. The percentage of this heterozygosity, however, seemed very small, as the number of resistant plants in F_1 progeny of each of these crosses was predominantly greater than the susceptible ones.

The F_2 populations, derived from F_1 resistant plants of K309xKalam or K309xC271, gave a satisfactory fit to 3 resistant: 1 susceptible plant. The back cross data of these crosses and their reciprocals fell into 1 resistant: 1 susceptible plant. This suggested one dominant gene for resistance in K309. The F_2 progenies, of crosses involving Chris and the two susceptible cultivars, segregated into 15 resistant:1 susceptible plant. The back cross data, in this case, fitted a ratio of 3 resistant: 1 susceptible. This indicated two dominant and duplicate genes for resistance to loose smut in wheat cultivar Chris. The results of this study agree with others (Kohli & Nambisan, 1962, Agrawal & Jain, 1965, Agrawal *et al,* 1963 and Richards, 1961), which showed that a single dominant

Table 1. Resistant and susceptible plants in F_1,F_2 and BC_1 populations of crosses involving resistant (K309 and Chris) and susceptible (Kalam and C271) cultivars of wheat

Cross	Generation	Number of plants			Ratio	X^2	Value of p
		Resis-tant	Suscep-tible	Total			
ResistantXresistant							
K309xChris	F_1	30	–	30			
	F_2	344	4	348		16.04	Below 0.01
ChrisxK309	F_1	99	–	99			
	F_2	246	2	248		4.01	0.02 – 0.05
ResistantXsusceptible							
K309xKalam	F_1	122	6	128			
	F_2	206	63	269	3:1	0.358	0.50 – 0.70
(K309xKlam) Kalam	BC_1	23	13	36	1:1	2.776	0.05 – 0.10
K309xC271	F_1	57	2	59			
	F_2	353	111	464	3:1	0.197	0.50 – 0.70
(K309xC271) C271	BC_1	33	31	64	1:1	1.996	0.10 – 0.20
ChrisxKalam	F_1	188	–	188			
	F_2	157	10	167	15:1	0.019	0.80 – 0.90
(ChrisxKalam) Kalam	BC_1	42	13	55	3:1	0.056	0.80 – 0.90
ChrisxC271	F_1	49–		49			
	F_2	294	18	312	15:1	0.123	0.70 – 0.80
(ChrisxC271) C271	BC_1	56	17	73	3:1	0.114	0.70 – 0.80
SusceptibleXResistant							
KalamxK309	F_1	49	3	52			
	F_2	214	60	274	3:1	1.406	0.20 – 0.30
(KalamxK309) Kalam	BC_1	24	28	52	1:1	0.30	0.50 – 0.70
C271xK309	F_1	43	3	46			
	F_2	344	118	462	3:1	0.072	0.70 – 0.80
(C271xK309) C271	BC_1	26	16	42	1:1	2.38	0.10 – 0.20
KalamxChris	F_1	86	–	86			
	F_2	188	12	200	15:1	0.021	0.80 – 0.90
(KalamxChris) Kalam	BC_1	18	5	23	3:1	0.13	0.70 – 0.80
C271xChris	F_1	49	–	49			
	F_2	162	10	172	15:1	0.055	0.80 – 0.90
(C271xChris)C271	BC_1	42	12	54	3:1	0.22	0.50 – 0.70
SusceptibleXsusceptible							
KalamxC271	F_1	–	25	25			
	F_2	3	194	197		9.04	Below 0.01
C271xKalam	F_1	–	14	14			
	F_2	6	329	335		36.10	Below 0.10

gene was responsible for resistance against *U. tritici* in Hussar and N.P. 790 and two dominant and duplicate genes in N.P. 798, Todd and Kawvale.

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