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Inheritance of *Alternaria* leaf blight resistance in durum wheat (*Triticum durum* Desf.)

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Abstract

Leaf blight incited by *Alternaria triticina* is a major biotic constraint to wheat (*Triticum durum* Desf.) cultivation particularly in north-eastern plain zones of India. For identifying the number and nature of resistance conferring genes to leaf blight, three resistant Leeds, Wakooma and Hercules and five susceptible cultivars of durum wheat (*Triticum durum* Desf.). HD 4502, DWL 5023, Raj 1555, HD 4530 and Meghdoot were crossed in an 8 × 8 half diallel fashion. Susceptibility of HD 4502, DWL 5023, Raj 1555 and HD 4530 was found to be controlled by a dominant gene and that of Meghdoot by two dominant complementary genes. The resistant parents carry recessive alleles of the genes present in susceptible cultivars. All the res-genes in the resistant parents are identical in nature.

Key words: Durum wheat, leaf blight, genetics, inheritance, disease resistance.

Introduction

Foliar blight is an important disease of wheat occurring all over India, particularly in major wheat growing regions and ranks close to rusts in destructiveness [1]. The disease occurs as a complex of which causal organisms are *Alternaria triticina* and *Bipolaris sorokiniana*. It has been observed that at the initial stage upto growth stage 47 on Zadoks scale [2], *A. triticina* is dominant pathogen and after growth stage 57, *B. sorokiniana* appear and cause significant damage [3]. Heavily infected fields with the *Alternaria* blight disease present a burnt look and losses of the crop may be to the extent of more than 90 per cent [4]. Resistance breeding is the most important control strategy and its success depends on the identification of resistant sources and resistant conferring genes in the genotypes. Therefore, the present investigation was undertaken to find out the number and nature of resistance genes against *Alternaria* blight disease in durum wheat.

Materials and methods

Eight varieties of durum wheat comprising three resistant and five susceptible to *Alternaria triticina* were crossed in all possible combinations to get 28 F_1s of an 8 × 8 half diallel set. Half of the seed from 28 crosses were sent to Indian Agricultural Research Institute, Regional Station, Wellington (Tamil Nadu) for generation advancement during the off season summer nursery so that F_2 progeny can be grown simultaneously with the F_1s at Pusa. All the 8 parental lines along with 28 F_1s and 28 F_2s were planted in 5 m row, having inter and intra row distance of 30 and 10 cm respectively. Each of the parents and F_1s were sown in a single row while F_2s were sown in 10 rows each. Every sixth row was of the infector cultivar, A 206. The entire plot was also surrounded by one row of the infector variety to create epiphytotic condition in the material. The recommended dose of fertilizer was applied and frequent irrigations were given to provide more humidity for proper disease development. Inoculum of *A. triticina* (Pusa isolate) developed by single spore culture was sprayed two times at an interval of 8 days. First spray was done on 25th January 1999. The population of viable spores was maintained at 10^5 spores per ml. of the suspension [5].

Assessment of the disease reaction was done by adopting 0 to 9 scale [6] subsequently followed by many other workers [7]. Genotypes scoring 1 to 3 were considered to be resistant, 4 to 5 as moderately resistant, 6 to 7 as moderately susceptible, and 8 to 9 as susceptible. Three disease scorings were done when the plants were 80 to 105 days old.

Results and discussion

High alternaria blight severity occurred in the experimental plot as reflected by >90 per cent diseased flag leaf area of susceptible infector row. Exotic Durum parents Leeds. Wakooma and Hercules being confirmed donor of resistance to alternaria blight, showed resistance (disease score 3) while the remaining Indian parents *viz.*, HD 4502, DWL 5023, Raj 1555, HD 4530, and Meghdoot recorded susceptible reaction (ranges in between 6 to 8) [8].

The F_1 plants involving resistant × susceptible and susceptible × susceptible parents, were uniformly susceptible; while F_1s from the crosses of resistant

Table 1. Segregation of field reaction to *Alternaria* leaf blight in F_1, F_2 and F_3 generations from resistant × susceptible crosses

Sl. No.	Cross	Generation	No. of plants observed	Segregation: No. of susceptible plants	Segregation: No. of resistant plants	Expected ratio Sus : Res	χ^2	'P' range
	Resistant × Susceptible							
1.	Leeds × HD 4502	F_1	26	26	-	-	-	-
		F_2	397	307	90	3 : 1	0.139	0.7-0.8
		F_3 (of F_2 sus.)	88	73	15	-	-	-
		F_3 (of F_2 res.)	37	-	37	-	-	-
2.	Leeds × DWL 5023	F_1	27	27	-	-	-	
		F_2	414	313	101	3 : 1	0.08	0.7-0.8
		F_3 (of F_2 sus.)	81	67	14	-	-	-
		F_3 (of F_2 res.)	31	-	31	-	-	
3.	Leeds × Raj 1555	F_1	24	24	-	-	-	
		F_2	318	235	83	3 : 1	0.24	0.5-0.7
		F_3 (of F_2 sus.)	85	71	14	-	-	-
		F_3 (of F_2 res.)	33	-	33	-	-	
4.	Leeds × HD 4530	F_1	25	25	-	-	-	
		F_2	354	269	85	3 : 1	0.184	0.5-0.7
		F_3 (of F_2 sus.)	67	55	12	-	-	-
		F_3 (of F_2 res.)	39	-	39	-	-	
5.	Leeds × Meghdoot	F_1	27	27	-	-	-	
		F_2	343	197	146	9 : 7	0.193	0.5-0.7
		F_3 (of F_2 sus.)	78	67	11	-	-	-
		F_3 (of F_2 res.)	34	-	34	-	-	
6.	Wakooma × HD 4502	F_1	26	26	-	-	-	
		F_2	413	315	98	3 : 1	0.355	0.5-0.7
		F_3 (of F_2 sus.)	71	58	13	-	-	-
		F_3 (of F_2 res.)	29	-	29	-	-	-
7.	Wakooma × DWL 5023	F_1	28	28	-	-	-	
		F_2	369	282	87	3 : 1	0.398	0.5-0.7
		F_3 (of F_2 sus.)	55	45	10	-	-	-
		F_3 (of F_2 res.)	28	-	28	3 : 1	-	-
8.	Wakooma × Raj 1555	F_1	26	26	-	-	-	
		F_2	359	276	83	3 : 1	0.676	0.3-0.5
		F_3 (of F_2 sus.)	57	44	13	-	-	-
		F_3 (of F_2 res.)	29	-	29	-	-	-
9.	Wakooma × HD 4530	F_1	26	26	-	-	-	
		F_2	324	245	79	3 : 1	0.065	0.7-0.8
		F_3 (of F_2 sus.)	66	45	21	-	-	-
		F_3 (of F_2 res.)	31	-	31	-	-	-
10.	Wakooma × Meghdoot	F_1	26	26	-	-	-	
		F_2	338	197	141	9 : 7	0.568	0.3-0.5
		F_3 (of F_2 sus.)	73	61	12	-	-	-
		F_3 (of F_2 res.)	36	-	36	-	-	-
11.	Hercules × HD 4502	F_1	26	26	-	-	-	
		F_2	341	250	91	3 : 1	0.516	0.3-0.5
		F_3 (of F_2 sus.)	53	41	12	-	-	-
		F_3 (of F_2 res.)	32	-	32	-	-	
12.	Hercules × DWL 5023	F_1	27	27	-	-	-	
		F_2	381	291	90	3 : 1	0.385	0.5-0.7
		F_3 (of F_2 sus.)	56	42	14	-	-	-
		F_3 (of F_2 res.)	29	-	29	-	-	-
13.	Hercules × Raj 1555	F_1	27	27	-	-	-	
		F_2	373	285	88	3 : 1	0.394	0.5-0.7
		F_3 (of F_2 sus.)	54	42	12	-	-	-
		F_3 (of F_2 res.)	38	-	38	-	-	-
14.	Hercules × HD 4530	F_1	27	27	-	-	-	
		F_2	386	297	89	3 : 1	0.777	0.3-0.5
		F_3 (of F_2 sus.)	47	37	10	-	-	-
		F_3 (of F_2 res.)	33	-	33	-	-	-
15.	Hercules × Meghdoot	F_1	26	26	-	-	-	
		F_2	361	211	150	9 : 7	0.709	0.3-0.5
		F_3 (of F_2 sus.)	70	56	14	-	-	-
		F_3 (of F_2 res.)	31	-	31	-	-	-
Susceptible × Susceptible								
1.	HD 4502 × Meghdoot	F_1	28	28	-	-	-	
		F_2	376	338	38	57 : 7	0.266	0.5-0.7
		F_3 (of F_2 sus.)	55	45	10	-	-	-
		F_3 (of F_2 res.)	30	-	30	-	-	-
2.	DWL 5023 × Meghdoot	F_1	27	27	-	-	-	
		F_2	367	332	35	57 : 7	0.738	0.3-0.5
		F_3 (of F_2 sus.)	54	44	10	-	-	-
		F_3 (of F_2 res.)	31	-	31	-	-	-
3.	Raj 1555 × Meghdoot	F_1	28	28	-	-	-	
		F_2	385	349	36	57 : 7	0.994	0.3-0.5
		F_3 (of F_2 sus.)	53	42	11	-	-	-
		F_3 (of F_2 res.)	31	-	31	-	-	-
4.	HD 4530 × Meghdoot	F_1	25	25	-	-	-	
		F_2	347	314	33	57 : 7	0.725	0.3-0.5
		F_3 (of F_2 sus.)	56	41	15	-	-	-
		F_3 (of F_2 res.)	21	-	21	-	-	-
Resistant × Resistant								
1.	Leeds × Wakooma	F_1	31	-	31	-	-	-
2.	Leeds × Hercules	F_1	35	-	35	-	-	-
3.	Wakooma × Hercules	F_1	34	-	34	-	-	-

× resistant parents were resistant (Table 1). These observations indicate that the susceptibility to *Alternaria* blight was inherited as a dominant trait [9, 10].

In F_2 population crosses between resistant and four susceptible parents *viz.*, HD 4502, DWL 5023, Raj 1555 and HD 4530 gave a segregating ratio of 3S: 1R. This indicates that a recessive gene governs resistance to *A. triticina* in the resistant genotypes [8, 9]. The susceptible parent, Meghdoot gave a segregating ratio of 9S : 7R in F_2 with all the three resistant parents, showing, thereby the presence of two dominant complementary genes for susceptibility.

In F_3 population, raised from F_2 susceptible plants, a few resistant plants were observed; while, those raised from F_2 resistant plants, none of them showed susceptibility to *Alternaria triticina*. This indicated that F_2 susceptible population is consisted of both homozygous dominant and heterozygous. However, the appearance of a few resistant plants in F_3 confirmed the F_2 segregation behaviour.

The four susceptible parents *viz.*, HD 4502, DWL 5023, Raj 1555 and HD 4530 when intercrossed did not segregate for resistance in F_2. But they gave a segregation ratio of 57S: 7R in F_2 with susceptible parent, Meghdoot (Table 1). This exhibited the presence of two dominant complementary genes for susceptibility to *A. triticina* in Meghdoot.

All the three resistant parents Leeds, Wakooma and Hercules carry identical genes for resistance because their intercrosses failed to segregate for susceptibility in F_2 generation. Leeds (BR 180/Wells) is an American source of resistance to *Alternaria* blight while Wakooma (Lakota *2/Pelissier) and Hercules (RL 3097/RL 3304//Stewart) are Canadian sources of resistance. It is likely that the resistance of these sources is derived from a common unknown parent. In conclusion, it can be categorically stated that the knowledge of number and nature of genes controlling resistance to *Alternaria* blight in Leeds, Wakooma and Hercules will be valuable to other breeders in developing foliar blight resistant varieties of wheat.

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