INHERITANCE OF RESISTANCE TO *Rhynchosporium secalis* (Oud.) DAVIS IN SEVERAL BARLEY CULTIVARS.

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Abstract

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Inheritance of resistance to *Rhynchosporium secalis* (Oud.) Davis, the causal organism of the scald disease of barley (*Hordeum vulgare* L.), was studied in six resistant cultivars, including Abyssinian (CI 4354) which had not previously been studied. F_1, F_2 and back-cross progenies of crosses between the susceptible betzes and the six resistant cultivars and between Abyssinian and the five other resistant cultivars were evaluated in a greenhouse at the seedling stage using two isolates of *R. secalis*. Inheritance of resistance in the five, previously studied cultivars was found to be similar to that of previous reports. Resistance in the Abyssinian was governed by one dominant or two complementary dominant genes for resistance, depending on the isolate.

Additional key words: barley, *Rhynchosporium secalis*, resistance.

Introduction

Scald, incited by *Rhynochosporium secalis* (Oud.) Davis, is a common foliar disease of barley in many parts of the world. It can seriously limit yield of barley grown in humid and subhumid areas. Control of this disease has been achieved mainly by genetic resistance. Studies on the genetics of scald resistance have been reported by a number of workers (1, 2, 3, 4, 5, 6, 7, 10, 11, 12). A majority of the cultivars studied have genes located on chromosome 3 at the complex locus. Rh-Rh3-Rh 4 (11).

The objectives of this study were to determine the number of resistant genes and mode of inheritance to two isolates of *R. secalis* in several barley cultivars, one of which was not previously studied.

Materials and Methods

The barley germplasm used in this investigation included «Trebi» (CI 936), «Bey» (CI 5581), «Atlas 46» (CI 7323), «La Mesita» (CI 7565) and «Turk» (CI 14400), which have previously been studied for resistance; «Abyssinian» (CI 4354), a resistant introduction from Ethiopia not previously studied; and «Betzes» (CI 6398) a susceptible cultivar. Betzes was crossed to all the resistant lines and Abyssinian was crossed to the other five resistant lines. The F^1 progenies of Betzes x Atlas 46 and Betzes x Abyssinian were back-crossed to the susceptible parent Betzes. Parents, F_1, F_2, and BC generations were studied at the seedling stage in the green house.

Two isolates of *R. secalis* from Montana and Morocco, were used in this study. The Montana isolate (Lew B 77) originated from scalded plants collected at Lewistown, MT, in 1975. The Moroccan (Mor. 25) isolate was collected in 1977 and maintained as Lyophilized cultures. These isolates were cultured on Lima Bean Agar (Difco) at 18°C and twelve hours of light. Cultures to be used as inocula were transferred to new agar plates on the same day the barley seeds were planted. Seeds were planted in metal flats (35 × 25 × 8cm) in a greenhouse maintained at 20 - 25°C. Plants were inoculated two weeks later. A water suspension, standardized to a concentration of 6×10^6 conidia /m1, was prepared from the agar plates. Each flat received 25 ml of inoculum applied with a Devilbis atomizer. Inoculated flats were transferred to an unlighted dew chamber at 20°C for 24 hours, then returned to the greenhouse. Two weeks later scald readings were recorded using a 0 to 3 scale (0 = no visible lesion, 1 = small marginal lesions, 2 = small lesions not confined to leaf margins and 3 = large, coalescing lesions resulting in collapse of the leaf).

Plants with reactions of 0, 1, and 2 classes were grouped as resistant and 3 as susceptible, then fitted to hypothetical genetic ratios using a Chi-square test.

Results and Discussion

Seeding reactions of the seven parents to the two isolates of *R. secalis* are shown in Table 1. Isolate Lew B 77 showed virulence only against Betzes whilt Mor. 25 isolate was virulent on four parents.

A. Betzes × Resistant Cultivars. Table.2 shows the results of crosses between Betzes and the six resistant cultivars. In the cross with Trebi segregation in the F_2 fit a 9:7 ratio when inoculated with Lew B 77, indicating two complementary dominant genes controlling resistance.

Studying the resistance in Trebi, Dyck and Schaller (5) and Starling et al. (11) reported a single dominant gene at the Rh - Rh3 - Rh4 locus, while Riddle and Briggs (9) found a dominant and a recessive gene. In the cross with Bey a good fit to a 3:1 ratio of resistant to susceptible plants in the F_2 was obtained when inoculated with Lew B 77 indicating a single dominant gene controlling resistance. Wells and Skoropad (12) also found a single dominant gene (Rh 3) in Bey. In the cross with Atlas 46 a single dominant gene was indicated when inoculated with Mor 25 in the F_1, F_2, and BC generations. In inoculations with Lew B 77, however, a poor fit to either a 13:3 or 15:1 resistance to susceptible in the F_2 was

Table 1. Seedling reactions of barley cultivars to two isolates of *R. secalis*.

Cultivar	CI No.	Isolate: Lew B 77	Isolate: Mor 25
Trebi	936	0[a]	3
Abyssinian	4354	0	0
Bey	5581	0	3
Betzes	6398	3	3
Atlas 46	7323	0	0
La Mesita	7565	0	3
Turk	14400	0	0

a) Reaction scale 0 = no visible lesion, 1 = small marginal lesions, 2 = small lesions not confined to leaf margins, 3 = large, coalescing lesions resulting in collapse of the leaf.

obtained, indicating either one dominant and one recessive or two dominant genes controlling resistance. Numerous previous studies (1, 5, 8, 11) on Atlas 46 found one or two dominant genes for resistance, one of which was located at the complex locus, Rh - Rh 3 - Rh 4. In the cross with La Mesita, segregation in the F_2 gave a good fit to 3:1 ratio of resistance to susceptible when inoculated with Lew B 77, thus, indicating a single dominant gene controlling resistance. Earlier workers (2, 5, 8, 9, 11) had found either one or two genes controlling resistance, one of which was at the RH - RH 3 - Rh 4 locus. In the cross with Turk a single dominant gene was manifested from F_1 and F_2 segregations when inoculated with Mor. 25. However segregation for one dominant and one recessive gene was observed when inoculated with Lew B 77. Habgood and Hayes (8) had found a dominant and a recessive gene in Turk. However, other workers (3, 5, 9, 11, 12) found either one or two dominant genes for resistance, one of which was at the Rh - Rh 3 - Rh 4. In the cross with Abyssinian a more confusing inheritance was found. In inoculations with Lew B 77 segregation in the F_2 fit either a 13:3 or 3:1 ratio. However, segregation in crosses of Abyssinian × other resistant lines (Table 3) supports a single dominant gene. In inoculations with Mor. 25 the best fit to the F_2 and BC segregations is two dominant complementary genes controlling resistance. The F_1 was susceptible, indicating recessive resistance, which conflicts with the other data. The data from crosses with other resistant lines (Table 3) supports the two complementary dominant gene model.

B. Abyssinian × Other Resistant Cultivars. The data from crosses of Abyssinian with the other resistant cultivars are shown in Table 3. No segregation was observed in the crosses, Abyssinian × Trebi and Abyssinian × Bey. The size of F_2 populations tested would have detected linkage down to approximately 2 map units. In the cross with Turk no segregation was observed when inoculated with Lew B 77 (Linkage detected to about 2.5 map units). However, when inoculated with Mor. 25 segregation was observed. Segregation was also observed in crosses with Atlas 46 and La Mesita.

The Cultivars, Trebi, Bey, Atlas 46, La Mesita, and Turk have all previously been reported to possess an allele for scald resistance at the Rh - Rh 3 - Rh 4 locus. Whether or not alleles at this complex locus are effective against the isolates of *R. secalis* used in this study is not clear. Therefore, inclusions regarding designation of scald resistance genes cannot be made. The cultivar, Abyssinian, has a gene or genes in common with Trebi and Bey (and perhaps Turk). The genes in Atlas 46 and La Mesita are independent of Abyssinian.

Table 2. Reaction class frequencies, hypothesized ratios, and gene action of F_1, BC_1, and F_2 progeny of crosses between Betzes and resistant cultivars to two isolates of *Rhynchosporium secalis*.

Cross	Generation	Isolate[a]	No. of Plants: R[1]	No. of Plants: S[2]	1st Hypothesis: Ratio	1st Hypothesis: P Value	1st Hypothesis: Gene action	Alternative Hypothesis: Ratio	Alternative Hypothesis: P value	Alternative Hypothesis: Gene action
Betzes × Trebi	F_2	L	95	64	9:7	.5 - .23	2 dominant complemantry	———		
Betzes × Bey	F_2	L	107	41	3:1	.75 - .5	1 dominant	———		
Betzes × Atlas 46	F_2	L	182	24	13:3	.025 - .01	1 dominant 1 recessive	15:1	< .01	2 dominant
	F_1	M	6	0	1.0		dominant	———		
	BC_1	M	8	11	1:1	.75 - .5	1 dominant	———		
	F_2	M		36	3:1	.75 - .5	1 dominant	13:3	.25 - .1	1 dominant, 1 recessive
Betzes × La Mesita	F^2	L	128	60	3:1.	05 - 025	1 dominant	———		
Betzes × Turk	F_2	L	165	40	13:3	. 9 - .75	1 dominant, 1 recessive	3:1	.1 - .05	1 dominant
	F_1	M	9	0	1:0		dominant	———		
	F_2	M	84	32	3:1	.75 - .5	1 dominant	13:3	.05 - .025	1 dominant, 1 recessive
Betzes × Abyssinian	F_2	L	126	26	13:3	.75 - .5	1 dominant 1 recessive	3:1	.05 - .025	1 dominant
	F_2	(recip.) L	115	34	3:1	.75 - .5	1 dominant	13:3	.25 - .1	1 dominant, 1 recessive
	F_1	M	0	14	0:1		recessive	———		
	BC_1	M	9	17	1:3	5 - .25	2 dominant complementary	1:1	.25 - .1	1 dominant
	F_2	M	53	47	9:7	.75 - .5	2 dominant complementary	———		
	F_2	(recip.) M	58	51	9:7	.75 - .5	2 dominant complemantary	———		

a) L = Lew B 77, M = Mor 25   R[1] = Resistant, S[2] = Susceptible

Table 3. Reaction class frequencies, hypothesized ratios, and gene action of F_2 progeny of crosses between Abyssinian and other resistant cultivars to two isolates of *R. Secalis*.

Cross	Isolate[a]			1[st] hypothesis			Alternative hypothesis		
		R[1]	S[2]	Ratio	P Value	Gene action	Ratio	P value	Gene action
Abyssinian × Trebi	L	185	0	——	——		——	——	
Abyssinian × Bey	L	157	,0	——	——		——	——	
Abyssinian × Atlas 46	L	209	6	61:3	0.25 - .1	1 dominant in Abyssinian, 1 dominant, 1 recessive in Atlas 46	63:1	.25	1 dominant in Abyssinian. 2 dominant in Altas 46
	M	129	27	57:7	0.025 - .01	2 dominant complementary in Abyssinian, 1 dominant in Atlas 46	——	——	
Abyssinian × La Mesita	L	138	13	15:1	0.5 - .25	1 dominant in Abyssinian. 1 dominant in La Mesita	61:3	.05 - .025	1 dominant, 1 recessive in Abyssinian, 1 dominant in La Mesita
Abyssinian × Turk	L	136	0	——	——		——	——	
	M	161	15	57:7	0.5 - .25	2 dominant complementary in Abyssinian, 1 dominant in Turk			

الملخص

هرابي، منصف، هـ . بوكلمان وأ. ل. شارب. 1987 . المقاومة الوراثية في بعض أصناف الشعير لمرض الاسمرار المتسبب عن الفطر *Rhynchosporium secalis* (Oud.) Davis . مجلة وقاية النبات العربية 5: 85 - 83

درست المقاومة الوراثية لمرض *Rhynchosporium secalis* (Oud.) Davis مسبب الاسمرار في نبات الشعير، في ستة أصناف مقاومة، بينها الصنف عبيسينيان (Abyssinian CI4354) الذي لم يدرس من قبل. وبعد تهجين الصنف الحساس Betzes والأصناف الستة المقاومة وبين الصنف عبيسينيان (Abyssinian) وخمسة أصناف مقاومة أخرى، وذلك في البيت الزجاجي وفي طور البادرات، درس سلوك الجيل الأول (F_1) والجيل الثاني (F_2) والهجين الرجعي (Backcross) وذلك بعد تلقيحها بعزلتين من الفطر *R. secalis*. ولقد تبين أن المقاومة الوراثية في الأصناف الخمسة التي أقيمت عليها دراسات سابقاً، متشابهة مع هذه الدراسة. كما تبين أن المقاومة في الصنف عبيسينيان ترجع لوجود موروث سائد (جين) أوجينين سائدين مكملين وذلك حسب عزلة الفطر المستعملة.

كلمات مفتاحية: شعير، راينكو سبوريوم سيكاليس، مقاومة.

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