



Reaction of European winter wheat cultivars to six isolates of *Puccinia triticina*

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Objective

Presented work is a part of larger project aiming at gene postulation using molecular markers and phenotype data. The aim of this study was postulation of resistance genes to leaf rust caused by the biotrophic fungus *Puccinia triticina*. Resistance genes can be postulated at seedling stage based on well-known gene-for-gene concept. Infection type (IT) pattern (virulent/avirulent phenotype) observed on differential set with known resistance genes is used to infer about *Lr* genes in cultivars after inoculation with the same *P. triticina* isolates.

Materials and methods

In the research 200 wheat cultivars/lines were used: 83 cultivars registrated on national list of COBORU (Research Centre for Cultivar Testing, Poland), 79 cultivars registrated in countries of Western Europe and a set of 38 near-isogenic lines of spring wheat cv. Thatcher (TcNILs) carrying specific leaf resistance genes (*Lr*). Pathology tests were performed in a growth chamber on seedlings with a fully expanded second leaf. Plants were inoculated with single isolates of *P. triticina*.

After the 12-day incubation infested seedlings were evaluated according to a scale of 0-4, where the type of infection 0-2 indicates resistance and 3-4 indicates susceptibility. For the inoculation test a set of six *P. triticina* isolates with different virulence spectrum were used: Tr11_A1/12, Tr09_3/13, Tr09_8/13, Tr11-2/13, Tr11_4/13 and Tr10_2/12.

Results

Phenotypic reaction of tested cultivars and near-isogenic lines are presented in table. This is a part of data that would be used during associaton mapping for leaf rust resistance genes.

NILs of cv. ‘Thatcher’ (TcNILs) carrying known *Lr* resistance genes and set of 162 European winter wheat cultivars collection including 83 cultivars registered on national list of COBORU (Research Centre for Cultivar Testing, Poland) were tested with six *P. triticina* isolates.

After testing 38 TcNILs, it was noted that all isolates were virulent to genes *Lr2c*, *Lr10*, *Lr11*, *Lr14a*, *Lr14b*, *Lr18*, *Lr23*, *Lr24*, *Lr27+Lr31*, *Lr30*, *Lr33*, *Lr44*, *LrB* (Carina) and avirulent to *Lr1*, *Lr9*, *Lr19*, *Lr20*, *Lr25* and *Lr28*. For the rest of TcNILs, at least one isolate displayed different IT than the other isolates. Among wheat cultivars tested, 36 were resistant to all isolates, 36 were resistant to five isolates and 63 were susceptible to all six *P. triticina* isolates. The other 27 wheat cultivars were resistant to 1–4 isolates of the pathogen.

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Table. Phenotypic reaction of 200 wheat cultivars/lines to infection of six *P. triticina* isolates (resistance: type of infection 0-2; susceptibility: 3-4).

No	Cultivar/Line	Registration country	Tr11_A1/2	Tr09_3/13	Tr09_8/13	Tr11_2/13	Tr11_4/13	Tr10_2/12
1	Akteur	Poland	2	4	4	2	2	2
2	Alcazar	Poland	2	4	4	2	2	2
3	Arkadia	Poland	4	4	4	4	4	4
4	Arktis	Poland	0	4	2	0;	0;	1
5	Artist	Poland	4	4	4	4	3	4
6	Askalon	Poland	4	4	4	4	4	4
7	Astoria	Poland	4	4	4	4	4	4
8	Bagon	Poland	4	4	3	4	3	4
9	Baletka	Poland	4	4	4	4	4	4
10	Bamberka	Poland	4	4	4	4	4	4
11	Banderola	Poland	4	4	4	4	2	2
12	Batuta	Poland	4	4	4	4	4	4
13	Belenus	Poland	0	0	0	0	0	0
14	Bockris	Poland	4	4	4	4	4	4
15	Bogatka	Poland	0	4	0;	1	2	1
16	Boomer	Poland	0	4	4	4	4	4
17	Bystra	Poland	0;	4	4	2	2	2
18	Dorota	Poland	4	4	4	4	4	4
19	Elipsa	Poland	0	0 & 4	0;	0;	1	1
20	Estivus	Poland	0	4	4	2	4	3
21	Fakir	Poland	4	4	4	4	4	4
22	Fidelius	Poland	0;	4	4	1	2	2
23	Figura	Poland	4	4	4	4	4	4
24	Forkida	Poland	4	4	4	4	4	4
25	Forum	Poland	0	4	0	0;	1	0;
26	Fregata	Poland	4	4	4	4	4	4
27	Garantus	Poland	0	4	0;	0;	2	2
28	Henrik	Poland	4	4	4	4	4	4
29	Jantarka	Poland	4	4	4	4	4	4
30	Jenga	Poland	4	4	4	4	3	4
31	Kampana	Poland	4	4	4	4	3	4
32	Kepler	Poland	4	4	4	3	3	2
33	Kohiera	Poland	4	4	4	4	4	4
34	Kohella	Poland	4	4	4	4	4	4
35	Kranich	Poland	4	4	4	4	4	4
36	Kredo	Poland	0	0	0;	0	0;	0;
37	Kris	Poland	4	4	4	4	4	4
38	KWS Dacanto	Poland	4	4	4	4	3	4
39	KWS Livius	Poland	4	4	4	4	4	4
40	KWS Magic	Poland	0	4 & 0;	0;	1	0;	2
41	KWS Ozon	Poland	0	0;	0;	0;	0	0;
42	Lavatus	Poland	0;	4	1	1	2	2
43	Legenda	Poland	4	4	4	4	4	4
44	Linus	Poland	4	4	4	3	4	3
45	Look	Poland	4	4	4	4	4	4
46	Ludwig	Poland	4	4	4	4	4	4
47	Markiza	Poland	0	4	0	0;	0;	0;
48	Meister	Poland	4	4	2	4 & 2	2	2
49	Meteor	Poland	0	4	0	0;	0;	0;
50	Mewa	Poland	0;	4	4	2	2	4
51	Mikula	Poland	0	4	0	0;	1	0;
52	Mulan	Poland	1	4	1	3	3	2
53	Muszelka	Poland	2	4	1	3	3	2
54	Muza	Poland	0	4	0;	1	2	2
55	Naridana	Poland	4	4	4	4	4	4
56	Natula	Poland	4	4	4	4	4	4
57	Nutka	Poland	4	4	4	4	4	4
58	Olvin	Poland	4	4	4	4	4	4
59	Operetka	Poland	4	4	4	4	4	4
60	Ostka Strzelecka	Poland	4	4	4	4	4	4
61	Ostroga	Poland	0	4	0;	1	1	0;
62	Ozal	Poland	4	4	4	4	4	3
63	Patras	Poland	4	4	4	4	4	4
64	Pengar	Poland	0	0	0	0	0	0;
65	Platin	Poland	4	4	3	3	2	3
66	Praktik	Poland	0	4	0;	0;	0;	1
67	Raprodia	Poland	0	4	0	0;	0;	0;
68	Rywalka	Poland	4	4	4	4	4	4
69	Sailor	Poland	0	4	1	1	0;	0;
70	Satyna	Poland	0	4	0	1	1	0;
71	Skagen	Poland	2	4	4	4	4	4
72	Smaragd	Poland	3	4	4	4	4	4
73	Smuga	Poland	4	4	4	4	4	4
74	Speedway	Poland	0	0	0	0	0	0
75	Sukces	Poland	4	4	4	4	4	4
76	Tonacja	Poland	4	4	4	4	4	4
77	Torriid	Poland	4	4	4	4	4	4
78	Tulecka	Poland	4	4	4	4	4	4
79	Türkis	Poland	0	4	0;	0;	0;	2
80	Turnia	Poland	4	4	4	4	4	4
81	Wydma	Poland	4	4	4	4	4	4
82	Zawisza	Poland	4	4	4	4	4	4
83	Zyta	Poland	4	4	4	4	4	4
84	Addict	France	0	0	0	0	0	0
85	Agape 192	Italy	0;	4	0;	2	2	2
86	Akratos	Germany	2	4	3	4	3	4
87	Armada	France	0;	4	0;	1	2	2
88	Artagnan	France	0;	4	0;	1	2	2
89	Astardo	Austria	0;	4	4	2	2	4
90	Avalon	United Kingdom	4	4	4	4	4	4
91	Avenir	Austria	4	4	4	4	3	3
92	Belepi	France	0	0	0	0	0	0;
93	Calumet	France	0;	4	4	4	4	4
94	Capone	Germany	0	0	0	0	0	0
95	Cappelle Deprez	United Kingdom	4	4	4	4	4	4
96	Carroll	Czech Republic	0	0;	0;	0;	1	1
97	Celebration	United Kingdom	0	4	0	1	1	0;
98	Cocoon	United Kingdom	1	4	1	2	2	2
99	Desamo	Germany	0	0	0;	0;	2	2
100	Descartes	France	0	4	0;	0;	2	2
101	Dickens	England	4	4	4	4	4	4
102	Diderot	France	1	4	1	2	1	1
103	Edelrun	Austria	4	0;	4	4	4	4
104	Elixer	Germany	0	0	0	0	0	0
105	Ennsio	Austria	0	0	0	0	0	0;
106	Eperon	France	0	0	0	0	0	0
107	Eriwan	Austria	4	0	4	4	4	4
108	Eron	Austria	0	0	0	0	0	0
109	Esket	Germany	0	0	0;	0	0;	0;
110	Estevan	Germany	2	0	2	4	4	3
111	Etana	Czech Republic	4	4	4	4	4	4
112	Event	Germany	0	0;	0	0;	0	2
113	Fermi	Czech Republic	0	0	0	0	0	0
114	Fulvio	Austria	4	4	4	3	3	2
115	Genius	Germany	2	4	4	2	3	3
116	Gordian	Germany	0	0	0	0	0	0
117	Grammax	France	0	0	0	0	0	0
118	Grapeli	France	4	4	4	4	4	4
119	Hermann	Germany	4	4	4	3	3	4
120	Heros	France	0	0	0	0	0	0
121	Ionesco	France	0;	4	4	2	2	4
122	Joker	Germany	0	4	0	0;	0;	0;
123	Julius	Germany	0;	4	1	1	2	1
124	Justinus	Austria	4	4	4	4	3	4
125	Kantao	France	0	4	0;	1	1	3
126	Kundera	France	4	4	4	4	4	4
127	KWS Cashel	England	0;	0;	0;	2	1	2
128	KWS Erasmus	Germany	0;	4	4	3	3	3
129	KWS Kielder	England	0;	4	0	1	1	0;
130	KWS Pius	Germany	1	4	1	2	2	2
131	Lahertis	Germany	0	4	0	0;	0;	0;
132	Lear	Germany	0	0	0	0	0	0
133	Lithium	France	0	0	0;	0	0	1
134	MV Lucilla	Germany	0	0	0;	1	1	0;
135	Lucio	Austria	4	4	4	4	4	4
136	Magnus	Germany	0;	4	0;	1	1	1
137	Matheo	France	0	0	0	0	0	0
138	Memory	Germany	0;	0	0;	1	0;	1
139	Modern	France	2	4	4	4	3	3
140	Music	France	4	4	4	4	3	4
141	Muskat	Germany	4	4	4	4	4	4
142	Nocbe	France	2	4	0;	2	2	2
143	Orcas	Germany	4	4	4	4	4	4
144	Pamier	Germany	0	4	0	2	0;	0;
145	Pionier	Germany	4	4	4	3	3	4
146	Rebel	Austria	0	4	0	0;	0;	0
147	RGT Djoko	France	0	0	0	0;	0	0
148	Richard	Austria	4	4	4	4	4	4
149	Salutos	Czech Republic	0	4	0;	0;	0	0
150	Scout	England	0	0	0	0	0	0;
151	Solky	France	1	4	3	2	2	0;
152	Sorokk	France	0;	4	0;	0	2	0;
153	Stadium	France	0	0	0	0;	0	0;
154	Tabasco	Germany	0	0	0	0	0	0
155	Tentation	France	0	0	0;	0;	0;	1
156	Terroir	France	0	0	0	0	0	0 & 4
157	Thalys	France	0	0	0	0;	0	0;
158	Tobak	Germany	0	0	0	0	0	0;
159	Valdo	France	4	4	4	4	4	4
160	Wasy	Germany	0;	0	0;	1	1	1
161	Xantippe	Germany	0	0	0;	0	0	0;
162	Zappa	Germany	0	0	0	0	0	0
163	Thatcher-Ts		4	4	4	4	4	4
164	TcNIL-Lr1		0	0;	0;	0;	0;	0;
165	TcNIL-Lr2a		0;	0;	4	4	2	1
166	TcNIL-Lr2b		2	0;	4	4	4	4
167	TcNIL-Lr2c		4	4	4	4	4	4
168	TcNIL-Lr3a		2	4	4	4	3	4
169	TcNIL-Lr3bg		0;	4	2	1	1	2
170	TcNIL-Lr3ha		4	4	4	2	2	4
171	TcNIL-Lr9		0	0	0	0	0	0;
172	TcNIL-Lr10		4	4	4	4	4	4
173	TcNIL-Lr11		4	4	4	4	4	4
174	TcNIL-Lr14a		4	4	4	4	4	4
175	TcNIL-Lr14b		4	4	4	4	4	4
176	TcNIL-Lr15		0	4	4	2	3	3