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RESISTENCE OF SOME WINTER WHEAT GENOTYPES TO PUCCINIA LEAF RUST

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Abstract

Winter wheat (*Triticum aestivum* L.) is one of the oldest and most important crops ever. Rust diseases are well-known more than a thousand years ago, and are the most frequent causal agents of wheat diseases in the world. Wheat leaf rust, caused by the biotrophic fungus *Puccinia triticina*, is a disease which accompanies wheat production regularly. The study was carried out during 2011 and 2012, in the condition of natural infection, at the location Kraljevo (Serbia). Resistance of 20 winter wheat cultivars was studied. Seeding was done a cultivar per row, with row length of 1 m and inter-row distance of 30 cm. During maximal pathogen development, reaction mode of the investigated cultivars was graded by determining infection type from 0-4 and infection intensity from 0-100%. A high level of resistance in 2011 and 2012 was shown by the cultivar Gordana, with infection coefficient of 0%. Moderately susceptible infection type 3 and trace infection intensity in 2011 was observed in the cultivar Zvezdana. Low infection intensity (10%) in 2012 was observed in the cultivar Renesansa, which reacted by infection type 3. Infection intensity of the most susceptible cultivar Rapsodija was 40% in 2011, and 30% in 2012.

Key words: *leaf rust, winter wheat, resistance, susceptibility, cultivars*.

Introduction

Wheat (*Triticum aestivum* L.) is the most important field crop which today is grown on large areas throughout the world. Wheat grain yield is affected by numerous factors, and among them are parasites, causal agents of various plant diseases. Denčić (2006) suggested that good utilizability of genetic potential for grain yield of grown wheat cultivars demands optimal weather conditions, adequate agro-technique, as well as resistance to diseases.

Leaf rust of wheat, caused by biotrophic fungus *Puccinia triticina*, is a disease which regularly follows wheat production. Bošković and Bošković (1994) stated that leaf rust is the most common wheat disease, which attacks this crop so in cold regions, as in subtropical ones. Damage caused by this parasite depends on resistance of grown cultivars, virulence of its pathotypes, as well as on ecological factors. Kolmer (2001) pointed out that grain yield decrease also depended on phenological stage of wheat during which primary infection happened. If plants were infected in initial developmental stages, they showed decreased resistance to low temperature, so that tillering was not strong enough, and spike size was also decreased. The all mentioned caused presence of empty grains in spikes, root and stalk lodging, and often death of whole plant (Roelfs and Bushnell, 1985). Samborski (1985) reported estimation that grain yield loss caused by leaf rust was from 5-15%, but also could be higher.

Causal agent of leaf rusts is present in Serbia every year and intensity of its attack rises rapidly from the second decade of May. In addition to grain yield decrease, this pathogenous fungus has a significant deteriorating effect on technological quality of wheat grain (Jerković

and Đurić, 1998). Among integrated protection measures, the most important one is breeding and growing resistant cultivars, and that way most efficient, most economical and environmentally friendliest protection is achieved. For that reason, in Serbia, a special attention is paid to studying resistance of various wheat cultivars, with the aim to identify good donors of resistance genes and to use them in wheat breeding programs. Jerković et al. (2007) pointed out that reaching high and stable grain yield in semiarid regions is possible only growing cultivars with genetic resistance. Introduction of new cultivars put a pressure on parasite population and force it to make adaptations. It does that by changing racial composition, and very quickly resistant cultivars become susceptible ones.
This study has been aimed to establish resistance of some wheat cultivars in order to recommend the most resistant ones to farmers and help them in achieving high and stable production.

Material and metods

The study was carried out during 2011 and 2012, in the condition of natural infection, at the location Kraljevo. The trials were set at 192 m of altitude, 43°43′N of latitude and 20°40’ E of longitude. Resistance of the following 20 winter wheat cultivars was studied: Rusija, Zvezda, Zelengora, Jasenica, NS-Rana 5, Etida, Jugoslavija, Panoramka, Lasta, Evropa, Renesansa, Pobeda, Rapsodija, Kruna, Žitnica, Francuska, Zvezdana, Natalija, Gordana and Simonida.
Seeding was done a cultivar per row, with row length of 1 m and inter-row distance of 30 cm. During maximal pathogen development, reaction mode of the investigated cultivars was graded by determining infection type from 0-4 (Stakman et al., 1962) and severity of infection from 0-100%(Peterson et al., 1948). Meaning of infection types is the following: 0 – very resistant (VR); 1 – resistant (R); 2 – moderately resistant (MR); 3 – moderately susceptible (MS); 4 – very susceptible (VS). Plants that react by infection type 0-2 are regarded as resistant, and those reacting by infection type 3-4 as susceptible ones. On the basis of determined infection type and severity of infection we calculated coefficient of infection multiplying severity of infection by numerical values for infection types (0-0; 1-0.2; 2-0.4; 3-0.8 and 4-1). Cultivars with observed coefficient of infection 0-5 were regarded as very resistant, 6-10 as resistant, 11-25 as moderately resistant, 26-40 as moderately susceptible, 41-65 as susceptible and 66-100 as very susceptible ones (Stojanović, 2004).

Results and discussion

Results of the study showed that severity of infection of the most susceptible cultivar Rapsodija in 2011 was 40%, while in 2012 it was 30% (tab. 1). The most resistant cultivar in both 2011 and 2012 was Gordana with coefficient of infection 0%. It pointed to this cultivar as having factors of complex resistance. High level of resistance was also shown by the cultivar Lasta which had coefficient of infection 2% in 2012. Resistance of cultivar Lasta was previously reported by Stojanović et al. (2006) and Stojanović et al. (1997), which was in accordance with the results of our investigation. Trace intensity of infection was established in cultivar Zvezdana during 2011 and in cultivars Zelengora, Jasenica and Francuska during 2012. Zvezdana and Jasenica reacted by moderately susceptible infection type 3, while Zelengora and Francuska by moderately resistant infection type 2. Low severity of infection (10%) during 2011 showed cultivars Zvezda, Zelengora, Panoramka and Simonida, as well as Renesansa in 2012, and all of them reacted by the infection type 3. Moderate resistance in 2011 was observed in cultivars Rusija, NS-Rana 5, Etida, Jugoslavija, Renesansa, Kruna, Žitnica and Natalija with coefficient of infection from 11% to 25%. According to Jerković and Jevtić (2002) the cultivar Renesansa reacts by partial resistance to this parasite. The results from 2012 showed a higher number of cultivars with severity of infection up to 20% (Rusija, Zvezda, NS-Rana 5, Etida, Jugoslavija, Panoramka, Evropa, Pobeda, Kruna, Žitnica,

Zvezdana, Natalija and Simonida). Furthermore, during the second year of investigation in most of cultivars the observed reaction types were moderately resistant or resistant. Having in mind that infection type is a result of interaction between host's resistance genes and pathogen's virulence genes, regardless severity of infection observed, it does not mean those values have to be the same in other environmental conditions. For that reason, before final decision on cultivars of choice, one ought to investigate resistance of available cultivars in given environmental conditions.

Table 1. Resistance of some winter wheat genotypes to *Puccinia triticina*

No	Cultivar	2011			2012		
		Type of infection	Severity of infection	Coeff. of infection	Type of infection	Severity of infection	Coeff. of infection
1	Rusija	4	20	20	3	20	16
2	Zvezda	3	10	8	2	20	8
3	Zelengora	3	10	8	2	t	-
4	Jasenica	3	20	16	3	t	-
5	NS-Rana 5	2	30	12	2	20	8
6	Etida	3	20	16	2	20	12
7	Jugoslavija	2	30	12	2	20	8
8	Panoramka	3	10	8	1	20	4
9	Lasta	0	0	0	1	10	2
10	Evropa	4	30	30	2	20	8
11	Renesansa	3	20	16	3	10	8
12	Pobeda	3	40	32	3	20	16
13	Rapsodija	4	40	40	4	30	30
14	Kruna	4	20	20	2	20	8
15	Žitnica	4	20	20	2	20	8
16	Francuska	2	20	8	2	t	-
17	Zvezdana	3	t	-	2	20	8
18	Natalija	3	20	16	2	20	8
19	Gordana	0	0	0	0	0	0
20	Simonida	3	10	8	1	20	4
Average			21.7			19.3	

Conclusion

Leaf rust is one of diseases regularly met in Serbia every year. The average coefficient of infection was higher in 2011 (21.7%) than in 2012 (19.3%). The most resistant cultivar to *Puccinia triticina* in both years of investigation was Gordana. Furthermore, a high resistance was also shown by the cultivar Lasta. Observing both years of the study, the greatest susceptibility was observed in the cultivar Rapsodija. Success in wheat protection from the causal agent of leaf rust could be achieved by combining various protection measures. In addition to growing resistant genotypes, an adequate attention should be paid to agrotechnical and chemical protection measures.

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