

Protection of Cereal Crops against Harmful Organisms



Proceedings of a Conference
held at Cereal Research Institute
Kroměříž, Ltd.

on 1-4 July 1997

TOLERANCE OF YUGOSLAV VARIETIES TO Puccinia recondita tritici

Z.Jerković, R.Jevtić

Institute of Field and Vegetable Crops, M.Gorkog 30, 21000 Novi Sad
Yugoslavia

Abstract

The objective of the study was to assess the tolerance of 13 Yugoslav winter wheat varieties and prospective lines to Puccinia recondita tritici. The study lasted two years.

The line NS 81/90 exhibited the most consistent level of tolerance. The variety Renesensa was stable and possessed a certain level of incomplete resistance. In 1996, tolerance was exhibited by Košuta and Slavija. NS 48/91 and Evropa 90 were close to them. Balkan was the variety with a low level of tolerance to medium severities of *P. recondita*. Pobeda and NS O-634 lacked tolerance to the medium intensities of the late infection.

Key words: LEAF RUST, WINTER WHEAT, TOLERANCE

Introduction

A genotype attacked by a disease agent as severely as others but suffering less damage in terms of yield or quality is regarded as tolerant (Robinson, 1969). It is wrong to exclude tolerance from resistance expressed interactions (Russel, 1978). Simonds (1966) points to the notion of relativity as the basis of the concept of tolerance even in titles.

Similar studies in connection with the harmfulness and control of obligate parasites and damage done by them have been conducted in our country as well (Bošković et al., 1985; Momčilović et al., 1986). Csosz et al. (1996) studied simultaneously wheat tolerance to Puccinia graminis and Erysiphe graminis using an original trial design that they compared to the center pivot method. Based on their study's

Results, they have concluded that tolerance is a resistance mechanism of secondary importance for the formation of yield, i.e., one of lesser importance than major gene resistance.

The objective of our study was to assort a certain number of genotypes according to the level of tolerance to the agent of leaf rust they possess. By comparing the level of damage in genotypes with incomplete resistance (these being the most frequent ones in an assortment of varieties), we can obtain information that can later be used in the process of breeding and developing a varietal assortment. Tolerant but very susceptible varieties in combinations with resistant ones could give very promising progenies from which can be selected future highyielding varieties.

Materials and methods

Fourteen winter wheat varieties and lines were tested successively in field trials in 1994/95 and 1995/96. A special method was used: sowing was done on October 14, 1994 and October 24, 1995, emergence occurred on October 25, 1994 and November 5, 1995, the plants were harvested on July 4, 1995 and July 10, 1996; and the basic plot size was $9 \times 1 \text{ m}^2$.

A sprayer with a capacity of 200 l and a range of 6 m was used to protect or inoculate the plots (on April 10, 1995 and May 1, 1996) with a water suspension containing a spore mixture in virulence type of Puccinia recondita tritici races 77 and 167 (Todorova and Jerković, 1996).

On May 10, 1995 and May 22, 1996, trial treatments marked with a number and "k" were treated with Folicur plus (tebuconazole + triadimenol) against the causal agents of leaf rust and powdery mildew. The rest of the treatments inoculated with the agent of leaf rust, marked only with a number, were treated against the causal agent of powdery mildew on May 10, 1995 (in 1996, the incidence of Erysiphe graminis tritici was negligible, so that no special control measures were needed).

The level of infection with Puccinia recondita tritici was determined using a modified version of Cobb's scale (Melchers and Parker, 1922). The final mark is the mean value of four observations that were made per plot on the following

dates: April 20, 1995 (1); May 18, 1995 (2); May 25, 1995 (3); May 31, 1995 (4); June 9, 1995 (5); May 27, 1996 (6); June 8, 1996 (7) and June 19, 1996 (8) (estimation dates 1-8 in the Tab.1a) . Yield per plot, hectoliter mass, and 1000 grain mass of each sample were measured.

Yield losses and yield component losses that occurred during the two trial years were expressed as percentage and then compared. The degree to which the studied traits were interrelated was determined using correlation analysis.

Results

Varieties that we used for our study (Table 1) were either those that were presumed to have a certain level of tolerance to Puccinia recondita tritici those that had been surviving on the market for a long time.

The following genotypes proved to be the most susceptible to leaf rust: NS 40/39, NS 81/90, Košuta and Slavija. Based on the degree of susceptibility it exhibited, the variety Evropa 90 was also close to this group, while Balkan and Pobeda were shown to have a similar level of incomplete resistance. The line NS 40/39 suffered the greatest damage from Puccinia recondita tritici , 37% and 17% in 1995 and 1996, respectively. This was also the line in which hectoliter mass decreased the most (by 8% in 1995). As far as 1000 kernel mass is concerned, the greatest decrease was recorded in the variety Slavija in 1995, 31%. In 1996, yield component losses were smaller (Table 1).

Tab. 1. Tolerance of wheat genotypes to Puccinia recondita tritici based on yield and yield components

Tab. 1a. Puccinia recondita tritici infection severity in winter wheat genotypes protected and artificially infected in 1995 and 1996.

Cultivar	Estimation dates							
	1	2	3	4	5	1	5	
	6	7	8			6	8	
1995. 1996.	Infected				Protected			
NS 40/39	-	t	15	40	70	-	20	
1995.	-	20	50					
1996.								
NS 81/90	t	10	20	40	80	10	30	
	5	30	70				5	
BALKAN	-	t	5	10	25	-	t	
	-	15	25				5	
POBEDA	t	t	5	10	25	-	t	
	t	15	40				t	
KOSUTA	-	15	15	40	60	t	t	
	5	25	70				t	
SLAVIJA	-	15	15	50	70	5	40	
	-	15	60				5	
EVROPA 90	-	5	5	25	50	-	20	
	-	20	60				t	
NS 0634	-	t	10	15	30	5	15	
	5	10	30				t	
ATINA	-	t	10	25	50	5	20	
	-	10	30				5	
RENEANSANSA	t	t	t	15	20	5	15	
	t	10	40				5	
DICNA	-	5	5	10	50	5	15	
	-	5	25				5	
ITALIJA	-	10	20	40	60	10	40	
	t	15	60				5	
DESA	-	5	5	15	30	-	t	
	-	t	20				t	

The average damage in terms of yield was 13.62% in 1995 and 10.92% in 1996. During the two trial years, the highest level of tolerance was exhibited by the line NS 81/90 and Košuta, their average yield losses being 7.5 and 8%, respectively. Interestingly, while the variety Košuta lost 16% of its yield when the attack by the agent of leaf rust came early in the season, the result of a late attack by the same disease agent was that there was barely any yield loss at all. In both trial years, Balkan and Pobeda, the two varieties with a certain level of incomplete resistance, were among the varieties that suffered the greatest damage, which was not the case with the variety Renesansa. Balkan showed the lowest level of tolerance even when the severity of the attack was relatively low. Pobeda was developed by combining the varieties Balkan and Sremica, so this is an indication of the heritability of the trait.

The respective coefficients of correlation (r) among the yields of protected and unprotected cultivars in the two years were -0.093 and -0.234 . The correlation coefficients between the check treatments and inoculated treatments regarding the yields and yield losses were -0.070 and -0.021 , respectively. All this leads to the conclusion that tolerance cannot be regarded a stable trait. The correlation between yields obtained from infested and protected plots was very high in 1995 ($r=0.860$) and high ($r=0.718$) in 1996.

Discussion

In comparison with the designs that had been previously used, the new trial design proved better in several respects:

- the protection and inoculation of the plots was more uniform.
- border rows and the fact that the plots differed as to their fertility had less effect on yields and the process of disease development.
- the trial was characterized by a greater yield measurement accuracy than in trials with a smaller basic plot.

In 1995, the high levels of infection present in control

plants at the later stages developmental stages brought about a decrease in the absolute differences in terms of yield relative to the infected crops. However, this had no significant effect on our conclusions regarding the study's objectives since infection levels increased in all of the varieties at the later stages of development.

In our country, there have been no studies aimed exclusively at determining the harmfulness of Puccinia recondita tritici. At the Rimski Šančevi site, a natural infection by this parasite that occurred during the 1993/94 season produced the amount of damage that was estimated at 5-10% (Jevtić et al., 1996), the reason being the incomplete resistance of the varieties. Moreover, the damage recorded in the susceptible varieties attacked early in the season was in some cases as high as 30% (Balaž et al., 1994). The 1994 estimates are closer to this study's figures for 1995, since in 1995 the attack came earlier than in 1996. To a great extent, the expression of tolerance depends on environmental conditions, just like all the other plant-pathogen relationships.

L i t e r a t u r e

Balaž, F., Jerković, Z., Jevtić, R. (1994): State of Health of Wheat in 1994. Prvi sastanak o regionalnoj saradnji iz zaštite bilja nekoliko podunavskih zemalja, Subotica, 1. XII 1994.

Bošković, M., Kostić, B., Momčilović, V., Pribaković, M., Jerković, Z. (1986): Suzbijanje lisne rdje i pepelnice na sortimentu pšenice u 1985. godini. Zaštita bilja, Vol.37 (1), br. 175: 51-58.

Csosz, M., Matuz, J., Mesterhazy, A. (1996): Tolerance reaction of wheat genotypes against stem rust and powdery mildew. Proc. of 9th CR&PM Conference, page 254.

Jevtić, R., Jerković, Z., Pribaković, M. (1995): Uzroci epifitocije lisne rdje na pšenici i ječmu 1993/94. godine. Biljni lekar, godina b XXIII, 1:

Melchers, L.E., Parker, J.H. (1922): Rust resistance in winter wheat varieties. U.S. Dept. Agr. Bull., 1046. 32 pp.

M o m č i l o v i ć, V., B o š k o v i ć, M., K o s t i ć, B.,
P r i b a k o v i ć, M., J e r k o v i ć, Z. (1985): Hemijsko suzbijanje
Puccinia recondita tritici i *Erysiphe graminis tritici* na raznim sortama
pšenice. *Zaštita bilja*, Vol. 36 (2), No 172: 171-178.

Robinson, R.A. (1969): Disease resistance terminology. Review of applied
Mycology, 48, 593.

Russell, G.E. (1978): Plant breeding for pest and disease resistance.
Butterworths, London-Boston, pp. 485.

Simonds, M.D. (1966): Relative tolerance of oat varieties to the crown rust
fungus. *Phytopathology*, 56: 36-40.

Todorova Maria, Jerković, Z. (1996): Virulentnost *Puccinia recondita*
tritici u Srbiji. "Zbornik radova", *Sveska* 28: 95-99.