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# Resistance of winter wheat varieties to fungal diseases *Erysiphe graminis* D. C. sp. *tritici* E. Marshal, *Septoria tritici* Rob. et Desm. and *Stagonospora nodorum* Berk.

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At the Lithuanian Institute of Agriculture, over the period 1993–2000 650 winter wheat varieties were tested. Susceptibility to powdery mildew (*Erysiphe graminis* D. C. F. sp. *tritici* E. Marshal) and septoria (*Septoria tritici* Rob. et Desm., *Stagonospora nodorum* Desm.) was evaluated and tolerant varieties were selected.

It was revealed that the varieties exhibiting the highest tolerance to *Erysiphe graminis* and *Septoria tritici* were of West-European origin. The varieties most tolerant to *Stagonospora nodorum* were bred in more dry climate countries. The following varieties were tolerant to powdery mildew: 'Greif', 'Bohme', 'Haven', 'Torfrida', 'Batis', 'Pentium', 'Mermaid', 'Aron', 'Toronto'.

The following varieties were most tolerant to *Septoria tritici*: 'Pentium', 'Stakado Abed', 'Bold', 'Previa', 'Dacota', 'Belissar', 'Batis', 'Pegasos', 'Record', 'Agent', 'Reaper', to *Stagonospora nodorum*: 'Donskaja polukarlikovaja', 'Dotnuva 458', 'Juna', 'Rostovčanka 2', 'Banga', 'Akuotuotiejai', 'Aidas', 'Rufa'.

**Key words:** winter wheat, varieties, *powdery mildew*, *septoria*

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## INTRODUCTION

In Lithuania, winter wheat crops occupy 233–319 thous. ha annually. It is one of the most important crops. The grain yield of winter wheat is not stable and varies from year to year. One of the major causes of yield losses is disease incidence. The most spread diseases are *Powdery mildew* and *Septoria tritici*.

*Powdery mildew* is caused by *Erysiphe graminis* D. C. f. sp. *tritici* E. Marshal. This disease occurs very widely throughout wheat-growing areas and is most damaging in cooler and moister regions and years. Although controlled by resistant cultivars, most well catalogued single gene sources of resistance have been overcome by virulent pathotypes. A breeding strategy aimed at the avoidance of highly susceptible genotypes, maybe as effective as that aimed at complete resistance based on genes conferring non-durable resistance [1].

*Powdery mildew* has increased in incidence and severity in America and Europe following the breakdown in resistance conferred by resistance gene

Pm 8. Attempts were then made to exploit resistance conferred by resistance genes Pm 6 and Pm 17, to incorporate resistance from emmers and to use slow mildewing sources [2].

The most developed *Erysiphe graminis* is between stem extension and heading of wheat plant [1]. The grain yield loss sometimes is as high as 50% [3].

The two diseases caused by *Stagonospora nodorum* Berk. and *Septoria tritici* Rob. and Desm. incur serious yield losses in wheat by reducing the photosynthetic capacity of leaves and ears. There is also some evidence for the production of a phytotoxin, septorin, increasing the effect on yield beyond that caused by loss of photosynthetic capacity. *Stagonospora nodorum* is usually more important in maritime countries, where it may cause losses of up to 40% in high-rainfall areas [4]. *Septoria tritici* is as a rule more important in hotter and drier countries.

It has been noticed that *Septoria tritici* is most harmful in Lithuania in spring and *Stagonospora nodorum* later in summer [5]. The weather conditions have a great influence for the development of *Septoria* diseases. A negative close correlation between

the grain yield and the leaf area affected by *Erysiphe graminis* and *Septoria* ( $r = -0.71...-0.82$ ) was established [6].

The response of various winter wheat varieties to the incidence of fungal diseases is different. There are considerable varietal differences in resistance to both diseases and possibly also differences in yield losses following similar levels of infection, *i.e.* different tolerance. Varietal differences in resistance are correlated with differences in resistance genes, presence of wheat-rye, translocations, difference in stem height, canopy structure, etc.

Intervarietal hybridization is one of the ways to obtain lines resistant to fungal diseases, which can be directly selected for commercial winter wheat varieties.

The main task of this study was to screen the winter wheat germplasm collected at the Lithuanian Institute of Agriculture for further purposful breeding programmes.

## MATERIALS AND METHODS

Investigations were conducted over the period 1993–2000. The varieties were planted in the collection block in 2 m<sup>2</sup> plots, without replications. The local variety Širvinta 1 was used as the control for all investigations. For the disease evaluation we used the following scale:

0 – plots with no infection; 1 – infected 0.1%; 2–1%; 3–3%; 4–5%; 5–10%; 6–25%; 7–50%; 8–75%; 9–100%.

## RESULTS AND DISCUSSION

Experimental material involved 950 varieties and lines of different geographical origin collected at the Lithuanian Institute of Agriculture.

*Erysiphe graminis* were spread every year. The highest disease incidence was in 1996 and 1999 when the average of infection was estimated in investigated varieties by 4.8 and 4.6 scores.

We selected the varieties that were not infected at all or their infection ranged within the 0–2 score (Table).

The varieties exhibiting the highest tolerance to *Erysiphe graminis* were of West-European origin, developed in the countries of high air humidity. Varieties bred in America were especially susceptible to *Erysiphe graminis*.

*Septoria tritici* is one of the most harmful diseases of winter wheat. The infection depends on weather conditions, especially on the amount of precipitation in May [5]. The highest incidence of *Septoria tritici* was recorded in 1995 and 1997. The average of infection was 5.9; 4.5 and 4.7, respectively. We selected the varieties with *Septoria tritici* infection below 4.

Table. Winter wheat varieties most tolerant to *Erysiphe graminis* in natural conditions, 1993–2000

Variety	Origin	Average of infection (score)	Resistance genes*
Širvinta(standard)	Lithuania	3.0	unknown
Zentos (standard)	Germany	1.6	absent
Greif	Germany	0.0	Pm 5, Pm 6
Bohme	Germany	0.5	Pm 4b
Haven	Great Britain	0.1	Pm 8, MIHa 2
Torfrida	Great Britain	1.0	Pm 2, Pm 4 b, Pm 5, Pm 6
Brigadier	Great Britain	1.7	Pm 4 b, Pm 6, Pm 8
Batis	Germany	1.0	Pm 5, Pm 6
Pentium	Denmark	1.5	Pm 2, Pm 4 b Mm 6, 21
Ritmo	The Netherlands	1.7	Pm 4 b, Pm 6 ,Pm 8
Athlet	Germany	1.6	Pm 5, Pm 8
Contra	Germany	1.7	Pm 2, Pm 4 b, Pm 6
Agent	Germany	1.7	Pm 2
Kraka	Denmark	2.2	Pm 5
Aron	Germany	1.5	Pm 4 b
Toronto	Germany	1.5	Pm 4 b, Pm 8
Nova	The Netherlands	2.2	Pm 2, Pm 6
Stakado Abed	Denmark	1.3	Pm 2, MIFi 4
Mermaid	Great Britain	1.5	MIHa 2, MIHe 2
Pegasos	Germany	2.0	Pm 5, Pm 6
Marabu	Germany	2.0	Pm 4b, Pm 8

Source: Beschreibende Sorten Liste 2000. Bundessortenamt, Hannover, 2000: 75–83.

Gron Widen. Landbrug Nr. 222. Tystofte, 2000: 10–1.

*Stagonospora nodorum* was recorded only in 1997. That year 234 accessions in natural conditions and 164 in artificial infection were investigated. The average of investigation was 4.1 and 5.2, respectively. It was determined that 8 varieties were most tolerant to *Stagonospora nodorum*: 'Donskaja polukarlikovaja', average of infection (score) was 3.5; 'Dotnuvos 458' – 4.0; 'Juna' – 4.0; 'Rostovčanka 2' – 4.0; 'Banga' – 4.0; 'Akuotuotiejai' – 4.0; 'Aidas' – 4.0; 'Rufa' – 4.0. Four varieties from the group of the most tolerant ones were of Lithuanian and Latvian, 4 varieties of Ukrainian and Russian origin.

The investigation of resistance to *Septoria tritici* revealed that most tolerant to this disease are varieties bred in West European countries: 'Bold' – average of infection (score) was 3.0; 'Previa' – 3.0; 'Dacota' – 3.0; 'Belissar' – 3.0; 'Batis' – 3.3; 'Pegasos' – 3.3; 'Reaper' – 3.3; 'Stakado Abed' – 3.5; 'Agent' – 3.5; 'Hereward' – 3.5; 'Pentium' – 3.7; 'Record' – 3.7; 'Chianti' – 3.7.

Thus, for breeding resistance to *Stagonospora nodorum* it is necessary to include the winter wheat germplasm from dry climate countries and for breeding resistance to *Septoria tritici* of West-European origin.

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**ŽIEMINIŲ KVIEČIŲ VEISLIŲ ATSPARUMAS  
GRYBINĖMS LIGOMS *ERYSIYPHE GRAMINIS* D.C. F.  
SP. *TRITICI* E. MARSHAL, *SEPTORIA TRITICI* ROB.  
ET DESM. IR *STAGONOSPORA NODORUM* BERK.**

S a n t r a u k a

Lietuvos žemdirbystės institute 1993–2000 m. buvo tyrinėta 950 žieminių kviečių veislių ir selekcinė linijų. Nustatyta, kad atspariausios veislės *Erysiphe graminis* bei *Septoria tritici* yra sukurtos Vakarų Europos šalyse, kur yra drėgnesni orai. Veislės, sukurtos sausesnio klimato kraštuose, labiau atsparios *Stagonospora nodorum*. Taigi tarpveislinės hibridizacijos programose, siekiant padidinti veislių atsparumą ligoms, tėvines formas reikia parinkti atsižvelgiant į jų geografinę kilmę. Tyrimų metu atrinktos šių ligų mažiausiai pažeidžiamos veislės: *Erysiphe graminis* – 'Greif', 'Bohme', 'Haven', 'Torfrida', 'Batis', 'Pentium', 'Mermaid', 'Aron', 'Toronto'; *Septoria tritici* – 'Pentium', 'Stakado Abed', 'Bold', 'Previa', 'Dacota', 'Belissar', 'Batis', 'Pegasos', 'Record', 'Agent', 'Reaper'; *Stagonospora nodorum* – 'Donskaja polukarlikovaja', 'Dotnuvos 458', 'Juna', 'Rostovčanka 2', 'Banga', 'Akuotuotiejai', 'Aidas', 'Rufa'.