

EVALUATION OF RESISTANCE TO POWDERY MILDEW IN GRAPEVINE GENETIC RESOURCES

HODNOCENÍ ODOLNOSTI K PADLÍ RÉVY VINNÉ U GENOVÝCH ZDROJŮ RÉVY VINNÉ

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ABSTRACT

One of major concerns of modern agriculture is conservation, evaluation and utilization of genetic resources of agricultural plants. The aim of this research was to evaluate the resistance of leaves and berries of table grape varieties to powdery mildew (*Erysiphe necator*) under field conditions. During the period 1996-2004, 32 table varieties (viz. 28 interspecific varieties and 4 varieties of *Vitis vinifera*) were investigated. A high resistance of leaves and berries to powdery mildew has been proved for varieties Augustovskii, Yalovenskii Ustoichivyi, Pólőskei Muskotály and Pleven Ustoichyvii. It was also possible to confirm a lower degree of resistance to powdery mildew in some hybrids of *V. vinifera* x *V. amurensis*. Varieties of *V. vinifera* showed a low degree of resistance to powdery mildew infestation.

Keywords: grapevine, grape variety, grape powdery mildew, leaf, berry, resistance

ABSTRACT

Jedním z hlavních zájmů moderního zemědělství je udržování, hodnocení a využití genových zdrojů zemědělských rostlin. Cíl tohoto výzkumu bylo vyhodnocení odolnosti vůči padlí révy vinné (*Erysiphe necator*) na listech a bobulích, u stolních odrůd révy vinné v polních podmínkách. V průběhu let 1996-2004 bylo pozorováno 32 stolních odrůd (28 interspecifických odrůd a 4 odrůdy *Vitis vinifera*). Vysoká odolnost k padlí révy vinné na listech a bobulích byla zjištěna pro odrůdy Augustovskii, Jalovenskii Ustoichivyi, Pólőskei muskotály a Pleven ustoichyvii.. Rovněž bylo možné potvrdit nižší odolnost u některých kříženců s *V. vinifera* x *V. amurensis*. Odrůdy *V. vinifera* vykazovaly vůči padlí révy vinné nízkou odolnost.

Klíčová slova: réva vinná, odrůda révy, padlí révy vinné, list, bobule, odolnost

DETAILED ABSTRACT

Identifikace a charakteristika genových zdrojů kulturních rostlin je velmi významná z pohledu studia genetické proměnlivosti a využití kulturních rostlin ve šlechtění a pěstitelské praxi.

Cílem tohoto výzkumu bylo vyhodnocení odolnosti vůči padlí révy vinné (*Erysiphe necator*) na listech a bobulích, u stolních odrůd révy vinné. Hodnocení probíhalo v polních podmínkách. Tento výzkum byl proveden s využitím genových zdrojů révy vinné soustředěných na Zahradnické fakultě MZLU v Lednici na Moravě. Hodnocení v polních podmínkách probíhalo v letech 1996-2004. Pokusná vinice nebyla v průběhu hodnocení ošetřovaná fungicidy. Hodnocení bylo provedeno u 28 interspecifických odrůd a 4 odrůd *Vitis vinifera*.

Hodnocení bylo provedené na listech a bobulích s využitím „International list for grapevine varieties and species evaluation“, který je celosvětově využíván pro hodnocení genových zdrojů révy vinné.

Průměrná odolnost listů u všech sledovaných odrůd byla 5,76. Nejvíce odolné k padlí révy vinné na listech byly následující odrůdy: Augustovskii, Pólšskei Muskotály, Yalovenskii Ustoichyvii, Plevn Ustoichyvii. Nízká odolnost byla zjištěna u odrůd: Cvetochnyi, Jolanka, V-46-40, Agat Donskoi, Dachnyi.

Při hodnocení odolnosti bobulí byla průměrná odolnost u všech sledovaných odrůd 6,05. Nejvyšší odolnost byla pozorovaná u těchto odrůd: Pólšskei Muskotály, Augustovskii, Yalovenskii Ustoichyvii, Plevn Ustoichyvii. Nižší odolnost k padlí révy vinné na bobulích byla pozorovaná u těchto odrůd: Cvetochnyi, V-46-40, Agat Donskoi.

Na základě dosaženého pozorování lze konstatovat, že vysoká odolnost k padlí révy vinné na listech a bobulích byla zjištěna pro odrůdy Augustovskii, Jalovenskii Ustoichyvii, Pólšskei muskotály a Plevn ustoichyvii.

Z pohledu využití výsledků této práce ve šlechtění je rovněž významné zjištění, které dokládá nižší až střední odolnost k padlí révy vinné na listech a bobulích révy u kříženců s *Vitis amurensis*.

Významné je rovněž zjištění korelačních závislostí mezi odolností k napadením padlí révy vinné na listech a bobulích. Korelační koeficienty v závislosti na barvě bobulí jsou velmi významné. Nejnižší hodnota korelačního koeficientu byla pozorovaná u odrůd s modrou barvou bobule ($r = 0.56^{**}$), zatímco nejvyšší byla zjištěna u odrůd s růžovou barvou bobule ($r = 0.70^{**}$).

Dosažené výsledky jsou využitelné při výběru donorů odolnosti při šlechtění nových stolních odrůd révy vinné a rovněž v pěstitelské praxi při introdukci nových odrůd.

INTRODUCTION

The biotrophic fungus *Erysiphe necator* Schw. is the causal agent of grape powdery mildew, a disease causing worldwide heavy yield and quality losses.

Powdery mildew is able to attack species in all members of the Vitaceae family [3].

On grapevine, powdery mildew grows readily on leaves, green stems, inflorescences, and berries. Most of the economic loss results from the effects of fungal infection on the fruit, i.e. uneven maturation, swelling and cracking that lead to fruit rot, yield depression and decline in wine quality [5].

One of the challenges facing breeders in the course of selection and development of new crop cultivars for agricultural use is to incorporate the resistance to diseases into the genotype of plants [14].

Breeding for the resistance to diseases is one of the major goals of the development of grapevine modern varieties.

The identification and characterization of grapevine germplasm is an important tool when studying and preserving the genetic variability which exists in viticulture [20].

Resistance to powdery mildew in different species and varieties of *Vitis vinifera* in Czechoslovakia was evaluated in [12, 13].

Methods of estimation of genetic resistance were described using field- vines cultivated under field conditions [6, 17, 15, 2, 4], in in vitro cultures [9] and in pots in a greenhouse [5].

Wild species are often a valuable source of resistance to crop pathogens. This is especially true in the case of grapevine because the species *V. vinifera* is susceptible to most pathogens whereas the wild grapevine species (*Vitis* spp.) are to same pathogens quite resistant [3, 8].

The aim of this research was the evaluation of resistance to grape powdery mildew (*Erysiphe necator* Schw.) of leaves and berries of table grape varieties grown under field conditions. The results of this research are important for grapevine breeding and selection of new grapevine varieties resistant to fungal plant diseases.

MATERIALS AND METHODS

This research was performed using the material originating from the collection of grapevine genetic resources at the Faculty of Horticulture in Lednice n. M. (Mendel University of Agriculture and Forestry Brno, Czech Republic). A survey of varieties used in this study is presented in Tab. 5.

Field experiments and evaluation of the resistance to powdery mildew were performed within the period of

EVALUATION OF RESISTANCE TO POWDERY MILDEW IN GRAPEVINE GENETIC RESOURCES

Table 1: Scale for resistance evaluation to powdery mildew on leaves – OIV 455 [11].
 Tabulka 1: Stupnice pro hodnocení odolnosti k padlí révy vinné na listech – OIV 455 [11].

Evaluation mark	Degree of resistance	Symptom description
1	A very low resistance	Very strong leaves infestation, almost all leaves are attacked, therefore they drop off
3	Low resistance	Leaves are almost covered with mycelium, many conidia appear. Most of leaves are infested, some of them drop off
5	Medium resistance	Infested leaves have small rounded spots. Normal conidia development. Medium of leaves infested.
7	High resistance	Bright spots at leaves. Weak mycelium formation. Small necrotic spots appear. Just single leaves infested.
9	A very high resistance	There are no disease symptoms at leaves

Table 2: Scale for resistance evaluation to powdery mildew on berries – OIV 456 [11].
 Tabulka 2: Stupnice pro hodnocení odolnosti k padlí révy vinné na bobulích - OIV 456 [11].

Evaluation mark	Degree of resistance	Symptom description
1	A very low resistance	Many berries at all grapes are infested by powdery mildew. Very strong fungus development. Frequent berries bursting and seed dropping
3	Low resistance	More than 30 % berries at all grapes infested by powdery mildew. Frequent berries bursting and seed dropping occur.
5	Medium resistance	Higher part of berries infested by powdery mildew. Up to 30 % berries infested. Most grapes show average infestation. None or unique berry bursting or seed dropping. Middle fungus fructification.
7	High resistance	Just few berries from all grapes infested. Only slightly covered with grey-white mycelium coating. No bursted berries.
9	A very high resistance	All berries are healthy, there is no berry bursting.

1996 – 2004 using genetic resources of grapevine plants collected in the experimental station Mendeleum situated in the locality Lednice na Moravě (the grapegrowing region of Mikulov, Czech Republic).

The resistance of plants to powdery mildew was analysed under field conditions without any artificial infection within the period of 1996 – 2004. In the course of the experiment no fungicides were applied. Research planting is organized in the 2,0 x 1,0 m distance between rows and plants. The training is medium with one trunk and one cane with 10 buds. Orientation of rows is N-S. Pruning, load of vines and vineyard management were identical during the whole experimental period.

Resistance was evaluated using the methodology described in [6]. Every year the symptoms of infection were followed from the end of July to the mid-August.

Altogether 25 leaves from the central part (6th– 8th node) of the leaf wall and 25 grapes were used for powdery mildew resistance evaluation. Leaves and grapes were randomly selected on 7 different vines.

Powdery mildew resistance has been evaluated using a scale published in the International list for grapevine varieties and species evaluation [11], in the Tabs. 1, 2.

Climatic parameters originated from meteor station in the distance 60 m from research planting. Table 3 show the mean month temperature, sum of rainfall and sunshine

Table 3. Climatic parameters from locality Lednice na Moravě.
Tabulka 3: Klimatické parametry na stanovišti Lednice na Moravě

	Average month temperature (°C)				Sum of rainfall(mm)				Sunshine (hours)			
	May	June	July	August	May	June	July	August	May	June	July	August
1996	15.9	18.7	18.3	18.8	65.7	44.6	36.9	96.1	201.3	269.6	251.4	205.8
1997	15.7	18.0	18.7	20.4	89.1	58.7	221.2	39.5	236.2	233.1	184.5	279.0
1998	15.7	19.5	20.4	20.1	25.8	101.1	57.0	42.4	247.5	235.4	216.5	257.0
1999	15.9	18.1	20.9	18.9	37.7	98.0	108.2	31.6	224.4	203.2	259.5	222.2
2000	17.6	20.0	18.2	20.8	27.3	39.0	143.1	51.0	274.4	302.2	155.4	274.3
2001	17.0	16.8	20.7	20.5	40.1	38.3	136.5	71.3	296.0	199.7	218.4	270.8
2002	17.5	19.5	21.4	20.1	33.5	63.3	106.0	148.2	208.0	259.5	352.2	187.6
2003	17.6	21.7	20.7	22.9	57.1	37.0	37.2	47.1	267.4	284.9	244.9	306.2
2004	13.7	17.6	19.7	20.3	27.7	99.4	58.9	31.6	214.2	195.2	210.6	248.9
1961-1990	14.5	17.5	19.1	18.4	57.7	66.4	59.8	50.0	225.8	230.2	241.4	233.5

Table 4: Intensity of attack and first symptoms of powdery mildew infection in Lednice na Moravě.
Tabulka 4: Intenzita napadení a prvních příznaků infekce padlím révy vinné v Lednici na Moravě.

Year	Intensity of attack	Date of the manifestation of the first symptoms
1996	medium	9 June
1997	Strong	27 June
1998	Strong	25 June
1999	Strong	1 July
2000	Low	25 July
2001	Strong	20 June
2002	Medium	17 June
2003	Medium	21 June
2004	Medium	1 July

hours in the research years and mean of 1961-1990.

Results were processed using statistical methods and given following features: average, and standard deviation. The variety influence on powdery mildew resistance was tested by means of Kruskal-Wallis analysis and Tukey test at the significance level $p < 0.05$ was used.

RESULTS AND DISCUSSIONS

Eco-friendly (organic) production is possible also due to the evaluation of grape genetic resistance to unfavourable biotic and abiotic factors and selection of varieties that are most resistant to diseases and winter frosts.

According to date of [19] is mentioned that especially young and just growing parts of plants are susceptible to

powdery mildew. Flower pedicels are therefore severely attacked shortly before flowering while young berries usually immediately after flowering` the reason is that because they grow very quickly in these periods. The sensitivity markedly decreases when the size of berries is greater than that of pea.

Climatic conditions of the locality as well as microclimatic conditions of the grapevine plantation are also very important for the spreading of powdery mildew infection and infestation of plants.

Conidia of powdery mildew germinate at temperatures from 6°C to 32°C, the optimum being 25°C. Germination and growth are rapid at 20°C to 27°C. At leaf and berry surface temperatures above 35°C, the germination of spores is inhibited. A high relative humidity increases

EVALUATION OF RESISTANCE TO POWDERY MILDEW IN GRAPEVINE GENETIC RESOURCES

Table 5: Evaluation of resistance leaves to powdery mildew infestation. Colours of berries: B – Blanc (white); N – Noir (black); RG – Rouge (rosé). Origin of variety: I – interspecific variety, V – variety of *Vitis vinifera* L.
 Tabulka 5: Hodnocení odolnosti k padlí révy vinné na listech. Barva bobule: B-bílá, N-modrá, RG-růžová.
 Původ odrůdy: I – interspecifická odrůda, V- odrůda *Vitis vinifera* L.

Variety	Colour of berries	Origin	Mean (x)	Standard deviation (Sx)	Min.	Max.
Ananasnyi	B	I	6.18 ^{efghij}	1.14	5.88	6.36
Aron	B	I	6.36 ^{efghijk}	1.20	5.96	6.84
Augustovskii	B	I	7.92 ^m	1.00	7.64	8.04
Cvetochnyi	B	I	5.28 ^{bcd}	1.10	4.68	6.04
Chasselas Blanc	B	V	2.36 ^a	1.30	1.96	2.84
Yalovenskii	B	I	7.32 ^{lm}		7.08	7.56
Ustoichyvii				0.74		
Jolanka	B	I	5.90 ^{defg}	1.57	5.24	6.76
Kristalli	B	I	6.50 ^{ghijk}	1.25	6.36	6.68
L-2-14	B	I	5.72 ^{bede}	1.12	5.32	6.28
Panonia Kincse	B	V	2.28 ^a	1.12	1.96	2.68
Pölöskei	B	I	7.80 ^m		7.40	7.96
Muskotály				0.98		
Palatina	B	I	5.90 ^{defg}	1.28	5.32	6.52
Rusmol	B	I	6.06 ^{efghi}	1.12	5.40	6.68
Startovyi	B	I	5.84 ^{cdef}	1.21	5.24	6.20
Suzi	B	I	5.84 ^{cdef}	1.28	5.00	6.52
Ustoichivii	B	I	5.98 ^{efgh}		5.56	6.28
Dokuchaevoi				1.04		
Vostorg	B	I	6.86 ^{kl}	0.95	6.44	7.24
Pleven Ustoichyvi	B	I	6.98 ^{kl}	1.52	6.44	7.88
V-46-40	B	I	5.22 ^{bc}	1.36	4.60	5.88
BV-18-29	RG	I	6.16 ^{efghij}	1.21	5.56	6.84
Chasselas Rouge	RG	V	2.22 ^a	1.33	1.88	2.76
VII-25-41	RG	I	5.08 ^b	1.10	4.60	5.64
XV-7-72	RG	I	6.80 ^{kl}	1.25	6.68	7.16
Agat Donskoi	N	I	5.10 ^b	1.18	4.20	5.88
Aivaz	N	I	6.74 ^{ijkl}	1.29	6.44	7.08
Alden	N	I	6.10 ^{efghij}	1.15	5.88	6.44
Dachnyi	N	I	5.32 ^{bcd}	1.35	4.84	5.96
Kodryanka	N	I	6.44 ^{fghijk}	1.03	6.28	6.60
Kutuzovskii	N	I	6.56 ^{hijk}	1.23	6.36	6.76
Nero	N	I	6.68 ^{ijkl}	1.35	6.44	6.92
Olsava	N	V	2.18 ^a	1.18	1.80	2.60
Smuglyanka	N	I	6.50 ^{ghijk}	1.31	6.28	6.84
Moldavskaya						

the sporulation. Free water from rains or irrigation may cause a poor germination of conidia.

The intensity of attack and the date of the manifestation of first symptoms in individual years of research, as resulting from the best conditions for the onset infection of in the locality Lednice na Moravě are presented in Tab. 4.

Results of the evaluation of powdery mildew infestation

of individual genetic resources of grapevines are very important not only with regard to the use of individual varieties in the process of selection and breeding but also from the viewpoint of the introduction of new varieties into the viticultural practice, especially when producing organic wine.

Vogt & Schruft [18] observed that in all cases when a defensive reaction of plants was quicker than the fungus

Table 6: Evaluation of resistance of berries to powdery mildew infestation. Colours of berries: B – Blanc (white); N – Noir (black); RG – Rouge (rosé). Origin of variety: I – interspecific variety, V- variety of *Vitis vinifera* L.

Tabulka 6: Hodnocení odolnosti k padlí révy vinné na bobulích. Barva bobule: B-bílá, N-modrá, RG-růžová. Původ odrůdy: I – interspecifická odrůda, V- odrůda *Vitis vinifera* L..

Variety	Colour of berries	Origin	Mean (x)	Standard deviation (Sx)	Min.	Max.
Ananasnyi	B	I	6.36 ^{fghi}	1.20	5.80	6.92
Aron	B	I	6.77 ^{ghijk}	1.22	5.96	7.80
Augustovskii	B	I	7.82 ^{mn}	1.10	7.40	8.28
Cvetochnyi	B	I	5.66 ^{cde}	1.30	4.76	6.28
Chasselas Blanc	B	V	3.16 ^b	1.57	2.04	4.76
Yalovenskii	B	I	7.42 ^{klm}		6.68	7.96
Ustoichyvii				1.18		
Jolanka	B	I	6.58 ^{fghij}	1.15	6.04	7.24
Kristalli	B	I	7.52 ^{lm}	1.12	6.52	8.12
L-2-14	B	I	6.04 ^{def}	1.25	5.64	6.60
Panonia Kincse	B	V	2.56 ^{ab}	1.35	1.64	3.48
Pölöskei	B	I	8.24 ⁿ		7.88	7.88
Muskotály				0.98		
Palatina	B	I	6.38 ^{fghi}	1.41	5.80	7.16
Rusmol	B	I	6.12 ^{defg}	1.25	5.48	6.44
Startovyi	B	I	6.42 ^{fghi}	1.25	5.72	6.92
Suzi	B	I	6.44 ^{fghi}	1.51	5.40	7.56
Ustoichivii	B	I	6.06 ^{def}		5.56	6.52
Dokuchaevoi				1.25		
Vostorg	B	I	6.64 ^{fghij}	1.00	6.36	6.92
Pleven	B	I	7.26 ^{jkm}		6.36	8.44
Ustoichyvi				1.32		
V-46-40	B	I	5.64 ^{cd}	1.45	4.36	6.44
BV-18-29	RG	I	6.16 ^{defg}	1.28	5.88	6.92
Chasselas Rouge	RG	V	2.70 ^{ab}	1.49	1.83	4.12
VII-25-41	RG	I	5.34 ^c	1.51	4.28	6.36
XV-7-72	RG	I	6.94 ^{ijk}	1.19	6.04	7.64
Agat Donskoi	N	I	5.56 ^{cd}	1.31	4.92	6.28
Aivaz	N	I	6.78 ^{ghijk}	1.10	6.04	7.40
Alden	N	I	6.34 ^{efghi}	1.24	5.80	6.92
Dachnyi	N	I	6.10 ^{defg}	1.22	5.40	6.92
Kodryanka	N	I	6.22 ^{defgh}	1.30	5.08	6.92
Kutuzovskii	N	I	6.78 ^{ghijk}	1.36	5.88	8.12
Nero	N	I	6.86 ^{hijk}	1.34	6.68	7.00
Olsava	N	V	2.36 ^a	1.27	1.72	3.08
Smuglyanka	N	I	6.52 ^{fghi}		5.88	7.08
Moldavskaya				1.31		

infection a further fungus proliferation was low or even zero. Such plants could be classified as resistant. However, in case that the pathogen fights off the defence mechanism of its host plant, it can further develop and proliferate. In such a case it can be concluded that the host plant is sensitive and that the disease break out.

In 1996 – 2004, the average resistance of leaves of all tested varieties was 5.76. The most resistant varieties to the powdery mildew infestation of leaves were the following: Augustovskii (7.92), Pölöskei Muskotály (7.80), Yalovenskii Ustoichyvii (7.32), Pleven Ustoichyvii (6.98), and XV-7-72 (6.90). The lowest resistance among

Table 7 Correlation coefficients existing between the resistance of leaves and berries to powdery mildew according to the genetic origin of varieties and/or colour of berries of individual varieties.

Tabulka 7: Korelační koeficienty mezi odolností k padlí révy vinné na listech a bobulích v závislosti na genetickém původu odrůd a barvě bobulí jednotlivých odrůd.

<u>Genetic origin of grapevine variety</u>	<u>Correlation</u>
All varieties	0,64**
Interspecific varieties	0,34**
<i>V. vinifera</i> varieties	0,23**
<u>Colour of berries</u>	
White varieties	0,64**
Rosé varieties	0,70**
Black varieties	0,56**

reviewed varieties from the group of interspecific varieties was found in the following: Cvetochnyi (5.28), Jolanka (5.90), V-46-40 (5.22), Agat Donskoi (5.10), and Dachnyi (5.32). As far as the species *Vitis vinifera* L. was concerned, the most resistant against powdery mildew infestation of leaves was Chasselas Blanc.

The effect of individual varieties on the resistance of leaves to powdery mildew was evaluated using the Kruskal-Wallis single factorial analysis. $Q = 1,629.99$ was the value, which was calculated for the effect of the variety on the resistance against powdery mildew infestation of leaves. Basing on the comparison of this calculated value with the table value $\chi^2_{(0.05)}$ (i.e. 43.80) it was demonstrated that the effect of the variety on the resistance of leaves to powdery mildew infestation was also statistically highly significant.

Results of a detailed evaluation and of Tukey test of resistance of varieties under study to the powdery mildew infestation of leaves within the experimental period are presented in Tab. 5

The average degree of resistance of berries for all varieties tested withing the period of 1996 – 2004 was 6.05. During this period, the most resistant varieties to powdery mildew infestation of berries were the following: Pölskei muskotály (8.24), Augustovskii (7.82), Yalovenskii Ustoichyvii (7.42), and Pleven Ustoichyvii (7.26). In the group of interspecific varieties the lowest degree of resistance was found in the following: Cvetochnyi (5.66), V-46-40 (5.64), and Agat Donskoi (5.56). In the group of *Vitis vinifera* L., Chasselas Blanc was the variety with the highest degree of resistance to powdery mildew infestation of berries.

The effect of individual varieties to the resistance of berries to the powdery mildew investigation was evaluated using Kruskal-Wallis single factorial analysis and $Q = 1,464.15$ was the value, which was calculated for

the effect of the variety on the resistance against powdery mildew infestation of berries. Basing on a comparison of this calculated value with table value $\chi^2_{(0.05)}$ (i.e. 43.80) it was demonstrated that effect of the variety on the resistance of berries to the powdery mildew resistance was also statistically highly significant.

Results of a detailed evaluation and of Tukey test of resistance of varieties under study to the powdery mildew infestation of leaves within the experimental period are presented in Tab. 6.

A high degree of resistance to powdery mildew infestation of leaves and berries was demonstrated in varieties Augustovskii, Jalovenskii Ustoichyvii, Pölskei Muskotály and Pleven Ustoichyvii.

Similar results were published also by other authors. As mentioned in [17], Smuglyanka Moldavskaya and Yalovenskii Ustoichyvii are varieties with a high degree of resistance. According to date of [16] suggested a high degree of resistance to powdery mildew infestation in Pölskei Muskotály, a medium degree in Nero and Suzi and a low degree in Palatina. According to date of [1] demonstrated a high degree of resistance to powdery mildew infestation of leaves in varieties Kutuzovskij, Augustovskij, and Krystal. The variety Aivaz can be classified as medium-resistant.

Varieties Cvetochnyi and Agat Donskoi belong to the group of hybrids with the botanical species *Vitis amurensis*; for these varieties a medium resistance to powdery mildew infestation of leaves and berries was demonstrated.

These conclusions correspond with results published by [10]. This author mentioned that varieties of *V. amurensis* origin obtained from different breeding showed a low tolerance to powdery mildew.

It was also possible to confirm a lower resistance of some hybrids with *V. amurensis* to powdery mildew. Varieties

of *V. vinifera* showed a low degree of resistance to powdery mildew.

From the viewpoint breeding and selection of grapevine on the base of resistance to fungal diseases and also with regard to the introduction of new varieties into the viticultural practice it is very important to analyse the correlations existing between the infestation of plants with major fungal diseases of the one hand and their genetic and phenotypic traits on the other.

In our experiment this concerned correlations existing between the resistance of leaves and berries to infestation with powdery mildew according genetic origin of varieties and/or colour of berries of individual varieties. The results are presented in Tab. 7.

Correlations between the resistance of leaves and berries to infestation with powdery mildew according to the colouration of berries are very important. The lowest values of correlation coefficients were observed in the group of black berries ($r = 0.56^{**}$) while the highest ones in the group of rosé berries ($r = 0.70^{**}$).

Similar correlations were published also by some other authors. According to date of [7] is a correlation coefficient of resistance to powdery mildew infestation of leaves and berries to be 0.55 for all observed genotypes (min = 0.35; max = 0.80). According to [5] wrote that the relative susceptibility of leaves corresponded with the relative susceptibility of fruit. The correlation coefficients of this comparison were 0.84 and 0.77 for two different dates of evaluation.

Pospíšilová [12] also found in 926 varieties of *Vitis vinifera* L. that the occurrence of powdery mildew on berries was in a close relationship with its occurrence on leaves.

From the viewpoint of breeding and selection of grapevines those varieties are prospective, which show a very high or high degree of resistance to powdery mildew. In our experiments, which involved altogether 32 varieties of grapevine, such a high degree of resistance was found out only in 4 of them. However, our long-term experiences indicate that for practical purposes of organic grape production it is possible to use also those varieties that show only a medium degree of resistance.

CONCLUSIONS

During the period 1996 - 2004 32 table varieties (28 interspecific varieties, 4 varieties of *Vitis vinifera*) were observed with regard to their resistance to powdery mildew infestation of leaves and berries under field conditions.

A high degree of resistance to powdery mildew infestation of leaves and berries was demonstrated in

varieties Augustovskii, Yalovenskii Ustoichivyi, Pölskei Muskotály and Pleven Ustoichivii. It was also possible to confirm a lower degree of resistance to powdery mildew in some hybrids with *V. amurensis*. Varieties of *V. vinifera* showed a low resistance to powdery mildew.

The obtained results are important from the viewpoints of selection and breeding of grapevine for the resistance to fungal diseases and of introduction of new varieties into the viticultural practice.

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