Virulence Complexity and its Increasing in the Czech Population of *Blumeria graminis* f.sp. *hordei*

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Abstract

The virulence frequency to 12 resistance genes present in the studied cultivars in the time before their first using in grown cultivars were estimated mainly based on the data of cultivar resistance in the field. The estimated virulence frequency is compared with results obtained from investigations of the air pathogen population in 2001. The comparison shows that virulence complexity increased from about 0.90 in 1971 to 8.73 in 2001. The increase in virulence complexity was caused by necessity of the pathogen to survive on cultivars possessing respective resistance genes, it means by direct selection [(*Va1*, *Va6*, *Va7*, *Va9*, *Va13*, *Vat*, *Vk1*, *VLa*, *Vg* and *V(Kr)*], indirect selection (*Va12*) and immigration (*Va3*).

Keywords: barley; *Blumeria graminis* f.sp. *hordei*; *Erysiphe graminis* f.sp. *hordei*; powdery mildew; resistance genes; virulence complexity; virulence frequency

INTRODUCTION

Powdery mildew caused by *Blumeria graminis* f.sp. *hordei* fungus induces 50% of all epidemics on spring barley (*Hordeum vulgare* L.) in the Czech Republic (DREISEITL & JUREČKA 1996). Genetic resistance is an economic and safe alternative of a disease control method. The pathogen population, however, is able to adapt to host resistances, as well as fungicides (LIMPERT & FISCHBECK 1987). The frequency of corresponding virulences increases therefore the virulence complexity of individuals in the population is also growing. A general cause of increasing the virulence complexity is the presence of specific resistance genes in grown cultivars (BROWN & JØRGENSEN 1991; DREISEITL & JØRGENSEN 2000) and adaptation of the pathogen population to these resistances.

MATERIALS AND METHODS

The 11 selected spring barley cultivars are the first ones possessing 12 resistance genes to powdery mildew in the Czech Republic. To detect resistance of these cultivars in the field, selected data on testing within the State Variety Trials at locations characteristic of severe powdery mildew incidence were used in the first years of their examination. The frequency of virulences to resistance genes present in the studied cultivars were estimated based on these data on cultivar resistance in the field and with regard to the data on virulence frequency in neighbouring countries. The estimated virulence frequency is compared with results obtained from investigations of the air pathogen population in 2001.

RESULTS AND DISCUSSION

The selected cultivars of spring barley, their genes for resistance to powdery mildew and field resistance in the respective year as well as earlier estimated and actually assessed virulence frequencies are given in Table 1. In 1971, the cultivar Merkur (registered in 1964) and another cultivars carrying the gene *Mlg* occupied about 20% of domestic area under spring barley. The cultivars with this gene were also cultivated in Germany. Though Merkur exhibited a relatively good resistance, resistance in other cultivars possessing the gene *Mlg* was lower. Therefore, the frequency of *Vg* in 1971 can be estimated up to 30%. The limited extent of this contribution does not allow to give the following estimates in greater detail.

The frequency of virulences *Va12*, *Vk1* and *VLa* could range to 10% prior to growing home cultivars with

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Table 1. Selected spring barley cultivars, their resistance genes to powdery mildew, resistance in the field, estimations of virulence frequency in the year studied and virulence frequency assessed in 2001

Cultivar	Resistance gene examined	Resistance in the field[1]	Year of resistance observation	Estimation of virulence frequency (%)	Virulence frequency 2001 (%)
Merkur	*Mlg*	6.6	1971	<30	97
Ametyst	*Mla6*	7.2	1971	<5	88
Elgina	*Mla7*	8.6	1971	<5	96
KM-1192	*Ml(Kr)*	9.0	1973	0	84
Spartan	*Mla9*	8.2	1975	0	58
Spartan	*Mlk1*	8.2	1975	<10	58
Zefir	*Mla12*	6.0	1978	<10	76
Opal	*MlLa*	5.8	1978	<10	93
Karat	*Mla13*	9.0	1979	0	84
Rubin	*Mla1*	6.2	1980	<5	39
Mars	*Mla3*	6.8	1980	<5	21
Jaspis	*Mlat*	7.2	1984	<10	79
Sum				90	873

[1]Scoring scale 1–9, 9 = resistant

corresponding resistance genes. Also the frequency of virulences *Vat* is estimated to 10% in spite of that Jaspis is the first European cultivar carrying the gene *Mlat*. The frequency of *Vat* was 36% in 1993 (DREISEITL 1997). The frequency of virulences *Va1*, *Va3*, *Va6* and *Va7* can be estimated to 5% because trapping cultivars with the genes *Mla1*, *Mla3* and *Mla6* were infected by powdery mildew at one location (South Moravia) as early as 1963 (BRÜCKNER 1965). An isolate virulent on *Mla9* was derived from a trapping cultivar in the mid-eighties; *Va13* and *V(Kr)* were not found at all in that period.

The comparison of estimated virulence frequencies with those found in 2001 clearly shows that average virulence complexity in individuals of the pathogen population to 12 examined resistance genes increased from about 0.90 in 1971 to 8.73 in 2001. The increase in virulence complexity was caused by necessity of the pathogen to survive on cultivars possessing respective resistance genes, it means by direct selection (*Va1*, *Va6*, *Va7*, *Va9*, *Va13*, *Vat*, *Vk1*, *VLa*, *Vg* and *V(Kr)* (DREISEITL 2000a), indirect selection (*Va12*) (DREISEITL 2000b) and immigration (*Va3*) (DREISEITL 2001).

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