# Aggressiveness Variation in Czech Isolates of *Erysiphe cichoracearum* Pathotype AB1B2CCm

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**Introduction.** *Erysiphe cichoracearum* /*Ec*/ is the predominating powdery mildew species on cucurbits in the Czech Republic (5). Its occurrence and spreading on cucurbits can be influenced not only by virulence, but also by aggressiveness of isolates within natural pathogen populations. Both forms of pathogenicity have an impact on plant cultivation and protection and should be considered in resistance breeding. The purpose of this study was to describe the aggressiveness variation within a group of *Ec* isolates of a known pathotype.

**Material and Methods.** A total of 27 *Ec* isolates were collected from field cultures of cucurbits (*Cucurbita pepo*, *C. maxima*, *Cucumis sativus*) at different regions of the Czech Republic in 1997-1998. They were maintained *in vitro* on the cotyledons of *Cucumis sativus* cv. Marketer according to Bertrand (2).

The determination of pathotypes followed the methods proposed by Bertrand (2). The set of differential plant genotypes was composed by *Cucumis sativus* cv. Marketer (A), *Cucumis melo* genotypes Védrantais (B1) and PMR 45 (B2), *Cucurbita pepo* cv. Diamant F1 (C), *Cucurbita maxima* cv. Goliáš (Cm) and *Citrullus lanatus* cv. Sugar Baby (D). Seeds of *C. pepo* and *C. lanatus* were provided by Dr. F. Bertrand (France), seed material of *C. melo* genotypes was supplied by Dr. M. Pitrat (France), *C. sativus* and *C. maxima* originated from the Czech germplasm collection (RICP, Gene Bank workplace in Olomouc).

Response of differential genotypes to the *Ec* isolates was evaluated *in vitro* as described by Bertrand (2). Leaf discs 1.5 mm in diameter were cut out from well developed leaves of plants 6-9 weeks old and placed on agar medium in Petri dishes. Each genotype was represented by five discs in at least two replications. Leaf discs were inoculated by dusting with powdery mildew conidia from *C. sativus* cotyledons. Incubation of isolates was performed in a growth chamber with day/night temperatures of 17 ºC/15 ºC and a 12-h photoperiod with a light intensity of 100.9 $\mu mol\ m^{-1}s^{-1}$.

Intensity of mycelium growth and sporulation on each disc was assessed visually 4, 7, 10 and 14 days after inoculation on a scale of 0 (no mycelium growth) to 4 (more than 75% of disc surface covered by mycelium) according to Lebeda (8). On a given genotype, isolates with an average intensity of sporulation 0-1 at the time of last evaluation were classified as avirulent and those with scores 2-4 were considered virulent as proposed by Bardin et al. (1). The pathotype formula of isolate indicates compatible response of differential genotypes.

Within a group of 27 *Ec* isolates pathotypes AC, ACm, ACCm, ACCmD, AB1C, AB1CD, AB2C, AB1B2, AB1B2CCm, AB1B2CCmD, B1B2C and B1B2CCmD were distinguished. As the pathotype AB1B2CCm was represented by 30% of isolates tested, the aggressiveness study was aimed at this group.

The aggressiveness of isolates was derived from their infection development. The average value of infection degree (ID) on each differential genotype was expressed as a % of disc surface covered by mycelium at time of each evaluation. The value of total infection degree (TID-%) was counted from all subsequent evaluations as a percentage of maximum potential score. Data were treated statistically by one-way analyses of variance and LSD multiple range analyses in a programme Statgraphics (3).

**Results and Discussion.** *Ec* isolates of pathotype AB1B2CCm were collected in five distinct districts of the Czech Republic (Table 1), representing different eco-geographic conditions as summarized

Table 1. Origin and aggressiveness of *Erysiphe cichoracearum* isolates (pathotype AB1B2CCm) on differential genotypes

| Isolate number | Host plant | District | TID (%) on differential genotypes A | B1 | B2 | C | Cm | D | mean TID(I) |
|---|---|---|---|---|---|---|---|---|---|
| 6/98 | *C. pepo* | Třebíč | 31.2 | 14.6[H] | 16.7 | 52.1 | 31.2 | 16.7 | 29.16 a* |
| 29/97 | *C. pepo* | Olomouc | 27.5 | 31.2 | 33.4 | 15.0[H] | 46.3 | 0.0 | 30.42 a |
| 11/97 | *C. maxima* | Kolín | 41.6 | 27.1 | 33.3 | 36.3 | 37.5 | 8.3 | 35.16 a |
| 70/98 | *C. maxima* | Olomouc | 27.1 | 25.0 | 25.0 | 79.2 | 27.1 | 6.2 | 36.68 a |
| 44/97 | *C. pepo* | Olomouc | 93.8 | 68.8 | 29.2 | 11.3[H] | 36.3 | 3.8 | 47.88 ab |
| 38/97 | *C. pepo* | Blansko | 65.0 | 54.2 | 31.2 | 38.8 | 68.8 | 10.0 | 51.60 ab |
| 23/97 | *C. maxima* | Prostějov | 81.3 | 60.4 | 50.0 | 81.3 | 46.3 | 0.0 | 63.86 b |
| 20/97 | *C. sativus* | Olomouc | 73.8 | nd | nd | 58.8 | 67.5 | 0.0 | 66.70 b |
| mean TID (G) | | | 55.16c* | 31.26b | 40.19bc | 46.60bc | 44.96bc | 5.63a | |

differential genotypes:
A *C. sativus* cv. Marketer
B1 *C. melo* Védrantais
B2 *C. melo* PMR 45
C *C. pepo* cv. Diamant F1
Cm *C. maxima* cv. Goliáš
D *C. lanatus* cv. Sugar Baby

mean TID (I) do not include TID (%) on genotype D
* - homogeneous groups (LSD 95%)
nd - aggressiveness (TID) not determined
[H] - heterogeneous response

on the web site http://www.chmi.cz/meteo/ok/. The district of Třebíč, situated on the Bohemian-Moravian Highlands with the average air temperature during vegetative period of 12.6 ºC, is considered to be the coldest one. The average temperature increases in districts of Blansko, Prostějov and Olomouc. The average air temperature during the vegetative period of 15.2 ºC in Olomouc is similar to the situation in Kolín, which is situated in Labe river aluvium in the warm region of Bohemia.

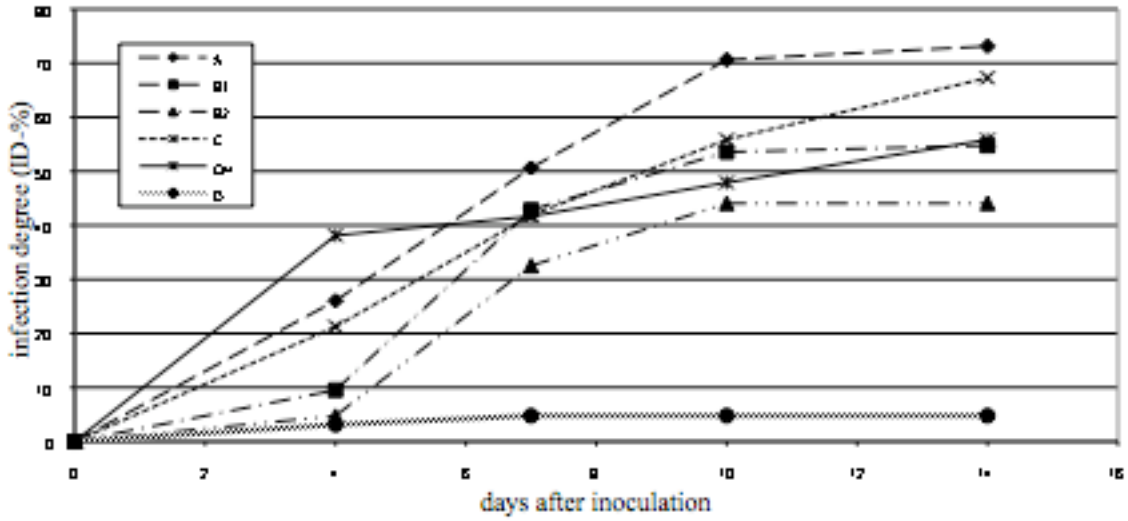
The mean values of total infection degree TID(I) of each *Ec* isolate counted from TID´s on differential genotypes A, B1, B2, C and Cm are considerably variable. The aggressiveness of isolates is not in relation to the original climatic conditions. According to the mean TID(I), isolates from opposite climatic conditions (districts of Třebíč and Kolín) were ranged to the same homogeneous group and on contrary, individual isolates from district of Olomouc expressed different levels of total infection degree (Table 1). Similar phenomenon was reported for some other powdery mildews, e.g. by Suliman et al (11) for *Leveillula taurica* isolates on pepper.

Isolates under study were collected on three different host plant species - cucumber, squash and pumpkin. The number of isolates from each species corresponds to the recent epidemiological observations in the Czech Republic (5). While *C. pepo* and *C. maxima* are common hosts of Erysiphales, the powdery mildew infection occurs on cucumbers only under conditions of high infection pressure. The *Ec* isolate 20/97 was collected on *C. sativus* in a proximity of greenhouse with heavily infected cucurbits.

The mean TID(I) value for *Ec* isolates from *C. pepo* was 39.77, for isolates from *C. maxima* 45.23 and for one isolate from *C. sativus* 66.70. These data have only an informative value. For the explanation of potential role of original host plant species on isolate aggressiveness further studies should include a larger host plant species spectrum.

The aggressiveness of *Ec* isolates on differential genotypes expressed by values TID(G) varied significantly (Table 1). Isolates of the same virulence (pathotype AB1B2CCm) were the most aggressive on the genotype A (*C. sativus*) with the mean value

Figure 1.Infection development of *E. cichoracearum* isolates pathotype AB1B2CCm on pathotype differential genotypes



of TID(G) = 55.16. Interactions with genotypes C (*C. pepo*), Cm (*C. maxima*) and B2 (*C. melo* PMR 45) resulted in medium level of total infection degree. The mean value of TID(G) on *C. melo* Vědrantais (genotype B1) was 31.26 only. A sporadic mycelium growth on *C. lanatus* (genotype D) leaf discs was recorded for five isolates, exhibiting low and/or medium level of their general aggressiveness capacity (TID/I/). These results correspond with data given by Sittterly (10) that within Cucurbitaceae cucumbers, squashes and pumpkins are generally highly susceptible to the powdery mildew infection and watermelons are the most resistant ones. The response of melons (*C. melo*) in genotype depending. The values TID(G) are in positive relation to the frequency of cultivation of each species in the Czech Republic. While cucumbers, squashes and pumpkins are commonly cultivated crops, growing melons and watermelons is very limited.

The infection development of *Ec* isolates on differential genotypes is given by the Figure 1. The infection development on Cm genotype (*C. maxima*) was very fast during first four days after inoculation, during the next ten days the infection progress was comparatively slower and finally the infection degree reached a medium value when compared to the infection development on other genotypes. The trend of infection development on genotypes B1, B2 (*C. melo*), C (*C. pepo*) and A (*C. sativus*) was similar with differences in absolute values of disease infection on each genotype. Within this group the genotype A was the most susceptible one at time of each evaluation and at the final evaluation the infection degree reached the maximum value (Figure 1). No substantial changes in mycelium development on genotypes A, B1, B2 and D between third and fourth evaluations were recorded, but infection degree on genotypes C and Cm increased at that period at ca 10%. Such phenomenon can be influenced by host leaf tissue capacity in providing substrate for pathogen continuous development.

In spite of the above mentioned general characterization of isolates, the infection development of individual isolates on each genotype varied considerably. A heterogeneous response of genotypes B1 and C to three isolates was noticed (Table 1). Isolates 23/97, 38/97 and 44/97 were partly virulent also to the *C. melo* line MR-1 which is considered as resistant to the powdery mildew (7). Their infection degrees on this genotype evaluated on leaf discs *in vitro* reached the values of 16.7, 25.0 and 8.3 at time of the last evaluation (14 days after inoculation) (7). Virulence of *Ec* isolates on *C. lanatus* (genotype D) was already reported by Křístková and Lebeda (6). Virulent isolates originated from the same district (Třebíč) as isolate 6/98 with the highest value of TID on this genotype.

Differences in aggressiveness within individual isolates were not associated with original host plant species and/or region of their collecting. Both temperature and host plant species influence *Ec* conidia size under natural conditions (4). Similarly the relation between temperature and aggressiveness of isolates was described for a group of obligate biotrophs – downy mildews, e.g. by Pietrek and Zinkernagel (9). The effects of original climatic conditions and temperature during *in vitro* cultivation on isolate aggressiveness should be studied in more details.

*Ec* isolates under study were the most aggressive on cucumber under *in-vitro* conditions, but recently the powdery mildew infection is very rare under field conditions of the Czech Republic. This phenomenon can be explained by occurrence of cucumber downy mildew (*Pseudoperonospora cubensis*) and by competition mechanisms between both groups of pathogens (obligate biotrophs) resulting in elimination of powdery mildew. This situation can contribute to future changes in pathogenicity of *Ec* populations and their geographic distribution.

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