Aggressiveness of Powdery Mildew Isolates on *Cucurbita maxima*

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Introduction. Pathogenicity of Czech isolates of cucurbit powdery mildew (*Erysiphe cichoracearum (Ec)* and *Sphaerotheca fuliginea (Sf))* on cucurbitaceous vegetables have been studied both on the level of their virulence and aggressivenes. Several *Ec* and *Sf* pathotypes previously described by Bertrand (2) were identified and new reaction patterns were recognized (4). Moreover some isolates were virulent also to watermelon (5) and one *Ec* isolate was virulent to *C. melo* MR-1 (6). The purpose of this study was to evaluate the aggressiveness of *Ec* and *Sf* isolates on *Cucurbita maxima* and to consider the influence of leaf side of this host genotype on the development of powdery mildew infection under controlled conditions.

Materials and Methods. A total of 15 *E. cichoracearum* and 8 *S. fuliginea* isolates collected from field cultures of cucurbits (*Cucurbita pepo*, *C. maxima*, *Cucumis sativus*) at seven distinct regions of the Czech Republic in 1997 were used for this study. Isolates were obtained from single spore lesions on leaves. Isolates were maintained *in-vitro* on the cotyledons of *Cucumis sativus* cv. Marketer according to methods described by Bertrand (2). For the determination of pathotypes the methods and differential plant genotypes proposed and kindly provided by Bertrand (2) were used. Czech *C. maxima* cv. Goliáš (accession number 09-H39-0137) originated from Gene Bank RICP in Olomouc (Czech Republic)

For the aggressiveness tests host material was prepared and inoculated separately from assays for pathopype determination. Leaf discs of 1.5 mm in diameter were cut out by a cork borer from well developed leaves of *C. maxima* cv. Goliáš plants 6-9 weeks old and placed either abaxial and adaxial sides on agar medium in Petri dishes. Aggressiveness of each isolate was evaluated on five discs in two replications for each side position. The inoculation was performed by spraying inoculum on discs. The inoculum was prepared by washing cucumber cotyledons with mycelium and conidia in water with addition of Tween. The number of conidia was approx. $55x10^3$ in 1 ml of suspension.

Intensity of sporulation on each disc was assessed visually 7, 10, 14 and 17 days after inoculation on a scale of 0 (no sporulation) to 4 (more than 75% of disc surface covered by mycelium) (7). The value of infection degree (ID) was counted for each isolate separately on the upper- (ID-u) and lower- (ID-l) leaf sides and a 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 Sheffe multiple range analyses in the programme Statgraphics (3).

Results and Discussion. Within isolates under study a total of three *Ec* pathotypes and two *Sf* pathotypes have been identified (Table 1). The average values of infection degree for *C. maxima* response to *Ec* were on the upper leaf side %TID-u = 34.3 (ab) and on the lower leaf side %TID-l = 22.3 (a), average values characterizing response of host genotype to *Sf* were on the upper leaf side %TID-u = 57.1 (b) and on the lower leaf side %TID-l = 37.2 (ab). Multiple range analyses (99%, Sheffe) proved differences between obtained values. Generally, the species *Ec* was less aggressive to *C. maxima* than *Sf* on both sides of leaf discs and the infection of both powdery mildew species (*Ec,Sf*) was more severe on the upper leaf disc side as compared to the response of the lower disc side. The curves characterizing infection development on each leaf side were similar for both powdery mildew species (Figure 1). During first seven days after inoculation the infection development of both *Ec* and *Sf* was faster on the upper leaf side, than during next three days this process accelerated on the lower side.

Table 1. Aggressiveness of powdery mildew isolates on *Cucurbita maxima* cv. Goliáš

Isolate number	Pathotype[x]	TID(%)[y] upper	TID(%)[y] lower	Host plant[z]	Region
E. cichoracearum					
3/97	nd	7.5	3.8	*C. maxima*	Olomouc
40/97	AB1B2CCm	15.0	3.8	*C. pepo* SC	Prostějov
15/97	nd	20.0	0.0	*C. pepo* ZU	Prostějov
30/97	nd	25.0	1.3	*C. pepo* ZU	Prostějov
41/97	AB1B2CCm	25.0	25.0	*C. pepo* ZU	Prostějov
19/97	AB1B2CCm	27.5	13.8	*C. maxima*	Praha
17/97	ACm	36.3	26.3	*C. pepo* PU	Prostějov
44/97	AB1B2CCm	36.3	42.5	*C. pepo* VM	Olomouc
29/97	AB1B2CCm	45.0	6.3	*C. pepo* ZU	Olomouc
23/97	AB1B2CCm	46.3	54.7	*C. maxima*	Prostějov
20/97	AB1B2CCm	67.5	33.7	*C. sativus*	Olomouc
38/97	AB1B2CCm	68.8	28.8	*C. pepo* ZU	Brno
25/97	ACCm	70.0	35.0	*C. pepo* ZU	Brno
average		**34.3 ab[1]**	**22.3 a[1]**		
S.fuliginea					
13/97	AB1CCm	40.0	17.5	*C. pepo* ZU	Kolín
36/97	AB1-CCm	45.0	42.5	*C. maxima*	Šumperk
32/97	nd	48.4	26.3	*C. pepo* ZU	Olomouc
34/97	AB1CCm	55.6	71.3	*C. pepo*	Olomouc
16/97	nd	58.8	12.5	*C. pepo* ZU	Olomouc
26/97	AB1CCm	60.0	77.5	*C. maxima*	Olomouc
37/97	AB1CCm	70.0	10.0	*C. pepo* ZU	Kroměříž
10/97	AB1Cm	78.8	40.0	*C. maxima*	Olomouc
average		**57.1b[1]**	**37.2ab[1]**		

[x] compatible reaction on:

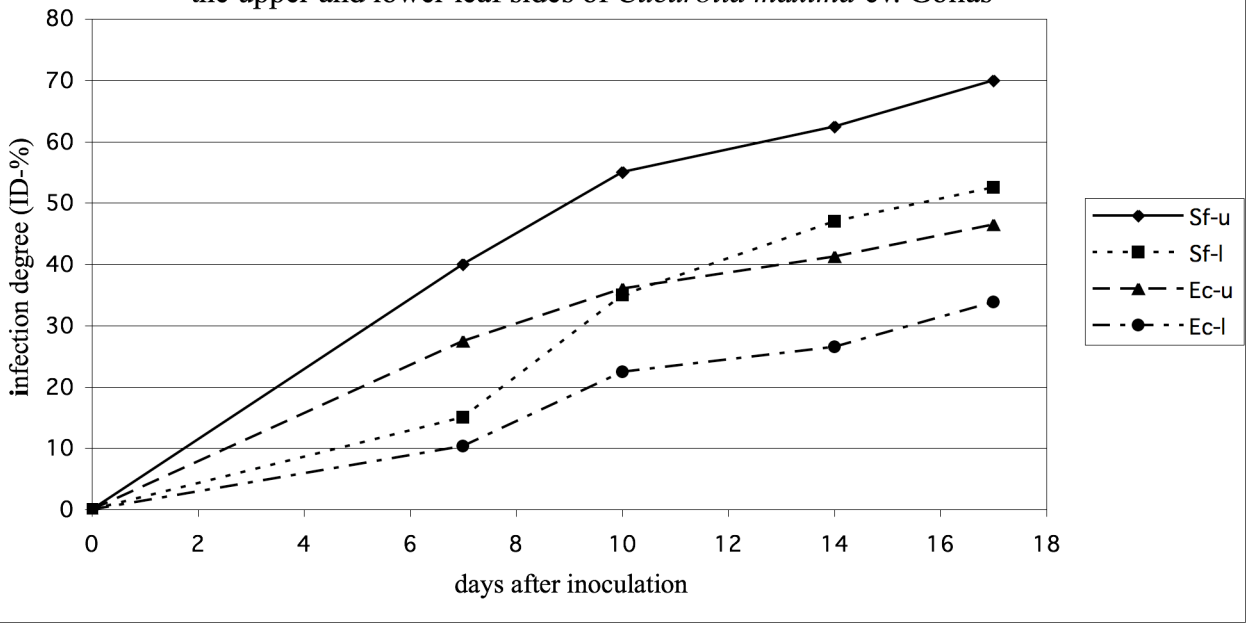
A	*C. sativus* cv. Marketer	C	*C. pepo* cv. Diamant F1
B1	*C. melo* Védrantais	Cm	*C. maxima* cv. Goliáš
B2	*C. melo* PMR 45	D	*C. lanatus* cv. Sugar Baby

[y] Total infection degree on lower and upper leaf side of *C. maxima*

[z] *C. pepo* morphotype according to Paris (9): PU pumpkin, SC scallop, VM vegetable marrow, ZU zucchini

[1] Homogeneous groups (Multiple range analyses, 99%, Sheffe)

Figure 1. Infection development of *E. cichoracearum* and *S. fuliginea* on the upper and lower leaf sides of *Cucurbita maxima* cv. Goliáš



A large variability of aggressiveness within individual isolates of both fungi was found. Similar phenomenon was mentionned also by Bardin et al. (1). *Ec* isolates with different virulence (e.g. 25/97 and 38/97) expressed very similar aggressiveness on both leaf sides of *C. maxima* and, on contrary the aggressiveness of *Ec* isolates virulent to the same spectrum of differential plant species (e,g, 38/97 and 40/97) was quite different. *Sf* isolates 34/97 and 37/97 with the same reaction pattern on differential genotypes proved different aggressiveness on both sides of *C. maxima* leaf discs. Three isolates of *Ec* and two isolates of *Sf* were more aggressive on the lower leaf side than on the upper one (Table 1).

Differences in aggressiveness within individual isolates were not associated with original host plant species, region of their collecting and/or their virulence (pathotype). Only one *Ec* isolate was not virulent on the lower leaf side. Such reaction would be further studied and considered to be used as a marker for partial resistance of *Cucurbita maxima* cv. Goliáš as proposed by Leibovich et al. (8) for some other *Cucurbita* species.

Explanation of the role of specific morphological, biochemical and physiological features of each leaf side and co-evolution with powdery mildews could provide general conclusions about specific host - pathogen interactions. Aggressiveness of powdery mildew isolates is further studied on a broader spectrum of host genotypes.

Till now, *Ec* is a predominating powdery mildew species on cucurbits in the Czech Republic (4). A very high aggressiveness of *Sf* isolates on *C. maxima* can influence a broader geographic distribution of this powdery mildew species on this territory.

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