Species and Races Composition of Powdery Mildew on Cucurbits in Bulgaria

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Introduction. Powdery mildew is one of the main fungal diseases infecting cucurbits (*Cucurbitaceae*) in Bulgaria, both in the field and greenhouse. Several pathogens can cause powdery mildew in cucurbits: *Sphaerotheca fuliginea* (Schlecht.: Fr.)Poll, *Erysiphe cichoracearum* DC *ex* Merat and *Leveillula taurica* (Lev.)Arn. (16). The most widespread species causing powdery mildew on cucurbits are *S. fuliginea* and *E. cichoracearum* (5, 10, 13). *L. taurica* has been reported on greenhouse cucumber (6, 20).

Races of *S. fuliginea* are not known in cucumber (*Cucumis sativus*), *Cucurbita spp*. and watermelon (*Citrullus lanatus*). In 1926, race 1 of *S. fuliginea* on melon (*Cucumis melo*) was differentiated for the first time in the USA (15). Race 2 was reported in 1938 (8). The third race of *S. fuliginea* appeared in the USA in 1978 (18) and in Israel in 1988 (4). Races 1 and 2 of *S. fuliginea* were later identified in Spain and Greece (1, 21). In France, Pitrat et al. (14) reported the existence of 7 races of *S. fuliginea* and 2 races of *E. cichoracearum*.

In Bulgaria, Tafradzhiiski (17) reported that *S. fuliginea* was widespread on field-grown cucurbits. Elenkov et al. (7) described *Leveillula cucurbitacearum* (Golov.) as a causal agent of powdery mildew on cucumber in the glasshouse. Lozanov and Angelov (11) reported that race 1 and 2 of *S. fuliginea* infest melon in the region of Gorna Oryahovitsa. However, until this report, no systematic work has been undertaken to establish the causal agent(s) of powdery mildew that are active in both field and greenhouse conditions in Bulgaria.

The aim of this study was to establish species and races composition of causal agents of powdery mildew on greenhouse cucumber in Bulgaria, and to determine which species is predominant in field grown cucurbits in the south-central parts of Bulgaria.

Materials and Methods: In order to establish the species and race composition of powdery mildew on cucumber in the greenhouse in Bulgaria (2000-2001), germplasm was observed in 18 glasshouses in different parts of the country. During the autumn in the fields of the south-central parts of Bulgaria, 88 isolates of powdery mildew were collected from various cucurbits in 45 locations.

The identification of powdery mildew species was based on morphology of conidia (shape and size, presence or absence of fibrosin bodies, side germination of conidia) or by features of cleistothecia (size of peridial cell, number of asci and ascospore) (13).

Some melon differential lines were used in order to identify physiological races of *S. fuliginea* (Table 1). Plants of melon lines were grown in glasshouse isolators in 5 liter pots containing composted soil. Artificial inoculation was conducted by water suspension inoculation of conidia on cotyledons (60 spores concentration) as determined under 6.3x0.20 microscope magnification. Six plants from each melon line were evaluated four weeks after inoculation.

Results and Discussion: By microscopic examination of morphological features of conidiospores of powdery mildew collected from cucumber plants in 18 glasshouses in Bulgaria, *S. fuliginea* was determined to be the significant species causing infection. After inoculation and visual assessment of differential melon lines, it was established that for glasshouse cucumber in Bulgaria, the causal agent of powdery mildew is race 1 of *S. fuliginea*. Other authors reported similar greenhouse results in Greece (21), where race 1 of *S. fuliginae* was the most frequently encountered pathogen on cucumber. In France (3), however, 39% of the isolates from greenhouse cucumber were identified as *E. cichoracearum*. In Germany, Ulbrich et al. (19) also reported severe damage by *E. cichoracearum* on cucumber. In our investigation, infection by *E. cichoracearum* or *L. taurica* was not found in the 18 glasshouses sampled. Possibly this phenomenon is

associated with climatic conditions that are unfavorable for the development of these two pathogens.

During the autumn in the south-central parts of Bulgaria, 74% of the cucurbit hosts were infected by *S. fuliginea*, 3% were infected by *E. cichoracearum,* and 23% were determined to be a mixed infection by the above-mentioned pathogens. In contrast, in Hungary (13) *S. fuliginea* and *E. cichoracearum* were observed to infest cucurbits in equal frequencies. In the Czech and the Slovak Republics (9, 10) *E. cichoracearum* prevailed, and in France (2) *E. cichoracearum* was identified in 9% to 39% of the isolates collected.

In our study, powdery mildew isolates were collected from cucumber, squash and melon (Table 2). Of the samples collected, 79% to 89% were infected by *S. fuliginea*. On pumpkin, the infection by *S. fuliginea* was 54% lower, but the mixed infection by the two pathogens was observed to be 38%. The fact that only *S. fuliginea* was observed to infect *Lagenaria vulgaris* may be due to the small number of samples taken. A mix of both pathogens was detected in all samples of watermelon.

These results confirm the conclusion by Tafradzhiiski (17) that, in Bulgaria, *S. fuliginea* is widespread. In contrast, however, it was found that *E. cichoracearum* was encountered on 3% of samples and 23% in mixed infection. However, Tafradzhiiski observed *E. cichoracearum* on only one host. Although infection by *E. cichoracearum* was observed in field experiments, 3-4 weeks after initial observations, *S. fuliginea* and *E. cichoracearum* were both detected, with the former pathogen was in highest frequency.

In conclusion, it was found that the causal agent of powdery mildew on glasshouse grown cucumber in Bulgaria is race 1 of *S. fuliginea*. Furthermore, during the autumn in the fields of the south-central parts of Bulgaria, *S. fuliginea* was the predominant pathogen for inciting powdery mildew on cucurbits.

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Table 1. Reaction of melon differential lines to races of *Sphaerotheca fuliginea*. (Mohamed Y. F. et al. 1995, Pitrat M. et al. 1998).

Melon lines	Race 0	Race 1	Race 2	Race 2	Race 3
			Europe	USA	
Hale's Best Jumbo	nt[1]	S	S	S	S
Iran H	S	S	S	S	nt
Védrantais	R	S	S	S	S
PMR 45	R	R	S	S	S
PMR 5	R	R	R	R	S
Edisto 47	R	R	R	S	R
Seminole	R	R	R	R	R

[1]S – susceptible; R – resistant; nt - not tested.

Table 2. Isolates of powdery mildew from different hosts of *Cucurbitaceae* collected in the fields during 2000-2001 in south-central part of Bulgaria.

Pathogen species[1]		Sf		Sf + Ec		Ec	
Host species	Total[2]	Number[3]	% [4]	Number	%	Number	%
Cucumber -*Cucumis sativus*	29	23	79	4	14	2	7
Melon - *Cucumis melo*	9	8	89	1	11	0	0
Squash - *Cucurbita maxima*	29	25	86	4	14	0	0
Pumpkin- *C. pepo var.giromontia*	13	7	54	5	38	1	8
Lagenaria vulgaris	2	2	100	0	0	0	0
Watermelon - *Citrullus lanatus*	6	0	0	6	100	0	0

[1]Sf - *Sphaerotheca fuliginea*; Ec - *Erysiphe cichoracearum*
[2]Total number of collected isolates on different hosts.
[3] Number of collected isolates on different hosts.
[4]Percentage ratio of casual agents of powdery mildew on different hosts.