

Occurrence of decreased sensitivity of *Sphaerotheca fuliginea* to ditalimfos

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Powdery mildew of cucurbits caused by *Sphaerotheca fuliginea*, has been controlled mainly by dinocap and quinomethionate for many years in Greece. From the early 1970's modern fungicides, mainly benzimidazoles, pyrazophos, ethirimol, ergosterol biosynthesis inhibitors (EBIs) and in some cases ditalimfos, were also used.

In experiments carried out recently in my institute, it was found that ditalimfos, in contrast to the other protective fungicides, showed a significant variation in effectiveness. *S. fuliginea* seems to be prone to resistance since it already developed resistance to benzimidazoles (Schroeder and Provvidenti, 1969; Petsikos-Panayotarou, 1977), dimethirimol (Bent et al., 1971), pyrazophos (Dekker and Gielink, 1979) and EBI's (Schepers, 1983; Huggenberger et al., 1984). So I tried to find out whether the reduced effectiveness of ditalimfos was due to decreased sensitivity of *S. fuliginea* to this fungicide.

Samples of powdery mildew were taken from plots where ditalimfos was not effective, as well as from other cucurbit crops. The fungal species was identified on the basis of the criteria suggested by Ballantyne (1975). Each sample was cultured on young cucumber plants for eight days to obtain a high yield of young spores and then its sensitivity to ditalimfos was tested. Two methods were used.

(a) Inoculation of plants previously sprayed with the fungicide. Two-leaved cucumber plants of the very susceptible local cv. Knossos were sprayed to run-off with ditalimfos at concentration of 50, 25, 12.5, 6.2, 3.1 and 0 $\mu\text{g.ml}^{-1}$ and 800, 400, 200, 100, 50 and 0 $\mu\text{g.ml}^{-1}$ for sensitive and resistant isolates, respectively. Four plants were used for each concentration. As soon as the plants had dried they were thoroughly dusted with fresh conidia of the *S. fuliginea* isolate under investigation. The inoculated plants were incubated in a growth chamber at 22 °C and at above 70% rh. Infection was rated 7 to 8 days later, using a 0-100 scale, where 0 = healthy plants and 100 = fully infected plants.

(b) Inoculation of fungicide-treated floating discs. Leaf discs were cut with a 15 mm cork borer from the second or third leaf of young cucumber plants. Six discs were dipped in either 50, 25, 12.5, 6.2, 3.1, 1.5 or 0 $\mu\text{g.ml}^{-1}$ ditalimfos per ml plus 0.1% Tween 80, left to dry, dusted with spores of *S. fuliginea*, floated on tap water and incubated at 22 °C under continuous fluorescent light. To avoid early senescence of the leaf tissue gibberelic acid was added to the fungicide suspensions and the control at a final concentration of 0.2 $\mu\text{g.ml}^{-1}$. Infection was rated on the same scale as above.

Table 1. Sensitivity of *Sphaerotheca fuliginea* isolates to ditalimfos.

Origin of the samples	Test by foliar sprays		Tests on leaf discs ED 50 ($\mu\text{g.ml}^{-1}$)
	ED 50 ($\mu\text{g.ml}^{-1}$)	ED 95 ($\mu\text{g.ml}^{-1}$)	
Field crops			
1	17.5	74.0	—
2	16.9	50.5	—
3	9.1	38.2	—
4	11.0	69.0	5.6
5	23.0	95.3	3.0
6	27.1	124.1	—
Average	17.4	75.2	4.3
Exp. plots			
1	219.0	> 800	> 25
2	299.7	> 800	> 25
3	494.0	> 800	> 25
Average	337.4	> 800	> 25

Table 1 shows that the average ED 50 value of ditalimfos for the isolates of *S. fuliginea* collected from the field, without ditalimfos history, when tested by foliar sprays, was $17.4 \mu\text{g.ml}^{-1}$. A very similar value, $16.6 \mu\text{g.ml}^{-1}$ was found by Huggenberger et al. (1984). In contrast, the average ED 50 value for the isolates taken from experimental plots, where ditalimfos was found to be ineffective, was $338 \mu\text{g.ml}^{-1}$, which is about 19 times higher. The decreased sensitivity to ditalimfos was also proved in leaf disc tests although the ED 50 values for the resistant strains could not be established due to the phytotoxicity of the fungicide at concentrations higher than $25 \mu\text{g.ml}^{-1}$. The samples with a low and high sensitivity to ditalimfos were sensitive to fenarimol (ED 50 values 2.2 and $3.5 \mu\text{g.ml}^{-1}$) and pyrazophos (ED 50 values 2.1 and $4.4 \mu\text{g.ml}^{-1}$).

Ditalimfos has been used by the growers in Crete on a very limited scale. I also used it only in two experiments for two years in four plots out of 30 in each experiment. Since there is no indication, so far of cross-resistance between ditalimfos and other anti-mildew fungicides used in our plots, the build-up of a resistant population is difficult to explain. It is possible that either the range of variation in respect to ditalimfos sensitivity in natural populations is rather wide and that strains with a reduced sensitivity were already present and subsequently selected by the chemical or that selection for resistance to ditalimfos proceeds very rapidly. Moreover the persistence of *S. fuliginea* at the same level of resistance for over nine months in the same plots in an area where a high dilution by a sensitive population should be expected, probably indicates that resistant strains are not less competitive than sensitive ones.

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Samenvatting

Verminderde gevoeligheid voor ditalimfos in Sphaerotheca fuliginea

In proefvelden van een instituut voor gewasbescherming te Heraklion op Kreta, waar fungiciden op hun werking tegen komkommermeeldauw worden getoetst, bleek de werking van ditalimfos na toepassing in twee proeven reeds verminderd te zijn. Het optreden van resistentie werd bevestigd in proeven in een klimaatkamer. Voor drie isolaten uit de proefvelden was de ED₅₀ van het middel ongeveer 19 maal zo hoog als die voor zes willekeurige isolaten uit praktijkpercelen.

De detalimfos-resistente isolaten waren wel gevoelig voor fenarimol en pyrazophos.

In proefvelden, die niet met het fungicide werden behandeld, bleken de resistente isolaten zich temidden van gevoelige isolaten te handhaven gedurende tenminste negen maanden.

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