Dynamics of Most Important Fungal Diseases of Strawberries in Croatia and Suggestions for Integrated Control

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Abstract

During trials (1998–2001) in the strawberry's plantation of the cv. Marmolade we monitored the appearance of the most important fungal diseases, their biology and possibilities of integrated control. Monitoring the biology of the determined fungi we established the way of overwintering, appearance of fruiting bodies and discharging of spores as well as beginning of primary infection and first symptoms of the following fungi: *Mycosphaerella fragariae*, *Diplocarpon earliana, Gnomonia comari*, *Phomopsis obscurans* on leaves and *Botrytis cinerea* on fruits. While checking the efficacy of fungicides, those most effecting to leaf diseases were Folicur Multi and Quadris, and on *B. cinerea* Switch and Teldor. Testing the resistance on botryticides the fungus *B. cinerea* showed low level of resistance to anilinopyrimidines and phenilsulfamides and high level to dicarboximides.

Keywords: *Botrytis cinerea*; integrated control; leaf diseases; resistance; strawberry

INTRODUCTION

In the last few years the strawberry production is in constant increase in Croatia, and the leading cv. are: Marmolada, Medeleine, Miss, Elsanta and Miranda, mentioning that cv. Marmolada occupies 80% of production. According to MAAS (1998) 74 mycoses appear on strawberries, but the economically important (PAULUS 1990; MANZALI 1994) are: red stele, crown rot, Verticillium wilt on the root system, powdery mildew, common leaf spot, leaf blotch, leaf scorch and leaf blight on leaves, and grey mould, leather rot, soft rot and anthracnose on fruits. In this study we will present: common leaf spots (*Mycosphaerella fragariae* (Tull.) Lindau), leaf scorch (*Diplocarpon earliana* (Ell. & Ev) Wolf), leaf blotch (*Gnomonia comari* Karsten), leaf blight (*Phomopsis obscurans* (Ell. & Ev.) Sutton) and grey mould (*Botrytis cinerea* Pers. ex Fr.). The biology and methods of controlling of these fungi were not investigated in Croatia, especially not the integrated control. Our goal was to establish the biological cycle of these fungi in our agroecological conditions, and the possibilities of their control in order to define the acceptable way of integrated control.

MATERIALS AND METHODS

The fungi were isolated on PDA and SLA (DELHOMES *et al*. 1995) medium, and determined according to morphological characteristics of their fruiting bodies and spores along with CMI descriptions (1970, 1976, 1982, 1984). Trials of fungicides efficacy were done according to a randomised complete block design in 4 repetitions. The fungicides were applied 4 times on the basis of the main pheno-phases (FELICI 1979), from blossoming to fruits ripening. On leaf diseases treatments were done 2–3 times after the summer renovation. Evaluation of the infection for leaf diseases was conducted on the 0–5 scale based on the percent of diseased leaves area and for the grey mould expressed by a number of diseased fruits among all examined fruits. The results were analysed according to the Townsend-Heuberger formula, and the fungicides efficacy according to Abbott. The biology of fungi was monitored from overwintering and fructifications, through the discharging of spores and the beginning of primary infections till the appearance of the first symptoms. The resistance testing of *B. cinerea* was conducted on dicarboximides, anilinopyrimidines and phenylsulfamides. For dicarboximides the colorimet-

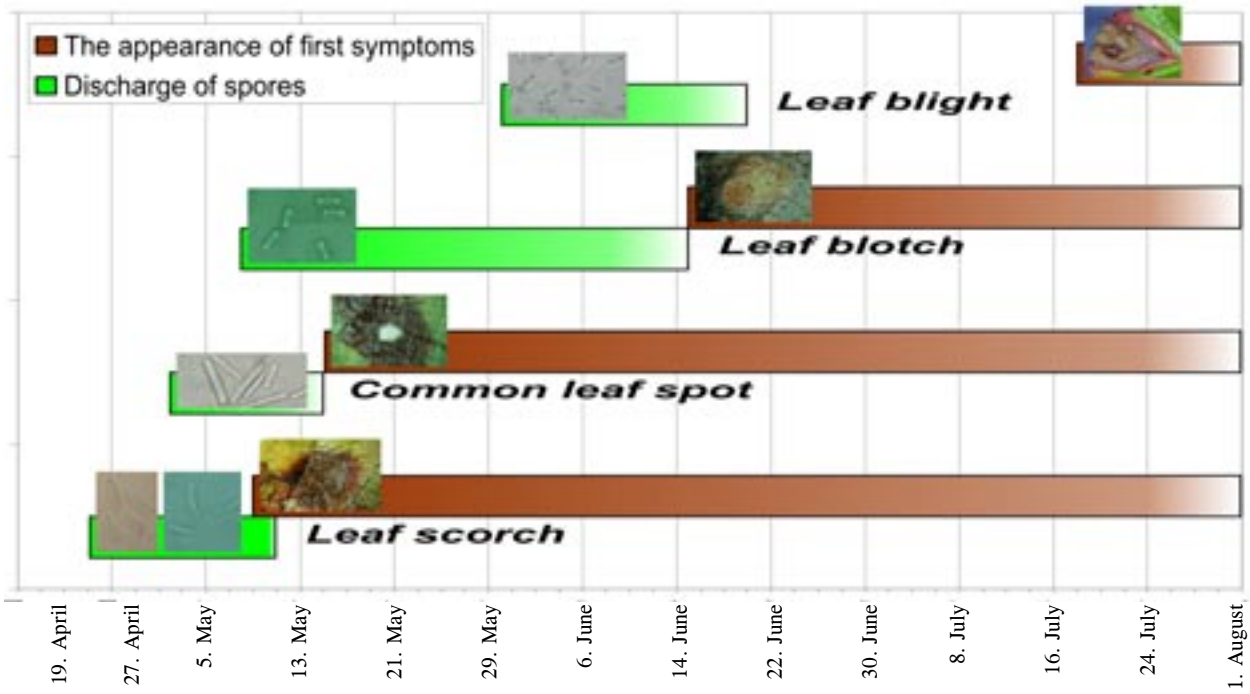

Figure 1. Discharge of spores for the primary infections and the appearance of the first symptoms of leaf diseases

ric method (CVJETKOVIĆ *et al*. 1994) was used, for anilinopyrimidines FRAC *in vitro* germ-tube assay (LEROUX & GREDT 1996) and for phenylsulfamides the mycelia growth method (POLLASTRO 1995).

RESULTS

Biology cycles of determined leaf mycoses are shown in Figure 1. The efficacy of fungicides to leaf diseases are given in Figure 2. The efficacy of fungicides to *B. cinerea* and resistance of *B. cinerea* on botryticides are shown in Figure 3.

CONCLUSION

Based on the obtained results of the integrated control management we recommend the following. First treatment must be conducted at the beginning of blossom for controlling *B. cinerea* with fungicides that has side effect to other fungi causing leaf diseases like:

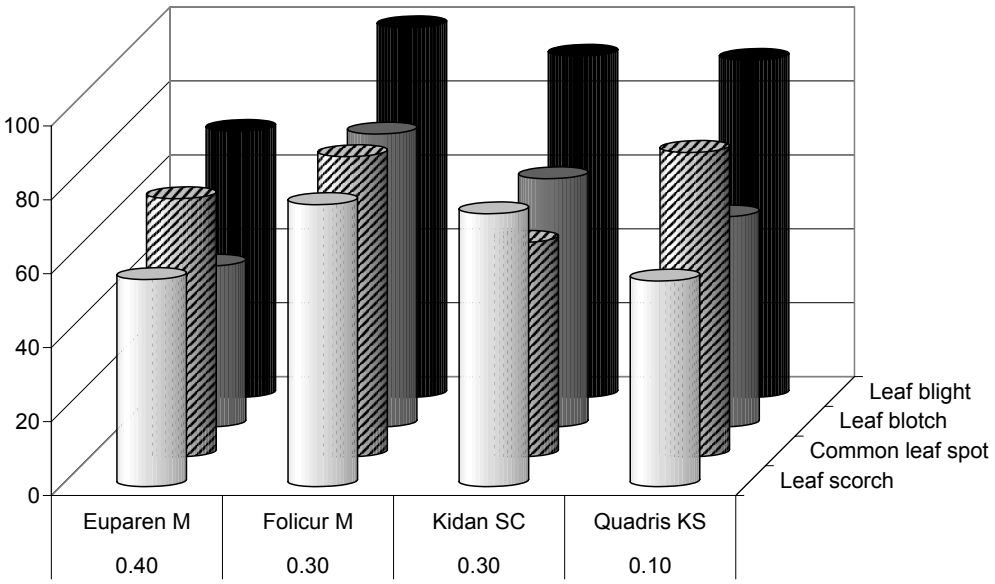

Figure 2. Efficacy of fungicides to leaf diseases 1998–2001

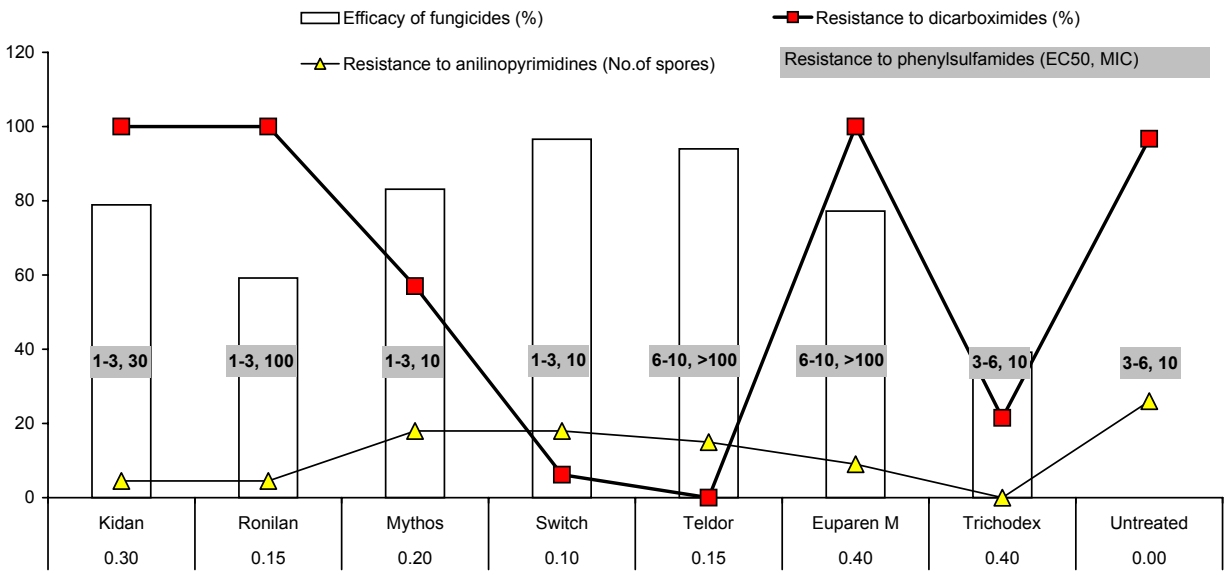

Figure 3. Efficacy of fungicides to grey mould 1998–2001 and resistance to fungicides

Folicur M (tebuconazole and tolylfluanid), Euparen M (tolylfluanid) and Kidan (iprodione). The iprodione must be preferred to other dicarboximides because of the known partial cross-resistance and because of its effecting fungal leaf diseases. Vinclozolin based fungicides must be avoided owing to the *B. cinerea* resistance, what we proved while testing (Figure 3). The application of pyrimethanil based fungicides should be limited to 1–2 times because of great resistance risk. For second treatment in full blossom the same fungicides can be applied, with restiriction for maximum two treatment with the same active ingredient. It is recommended to use ecologically acceptable fungicide Teldor, with short pre-harvest interval, for the last 2–3 treatments against *B. cinerea*. During ripening and vintage the biofungicid Trichodex can be used. After renovation at 2 or 3 years old plantation 2–3 additional treatment with Folicur M or Euparen M can be done depending on the amount of the rain in summer.

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