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Sensitivity of *Venturia inaequalis* to Fungicides

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INTRODUCTION

Venturia inaequalis causes apple scab and is the most important fungal disease in apples worldwide. It is classified as a pathogen with a high resistance risk (FRAC 2016) and therefore sensitivity monitoring for fungicides with a medium or high resistance risk is necessary. The fungicides registered for scab control belong to quinone outside inhibitors (QoI), anilinopyrimidines (AP), sterol biosynthesis inhibitors (SBI) and succinate dehydrogenase inhibitors (SDHI). Fungicides with a multi-site inhibition type play also an important role for the control of apple scab, including dithianon and metiram.

MONITORING RESULTS

Many *V. inaequalis* populations in various regions of Europe have developed resistance to QoIs in the last years. The resistance is based on the target site mutation G143A in the cytochrome *b* gene. Data are reported on an annual basis at the Fungicide Resistance Action Committee (FRAC); the current situation can be followed on the FRAC web page (FRAC 2016).

AP resistance is recognised by different phenotypes, *i.e.* levels of resistance, but the resistance mechanisms have not yet been elucidated for *V. inaequalis*. According to the response to 100 ppm pyrimethanil in a 1 day preventive detached apple leaf test, samples are classified either in "sensitive" (>80% efficacy), "less sensitive" (50-80%) and "resistant" (<50%). Current data indicate a stabilisation in AP resistance with a decrease in 2015 (FRAC 2016, Fig. 1).

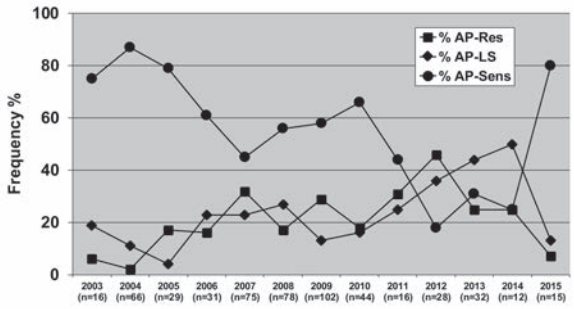

Figure 1 Frequency of sensitive (AP-Sens), less sensitive (AP-Ls) and AP resistant (AP-Res) samples from European countries from 2003-2015

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The shift to a lower sensitivity towards SBIs is well known in literature and reported for a range of SBI fungicides. The shift led to a low efficacy of "older" SBIs in many regions. However, sensitivity data from the last 5 years indicate a stable situation for more recently introduced SBIs (FRAC 2016) and confirms their reliable field performance.

Different SDHIs have been introduced for scab control in the last years and some strains with a reduced SDHI sensitivity have been found at a few trial sites in Europe. The molecular mechanisms have been identified: mutations T253I in the SDH-B or H151R in the SDH-C. Both mutations affect the efficacy of SDHIs in spore germination (Fig. 2) and greenhouse tests. The B-T253I results in general in lower resistance levels than the C-H151R. These results are in accordance with findings in *Zymoseptoria tritici*, where the homologous mutations (B-T268I and C-H152R, respectively) have also been detected and are responsible for medium (B-T268I) and higher (C-H152R) resistance levels (FRAC 2016). Currently, fitness tests are running to evaluate if these mutations are accompanied with fitness penalties.

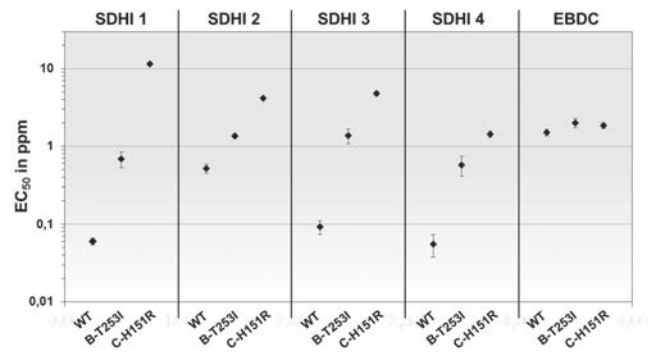

Figure 2 EC_{50} values of isolates with reduced SDHI sensitivity in spore germination tests. Data show that all tested SDHI are affected by both mutations. EBDC: ethylene-bis-dithiocarbamates.

The monitoring of fungicides with a multi-site mode of action were carried out throughout the last 5 years with metiram and dithianon according to the method described earlier (Stammler et *al.*, 2013). Data from 2015 show MIC values in the range of 0.3 to 10 ppm for dithianon and 1 to 10 ppm for metiram in 29 populations from Europe (Austria, Germany, France, Italy, Netherlands, Poland), which is in the range of previous years. No adaptations have been found for either AI despite their market introductions over 50 years ago, confirming their invaluable importance for disease control and effective resistance management in commercial practice.

REFERENCES

FRAC (2016). www.frac.info

Stammler G; Teichmann M; Gold R (2014). Sensitivity of *Venturia inaequalis* to dithianon. In: eds HB Deising; B Fraaije; A Mehl; EC Oerke; H Sierotzki; G Stammler, *Modern Fungicides and Antifungal Compounds*, Vol. VIII, pp. 271-272. Deutsche Phytomedizinische Gesellschaft: Braunschweig, Germany