



First report of benzimidazole, DMI and QoI-insensitive *Cercospora beticola* in sugar beet in Morocco

Z. El Housni^{1,2}, S. Ezrari^{1,3}, A. Tahiri¹, A. Ouijja² and R. Lahlali^{1*}

¹ Phytopathology Unit, Department of Plant Protection, Ecole Nationale d'Agriculture de Meknès, BPS 40, 50001, Meknès, Morocco; ² Department of Biology, Faculty of Sciences, Moulay Ismail University, PO Box 11201, Zitoune, Meknès, Morocco; ³ Laboratory of Functional Ecology and Environment, Sidi Mohamed Ben Abdellah University, PO Box 2202, Route d'Imouzzer, Fez, Morocco

*E-mail: rlahlali@enameknes.ac.ma

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Sugar beet (*Beta vulgaris*) is one of most important industrial crops in Morocco. In 2016, the cultivated area exceeded 61,000 ha and it's anticipated that this area will increase to 77,500 ha by 2020. However, sugarbeet yield is often restricted by several diseases. *Cercospora* leaf spot, caused by *Cercospora beticola*, is of the major foliar diseases of sugar beet in Morocco. Its control mainly involves extensive use of fungicides such as benzimidazoles (thiophanate-methyl) and demethylation inhibitors (DMI) (difenoconazole, epoxiconazole and tetraconazole). To evaluate the sensitivity of *C. beticola* isolates to commonly used fungicides benzimidazole, DMI and QoI, symptomatic sugarbeet leaves were collected from the four major sugarbeet producing regions (Berkane, Doukala, Ghareb and Tadla) during the 2016-2017 growing season.

Several isolates of the fungus were isolated from different regions and purified on potato dextrose agar (PDA) medium. To test their reactions to fungicides, the isolates were sub-cultured on Petri dishes containing PDA medium amended with different concentrations of thiophanate-methyl (1.5, 10 and 50 ppm), difenoconazole, epoxyconazole and tetraconazole (0.1, 0.5, 1.5, 10, and 50 ppm), and azoxystrobin and trifloxystrobin (1, 5, 10 and 50 ppm). Using the data collected from the *in vitro* tests, the mycelial inhibition rate with respect to the fungicidal concentration was calculated and the EC₅₀ (effective control of 50% of mycelial growth) was recorded for each isolate. Twenty-two isolates were tested against fungicides with 5 ppm as a reference dose for thiophanate-methyl (Trkulja *et al.*, 2015), 1 ppm for tetraconazole and epoxiconazole (Bolton *et al.*, 2012), 0.05 ppm for difenoconazole (Karaoglanidis *et al.*, 2003) and 100 ppm for azoxystrobin (Piszczek *et al.*, 2018). The results showed that all isolates were resistant to thiophanate-methyl with an EC₅₀ >5 ppm but with different levels of resistance (Fig. 1). Three groups were distinguished according to Trkulja *et al.* (2012); the first group had low resistance and an EC₅₀ 1000 ppm (63.63% of isolates). For difenoconazole 41% of isolates were sensitive and 59% were resistant while for tetraconazole and epoxiconazole 27.3% of isolates were resistant, 66.7% with medium resistance and 6% were sensitive (Fig. 2). Furthermore, the mycelial growth inhibition with QoI was less effective with azoxystrobin compared to that obtained with trifloxystrobin (Fig. 3). There were at least 54.54% of isolates which demonstrated resistance to azoxystrobin. This is the first report of benzimidazole-DMI and QoI-insensitive *C. beticola* isolates in Morocco.

This situation is of concern because more than 73% of the registered

fungicides belong to these three groups, leaving the dithiocarbamate-based products the only effective tools for managing *Cercospora* leaf spot. In addition, the combination of two DMI applications and QoI or DMI/benzimidazole with a contact fungicide might be less effective as resistant *Cercospora* isolates are widespread in sugarbeet growing areas in Morocco.

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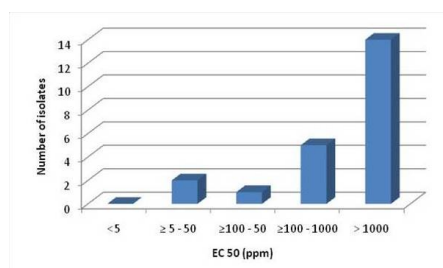


Figure 1

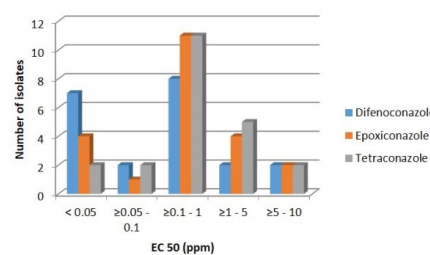


Figure 2

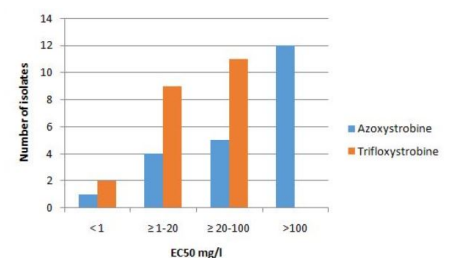


Figure 3

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