An integrated approach to define management strategies of fungicide resistance in populations of the plant pathogenic fungus *Mycosphaerella fijiensis*

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Summary

The adaptation of populations of plant pathogenic fungi in response to the use of fungicide is generally rapid. In principle, such adaptation could be canalized through the introduction of heterogeneity in agro-systems with mosaics of treated and untreated areas. The evolution of fungicide resistance in such landscapes will depend on the interactions between gene flow, selection and the cost of resistance. It is then of prime importance to estimate parameters related to these factors and to integrate them into models to define management strategies based on mosaics.

The fungus *Mycosphaerella fijiensis* causing black leaf streak disease of banana is a good example to develop such an integrated approach. In Cameroon, using systemic fungicides and an original forecasting system, the number of treatments to control the disease in agro-industrial plantations has been maintained to 12-14 per year until the emergence of resistances. From then onwards, like in most banana exporting countries, the control implies 50-60 fungicide applications/year using mostly contact fungicides. This evolution has led to an important increase of negative environmental effects since 30-40 kg/a.i/ha/year are now applied (vs. 2-4 kg/ha/year in the former forecasting system). The level of resistance to systemic fungicides, that have been abandoned, is now regularly decreasing in the banana farms. Because a mixture of treated and untreated areas exists in the Cameroon production area, this evolution should depend on interactions among the factors mentioned above. Finally *M. fijiensis* can be considered as a good model to apply population genetic methods since its populations show relative demographic stability and panmixia.

To further understand evolution of fungicide resistance in *M. fijiensis* and to define new management strategies we developed an integrated approach including the following steps:

(i) Estimate gene flow and dispersal parameters using both indirect and direct methods.
(ii) Estimate a selection coefficient for two systemic fungicides using an original field experiment located in an isolated area in order to reduce gene flow.
(iii) Evaluate potential changes in aggressiveness traits in resistant versus susceptible individuals through artificial inoculations.
(iv) Integrate the different factors through modelling.

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