MOLECULAR CHANGES IN TARGET SITES OF MAIN FUNGICIDE CLASSES AND CONSEQUENCES FOR SOYBEAN RUST CONTROL AND RESISTANCE MANAGEMENT´

Dr. Andreas Mehl

Bayer AG, Crop Science Division, 40789 Monheim, Germany

Email: andreas.mehl@bayer.com

Asian soybean rust (*Phakopsora pachyrhizi*) has turned out since 2003 to be a very devastating soybean disease in Brazil. The pathogen is known for its severe negative impact on yield quantity and quality. In areas where the pathogen occurs commonly, yield losses up to 80% have been reported. Fungicides used for the control of soybean rust in the last 14 years belong mostly to QoI and DMI compounds inhibiting the mitochondrial respiration or sterol biosynthesis, respectively. SDH inhibitors have been recently introduced into the market.

During the first quarter of 2008, a weaker than expected efficacy of straight applied azoles was reported for the first time particularly in regions of Mato Grosso and Mato Grosso do Sul whereas triazole-strobilurin mixtures performed very well. Since this time, such mixtures were preferably applied to ensure proper disease control and resistance management, especially for DMIs. The resistance risk for QoIs was regarded to be low due to the presence of an intron,identified as well in other rust species, which does not allow the occurrence of the target site mutation G143Aknown tostrongly reduce the fungicidal efficacy of QoI fungicides in other important plant pathogenic fungi.However, in season 2014, reduced field performance of QoI containing products has been reported in some Brazilian soybean growing regions. DNA analysis of respective samples carried out at Bayer identified for the first time presence of the mutation F129L.
In season 2017,first observation of reduced field performance of SDHI containing products in someBrazilian soybean fields were reported. Consequently,the FRAC SDHI Working Group informedabout the identification of a first target site mutation in subunit C of the SDHI enzyme in *P. pachyrhizi*.

Considering the importance of the DMI, QoI, and SDHI fungicide groups for the control of soybean rust and to ensure their sustainable use, Bayer has developed as the first company in Brazildirectly after the severe outbreak of the disease a sensitivity monitoring program for major fungicides, which is now well established since more than a decade and which is the cornerstone for sound fungicide use recommendations and resistance management. Sensitivity analysis of Brazilian soybean rust populations were performed *in vivo* by EC_{50} evaluation, molecular biological analyses by pyrosequencing.Molecular methods were particularly developed to detect target site modifications in the *cyt b* gene and in the SDH-B, SDH-C, and SDH-C subunit of *P. pachyrhizi*.

During the last two years, greenhouse studies with selected populations bearing high frequency of F129L showed a varying impact of the mutation on different QoIs, but did not show reduced sensitivity towards trifloxystrobin *in vivo*.This study shows results of latest DMI, QoI, and SDHI resistance research, discuss consequences of the F129L mutants for the use of QoI fungicides in disease management strategies,and especially focuses on the distribution and practical relevance of possibly presentSDHI mutants, e.g. in regard to virulence, competitiveness towards wild-type populations, or*in vivo* sensitivity towards other fungicide classes.As sensitivity shifts of soybean rust towards DMIs have been described earlier including molecular biological detection of *cyp*51 target site mutations, options for future sound resistance management strategies for the use of DMI,QoI, and SDHI fungicides in soybean as well as adherence to FRAC SBI, QoI,and SDHI guidelines are discussed under the light of the new findings.