SITE – SPECIFIC MONITORING FOR DISEASE FORECASTING IN WINTER WHEAT. **Moussa El Jarroudi[1*], Frédéric Giraud[2, 3], Philippe Delfosse[2], Marco Beyer[2], Lucien Hoffmann[2], Henri Maraite[4] and Bernard Tychon[1].** *[1]Université de Liège, 185 Avenue de Longwy, 6700 Arlon, Belgique. [2]Centre de Recherche Public-Gabriel Lippmann, Département Environnement et Agro-biotechnologies, 41, Rue du Brill, 4422 Belvaux, Luxembourg. [3]Present adress: Staphyt/BIORIZON, Rue Magendie/Bordeaux Montesquieu, 33650 Martillac, France. [4]Unité de Phytopathologie, Université catholique de Louvain (UCL), Croix du Sud 2/3, 1348 Louvain-la-Neuve, Belgium. E-mail: meljarroudi@ulg.ac.be*

In the Grand-Duchy of Luxembourg (GDL), winter wheat is the most important cereal crop (14,597 ha) with an annual production of ca. 75,000 tons in 2008 (Le Portail des statistiques du Grand Duché de Luxembourg 2008). In the GDL, fungicide applications are an essential part of cereal crop management. Crop protection often relies on preventive fungicide applications, and small grain cereals are systemically protected with two or three foliar treatments. But environmental concerns and changes in the cost/revenue ratio for winter wheat are likely to increase the demand for more accurate identification of spraying needs. Integrated pest management requires that pesticides are only applied at particular infection stages, and when the pathogen has been correctly identified. Diseases that have become economically important are Septoria Leaf Blotch (SLB) caused by *Septoria tritici* Roberge in Desmaz., Wheat Leaf Rust (WLR) caused by *Puccinia triticina* Eriks., Wheat Stripe Rust (WSR) caused by *Puccinia striiformis* Westend. f. sp. Tritici Eriks., Wheat Powedery Mildew (WPM) caused by *Blumeria graminis* DC. f. sp. *tritici* Em. Marchal, and Fusarium Head Blight (FHB) mainly caused by *Fusarium graminearum.* Control of the diseases caused by these pathogens has a high priority in minimizing yield losses. SLB is widespread in the GDL winter wheat and is considered to cause one of the most serious foliar diseases that farmers need to take into account when deciding upon fungicide application during stem elongation. The mechanistic model "PROCULTURE" has been validated to be correct in about 85% of all cases (El Jarroudi *et al.*, 2009a). The treatment defined by the simulation model over the 2003 to 2009 period resulted in a better return on investment (80%) than the other single treatments tested and as important as the double fungicide application [GS31 (growth stage, first node detectable) and GS 59 (emergence of inflorescence completed)] in the three experimental sites of Everlange, Christnach and Burmerange (El Jarroudi et al., 2010a; El Jarroudi et al., In press-b). Over the 2003-2009 period, at Reuler, located in the North, only in 2007 one treatment based on the *Septoria* risk simulation was recommended (El Jarroudi et al., 2010a; El Jarroudi et al., In press-b). A stochastic model was developed to predict the wheat leaf rust severity (El Jarroudi et al., 2010b; El Jarroudi et al., 2010c). During the 2004 to 2009 period, at four sites, the linear regression between simulated and observed values for *Puccinia triticina* was highly significant ($P<0.01$) and the coefficient of determination (R^2) explained 80 to 85% of the variability (El Jarroudi et al., 2010c).

WPM appeared much earlier in the northern Ösling (GS 30, pseudostem erection) than in the southern Gutland (GS 39, flag leaf ligule visible) (El Jarroudi et al., 2009b). Two major climatic factors favored the 2003 and 2009 outbreaks, i.e. a daily mean temperature between 15 and 22°C and a relative humidity of at least 80% during May-June (El Jarroudi et al., 2009b). For the WSR, from 1999 to 2010, the difference between $Yr17^+$ (Yr17 resistance gene) cultivars and cultivars not possessing this gene was highly significant ($P<0.001$), with the highest severity being observed for the $Yr17^+$ cultivars (mean severity of 13%) compared to the $Yr17^-$ cultivars (0.2%) (El Jarroudi et al., In press-a). This new virulent pathotype appeared more aggressive on the $Yr17^+$ cultivars than on the $Yr17^-$ ones. A stochastic model based on Monte Carlo simulation methods was developed to determine the conditions

conducive to WSR in GDL. Simulations of infection and latency data by this model are in very good agreement ($R = 0.92$, $P < 0.05$) with the observational data.
Finally, a stochastic model was developed to predict FHB in the GDL. The linear regression between simulated and observed values was highly significant ($P < 0.05$) and R^2 explained 75% of the variability. The model results are used in warning bulletins. The model has predicted correctly the disease between 2004 and 2010.
The research group will pursue the development and fine-tuning of these models in order to provide a large service to the farmer's community in the domain of pest and disease control through environmentally friendly methods in the GDL and Belgium.

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