Andrea[9], Klocke, Bettina[6], Djurle, Annika[10], Prieto-Ruiz, Inés[11]
[1] Leibniz Centre for Agricultural Landscape Research, Müncheberg, Germany
[2] INRA, UMR1248 AGIR, Castanet-Tolosan, France
[3] Università Cattolica del Sacro Cuore, Piacenza, Italy
[4] Aarhus University, Tjele, Denmark
[5] Council for Agricultural Research and Economics (CREA), Bologna, Italy
[6] Julius-Kuehn-Institut, Kleinmachnow, Germany
[7] University of Florence, Firenze, Italy
[8] University of Florida, Gainesville, USA
[9] Norwegian Institute of Bioeconomy Research (NIBIO), Ås, Norway
[10] Swedish University of Agricultural Sciences, Uppsala, Sweden
[11] Spanish National Research Council, Madrid, Spain
Abstract: Modelling the effects of plant diseases and pests on crop performance and yield is an important new challenge AgMIP and MACSUR want to address. The PeDiMIP (pest and disease modelling inter-comparison project) group of AgMIP, and the "Pest and Disease" group within MACSUR address this question. We report here progress in our work on wheat health. In a first step, five wheat growth models of differing complexity implemented generic damage mechanisms associated with four foliar diseases: septoria tritici blotch, leaf (brown) rust, stripe (yellow) rust, and powdery mildew. Using a reference data set from Denmark, field data of a "pest-free" treatment was first used for crop model calibration, and for modelling wheat growth and yield in absence of disease. Idealised (temporal) patterns of disease injuries represented by simplified disease progress curves were then used as drivers to simulate the effects of individual and combined diseases on wheat growth and yield. In a second step, field data from the reference (experimental) data set of non-protected field plots together with observed disease severity data was used to test simulations of disease effects on biomass, leaf area and crop yield loss against observed data affect by septoria tritici blotch and powdery mildew. We are currently collecting data on disease spread, intensity, disease impact and crop yield loss from a range of experiments different countries to take a third step to estimate yield losses caused by individual and combined wheat diseases in several European countries.

***Title*: Identification of microclimatic variables determining the appearance of the symptoms of a leaf disease: case of the coffee leaf rust**

Presenter: Merle Isabelle
Author: Merle Isabelle[1], Tixier Philippe[2], Cilas Christian[1], Avelino Jacques[1]
[1] CIRAD, UR Bioagresseurs, TA A-106, Avenue Agropolis, 34398, Montpellier, France
[2] CIRAD, UPR GECO, TA B-26/PS4, Boulevard de la Lironde, 34398 Montpellier, France
Abstract: Coffee leaf rust (Hemileia vastatrix) caused major epidemics since 2012 in Central America. In order to prevent future epidemics, PROCAGICA program (Programa Centroamericano de Gestión Integral de la Roya del Café) aims to the creation of a warning system with an epidemic forecast component based on meteorological variables. Currently, recommendations to control this disease are based on costly treatment schedules. We hypothesize that it is possible to predict the outbreaks of coffee leaf rust

and that dynamic of epidemics is the result of complex combinations of microclimatic variables acting at different times (times and durations). Our goal is to build three models: appearance of infections, first produced spores, intensification of sporulation. For this purpose, a trial was set up in Costa Rica in three sites at different altitudes and under different oceanic influences in order to cover important fluctuations of the mesoclimate. The microclimate is measured continuously using weather stations and a weekly monitoring of rust lesions is performed to know the dates of onset of the different symptoms corresponding to different stages of development of the epidemic. Preliminary results on the microclimate variables (nature and timing) that determine the onset of first symptom (emergence of non-sporulating lesions) will be presented and discussed.

***Title*: Crop diseases and pests: from crop losses to biocomplexity**

Presenter: Kersebaum, Kurt Christian

Author: S. Savary, INRA France, P. D. Esker PennState, USA, N. McRoberts UCDavis, USA, L. Willocquet, INRA France, K. C. Kersebaum, ZALF Germany, S. Asseng U. Florida, USA, W. Pavan, U. Passo Fundo, Brazil, R. Ferrise, U. of Florence, Italy, R. Magarey, North Carolina State U. USA, M. Donatelli, CREA Italy, S. Bregaglio, CREA Italy.

Abstract: PeDiMIP, the pest and disease modeling intercomparison project, participated in the International Conference on Global Crop Losses organized in Paris in October 2017, where participants from some 20 countries addressed the effects and modeling of crop losses. Progress is also underway at several centers in Europe and the USA in the intercomparison of several Wheat crop models augmented with dynamic damage mechanisms for an array of diseases, insects and weeds. Diseases and pests are integral part of world's crop systems, and are critical elements to understand, model, and manage sustainable farming systems. These systems – their design, development, management, and their disruption or sustainability – involve human beings – farmers, policymakers, consumers – to a very high degree. A next frontier in the modeling of crop diseases and pests therefore involves addressing the biocomplexity of human-managed systems. While the Wheat - Multiple Pest system exemplifies biocomplexity in annual crops, the Coffee-Rust system is an excellent and key example of biocomplexity in perennials. Simulation outputs illustrate the annual oscillations of coffee yields, the negative effect of rust intensity on yield, and the positive feed-back of attainable yield on rust intensity. Simulation modeling enables understanding why rust exacerbates variation in coffee yield, how fungicides may reduce losses, and why shade trees dampen dangerous annual oscillations in yield and disease, while enhancing ecosystem services. Modeling biocomplexity in [human - crop - diseases and pests] systems is a critical challenge for sustainable farming systems modeling, as well as for the development of next generation models and tools.

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Session 2B: Advanced Computational Applications for Agriculture

***Title*: The Agricultural Model Exchange Initiative**

Presenter: Pierre Martre