Mathematical issues in Crop protection, yield improvement, and Pest control

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Food security is an important issue throughout the World. While it is important to maintain food production in a changing environment, it is also important to improve crop yield and crop protection against pest attacks and diseases. To this aim, many programs have been launched, since decades, to select crops and/or to develop (biological) tools against pest and diseases, etc. However, these field experiments are long, tedious and costly. That is why, Modeling is more than useful. Some people, in Europe and North-America, decided to use computers and developed simulations tools to realize in-silico or virtual experiments of crop growth and pest/disease control. However, these digital developments leaded to very complex models with hundreds of parameters, relying on thousands of (long time) simulations. In general these models have been or are developed by thematicians, like crop experts, using computer modeling tools that are now available and are supposed to easier the development of models. Thus, the (natural) tendency is to replicate exactly what is supposed to occur in the crop, and not to model, only, the important processes. Last but not least, the use of such models require a long and tedious learning, such that only very few people are able to use them. In mathematical modeling, the objective is to capture the essential processes in such a way that a theoretical analysis of the model is still possible in order to derive useful (new) outputs to the field experts, according to the initial questioning.

I will present an overview of biological issues we studied in Cameroon (Mirid-Cacao), Indonesia (Pollinator-Oil palm), South Africa (pest/vector control), and, now studying in La Réunion (fruit flies - sterile insect), leading to a wide variety of mathematical models and, thus, to "nice" mathematical issues: see for instance [1, 2, 3, 4, 5, 6, 7]. I will also discuss about ongoing projects and upcoming mathematical challenges.

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