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A STAGE STRUCTURED DEMOGRAPHIC MODEL FOR INSECT PEST DYNAMICS

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Insect pests are insects causing damage to crops, farm animals and human health. It is then important to have a good knowledge of their temporal dynamics to usefully apply phytosanitary treatments. Often pesticides are effective only for a particular insect life stage. This suggests to consider the insect population as a stage structured population.

Here a physiologically based demographic model is used to describe the temporal dynamics of the stage structured insect pest population. Each individual of the population is characterized by a physiological age, that is a percentage of development in a stage. The physiological age is considered as a random variable driven either by a Wiener process allowing regression or by a Gamma process that guarantees a non-decreasing behaviour of the physiological age. The model gives the abundance of the population in each stage in time and physiological age. It is represented by a system of Fokker-Planck partial differential equations taking into account the dispersion effects of the individuals during the development. The model includes the stage-specific biodemographic functions (development, mortality and fecundity) describing the biology of the species. The biodemographic functions depend on environmental variables, mainly temperature. A reliable population dynamics model requires a good estimate of the biodemographic functions. The estimation can be easily obtained using a least square method when data on the biology of the species are available from literature. This is not often the case for the mortality, then a statistical estimation method based on population abundance data is considered.

The model is used to describe the dynamics of an insect pest for which field data are available.

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