

Mathematical Modeling of Miridae population, a Cocoa Pest.

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Abstract: Cocoa is an important cash crop in Central and West Africa, and particularly in Cameroon. However cocoa production is often severely impacted by many pests and diseases among which the mirid bugs *Sahlbergella singularis*. This hidden pest, that is non populous, is very harmful to cocoa trees development, affecting principally vegetative growth parts. In addition, Mirids are difficult to study in situ, and mathematical model appears to be a promising way to study their long term impact.

Based on biological and ecological knowledge, we develop two cooperative mathematical models that aim to describe the dynamics of the cocoa mirid *Sahlbergella singularis* [1]. We first develop a stage-based model, and derive some qualitative results and a sensitivity analysis study in order to show what are the most important parameters. Then, assuming that all parameters are periodic, we obtain conditions that allow the persistence or not of the population. We study, in particular, the influence of cocoa pods along the year on the time evolution of the population. Then, we develop a second model, that takes into account the developmental time in larvae and adult stages: we obtain a cooperative delay differential system, with several delays. We show that the delayed system has the same properties than the non-delayed system. We also present some simulations and show that the delayed system provides more realistic results. We discuss the results and their implications in terms of control, using, for instance, mating disruption [2].

References

- [1] M. Tapi, L. Bagny Beihle, S. Bowong, Y. Dumont, Modeling Miridae population, a Cocoa Pest. Mathematical Analysis and Simulation. Submitted.
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