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About sterile insect control strategies in a two patches system

Yves Dumont^{1,2,3}, Michel Duprez⁴, Yannick Privat^{5,6}¹CIRAD, UMR AMAP, F-97410 Saint-Pierre, France²AMAP, Univ Montpellier, CIRAD, CNRS, INRA, IRD, Montpellier, France³Department of Mathematics and Applied Mathematics,

University of Pretoria, Pretoria, South Africa

yves.dumont@cirad.fr

⁴INRIA, Mimesis, Université de Strasbourg, ICube, France

michel.duprez@inria.fr

⁵IRMA, Université de Strasbourg, CNRS UMR 7501, France⁶Institut Universitaire de France (IUF), France

yannick.privat@unistra.fr

Sterile Insect Technique is an autocidal method to control Vector of diseases and crop pest. It consists of releasing males sterilized by ionization, in a targeted area, that will mate with the wild females, resulting in a reduce, eventually a local elimination, of the wild population. However, migration of wild insects, from a non-targeted area, can be problematic and reduce the efficiency of SIT [1]. The control strategies should be adapted to take this issue into account. We consider a two patches system, where Patch 1 is the targeted area linked to another area, Patch 2, that needs not to be controlled. Wild and sterile insects can circulate between the two Patches, so that different issues have to be solved. Is it possible to find one or several strategies, and among them an optimal strategy, to reach elimination in patch 1? Should we control both patches? Using results related to monotone cooperative systems [2] and also tools from optimal control theory, we will show some theoretical responses [3]. We will also illustrate the theoretical results with numerical simulations and discuss the extension of our results.

Keywords: Sterile Insect Technique, patches, biological control, metapopulation model, monotone cooperative system, optimal control

References

- [1] P.-A. Bliman, Y. Dumont, Robust control strategy by the sterile insect technique for reducing epidemiological risk in presence of vector migration, *Mathematical Biosciences*, 350:108856, 2022.

- [2] Z. Lu, Y. Takeuchi, Global asymptotic behavior in single-species discrete diffusion systems, *Journal of Mathematical Biology* volume, 32:67-77, 1993.
- [3] Y. Dumont, M. Duprez, Y. Privat, Influence of migration on optimal population control strategies using the sterile insect technique, submitted, 2023.