

The Sterile Insect Technique against fruit flies.

Some new mathematical results

BIOMATH 2024

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The sterile Insect Technique (SIT) is an old autocidal method used to control Vectors of diseases and crop pests. This is a biological control method that consists of releasing males sterilized by ionization that will mate with the wild females, resulting in a decay, eventually a local elimination, of the targeted wild population. While conceptually very simple, SIT is very challenging to implement in the field. Thus, mathematical modeling and simulations can be helpful to anticipate numerous issues.

We consider the Sterile Insect Technique against fruit fly, that is known to mate more than once, contrary to mosquitoes. In addition, since female fruit fly can remate, they may remate more rapidly if the first mating is done with a sterile male. Last but not least, depending on the dose of irradiation, sterile males are not necessarily 100% sterile, such that we may have some residual fertility [1]. In this talk, I intend to present a mathematical model with single and double matings, that gathers all these issues in order to study their impact on SIT success [2]. We show that there exists a threshold parameter for the residual fertility that depends on parameters, like, the basic offspring number, the refractory periods between two matings, the death-rate and eggs deposit-rate from single- and double-mated females.

We illustrate our theoretical results with the oriental fruit fly, *bactrocera dorsalis*, for which a SIT project is ongoing (AttracTIS, funded by the Ecophyto program) and discuss future developments [3].

References

- [1] M.S. Aronna, Y. Dumont, On nonlinear pest/vector control via the sterile insect technique: Impact of residual fertility, *Bull. Math. Biol.*, 82 (8): 110, 2020
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- [3] Y. Dumont and M. Duprez. Modeling the impact of rainfall and temperature on sterile insect control strategies in a tropical environment. *Journal of Biological Systems*, 32(01):311–347, 2024.