

MODELLING MEDFLY PEST MANAGEMENT

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ABSTRACT

The Mediterranean fruit fly *Ceratitis capitata* Wiedemann is a very important pest of fruit crops. Originally from the African continent, it is now distributed worldwide and causes great losses in the quantity and quality of fruit, making its trade difficult or impossible. One form of pest control is the so-called “sterile insect technique”, which is widely used because it is environmentally friendly. The introduction of sterilized insects into the agricultural system seeks to reduce the pest’s reproduction rate with the consequent decrease in population size. The mathematical modelling of this problem is presented in this paper in three stages. First, the following theoretical model is proposed for the state of the pest in the absence of control:

$$\begin{aligned}\frac{dx}{dt} &= \varphi\nu y - (\alpha + \gamma)x - cx^2 \\ \frac{dy}{dt} &= p\alpha x - \mu_h y - \beta y^2 \\ \frac{dz}{dt} &= (1 - p)\gamma x - \mu_m z - \delta z^2\end{aligned}$$

where x , y and z are the states variables corresponding to count of juvenils (eggs, larvae and pupae), count of adult females and count of adult males. The positive real parameters are φ , α , γ , c , β , δ , μ_h , μ_m , ν and p .

In a second stage an empirical rule is introduced and consequently the model obtained is a theoretical-empirical hybrid which is simpler than the original having two differential equations: one for the female’s growth rate and the other for the male’s growth rate.

In last stage, control by the sterile insects is included.

For the models in each state stability conditions of some equilibrium points as well as pest persistence or pest eradication conditions are presented and justified in this work which is developed in an field of confluence of Mathematics, Biology, Ecology and Agronomic Engineering.

Keywords Mediterranean fly · Sterile Insect Technique · Dynamical Systems in Ecology

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