Modeling pheromone control and trapping of the Asian citrus psyllid, Diaphorina citri

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Diaphorina citri or Asian citrus psyllids (ACP) are small insects that live on citrus trees and feed on young stems, sprouts, and leaves during all stages of development. This insect is also the major vector of the most serious citrus plant disease known as Huanglongbing (HLB or Citrus Greening) that affects citrus production in various parts of the world [1]. At the moment, there is no cure for this infectious plant disease, and the major control efforts are centered on controlling the local ACP populations.

In this presentation, we propose a sex-structured mathematical model that encompasses only the adult population of D. citri, even though the ACP life cycle also includes the immature phase (consisting of eggs and five nymphal instars). Following [2], the model is based on the behavioral and biological features of this particular insect species, and special attention is paid to the ACP mating behavior.

When seeking to mate, the female psyllids emit sex pheromones that attract the male insects. Pheromone traps are considered as an eco-friendly component of integrated pest control, and our model readily accommodates this type of external intervention. Sticky pheromone traps are usually set up for pursuing two simultaneous goals of pest control: (1) mating disruption leading to the offspring reduction, and (2) mass trapping of male insects followed by their direct removal.

We also outline the theoretical analysis of the model and revise several scenarios that accentuate its practical value for controlling the ACP adult population by pheromone traps.

References:

[1] J.V. da Graça, L. Korsten, Citrus Huanglongbing: Review, Present Status and Future Strategies. In: Naqvi S.A.M.H. (Eds.) Diseases of Fruits and Vegetables Volume I. Springer, Dordrecht, 2004.

[2] R. Anguelov, C. Dufourd, Y. Dumont, Mathematical model for pest–insect control using mating disruption and trapping, Appl. Math. Model. 52 (2017) 437–457.

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