Maidana, Norberto Aníbal; Yang, Hyun Mo

Describing the geographic spread of dengue disease by traveling waves. (English)

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Summary: Dengue is a human disease transmitted by the mosquito Aedes aegypti. For this reason geographical regions infested by this mosquito species are under the risk of dengue outbreaks. We propose a mathematical model to study the spatial dissemination of dengue using a system of partial differential reaction-diffusion equations. With respect to the human and mosquito populations, we take into account their respective subclasses of infected and uninfected individuals. The dynamics of the mosquito population considers only two subpopulations: the winged form (mature female mosquitoes), and an aquatic population (comprising eggs, larvae and pupae). We disregard the long-distance movement by transportation facilities, for which reason the diffusion is considered restricted only to the winged form. The human population is considered homogeneously distributed in space, in order to describe localized dengue dissemination during a short period of epidemics. The cross-infection is modeled by the law of mass action. A threshold value as a function of the model parameters is obtained, which determines the rate of dengue dissemination and the risk of dengue outbreaks. Assuming that an area was previously colonized by the mosquitoes, the rate of disease dissemination is determined as a function of the model parameters. This rate of dissemination of dengue disease is determined by applying the traveling wave solutions to the corresponding system of partial differential equations.

MSC:

92D30	Epidemiology
35K57	Reaction-diffusion equations
35Q92	PDEs in connection with biology, chemistry and other natural sciences
92C60	Medical epidemiology

Keywords:

dengue; aedes aegypti; traveling waves; control

Full Text: DOI

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