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COMPLEX DYNAMICS OF A BEDDINGTON-DEANGELIS EPIDEMIC MODEL WITH PULSE

Xia Wang*, Youde Tao and Xinyu Song

College of Mathematics and Information Science
Xinyang Normal University, Xinyang, Henan, P.R. China

*Corresponding author email: xywangxia@163.com

Abstract. In this paper, a Beddington-DeAngelis epidemic model with pulse and individual difference in immunity is investigated. Using the Floquet's theorem and small amplitude perturbation method, we obtain the disease-free periodic solution is locally stable if some conditions are satisfied. The permanent conditions of the system are also given. Furthermore, we proved that the existence of nontrivial periodic solution via a supercritical bifurcation.

Keywords. Impulsive recruitment; Beddington-DeAngelis epidemic model; Periodic solution; Permanence.

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1 Introduction

In recent years, there has been made a significant progress in understanding different scenarios for disease transmissions and behavior of epidemics. Some works have investigated permanent and temporary immunity (see [5,8,10,15,22-23]). One of the unrealistic assumptions in these works, is that all the infected individuals except those who die acquire immunity. For example(see[1,3]), from measles encephalitis in adults shows that some infected individuals can acquire immunity after recovery, but some do not acquire immunity and can be infected once more. In reality, immigration often appear in pulse. Thus, we first introduce the following model:

$$\begin{cases} \dot{S}(t) = -\dfrac{\beta S(t)I(t)}{\alpha + S(t)} - d_1 S(t) + r_1 I(t), \\ \dot{I}(t) = \dfrac{\beta S(t)I(t)}{\alpha + S(t)} - d_2 I(t) - r_1 I(t) - r_2 I(t), \\ \dot{R}(t) = r_2 I(t) - d_3 R(t). \end{cases} \tag{1.1}$$

The following assumptions for model (1.1) are

(H_1) The population is divided into three compartments with $N(t) = S(t) + I(t) + R(t)$, where $S(t)$, $I(t)$ and $R(t)$ denote the number of individuals in the susceptible class, infectious class and permanent immunity class, respectively.