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Existence of limit cycles and homoclinic bifurcation in a plant–herbivore model with toxin-determined functional response

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Abstract

In this paper we study a two-dimensional toxin-determined functional response model (TDFRM). The toxin-determined functional response explicitly takes into consideration the reduction in the consumption of plants by herbivore due to chemical defense, which generates more complex dynamics of the plant–herbivore interactions. The purpose of the present paper is to analyze the existence of limit cycles and bifurcations of the model. By applying the theories of rotated vector fields and the extended planar termination principle, we establish the conditions for the existence of limit cycles and homoclinic loop. It is shown that a limit cycle is generated in a supercritical Hopf bifurcation and terminated in a homoclinic bifurcation, as the parameters vary. Analytic proofs are provided for all results, which generalize the results presented in [11].

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Keywords: Plant–herbivore model; Limit cycles; Homoclinic bifurcation; Rotated vector fields; Extended planar termination principle

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