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Multi-stage dynamic model for prey-predator interaction: Application to *Spodoptera exigua* (Lep.: Noctuidae) and *Nabis pseudoferus* (Hem.: Nabidae) under greenhouse conditions

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Abstract: The beet armyworm, *Spodoptera exigua*, is a highly polyphagous insect pest that affects various agricultural crops including vegetables and ornamentals. It is a serious pest in several greenhouse crops, including pepper and watermelon. In turn, the predator *Nabis pseudoferus*, a member of the Nabidae family, is a strictly zoophagous species that is commercially available in Spain. Several trials were carried out on the biology and ecology of the pest and predator species in pepper crops grown in southern Spain, under both laboratory and greenhouse conditions. This work describes trials to evaluate the efficacy of the predator species for controlling different levels of pest infestation in commercial pepper greenhouses. With the resulting data, a degree-day dependent and stage-structured dynamic mathematical model for predator-prey systems was developed and validated. From the results, it can be seen that the "degree of depression" found in the prey population between the first and second generations was 7.3, which is equivalent to an 86.3 % mortality rate between generations. This value is close to the percentage of efficiency reported in other publications and therefore provides a good validation of the model. The current situation of biological control in greenhouse crops is quite complex, including: the use of entomophagous species (parasitoids or predators) whether separately or in combination with other natural enemies, different nutritional characteristics of entomophagous insects (ranging from omnivorous to strictly zoophagous species), different release techniques (bio-propagation or pre-transplant, inoculative or inundative releases, reservoir plants, etc.). This complexity may call for the application of mathematical models and they could be considered excellent tools for biological control.

Key words: Dynamic model, degree-day dependence, functional response, prey-predator system, pepper crops, greenhouse

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