

Conclusions

This study suggests that the use of the fuzzy rule-based system instead of usual differential equations in Ecology may represent the interaction among species in the environment where the available data are only qualitative. We only use intuitive hypotheses of the dynamics of prey-predator and host-parasitoids and the data from experts to elaborate the model without explicit differential equations, mainly when parameters of the differential equations are not available. The great advantage of obtaining the parameters of differential equations lies on the fact that we may analyze the stability of the system. The main contribution of this fuzzy model is the predation and the parasitism in a single rule base. We would like to highlight the advantages of using fuzzy rule-based models compared to deterministic models: (1) several parameters of differential equations of the predator-prey and the parasitoid-host type systems are not available; (2) in the fuzzy model, we used a rule base instead of systems given by equations, eliminating the difficulty of obtaining the parameters. These parameters may be obtained through curve fitting procedure from the solutions taken from the fuzzy rule-based models; (3) the input and output sets of fuzzy rule-based systems may be easily defined by experts, that is, specialists not have a sufficient training in the differential equations but who may know when the population of a particular species is small, large and so forth.

The model control suggests using this as a policy to control soybean aphids because the fuzzy system provides how often and how much to apply the insecticides on the plants in a simple, intuitive and a direct way. An interesting result is that it is feasible to control a pest by means of an insecticide that not destroys the predators and the parasitoids but affects these populations indirectly, due to a decrease in the population of aphids. This is because the system is dynamical.

On the one hand, the control variations may be difficult to achieve due to it is necessary to know the approximate number of aphids per plant and, therefore, think about the feasibility of releasing insecticide in time, following exactly as recommended by control. On the other hand, the concern about the environment has been increasingly important. In this way, the model suggests that the quantity of insecticide may be lower than the quantity recommended by manufacturer may be effective.