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Abstract

Simulating Bee Pollination for Horticultural Applications †

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Abstract: We depend on wild and managed bees for the pollination of a third of fruits, vegetables and nuts for human consumption. Consequently, the details of the interactions between bees and flowers are of utmost concern to growers and seed producers. However, due to the increasing variability of our climate, the loss of bees' natural habitat, the use of pesticides and the industrialisation of agriculture, the interactions between bees and our flowering crops are changing in complex ways. Traditional field trials are one approach helping to establish how these changes are impacting on food production, but these techniques are time-consuming, season-limited, and susceptible themselves to the same rapid and dynamic disruptions the ecosystems are subject to. Instead, we propose an iterative experimental approach, in which detailed computer simulations that predict how best to run field trials, are repeatedly informed by field observations and field trial outcomes. The simulations account for bee species' unique perceptual, behavioural, physiological and morphological characteristics, and realistically model the bees' foraging environments, including open fields, protected crops, and natural ecosystems. We explain how our simulations work, and provide case studies detailing the results of experiments with planting layout to boost pollination. These models lead to improved plant/pollinator interaction management. They have the potential to boost yield, quality, and shelf-life for a variety of crops, to raise food security generally, and to improve the sustainability of our farm and natural ecosystem management practices.

Keywords: insect pollination; agent-based simulation; honeybees