A MATHEMATICAL MODEL OF INTER-COLONY SPREAD OF AMERICAN FOULBROOD IN EUROPEAN HONEYBEES (APIS MELLIFERA L.)

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ABSTRACT

American Foulbrood (AFB) poses a significant threat to European honeybee colonies worldwide, impacting bee health and apiary productivity. This study aims to deepen our comprehension of the inter-colony transmission dynamics of AFB among European honeybee colonies by developing a comprehensive compartmental model. Incorporating influential factors such as bee drifting between colonies, the model offers a nuanced exploration of disease ecology in honeybee communities. The research highlights that while a source colony initiates infection, the receiving colony exhibits a higher peak of infected bees, elevating the risk of disease transmission to neighboring colonies. The findings suggest that bee drifting may delay the onset of infection in broods within the source colony but will not lessen its severity. Additionally, drifting can cause the infection to spread to neighboring colonies. Furthermore, simulations indicate that a combination of lower drift rates and higher rejection rates delays the onset of brood infection in the receiving colony while accelerating it in the source colony. Additionally, infected broods are found to have a more significant impact on colony health than infected adult bees, warranting further study. The simulations show that lower contamination caused by these two factors—hygienic behavior of adult bees and beekeeper cleaning habits—significantly delays the onset of brood infection, emphasizing their critical role in managing AFB outbreaks. This research significantly advances our understanding of disease ecology in honeybee populations, crucial for sustainable beekeeping practices and honeybee population preservation.

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