Development of 3D Pollen Adsorption Models by Analyzing Pollinating Insects' Setae Structures

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Bee colonies across the world have recently declined. The number of bumblebees throughout the United States have plummeted to 87% since the 1990s and have become endangered according to recent studies. The most serious problem with this phenomenon is the decrease in pollination that leads to a lower growth rate in plants. Even if artificial pollination can be one of the solutions, its shows a lower degree of pollen adsorption than with natural pollination. This study aims to develop models that improve the efficiency of artificial pollination by analyzing pollinators' setae structures. Two experiments were carried out to achieve these aims: (1) Degrees of pollen adsorption among six species of pollinators were compared through analysis of the amount of pollen adsorbed by the pollinators. (1) The structural and morphological characteristics of setae of pollinators were discovered and 3D pollen adsorption models were developed. Degrees of pollen adsorption of three species of Apidae family were higher than the Syrphidae family. Bumbus opulentus, which belongs to the Apidae family, showed the highest degree of pollen adsorption. Branch setae of Apidae shows specific angles and intervals. The branching angles of B. opulentus, which showed the highest degree of pollen adsorption, are 23.5° and the intervals between two branches are 9.0μm on average. The 3D pollen adsorption models are developed based on these findings. The models could be applied to artificial pollination with higher degree of pollen adsorption. Imitation of these models for artificial pollination is expected to solve various problems of pollination.