N O T E

Honey Bee (Hymenoptera: Apidae) Pollen Load Rate Based on Pollen Grain Size[1]

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Pollination by honey bees, *Apis mellifera* L., is an important component of productivity in several crops (Danka 1993. J. Econ. Entomol. 86: 131-136). Successful yields of many small vegetable crops are wholly dependent on insect-mediated pollination [Philippe 1992. La pollinisation par les abeilles. pp. 182 (French)]. Pollination by honey bees resulted in a $14.6 billion increase in agricultural productivity for 1999 in the U.S. (Pratt 1999. Agri. Stat. U.S.D.A., Nat. Agri. Stat. Ser.). Before returning to the hive, honey bees will visit the same type of crop (blossom) until its pollen basket (via corbicula) is full. Because honey bees tend to be monogamous to the crop variety visited at any given time, the pollen load is composed primarily of host pollen with very little outside contamination either from competing foragers, wind, or a number of other factors (Macior 1975. Amer. J. Bot. 62: 1065-1072).

Information about the relationship between pollen grain size and pollen load is important to understand the dynamics of crop pollination by honeybees. Corbicular load-carrying capacity can be determined by collecting honey bee loads from pollen traps, weighing a representative number of pellets, and then determining grain size under a compound microscope. Grain size is an important factor in success of pollination. There exists a strong correlation between pistil length and pollen size (Torres 2000. Sexual plant reproduction. 12: 365-370). Depth and access to the pistil and accessibility to pollen via nectar feeding plays an important role in the sexual reproduction of the flower. Because quantity of pollen grains gathered by honey bees can influence the necessity to return to the hive with the pollen load, both pollen grain size and load size may be factors in the success of honey bee-assisted pollination tasks.

Four colonies, started from a 0.90-kg honey bee package, were used with two standard pollen traps. Traps were rotated every week between two other colonies to reduce pollen starvation and brood reduction in the study hives. These treatments continued through the year until pollen was no longer present in traps. Traps were emptied weekly and pollen loads were frozen. When brood levels dropped too low, traps were omitted for an additional week until colony revived brood strength. A random sample of 1500 mg of pollen was collected from the trap with an additional

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500 mg sub-sample. Each pellet was weighed, and the total number of pellets was determined based on two legs of a foraging bee (each pellet represented a half load). Color-separated pollen pellets were segregated and placed on microscope slides to determine grain size. After a representative set of grains were photographed, visual comparisons were made of the pollen grains.

We found an inverse relationship between pollen grain size and the weight of the pollen load in the samples (N = 54). The larger the grain size of the pollen, the lighter the overall pollen load. Grain size data, using color as a corbicular pollen load determiner, indicated that "small" grains (18 to 24 μm) comprised heavier corbicular loads than the "large" grains (64 μm) that correspondingly comprised lighter corbicular loads (t = 6.677, df = 51, $P < 0.0001$). As size of pollen grain increased the space available to hold pollen in the corbicula was reduced. Thus, there was a direct correlation between pollen weight and size. Smaller grains were more compactly placed (due to grain size) in the pollen basket and thus required less space. Our data suggest that a greater weight and number of grains of pollen could be carried before returning to the colony to unload the pollen basket. Because more flowers were visited in order to fill the corbicula with small grains of pollen, less time was consumed with return visits to the hive to unload corbicula although a larger load (by weight) was achieved. Previously, it was assumed that larger pollen grains would require more return trips to unload than smaller pollen grains in corbicular loads because less flowers would be visited to complete a load. Thus, relationships of pollen grain size to corbicular load may be important factors to consider in the experimental design of future honey bee pollination studies.

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