Imaging-based honeybee traffic measurement system and its application to strawberry pollination

Kyeong Yong Lee, Kathannan Sankar, Young Bo Lee

Department of Agricultural Biology, The National Institute of Agricultural Science, RDA, Wanju 55365
(ultrataro@korea.kr)

ABSTRACT

Bee traffic can be used as an indicator of the health of bee colonies, age, production of honeybee products, and crop pollination. To study bee pollination processes, we developed an algorithm that can automatically measure bee traffic through an image processing system. The match rate between the bee traffic observed through the system and the traffic that was visually observed was 93.6%. However, the higher the bee traffic, the lower the match rate. We applied the system in a strawberry cultivation greenhouse containing two colonies (one with 12500 bees and one with 10000 bees), and there was a significant difference in bee traffic between the two colonies. In addition, bee traffic depends on the climatic conditions inside the greenhouse (air temperature, relative humidity, illumination, and UV radiation), and there was a significant correlation between these indicators and the level of bee traffic observed. There was also a strong correlation (R>0.8) between bee traffic and foraging activity (which is correlated with pollination), and the foraging activity could be estimated with a high probability (R^2=0.74). Therefore, the bee traffic measurement system developed in this study can be used to study the effect of pollination on crops, and is expected to be applied as a major model for producing high–quality agricultural products in smart beekeeping and crop smart farms.

RESULTS

○ Algorism

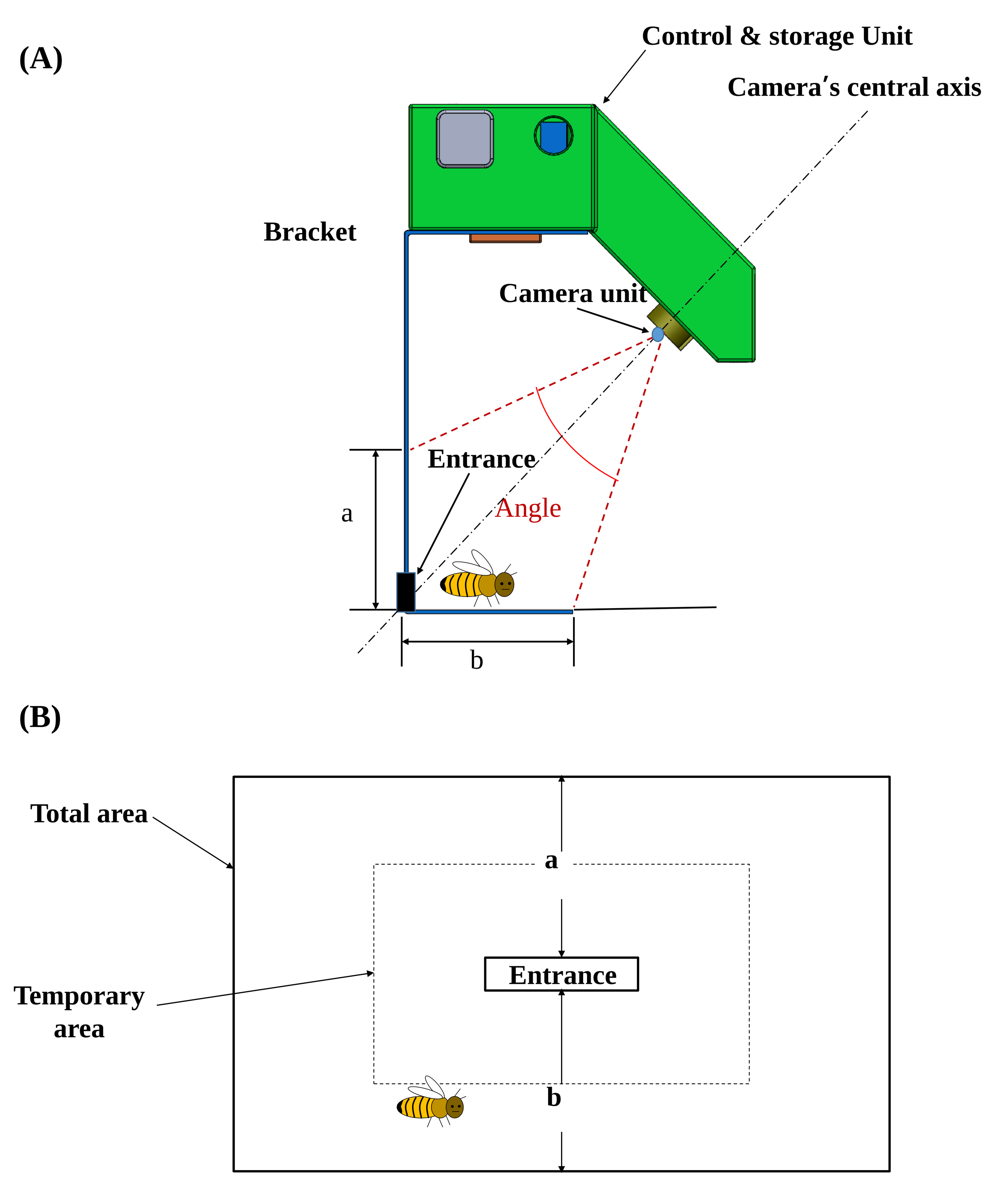

Fig. 1. Image capture and transformation for honeybee recognition: (A) camera's field of view for taking images; (B) two–dimensional transformation of image.

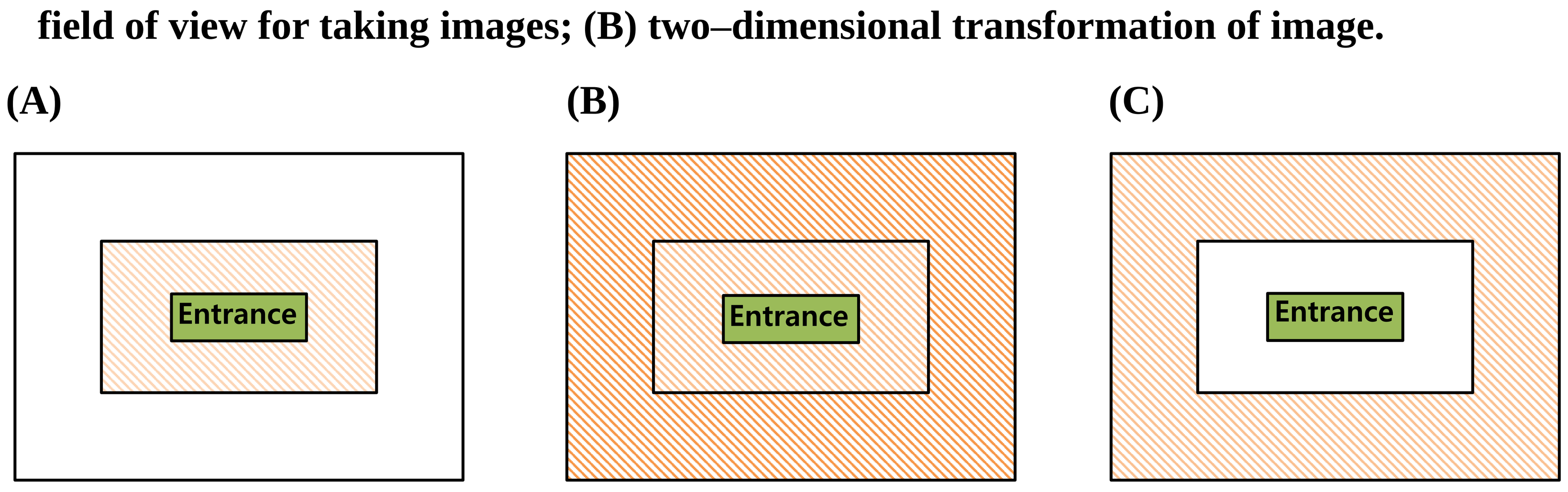

Fig. 2. Setting the area inside the image for traffic measurement: (A) temporary area inside camera's field of view; (B) entire area of camera's field of view; (C) entire area – temporary area.

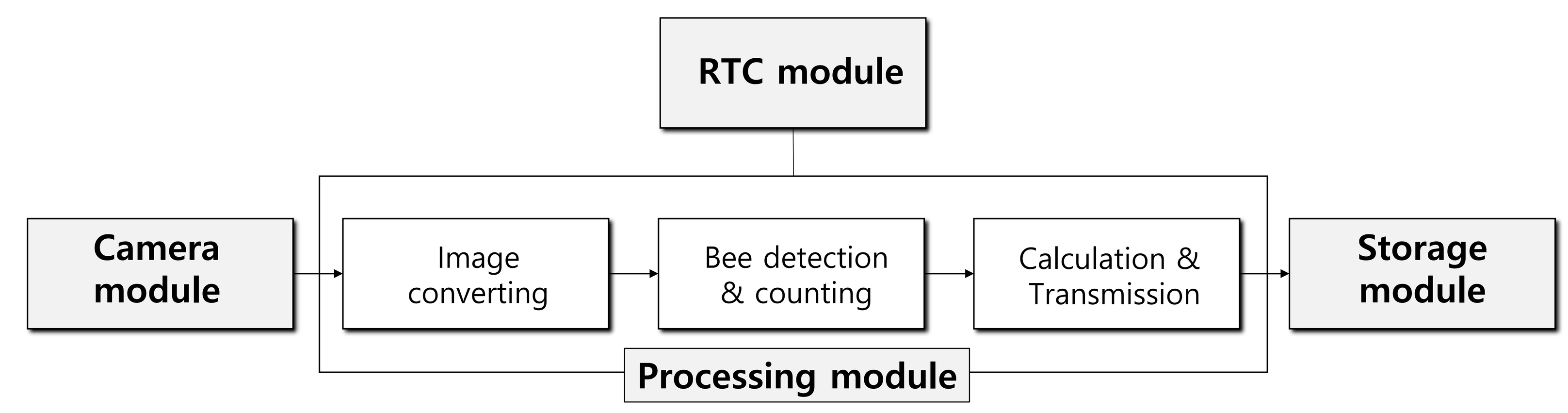

Fig. 3. Bee traffic measurement system configuration

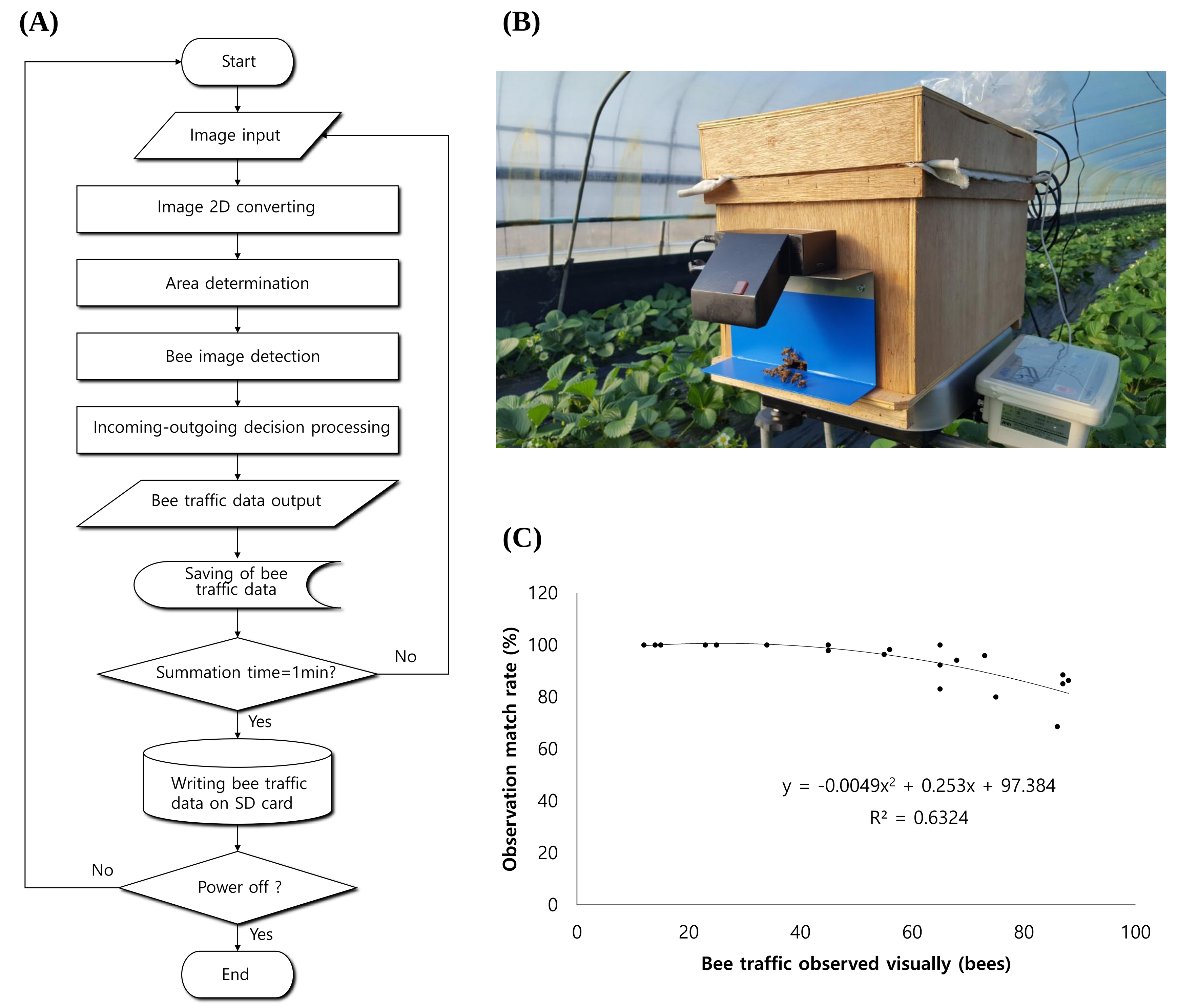

Fig. 4. (A) Flowchart for measuring bee traffic, (B) the bee traffic measurement system, and (C) Regression analysis between visual observation of bee traffic and observation match rate

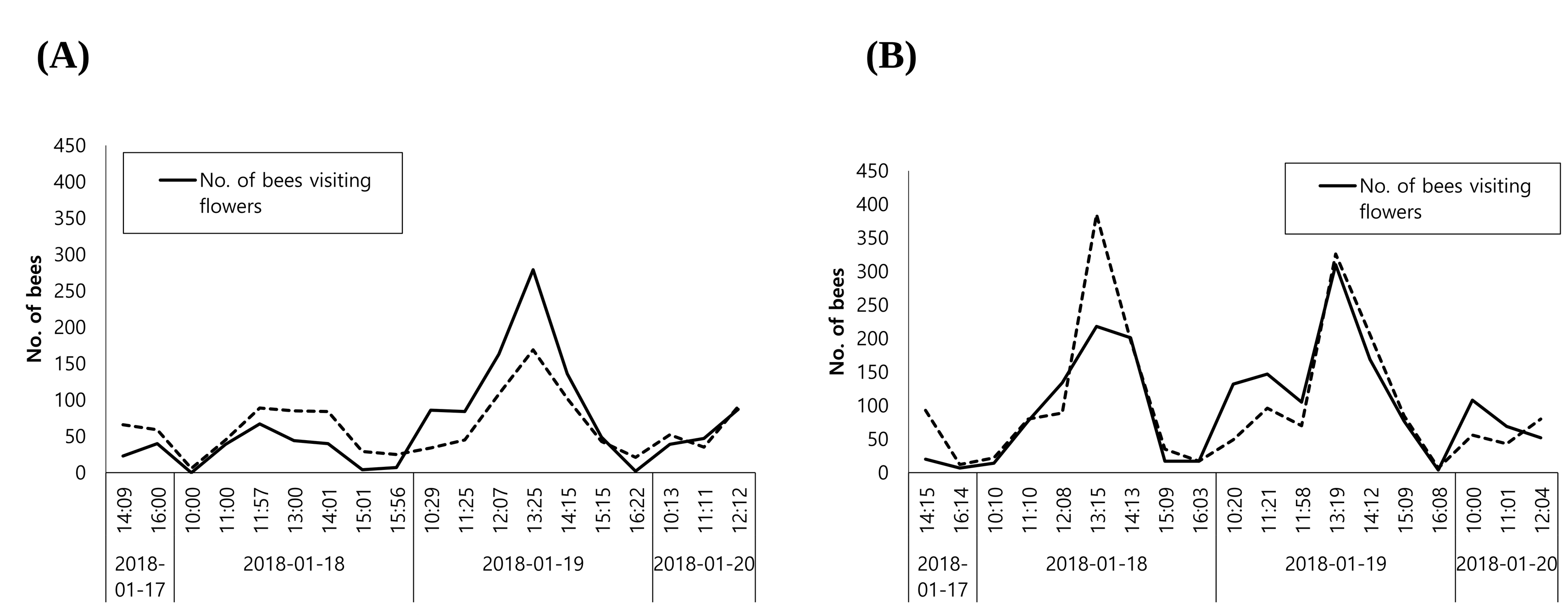

Fig. 5. Bee traffic and foraging behavior of *A. mellifera* in the strawberry greenhouse: (A) colony of 10000 bees; (B) colony of 12500 bees.

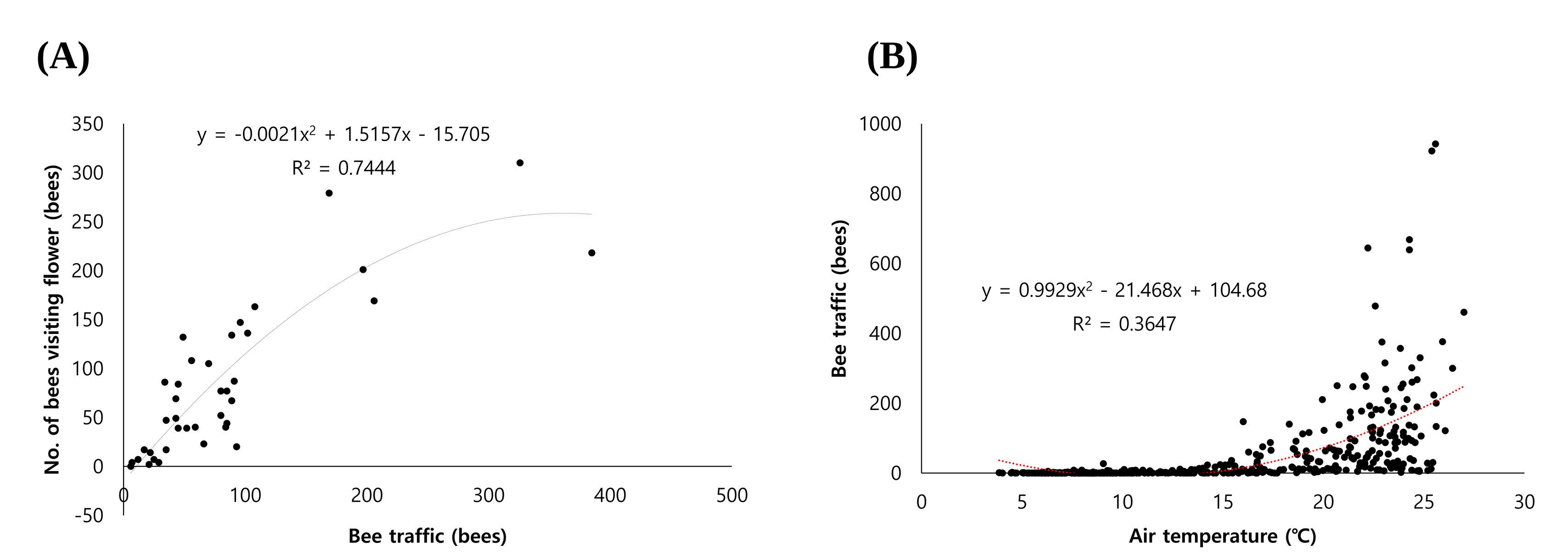

Fig. 6. (A) Correlation between bee traffic and foraging behavior of *A. mellifera* and (B) regression analysis between air temperature and bee traffic

농촌진흥청
국립농업과학원