Research project of counterparts funded at IPB University

Name	Counterpart	Title
Tiara Sayusti, Rika Raffiudin, Nina Ratna Djuita, Windra Priawandiputra	**A01**	Pollen diversity in honey revealed the foraging preference of the sympatric honey bee and stingless bee

Research Summary

Resource partitioning is essential to regulate competing community species to use the same resource at different places and times Pringle, 2021), it can stabilize the coexistence of species and maintain biodiversity. Resource partitioning was observed between the eusocial honey bee (*Apis mellifera*) and the stingless bee (*Melipona quadrifasciata*) in Brazilian rain forest (Wilms & Wiechers, 1997), where *M. quadrifasciata* collected pollen less diverse compared to *A. mellifera*. The research also found that the same resources were collected at different times.
Melissopalynology in stingless bee honey of *Heterotrigona itama* and *Tetragonula laeviceps* from Belitung Island revealed that the smaller-sized stingless bee *T. laeviceps* collected more diverse pollen compared to *H. itama* (Priambudi *et al.* 2021). Thus, we aimed to analyze the melissopalynology of pollen from honey to reveal the resource partitioning of the sympatric honey bee and stingless bee species in the high- and lowland.

We used honey bee *A. cerana* and the stingless bee *T. laeviceps* at the highland of Gunung Puntang Bee Learning Centre, Bandung Regency, West Java (1.258 m asl) and *A. cerana* and *H. itama* in the lowland of Flora Nauli bee farm in Pematang Siantar, North Sumatra (445 m asl). Honey from the observed bees was collected for melissopalynology. Pollen was extracted from honey and analyzed using acetolysis solution (Erdtman, 1972). Pollen identification was conducted based on APSA (*https://apsa.anu.edu.au/*). Pollen types and composition from the honey were determined for a minimum of 300 pollen grains.

A total of 13 pollen types were identified from the honey samples from the highland (Fig. 1A) and 14 pollen types from the lowland (Fig. 1B). Based on the pollen diversity in honey, we found that *A. cerana* collected pollen from

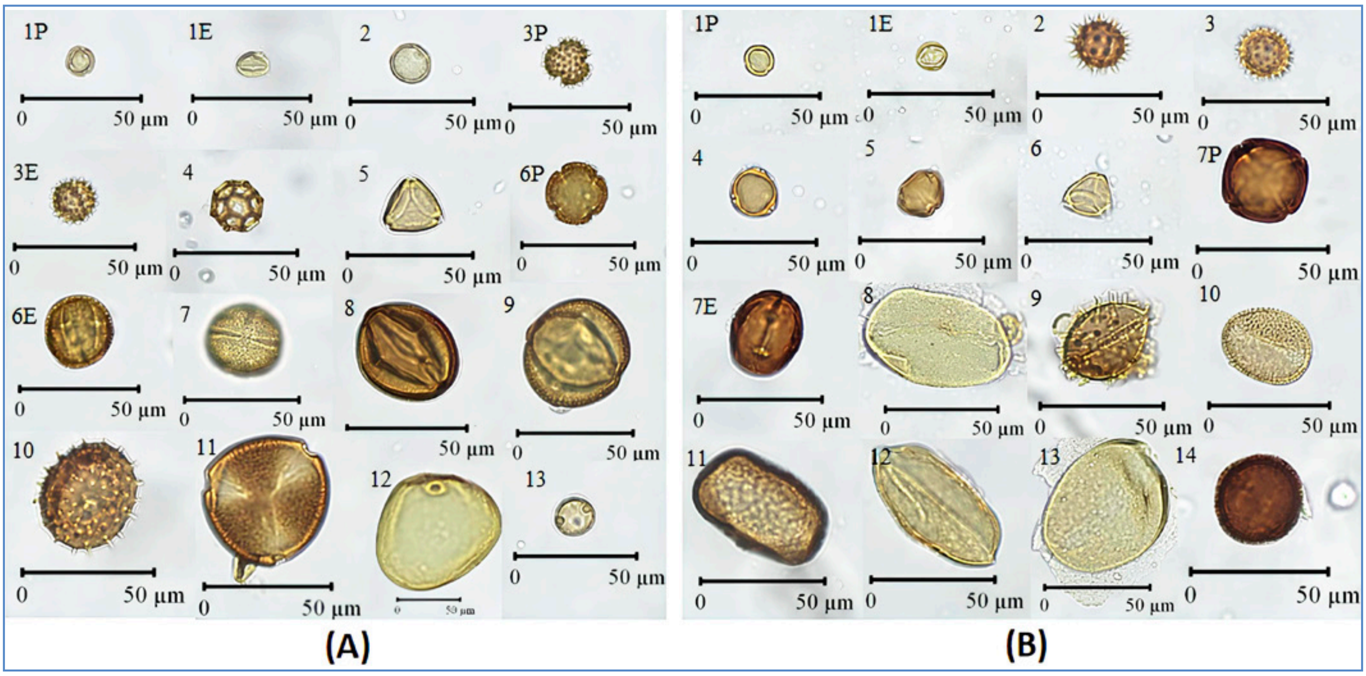

Figure 1. Pollen diversity is contained in the honey of sympatric honey bee and stingless bee species. **(A)** Stingless bee *T. laeviceps* and honey bee *A. cerana* in the highland: 1) Fagaceae; 2) Urticaceae/Moraceae type; 3) *Ageratum* sp.; 4) Asteraceae; 5) *Eucalyptus* sp.; 6) *Glochidion* sp.; 7) Euphorbiaceae-1; 8) Euphorbiaceae-2; 9) Euphorbiaceae-3; 10) Convolvulaceae; 11) Euphorbiaceae-4 type; 12) Poaceae; and 13) Sp.1. **(B)** Stingless bee *H. itama* and honey bee *A. cerana* in the lowland: 1) Fagaceae; 2) *Ageratum* sp.; 3) Asteraceae; 4) *Fagus* sp.; 5) *Ziziphus* sp.; 6) *Syzygium* sp.; 7) *Mimusops* sp.; 8) *Cocos nucifera*; 9) *Arenga* sp.; 10) Arecaceae-1; 11) Arecaceae-2; 12) Arecaceae-3); 13) Arecaceae-4; 14) Sp.2. Scale bar = 50 µm; P = Polar; E = Equatorial.

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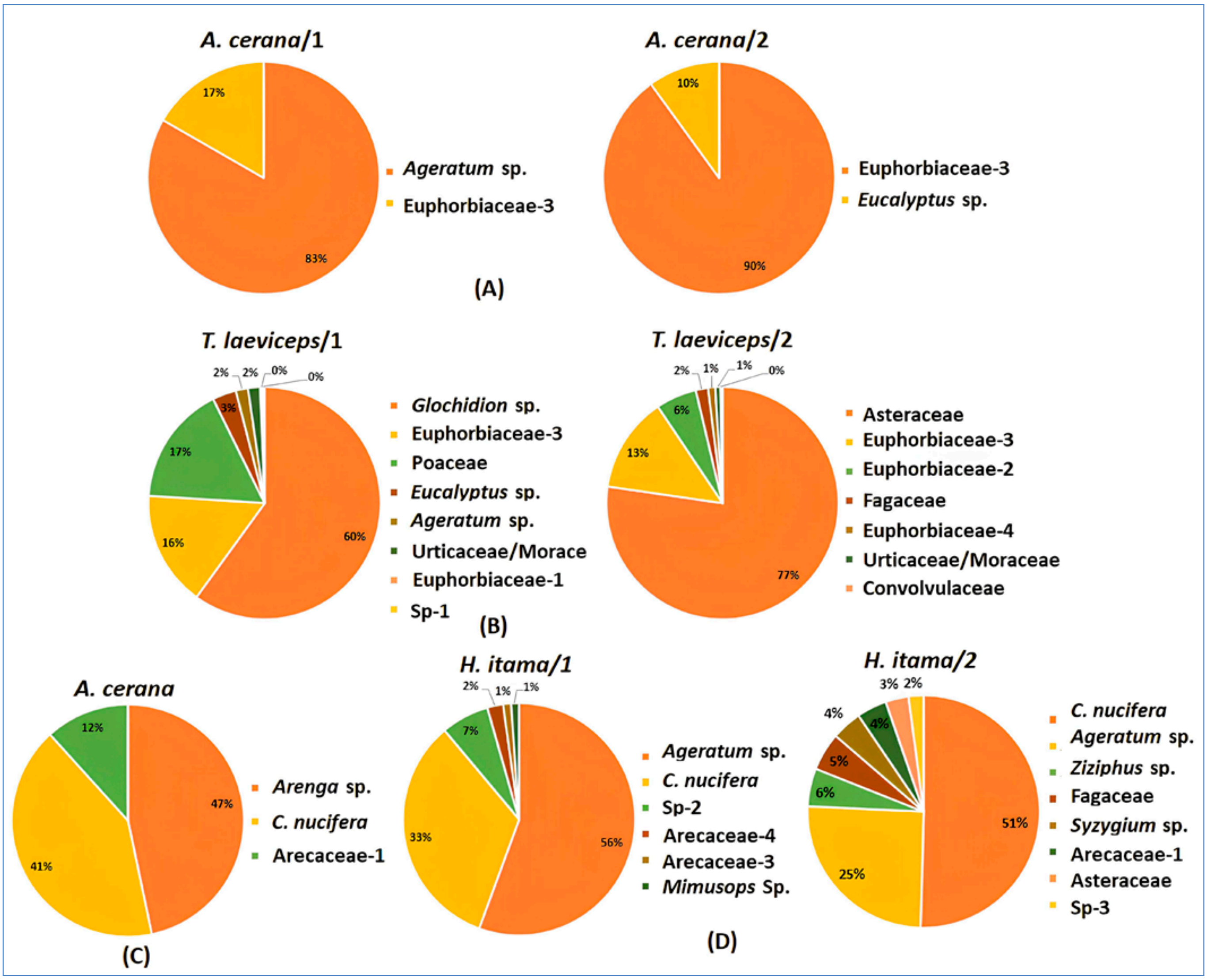

Figure 2. Pollen composition contained in honey from highland and lowland. (A) A. *cerana* highland, (B) T. *laeviceps* highland, (C) A. *cerana* lowland, and (D) H. *itama* lowland.

less diverse flowers than *T. laeviceps* in the highland (Fig. 2). Both *A. cerana* colonies only collected two pollen types. *Ageratum* sp. dominated the first colony, while the second colony was dominated by Euphorbiaceae-3 (Fig. 2A). In contrast, the pollen collected by *T. laeviceps* was more diverse (13 pollen types from seven different families), i.e., Euphorbiaceae, Poaceae, Myrtaceae, Asteraceae, Urticaceae/Moraceae type, Fagaceae, Convolvulaceae, and one unidentified pollen. The first colony was dominated by *Glochidion* sp., while the second colony was dominated by Asteraceae (Fig. 2B). The pollen of Euphorbiaceae-3 was found in all honey samples of *A. cerana* and *T. laeviceps* (Fig. A-B), which indicates that *A. cerana* and *T. laeviceps* also shared the same pollen resources. While the pollen type of Urticaceae/Moraceae was only collected by *T. laeviceps* colonies (Fig. 2B).

Consistent with the highland results, the lowland *A. cerana* also collected pollen from less diverse flowers than *H. itama* (Fig. 2C). Apis cerana honey contained three pollen types from a single family Arecaceae and was dominated by *Arenga* sp. (Fig. 2C). In contrast, *H. itama* collected more diverse pollen from several plant families, i.e., 11 pollen types from six different families (Asteraceae, Arecaceae, Fagaceae, Sapotaceae, Rhamnaceae, Myrtaceae, and one unidentified family). *Ageratum* sp. dominated the first colony, while the second colony was dominated by *Cocos nucifera* (Fig. 2D). In the lowland, each colony of honey bee *A. cerana* and stingless bee *H. itama* have specific pollen resources. Pollen of *Ageratum* sp. was shared between *H. itama* colonies, while pollen of *C. nucifera* was shared at the intra- and inter-species level.

In summary, both in the high- and lowland, stingless bee honey contained more diverse pollen types than honey bees. Stingless bee *T. laeviceps* and *H. itama* have a smaller body size compared to honey bee *A. cerana*. Body size facilitates resource partitioning of organisms with the same food resources (Schoener, 1974). Stingless bees visit more diverse flowers with small and narrow petals, due to their small body size (Engel & Bakels, 1980). Thus, different body size provides different niches, which allow sympatric species to coexist stably by decreasing the likelihood that one species will deplete the resources needed by another. We conclude that stingless bees *T. laeviceps* and *H. itama* utilized a higher diversity of pollen resources than the honey bee *A. cerana* in the high- and lowland and each colony showed preferred pollen types.

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