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Pollen Resources Partitioning of Stingless Bee Species *(Tetrigona Apicalis (*Smith*)) (*Hymenoptera*:*Apidae*)* from the Saiburi, Pattani, Thailand

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ABSTRACT

This is the first foraging plant and palynological study using pollen stored by *Tetrigona apicalis (*Smith*) (*Apidae*:* Meliponini*)* in the Saiburi, Pattani, Thailand**.** The samples were directly collected from the pollen pots of *T. apicalis (*Smith*)* species in apiaries located in the Pattani province**.** The samples were dried, weighed, diluted in warm water and ethanol, centrifuged and then processed using the acetolysis method**.** After mounting the pollen samples on the glass slides, we identified and counted at least 500 pollen grains per sample**.** The results show that the main and dominant pollen *(*over 10*%)* combinations in the pollen pots of *T. apicalis (*Smith*)* include pollen from Arecaceae *(*14**.**25*%)*, Euphorbiaceae *(*12**.**33*%)*,Polygonaceae *(* 12.1*%)*, Fabaceae *(*10**.**74*%)* andTalinaceae *(*10**.**63*%)* respectively**.** This result, we can use data for present to the stingless bee farm in the future.

Keywords
Stingless Bee, Pollen Resources, Tetrigona apicalis (Smith), Foraging Plant, Pollen

INTRODUCTION

Stingless bees appear in the subtropical and tropical regions**.** Stingless bees are adapted to different species of foraging plant including fields, forests, savannas and mountains**.** Flowering duration effect on the honey properties and pollen diversity**.**The melissopalynology of stingless bees allows recognizing floral preferences in different duration, localities and the vegetation types**[1].** The pollen analysis in the pollen pot of stingless bee is importance for providing data about pollen source **[2**,**3].**There are many countries that support for research about the relation of plant and pollen in the hive such as New Zealand**[4]** Nigeria **[5]** Spain **[6]**and many in Turkey **[7].**
Most of the plants were pollinated and the nectar had large flowers, fragrant and sweet water **[8]** Orange **[9].** Coconut **[**1**0].**and Eucalyptus **[11].**
Thus, the objective of this study was to identify the foraging plants that contribute to the pollen pot composition of stingless bees**.**

MATERIALS AND METHODS

Study Sites

This study was conducted in an apiary of Saiburi, in the Pattani province, Thailand**.** The apiary chosen covered approximately 2**.**0 hectares**.**The apiary is selected as there are active stingless beekeeping and honey productionactivities by the local people**.** The approximately 30 colonies of stingless bees, *T. apicalis* **(**Smith**)** were reared there **[**FIGURE 1**].** The area was an orchard that contains different species of crops**.** In general, the climate in Saiburi is hot and humid, with average year-round temperatures of ~27^{o}C**.** There was a rainy season from November to January, and another relatively dry season from February to September**.**

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FIGURE 1. **Nests of *T. apicalis* (Smith) (A) from the Saiburi, Pattani, Thailand**

Preparation of Pollens Collected from*T. apicalis (Smith)* and Pollens Identification

The pollen loads from the pollen baskets of the captured *T. apicalis (Smith)* foragers were removed with a forceps**.** The pollen clusters from each stingless bees were then preserved in the centrifuge tubes that containing 70**%** ethanol and the centrifuge tubes were labeled**.** Micropipette was used to transfer 1 mL of pollens that have been preserved earlier in the centrifuge tubes to the haemocytometer slide**.** Twenty replicates of slides for each centrifuge tubes were prepared in order to provide representative coverage pollens that were collected by each individual of the stingless bees**.** The haemocytometer slide was observed under light microscope**.** In the microscopic pollen analysis and identification, reference samples and available keys were used **[**12**]**

RESULTS AND DISCUSSION

The Areceae families were the highest number of pollen collectedby stingless bee species **(** *T. apicalis* **(**Smith**))**, accounting for 28**.**62**%** of the total species visited **(**Figure 2**).** Species of Areceaewas considered as important sources of pollen due to frequency of occurrence of different pollen types **(**dominant, supplementary, or important isolated pollen**).** On the other hand, considering the frequency of occurrence was minor source of pollen **(** occasionally isolated pollen**)**, including Euphorbiaceae *(*12**.**33*%)*, Polygonaceae *(*12**.**1*%)*, Fabaceae *(*10**.**74*%)* and Talinaceae *(*10**.**63*%)*which were also important as a source of pollen **(**Table 1**).** Eusocial bees, such as those of the Meliponini tribe was previously reported to most commonly visit Fabaceae and Myrtaceae species **[**13, 14, 15**].**

Table 1 Plant species used by *T. apicalis* (Smith) (Apidae: Meliponini) in the Saiburi, Pattani, Thailand.

Family	Plant Species	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
Acanthaceae	*Asystasia gangetica* L**.**					*	*						
Arecaceae	*Cocos nucifera*	*	*	*	*	*	*	*	*	*	*	*	*
	Elaeis guineensis	*	*	*	*	*	*	*	*	*	*	*	*
	Areca catechu L**.**				*	*	*	*	*	*	*		
	Cyrtostachys renda Blume**.**	*	*	*	*	*	*	*	*	*	*		
	Salacca edulis Reinw					*	*	*					

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Family	Plant Species	Months											
Asteraceae	*Wrightia antidysenterica* R. Br.			*	*	*	*			*	*		
Capparideceae	*Cleome rutidosperma* DC.						*	*	*				
Cucurbitaceae	*Coccinia grandis* (L.) Voigt	*	*				*	*	*				
Euphorbiaceae	*Manihot esculenta* (L.) Crantz)			*	*	*	*						
	Sauropus androgynus (L.) Merr.					*	*	*					
Fabaceae	*Mimosa pudica*		*	*	*	*	*	*	*	*	*		
	Ixora coccinea L.				*	*	*	*	*	*	*		
	Solanum xanthocarpum Schrad. & Wendl.						*	*	*			*	
	Leucaena leucocephala (Lamk.) de Wit					*	*	*	*				
	Parkia speciosa Hassk.					*	*	*	*				
	Acacia mangium Willd.					*	*	*				*	
Malvaceae	*Urena lobata* L.					*	*	*					
Melastomataceae	*Melastoma malabathricum* L.	*	*	*	*	*	*	*					
Moringaceae	*Moringa oleifera* Lam.							*	*				
Myrtaceae	*Psidium guajava* L.					*	*	*	*	*			
Poaceae	*Dactyloctenium aegyptium*			*	*	*			*	*	*		
Polygonaceae	*Antigonon leptopus* Hook. & Arn.	*	*	*	*	*	*	*	*	*	*	*	*
Portulacaceae	*Portulaca grandiflora*												
Talinaceae	*Talinum paniculatum* Gaertn.					*	*	*	*				
Solanaceae	*Solanum torvum* Swartz *Capsicum flutescens* Linn.				*	*	*	*	*				
Unidentified	*Unidentified **1***	*	*	*	*								
	*Unidentified **2***			*	*	*							
	*Unidentified **3***		*	*	*	*							

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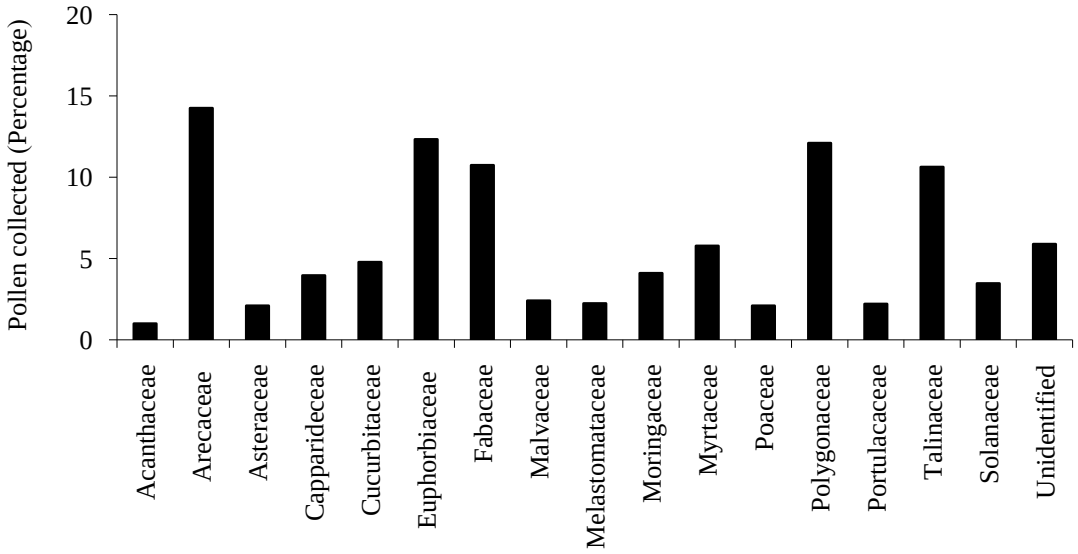
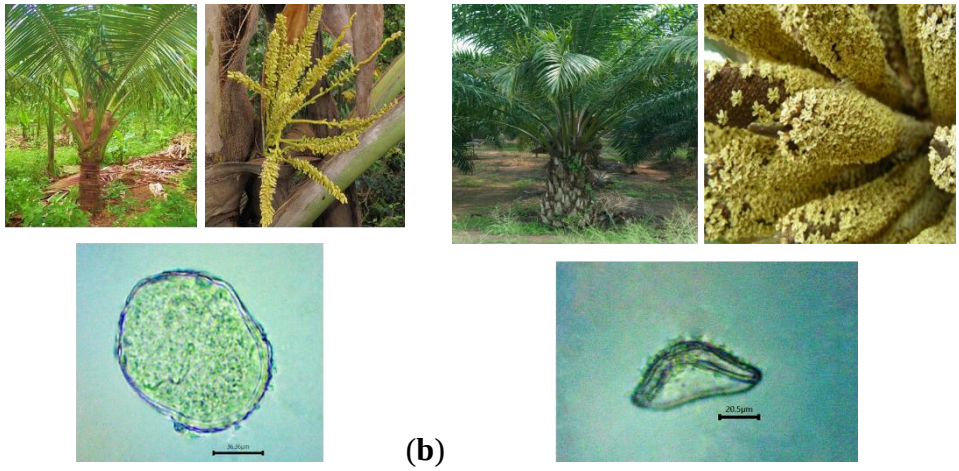


Figure 2 Percentage of pollen collected by *T. apicalis*(Smith)(Apidae: Meliponini) in the Saiburi, Pattani, Thailand.



(a) **(b)**

Figure 3 Photomicrographs of pollen grains of the most used species by *T. apicalis* (Smith)(Apidae: Meliponini)) in the Saiburi, Pattani, Thailand.
(a) *Cocos nucifera* (Arecaceae)
(b) *Elaeis guineensis* (Arecaceae)

Jongjitvimol and Wattanachaiyingcharoen **[**16**]**, who examined pollen loads of three species of Trigona; ***T.*** *apicalis* Smith 1857, ***T.*** *collina* Smith, 1857 and ***T.*** *fimbriata* Smith, over one year in thePhitsanulok Wildlife Conservation Development and Extension Station in Thailand , reported that families were visited and that the Acathaceae **(***Ruellia tuberose***)**, Agavaceae **(***Agave angustifolia***)**, Alangiaceae **(***Alangium salviifolium***)**, Arecaceae **(***Caryota bacsonensis***)**, Asteraceae **(***Tridax procumbens***)**, Bignoniaceae **(***Rernandoa adenophylla***)**, Caesalpiniaceae **(***Cassia bakeriana*, *Delonix regia* and *Senna siamea***)**, Convolvulaceae **(***Ipomoea aquatica* and *Merremia vitifolia***)**, Cucurbitaceae **(***Coccinia grandis***)**, Euphorbiaceae **(***Croton roxburghii***)**, Lythraceae

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(*Lagerstroemia calyculata, L. macrocarpa* and *L. tomentosa***)**, Mimosaceae **(***Mimosa pigra* and *M. pudica***)**, Papilionaceae **(***Butea monosperma, Dalbergia lanceolaria, Erythrina stricta* and *Millettia brandisiana***)**, Rubiaceae **(***Ixora grandifolia* and *Paederia linearis***)**, Scrophulariceae **(***Torenia fournieri***)**, Thunbergiaceae **(***Thunbergia laurifolia***)**, Verbenaceae **(***Tectona grandis***)** and Zingiberaceae **(***Costus speciosus* and *Zingiber officinale***).** *T. collina* was by far the most polylectic species collecting 29 plant species, while *T. apicalis* foraged on 20 and *T. fimbriata* only 16**.** This suggests that the small *T. collina* is the most important pollinator among the three species**.** Similarly, Ramalho et al**. [**17**]**, who reportedof the generally pollen loads of Stingless bee, ie Arecaceae, Anacardiaceae, Compositae, Euphorbiaceae, Labiatae, Leguminosae, Melastomataceae, Moraceae, Myrtaceae, Rubiaceae and Solanaceae, are also the most consistent pollen and nectar**.**

Notably, of all the plant species visited, *T. apicalis* **(**Smith**)** concentrated its collection on only a few sources along the year**.** Based on the monthly percentage, the most frequently visited species were *Cocos nucifera* and *Elaeis guineensis* **(** Arecaceae**) (** All Year**),** *Manihot esculenta* **(** L**.)** Crantz**) (** Euphobiaceae**) (** in February**),** *Mimosa pudica* **(** Fabaceae**) (** All Year**),** Antigonon leptopus Hook**.**& Arn**. (**Polygonaceae**) (**All Year**)** and *Talinum paniculatum* Gaertn**. (**Talinaceae**) (**in June**) (**Figure 6**)** once their pollen grains were classified as dominant in the samples **(**Table 1**).** Arecaceae families are often cited as commonly used by Meliponini**.** Alves, **[**18**]** attributes this loyalty to the high concentration of pollen in the inflorescences of these trees, which serve as a reward display for the bees**.** This pattern was also observed by Sabine Engeland Dingemans-Bakels **[**19**]**, who studied bees and stingless bees**.** Ramalho **[**20**]** suggested that regional is a factor for different of plant foraging Additionally, species of Arecaceae commonly hold open flowers with many stamens and anthers opening lengthwise, exposing the pollen grains, and facilitating visits by stingless bees**.**

CONCLUSIONS

The main and dominant pollen combinations in the pollen pots of *T. apicalis* **(** Smith**)** include pollen from Arecaceae, Euphorbiaceae, Polygonaceae, Fabaceae and Talinaceae respectively**.** On the other hand, minor pollen that foraging plants include pollen from Acanthaceae, Asteraceae, Capparideceae, Cucurbitaceae Malvaceae, Melastomataceae, Moringaceae, Myrtaceae, Poaceae, Portulacaceae, Talinaceae, and Solanaceae**.**

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