Biosaintifika 12 (3) (2020): 478-487
Journal of Biology & Biology Education
p-ISSN 2085-191X | e-ISSN 2338-7610
https://journal.unnes.ac.id/nju/index.php/biosaintifika

Feed Resources Determination Based on Pollen Diversity in Trigona Bees (*Trigona* sp.) Colony

Muachiroh Abbas*, Eddy Tri Sucianto

Faculty of Biology, Universitas Jenderal Soedirman, Indonesia
*Corresponding author: muachiroh@gmail.com

Submitted: 12 October 2020. Revised: 20 November 2020. Accepted: 25 December 2020

Abstract. Trigona bees' food resources can be determined either directly based on flowering plants live closed to the nest or based on pollen diversity inside the nest. There is no study about Trogona bee's food resources determination based on pollen diversity inside the bee colony's nest. This study aimed to determine plant food resources based on pollen diversity found inside the Trigona nest. This research was conducted in Serang village, sub-district of Karangreja, Purbalingga Regency. Pollen samples were taken from flowering plants lives around the nest and those in the nest and then were prepared using the acetolysis method. The variables observed were pollen morphology, with parameters such as unit, shape, size, aperture, and ornamentation. The data obtained were analyzed descriptively. Based on pollen diversity, 43 species and 22 plant families were live around Trigonanest in Serang Village. Forty-one pollen types were found inside the Trigonas' nest, with 37 of them are identic to the pollen collected from flowers around the nest. It can be concluded that 37 species of flowering plants could be determined as food resources for the Trigona bee based on pollen diversity inside the nest. This research provides the first data about feed resources for Trigona bee in Serang Village based on pollen diversity. The results provide essential information about food resources, which is vital for the development of Trigona bee cultivation.

Key words: colony; feed resources; pollen diversity; trigona bee

How to Cite: Abbas, M., & Sucianto, E. T. (2020). Feed Resources Determination Based on Pollen Diversity in Trigona Bees (Trigona sp.) Colony. *Biosaintifika: Journal of Biology & Biology Education*, *12*(3), 478-487.

DOI: http://dx.doi.org/10.15294/biosaintifika.v12i3.26603

INTRODUCTION

Food availability is a crucial factor in honeybee cultivation. Various plant species might become food resources for the honeybee, which includes all flowering plants. Therefore, flowering plants have a mutually beneficial relationship with the honeybee. The flowering plants provide nectar and pollen or both nectar and pollen as food resources for the honeybee (Suwannapong et al., 2012). Meanwhile, bees act as a pollinating agent for these plants (Agussalim et al., 2017; Sihombing, 2015; Widowati, 2013; Setiawan et al., 2017).

Several honeybee species acted as pollinating agents for flowering plants (Corlett, 2011). The things that attract bees to visit flowers are pollens' color, aroma, shape, and size (Nugroho & Soesilohadi, 2014). The bees carry nectar and pollen to their nest. The availability of sufficient nectar or pollen as food resources strongly affecting the production of honey and propolis by a bee colony.

Trigona bee, locally known as Trigona, is one of the bee species capable of producing honey and propolis. It is among stingless bee species (Kwapong et al., 2010). Honey and propolis produced by Trigona bees are determined mainly by plants around the nest as pollen or nectar sources. Furthermore, Nugroho and Soesilohadi (2014) and Widhiono and Eming (2016) have reported that Trigona bees could explore pollen with the maximum distance or radius of 500 meters from their nest.

Besides the flowering plant live around the Trigona bee's nest, plant food resources can also be determined based on pollen diversity in the bee colony (Chauhan et al., 2017). Sajwani et al. (2014), who performed the study in Oman, showed that analysis of pollen diversity in beehives is fundamental to determine the life-supporting plants of bees. A previous study by Bareke and Admassu (2019) in Ethiopia reported that 150 plant species were identified as food resources for bees based on pollen diversity in the bee's nest. Moreover, using the same method, Farkas and Orozs-Kovacs (2012) identified 90 plant species as food resources for bees, while Salman and Azzazy (2013) found 32 plant species in Saudi Arabia.

Research on pollen diversity in bee's nests is not available, especially in Serang Village, Karangreja sub-district, Purbalingga Regency. The village is located on the southeastern eastern slopes of Mount Slamet with hilly areas. This village has an average temperature of 20ºC at an altitude of 600-1500 meters above sea level and also has fertile soil conditions suitable for agriculture, horticulture, and plantations (Azhari & Apik, 2019). Most areas of the village are utilized in vegetable crops and farms. The condition provides essential support for developing the wild bee (Pratama et al., 2018).

This study aimed to determine plant species as food resources for the Trigona bee based on pollen diversity collected from the bee's nest. There is no study about pollen utilization for plant identification as feed resources for Trigona bee. The data is vital for the developing of Trigona cultivation in Serang Village, District of Karangreja, Purbalingga Regency.

METHODS

Research site and time

Pollen collection was conducted in Serang Village, District of Karangreja, Purbalingga Regency. The sampling sites was located at the coordinates of -7º14’10,5’’ to -7º14’10,7’’ and 109º16’46,8’’ to 109º16’50,5’’. Pollen preparation and identification were carried out at the Laboratory of Plant Structure and Development, Biology Faculty, Jenderal Soedirman University. The research was conducted from May to September 2020.

Sample Collection

The samples were collected based on a random sampling technique inside the nest of the Trigona bee. Pollens were also collected from the flowering plants' lives around Trigona’s nest with a maximum radius of approximately 200 m apart. Pollen samples were prepared by the acetolysis method. Pollen was scrapped from the nest using tweezers then placed in a flacon bottle containing glacial acetic acid (GAA). All the bottles were then labeled. Pollen from plants was collected by removing the anthers from the flowers and put in a flacon bottle containing glacial acetic acid (GAA) and labeled.

Variable and parameter

Pollen diversity was identified based on their morphology. The parameters included unit form, aperture, size and shape, and ornamentation of the exines.

Plant identification

Plants' flowers were taken from around Trigona nest, photographed for easy identification, and their morphological characteristics were observed. Plant identification was carried out by asking residents for guidance using the PlanNet Plant Identification application and Flora by Steenis (2013).

Pollen preparation

Pollen preparation was carried out using the acetolysis method (Purnobasuki et al., 2014; Aprianty & Kriswiyanti, 2007). The steps are that the pollen was put into a flacon bottle that had been filled with a solution of glacial acetic acid, fixed for 24 hours. Then the sample was centrifuged at 1000 rpm for 10 minutes. After that, glacial acetic acid was removed, replaced with a mixture of glacial acetic acid and concentrated sulfuric acid in a ratio of 9:1, then heated in a water bath at 60ºC for 5 minutes and left to stand for 10 minutes. It was then centrifuged at 1000 rpm for 10 minutes. The next step was washing with distilled water, centrifuged again at 1000 rpm for 10 minutes, and washed it twice. The pollen was then proceed with the staining process using safranin in glycerin jelly, then let stand for 10 minutes. The stained pollen was placed on the object-glass and covered with a glass cover and then observed.

Pollen measurement

Polar axis length (P) and equatorial diameter (E) were measured using an ocular micrometer under a microscope with 400 times magnification to determine pollen's shape and size. The pollen's shape can be determined by comparing the polar axis length and the equatorial diameter. Pollen shapes were determined based on the P / Ex100 index as follows, Peroblate (<50), Oblate (50-70), Sub-oblate (75-88), Oblate-spheroidal (88-99), Spheroidal (100), Prolate-spheroidal (101-114), Sub-prolate (114-133), Prolate (133-200) and Per-prolate (> 200) (Halbritter et al., 2018). The pollen size was determined based on the size of the longest axis as follows: very small (<10 µm), small (10-25 µm), medium (25-50 µm), large (50-100 µm), very large (100-200 µm), and giants (> 200 µm) (Halbritter et al., 2018).

Pollen observation

The pollen was observed for their unit forms, i.e., monad, dyad, tetrad, polyad. Aperture type was also examined whether porus, colpus, or colporus, and also the ornamentation of exines (psilate, scabrate, verrucate, clavate, echinate, reticulate, baculate) (Hesse et al., 2009; Halbritter et al., 2018)

Pollen identification

Pollen identification was made by observing the morphological character of pollen from each flower and compared to literature by Palynological Database (www.paldat.org), Hesse et al. (2009), and Halbritter et al. (2018). The morphological characters of pollens collected inside the nest were compared to pollens collected from plants live around the nest to know the plant species.

Data analysis

Data were analyzed descriptively based on pollen's morphological characters. The pollens' polar axis (P) and the equatorial diameter (E) were measured using micrometry. The results were analyzed descriptively.

RESULTS AND DISCUSSION

Flowering Plant

Morphological identification placed the plants in Serang Village, District of Karangreja Purbalingga Regency, into 43 species and 22 families (Table 1). Further examination proved that those plants consist of ornamental, food, vegetable, and medicinal plants. The results were similar to Sucianto et al. (2020) that various vegetable plants are cultivated in Serang Village.

Those plants have potential as food resources for Trigona bees, which were mostly in referred herbaceous plants. According to Rasic et al. (2018), pollens are a good feed source for bees. Other studies by Rismayanti et al. (2015) and Kifle et al. (2015) stated that herbaceous plants are essential pollen sources for bees. It is because herbaceous plants tend to have shorter growth and flowering times than tree plants. Besides, herbaceous plants can flower at any time.

Pollen diversity collected from plants live around Trigona nest

The observed pollen has polar axis length (P) ranges from 12.2±14.0 in *Solanum muricatum* L to 68.4±75.9 in *Hemerocallis fulva* L. Pollens' equatorial diameters (E) were varied between 12.9±14.0 in *Seemannia sylvatica* L. and 67.2±74.1 in *Sechium edule* L. The P/E indexes ranged from 100 to 191. That P/E indexes are essential for pollen shape determination. The pollen of forty plant species had P/E index ranges from 101 to 114, and two species had pollens with P/E index ranged between 115 and 122, while pollens of one species had a P/E index from 155 to 191. Complete data about pollen characteristics owned by each plant species is presented in Table 2.

Based on the P/E indexes, as presented in Table 2, it can be determined that three different pollen shapes were observed during the study. According to Halbritter et al. (2018), pollen shapes are determined based on the P/E index. The detailed and careful examination proved that forty plan species have prolate spheroidal (P/E 100 to 114), two species have subprolate (P/E index between 114 and 133), and one plant has prolate (P/E index from 133 to 200) pollen. Pollen shape was determined after comparing the observed P/E index to P/E indexes as previously described by Zahrina et al. (2017). According to Zahrina et al. (2017), prolate spheroidal pollen has a P/E index ranged from 100 to 114; subprolate pollen has a P/E index ranged between 114 and 133; whereas prolate a P/E index ranged from 133 to 200.

Further examination showed that various pollen morphologies were observed. The results were similar to a previous report by Suwannapong et al. (2012) that pollen morphology is species-specific. Pollen morphology can be seen from apertures, units, and ornamentation. One species among of 43 plant species has pollens with 2 to 4 colporate apertures, 17 plant species have tricolporate apertures, 10 species have tricolpate apertures, and the remaining plant species have tetracolpate, polysorbate, polycolporate, monocolpate, triporate, pantoporate, and pantocolpate apertures (Table 3). According to Hesse et al. (2009), several possibilities can be seen in the number and type of pollen apertures if there is a change in the aperture position to give different results when viewed from the polar equatorial fields.

Pollens' ornamentations were determined based on the size, shape, and arrangement of the ornamentation elements. It was observed that various pollen ornamentations were also observed during the field trips in Serang Village. Fourteen plant species have echinate pollen, eight plant species have psilate, seven plant species has reticulates, five species have scabrate pollen, five species have verrucate pollen, two plant species have baculate, and the remaining two plant species have clavate pollen (Table 3). According to Hesse et al. (2009), pollen ornamentations can be varied. The pollen ornaments are psilate, echinate, verrucate, scabrate, clavate, reticulate, and baculate.

Another morphological characteristic of the examined pollens was the unit. The examination showed that most of the pollens have monad units, and only one was the tetrad. Hesse et al. (2009) stated that most of the angiosperms pollen is solitary and monad (single) pollen. Since almost all plant found in Serang Village was angiosperm, it was reasonable that most of the pollens are monad.

Pollen collected inside the Trigona nest

The morphology of pollen collected both inside and outside the Trogona nest is presented in Figure 1. A total of 41 pollen morphotypes were found inside the Trigona nest. Those results are a good indication that the Trigona bee utilizes 41 plant species as food resources. The argument is that each plant species has pollen with specific morphology. According to Suwannapong et al. (2012), pollen is highly variable. The variability is positively related to the taxonomic status of the plants. Moreover, Chauhan et al. (2017) has reported that pollen morphology can be used as an indicator to determine the taxonomic diversity of plants producing pollen. Therefore, it is undoubted that the Trigona bee in Serang Village feeds on 41 plant species. Comparison between pollens collected inside and outside the Trigona nest resulted that 37 pollens are morphologically matching 37 pollens of plant species.

Table 1. Plant species live closed to Trogona bees' nest

Local Name	Scientific Name	Family
Bunga kertas	*Zinnia elegans* L.	Asteraceae
Bunga Matahari	*Helianthus annuus* L.	Asteraceae
Dahlia	*Dahlia pinnata* L.	Asteraceae
Ketul	*Bidens pilosa* L.	Asteraceae
Terompet Matahari	*Chrysanthemum myrtifolia* L.	Asteraceae
Strong	*Crassochepalum crepidioides* L.	Asteraceae
Sawagiku	*Senecio vulgaris* L.	Asteraceae
Jong	*Spilanthes oleracea* L.	Asteraceae
Bunga keranjang	*Centaurea cuneifolia* L.	Asteraceae
Brandon	*Ageratum conyzoides* L.	Asteraceae
Kenikir Kuning	*Cosmos sulphureus* L.	Asteraceae
Jukut	*Galinsoga parviflora* L.	Asteraceae
Bunga laba-laba	*Cleome hasslerana* L.	Capparaceae
Cabai rawit	*Capsicum frutescens* L.	Solanaceae
Cabai Besar	*Capsicum annuum* L.	Solanaceae
Melodi	*Solanum muricatum* L.	Solanaceae
Tomat	*Solanum lycopersicum* L.	Solanaceae
Casino	*Brassica juncea* L.	Brassicaceae
Tanjung	*Barbarea rupicola* L.	Brassicaceae
Singkong	*Manihot utillisima* L.	Euphorbiaceae
Stroberi	*Fragaria vesca* L.	Rosaceae
Mawar	*Rosa* sp.	Rosaceae
Ocean	*Rubus rosifolius*	Rosaceae
Puspa	*Schima wallichii* (DC) Korth	Theaceae
Lili orange	*Hemerocallis fulva* L.	Liliaceae
Bawang Daun	*Allium fistulosum* L.	Alliaceae
Bunga pagoda	*Cleodendrum paniculatum* L.	Lamiaceae
Salvia	*Salvia splendens* L.	Lamiaceae
Buncis	*Phaseolus vulgaris* L.	Fabaceae
Labu siam	*Sechium edule* L.	Cucurbitaceae
Zuniki	*Cucurbita pepo* L.	Cucurbitaceae
Pacar air	*Impatiens balsamina* L.	Balsaminaceae
Lantanas	*Lantana depressa* L.	Verbenaceae
Tembelekan	*Lantana camara* L.	Verbenaceae
Bayam	*Amaranthus* sp.	Amaranthaceae
Geranium	*Pelargonium zonale* L.	Geraniaceae
Lumut Kuku	*Paronychia rugelii* L.	Caryophyllaceae
Bunga azalea	*Rhododendron indicum* L.	Ericaceae
Bunga pukul Sembilan	*Portulaca grandiflora* L.	Portulacaceae
Balancing	*Oxalis latifolia* L.	Oxalidaceae
Bunga lonjong	*Seemannia sylvatica* L.	Gesneriaceae
Senggani	*Melastoma polyanthum* L.	Melastomaceae
Ketela rambat	*Ipomoea batatas* L.	Convolvulaceae

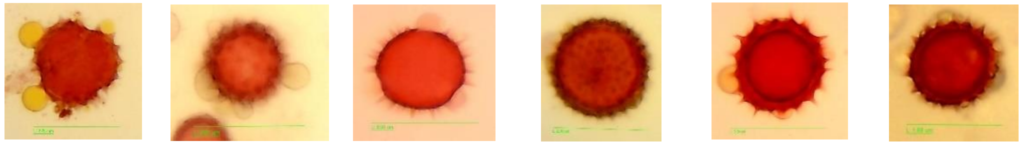
Table 2. Characteristic of pollen collected from plants live around Trigona nest

Plant species	Measure		Indeks P/E	Shape	Size
	P (µm)	E (µm)			
Zinnia elegans L.	21.8±24.1	20.6±23.1	101 – 113	Prolate spheroidal	Small
Helianthus annuus L.	25.5±30.0	23.7±27.0	101 – 112	Prolate spheroidal	Medium
Dahlia pinnata L.	32.5±36.5	30.05±32.5	107 – 113	Prolate spheroidal	Medium
Bidens pilosa L.	15.7±22.5	14.8±20.0	105 – 114	Prolate spheroidal	Small
Chrysanthemum myrtifolia L.	32.4±35.0	30.0±32.5	103 – 108	Prolate spheroidal	Medium
Crassochepalum crepidiodes L.	28.6±32.5	25.0±30.0	108 – 114	Prolate spheroidal	Medium
Senecio vulgaris L.	27.0±35.0	26.4±32.5	102 – 108	Prolate spheroidal	Medium
Spilanthes oleracea L.	22.5±25.0	20.0±22.5	106 – 112	Prolate spheroidal	Small
Centaurea cuneifolia L.	25.0±40.0	25.1±37.5	103 – 109	Prolate spheroidal	Medium
Ageratum conyzoides L.	17.0±22.0	16.5±17.5	101 – 114	Prolate spheroidal	Small
Cosmos sulphureus L.	20.0±24.8	17.5±21.9	111 – 114	Prolate spheroidal	Small
Galinsoga parviflora L.	17.2±17.5	16.0±17.1	102 – 107	Prolate spheroidal	Small
Cleome hasslerana Chod.	13.4±15.3	13.1±15.2	101 – 103	Prolate spheroidal	Small
Capsicum frutescens L.	19.4±21.1	16.9±19.7	102 – 114	Prolate spheroidal	Small
Capsicum annuum L.	18.0±20.4	17.7±19.9	101 – 108	Prolate spheroidal	Small
Solanum muricatum L.	12.2±14.0	11.8±12.7	101 – 111	Prolate spheroidal	Small
Solanum lycopersicum L.	16.8±18.4	14.0±16.5	109 – 113	Prolate spheroidal	Small
Brassica juncea L.	20.6±22.0	20.3±21.5	101 – 102	Prolate spheroidal	Small
Barbarea rupicola L.	18.5±24.0	17.5±23.0	104 – 113	Prolate spheroidal	Small
Manihot utillisima L.	22.0±23.1	20.7±22.8	101 – 108	Prolate spheroidal	Small
Fragaria vesca L.	16.1±17.0	15.4±16.2	104 – 108	Prolate spheroidal	Small
Rosa sp	25.5±26.7	25.4±26.5	101 – 102	Prolate spheroidal	Medium
Rubus rotifolius L.	20.2±20.4	18.3±19.0	107 - 110	Prolate spheroidal	Small
Schima wallichii (DC) Korth	28.4±38.5	27.4±36.2	104 - 108	Prolate spheroidal	Medium
Hemerocallis fulva L.	68.4±75.9	59.3±62.3	115 – 121	Subprolate	Large
Allium fistulosum L.	25.8±27.1	13.4±17.2	155 – 191	Prolate	Medium
Cleodendruma paniculatum L.	50.8±55.2	49.6±54.7	101 – 102	Prolate spheroidal	Large
Salvia splendens L.	42.5±49.4	38.8±42.3	115 – 122	Subprolate	Medium
Phaseolus vulgaris L.	30.2±43.7	29.2±38.3	103 – 114	Prolate spheroidal	Medium
Sechium edule L.	67.8±75.1	67.2±74.1	101 – 102	Prolate spheroidal	Large
Cucurbita pepo L.	36.8±50.1	35.5±47.2	102 - 106	Prolate spheroidal	Medium
Impatiens balsamina L.	25.8±26.6	22.7±23.6	112 – 113	Prolate spheroidal	Medium
Lantana depressa L.	20.7±20.9	19.3±20.7	101 – 107	Prolate spheroidal	Small
Lantana camara L.	19.0±24.3	17.1±24.0	101 – 111	Prolate spheroidal	Small
Amaranthus sp.	18.0±20.2	16.2±19.4	105 – 111	Prolate spheroidal	Small
Pelargonium zonale L.	50.0±55.0	49.0±51.4	101 – 107	Prolate spheroidal	Large
Paronychia rugelii L.	14.9±16.6	14.3±16.5	101 – 104	Prolate spheroidal	Small
Rhododendron indicum L.	40.1±43.1	38.4±41.2	103 – 107	Prolate spheroidal	Medium
Portulaca grandiflora L.	53.7±54.1	51.2±53.3	101 – 105	Prolate spheroidal	Large
Oxalis latifolia L.	22.0±24.3	20.4±23.2	103 – 108	Prolate spheroidal	Small
Seemannia sylvatica L.	13.5±14.8	12.9±14.0	105 – 108	Prolate spheroidal	Small
Melastoma polyanthum L.	13.6±14.6	13.1±14.4	100 - 108	Prolate spheroidal	Small
Ipomoea batatas L.	57.9±86.5	56.8±84.2	100 - 103	Prolate spheroidal	Large

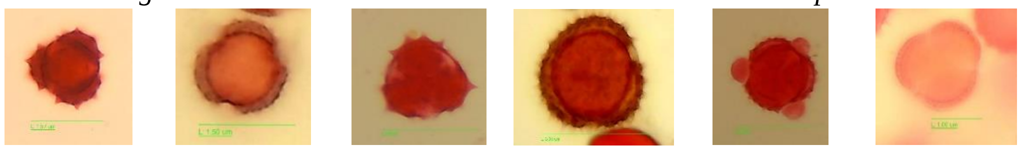
Table 3. Unit, aperture, and ornamentation of pollen collected from flowering plants live around Trigona nest

Plant species	Unit	Apertura	Ornamentation
Zinnia elegans L.	Monad	Tricolpate	Echinate
Helianthus annuus L.	Monad	Tricolpate	Echinate
Dahlia pinnata L.	Monad	2 – 4 Colporate	Echinate
Bidens pilosa L.	Monad	Tricolporate	Echinate
Chrysanthemum myrtifolia L.	Monad	Tricolporate	Echinate
Crassochepalum crepidiodes L.	Monad	Tricolporate	Echinate
Senecio vulgaris L.	Monad	Polycolpate	Echinate
Spilanthes oleracea L.	Monad	Polycolporate	Echinate
Centaurea cuneifolia L.	Monad	Tricolporate	Echinate
Ageratum conyzoides L.	Monad	Tricolporate	Echinate
Cosmos sulphureus L.	Monad	Tricolporate	Echinate
Galinsoga parviflora L.	Monad	Polycolpate	Verrucate
Cleome hasslerana Chod	Monad	Tricolporate	Baculate
Capcicum frutescens L.	Monad	Tricolporate	Scabrate
Capsicum annuum L.	Monad	Tricolporate	Reticulate
Solanum muricatum L.	Monad	Tricolporate	Verrucate
Solanum lycopersicum L.	Monad	Tricolporate	Verrucate
Brassica juncea L.	Monad	Tricolpate	Clavate
Barbarea rupicola L.	Monad	Tricolpate	Clavate
Manihot utillisima L.	Monad	Tricolporate	Echinate
Fragaria vesca L.	Monad	Tetracolpate	Verrucate
Rosa sp.	Monad	Tricolporate	Reticulate
Rubus rosifolius L.	Monad	Tricolporate	Reticulate
Schima wallichii (DC) Korth	Monad	Tricolporate	Scabrate
Hemerocallis fulva L.	Monad	Monocolpate	Reticulate
Allium fistulosum L.	Monad	Monocolpate	Psilate
Cleodendrum paniculatum L.	Monad	Tricolpate	Reticulate
Salvia splendens L.	Monad	Polycolpate	Baculate
Phaseolus vulgaris L.	Monad	Triporate	Psilate
Sechium edule L.	Monad	Polycolpate	Verrucate
Cucurbita pepo L.	Monad	Pantoporate	Psilate
Impatiens balsamina L.	Monad	Tetracolpate	Reticulate
Lantana depressa L.	Monad	Tricolporate	Psilate
Lantana camara L.	Monad	Tricolporate	Psilate
Amaranthus sp.	Monad	Pantoporate	Psilate
Pelargonium zonale L.	Monad	Tricolpate	Reticulate
Paronychia rugelii L.	Monad	Triporate	Scabrate
Rhododendrum indicum L.	Tetrad	Tricolporate	Psilate
Portulaca grandiflora L.	Monad	Pantocolpate	Echinate
Oxalis latifolia L.	Monad	Tricolpate	Scabrate
Seemannia sylvatica L.	Monad	Tricolpate	Scabrate
Melastoma polyanthum L.	Monad	Tricolporate	Psilate
Ipomoea batatas L.	Monad	Pantoporate	Echinate

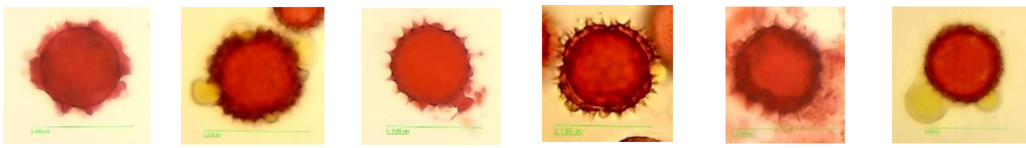
Pollen collected from around the nest	Pollen collected inside the nest	Pollen collected from around the nest	Pollen collected inside the nest	Pollen collected from around the nest	Pollen collected inside the nest.



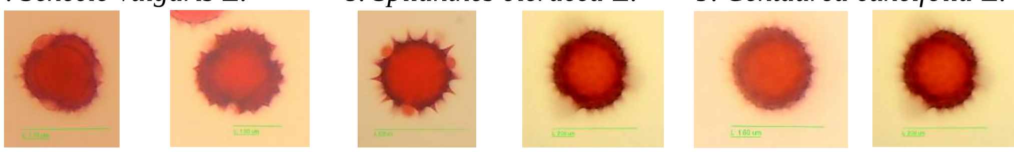
1. *Zinnia elegans* L.
2. *Helianthus annuus* L.
3. *Dahlia pinnata* L.



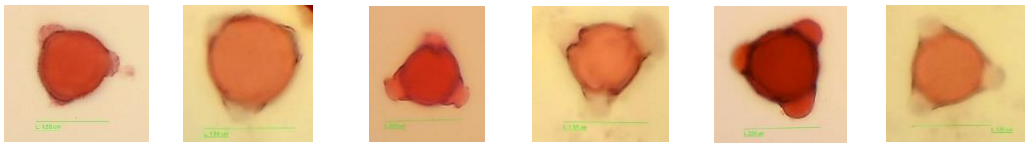
4. *Bidens Pilosa* L.
5. *Chrysanthemum myrtifolia* L.
6. *Crassochepalum crepidiodes* Benth.



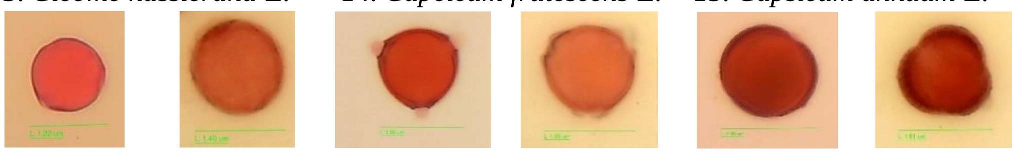
7. *Senecio vulgaris* L.
8. *Spilanthes oleracea* L.
9. *Centaurea cuneifolia* L.



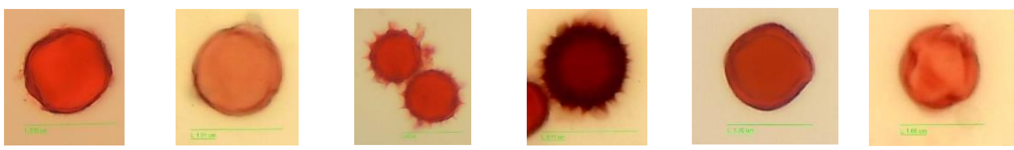
10. *Ageratum conyzoides* L.
11. *Cosmos zulphereus* L.
12. *Galinsoga parviflora* L.



13. *Cleome hasslerana* L.
14. *Capcicum frutescens* L.
15. *Capsicum annuum* L.

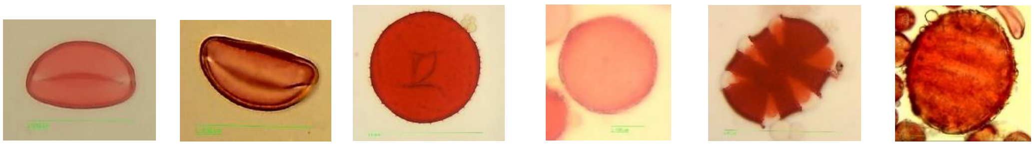


16. *Solanum muricatum* L.
17. *Solanum lycopersicum* L.
18. *Brassica uncea* L.



19. *Barbarea rupicola* L.
20. *Manihot utillisima* L.
21. *Fragaria vesca* L.

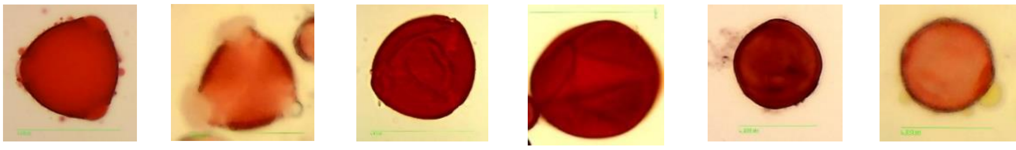
22. *Rosa* sp.
23. *Schima wallichii* (DC) Korth
24. *Hemerocalis fulva* L.



25. *Allium fistulosum* L.

26. *Cleodendrum paniculatum* L.

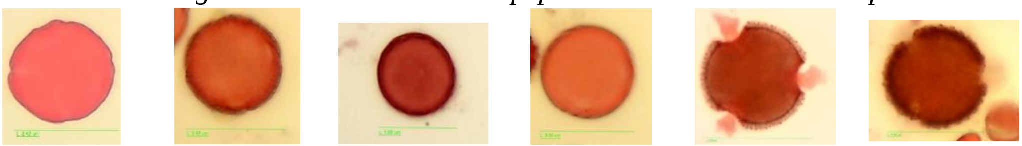
27. *Salvia splendens* L.



28. *Phaseolus vulgaris* L.

29. *Cucurbita pepo* L.

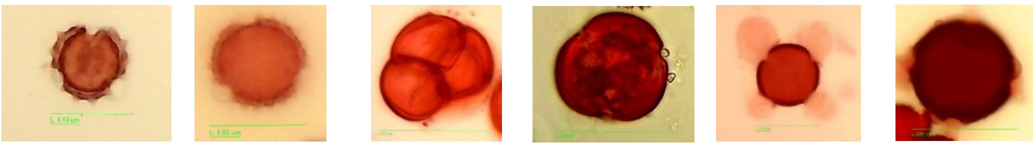
30. *Lantana depressa* L.



31. *Lantana camara* L.

32. *Amaranthus* sp.

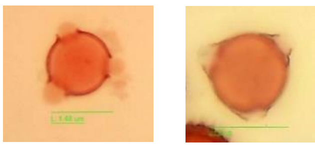
33. *Pelargonium zonale* L.



34. *Paronychya rugelii* L.

35. *Rhododendrum indicum* L.

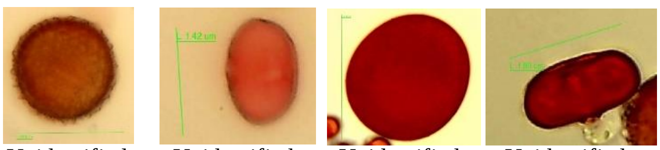
36. *Oxalis latifolia* L.



37. *Seemannia sylvatica* L.

Figure 1. The morphology of the pollen collected from inside and outside Trigona nest

Four pollens do not match the pollens morphology that collected outside the nest. It means that those four pollens could not be used to identify the plants producing them (Figure 2).



Unidentified 1 | Unidentified 2 | Unidentified 3 | Unidentified 4

Figure 2. Unidentified pollen collected inside Trigona nest

Unidentified pollen could be due to it was collected by Trigona from distance flowers outside the radius of observation. The argument was made based on Pratama et al. (2018) and Nugroho and Soesilohadi (2014) that the Trigona bee can fly with a distance of up to 500 m from the nest. Therefore, outside the flowering season, the bees will take pollen from plants located far from the nest. Meanwhile, in this study, pollen outside the nest was collected from plants near the nest. Nevertheless, Trigona bee more likely to forage for food from flowers that are close to the nest.

The observation showed that the majority of the collected pollen was pollen from the Asteraceae family. It was because sampling was conducted during their flowering season. Besides, plants that are lived close to the nest within a radius of approximately 8 m were Asteraceae. Moreover, a member of the Asteraceae has bright colors of flowers. The color attracts bees to visit them and used them as pollen resources. According to Rustam and Agus (2018) and Yanto et al. (2016), flower color is an attractive factor for pollinator insects. Moreover, Widowati (2013) stated that a bee commonly utilizes flowering plants as food resources.

When we refer back to Table 2, it is realized that there was no correlation between size and the collected pollen. Sihombing (2015) has stated that distance affects pollen intensity collection. Moreover, Nugroho and Soesilohadi (2014) said that Trigona bees collected pollens based on the distance of pollen sources, aroma, and flower color, rather than based on pollen size. Therefore, it was reasonable that the present study observed variable pollen size inside Trigona bee.

Another factor affecting pollen collection is open type and small sizes flowers. Such flower types and sizes help the bee to collect pollen more easily. The result is similar to the result of a study by Khairiah et al. (2012) that showed that due to its small body size, bees tend to collect pollen from small or tubular flowers. Besides that, the Trigona bee likes bilateral symmetry flowers because that symmetry provides a suitable base for bees to perch.

This study provides the first data about plant diversity identified based on the pollen collected inside Trogona nest in Serang Village, District of Karangreja, Purbalingga Regency. The information is valuable for developing Trogona bee cultivation, which supports honey and propolis production in that area.

CONCLUSION

Based on pollen diversity collected inside the Trigona nest, it can be concluded that 37 plant species were potential as food resources for the Trigona bee in Serang Village, District of Karangreja, Purbalingga Regency.

ACKNOWLEDGMENT

We would like to thank the Research and Community Service Institute Unsoed for the funding. Our gratitude was delivered to the Dean of the Faculty of Biology, Unsoed. Thanks to all those who have contributed to the research to completion.

REFERENCES

Agussalim, Ali, A., Naflatul, U., & I Gede, S. B. (2017). Variasi Jenis Tanaman Pakan Lebah Madu Sumber Nektar dan Polen Berdasarkan Ketinggian Tempat di Yogyakarta. *Buletin Peternakan, 41*(4), 448-460.

Aprianty, N. M. D., & Kriswiyanti, E. (2007). Studi Variasi Ukuran Serbuk Sari Kembang Sepatu (*Hibiscus rosa-sinensis* L.) dengan Warna Bunga Berbeda. *Jurnal Biologi, 12*(1), 14-18.

Azhari, B., & Apik, B. S. (2019). Tinjauan Geografi dalam Pengembangan Desa Wisata Serang di Kecamatan Karangreja Kabupaten Purbalingga. *Geo-Image*, *8*(2), 157-161.

Bareke, T., & Admassu, A. (2019). Bee flora resources and honey production calendar of Gera Forest in Ethiopia. *Asian Journal of Forestry, 3*(2), 64-74.

Chauhan, M. H., Farooqui, A., & Trivedi, A. (2017). Plants foraged by bees for honey production in northern India: The diverse flora of India and its implications for apiculture. *Acta Palaeobotanical*, *57*(1), 119-32.

Corlett, R. T. (2011). *Honeybees in Natural Ecosystems.* In Honeybees of Asia. Springer, Berlin, Heidelberg. 215-225 pp.

Farkas, A., & Orozs-Kovacs, Z. (2012). Assessment of Honey Plant Resources through Pollen Analysis in Coorg Honey of Karnataka State. *The International Journal of Plant Reproductive Biology, 4*(1), 31-39.

Halbritter, H., Silvia, U., Friogeir, G., Martina, W., Reinhard, Z., Michael, H., Rafl, B., Matthias, S., & Andrea, F. R. 2018. *Illustrated Pollen Terminology Edition 2nd*. Spinger International Publishing, Switzerland. 483 pp.

Hesse, M., Heidemarie, H., Reinhard, Z., Martina, W., Ralf, B., Andrea, F. R., & Silvia, U. (2009). *Pollen Terminology: An Illustrated Handbook*. Springer Wien New York. 261 pp.

Khairiah, N., Dahelmi, & Syamsuardi. (2012). Jenis-Jenis Serangga Pengunjung Bunga Pacar Air (*Impatiens balsamina* Linn.:Balsaminaceae). *Jurnal Biologi, 1*(1), 9-14.

Kifle, T. B., Kibebew, W. H., & Admassu, A. M. (2015). Screening of Potential Herbaceous Honey Plants for Beekeeping Development. *Agriculture, Forestry and Fisheries, 3*(5), 386-391.

Kwapong, P., Kwame A., Rofela, C., & Afia, K. (2010). *Stingless Bees*: *Importance*, *Management and Utilisation*: *A Training Manual for Stingless Beekeeping*. Unimax Macmillan LTD, Accra North. Ghana. 12-20 pp.

Nugroho, R. B., & Soesilohadi, R. C. H. (2014). Identifikasi Macam Sumber Pakan Lebah *Trigona* sp. (Hymenoptera:Apidae) di Kabupaten Gunung Kidul. *Jurnal Biomedika*, *7*(2), 42-45.

Pratama, I. P. N. E., Watiningsih, N. L., & Ginantra, I. K. (2018). Perbedaan Ketinggian Tempat terhadap Jenis Polen yang Dikoleksi Lebah Trigona. *Jurnal Biologi Udayana*, *22*(1), 42-48.

Purnobasuki, H., Etik, P., & Thin, S. (2014). Keanekaragamn Morfologi Serbuk Sari pada 5 Spesies Bougainvillea. *Jurnal Bioscientiae*, *11*(1), 48-59.

Rasic, S., Stefanic, E., Antunovic, S., Jovic, J., & Kristek, S. 2018. Pollen Analysis of Honey from North-Eastern Croatia. *Poljoprivreda*, *24*(2), 43-49.

Rismayanti, Tridiati, & Rika, F. (2015). Ecology Service Tumbuhan Herba untuk Lebah *Trigona* sp. *Jurnal Sumberdaya Hayati*, *1*(1), 19-25.

Rustam, E., & Agus, A. P. (2018). Morfologi dan Perkembangan Bunga-Buah Tembesu (*Fragraea fragrans*). *Pros Sem Nas Masy Biodiv Indon, 4*(1), 13-19.

Sajwani, A., Sardar, A. F., & Vaughn, M. B. (2014). Studies of Bee Foraging Plants and Analysis of Pollen Pellets from Hives in Oman. *Journal Palynology*, *38*(2), 207-223.

Salman, A. A., & Azzazy, M. F. (2013). Pollen Grains Indicators to Plant Habitat Conditions at Some Arid Regions Sadat Area Egypt. *Jurnal Catrina*, *8*(1), 21-28.

Setiawan, A., Sulaeman, R., & Arlina, T. (2017). Strategis Pengembangan Usaha Lebah Madu Kelompok Tani Setia Jaya. Desa Kembal Jaya Kecamatan Bangun Purba Kabupaten Rokan Hulu. *Jurnal Bappeda Selodang Mayang*, *3*(3), 183-190.

Sihombing, D. T. H. (2015). *Ilmu Ternak Lebah Madu*. Gadjah Mada University Press, Yogyakarta. 243 hal.

Steenis, C. G. G. (2013). *Flora*. PT Balai Pustaka, Jakarta. 495 hal.

Sucianto, E. T., Muachiroh, A. & Endang, S. P. (2020) Anthracnose Disease on Vegetables Crops in Serang Village, District of Karangreja, Purbalingga Regency. *Biosaintifika 12*(1)*, 50-56.*

Suwannapong, G., Eiri, D. M., & Benbow, M. E. (2012). Honeybee Communication and Pollination. In: New Perspective in Plant Protection. *Intechopen*, 39-62.

Widhiono, I., & Eming, S. (2016). Impact of Distance from the Forest Edge on the Wild Bee Diversity on the Northern Slope of Mount Slamet. *Biosaintifika 8*(2)*, 148-154.*

Widowati, R. (2013). Pollen Substitute Pengganti Serbuk Sari Alami bagi Lebah Madu. *Jurnal WIDYA Kesehatan dan Lingkungan*, *1*(1), 31-36.

Yanto, S. H., Defri Y., & Evi, S. B. (2016). Potensi Pakan *Trigona* spp. di Hutan Larangan Adat Desa Rumbia Kabupaten Kampar. *JOM Faperta Universitas Riau, 3*(2), 1-7.

Zahrina, Z., Hasanudin, H., & Wardiah, W. (2017). Studi Morfologi Serbuk Sari Enam Anggota Familia Rubiaceae. *Jurnal Ilmiah Mahasiswa Fakultas Keguruan dan Ilmu Pendidikan Unsyiah, 2*(1), 114-123.