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Book:
Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in book:
Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds) Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:
Assaeed AM. 2007. Seed production and dispersal of Rhazya stricta. 50th annual symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:
Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.) Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:
Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

Information from internet: Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic Escherichia coli predator-prey ecosystem. Mol Syst Biol 4:187. www.molecularsystembiology.com

Enhances production of coffee (*Coffea robusta*): The role of pollinator, forages potency, and honey production from *Tetragonula* sp. (Meliponinae) in Central Lombok, Indonesia

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Abstract. *Supeno B, Erwan, Agussalim. 2021. Enhances production of coffee (*Coffea robusta*): The role of pollinator, forages potency, and honey production from* Tetragonula *sp. (Meliponinae) in Central Lombok, Indonesia. Biodiversitas 22: 4687-4693.* The bees role as an agent of pollinators to improve the productivity of plants. This study was purposed to enhance coffee production (*Coffea robusta*) by roles of stingless bee *Tetragonula* sp. as pollinator agent, forages potency, and honey production. This study has been conducted in a coffee plantation in Lantan, Central Lombok, Indonesia. Several parameters were measured such as the number of bunches and flowers, production of nectar and pollen, nectar sucrose content, production of coffee, and production of honey. The results showed that the different observation time influenced the number of bunches, flowers, production of nectar and pollen, nectar sucrose content (P<0.01). The number of bunches ranged from 58.20 to 144.87 bunches/tree, the number of flowers 36.33 to 58.73 flowers/bunches, and 2,362.53 to 8.250.63 flowers/tree. Furthermore, the nectar production 9.16 to 34.01 g/tree, pollen production 1.72 to 5.99 g/tree, nectar sucrose content 20.6 to 35.0%. Estimation of coffee production before pollinated by *Tetragonula* sp. was 1,230.8 kg/ha, but after pollination by *Tetragonula* was increased it became 3,605.7 kg/ha (49.1%). Fruit production before pollinated by *Tetragonula* sp. was 2,127.2 fruit/tree, but after pollination by *Tetragonula* sp. increased to 8,309.2 fruit/tree (59.2%). Production of honey from *Tetragonula* sp. was 3.74 g/hive/5 months and in *Apis cerana* was 301.35 g/hive/5 months. It can be concluded that the *Tetragonula* sp. as an agent of pollinators can enhance the production of coffee and increase the biodiversity of coffee.

Keywords: Biodiversity, coffee flowers, nectar, pollination, pollen

INTRODUCTION

Estates has an area 23.63 thousand hectares and in 2018 became 19.92 thousand hectares and in 2019 it decreased to 14.5 thousand hectares. Furthermore, Private Estates also decreased where in 2017 it has an area 23.19 thousand hectares and decreased in 2018 became 22.25 thousand hectares, and in 2019 decreased became 9.71 thousand hectares. The decrease of coffee plantation area is caused by the land conversion in several provinces. However, in Smallholders Estates it increased in 2017 1.192 million hectares, then in 2018 became 1.210 million hectares and in 2019 increased 1.215 million hectares. The decrease of coffee plantation area is impacted by the decrease in coffee production. The production of coffee in Indonesia from year of 2017 to 2019 is fluctuating where the production of coffee in 2017 is 30.29 thousand ton and decreased to 28.14 thousand in 2018 (decreased 7.1%) and in 2019 decreased to 10.01 thousand ton (BPS-Statistics Indonesia 2019). In West Nusa Tenggara Province, Indonesia showed that smallholders coffee area in 2016 is 12,256 ha with coffee production is 4,641 tons (BPS-Statistics Indonesia 2017) and in 2017 is decreased became 11,978 ha with coffee production is 4,865 tons (BPS-Statistics Indonesia 2018) and in 2018 is decreased became 11,942 ha with

coffee production 5.037 tons (BPS-Statistics Indonesia 2019).

To increase the coffee production requires the role of insects to pollinate their flowers and one of the insects as the best pollinators is honeybees or stingless bees. Coffee flowers produce nectar and pollen for honeybees or stingless bees food. Nectar and pollen are used by honeybees or stingless bees to produce honey and bee bread which are required for their growth and development in the colonies (Abrol 2011; Agussalim et al. 2018). When coffee flower blooming is usually found the honeybees or stingless bees visit the flowers to collect nectar and pollen. Stingless bee species that can be found in Lombok include *Tetragonula* species (Meliponinae) that can produce honey, bee bread, and propolis (Agus et al. 2019; Agussalim et al. 2019, 2020, 2021; Erwan et al. 2020, 2021). Furthermore, when the bees collect nectar and pollen indirectly, they serve as an agent of pollinators, which increases the productivity of coffee. Coffee flowers include in hermaphrodite where they are can perform the self-pollination, but assumed is predominant pollinated by wind, however the cross pollination by the bees can significantly increase the production of coffee (*Coffea canephora*) (Klein et al. 2003; Quezada-Euan 2018; Roubik 2002). In Mexico, the main visitor in coffee flowers is the honeybee *Apis mellifera* for about 84% of the

total of visitors. Furthermore, stingless bee *Trigona corvina* also reported their visit for about 6% of total of visitors (Vergara and Badano 2009).

Klein et al. (2003) reported that the insects that serve as pollinators are mostly pollinated by the bees, ranging from 2,038 to 2,269 bees that visit coffee flowers. Several studies showed that honeybees or stingless bee can improve the productivity of several plants such as number of fruits, weight, length, and other parameters from various countries (Atmowidi et al. 2008; Azmi et al. 2016; Bezabih and Gebretsadikan, 2014; Calderone 2012; Putra and Kinasih 2014; Kishan Tej et al. 2017; Layek et al. 2021; Putra et al. 2014; Rogers et al. 2014; Veddeler et al. 2008). However, the studied the roles of stingless bee *Tetragonula* sp. as an agent of pollinators in coffee (*Coffea robusta*) in Central Lombok, Indonesia has not been studied. Therefore, the objectives of this study are to enhance coffee production (*Coffea robusta*) by roles of stingless bee *Tetragonula* sp. as an agent of pollinator, forages potency from coffee flowers, and evaluates the honey production from *Tetragonula* sp. in Central Lombok, West Nusa Tenggara Province, Indonesia.

MATERIALS AND METHODS

Study area

This study has been conducted in the coffee plantation managed by communities in forest area (smallholders) in Lantan (8°29'39"S 116°20'33"E) located at 507 above sea level, North Batukliang Sub-district, Central Lombok District, West Nusa Tenggara Province, Indonesia was shown in Figure 1.

Procedures

One hundred coffee flowers were wrapped for about 9 months using gauze (size 10 x 10 cm) (Figure 2) that have been counted to determine their ability to self-pollinate. Afterward, the coffee fruit amount was counted for each wrap. Furthermore, the flowers percentage that became fruit from the treatment without stingless bee pollinated and pollinated by stingless bee was calculated by the equation: Flowers percentage = (flowers amount per bunch – coffee fruit) x 100%

The flowering characteristic of coffee was obtained by observing from April to November. The nectar production from coffee flowers and the capacity of coffee plantation per hectare for stingless bee meliponiculture. Thirty coffee trees were chosen randomly, and each tree was counted production per bunch, flowers amount per bunch. Afterwards, the flowers were taken 4 bunches and were counted flowers per bunches randomly. The number of blooming flower bunches, blooming flowers per bunches, and flowers per coffee tree were counted directly from the coffee plant. The colonies of stingless bee *Tetragonula* sp. was used as an agent of pollinator for coffee plants were 20 colonies per hectare of coffee plantation.

Figure 2. Coffee flowers were covered by gauze used in this study

Figure 1. The location of coffee plantation in Lantan, Central Lombok District, West Nusa Tenggara Province, Indonesia

Figure 3. Coffee flowers when collected a nectar (A) and nectar has been collected put in Eppendorf tubes (B)

Nectar collecting and their sucrose content

Coffee flowers were covered by gauze (Figure 2) before collecting their nectar from 18 coffee bunches and their bunches were at least 50 flowers. Every 2 bunches that blooming flowers were collected their nectar using a glass pipette has been modified (Figure 3.A) in the morning (06.00 to 09.00), afternoon (11.00 to 13.00), and evening (16.00 to 18.00) in one day every period of flowers blooming. Afterwards, the nectar was put into the Eppendorf tube (Figure 3.B) and then analyzed using the Luff Schoorl method as described by AOAC (2005). All analyses were performed in triplicates and each in duplo.

Production of nectar and pollen of coffee flowers

The production of nectar from coffee flowers was measured from 1,220 flowers and the average of each flower was counted. Production of nectar from one flower was measured from one flower sample and sucked by a glass pipette has been modified (Figure 3.A) and weighed by digital scale. For production of nectar per coffee tree was counted from the number of flowers per coffee tree multiplied by production of nectar per flower. The production of nectar per hectare of coffee plantation was counted by the production of nectar per coffee tree multiplied by the number of coffee trees per hectare (coffee trees per hectare were 1,322 trees). The pollen production from coffee flowers were measured from 1,062 flowers and then were counted as the average of each flower. The production of nectar and pollen each month was counted from the number of flowers per tree multiplied by production of nectar and pollen from each flower and measured from July to October. The total production of nectar and pollen were counted as the production total from July to October. The total production of nectar from coffee flowers was counted from the sum of nectar from 4 month from July to October period and production per hectare of plantation also was counted.

Estimation of coffee production

Estimation of coffee production was counted from the production of coffee per tree multiplied by the number of coffee trees per hectare (coffee trees per hectare of

plantation were 1,322 trees) and was counted during May to October each for the flowers covered by gauze (without stingless bee pollinate) and pollinated by stingless bee *Tetragonula* sp. Production of coffee before pollination by stingless bees was obtained from the data previously collected by farmers.

Data analysis

The data of number of bunches, flowers, production of nectar and pollen, and nectar sucrose content were analyzed using one-way analysis and followed by the Tukey test using SPSS (Windows version of SPSS, release 23). The data of total bunches per coffee, flowers per bunches, flowers per coffee and the total production of nectar and pollen per hectares, and production of honey were analyzed by descriptive analysis using Microsoft excel (Steel et al. 1997).

RESULTS AND DISCUSSION

Number of bunches and flowers

The results showed that the number of bunches per coffee tree were differed among the observation months. The number of bunches per tree from the highest was 144.87 bunches/tree in September, followed by October was 119.87 bunches/tree, August was 83.20 bunches/tree and the lowest in July was 58.20 bunches/tree (P<0.01) (Table 1). This condition, in line with the flower number per coffee tree where in September as the peak of flowering in coffee was 8,250.63 flowers/ tree, followed by October was 5,534.33 flowers/tree, August was 3,025.57 flowers/tree, and decreased in July was 2,362.53 flowers/tree. In addition, the coffee tree in Lantan, Central Lombok when we studied showed that the flowering was delayed and started in July, though usually flowering started in May to July periods. Furthermore, the number of flowers per bunch was higher in September was 58.73 flowers/bunch, followed by October was 45.93 flowers/bunch, and decreased in July and August were 39.60 flowers/bunch and 36.33 flowers/bunch, respectively (Table 1).

The difference in the number of bunches and flowers from the coffee tree each month may be affected by the difference in the ability in each plant to grow and absorb the soil nutrients that are used to produce flowers in each bunch. Based on the number of bunches and flowers per coffee tree indicates potential as an area for beekeeping of honeybees or meliponiculture of stingless bees. The number of coffee flowers per plant in our study was different from previously studied by Bareke et al. (2021) that the number of flowers per plant for *Coffea arabica* L. is ranged from 485 to 2330 flowers/plant.

Pearson correlation showed that the number of blooming flower bunches per coffee has a positive correlation with blooming flowers per bunches (r = 0.256, p<0.001) and number of flowers per coffee (r = 0.772, p<0.001). In addition, the blooming flowers per bunches has a positive correlation with the number of flowers per coffee (r = 0.778, p<0.001) (Table 3). It indicates that the higher number of blooming flowers, blooming flowers, and flowers of coffee trees have an impact on increased the production of nectar and pollen from coffee trees. Therefore, it can support the availability of nectar and pollen for honeybees or stingless bees to support the increase of biodiversity especially coffee trees.

The total number of bunches per coffee tree was 421.63 bunches/tree/4 months and the number of flowers per bunches was 180.60 flowers/bunches/4 months. Furthermore, the total number of flowers per coffee tree was 19,173 flowers/tree/4 months, while per hectare of plantation was 25,352,815 flowers/ha (Table 2). It indicates that the coffee plantation has potential to support the nectar and pollen for honeybees or stingless bees. Thus, in the future a comprehensive study is needed about the production of honey and bee bread from honeybees or stingless bees and the quality of honey or bee bread based on their chemical composition.

Production of nectar and pollen

The results showed that the production of nectar from one coffee flower was 4.12 mg/flower, while the pollen production was 0.73 mg/flower. It indicates that the coffee flowers have the potential as the source of nectar and pollen for honeybees or stingless bee forages. The results showed that the production of nectar and pollen from coffee flowers each month was different. The production of nectar from coffee flowers was higher in September period was 34.01 g/tree, followed by October was 22.81 g/tree, August was 12.47 g/tree, and decreased in July period was 9.16 g/tree (Table 1). Coffee flowers was produced the nectar for 3 days and depend on climate or season, when the rain season flowers when flowers are started blooming so the flowers just can produce nectar for 2 days.

Table 2. The total number of bunches, flowers and total production of nectar and pollen from coffee flowers

Parameters	Total (4 months)	Per hectare (ha)
Total number of bunches per tree	421.63	-
Total number of flowers per bunches	180.60	-
Total number of flowers per tree	19,173	25,352,815
Total production of coffee nectar (g)	78.45	103,739.44
Total production of coffee pollen (g)	13.92	18,405.86

Note: Production of nectar (n = 1,220 flowers) and pollen (n = 1,062 flowers) of coffee flowers and coffee trees were 1,322 trees/ha.

Table 1. The mean of bunches number, number flowers and production of nectar and pollen of coffee flowers during July to October periods

Parameters	Observation months			
	July	August	September	October
Number bunches per tree	58.20±4.27[d]	83.20±3.46[c]	144.87±6.58[a]	119.87±7.39[b]
Number flowers per bunches	39.60±2.15[b]	36.33±2.01[b]	58.73±3.51[a]	45.93±3.75[b]
Number flowers per tree	2,362.53±262.19[d]	3,025.57±213.67[c]	8,250.63±534.78[a]	5,534.33±578.69[b]
Production of nectar (g/tree)	9.16±1.08[c]	12.47±0.88[c]	34.01±2.20[a]	22.81±2.39[b]
Production of pollen (g/tree)	1.72±0.19[c]	2.20±0.16[c]	5.99±0.39[a]	4.02±0.42[b]

Note: [a,b,c,d] Different superscripts within rows indicate differences at P<0.01; Data was presented in mean ± standard error

Table 3. Pearson correlation numbers of blooming flowers bunches per coffee, blooming flowers per bunches, flowers per coffee, production of nectar and pollen from coffee flowers

		1	2	3	4	5
1	Production of nectar	1				
2	Production of pollen	1.000**	1			
3	Blooming flowers bunches	0.772**	0.772**	1		
4	Blooming flowers	0.778**	0.778**	0.256**	1	
5	Flowers	1.000**	1.000**	0.772**	0.778**	1

Note: **Indicates significant at P<0.01 (2-tailed)

However, in our study it was differ from reported by Bareke et al. (2021) that the *Coffea arabica* L. flowers produced nectar for 5 days where the production peak of nectar in the second day and decreased in the third day until the fifth day. The production of pollen from coffee flowers was higher in the September period was 5.99 g/month, followed by October was 4.02 g/coffee, in August was 2.20 g/coffee, and decreased in July period was 1.72 g/coffee (Table 1). The total of nectar production for 4 months from one coffee tree was 78.45 g/tree, while the production per hectare of plantation was 103,739.44 g/ha (Table 2). Based on production of nectar per plant and per hectare plantation indicates that the coffee flowers are the potential nectar source for honeybees or stingless bees. The production of nectar from coffee flowers were positively correlated with the number of blooming flowers bunches (r = 0.772, P<0.01), blooming flowers (r = 0.778, P<0.01), and number of flowers (r = 1.000, P<0.01) (Table 3).

Production of nectar from one of the coffee flowers in our study was differ from that reported by Manila-fajardo and Cervancia (2020) for *Coffea liberica* var. *liberica* is ranged from 4.22 to 14.43 μL. Furthermore, production of nectar per coffee *Coffea arabica* L. flowers in 07.00 to 18.00 hours is ranged from 2.5 to 6.6 μL (Bareke et al. 2021). The production of nectar from coffee flowers is affected by coffee cultivars, plant age, season or climate (include temperature, humidity), and availability of soil nutrients and their ability to absorb of soil nutrients.

The production of pollen from coffee flowers was higher in the September period was 5.99 g/coffee, followed by October was 4.02 g/coffee, in August was 2.20 g/coffee, and decreased in July period was 1.72 g/coffee (Table 1). Furthermore, the production of pollen for one coffee tree was 13.92 g/4 months and the total production of pollen from one hectare plantation was 18,405.86 g/ha. It indicates that the availability of coffee pollen can support beekeeping or meliponiculture and to increase the coffee production by cross pollination from pollen from each coffee plant. The production of pollen from coffee flowers were positively correlated with the number of blooming flowers bunches (r = 0.772, P<0.01), blooming flowers (r = 0.778, P<0.01), and number of flowers (r = 1.000, P<0.01) (Table 3). It indicates that the coffee flowers have the potential to produce pollen as the honeybees or stingless bee's food.

Nectar sucrose content

The results showed that the nectar sucrose content from coffee flowers were differ during the time to collecting in the morning, afternoon, and evening for first, second, and third days collecting, respectively. On the first day, the nectar sucrose content in the morning (23.3%) and afternoon (23.3%) were similar and higher than nectar sucrose content in evening was 23.2% (P<0.01). Furthermore, in the morning (24.4%) and afternoon (24.4) were similar and lower than nectar sucrose content in evening was 27.1% for second day and the third day was higher in afternoon was 35.0%, followed by evening was 29.0%, and the lowest in morning was 20.6% (P<0.01) (Table 4).

The different days to collecting nectar from coffee flowers have an impact on the difference of nectar sucrose content. The nectar sucrose content of coffee flowers when collected in the morning was higher on the second day was 24.4%, followed by the first day was 23.3%, and the lowest on the third day was 20.6% (P<0.01). In the afternoon the nectar sucrose content was higher on the third day was 35.0%, followed by the second day was 24.4%, and the lowest on the first day was 23.3% (P<0.01). Furthermore, in the evening the higher nectar sucrose content on the third day was 29.0%, followed by the second day was 27.1%, and the lowest on the first day was 23.2% (P<0.01) (Table 4). The nectar sucrose content in our study was differ from previously reported by Manila-fajardo and Cervancia (2020) for *Coffea liberica* var. *liberica* where the mean of calorie content based on nectar sucrose content is ranged from 0.87 to 2.98 cal/μL. Furthermore, Bareke et al. (2021) reported that the sugar content from *Coffea arabica* L. nectar is ranged from 2.8 to 4.6 mg/flower/day.

Production of coffee

The results showed that the production of coffee before pollination by the stingless bee *Tetragonula* sp. was 1,230.8 kg/ha, but after pollination by *Tetragonula* sp. was 49.1% became 3,605.7 kg/ha from previous production. In addition, the fruit production before pollination by *Tetragonula* sp. was 2,127.2 fruit/tree, but after pollination by *Tetragonula* sp. was 59.2% became 8,309.2 fruit/tree from previous production (Table 5). It indicates that the involvement of stingless bee *Tetragonula* sp. as an agent of pollinators can improve the productivity of coffee, especially coffee production per hectare and fruit production per tree, however other parameters have not been studied such as fruit weight, fruit production per bunches, and the involvement of other insects as the pollinator. Veddeler et al. (2008) reported that the bee visiting the coffee flowers (*Coffea arabica*) increased coffee yield until 80% and 800% in net revenues. Furthermore, Calderone (2012) reported that the honey bees increased production 28.9% from plants total as an indirectly dependent on the pollinators. These results showed that the diversity of bee species is more effective and productive to enhances the productivity of perennial crops by pollination services (Rogers et al. 2014).

Table 4. Nectar sucrose content from coffee flowers in various time and day of observe

Observe days	Time collection		
	Morning (%)	Afternoon (%)	Evening (%)
First (%)	23.3±0.03^ay	23.3±0.00^az	23.2±0.00^bz
Second (%)	24.4±0.00^bx	24.4±0.03^by	27.1±0.03^ay
Third (%)	20.6±0.03^cz	35.0±0.00^ax	29.0±0.03^bx

Note: ^a,b,c Different superscripts within rows indicate differences at P<0.01; ^x,y,z Different superscripts within columns indicate differences at P<0.01; Data was presented in mean ± standard error

Table 5. Estimation of coffee production before and after pollinated by stingless bee *Tetragonula* sp. during May to October period

Parameters	Before pollinated by bees	After pollinated by bees	Total	Amount increasing (kg)	Percentage increasing (%)
Coffee production (kg/ha)	1,230.8	3,605.7	4,836.5	2,374.9	49.1
Fruit production (fruit/tree)	2,127.2	8,309.2	10,436.4	6,182.0	59.2

Table 6. Production of honey from honeybee *Apis cerana* and stingless bee *Tetragonula* sp.

Parameters	Weight
Production of honey from *Tetragonula* sp. (g/hive/5 months)	5.74±0.62
Production of honey from *Apis cerana* (g/hive/5 months)	301.35±13.10

This study in line with reported by Bezabih and Gebretsadikan (2014) that the onion 50% is pollinated by honeybee *Apis mellifera* L. and increased onion production was 41.2%, seeds 1,000 mass was 25%, and percentage of germination was 68%. Furthermore, Azmi et al. (2016) reported that the chili pollinated by stingless bee *Heterotrigona itama* and hand cross pollination resulted in longer, heavier, and greater seed number per fruit than chilies self-pollinated. Furthermore, Putra et al. (2014) reported that the tomato flowers pollinated by honey bee *Apis cerana* more efficiently (80.3%) than pollinated by stingless bee *Trigona iridipennis* (70.2%), however weight and size of tomato fruit is similar. Kishan Tej et al. (2017) reported that the stingless bee *Tetragonula iridipennis* Smith used as the pollinator in greenhouse can be increased the production attributes of cucumber (fruit length, girth, weight, fruit number per plant, and production per plant) than control (without stingless bee as the pollinator). Furthermore, Layek et al. (2021) reported that the open pollination of stingless bee and honeybee can increase watermelon fruit set is 14% for *Tetragonula iridipennis* and 17% for *Apis mellifera* compared to open pollination and geitonogamy. In addition, open pollination added by stingless bee and honeybee increased the quality of watermelon (length, girth, and weight of fruits) then open pollination and geitonogamy, however is lower compared to cross pollination using hand.

Production of honey

The results showed that the honey production from stingless bee *Tetragonula* sp. after 5 months meliponiculture in the coffee plantation was 5.74 g//hive (Table 6). Its honey production is described by the stingless bee *Tetragonula* sp. might be the colonies have started to develop and focused on constructing their nest. Supeno and Erwan (2013) reported that the stingless bee *Tetragonula* sp. can produce honey 300 mL/hive for 8 months meliponiculture in North Lombok, Indonesia. Honey production in our study was different from that reported by Agussalim et al. (2020) for *Tetragonula laeviceps* after meliponiculture for 4 months ranged from 60 to 263 ml/hive (79.2 to 328 g/hive). In addition, Erwan et al. (2020) reported that the volume of honey pots from *Tetragonula* sp. is ranged from 0.14 to 0.37 mL/pot, total production for 1 month meliponiculture in North Lombok is 9.18 mL/bamboo hive and 18.72 mL/box hive.

Production of honey from *Apis cerana* after beekeeping for 5 months was 301.35 g/hive (Table 6) with coffee flowers as the nectar source. This production was differ from previously studied by Schouten et al. (2019) reported that the annual honey production from *Apis cerana javana* Fabr. that beekeeping in Java, Bali, Nusa Penida, and Sumbawa is ranged from 0.5 to 5 kg/hive. The difference in honey production for each species *Tetragonula* sp. and *Apis cerana* is affected by the difference of plant types as the nectar source, activity of foragers to collect nectar, bee species or genetics, and climate condition (temperature and humidity). It can be concluded that the role of stingless bee *Tetragonula* sp. as an agent of pollinators can increased the production of coffee (*Coffea robusta*) is 49.1% and coffee fruit increased 59.2%. Production of nectar from coffee flowers is 78.45 g/tree/4 months (103,739.44 g/ha) and production of pollen is 13.92 g/tree/4 months (18,405.86 g/ha). Production of honey from stingless bee *Tetragonula* sp. is 5.74 mL/hive/5 months and *Apis cerana* is 301.35 mL/hive/5 months.

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