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Identifying feeding plants for trigona sp. species in royal honey sakah, gianyar regency, bali

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ABSTRACT

Plants are one of the sources of feed for honey bees to carry out their lives. Currently, the identification of honey-producing plants still needs to be carried out. This research examines the types of plant species used as a source of food for Trigona sp. bees at Royal Honey Sakah in Gianyar, Bali. Qualitative descriptive research uses observation, documentation, and direct interviews with agro-tourism owners. Royal Honey Sakah's investigation will continue until May 2022. As a result, Royal Honey Sakah provides several types of plants as a feed source for Trigona spp. bees. Red Santos (*Xanthostemon novoguineensis*), which has the largest population, is followed by santos lemon (*Xanthostemon chrysanthus*), Bidarasari (*Porana volubilis*), red Kaliandra (*Calliandra calothyrsus*), bridal tears (*Antigonon leptopus*), Batavia (*Jatropha intergerrima*), and princess's palm (*Veitchia merillii)*. The plant produces nectar that is much needed by bees. The number of honey bees depends heavily on the availability of nectar from plants.

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1. INTRODUCTION

Honey is a natural substance that can be used as an antioxidant source. A sweet liquid known as honey is created by bees from plant nectar and kept in the cells of honeycombs (Bouddine et al., 2022). Ratnayani et al. (2008)) found that each type of honey has a different effect on free radicals and that the source of the nectar significantly affects the amount and type of antioxidants. Honey contains 181-200 components (Nagaraja, 2020), including 75–80% monosaccharides (fructose 38.2% and glucose 31.3%), disaccharides (1.31 percent sucrose, lactose 7.11 percent, and maltose 7.11 percent), and water (15–23 percent). Honey contains B1, B2, B5, B6, and C vitamins, calcium, Ca, Na, P Fe, Mg, and Mn minerals, and atase enzymes (Ferreira et al., 2009; Freitas et al., 2022). There is an enzyme that converts sucrose into fructose and glucose, an enzyme that converts sucrose into fructose and glucose, and enzymes that create hydrogen peroxide and glucose gluconic acid. Some studies indicate that honey is a natural source of antioxidants that help reduce the risk of cardiovascular disease, cancer, a weakened immune system, cataracts, and several inflammatory processes, among others (Vulic et al., 2015).

The main element in honey production is nectar. 20 to 60 percent of nectar is sugar, while 40 to 80 percent is water. Besides sugar and water, nectar contains minerals, organic acids, vitamins, and fragrant compounds. The nectar determines the content, quality, and flavor of honey gathered from a plant (Mertha Adnyana & Sudaryati, 2023). The quality of honey varies based on geography, geographical location, the origin of the floral source of honey bee food, the region, and the harvest season. The effects of ethyl alcohol and carbon dioxide can cause honey to become sour if the honey has high water content, so shortening its shelf life and reducing its freshness (Vulić et al., 2015).

Trigona sp. makes honey and bee pollen by eating nectar from flowers and flower pollen, respectively (Okińczyc et al., 2020). *Trigona* sp. bees make honey and propolis primarily based on which plants are close to the hive and can be used as a food source. The feed ingested by *Trigona* sp. is one of the aspects that must be considered in its cultivation activity since the quality of the beekeeping products produced might be affected by the diet (Alex, 2012; Freitas et al., 2022; Okińczyc et al., 2020). *Trigona* sp. species will make more honey and propolis if there are more places to get food. Honey bees and flowering plants have a good relationship for both of them. The plants give honey bees food from nectar and pollen, and honey bees pollinate the flowers. Worker honeybees continuously harvest nectar and pollen from plant blooms for honeybee consumption. Almost all flowering plants can feed bees. However, some flowering plants give off poisonous chemicals, so bees and other insects avoid them (Alex, 2012). Based on this, it is required to identify bee feed plants at Royal Honey Sakah to determine the type and potential of Trigona sp. bee feed plants. This research will give an overview of plants that make safe pollen, nectar, and resins, which can then be looked at to see if they could be used as traditional medicines.

2. RESEARCH METHOD

Qualitative descriptive research was used in this study. The research was conducted in May 2022 at Royal Honey Sakah, Gianyar Regency, Bali Province. The owner of the royal honey sakah agrotourism and staff conducted interviews related to cultivated plants to meet the feed sources of cultivated bees during the study's implementation. The information gathered gives a brief overview of Royal Honey Sakah agrotourism, cultivated plants (species), and plants that make pollen, nectar, and resin. The results are further analyzed descriptively, accompanied by the results of documentation, and all results are presented as a narrative (Darwin et al., 2021).

3. RESULTS AND DISCUSSIONS

3.1. Royal Honey Sakah Brief Overview

Royal Honey Sakah is one of the locations in Banjar Sakah, Batuan Kaler Village, Sukawati District, Gianyar, Bali, where honey bees are cultivated. Mr. Dr. I Wayan Wahyudi, S.Si., M.Si., is the proprietor of Royal Honey Sakah and the coordinator of the biology study program at the Faculty of Information Technology and Science, Hindu University of Indonesia. The 10-acre Royal Honey Sakah was established in February 2020. On this site, which used to be a shrub, plants like Santos, Batavia, and Porana were put there to feed bees. Royal Honey Sakah raises 150 colonies of 5 types of bees: *Heterotrigona Itama*, *Apis cerana* (Balinese nyawan), *Trigona* (*kele-kele*), *Tetragonula biroi*, and *Genio Trigona Thoracica*. Royal Honey Bali's honey bee farming includes four official branches: Royal Honey Sakah, Royal Honey Bongkasa, Royal Honey Taro, and Royal Honey Sibetan. It employs over 70 young farmers throughout Bali. In Bali, honey is distributed through a network of hundreds of resellers. The most popular varieties of honey are still Nyawan honey and Kele honey. *Nyawan* honey is recommended to stimulate children's appetite over one and a half years old. It is also beneficial for persons with stomach ulcers. Meanwhile, the demand for *kele* honey among diabetic elderly adults has increased. In addition to being a location for the production of Royal Honey Sakah, it also serves as an educational resource.

3.2. Plant species as a source of feed for bees *Trigona* sp.

The findings of the identification of cultivated plant species used by *Trigona* sp bees for nectar, pollen, and resin production are reported in Table 1.

Table 1. Nectar, pollen, and resin-producing plants

Name	Functions/ generators		
	Nectar and Pollen	Resin	Information
Red Santos	√		Daily flowering
Santos-lemon	√		Daily flowering
Bidarasari	√		Daily flowering
Red Kaliandra	√		Daily flowering
Tears of the bride and groom	√		Daily flowering
Batavia	√		Daily flowering
Princess's palm	√		Daily flowering
Coconut	√		Daily flowering
Golden rain	√		Daily flowering, as an indicator
Jackfruit		√	Inscribed on the stem
Sawo manila	√	√	Seasonal flowering, Inscribed on the stem
Mango	√	√	Seasonal flowering, Inscribed on the stem

3.2.1. Red Santos (*Xanthostemon novoguineensis*)

Xanthostemon is a genus of shrubs and trees belonging to the Myrtaceae plant family. To present, 45 to 50 Xanthostemon species have been identified, with diversity centers in New Caledonia, Australia, the Solomon Islands, Papua New Guinea, Indonesia, and the Philippines (Sedayu, 2009; Wilujeng, 2015) Even though the genus Xanthostemon is found in many places, many of its species are only found in one place. There are five types of Xanthostemon in Indonesia, including *X. confertiflorus*, *X. natunae, X. petiolatus, X. verus,* and *X. novoguineensis* (Sanito, 2018; Wilson, 1990). One of the few *Xanthostemon* has only been documented in New Guinea. This tree nursery can be propagated through cuttings or seeds and germination, albeit slowly. The plant is quite hardy, tolerates dry soils, prefers a warm environment in sunny locations, and tolerates dry soils. The plant responds well to pruning and can be easily shaped into shrubs, hedges, or windbreaks with regular pruning. Once it has been shaped, it needs almost no watering, but it will only grow in soils with good drainage In Figure 1 a red Santos plant is shown.

Figure 1. Red Santos plant (*X. novoguineensis*)

The inside of the pepagan is reddish-brown and very sticky. The heartwood is complex and ranges from dark brown to deep black. The tree can grow up to 30 meters tall without any branches, and its branches grow in a single point. The sowang plant has single, flat, edging leaves with a phyllotaxis of 2.5. The leaf bones are set in place, and their angles are between 60 and 80 degrees. The order of the leaf bones is set, and the angles of the leaf bones range from 60 to 80 degrees. The leaves have a cuticle and oil glands that make them look shiny. The inflorescences are 3-10 closely packed, each with three flowers. However, 2 or 4 flowers are frequently present. 5–6 minor crown leaves and 16–18 visible sifting anthers are present. The filament is connected to the base of the anthers (basifixed). The leaves of the petals are four to five in number, small, green, and

unimpressive. The flowers are red, and the floral parts are perigynous and joined. The fruit base is attached to the hypanthium, and it is dehiscent. The fruit will separate into three sections, each with two chambers, for six. Every fruit has 30 to 36 seeds. Flattened, spherical seeds are wingless and have a diameter of 1.5–2 mm (Wilson, 1990).

3.2.2. Santos Lemon (*Xanthostemon chrysanthus*)

The Golden Penda Tree, also called *Xanthostemon chrysanthus*, is a garden plant from a specific area with beautiful golden flowers. Santos-lemons are medium-sized, medium-shaped tropical trees that can grow up to 8 to 12 meters tall and have a spreading crown in the wild, but can grow as high as 40 meters in their natural habitat. Dark green and leathery leaves are pointed, 8–20 cm long, and 1.5–5 cm wide. They are grouped in a spiral. The young person's blush appeared bronze-red. The edges of the petals are linked to five-petal, bright yellow, bisexual blooms. Yellow stamens between 3 and 4 centimeters long surround the pistil in the center. Fruits have a capsule shape and ripen by changing color from green to brown. Explosive activity is used to distribute seeds. It is easy to grow, spreads quickly, and does not need much care when started from seeds or stem cuttings. After two to three years of growth from seed, flowering can start and is thought to be brought on by a sudden drop in temperature. The words "*Xantho*" in Greek and "*stamen*" in Latin, both of which imply "*yellow thread*," make up the genus name. The species name alludes to gold and flowers. The sole variation between this plant and Xanthostemon novoguineensis' growth of leaves, flowers, and fruits is the color of the blooms. Figure 2 illustrates the Golden Penda flowers of *Xanthostemon chrysanthus* (Sedayu, 2009; Wilson, 1990).

Figure 2. Morphology of the Lemon Santos Flower (*Xanthostemon chrysanthus*)

3.2.3. Bidarasari (*Porana volubilis*)

One of the flowers loved by trigona bees that grow on vines in the house or yard and is frequently used as an ornamental plant is bidarasari (*Porana volubilis*) (Simões et al., 2011). The Bidarasari (*P. volubilis*) has a Liane Length of 6-10 (-20) m, a mature woody branch with a diameter of up to 4 cm, coarsely wrinkled, serrated to verrucose, and glabrate brown bark; smaller stems are malleable and have a diameter of 2-5 mm, and grayish-brown, whitish speckled bark. Leaf numbers are 1.3-2.7(-3.8) cm long, slightly pulvinate at the base, and velutinous in the grooves; blades are ovate, ovate-elliptic, or rarely suborbicular, 5.8-10.7 by 3.7-6.3 cm, truncated at the base, emarginate or shallowly heart-shaped, occasionally with wavy edges when dry, tapered or tailless; and Stamen filament is 4-5 mm long, and CA anthers are 1 mm long with a white inside. Pollen oblate (or prolate), spheroidal, surface plate, 19–28 by 18–27 micrometers. The pistil measures 7-8 mm in length with a shiny orange disc. The ovaries are wide oval, slightly lobed 4, and have a height of 1 mm. The force is 3-5 mm long, whitish, severe at its base, and naked on top. There are pieces on the surface of flowers that have pollen in the shape of pollen oblate spheroidal measuring 19–28 by 18–27 micrometers (Staples, 2006; Wang & Manchester, 2000).

All of the plant's sepals are equally large, elliptical to oblong or narrow spathulate, 7-9(-11) by 3-4.5 mm, slightly concave, the short base of the keel, scary, stramineous to tan, bare; veins are parallel, nine at the base, and 3 reach the apex. The plant's fruit has a reflex fruiting chimp in the fall. Utricle: globose, globose, or ovoid depression, occasionally faint-cupped, 2-4 mm in diameter, apical, chartaceous stiff, stramineous to dark brown, glossy or opaque, seldom naked or sericeous. On fruits with 1.5–3 mm diameter, dark brown to black, 2–3 lobes, or three spherical or vaguely shaped; stationary hilus less than 1 mm. Figure 3 illustrates the *Porana volubilis* plant known as Bidarasari.

Figure 3. Morphology of the Bidarasari plant (*Porana volubilis*)

3.2.4. Red Kaliandra (*Calliandra calothyrsus*)

A variety of adaptable plants called red kaliandra was initially brought to the United States from Guatemala in 1936. The plant kaliandra is well-known for providing greenery and serving as a good source of animal feed in Indonesia. Red kaliandra is better since it is suitable for both people and the environment. This plant has the traits of a tiny, practically evergreen, non-prickly, legume tree that is usually between 5 and 6 meters tall but can grow up to 12 meters tall. It has multiple branches that produce a dense crown and a straight trunk with a diameter of up to 30 cm. The range of skin tones is broad, ranging from white to reddish brown to blackish brown. Although it can be beautifully pubescent, it is primarily naked. Kaliandra has a quick-growing, robust root system that can reach a depth of 1.5–2 m in about 4-5 months. The root system consists of deep-growing, occasionally forming taproots, and shallow adventitious roots. Rhizobium strains give kaliandra's roots a bright appearance. The root system makes it simple to create new sprouts. The tree can live for many years if just 3-5 cm of its trunk is cut down yearly (MACQUEEN, 1992; Yudaputra, 2020).

Compound kaliandra has crisscrossing, two-finned leaves with rachis lengths of 10 to 19 cm and pinnae ranging from 3 to 20. Pinnae measure 4–7 cm in length and have 19–60 pairs of linear, opposing, sharp or blunt leaflets that measure 5-8 mm long and 1 mm wide. The spectacular spike-like raceme-shaped inflorescences, borne at the apex, have a length of 10 to 30 cm. Its name, "*kaliandra*," derives from the numerous clusters of 4-6 cm long purplish-red blooms on which it bears ("*beautiful male*"). The fruit is dark in color, straight-lined, flattened, pubescent, cracked, and 8–11 cm long by 1 cm wide. They have 3 to 15 seeds. The seeds are ellipsoid, flattened, and 5-7 mm long with dark brown mottling (Yadi et al., 2022) Figure 4 shows the morphology of the Red Kaliandra (*Calliandra calothyrsus*).

Figure 4. Morphology of Red Kaliandra (*Calliandra calothyrsus*)

3.2.5. Bridal Tears (*Antigonon leptopus*)

One of the ornamental tears, Bridal Tears (*Antigonon leptopus*), is common in Indonesia and is said to have originated in Mexico (Raju et al., 2001). *Antigonon leptopus* is the most prevalent kind in Indonesia (Figure 5). This plant resembles a vine (liana), and each rib on the antigonon stem length is between 3 and 6 cm. The stem has protruding ribs and delicate hairs. A buyer's instrument entangling the vines to sustain the plant's upright is also on the trunk. The leaves are heart-shaped, green, and have wavy surfaces (uneven). The antigonon leaf measures 5 to 10 cm in length. It has a complex bulb that emerges from the undersides of the leaves and is placed on panicles. The wedding tear flower's crown comprises five pink or white sheets, each measuring around 7 mm long. While the two deepest flower crowns have a more pointed shape, the three outermost flower crowns have an ovoid or heart-shaped shape. They will grow larger and envelop the fruit once all the crowns bloom. The fruit has a greenish hue and resembles a membrane (Raju et al., 2001).

Figure 5. Bridal Tears (*Antigonon leptopus*)

3.2.6. Batavia (*Jatropha intergerrima*)

When inoculated with Jatropha plants, the Batavia plant name asks, a species of shrub that can reach a height of 2 meters, can develop into a tree. Chemicals found in the fruit and sap have the potential to irritate the skin (Bala et al., 2022). This plant's distinctive feature is a thin trunk and a moderate tree height. The shape of the leaves varies quite a bit; some are oval, fashioned like a violin, others are elongated and circular, and others even have tapering leaf tips. The lower side of the young leaves is slightly brownish and has a tint resembling copper (Kolawole et al., 2016). The flowers are multi-cluster or group members, star-shaped, and bright red to crimson in hue. Cuttings and seeds can both be used to propagate this plant (Oladipo & Illoh, 2010; Santos et al., 2005). Figure 6 shows the morphology of Batavia plants.

Figure 6. Batavian flower *(Jatropha intergerrima)*

3.2.7. Princess palm (*Veitchia merillii*)

Like king palms, princess palms are native to Madagascar and are frequently grown as garden ornaments or along roadsides. Although the design is comparable to a king palm, the leaves are more significant and greener in hue. The stem is also smaller than that of the royal palm. This plant has a single gray-colored stemmed palm trunk that grows erect upwards, is rarely branched, and is unfolded. Generally speaking, palm tree trunks develop as a single trunk, much like coconut trees. The daughter's palm can grow up to 5 m tall. Princess palms typically thrive in tropical or subtropical regions ranging from lush or desert terrain to lowlands, highlands, mountains, or beaches. The palm tree's roots will spread within. The roots will continue to multiply as they get older (Palm et al., 1994). Figure 7 shows the anatomy of the daughter's palm.

Figure 7. Princess Palm Flower (*Veitchia merillii*)

Pinnate and compound are also placed in the leaves portion. The leaves have an overabundance of thorns and are covered with midrib on the stalk. They can grow to be three meters long. The leaves have a white or pale green underside with a dark green top portion and a green lower portion. The young palm tree blossoms are arranged in a bouquet and covered with a sheath (protective leaf). When the Mayang stalk is cut or injured, a pleasant liquid known as nira is released. There are both male and female flowers in the bouquet. Insects or birds aid in the pollination process.

The palm flower can be found in the leaf canopy of several varieties of palms (Vanda et al., 2021). The fruit of the palm tree has a massive diameter that typically reaches 4 m. The sign towers down and becomes bubbly. Young fruits have a brownish hue, whereas ripe fruits have a vivid red color. The myocardium's juicy (inner) portion is covered by a thick outer membrane that lines the inside of the fruit (Balqis et al., 2017; Palm et al., 1994).

Finally, the seed is shielded by an endocardium, a complex, woody inner fruit layer like a coconut shell. The liquid seeds inside the shell indicate that the fruit is still immature and will gradually harden to create a precipitate. These deposits are rich in protein and fat. The leftover liquid in some palm plant species can be drunk as a cool beverage, like the water found in siwalan fruit or the water produced by coconut trees. These deposits are rich in protein and fat. The leftover liquid in some palm plant species can be drunk as a cool beverage, like the water found in siwalan fruit or the water produced by coconut trees (Zona & Fuller, 1999).

3.2.8. Coconut (*Cocos nucifera*)

Coconut has many cultivars, making it a plant with many uses. The coconut plant Cocos nucifera has many health benefits for people (Arsyad et al., 2015; Koffi et al., 2013; Schmier et al., 2020). This coconut plant has a specific purpose in its fruits, which range from coconut water to skin. A fiber root with a shape like a weevil and relatively thick and woody is one of this plant's traits. This root is so sturdy that coconut trees can grow on it and even endure the wind. The coconut tree's wooden trunk has cavities that resemble fibers. This item can ascend to a height of 20 meters. Coconut leaves feature midrib and parallel leaf bones. Coconut leaf strands are orderly on the right and left sides of the midrib. Even the older leaves have a hard time separating from the stem because the midrib of the coconut leaf is so tightly linked to it. Compound flowers, such as those found on coconuts, cluster together in the undersides of the leaves. This flower is a somewhat yellowish white with a reasonably hard texture shielded by a manager shell with an elongated shape. This bloom can grow between 30 cm and 1.5 m long: sufficiently sized and rounded coconut fruits. Nevertheless, there are also oblong ones depending on the type of coconut variety (Setiado et al., 2021; Siregar et al., 2019; Zhang et al., 2021). The coconut fruit has a 10 to 20-cm diameter. When the coconut fruit is old, the colors can range from green to yellow to orange or red-brown (Arunachalam, 2012; Beveridge et al., 2022; Pham, 2016) Figure 8 shows the morphology of the Coconut flower.

Figure 8. Coconut Flower (Cocos nucifera)

3.2.9. Golden rain (*Galphimia glauca*)

Golden rain is a plant that grows between 700 and 2,300 meters above sea level in deciduous forests, pine forests, pine-oak forests, meadows, undulating slopes, dry, rocky hillsides, and by the sides of roads. Golden rain is a source of nectar, but it also has many other advantages, including the ability to treat ulcers, flatulence, and cough in addition to providing nectar. In the appropriate growing region, the golden rain plant often forms a bush that grows to a height of 2-3 m and is a member of the low-growing family (Sharma et al., 2018). Young stems have reddish-colored fluffy fur covering them. The oval leaves measure 2.5 to 4 cm in length. Flowers have a diameter of 2 to 3 cm, are bright yellow, and are grouped on flower stalks that are 10 to 15 cm long. The 2 cm yellow shrub flower has three styles, ten crisscrossed short and long anthers, five sepals, five petals, and two outermost leaves. Long terminal panicles with blooms resembling waves and movement *Galphimia* is a popular garden plant because of its volume of flowers and rapid growth rate. The

shrub may also thrive in arid settings and can withstand brief frosts as low as -2^{o} C (Rios et al., 2020). *Galphimia glauca* bloom form is depicted in Figure 9.

Figure 9. Morphology of the flower *Galphimia glauca*

3.2.10. Jackfruit (*Artocarpus heterophyllus*)

The jackfruit may still bear fruit at 30° and grows well in tropical regions up to 25° north and south (Saxena et al., 2011). The plant thrives in areas with more than 1500 mm of annual rainfall when the dry season is not too severe. Jackfruit is less resistant to extreme temperatures, droughts, and flooding. The taproot, branches, and hairy stem of jackfruit plants, which can reach a diameter of up to one meter, are their distinguishing features. The header is vast, dense, and rounded when in the open. Every portion secretes a thick, white sap when the plant is hurt. The leaves are single, dispersed, stemmed 1-4 cm long, stiff, flat-brimmed, ovate upside down to oblong (elongated), 3.5-12 5-25 cm, with the base narrowing little by little, and the short tip pointy or slightly pointed. The leaf blades are relatively thick as the skin (Azad et al., 2007; Bolanle-Ojo et al., 2018). Up to 8 cm long, pointed ovate stacking leaves are quickly lost and leave ring-shaped imprints. Short, unique shoots that sprout on the sides of the trunk or ancient branches are the one-housed jackfruit plant's (monoecious) inflorescences, which are visible on the armpits of the leaves. Male flowers in mace- or spindle-shaped humpbacks are 1-3 3-8 cm long, dark green, with yellowish pollen, and hardly scented when ripe. They have distinct fleshy rings at the base of the hump. Babal is the blossoms of the jackfruit. The babals will decay (get infested with mold) and turn black after reaching their peak ripeness before finally dropping from the tree. Dark green, cylindrical or oblong female flowers, either single or in pairs, are seen (Azad et al., 2007; Bolanle-Ojo et al., 2018).

Compound fruits (syncarp) are up to 100 cm long, elongated spindle-shaped, frequently uneven, and have soft, short spines on the outside. When ripe, the fruit's "meat," which is the development of the floral tent, is golden yellow, smells strongly of flesh, and is occasionally filled with sweet liquid (nectar) (Prakash et al., 2009). The seeds are 2-4 cm long, oblong-round to slightly flat, and covered in successive layers of soft exocarps, whitish hard clay endocarps, and a thin, skin-like brown seed coat. The seed fragments do not have as much sprig. Figure 10 shows the shape of the jackfruit plant blooms (Azad et al., 2007; Prakash et al., 2009).

Figure 10. Flowers of Jackfruit Plant (*Artocarpus heterophyllus*)

3.2.11. Sawo manila (*Manilkara zapota*)

Fruit trees called "*sawo manila*" live a long time. There are many names for the tree and its fruits, including sawo, sauh or sauh manila, and ciku. A fruit plant from the Sapotaceae family, the sawo manila is indigenous to Central America and Mexico. Sawo plants are tropical plants that may be grown in various climates, including Indonesia. Sawo is extensively grown in yards and is extremely simple to find in the market. This plant may grow up to 40 meters tall and has a huge,

shady tree as one of its properties (Islam et al., 2016). Gray-black to dark brown, low-branched manila sawo stem with tough skin. The entire component is made of latex, a thick, milky-white sap. At the extremities of the twigs, single, alternately positioned leaves frequently gather. The leaf blade is round-egg to slightly lanceolate, flat-brimmed, hairy, shiny dark green, and 1.5-7× 3.5-15 cm in size. The base and tip are wedge-shaped, stemmed at 1-3.5 cm, and the prominent leaf bone protrudes on the underside. Figure 11 shows the anatomy of the sawo manila plant (*Manilkara zapota*) (Moura et al., 2019; Sari et al., 2018; Ying et al., 2017).

Figure 11. Flowers sawo manila (*Manilkara zapota*)

Single blooms can reach a diameter of 1.5 cm, are 1-2 cm in stem length, and are numbered 6; they are found in the armpits of the leaves close to the terminals of the branches. Petals are typically grouped in two rings; the white crown of the shape occupies up to half of the tube's length. Buni fruits are short-stemmed, round, ovate or rectangular, 3-6 × 3-8 cm, reddish-brown to yellowish on the outside, covered in brown leathery scales that are easy to peel off, and frequently with the remaining pistil stalks drying at the ends. Thin-skinned, reddish-brown to yellowish, delicious, and packed with juice. The pulp is delicate and can sometimes squeeze out. Drupes are oblong, flattened, black or shiny brown, length lk. 2 cm, with up to 12 grains, but most often less than 6, and waxy white seed chips (Moura et al., 2019; Yuniastuti et al., 2022).

3.2.12. Mango (*Mangifera indica*)

Mangoes originated around the boundary between India and Burma, and they first reached Southeast Asia some 1500 years ago. Although most yard mangoes are about 15 meters or less tall, this plant can grow to 30 meters or more, according to its characteristics. Strongly branched, upright stems with dense foliage create a stunning crown with an oval or elongated shape and a diameter of up to 10 meters. The trunk's bark is thick, leathery, and covered with little fissures and scales from previous petioles. The bark of the trunk, known as the old pepagan, is typically grayish brown, dark gray, or virtually black. It has a long, branching taproot that can reach a length of 6 m. The depth of the branch roots is typically between 30 to 60 cm. However, they are becoming increasingly scarce (Cahyanto et al., 2017; Igbari et al., 2019).

Single leaves dispersed throughout. The petiole ranges from 1.25 to 12.5 cm, has an expanded base, and has a groove on the top. The standard rule for leaf placement on a stem is 3/8. However, the closer the leaves are to the end, the closer they are, giving the impression that they are in a circle. Flowers have pleasant scents and small, infrequently lengthy stems. The flower crown typically has five leaves, although occasionally, there are four to eight; similarly, the petals are often five in cahoots. The background is a light yellow, and the embossed lines with the numbers 3 to 5 are slightly faded in color in the center (Hussain et al., 2021). The crown's leaves have white borders around them. The color of the flower's crown changes to a reddish hue as it withers. Stone fruits (*drupa*) clusters are meaty and come in a wide range of sizes and shapes, including round (such as Mango *Gedong*), ovoid (such as *Gadung, Indramayu,* and *Arumanis*), and elongated *oblong* (*Mango Golek*) (Cahyanto et al., 2017; Pierson et al., 2014). The fruit is 2.5 to 30 cm long on average. The fruit has a beak and a tapered portion at the end. The sinus bends upwards into the abdomen and is located above the beak. Gamma 12 shows the morphology of the mango plant (*Mangifera indica*).

Figure 12. Flower mango (*Mangifera indica*)

3.3. Flowers as a source of feed for bees *Trigona* sp. at Royal Honey Sakah

Nectar and pollen from practically all flowering plants can be used as food by honey bees. Ants, birds, and other insects, including honey bees, can ingest nectar, a sweet liquid generated by plant-nectarized glands that can appear on flowers, stems, and leaves (Alves et al., 2013; Nagaraja, 2020). A highly effective pollinator agent for plants, honey bees increase productivity, which enhances food safety, farmer income, and farmer welfare (Hikmah et al., 2021). The nectar supplies the honey bees in the hive with protein as a source of amino acids, water, glucose, and sucrose for energy. Nectar's components are K+ ions, ascorbic acid antioxidants, lipids, phenols, and alkaloids. Nectar serves as the foundation for worker bees' production of honey (Evahelda et al., 2021; Freitas et al., 2022).

Honeybees can gather pollen, the male genitalia of flowering plants, as a source of protein. Small (0.01 to 0.10 mm) pollen grains are put on the back legs of the corbicle or pollen basket by worker bees, who extract them using their mouth, tongue, and nearly all of their outer body parts. On the empty nest's comb, pollen is spread. The pollen provides the raw materials for royal jelly production and the protein, vitamins, and minerals bees require to maintain a healthy colony. Plants are living things that create secondary metabolites due to metabolic activity. Resin is one of the categories of secondary metabolites. Resins can be created either naturally or intentionally. They are solid, brittle, shiny, transparent, or dull; if exposed to heat, they will quickly melt and burn, generating smoke and a distinct odor (Evahelda et al., 2021; Montaser et al., 2022; Zarei et al., 2019). Bees collect numerous plant resins, which they combine with saliva and different bee enzymes to create a new compound called propolis. Propolis is aromatic-smelling and ranges in hue from yellow to reddish brown. Bees use propolis to hide the bodies of bullies they kill, seal openings in the nest, construct the hive's entrance, and help keep the hive's interior at a consistent temperature. Bees, including bees of the species Trigona, create propolis. Compared to Apis sp., Trigona produces more propolis (Freitas et al., 2022; Wibowo & Ramadhan, 2022).

Twelve different plant species are used as a source of bee food at Royal Honey Sakah. There are two types of vegetation: those that produce nectar and pollen and those that produce resin. Most of the nectar-producing plants in Royal Honey Sakah bloom daily, allowing bees to make honey at any time. The following plants can be found in Royal Honey Sakah as daily flowering producers of nectar and pollen: red Santos (*Xanthostemon novoguineensis*), santos lemon (*Xanthostemon chrysanthus*), Bidarasari (*Porana volubilis*), red Kaliandra (*Calliandra calothyrsus*), Bridal Tears (*Antigonon leptopus*), Batavia (*Jatropha intergerrim*), coconut (*Cocos nucifera*). In addition to providing nectar, golden rain (*Galphimia glauca*) also signifies the bees' willingness to feed in Royal Honey Sakah. If numerous bees consume the nectar of this flower, this suggests that the bees are less willing to feed. The plants that produce resin include Jackfruit (*Artocarpus heterophyllus*), Sawo manila (*Manilkara zapota*), and Mango (*Mangifera indica*), which are seasonal and also produce resin and nectar. Bees mainly depend on nectar-producing plants; nectar is typically obtained from flowers, though it can also be found on stems, leaves, and twigs. However, nectar can occasionally be obtained from honeydew, a delicious liquid excreted by plant parasites. Honey bees typically consume nectar, and more nectar is only required during times of famine. Bee production of honey relies heavily on the plant's ability to provide nectar. According to observations made during plant identification in Royal Honey Sakah, santos flora, such as red Santos (*Xanthostemon novoguineensis*) and santos-lemon, have the densest populations (*Xanthostemon chrysanthus*).

4. CONCLUSION

Royal Honey Sakah offers several different plant species as a food source for Trigona sp. bees. Red Santos (*Xanthostemon novoguineensis*), which has the largest population, Santos lemon (*Xanthostemon chrysanthus*), Bidarasari (*Porana volubilis*), Red Kaliandra (*Calliandra calothyrsus*), Bridal Tears (*Antigonon leptopus*), Princess palm (*Veitchia merillii*), Batavia (*Jatropha intergerrim*), coconut (*Mangifera indica*). Since nectar is what bees require most, the majority of the plants in Royal Honey Sakah provide it. Bee production of honey is heavily reliant on the availability of plant nectar. More research is required regarding the quantity of honey generated by bees in one variety of plants.

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