TRENDS IN AGRICULTURE SCIENCE
ISSN:2583-7850

Popular Article
Domain: Apiculture
Vol 4 Issue 5, May 2025, 3525-3531

Meliponiculture: Importance in Sustainable Economy & Challenges

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DOI:10.5281/TrendsinAgri.15422491

Abstract

Stingless bees are eusocial insects with vestigial stings. Stingless bee keeping is known as the meliponiculture. Now a days the number of wild and managed bee colonies are declining so that cause global concern in applied pollination so meliponiculture is practiced to minimize this threat. But the deforestation and poor management practices of hive is the main problem faced by the commercial industries. The biological feature which makes the stingless bee fit for commercial pollination service is discussed here. With the growing pressure on the environment and the associated loss of honeybees, the need exists for additional pollinator species to be used in agriculture to maintain resilience in food production and improvement of yield. We believe that successful use of this pollinators will promote the development of new breeding techniques and commercialization possibilities.

Key Words: Meliponiculture, Honey, Global Challenges, ***Melipona***, ***Trigona***.

Introduction

Stingless bees along with honeybees plays a major role in pollination of 30% of human food. Over the past 6 years the total number of crops which are pollinated by the stingless bee has been increased by double. Today over 600 sp in 56 named genera of stingless bees found in tropical and subtropical region of world. The most important genera are ***Melipona*** which consists of 50 species having more complex communication system and ***Tetragonula*** which is largest with 130 species. Here the global regional status of meliponiculture is discussed along with the use of it in crop pollination which form a new economic possibility, and also the challenges during large scale rearing as it is related with the sustainable development.

Origin Of Meliponiculture

As the diverse indigenous peoples lived in Mexico when the Spanish conquerors arrived in sixteenth century, the ancient Maya people held stingless bees in high regard and considered them an integral part of social and religious life. At that time, stingless bees provided a vital small-scale economy, due to their honey, waxes, and resins. The cultural importance of a single central species is called Xunan-Kab (***Melipona beecheii***), was recorded in documents written with ideograms by the Maya, recorded in codices. Only three of these codices have survived and one, the Tro Codex, contains most data on bees and their meaning in society. The honey produced by Xunan-Kab was considered sacred by the Maya and was also traded. Lopes de Gomara (1552) wrote that stingless bee honey occurred in different colors, flavors, and fluidity, and indicated that it was an important medicinal product.

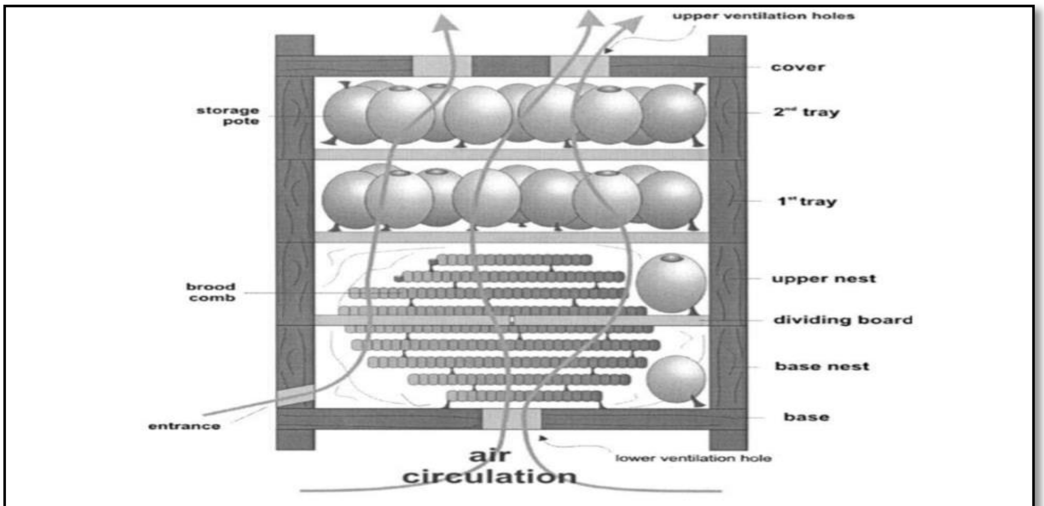

Figure 1. Vertical hive with special ventilation system for stingless bees of tropical areas (from Giorgio C. Venturieri in www.cpatu.embrapa.br/meliponicultura.htm).

Classification Of Stingless Bees

The development of traditional meliponiculture provides new opportunities for people in the rural areas, especially women and it can improve the economics of many households. All stingless bees are in the order Hymenoptera and family Apidae. They are classified into the subfamily Meliponinae which is comprised of two tribes: Meliponini and Trigonini (Wille 1979). These tribes are characterized by morphological differences, and reinforced by some biological and nesting characteristics. Meliponini are more robust in body shape and size than Trigonini and have shorter wings and more densed pubescence (Michener 1990). Stingless bees have a vestigial, functionless sting (Michener 2000); however, they have substantial mandibles, connected to comparatively larger muscles than in ***Apis*** (Sakagami, 1982), that are effectively used for defense. There is a ***Penicillum*** (long, stiff bristle) on the outer apical margin of their hind tibiae (Wille 1983) and wax glands are located on the dorsal side of the abdomen in stingless bees (Sakagami, 1982), whereas they are ventrally located in ***Apis***.

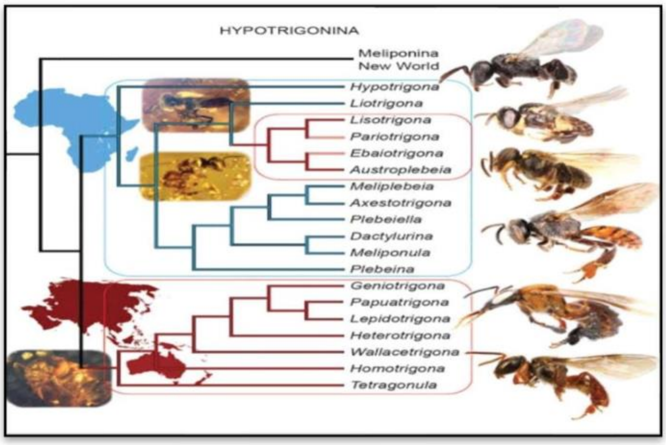

Fig 2: Classification of stingless bees (https://images.app.goo.gl/MDvVRe464ncbwLZ48)

Why Stingless Bee?

Stingless bees form perennial colonies from which they forage round the year. Worldwide several hundred species exist, which differ significantly in colony size (from a few dozen to tens of thousands of individuals), body size (from 2to 14 mm; compare to 12 mm for honeybees).

Many characteristics of stingless bees are as same as of honey bees. Some of the characteristics that influence their ability as efficient pollinators are:

1. **Polylecty and adaptability:** This enables them to pollinate multiple plant species and adapt to new ones.
2. **Floral constancy and Domestication:** A worker on a trip usually visits only one plant species and colonies can be placed in hives, inspected, propagated, fed, re-queened, controlled for enemies, transported, and otherwise managed easily.
3. **Large food reserves are stored in nests:** This has the obvious benefit of allowing colonies to survive long periods of low food availability. Additionally, it means that workers will collect floral resources beyond immediate needs, resulting in intensive visitation of preferred flowers.
4. **Possibility of in-hive pollen transfer:** This decreases the need for bee movement between plants of self-incompatible species. It has been found for honey bees and is equally likely for stingless bees.
5. **Forager recruitment:** Workers recruit nest mates to rewarding floral resources and provide information on the position of those floral resources, which allows the rapid deployment of large numbers of foragers relative to other bees and insects in which each individual has to find the resource.

Economic Potential of Stingless Bees

The development of traditional meliponiculture provides new opportunities to rural people, especially women which improve the economics of many households. If flora resources are abundant then beekeeper can adopt meliponiculture because it provides income in term of honey, cerumen which id mixture of plant resin and honey, resin products. The bee wax of the stingless bee is used as an emulsifierin cold creams, oinment, lipstick, pomade and also ink, candle, crayon industry can use this bee wax.

The stingless bee honey is sold in market in very high price rather than ***Apis*** bees' honey. High quality honey, beewax, pollen can be used in food production and pharmaceutical industry which also can generate the income and employment for the unemployed youth. The most attractive feature in stingless bee culture is keeper does not need to invest in the high-cost protective equipment to protect themselves as stingless bees does not have stings to attack. The delicious taste to stingless bees' honey increases export market value and also the antibiotic property of honey make it more valuable. Floral consistency leads to the assertive mating of visited plants so less pollent waste and very less non-selective pollen reach to stigma so very efficient pollination occurs by this bee. And these bees suffer less disease than other bee so beekeeper don't need to invest more in disease management.

Crop Pollinated by Stingless Bee

TREES	**STINGLESS BEE SPECIES**
Mango	***T. thoracica***, ***T. apicalis***, ***T. atripes***
Starfruit	***T. thoracica***
Durian	***T. thoracica***
Rambutan	***T. thoracica*** & ***T. atripes***
Watermelon	***T. thoracica***, ***T. itama***, ***T. peninsularis*** & ***T. atripes***
Honeydew	***T. thoracica*** & ***T. itama***
Annato	***Melipona melanoventer***
Camu-Camu	***Melipona fuliginosa***
Chayote	***T. corvina***
Coconut	***Partamonacupira***
Carambola	***T. thoracica***
Macadamia	***Trigona spp.***
COFFEE (***Coffea Arabica***)	***T. terminata***
COFFEE (***Coffea Canephora***)	***T. terminata***
Avocado	***Trigona nigra***
Strawberry	***Plebeiato bagoensis***
Sweet Pepper	***Melipona favosa***
Tomato	***Melipona quadrifasciata***
Cucumber	***Scaptotrigonaaff. Depilis***

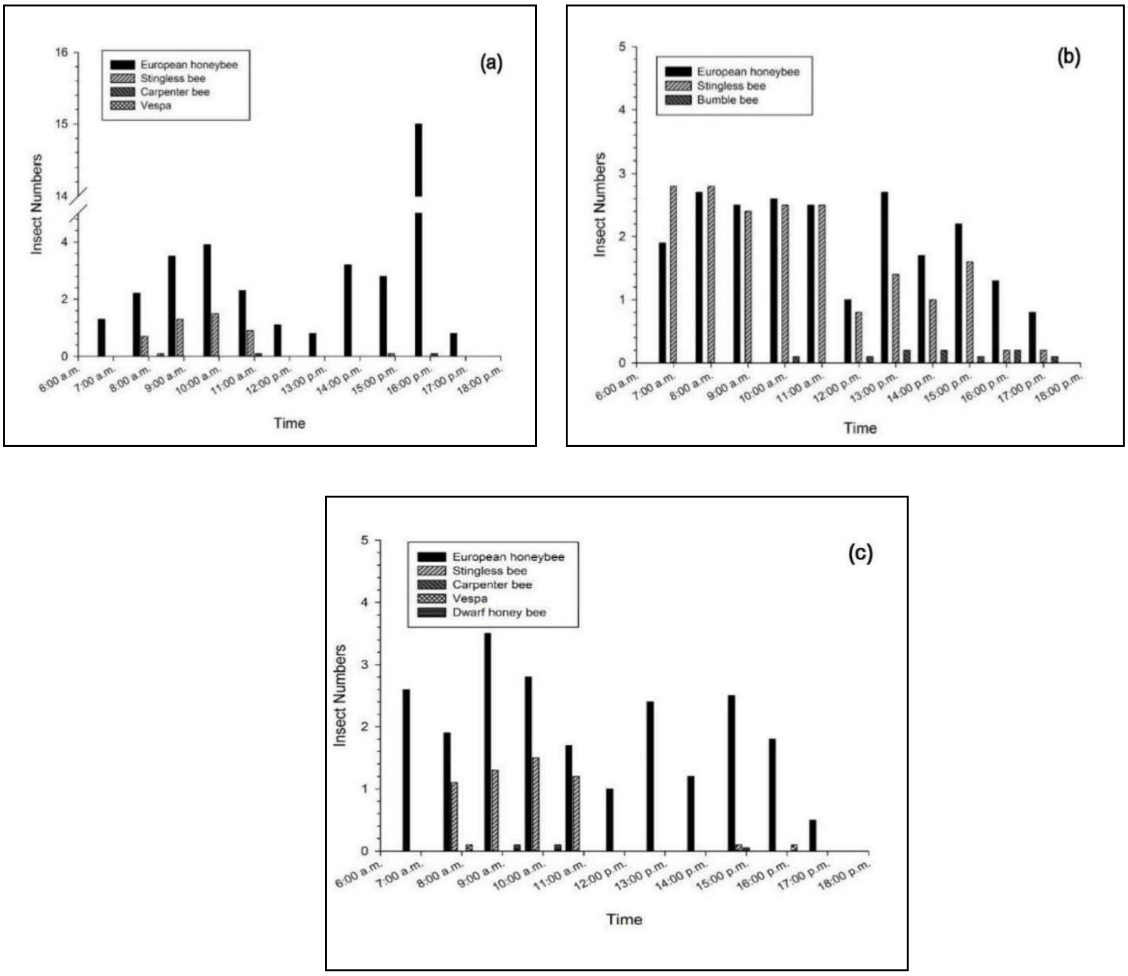

Figure: relationship between time & insect species visited the three sunflower varieties:

A) Relationship between time & type of insect pollinators found on the chiang rai sunflower variety;

B) Relationship between time & type of insect pollinators found on the pacific 77 hybrid sunflower variety; &

Relationship between time & type of insect pollinators found on the hungarians sunflower variety.

Challenges and threats:

Meliponiculture, the practice of keeping stingless bees, faces numerous global challenges and threats. Some of the key issues include:

A) **Habitat Loss and Fragmentation**: Extensive agriculture, urban development, and deforestation contribute to habitat destruction, affecting stingless bee populations and their habitats.

B) **Agrochemicals and Pesticides**: Chemical pesticides can harm stingless bees, contaminate their honey, and impact biodiversity. Studies show that exposure to pesticides can alter flower visitation rates and affect crop yields.

C) **Climate Change**: Changes in climate can disrupt stingless bee populations, impacting pollination services and ecosystem health. This may lead to a shift in suitable habitats and increased risk of species invasion.

D) **Invasive Species and Competition**: Non-native species can outcompete stingless bees for resources, potentially leading to population decline.

E) **Lack of Knowledge and Research**: Insufficient understanding of stingless bee biology, ecology, and conservation threatens their sustainability.

F) **Regulatory Challenges**: Complex regulations and permitting processes can limit access to meliponiculture.

G) **Loss of Genetic Diversity**: Declines in stingless bee populations can lead to reduced genetic diversity, making them more vulnerable to threats.

H) **Predatory Extractivism**: Over-extraction of stingless bee products, such as honey, can harm the bees and lead to population decline.

I) **Biocultural Diversity Loss**: The decline of native stingless bees is often linked to the loss of local ecological knowledge and cultural significance.

To Mitigate These Challenges, Potential Solutions Include:

Governments and conservation efforts can create biological corridors to connect fragmented habitats and safeguard ecosystem services. Restoring disturbed areas and protecting conserved areas can improve habitat connectivity and promote biodiversity. Promoting sustainable agriculture practices, reducing pesticide use, and supporting conservation efforts can help protect stingless bee populations. Conducting research and educating communities about the importance of stingless bees and their conservation can help address knowledge gaps.

Conclusion

Meliponiculture, the practice of keeping stingless bees, plays a vital role in maintaining ecosystem health, promoting biodiversity, and supporting sustainable agriculture. However, this valuable practice faces numerous global challenges, including habitat loss, pesticide use, climate change, and regulatory hurdles. Addressing these challenges through sustainable practices, conservation efforts, and research is crucial to ensuring the long- term viability of meliponiculture and the many benefits it provides to both humans and the environment. Stingless bee beekeeping, at least in some areas, is disappearing. The younger potential beekeepers must join the effort in maintaining the population of stingless bees. Basic biology studies are needed, mainly concerning the exploitation of natural resources by these bees and medium-long-term studies. The new meliponiculture will be organized to ideally provide agriculture and wildlife with the ecosystem services essential for pollination. In all places where meliponiculture develops, bottlenecks for their improvement include how to keep and conserve their honey, how to rear them in large quantities, how to prevent colonies from being contaminated by agricultural pesticides and maintain the bees, how to use their services and conserve their populations, and how to provide qualified information and training in all levels.

References

Devanand r. Bankar, Renuka Sunil Mahajan, Pushpalatha M.- Stingless Bees & Their Importance in Crop Pollination, Vol.3 Issue-1, September 2022: 1-5

Erubiel. T. H., Guadalupe, P. C., Victor, M. H. V., Caleb, C. L. Jeiry, T. J., Yanet, R. R. and Renato, L. R., 2022, The stingless bees (Hymenoptera: Apidae: Meliponini): a review of the current threats to their survival. Apidologie, 53(8): 1-23.

Heard, T. A., 1999, The role of stingless bees in crop pollination. *Annu. Rev. Entomol*., 44: 183-206.

Kearns, C.A., Inouye, D. W. and Waser, N. M., 1998, Endangered mutualisms: The conservation biology of plant-pollinator interactions, Annu. Rev. Ecol. Syst. 29: 83 112.

Anchalee Sawatthum- Role of Stingless Bee, ***Tetragonula pegdeni*** & European Honey Bee, ***Apis mellifera*** in the pollination of Confectionery Sunflower

Fernando Zamudio- From Extraction to Meliponiculture: An Ethnobiological Synthesis of a Long-Standing Process in Argentina.

Ester Judith SLAA, Luis Alenjandro Sanchez Chaves, Katia Sampaio Malagodi-Braga, Frouke Elisabeth Hofstede- Stingless Bees in Applied Pollination: Practice & Perspectives

Amano K. (2004) Attempts to introduce sting less bees for the pollination of crops under greenhouse conditions in Japan, Food & Fertilizer Technology Center, [online] http://www.fftc.agnet.org/library/article/tb167.html (ac cessed on 6 March 2006).

Amano K., Nemoto T., Heard T.A. (2000) What are stingless bees, and why and how to use them as crop pollinators? a review, JARQ 34, 183–190. [online]http://ss.jircas.affrc.go.jp/engpage/jarq/34-3/amano/ amano.htm (accessed on 6 March 2006).

Asiko A.G. (2004) The effect of total visitation time and number of visits by pollinators (Plebeia sp. and Apis mellifera mellifera) on the straw berry, M.Sc. Thesis, Utrecht University, The Netherlands.

Camargo C.A. de (1972) Mating of the social bee Melipona quadrifasciata under controlled conditions (Hymenoptera: Apidae), J. Kans. Entomol. Soc. 45, 520– 523.

Caron D. (2001) Africanized Honey Bees in the Americas, A.I. Root Company, Ohio, USA.

Michener C.D. (2000) The bees of the world, Johns Hopkins University Press, Baltimore, Maryland

Willmer P.G., Stone G.N. (1989) Incidence of entomophilous pollination of lowland coffee (Coffea canephora); the role of leaf cutter bees in Papua New Guinea, Entomol. Exp. Appl. 50, 113–124.

Seeley T.D. (1985) Honeybee Ecology, Princeton University Press, Princeton, New Jersey.

Slaa E.J. (2003) Foraging ecology of stingless bees: from individual behaviour to community ecology, Ph.D. dissertation, Utrecht University, The Netherlands.