First report of stingless bee, *Tetragonula iridipennis* Smith from Himachal Pradesh and resource partitioning studies in *Hibiscus rosa chinensis*

AVINASH CHAUHAN*

Department of Entomology
School of Agricultural Sciences and Rural Development
Nagaland University, Medziphema 797106 Nagaland, India
*Email for correspondence: avi_shimla@hotmail.com

 Received: 07.04.2024/Accepted: 19.05.2024

ABSTRACT

Stingless bees are important pollinators and honey producing bees that belong to order Hymenoptera like honeybees and are reported from different parts with their higher diversity in northeastern region of the country. A survey was conducted in July 2023 in the mid-hills (Solan district) and higher hills (Shimla district) of Himachal Pradesh to know the presence and diversity of stingless bees in these areas. Specimens were collected with the help of nylon sweeping net and brought to the laboratory for further study. Different morphological and morphometrical parameters were studied for identification. The resource partitioning studies were also conducted on China rose flower where a large variety of pollinators was observed and abundance of different visitors was recorded. The Shannon-Weiner diversity index was also calculated for the region. The collected specimens of stingless bees were identified as of *Tetragonula iridipennis*, which is the first record of stingless bees from Himachal Pradesh. The other insect visitors recorded on China rose were bumble bees, *Bombus haemorrhoidalis*, syrphid flies, *Episyrphus balteatus, Metasyrphus confrator*, *Megachile* bees, *Megachile dysjuncta*, halictid bees, *Lasioglossum* sp, *Apis dorsata*, *A cerana*, houseflies, butterflies, *Pieris brassicae*, *Ceratina* sp and ants. The diversity index revealed the higher diversity of bees in the region.

Keywords: Stingless bee; *Tetragonula iridipennis*; bee diversity; diversity index, abundance

INTRODUCTION

The stingless bees belong to the family Apidae and are close relatives of true honeybees, carpenter bees, orchid bees and bumble bees. Stingless bee is the smallest (4.0 to 5.0 mm long) of the honeybees. Contrary to *Apis* honeybees, the sting in stingless bees is atrophied in size and does not sting. But they can defend themselves by biting when their nest is disturbed. Stingless bees, known to have the oldest evolved bees, were found preserved inside ambers which were 80 million years old.

Stingless bees are a large group of bees (approximately 600 species) comprising the tribe Meliponinae. Approximate number of species so far identified is 50 in Africa, 300 in the Americas, 60 in Asia, 10 in Australia and 4 in Madagascar (Bradbear 2009).

Stingless bees are reported to be found throughout most of the tropical and subtropical regions of the world such as Australia, Africa, southeast Asia and tropical America. They are active all the year round but are less active in cooler weather periods. According to Roubik (1989), local and regional diversities are high in the neotropics, where up to 60 meliponine species can be found locally in a single forest. Nests of stingless bees are mostly found in cavities of tree trunk, old walls, inside the termite mounds and subterranean cavities (Eltz et al 2003, Roubik 2006).

Rasmussen (2013) studied the distribution of stingless bees throughout the Indian subcontinent and concluded that stingless bees are available in most parts of the Indian subcontinent, except at higher elevations or the drier interior regions. The author found nine species of stingless bees in Indian subcontinent viz *Lepidotrigona arcifera* Cockerell,

Lisotrigona cacciae Nurse, *L mohandasi* Jobiraj and Narendran, *Tetragonula* aff *laeviceps* Smith, *T bengalensis* Cameron, *T gressitti* Sakagami, *T iridipennis* Smith, *T praeterita* Walker and *T ruficornis* Smith.

The distribution pattern of stingless bees in India was studied by Rahman et al (2015) who reported different species of stingless bees prevalent in south India viz *Tetragonula iridipennis*, *T laeviceps* and *Lepidotrigona arcifera*. *T iridipennis* and *T laeviceps* were present in the northwestern India. Likewise, from Kerala, two stingless bees are mainly reported viz *T iridipennis* by Raakhee and Devanesan (2000) and *Lisotrigona mohandasi* by Jobiraj and Narendran (2004). In northeastern India, five species were reported by Rahman et al (2015) viz *T bengalensis, T iridipennis, T ruficornis, T laeviceps* and *Lepidotrigona arcifera*. From Anurachal Pradesh, *Lepidotrigona arcifera* Cockrell was recorded. However in 2013, *T gressitti* was also observed in Arunachal Pradesh but the sample size was very small (Rathor et al 2013). In Nagaland, Singh (2016) has observed three species viz *Tetragonula irridipenis, T laviceps* and *Lophotrigona canifrons.* However, later on five stingless bee species were reported viz *Tetragonula iridipennis, L ventralis, T laeviceps*, *L arcifera* and *Lophotrigona canifrons* (Chauhan et al 2019). In 2021, *Tetragonula gressitti* was added to the list (Chauhan and Singh 2021). At the same time, reports of stingless bee, *T iridipennis* was coming from Punjab, Haryana, Uttarakhand, Delhi and central India (Choudhary et al 2021). However, the presence of stingless bees in Himachal Pradesh was still not explored.

Hibiscus rosa chinensis belongs to Malvaceae having perfect flowers with distinguished style and anthers and is an important floral source for insects including bees. It is known to act both as nectar and pollen source. More than 300 species of it are spread in tropical and subtropical parts of the globe (Barrows 2011) and are mostly pollinated by biological agents especially bees (Spira 1989). The plant flowers mainly from October to January but sporadic flowering is observed round the year thus making it an important floral source for pollinators (Aluri et al 2020).

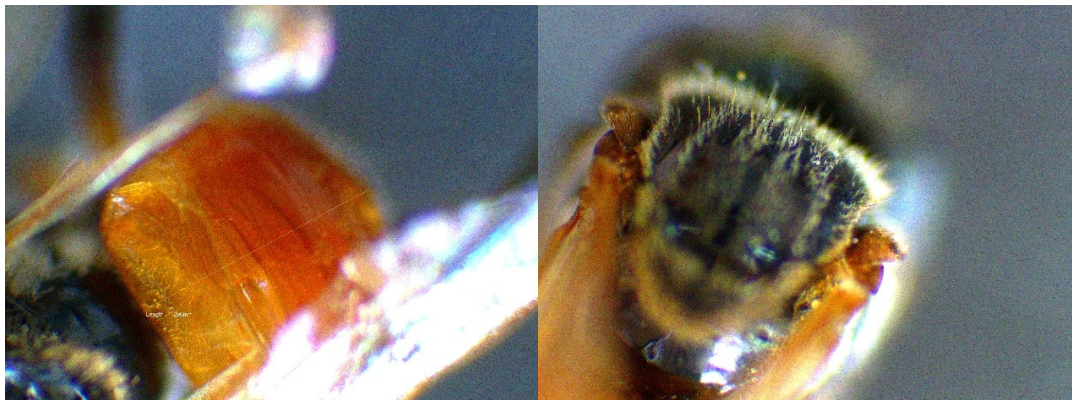
Keeping in view the importance of location of stingless bees in Himachal Pradesh and their resource partitioning with other anthophiles, present study was undertaken to know the availability of stingless bees and their share in resource distribution. Insect complex on *Hibiscus rosa chinensis* was also explored to know the importance of this flora for the bees.

MATERIAL and METHODS

The study was carried out in Solan and Shimla districts of Himachal Pradesh. A survey was conducted in different parts of Solan (Ramshehar and Nalagarh hills) and Shimla (Kufri, Narkanda and Kotgarh) districts during July 2023. The samples were collected with the help of insect collection net during the day time (1100-1300 h). The specimens of collected bees were preserved as dry and wet in 70 per cent ethyl alcohol for further identification at the apiculture laboratory of School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema, Nagaland. The different morphological and morphometrical parameters were studied for the identification of stingless bees. The samples were also sent to Indian Agricultural Research Institute, New Delhi for confirmation of identification. The diversity of different anthophiles on *Hibiscus rosa chinensis* was recorded for three consecutive days from early morning to late evening hours (0500 – 1900 h) at two hours interval. Abundance of different visitors was recorded. The Shannon-Weiner diversity index was also calculated as per Chauhan et al (2019).

RESULTS

A total of 43 samples of stingless bees were collected from two major flora from Ramshehar area of Solan district. Foragers were also seen foraging on crops in Nalagarh and Kunihar region of the district. However, in Shimla district (Narkanda, Kufri, Dhalli and Kotgarh), stingless bees were not found. Out of the total collected samples, 20 samples were used for morphometric and morphological studies while 10 were sent to Indian Agricultural Research Institute, New Delhi and others were kept preserved for future references. The specimens of foraging stingless bees collected from Canna lily (*Canna indica*) and China rose (*Hibiscus rosa chinensis*) (Plate 1) were identified as *Tetragonula iridipennis* Smith on morphological and morphometrical studies. The bees were having yellowish brown coloured abdomen with body clearly divided into head, thorax and abdomen. The total body length varied between 4.09-4.11 mm. The head and mesosoma was black, metasoma



A. Yellowish brown abdomen B. Thorax with sparse hair

C. Antennae and compound eyes D. Hind leg

Plate 1. Different body parts of *Tetragonula iridipennis*

brownish, antenna brownish, legs brownish black, the head devoid of pubescence and mesosomal pleuron with brownish short keirotrichia. The head length was 1.25-1.26 mm while the compound eyes were 1.06-1.07 mm in length. The distance between two antennal lobes was 0.169-0.170 mm. The length of scape, pedicel and flagellum was 0.523, 0.119 and 1.134 mm respectively. The total number of flagellomeres was 10 and total hamuli were 5 in number. The wing length (forewing and hindwing) was recorded as 3.738-3.741 and 2.475-2,477 mm while the width was 1.381-1.383 and 0.672-0.673 mm respectively.

Resource partitioning

The anthophiles recorded visiting *H rosa chinensis* were stingless bees (*Tetragonula iridipennis, Bombus haemorrhoidalis, Apis dorsata, A cerana, A florea*, *Ceratina* sp, *Episyrphus balteatus*, *Metasyrphus confrator*, *Megachile dysjuncta*, *Lasioglossum* sp, *Pieris brassicae* and ants (Plate 2). The Shanon Weiner's diversity index was found to be 1.97 which depicted a higher diversity of anthophiles in the region. The relative abundance of *Apis cerana*, *A dorsata*, *A florea*, *Tetragonula iridipennis*, *Bombus haemorrhoidalis*, syrphids (*Episyrphus* and *Metasyrphus*), *Megachile dysjuncta, Ceratina* sp and *Lasioglossum* sp was 4.22 bees/10 minutes, 3.00 bees/10 minutes, 2.67 bees/10 minutes, 4.00 bees/10 minutes, 3.67 bees/10 minutes, 2.33 flies/10 minutes, 0.67 bees/10 minutes, 1.33 bees/10 minutes and 0.67 bees/10 minutes respectively. Ants, butterflies and houseflies were the least frequent visitors while honeybees, stingless bees, bumble bees were the most frequent insect visitors. Similarly, *Ceratina, Lasioglossum* sp and megachilids were frequent visitors. The availability of nectar and pollen in China rose attracts number of insect visitors thus making it one of the important bee flora. During the study, it was found that the highest number of foragers belonged to order Hymenoptera (84%) followed by Diptera (14%). The major visitor family was Apidae followed by Muscidae.

DISCUSSION

Stingless bee, *T iridipennis* Smith was recorded from Solan district (Ramshehar, Kunihar and Nalagarh area) that established the presence of

A. ***Bombus haemorrhoidalis*** **B.** ***Lasioglossum*** **sp** **C.** ***Apis dorsata***

D. **E.** **F.**

D-F: ***Tetragonula iridipennis*** **visiting on** ***Canna indica*** **and** ***Hibiscus rosa chinensis***

G. ***Apis cerana***

Plate 2. Different bee visitors on ***Hibiscus rosa chinensis*** **and** ***Canna indica***

stingless bees in low-hill regions of Himachal Pradesh. The body colour of the workers of *T iridipennis* was yellowish brown and total length ranged between 4.09-4.11 mm. The different body parameters revealed similarity with the description of *T iridipennis* by other workers (Makar et al 2016, Chauhan and Singh 2021, Choudhary et al 2021). They were reported to have yellow brownish coloured body with total length ranging from 3.6 to 4.10 mm. In Nepal, *T iridipennis*, which is the only species of stingless bee present there, is used for extraction of honey and cerumen and is culturally very important in the daily life of people (Bhatta et al 2020).

In Nagaland, the honey and other products derived from *T iridipennis* are used in different religious and cultural ceremonies (Singh 2016). Several reports of presence of *T iridipennis* and its use for

honey extraction and pollination are documented from West Bengal, Arunachal Pradesh, Assam, Orrisa, Karnataka, Tamil Nadu, Kerala, Gujarat, Maharastra, Madhya Pradesh, Uttar Pradesh, Punjab, Uttarakhand and Haryana (Anon 2023, Chauhan and Singh 2022). Stingless bees are highly evolved social insects and live in colonies like honeybees. They are important pollinators of many crops and hey provide hive products like honey, wax and cerumen of high medicinal value.

The relative abundance of different insect visitors on *H rosa chinensis* disclosed its importance as bee flora in sustaining the natural bee population of these areas. Stingless bees, honeybees, bumble bees and other solitary wild bees along with some dipterans are frequent visitors of this flora. The higher diversity index (1.97) disclosed the species richness of these areas and the association of important vegetation in these regions which is required to be conserved.

The stingless bees are important visitors of many ornamental, medicinal, vegetable and fruit crops (Bueno et al 2023, Sangma et al 2022, Chauhan and Singh 2021, Singh and Chauhan 2020, Singh 2016). Similarly, bumble bees visit a number of crops (Chauhan 2011, 2015, Chauhan et al 2014). *Apis dorsata*, *A florea* and *A cerana* are pollinators of numerous crops (Ali et al 2017).

The data on the abundance, nesting attributes, floral preferences, pollination and conservation of stingless bees are inadequate in Himachal Pradesh.

The report of presence of stingless bee, *T iridipennis* in Solan district of Himachal Pradesh will help in opening of new avenues of research in rearing, conservation and its management. The species diversity needs to be investigated in Himachal Pradesh. Further new collections are required from other parts of Himachal Pradesh to ascertain the habitat preference of this species which in turn would assist in making rearing protocols and potential commercial rearing of this pollinator.

ACKNOWLEDGEMENT

The authors are thankful to Project Coordinator, All India Coordinated Research Project on Honeybees and Pollinators, Indian Council of Agricultural Research, New Delhi for providing financial support for this study.

REFERENCES

Ali M, Sajjad A and Saeed S 2017. Yearlong association of *Apis dorsata* and *Apis florea* with flowering plants: planted forest vs agricultural landscape. Sociobiology **64(1):** 18-25.

Aluri JSR, Kunuku VR, Chappidi PR and Kammarchedu BJP 2020. Pollination ecology of *Hibiscus tiliaceus* L (Malvaceae), an evergreen tree species valuable in coastal and inland eco-restoration. Transylvanian Review of Systematical and Ecological Research **22(2):** 47-56.

Anonymous 2023. Annual report 2023. All India Coordinated Research Project on Honeybees and Pollinators, Indian Council of Agricultural Research, New Delhi, India.

Barrows EM 2011. Animal behaviour desk reference – a dictionary of animal behaviour, ecology and evolution. 3rd Edn, CRC Press, Bora Raton, Florida, 800p.

Bhatta C, Gonzalez VH and Smith D 2020. Traditional uses and relative cultural importance of *Tetragonula iridipennis* Smith (Hymenoptera: Apidae: Meliponini) in Nepal. Journal of Mellitology **97:** 1-13.

Bradbear N 2009. Bees and their role in forest livelihoods – a guide to the services provided by bees and the sustainable harvesting, processing and marketing of their products. Food and Agriculture Organization of the United Nations, Rome, Italy, 194p.

Bueno FGB, Kendall L, Alves DA, Tamara ML, Heard T, Latty T and Gloag R 2023. Stingless bee floral visitation in the global tropics and subtropics. Global Ecology and Conservation, Vol 43, 13p.

Chauhan A 2011. Refinement of bumble bee rearing technology and its use in cucumber pollination. MSc Thesis, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India, 97p.

Chauhan A 2015. Studies on pests and diseases of bumble bee (*Bombus haemorrhoidalis* Smith). PhD Thesis, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India, 119p.

Chauhan A and Singh HK 2021. Nest architecture of stingless bee, *Tetragonula gressitti* Sakagami from Nagaland, India. International Journal of Tropical Insect Science **41(1):** 3099-3104.

Chauhan A and Singh HK 2022. Stingless bees – an unexplored pollinator in India. Indian Council of Agricultural Research, New Delhi, India, 162p.

Chauhan A, Rana BS and Katna S 2014. Successful rearing of bumble bee, *Bombus haemorrhoidalis* Smith year-

round in Himachal Pradesh in India. International Journal of Current Research **6(12):** 10891-10896.

Chauhan A, Singh HK and Kumaranag KM 2019. Pollination potential of stingless bee *Tetragonula iridipennis* Smith in ash gourd. Indian Journal of Entomology **81(4):** 854-859.

Choudhary A, Singh J and Chhuneja PK 2021. Nest architecture and nesting site preference of *Tetragonula iridipennis* Smith in northwestern plains of India. Journal of Apicultural Sciences **65(1):** 1-11.

Eltz T, Brühl CA, Imiyabir Z and Linsenmair KE 2003. Nesting and nest trees of stingless bees (Apidae: Meliponini) in lowland dipterocarp forests of Sabah, Malaysia, with implications for forest management. Forest Ecology and Management **172(2-3):** 301-313.

Jobiraj T and Narendran TC 2004. Revised key to the world species of *Lisotrigona moure* (Hymenoptera: Apoidea: Apidae) with description of a new species from India. Entomon **29(1):** 39-43.

Makkar GS, Chhuneja P and Singh J 2016. Stingless bee, *Tetragonula iridipennis* Smith, 1854 (Hymenoptera: Apidae: Meliponini): molecular and morphological characterization. Proceedings of the National Academy of Sciences, India, Section B: Biological Sciences **88(1):** 83-89.

Raakhee M and Devanesan S 2000. Studies on the behaviour of stingless bee, *Trigona iridipennis* Smith (Apidae: Meliponinae). Indian Bee Journal **62(4):** 59-62.

Rahman A, Das PK, Rajkumari P, Saikia J and Sharmah D 2015. Stingless bees (Hymenoptera: Apidae: Meliponini): diversity and distribution in India. International Journal of Science and Research **4(1):** 77-81.

Rasmussen C 2013. Stingless bees (Hymenoptera: Apidae: Meliponini) of the Indian subcontinent: diversity, taxonomy and current status of knowledge. Zootaxa **3647(3):** 401-428.

Rathor VS, Rasmussen C and Saini MS 2013. New record of the stingless bee *Tetragonula gressitti* from India (Hymenoptera: Apidae: Meliponini). Journal of Melittology **7:** 1-5.

Roubik DW 1989. Ecology and natural history of tropical bees. Cambridge University Press, Cambridge, UK, 514p.

Roubik DW 2006. Stingless bee nesting biology. Apidologie **37:** 124-143.

Sangma RHC, Pongen A, Bendangsenla and Singh HK 2022. Stingless bee flora in foothills of Nagaland. Pharma Innovation **11(Special Issue 9):** 2935-2941.

Singh AK 2016. Traditional meliponiculture by Naga tribes in Nagaland, India. Indian Journal of Traditional Knowledge **15(4):** 693-699.

Singh HK and Chauhan A 2020. Beekeeping in Nagaland with stingless bees: present and future. RASSA Journal of Science for Society **2(1):** 41-45.

Spira T 1989. Reproductive biology of *Hibiscus moscheutos* (Malvaceae). In: The evolutionary ecology of plants (JH Bock and YB Linhart, Eds), Westview Press, Boulder, Colorado, pp 247-255.