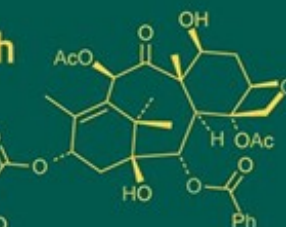


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): NAAS
Rating (2026): 5.29
Indexing: Embase
IJABR 2026; SP 10(9): 1465-1471
www.biochemjournal.com
Received: 18-06-2026
Accepted: 21-07-2026
Published: 17-9-2026

MJ Manjunatha

Department of Entomology,
University of Agricultural
Sciences, Raichur – 584104,
Karnataka, India

Raghavendra Yaligar

ICAR- Krishi Vigyan Kendra,
Koppal – 583227, Karnataka,
India

PR Badariprasad

Agriculture Extension
Education Centre, Koppal –
583231, Karnataka, India

AG Sreenivas

University of Agricultural
Sciences, Raichur – 584104,
Karnataka, India

Srikanth Barkeer

College of Agriculture, Hagari
– 583111, Karnataka, India

Month-wise floral calendar of *Tetragonula iridipennis* (Smith, 1854) at Agriculture Research Station, Gangavathi, Karnataka, India

MJ Manjunatha¹, Raghavendra Yaligar², PR Badariprasad³, AG Sreenivas⁴, Srikanth Barkeer⁵

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i9Sr.10029>

ABSTRACT

A systematic field survey was conducted from 1 November 2025 to 31 March 2026 (151 days) within a 500 m foraging radius of the apiary at Agricultural Research Station (ARS), Gangavathi, Koppal district, Karnataka, to document the floral resources exploited by the Dammar bee, *Tetragonula iridipennis* (Smith, 1854). A total of 108 plant species belonging to 48 plant families were recorded as bee pasture plants through bi-weekly roving observation surveys. Fabaceae (17 species; 15.74%) was the dominant family, followed by Asteraceae (10 species; 9.26%) and Solanaceae and Apocynaceae (5 species each; 4.63%). Sixteen plant species demonstrated year-round blooming, ensuring perennial forage continuity. The major honey flow period spans October through February and a secondary flow occurs during March–April. The critical dearth period was identified from mid-May through mid-August, coinciding with extreme heat and peak monsoon rainfall that suppress foraging. The constructed month-wise pollen and floral calendar provides a practical decision-support tool for stingless bee colony management, apiary site selection and bee pasture augmentation in the semi-arid agro-ecological zone of northern Karnataka.

Keywords: Stingless bee, *Tetragonula iridipennis*, Bee pasture, Floral calendar, Pollen calendar, Meliponiculture, Karnataka

Introduction

Stingless bees (*Hymenoptera: Apidae*; tribe *Meliponini*) are the most species-rich group of social bees and are ecologically important pollinators across tropical and subtropical ecosystems worldwide (Engel *et al.*, 2023; Wille, 1983) [1, 2]. In peninsular India, *Tetragonula iridipennis* (Smith, 1854), commonly known as the Dammar bee, is the most widely distributed and commercially reared meliponine species. Meliponiculture has gained considerable momentum in Karnataka, Tamil Nadu and Kerala owing to the high medicinal and nutraceutical value of its honey (Rasmussen, 2013; Sabatina *et al.*, 2024; Slaa *et al.*, 2006) [3, 4, 5].

The foraging behaviour of *T. iridipennis* is governed by the availability, diversity and phenological succession of floral resources within its effective foraging radius, typically constrained to 500 m in small-bodied meliponines (Bisui *et al.*, 2019; Layek *et al.*, 2018; Layek *et al.*, 2024) [6, 7, 8]. A detailed knowledge of the local bee pasture is therefore a prerequisite for productive meliponiculture and for scheduling colony management interventions such as supplementary feeding, colony splitting and honey extraction (Sabatina *et al.*, 2024; Sabatina *et al.*, 2025; Sheetal *et al.*, 2025) [4, 9, 10].

Pollen and floral calendars are tabular or graphical representations integrating field-observed flowering phenology to depict the temporal availability of pollen and nectar for bees across the annual cycle. Such calendars have been employed in apicultural research to identify honey flow and dearth periods, to guide migratory beekeeping and to plan bee pasture improvement (Nalini *et al.*, 2024; Rani *et al.*, 2026; Waykar *et al.*, 2015) [11, 12, 13]. However, species-specific calendars for *T. iridipennis* remain sparse for the semi-arid agro-ecological conditions of northern Karnataka (Moulyya *et al.*, 2023; Sheetal *et al.*, 2025; Vamshikrishna *et al.*, 2021) [14, 10, 15].

The Agricultural Research Station (ARS), Gangavathi, maintained by the University of Agricultural Sciences, Raichur, hosts an active meliponiculture programme, making it an ideal site for systematic bee pasture documentation. The present study was designed to (1) enumerate and identify plant species visited by *T. iridipennis* foragers within the 500 m apiary radius; (2) characterise seasonal foraging patterns and construct a month-wise pollen and floral calendar; and (3) delineate honey flow and dearth periods to support evidence-based colony management.

Corresponding Author:**MJ Manjunatha**

Department of Entomology,
University of Agricultural
Sciences, Raichur – 584104,
Karnataka, India

Materials and methods

Study site: The study was conducted at Agriculture Research Station (ARS), Gangavathi (15°25'N, 76°31'E; ~385 m asl), Koppal district, Karnataka, India. The site experiences a semi-arid climate with mean annual rainfall of approximately 580–620 mm distributed across two monsoon seasons. Temperatures range from 15–22 °C in December–January to 36–42 °C in April–May. The apiary housed colonies of *T. iridipennis* in traditional clay pots and wooden log hives. The landscape within a 500 m radius comprised experimental crop plots, avenue plantations, kitchen gardens, ornamental beds and patches of scrub vegetation.

Study period and seasonal coverage

Floral resource surveys and corbicular pollen sampling were carried out continuously from 1 November 2025 to 31 March 2026 (151 days), spanning the cool-dry phase (November 2025–January 2026) and the transitional phase (February–March 2026).

Field survey design: A roving observation survey was conducted within a 500 m radius of the apiary (Bisui *et al.*, 2019; Layek *et al.*, 2024) [6, 8]. Surveys were undertaken twice per week, yielding approximately 43 survey events. Observations were carried out on rain-free days with calm to light wind conditions, between 08:00 and 17:00 h, with concentrated effort during the two documented foraging peaks of *T. iridipennis*: 10:00–12:00 h and 14:00–16:00 h (Bharath *et al.*, 2020) [16]. A plant species was scored as a bee forage plant only when at least three foragers were observed simultaneously visiting its flowers within a 10-minute observation window (Waykar *et al.*, 2015) [13].

Plant identification

All plants visited by foragers were identified to species level by consulting a resident botanist and cross-referencing regional floristic literature, authenticated pictorial field guides and online databases including the Botanical Survey of India and Digital Flora of Karnataka. Nomenclature follows the World (Flora Online) [17].

Floral calendar construction

A month-wise floral and pollen calendar was constructed by integrating field observation records (November 2025–March 2026) with published phenological data for plants flowering outside the survey window. Flowering intensity was recorded on a two-point scale: peak bloom (●; abundant flowering suitable for sustained foraging) and occasional bloom (○; sparse flowering, limited foraging potential) (Rijal *et al.*, 2018; Waykar *et al.*, 2015) [18, 13]. Honey flow and dearth periods were delineated based on monthly peak-bloom species count (Kumar *et al.*, 2013; Waykar *et al.*, 2015) [19, 13].

Results

A total of 108 plant species distributed across 48 families were documented as bee pasture plants of *T. iridipennis* within the 500 m foraging radius at ARS, Gangavathi (Table 1). The collective pool comprised cultivated crops (36 species; 33.33%), ornamental plants (24 species; 22.22%), roadside/plantation trees (22 species; 20.37%), wild and weedy species (18 species; 16.67%) and medicinal plants (8 species; 7.41%).

Fabaceae was the most species-rich family with 17 species (15.74%), followed by *Asteraceae* (10 species; 9.26%), *Solanaceae* and *Apocynaceae* (5 species each; 4.63%), *Cucurbitaceae* (5 species; 4.63%) and *Lamiaceae* and *Euphorbiaceae* (4 species each; 3.70%). The ten dominant families collectively accounted for approximately 53.70% of the total bee pasture flora (Table 2).

The month-wise pollen and floral calendar reveals four overlapping seasonal phases:

Cool-dry phase (November–January): This phase recorded the highest species richness in bloom (65–72 species), with dominant contributors including *Leucaena leucocephala*, *Senna auriculata*, *Sesbania grandiflora*, *Tagetes erecta*, *Chrysanthemum indicum*, *Millingtonia hortensis*, *Cajanus cajan*, *Sorghum bicolor*, *Moringa*

oleifera and *Eucalyptus globulus*. This is the primary honey flow season for *T. iridipennis* colonies at the study site.

Transitional phase (February–March): Pre-summer flowering is characterised by early-season crops (*Brassica juncea*, *Coriandrum sativum*, *Anethum graveolens*) and prominent bloom of *Mangifera indica*, *Azadirachta indica*, *Delonix regia*, *Samanea saman* and *Terminalia catappa*. Species richness remains moderate (50–60 species), providing a secondary honey flow period.

Pre-monsoon/summer phase (April–June): High ambient temperatures (> 40 °C), scarce soil moisture and wilting of annual vegetation reduce peak-bloom species to 20–30 per month. Canopy bloomers (*Peltophorum pterocarpum*, *Cassia javanica*, *Lagerstroemia speciosa*) and perennial ornamentals (*Turnera ulmifolia*, *Hamelia patens*, *Duranta erecta*) provide critical forage bridges.

Monsoon phase (July–September): Monsoon rains stimulate flowering of crops (*Vigna spp.*, *Eleusine coracana*, *Pennisetum glaucum*, *Sesamum indicum*, *Cucurbita moschata*, *Momordica charantia*), partially replenishing forage. However, sustained heavy rainfall restricts foraging hours, rendering this a secondary dearth period despite moderate species richness (40–50 species).

Sixteen plant species demonstrated year-round peak or near-continuous blooming: *Callistemon lanceolatus*, *Calotropis gigantea*, *Canna indica*, *Capsicum annuum*, *Carica papaya*, *Catharanthus roseus*, *Cocos nucifera*, *Duranta erecta*, *Euphorbia milii*, *Hamelia patens*, *Hibiscus rosa-sinensis*, *Musa paradisiaca*, *Muntingia calabura*, *Roystonea regia*, *Solanum lycopersicum* and *Solanum melongena*. *Muntingia calabura* was the most heavily visited year-round forage plant, with foragers recorded across all survey days and observation hours.

Discussion

The documentation of 108 plant species across 48 families as bee pasture resources of *T. iridipennis* at ARS, Gangavathi highlights the remarkable floral breadth exploited by this generalist forager in a semi-arid agro-ecosystem. This species richness is comparable to figures from similar surveys for *Apis* species in subtropical India, where studies typically enumerate 60–130 bee forage species (Rani *et al.*, 2026; Waykar *et al.*, 2015) [12, 13] and for stingless bees at other Karnataka sites (Mouly *et al.*, 2023; Sheetal *et al.*, 2025) [14, 10]. The higher-than-expected richness at a semi-arid site is attributable to the mosaic land use of ARS, which juxtaposes experimental crop plots, plantation rows, ornamental gardens and natural scrub, each contributing complementary bloom windows (Bisui *et al.*, 2021; Ponnuchamy *et al.*, 2014) [20, 21].

The dominance of *Fabaceae* is consistent with its ecological prominence in tropical and subtropical apicultural landscapes across India (Mouly *et al.*, 2023; Rani *et al.*, 2026; Sheetal *et al.*, 2025) [14, 12, 10]. This family's diverse growth forms from large forest trees (*Pongamia pinnata*, *Delonix regia*) to annual crops (*Cajanus cajan*, *Vigna spp.*) ensure representation across habitats and seasons. The consistent foraging preference for Fabaceous species may reflect the protein-rich pollen of this family, which supports colony development and brood production in meliponines (Brodschneider *et al.*, 2010; Slaa *et al.*, 2006) [22, 5].

The major honey flow period (October–February) has direct practical significance for meliponiculture management. Colony operations including expansion to new boxes, colony splitting and primary honey harvest should be scheduled within this window (Keller *et al.*, 2005) [23]. The critical dearth period (mid-May to mid-August) demands proactive management: supplementary feeding should be initiated by mid-April (Brodschneider *et al.*, 2010; Keller *et al.*, 2005) [22, 23].

The sixteen year-round bloomers particularly *Muntingia calabura*, *Calotropis gigantea*, *Lantana camara*, *Hibiscus rosa-sinensis* and *Musa paradisiaca* function as keystone forage anchors sustaining baseline colony survival during climatically unfavourable periods (Bharath *et al.*, 2020; Sabatina *et al.*, 2025) [16, 9]. The comparative analysis with studies in Maharashtra (Waykar *et al.*, 2015) [13], Karnataka (Mouly *et al.*, 2023; Nalini *et al.*, 2024; Sheetal *et al.*,

2025) [14, 11, 10] and Uttar Pradesh (Rani *et al.*, 2026) [12] reveals shared dominant families (*Fabaceae*, *Asteraceae*, *Apocynaceae*) pointing to pan-Indian patterns in stingless bee forage preferences (Ponnuchamy *et al.*, 2014) [21]. The stronger contribution of *Areaceae* (*Cocos nucifera*, *Phoenix sylvestris*, *Roystonea regia*) at the semi-arid Gangavathi site reflects the greater prevalence of palm cultivation in peninsular Karnataka (Vijayakumar *et al.*, 2016) [24]. The 151-day survey window covers the primary foraging season. Future work should extend to a full twelve months, particularly covering the monsoon months (July–September) when crop-related floral resources bloom and when the actual foraging response of *T. iridipennis* to rain-interrupted conditions can be directly quantified. Palynological analysis of corbicular pollen loads would further refine species-specific forage preferences and enable construction of a quantitative seasonal pollen spectrum (Bisui *et al.*, 2021; Ponnuchamy *et al.*, 2014) [20, 21].

Conclusion

This study presents the first systematic month-wise pollen and floral calendar for *Tetragonula iridipennis* in the semi-arid agro-ecosystem of northern Karnataka, documenting 108 plant species across 48 fam-

ilies as bee pasture resources at ARS, Gangavathi. *Fabaceae* (15.74%), *Asteraceae* (9.26%) and *Solanaceae*/*Apocynaceae* (4.63% each) dominate the bee pasture flora. Sixteen keystone year-round bloomers ensure perennial forage continuity. The major honey flow period spans October–February and a secondary flow occurs in March–April, representing the optimal windows for colony expansion and honey harvest. The critical dearth period (mid-May to mid-August) requires proactive supplementary feeding. Augmentation of bee pasture with year-round bloomers (*Muntingia calabura*, *Callistemon lanceolatus*, *Hamelia patens*, *Turnera ulmifolia*) within 200–300 m of apiaries is recommended to buffer dearth periods and enhance forage continuity.

Acknowledgements

The authors express sincere gratitude to the Centre of Excellence in Apiculture, CoA, Gangavathi funded by Dept. of IT and BT under VGST program, GoK for providing all the necessary facilities to conduct experiment. Authors are also grateful to the Department of Apiculture, University of Agricultural Sciences, GKVK, Bangalore for assistance in pollen identification studies. The authors declare no conflict of interest.

Table 1. Month-wise pollen and floral calendar of bee pasture plants of *Tetragonula iridipennis* (Smith, 1854) at ARS, Gangavathi, Karnataka

Sl. No.	Botanical Name	Family	Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	<i>Acacia arabica</i> Willd.	<i>Mimosaceae</i>	Wild		○	○		●	●		●	●			
2	<i>Acalypha indica</i> L.	<i>Euphorbiaceae</i>	Weed							●	●	●	●		
3	<i>Ailanthus excelsa</i> Roxb.	<i>Simaroubaceae</i>	Roadside	●	●									●	
4	<i>Albizia amara</i> (Roxb.) Boivin	<i>Fabaceae</i>	Forest			○	●	●	●	○					
5	<i>Allium cepa</i> L.	<i>Alliaceae</i>	Cultivated	●	●	●									○
6	<i>Amaranthus spinosus</i> L.	<i>Amaranthaceae</i>	Weed					○	○		●	●	●		
7	<i>Anethum graveolens</i> L.	<i>Apiaceae</i>	Cultivated	●	●									●	
8	<i>Antigonon leptopus</i> Hook. & Arn.	<i>Polygonaceae</i>	Ornamental							●	●	●	●	●	
9	<i>Azadirachta indica</i> A. Juss.	<i>Meliaceae</i>	Roadside		●	●	●								
10	<i>Barleria cristata</i> L.	<i>Acanthaceae</i>	Wild	○							●	●	●	●	
11	<i>Bidens pilosa</i> L.	<i>Asteraceae</i>	Weed	○							●	●	●	●	
12	<i>Boerhavia diffusa</i> L.	<i>Nyctaginaceae</i>	Medicinal					○	○		●	●	●		
13	<i>Brassica juncea</i> (L.) Czern.	<i>Brassicaceae</i>	Cultivated	●	●								○	●	
14	<i>Cajanus cajan</i> (L.) Millsp.	<i>Fabaceae</i>	Cultivated	●	●						●	●	●		
15	<i>Callistemon lanceolatus</i> DC.	<i>Myrtaceae</i>	Ornamental	●	●	●	●	●	●	●	●	●	●	●	
16	<i>Calotropis gigantea</i> L.	<i>Apocynaceae</i>	Wild	●	●	●	●	●	●	●	●	●	●	●	
17	<i>Canna indica</i> L.	<i>Cannaceae</i>	Ornamental	●	●	●	●	●	●	●	●	●	●	●	
18	<i>Capsicum annuum</i> L.	<i>Solanaceae</i>	Cultivated	●	●	●	●	●	●	●	●	●	●	●	
19	<i>Carica papaya</i> L.	<i>Caricaceae</i>	Cultivated	●	●	●	●	●	●	●	●	●	●	●	
20	<i>Cassia javanica</i> L.	<i>Fabaceae</i>	Roadside			●	●	●							
21	<i>Casuarina equisetifolia</i> L.	<i>Casuarinaceae</i>	Plantation	●	○							○	●	●	
22	<i>Catharanthus roseus</i> (L.) G. Don	<i>Apocynaceae</i>	Ornamental	●	●	●	●	●	●	●	●	●	●	●	

(continued on next page)

Sl. No.	Botanical Name	Family	Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
23	<i>Chenopodium album</i> L.	<i>Chenopodiaceae</i>	Weed	●	●									●	
24	<i>Chrysanthemum indicum</i> L.	<i>Asteraceae</i>	Ornamental	●								●	●	●	
25	<i>Citrus aurantiifolia</i> (Christm.) Swingle	<i>Rutaceae</i>	Cultivated	●	●	○					○	○			
26	<i>Cleome viscosa</i> L.	<i>Cleomaceae</i>	Weed					○	○		●	●	●		
27	<i>Cocos nucifera</i> L.	<i>Areaceae</i>	Cultivated	●	●	●	●	●	●	●	●	●	●	●	
28	<i>Combretum indicum</i> (L.) DeFilipps	<i>Combretaceae</i>	Climber					○	●	●	●	○			
29	<i>Coriandrum sativum</i> L.	<i>Apiaceae</i>	Cultivated	●	●									●	
30	<i>Cosmos sulphureus</i> Cav.	<i>Asteraceae</i>	Ornamental								●	●	●	●	●
31	<i>Crinum asiaticum</i> L.	<i>Amaryllidaceae</i>	Ornamental					●	●	●	●				
32	<i>Cucumis sativus</i> L.	<i>Cucurbitaceae</i>	Cultivated	○	○	○					●	●	●		
33	<i>Cucurbita moschata</i> Duchesne	<i>Cucurbitaceae</i>	Cultivated					●	●	●	●	●			
34	<i>Delonix regia</i> (Hook.) Raf.	<i>Fabaceae</i>	Roadside			●	●	●							
35	<i>Duranta erecta</i> L.	<i>Verbenaceae</i>	Ornamental	●	●	●	●	●	●	●	●	●	●	●	●
36	<i>Eleusine coracana</i> (L.) Gaertn.	<i>Poaceae</i>	Cultivated								●	●	●		
37	<i>Eucalyptus globulus</i> Labill.	<i>Myrtaceae</i>	Plantation	●								●	●	●	
38	<i>Euphorbia milii</i> Des Moul.	<i>Euphorbiaceae</i>	Ornamental	●	●	●	●	●	●	●	●	●	●	●	●
39	<i>Gaillardia pulchella</i> Foug.	<i>Asteraceae</i>	Ornamental			●	●	●	●	●	●	●			
40	<i>Grevillea robusta</i> A.Cunn. ex R.Br.	<i>Proteaceae</i>	Roadside		○	●	●	○							
41	<i>Hamelia patens</i> Jacq.	<i>Rubiaceae</i>	Ornamental	●	●	●	●	●	●	●	●	●	●	●	●
42	<i>Helianthus annuus</i> L.	<i>Asteraceae</i>	Cultivated	●	●	●					●	●	●		
43	<i>Hibiscus rosa-sinensis</i> L.	<i>Malvaceae</i>	Ornamental	●	●	●	●	●	●	●	●	●	●	●	●
44	<i>Holarrhena pubescens</i> Wall. ex G.Don	<i>Apocynaceae</i>	Forest			●	●	●	○						
45	<i>Hylocereus undatus</i> (Haw.) Britton & Rose	<i>Cactaceae</i>	Cultivated					○	●	●	●	○			
46	<i>Impatiens balsamina</i> L.	<i>Balsaminaceae</i>	Wild					○	○		●	●	●		
47	<i>Indigofera tinctoria</i> L.	<i>Fabaceae</i>	Wild								○	●	●	●	○
48	<i>Ixora arborea</i> Roxb. ex Sm.	<i>Rubiaceae</i>	Ornamental		●	●	●	●							
49	<i>Jacaranda mimosifolia</i> D.Don	<i>Bignoniaceae</i>	Roadside		●	●									
50	<i>Jasminum auriculatum</i> Vahl	<i>Oleaceae</i>	Ornamental		●	●	●	●	●						
51	<i>Jatropha curcas</i> L.	<i>Euphorbiaceae</i>	Roadside					○	○		●	●			
52	<i>Lagerstroemia speciosa</i> (L.) Pers.	<i>Lythraceae</i>	Roadside		●	●	●	●							
53	<i>Lantana camara</i> L.	<i>Verbenaceae</i>	Weed	●	●	○	○	●	●	●	●	●	●	●	●

(continued on next page)

Sl. No.	Botanical Name	Family	Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
54	<i>Lawsonia inermis</i> L.	<i>Lythraceae</i>	Cultivated		●	●	●	●	●						
55	<i>Leucaena leucocephala</i> (Lam.) de Wit	<i>Fabaceae</i>	Plantation	○	○	○	○	○	○	○	○	●	●	●	●
56	<i>Leucas aspera</i> (Willd.) Link	<i>Lamiaceae</i>	Medicinal	●	○						○	●	●	●	
57	<i>Luffa acutangula</i> (L.) Roxb.	<i>Cucurbitaceae</i>	Cultivated	○	○						●	●	●		
58	<i>Mangifera indica</i> L.	<i>Anacardiaceae</i>	Cultivated	●	●	○									●
59	<i>Manilkara zapota</i> (L.) P.Royen	<i>Sapotaceae</i>	Cultivated	○	●	●			○	●	●	●	○		
60	<i>Millingtonia hortensis</i> L.f.	<i>Bignoniaceae</i>	Roadside									●	●	●	
61	<i>Mimosa pudica</i> L.	<i>Fabaceae</i>	Weed						○	○	●	●	●		
62	<i>Momordica charantia</i> L.	<i>Cucurbitaceae</i>	Cultivated		○	○					●	●	●		
63	<i>Moringa oleifera</i> Lam.	<i>Moringaceae</i>	Cultivated	●	●	●					○	○			●
64	<i>Muntingia calabura</i> L.	<i>Muntingiaceae</i>	Roadside	●	●	●	●	●	●	●	●	●	●	●	●
65	<i>Murraya koenigii</i> (L.) Spreng.	<i>Rutaceae</i>	Cultivated		●	●	●								
66	<i>Murraya paniculata</i> (L.) Jack	<i>Rutaceae</i>	Ornamental		●	●	●	●							
67	<i>Musa paradisiaca</i> L.	<i>Musaceae</i>	Cultivated	●	●	●	●	●	●	●	●	●	●	●	●
68	<i>Nerium oleander</i> L.	<i>Apocynaceae</i>	Ornamental	○	●	●	●	●	●	●	●	○	○	○	
69	<i>Ocimum tenuiflorum</i> L.	<i>Lamiaceae</i>	Medicinal	●	●	●	○	●	●	●	●	●	●	●	●
70	<i>Parthenium hysterophorus</i> L.	<i>Asteraceae</i>	Weed	●	●	○	○	●	●	●	●	●	●	●	●
71	<i>Peltophorum pterocarpum</i> (DC.) Backer	<i>Fabaceae</i>	Roadside				●	●	●	●	●	○			
72	<i>Pennisetum glaucum</i> (L.) R.Br.	<i>Poaceae</i>	Cultivated								●	●	●		
73	<i>Phoenix sylvestris</i> (L.) Roxb.	<i>Areaceae</i>	Wild	●	●	●									○
74	<i>Phyllanthus emblica</i> L.	<i>Phyllanthaceae</i>	Cultivated		●	●	●								
75	<i>Plumeria alba</i> L.	<i>Apocynaceae</i>	Ornamental	○	●	●	●	●	○						
76	<i>Polianthes tuberosa</i> L.	<i>Asparagaceae</i>	Cultivated					●	●	●	●	●			
77	<i>Pongamia pinnata</i> (L.) Pierre	<i>Fabaceae</i>	Roadside			○	●	●	●						
78	<i>Portulaca oleracea</i> L.	<i>Portulacaceae</i>	Weed	○	○	○	○	○	●	●	○	●	●	●	○
79	<i>Prosopis juliflora</i> (Sw.) DC.	<i>Fabaceae</i>	Invasive	●	●	●	●	○	○	○	○	○	○	○	○
80	<i>Psidium guajava</i> L.	<i>Myrtaceae</i>	Cultivated		●	●		○	○						
81	<i>Punica granatum</i> L.	<i>Punicaceae</i>	Cultivated		●	●		●	●			○			
82	<i>Ricinus communis</i> L.	<i>Euphorbiaceae</i>	Wild	●	●	○	○				●	●	●	●	
83	<i>Rosa indica</i> L.	<i>Rosaceae</i>	Ornamental	●	●	●						●	●	●	
84	<i>Roystonea regia</i> (Kunth) O.F.Cook	<i>Areaceae</i>	Ornamental	●	●	●	●	●	●	●	●	●	●	●	●

(continued on next page)

Sl. No.	Botanical Name	Family	Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
85	<i>Rungia pectinata</i> (L.) Nees	<i>Acanthaceae</i>	Medicinal								●	●	●	○	
86	<i>Samanea saman</i> (Jacq.) Merr.	<i>Fabaceae</i>	Roadside		●	●	●	●							
87	<i>Santalum album</i> L.	<i>Santalaceae</i>	Forest		●	●					○	○			
88	<i>Senna auriculata</i> (L.) Roxb.	<i>Fabaceae</i>	Wild	●								●	●	●	
89	<i>Sesamum indicum</i> L.	<i>Pedaliaceae</i>	Cultivated		○	○					●	●			
90	<i>Sesbania grandiflora</i> (L.) Poir.	<i>Fabaceae</i>	Cultivated								●	●	●	●	
91	<i>Simarouba glauca</i> DC.	<i>Simaroubaceae</i>	Plantation	●	●									●	
92	<i>Solanum lycopersicum</i> L.	<i>Solanaceae</i>	Cultivated	●	●	●	●	●	●		●	●	●	●	
93	<i>Solanum melongena</i> L.	<i>Solanaceae</i>	Cultivated	●	●	●	●	●	●		●	●	●	●	
94	<i>Sorghum bicolor</i> (L.) Moench	<i>Poaceae</i>	Cultivated	●	○						●	●	●	●	
95	<i>Syzygium cumini</i> (L.) Skeels	<i>Myrtaceae</i>	Forest		●	●									
96	<i>Tagetes erecta</i> L.	<i>Asteraceae</i>	Ornamental	●	●						●	●	●	●	
97	<i>Tamarindus indica</i> L.	<i>Fabaceae</i>	Roadside			●	●	●							
98	<i>Tecoma stans</i> (L.) Juss. ex Kunth	<i>Bignoniaceae</i>	Ornamental	●	●	○					●	●	●	●	
99	<i>Tectona grandis</i> L.f.	<i>Lamiaceae</i>	Forest					●	●		●	○			
100	<i>Terminalia catappa</i> L.	<i>Combretaceae</i>	Roadside		●	●	●	●							
101	<i>Trachyspermum ammi</i> (L.) Sprague	<i>Apiaceae</i>	Cultivated	●	●									●	
102	<i>Tridax procumbens</i> (L.) L.	<i>Asteraceae</i>	Weed	●	●	○	○	●	●	●	●	●	●	●	
103	<i>Turnera ulmifolia</i> L.	<i>Turneraceae</i>	Ornamental	●	●	●	●	●	●		●	●	●	●	
104	<i>Vigna catjung</i> Walp.	<i>Fabaceae</i>	Cultivated		○	○					●	●			
105	<i>Vigna mungo</i> (L.) Hepper	<i>Fabaceae</i>	Cultivated		○						●	●			
106	<i>Vigna radiata</i> (L.) R. Wilczek	<i>Fabaceae</i>	Cultivated			○					●	●			
107	<i>Zea mays</i> L.	<i>Poaceae</i>	Cultivated	○	○						●	●	●		
108	<i>Ziziphus mauritiana</i> Lam.	<i>Rhamnaceae</i>	Wild			○	○				●	●	●		

(● = Peak bloom; ○ = Occasional bloom)

Table 2. Family-wise species richness and percentage contribution of bee pasture plants of *Tetragonula iridipennis* at ARS, Gangavathi, Karnataka

Family	No. of species	Percentage (%)
<i>Fabaceae</i>	17	15.74
<i>Asteraceae</i>	10	9.26
<i>Solanaceae</i>	5	4.63
<i>Apocynaceae</i>	5	4.63
<i>Cucurbitaceae</i>	5	4.63
<i>Lamiaceae</i>	4	3.70
<i>Euphorbiaceae</i>	4	3.70
<i>Areaceae</i>	3	2.78

Family	No. of species	Percentage (%)
<i>Myrtaceae</i>	3	2.78
<i>Rubiaceae</i>	2	1.85
Others (38 families)	50	46.30
Total	108	100.00

References

- Engel MS, Rasmussen C, Ayala R, de Oliveira FF. Stingless bee classification and biology (*Hymenoptera, Apidae*): a review, with an updated key to genera and subgenera. *ZooKeys*. 2023;1172:239-312.
- Wille A. Biology of the stingless bees. *Annu Rev Entomol*. 1983;28(1):41-64.

3. Rasmussen C. Stingless bees (*Hymenoptera: Apidae: Meliponini*) of the Indian subcontinent: diversity, taxonomy and current status of knowledge. *Zootaxa*. 2013;3647(3):401-428.
4. Sabatina P, Srinivasan MR, Murugan M, Saminathan VR. What makes them masters of survival? Unraveling the intricacies of adaptive thrive of *Tetragonula iridipennis* Smith in the dynamic ecosystems of Tamil Nadu, India. *Sociobiology*. 2024;71(3):e10576.
5. Slaa EJ, Sanchez Chaves LA, Malagodi-Braga KS, Hofstede FE. Stingless bees in applied pollination: practice and perspectives. *Apidologie*. 2006;37(2):293-315.
6. Bisui S, Layek U, Karmakar P. Comparing the pollen forage pattern of stingless bee (*Trigona iridipennis* Smith) between rural and semi-urban areas of West Bengal, India. *J Asia-Pac Entomol*. 2019;22(3):714-722.
7. Layek U, Karmakar P. Nesting characteristics, floral resources and foraging activity of *Trigona iridipennis* Smith in Bankura district of West Bengal, India. *Insectes Soc*. 2018;65(1):117-132.
8. Layek U, Bisui S, Karmakar P. Flight range and resource loading-unloading behavior of stingless bee *Tetragonula iridipennis* (Smith). *J Apic Res*. 2024;63(3):400-411.
9. Sabatina P, Srinivasan MR, Murugan M, Saminathan VR. Sunny days and busy bees: Unveiling the weather-driven foraging patterns of *Tetragonula iridipennis* and their role in tomato pollination. *Environ Sci Pollut Res*. 2025;32(3):1640-1652.
10. Sheetal VK, Basavarajappa S. Floral source to stingless bees in and around the apiaries of meliponiculturists at different districts of *Karnataka*, India. *Int Adv Res J Sci Eng Technol*. 2025;12(1):7-25.
11. Nalini BM, Basavarajappa S. Floral source and pollen calendar of pollinating insects amidst agro-ecosystems of Kodagu district, *Karnataka*, India. *Acta Entomol Zool*. 2024;5(2):202-212.
12. Rani A, Verma S, Buddhe A, Kalkar S. Nectar and pollen diversity in bee foraging ecosystem at Terai Region, Uttar Pradesh, India. *Bioinfollet*. 2026;23(2):143-164.
13. Waykar B, Baviskar RK. Diversity of bee foraging flora and floral calendar of Paithan taluka of Aurangabad district (Maharashtra), India. *J Appl Hortic*. 2015;17(2):155-159.
14. Moulya MR, Jagadish KS, Belavad V, Eswarappa G, Sringswara AN. Diversity of floral resources of stingless bee, *Tetragonula nr. pagdeni* (*Hymenoptera: Apidae: Meliponini*). *Mysore J Agric Sci*. 2023;57(1):152-158.
15. Vamshikrishna N, Vinaykumar MM, Venkateshalu JB, Gopali JB, Ajjappalavara PS, Patil BB, *et al*. Foraging flora of stingless bees, *Tetragonula* spp. in Bagalkot, *Karnataka*, India. *J Exp Zool India*. 2021;24(2):1449-1453.
16. Bharath MP, Chinniah C, Jayaraj J, Suresh K, Balamohan TN, Vellaikumar S. Foraging activity of stingless bee, *Tetragonula iridipennis* Smith (*Hymenoptera: Apidae*) during summer season in Madurai district of Tamil Nadu, India. *J Pharmacogn Phytochem*. 2020;9(1):1144-1148.
17. World Flora Online. World Flora Online Plant List [Internet]. 2025 [cited 2026 Sep]. Available from: <http://www.worldfloraonline.org>
18. Rijal SP, Thapa RB, Sharma MD, Sah SK, GC YD. Bee floral calendar of cultivated and wild plants available in different agro-ecosystems of Chitwan, Nepal. *Int J Res Granthaalayah*. 2018;6(11):222-245.
19. Kumar R, Rajput GS, Mishra RC, Agrawal OP. A study on assessment of duration of dearth period for honey bees in Haryana, India. *Munis Entomol Zool*. 2013;8(1):434-437.
20. Bisui S, Layek U, Karmakar P. Determination of nectar resources through body surface pollen analysis: a study with the stingless bee *Tetragonula iridipennis* Smith (*Apidae: Meliponini*) in West Bengal, India. *Sociobiology*. 2021;68(3):e6173.
21. Ponnuchamy R, Bonhomme V, Prasad S, Das L, Patel P, Gaucherel C, *et al*. Honey pollen: using melissopalynology to understand foraging preferences of bees in tropical South India. *PLoS One*. 2014;9(7):e101618.
22. Brodschneider R, Crailsheim K. Nutrition and health in honey bees. *Apidologie*. 2010;41:278-294.
23. Keller I, Fluri P, Imdorf A. Pollen nutrition and colony development in honey bees: Part II. *Bee World*. 2005;86(1):3-10.
24. Vijayakumar K, Jeyaraaj R. Floral sources for stingless bees in Nellithurai Village, Tamilnadu, India. *Ambient Sci*. 2016;3(2):69-74.
25. Bista S, Shivakoti GP. Honeybee flora at Kabre, Dolakha district. *Nepal Agric Res J*. 2001;4-5:18-25.
26. Das R, Nandi T, Kunal G, Layek A, Jha S. Dearth period pollen foraging pattern by *Apis mellifera* L., *Apis cerana indica* F. and *Tetragonula bengalensis* C. in lower Gangetic alluvium of West Bengal, India: a comparative study. *Int J Trop Insect Sci*. 2024;44(3):1435-1447.
27. Divekar PA, Nebapure S, Majumder S, Verma CK. Floral resources and seasonal dynamics of bee foraging. *Emer Life Sci Res*. 2021;9(2):68-79.
28. Erdtman G. The acetolysis method: a revised description. *Sven Bot Tidskr*. 1960;54:561-564.
29. Layek U, Das N, Kundu A, Karmakar P. Methods employed in the determining nectar and pollen sources for bees: a review of the global scenario. *Ann Entomol Soc Am*. 2022;115(6):417-426.
30. Michener CD. The Bees of the World. 2nd ed. Baltimore: Johns Hopkins University Press; 2007.
31. Roopa AN, Eswarappa G, Sajjanar SM, Gowda G. Study on identification of pasturage sources of stingless bee (*Trigona iridipennis* Smith). *Int J Curr Microbiol Appl Sci*. 2017;6(11):938-943.
32. Singh AK, Jaiswal DK, Singh HK, Thakur RK. Diversity of bees' flora and floral calendar of native honeybees in Nagaland, India. *Adv Life Sci*. 2016;5(6):2285-2292.

How to cite this article: Manjunatha M, Yaligar R, Badariprasad P, Sreenivas A, Barkeer S. Month-wise floral calendar of *Tetragonula iridipennis* (Smith, 1854) at Agriculture Research Station, Gangavathi, *Karnataka*, India. *International Journal of Advanced Biochemistry Research*. 2026;SP 10(9):1465-1471. doi: <https://www.doi.org/10.33545/26174693.2026.v10.i9Sr.10022>