



BEE FORUM 2026



Abstract Proceedings

1st Research Symposium on Apiculture and Melittology



Bee PERA Students' Society
Faculty of Agriculture
University of Peradeniya
Sri Lanka

Proceedings of the 1st Research Symposium on Apiculture and Melittology



***bee* FORUM- 2026**

held in

Faculty of Agriculture
University of Peradeniya
Sri Lanka

8th August 2026

Organized by



bee PERA Society, Faculty of Agriculture
University of Peradeniya
Sri Lanka

1st Research Symposium on Apiculture and Melittology

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Suggested citation

Author(s) name, 2026, Article name. *Proceedings of the 1st Research Symposium on Apiculture and Melittology* held in Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka, 8th August 2026, pp.

Published by:

bee PERA
Faculty of Agriculture
University of Peradeniya
Peradeniya 20400
Sri Lanka

Cover Design by:

G.A.H.H. Godellawaththa

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Message from the Dean



It is my great pleasure to extend my warm greetings on the occasion of Bee Forum 2026, the first research symposium organized by the Bee PERA Society of the Faculty of Agriculture, University of Peradeniya.

The Faculty of Agriculture has always encouraged student-led initiatives that promote academic excellence, innovation, and leadership. Since its establishment in 2023, the Bee PERA Society has grown into one of the leading student societies of the faculty through its dedication to promoting apiculture, research, environmental sustainability, and community engagement. The Society's remarkable achievements were recognized when it was awarded the Best Student Society under the Aquatic Resource Development Project Scholarship 2025, reflecting the commitment and enthusiasm of its members.

The beginning of Bee Forum 2026 marks an important milestone in the Society's journey. This symposium provides an excellent platform for undergraduate students, researchers, academics, and professionals to present original research, exchange scientific knowledge, and explore innovations in apiculture and related disciplines. Such initiatives not only strengthen research culture and scientific communication but also inspire collaboration and innovation for the sustainable development of the beekeeping sector.

I sincerely congratulate the Executive Committee, and the Organizing Committee of the Bee PERA Society for their vision, commitment, and hard work in organizing this landmark event. I also extend my warm congratulations to all presenters whose research reflects their dedication, curiosity, and passion for scientific discovery.

I encourage all participants to actively engage in the symposium, exchange ideas, and make the most of this valuable learning opportunity. I am confident that Bee Forum 2026 will be a successful event that promotes research and innovation in apiculture and related fields.

I wish Bee Forum 2026 every success.

Prof. B.C. Jayawardana

Dean, Faculty of Agriculture
University of Peradeniya

8th August 2026

Message from the Keynote Speaker



It is my great pleasure to be part of BeeFORUM-2026, an important platform for bringing together researchers, academics, students, beekeepers, and other stakeholders interested in honeybee science and sustainable apiculture.

Honeybees play an indispensable role in pollination, biodiversity conservation, food security, livelihoods, and the sustainable development of agricultural systems. At the same time, honeybee populations and beekeeping are increasingly challenged by climate change, habitat loss, pests and diseases, and changing agricultural practices. Addressing these challenges requires innovative research, knowledge sharing, and strong collaboration among scientists and practitioners.

I sincerely commend Bee PERA for organizing BeeFORUM-2026 and creating an opportunity for young researchers and students to present their work, exchange ideas, and build networks. I am particularly pleased to see the wide range of research presented at this forum, covering bee biology and health, pollination, bee products, sustainable beekeeping, and the economics of apiculture. I would also particularly like to express my sincere appreciation to Dr. Wikum Jayasinghe for his guidance, encouragement, and continued support to the members of Bee PERA in initiating this important event, which will greatly contribute to the development of the next generation of beekeepers in our country.

I encourage all presenters and participants to use this opportunity not only to showcase their research but also to engage in meaningful scientific discussion. The questions we ask, the collaborations we develop, and the ideas we share today can contribute to the future of sustainable beekeeping and honeybee conservation.

I wish BeeFORUM-2026 every success and congratulate the organizers, presenters, reviewers, judges, and participants for their valuable contributions to this important field.

Thank you, and I wish you all a productive and inspiring BeeFORUM-2026.

Dr. U.G.A.I. Sirisena

Senior Lecturer in Entomology

Department of Plant Sciences, Faculty of Agriculture

Rajarata University of Sri Lanka

8th August 2026

Message from the Symposium Secretaries



Every meaningful journey begins with a vision, and every achievement is built through collective effort. The journey of the Bee PERA Society, since its establishment in 2023, has been one of continuous learning, growth, and commitment to the advancement of apiculture. In 2026, we proudly take another significant step forward by organizing Bee FORUM-2026, our first-ever Research Symposium.

I extend my sincere gratitude to our Keynote Speaker, Review Panel, Judging Panel, authors and presenters, Senior Treasurer, Symposium Organizing Committee, and all Bee PERA members for their valuable dedication and support.

May Bee FORUM-2026 become a foundation for new ideas, meaningful collaborations, and future research in apiculture and related fields.

With best wishes,

W. Chanuka Lakshan Chandrapala

Faculty of Agriculture, University of Peradeniya



It is my great pleasure to extend a warm welcome to all participants of Bee FORUM 2026, the inaugural Research Symposium organized by the Bee PERA Society, Faculty of Agriculture, University of Peradeniya.

This symposium offers a meaningful platform for sharing research, exchanging ideas, and strengthening scientific dialogue within the field of apiculture. This Abstract

Proceedings volume brings together the research contributions of our participants, reflecting their dedication to scientific inquiry and their commitment to advancing knowledge in apiculture and allied fields.

I am deeply grateful to our keynote speaker, judges, reviewers, academic advisors, organizing committee members, presenters, and all who have supported this initiative.

My warmest congratulations to every author featured in these proceedings. I wish you continued success in your academic and research journey.

R.M. Manilki Rathnayaka

Faculty of Agriculture, University of Peradeniya

Keynote Address

Community Beekeeping for Sustainable Agriculture, Biodiversity Conservation, and Rural Development

UGAI Sirisena

Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka

Good morning to everyone, Dr. Wikum, distinguished academics, researchers, members of the Bee Pera Society, and all the presenters today. It is both an honour and a privilege to address this symposium on a subject that is more relevant in sustainable agriculture. I sincerely appreciate the initiative of organizing this Bee Symposium; it is a timely and much-needed event. I hope this symposium provides an excellent platform for researchers, beekeepers, extension officers, students, and other stakeholders to come together, exchange knowledge, and promote the development of the beekeeping sector in Sri Lanka. I would especially like to express my sincere gratitude to Dr. Wikum Jayasinghe, the advisor of the Bee Pera society for his guidance, encouragement, and unwavering support to the Bee Society of the University of Peradeniya in making this symposium a reality. Today, I would like to discuss how community beekeeping can become a powerful tool for sustainable agriculture, biodiversity conservation, and rural development, and I would like to share some of my own experiences very briefly.

Generally, people associate bees with honey, but honey is actually the smallest contribution bees make to humanity. The greatest contribution of bees is pollination. Nearly every flowering plant depends, to some extent, on pollinating insects, and bees are undoubtedly the most efficient among them. In fact, about seventy of the hundred major food crops that feed 90% of the world's population depend on bee pollination. Bee pollination impacts on the quality and quantity of the agricultural produce significantly. Without bees, crop yields decline, fruit quality decreases, biodiversity diminishes, and ecosystems gradually become unstable.

When many people hear the word "bee," they immediately imagine the honeybee. In reality, honeybees represent only a tiny fraction of bee diversity. Scientists have identified over 20,000 bee species worldwide, and Sri Lanka itself possesses remarkable bee diversity despite its relatively small size. As you all know, we have three species of honeybees, *Apis cerana*, *Apis dorsata* and *Apis florea* two species of stingless bees namely, *Tetragonula irridipennis* and *Tetragonula praeterita*. However, we use only *Apis cerana* for the domestication purpose. When it's come to beekeeping, in Sri Lanka, we can see some major potential areas such as Rubber zone, eucalyptus zone, forest zone and coconut zone of the of the country. However,

due to presence of bee foraging plants, I think beekeeping can be done in anywhere of the island. As you all are well aware, our traditional communities have harvested honey for centuries; however, doing so from wild colonies often destroys entire colonies. Therefore, our responsibility is not encouraging wild harvesting of honey, but to domesticate and manage bees sustainably through modern beekeeping practices.

Community beekeeping is much more than producing honey; it is a rural development strategy. A single bee colony requires very little land. Even landless families can maintain colonies; women can manage them; youth can develop businesses around them; and elderly farmers can maintain colonies without heavy labour. Beekeeping is, therefore, one of the most inclusive agricultural enterprises available today. During the past several years, we have introduced beekeeping into several farming communities, including Endana biodiversity corridor in Ratnapura, farmers in Polonnaruwa, Batticaloa, and Anuradhapura districts. Rather than distributing equipment alone, we focused on awareness programmes, farmer training, and establishing colonies within home gardens. These experiences demonstrated that farmers quickly appreciate the value of bees once they begin observing improvements in both honey production and crop productivity. I believe that just sharing beekeeping tools are not adequate to achieve the sustainability in beekeeping projects, but also require proper training and follow-up activities to see their progress periodically.

Many of our most vital crop including maize, sesame, legumes, beans, sunflower, mango, avocado, citrus, coconut, rubber, coffee, and numerous forest trees, either depend on or greatly benefit from insect pollination. In this sense, every bee colony functions as a natural production unit, working tirelessly and free of charge for farmers. By integrating beekeeping into cultivated lands, we can harness the pollination services of bees while they, in return, receive nourishment from the flowers they visit, such as nectar and pollen. However, to ensure the success of this mutually beneficial relationship, careful planning is essential. Before starting beekeeping, we must develop a flowering calendar to guarantee a continuous and year-round supply of flowers. If there are periods when floral resources are scarce, appropriate measures should be taken to introduce suitable foraging plants in the area. In addition, practices such as establishing plant hedgerows, increasing crop diversity, practicing intercropping, maintaining buffer zones, and protecting natural vegetation can all contribute to a more resilient agricultural landscape. These strategies not only support bee populations but also enhance overall farm productivity, creating a sustainable environment where both agriculture and nature thrive together.

Another important things to remember is that honeybees are not the only pollinators. Sri Lanka has 159 recorded bee species belonging to four families, and many are solitary bees. Some nest in soil, others in dead wood, and some require hollow stems. Unfortunately, these native pollinators are disappearing because modern agriculture often removes the habitats they require. Our conservation efforts should, therefore, include all bees not only honeybees. Perhaps the greatest threat facing bees today is inappropriate pesticide use (i.e Neonicotinoids). Bees may die through direct spray, collecting contaminated pollen, or drinking contaminated water. Therefore, protecting bees does not necessarily mean banning pesticides; it means using them responsibly. Integrated Pest Management, correct spray timing, avoiding spraying during flowering, and selecting safer products can greatly reduce harm to pollinators.

In Sri Lanka, there are several challenges remained related to beekeeping. We need more trained personnel, better bee breeding programmes, improved disease monitoring, stronger honey marketing systems, greater colony multiplication, more research on flowering plants, and increased public awareness. Addressing these challenges requires collaboration rather than isolated efforts. Fortunately, there are much enthusiasm can be seen in the society for beekeeping nowadays. However, I believe we should focus on developing improved bee strains, building farmer capacity, introducing floral calendars, encouraging migratory beekeeping, strengthening institutional partnerships, and developing supportive national policies.

Before I conclude, I wish to acknowledge two key figures who have profoundly reshaped the beekeeping sector in Sri Lanka: Mr. H.N.P. Wijayagunasekara, former Senior Lecturer in the Department of Agricultural Biology at the University of Peradeniya, and Dr. R.W.K. Punchihewa, former Senior Lecturer at the University of Ruhuna. Their contributions to the beekeeping industry have been invaluable, and I truly appreciate their service. Both of them have also mentored me throughout my journey in beekeeping, for which I am deeply grateful. I would also like to express my sincere gratitude to all the institutes, private companies, NGOs, and research students who have collaborated with me over the past decade and a half. Your support has been instrumental, and I am thankful for every contribution.

Dear participants of today's symposium, Karl von Frisch once said, "The life of the bee is like a magic well; the more you draw from it, the more there is to draw." I believe this quotation perfectly captures the future before us. Let us work together to ensure that every village, every farm, and every landscape in Sri Lanka becomes a place where bees and people thrive together. I hope this symposium will become a regular annual event, continue to grow in stature, and evolve into an

internationally recognized forum for sharing scientific knowledge and practical experiences in beekeeping. In fact, I have encouraged Dr. Wikum to consider taking the next step by establishing a scientific journal on bees and beekeeping. Such a journal would provide an excellent platform for publishing research findings, sharing innovations, and strengthening collaboration among scientists, extension workers, and practitioners both in Sri Lanka and abroad. Once again, I sincerely thank Bee PERA for inviting me to this wonderful occasion, and I wish you all a very pleasant day ahead.

Thank you very much.

Dr. U.G.A.I. Sirisena

8th August 2026

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Environmental Buffering Capacity and Temporal Dynamics of Hive Microclimate in *Apis cerana* Colonies

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Honeybee colonies maintain a stable brood-nest microclimate, which is essential for brood development and overall colony performance. This study investigated the effects of temporal environmental variation on internal hive temperature, relative humidity (RH), and buffering capacity in *Apis cerana* colonies of two strengths, classified as strong or weak based on worker bee population. Six colonies, comprising 3 strong (C1–C3) and 3 weak (C4–C6) colonies, were monitored over 12 weeks using 6 brood-area sensors and 1 ambient sensor. Measurements were recorded 3 times daily (morning, noon, and evening) to evaluate the influence of colony strength on microclimate regulation. Strong colonies maintained significantly higher and more stable internal temperatures, with colony-level mean temperatures ranging from 32.5–32.6°C, compared with 29.9–31.3°C in weak colonies, while the mean ambient temperature was 27.63 ± 3.47°C. Internal RH remained consistently lower than ambient conditions, with strong colonies maintaining the lowest colony-level mean RH (72–73%), compared with weak colonies (78–79%) and ambient conditions (82.17 ± 9.98%). Temperature buffering was greatest in strong colonies (+4.0–4.2°C) and lower in weak colonies (+2.3–2.4°C), whereas RH buffering values remained consistently negative, indicating active regulation of hive moisture. All values are reported as mean ± SD unless otherwise stated. Colony strength had a highly significant effect on temperature regulation ($p < 0.001$). Temperature buffering varied according to the time of day. It peaked in the morning (5.62 ± 2.70°C) and evening (4.29 ± 2.50°C), when ambient temperatures were lower, and declined at noon (0.39 ± 2.74°C). Coefficient-of-variation and distribution analyses further confirmed that strong colonies maintained the most stable microclimate, whereas ambient conditions showed the greatest variability. These findings demonstrate that colony strength is a key determinant of brood-nest environmental stability and provide insights for identifying vulnerable colonies and improving apiary management.

Keywords: *Apis cerana*, brood nest, colony strength, environmental buffering, hive microclimate

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This research was funded by the multidisciplinary research grant (MDRG 351)

Detection of Bee Honey Adulteration with Sucrose Solution and Rock Bee Honey through Physicochemical Characterization

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Honey is one of the most frequently adulterated foods globally. In Sri Lanka, *Apis cerana* honey is commonly adulterated with sucrose solutions and rock bee (*Apis dorsata*) honey. This study investigated the effects of adding sucrose solution and rock bee honey to pure *Apis cerana* honey. For the study, pure bee honey samples were collected from apiaries maintained by the Faculty of Agriculture. The samples were adulterated with 10%, 20%, 30% and 40% (w/w) of sucrose solution and rock bee honey. The adulterated samples were analysed for key physicochemical parameters: pH, total soluble solids (TSS), moisture content (MC), electrical conductivity (EC), viscosity and free acidity (FA). Analysis was done using standard analytical methods of the International Honey Commission protocols, AOAC procedure and standard refractometric and rheological techniques. Data were analysed using a general linear model at $p < 0.05$. The results indicate that the type and the level of adulteration had a significant impact on all measured parameters. Only the moisture content of adulterated samples exceeded the Codex Alimentarius maximum standard limit of 20%. All other parameters; TSS, EC, pH, and FA remained within the relevant Codex Alimentarius limits even at high adulteration levels. Therefore, to overcome the insufficient detection of adulteration, multivariate Principal Component Analysis (PCA) was conducted. The PCA successfully differentiated pure honey from all the adulterated samples. Moreover, the PCA biplot indicated that the addition of sucrose solution degraded the quality of pure honey more than the addition of rock bee honey. These findings indicate that a multivariate approach is more effective than individual standard tests in detecting honey adulteration.

Keywords: adulteration, bee honey, rock-bee honey, honey standards, physicochemical properties

Factors Associated with Pest Management Adoption, Pest Species and Colony Losses among *Apis cerana* Beekeepers in Sri Lanka.

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Sustainable management of the indigenous Asian honeybee (*Apis cerana*) in Sri Lanka is increasingly challenged by pest infestations and colony losses. Understanding the influence of socio-demographic characteristics, educational background, beekeeping training, and beekeepers' knowledge on pest management practices, pest infestation levels, and colony survival is essential. A descriptive cross-sectional survey was conducted among 60 *A. cerana* beekeepers representing the major agro-climatic zones of Sri Lanka. Data were collected using a structured questionnaire and analysed using IBM SPSS Statistics version 26.0. Descriptive statistics and inferential statistical methods, including Chi-square tests, Kruskal–Wallis tests, and Spearman's rank correlation analysis, were used to evaluate relationships among variables. Pest infestation levels differed significantly among beekeeper types ($H = 12.86$, $p = 0.002$) and were significantly associated with age category ($\chi^2 = 11.353$, $p = 0.045$). Commercial and small-scale beekeepers showed higher pest infestation levels than backyard/hobbyist beekeepers, while the 41–50 year age group recorded the highest infestation levels. Climatic zone significantly influenced colony loss severity ($\chi^2 = 8.92$, $p = 0.012$), with beekeepers in the dry zone reporting higher colony losses than those in the wet and intermediate zones. Spearman's rank correlation analysis showed that training exposure was positively associated with pest management adoption ($r_s = 0.468$, $p = 0.001$), which was linked to higher honey production ($r_s = 0.276$, $p = 0.033$). Years of beekeeping experience also showed a significant positive correlation with honey production ($r_s = 0.438$, $p = 0.001$), indicating that experienced beekeepers achieved higher yields, possibly due to accumulated knowledge, improved skills, and training exposure. Beekeeping training plays an important role in improving pest management and reducing colony losses. Targeted extension programs and region-specific pest management strategies are needed to address the different challenges faced by beekeepers in Sri Lanka.

Keywords: *Apis cerana*, Sri Lanka, pest management, colony losses, beekeeping training

Whole-Genome Characterization of the *Apis cerana* Fabr. (Sri Lankan Honey Bee) with Comparative Analysis of Foraging-Related Genes

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Genome-level assemblies of *Apis* species have become a foundational resource, facilitating advances in selective breeding, conservation management, and evolutionary genomic studies of bees. Nevertheless, the Sri Lankan honeybee constitutes a notable exception, as its genomic architecture remains largely unexplored to date. Addressing this gap, this study provides the first high-quality whole-genome assembly of the Sri Lankan honeybee, with a comparative analysis of genes associated with foraging behaviour. High-throughput paired-end Illumina sequencing was used to generate reference-guided (assembled using Pilon) and de novo assemblies (assembled using SPAdes), both demonstrating high gene coverage completeness, with Benchmarking Universal Single-Copy Orthologs (BUSCO) scores of 99.6% and 99.2%, respectively. The final assembly exhibited 98.8% average nucleotide identity to the Asian honeybee reference genome (GCF_029169275.1), with genome annotation performed using AUGUSTUS predicting more than 27,000 coding sequences. This assembly was then used to conduct a comparative analysis of 42 foraging-related genes, curated from the literature, across multiple honeybee populations. These comparative analyses uncovered notable variations in key protein domains specific to the Sri Lankan honeybee lineage, offering the first genomic evidence underpinning its distinct adaptive traits. Collectively, this work advances our understanding of the foraging ecology of the Sri Lankan honeybee and provides a foundational genomic resource to guide future breeding and conservation strategies.

Keywords: Sri Lankan honey bee, whole-genome assembly, de novo assembly, reference-based assembly, foraging-related genes

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This research was funded by the multidisciplinary research grant (MDRG 351)

Effect of Natural Pre-treatments of Wooden Hives on Acceptance and Colony Performance of *Apis cerana*

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Establishment, survival and performance of honeybees depend on the nature of the beehives. Natural odors and chemical compounds in timber may affect the acceptance of man-made beehives. Bait hives can be used to attract swarming colonies, however, the use of bait hives on Asian honeybees is limited. Therefore, this study evaluated the effects of different natural fruit juice pre-treatments on hive acceptance and colony performance of *Apis cerana*. Nine wooden beehives (24×24×15 cm) were pretreated using boiled water followed by treatment with 3 fruit juices: mango (50%) and pineapple (40%), and mango + pineapple (1:1), along with a control colony, two times at one-week intervals. Afterwards, honeybee colonies of similar strength were introduced into the treated hives. Data such as brood area, pollen area, honey area, comb development, and colony weight were measured at weekly intervals, while the Colony Performance Index (CPI) was measured at 3-day intervals. Temperature and relative humidity inside and outside of hives were measured during the study period. The data were analyzed using a one-way ANOVA. The results revealed that the CPI was significantly ($P<0.05$) higher in the hives treated with mango (5.71 ± 5.03) and pineapple (4.10 ± 3.44) compared to control colonies (1.03 ± 0.29). Mango-treated colonies resulted in the highest brood area (249.58 cm^2), pollen area (26.09 cm^2), colony weight (2.76 kg), and comb development (164.86 cm^2), compared to other treatments (lowest values were recorded in control colonies: Brood area- 5.25 cm^2 , pollen area- 3.50 cm^2 , weight- 2.13 kg , and comb development- 58.20 cm^2), respectively. The hive temperature fluctuated less (27.2 ± 0.8) even though the ambient temperature fluctuated highly. According to these results, mango juice pre-treatment enhanced colony establishment and several indicators of colony performance under the conditions of this study.

Keywords: colony performance, fruit juices, honeybees, man-made beehives

Assessment of Floral Resources, Spatial Suitability, and Farmer Perspectives for Sustainable Beekeeping Development in Communities Adjacent to the Wilpattu Forest Reserve, Sri Lanka

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Wild honey harvesting is a traditional livelihood activity among rural communities surrounding the Wilpattu Forest Reserve in Sri Lanka, which limits sustainable honey production and threatens natural bee colonies. Establishing domesticated honeybee colonies in movable-frame hives could provide a continuous source of honey while enhancing crop pollination in home gardens. Therefore, this study aimed to evaluate the potential for sustainable domesticated beekeeping by assessing floral diversity, flowering patterns, and farmers' willingness to engage in beekeeping in two villages of Helambawewa, Nochiyagama, based on surveys of 24 home gardens. Bee forage plant diversity data integrated with GPS-based spatial information were used to identify suitable areas for beekeeping within the study region. A total of 74 honeybee foraging plant species were identified from the area. Ornamental plants contributed the highest proportion (32%), followed by fruit crops (26%) and forest species (23%). *Cucurbita maxima*, *Drypetes sepiaria*, *Limonia acidissima*, *Mangifera indica*, *Manilkara hexandra*, *Sesamum indicum*, *Tamarindus indica*, *Vigna mungo*, *V. unguiculata*, and *Zea mays* were identified as important bee forage plants, based on the villages' experience. The flowering calendar indicated year-round availability of bee forage plants, with an average of 50 species flowering monthly. Peak flowering occurred during March–May, which was consistent with farmers' observations that April–June is the most favourable period for beekeeping due to abundant floral resources. Farmer interviews indicated that 50% of households engaged in wild honey harvesting from forests, and only 13.6% had experience managing domesticated colonies. However, 91% of households expressed willingness to engage in beekeeping with appropriate guidance and support. The findings indicate that Helambawewa and Nochiyagama have considerable ecological and social potential for sustainable beekeeping, but systematic training, forage management, and continuous technical support are essential for replacing destructive wild honey harvesting with a sustainable cottage industry.

Keywords: *Apis cerana*, apiculture, honeybee forage plants, rural livelihoods

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The authors gratefully acknowledge the Biodiversity Sri Lanka for funding this study.

Morphometric Characteristics Associated with Nectar and Pollen Collection in *Apis cerana* in Different Agro-climatic Zones in Sri Lanka

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The Asian honeybee, *Apis cerana* Fabricius (1793), is an important pollinator and honey-producing species in Sri Lanka. However, geographic variation in its foraging-related morphometric traits across agro-climatic zones remains poorly understood. This study investigated morphometric variation among *A. cerana* worker bees from the major agro-climatic zones of Sri Lanka to assess population differentiation and potential local adaptation. A total of 720 pollen-carrying worker bees were collected from 72 managed colonies representing seven agro-climatic zones: Wet Up-country (WU), Wet Mid-country (WM), Wet Low-country (WL), Intermediate Up-country (IU), Intermediate Mid-country (IM), Intermediate Low-country (IL), and Dry Low-country (DL). Five foraging-related morphometric traits: proboscis length (PL), thorax length (ThL), forewing length (FWL), forewing width (FWW), and metatarsus length-to-width ratio (MTL:MTW) were measured using a Dino-Lite digital microscope. Data were analysed using descriptive statistics, one-way analysis of variance (ANOVA) followed by Tukey's post hoc test, principal component analysis (PCA), and linear discriminant analysis (LDA). Significant differences among agro-climatic zones were observed for all measured traits ($p < 0.05$). The IU population exhibited the highest PL and FWW, whereas the WU population showed the highest ThL, FWL, and MTL:MTW. PCA indicated that the first three principal components explained 86.86% of the total morphological variation, with PL, FWL, and ThL contributing most strongly to population differentiation. LDA demonstrated further morphological differentiation, with FWW and MTL:MTW being the most discriminating traits. Overall classification accuracy was 58.33%, indicating moderate differentiation, with complete separation of the WU population (100% correct classification) and greater phenotypic overlap among intermediate-zone populations. These findings demonstrate significant agro-climatic variation in *A. cerana* morphometric traits and identify FWW and MTL:MTW as useful indicators of regional differentiation. The results provide baseline information for future research on local adaptation, conservation, and breeding of Sri Lankan honeybee populations.

Keywords: *Apis cerana*, agro-climatic zones, morphometrics, foraging traits, principal component analysis, linear discriminant analysis.

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This research was funded by the multidisciplinary research grant (MDRG 351)

Evaluating the Contact Toxicity of *Mikania micrantha* Leaf Extract on Worker Honey Bees (*Apis cerana*)

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Extracts of *Mikania micrantha* have demonstrated successful effects as a botanical pesticide against multiple insect pests, making it vital to evaluate their effects on beneficial non-target insects. While botanical pesticides are often promoted as environmentally safe alternatives to synthetic chemicals, some may still exert severe, non-selective toxicity on non-target pollinators. This study evaluated the acute contact toxicity of *M. micrantha* fresh leaf extract (FLE) on worker honeybees (*Apis cerana*) to assess its potential use in Integrated Pest Management (IPM) programs. Freshly collected *M. micrantha* leaves were homogenized in distilled water, in a ratio of 100 mL of water to 100 g of leaves, and filtered to obtain the FLE, which was subsequently applied topically to groups of worker bees using an electric airbrush. One milliliter of the extract was applied to a group of 10 healthy bees temporarily immobilized by exposure to 4 °C temperature, while the control group was treated with 1 mL of distilled water following the same method. Three replicates of 10 honeybees were used for each extract and the control, and the treated honeybees were transferred to cages in groups of 10. The bees were maintained under controlled laboratory conditions (32 ± 2 °C; 60 ± 10% relative humidity), and survival was monitored over an 80-hour observation period. The results showcased a gradual decline in survival in both the FLE-treated and control groups, with no statistically significant difference in mortality detected during the initial 72 hours post-application, as indicated by the data analysis using independent t-tests ($p > 0.05$). Survival in the FLE-treated group decreased significantly at 80 hours post application ($p < 0.05$). The lack of significant mortality during the first 72 hours suggested that *M. micrantha* FLE lacks rapid contact toxicity under the tested laboratory conditions. The delayed mortality observed at 80 hours may have resulted from prolonged confinement or ingestion of residues during grooming rather than from immediate contact toxicity. Ultimately, the results suggested that it is a potential candidate for IPM. However, further laboratory and field studies are required before it can be considered safe for pollinators.

Keywords: *Mikania micrantha*, honeybees, botanical pesticide, contact toxicity

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This research was funded by the NSF School Project 2025

Evaluation of Wax Rendering Methods for Beeswax Extraction from *Apis cerana* and *Apis dorsata* Combs in the Anuradhapura District

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Beeswax, a valuable by-product of apiculture, has often been overlooked and underutilized in local beekeeping practices due to a lack of effective wax extraction methods. Although various techniques exist globally, their adoption by local beekeepers remains minimal. This study aimed to compare the efficiency of four wax rendering methods and evaluate the physicochemical qualities of beeswax obtained from *Apis cerana* and *Apis dorsata* combs. Old bee comb samples of *A. cerana* and *A. dorsata* were randomly collected from beekeepers and honey hunters in the Anuradhapura district were used. Four extraction methods, solar extraction, steam extraction, manual extraction and submerged extraction method were used to extract beeswax with three replicates in each method. The efficiency of melting and the time taken for the extraction were compared. Laboratory analysis was performed to evaluate the physicochemical parameters i.e. color, acid value, melting point and total volatile matter of the extracted beeswax compared to the commercially available beeswax. According to the results, the effect of the extraction method, the species, or their interaction had no significant effect on the efficiency of melting, acid value and total volatile matter content ($p>0.05$). However, the study revealed significant differences ($p<0.05$) in time taken to wax extraction, melting point, and color among different beeswax sources and extraction methods. The solar extraction took significantly longer time than manual and submerged methods for the extraction. The beeswax obtained in this study exhibited similar characteristics to that of beeswax available in the local market in terms of acid value, total volatile matter content, and colorimeter values. Market-available beeswax and *A. cerana* beeswax exhibited statistically similar melting points, of $66.22\pm1.00^{\circ}\text{C}$ and $63.94\pm0.50^{\circ}\text{C}$ respectively, both of which were significantly higher than the melting point of *A. dorsata* beeswax ($60.03\pm0.50^{\circ}\text{C}$).

Keywords: beekeepers, beeswax, efficiency of melting, extraction

Development of a Novel Mead with Sensory Properties Comparable to Commercial Mead

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Mead, an alcoholic beverage produced by fermenting honey, has gained increasing attention due to its unique sensory characteristics and growing consumer interest in natural fermented beverages. Fermentation process in Mead production involves the converting sugars in honey into alcohol, Carbon dioxide and various flavor compounds. This study aimed to develop an optimized mead formulation and evaluate its sensory acceptability in comparison with a commercial mead. Four formulations (F1–F4) were subjected to a ranking test and evaluated each formulation based on color, aroma, sweetness, mouthfeel, and overall acceptability. F1, F2, F3 and F4 were prepared according to a standard method by changing the amount of water content, *Hemidesmus indicus* extraction and the sugar contained in each formulation. Results of sensory analysis were analyzed using the Friedman test followed by Wilcoxon sign rank test. Statistical analysis revealed that the significant differences exhibited ($p < 0.05$) among the four formulations (F1-F4) for color, aroma, mouthfeel, and overall acceptability, whereas sweetness showed no significant difference ($p > 0.05$). Formulation F4 recorded the lowest rank sums for all sensory attributes and was therefore selected as the optimum formulation. The selected formulation was subsequently evaluated against a commercial mead using a 9-point hedonic scale and the results were expressed as mean rank values based on parameters of color, aroma, sweetness, mouthfeel and overall acceptability. F4 exhibited a higher mean score for sweetness and it was significantly different ($p < 0.05$) from the commercial mead ($p < 0.05$), while the scores for aroma, mouthfeel, color and overall acceptability were similar and not statistically different ($p < 0.05$) for F4 and the commercial mead. These findings demonstrate that the optimized mead formulation possesses sensory characteristics and overall consumer acceptability comparable to those of a commercial mead, indicating its potential for further development as a commercially viable fermented beverage.

Keywords: Mead, honey fermentation, formulation optimization, sensory evaluation, ranking test, hedonic test, consumer acceptability.

Buzz & Bloom: A Case Study on Value Creation Through Sustainable Supply Chains in Community-Based Beekeeping and Tourism in Sri Lanka

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This case study aimed to evaluate how sustainable supply chains linking community-based beekeeping with the tourism sector can create diversified, stable income for rural producers in Sri Lanka. Buzz & Bloom, a project developed by the Fabulous Getaway in collaboration with the Faculty of Agriculture, Rajarata University of Sri Lanka was implemented in the Palugaswewa cascade in Anuradhapura, where selected households received complete starter kits, including bee colonies, hives, equipment, technical training, and continuous mentoring to establish sustainable apiaries. The project was started in 2024 and honey harvested by beneficiaries was purchased by partner hotels, providing a reliable market, while apiaries were incorporated into immersive tourism experiences educating visitors on beekeeping, biodiversity, and rural livelihoods. A secondary product stream also emerged, as beeswax, a byproduct of honey production, was upcycled by villagers into candles sold directly to guests. The supply chain was reinforced financially, as a portion of every experience booking fee, together with a percentage of the company profit, was reinvested into the project. Harvests increased from approximately 4.75 L from 3 apiaries in the first harvesting cycle to 20 L from 5 apiaries in the second, corresponding to a rise in per-apiary yield from 1.58 L to 4 L. The initiative strengthened household income diversification, promoted pollinator conservation, and created new opportunities for community participation in the tourism value chain. Further, it was noted that the productivity is significantly high in the studied area compared to the other areas of the dry zone, probably because the microclimatic conditions of the cascade system highlighting the potential of expanding the project. Buzz & Bloom demonstrates how integrated, reinvested supply chains linking production, hospitality, and Tourism can build resilient rural livelihoods through strengthened beekeeping economy.

Keywords: Sustainable supply chains, community-based beekeeping, tourism, pollination, biodiversity conservation

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This project was funded by The Fabulous Getaway.

Formulation and Evaluation of a Protein-Standardized Supplemental Feed Based on Natural Bee Bread Protein Content for *Apis cerana* (Asian Honey Bee) and Its Effects on Colony Development

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Protein nutrition is a key determinant of honey bee colony development. Inadequate protein intake reduces brood area, compromises comb construction, and weakens colony strength, highlighting the importance of supplemental diets during periods of limited pollen availability. Although protein supplementation has been extensively studied in *Apis mellifera* (Western honey bee), validated protein-balanced diets for *Apis cerana* under tropical conditions remain limited. This study formulated a protein-standardized supplemental feed for *Apis cerana* based on natural bee bread protein content. Four key protein sources-egg white powder, *Vigna mungo* (black gram) powder, skimmed milk powder, and dried yeast were selected for their complementary amino acid profiles and nutritional efficacy. Total soluble protein content of these four ingredients and bee bread was quantified using the Biuret assay to guide diet formulation. Sugar, honey, salts, multivitamins, and water were added for carbohydrates, micronutrients, and palatability. Pre-trials confirmed highest acceptance with a semi-solid feed patty. The diet was evaluated over eight weeks using six colonies arranged as three matched pairs, with controls receiving no supplemental feed. Statistical evaluation using a paired-samples *t*-test revealed that colonies receiving the protein-standardized diet showed significantly greater increases in brood area (51.03%; $p = 0.040$) and comb development (30.17%; $p < 0.001$), alongside elevated honey storage (52.01%; $p = 0.118$) and pollen storage (111.04%; $p = 0.054$) compared with controls, demonstrating that the formulated diet serves as an effective nutritional intervention to stimulate active worker comb construction and accelerate brood nest expansion in *Apis cerana* colonies under tropical conditions.

Keywords: *Apis cerana*, protein-standardized diet, colony development, supplemental feeding, bee bread

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