Issue 26 · August 2026

NO BEES NO LIFE

EBA MAGAZINE

32 COUNTRIES

FROM WHICH EBA HAS MEMBERS

(65 beekeeping organizations)

In order of confirmation of the Statute of EBA

430.584 beekeepers

Serbia
Slovenia
North Macedonia
Bulgaria
Greece
Romania
Malta
Germany
Hungary
Ukraine
Montenegro
Lithuania
Bosnia and Hercegovina
Sweden
Croatia
Czech Republic
Poland
United Kingdom
Netherlands
Italy
Ireland
Belgium
Cyprus
Türkiye
Switzerland
Prishtina*
Portugal
Spain
Slovakia
Austria
Albania
Iceland
Estonia

GENERAL SPONSOR

OF THE
EUROPEAN BEEKEEPING ASSOCIATION

SAVA
INSURANCE
GROUP

AMONG GOOD PEOPLE

SAVA
ZAVAROVALNA
SKUPINA

V DRUŽBI DOBRIH LJUDI

SILVER SPONSOR

OF THE
EUROPEAN BEEKEEPING ASSOCIATION

BRONZE SPONSOR

OF THE
EUROPEAN BEEKEEPING ASSOCIATION

GOD WILL NOT HELP US, IF WE DON'T TRY TO HELP OURSELVES

Across Europe, our markets are increasingly flooded with low-priced honey of questionable origin.

European beekeepers simply cannot produce honey at such prices.

We all know that this is a serious challenge for the future of European beekeeping.

But I believe we also need to be honest with ourselves: we cannot expect someone else to solve this problem for us.

If we want consumers to choose real, local honey, we need to do much more ourselves. We need stronger communication, better promotion, more education and a much more visible presence of local honey in the market.

As beekeeping organisations, we have a responsibility to take the initiative and bring the value of European and local honey much closer to consumers.

We cannot just wait for governments, institutions or someone else to act. We need to act ourselves – and we need to do much more than we are doing today.

The future of European beekeeping will not be secured by waiting.It will be secured by what we are willing to do ourselves.

Boštjan Noč

President of the European Beekeeping Association

COMMITTEE ESTABLISHED

TO COMBAT HONEY FRAUD IN GREECE WITH THE PARTICIPATION OF AN EBA REPRESENTATIVE

The Greek Ministry of Rural Development and Food has established a Working Group on Greek Honey and Beekeeping Products (Decision 172446/1-6-2026).

The Committee consists of:

specialized scientists in apiculture; representatives of the Federation of Greek Beekeeping Associations; Greek honey packers and distributors; beekeeping cooperatives; inspection and control authorities (ELGO-DIMITRA and EFET); the General Chemical State Laboratory; and administrative officials of the Ministry of Rural Development and Food.

The Ministry also invited a representative of the European Beekeeping Association (EBA) to participate in the Committee, thereby recognizing EBA's active contribution to the fight against honey fraud and its efforts to support and promote local beekeepers. The Committee's areas of discussion include:

a) The development and implementation of digital tools for honey traceability.

b) The harmonization and combined use of validated methodologies for honey analysis and quality control.

c) The identification, legal protection, certification, and promotion of the distinctive characteristics of various types of Greek honey.

d) The updating of the regulatory framework concerning inspections, sanctions, and related matters, as well as organizational and structural reforms in the honey and beekeeping sector.

As the EBA representative, Professor Andreas Thrasyvoulou, a member of the EBA Scientific Committee on Safety and Quality of Bee Products, has been nominated. Professor Thrasyvoulou frequently presents the Committee's positions and his views on these issues in the EBA magazine No Bees No Life.

THE AMENDED HONEY DIRECTIVE: IMPLEMENTATION, TRANSITIONAL LOOPHOLES, AND THE READINESS OF THE EU MARKET

Introduction

Under Article 6 of the revised Honey Directive (Directive (EU) 2024/1438), products placed on the market or labelled before 14 June 2026 in accordance with the older Directive 2001/110/EC may continue to be marketed until stocks are exhausted.

In practice, this means a retailer can legally sell a honey jar labelled with the vague "blend of EU and non-EU honeys" designation well into 2028 or even 2029, provided it was packaged and labelled prior to the mid-June deadline. Consequently, consumers will continue to encounter old, opaque labels on supermarket shelves for a considerable time. This overlap makes it extraordinarily difficult for the public to differentiate between products lawfully benefiting from transitional leniency and those actively non-compliant with the new country-of-origin and percentage-labelling mandates (figure 1).

These updated regulations were heavily driven by consumer demand for supply-chain transparency. The public promised that honey blends would explicitly state both the countries of origin and their exact percentages in descending order. However, because thousands of jars carrying the generic "EU/non-EU" label remain on the shelves for an indefinite period, consumer confidence faces an immediate threat. If buyers see little visual change in stores for years, paired with the knowledge that these new declarations cannot yet be independently verified in a laboratory, many may question whether this hard-fought legal reform has actually delivered on its promise.

Can Consumers Spot a Mislabeled Product?

The short answer is no. Regular consumers have no practical means of distinguishing an old, lawfully grandfathered label from an illegally mislabeled product.

- The Lot Number: This identifier is designed for internal traceability, not public informa-

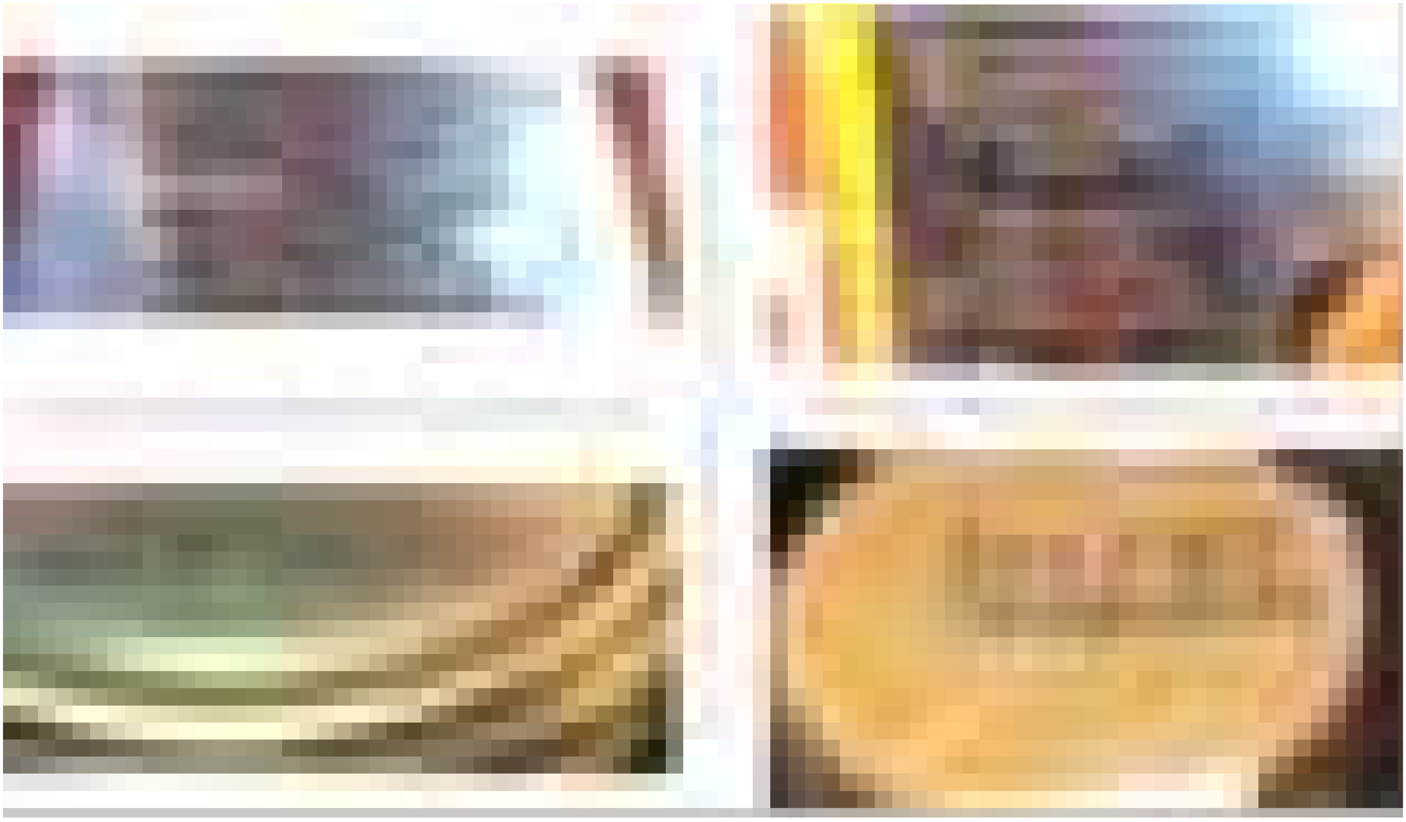


Figure 1: Two jars of honey purchased in the Greek market on July 7th, featuring "best before" dates of 20/09/2027 and 09/03/2028, respectively. Both remain legally permitted on store shelves under current transitional rules as Blends of EU and non-EU honey

tion. Its format is chosen entirely at the manufacturer's discretion; there is no EU-wide standard that encodes a readable production or packaging date.

- The Best-Before Date: This metric offers no proof of when a jar was actually filled. Because honey naturally possesses a long shelf life, producers arbitrarily set best-before windows between 18 and 36 months. A jar marked for March 2028 could have been filled either just before or well after the June 2026 deadline.

The only way a consumer could verify legality is by contacting the packer directly to request specific manufacturing logs—or by filing an official complaint with a national food authority. The statistical likelihood of a consumer taking either step is exceptionally low.

Can Competent Authorities Verify Compliance?

If formally challenged by regulatory authorities, a producer is expected to provide comprehensive documentation: ink-jet production logs, label printing receipts, batch sheets, and initial invoices demonstrating exactly when a lot was packed and placed on the market. It is this paper trail—not the visible lot number on the jar—that determines whether the transitional measure legally applies.

Protection for Industry Over Transparency for Consumers?

The EU's justification for the open-ended transitional period is economic: avoiding the destruction of compliant packaging material, reducing sudden overhead costs for manufacturers, and preventing food waste (table 1).

This leniency deserves healthy criticism. The previous Honey Directive had been in place since 2001, and commercial packers knew for years that country-of-origin transparency was becoming a major political priority. Furthermore, the

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Table 1. The current setup suggests that European frameworks favor operators over consumers:

amended text was adopted in May 2024, providing a full two-year runway before its application date. Granting an open-ended transition period despite this two-year grace period means that consumer transparency is delayed by years for a long-shelf-life product like honey, while businesses were given a generous two-year window to phase out old stock.

The core flaw of Article 6 is not the existence of a transition period, but that it is open-ended. Had the Directive mandated a strict sunset clause—ruling that old labels could only be sold until June 14, 2027—consumers would have a clear date for total transparency. Instead, "until stocks are exhausted" tethers public transparency entirely to commercial inventory rates.

While packers regularly replenish inventory, and most old labels will naturally disappear within 12 to 24 months, there is a distinct risk that some operators may have deliberately printed massive quantities of old labels right before June 2026 to bypass the stricter rules for as long as possible.

The Unfulfilled Realities of the Two-Year Window

The two-year gap between May 2024 and June 2026 was intended to give the European Commission, competent national authorities, and commercial packers ample time to establish a functional ecosystem.

The EU Commission was expected to:

- Provide validated analytical methods capable of verifying both the countries of origin and the exact percentages declared in a blend.
- Establish a European Union Reference Laboratory (EURL) specifically dedicated to honey authenticity.
- Drive framework discussions within expert groups and the Honey Platform to establish practical enforcement guidelines.

Competent National Authorities were expected to:

- Update national guidance, train inspectors, and adjust local legislation.

Packers were expected to:

- Redesign corporate packaging, update internal traceability software, and adjust purchasing records to list countries of origin in descending order.

Despite these clear expectations, a massive systemic gap remains:

While the amendment successfully introduced stricter origin-labelling obligations, it failed to simultaneously establish the infrastructure required to police them. We now have a law without an accompanying harmonized analytical method, an operational EURL, or a modernized traceability framework capable of scientifically verifying percentage claims.

Consequently, market enforcement relies almost entirely on documentary evidence—purchase invoices, import customs slips, and batch records—rather than laboratory testing. This severely limits the real-world effectiveness of the new consumer protections.

Furthermore, market surveillance remains uneven. In Greece, for instance, competent authorities are not exercising sufficient oversight to ensure the transitional exemption isn't being exploited. There is a very real concern that some packers may have deliberately printed massive quantities of old labels prior to June 2026, knowing they could legally exhaust them over the coming years.

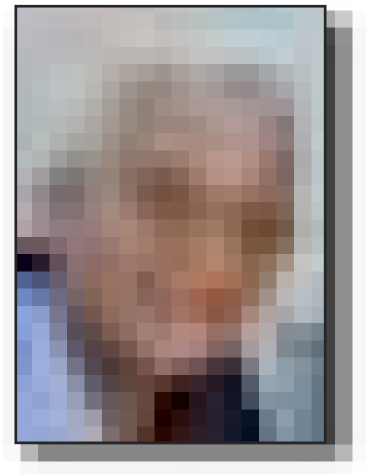
Conclusion

A fundamental question arises: should analytical capabilities and enforcement infrastructure be fully established before legal obligations are codified, or should they develop in parallel? Legally mandating a standard before anyone has the practical tools to verify it is a flawed approach. Yet, this is exactly what has happened to the honey sector.

The European Union is implementing an origin provision 23 years after its original directive, which—when factored alongside these transition windows—stretches the timeline out to nearly 27 years. Even so, the appropriate analytical infrastructure is still missing. The law binds operators to absolute accuracy on their labels but leaves inspectors unable to verify those claims via a laboratory test.

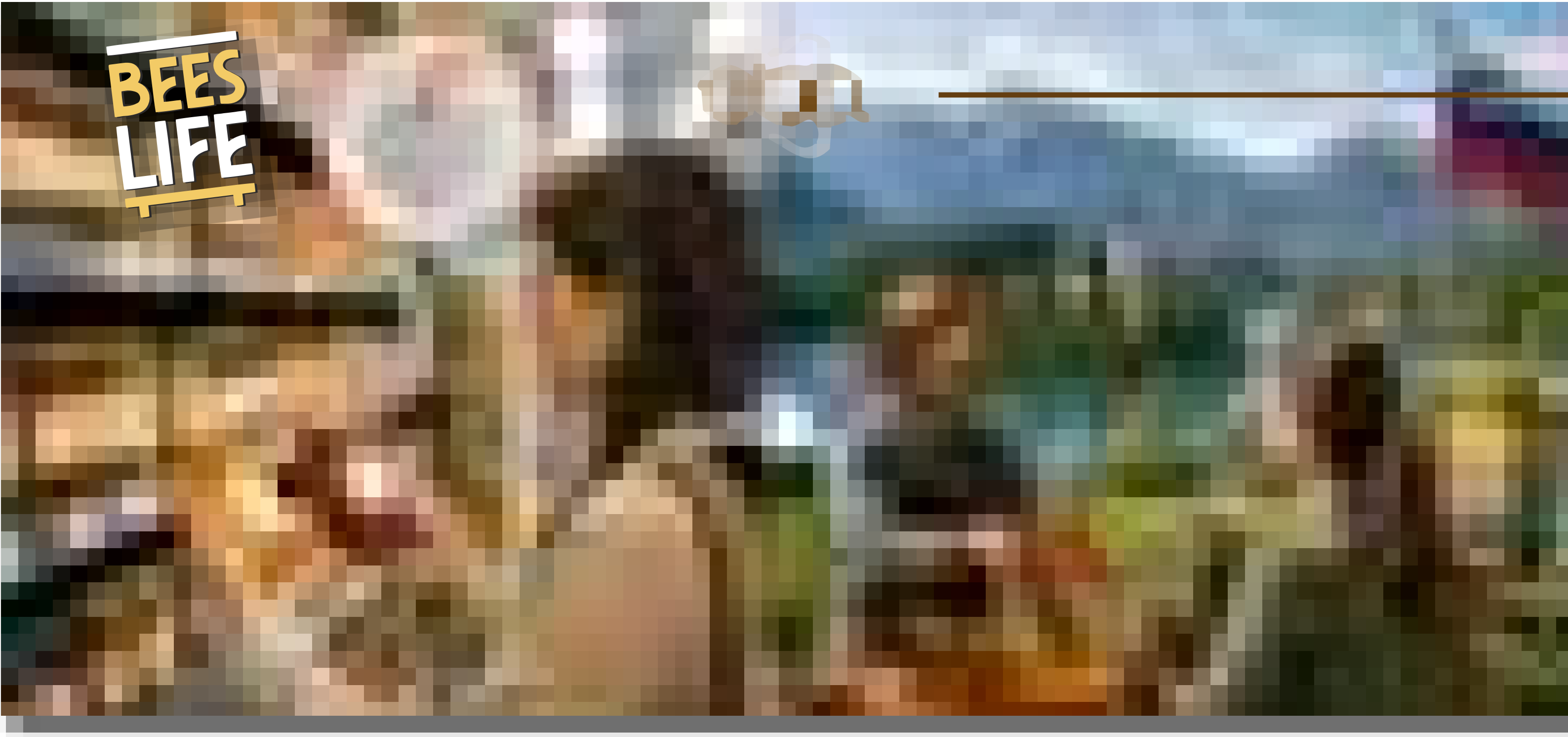
This does not render the new Breakfast Directive useless. Forcing companies to document countries and percentages creates an unprecedented legal accountability mechanism. False declarations can still be prosecuted through standard corporate audits and paperwork tracing. However, until the EU backs its legislation with robust, harmonized scientific verification tools, the true promise of honey transparency will remain trapped on paper rather than realized on supermarket shelves. The law expects operators to tell the truth, even though authorities lack the tools to catch those who do not.

However, laws are only as strong as their mechanisms of verification. Until the EU provides standardized analytical methodologies and strict, proactive market surveillance, the true transparency promised to consumers will remain largely on paper.



Andreas Thrasyvoulou

Emeritus Professor
Aristotle University of Thessaloniki, Greece



REPORT FROM SLOVENIA:

IN ACCORDANCE WITH THE NEW DIRECTIVE, ONLY 1.79% OF HONEY BLENDS IN SLOVENIAN STORES ARE LABELED – GO TO A LOCAL BEEKEEPER!

A month and a half ago, on June 14, 2026, the Rules on the Quality and Labeling of Honey came into force. The key change incorporates Directive (EU) 2024/1438, which requires more precise origin labeling for honey blends. Instead of the old, vague label "blend of EU and non-EU honey," packers must now state all countries of origin alongside their corresponding percentages in descending order in the product's primary field of vision.

Because the Directive includes a safeguard mechanism allowing packers to sell off stocks placed on the market or labeled under the old rules (before June 14, 2026), the situation across Slovenia's six largest retailers remains virtually unchanged. Out of 56 honey blend products counted on store shelves, only one product was labeled in accordance with the new rules—found in a Hofer d.o.o. store. Four products were incompletely labeled, displaying only some countries of origin without their respective percentages. The remaining 51 products still carried the general label "blend of EU honey" or "blend of EU and non-EU honey."

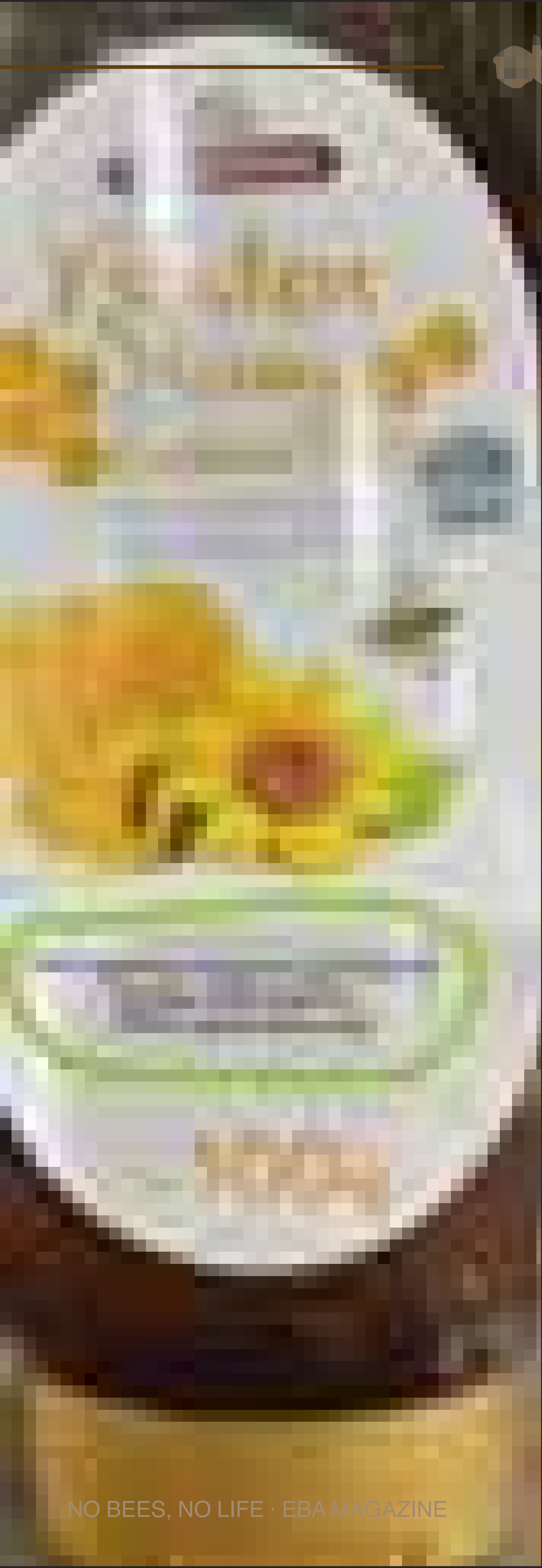
This review confirms that packers intend to fully utilize the transitional period. Even though Directive (EU) 2024/1438 was adopted way back in May 14, 2024, consumers still rarely encounter the new labels on store shelves more than two years later.

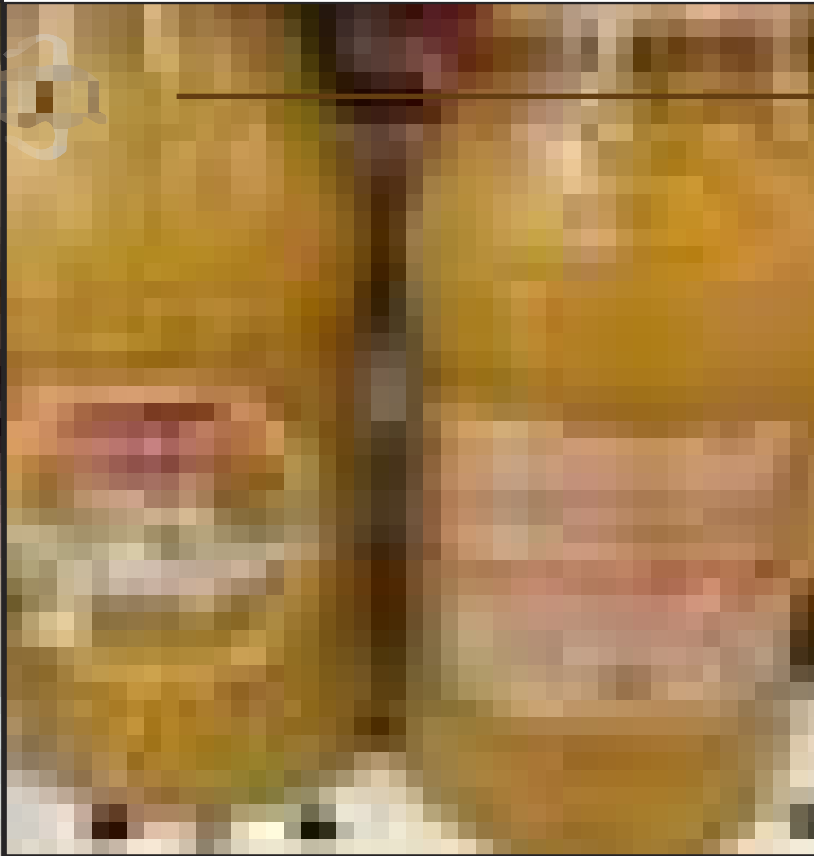
Nevertheless, options do exist in Slovenia: alongside the 56 honey blends from various countries, 36 products of Slovenian origin were also observed. Furthermore, consumers can always purchase bee products directly from local Slovenian beekeepers. To find local suppliers, consumers can also use the Map of Active Producers of Slovenian Honey with Protected Geographical Indication (Slovenski med z zaščiteno geografsko označbo), accessible here: https://www.okusi-med.eu/zemljevid-smgo

Slovenian Beekeeper's Association and the European Beekeeping Association urge other countries to also actively inspect the current situation on the market. It is absolutely key for the consumer to know where honey comes from!

Boštjan Noč

President of the European Beekeeping Association and the Slovenian Beekeeper's Association





The French parliament has reauthorised the exceptional use of nationally banned neonicotinoid pesticides—including acetamiprid and flupyradifurone—triggering deep anger across the beekeeping community.

Environmentalists and French beekeeping unions (UNAF) have condemned the decision as a catastrophic setback for biodiversity and pollinators. Scientific research shows that acetamiprid inflicts neurotoxic damage on honeybees, disrupting their memory, foraging capacity, and colony survival.

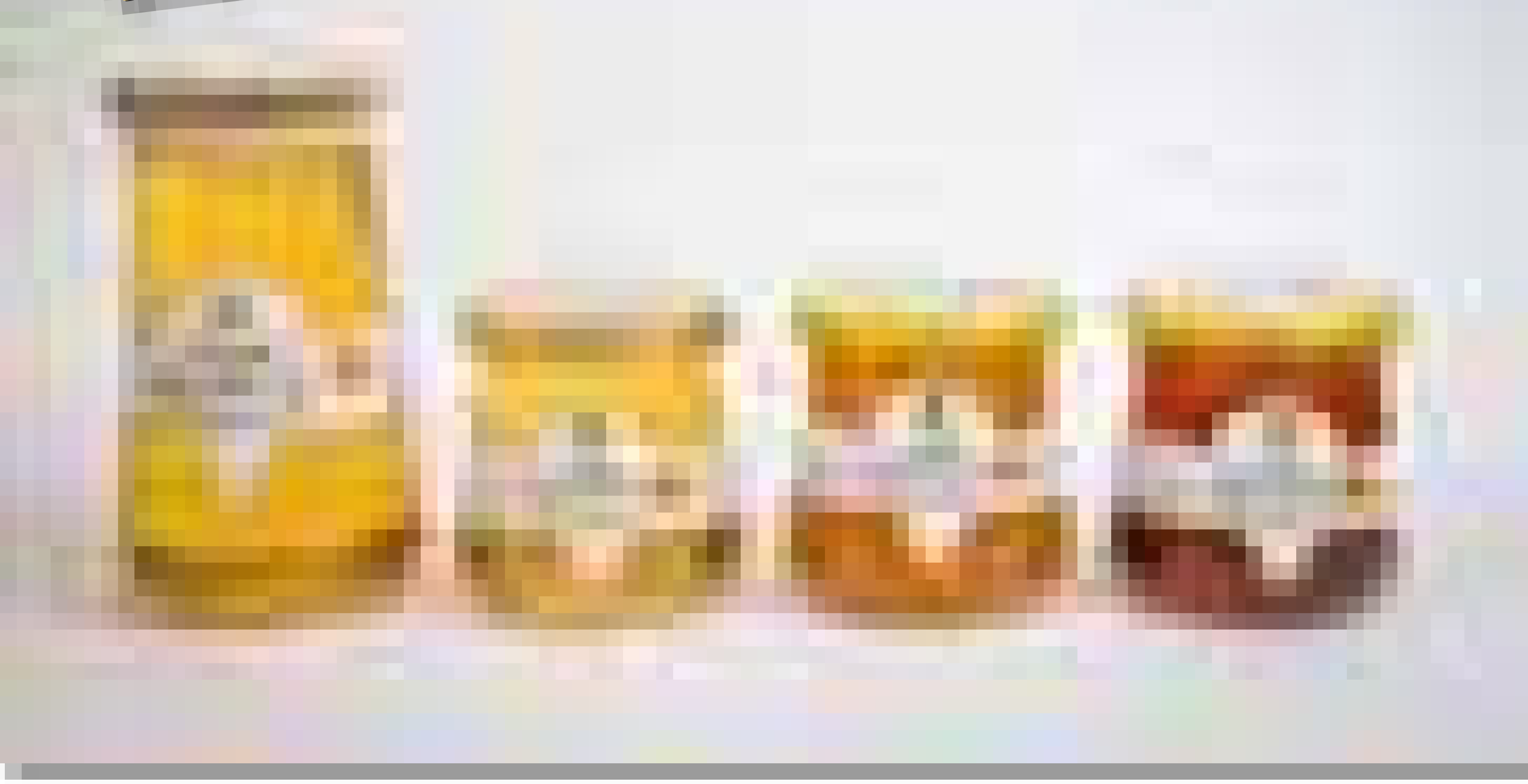
The European Beekeeping Association (EBA) stands fully in solidarity with our French colleagues. Reauthorising bee-toxic chemicals under the guise of agricultural emergencies threatens the future of European apiculture and undermines years of progress in pollinator protection. Bees are fundamental to biodiversity and our food systems; protecting them must remain a non-negotiable priority.

This decision underscores the urgent need for systemic change across Europe. Read the official EBA Position Paper on the Acetamiprid Vote to learn more about our stance against raising pesticide residue limits (voted for by the EU Parliament in December 2025) and how we are fighting to safeguard honeybees, the environment and the consumer.

Article: 'Scandalous, irrational and irresponsible': French beekeepers' fury at lifting of pesticides ban | France | The Guardian

EBA position paper:
https://ebaeurope.eu/acetamiprid-again/

Boštjan Noč
President of the European
Beekeeping Association



HOW TO PRODUCE HIGH-QUALITY MONOFLORAL HONEY FOR SUCCESSFUL SENSORY EVALUATION

Honey contests, including the European honey contest, are not intended solely to identify the best honey. Its primary purpose is to assess honey quality, authenticity, and the characteristic properties of individual honey varieties. One of the most important requirements is the correct botanical classification of the honey.

It is not enough for honey to be of high quality. If it is labelled as acacia (black locust), linden, chestnut, forest, multifloral, or another monofloral honey, it must exhibit the characteristic appearance, aroma, odour, taste, and sensory profile of that variety. During sensory evaluation, one of the most common reasons for lower scores is a mismatch between the declared botanical origin and the actual sensory characteristics of the honey.

Producing Monofloral Honey Begins Before the Nectar Flow

Successful production of monofloral honey requires a thorough knowledge of the nectar and honeydew sources available at the apiary

or at locations where colonies are moved for migratory beekeeping. Beekeepers should closely monitor plant development, weather conditions, and the progress of the nectar flow.

Climate change is increasingly affecting both the timing and intensity of honey flows. Flowering periods are becoming less predictable, and new combinations of nectar and honeydew sources are appearing more frequently. Beekeepers therefore need to determine accurately when the dominant honey flow begins and when it ends.

Strong, Healthy Colonies Are the Foundation of Quality Honey

To make full use of often short honey flow periods, colonies should be healthy, populous, and headed by young, high-quality queens. Colonies must reach peak strength in time for the main honey flow while avoiding weakening through swarming.

Honey production depends not only on foraging bees but also on the many house bees that receive incoming nectar or honeydew, process it, reduce its moisture content, and enrich it with enzymes and other natural substances.

Properly ripened honey with a lower moisture content generally has a more pronounced aroma and flavour, which are key attributes during sensory evaluation. During periods of exceptionally high nectar intake, beekeepers should be aware that bees may cap honey before it has reached optimal maturity.

Timely Harvesting Preserves Botanical Purity

When producing monofloral honey, it is essential that honey supers are extracted and emptied before the next major honey flow begins. This minimizes the risk of mixing honey from different floral or honeydew sources.

Honey should be harvested promptly after the end of the dominant honey flow and before the next significant nectar or honeydew source becomes available. Only in this way can the distinctive characteristics of each honey variety be preserved.

Particular care is required when several important nectar or honeydew sources overlap, such as linden, chestnut, honeydew, or mixed blossom flows. Although these honeys may be excellent products for consumers, they often lack the clearly defined sensory characteristics required for successful classification as a specific monofloral honey during sensory evaluation.

Comb Is the First Container for Honey

The condition of the comb also has a significant influence on honey quality. Fresh, clean comb enables the production of lighter-coloured and purer honey. This is especially important for light-coloured varieties such as acacia (black locust) and linden honey.

Older comb may affect the colour and appearance of honey. In addition, various substances can accumulate in beeswax over time, making regular comb renewal an important component of good beekeeping practice.

Take Care with Feeding and Varroa Control

During late-season honey flows, particular attention should be paid to colony feeding. Bees should not be overfed, as stored sugar syrup may later become mixed with harvested honey.

Effective and timely control of Varroa destructor is equally important. Only approved and properly applied treatment methods should be used, while ensuring that residues from varroa treatments do not contaminate beeswax and, consequently, honey.

Cleanliness and Proper Storage Influence the Final Score

The overall presentation of the sample is also an important part of sensory evaluation. Honey should be clean and free from wax particles, foam, bee parts, or any other visible impurities.

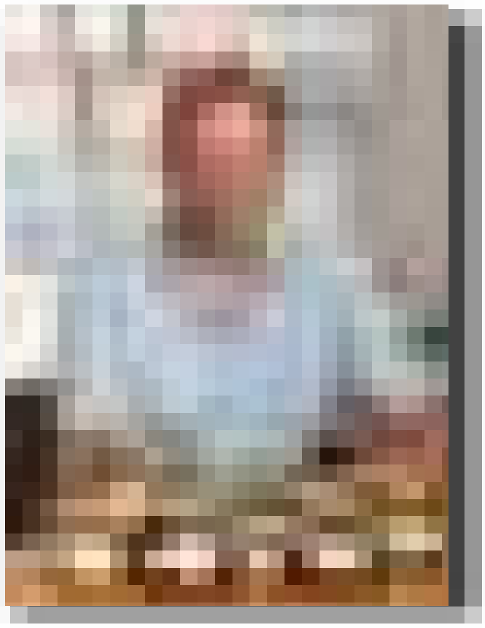
Before submitting a sample, beekeepers are advised to inspect the honey under good lighting. The jar should be perfectly clean, and the honey should be stored correctly, protected from light, excessive temperatures, and foreign odours.

Nothing should be added to or removed from the honey—it should be presented exactly as the bees collected and naturally transformed it.

The Best Honey Is the Result of Good Decisions Throughout the Season

Success in sensory evaluation is not determined solely by favourable weather or an excellent honey flow. It is the result of knowledge, careful observation of nature, proper colony management, timely harvesting, good hygiene, and careful handling of honey throughout production.

Beekeepers who apply good beekeeping practices, understand their local forage conditions, know their colonies well, and combine experience with careful management—and a little help from nature—have the greatest chance of producing monofloral honey whose quality and distinctive sensory characteristics will impress even the most demanding judges.



Klavdijo Babič

Field Beekeeping Advisor
Slovenian Beekeepers' Association

CAN HONEY BEE WINTER LOSSES BE PREDICTED?

The results of numerous studies have confirmed the persistence of several characteristic risk factors (markers) that can be used to predict honey bee colony losses several months in advance and may help beekeepers assess their colonies' chances of successful overwintering.

Honey Bee Losses Worldwide and in Serbia

In recent years, large-scale honey bee colony losses have been recorded during the winter period in many parts of the world. Winter has always been the most critical period for honey bee colony survival, but since the emergence and spread of the parasitic mite Varroa destructor, winter colony mortality has increased dramatically.

During the winter of 2018/2019 (1 October 2018–1 April 2019), winter colony losses in the United States amounted to 37.7%, according to a survey involving 47,000 beekeepers managing approximately 12% of all managed honey bee colonies in the country. This represented an increase of 7 percentage points compared with the previous year (30.7%) and an increase of 8.9 percentage points compared with the 13-year average winter loss rate of 28.8%. It was

Varroa destructor – the leading cause of winter honey bee colony losses
(Photo: Maja Dumat – CC BY 2.0)

the highest winter loss rate recorded since the survey began in 2006/2007 (Bee Informed Partnership).

At the end of July 2019, the Canadian Association of Professional Apiculturists published the results of its survey of honey bee colony mortality during the winter of 2018/2019. During this period, 25.7% of colonies were lost. This was close to the average loss recorded since winter colony mortality monitoring began in 2007. Losses varied considerably among provinces, ranging from 19.8% in Nova Scotia to 54.1% on Prince Edward Island. During the winter of 2017/2018, colony losses amounted to 32.6%.

Results from the COLOSS survey, which included 25,363 beekeepers from 33 European countries, as well as Algeria, Israel and Mexico, showed an average winter colony loss rate of 16.4% during 2017/2018, with considerable variation among countries, ranging from 2.0% to 32.8% (Journal of Apicultural Research, Volume 58, 2019, Issue 4).

Average colony losses in Serbia during the 2017/2018 season were only 7.4%.

This was considerably lower than the losses recorded in Serbia during the previous year, as well as the average loss rate of 16.4% recorded across the 36 countries included in the survey that season.

It was also lower than the losses recorded in Croatia (13.7%) and Macedonia (13.2%) (Stevanović et al., 2019).

Varroa and Viruses as the Main Predictive Markers

The single most important factor associated with winter colony losses remains Varroa de-

Visible signs of DWV usually become apparent only when a colony is heavily infested with Varroa mites (Photo: scientificbeekeeping.co.uk/DWV.html)

structor. However, it is now clear that the greatest damage is caused not merely by the presence of Varroa mites themselves, but by their interaction with Deformed Wing Virus (DWV).

The most widespread and damaging parasite shown to affect honey bee populations worldwide is the parasitic mite Varroa destructor (Rosenkranz et al., 2010).

Among the numerous factors considered responsible for winter honey bee colony losses, Varroa destructor ranks first, followed by viruses and the microsporidian Nosema ceranae.

Long-term research conducted at the Swiss Bee Research Centre in Bern (2012) showed that Deformed Wing Virus (DWV), Nosema ceranae, Varroa destructor and vitellogenin are reliable indicators that can be used to predict winter colony losses with a relatively high degree of confidence. The individual contribution of each of these factors varied from year to year.

Varroa destructor is considered the most common cause of winter honey bee colony mortality in Europe.

Viral infections are also regarded as one of the major causes of colony losses, with Varroa again playing a crucial role as both a mechanical and biological vector of several viruses, thereby accelerating the spread of infection.

Although 19 different viruses associated with the Western honey bee, Apis mellifera, had been identified at the time—and more recent research has suggested as many as 23—researchers have linked only three viruses particularly closely with large-scale winter colony losses: Deformed Wing Virus (DWV), Acute

Bee Paralysis Virus (ABPV) and Israeli Acute Paralysis Virus (IAPV).

Taken together, Varroa destructor infestation and DWV infection represent the most reliable predictors of winter honey bee colony losses.

The aforementioned study showed that all colonies that had not been treated against Varroa—11 of the 29 colonies included in the experiment—had died by the end of December, while two of the 18 appropriately treated colonies died during February.

The colonies that died during winter (13 in total) had significantly higher Varroa infestation levels during summer, autumn and winter than the colonies that survived (16 in total).

This provides strong evidence that the level of Varroa infestation is a highly reliable indicator of subsequent overwintering success.

The Varroa population in colonies that eventually died increased over time, reaching a peak in October, after which it began to decline in proportion to the decreasing adult bee population within the colony.

When the Varroa population exceeds approximately 2,000–3,000 mites per colony during autumn, most bees entering the overwintering period become susceptible to DWV infection, which can ultimately result in colony collapse during winter. This occurs because the new brood produced during this period is insufficient to compensate for the loss of infected overwintering bees that die during winter (Martin, 2001).

Even when larvae affected by DWV and Varroa survive, the resulting adult bees may exhibit altered behaviour, impaired learning ability and reduced longevity (Iqbal and Mueller, 2007; Benaets et al., 2017; Nazzi and Pennacchio, 2018).

The Fat Body and the Quality of Winter Bees

The honey bee fat body is a key organ involved in immunity, nutrient storage and vitellogenin synthesis. Damage to this tissue during August and September can therefore have a major influence on the quality and longevity of winter bees.Because of the close biological association between DWV and Varroa mites, the study found high levels of DWV in honey bee colonies during summer and early autumn. Following treatment of colonies against Varroa, DWV levels also declined dramatically.

This confirmed the previously established finding that this virus is transmitted relatively slowly horizontally—that is, from one bee to another—while vertical transmission from one generation to the next is unlikely, by itself, to result in high levels of infection in subsequent generations.

Colonies that died during winter were found to have higher DWV loads than colonies that survived.

The virus was also shown to replicate in various honey bee tissues, including the fat body, which plays a key role in numerous physiological processes, particularly immune function, nutrient metabolism and the production of the protein vitellogenin.

Vitellogenin is closely associated with honey bee immunity and longevity and is particularly important for the physiology and extended lifespan of winter bees.

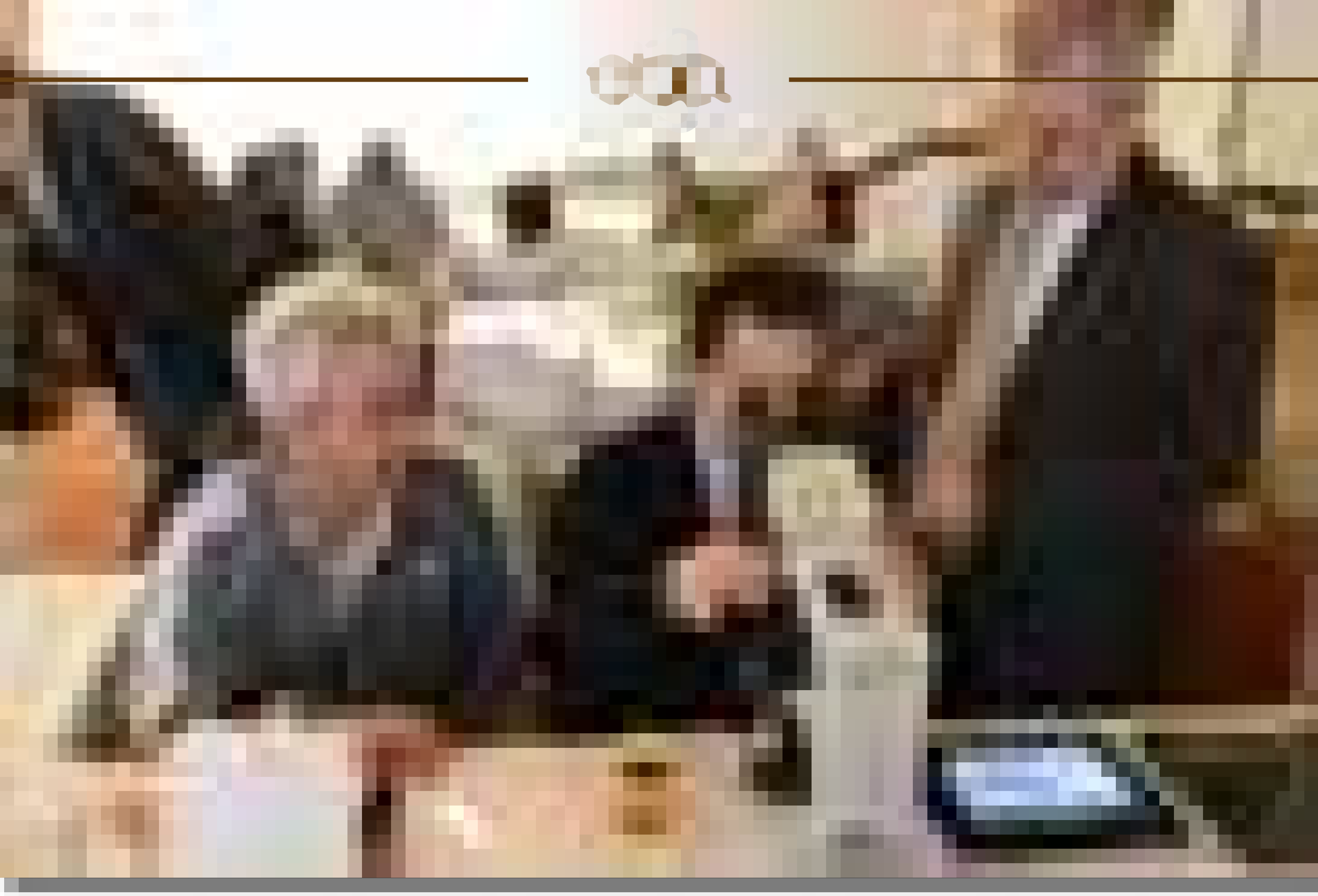
Researchers therefore consider DWV infection to be a likely cause of the significantly lower vitellogenin levels observed in colonies that subsequently died during winter.

Nosema ceranae — A Commonly Detected Pathogen

Another pathogen associated with winter honey bee colony losses is the microsporidian Nosema ceranae, although, according to many researchers, the impact of this pathogen on honey bee health in Europe remains controversial.

The presence of Nosema ceranae is considered relatively common, even in the absence of clinical signs.

Recent studies indicate that this honey bee pathogen has not been responsible for large-scale colony losses in Europe, with the notable exception of Spain (Barroso-Arévalo et al., 2019).



Zoran Stanimirović PhD, testing for the presence of Nosema infection

The results of the Swiss study also support the conclusion that N. ceranae is not a major cause of widespread winter colony losses. Levels of infection with this pathogen were almost identical in colonies that died and those that successfully overwintered.

Likewise, no increase in N. ceranae infection levels was observed from summer into autumn, or even in December, when the colonies died.

Furthermore, N. apis was not detected in any of the samples, despite the fact that this species is better adapted to lower temperatures than N. ceranae and might therefore be expected to occur more frequently in the colder climatic regions of northern Europe.

Nutrition and Climatic Stress

Prolonged droughts and unusually warm autumn periods can reduce pollen quality and extend the reproductive period of Varroa destructor, thereby increasing viral pressure on the colony.

Subtle indicators of increased winter-loss risk

Subtle indicators of increased winter-loss risk include:

* high Varroa infestation levels in late summer;

* a rapid decline in colony strength following the main nectar flow;

* a reduction in the area of healthy, high-quality brood; and

* poor pollen intake during the period when winter bees are being reared.

Conclusion

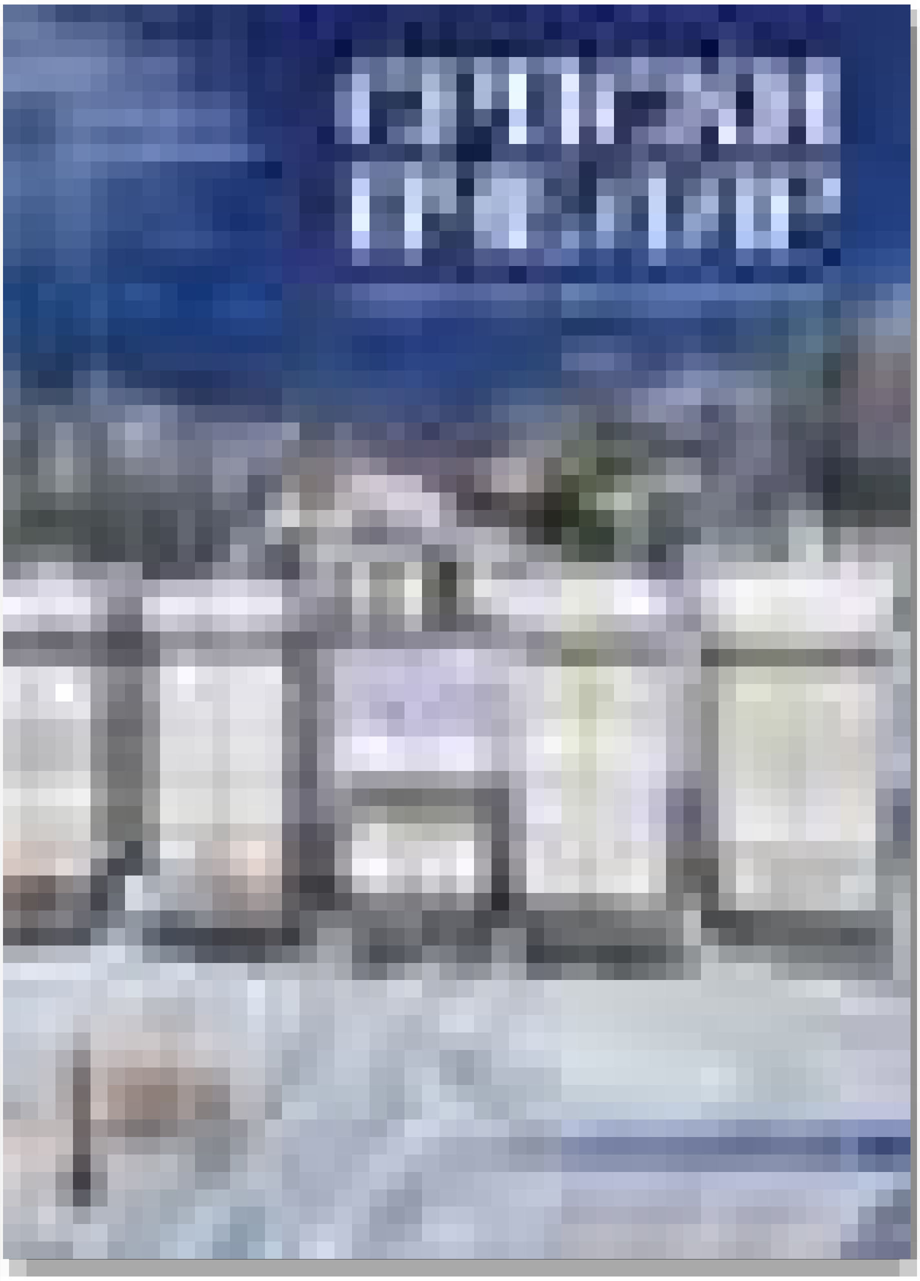
Based on the four indicators (markers) described above, winter honey bee colony losses can be predicted with a relatively high degree of reliability.

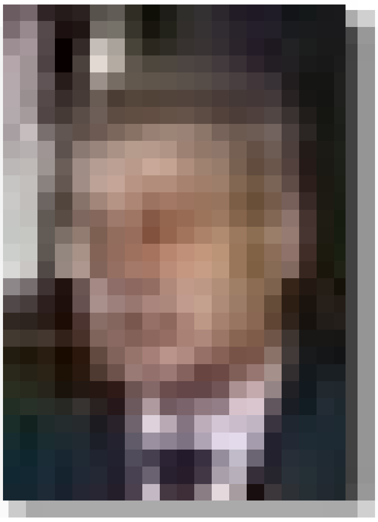
Among these, Varroa destructor and DWV have been identified as the most important predictors of winter colony mortality.

Since winter bees are reared from approximately mid-July to mid-September, beekeepers are advised to assess Varroa infestation levels well before the end of summer. Early monitoring makes it possible to identify colonies at increased risk and take appropriate action while there is still sufficient time to protect the generation of bees that will have to survive the winter.

The most important assessment of a colony's overwintering risk should therefore not be made in November, but between late July and late September.

It is during this critical period that the quality and longevity of winter bees, Varroa infestation levels, viral load, and ultimately the colony's ability to survive until spring are largely determined.





Vlastimir Spasić

Editor-in-Chief of the Serbian beekeeping magazine "Serbian beekeeper - Srpski pčelar"

+381 60/444-0110
srpskipcelar@gmail.com

INDIVIDUAL-LEVEL COMPARISONS OF HONEY BEE (Hymenoptera: Apoidea) HYGIENIC BEHAVIOR TOWARDS BROOD INFESTED WITH VARROA DESTRUCTOR (Parasitiformes: Varroidae) OR TROPILAELAPS MERCEDESAE (Mesostigmata: Laelapidae)

ABSTRACT

The mites Varroa destructor Anderson and Trueman and Tropilaelaps mercedesae Anderson and Morgan are both serious threats to the Apis mellifera beekeeping industry. A trait frequently used in selection programs for V. destructor resistance is hygienic behavior, the selective removal of diseased/damaged brood. Here, we measured the level of association of the expression of hygienic behavior against both mites in A. mellifera, by observing whether the same individual bees would carry out the opening and removal of brood infested by the two parasites. The groups of bees showing these behaviors on cells artificially infested by either parasite showed a large overlap, making it appear likely that the two traits are at least closely coupled. Therefore, breeding for V. destructor resistance based on hygienic behavior could prepare A. mellifera populations for dealing with Tropilaelaps sp. mites, and vice versa. Using the same bioassay, we also compared the hygienic behavior of A. mellifera towards T. mercedesae to that of the Asiatic honey bee, Apis cerana. A. cerana workers eliminated a greater proportion of infested cells, which may in part explain the resistance of this bee to Tropilaelaps and the observation that Tropilaelaps reproduction on brood of this species is extremely rare.

1. INTRODUCTION

Parasitic mites and associated pathogens are among the most frequent causes of Apis mellifera (L.) colony losses in most parts of the world [1–4]. In Europe, North and Central America, and most of temperate Asia, Varroa destructor (Anderson and Trueman) is by far the mite species with the greatest economic impact. In those parts of Asia in which the introduced A. mellifera coexists with autochthonous giant honey bees (Apis dorsata, Apis breviligula, and/or Apis laboriosa), mites of the genus Tropilaelaps are often equally or even more damaging to the A. mellifera beekeeping industry [5,6].

The Asian giant honey bees are thought to be the original hosts of the genus Tropilaelaps [5].

Like V. destructor, all four Tropilaelaps species reproduce inside capped brood. Two species, Tropilaelaps clareae and Tropilaelaps mercedesae, are known to cause damage also to A. mellifera colonies, and at least T. mercede-

sae (Anderson and Morgan) is capable of transmitting Deformed Wing Virus as well as black queen cell virus [7,8]. Unlike V. destructor, adults of T. mercedesae also feed on early larval stages of A. mellifera [6]. It is not clear, however, whether mites of the genus Tropilaelaps are able to feed on adult bees, and they survive for only a few days if the host colony is broodless [5]. This is thought to be an important limiting factor of the spread of this genus of bee parasitic mites. However, the main condition for T. mercedesae survival, continuous brood rearing, is fulfilled in many parts of the distribution area of the western honey bee, and there are indications that the mite may also survive on rats [9]. Therefore, tropilaelapidosis is seen as a serious risk to A. mellifera beekeeping worldwide [10].

The best-studied Asian honey bee, Apis cerana (Fab.), appears to be resistant to both mites of the genus Tropilaelaps and V. destructor [11–13]. In the case of V. destructor, this resistance is probably due to a combination of behaviors of the adult bees, including grooming, “entombing” of infested drone pupae, and removal of infested worker brood, with the inability of the mite to reproduce on worker brood [11,14,15]. In the case of T. mercedesae, grooming behavior seems to play an important role [16]. Whether A. cerana removes T. mercedesae-infested brood has not yet been tested to our knowledge.

Beekeepers working with A. mellifera in regions where either T. mercedesae or T. clareae occur have to find ways to control these parasites, since untreated Tropilaelaps infestations regularly lead to colony collapse in this honey bee species. Although chemical treatments used to control V. destructor seem, for the most part, also effective against mites of the genus Tropilaelaps [17–19], the availability of resistant stocks of bees would represent a more sustainable solution. In the case of V. destructor, more than four decades of selective breeding, as well as natural selection of resistance traits in isolated populations, are finally beginning to show results [20–24]. Hygienic behavior, the detection and removal of damaged/diseased brood by worker bees, affects mite reproductive success [15] and is central to many resistance breeding programs. Khongphinitbunjong et al. [25] have studied T. mercedesae non-reproduction and infested brood removal by A. mellifera worker bees in Thailand, where bees of this species have been exposed to T. mercedesae for many years. They found removal rates of artificially infested brood of 53%, and high rates of non-reproduction on artificially and naturally infested A. mellifera brood. This seems to indicate that in A. mellifera, hygienic behavior could be a promising resistance trait not only with regard to varroosis, but also to tropilaelapidosis. An important question now is whether the removal of T. mercedesae- and V. destructor-infested brood really constitutes the same trait. Given that the type of injuries produced by feeding of T. mercedesae on larvae and pupae is distinct from that produced by V. destructor [6,26], it may be hypothesized that different genetic specializations are required on behalf of the hygienic workers in order to sense them across the cell capping. Also, the role of hygienic behavior in A. cerana resistance to T. mercedesae remains to be elucidated.

In the present study, we aimed to:

(1) Compare hygienic behavior of A. mellifera and A. cerana against T. mercedesae. For this, we first observed hygienic behavior separately in monospecific groups of bees. We then went on to observe mixed groups of bees on brood of either species. This was done with the objective of comparing their reaction to strictly identical removal stimuli.

(2) Verify whether hygienic behavior against T. mercedesae and V. destructor are co-expressed in A. mellifera, by determining whether the same individual worker bees perform these behaviors.

2. MATERIAL AND METHODS

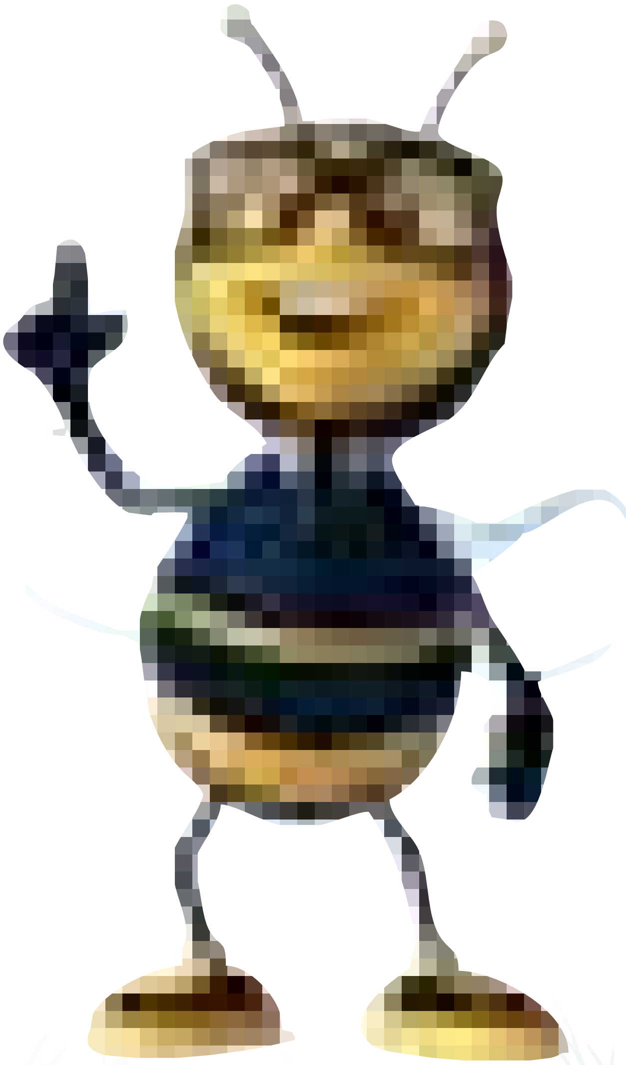
2.1. Bees and Mites

The experiments were performed in an experimental apiary in Kathmandu, Nepal. Colonies of

A. mellifera used in the study included local hybrids as well as hives headed by Apis mellifera carnica queens imported from Germany. A. cerana was represented by colonies from three Nepalese regions, the Terai, the Kathmandu Valley, and the mountains around this valley. Bees from the different stocks within both species were mixed in the experiments, equalizing the numbers of bees from each stock as far as possible. All mites were obtained from local A. mellifera colonies, and were collected from newly-capped brood (prepupal or white-eyed stages). Great care was taken not to injure the brood while collecting the mites, and also in order to avoid contamination through leaking body fluids. The species affiliation of V. destructor and T. mercedesae was verified morphometrically by applying published identification keys [12,27].

2.2. Bioassay for Observing Hygienic Behavior

The bioassay used is described in detail in [28] and is depicted in Figure 1. The day before



an experiment, combs of emerging brood were removed from the source colonies. An additional comb of freshly-capped brood was taken from a donor colony, unrelated to the bees used in the experiment, to be used for artificial infestation. Source colonies of these combs were treated with Amitraz, and were monitored for infestation by opening variable numbers of brood cells in order to avoid using brood with sizeable natural infestation. Between 20 and 35 mites were introduced into brood cells with a brush (one per cell) after carefully opening the cells with a razor blade. The caps were closed again, and their positions marked on transparency sheets. Between three and five cells were opened and closed without the introduction of a mite ("sham-manipulation"), and served to check whether brood removal was due to the presence of the mite or to manipulation of the cell. The comb was then placed inside a hive previously shown to present little brood hygiene, for repair of the manipulated cell caps. Groups of 1100–2100 newly-emerged (<24-h-old) worker bees were individually labelled with opalith plates of different shapes and orientation, using nail polish (Maybelline Express; L'Oréal, Paris, France) as glue. After 24 h, the manipulated comb was placed in a wire mesh cage with one glass side. The labelled bees were introduced together with a mated queen, and the cage was placed inside a strong colony of the same species as the labelled bees, with the glass pane facing an opening in the side wall of the hive. In cases where a mix of cerana and mellifera workers were used, the species of the fostering colony was alternated between repetitions of the experiment. Hygienic behavior was then observed under infrared illumination with the help of a suitable CCTV camera (PS/DX4-285GE; Kappa optronics, Gleichen, Germany). Observations were recorded continuously for 4–5 days (corresponding to days 2 to 5–6 post-infestation), and later viewed. From these videos, we determined the time of cell openings, as well as the identity of the bee initiating the cell opening, and of the first two bees continuing with this task. In order to limit the effort required to analyze the ~2400 h of video material, we only looked at those cells that had been emptied at the end of the experiment. Only the event that ultimately led to the removal of the pupa was observed. Potential earlier attempts at uncapping and events of re-capping could not be included. The intensity of these behaviors was judged as either "low" (a bee nibbling briefly at a cell cap and then leaving), "medium" (a bee nibbling repeatedly with brief interruptions or for a period of up to 30 s), or "high" (sustained nibbling for >30 s).

2.3. Comparisons

The above-described assay was performed 19 times, with a total of 35,910 tagged worker bees:

(1) Five times with A. cerana bees on A. cerana brood (designated below as "cbees_cbrood").

(2) Four times with A. mellifera bees on A. mellifera brood ("mbees_mbrood").

(3) Eight times with equal numbers of bees from both species and alternating origins of brood ("xbees_xbrood").

(4) One time with A. cerana bees on A. mellifera brood ("cbees_mbrood").

One round of the experiment could not be used, because bees started to indiscriminately remove all brood, possibly due to overheating. V. destructor and T. mercedesae mites were used together in the same experiments at a ratio of approximately 1:2. In four of the experiments with A. cerana bees on A. cerana brood, only T. mercedesae mites could be used because no V. destructor mites were available.

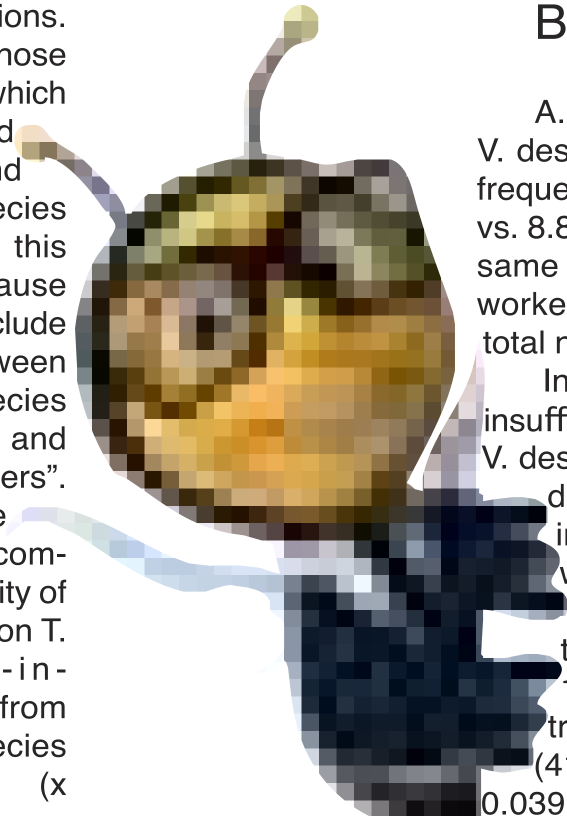
2.4. Data Analysis

All statistical analyses were conducted using IBM SPSS software (IBM, Amonk, NY, USA).

We first verified, for each of the bees/brood combinations cbees_cbrood, mbees_mbrood, and xbees_xbrood, whether hygienic behavior was specific to infested cells, i.e., whether the bioassay really allowed us to observe mite-related responses. We did this by comparing removal ratios using the χ^2 test. These tests were performed separately for T. mercedesae- and V. destructor-infested cells.

Next, we compared the removal dynamics of Tropilaelaps-infested brood among the three bee/brood combinations cbees_cbrood, mbees_mbrood, and xbees_xbrood. This was done using Kaplan–Meier analysis with pairwise comparisons (Mantel–Cox test). In the case of the experiments with mixed worker bees (xbees_xbrood), experiments with A. mellifera brood and with A. cerana brood were distinguished, in order to also visualize the role of the species of brood used.

We then went on to compare the efficiency and intensity of cell opening behavior towards T. mercedesae - and V. destructor-infested brood in A. mellifera using $\chi 2$ tests on the frequency distributions. Only data from those experiments in which bees and brood were of one and the same species were used for this analysis, because we could not exclude interactions between the factors “species of brood” and “species of workers”. In a separate analysis, we compared the intensity of opening events on T. mercedesae-infested brood from the mixed-species experiments (x bees_x brood), contrasting cases in which workers had opened brood of their own or the other species.



Finally, we investigated whether a bee involved in the opening of cells infested by one of the two mite species had a greater-than-arbitrary probability of also being involved in the removal of the other. For this, we calculated the proportions of both T. mercedesae- and V. destructor-infested cell-openers in all bees in the experiments. We multiplied these two probabilities to obtain the likelihood of any bee to become an opener of both types of cells, under the hypothesis that the two traits occurred independently. This theoretical likelihood was then compared with the observed frequency of openers f both cell types using the $\chi 2$ test. This analysis was performed only for A. mellifera bees, because too few cases of A. cerana opening V. destructor-infested cells were available, due to the lack of V. destructor mites during experiments with this bee species.

The significance level of the type 1 error for all tests was 0.05.

3. Results

3.1. Specificity of Opening Behavior to Infested Cells

A. mellifera workers opened and removed V. destructor-infested brood significantly more frequently than sham-manipulated brood (45.5 vs. 8.8%; total n = 56; $\chi 2 = 5.5$; $p = 0.017$). The same was true for mixed-species groups of worker bees (xbees_xbrood; 43.6 vs. 18.2%; total n = 61; $\chi 2 = 8.4$; $p = 0.004$).

In the cbees_cbrood experiments, insufficient numbers of cells were infested with V. destructor to carry out the test. Similar to V. destructor, the removal of T. mercedesae-infested larvae/pupae by A. mellifera workers was a specific response to infestation, rather than to the manipulation of the cells alone (37.6 vs. .8%; total n = 121; $\chi 2 = 4.1$; $p = 0.043$). This was also true for the xbees_xbrood experiments (41.3 vs. 18.2%; total n = 148; $\chi 2 = 4.2$; $p = 0.039$). The frequency of removal of T. mercedesae-infested brood byA. cerana (experiments cbees_cbrood), however, was not significantly different from that observed in sham-manipulated brood (37.6 vs. 20.0%; total n = 129; $\chi 2 = 2.3$; $p = 0.13$).

3.2. Comparison of Removal of T. mercedesae- and V. destructor - Infested Brood Cells by A. mellifera Here, “survival” means that brood was not opened and removed by the worker bees. The graph is based on a total of 745 artificially infested cells. The period of 0–24 h post-infestation is not displayed, because combs were placed inside a non-hygienic hive for repair of manipulated cell caps by the bees.

Figure 1.
Experimental setup for the observation of hygienic behavior

The time course of brood survival differed significantly between T. mercedesae- and V. destructor-infested cells ($\chi 2 = 11.3$; df = 1; p = 0.001).

The graphs are based on the following numbers of observations (= opening events; from left to right): 38; 49; 54; 22. In the case of cerana bees observed on cerana brood, no cells were infested with V. destructor mites. The intensity of opening behavior shown by A. mellifera bees was not different for T. mercedesae- and V. destructor-infested brood of this same species (left part of graph; $\chi 2 = 3.9$; p = 0.14). Different combinations of the factors "species of bees" and "species of brood" produced different intensities of opening behavior towards Tropilaelaps-infested brood (comparison of the four parts of the graph; $\chi 2 = 14.9$; p = 0.02); n.a.: not analyzed.

Figure 2 depicts the time course of infested brood removal of larvae/pupae for the two species of mites. Only A. mellifera bees observed on A. mellifera brood are included here. It shows that, although both types of infested brood are removed, V. destructor-infested cells are emptied slightly faster and to a greater proportion (log-rank test; $\chi 2 = 11.3$; df = 1; p = 0.001; total number of cells observed = 745). The intensity of removal behavior of A. mellifera towards T. mercedesae- and V. destructor-infested brood was not different, however (initiation of uncapping: $\chi 2 = 3.9$; total n = 49; p = 0.14; continuation of uncapping/removal: $\chi 2 = 0.1$; total n = 89; p = 0.98; data for initiation of uncapping shown in Figure 3). The chance of any A. mellifera worker bee to perform com-

Figure 2.
Survival of Tropilaelaps mercedesae or Varroa destructor-infested brood by Apis mellifera worker bees

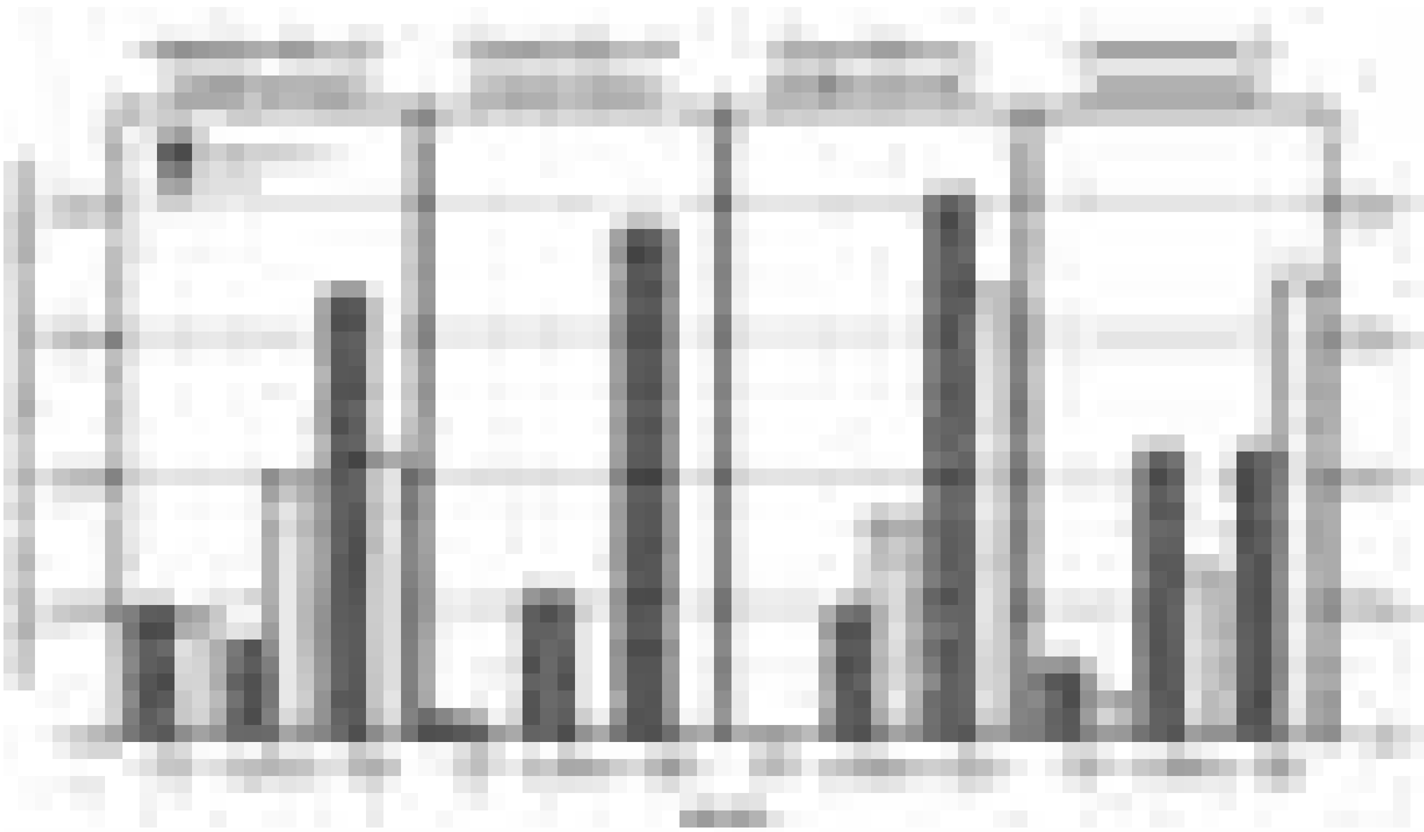


Figure 3.
Intensity of cell opening behavior towards V. destructor- and T. mercedesae-infested brood

ponents f hygienic behavior on both T. mercedesae- and V. destructor-infested brood was far greater than ould be expected if the two traits had occurred independently of each other ($\chi2 = 9.0$; df = 1; total n = 1213; $p = 0.003$).

3.3. Comparison of Tropilaelaps Removal by A. mellifera, A. cerana, and Mixed-Species Groups of Worker Bees Here, “survival” means that brood was not opened and removed by the worker bees. The graph is based on a total of 1228 artificially infested cells. The period of 0–24 h post-infestation is not displayed, because combs were placed inside a non-hygienic hive for repair of manipulated cell caps by the bees. The time course of brood survival differed significantly between treatments ($\chi2 = 26.8$; $p < 0.001$).

Figure 4 compares the cumulated survival over time of Tropilaelaps-infested cells in the treatments mbees_mbrood, cbees_cbrood, and xbees_xbrood. It can be seen that A. cerana bees, when bserved on their own brood and in the absence of A. mellifera workers, showed the fastest removal of infested brood, and also removed the greatest proportion of it. This difference was significant for the comparisons with mbees_mbrood, as well as with xbees_cbrood ($\chi2 = 20.7$ and 7.3; $p <0.001$ and 0.007), while it was marginally non-significant in the case of xbees_mbrood ($\chi2 = 3.2$; $p = 0.075$). The three sets of experiments in which mellifera workers were used, either alone or in combination with A. cerana, formed a homogeneous block ($\chi2 = 2.3$–3.8; $p = 0.127$–0.053), indicating that the presence or absence of A. cerana workers did not influence hygienic behavior in these experiments. A. cerana and A. mellifera did not differ with regard to the median duration of uninterrupted cell opening events, although the range of durations was far wider in A. cerana (total n = 167; A. cerana: median = 104 s (7 to 5569); A. mellifera: median = 94 s (1 to 630)). The intensity of initiations of cell openings was generally quite similar in all treatments, but judged slightly lower in the case of xbees_cbrood than in the others

Figure 4.
Survival of T. mercedesae-infested Apis cerana and A. mellifera brood in the presence of workers of both species

($\chi 2 = 14.9$; $n = 169$; $p = 0.02$; Figure 3). In contrast, the intensity of continuations of cell opening and brood removal was lowest in treatment bees_mbrood ($\chi 2 = 13.2$; $n = 262$; $p = 0.04$; data not shown).

3.4. Hygienic Behavior in Mixed Groups of Worker Bees

Hygienic behavior in mixed groups of workers (experiments x brood_x bees) was almost exclusively performed by A. mellifera bees, despite the fact that equal numbers of individuals from both species were present, and regardless of the species affiliation of the brood (173 observed actions of initiation or continuation by A. mellifera vs. only 4 by A. cerana). In order to clarify whether the absence of hygienic behavior by A. cerana on brood of A. mellifera was due to factors linked to the brood, we performed an additional experiment in which an A. cerana-only group of worker bees was placed on infested mellifera brood. In this experiment, 16 infested pupae out of 25 were removed.

The fact that, in each of the xbees_xbrood experiments, one half of the bees was confronted with brood from another species did not lead to indiscriminate removal of brood. This is illustrated by the removal of sham-manipulated cells, which was not greater in the “xbees_xbrood” experiments than in the mbees_mbrood or cbees_cbrood experiments ($\chi 2$ = 1.6; df = 2; total n = 86; p = 0.46).

4. DISCUSSION

It has been reported several times that T. mercedesae, like V. destructor, can trigger hygienic behavior towards infested brood in Apis mellifera ([25,29], Ritter and Schneider-Ritter 1987; as cited in [15]). Our data confirm this finding. Khongphinitbunjong et al. [25] have also shown that T. mercedesae reproductive success in cells targeted by hygienic behavior is effectively reduced. However, while the earlier authors agree on the fact that cells singly infested by T. mercedesae females are removed faster than cells singly infested by V. destructor, our results point to the contrary. It may be speculated that differences between local strains of the two mite species are responsible. The two earlier studies were performed with locally-occurring mites in Thailand, while ours was performed in Nepal. According to Anderson et al. [30], at least two different haplotypes of T. mercedesae are present in Thailand, one of which is the “mainland Asia” type also found in both India and China, the two neighboring countries of Nepal. Samples of V. destructor from the Kathmandu region have been genotyped by Solignac et al. [31]. They presented an unusually high heterozygosity in microsatellite markers, and were classified as belonging to the rare “Japan” haplotype, based on the analysis of mtDNA. This haplotype is thought to show a lower virulence than the more common “Korean” haplotype [31]. Our bioassay involved the transfer of mites from early capped stages of donor brood to similar stages of recipient brood. As reproduction of both V. destructor and T. mercedesae started shortly after cell capping [26,32], the transfer might have interrupted reproduction, thereby influencing the onset of reproduction-related removal stimuli. From earlier experiments, we know that most transferred mites nevertheless manage to produce viable offspring. As a possible retardation of reproduction would concern both mites alike, it can be assumed to be of minor importance for the interpretation of the present results.

For more than 30 years now, big efforts have been, and are being, made to increase the prevalence of hygienic behavior (and related traits such as Varroa sensitive hygiene/suppressed mite reproduction) in populations of A. mellifera in many parts of the world [28,33–39]. If it can be shown that hygienic behavior against V. destructor and against T. mercedesae are really the same trait, or at least closely coupled, then this would mean that breeding for V. destructor resistance through selection on hygiene traits is also a preventive strategy in view of a possible introduction of T. mercedesae. It has been reported that lines of bees partially resistant to the latter (from a commercial strain used in Thailand) and bees partially resistant to V. destructor (ARS (Agricultural Research Service) “Russian bees”) are characterized by similarly high levels of hygienic behavior, as measured by the freeze-killed brood assay, making it likely that the genetic bases of V. destructor- and T. mercedesae - specific hygiene are at least linked [40]. Even in strongly hygienic colonies, recognition and removal of damaged brood is a behavioral specialization only expressed by a small minority of the worker bees [28]. Our data now show that V. destructor- and T. mercedesae-infested cells are often opened by the same specialized individuals, meaning that the two traits were coupled or identical. This strongly suggests a close association of the two traits.

It is known that A. cerana workers remove V. destructor-infested worker brood with far greater efficiency than A. mellifera workers [11,41]. We show here that this is also true for T. mercedesae -infested brood. This may seem surprising given that brood removal is thought to be triggered by stimuli linked to the reproduction of mites on the brood [42], and that T. mercedesae only very rarely reproduces on A. cerana pupae [30]. An explanation could be that hygienic behavior is the reason for Tropilaelaps non-reproduction. Another explanation may lay

in the fact that mite infestations are often lethal to A. cerana pupae [43], and that dead pupae presumably emit stronger cues for removal. Viral replication, which has also been reported to increase the likelihood of mite detection inside brood [44], is triggered by feeding of the parasite on its host, and so may also be involved in T. mercedesae recognition by A. cerana. In every case, the stronger hygienic behavior of A. cerana towards T. mercedesae offers an additional explanation for the fact that A. cerana colonies, in general, appear to be more resistant to mites of the genus Tropilaelaps than colonies of the western honey bee [26]. The relative importance of hygienic behavior with regard to other resistance mechanisms, including other mechanisms suppressing mite reproduction, will be an important subject of future research.

Our experiments with mixed groups of A. cerana and A. mellifera workers were originally designed to be able to directly compare the ethology and temporal pattern of hygienic behavior of the two species side by side on the same brood comb, i.e., in response to strictly the same stimuli. This turned out not to be possible, because hygienic behavior was almost completely suppressed in A. cerana workers by the presence of A. mellifera bees. This suppression was apparently not due to an inability of A. cerana workers to sense infestation in A. mellifera brood, because it equally occurred in mixed groups of bees on A. cerana brood, and because in the absence of A. mellifera workers, infested A. mellifera pupae were removed at a high proportion. This result is interesting with regard to the question of task affiliation between worker bees. In mixed colonies of A. cerana and A. mellifera, both species participate in almost equal numbers in queen retinue behavior [45], whereas A. cerana workers tend to specialize in foraging [46]. Communication via the dance language is possible across the species barrier [47].

One hypothesis to explain the suppression of brood hygiene in A. cerana is that A. mellifera workers possess a lower detection threshold for the signals emitted by infested pupae. Hygienic behavior is at least in part triggered by chemical cues that are perceived through the wax capping [48,49]. A. cerana pupae have been shown to react more strongly to mite infestations [43].

Therefore, it seems possible that a moderate olfactory sensitivity of A. cerana workers would be sufficient to reliably sense them, whereas A. mellifera may have had to evolve a greater sensitivity, because the stimuli emitted by infested pupae are weaker.

T. mercedesae has recently been detected on A. mellifera in several areas outside of the distribution range of A. dorsata [31]. Our study confirms that one of the central defense mechanisms of the western honey bee against brood diseases, hygienic behavior, is also expressed vis-à-vis this new parasitic mite.

Given that hygienic behavior against V. destructor and T. mercedesae appear to be closely coupled, breeding for behavioral resistance to varroosis likely can reduce the vulnerability of A. mellifera beekeeping also to T. mercedesae, and possibly also to other species of this genus.

This is of particular importance, given the increasing trend of A. mellifera colonies to produce brood throughout the winter, even in “temperate” regions, brought about by climate change. At the same time, greater efforts will be needed to elucidate the biology of the four Tropilaelaps species, where great knowledge gaps need to be filled e.g., with regard to reproduction biology, dispersal, and host–pathogen interactions.

Funding

This research was funded by the European Union within the framework of the FP7-project SmartBees (Sustainable Management of Resilient Bee Populations; project number 613960), and materials used were funded by the European Fund for Regional Development (grant 80137041).

Acknowledgments

We are grateful to many helpers at the Natural History Museum, Tribhuvan University, who helped us to overcome earthquakes, an economic blockade, and hornet attacks of our apiary, and who assisted in marking bees and organizing colonies.

Monica Shrestha

Jakob Wegener

Department of Breeding and Genetics,
Bee Research Institute
16540 Hohen Neuendorf, Germany
monica_2762@yahoo.com

Ishan Gautam
Madhusudan Singh

Department of Breeding and Genetics,
Bee Research Institute
16540 Hohen Neuendorf, Germany

Christoph Schwekendiek
Kaspar Bienefeld

Department of Breeding and Genetics
Bee Research Institute
16540 Hohen Neuendorf, Germany
schwekec@hu-berlin.de (C.S.)
kaspar.bienefeld@hu-berlin.de (K.B.)

Correspondence:
wegenerj@hu-berlin.de
Tel.: +49-3303-293843

References

1. Genersch, E.; Von Der Ohe, W.; Kaatz, H.; Schroeder, A.; Otten, C.; Büchler, R.; Berg, S.; Ritter, W.; Mühlen, W.; Gisder, S.; et al. The German bee monitoring project: A long term study to understand periodically high winter losses of honey bee colonies. Apidologie 2010, 41, 332–352. [CrossRef]

2. Le Conte, Y.; Ellis, M.; Ritter, W. Varroa mites and honey bee health: Can Varroa explain part of the colony losses? Apidologie 2010, 41, 1–11. [CrossRef]

3. Neumann, P.; Carreck, N. Honey bee colony losses. J. Apic. Res. 2010, 49, 1–6. [CrossRef]

4. Van Der Zee, R.; Gray, A.; Pisa, L.; De Rijk, T. An ObservationalStudy of Honey Bee Colony Winter Losses and Their Association with Varroa destructor, Neonicotinoids and Other Risk Factors. PLoS ONE 2015, 10, e0131611. [CrossRef]

5. Burgett, A.; Akratanakul, P.; Morse, R.A. Tropilaelaps clareae-A parasite of honey bees in Southeast Asia. Bee World 1983, 64, 25–28. [CrossRef]

6. Phokasem, P.; De Guzman, L.I.; Khongphinitbunjong, K.; Frake, A.M.; Chantawannakul, P. Feeding by Tropilaelaps mercedesae on pre- and post-capped brood increases damage to Apis mellifera colonies. Sci. Rep. 2019, 9.[CrossRef]

7. Dainat, B.; Ken, T.; Berthoud, H.; Neumann, P. The ectoparasitic mite Tropilaelaps mercedesae (Acari, Laelapidae) as a vector of honeybee viruses. Insectes Sociaux 2008, 56, 40–43. [CrossRef]

8. Khongphinitbunjong, K.; De Guzman, L.I.; Tarver, M.R.; Rinderer, T.E.; Chantawannakul, P. Interactions of Tropilaelaps mercedesae, honey bee viruses and immune response in Apis mellifera. J. Apic. Res. 2015, 54, 1–8. [CrossRef]

9. Delfinado, M.D.; Baker, E.W. Tropilaelaps, a new genus of mite from the Philippines (Laelaptidae (s. lat.): Acarina). Fieldiana Zool. 1961, 44, 53–56.

10. Chantawannakul, P.; Ramsey, S.; Vanengelsdorp, D.; Khongphinitbunjong, K.; Phokasem, P. Tropilaelaps mite: An emerging threat to European honey bee. Curr. Opin. Insect Sci. 2018, 26, 69–75. [CrossRef]

11. Peng, Y.-S.; Fang, Y.; Xu, S.; Ge, L. The resistance mechanism of the Asian honey bee, Apis cerana Fabr., to an ectoparasitic mite, Varroa jacobsoni Oudemans. J. Invertebr. Pathol. 1987, 49, 54–60. [CrossRef]

12. Anderson, D.L.; Roberts, J.M.K. Standard methods for Tropilaelaps mites research. J. Apic. Res. 2013, 52, 1–16. [CrossRef]

13. Lin, Z.; Page, P.; Li, L.; Qin, Y.; Zhang, Y.; Hu, F.; Neumann, P.; Zheng, H.-Q.; Dietemann, V. Go East for Better Honey Bee Health: Apis cerana Is Faster at Hygienic Behavior than A. mellifera. PLoS ONE 2016, 11, e0162647. [CrossRef]

14. Boecking, O. Sealing up and non-removal of diseased and Varroa jacobsoni infested drone brood cells is part of the hygienic behaviour in Apis cerana. J. Apic. Res. 1999, 38, 159–168. [CrossRef]

15. Boecking, O.; Spivak, M. Behavioral defenses of honey bees against Varroa jacobsoni Oud. Apidologie 1999, 30, 141–158. [CrossRef]

16. Khongphinitbunjong, K.; De Guzman, L.I.; Burgett, M.D.; Rinderer, T.E.; Chantawannakul, P. Behavioral responses underpinning resistance and susceptibility of honey bees to Tropilaelaps mrecedesae. Apidologie 2012, 43, 590–599. [CrossRef]

17. Woyke, J. Infestation of honey bee (Apis Mellifera) colonies by the parasitic mites Varroa jacobsoni and Tropilaelaps clareae in South Vietnam and results of chemical treatment. J. Apic. Res. 1987, 26, 64–67. [CrossRef]

18. Wilde, J.; Woyke, J.; Neupane, K.R.; Wilde, M. Comparative evaluation tests of different methods to control Tropilaelaps clareae, a mite parasite in Nepal. In Proceedings of the 5th Asian Apicultural Association Conference 2000, Chiang Mai, Thailand, 19–25 March 2000; pp. 249–251.

19. Pettis, J.S.; Rose, R.; Chaimanee, V. Chemical and cultural control of Tropilaelaps mercedesae mites in honeybee (Apis mellifera) colonies in Northern Thailand. PLoS ONE 2017, 12, e0188063. [CrossRef]

20. Harbo, J.R.; Harris, J.W. Selecting honey bees for resistance to Varroa jacobsoni. Apidologie 1999, 30, 183–196. [CrossRef]

21. Büchler, R. Design and success of a German breeding program for Varroa tolerance. Am. Bee J. 2000, 140, 662–665.

22. Le Conte, Y.; De Vaublanc, G.; Crauser, D.; Jeanne, F.; Rousselle, J.-C.; Bécard, J.-M. Honey bee colonies that have survived Varroa destructor. Apidologie 2007, 38, 566–572. [CrossRef]

23. Harbo, J.R.; Harris, J.W. Responses to Varroa by honey bees with different levels of Varroa Sensitive Hygiene. J. Apic. Res. 2009, 48, 156–161. [CrossRef]

24. Oddie, M.; Dahle, B.; Neumann, P. Norwegian honey bees surviving Varroa destructor mite infestations by means of natural selection. PeerJ 2017, 5, e3956. [CrossRef][PubMed]

25. Khongphinitbunjong, K.; De Guzman, L.I.; Buawangpong, N.; Rinderer, T.E.; Frake, A.M.; Chantawannakul, P. Observations on the removal of brood inoculated with Tropilaelaps mercedesae (Acari: Laelapidae) and the mite's reproductive success in Apis mellifera colonies. Exp. Appl. Acarol. 2013, 62, 47–55. [CrossRef]

26. De Guzman, L.I.; Williams, G.R.; Khongphinitbunjong, K.; Chantawannakul, P. Ecology, Life History, and Management of Tropilaelaps Mites. J. Econ. Èntomol. 2017, 110, 319–332. [CrossRef]

27. Dietemann, V.F.; Nazzi, S.J.; Martin, D.L.; Anderson, B.; Locke, D.S.; Delaplane, D.; Wauquiez, C.; Tannahill, E.; Frey, B.; Ziegelmann, P.; et al. Standard methods for Varroa Research. J. Apic. Res. 2013, 52, 1–54. [CrossRef]

28. Bienefeld, K.; Zautke, F.; Gupta, P. A novel method for undisturbed long-term observation of honeybee (Apis mellifera) behavior–illustrated by hygienic behavior towards Varroa infestation. J. Apic. Res. 2015, 54, 541–547. [CrossRef]

29. Boecking, O. Removal behaviour of Apis mellifera colonies towards sealed brood cells infested with Varroa jacobsoni: Techniques, extent and efficacy. Apidologie 1992, 23, 371–373.

30. Anderson, D.; Morgan, M.J. Genetic and morphological variation of bee-parasitic Tropilaelaps mites (Acari: Laelapidae): New and re-defined species. Exp. Appl. Acarol. 2007, 43, 1–24. [CrossRef]

31. Solignac, M.; Cornuet, J.; Vautrin, D.; Le Conte, Y.; Anderson, D.; Evans, J.D.; Cros-Arteil, S.; Navajas, M. The invasive Korea and Japan types of Varroa destructor, ectoparasitic mites of the Western honeybee (Apis mellifera), are two partly isolated clones. Proc. R. Soc. B Boil. Sci. 2005, 272, 411–419. [CrossRef]

32. Rosenkranz, P.; Aumeier, P.; Ziegelmann, B. Biology and control of Varroa destructor. J. Invertebr. Pathol. 2010, 103, S96–S119. [CrossRef][PubMed]

33. Spivak, M.; Reuter, G.S. Performance of hygienic honey bee colonies in a commercial apiary. Apidologie 1998, 29, 291–302. [CrossRef]

34. Spivak, M.S.; Gilliam, M. Hygienic behavior of honey bees and its application for control of brood diseases and Varroa; part, II. Studies on hygienic behavior since the Rothenbuhler era. Bee World 1998, 79, 169–186. [CrossRef]

35. Boecking, O.; Bienefeld, K.; Drescher, W. Heritability of the Varroa-specific hygienic behaviour in honey bees (Hymenoptera: Apidae). J. Anim. Breed. Genet. 2000, 117, 417–424. [CrossRef]

36. Spivak, M.; Reuter, G.S. Varroa destructor infestation in untreated honey bee (Hymenoptera: Apidae) colonies selected for hygienic behavior. J. Econ. Èntomol. 2001, 94, 326–331. [CrossRef]

37. Wilson-Rich, N.; Spivak, M.; Fefferman, N.H.; Starks, P.T. Genetic, individual, and group facilitation of disease resistance in insect societies. Annu. Rev. Entomol. 2009, 54, 405–423. [CrossRef]

38. Guarna, M.M.; Melathopoulos, A.P.; Huxter, E.; Iovinella, I.; Parker, R.; Stoynov, N.; Tam, A.; Moon, K.-M.; Chan, Q.W.T.; Pelosi, P.; et al. A search for protein biomarkers links olfactory signal transduction to social immunity. BMC Genom. 2015, 16, 63. [CrossRef]

39. Spötter, A.; Gupta, P.; Mayer, M.; Reinsch, N.; Bienefeld, K. Genome-Wide Association Study of Varroa-Specific Defense Behavior in Honeybees (Apis mellifera). J. Hered. 2016, 107, 220–227. [CrossRef]

40. Kavinseksan, B.; Wongsiri, S.; Rinderer, T.E.; De Guzman, L.I. Comparison of the hygienic behavior of ARS Russian and commercial honey bees in Thailand. Am. Bee J. 2004, 144, 870–872.

41. Rath, W.; Drescher, W. Response of Apis cerana Fabr towards brood infested with Varroa jacobsoni Oud and infestation rate of colonies in Thailand. Apidologie 1990, 21, 311–321. [CrossRef]

42. Harbo, J.R.; Harris, J.W. Suppressed mite reproduction explained by the behaviour of adult bees. J. Apic. Res. 2005, 44, 21–23. [CrossRef]

43. Page, P.; Lin, Z.; Buawangpong, N.; Zheng, H.-Q.; Hu, F.; Neumann, P.; Chantawannakul, P.; Dietemann, V. Social apoptosis in honey bee superorganisms. Sci. Rep. 2016, 6, 27210. [CrossRef][PubMed]

GENETICALLY ENGINEERED MICROBES POSE SIMULTANEOUS RISKS FOR HUMANS, BEES AND PLANTS

New backgrounder warns against fast-track releases

The European Commission is proposing a far-reaching deregulation of environmental releases of genetically engineered microorganisms if, in their natural forms, they are considered as safe. Testbiotech research shows that around 40 species of such microbes are found in honey bees and bee products. Many of them are also are part of the microbioms of soil, plant, animals and humans.

If genetically engineered microorganisms that belong to these species are released into the environment, they may easily enter the food and feed chains and may end up in human diets, for example, via bee products. Against this background, lower standards in risk assessment cannot be justified.

Microbes obtained from genetic engineering processes can exhibit unique patterns of genetic changes and biological characteristics that are new to the environment, even without the insertion of additional genes. This is because new genetic engineering allows microbial genes and their activity to be changed, blocked, enhanced or suppressed to achieve results far beyond what was possible with previously used methods.

The risks, for example, include higher toxin production, higher invasiveness and negative effects on natural microbial communities necessary to maintain the health of plants, animals and humans.

The proposed future regulation would allow environmental releases of genetically engineered microbes, even if there were significant data gaps. Furthermore, any potential environmental spread would not be subject to control, and the authorisation would not be restricted to a maximum of ten years, as is currently the case, but would be unlimited after the first renewal.

The list of microorganisms considered environmentally safe currently comprises more than 120 species of bacteria, fungi, algae and viruses. The proposal made by the Commission assumes that genetically engineered organisms belonging to these species, can benefit

from fast-tracked market approval if no additional 'genes of concern' are inserted. However, as the report shows, the risks of genetically engineered microbes does not depend on the insertion of additional genes.

Contact:

Christoph Then
info@testbiotech.org
Tel +49 151 54638040

Further information:

https://www.testbiotech.org/publikation/fast-track-releases-of-genetically-engineered-micro-organisms-gemos-risks-across-the-domains-of-life/

The Commission proposal:

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025PC1031

SO, HOW ARE POLLINATOR CONSERVATION AND PROPOLIS HARVESTING INTERCONNECTED?

It is well known that the honey bee (Apis mellifera L.) is one of the most important pollinators of entomophilous agricultural crops and wild plants worldwide.

For this reason, numerous scientific, environmental, and governmental programmes have been implemented in many countries to conserve pollinator populations, particularly honey bees, and to maintain their abundance. At the same time, honey bee conservation has traditionally been considered primarily in the context of combating diseases, parasites, pesticide exposure, and other adverse factors. Considerable efforts have also been devoted to expanding forage resources and preserving and restoring floral biodiversity. This article presents a different perspective by considering propolis collection as one of the factors that may contribute to honey bee conservation. This raises a logical question: how can propolis harvesting and the stimulation of honey bees to intensify the collection of plant resins positively affect the viability and conservation of honey bee colonies?

In addressing this question, we draw attention to the findings of researchers including Marla Spivak, Michael Simone-Finstrom, Jay D. Evans, Renata S. Borba, Megan Shanahan, Kirk E. Anderson, Daniel C. Copeland, Heather Dalenberg, and others, whose studies have made a significant contribution to our understanding of the role of propolis and social immunity in honey bee colonies.

One of the most important areas of contemporary honey bee health research is the study of social immunity, which describes the collective defence mechanisms by which a honey bee colony protects itself against pathogens and parasites through the coordinated behaviour of individual bees. One of the key components of this defence is the collection of plant resins possessing pronounced antimicrobial properties. Under natural conditions, honey bees (Apis mellifera) nesting in tree cavities coat the inner surfaces of their nests with a continuous propolis envelope formed from a mixture of plant resins and beeswax.

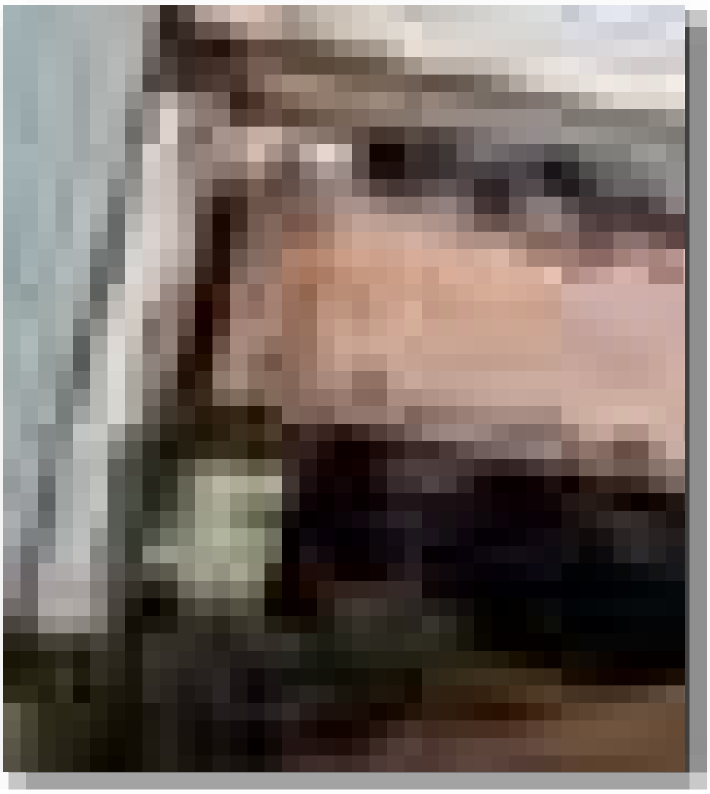


Fig. 1. Propolis deposition by honey bees in the crevices of a wooden hive
Photo by the author

In contrast, the smooth wooden hive bodies commonly used in modern beekeeping provide considerably less stimulus for resin collection, resulting in most managed honey bee colonies being maintained under conditions of propolis deficiency (Fig. 1).

It has been demonstrated that hives with roughened internal surfaces significantly stimulate propolis deposition, which is associated with a reduced prevalence of bacterial and viral infections, including Melissococcus plutonius, stabilization of immune gene expression, increased colony population size, and maintenance of colony homeostasis (Shanahan et al., 2024). The propolis envelope contributes to the maintenance of the microbial homeostasis of the nest by suppressing the growth of pathogenic microorganisms on hive surfaces, reducing the infiltration of undesirable air currents, and providing an additional mechanical barrier against pest intrusion. Experimental studies have further demonstrated that the presence of a propolis envelope is associated with reduced expression of the immune-related genes hymenoptaecin and AmEater, together with a lower bacterial load in honey bee colonies. Furthermore, age-dependent patterns of the expression of these genes have been identified in both larvae and adult honey bees. It has also been demonstrated that, in seven-day-old worker bees, a propolis-rich nest environment reduces the energetic costs associated with maintaining the immune system. These findings indicate that propolis not only directly suppresses the development of pathogens but also indirectly promotes colony health by reducing the physiological burden placed on the individual immune system of colony members.

Numerous studies have also demonstrated that propolis exhibits activity against the causative agent of American foulbrood, the ectoparasitic mite Varroa destructor, and the small hive beetle (Aethina tumida), further confirming its important role as a natural factor contributing to honey bee colony health (Simone-Finstrom et al., 2009; Simone-Finstrom & Spivak, 2010). In addition, the presence of a propolis envelope within the nest has been shown to enhance the antimicrobial activity of the larval food produced by nurse bees. In colonies with a propolis envelope, larval food inhibited the growth of the American foulbrood pathogen (Paenibacillus larvae) significantly more effectively, both before the appearance of clinical signs of disease and after disease onset. These findings indicate enhanced natural protection of the brood and highlight the important role of propolis in the prevention of American foulbrood (Borba & Spivak, 2017).

Subsequent studies have confirmed that the beneficial effects of the propolis envelope extend beyond the suppression of pathogenic microorganisms to include the maintenance of the honey bee microbiome and physiological homeostasis. Colonies with a well-developed propolis envelope have been shown to harbour significantly higher populations of beneficial indigenous gut microbiota in young worker bees without substantial changes in the taxonomic composition of the microbial community.

At the same time, reduced expression of genes associated with immune responses and redox regulation, including pro-phenol oxidase and catalase, has been observed, together with increased expression of superoxide dismutase. These findings indicate that the propolis envelope contributes to the maintenance of redox homeostasis, reduces the physiological costs associated with immune defence, and creates favourable conditions for the establishment and persistence of beneficial microbiota.

In addition, colonies with a propolis envelope exhibited significantly greater abundances of beneficial bacteria associated with the mouthparts of worker bees and a lower prevalence of pathogens, providing further evidence of the fundamental role of propolis in the social immunity of honey bee colonies (Dalenberg et al., 2020; Anderson et al., 2024).

Taken together, the collection of plant resins and the subsequent formation of a propolis envelope represent one of the key adaptive mechanisms of social immunity in honey bees. This mechanism enhances resistance to infectious diseases, supports colony homeostasis, and ultimately contributes to the maintenance of colony viability and productivity.

Most contemporary hives used in both commercial and hobbyist beekeeping are manufactured from smoothly finished wood or other materials with low surface roughness. Such hive constructions provide considerably less stimulation for the natural instinct of honey bees to collect plant resins and establish a propolis envelope within the nest.

As a result, propolis accumulates primarily in frame rests, grooves, crevices, and other confined areas of the hive, where it gradually loses its physicochemical properties over time.

Propolis contains both volatile and non-volatile bioactive constituents.

The volatile fraction consists predominantly of monoterpenes, sesquiterpenes, and essential oils, whereas the non-volatile fraction is dominated by phenolic acids, their esters, flavonoids, and, depending on the botanical origin of the resin source, diterpenoids. According to Saccardi et al. (2022), propolis samples maintained at room temperature (24 °C) lost, on average, 0.9 ± 0.3% of their mass within seven hours, indicating substantial evaporation of volatile constituents.

Furthermore, the physicochemical properties of propolis gradually change over time as a consequence of the evaporation of volatile compounds, oxidative processes, and the polymerization of specific resin constituents. As a result, propolis progressively hardens, loses its plasticity, and becomes less suitable for further manipulation and redistribution by honey bees within the nest.

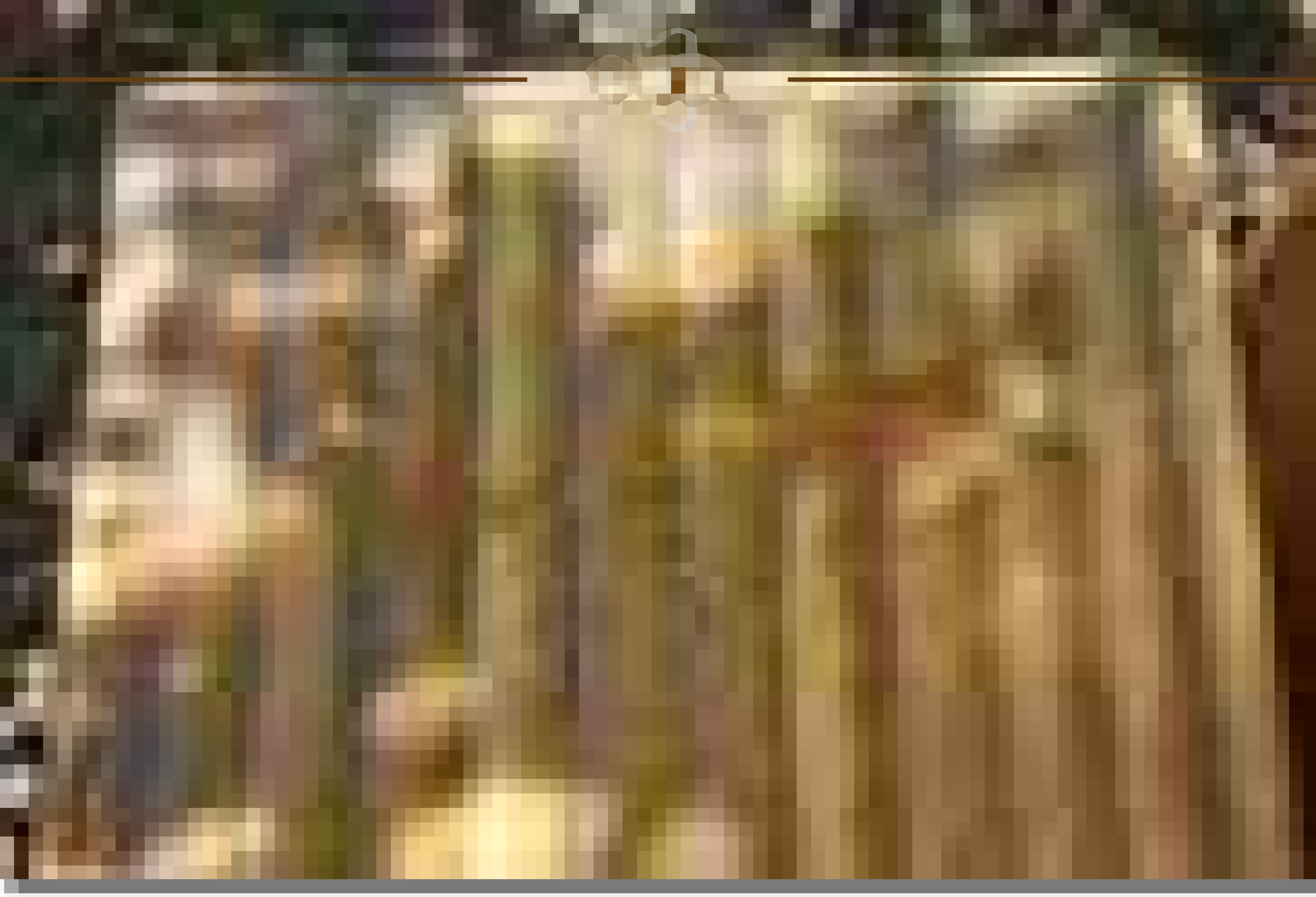


Fig. 2.
Propolis deposition by honey bees on flexible propolis collectors installed in a 10-frame hive
Photo by the author

One of the most promising approaches to maintaining a continuous supply of fresh propolis within the nest and promoting the formation of a well-developed propolis envelope is the use of modern flexible propolis collectors. The placement of flexible plastic grids with specially designed mesh geometry inside the hive stimulates honey bees to intensify the collection of plant resins and deposit fresh propolis on their surfaces. This not only ensures the continuous renewal of the propolis layer but also helps preserve its antimicrobial properties, promotes the development of an effective propolis envelope, and consequently enhances the health, resilience, and long-term survival of honey bee colonies (Fig. 2).

At the same time, commercial apiaries, where colony management is performed according to well-established and standardized operating protocols, generally do not use propolis collection devices. The primary reason is the high labour demand associated with cleaning the collectors, a process that is still traditionally performed manually. According to official statistics, Ukraine has more than 6,800 registered beekeeping enterprises maintaining 100 or more honey bee colonies. Even the use of only 100 propolis collectors on a single apiary requires considerable time and labour for subsequent cleaning. As a result, beekeepers frequently postpone this task for extended periods after the end of the beekeeping season. In commercial beekeeping operations, where profitability is the primary objective, the adoption of any technological practice is determined by its economic feasibility, operational efficiency, and labour and resource requirements.

As a result of many years of research and practical validation, we have developed a comprehensive solution to this challenge. A device for the mechanized removal of propolis from flexible propolis collectors was designed and successfully implemented. Its application enables beekeepers to install propolis collectors

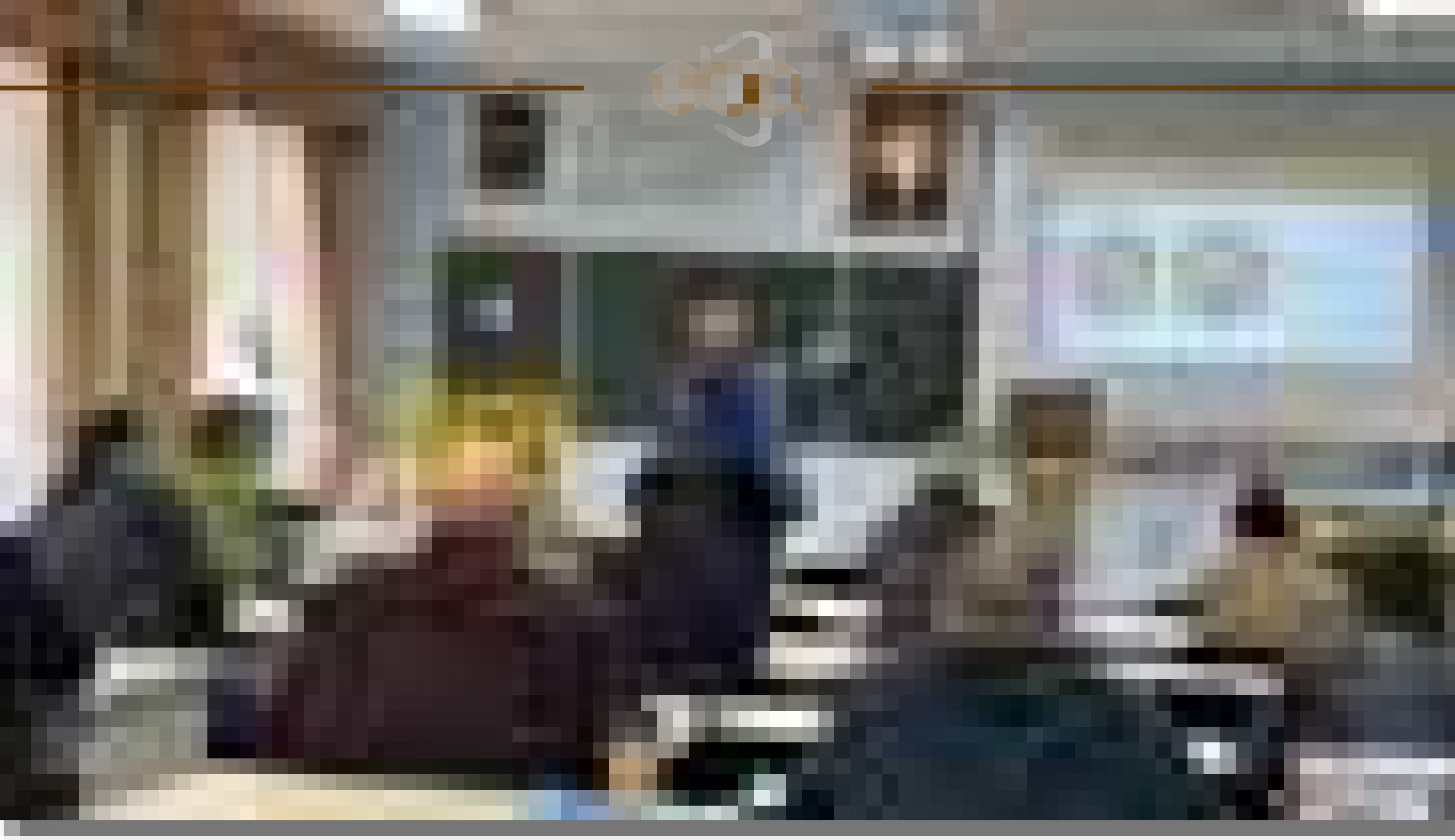


Fig. 3.
Training beekeepers in the operation of the propolis collector cleaning device at the Department of Beekeeping, National University of Life and Environmental Sciences of Ukraine (NUBiP)
Photo by the author

in hives more frequently and, consequently, to remove and clean them repeatedly throughout the season rather than limiting propolis harvesting to a single collection. This approach continuously stimulates honey bees to reconstruct the propolis envelope within the nest, thereby contributing to the maintenance of the colony's natural sanitary environment.

The device was awarded a Bronze Medal in the Innovation category at the 49th Apimondia Congress, held in Denmark.

Following cooling of the propolis collectors for approximately one hour to a temperature of about +5 °C, the propolis can be readily separated using the devel-

Fig. 4.
Demonstration of the propolis collector cleaning device by the author at an exhibition in Cherkasy, Ukraine, February 2026
Photo by the author

oped device. The system is capable of processing more than 150 propolis collectors within 2 hours, reducing labour requirements many times over compared with conventional manual cleaning.

Thus, implementation of the proposed technology not only provides beekeepers with an additional source of income through the commercialization of propolis but also creates favourable conditions for improving honey bee colony health by stimulating the formation of a natural propolis envelope. Consequently, this approach has the potential to reduce the need for veterinary treatments while increasing the overall efficiency and sustainability of beekeeping operations. Moreover, by providing commercial beekeepers with an effective solution to the long-standing challenge of cleaning propolis collectors, we encourage the wider adoption of this technology. In many cases, beekeepers install propolis collectors primarily to generate additional revenue from propolis production rather than to improve colony health. Nevertheless, this practice inherently stimulates honey bees to reconstruct a new propolis envelope within the nest, thereby enhancing the sanitary status of the colony and strengthening its natural defence mechanisms. The device we developed has already been successfully implemented in a number of commercial apiaries in Ukraine, and its adoption continues to expand (Fig. 3; Fig. 4).

Roman Dvykaliuk, PhD

Senior Research Fellow
Institute of Food Resources
National Academy of Agrarian Sciences of Ukraine
CEO "BeesAgro"
Controlled Pollination Association
roman.dvykaliuk@delta-sport.kiev.ua
https://orcid.org/0000-0001-7732-6365
https://dvykaliuk.org.ua/en/about-propolis/

Literature

1. Simone-Finstrom, M., Evans, J. D., & Spivak, M. (2009). Resin collection and social immunity in honey bees. Evolution, 63(11), 3016–3022. https://doi.org/10.1111/j.1558-5646.2009.00772.x
2. Simone-Finstrom, M., & Spivak, M. (2010). Propolis and bee health: the natural history and significance of resin use by honey bees. Apidologie, 41(3), 295–311. https://doi.org/10.1051/apido/2010016
3. Borba, R. S., & Spivak, M. (2017). Propolis envelope in Apis mellifera colonies supports honey bees against the pathogen, Paenibacillus larvae. Scientific Reports, 7(1). https://doi.org/10.1038/s41598-017-11689-w
4. Shanahan, M., Simone-Finstrom, M., Tokarz, P., Rinkevich, F., Read, Q. D., & Spivak, M. (2024). Thinking inside the box: Restoring the propolis envelope facilitates honey bee social immunity. Plos One, 19(1), e0291744. https://doi.org/10.1371/journal.pone.0291744
5. Anderson, K. E., Copeland, D. C., Mott, B. M., Kortenkamp, O. L., Erickson, R. J., Allen, N. O., Maes, P. W., Chao, N., Dalenberg, H., & Spivak, M. (2026). A propolis-rich hive environment affects redox gene expression and gut microbiota at the individual and social level in honey bees. FEMS Microbes, 7. https://doi.org/10.1093/femsmc/xtag019
6. Dalenberg, H., Maes, P., Mott, B., Anderson, K. E., & Spivak, M. (2020). Propolis Envelope Promotes Beneficial Bacteria in the Honey Bee (Apis mellifera) Mouthpart Microbiome. Insects, 11(7), 453. https://doi.org/10.3390/insects11070453
7. Saccardi, L., Brümmer, F., Schiebl, J., Schwarz, O., Kovalev, A., & Gorb, S. (2022). Interaction between honeybee mandibles and propolis. Beilstein Journal of Nanotechnology, 13, 958–974. Portico. https://doi.org/10.3762/bjnano.13.84

14TH INTERNATIONAL MEETING OF YOUNG BEEKEEPERS (IMYB) NORTHERN IRELAND 2026

The 14th International Meeting of Young Beekeepers (IMYB) was hosted in Northern Ireland for the first time in July 2026, bringing together young beekeepers from around the world for five memorable days of learning, competition, friendship and cultural exchange.

This year's event welcomed 79 young beekeepers aged 12–18, supported by 14 young facilitators aged 18–25, together with 55 accompanying adults' "mentors" and 4 judges. from across Europe and beyond.

Countries:- Australia, Austria, Bulgaria, Canada, China, Czech Republic, England, Estonia, Finland, France, Germany, Greece, Israel, Lithuania, Malta, Northern Ireland (2 teams) Poland, Republic of Ireland, Romania, Scotland,

Slovakia, Slovenia, Turkey, United Arab Emirates and Ukraine, making IMYB 2026 a truly international celebration of youth beekeeping.

Based at the beautiful surroundings of Queen's University Belfast's Riddel Hall and the University's modern Elms Village accommodation, the event benefited from outstanding facilities throughout the week. The professionalism, friendliness and "can-do" approach of the Queen's University staff contributed significantly to the success of the event, with every request met with enthusiasm and efficiency.

The memorable Opening Ceremony set the tone for an exciting programme that combined practical beekeeping, scientific knowledge, teamwork and cultural exchange. Throughout the week, participants demonstrated their beekeeping knowledge and practical skills while

developing friendships that will last a lifetime. As is traditional at IMYB, young beekeepers competed both individually and in mixed international teams. Evening cultural presentations showcased each country's traditions, heritage and beekeeping practices, encouraging collaboration, mutual understanding and international friendship.

The Competition

The core element of each IMYB is the Competition

2 multiple choice papers each with 50 questions

Bee Biology & Behaviour. Then Hive Management, equipment, Disease and pests.

Practical Tests

Hive management At Minnoburn apiary

Microscopy - Identification of bee anatomy

Equipment identification, Frame building, Hive Building, Honey Testing, Honey Labelling design, Candle rolling.

Awards given to – Individual participants, Top Country, Mixed teams

Awards for Cultural presentations- These were awarded on the bases of the young people participation, a bee element to the presentation as well as country traditions and finally involving the audience.

Judges included Enid Brown Scotland, Michael Gleeson Ireland, Ruth Homer England and Joyce Nisbet Scotland.

The practical beekeeping competition was held at the Belfast Beekeepers' Association apiary at the National Trust's Minnowburn site in South Belfast. Competitors worked with colonies of Apis mellifera mellifera under the assessment of four experienced international judges from Scotland, England and Ireland. The standard of practical skills and enthusiasm displayed by the young competitors reflected the bright future of beekeeping across the world.

One of the highlights of the week was the Fun Day, generously hosted by the Northern Ireland Assembly at the historic Stormont Estate, the seat of government in Northern Ireland. Alongside recreational activities, participants planted a legacy wildflower

meadow adjacent to the Native Irish Honey Bee conservation apiary, creating a lasting environmental contribution to the estate. The day concluded with a barbecue, providing participants, volunteers and organisers with the opportunity to relax and enjoy one another's company outside the competition environment.

The event concluded with a prestigious Closing Ceremony and Awards Presentation, generously hosted by Belfast City Council in the magnificent surroundings of Belfast City Hall. The venue was beautifully decorated with the flags of all participating nations and enhanced by stunning floral displays provided by Belfast Botanic Gardens.

Guests were welcomed by the stirring sound of a lone piper before enjoying traditional Irish dancing performed by a talented group of young dancers. Following refreshments, the ceremony celebrated the achievements of the competitors and recognised the outstanding performances demonstrated throughout the week.

Mentors' (Adults') Programme

Running alongside the youth competition was a comprehensive programme for mentors and accompanying adults, designed to encourage international cooperation, knowledge exchange and the development of youth beekeeping programmes.

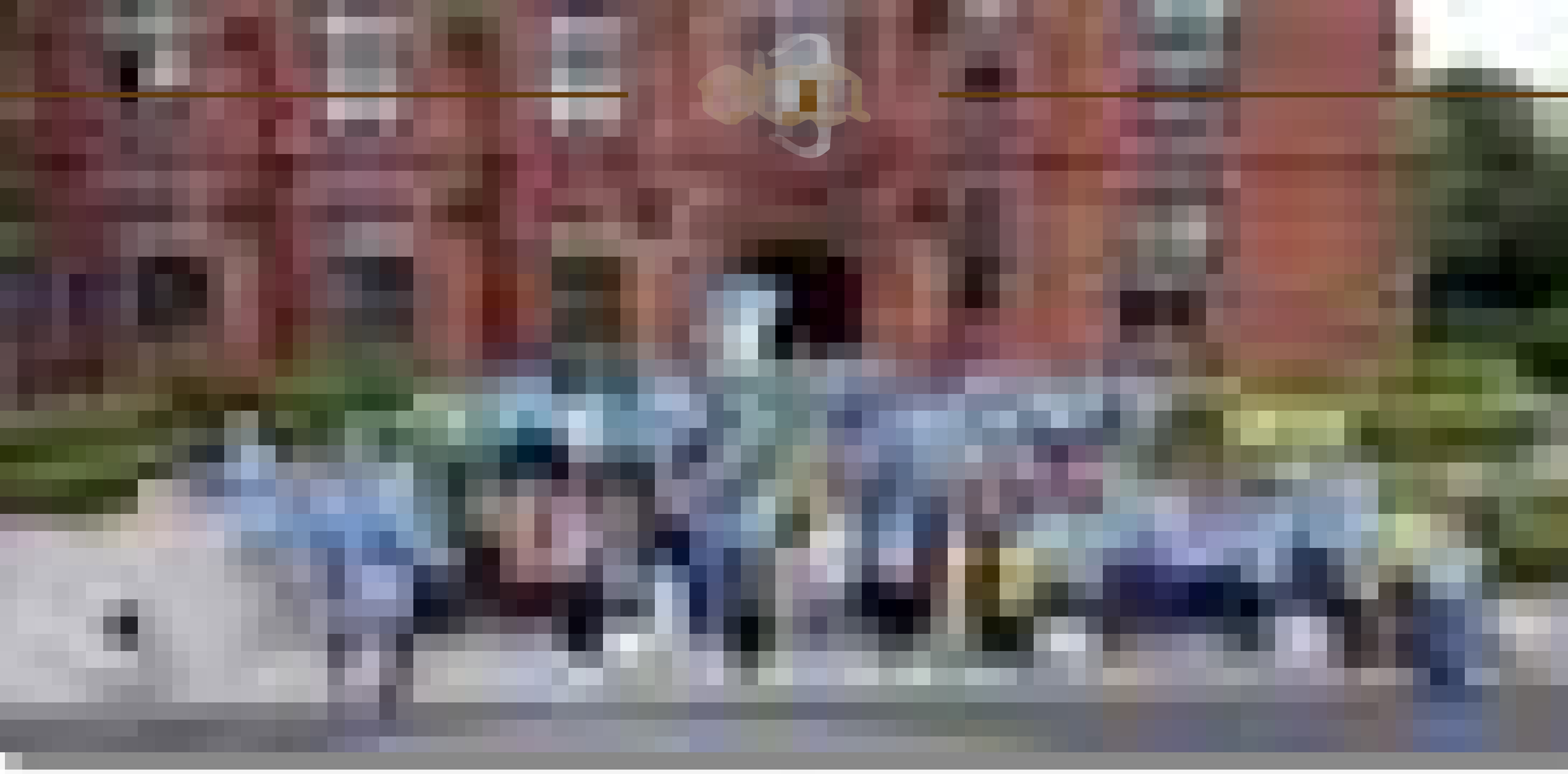
Day One

The programme commenced with an open-top bus tour of Belfast, providing visitors with an introduction to the city's rich history, culture and diverse communities. This was followed by a guided visit to the Ulster Museum, where participants explored exhibits covering natural history, biodiversity and insect life.

Day Two

Mentors enjoyed a guided tour of Belfast Botanic Gardens, one of the city's most treasured Victorian attractions. The visit included exclusive access to areas not normally open to the public, including the famous Palm House and the beautifully restored Tropical Ravine, home to rare tropical plants more than a century old. Participants also explored the extensive gardens, rose collections and mature parkland.

The afternoon continued with a walking tour of the historic Queen's University Belfast campus, recognised in 2026 as one of the UK's highest-rated universities for student satisfaction. The day concluded with a visit to a traditional Belfast public house, allowing delegates



to experience Northern Ireland's renowned hospitality and continue informal discussions.

Day Three

Following a walk along the historic Prince of Wales Avenue through the Stormont Estate, mentors received a personalised tour of Parliament Buildings, home of the Northern Ireland Assembly. Delegates were welcomed by the Deputy Speaker and gained valuable insight into the operation of devolved government in Northern Ireland.

While the young participants were creating the IMYB legacy wildflower meadow, the adult delegates attended presentations and discussions focused on youth development in beekeeping.

Hosted in the long Gallery within Parliament Buildings, Representatives from each participating country outlined their national youth programmes, highlighting achievements, challenges, barriers to participation and future ambitions.

These presentations generated valuable discussion, enabling delegates to exchange ideas, share successful initiatives and establishnew international partnerships.

Many considered this collaborative forum to be one of the most valuable aspects of IMYB 2026, with the International Centre for Young Beekeepers committing to continued cooperation and the sharing of best practice long after the event. The day concluded with award winning, locally produced Glastry Farm Ice Cream, enjoyed by participants and delegates in the beautiful surroundings of the Stormont Estate during the exceptionally warm summer weather.

Competition Results

Individual Competition – Top Ten

1. Fabio Rieder	Austria
2. Joshiah Dick	Australia
3. Maria McLoone	Northern Ireland
4. Charles. Schulz	Canada
5. Adam Simonik	Czech Republic
6. Esme Huey	Northern Ireland
7. Bridget Matthews	Canada
8. Oskar Dahms	Germany
9. Gabriel Borz	Romania
10. Leah Buchanan	Scotland

Country Rankings – Top Ten

1. Austria
2. Canada
3. Czech Republic
4. England
5. Northern Ireland.2

Mixed International Teams

(names: based of County names in Northern Ireland)

1st Place- Ballymena – Facilitator Jan Krchnscek – Czech Republic

- Elija Raab Austria
- Giedre Armoskaite Lithuania
- Elean Meyer Australia
- Richard Bazso United Arab Emirates
- Rashed Almazrouel, United Arab Emirates
- Lameece Ewas Scotland

6. Germany
7. Australia
8. Northern Ireland.1
9. Netherlands
10. Estonia

2nd Place – Carrickfergus – Facilitator Lorenz Paul Hinterplattner – Austria

- Jan Kopacek Czech Republic
- Lucy Hawthorne Northern Ireland
- Xinyue Zhang China

- Yaniek Van Es Netherlands
- Denislav Monevm Bulgaria
- Joel Terheide Germany

3rd Place – Armagh - Larissa Kreuzhuber – Germany

- Sofia Berger – Israel
- Emilia Huey - Northern Ireland
- Kristjan Meserko - Slovenia
- Ivanna Sokolave - Ukraine
- Tobia Oriescik Slovakia

Cultural Presentation Awards

Ist Place - Northern Ireland 1

- Esme Huey
- Emilia Huey
- Isabelle Vangrove

2nd Place - Slovenia

- Lukas Klabjan
- Leon Taj Lustek
- Kristjan Meserko

3rd place - Republic of Ireland

- Patrick Bourke
- Alex O'Sullivan
- Stan O'Sullivan

A Lasting Legacy

The success of IMYB 2026 was the result of an extraordinary team effort. The organising committee worked tirelessly over several years to secure funding, coordinate with the International Centre for Young Beekeepers and collaborate with participating national committees to transform the vision of hosting IMYB in Northern Ireland into reality.

We are deeply grateful to our local, national and international supporters whose encouragement, generosity and commitment enabled the successful delivery of this prestigious event. Our sincere thanks also go to the many volunteers who gave so generously of their time and expertise throughout the week, and to our sponsors whose support allowed us to provide a truly world-class experience promoting education, international friendship and the future of beekeeping.

IMYB 2026 concluded with the Closing Ceremony at the beautiful Belfast City Hall.

Hosting this remarkable event has created a lasting legacy for beekeeping in Northern Ireland. It has strengthened our beekeeping community, inspired a new generation of young beekeepers and demonstrated what can be achieved when volunteers, organisations, sponsors and communities work together towards a shared vision.

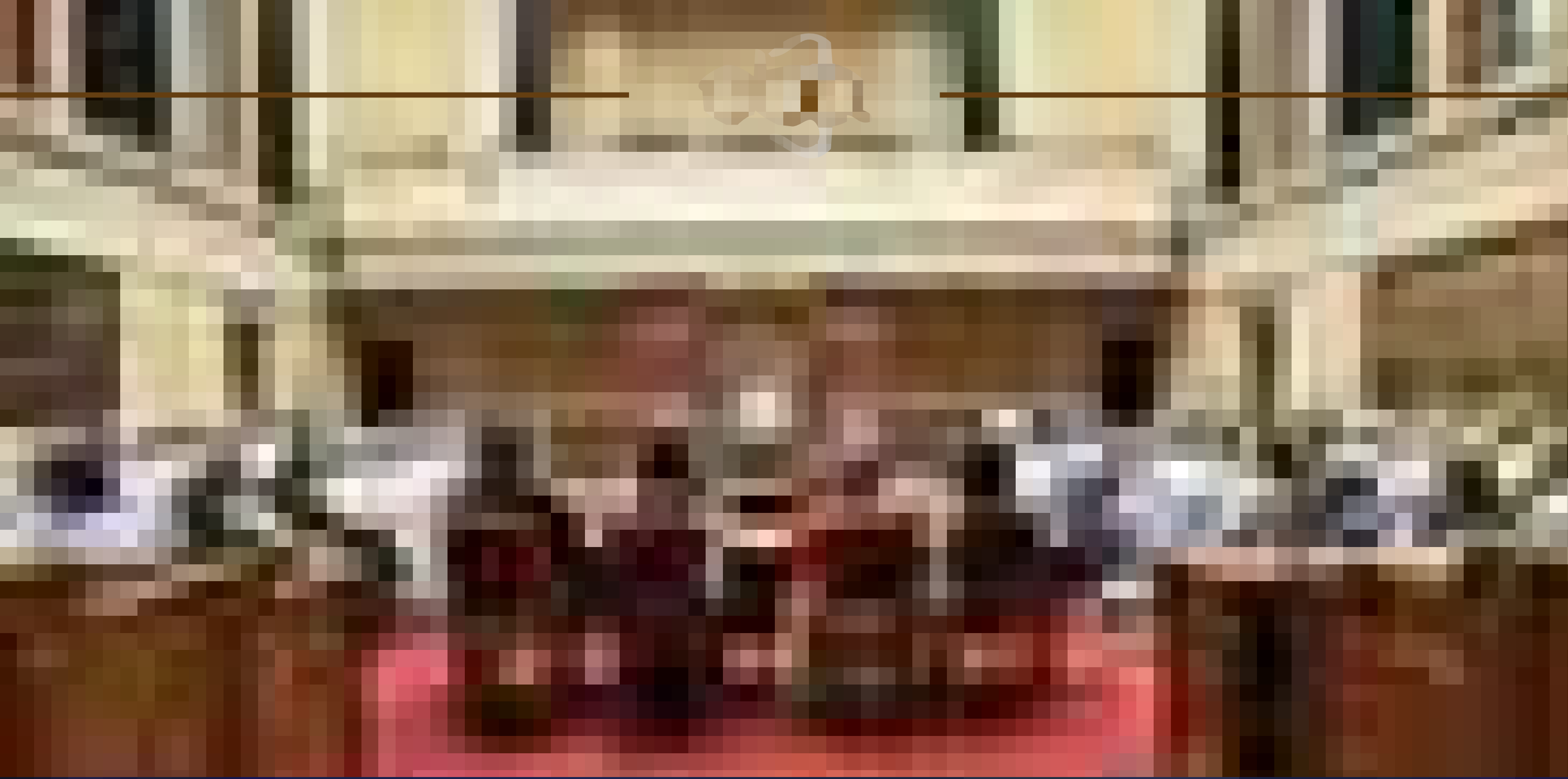
The event celebrated excellence in beekeeping while creating lifelong friendships, strengthening international relationships and inspiring young people to become ambassadors for bees, biodiversity and environmental stewardship.

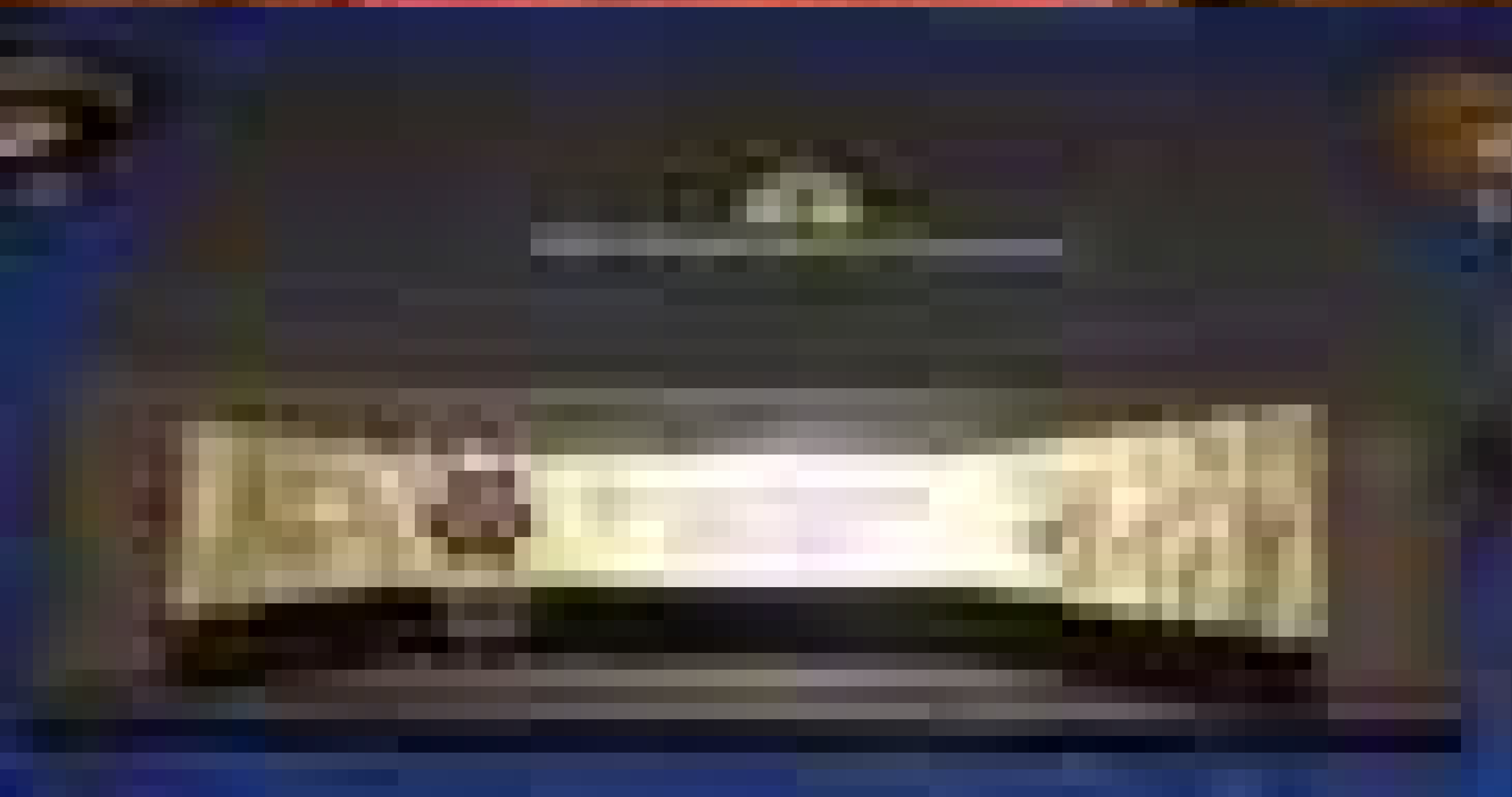
Building upon this success, the Ulster Beekeepers' Association is delighted to announce the establishment of a dedicated Young Beekeepers Section. This initiative will provide young people aged 12–18 with year-round opportunities for education, practical training and participation.

The Association has committed to:

- Establishing a dedicated Young Beekeepers Committee within the UBKA.
- Organising regular training events led by young people for young people.
- Creating dedicated youth sessions within the annual UBKA Conference.
- Introducing a dedicated Young Beekeepers section within the annual UBKA Honey Show.
- Continuing to encourage, support and develop the next generation of beekeepers throughout Northern Ireland.

The true success of IMYB 2026 will ultimately be measured not simply by competition results, but by the knowledge shared, the friendships formed and the enduring legacy that will continue to inspire young beekeepers for many years to come.





FREE EXHIBITION RENTAL
3D GIANT CARNIOLAN HONEYBEE

The initiator and conceptual designer of the project was Boštjan Noč, president of the Slovenian Beekeepers' Association.

Bring the fascinating world of bees to your visitors with the 3D Giant Carniolan Honeybee – a unique, interactive exhibition featuring a 1:100 scale model of the Slovenian indigenous Carniolan honeybee (Apis mellifera carnica).

The 170 cm long 3D-printed model includes moving body parts and educational animations in English, making it an attractive exhibit for museums, science centres, schools, fairs and public events. Originally created for showcased at Expo Dubai, where it attracted almost one million visitors.

Rental is FREE OF CHARGE.

The borrower only covers the transportation costs.

For more information and bookings:

Barbara Dimc
barbara.dimc@czs.si

EBA SUPPORTS THE EFFORTS OF SLOVAKIA

The European Beekeeping Association supports the efforts of Slovakia to lodge an action for annulment before the Court of Justice of the European Union against the Regulation (EU) 2026/1388 of the European Parliament and of the Council of 17 June 2026 on plants obtained by certain new genomic techniques and their products, and amending Regulation (EU) 2017/625“ and supports the initiatives of national and international organizations joining this legal action.

The European Beekeeping Association calls upon the competent ministries and institutions of the EU Member States to support, within their respective remits, the filing of the action for annulment against the aforementioned regulation. Unregulated modifications to plant genomes can unpredictably alter the composition of nectar and pollen, directly endangering the health and reproductive capacity of bee colonies. By disrupting natural food chains and introducing potential toxicity to insects, these changes pose a severe threat to ecological stability and overall biological security. Moreover, by abolishing mandatory GMO labeling, the regulation undermines market transparency and strips consumers of their fundamental freedom of choice.

BEST HONEY PRODUCT 2026 COMPETITION

The Slovenian Beekeepers' Association is inviting beekeepers to participate in the "Best Honey Product 2026" competition, which will take place on Saturday, 19 September 2026, at the Beekeeping Centre Lesce as part of the Honey in Culinary Arts Day.

The competition is intended for innovative products made by combining honey with other foods, such as raspberries, cocoa, pistachios, hazelnuts, walnuts, spices and other ingredients.

The aim is to promote innovative honey-based products and showcase the wider range of products offered by Slovenian beekeepers.

Requirements for participation:

Two jars of each submitted product are required. The jars must be 212 ml and intended for Slovenian beekeeping products.

One jar must be properly labelled according to current legislation.

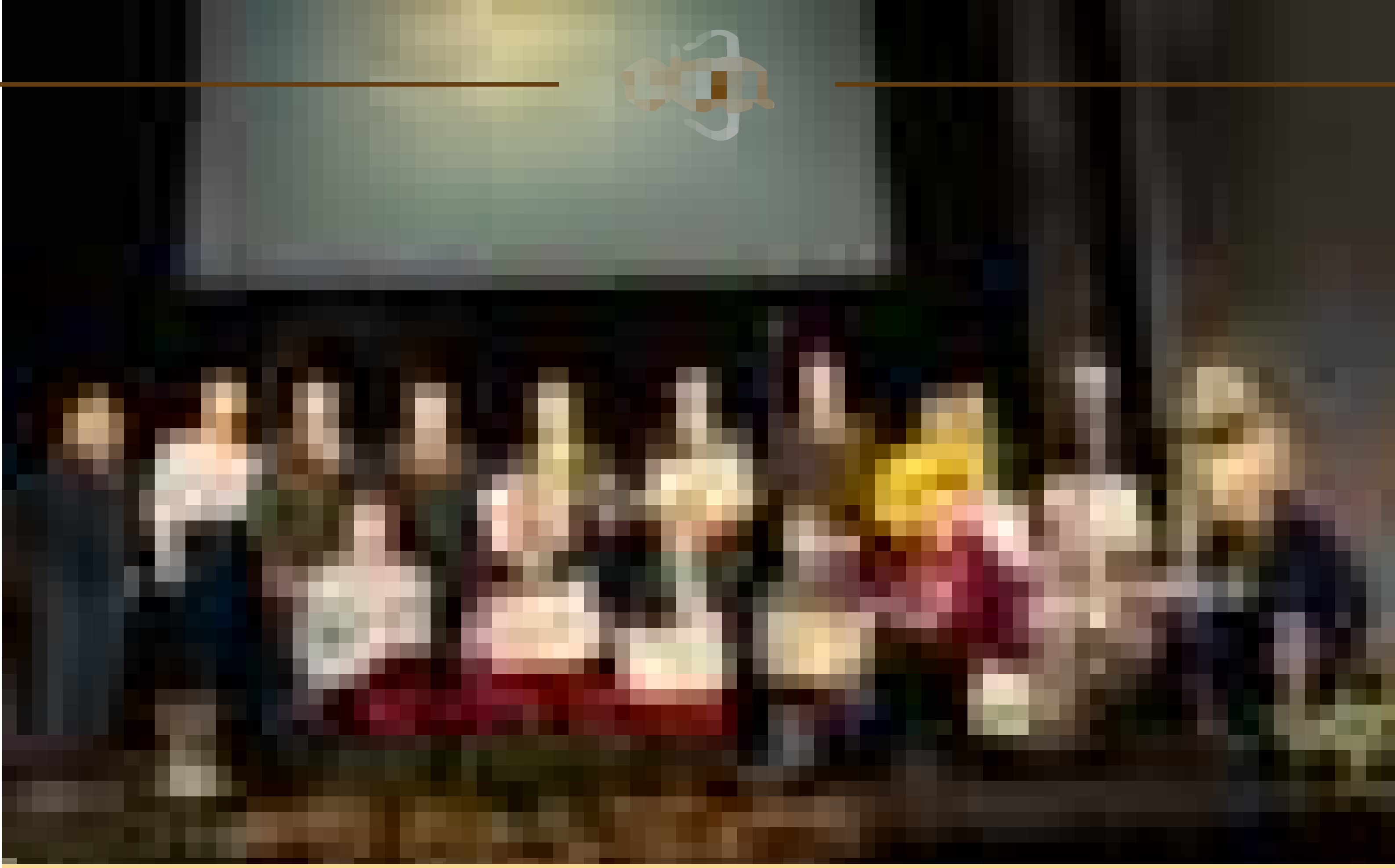
The second jar must be completely unlabelled for anonymous judging. Products must be delivered to the Beekeeping Centre Lesce by Friday, 11 September 2026, on working days between 8:00 and 14:00.

A completed application form must be submitted with the products. There is no participation fee. A three-member professional committee will select five finalists. Visitors at the event will then taste the five finalist products and vote for their favourite.

The product receiving the most votes will receive the title "Best Honey Product 2026", with the winner announced at 3:00 PM.

The organisers also state that registration of a food-processing activity is not required for the tasting at the event, because the products are not being sold.

The event is organised by the Slovenian Beekeepers' Association, the Public Advisory Service for Beekeeping, and the Beekeepers' Association of Gorenjska.



We are looking for new EUROPEAN CHAMPIONS in honey – a prestigious title for the next two years!

Sample submission

- **3 jars of honey (450 g each)**, properly labelled for sale.
- Register via the online form using the QR code.
- Attach the printed confirmation and proof of payment to the sample.
- Participation fee: **€70** per sample.
- Samples can be sent by post or delivered in person to:

Čebelarska zveza Slovenije, Brdo pri Lukovici 8, 1225 Lukovica, Slovenija.

Evaluation process

The honey will be evaluated by a panel of international honey experts.

- Evaluation is carried out in liquid form (crystallized honey will be properly liquefied beforehand).

A minimum of 7 samples per category is required

- If fewer samples are submitted, the commission will classify them based on electrical conductivity into: honeydew or multifloral.

All samples will be tested for **basic quality parameters** (≤ 18.6% moisture content, HMF ≤ 15 mg/kg). The top three honeys in each category will undergo additional analysis for **authenticity** and **safety**.

Online submission form with instructions for sample submission

Submit your samples by: 14.9.2026

AWARD CEREMONY IN KOPER, SLOVENIA
5 DECEMBER 2026

European Honey Contest
Koper - Slovenia

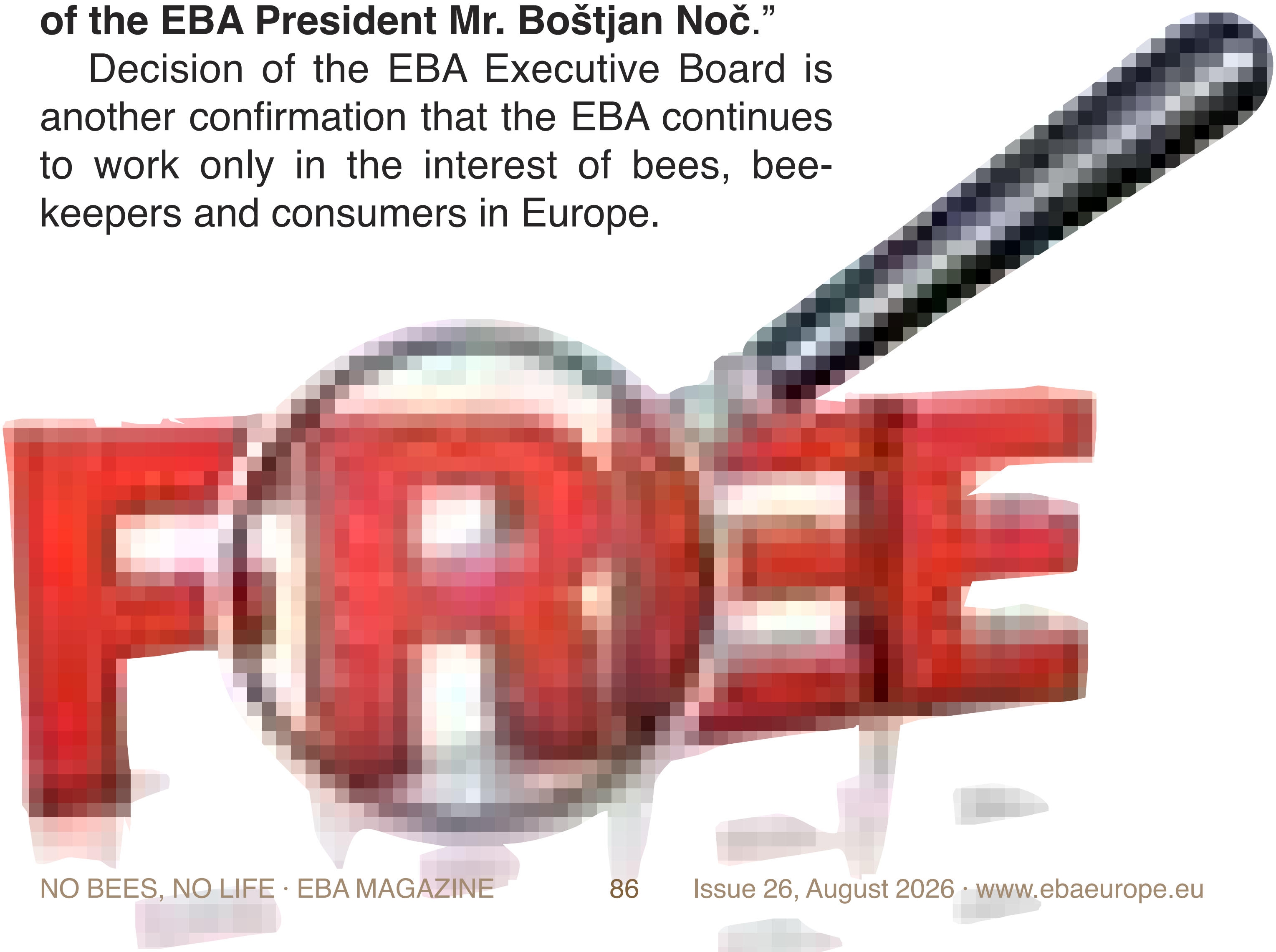
www.honey-contest.eu

Only authentic honeys with exceptional sensory characteristics typical of their variety will be awarded the top three distinctions and earn the right to promote this prestigious title.

TO THE EBA WITHOUT MEMBERSHIP FEE

At the meeting of the EBA Executive Board, on the proposal of the EBA President Mr. Boštjan Noč, an important decision was made regarding membership in the EBA in the upcoming period: “**Membership in the EBA is free for the duration of the mandate of the EBA President Mr. Boštjan Noč**.”

Decision of the EBA Executive Board is another confirmation that the EBA continues to work only in the interest of bees, beekeepers and consumers in Europe.



SPONSORSHIP REQUEST

AND METHOD OF ADVERTISING IN THE MAGAZINE

On behalf of the European Beekeeping Association (EBA),I am writing to seek your support in the form of sponsorship to help ensure the smooth and effective operation of our Association.

The EBA is dedicated to promoting and supporting beekeeping across Europe. The Association was founded out of necessity, as bees and beekeepers are essential for our ecosystem and society. Without beekeepers there are no bees, and whithout bees there is no pollination, leading to a lack of food on planet Earth.

EBA works for bees, beekeepers and consumers.

Our mission is to:

1. Fight against counterfeit honey that flooded the European market;
2. Introduction of incentives per beehive as agro-ecological programme;
3. Fight against the improper use of chemicals that are harmful to bees;

In return for your generous support, we offer various sponsorship benefits. We believe that this partnership would be mutually beneficial and would significantly contribute to the advancement of the european beekeeping sector.

ADVERTISING IN THE MAGAZINE:

1. Through sponsorship packages;
2. It is possible to pay for an ad only for 1/4 page (100 euros), for a larger area by agreement. The entire page cannot be obtained, it belongs only to the General Sponsor.

IT CONTINUES

EBA
sponsorship packages

GOLD sponsor - 5.000 euros:
Advertisement on the EBA website
Presentation at all EBA events, logo on all EBA correspondence
12 advertisements in the EBA monthly e-magazine in A4 page size

SILVER sponsor - 3.000 euros:
Advertisement on the EBA website
Presentation at all EBA events, logo on all EBA correspondence
12 advertisements in the EBA monthly e-magazine in half A4 page size

BRONZE sponsor - 2.000 euros:
Advertisement on the EBA website
12 advertisements in the EBA monthly e-magazine in the size of 1/4 A4 page

EBA SUPPORTER - 1.000 euros:
Advertisement on the EBA website
12 advertisements in the EBA monthly e-magazine in the size of 1/8 A4 page

These are basic packages, but we are open to different forms of cooperation, which we agree on individually. We would be delighted to discuss this opportunity further and explore how we can align our goals with your organization's values.

Thank you for considering our request. We look forward to the possibility of working together.

Yours sincerely,

Boštjan Noč
President of the European Beekeeping Association

6 GOD WILL NOT HELP US, IF WE DON'T TRY TO HELP OURSELVES

7 COMMITTEE ESTABLISHED TO COMBAT HONEY FRAUD IN GREECE WITH THE PARTICIPATION OF AN EBA REPRESENTATIVE

8 THE AMENDED HONEY DIRECTIVE: IMPLEMENTATION, TRANSITIONAL LOOPHOLES, AND THE READINESS OF THE EU MARKET

12 REPORT FROM SLOVENIA: IN ACCORDANCE WITH THE NEW DIRECTIVE, ONLY 1.79% OF HONEY BLENDS IN SLOVENIAN STORES ARE LABELED – GO TO A LOCAL BEEKEEPER!

14 EBA STANDS WITH FRENCH BEEKEEPERS AS PESTICIDE ROLLBACK SPARKS OUTRAGE

15 HOW TO PRODUCE HIGH-QUALITY MONOFLORAL HONEY FOR SUCCESSFUL SENSORY EVALUATION

19 CAN HONEY BEE WINTER LOSSES BE PREDICTED?

25 INDIVIDUAL-LEVEL COMPARISONS OF HONEY BEE (Hymenoptera: Apoidea) HYGIENIC BEHAVIOR TOWARDS BROOD INFESTED WITH VARROA DESTRUCTOR (Parasitiformes: Varroidae) OR TROPILAELAPS MERCEDESAE (Mesostigmata: Laelapidae)

37 GENETICALLY ENGINEERED MICROBES POSE SIMULTANEOUS RISKS FOR HUMANS, BEES AND PLANTS

39 SO, HOW ARE POLLINATOR CONSERVATION AND PROPOLIS HARVESTING INTERCONNECTED?

45 14th INTERNATIONAL MEETING OF YOUNG BEEKEEPERS (IMYB) NORTHERN IRELAND 2026

55 FREE EXHIBITION RENTAL 3D GIANT CARNIOLAN HONEYBEE

56 EBA SUPPORTS THE EFFORTS OF SLOVAKIA

71 BEEXPERT 1st ANNUAL MEETING 26 avgust

73 B-THENET EUROPEAN BEEKEEPING EVENT 27 avgust

78 BEST HONEY PRODUCT 2026 COMPETITION

79 2nd HONEY SENSORY ANALYSIS EDUCATION IN GREECE

85 EUROPEAN HONEY CONTEST IN KOPER, SLOVENIA

86 TO THE EBA WITHOUT MEMBERSHIP FEE

87 SPONSORSHIP REQUEST AND METHOD OF ADVERTISING IN THE MAGAZINE

89 EBA SPONSORSHIP PACKAGES

EBA informative and professional monthly magazine "NO BEES, NO LIFE"

August 2026.
Issued since July 2024.
Publisher: **European Beekeeping Association** (EBA)
Head office: Brdo pri Lukovici 8, 1225 Lukovica, Slovenija
eba@ebaeurope.eu
www.ebaeurope.eu

Editor in chief of the electronic edition of the magazine:
MD Rodoljub Živadinović, Epidemiology Specialist, Apitherapist
apikult@gmail.com, +381 60 444 01 01 (Viber, WhatsApp, Telegram, Signal, WeChat, Daze)