D2.3

Inventory of priority practices and innovations bottom-up M16

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Abstract	Deliverable 2.3 presents the results of the second bottom-up survey analysis carried out by B-THENET, the first Thematic Network for European Beekeepers. The aim of the current analysis was to identify a list of good beekeeping practices that are considered a priority by EU beekeepers and advisors. A total of 1,054 replies from 22 EU countries were received and a total of 28 priority practices were identified.
Keywords	EU Beekeeping, Bottom-up approach, Good Beekeeping Practices, Biosecurity Measures in Beekeeping, Inventory, Priority Practices

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1 Executive Summary

Deliverable 2.3 presents the results of the second survey analysis carried out by B-THENET, the first Thematic Network for European Beekeepers. The deliverable consists of two files:

- The database containing the "Inventory of priority practices and innovations bottom-up".
- The summary report, meant to support and contextualise the above-mentioned database.

In the survey, European Beekeepers were asked to rate practices from the most to the least relevant. The bottom-up approach allowed B-THENET researchers to select the practices to develop in 2024 within the Thematic Network, according to beekeepers needs. The resulting inventory of priority practices, will be fully developed at the digital level (using two online platforms, the "Exchange" and "Repository" Platforms) and at the physical level (by B-THENET centres, the project' hubs for discussion, refinement, and dissemination of Best Beekeeping Practices).

Two themes were addressed in the second survey of B-THENET: Colony set-up and daily management/maintenance for the Good Beekeeping Practices (GBPs) category, and American Foulbrood for the category Biosecurity Measures in Beekeeping (BMBs).

The survey was distributed between the 17th November and 19th December 2023. A total of 1,054 answers were received, coming from 22 EU countries. As a result of the rating of the EU beekeepers and advisors, 20 priority practices in the GBPs category and 8 in the BMBs category were identified.

2 Introduction

The current deliverable presents the results of the second bottom-up survey distributed among European beekeepers by the project B-THENET. B-THENET is a thematic network involving 18 European partners, including research institutes, universities, and beekeeping associations.

In particular, the project pursues the following objectives:

• Modernize the EU beekeeping sector by establishing a multi-actor network with complementary knowledge that connects beekeepers, researchers, advisors, and the other actors in the apiculture sector.

• Collect, categorize ("Inventory"), and select good practices for sustainable beekeeping and new research findings ready to put into practice or not sufficiently known using a bottom-up methodology.

• Create a digital knowledge platform ("Exchange") to increase the flow of practical information and knowledge sharing within the EU.

• Create a digital knowledge platform ("Repository") to collect, share and store knowledge on best practices, for the long term, facilitating and harmonizing the education of the EU beekeeping sector.

The collection of priority practices from beekeepers through the bottom-up surveys represents the starting point of this process. The survey was developed by consortium partners, translated in 14 languages, and distributed across the partner countries. European beekeepers were asked to rate a list of GBPs and BMBs, to provide an overview of what are priority practices in Europe, according to beekeeper's needs. Beekeepers could also provide new practices that they felt were not considered in the survey, and to suggest relevant innovations that may be applicable to any of the listed practices. The resulting document, is an inventory of priority practices according to beekeepers needs, that will be subject to the full development in 14 national languages during the second year of B-THENET.

3 Methodology

3.1 Survey design and analysis

The methodology for the second-round survey was rigorously evaluated and discussed within the consortium, leading to a formal vote. This led to significant revisions and improvements to the B-THENET survey's structure compared to the first survey. In its revised format, the B-THENET survey now focuses on individual practices rather than broader practice containers, which have been repurposed to headers for the corresponding practices. Based on the results, the highest-rated practices will be selectively filtered and subjected to further in-depth analysis on the platform in 2024. If desired, it is now possible to include also top-ranked practices from practice containers which would not have made it to the top practices. By adopting this approach, practices within a container will be more visible to participants, ensuring they are not overlooked or underrepresented for future implementation on the platform.

Following the format of Deliverable 2.2, the B-THENET survey was again implemented using the EU Survey System (https://ec.europa.eu/eusurvey/). The survey was translated into 14 languages (Croatian, Danish, English, Flemish, French, German, Hungarian, Italian, Latvian, Polish, Slovakian, Slovenian, Spanish and Swedish) and distributed to beekeepers and advisors by the project partners. The link to the survey was accessible from the 17th November 2023 to the 19th December 2023 and included GBPs and BMBs for evaluation. These were derived from earlier research conducted under the SusAn ERA-NET project "BPRACTICES" (Pietropaoli et al., 2020a; Pietropaoli et al., 2020b; Rivera Gomis et al., 2019). For the whole survey, see Appendix 6.1.

Each year of the project, different themes encompassing both GBPs and BMBs will be discussed to comprehensively address all beekeeping areas in which the adoption of practices may be of particular relevance (Table 1). In the second year, we focused on **Colony set-up and daily management/maintenance** (GBPs) and **American Foulbrood** (BMBs). Beekeepers and advisors were asked to rate a list of 81 GBPs and BMBs.

Table 1: Topics covered in B-THENET Surveys across the four years of the project

THEMES	CATEGORY (GBPs or BMBs)	YEAR
Apiary set-up and management/maintenance	GBPs	2023
Varroosis	BMBs	
Colony set-up and daily management/maintenance	**GBPs**	**2024**

American foulbrood	BMBs	
Record-keeping + AMR prevention	GBPs	2025
Bee feeding and watering		
European foulbrood	BMBs	
Routine (preventive) hygiene practices	GBPs	2026
Nosemosis + Small Hive Beetle + *Vespa velutina*	BMBs	

In the current B-THENET survey, beekeepers and advisors were invited to evaluate various "**practices**" based on their personal perspectives, using a rating scale from 1 star (least relevant) to 5 stars (most relevant). If respondents had no opinion about a particular practice, they had the option to leave it unrated (no stars). The rating values were assigned as follows: 1 star equalled 1 point, 2 stars equalled 2 points, and so on, up to 5 stars equal to 5 points. An unrated practice (no stars) was recorded as a null value (empty cell). Additionally, beekeepers had the opportunity to briefly describe any practice they believed was crucial but not included in our list. They were also encouraged to suggest any significant innovation that could be applied to one of the practices listed in the survey.

Answers were analysed in a two-stages process:

1. **Priority practices**

The first part of the analysis focused on identifying the priority practices among European beekeepers. This was achieved by having beekeepers rating different practices within different practice containers, thereby revealing which operational activities they considered most crucial for discussion in B-THENET. As a result, the 20 overall best rated practices of both categories were chosen. To further enhance representation of each practice container, the top 2 rated practices within each container, provided they were not already included in the top 20 list, were also selected. This approach resulted in a comprehensive list of 28 priority practices covering practices from all practice containers (tables 2 and 3).

2. **New practices - Practice containers**

In the second part of the analysis each new practice proposed by beekeepers was checked to understand if it was already included in one of the proposed practices to be discussed in 2024, or if it could be assigned to past/future themes (and therefore not be discussed in the current year). The list with the new practices suggested by beekeepers and advisors is in Appendix 6.2.

4 Results

4.1 Survey responses

We gathered a total of 1,054 responses, reflecting the perspectives of beekeepers from 22 EU countries. Six of these countries (Bulgaria, Czechia, Estonia, Ireland, Portugal and Romania), which are not project partners, contributed only with one response each (Fig. 1).

The beekeepers collectively provided 72778 ratings of the practices. Each individual practice was thereby rated by between 732 and 1026 beekeepers.

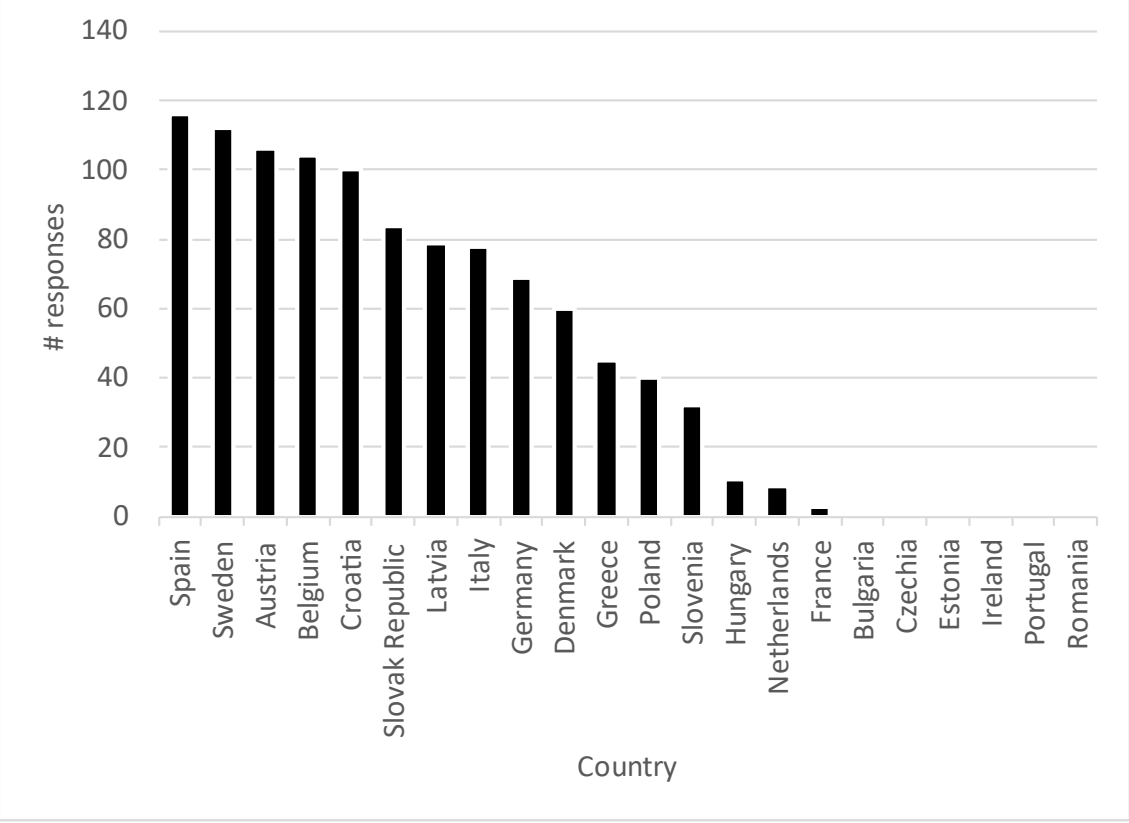

Figure 1: Overall distribution of responses per EU-country (n=1,054).

4.2 Priority practices

In total, respondents rated a list of 81 practices from 11 practice containers (see Appendix 6.1).

The top 20 practices are listed in table 2: 17 belong to the category of GBPs and 3 to the category BMBs.

The further 8 top practices (top 2 from each container, if not already in the overall top 20 list) are shown in table 3: 3 belong to the category of GBPs and 5 to the category of BMBs.

This methodology was applied to ensure that all practice containers were represented with at least 2 practices.

The average ratings of priority practices spanned from 4.59 for "Wintering colonies: Feeding and verify food storage" to 3.31 for the "Management of hives that show clinical symptoms of AFB: Form a "Disinfection unit" in the local community". The sample size spanned from 682 (Management of hives that show clinical symptoms of AFB: Form a "Disinfection unit" in the local community) to 1,026 (Colony inspection: Inspect colonies during suitable weather conditions).

Table 2: The top 20 practices. Practices of the theme "colony set-up and daily management/maintenance" under the GBPs category are highlighted in orange, practices of the theme "American foulbrood" under the BMBs category are highlighted in grey (sample size is between 786 and 1,026).

Category	Practice container/Practice	Average ranking	Number of votes
Good beekeeping practice	Wintering colonies: Feeding and verify food storage	4.59	1,017
Biosecurity measure	Prevention of AFB outbreaks: Visual inspection of brood combs during work in the colony	4.55	941
Good beekeeping practice	Swarming prevention: Expanding the colony to give the colony space	4.54	1,022
Good beekeeping practice	Prevention of disease transmission when transferring colonies, bees or frames: Only transfer disease-free bees and/or frames to other colonies	4.49	984
Good beekeeping practice	Colony inspection: Evaluate the space needed by the growing colony	4.46	1,010
Good beekeeping practice	Queen rearing: Choose the best colonies as larvae donors	4.44	885
Good beekeeping practice	Prevention of disease transmission when transferring colonies, bees or frames: Follow national rules for migratory beekeeping	4.40	927
Biosecurity measure	Disinfection of materials of AFB contaminated colonies: Disinfection of apiary after AFB sanitation	4.40	786
Good beekeeping practice	Colony inspection: Evaluate the food stores	4.39	1,017
Good beekeeping practice	Colony inspection: Optimise inspection time/number of visits (e.g., to minimise stress; planning)	4.39	1,022
Good beekeeping practice	Colony inspection: Internal colony evaluation	4.38	1,008
Good beekeeping practice	Comb management: Replace beehive frames (how many and when)	4.38	1,008
Good beekeeping practice	Comb management: Wax moth control and wax moth safe comb storage	4.36	985

Good beekeeping practice	Improvement of colony resilience and resistance to diseases: Eliminate diseased colonies, so that they cannot reproduce	4.35	983
Good beekeeping practice	Colony inspection: Inspect colonies during suitable weather conditions	4.34	1,026
Good beekeeping practice	Swarming prevention: Adding honey supers	4.32	998
Biosecurity measure	Detection of AFB: Visual detection of AFB-typical signs	4.31	881
Good beekeeping practice	Comb management: Processing beeswax – from removing old combs to production of new wax foundations	4.31	975
Good beekeeping practice	Wintering colonies: Overwinter in the brood chamber	4.30	927
Good beekeeping practice	Prevention of disease transmission when transferring colonies, bees or frames: Carry out inspections for honey bee diseases before transferring colonies to a new location	4.27	977

To further enhance representation of each practice container, the top 2 rated practices within each container, provided they were not already included in the top 20 list, were also selected and shown in table 3.

Table 3: Additional 8 practices selected for further elaboration. Practices of the theme "colony set-up and daily management/maintenance" under the GBPs category are highlighted in orange, practices of the theme "American foulbrood" under the BMBs category are highlighted in grey (sample size is between 682 and 976).

Category	Practice container/Practice	Average ranking	Number of votes
Biosecurity measure	Detection of AFB: Information about the AFB case to neighboring beekeepers/apiaries/migratory apiaries	4.25	822
Biosecurity measure	Disinfection of materials of AFB contaminated colonies: Disinfection of flammable beekeeping equipment (e.g., wooden hives or nucs, boards, frames, combs, wax sterilisation etc.)	4.24	791
Good beekeeping practice	Improvement of colony resilience and resistance to diseases: Perform selection to have queens that are more resistant to disease and adapted to local climatic conditions	4.19	976
Biosecurity measure	Management of hives that show clinical symptoms of AFB: Destruction of AFB positive colonies or whole apiary	4.16	797
Biosecurity measure	Management of hives that show clinical symptoms of AFB: Form a "Disinfection unit" in the local community	3.31	682
Biosecurity measure	Prevention of AFB outbreaks : Management of asymptomatic colonies when AFB cases have been detected in	3.96	756

	the apiary or in other hives of the same beekeeper		
Good beekeeping practice	Queen rearing: Evaluation of mating success and start of oviposition of the new queen	4.00	830
Good beekeeping practice	Routine queen management: Replace queens with high mite levels and or poor hygienic behavior	3.93	967

Figure 2 presents the rankings of the 11 practice containers, offering insights on which containers the respondents found most relevant. The average ratings span from 4.20 for the "Disinfection of materials of AFB contaminated colonies" to 3.54 for the "Management of hives that show clinical symptoms of AFB".

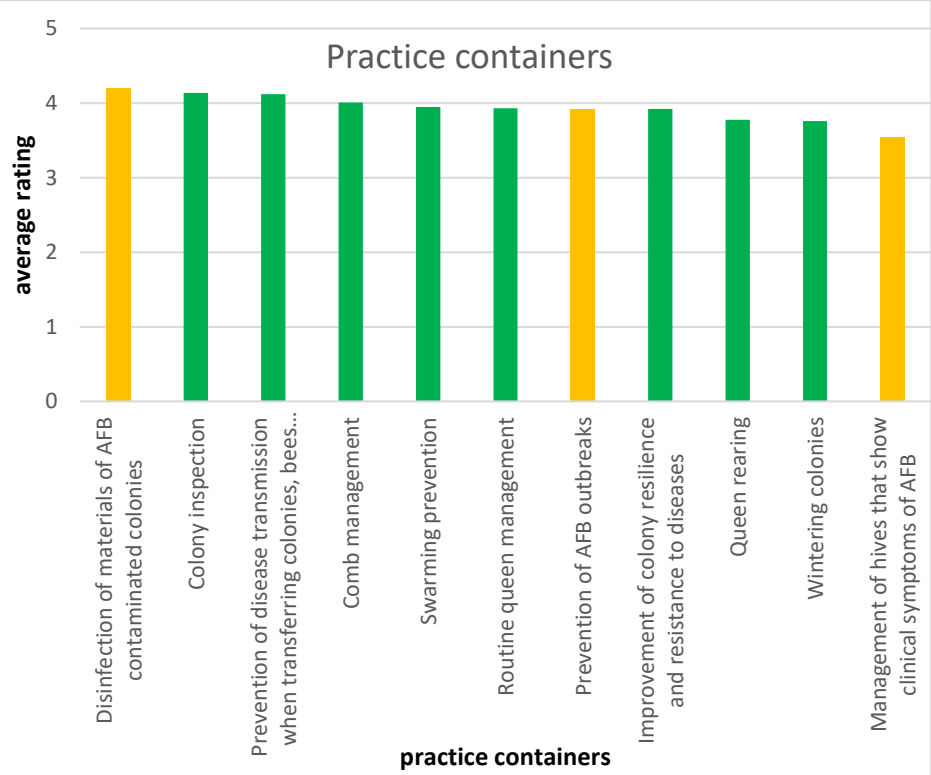

Figure 2: Average rating of practice containers (n=1,054). GBPs' containers are shown in green, BMBs' containers are shown in orange.

5 Conclusions

We received a total of 1,054 answers, representing the opinion of beekeepers coming from 22 EU countries. The resulting inventory of priority practices, consists in a list of 28 practices, across the themes of Colony set-up and daily management/maintenance (GBPs category) and American Foulbrood (BMBs category). The practices and innovations selected by European beekeepers will be analysed, categorised, fully described and exchanged in 14 national languages, with the active collaboration of European beekeepers and advisors. Once fully developed, the practices will be validated theoretically (online) and practically (on-field), and will become training material.

6 Appendix

6.1 Survey for beekeepers

Dear beekeeper,

B-THENET is the first platform for European beekeepers. Our goal is to collect good beekeeping practices and innovations and discuss them among beekeepers, advisors, and other stakeholders in 14 languages through our digital platforms. Each year, we target different beekeeping themes. For 2024, **Colony set-up and daily management/maintenance** as well as **American foulbrood** will be in the focus of the project. This survey is part of the project's bottom-up approach and is meant for rating the most relevant practices and innovations within these categories. Please rate the practices, according to your opinion as a beekeeper, from the most (5 stars) to the least (1 star) relevant. If you have no opinion or if the practice is unknown to you, leave the field empty. For better understanding and to distinguish between the practices, they are categorised under a collection title.

First category: Colony set-up and daily management/maintenance

Prevention of disease transmission when transferring colonies, bees and/or frames refers to the following practices:

- Carry out inspections for honey bee diseases before transferring colonies to a new location
- Only transfer disease-free bees and/or frames to other colonies
- Disinfect material in contact with bees in field conditions
- Use new frames and material
- Follow national rules for migratory beekeeping

Improvement of colonies resilience and resistance to diseases refers to the following practices:

- Perform selection to have queens that are more resistant to disease and adapted to local climatic conditions
- Purchase of local bees (swarms, queens, …) adapted to the local ecosystem
- Purchase queens bred for disease resistance
- Nosema (Vairimorpha) tests
- Eliminate diseased colonies, so that they cannot reproduce

Routine queen management (e.g. marking, replacing queens) refers to the following practices:

- Replace queens at least every two or three years, except for those of high genetic value

- Mark queens using standard international colors according to their year of birth, keep track on the queen's pedigree, and evaluate the queen's performance
- Replace queens with "bad" evaluation on behavior
- Replace queens with high mite levels and or poor hygienic behavior

Queen rearing refers to the following practices:

- Choose the best colonies as larvae donors
- Choose the best colonies for drone production
- Preparation of cell starter and cell finisher
- Transferring larvae (grafting)
- Queenless builder Colony (Combined Starter-Finisher)
- Handling & transporting queens in different stages
- Drone production
- Nucleus production, adding cells to nuclei
- Evaluation of mating success and start of oviposition of the new queen

Colony inspection refers to the following practices:

- Calm down bees by use of a smoker and others
- Proper choice of fuel for a smoker
- Inspect colonies during suitable weather conditions
- Optimise inspection time/number of visits (e.g., to minimise stress; planning)
- External colony evaluation: colony condition, colony entrance activity, pollen collection, weight of colony
- Internal colony evaluation
- Evaluate the food stores
- Evaluate the queen status
- Evaluate the space needed by the growing colony
- Evaluate swarming tendency in the season
- Colony monitoring using hive-scales and sensors

Swarming prevention refers to the following practices:

- Expanding the colony to give the colony space
- Colony splitting
- Secure the right place for the brood nest
- Proper hive transportation (e.g. avoid overheating, dust and guarantee watering)
- Adding honey supers Insertion of drawn combs
- Manage beehive's bottom board along the year
- Signs of swarming and determination of how far it is
- Brood inspection by tipping boxes and examining frame gaps for queen cells from below
- Destroying queen cells

- Artificial swarm (shook swarm)

Wintering of the colonies refers to the following practices:

- Reduce the empty space in the hive
- Annual management of the entrance space
- Wrapping techniques (black tar paper, etc.)
- Feeding and verify food storage
- Keeping the feeder on the hive during the winter
- Estimate the minimum size of the colony that is able to overwinter
- Protection against mice (and possible other disturbances)
- Overwinter with a super and no queen excluder
- Overwinter in the brood chamber

Comb management refers to the following practices:

- Replace beehive frames (how many and when)
- Indicate the age of the combs Processing beeswax – from removing old combs to production of new wax foundations
- Recognition of adulterated wax / wax foundations
- Heat up old beeswax to 130°C before the production of wax foundations
- Manage food combs of dead bee colonies
- Wax moth control and wax moth safe comb storage
- Use the queen excluder to avoid brood on combs which are expected to contain only honey

If missing, please add the name of a practice that you consider relevant ……..
Please describe the most relevant innovation that could be applied to one of the above-listed practices (specifying which one it relates to) ……..

Second category: American foulbrood

Prevention of AFB outbreaks refers to the following practices:

- Select and breed colonies that are AFB-tolerant/resistant
- Check annually for P. larvae in asymptomatic colonies
- Management of asymptomatic colonies when AFB cases have been detected in the apiary or in other hives of the same beekeeper
- Visual inspection of brood combs during work in the colony
- Increase of the immunity of the bee colonies (e.g. by application of immunomodulators such as probiotics, prebiotics, phytoadditives and nutrition)

Detection of AFB refers to the following practices:

- Potential signs of AFB
- Visual detection of AFB-typical signs
- Perform the ropiness test on suspicious larvae
- Apply an AFB test (field kit)

- Sampling for laboratory analysis for confirmation
- Information about the AFB case to neighboring beekeepers/apiaries/migratory apiaries

Management of hives that show clinical symptoms of AFB refers to the following practices:

- Make shook swarms to sanitize colonies with clinical symptoms of AFB
- Destruction of AFB positive colonies or whole apiary
- Form a "Disinfection unit" in the local community

Disinfection of materials of AFB contaminated colonies refers to the following practices:

- Disinfection of apiary after AFB sanitation
- Disinfection of flammable beekeeping equipment (e.g., wooden hives or nucs, boards, frames, combs, wax sterilisation etc.)
- Incineration of flammable beekeeping equipment
- Disinfection of fire-proof or plastic beekeeping equipment (styrophoam nucs, metallic queen excluders, etc.)
- Disposal of fire-proof or plastic beekeeping equipment (styrophoam nucs, etc.)

If missing, please add the name of a practice that you consider relevant ……
Please describe the most relevant innovation that could be applied to one of the above-listed practices (specifying which one it relates to)……

6.2 List of new practices proposed by the beekeepers

Category	Theme	Practice container	Practice	Country
GBP	Colony set-up and daily management/maintenance	Comb management	Use of natural combs (foundationsless)	Austria, Sweden
GBP	Colony set-up and daily management/maintenance	Comb management	Focus on own, closed comb circuit	Austria
BMB	AFB	Management of hives that show clinical symptoms of AFB	Notify official services in your region in case of clinical signs of American Foulbrood	Spain
GBP	Colony set-up and daily management/maintenance	Swarming prevention	Adding frames with comb foundation to prevent swarming	Sweden
GBP	Colony set-up and daily management/maintenance	Queen rearing	Mating queens on mating stations with known genetics	Sweden
GBP	Colony set-up and daily management/maintenance	Wintering of the colonies	Overwinter the bee colonies on their own honey	Sweden
GBP	Colony set-up and daily management/maintenance	Swarming prevention	Use checkerboarding technique according	Austria, Sweden

			to Walt Wright for swarm prevention	
GBP	Colony set-up and daily management/maintenance	Colony inspection	Technological solutions for monitoring (e.g. temperature or other sensors, hive scales)	Belgium, Croatia
GBP	Colony set-up and daily management/maintenance	Prevention of disease transmission	Removal of abandoned hives from surrounding apiaries	Croatia
BMB	AFB	Prevention of disease transmission	Transferring colonies-taking care of robbing	Greece
GBP	Colony set-up and daily management/maintenance	Comb management	Breeding restriction (caging the queen) before changing comb	Belgium
BMB	AFB	Prevention of AFB outbreaks	Registration with the competent authorities (government, associations) to receive news about spread of diseases and do infection declarations to those authorities	Belgium

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