

Conclusions and recommendations based on the EurBeST findings:



Selective breeding of honey bees is an efficient way to increase productivity, to reduce colony losses and to improve bee health. The use of well-selected stock is a major factor of economic success in commercial beekeeping.



Regional breeding structures are needed to select locally adapted bees. These include cooperation among breeders, queen producers and commercial beekeepers with scientific support.



Selection for resistance works, but it is costly. Mite infestation development and hygiene behaviour are useful criteria to select varroa-resistant stock. However, the costs of testing for the breeders are high and need to be compensated.



Market for queens must be improved. There is high demand from commercial beekeepers for resistance selected queens. However, the usual market prices for queens do not cover extra costs for selection. Subsidising the production of high quality queens could help.



Honey bee breeding needs support: The success of breeding programs depends on their dimension and consistent development over several years. Considering the high costs for specific selection methods towards improved varroa resistance, public funding of the beekeeping breeding sector is recommendable.

The results of the EurBeST study contribute to achieving the goals of the EU Green Deal, specifically of the Farm to Fork and Biodiversity strategies.



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PROJECT TEAM



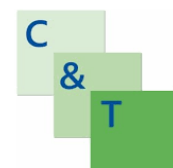
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RESTRUCTURING OF THE HONEY BEE CHAIN AND VARROA RESISTANCE BREEDING & SELECTION PROGRAMME

A pilot study comparing varroa resistant bees
under commercial beekeeping conditions

AGRI-2017-0346

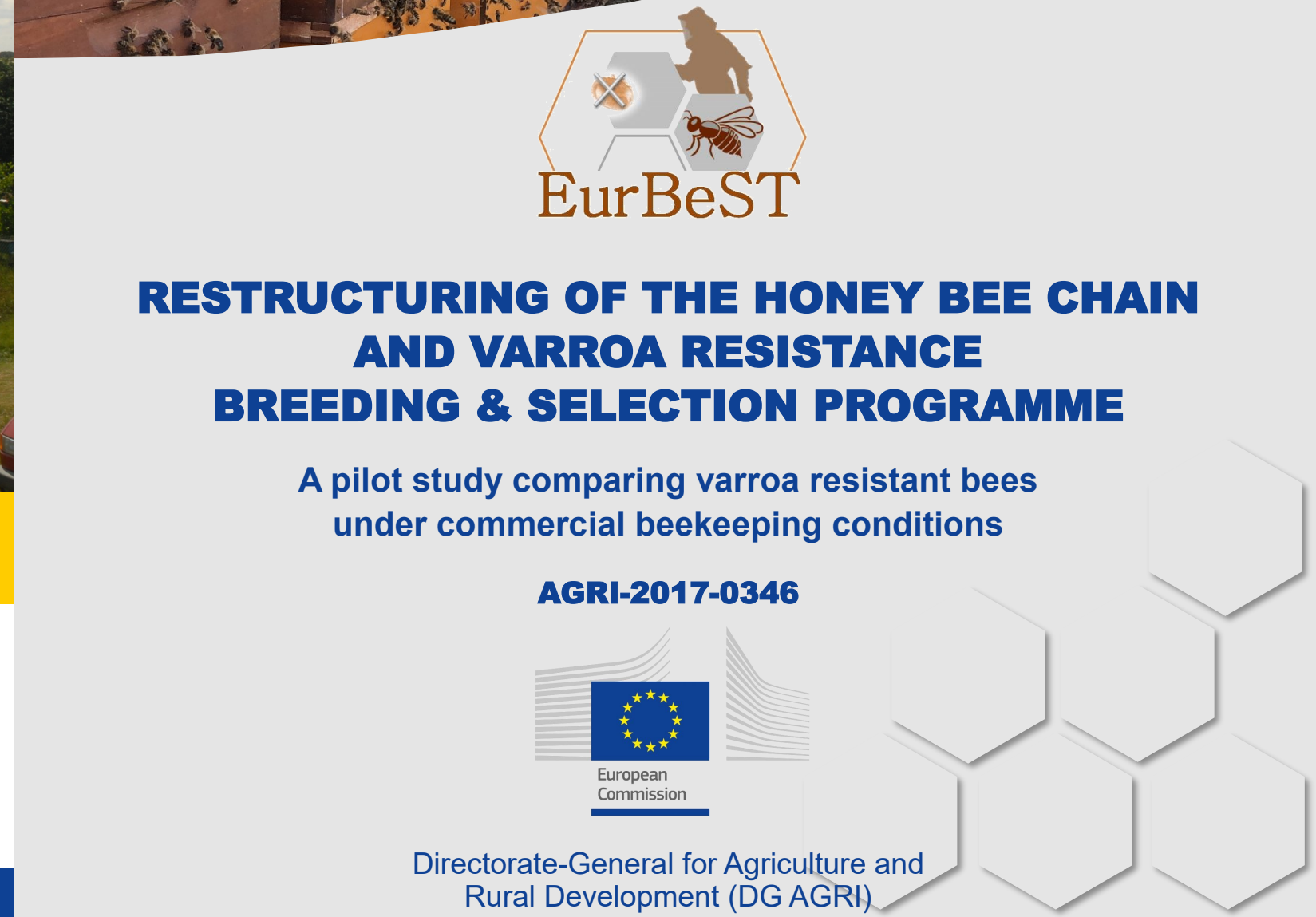


Directorate-General for Agriculture and
Rural Development (DG AGRI)

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The largest study on honey bee selection ever conducted in Europe, to answer the following questions:

- What is the status and entity of the honey bee breeding and reproduction market in the EU?
- What is known about varroa resistance? Do varroa-resistant bees exist in the EU? Are they available for beekeepers to use?
- Are beekeepers interested in using varroa-resistant honey bees? What do they expect when they buy honey bee queens?
- What methods are available for selecting varroa-resistant bees? Do they work?
- What are the efforts and costs to obtain varroa-resistant honey bee stock?

The EurBeST study explores possibilities for increasing the varroa resistance of commercially available honey bees by selective breeding and analyses ways to improve beekeepers' access to resistant material.

Beekeeping: a small sector of huge importance!

The apicultural sector in Europe represents a limited market compared to other agricultural sectors, but the pollination services provided by beekeepers and their honey bees are essential to maintain healthy ecosystems and food production chains.

Honey bees are in trouble!

Honey bees have been under huge stress for several years, due to intensification of agricultural practices as well as climatic changes and globalisation, which bring new diseases to bees. Amongst them is the parasitic mite *Varroa destructor*, which leads to the death of most infested colonies within a few months if no treatment is performed by beekeepers.

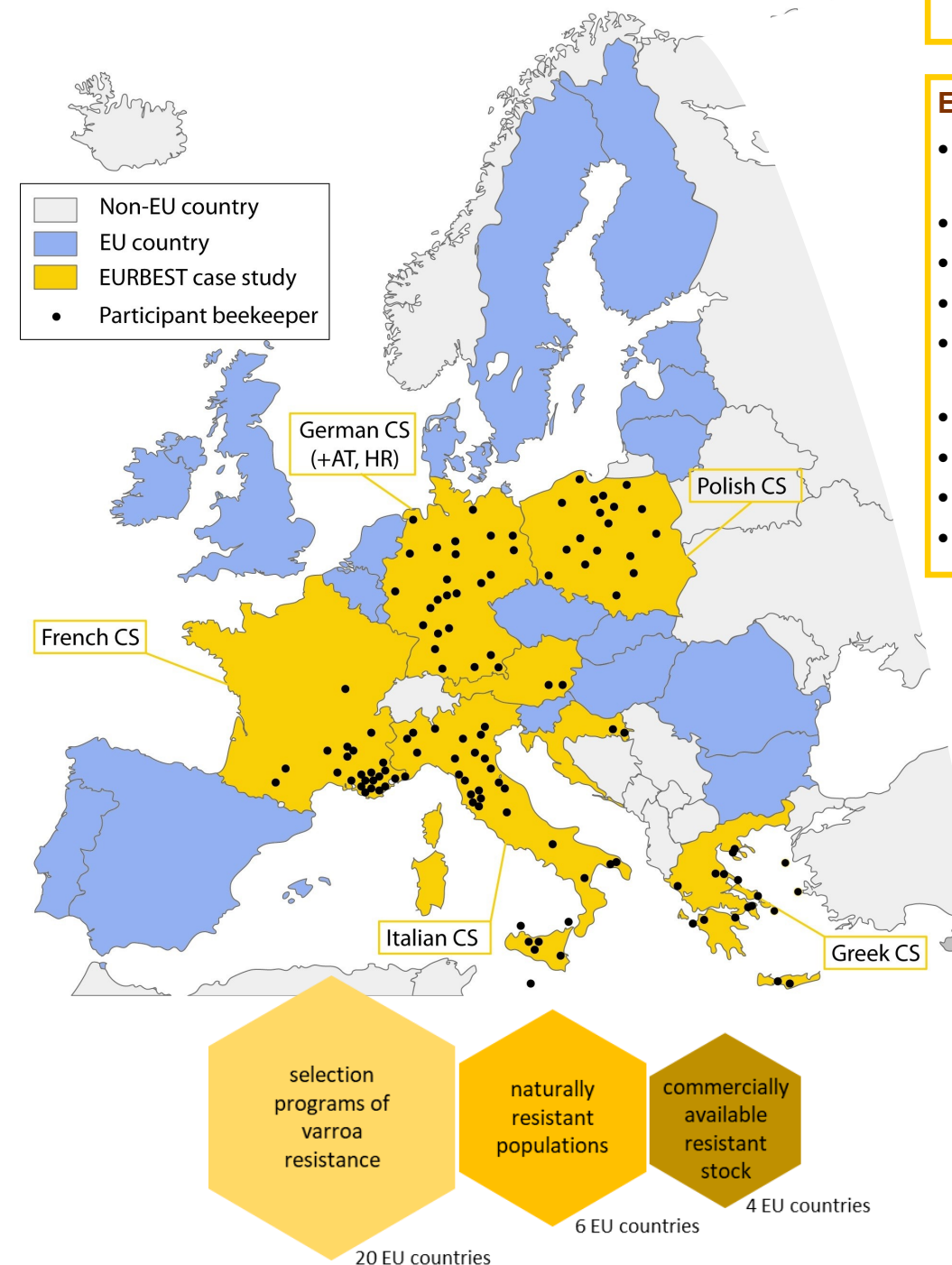
The varroa mite: a deadly menace for European honey bees

This mite feeds on the adult bees and bee pupae and, during this process, can transmit viruses. Since its arrival in Europe in the late 70's, varroa infests most colonies and represents the most impacting pathogen threat for honey bees and the beekeeping industry worldwide.



Varroa-resistant bees, a sustainable prospect for beekeepers!

Beekeepers only have limited solutions to control the mite. A new promising and sustainable solution emerges: some honey bee populations are able to survive mite infestation, in the absence of treatments. These survivor bees develop defences to maintain the parasite population under control. As this ability can be transmitted to the next generation, it opens up the possibility for beekeepers to specifically select and breed for varroa-resistant bees.

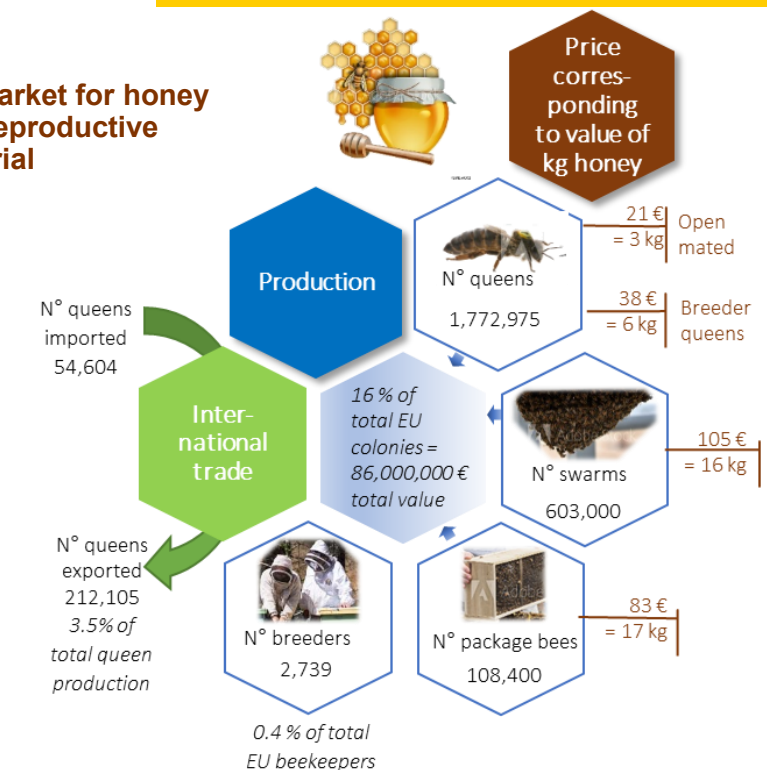


Despite a high demand, availability of varroa-resistant stock is limited

EurBeST team and study design

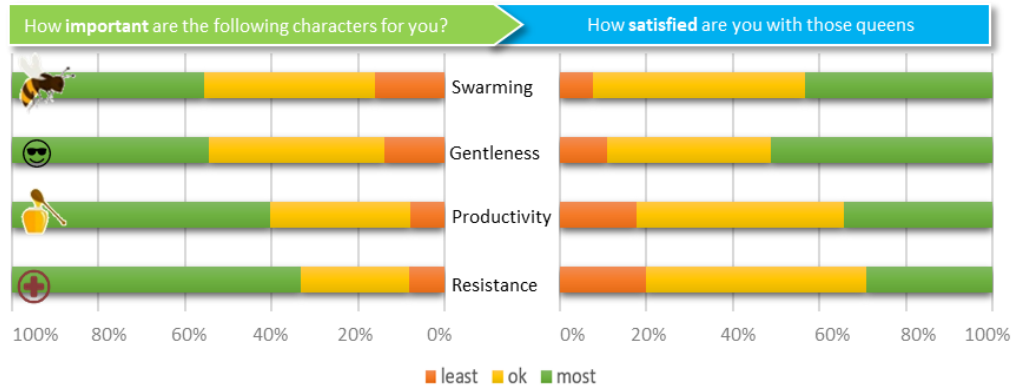
- Coordinating body with experts in beekeeping, bee biology, breeding, economics and statistics
- Analysis of the EU market for honey bee reproductive material
- Literature review and expert interviews on the state of play in varroa resistance
- Queen customer survey on expectations and quality
- 5 large-scale case studies (CS) in 7 EU countries comparing varroa-resistant lines under commercial beekeeping conditions
- 130 participating beekeepers
- 23 EurBeST selected lines belonging to 6 subspecies / races
- > 3,500 colonies tested for one full beekeeping season
- More than 40,000 single records collected

EU market for honey bee reproductive material



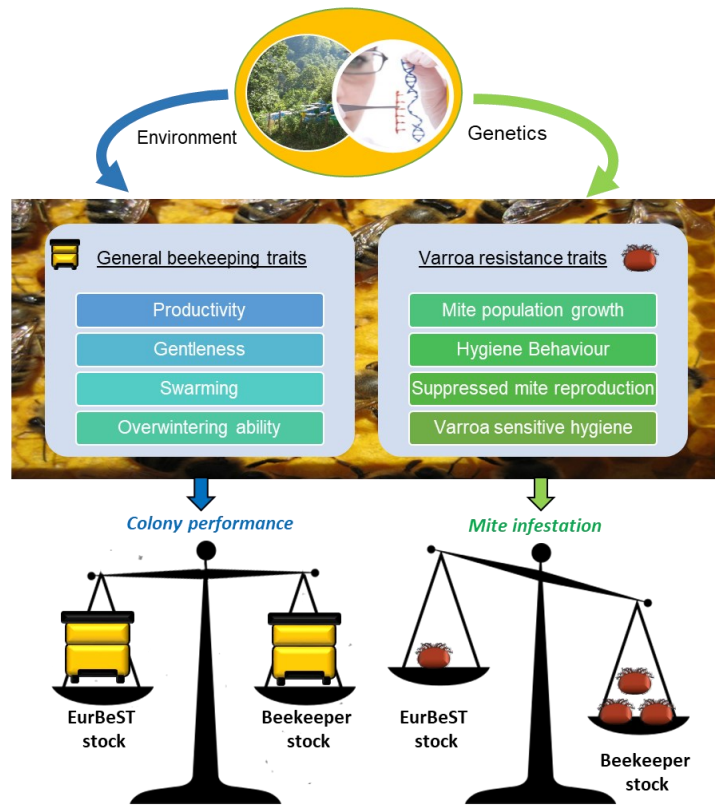
Beekeepers' views on the queen market: high expectations, but moderate satisfaction

- ◆ Most important for beekeepers is to have disease-resistant colonies, followed by a good productivity.
- ◆ Beekeepers are least satisfied with the disease resistance of available stock.



Local adaptation is important

Strong interactions between genetic and environmental factors regulate honey bee colony general performance as well as varroa-resistance potential. Practically, the same line of bees used in two different locations may perform very differently, highlighting the need for local selection strategies.

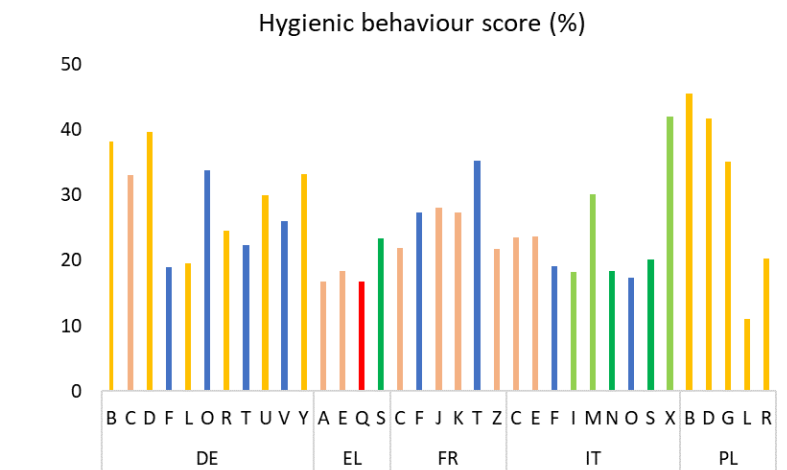
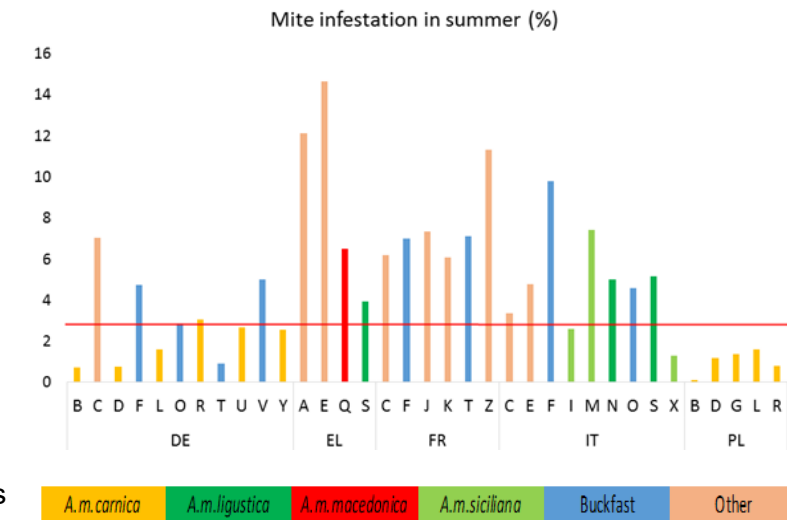
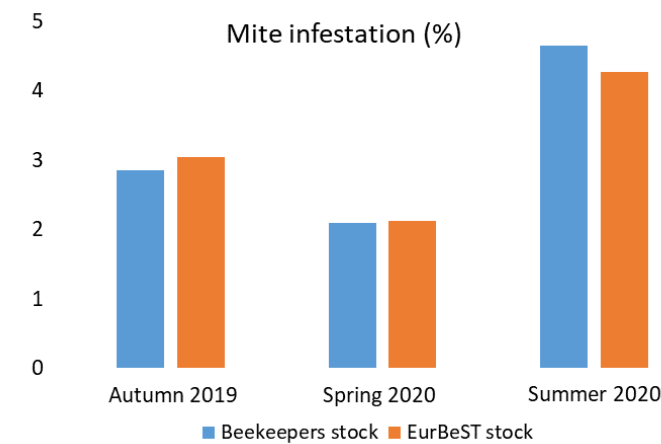


Selection works!

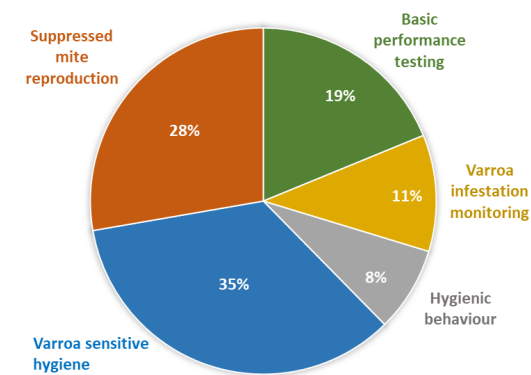
The EurBeST selected lines show similar survival rates to the beekeepers' stocks. While there is not much difference on average for the general traits, the EurBeST lines clearly outperform the commercial beekeepers' own stock with regard to mite resistance. Some of the selected lines demonstrated high productivity combined with low varroa infestation.

Higher resistance of selected stock

- ◆ While starting with a trend of higher infestation in autumn 2019, the EurBeST lines were on average less infested compared to commercial beekeepers' own stock by the end of test season in summer 2020.
- ◆ After a full season without any treatment against varroa, the infestation of several lines clearly remained below the 3% infestation threshold for required mite treatment, showing promising avenues for a treatment-free beekeeping.
- ◆ Varroa infestation levels closely correlate with the bee colonies' hygiene behaviour. Different expression of hygiene behaviour among the EurBeST lines thus serves as a useful selection criterion for mite resistance.



Economic Aspects



Selection is expensive...

Testing a colony costs 193 € on average, ranging from 273 € in Germany to 85 € in Greece.

... especially selection for varroa resistance!

The main costs of colony evaluation derive from assessing varroa resistance traits. Varroa infestation monitoring and hygienic behaviour testing together reach almost 20%, while more than 60% of the total results from assessing specific traits of bee defense against varroa.

Queen prices often do not cover these costs!

The average costs for queen production across the study countries amount to 22.58 € per queen, with the main share of costs originating from labour, which significantly varies between countries. The average selling price per queen was 23.32 €.

