Better-B
FOR RESILIENT BEEKEEPING

Simultaneously applying Darwinian selection for honey bee survival in 8 European countries

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Introduction

A sustainable approach to bee health is to foster natural resistance to Varroa (*V. destructor)* in European honey bees *(A. mellifera)*. The Darwinian Black Box protocol propagates colonies left untreated against *Varroa* and selects for reproduction, growth, and survival. It has shown long-term persistence in the Netherlands, though its broader applicability remains to be tested.

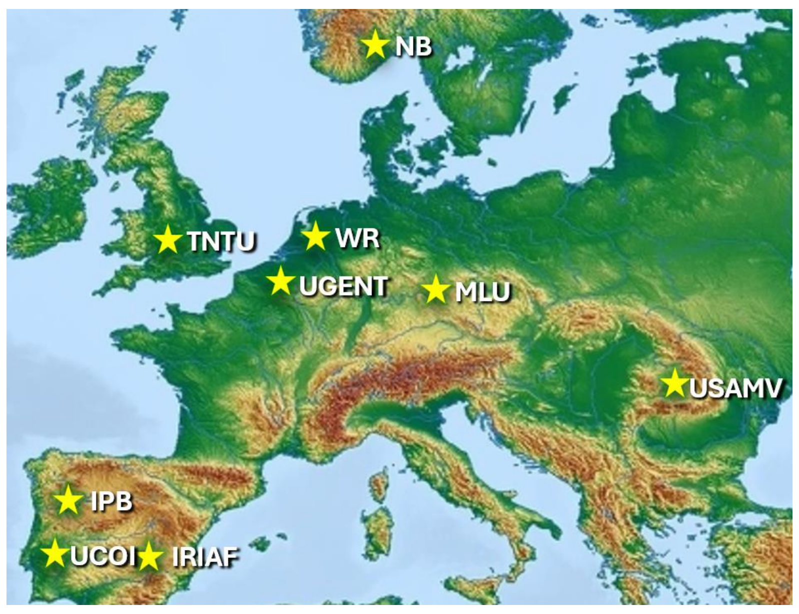
Objectives

Testing the Darwinian Black Box protocol across different climates and subspecies.

→ evaluate its potential as a sustainable beekeeping strategy.

We focus on identifying early indicators of success (survival):

- Genetic traits
- Developmental patterns
- Behaviour



From North – South: Norges Birokterlag Forening (NB), Stichting Wageningen Research (WR),Martin-Luther-Universität Halle-Wittenberg (MLU), Universitatea de Științe Agricole și Medicină Veterinară (USAMV), Universiteit Gent (UGENT), Nothingham Trent University (TNTU), Universidade de Coimbra (UCOI), Instituto Regional de Investigación y Desarrollo Agroalimentario y Forestal de Castilla-La Mancha (IRIAF), Instituto Politécnico de Barganҫa (IPB).

Methods

Locally adapted *A. mellifera* subspecies (Map) are managed using the **Darwinian Black Box protocol** (see right):

- **In brief:** Genetically diverse colonies → split into 4 nukes (T1–T6) → virgin queens mated on isolated islands (T6–T8) → winter survivors (T) propagated annually (2024–2027) → selection on survival, reproduction, growth

Monitoring: Automated hive weight data (BEEP, NL); annual worker genetic analyses; responsiveness to vibrational stimuli (see poster: Knocking on a honeybee hive); colony-level aggression assays.

- **Analysis:** Regional comparisons to test robustness & limits of DBB and identify early signatures of colony success.

Preliminary Results (2024-2025, 1st year of selection)

	2024				2025						
Partner	#mother colonies	#splits	#colonies autumn	#wintering	#survivors	% mortality	#surviving mother lines	# splits	#final splits	#mother lines	% success mother lines
IRIAF	32	108	54	41	3	90	2	11	11	2	8
USAMV	30	74	57	51	26	49	26	25	66	25	83
UCOI	18	72	7	2	0	100	0	40	40	40	0
IPB	23	92	57	38	21	45	21	53	53	15	65
TNTU	22	34	34	27	18	33	12	54	58	12	55
UGENT	25	100	76	47	0	100	0	69	63	44	0
NB	24	65	57	57	54	5	24	69	69	21	88
WR	25	96	80	70	11	84	8	24	20	6	24
MLU	25	100	79	66	16	76	10	50	70	10	40
			Mean mortality across partners:			64,6%			Mean success motherlines :		40,3%

Darwinian Black Box across Europe : First-Year Insights

- Low 1st-year survival in some regions
- ➔ Regional adaptations: fewer splits (larger nukes), multiple splitting rounds, extra queens fostered in donor colonies, broader genetic base.
- Additional challenges: Asian hornet (*Vespa velutina)* and extreme weather.

The Darwinian Black Box Protocol

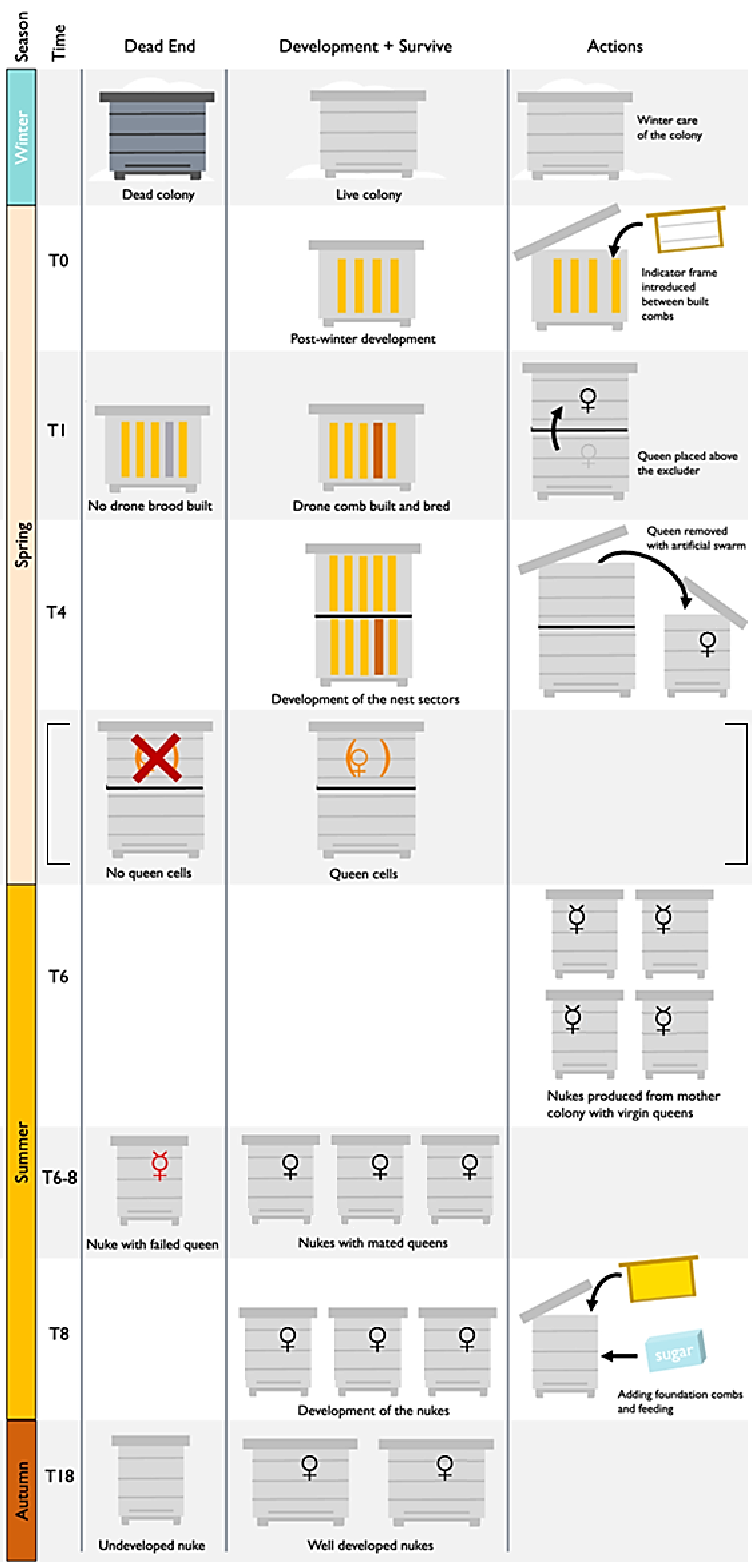


Figure from: Blacquière, T., Boot, W., Calis, J., Moro, A., Neumann, P., & Panziera, D. (2019). Darwinian black box selection for resistance to settled invasive Varroa destructor parasites in honey bees. *Biological Invasions*, *21*(8), 2519-2528.

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