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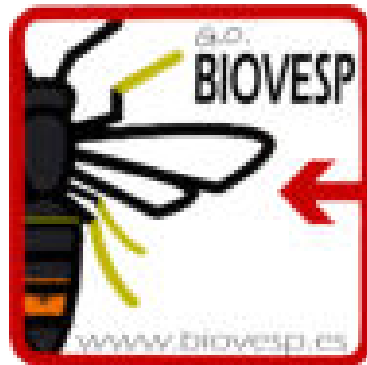
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The Asian hornet (*Vespa velutina*) is an ecologically and economically detrimental invasive species that exerts significant predatory pressure on honeybee (*Apis mellifera*) colonies. *Beauveria bassiana* is a naturally occurring fungus, widely used in biological pest control. It infects and kills insects via multiple mechanisms, including cuticle penetration, toxin production, and suppression of the host's immune response.

This study, conducted within the framework of the GO Biovesp project, investigated the efficacy of the entomopathogenic fungus *Beauveria bassiana* as a biological control agent against *V. velutina* in apiary environments. The experimental design encompassed a preliminary trial involving 21 apiaries, followed by an expanded trial with 32 apiaries. *B. bassiana* was administered through nebulization onto captured hornets, which were subsequently released to potentially spread the infection within the *V. velutina* nests.

The results indicate that *B. bassiana* is effective in reducing *V. velutina* predation pressure on managed apiaries. Furthermore, we observed honeybee tolerance to *B. bassiana* on direct applications with no significant impact on beehives' viability. The preliminary results suggest that a minimum threshold of 10 infected hornets per application is required to observe a reduction in *V. velutina* pressure. These results provide promising evidence for the use of *B. bassiana* as a viable, ecologically sustainable biocontrol strategy for *V. velutina* management.

This research contributes to the broader objectives of the GO BIOVESP project, which aims to develop and implement innovative strategies for honeybee protection and biodiversity conservation. Further investigations are underway to optimize application methods and assess the long-term impacts of *B. bassiana* on *V. velutina* populations and the broader ecosystem.



Preliminary results on the control of *Vespa velutina* using *Beauveria bassiana* in apiary environments within the GO BIOVEST Project

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GO BIOVESP: Control biológico integrado de vespa velutina: enfoques multidisciplinares y medidas innovadoras, busca soluciones innovadoras para el control de la avispa asiática mediante el uso de distintas estrategias de control integrado. Comisión Europea: https://agriculture.ec.europa.eu/common-agricultural-policy/rural-development_es. El grupo operativo GO BIOVESP ha recibido para su proyecto de innovación una subvención de 558.363,37 €. El importe del proyecto es cofinanciado al 80% con fondos procedentes del Instrumento de Recuperación Europeo (EU Next Generation), tal como se establece en el Real Decreto 169/2018, de 23 de marzo. El organismo responsable del contenido es el GO BIOVESP. La Dirección General de Desarrollo Rural, Innovación y Formación Agroalimentaria (Ministerio de Agricultura, Pesca y Alimentación) es la autoridad de gestión encargada de la aplicación de la ayuda del FEADER. «Fondo Europeo Agrícola de Desarrollo Rural: Europa invierte en las zonas rurales»



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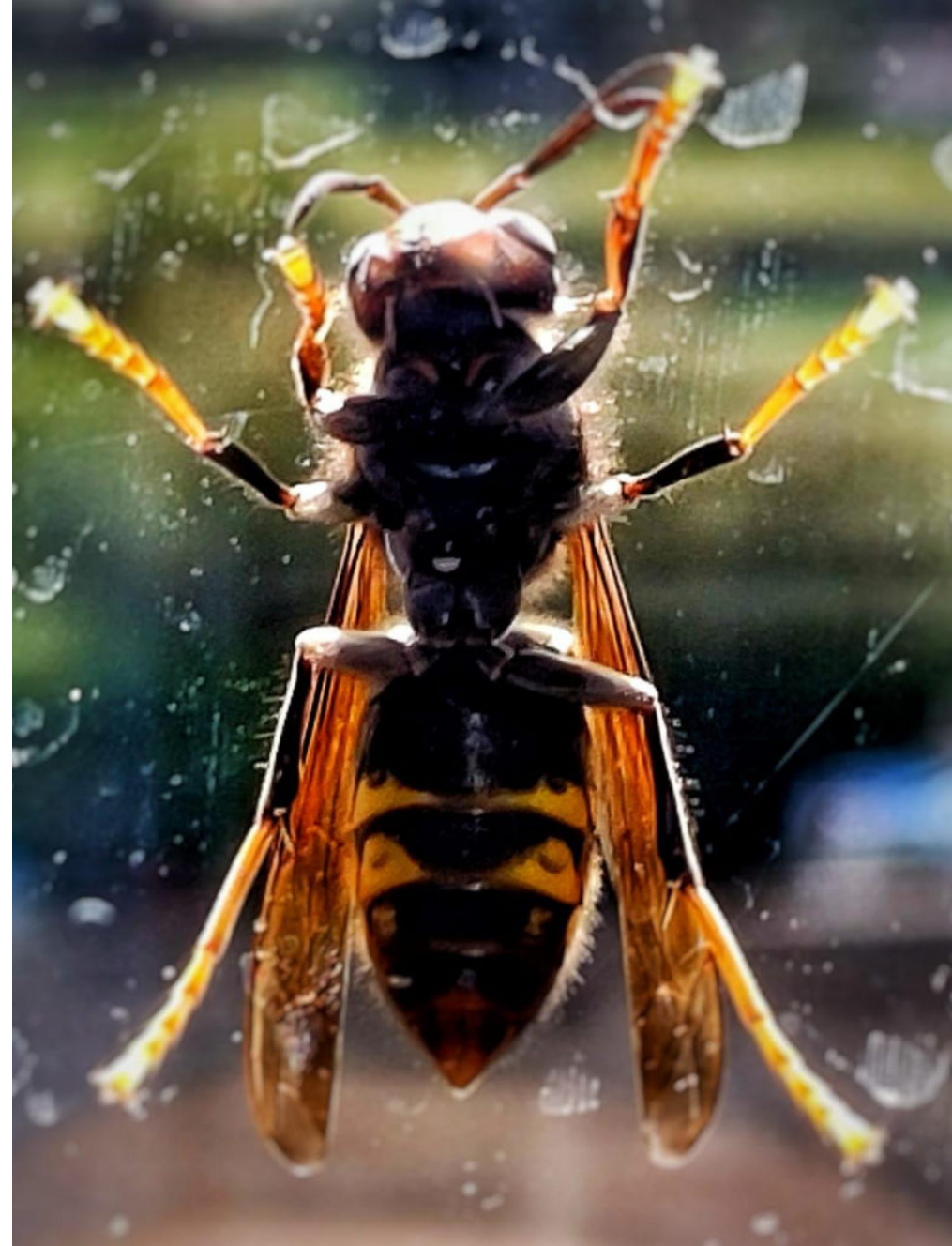


Vespa velutina (Lepeletier, 1836)

Invasive *Vespa velutina*, native to Southeast Asia, poses a significant threat to European honeybee populations (*Apis mellifera*) following its introduction to France in 2004. The predatory pressure from *V. velutina* affects honeybee colonies through two primary mechanisms: **direct predation** and **behavioral stress**.

- **Direct predation** involves *V. velutina* "hawking" at hive entrances, which significantly reduces the honeybee foraging workforce and, consequently, colony productivity.
- **Behavioral stress** results from the continuous presence of hornets near the hive, causing honeybees to remain defensively confined. This confinement leads to a cessation of foraging, depleting food stores crucial for colony overwintering and survival.

The high vulnerability of *A. mellifera* to this novel predatory threat is attributed to a **lack of coevolutionary defenses**, unlike native Asian honeybees (*Apis cerana*), which have evolved effective group defensive strategies. This renders European beekeeping populations highly susceptible to colony decline and collapse.





Beauveria bassiana (Bals.-Criv.) Vuill. (1912)

Beauveria bassiana, an entomopathogenic fungus, is a promising **biocontrol agent** for managing social wasps, including the invasive *Vespa velutina* and native *Vespula vulgaris*. The fungus infects its host by penetrating the cuticle, leading to a fatal condition known as "white muscardine disease."

The strategy for using this fungus involves contaminating foraging wasps, which then carry the fungal spores back to the nest. This results in the horizontal transmission of the pathogen throughout the colony, ultimately leading to its collapse.

A **key concern** is the potential impact of *B. bassiana* on non-target species, such as the European honeybee (*Apis mellifera*). While some honeybee susceptibility exists, bees have evolved defense mechanisms, including **social immunity**, where hygienic behaviors like grooming and removing infected individuals help to limit the spread of the fungus. The hive environment is also less conducive to fungal proliferation.

To ensure the safety of honeybee populations, research highlights the importance of using **host-specific fungal strains** and employing **targeted application methods** to minimize non-target effects.

B. bassiana growing on infected *V. velutina*





Objective

Grupo Operativo Biovesp objective and essays presented

The main objective of Grupo Operativo Biovesp is to develop and implement innovative, integrated biological control strategies for the invasive hornet, *Vespa velutina*.

The results presented are preliminary and base results of GO Biovesp focused on use of *V. velutina* as vector of *Beauveria bassiana* to control nest development and *V. velutina* pressure on pest control stations.

Biovesp apiary settlement



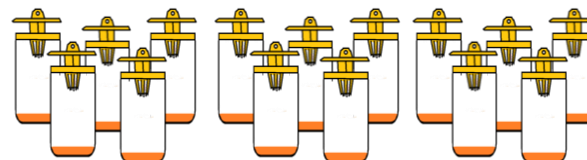


Methodology

Trap pest control stations in urban, suburban areas and in apiaries

Nº of traps/ station: 15

Bait: Sweet, salty , alcoholic and proteic liquid bait

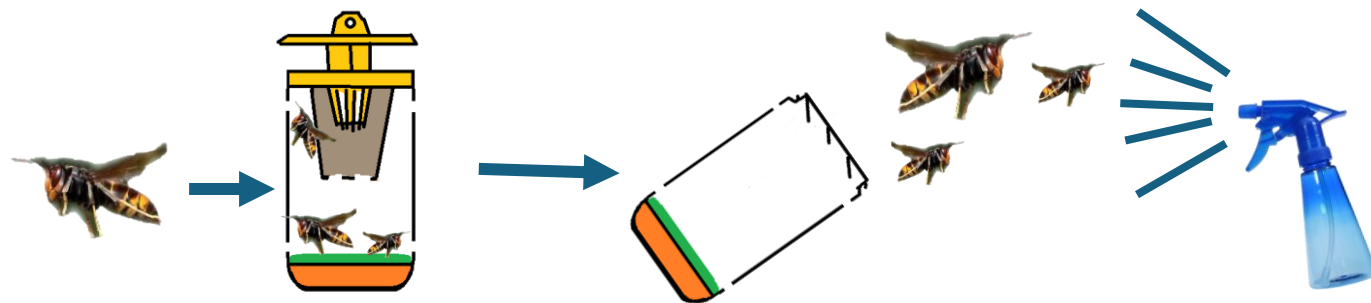
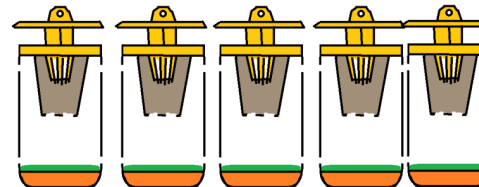


Application method of *Beauveria bassiana*

Nº of alive capture-and-release traps: 5 or direct capture

Dose: 2ml 10^8 cfu/ml *Beauveria bassiana* diluted on 250ml bait

Application: Sprayed specifically on released wasps



Biovesp trap bait





Methodology

Complimentary experiments:

Effect of *Beauveria bassiana* on *Apis mellifera*

Apiary wasp pressure and wasp count methods

Different biocides

Trap selectivity



Biovesp Selective Bait in a non Selective trap



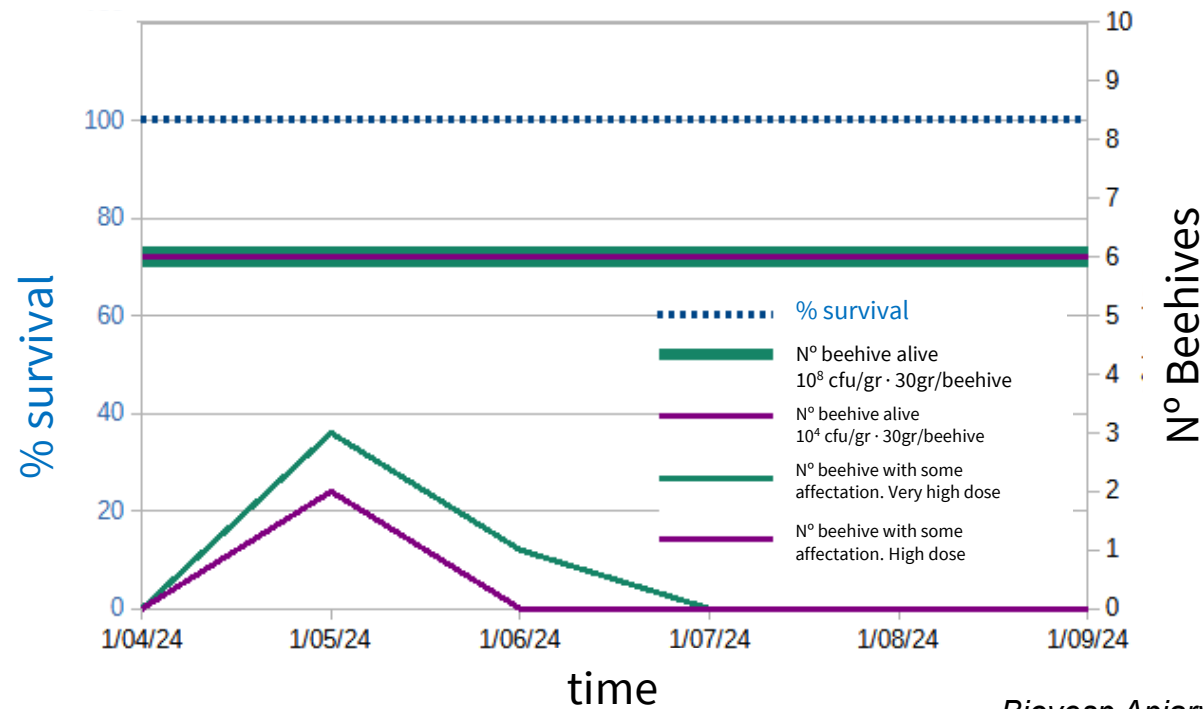
Results

Effect of *Beauveria bassiana* on *Apis mellifera*

n: 1 Apiary - 12 beehives

- 6 beehives 10^8 cfu/gr · 30gr/beehive
- 6 beehives 10^4 cfu/gr · 30gr/beehive

Beehives survival and affectation for *Beauveria bassiana* exposure
Very high and High doses



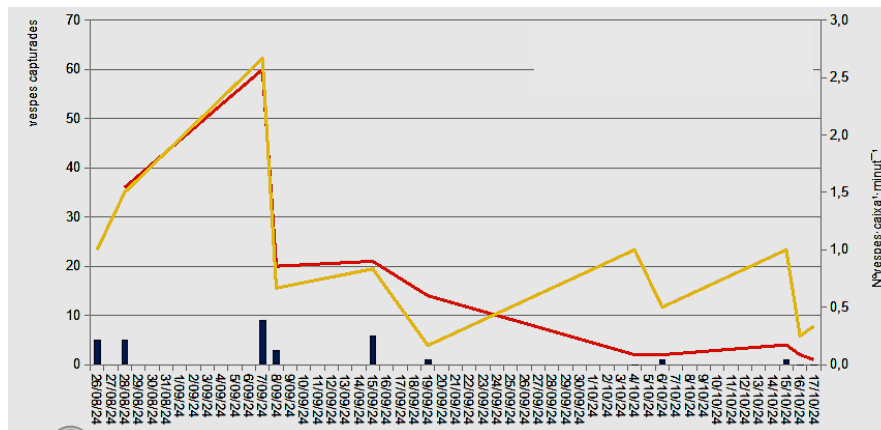
Biovesp Apiary pest control station





n: 4 Apiaries – – 5~20 beehives

Wasp-hive-time 1 minute count vs. catch and release experiment



- Capture and recapture population size
■ $V. velutina \cdot \text{beehive}^{-1} \cdot \text{minute}^{-1}$
■ Capture and released marked *V. velutina*



Catch and re-catch population estimation essay

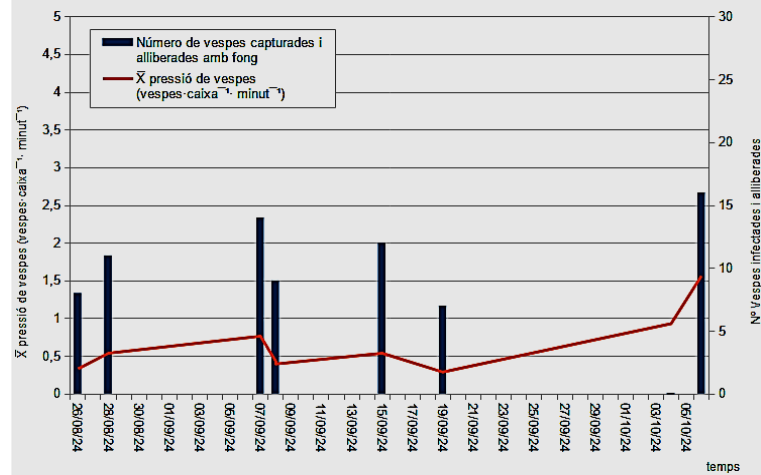
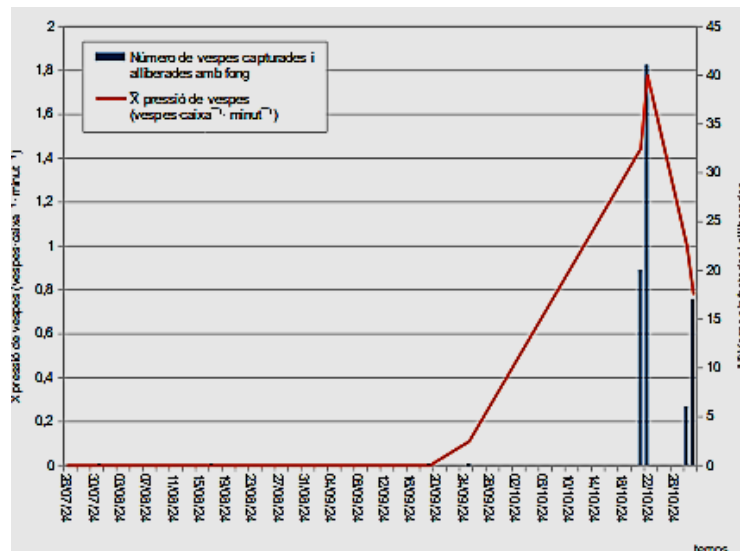
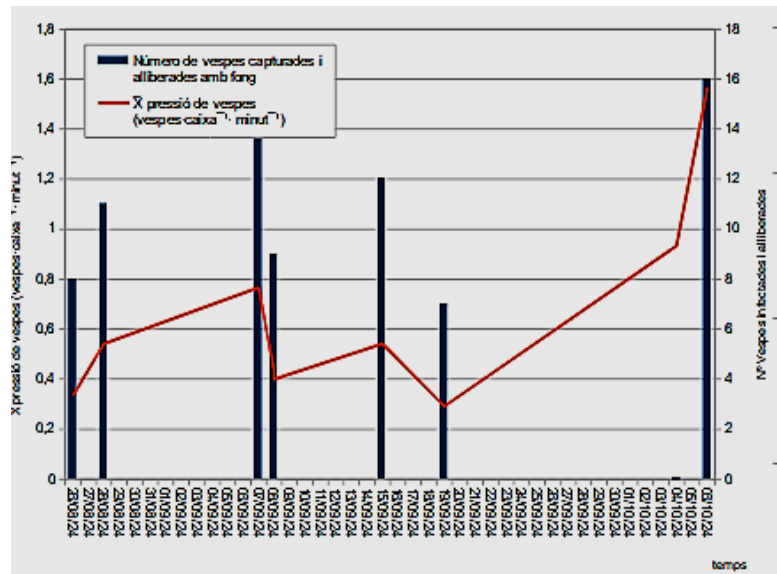


Apiary experiments

n: 26 Apiaries – 5~45 beehives

V. velutina pressure vs. Release infected wasps

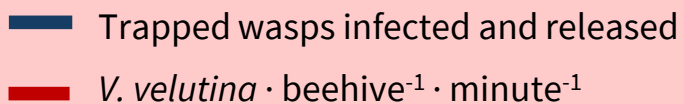
Results



- Trapped wasps infected and released
- V. velutina* · beehive⁻¹ · minute⁻¹

Spray infection of *V. velutina*



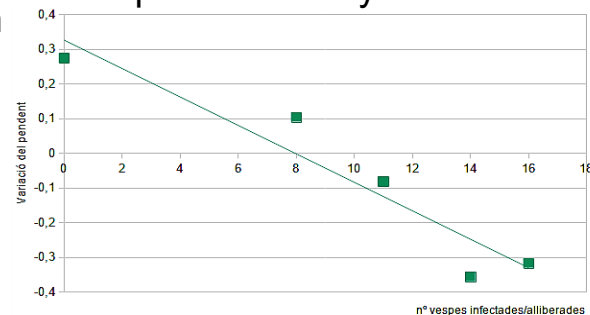


Results

Slope before infection

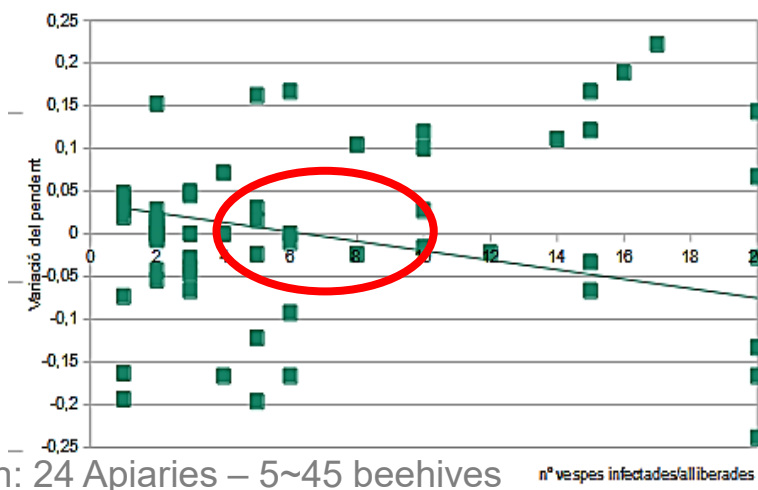


Slope variation by infection

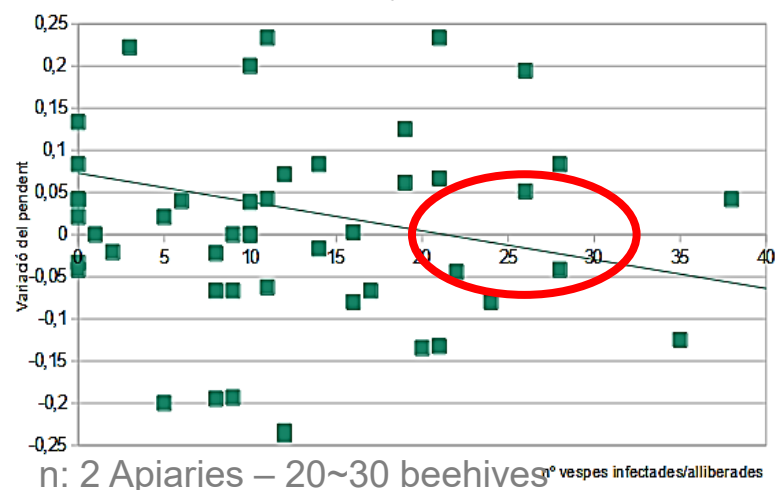


- Slope after infection
- Slope before infection
- Slope variation by infection

Total slope variation by infection - Virulent



Total slope variation by infection – NON Virulent



High abundance *V. velutina* captures

Infection \ Slope:	Increase	NO Increase
Episodes >10 infected wasps	20	40
Episodes without infection	24	5

$\chi^2 (1, N = 89) = 19.1061, p = 0,000012$

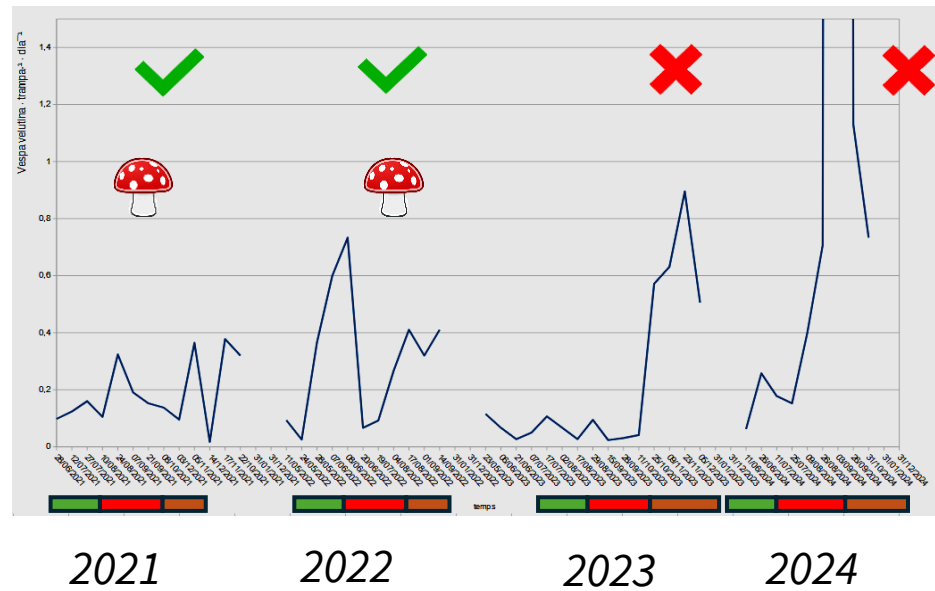


Results

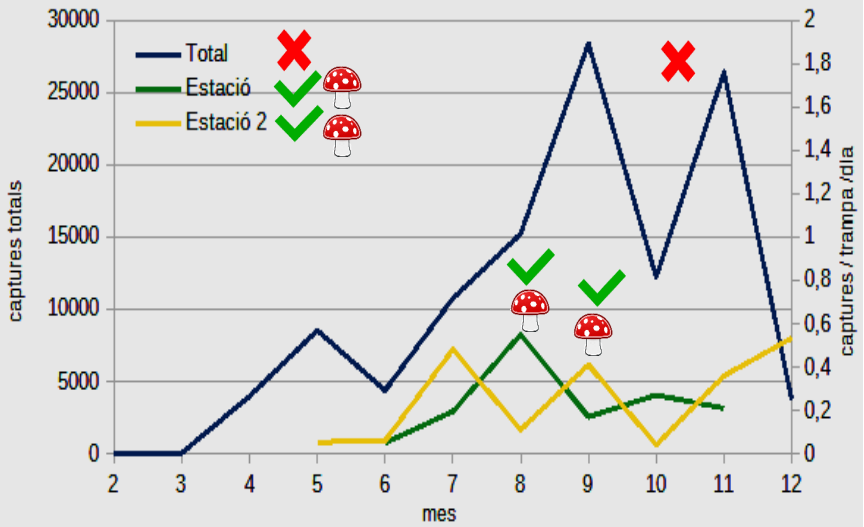
Beauveria bassiana on suburban and urban pest control stations

n: 116 Urban wasp control stations (15traps)

Control Stations capture pattern



Control Stations without *B. bassiana* vs. Control Stations with *B. bassiana*



Biovesp – VCI Urban pest control stations



Beauveria bassiana application and affection on abundance of *V. velutina*



NO Beauveria bassiana application and affection on abundance of *V. velutina*

 *V. velutina* captures
 *V. velutina* captures infected
 *V. velutina* captures infected

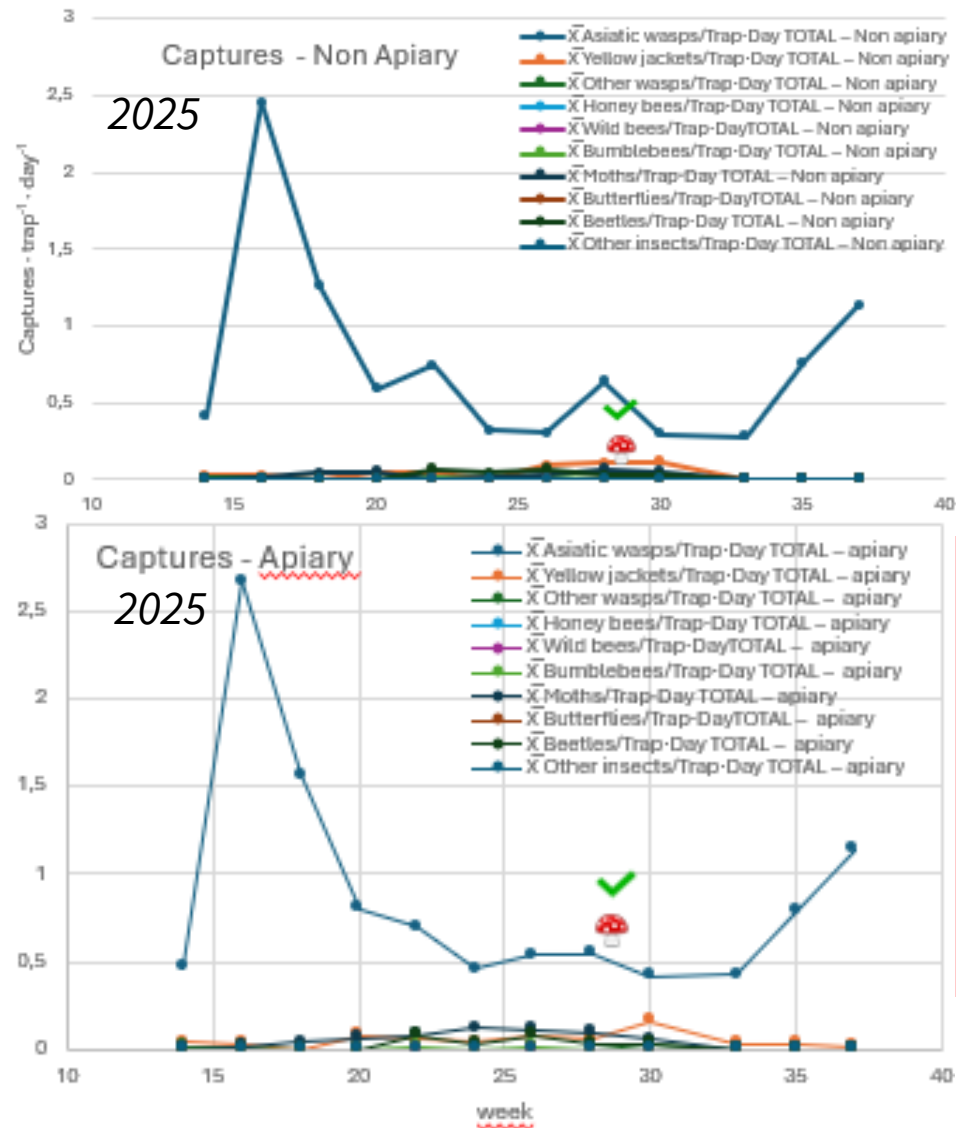
	Control	No control	
Beauveria bassiana	53	14	67
No Beauveria bassiana	28	21	49
	81	35	116
$X^2(1,N=116)=6,4789, p=0,010916$			
	Control	No control	
Beauveria bassiana from july	43	3	46
Beauveria bassiana from september	10	11	21
	53	14	57
$X^2(1,N=57)=18,3443, p=0,000018$			



Results

Beauveria bassiana apiary & non apiary pest control stations Biovesp

8 Apiaries · 20 beehives
stations minimum
(160 beehives)
& Non apiary stations



— $\bar{X}$ *V. velutina* captures



Beauveria bassiana
application and
affection on
abundance of *V.*
velutina

Biovesp Selective alive trap





GO Biovesp

GO Biovesp

n: 32 apiaries (640 Beehives) / year • 2 years

16 apiaries • 20 beehives in Catalunya

(NW Iberian Peninsula - Mediterranean)

16 apiaries • 20 beehives in Asturias

(N Iberian Peninsula - Atlantic)

4 Conditions:

4(Cat) +4(Ast) **Control** with no biocide

4(Cat) +4(Ast) with ***Beauveria bassiana***

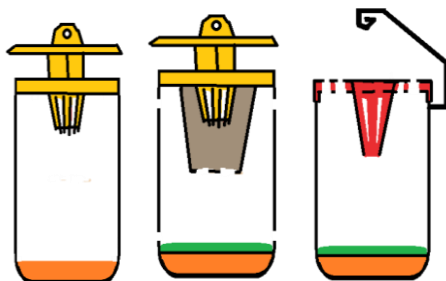
4(Cat) +4(Ast) with **Etofenprox**

4(Cat) +4(Ast) with **Diflubenzuron**

Essays on trap and bait selectivity

POSTER 76 APIMONDIA:

Selective trapping of *Vespa velutina* in apiary and non-apiary environments: a comparative study of trap efficacy and selectivity within the GO BIOVESP Project



Biovesp

Conclusions

- *Apis mellifera* shows some kind of resistance to *Beauveria bassiana* even at the highest dose.
- In urban and suburban areas, *Beauveria bassiana* reduces captures of *Vespa velutina* in 15 trap pest control stations.
- In apiaries, the application of *Beauveria bassiana* reduces trap captures and entrance pressure on bee-hives.
- Minimum application is needed to observe effects on *Vespa velutina* pressure.

Biovesp apiary inspection





Thanks for your attention



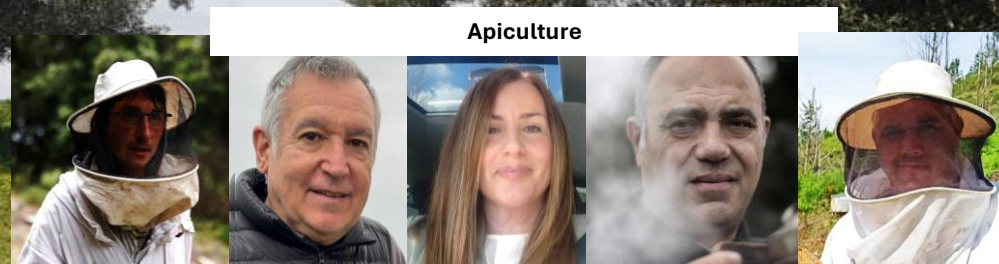
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