

## Introduction

NOFLY® WP is a biopesticide based on the ability of the entomopathogenic fungus *Isaria fumosorosea* FE 9901 (formerly *Paecilomyces fumosoroseus*) to naturally control the whitefly, one of the most damaging insects of crops worldwide, not only for the direct damage that it represents, but because this insect is also a transmitter of different viruses.

Unlike the toxic action exerted by traditional synthetic insecticides on insect pests, NOFLY® WP is formulated with a microorganism, that causes a natural infection process. Spores of the strain FE 9901, infect whiteflies through the contact and germination in adults, larvae and eggs, causing its death in 3 to 5 days. Under favourable conditions of temperature and humidity, the fungus grows on the outside of the insect, producing new spores that can induce epizootics (and disperse to new hosts).

No observed adverse applying of NOFLY®WP on beneficial arthropods that act as natural enemies of whiteflies such as *Macrolophus*, *Encarsia formosa*, *Orius laevigatus*, *Eretmocerus mundus*, *Phytoseiulus persimilis* and *Amblyseius swickii* effects, evaluated in laboratory tests and semi-field.

The aim of this study was to evaluate the effect of biopesticide NOFLY®WP on insect pollinators (bees and bumblebees) in order to determine their degree of compatibility.

## Materials and Methods

Oral contact tests: two trials in order to evaluate the effect of strain FE 9901 *Isaria fumosorosea* on adult bees (*Apis mellifera* L.) administering the fungus from two different routes were made. In both trials was used as a positive control Chlorpirifos (0.72 mg ai/L), a negative control sucrose solution (1g/L), and as the substance to evaluate NOFLY® WP (7.87·10<sup>9</sup> cfu/g). Each treatment had four replicates with 10 bees each. Both trials were conducted under controlled conditions: A first temperature of 27°C to 28°C and relative humidity (RH) of 53% to 74%, while the second temperature was of 24°C to 26°C and a RH of 67% to 83%.

Similarly, a GLP test on bumblebees (*Bombus terrestris*) as a positive control where Dimethoate (7ug/bee), negative was used a solution with 30 % sucrose, the product to be evaluated (NOFLY WP, at a commercial dose), and NOFLY WP inactivated by heat. Mortality was recorded twice a week for a total of 50 days.

## Results

### a) Laboratory tests of acute oral toxicity on Bees

Under test conditions, mortality of adult bees in the negative control and NOFLY® WP were similar and indicate that this formulation would have detrimental effects on adult bees (Graph 1). Mortality with the synthetic product (dimethoate) was 100 % at 24 hours.

Graph 1. Tests of acute oral toxicity on *Apis mellifera*.

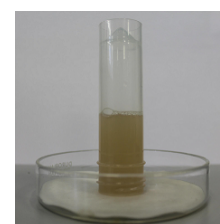
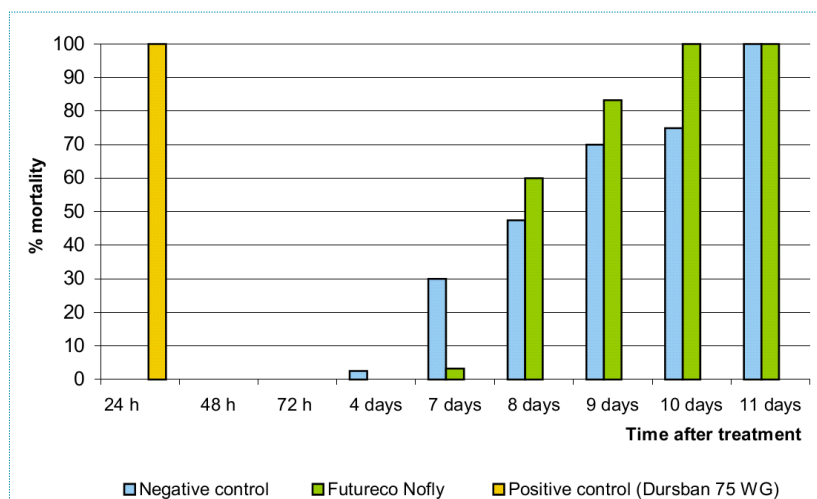


Fig 1. Evaluation of acute oral toxicity on *Bombus terrestris*, in which there was a queen amongst 60 and 80 bumblebees.



Fig 2. By order: Tests of oral acute and contact toxicity on *Apis mellifera* L.



Fig 3. Characteristic icons of NOFLY. By order, NOFLY is suitable for greenhouse and field veggies, fruit trees, ornamentals and cereals. It is a featured product of Futureco Bioscience SA as it is considered the first biological insecticide entirely developed and registered from Spain. For its commercialization approval in all the European Union. NOFLY WP is sold in recipients of 500g, is used as a phytosanitary in IMP and can be used in organic farming.



This trial was performed by standardized and official laboratories for the registration of bioinsecticides and its commercialization in the European Union.

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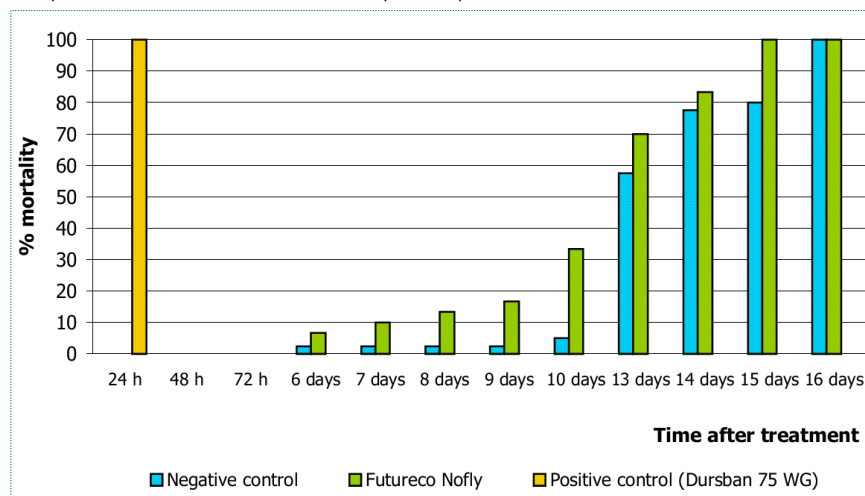
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### b) Laboratory tests of contact toxicity on Bees

The evolution of mortality was similar in the negative control and with the NOFLY® WP treatment, mainly from the 13th day of the trial. Again, mortality in the positive control (standard chemical) was of 100% at 24 hours (Graph 2).

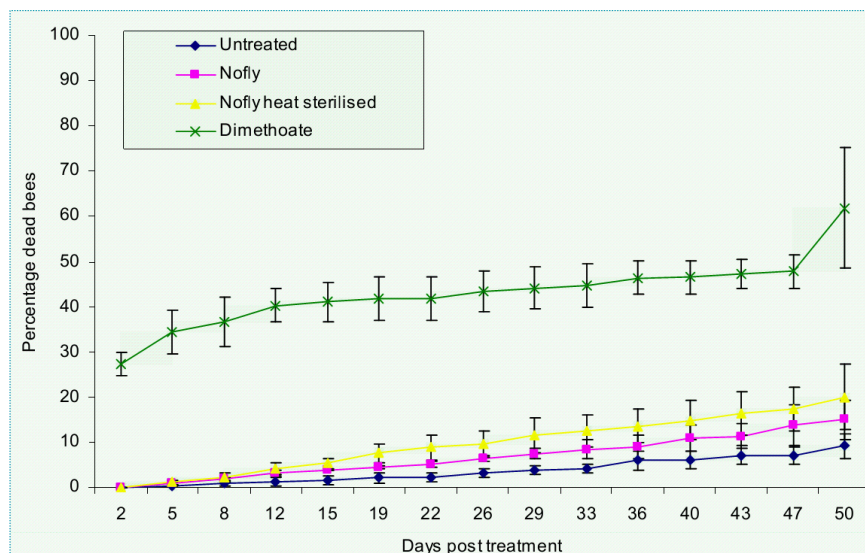
Graph 2. Tests of contact toxicity on *Apis mellifera*.



### c) Laboratory tests of acute oral toxicity on Bumblebees

Exposure to Dimethoate resulted in an increased bee mortality (average of 62%) compared to NOFLY® WP, NOFLY® WP inactivated by heat and untreated control (average 15%, 20% and 9 %, respectively) during the experimental period of 50 days (Graph 3).

Graph 3. Tests of acute oral toxicity on *Apis mellifera*.



## Conclusions

The bioinsecticide NOFLY® WP has demonstrated a very low toxicity profile for pollinators (bees and bumblebees) in trials of oral and contact toxicity, resulting in a product entirely appropriate for Integrated Pest Management (IPM) programs and for biological control support.