

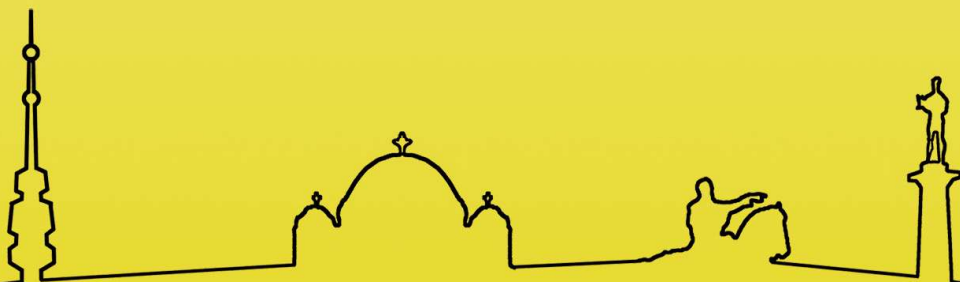
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PHENOLOGY OF THE MICROSPORIDIA NOSEMA CERANAE IN FOUR MEDITERRANEAN COUNTRIES

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The presence and prevalence of the Microsporidia *Nosema ceranae* was assessed as part of the BEEHEAL project during a 2-year study period (2018-2019). Monitoring took place in six apiaries located in four Mediterranean continental apiaries: France, Israel, Portugal and Spain, and two insular apiaries located on Ouessant (France) and on São Miguel (Azores archipelago, Portugal). Besides honeybee sample collection every two months, parameters on colony strength, honey production, beekeeping management and climate were recorded. The pathogen was not detected on São Miguel Island during the study. Infection at the apiary level showed that most of the colonies were positive to *N. ceranae* except in mainland France, where the percentage of infected colonies was the lowest and it fluctuated, with an increase in August in both years. The percentage of infected honeybees per colony varied among apiaries, with Israel having the highest mean levels (32.39%). Colonies in Spain and Portugal showed a similar pattern with the highest levels of infection in April 2018. Ouessant Island had a high percentage of infected honeybees in 2018 and it decreased on 2019. Temperature was not correlated with *N. ceranae* infection, although high temperatures combined with high relative humidity were associated to high infection levels in Israel. Intra-colony percentage of infection was positively correlated with honeybee population when all apiaries were analysed together. Honey production was not related with *N. ceranae* infection. Regarding queen replacement, infection levels in spring 2019 in mainland Portugal and Spain decreased in those colonies that had replaced the queen the previous summer (August 2018). Colony mortality varied among apiaries, with mainland France and Spain showing the highest colony losses (47.6% and 39.1%, respectively). However, this parameter was not correlated with the levels of infection. These results allowed to compare the *N. ceranae* phenology among different countries,

showing that the infection is dependent on many factors. This information could assist in the development of beekeeping management strategies.

Keywords: intra-colony prevalence, climate and beekeeping management effect

DIRECT AND SENSITIVE DETECTION OF DEFORMED WING VIRUS USING LOOP-MEDIATED ISOTHERMAL AMPLIFICATION (LAMP) IN HONEY BEES

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The decline of honey bees is one of the biggest threats to biodiversity and the deformed wing virus is one of the main culprits. The deformed wing virus is transmitted by the ectoparasitic mite, *Varroa destructor*. Almost all efforts to tackle this double infection have so far focused on controlling the Varroa mite alone and not the viruses it transmits. In a recent study (de Graaf et al., 2020), we were able to show that the trait ‘suppressed in ovo virus infection’ (SOV) shows moderate heritabilities for the presence of multiple viruses simultaneously and for the presence of a single virus species. Colonies expressing the SOV trait appeared more resistant to virus infection as a whole, with fewer and less severe deformed wing virus infections. The implementation of this new trait in breeding programmes is recommended and therefore a simple and direct detection method for bee viruses is essential. The potential of loop-mediated isothermal amplification (LAMP) for bee virus detection was investigated and its implementation in beekeeping practice was explored. Primers sets for different bee viruses were developed. Currently, a colorimetric detection of deformed wing virus complex and chronic bee paralysis virus is being optimized. The ease with which this test can be performed together with the possibility of using crude extracts make it feasible to have this method performed as a field test by the beekeeper himself.

Keywords: diagnostics, virus, LAMP