

Evaluation of the Development of Resistance of the Mite *Varroa destructor* to the Chemical Acaricides Apistan® and Bayvarol® in Costa Rica

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The control of the mite *Varroa destructor*, the primary parasite of the honeybee *Apis mellifera*, largely depends on the use of chemical acaricides. However, the prolonged and indiscriminate use of synthetic pyrethroids, such as fluvalinate (Apistan®) and flumethrin (Bayvarol®), has promoted the development of resistance in mite populations worldwide. This study aimed to determine the presence of resistant *Varroa* populations to these acaricides in Costa Rica and to establish whether cross-resistance exists between them. Standardized bioassays were conducted on 62 hives from 17 apiaries across different beekeeping regions of the country to assess the mites' susceptibility to pyrethroids. Additionally, information was collected on beekeeping management practices, including the historical use of acaricides and strategies for rotating chemical and organic products. A bioassay based on the method described by Pettis (1998). The results showed that 57% of the apiaries had mites resistant to at least one of the evaluated acaricides, while 70% of these cases exhibited cross-resistance between fluvalinate and flumethrin. Furthermore, 100% of the apiaries that had not used pyrethroids for more than three years still exhibited non-susceptible populations, indicating that resistance can persist even in the absence of recent chemical pressure. The study identified critical factors associated with the development of resistance, such as repetitive and non-rotational use of pyrethroids, lack of comb replacement in brood chambers, and low implementation of organic alternatives. This work documents the first formal case of *Varroa destructor* resistance to pyrethroids in Costa Rica, highlighting the urgent need to adopt integrated pest management strategies. Recommendations include rotating chemical and organic acaricides, constant monitoring of infestations, and educating beekeepers on proper product use. This study provides significant contributions to tropical apiculture by offering a scientific basis to address the challenges posed by mite resistance and ensuring the sustainability of beekeeping in the region.