

ASSESSING THE EFFECTS OF COUMAPHOS IN BEESWAX ON HONEY BEE BROOD

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Abstract

Coumaphos, a lipophilic acaricide widely used for *Varroa destructor* control, accumulates in beeswax and may expose developing honey bee (*Apis mellifera*) brood to residues. However, its effects under realistic field conditions remain insufficiently understood. Here, we experimentally assessed the impact of coumaphos-contaminated wax on worker brood development, emergence success, and adult body mass. Beeswax foundation sheets were spiked with coumaphos at nominal concentrations of 25, 50, and 100 mg kg⁻¹, reflecting residue levels reported from treated colonies, alongside untreated controls. After comb construction, experimental frames were introduced into four colonies, and queens were confined for 48 h to synchronize oviposition. Brood development was monitored across developmental stages, emergence success quantified, and newly emerged workers weighed individually. Chemical analyses confirmed a homogeneous distribution of coumaphos in wax, followed by redistribution into cell walls, resulting in approximately 2.4-fold reduction in effective brood exposure. Mortality during early brood stages (i.e., egg to larva) remained within natural variation across all treatments (18-20%). In contrast, brood reared in wax containing 100 mg kg⁻¹ coumaphos exhibited increased mortality during pupation, leading to reduced emergence rates (64%) compared with controls and lower concentrations (70–75%). No treatment-related effects were detected on adult body mass. Coumaphos residues levels above 50 mg kg⁻¹ in beeswax significantly reduced brood development, while the emergence rate of bees exposed to lower coumaphos levels was comparable to the control. These findings underscore the importance of accounting for residue redistribution and reduced effective exposure when assessing the risks of lipophilic varroacides. Future risk assessment should also consider potential interactions with co-occurring pesticide residues.