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Lethal and Sublethal Effects of Bendiocarb, Halofenozide, and Imidacloprid on *Harpalus pennsylvanicus* (Coleoptera: Carabidae) Following Different Modes of Exposure in Turfgrass

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Abstract

Routes by which nontarget predatory insects can be exposed to turfgrass pesticides include topical, residual, and dietary exposure. We used each of these routes to evaluate potential lethal or sublethal effects of two novel turfgrass insecticides, imidacloprid and halofenozide, and a carbamate, bendiocarb, on survival, behavior, and fecundity of the ground beetle *Harpalus pennsylvanicus* DeGeer. Field-collected

carabids were exposed to direct spray applications in turf plots, fed food contaminated by such applications, or exposed to irrigated or nonirrigated residues on turf cores. Halofenozide caused no apparent acute, adverse effects through topical, residual, or dietary exposure. Moreover, the viability of eggs laid by females fed halofenozide-treated food once, or continuously for 30 d, was not reduced. In contrast, topical or dietary exposure of carabids to bendiocarb inevitably was lethal. Exposure to imidacloprid by those routes caused high incidence of sublethal, neurotoxic effects including paralysis, impaired walking, and excessive grooming. Intoxicated beetles usually recovered within a few days in the laboratory, but in the field, they were shown to be highly vulnerable to predation by ants. One-time intoxication by imidacloprid did not reduce females' fecundity or viability of eggs. There was no apparent behavioral avoidance of insecticide residues, or of insecticide-treated food. Carabids exposed to dry residues on turfgrass cores suffered high mortality from bendiocarb, and some intoxication from imidacloprid, but these effects were greatly reduced by posttreatment irrigation. Implications for predicting hazards of insecticides to beneficial invertebrates in turfgrass are discussed.

Keywords: *Harpalus pennsylvanicus*, Carabidae, ecotoxicology, turfgrass, imidacloprid, halofenozide

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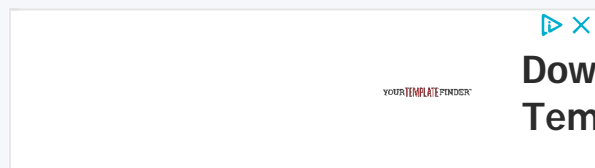
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