# ROTATION of INSECTICIDAL BAITS and GELS for DELAYING DEVELOPMENT of RESISTANCE in the GERMAN COCKROACH

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The German cockroach, *Blattella germanica* (L.), is the most important cockroach pest in Russia. After WW II, the use of inorganic compounds — such as boric acid, sodium fluoride, and arsenic — for cockroach control decreased, and the use of organic insecticides — such as organochlorines, organophosphates, carbamates, and pyrethroids — increased. As a result of the widespread use of these organic compounds, physiological resistance in *B.germanica* has developed in many populations. During the last 50 years the German cockroach has developed resistance to chemicals in nearly every class of insecticide used for its control. These include the cyclodienes, organophosphates, carbamates, pyrethroids, and avermectins (Heal et al., 1953; Bennett and Spink, 1968; Nelson and Wood, 1982; Cochran, 1990; Koehler and Petterson, 1991; Rust and Reierson, 1991; Zhai and Robinson, 1991; Ajjan and Robinson, 1996). The decrease in susceptibility that characterizes resistance is usually the result of exclusive and prolonged exposure to one insecticide. Resistance development is variable, depending on the insecticide and the pest population, and may not be apparent in field populations until there is control failure. In German cockroach populations in Moscow, Russia, there have been reports of resistance to organophosphate insecticides, including trichlorphon and malathion, and to pyrethroid insecticides, including permethrin, deltamethrin, cypermethrin, and fenvalerate. The use of insecticidal baits and gels has become an alternative to surface spraying (Ballard and Gold, 1982) in cockroach control programs in many regions of the world, including Russia. To eliminate the development of resistance in the German cockroach, toxic bait stations and toxic gel baits were rotated. The objective of this strategy was to alternate insecticides from different classes and with different modes of action. This strategy was used on an annual basis, and followed this alternation schedule: organophosphates (chlorpyrifos, diazinon, fenitrothion), boric acid, hydramethylnon, fipronil, lithium perfluoroctansulfonate, imidacloprid, avermectins, sulfluoramid.

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