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PHOSPHINE RESISTANCE IN MAJOR STORED GRAIN INSECTS IN THE USA

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ABSTRACT

Phosphine gas, or hydrogen phosphide (PH₃), is the most common insecticide applied to durable stored products worldwide and is routinely used in U.S. for treatment of bulk-stored cereal grains and other durable stored products. Research from the late 1980s revealed low frequencies of resistance to various residual grain protectant insecticides and to phosphine in grain insect species collected in Oklahoma. The present work, which employed the same previously established discriminating dose bioassays for phosphine toxicity as in the earlier study, evaluated adults of nine different populations of red flour beetle, *Tribolium castaneum*, and five populations of lesser grain borer, *Rhyzopertha dominica*, collected from broad geographic locations in Oklahoma. One additional population for each species was a laboratory susceptible strain. Discriminating dose assays determined eight out of the nine *T. castaneum* populations, and all five populations of *R. dominica*, contained phosphine-resistant individuals, and maximum resistance frequencies were 94% and 98%, respectively. Dose-response bioassays and logit analyses determined that LC₉₉ values were approximately 3 ppm for susceptible and 377 ppm for resistant *T. castaneum*, and approximately 2 ppm for susceptible and 3,430 ppm for resistant *R. dominica*. The most resistant *T. castaneum* population was 119-fold more resistant than the susceptible strain and the most resistant *R. dominica* population was over 1,500-fold more resistant. Results suggest a substantial increase in phosphine resistance in these major stored-wheat pests in the past 20 yr, and these levels of resistance to phosphine approach those reported for other stored-grain pest species in other countries.