CYLINDER-BASED PHOSPHINE FOR CONTROL OF POSTHARVEST INSECT PESTS

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A cylinder-based formulation of phosphine dissolved in liquid CO_2 was evaluated as a toxicant against *Plodia interpunctella*, *Rhyzopertha dominica*, *Sitophilus oryzae* and *Tribolium castaneum* in controlled laboratory studies. A dose of approximately 200 ppm phosphine was used in all studies. Adults of the three beetle species were the most susceptible life stages and experienced 100% mortality within the first 8 hrs of exposure at both 32° and 18° C. Exposure times up to 3 days were required for 100% mortality of beetle adults at the lower temperature of 0.5° and 5°. Six days or longer were required to attain 100% mortality at 0.5° and 5° with eggs and pupae, the more tolerant life stages, of all species. However, 100% mortality of these same tolerant life stages was achieved in 1-2 days at 32°.

Table 1. Mortality of stored grain insects exposed to cylinderized phosphine dissolved in CO_2, approximately 200 ppm phosphine, at 32° C.

Species	Life Stage	Mean % Mortality (n=3) at Given Exposure Time (hr)[a]					
		8	18	24	48	72	96

Table 2. Mortality of stored grain insects exposed to cylinderized phosphine dissolved in CO_2, approximately 200 ppm phosphine, at 18° C.

Species	Life Stage	Mean % Mortality (n=3) at Given Exposure Time (hr)[a]					
		8	18	24	48	72	96

Table 3. Mortality of stored grain insects exposed to cylinderized phosphine dissolved in CO_2, approximately 200 ppm phosphine, at 5° C.

Species	Life Stage	Mean % Mortality (n=3) at Given Exposure Time (hr)[a]					
		8	18	24	72	144	216

Table 4. Mortality of stored grain insects exposed to cylinderized phosphine dissolved in CO_2, approximately 200 ppm phosphine, at 0.5° C.

Species	Life Stage	Mean % Mortality (n=3) at Given Exposure Time (hr)[a]					
		8	18	24	72	144	216

Phosphine in cylinders can be applied to bulk grain at cold temperatures and can clearly control insects under such conditions provided that the exposure time is adequate. For phosphine to be a substitute for methyl bromide in structural fumigations, applications should utilize a cylinder-based formulation for rapid delivery, maintenance of the required dose, and application of heat to ensure that tolerant life stages will be killed in a timely manner. Avoidance or tolerance of corrosion risks will need to be considered by those using phosphine in structures.

Phosphine may be a replacement for methyl bromide in other applications. Early research on fresh commodities treated with phosphine utilized pellet formulations, for which the dose is dynamic and not easily regulated, and resulted in phytotoxicity. Application of phosphine to fresh fruits in controlled low doses from cylinders may avoid damage and provide for effective pre-shipment quarantine treatments. Preliminary studies with Fuji variety apples treated for 5 days at 100 and 300 ppm phosphine from a cylinder resulted in no injury or apparent loss of quality several days after treatment. Emergency treatments of non-agricultural goods for intercepted quarantine pests could utilize cylinder-based phosphine provided that sensitive materials were not treated and that adequate treatment chambers were utilized.