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**RESIDUES OF PHOSPHINE IN COCOA BEANS AFTER FUMIGATION  
AND ITS EFFECT ON THE RUSTY GRAIN BEETLE *CRYPTOLESTES  
FERRUGINEUS* (STEPHENS)**

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**ABSTRACT**

Cocoa beans and rusty grain beetles *Cryptolestes ferrugineus* were fumigated with phosphine releasing formulated products under practical conditions with different phosphine dosages of 2, 4, and 6 g/m<sup>3</sup> respectively, at 20°C and 60% rh for about 60 hours. Experiments included all developmental stages of a phosphine resistant strain, found in the port of Hamburg, Germany, in African cocoa, and a susceptible laboratory strain for comparison. Especially resistant adult beetles survived high dosages with peak concentrations of 7,500 ppm phosphine in air. Pupae followed in tolerance. Eggs were tolerant than pupae and larvae were the most susceptible. The insects of the laboratory strain failed to survive the lowest dosage.

Gas chromatography together with a mass selective detector served to determine the residues of phosphine in the fumigated cocoa beans. At 2 g/m<sup>3</sup> and under the described fumigation conditions, the residues in cocoa beans were within the range of 0.03 mg/kg directly after the treatment. They increased to 0.18 mg/kg at 6 g/m<sup>3</sup>. Even the highest dosage did not lead to an exceeding of the accepted maximum residue limit (MRL) of 0.01 mg/kg for cocoa beans after 5 weeks of waiting period after the end of the fumigation. This waiting period is part of the German registration for this application with the maximal recommended dosage of 2 g/m<sup>3</sup>.