

**Title** The effect of diurnally interrupted doses of phosphine over four days on egg mortality of susceptible and resistant strains of *Sitophilus oryzae* (L.)

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### Abstract

Phosphine concentrations in stored grain are uneven and can undergo cyclic fluctuations caused by diurnal changes in solar heat exchange and wind. Experiments were conducted to investigate the influence of daily concentration variations on insect mortality. Values of  $LT_{50}$  and  $LT_{99,9}$  are presented for *Sitophilus oryzae* eggs in response to a range of diurnally interrupted phosphine treatments over four days. Egg mortality was determined for three insect strains that varied in susceptibility to the fumigant, at concentrations that ranged from 0.75 mg/L to 3 mg/L for 32–8 h respectively, giving the same Ct product for all treatment combinations. Effects on mortality were analyzed in terms of accumulated phosphine exposure over 4 days of treatment, and in terms of the total elapsed time of treatment. Results were compared to those obtained from continuous treatments having equivalent Ct combinations. Treatments that were interrupted daily extend the total elapsed time required for a given level of mortality and that time increased as concentration increased and daily treatment time decreased. Values of  $LT_{99,9}$  for a susceptible strain were 67.6 h and 103.6 h, and for a resistant strain were 133.6 h and 179.5 h at concentrations of 1 mg/L and 3 mg/L respectively. However, diurnal treatments were more efficacious than continuous treatments when only dosage time was measured. Values of  $LT_{99,9}$  for the susceptible strain were 21.0 h compared with 33.8 h and 11.0 h compared with 17.7 h, and for the resistant strain were 35.2 h compared with 57.4 h and 22.2 h compared with 44.3 h at 1 mg/L and 3 mg/L respectively. The findings show that the level of mortality during interrupted treatment is mainly due to the additional time that the fumigant is absent and not a combined affect including insect recovery during the intervening periods. In fact, the dosage time is reduced by an apparent increase in phosphine toxicity.