Title Optimising indoor phosphine fumigation of paddy rice bag-stacks under sheeting for control of resistant insects

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Citation Journal of Stored Products Research Volume 42, Issue 2, 2006, Pages 207-217

Keyword Fumigation; Phosphine; Bag-stack; Resistance; Paddy rice

Abstract

Three indoor, sheeted bag-stack fumigations of paddy rice using aluminium phosphide were undertaken in Guangdong Province, southern China. We measured the effect of two types of sheeting (polyvinylchloride [PVC] or polyethylene [PE]) and two types of floor sealing (clips or fixing into a slot with a rubber pipe) on phosphine concentration and retention. The aim was to test the feasibility of retaining fumigant at a sufficient concentration for long enough to control known resistant insect pests. Each stack was pressure tested and phosphine concentrations measured daily during the fumigation. Cages of test insects in culture medium, including resistant and susceptible strains, were placed inside each stack and could be observed through the clear sheeting. Highest concentrations for the longest period were obtained in a PVC-covered stack that included a ground sheet and wall sheets sealed to the floor with rubber pipes. A similar PVC-covered stack sealed to the floor with clips instead of pipe did not retain gas as efficiently and required re-dosing. A PE-covered stack, with no ground sheet but also with wall sheets sealed to the floor with pipe, produced an acceptable fumigation. Susceptible *Rhyzopertha dominica* were controlled in 2 days and the most resistant strain in 15 days. Resistant *Cryptolestes ferrugineus* survived until day 21. The paddy was still free of insect infestation 7 months later when the bag-stack was opened to mill the rice. Pressure half-lives correlated with gas concentration and retention. Sorption appeared to be a major limiting factor, reducing potential fumigant dosage by about 50%. The trials demonstrated the feasibility of sealing bag-stacks to a standard high enough to control all known resistant strains.