

Title Models linking insecticidal efficacy decline and residue concentration decrease with time, temperature and water activity in chlorpyrifos-methyl treated wheat.

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Abstract

Contact insecticide admixture with stored grain is widely used in France to give long-term protection of stored cereals. Among the range of registered insecticides, organophosphates such as chlorpyrifos-methyl (CPM) are commonly used. To predict the level of CPM residues at any time within the storage period, changes in CPM residue content and their efficacy against the most harmful species (*Sitophilus granarius* and *Tribolium castaneum*) during storage time were investigated. Wheat conditioned at two different moisture contents (corresponding to water activities (Aw) of 0.7 and 0.8 in grain) was treated at 2 mg/kg CPM, then stored at constant and controlled conditions of relative humidity (at equilibrium with Aw) and temperature. Subsamples of treated grain were stored at 15, 22.5 and 30 deg C. During a 20-week storage period, measurements of CPM residue content and residual efficacy were carried out every 3 weeks. Models of degradation were produced over the Aw range 0.7-0.8 and at the three temperature levels of the experimental design. With these models, the half-life of residues was accurately predicted. A generalized model was then developed through a multivariate linear regression with the three measurable variables: storage time, temperature and Aw. Bioassays were performed on the two target insect species to assess the decline in efficacy of residues. The length of the period with no insect survival and the storage time when the point of 50% survival is observed (for each species) were also assessed. A more rapid decline of efficacy of CPM residues with *T. castaneum* than with *S. granarius* was observed. The limit for 50% mortality of *T. castaneum* in the different storage conditions was observed in the same range of the half-life of CPM residues.