SIMULATION MODEL OF LOW-OXYGEN ATMOSPHERES ON INSECT POPULATION DYNAMICS IN STORED GRAIN

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ABSTRACT

A spatial model of the relationship between *Sitophilus oryzae* (L.) population dynamics and bin temperature was used to predict the efficacy of low-oxygen (0_2) atmospheres in suppressing insect pests in bins of stored wheat. A two-dimensional spatial model was used to predict population growth of *S. oryzae* as a function of grain temperature and moisture. In the model, a cylindrical 82-t steel bin was divided into 12 compartments, allowing the model to predict different insect growth rates based on each compartment's temperature and moisture. Incorporated into the model were equations to predict the effects of low-0_2 atmospheres, grain temperature and insect stage on insect mortality. This model can predict the duration of fumigation required to produce a given mortality using low 0_2levels. It can also be used to predict insect density in grain 1-2 months post-fumigation. Simulations showed that fumigating grain at 29°C for 15 d resulted in 99.9% mortality to all stages of *S. oryzae*. However, fumigating at 17°C for 15 d only resulted in 95.7% mortality of the pupae. Thus, with cool grain near the bin walls longer fumigation intervals are required to kill all development stages *of S. oryzae*, and the pupal and adult stages take longer to kill than the egg and larval stages.