Title Low-temperature aeration to control Indianmeal moth, *Plodia interpunctella* (Hübner), in stored grain in twelve locations in the United States: a simulation study

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Abstract

Aeration management strategies were developed to control cold-acclimated and diapausing Indianmeal moth, *Plodia interpunctella* (Hübner), larvae in grain bins during winter in north- and east-central regions of the US. The application in this study focuses on corn because it is the dominant crop in these regions, but we believe that the analyses can be applied to other grains as well. Contour maps for hours below −10 °C for the months of December, January, and February were developed to help effective planning and management of aeration to control overwintering stored-grain insects. Two cumulative lethality index (CLI) models were developed to estimate mortality of laboratory-reared (diapausing without cold-acclimation) and field-collected (cold-acclimated, and diapausing with cold-acclimation) *P. interpunctella* larvae under changing temperature conditions. The CLI models were used for evaluating aeration management strategies. Simulation studies were conducted using 30 years of weather data for 12 locations in north- and east-central regions of the US to evaluate different aeration management strategies for controlling *P. interpunctella* larvae. For each strategy, temperatures of headspace air and grain in the top meter of the grain mass were simulated using an existing model for the period of December–February. The tested management strategies included no aeration, continuous aeration, and intermittent aeration by controlling fan operation. During aeration, air was pulled from the headspace downward through the grain with an airflow rate of 0.11 m^3/min-t (0.1 cfm/bu). Simulation results indicated that a fan control strategy that turned the aeration fan on when the grain temperature at 0.4-m depth was greater than the headspace-air temperature was the best strategy for managing *P. interpunctella* larvae in all tested locations. For this strategy, the CLI model indicated that 100% mortality of *P. interpunctella* larvae could be achieved at a grain depth of 0.4 m from the top grain surface in all locations. For this strategy, the aeration fan operated about 10% of the time from December to February. The average cost of electrical energy required for aeration fan operation with this strategy for all locations was 1.3 ¢/t (0.033 ¢/bu) based on an electrical energy cost of 7 ¢/kWh.