IMPACT OF AERATION ON INSECT PEST POPULATIONS IN STORED CORN

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Corn is an important fall crop in much of the eastern United States. Harvest date can range from late August to mid-November, depending on latitude, soil moisture, planting date, and growing season. There are several major insect pests of stored corn, including the maize weevil, Sitophilus zeamais, and the Angamois grain moth, Sitotroga ceraella, which are internal feeders. Secondary beetle pests include the red flour beetle, Tribolium castaneum, and the sawtoothed grain beetle, Oryzaephilus surinamenis. These secondary pests are ubiquitous species that are found in a variety of post-harvest environments. As corn is binned it can be treated with pirimiphos-methyl, an organophosphate insecticide. Malathion is currently labeled for stored corn but most of these labels are being withdrawn from registration.

The process of cooling grain through low-volume aeration (typically 0.05 to 0.3 cubic feet per minute, or CFM) is an important management component for stored wheat grains in the midwestern and north-central United States. Wheat is harvested and binned during the summer, when temperatures are conducive to rapid population growth of insect pests. Aeration cannot be utilized until ambient temperatures cool in the fall. Aeration may be even more effective in management programs for corn, because corn is harvested in the fall in much of the U. S. In the southeastern U. S. corn is harvested earlier, and the warmer temperatures will delay aeration. However, even in this region aeration can be effectively used for managing insect pests.

In the absence of aeration the interior of the storage bin will eventually cool in response to environmental temperatures during the fall. The bulk mass of any stored commodity has considerable insulating properties so that when the bin is cooled the cool temperatures will be retained throughout the winter months. However, temperatures on the top surface and along the bin walls may rise and fall in response to the outside air temperature, which could result in a temperature differential between the peripheral regions and the interior core. These peripheral regions are extremely susceptible to insect infestations. Aeration will quickly cool the entire bulk faster than natural cooling from ambient temperatures, cool these peripheral regions, and equalize temperatures throughout the storage bin.

The degradation rate of organophosphate insecticides will increase as commodity temperature and moisture content increase. Aeration will cool stored corn and reduce the moisture content, thereby slowing the degradation rate of pirimiphos-methyl so that the residues remain biologically active for a longer time period as compared to unaerated corn.

The lower developmental limits for most stored-product insects is approximately 18°C (65°F). Cooling corn below this level can reduce population development of maize weevils and red flour beetles. Corn moisture content, beetle populations, the percentage of insect-damaged kernels, and insect feeding damage (ground flour and insect frass) were all significantly lower in aerated corn versus unaerated corn.

Aeration can be used on farm-stored corn or corn stored in commercial structures. The only difference would be the size of the fan motors required to produce the necessary airflow rates. Approximately 120 hours of temperature accumulation below a specified threshold are required to cool grain at an airflow rate of 0.1 CFM. Increasing the fan speed leads to a decrease in the time required for cooling. In the southern U. S. it may be necessary to use higher airflow rates to quickly cool the corn because of the earlier harvest time compared to more northerly regions.

Historical weather data can be used to predict hours of temperature accumulation below thresholds used for aeration and evaluate the potential for using aeration in warm-weather sites such as the state of Georgia, which is a major producer of corn among southeastern states. Assuming a fan speed of 0.01 CFM, 120 hours below 65° can be accumulated by mid-October in the southern part of the state where most of the corn is grown. A second cooling cycle could be accomplished in November.

There is potential for the expanded use of aeration in stored corn, even in the southern regions of the U. S. that were considered to be unfavorable for fall aeration. Aeration could reduce chemical inputs and produce an economic savings by eliminating unnecessary applications. Stored corn is usually fumigated with phosphine but can be fumigated with methyl bromide if a quick kill is required. Aeration is compatible with programs that emphasize integrated management, and if a protectant insecticide is required at binning aeration will increase the residual efficacy of the protectant during the storage period.