Stirring of Maize Stored in Farm-Sized Grain Bins to Control Maize Weevils

RFR-A19102

Mike Sserunjogi, research assistant
Carl Bern, professor emeritus
Thomas Brumm, professor
Dirk Maier, professor
Agricultural and Biosystems Engineering
Thomas Phillips, professor
Entomology, Kansas State University

Introduction

This research was conducted between mid-summer and mid-fall (July and October, 2019). The study investigated the effectiveness of stirring infested maize in a farm-sized bin to control maize weevils (*S. zeamaiz*). Farm-sized steel grain bins have stirring machines suspended from the bin roof and sidewall with one or more vertical augers extending through the grain mass nearly to the bin drying floor. The augers rotate continuously through the grain mass lifting maize kernels from the bottom to the top of the bin, reducing the moisture gradient at different layers of the grain mass. The principle of using stirring augers to mix maize with insects has not been explored. The objective of this research was to determine effects of stirring weevil infested maize in a farm-sized bin on the population of maize weevils and quality of the maize.

Materials and Methods

Steel grain bin. Two steel grain bins with diameters of 32 ft and 24 ft were assigned as stirred and unstirred (control) treatments respectively. The stirring machine was a Sukup Fastir Plus triple auger with a mechanical reversing drive.

Maize and maize weevils. Maize was a mixture of several varieties combine harvested October 2018. The bins were loaded with maize at 13 percent moisture, 4,000 bushels in the unstirred bin and 5,000 bushels in the stirred bin, to a depth of 9 ft above the perforated floor. Both bins were infested with maize weevils based on a commercial tolerance rate of two weevils/kg of maize. Colonies of *S. zeamaiz* were raised by the departments of Agricultural and Biosystems Engineering, Iowa State University (ISU), and Entomology, Kansas State University (KSU). Weevils were raised in environmental conditions at 81°F and 65 percent RH. Probe traps set at different locations in the bins monitored the changes in populations of other insect species during bin infestation with maize weevils.

Fans and heaters. The bins had axial fans with heaters using propane. Summer warming with ambient air achieved temperatures up to 86°F suitable for maize weevil activity and multiplication. Fall warming with heated air never quite achieved 86°F. The changes in temperature and humidity in both bins were monitored for decisions on bin aeration. Maize samples were collected at 0, 3, 6, and 9 ft depth of maize with a vacuum-probe sampler. Sampling of maize happened before stirring and at 10, 20, 30, and 40 days of continuous stirring machine operation.

Response measurement. Samples of maize were analyzed for live maize weevils, other insect species, and maize quality in terms of moisture content, test weight, Broken Corn and Fine Material (BCFM), insect damage, and mold damage.

Results and Discussion

Stirring achieved 100 percent mortality of live maize weevils/kg maize in the stirred bin. The

population of live weevils in the unstirred bin was increasing during 40 days of maize storage. In addition, stirring achieved a significant reduction in the populations of other insect species, which were mostly beetles. Disturbing maize through stirring triggered a stressing environment, which perhaps exhausted live maize weevils, prompting their mortality. Although the quality of maize in both bins changed at different depths and storage times, the stirred bin had a higher test weight and lower insect damage of maize. The allowable storage time was reduced due to an increase in moisture content and mold damage of maize in the unstirred bin. Stirring loosens caked grain, thus getting rid of moist spots, and allows air flow in the grain mass to bring maize to a uniform moisture content. Therefore, no signs of maize deterioration or spoilage were found in the stirred bin. Additionally, longer storage time with little or no changes in the quality of maize was achieved in the bin with an operating stirring machine. Stirring generated high BCFM at the bottom of the bin. The concentration of BCFM and the effect this has on aeration can be of significant importance in the management of the stored maize.

Acknowledgements

Funding for this research was provided by the Sukup Manufacturing Company of Sheffield, Iowa. Gratitude is extended to the staff at the Ag Engineering/Agronomy and Central Iowa Research Farms for their efforts with this experiment.