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## Evaluation of Stirring to Control Lesser Grain Borers in Stored Wheat

### Introduction

Wheat is the mostly widely grown crop in the world and a food source for billions of people. Fulfilling the food demand of an increasing world population is of growing concern. One-third of food produced is lost during postharvest operations.

The lesser grain borer (LGB), *Rhyzopertha dominica* (Fig. 1), is a large contributor to postharvest losses (PHLs) in wheat. The lesser grain borer feeds on stored wheat, decreasing wheat quality, increasing dry matter loss, and decreasing nutritional value. An approach that may be effective for use by smallholder farmers to control LGBs is physical disturbance of stored grain.

Disturbance is an approach that is affordable, simple, and environmentally friendly since it does not require use of any chemicals. Stirring devices are often used in grain bins to assist in drying. I hypothesized that physical disturbance by stirring interferes with LGB reproduction and could control LGB infestations, thereby reducing PHLs and increasing the world's food supply.

### Objective

The objective of this experiment was to determine the effect that disturbing LGB-infested wheat by stirring has on the population density of lesser grain borers and on wheat quality.

### The Lesser Grain Borer



Figure 1: Lesser Grain Borer

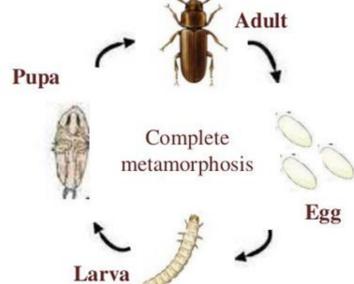


Figure 2: Lesser Grain Borer Life Cycle

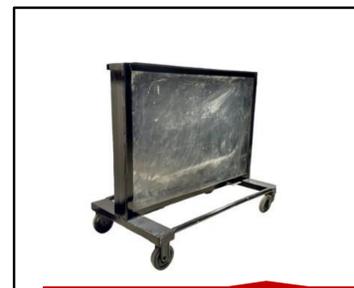
Each female grain borer deposits ~500 eggs loosely onto kernels of grain (Fig. 2). After ~32 days, larvae hatch and eat into wheat kernels where they complete their development. After the larvae develop within wheat kernels, adult LGBs emerge by chewing through the outer grain layers. Adults live up to 240 days (Akol et al., 2011). LGBs feed on the grain and leave behind empty husks and grain dust (fine material).

### Methods and Materials



Three Stirring Containers

Figure 3: Experimental Stirring Container



Three Control Containers

Figure 4: Control Container

Six containers, three equipped with vertical stirring augers (Fig. 3) and three without (Fig. 4), were used to contain the wheat. The containers and stirrers that were designed and built by Sukup Manufacturing Company based on their Fastir stirring machine product.

Merschman Millie 4, a soft red winter wheat variety, was used. Each container was loaded with 28 kg (61.7 lb) of wheat at 11.3% moisture and test weight of 57.3 lb/bu.

Lesser grain borers were obtained from the USDA ARS Center for Grain and Animal Health Research Center located at Kansas State University. Adult unsexed lesser grain borers were placed into each loaded container at a rate of 25 borers per kg of wheat.

### Experimental Design

The experimental design consisted of two treatments: unstirred and stirred wheat. Three replications of each treatment were conducted using three experimental and three control containers in a completely randomized design. The experiment was conducted in a 27°C room to encourage activity and growth of the LGBs.

Experimental wheat containers were auger stirred one length of the container every 12 hours. Wheat samples were drawn at 40, 80, and 120 days using a grain probe in three different locations in each container. For each measurement, LGB mortality was determined by sight. Samples were analyzed for moisture content, fine material, and test weight. After 80 days, the stirring mechanism was disabled and the containers were allowed to sit undisturbed for another 40 days when samples were drawn again.

### Results and Discussion

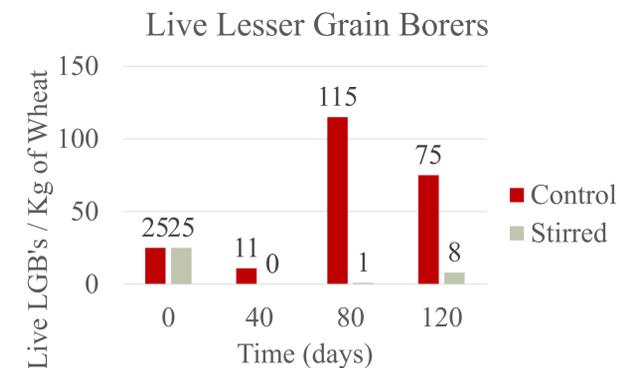


Figure 5: Live Lesser Grain Borers Data

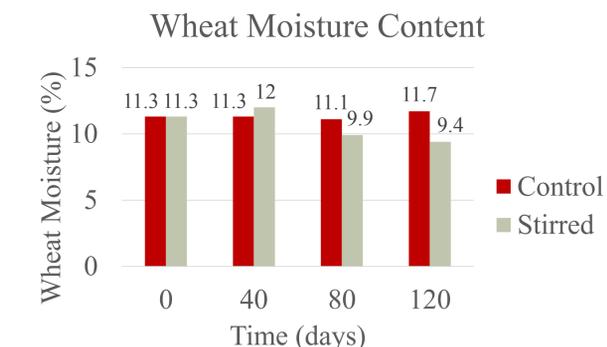


Figure 7: Wheat Moisture Content Data

At 80 days, live LGBs per kg in the stirred containers were reduced by over 99% compared to the control (Fig. 5). Overall, stirring created less fine material than LGB activity (Fig. 6). Moisture content of the wheat was higher in the control container (Fig. 7) and test weight was lower (Fig. 8). Stirring did not eliminate LGBs in this experiment but it significantly reduced the LGB population and minimized the damage to wheat.

Stirred containers still had LGBs at T=80 days likely because all the wheat in the container was not disturbed equally by the stirring auger. There were pockets of undisturbed grain where the LGBs were unaffected by the treatment. At T=120 days, the undisturbed pocket contained much more damage and debris compared to the disturbed area in the grain (Figs. 9 and 10).

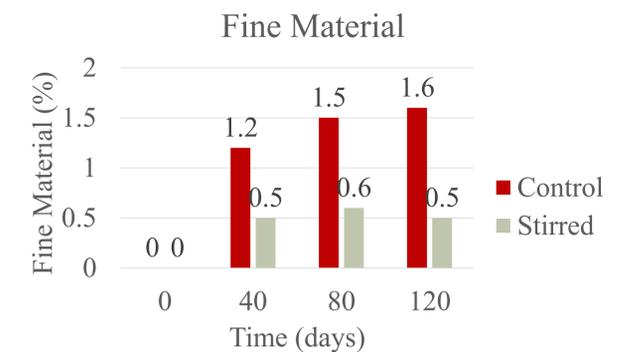


Figure 6: Amount of Fine Material Generated

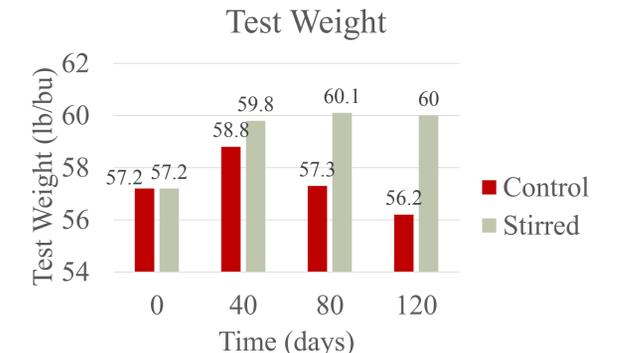


Figure 8: Wheat Test Weight Data



Figures 9 and 10: Experimental container undisturbed area of wheat at T=80 days and T=120 days

### Conclusion

Overall, stirring is an effective method of reducing the live Lesser Grain Borer population in stored wheat. Stirring did not eliminate Lesser Grain Borers in this experiment but it significantly reduced the Lesser Grain Borer population and minimized the damage to wheat.

### Reference

Akol, A. M., Talwana, H. A., & Mauremootoo, J. R. (Eds.). (2011). *Rhyzopertha dominica* (Fabricius) - Lesser Grain Borer. Retrieved February 22, 2018.