

Detection of Stored-Grain Insect Infestation in Wheat Transported in Railroad Hopper-Cars



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INTRODUCTION

- Insect infestation is an important quality factor of stored grain and represents a serious and continuing problem for the grain and milling industries.
- Acceptance of a specific grain lot by millers depends mainly on the number of live insects and the number of insect-damaged kernels (IDK) detected before the grain is unloaded from a railroad car.
- The most commonly used method for determining insect contamination and damage in railcars is sampling with a grain trier and visual inspection for insect-damaged kernels.
- However, these methods have been reported to be inaccurate when detecting population densities below 4 insects/kg and do not detect the internally feeding stages that can generate insect fragments in the final milled product.
- The specific objectives of this study were to determine (1) if IDK counts are indicative of insect infestation levels; (2) the age structure of the insect population in the infested cars; and (3) the spatial distribution of insects and IDK in the grain mass.

METHODS

- 8 railroad cars (3 compartments/car) were sampled using a pneumatic (vacuum) grain sampler fitted with 91.5 cm (3 ft) probe sections (pictures 1 and 2).
- 2.75- Kg samples were taken from 18 points in each compartment: two on the front, two near the center, and two near the back on either side of the centerline at three different grain depths: 91.5 cm (3 ft), 1.85 m (6 ft), and 2.75 m (9 ft) (picture 3).
- The day after collection, each sample was passed over an inclined sieve to remove all of the live and dead insects present outside of the grain kernels. One 100 g sub-sample was taken from each grain sample for IDK analysis.
- The samples were placed in a rearing chamber at 30°C and 75% RH and held for 7 weeks to determine the presence of insects inside kernels and the age structure of the population.
- The grain samples were passed over an inclined sieve again after one, four, and seven weeks to remove any insects that emerged from inside the grain kernels.
- Adult insects were identified, and the numbers of live and dead insects were recorded by species.



1. Hopper-Car



2. Vacuum grain sampler

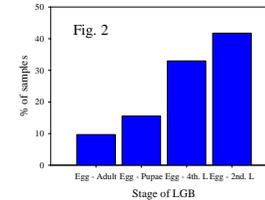
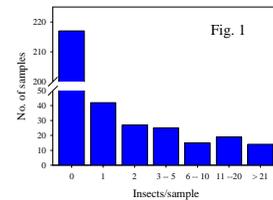


3. Sampling grain

RESULTS

Insect Density and Insect-Damaged Kernels

- Insect infestations were found in six of the eight cars sampled. The infestation level and the numbers of insect-damaged kernels varied among the cars and among the compartments in the same car.
- Around 40% of the samples collected from cars were infested with insects; the majority of these samples contained only one insect (Fig. 1).



Occurrence of Insect Species

- *Rhyzopertha dominica* was present in 31.1% of the total samples collected, followed by *Cryptolestes ferrugineus* (23.1%), *Tribolium castaneum* (11.7%), *Sitophilus oryzae* (2.2%), dermestids (0.8%), *Oryzaephilus surinamensis* (0.6%), *Typhaea stercorea* (0.3%), and *Ahasverus advena* (0.3%) (see pictures below).
- The age structure of *R. dominica* at sampling time was eggs and first instars 50.7%; second, third, and fourth instar 42.2%; pupae and pre-emerged adults 4.8%; and only 2.3% were adults.
- More than 40% of the samples were infested simultaneously with eggs and first and second instar at sampling time, and only around 10% of the samples were infested with all the stages of *R. dominica* (Fig. 2).



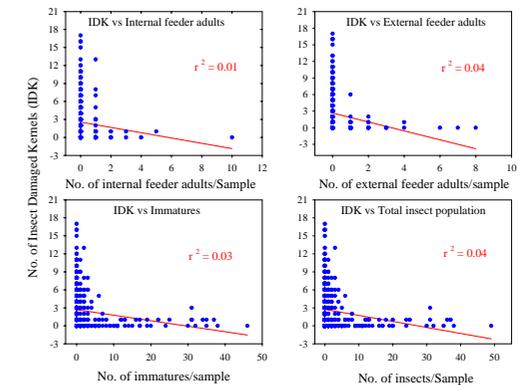
Distribution of insects in the grain mass

- The spatial distributions of *R. dominica* and *C. ferrugineus* within the grain mass were typically clumped in compartments containing more than 0.4 insects/sample, and the foci of high grain sample capture varied in compartments within the cars and among the sampled cars.

Relationship Between Insect-Damaged Kernels and Presence of Insects in the Grain

- There were no significant correlations between insect-damaged kernels and insect density for any of the different stage-specific insect populations that were collected in the grain samples (Fig. 3).

Fig. 3



SUMMARY

- Insect infestations were found in six of the eight cars sampled. The infestation level varied among the cars and among the compartments in the same car.
- The two most abundant species were *R. dominica*, which accounted for 84.5% of the total live insects recovered, and *C. ferrugineus*, which accounted for 14.2% of the total insect population.
- Visual examination of grain samples gives information about the population of adult and immature external feeders and the relative number of adult internal feeders present in the grain sample, but does not provide information about the number of immature internal feeders infesting the grain.
- Our data show that the current grain classification practice based on IDK is not a reliable technique because there is not a clear relationship between IDK and the insect infestation level present in the grain.