Managing Mill Insects

Good monitoring program is essential for millers

Several species of stored-product insects are associated with flour mills. Many of these species are beetles and a few are moths. The most important beetle pests familar to every miller are the red and confused flour beetles.

Moths typically found in mills include the Indianmeal moth, almond moth, and Mediterranean flour moth.

There are several recommended pest management methods for controlling mill insects. These methods range from inspection of raw ingredients for insects, sanitation, stock rotation, application of residual pesticides to cracks/crevices, spots, and general (non-food) surfaces, closing doors, screening windows, and fumigation.

The fumigants legal to use in mills include methyl bromide, phosphine, and $ECO_2FUME^{®}$ (2% phosphine and 98% carbon dioxide).

The use of high temperatures or heat treatments is again becoming popular because methyl bromide may be phased out in the United States by 2005.

Except for the use of fumigants, all other pest management measures can be classified as preventive tactics. The use of fumigants or heat treatments is a responsive tactic, because these should be used not to prevent but to manage severe and widespread infestation.

Fumigations or heat treatments are typically done when the mill is shut down for holidays or during a long weekend, because mills sometimes operate 24 hours a day.

Research done from 1932 and 1934 to 1935 by George B. Wagner and R. T. Cotton, published in the 1935 issue of the *Northwestern Miller* (pages 522-523), in 21 mills in Kansas, Oklahoma, and Missouri, revealed that mills that operate eight hours a day had 77% fewer insects in December than in August. However, mills that operated 24 hours a day did not show this trend, because it is difficult to perform sanitation and pest management in mills that operate continuously.

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There are no easy explanations to these critical questions, because very little research data exists to answer them. In the absence of any tangible explanations, one may surmise that since insect numbers were similar before and after intervention, the treatment was a total failure!

The reasons for writing this article is not to suggest fumigation or heat treatment are ineffective, but rather to highlight the importance of additional information that is needed to accurately gauge effectiveness of any pest management intervention in mills. After all, pest management is a simple exercise in balancing costs (mill downtime, pesticide costs, etc.) and benefits (elimination or suppression of insects below acceptable levels for extended periods).

No Guarantees

Responsive tactics such as fumigation or heat treatment do not necessarily guarantee their effectiveness in disinfesting a mill.

Research conducted in the last five years by stored-product entomologists at Oklahoma State University and Kansas State University (KSU) has shown that insect levels in mills following a fumigation or heat treatment are sometimes sim ilar to pretreatment levels or greater than pretreatment levels. Research workers used food- and pheromone-baited traps to assess insect levels before and after intervention.

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This interesting finding leads us to ask several questions: Was the intervention effective in killing insects? What is the source of the insects? Are the insects found following intervention coming from outdoors or on raw ingredients?

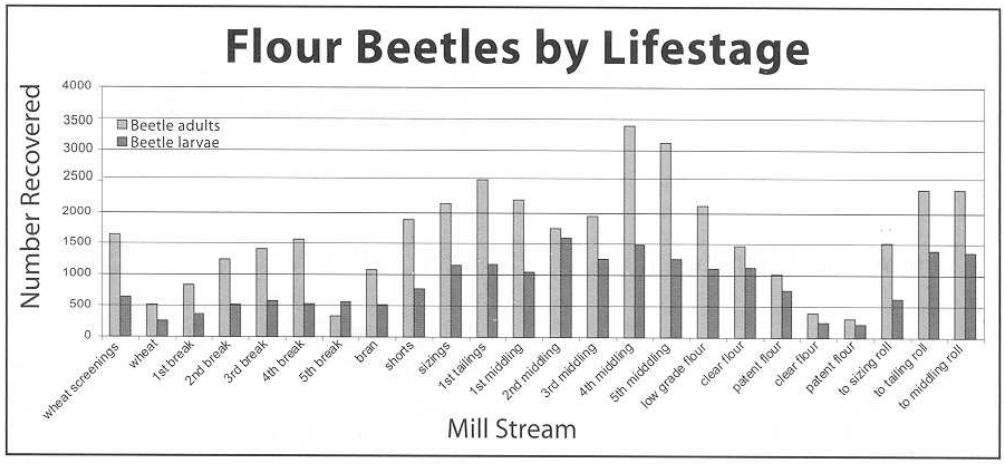
Assessing Effectiveness

In order to assess whether a treatment has been effective or not requires a thorough understanding of insect sources and dynamics in the flour mill environment and our ability to sample these populations.

Stored-product insects can enter flour mills on raw grain. This is especially true of insects such as the rice, granary, or maize weevils, lesser grain borer, and Angoumois grain moth, which develop larvae and pupae within kernals.

Visual inspection of kernels may not reveal larvae and pupae inside the kernels at the time of unloading grain from trucks or railcars, and there isn't time to incubate samples for seven to eight weeks to confirm an internal infestation. A recent unpublished study by USDA's Grain Marketing and Production Research Center scientists in Manhattan, KS at a processing plant in the

Midwest conclusively showed that internal infestations are common. Researchers found a total of 1,024 insects in wheat samples taken from seven of eight railcars. Approximately 3% of the insects were found immediately after sample collection and examination, whereas a little over 77% of insects were found after seven weeks of sample incubation in the laboratory.



This limited data suggests that insects may be entering on raw grain or other ingredients frequently being brought into the mill environment. Therefore, it is important to have a thorough inbound inspection of raw ingredients and/or special handling or pesticide (fumigation) treatment of incoming ingredients.

Movement Patterns

Numerous studies have documented the presence of stored-product insects outdoors on farms, at elevators, and mills. The warehouse beetle and Indianmeal moth are two important pests that are found in abundance outdoors, especially around food-processing facilities, in rural as well as in urban settings.

It is conceivable that insects outdoors can enter mills after fumigation or heat treatment. We understand very little about the degree of insect movement between the mill and outside environments. Trapping and insect marking techniques are available to study insect movement patterns, but we need the milling industry to support us in this endeavor and provide mills to conduct these important ex- periments.

In mills, infestations are widespread and not localized. Insects have been reported from static and moving mill stock.

Data from the 1932 and 1934 to 1935 survey were summarized in detail by Nowell E. Good, and the results were published in 1937 in the *Journal of Kansas Entomological Society*, Vol. 10, pages 135 to 148. In this survey, 8 oz. samples were collected from 24 elevator boots and other mill streams from 21 flour mills in Kansas, Oklahoma, and Texas. However, data from 19 mills were reported. A total of 30 insect species were associated with flour mills. Nearly 99% of the insects collected from over 2,300 samples were beetles. Flour beetles made up about 78% of all the beetles found in samples. Flour beetle adults and larvae were found in all mill streams (see chart above). However, rice weevil and lesser grain borer, which require intact kernels for immature development, were pre- dominantly found in whole grain.

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The widespread and well-established infestation of red flour beetles in all mill streams suggests that the only means of controlling this pest is with a fumigant such as methyl bromide.

Graduate Student Study

From June to October in 2002, my graduate student, Andy Allen, took 439 product samples from various locations in the KSU Pilot Flour Mill and found that 54% of the samples had one or more insects immediately upon examination, and about 80% had insects after eight weeks of incubation at 28 degrees C and 65% relative humidity. The average number of insects found ranged from zero to 6.3 insects per gram of product.

During the same time period, Allen placed 1,634 food-baited trap samples on the mill floors and found that 95% of the traps had captured one or more beetles. Similarly, 32% of the 1,596 stick-trap samples placed within the mill captured Indianmeal moths. However, Indianmeal moth larvae or adults were not found in the product samples, suggesting that these moths could have come in from outdoors.

This leads us to an important question? Can we rely on traps to monitor insects within the mill and to evaluate treatment effectiveness? In the absence of scientifically tested plans for sampling the static and moving mill stock within the mill, we have no other choice but to use commercially available traps that the industry is familiar with and has been using for years.

Pest management in mills cannot be properly implemented if we do not fully understand the sources and dynamics of insects in static and moving mill stocks and the impact of intervention of insect numbers in these stocks. In addition, programs should be developed to prevent reinfestation of mills following intervention.

Insect Monitoring Programs

It is extremely important to have an insect monitoring program in flour mills that is based on both product/food residue sampling and trapping. Such a program will help in knowing the types and numbers of insect species found, extent of infestation, and impact of intervention on degree and duration of insect suppression.

To date, we have certain "recommended" pest management options for flour mills, most of which rely on the use of responsive tactics. Filling the data gaps identified above should help in developing and implementing a cost-effective pest management program for flour mills.

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