Aerosols for Managing Insects

Used properly in mills, these alternative materials are economical and effective.

This is the second in a two-part series about using aerosols to control and manage insects. The phaseout of methyl bromide in the United States has led to exploring alternative treatments for insect pests associated with flour mills, such as $ECO_2FUME^{®}$, heat treatments, aerosols, and sulfuryl fluoride. While the first part of this series, which appeared in the Fourth Quarter 2011 *Milling Journal*, provided a general overview of using alternative treatments, this second part will examine more closely the actual use and application of aerosols.

Aerosol Products

Although using a nonsynergized insecticide such as dichlorvos (Vapona) was very common when aerosol technology was introduced, pyrethrins and pyrethroids, which were used as aerosols later, contained a synergist, piperonyl butoxide, for improving the efficacy of aerosols against stored-product insects.

The latest strategy in aerosol technology is to use a combination of insecticides.

The most widely evaluated treatment in both laboratory and field settings combines a synergized pyrethrin with methoprene or pyriproxyfen primarily, which are growth regulators.

This is done to provide quick knockdown and, at the same time, deliver long residual activity. The synergized pyrethrins provide quick knockdown, and the growth regulator provides long residual activity.

Pest Management

Dr. Bhadriraju Subramanyam

Efficacy of Aerosols

Synergized pyrethrins applied alone as an aerosol at the label rate in a large storage room of a commercial food bank effectively controlled the larvae, pupae, and adults of red and confused flour beetles exposed in Petri dishes in the presence of flour as a food source and at open locations. The mortality also increased with an increase in the post-exposure time.

Similarly, methoprene ►

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Shown here is a typical pressurized cylinder that is holding the aerosol dichlorvos (Vapona). Photo courtesy of Dr. Bhadriraju Subramanyam (Subi).

applied alone at the label rate was highly toxic to larvae of the confused flour beetle in open locations and red flour beetle in both open and concealed (within equipment) locations, but it was moderately toxic to Indianmeal moth eggs.

Several researchers have shown that both exposure location and presence of flour as a food source in a facility influenced insect control.

Synergized pyrethrins applied at the label rate in an empty warehouse resulted in a wide variation in mortality (20% to 94%) of adults of the confused flour beetle exposed in Petri dishes, without flour in the rear part of the warehouse. In comparison, more than 80% mortality rate occurred in Petri dishes that were placed in the front part of the warehouse.

This discrepancy was explained partly by the fact that the nozzles delivering aerosol particles were directed to the front of the room suggesting there was nonuniform distribution throughout the empty warehouse.

In another study, synergized pyrethrins and esfenvalerate applied separately as aerosols at label rates resulted in higher mortality of all life stages of the red flour beetle in open locations in Petri dishes placed underneath wooden pallets.

When confused flour beetles were exposed to synergized pyrethrins in Petri dishes with flour in open locations, 100% of the adults were knocked down. However, the knocked-down adults recovered later.

> Since no or poor sanitation undermines the actual efficacy of aerosol insecticides, proper sanitation is important for maximizing the effectiveness of aerosol treatments in controlling insects.

The recovery and survival were correlated positively with post-exposure time and the amount of flour present in the Petri dishes.

Similar observations of knockdown and the recovery of red flour beetle life stages exposed to synergized pyrethrins and esfenvalerate and applied separately at label rates in pilot scale warehouses were made in the presence of flour as food—both in the open and in Petri dishes placed under wooden pallets.

The confused flour beetles exposed to ►

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synergized pyrethrins in Petri dishes during application and later placed on flour also showed increased survival rates. This finding also stresses the need for sanitation of a facility prior to aerosol treatment.

With proper sanitation, the proportion of insects exposed directly to aerosol during application would be increased considerably, either by preventing them from taking refuge in the flour patches or by forcing them to come out of their hiding places in search of food.

On the other hand, poor sanitation reduces the chances of insects coming into contact with food, either during or after an aerosol application, especially if insects are in the flour patch.

Since no or poor sanitation undermines the actual efficacy of aerosol insecticides, proper sanitation is important for maximizing the effectiveness of aerosol treatments in controlling insects.

Advantages of Using Aerosols

There are several advantages of using aerosol technology for insect control in mills. The cost of using aerosol insecticides is less compared to fumigation with methyl bromide and sulfuryl fluoride or heat treatments.

For example, the costs for methyl bromide, sulfuryl fluoride, and heat treatments amounted to 5 cents, 10.7 cents, and 8.9 cents per cubic foot, respectively, which were based on an average of three separate treatments of 340,000 cubic feet of the pilot flour mill during 2009-10 at Kansas State University.

In contrast, other researchers have shown that treatments using aerosol formulations of esfenvalerate and methoprene – each applied alone – was 0.007 cents per cubic foot, and when applied together, was 0.02 cents per cubic foot.

Using Aerosols Safely

Relatively airtight sealing and documentation to comply with federal regulations are essential when using fumigants, but such requirements are a little less stringent when using aerosols. However, airtight sealing of the facility during aerosol treatments may be necessary, if the facility is located in a residential area.

Aerosol treatments can be conducted in a portion of or the whole facility, and the treatment times are very short (two to four hours), depending on the product. Aerosol treatments can be made in specific rooms, where infestations are found, and the facility need not be shut down.

Treatments with the fumigants methyl bromide and sulfuryl fluoride require a minimum exposure time of 24 hours. For heat treatments, the time may be as short as 24 hours or as long as 34 hours.

Like fumigants, aerosol treatments require a period of clearing, which with certain aerosols could range from two to 12 hours (overnight).

After an aerosol treatment is conducted, concentrations of certain aerosols need to be monitored to make sure that it is safe for workers to re-enter facilities. Also, food-contact surfaces need to be protected or covered for some aerosol applications.

Nevertheless, the duration that the facility should be out of operation (shutdown) for an aerosol treatment is much shorter (≤12 hours) than that required for fumigation or heat treatments (24 to 34 hours).

After an aerosol treatment is conducted, concentrations of certain aerosols need to be monitored to make sure that it is safe for workers to re-enter facilities. Also, food-contact surfaces need to be protected or covered for some aerosol applications.

Integrated with Other Measures

Aerosol applications can be integrated with other management tactics for controlling insects in mills such as fumigation, application of residual contact insecticides, and sanitation.

Unlike fumigants, aerosols cannot penetrate packages and kill insects. Therefore, insects in the egg stage and inside packaged food escape the exposure and need to be controlled by fumigation.

This limitation can be offset to some extent by doing aerosol treatments in empty warehouses and bringing clean raw, finished, or packaged products into the facilities, which reduces the chance of cross-contamination and infestation.

Alternative aerosols may complement control achieved by insect-resistant packaging.

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