Methyl Bromide Update

Interview with Dr. Paul Fields on his five-year alternative fumigation research project.

Dr. Paul Fields is a research scientist at the Cereal Research Centre, Agriculture and Agri-Food Canada, Winnipeg, MB (paul.fields@agr.gc.ca). Fields is known internationally for his work on stored-product insect management, especially use of temperature extremes to control insects.

He recently completed a five-year research project examining alternatives to methyl bromide in Canadian flour mills.

Here is my candid discussion with Dr. Fields on his experiences and research outcomes with respect to use of methyl bromide and alternatives for disinfestation of mills.

Pest Management

Dr. Bhadriraju Subramanyam

Do Canadian mills still use methyl bromide to control insects in flour mills?

Canadian flour mills are using less and less methyl bromide. In 2005, they used 36 metric tons. By 2008, this had dropped to 28 metric tons.

You were involved in studies designed to evaluate various technologies for stored-product insect pest management. What are your general findings on the effectiveness methyl bromide and alternatives in Canadian mills?

The study was funded by Agriculture and Agri-Food Canada, the Canadian National Millers Association, and its member companies. I was responsible for measuring the effectiveness of the treatments.

We followed four sulfuryl fluoride (ProFume®) treatments; two phosphine (ECO_2FUME®), heat, and carbon dioxide treatments; three heat treatments; and one IPM and sanitation treatment; and compared them with seven methyl bromide treatments in flour mills across Canada.

We measured efficacy three different ways:

- Survival of red flour beetle adults and eggs during the treatment.
- Relative changes in pheromone trap

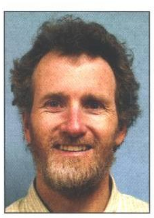
The red flour beetle (Tribolium castaneum), a common pest of flour mills.

catches before and after treatments.

• Relative changes in the rebolt sifter tailings before and after the treatments.

Just before the treatments, bioassay vials adults, and eggs of the red flour beetle were placed throughout the mill to determine efficacy. Almost all treatments were effective in killing 100% of adult red flour beetles put out as bioassays. In only one trial, where portable propane heaters were used, there was only 94% mortality. There was more survival of the eggs compared to adults. In the sulfuryl fluoride treatments, egg mortality ranged from 35% to 99.6%. The other treatments had egg mortalities over 98%.

Insect populations in the mill were estimated using pheromone traps that were placed on the roll floor and the sifter floor for six weeks before a treatment and at least 16 weeks after a treatment. In methyl bromide treatments, the rebound of insect populations to pre-treatment levels occurred in as little as three weeks to never within the 30-week sampling period. For sulfuryl fluoride, the rebound took from as little as one week to never rebounding within the 18-week study.



Paul Fields

The phosphine combination treatment saw populations rebound within seven to 29 weeks. For the heat treatments, none of the populations returned to the original levels even at 19 weeks after treatment.

Adult and larvae of flour beetles were monitored in the tailings from rebolt sifters. The data for the rebolt sifter tailings are available for only about half the mills where we conducted trials. In the other mills, either millers did not sample regularly for insects in the rebolt sifter tailings, or they did not find insects in the tailings.

For most of the mills, there is a good correlation between insects found in the pheromone traps and insects found in rebolt sifter tailings.

However, on several occasions, pheromone traps were not a good predictor of insect numbers in the rebolt sifter tailings. In methyl bromide treatments, the rebound of insect populations to pre-treatment levels occurred in as little as 15 weeks to never within the 31 week sampling period. For sulfuryl fluoride, the rebound took from as little as nine weeks to never rebounding within the 18-week study. Phosphine combination treatment saw populations rebound within one to 33 weeks. In all three heat treatments, the mills either did not sample rebolt sifter tailings, or there were no insects in the tailings.

Sulfuryl fluoride, heat, and phosphine combination treatment (phosphine, heat and carbon dioxide) can control insect populations in flour mills for over 18 weeks.

It is difficult to know where insects are hiding and breeding in a mill. ▶

Therefore, both mill managers and companies that do pest management use indirect indicators, such as bug cards, insects in vials, trapping, or examining tailings. What does your research show to be a reliable indicator of any treatment effectiveness against insects?

Adult insects are fairly easy to kill with fumigants. The egg is the most resistant stage against sulfuryl fluoride and the pupa is the most resistant against methyl bromide. Pheromone traps are a good indicator of the increase in insect populations in the mill.

Traps should not be moved, once a trapping program begins, as moving traps can affect trap catch numbers. Traps should be serviced once every seven to 14 days. Rebolt sifter tailings counts are more variable than the trap data, and insects usually appear in pheromone traps before they are seen in the tailings.

However, I have seen mills where no insects were caught in the tailings, yet there were insects in the traps, and vice versa.

What are some practical difficulties in comparing methyl bromide and alternatives in the real world?

Cylinders of sulfuryl fluoride gas (ProFume®) used in treatments to control insects in Canadian mills.

There are limitations to this study. Replications were limited in the mills. Even treatments done in the same mill are done at different times, so pest pressures may be different from one treatment to another.

For example, pest pressure is much greater in the summer than in the winter. One would expect that all things being equal, the rebound of insect populations from a treatment in the fall would be slower than a treatment done in the spring, because of cooler temperatures in the fall.

> "Almost all treatments were effective in killing 100% of adult red flour beetles put out as bioassays. In only one trial, where portable propane heaters were used, there was only 94% mortality."

In Europe and other countries methyl bromide is no longer used in mills. How are these millers managing insects, without using methyl bromide?

Some mills I have visited in Mexico, Brazil, and Canada have never used methyl bro-

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mide, whereas for most mills in Canada and Europe, methyl bromide was a large part of their pest control strategy. The phaseout of methyl bromide has been more rapid in Europe than in Canada and the United States.

Denmark completely phased out methyl bromide in 1998. The Danish mills increased sanitation and used residual insecticides. The alternatives currently being used are sulfuryl fluoride, heat, residual insecticide sprays and improved sanitation.

There are several mills that produce organic products. What are some options for such mills?

Heat treatment is used by several organic mills. Sanitation is another tool used by organic mills. Some residual sprays, such as diatomaceous earth and pyrethrum can be used, but mills need to check with their organic certification agencies as to what is allowed, because often, pyrethrum has the synergist piperonyl butoxide (PBO). Several diatomaceous earth formulations have synthetic additives, none that are allowed by many certification agencies.

Small scale carbon dioxide or vacuum fumigations in well-sealed containers (hermetic structures), such as GrainPro's Cocoons are effective for bagged products. High-pressure carbon dioxide fumigation has been used in Europe for over 10 years in the spice industry, although this requires extensive capital investment.

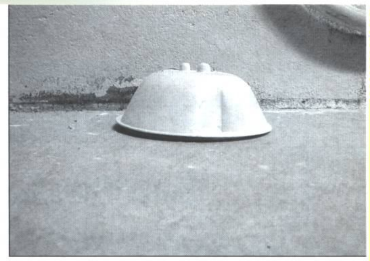
Methyl bromide is a fantastic product for use in mills. Does that mean we cannot manage insects in mills without methyl bromide?

Many mills around the world have stopped using methyl bromide for many years.

Your research report is available online. Please list the resources for our interested readers.

The complete report of the Canadian trials for methyl bromide alternatives is available on-line from the Canadian National Millers Association: *http://www.canadianmillers.ca/*.

For alternatives used in other countries, see reports from the United Nations: Methyl Bromide Technical Options Committee: *http://ozone.unep.org/Assessment_Panels/TEAP/Reports/MBTOC/index.shtml*. The Kansas State University web site is one of the best for learning about heat treatments: *http://www.oznet.ksu.edu/grsc_subi/*.



A trap (Dome™ Trap, Trécé Inc.) baited with pheromones for the confused and red flour beetles (Tribolium confusum and Tribolium castaneum), common pests in flour mills.

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