METHYL BROMIDE AND SULFURYL FLUORIDE EFFECTIVENESS AGAINST RED FLOUR BEETLE LIFE STAGES

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Researchers at Kansas State University, Purdue University, and USDA's Grain Marketing and Production Research Center in Manhattan received an USDA integrated grant last year to determine the cost effectiveness of methyl bromide (MB), sulfuryl fluoride (SF), and heat treatment for managing insects associated with grain and food-processing facilities. The researchers involved include Bhadriraju Subramanyam, Dirk Maier, Watcharapol Chayaprasert, and Michael Langemeier from Kansas State University; Linda Mason from Purdue University; and James Campbell and Paul Flinn from the USDA's Grain Marketing and Production Research Center, Manhattan, KS. The initial research involves evaluating the three technologies in the state-of-the-art Hal Ross flour mill on K-State campus. This unique facility offers the ability to do a side by side comparison of all three pest intervention methods within a given month. In the real world such side by side comparisons are difficult, because whole facility treatments usually occur on major holidays and only one of the three methods is used at any given time. Therefore, comparing one method to the other in such circumstances can lead to misleading conclusions. In May 2009, all three methods were tested in the Hal Ross flour mill for their ability to control all life stages of the red flour beetle.

Insect bioassay boxes

The Hal Ross flour mill opened in October 2006 and is a clean facility with little or no resident infestations. In order to gauge the effectiveness of MB, SF, and heat we designed a bioassay box with 12 compartments (Figure 1). Eggs, young larvae, old larvae, pupae, adults of the red flour beetle,

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Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae)—a major pest in the food industry—and a temperature sensor were introduced into separate compartments of the bioassay box. In these boxes two levels of sanitation were simulated—dusting of flour (good sanitation) and 2 cm deep flour (poor sanitation). In each compartment there were 50 individuals of a life stage. Boxes with life stages were placed in 25 locations of the mill across all five floors. Boxes were placed on the floor and in pieces of equipment. In this summary, we report on the efficacy of MB and SF against life stages of the red flour beetle based on the May 2009 treatments. Heat treatment data and efficacy against life stages of the red flour beetle will be reported separately at this conference.

Pest intervention methods

The mill was subjected to MB fumigation during May 6-7, 2009, heat treatment using forced air gas heaters during May 13-15, and SF fumigation during May 27-28. Each of these treatments lasted 24 hours. MB and SF gas monitoring lines were placed near the bioassay boxes to know measure gas concentrations over time (reported separately in another MBAO submission). Temperatures were monitored in at least more than 40 locations during the heat treatment.

Pest mortality assessment methods

After the treatments the boxes were brought back to the laboratory. Boxes containing, eggs, young larvae, old larvae, and pupae were transferred to 150 ml round plastic containers with flour. The containers were closed with lids and these containers were labeled and placed in growth chambers at 28^{o}C and 65% relative humidity until adult emergence. Mortality was based on number of adults that emerged out of the total exposed. The adults were not transferred to boxes but were examined after 24 hours to determine mortality. Pupae became adults in 10 days, old larvae after 17 days, and small larvae and eggs after 45 days.

May 2009 MB and SF efficacy results

The temperatures during MB and SF treatments inside the mill ranged from 22-26^{o}C and the humidity from 34-50%. The Hal Ross mill is a tight building and the half loss time during the MB fumigation ranged from 10-111 hours and during the SF fumigation it was about 20 hours. A total of 181.4 kg of MB and 567 kg of SF were used. The CT product at locations monitored for MB ranged from 283-327 gram-hours per cubic meter and for SF it ranged from 923-1191 gram-hours per cubic meter.

The mortality of all life stages in a bioassay box placed in the laboratory at 28^{o}C and 65% humidity was less than 10%. The MB treatment killed 100% of all stages in the boxes placed at the 25 locations except for old larvae in one box with dusting and in five boxes with 2 cm of flour. In these locations, the mortality of old larvae ranged from 97-98%. SF killed 100% of all stages except eggs. In 17 out of the 15 locations the egg mortality was 100% in compartments with flour dusting. In the other 8 locations it ranged from 88-98%. In compartments with 2 cm of flour, egg mortality ranged from 44-96% in 24 locations and 100% in just one location.

Another set of treatments was conducted in August of this year with a third treatment is planned for next year. These preliminary results are not conclusive as they constitute data from just one replication out of the three that we plan to complete and summarize.

During the May treatment a heat treatment workshop was held and during the August treatment a SF workshop was held to provide practical hands-on information to participants. Pictures and information from these workshops is available at www.oznet.ksu.edu/grsc_subi under the Conferences/Workshops link.

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Figure 1. Bioassay box showing 12 compartments. The top compartments had 2 cm of flour each and the bottom had a light dusting.