INSECT PESTS IN FOOD PLANTS PRIOR TO, DURING, AND POST SF OR MB FUMIGATION

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Fumigation experiments under laboratory conditions are common but due to a number of factors, fumigation experiments under real-world conditions are difficult and rare. This study compares the efficacy of two important fumigants (methyl bromide (MB) and sulfuryl fluoride (SF)) in working flour mills and examines factors that cause variations in their efficacies. A total of eight SF and three MB fumigations were performed in four different flour mills in the Midwestern United States. Bioassays of red flour beetles (*Tribolium castaneum*) and Indianmeal moths (*Plodia interpunctella*) using all insect life stages (egg, larvae, pupae and adult) were placed inside fumigated structures. In addition, in most of the fumigations, environmental conditions (e.g., temperature and relative humidity) and gas concentrations were monitored. Bioassay data showed that 1) MB and SF have the same efficacy when controlling *T. castaneum* and *P. interpunctella* larval and adult stages; 2) MB was slightly more effective in controlling *T. castaneum* and *P. interpunctella* egg life stage, while SF controlled *T. castaneum* pupae better than MB; and 3) there were no significant differences between MB and SF when comparing all mortality data observed irrespective of life stages.

The second part of this study examined the impact of MB and SF fumigations on *Tribolium* spp. and *P. interpunctella* population dynamics. Insect monitoring devices (moth flight traps and flour beetle Dome traps) were placed inside and outside of the mills and monitored 0-1 month pre-fumigation and a minimum of 3 months post-fumigation. Daily average capture rates from each monitoring period were determined. *Tribolium* spp. daily capture rates 2 weeks post-fumigation were significantly lower than pre-fumigation levels and in general, gradually increased over the next 3 months. Indoor *P. interpunctella* pre-fumigation populations were not significantly different from post-fumigation levels due of extremely low daily average captures regardless of fumigant type. *P.interpunctella* populations were significantly higher outside compared to inside of the facilities. The majority of those caught within the facility were captured on the first floor. Loglinear models were used to evaluate the effect of fumigants on the rebound rate of both species. Rebound rates ranged from 2-3 months up to 9-10 months depending on facility sanitation, exclusion, and number and type of additional pesticide treatments. Post-fumigation trapping data indicates SF is as effective as the known current fumigant, MB, in controlling *Tribolium* spp. populations for up to three months post-fumigation. Due to low *P. interpunctella* populations within the structures prior to fumigation, no detectable difference in control between the fumigants could be determined but both were significantly better than the control.

Lastly, sanitation level and pesticide usage post-fumigations in five flour mills were evaluated to determine their influence on pest dynamics and rebound rates post-fumigation. To accomplish this, a sanitation score sheet and scale were developed and used to audit these flour mills post-fumigation. Audit results were then related to post-fumigation insect rebound levels and other pesticide usage patterns. Residual pesticide application influenced pest rebound rates; those mills with heavy insecticide use had shorter rebound rates. However, the major factor that influenced the pest level post fumigation within a facility was the mill sanitation level. Pest populations took longer to rebound (5-10 months versus 2-5 months) to pre-fumigation levels in mills that practiced better sanitation.