SULFURYL FLUORIDE FOR POST HARVEST FUMIGATION OF ARTHROPOD PESTS IN AGRICULTURAL PRODUCTS

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Methyl bromide (MB) has been the industry standard for rapid killing of all life stages of many insect and mite pests for both fresh and durable high value and value-added agricultural products. Sulfuryl fluoride (SF) has been registered by EPA for numerous postharvest uses, and is being evaluated as an alternative for MB in many cases. Hydrogen phosphide, also referred to as phosphine gas (PH3), is commonly used for pest control in bulk commodities such as grains, nuts and dried fruits. The impending world-wide ban on MB as an ozone-depleting substance and the development of genetically-based resistance to PH3 in some insect populations has stimulated research on chemical and non-chemical alternatives to these commonly used fumigants. Sulfuryl fluoride (SF), a non-ozone depletor, recently received registration for use in stored food products and food processing buildings. SF has toxicity characteristics similar to those of PH3 for stored product insects. The paper reports recent and planned research on new applications for SF to post-harvest agricultural products as an alternative to MB.

Comparative studies of sorption characteristics of SF on nine commodities found that sorption was very low on polished rice, but that rough rice had more sorption, or loss of fumigant during the exposure time. Fluoride ion residue remaining in food after treatment has an actionable level of 70 ppm, of which none of the products treated exceeded in our study. Popcorn, polished long grain rice, coffee, cacao, soybeans, cowpeas, dried apricots, dried figs, and raisins were fumigated in small chambers at 25^{o} C and an initial concentration 35 oz SF/ mcf. All chambers were held for 2 days (48 hrs). Fumigant samples were taken at 0, 6, 24, and 48 hrs. All commodities were replicated 3 times. The disappearance of fumigant in the chambers via sorption followed an exponential decay pattern with a high degree of statistical significance for most commodities. Sorption was not observed for raisins and was negligible for apricots, figs, coffee and polished long grain rice. Sorption rates for all other commodities were intermediate to those previously reported for long grain rough rice and wheat under the same experimental conditions. Application of SF to a variety of packaged, finished food products was conducted under label conditions in commercial size shipping

containers to determine if gas clearance, desorption and F-ion residue levels were acceptable following treatment. SF was generally not detected in or around palletized packaged products following treatment, although some packages were noted to retain gas and de-gassing was very slow in one bulk food ingredients that required better ventilation of the storage box. F-ion residues were all very low after treatment, with no marked increase in any products.

New research recently funded by the Methyl Bromide Transition Program of the USDA CSREES will investigate the efficacy and practicality of using SF to control arthropod pests of dried cures hams. Market-ready hams are kept in storage for several weeks to months prior to retail sail, and have been routinely treated with MB for dis-infestation of the ham mite, *Tryophagus putrescentiae* and the red-legged ham beetle, *Necrobia rufipes*. Controlled laboratory studies will be conducted with ham mites and ham beetles to determine the optimal SF gas concentration, exposure time and treatment temperature to an acceptable level of kill for these pests. Once optimum conditions for toxicity are determined then field validation trials with SF treatments of ham storage facilities will be conducted using mite and beetle-infested hams as bioassays. Preliminary studies on sorption and F-ion residue with sliced ham pieces found F-ion residues of 24.9 and 35.4 ppm in ham slices following exposure for 48 hrs at room temperature to SF at 24 and 36 g/l. The EPA tolerance level for F-ion residue in dried cured ham is 20 ppm. This experiment could have yielded high F-ion results due to direct exposure of the gas to sliced ham surfaces. Additional studies will be conducted with whole, un-sliced hams exposed at label rates of SF to determine if F-ion residues in the meat would exceed EPA tolerance levels.