TOXICITY OF CARBONYL SULFIDE TO STORED PRODUCT INSECTS

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The loss of either methyl bromide or phosphine could have a significant negative impact on U.S. agriculture, particularly in view of the fact that no available alternatives to either fumigant presently exist. Thus there is a critical need to develop new fumigants for postharvest pest control. Carbonyl sulfide (COS) (= carbon oxysulfide) has been identified as a potential alternative to both methyl bromide and phosphine.

Known since 1867, COS has only recently been patented as a fumigant for control of insects and mites in postharvest commodities. It is reported to have many characteristics which indicate it could replace methyl bromide or phosphine, or both, in some circumstances. It is toxic to a broad taxa of pest insects, mites and fungi, it is environmentally friendly, it has good commodity penetration and aeration characteristics, it is versatile in being toxic in short exposure periods or for longer exposure periods at reduced doses, and it shows no adverse effects on seed germination. Further, it occurs naturally in the atmosphere and is the most common form of sulphur in the stratosphere. It is emitted from soil, marshes, manures, compost and most combustible products.

COS is a colorless, odorless, tasteless gas with properties midway between those of carbon disulfide and carbon dioxide. It is highly flammable, slightly soluble in water, and very stable in the absence of water. With water or in the presence of water vapor, COS slowly hydrolyzes to form carbon dioxide and hydrogen sulphide. Pure COS does not corrode polished copper but contamination by as little as 1 ppm elemental sulphur or hydrogen sulphide causes discoloration of copper.

Using modified desiccators as fumitoria, we tested the relative toxicity of COS to five species of insects that are common pests of dried fruits and nuts: confused flour beetle, *Tribolium confusum* duVal; cigarette beetle, *Lasioderma serricorne* (F.); sawtooth grain beetle, *Oryzaephilus surinamensis* (L.); dried fruit beetle, *Carpophilus hemipterus* (L.); and navel orangeworm, *Amyelois transitella* (Walker). Results of the laboratory tests showed that COS was toxic to the test insects. At the LC_{50}, the most susceptible insects were: larval navel orangeworm > adult sawtooth grain beetle > adult dried fruit beetle > adult cigarette beetle > confused flour beetle. Susceptibilities of life stages of confused flour beetle, the most tolerant species of those tested, varied. The egg

and pupal stages were least susceptible, requiring CXTs of 1,008 and 750 mg/L/h, respectively, for an $LC_{99.9}$ during a 24 h exposure period. Based on pest toxicity, carbonyl sulfide has potential for use as a fumigant for dried fruits and nuts.