INSECT CONTROL WITH OZONE GAS AS AN ALTERNATIVE TO METHYL BROMIDE

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With the uses of methyl bromide becoming fewer as we approach the cutoff year of 2005, new and inventive alternatives to those uses are becoming more important. In 1999, we began to investigate the possibility that ozone could replace some fumigant uses by methyl bromide against postharvest insect pests. We first found that ozone produces mortality throughout the life stages of the insect even though exposure was to the egg or larval stages. We also found that carbon dioxide enhanced the toxic effects of the ozone.

In 2001, we entered into a cooperative agreement to conduct research on the use of ozone combined with carbon dioxide and/or vacuum to control postharvest insects. We began by attempting to discover the most tolerant stage of a common moth and beetle pest. We chose the Indianmeal moth, *Plodia interpunctella* (Hübner), and the confused flour beetle, *Tribolium confusum* Jacquelin du Val, to be representative of the 2 common postharvest insect pests with ozone, carbon dioxide and vacuum. Using an ozone concentration ranging up to 10,000 ppm (v/v), a carbon dioxide concentration of 5 to 7%, a vacuum of –10 in. Hg, and a 2 hour exposure, we found that with both insects, the egg stage was the most tolerant stage. We then began to look for areas where ozone might be used as a treatment to replace methyl bromide.

Currently we are investigating the possible use of ozone to kill bean thrips, *Caliothrips fasciatus* (Pergrande), in the navel of navel oranges where they overwinter and present a problem to the export of California navel oranges to Australia. In addition, we are investigating the uses of ozone to control the coffee berry borer, H*ypothenemus hampei* (Ferrari) in coffee beans being imported into the United States. We have found that efficacious insecticidal results can be obtained with ozone combined with carbon dioxide and vacuum while not being phytotoxic to the commodities on which they are feeding.

Ozone uses as a fumigant has the following advantages over conventional methyl bromide fumigation:

- It is generated at the site of use.
- It is easily destroyed so that no ozone enters the atmosphere after use.
- It is a GRAS compound (Generally Regarded as Safe) as far as registration is concerned.
- It is already being used on spices for the control of microorganisms.
- Technology to build or retrofit current chambers is available and relatively easy to apply.

The disadvantages of ozone compared to conventional methyl bromide fumigation are as follows:

- Ozone is a very strong oxidizer. It may damage regular steel exposed for prolonged periods.
- Ozone at the levels required must be generated from oxygen or a mixture of oxygen and carbon dioxide bottled in high-pressure cylinders.
- Ozone has a TLV (threshold limit value – 8 hr exposure Time Weighted Average) of 0.1 ppm (v/v)
- Some commodities will not tolerate the oxidative action of ozone.
- Ozone fumigations must be conducted in rigid chambers.
- Does not penetrate as well as methyl bromide into commodities.