Progress Report

California Energy Commission
Energy in Agriculture Program

Ozone as a Gaseous Fumigant

Goal: To research the efficacy of ozone in air as a replacement for chemical fungicides, including methyl bromide on fresh fruits and vegetables in post-harvest processing.

Technology Path: Presently, fumigation is conducted in chambers or under tarpaulin. A fumigant at specified concentration is introduced onto the commodity in the chamber for certain length of time. Following fumigation, the chamber is aerated by forcing air through the chamber for some extended period of time. The commodity is then ready for export. Methyl bromide is the most often used fumigant. This research will evaluate on-site generation of ozone as a gas fumigant replacement for methyl bromide. At the completion of this task (assuming that the test results show that ozone is an effective fumigant) the researchers expect the technology to be ready for commercial deployment.

However, a commercial company would have to be found (with a registrant with the US EPA) to demonstrate the technology as well as apply for GRAS status as a gas fumigant (only ozone use in water has been approved the GRAS status). Commercialization should be rather simple if the above processes have been undertaken by interested commercial partner(s) to the technology.

Energy Efficiency Benefits: Potential energy efficiencies will result from higher yields of export quality agricultural commodities. The project will calculate an energy efficiency ratio by comparing the energy used to manufacture, transport and deliver methyl bromide with the energy used by the ozonator, as well as account for the reduced loss of marketable product. In addition, ozone will address the environmental problems caused by the use of chemical fumigants.

Technical Objectives:

- To evaluate the effectiveness of ozone as a gaseous, air-borne fumigant to control selected insects which infest fresh and dried fruit such as the codling moth, the Indianmeal moth, the sawtooth grain beetle, the merchant grain beetle and scale insects;
- Assess gaseous ozone on fruit and durable commodities as a replacement fumigant for methyl bromide.
- Evaluate the phytotoxicity and organo-leptic effects of ozone gas on various fruits and vegetables

Economic Objectives:

Achieve sufficient energy and other production-cost savings to reach a positive return on investment for replacing methyl bromide by the proposed ozone system.

Update September 2002

- We completed preparations and modified equipment to expose previously treated insect stages with various carbon dioxide/ozone mixtures. Tests have shown that carbon dioxide at 7 to 7.5% applied with ozone is synergistic against all Indianmeal moth (IMM) stages except eggs, which are still quite tolerant to ozone whether or not it is used with carbon dioxide. These tests have been completed for all stages of IMM treated at 800-PPM ozone/ 7% carbon dioxide/- 10 in. Hg vacuum. Eggs are the most tolerant stage and will require further testing to determine levels of ozone/carbon dioxide/vacuum that will be efficacious. Testing of adults of CFB (confused flour beetle) showed that the beetle adults are more tolerant of ozone when compared to the adults of IMM.
- The poly chamber used for studies at the Peach Ave. location has been modified by the addition of an efficient catalysis chamber to destroy ozone being emitted from the chamber and is now being installed in the new temperature-controlled room for use in further tests. In addition to combining carbon dioxide with ozone, we need to determine the role of humidity and temperature on the efficacy of ozone to IMM and CFB. These tests will continue when we complete the set up in Parlier.
- I gave the presentation titled “Pest control Applications (insects)” in the symposium titled “Applications of Ozone Technology in the Food Industry: A State-of-the-art Case Review” to the Institute of Food Technologists (IFT) Symposium held in Anaheim, CA on June 15-19, 2002.

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