THE MORTALITY OF INDIANMEAL MOTH AND CONFUSED FLOUR BEETLE AFTER EXPOSURE TO OZONE

James G. Leesch and Jane C. Tebbets

USDA-Agricultural Research Service
San Joaquin Valley Agricultural Sciences Center
9611 So. Riverbend Avenue
Parlier, CA 93648

Summary

With the impending loss of one of the 2 remaining fumigants used to treat stored products, methyl bromide, scientists are searching for alternatives that can be used to rid commodities of insects that often cause severe damage. Ozone, particularly the depletion of it, is the very reason we are phasing out methyl bromide. Yet ironically, it may itself be a potential fumigant. Ozone, that is good for us in the stratosphere, is not very healthy as a gas in the air we breathe. It is a toxic gas for both plants and animals and therefore may possess lethal properties for insects.

After all, methyl bromide has been used for decades to kill insects in commodities both for control purposes and for quarantine purposes, which require very high standards. We decided to test ozone as a toxicant to stored product insects in hopes of killing insects at low dosages in short periods of time. We built a chamber made of high-density polyethylene and polycarbonate. Then we introduced ozone into the continuous air stream flowing through the chamber. By increasing or decreasing the flow of ozone and/or the air, we could achieve many different concentrations of ozone in the chamber. Indianmeal moths (IMM) were exposed as eggs, larvae and/or pupae and adults to the ozone levels for different times. Confused flour beetles (CFB) were exposed as adults.

Results were disappointing when only ozone was used. Long exposure periods were necessary and we found that the active, immature stages of the insects exhibited a delayed toxicity and immature insects exposed to ozone had to be held until they emerged as adults. In addition, high concentrations of from 200 to 500 ppm (v/v) required many hours to kill the insects exposed. We then looked at the use of carbon dioxide and/or vacuum to stimulate the opening of the spiracles of the insects or to have some other synergistic effect on insects when combined with ozone. We discovered that ozone in high concentrations and in combination with carbon dioxide and vacuum could be used to obtain significant mortality within a 2-hour exposure. We found that eggs were the most tolerant stage of the IMM. Indeed, we have yet to demonstrate any mortality to eggs as a result of exposure to ozone or a ozone/carbon dioxide/vacuum combination. Using the combination of ozone/carbon dioxide/vacuum, CFB adults are much more tolerant than

IMM adults to this treatment. We have found that the concentrations with which we are working are highly corrosive to many materials including brass, steel, rubber and iron especially in moist conditions. Results of our combining carbon dioxide and/or vacuum with ozone will be reported in addition to the results of the use of ozone alone to kill stored-product insects.