THE USE OF 3 FUMIGANTS ON WALNUTS TO CONTROL DIAPAUSING CODLING MOTH LARVAE

James G. Leesch*
USDA-ARS
Horticultural Crops Research Laboratory
Fresno, CA

For the export of walnuts to foreign countries, it is often necessary to fumigate the walnuts to kill any diapausing larvae of the codling moth that may be inside the nuts. Presently, this is accomplished using a vacuum fumigation of the walnuts using methyl bromide. With the approaching loss of most methyl bromide in 2005 and its stepwise reduction up to that date, it is important to find another fumigant to rid the nuts of any diapausing larvae that may be present. To this end, we have tested 3 potential fumigants to replace methyl bromide; carbonyl sulfide, methyl iodide, and sulfuryl fluoride.

Walnuts artificially infested with diapausing codling moth larvae were fumigated in 1 cubic foot chambers at 20^{o}C for 24 hours at atmospheric pressure. Results of the tests showed that both methyl iodide and sulfuryl fluoride were comparable to methyl bromide in their ability to kill the diapausing stage of the codling moth larvae inside walnuts. Carbonyl sulfide also was able to kill the larvae inside the walnuts but at much higher concentrations. Sorption on the walnuts was greatest with methyl iodide and least with sulfuryl fluoride. When aeration began immediately following fumigation, it was noticed that those nuts fumigated with carbonyl sulfide had a distinct sulfur odor that disappeared during the aeration period.

Testing of the 3 potential fumigants is now being conducted using a 4-hour vacuum fumigation. This schedule corresponds to the methyl bromide schedule presently used for diapausing codling moth larvae in walnuts. Initial work by Zettler et al. (in press) has shown that vacuum fumigation with sulfuryl fluoride is effective against the naked diapausing codling moth larvae but not the eggs. We are hopeful that the other two compounds will also show potential to replace methyl bromide under these vacuum conditions.

Of these 3 potential fumigants, only one, sulfuryl fluoride has been registered for a use in the U. S. It is registered and has been used for many years as a structural fumigant. It is well suited for use against larvae in walnuts because codling moth eggs are not found on the nut shell or inside. This is important because the egg stage of insects is from 2 to 50 times as tolerant of sulfuryl fluoride as the other stages. Thus sulfuryl fluoride may be an effective replacement for methyl bromide. Of course, other testing must be done to establish food tolerances its acceptability as a fumigant on food products.

The other 2 potential fumigants, carbonyl sulfide and methyl iodide, although they have shown promise, do not at present have a registrant to seek an EPA registration. Carbonyl sulfide is currently being registered in Australia as a fumigant for grain, but no attempt has been made to register it in the U.S.

Advantages and disadvantages to using each of the 3 compounds are as follows:

Carbonyl Sulfide

Advantages

- Gas at room temperature
- Many characteristics of carbon dioxide and carbon disulfide
- Easily handled and applied
- Not an ozone depleter

Disadvantages

- Heavy gas requiring circulation
- Some odor remains following fumigation but dissipates
- Not as toxic to insects as methyl bromide
- No registration

Methyl Iodide

Advantages

- Acts much like methyl bromide
- As toxic or more toxic to insects than methyl bromide
- Not an ozone depleter

Disadvantages

- Liquid at room temperature
- Heavier than methyl bromide as gas requiring circulation
- No registration

Sulfuryl Fluoride (Vikane®)

Advantages

- Gas at room temperature
- Easily applied
- Excellent penetrating properties and as toxic or more toxic that methyl bromide
- Already registered for structural uses
- Not an ozone depleter
- Aerates from commodities quickly leaving no odor

Disadvantages

- Needs food tolerances and registration on foods

References Cited:

Zettler, J.L., J.G.Leesch, R. F. Gill and J. C. Tebbets. (in press). Chemical alternatives for methyl bromide and phosphine treatments for dried fruits and nuts. Proc 7th International Working Conf. Stored Prod. Prot. October 15-18, 1998, Beijing, China