Confirmation of Phosphine Schedules and Survival of Three Moth Species on Almonds

Jeannette Muharb[1], Jim Leesh[2], Preston Hartsell[1], J.M. Hurley[1], Margaret Arnest[1]
[1]DFA of California (American Council for Food Safety and Quality), Fresno, CA;
USDA-ARS, Horticultural Crops Research Laboratory, Parlier, CA

India is the US almond industry's 4th largest export market. As of January 1, 2004 exporters were required to have all shipments fumigated with methyl bromide. With the phase out of methyl bromide, phosphine has been administered to protect durable dried food and nut commodities to control stored product insects. It has been used as a replacement and has been a highly effective fumigant for the California Almond industry for 20 years. The news of this announcement caused immediate reaction because not all industry members are equipped to handle methyl bromide nor do they have the operating cost that is needed to change back to this fumigate. In addition, this would be a step backwards, since MB will eventually be phased out. The almond industry has never found Mediterranean flour moth (MFM) *Ephestia kuetniella* or Tobacco moth (TM) *Ephestia elutella* as being problematic, but these species are closely related to Indian meal moth (IMM) *Plodia interpunctella* and can be found infesting many stored product commodities including nuts and dried fruit.
The first part of this study was developed to determine if IMM, MFM and TM eggs and neonate larvae could survive on whole almonds as their only food source. The naturally infested almonds, administered at DFA of California, were accomplished by weighing out (65 grams) inshell almonds and adding insect eggs (200-400) in plastic jars. The eggs were observed approximately every week for about a three month period. Insects were contained in and placed into treatment jars (8.2cm wide x 6.4cm height) with 80-100 mesh brass or stainless steel screened lids.

Our results concluded that IMM, MFM, and TM can cycle on almonds. IMM average survival with larvae on the almonds was 22.2%, MFM averaged 46% survival and TM showed an average of 14% survival. Infestation with eggs showed a lower survival rate but did cycle on the almonds; IMM had an average of 1.7% survival, MFM averaged 12.8% survival and TM showed and average of 11.8%.

In the second part of this study we conducted conformation tests to provide confidence and assurance to India as to the effectiveness of typical phosphine fumigation by this industry. We performed two commercial fumigations using aluminum phosphide pellets and followed the treatment label exposure times (2-4 days) and temperatures (20^oC-25^oC) i.e.

Temp.	Dosage	Exposure Time
20^oC	40g 1000/ft^3	4
25^oC	40g 1000/ft^3	2

Our focus was on IMM, MFM and TM; eggs, larvae, pupae and adults. In addition, diapausing larvae from all three species were tested. Natural infested almonds,

accomplished at DFA, with IMM, MFM and TM, eggs and larvae were also tested. For these treatments, rearing and preparation of the insect work was conducted at the DFA of California and the actual fumigations were performed in Sacramento, CA at Blue Diamond Growers, using large commercial scale field conditions. For fumigations, insects were contained in and placed into treatment jars (8.2cm wide x 6.4cm height) with 80-100 mesh brass or stainless steel screened lids. These treatment jars were then placed into plastic woven poly bags and positioned within the load of almonds at the top, middle and bottom (diagonally) locations of the chamber.

Both fumigations produced 100% mortality with all three species and all stages.

This study shows that phosphine fumigation is highly effective for almonds. Additional lower temperature fumigations will be conducted this year.