PROFUME GAS FUMIGANT AS AN ALTERNATIVE TO METHYL BROMIDE FOR CHAMBER FUMIGATION OF DATES

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ProFume® gas fumigant (99.8% sulfuryl fluoride) was registered by the U.S. Environmental Protection Agency (USEPA) in January 2004 for post-harvest insect control on dried fruit (incl. fresh dates), tree nuts and cereals, and by the California Department of Pesticide Regulation (CDPR) in May 2005. In November 2006 and again in April 2007, Dow AgroSciences, Cardinal Professional Products, the Dried Fruit and Nut Association of California (DFA) and the California Date Commission together evaluated ProFume under field-use conditions as an alternative to methyl bromide (MB) for chamber fumigation of inbound freshly-harvested dates (November) and over-wintered stored dates (April) prior to processing. The freshly-harvested dates in November were infested with carob moth (*Ectomyelosis certonia*). Infestations of another pest of concern, dried fruit beetle (*Carpophilis hemipterus*), generally not a problem in dry seasons typical of recent years, were not observed.

For complete assessment of fumigation performance, gas monitoring lines were placed throughout the bin-filled chambers, both in airspaces around and between bins and with each of the five sets of buried insect bioassays inside bins. For each trial, the 5,000-ft^3 chamber (constructed of wood walls sealed with latex paint) was filled about 80% full with 90 bins stacked 3 abreast, 3 high and 10 deep, leaving about 1 ft clearance above and to the sides of the stacked bins, and representing a common worst-case condition for fumigant penetration, equilibrium and aeration.

A standard practice for MB fumigations at this date receiving yard was to introduce 1.3 lb/Mcf of MB about 4:00-4:30 PM and initiate aeration about 5:30-6:00 AM the next morning for an overnight exposure of 11-14 hours. Aeration generally required 4 hours and the bins were usually removed by noon making the chamber available for the next fumigation that afternoon. Therefore, the entire fumigation event through bin removal was about 20 hours. MB was used only in the spring trials, and the target CT for the 1.3-lb/Mcf MB dose was about 287 g-h/m^3.

A necessary modification for the evaluation of ProFume included a 15-h exposure from 4:30 PM until 7:30 AM due to the state permit conditions limiting the initiation of aeration between 1-h post-sunrise and 1-h pre-sunset. ProFume introduction doses were calculated using the Fumiguide™ program for ProFume® gas fumigant based on the exposure time, estimated chamber half-loss time (HLT) and the test CT dosages of 750 and 1,000 g-h/m^3. Introduction doses were determined to be equivalent to about 2.9 and 3.8 lb/Mcf for the high and low CT dosages, respectively.

Each of the five sets of bioassays in the fall trials consisted of two dates naturally infested with carob moth (CM) larvae (provided by John Davies, Date Industry Technical Consultant - Indio, CA), obtained from the naturally infested bins to be fumigated, and one dried fruit beetle (DFB) all-life-stage culture in a banana medium (provided by DFA - Fresno, CA). Each of the five bioassays in the spring trials consisted of only one DFB all-life-stage culture in banana medium (provided by DFA). No CM for bioassays was available for the spring trials. Each CM-infested date and each DFB culture

were contained in separate 250-ml plastic cups with mesh-screen lids. All bioassays were buried with a gas concentration monitoring line and a HOBO RH/Temp data logger (Onset Computer Corp. – Manhasset, MA) about 1 ft below the surface of the dates inside five separate "macro" bins (48-in x 48-in x 28-in) filled with about 24-in of dates. All bioassays were returned to DFA immediately following fumigation exposures and were evaluated for mortality over 5-7 week incubation observation periods.

Fumigation mortality of CM in the fall was 100% at actual ProFume CT dosages of 826 and 1,007 g-h/m^3 at 22°C (71°F). Corresponding DFB mortality was 91% and 93%, respectively. MB was not evaluated in the fall. At a slightly warmer temperature of 27°C (80°F) in the spring, DFB mortality was 100% at both an actual ProFume CT dosage of 766 g-h/m^3 and an MB dosage of about 231 g-h/m^3.

These studies suggest that the primary pest CM may be controlled at less than 2.9-lb/Mcf of ProFume. At an equivalent dose, greater than 90% of DFB mortality occurred at cool temperatures of about 22°C (71°F), and 100% DFB mortality occurred at slightly warmer temperatures of 27°C (80°F). These ProFume doses are about 2.2X the 1.3-lb/Mcf dose of MB used in the spring.

Technical aspects of the two fumigants were compared:

- The same state-mandated 60-ft buffer zones are enforceable for both ProFume and MB, with similar worker and bystander precautions for each.
- Introduction of ProFume required less time than MB: less than 5 minutes for this small chamber with ProFume vs. more than 15 minutes with MB.
- Equilibrium across all 5 bioassays occurred within 15 minutes for ProFume with the aid of a portable 5,000-cfm fan assisting the smaller wall-mounted chamber fan vs. about 1.5 hours for MB using the wall-mounted fan alone.
- Chamber HLTs were equivalent for both fumigants.
- Aeration of ProFume, again with the aid of the second fan, to less than 1 oz/Mcf required about 1-1.5 hours vs. about 4 hours for MB with the use of only one fan.
- Time to clear the chamber to legal exposure limits as the bins were progressively removed was about the same for both fumigants, but was considerably easier and more accurate for ProFume with the use of a continuously running real-time clearing device.
- The entire aeration, clearing and bin removal process was about 2 hours faster with ProFume.

In conclusion, these trials have demonstrated the flexibility of ProFume in exposure time, dosage rates and rapid aeration characteristics. Further evaluation may be merited to refine CT dosages as they relate to efficacy and cost effectiveness to make ProFume fit within current industry practices.