

Title: Project 79-K6 - Fumigation

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I. Objectives:

Methyl Bromide

To work closely with IR-4 to obtain a tolerance for the use of methyl bromide as a fumigant for almond hulls and shells.

Malathion

This objective has been reached, since it was effective July 3, 1979; malathion was approved for use by EPA as a treatment for almond shells. The permissible residue on the shells must not exceed 50 parts per million.

Hydrogen Phosphide (Phosphine)

As mentioned previously, this is the only approved fumigant for use on almond hulls and shells if the hulls and shells are to be used for feed. The objectives of the current study were (1) to determine the effectiveness of Fumi-cels[®] (magnesium phosphide) as a fumigant for in-hull almonds stored on the farm and (2) determine the temperature pattern within the stacks of almonds.

Fumigation Manual

The fumigation manual was revised and made available to the almond industry prior to the almond season. It is planned to prepare a second edition before the 1980 crop.

Aeration Systems for use in Stacks of In-hull Almonds

Studies will be conducted in cooperation with Drs. John Labavitch and Jim Thompson of UC Davis. The purpose of the study was to develop a method for reducing moisture and temperature within the stacks of almonds also recirculate and exhaust fumigants.

II. Interpretive Summary:

Methyl Bromide

A petition was submitted to EPA through IR-4 in September 1978. Upon review, EPA requested additional information which was supplied to IR-4. An addendum to the original proposal is now being prepared and will be submitted to EPA soon.

Malathion

On July 3, 1978, malathion was approved for use on almond shells. The tolerance that was established was 50 p.p.m. This announcement appeared in the Federal Register (Vol. 44, No. 129/Tuesday, July 3, 1979/ Rules and Regulations 38843.

Hydrogen Phosphide (Phosphine)

Five stacks of inhull almonds were fumigated with hydrogen phosphide evolved from Fumi-cels. The Fumi-cels are made up of magnesium phosphide and in the presence of moisture in the air breakdown to eliberate hydrogen phosphide. The primary differences between Fumi-cels and Phostoxin[®] pellets and tablets are that the Fumi-cels break down faster and do not give off ammonia.

Five stacks of Nonpareil inhull almonds were fumigated with Fumi-cels, and three stacks were used as controls. The procedure followed was the same as described in previous reports. The dosage for each stack was equivalent to 22 tablets or 110 pellets/M cu ft and the exposure period was 72 hrs. The peak concentration of 240 ppm was reached 13 hrs after the fumigation began and at end of 72 hrs was 60 p.p.m. A complete kill of the early egg stage and the pupae stage of the NOW was obtained in each treated stack. The average moisture content of the hulls were 6.08%, shells 6.72% and

meats 3.49%.

Detailed temperature readings were taken at various locations in one covered stack. The average temperatures for each location are as follows: (1) One foot below top of almonds 108.4°F, (2) two ft from top 98.2°F (3) center of stack 89.8, (4) three-fourths down in stack 79.9°F, (5) one foot up from bottom 79.8°F, (6) average temperature west side - 89.2°F, east side 94.0°F, north side 89.6°F, south side 95.3°F.

Revision of Fumigation Manual

The first revised copies of this bulletin have been printed and distributed. More than two thousand copies of the manual were printed and there are virtually none left. A second revision will be printed in time for the 1980 season.

Aeration Systems for Use in Stacks of Inhull Almonds

In cooperation with Drs. John Labavitch and Jim Thompson, a study is being conducted on the development of an aeration system for use in drying and cooling inhull almonds stored on the farm. It is hoped that such a system would also aid in fumigation by recirculating and exhausting the fumigant. This project is in the early stages of development.

III. Experimental Procedure:

Methyl Bromide (1978 & 1979 Activities)

A continued effort is being made to obtain a tolerance by working through the IR-4 program and answering questions proposed by EPA.

Malathion

Worked through the IR-4 program to obtain a tolerance for the use of malathion as a protectant for inshell almonds.

Hydrogen Phosphide (Phosphine)

Fumi-cels were used in this study. They resemble rectangular pieces of cardboard approximately 7 inches wide, 10- $\frac{1}{4}$ inches long and $\frac{3}{8}$ inches thick. The active ingredient in the Fumi-cels is magnesium phosphide and upon exposure to moisture in the air break down to liberate hydrogen phosphide. Each Fumi-cel will generate hydrogen phosphide equivalent to the amount produced by 33 Phostoxin tablets or 165 pellets. The Fumi-cels break down more rapidly than Phostoxin and does not produce ammonia.

Five stacks of Nonpareil inshell almonds were fumigated with Fumi-cels at a dosage of two per stack and the exposure period was 72 hours. Three stacks were also used as controls. The volume of each stack was approximately 3,000 cu ft. The procedure used was the same as described in 1976.

An effort was made to obtain a clearer picture of the temperature variation within stacks of inshell almonds during the fumigation period. To accomplish this, temperature readings were taken from 37 locations within a stack of almonds. Thermistors were used as the sensing units and these were plugged into a telethermometer to obtain the readings. Temperature readings were taken at intervals throughout the 72 hr exposure period.

Revision of Fumigation Manual

Revision of the fumigation manual as mentioned in the previous report was accomplished. A second revision is planned for next year.

Aeration Systems for Use in Stacks of Inhull Almonds

Our part in this study will involve the use of fumigants as soon as the development of an aeration system is more nearly completed.

IV. Results:Methyl Bromide

An addendum to the original petition for a tolerance for the use of methyl bromide as a fumigant for almond hulls and shells is being prepared by representatives of IR-4 and will soon be submitted to EPA. The addendum includes answers to questions that EPA asked regarding the original petition.

Malathion

A tolerance of 50 p.p.m. has been established for the use of malathion on almond shells. If anyone is interested in this treatment, they should contact Mr. Garth H. Spitler, Research Entomologist at this laboratory. Phone (209) 487-5310.

Hydrogen Phosphide (Phosphine) 1979 Studies

The results of this study are as follows:

1) Concentration of phosphine. The average concentrations of hydrogen phosphide in the five stacks of in-hull almonds is presented in Fig. No. 1.

2) Temperatures observed within stacks. The average temperature (F°) observed within the stacks of almonds during the exposure period are listed below:

- a. 108° - 1 ft from top of almonds
- b. 98° - 2 ft below surface
- c. 90° - Center of stack
- d. 80° - $2\frac{1}{2}$ ft above bottom of stack
- e. 80° - 1 ft above bottom of stack
- f. 89° - West side of stack
 94° - East side of stack
 90° - North side of stack
 95° - South side of stack

3) **Moisture content of hulls, shells and meats:**

The average percent moisture is presented in Figure 2.

4) **Mortality of egg and pupa stages of the navel orangeworm.**

There was no survival of those eggs and pupae that were exposed to the fumigant. There was an indication that the temperature within the untreated stacks caused some mortality of the eggs and pupae.

Revision of Fumigation Manual

More than 2,000 copies of the revised manual were printed and distributed. There are very few copies remaining.

Aeration Systems For Use in Stacks of Inhull Almonds

There are no results to report at this time.

V. Discussion:

Methyl Bromide

A revision or (addendum) is being prepared for submittal to EPA by the IR-4 Coordinator and should be submitted to EPA within the next few weeks.

Malathion

As previously mentioned tolerance has been established by EPA for the use of malathion on almond shells. The tolerance was established at 50 p.p.m.

Hydrogen Phosphide (Phosphine)

Hydrogen phosphide generated from Fumi-cels (magnesium phosphide) resulted in 100% mortality of the early egg and pupa stages of the NOW. Peak concentrations were reached sooner than those produced by Phostoxin but generation of the fumigant continued throughout the exposure period

resulting in a higher level of concentration. Temperature readings indicated again that there is a consistent trend of lower temperatures in the lower regions of the stacks.

Revision of Fumigation Manual

The first revision was completed, printed and made available to the industry this past season. A second edition will be prepared and printed in time for use this summer.

Aeration Systems for Use in Stacks of Inhull Almonds

Fumigation studies will be included in this study after an aeration system has been developed to a point where such studies could be conducted.