MALATHION AS A PROTECTANT FOR RAISINS, INSHELL WALNUTS AND ALMONDS IN STORAGE

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It is indeed a pleasure to be here today to tell you about our current research studies on the control of insects that attack dried fruits and stored tree nuts - through the use of protectants.

A brief review of the word "protectant" should be made before the actual presentation of this progress report.

The application of chemicals and inert materials to commodities - to preserve them, and to prevent damage, began several years ago. Many noticeable things such as sawdust, lime, and shellac were applied to the outer surfaces of commodities to protect them from the elements, and from rodents, and insects. Many of these applications did not enhance the appearance of the commodity. Progress from these unsightly treatments to newer, sometimes invisible, chemicals - known as insecticides, fungicides, and rodenticides, was fairly rapid, and the public began using these preventive practices around the home and garden with considerable vigor. It seemed that an ounce of prevention was, indeed, worth a pound of cure.

This was true for a number of years, until someone stated that too much prevention could cause considerable problems. At the present time we find ourselves bombarded with claims supporting, and also distorting, these protective applications.

We do not know just when the use of the term "protectant" as a means of insect control came into being. I do feel that the use of the word gained considerable popularity after the term "insecticide" became one of contamination. This, to me, is not a fair image of either term. The use of insecticides to eliminate insects from the home and garden was an acceptable practice until birds, fish, plant life, and other things declined, and the decline was blamed on insecticides. The public then quickly reacted by rejecting the liberal use of them. A substitute was needed in a hurry and it was at this time I think that the use of the word "protectant" really became pupular.

According to Webster's dictionary - an insecticide is "any substance used to kill insects". A "protectant" is a protecting agent. This latter definition, to me, is an inadequate definition and perhaps misused. I personally love to toss it into the classification of a "weasel word". To quote Paul Douglass, the author of "Communication Through Reports": "A weasel word is an insipid phrase placed in a sentence to acquit the writer of any responsibility for a statement." It is "an attempt to wiggle out of a position of accountability for an observation, conclusion, inference, or prediction". Perhaps the word doesn't deserve this classification, but I feel it has digressed a great deal from its earlier intended meaning. My fellow workers at the Fresno lab do not agree with me, but I don't require this - and I trust that they, in turn, do not demand it of me.

In our own Branch there is considerable history on the use of protectants. When the word was first used in our Branch, I think it was meant to serve as a term to include both repellency and killing power. No one knew which force was predominant, because both served the purpose of protecting the product from insect damage. The tobacco industry applied pyrethrin dusts and sprays, to the outside of hogsheads of tobacco for protection. The peanut industry used similar treatments as protectants. In the midwest, the grain industry has been interested in the use of protectants for at least the past 10 to 12 years. Several of these treatments showed great promise, but many of them could not be used since a reliable method of chemical analyses had not been developed. In the cas of dusts, the formulations were objectionable because of the "off-grade" classification they gave to the commodity.

With this as a background, I will now discuss the current work, which is The Use of Malathion Dust and Emulsifiable Concentrate Spray as a PROTECTANT for Softshell Almonds (inshell), Raisins (Natural - Thompson Seedless), and English Walnuts (inshell). Should these tests give encouraging results, I am sure that next season's work will include Figs and Prunes.

The objective in this study is to determine under laboratory conditions the effectiveness of malathion as a protectant against insect infestation when applied directly to the agricultural commodity.

Malathion is being used in this study because of the work during the past few years on malathion-treated raisin trays. Here is an insecticide that shows considerable promise. It has very low mammalian toxicity (unlikely to be harmful to mammals, which includes us humans) and is approved as a treatment on raw agricultural products such as grapes.

In the raisin tray work the spraying of malathion on raisins and raisin trays gave indication that approximately 2 ppm of malathion would protect raisins from insect attack while in storage for over one year. In other words, insects forced to feed on these raisins at the end of the 12-month storage period did not survive. On the basis of this information, the selection of the three spray dosages was made. They are as follows:

1. <u>1 ppm</u>: (Slightly under the dosage that was believed needed to give protection).
2. <u>2 ppm</u>: (The dosage that had protected raisins for 1 year, even when subjected to heavy insect populations).
3. <u>5 ppm</u>: (An insurance dosage - over double that which chemical analyses had confirmed as needed to give complete mortality).

The method of applying insecticides has always been of great concern to many researchers. Turntables, air brushes, dipping, and other methods, have been tried with varying degrees of success. The applicator used in this study employed the tumbling effect, and was used for the purpose of obtaining uniformity of application.

At this point I should like to take time to show and tell you how we made the applications. Four gallon-jars were treated with the desired amount of dust and/or spray. In the case of dust, these small vials contained the amount used on 2 pounds of raisins at the three dosages of 5 ppm, 10 ppm, and 20 ppm. In the sprays, the amount needed to cover the commodity with ample coverage was determined to be 10 ml. Of course, this amount remained constant for each jar treated. Only the strength of the concentrate was changed to give the correct dosage. The dust was poured on the top layer of the commodity, but in the sprays the liquid was applied by means of draining a 10 millileter pipette's solution on the inner wall of the jar as it was rotated.

These jars were then fastened on the various paddles on the front and back sides of the wheel. Wide rubber bands, cut from inner tubes, were used to fasten the jar to the spoke. Three bands per jar kept the jar in place with a minimum of movement. The motor was then turned on, and a tumbling action took place once every revolution. This speed was 33 revolutions per minute - and the diameter of the wheel assembly was 27 inches. When raisins were used, the action was fairly quiet and tolerable. Almonds increased the noise somewhat, and walnuts were downright unbearable. This tumbling action continued for 15 minutes.

The dosages applied in these tests differ from those intended. The malathion dust rates were 5 ppm, 10 ppm, and 20 ppm. These were applied to almonds, raisins, and walnuts. The sprays applied were 10 ppm, 20 ppm, and 50 ppm. This was ten times stronger than intended, but turned out to be a rather intelligent goof as you will learn in my closing remarks.

I thought you might be interested in the number of jars of each commodity involved.

1. Almonds - were placed in 2,100 quart jars. Three-hundred-and-fifty jars were examined each month, less those that no longer gave protection after the first month. The first month's examination required cracking 22,000 to 27,000 almonds by hand. This may not be an impressive figure to you, but I know several who were certainly impressed.

2. Raisins - were placed in 350 quart jars. Each month examinations were made, and the raisins reused, with the nuts we couldn't reuse them. In the treating of raisins very little sound is produced, but as they tumble there is a possibility that stickiness will develop and reduce the uniformity of the application, especially in the spray treatment.

3. Walnuts - were placed in 1,715 quart jars. Two-hundred-and-forty-five jars were examined each month, less those that no longer protected after the first month. There is one additional point concerning the nuts - and that is in the cracking. This will differ from the almond test in that a hammer and steel will be needed to crack the nuts properly.

The test insects used in this study were the Indian-meal moth, the merchant beetle, and the larger cabinet beetle. With the Indian-meal moth and merchant beetle we used three stages of development - the egg, the larva, and the adult. The stage of the dermestid used was the adult. Thus, a total of seven different stages of three insects was used.

Perhaps someone is wondering about the term "merchant beetle". It was our intention to use the saw-toothed grain beetle as one of the test insects. When we sent specimens of the beetles used in the test to Sacramento for identification we learned that they were merchant beetles. This could be quite a startling development. Even though these insects are what you might call first cousins, it could be possible that one of them does not care for a diet of dried fruit. Perhaps, on the other hand, they both like dried fruit - but only one species is found in California, or England, Germany -- or other country, or state. I'm sure you see the possibilities! Regardless of the bearing this identification and location may have, these two insects identity should be confirmed, by species and location, here in the states - by an expert. A leading systematic entomologist here in California believes that the merchant beetle could easily be a pest of the dried fruit industry, and that the saw-toothed grain beetle is confined to the grain and allied industries. Our Fresno lab feels that this idea certainly warrants a thorough investigation.

The number of replications of the commodity, insect species, and treatments in all work in our Branch, is five. The exposures used in this work were set up to follow the life cycle of the Indian-meal moth. This cycle in our laboratory is completed within 30 days. This meant that if we used the egg stage, 30 days later we should find adults laying eggs. If the adults stage was used, 30 days later we could find fresh hatching pupae and if the mature larva stage was used, 30 days later we should find equally large larva. With an examination period of 30 days used for the moth, no deviation was made for the stages of the merchant beetle and dermestid. There have been complications developing in several insect stages, but they may not be associated with the length of the exposure period.

Our examinations are scheduled for 1, 2, 3, 6, 9, and 12 months after starting the tests. The actual examinations of the commodities are departures from the standards previously used. For instance, in the almonds and walnuts the outer protective shell must be removed in order to examine the inner nut meat, shaking or screening won't work! Raisins can be examined by several means: (1) Dumping the contents into a flat pan. (2) Visually, while still in the jars. (3) By screening, in the case of the three merchant beetle stages and the dermestid beetle. Screening is not a foolproof method for raisins, but does work in those samples where heavy populations of insects have survived or built up.

The initial toxicity test was needed to determine if a try would be made for a residual life study. There certainly was no use to go on if the treatment failed to give any kills the first month. At this date, we are in the 4th month on the raisin and almond test, and immediately after this meeting we examine the walnuts for the first time.

It was originally planned for the commodities to be held in a room at a constant temperature of 80°F and a humidity of 50%. This is still being used for the raisin work, but not in the almond and walnut tests. The almond processors informed us that we were asking for trouble in trying to hold the almonds at 80°F and 50% relative humidity for a 12-month period. Now, the only time they will be under those conditions will be when they are being exposed to insects. The replacement replications will remain under 60°F storage conditions until their time for infestation with insects comes due. This change in plans was necessary in order to keep the nuts in a non-rancid condition. Also, the high humidity was raising the moisture content to the point where various molds, or structural breakdowns, might occur.

Here are some indications of things we've learned so far -

1. That merchant beetle eggs are easier to kill than the larvae or adults.
2. That the two lower spray treatments are not giving protection. Now we have to find out the percentage of the dosage that we applied to the commodities. How efficient was our applicator?

3. That these sprays, intended as 1 ppm spray and 2 ppm spray applied in these tests have failed to protect the commodity for any length of time, but these are actually 10 ppm and 20 ppm sprays.

4. The only spray to give residual life seems to be the 50 ppm. This is 10 times over the intended high dosage of 5 ppm.

5. That the mature larvae stage of the Indian-meal moth are much too unpredictable to use as a test insect. Perhaps the raising of larvae on the host commodity will solve this problem.

6. A tangent study - The Taste Panel Studies being conducted at Davis under Dr. Miller's supervision have started and the first phase, 30 days after treatment has revealed no odors or off-flavor. This certainly is encouraging.

7. The really important role of the untreated or "controls". In order to have an ideal test you want the controls to really thrive on the diet of the commodity you've placed them on. May this always take place in our future tests.

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