ARE WE WINNING THE DROSOPHILA FIGHT?

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To the dried fruit industry, which considers the drosophila or vinegar fly one of its most important pests, this question may invoke a variety of answers ranging all the way from "we are losing the fight" to "we are making rapid strides towards winning the fight". It is obvious that we still have a long way to go. Therefore I thought that this year it would benefit us if we gave a summary of the progress that has been made and describe what research is going on at the present time. I hope that you may then answer this question to your own satisfaction.

First, let us discuss why this pest has become so important. Of course your chief concern with vinegar flies is the presence of the insect in and around processing and packing plants, and this can be extended to cover almost all fruit plants, fresh or dried. Tomatoes to be processed are a favorite target for this pest. The wine industry has the same problem. There are also certain fruit crops which have more vital interests in dealing with the vinegar fly. The fig growers have long associated the vinegar fly with the spread of souring organisms in figs, plus the fact he also likes to make his home in a fig. The vineyardist is noting increasing evidence that drosophila is one of the prime carriers of bunch rot, and some molds of tomatoes are known to be carried by this same insect. Peach growers in the Northwest found that Rhizopus molds were carried by vinegar flies to peaches to be packed fresh. Stem rot of melons is also carried by the same insect. From this list we can see that this insect has branched out in the last few years and now has a large segment of agriculture concerned with its activities.

Let us take a brief look at this insect for a better understanding of just why he can become such a pest. Under average conditions and temperatures in the 85 degree F. range the fly can complete its life cycle in 7 to 9 days. In a 9 day life cycle it spends about one day in the egg stage, 5 days in larval stage, and 4 days as a pupa. At temperatures of 75 to 85 degrees the female may live for 31 days and lay an average of 430 eggs in her lifetime, averaging 14 eggs a day. At 65 degrees she may live for 70 days. And it doesn't take much food to rear a fly either. Using a 4 to 1 yeast and water mixture it was determined that it takes only .01 milliliter of the mixture to allow a larvae to completely develop, and remember that 30 milliliters only makes an ounce. In the laboratory we reared over 600 drosophila on one medium size peach. Is it any wonder that this insect can suddenly appear in large numbers almost overnight?

Now that we know a little about the vinegar fly, let us review what has been done and what is being done about it. Until about 1950 there was very little concern about the vinegar fly on the west coast, although tomato growers and processors in the east had been concerned with the problem as far back as 1936. About 1950 the California Fig Institute became increasingly alarmed over apparent build-ups of drosophila in fig orchards and their possible carrying of souring organisms. About the same time the wine industry began to notice drosophila in large numbers around their wineries. By 1954 the tomato industry was experiencing trouble, and experiments to control vinegar flies were being carried on by Dr. Michelbacher and others from the University of California and by sanitarians from various tomato processors, namely California Packing Corporation and National Canners Association. Mr. Perez Simmons and Mr. Dwight Barnes of the Stored-

Product Insects Laboratory also made some studies at the same time. In 1957 a full-time drosophila project was initiated at this laboratory at the recommendation of the Dried Fruit Association and other organizations. Outside of California, work has been done by the U. S. Department of Agriculture in the states of Washington and Utah, and at Beltsville. Also various experiment stations in the east conducted tests on tomatoes. In California at the present time the following organizations are engaged in some type of work on drosophila: University of California at Davis, California Department of Agriculture, California Department of Public Health, California Fig Institute, Western Regional Utilization Laboratory of the U.S.D.A., and the Stored-Product Insects Laboratory of the U.S.D.A. With all of these agencies concerned with drosophila, let us see what progress is being made. First of all, the attractant studies. We feel that these are important so that the efficiency of bait traps may be increased. At the present time this is a joint affair with Western Regional and Northern Regional Utilization laboratories furnishing samples to Beltsville A.R.S. facilities to test. Although there has been no really promising compound developed to date, a great many samples have been tested. Our own work has shown that the type yeast used in baits is important. Tests conducted in vineyards and fruit orchards indicate that champagne yeast is more efficient than baker's yeast.

A great deal has been learned on the biology of the vinegar flies in the last few years. The Fig Institute under Dr. Warner learned considerable about their winter habits, including the fact that there are always spots where the flies can be found. Work by Michelbacher in tomato fields of Northern California and by this laboratory in the San Joaquin Valley has shown that drosophila prefer amounts of light under 100 foot candles, a moderate amount of humidity, temperatures of 65 to 95 degrees, and wind movements under 10 miles per hour. The times of greatest fly activity are the morning and evening hours, but our experiments have also shown that there are some ecological sites suitable for fly activity at almost any time of the day. Again in cooperative work done by this laboratory and Dr. Warner of the California Fig Institute, using radioactive tagging methods, it was possible for us to extend the known flight range of drosophila from a few hundred yards to 6.4 miles in a 24 hour period. In our opinion this is one of the most significant findings to date. In our trapping tests it was determined that the species Drosophila melanogaster made up over 95 percent of the populations infesting vineyards and fig orchards, and work is now being carried on by the California Departments of Public Health and Agriculture in determining species to be found in all parts of the state in relation to agriculture. Also from the surveys made by these two departments we are beginning to understand the relationships between drosophila and the various crops grown in the state. From the work that has been done and the work now underway I feel that we have a pretty good picture of the habits and biology of the vinegar fly.

This brings us to the problem of control and, here too, progress has been made. The importance of fruit dumps as breeding sites of drosophila has been recognized and work has been done. Howard Dorst of the U.S.D.A. in Utah has done considerable work with cull peaches and tomatoes. Using his recommendations, Dr. Warner and this laboratory found that granulars applied at the rate of 8 pounds per 100 cubic feet gave complete control of drosophila for over two weeks. Compounds used were heptachlor (5 percent), malathion (4 percent), and endrin (2 percent). It was also found that in piles of cull peaches a spray of 1-1/2 pounds of Guthion (15 percent) in 8 gallons of water applied to 100 square feet also gave good control for 2 weeks. The Bureau of Vector Control of the California Department of Public Health found that emergence of adult Drosophila melanogaster can be prevented by covering the breeding medium with as little as 4 inches of non-compacted soil or 1-1/8 inches of compacted soil. This is also an important finding.

The California Fig Institute has tested many compounds in efforts to control drosophila in fig orchards beginning with experiments with TEPP back in 1950. During the last two years they

have initiated the first efforts at area control using bait cans only. Dr. Warner reports that reductions in populations and increases in yield of good quality figs has resulted from these experiments.

In cooperation with Dr. E. M. Stafford of the University of California at Davis, our experiments to control drosophila in vineyards have been very encouraging. By counting fly infested bunches before and after treatment, a significant reduction in numbers of infested bunches was obtained using Dimethioate 2 percent or Dibrom 4 percent. Malathion 4 percent and Diazinon 2 percent gave good results. All dusts were applied at the rate of 50 pounds per acre. In contrast, the check or untreated plot showed an increase of 144 percent in infested bunches in the three weeks that the experiment was conducted. These were Thompson Seedless intended for golden bleached raisins. About the same results were recorded with the Carignane wine variety. Another factor, although we were not trying to prove it, was that the results seem to indicate that drosophila is a very good carrier of bunch rot.

In case you are thinking that the processing plant has been forgotten in our work, let me assure you that this is not the case, although our work is just getting underway. I would like first to refer you to the efforts of the Wine Institute and the California wineries, who I believe have made a strong effort to exclude the flies from their plants. The use of fans, pressurization and air screens are common practices among wineries. During 1960 we conducted two tests in wineries which might be of interest to you. The first one consisted of painting all screen doors and windows leading in the storage areas with an emulsion of 6 percent malathion. This was very successful in reducing the numbers of flies gaining entrance to the wine storage areas. Efforts will be made to modify this experiment to be applicable to other type plants. We also found that it was necessary to use a screen of at least 24 by 24 mesh to exclude drosophila.

The second experiment conducted around wineries consisted of using bait cans made of five gallon paint cans to trap flies around entrances. While the traps did reduce the number of flies trying to get into the winery, it did not cut the population to low enough levels to warrant use by themselves without other methods being used also. Bait cans are also being used experimentally at a raisin plant.

The use of Argon light traps in a processing plant was tried but they proved ineffective against drosophila.

Future work planned by this laboratory includes testing of various aerosols to be used in processing plants and the development of other protective measures to be used around plants.

In conclusion, I am not sure that I have answered the question asked in the title of the paper, but I hope that I have brought to your attention what has been done and what is being done on this very serious problem. I feel certain that, with the large numbers of agencies now actively working on this problem, within a few years you will no longer consider this insect as one of your major pests.

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