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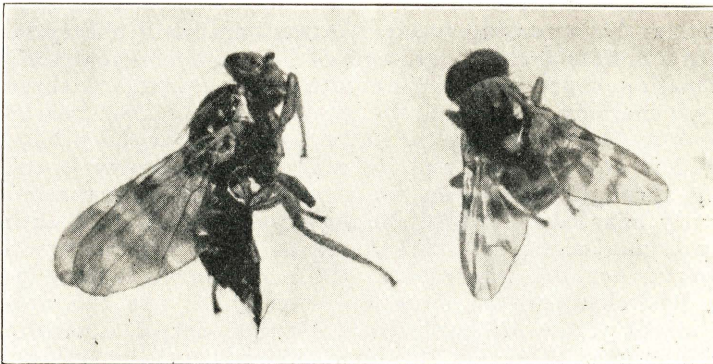
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# THE CHERRY FRUIT-FLIES

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By R. H. PETTIT AND G. S. TOLLES

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Cherry Fruit-fly greatly enlarged.

AGRICULTURAL EXPERIMENT STATION

MICHIGAN STATE COLLEGE  
Of Agriculture and Applied Science

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ENTOMOLOGICAL SECTION

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East Lansing, Michigan

## FOREWORD

The constantly increasing interest in the control of cherry fruit-flies among the commercial cherry growers of the state has created a demand for information concerning the activities and control of these major enemies of cherries. Already, the cherry industry has reached such proportions in Michigan that the state now leads in the production of canned and frozen cherries, and the size of the industry is constantly increasing through the setting of new orchards. Furthermore, the law recently enacted by the Michigan legislature of 1929, authorizing the State Commissioner of Agriculture to adopt certain practices intended to further the interests of those connected with the cherry industry, has changed the situation somewhat. At the request of representatives of the Michigan State Department of Agriculture, the present bulletin is offered in the hope that it may, through supplying the growers with detailed information, aid in the restriction of this major pest.

R. H. PETTIT,  
Entomologist of Experiment Station.

## THE CHERRY FRUIT-FLIES

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The two fruit-flies, the white-banded (*Rhagoletis cingulatus*) and the dark-bodied (*R. fausta*) which are almost indistinguishable one from the other in the larval stage, are also known as cherry-maggots because of the habit of the larvae which feed in ripening cherries and often cause severe losses. Both are native to North America, and both are major pests of cherries. They are sometimes found in pear, plum, and prune. They are common in the northeastern United States and Canada where the white-banded species works freely in both sweet and sour cherries; the dark-bodied species seems to prefer sour cherries in preference to the "sweets." The white-banded species is likely to be



Fig. 1.—Adults of white-banded cherry fruit-fly, much enlarged.

found in Michigan wherever cherries are grown, and the dark-bodied species is present in the state although thus far it appears to be restricted to small areas in Van Buren and Kent Counties.

### Seasonal Habits and Appearance

In the course of development, all two-winged flies pass through what corresponds to four stages. The egg hatches into the larval or feeding stage, which changes later into a resting stage known as the pupa, from which comes eventually the winged adult stage dedicated to the laying of eggs for the next generation. During the winter season, the cherry fruit-fly is in the pupal condition. That is, the small capsule-like pupa is going through a resting stage while buried usually

less than an inch deep beneath the surface of the soil. About the middle of June, in southern Michigan, there emerges from each pupal case a small fly which works its way to the surface and flies about for several days. After this time the females begin to lay their eggs, each egg being placed in a small slit which is cut in the skin of a rapidly growing cherry. At the time the egg is laid, it is so placed that part of it is really inside the cherry. On hatching, the tiny maggot that comes from the egg is already at home inside the flesh of the fruit.

The maggot grows very rapidly and by the time that the cherry is picked or, at the latest, shortly afterwards, the maggot has reached full size. It is then ready to leave the fruit, bury itself underground, change to the pupal condition, and there wait until the following summer when another crop of cherries will be ready to serve as food for the next generation.

It will thus be seen that the emergence of the fly, followed by the deposition of the eggs, the growth of the larva, and its subsequent



Fig. 2.—Adults of dark-bodied cherry fruit-fly, much enlarged.

descent into the soil occupy but a short time and that these events take place only once each season.

It also follows that, in order to succeed, any attack aimed at the destruction of the adult fly must be timed so that the application will be made immediately after the fly emerges and before the eggs are laid.

The adult white-banded cherry fruit-fly is a small, two-winged fly; the larger specimens measure about three-sixteenths of an inch from the head to the tip of the abdomen. The body is polished, shiny, and amber and black in color except for the abdomen which is ornamented by four transverse, narrow white bands. There is also a white band on each side extending longitudinally along the thorax about the level of the wing base. The wings are transparent and are ornamented with several transverse dark smoky bands.

The dark bodied fruit-fly presents in general much the same appearance as the white-banded species. Its abdomen, however, lacks the

transverse bands and there is more and darker smoky ornamentation on the wings. Both of these flies present a very pretty appearance and are perhaps two-thirds as large as an ordinary house-fly.

The larvae are white, plump maggots without feet and without distinct, dark, chitonized heads. They sometimes reach a length of slightly more than a quarter of an inch, and taper quite strongly almost to a point at the mouth. In the pupal stage, which is passed underground, individuals are brown in color, a little shorter, plump, and rounded at each end. These characteristics are well shown in the accompanying illustrations. If the larva is closely examined with the aid of a hand lens, chitonous, jaw-like structures are discovered inside the head. These structures can be extended somewhat and are used to scrape and shred the flesh of the fruit. By means of these "jaws," the maggot is able to tear its way through the flesh and to loosen juicy shreds on which it feeds. Not being a chewing insect but rather depending on scraping and shredding for getting its food, the cherry maggot does

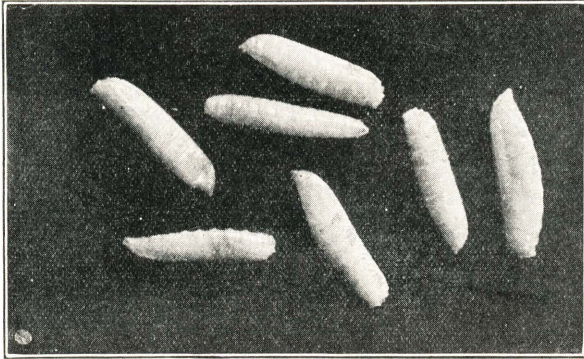


Fig. 3.—Cherry fruit-fly larvae or maggots, greatly enlarged.

not eat a well defined hole through the fruit, but works its way without producing a well defined cavity. For this reason, their workings are filled with juice and not with air, and, consequently, the tendency of the damaged cherries to float when thrown into cold water is less marked than in the case of cherries injured by the curculio, which leaves an air-filled cavity in the cherry.

#### Feeding Habits of the Adult

After coming to the surface from the underground pupal cases, usually in June, the adult cherry fruit-flies spend several days in feeding before starting to lay their eggs. These flies are not provided with chewing mouthparts but get their food by vigorously scraping and scrubbing the surfaces of the leaves and fruit with their tongues. This loosens minute particles of food on which the flies subsist. Water is always available for drink early in the day before the dew evaporates. It is entirely practicable to take advantage of this scrubbing and scrap-

ing habit of the flies and to poison the leaves and fruit so that the flies may readily be destroyed before eggs are deposited.

### Character of Injury

The appearance of maggot infested cherries is not by any means uniform. The cherry seldom falls to the ground because of an attack by maggots. Sometimes, the fruit retains its natural appearance until dead ripe. Sometimes, there is a sunken area on the surface, and, sometimes, the fruit becomes deformed and loses its attractiveness. Practically the only way in which one may be positive of the presence or absence of maggots is by opening the fruit and making an examination. The detection of living maggots is none too easy even after the fruit has been opened. Especially is this true when the maggots are small and almost transparent.

While it is entirely practical to safeguard the sour cherry crop in commercial orchards which are properly cultivated and sprayed at



Fig. 4.—Puparia of white-banded cherry fruit-fly, much enlarged.

exactly the right time, roadside trees and unsprayed and neglected back yard trees in the vicinity of commercial orchards will always serve as breeding places for fruit-flies, which will fly to a reasonable distance and produce maggots in commercial orchards. The distance which these flies will travel in search of new fields is apparently unknown as yet, but there is reason to believe that they do not habitually travel to great distances.

### The Examination of Harvested Fruit

The testing of samples taken from lots of cherries suspected of harboring maggots offers some difficulty since the small maggots are almost transparent when living. When the fruit is first opened, the translucent maggots submerged in the fruit juices are not at all conspicuous. The ability to detect the maggots when present, even in small numbers, is an important matter to canners and those engaged in freezing cherries for preservation in cold storage. No dependence should be placed on tests made when using fresh **raw** fruit. All fruit

should be raised to the boiling point for a few minutes at least, in order to coagulate the body contents of the maggots, which then become considerably more opaque. In other words, cooked maggots are very much easier to detect in the fruit juices than raw or living ones.

In making a test of a sample of cherries, the fruit should first be pitted or crushed by hand. It then should be cooked for several minutes in order to render the larvae opaque, and the pulp should be rubbed through a coarse screen. After this has been done, the usual practice is to remove most of the coarse material little by little and to add water and agitate. The semi-liquid mass is then diluted and placed in a dark colored tray. The material is then washed several times, much of the pulp being removed between washings by decanting, after which the remainder is carefully searched for maggots which, if present, show up fairly well against the black background of the tray. Any black.



Fig. 5.—Larvae of pomace-flies, greatly enlarged.

shallow pan may be used for this purpose. The writer habitually uses one made of sheet-iron and which is known to the housewife as a small-sized dripping pan. For full directions, for making examination of cherries for the presence of the larvae of cherry fruit-fly, see page 11.

### CONTROL MEASURES

Practically all Michigan canners of cherries, employ what is known as the cold-water storage system in preparing their fruit for the cans. In other words, cherries are thrown into washing machines where they are thoroughly agitated with streams of cold water for a sufficient time to remove all leaves, twigs, and all of the dirt from the fruit. The fruit is then transferred to large vats into which cold water is constantly flowing. Practically all of the curculio infested cherries float to the top and are skimmed off and removed. During this operation, very many maggot infested cherries suffer the same fate although this method of flotation does not remove all maggot-infested cherries by any means. The cherries then pass inspection on conveyors and, as they pass, they are examined individually by observers



who pick out all fruits which show imperfections of any kind. It follows that in the course of a day's run, enormous quantities of cull cherries accumulate, many of which contain maggots or the larvae of curculios.

The importance and indeed the necessity for the immediate disposal of such culls and waste fruit, cannot be over stated. The immediate destruction by fire, by burying, or by cooking is imperative. If, as sometimes happens, such culls are thrown on the ground, the larvae desert the fruit, bury themselves under the surface of the soil and go into the pupal stage ready to emerge the following year. For precisely the same reason, all culls which accumulate at the time of picking cherries for the basket trade or for any other purpose should be likewise destroyed.



Fig. 6.—Adult pomace-flies, much enlarged.

Furthermore, all cherries, immediately after they are picked or as soon thereafter as is expedient, should be placed either in a cool place inaccessible to pomace-flies or should be placed in cold-water storage immediately after delivery to the cannery. Pomace-flies are the tiny flies which collect around all fruit refuse. They lay their eggs on such refuse and in an unbelievably short time the fermenting fruit "becomes alive" with their tiny slender maggots. It is obvious that the presence of pomace-fly maggots either in canned or basket fruit, just as effectually renders such fruit unfit for human consumption as the presence of the larvae of cherry fruit-flies themselves.

### Sprays

The adult, winged, cherry fruit-flies usually commence laying their eggs about the time that the red blush appears on early sour cherries. This is not the invariable rule however, sometimes the process of egg-

laying is delayed until considerably later. Any spray to be very effective, must be applied immediately after the flies emerge from their puparia and while they are feeding on the leaf and fruit surfaces, at all events, before egg-laying commences. As before stated, these flies scrub and scrape the surfaces of the leaves and fruit for several days before they begin to place their eggs. The spray which has proved most effective in the control of this pest, is an arsenical spray put on **immediately** after the flies appear in the adult condition. The spray commonly used for spraying sour, canning cherries is made up of two and one-half pounds of dry powdered arsenate of lead with or without two and one-half gallons of liquid lime-sulphur to each 100 gallons of water. In the case of sweet cherries, use two and one-half pounds of arsenate of lead to each 100 gallons of water, with or without two gallons of liquid lime sulphur. In the East, a second spray is often applied two weeks after the first one if the cherries have not yet been

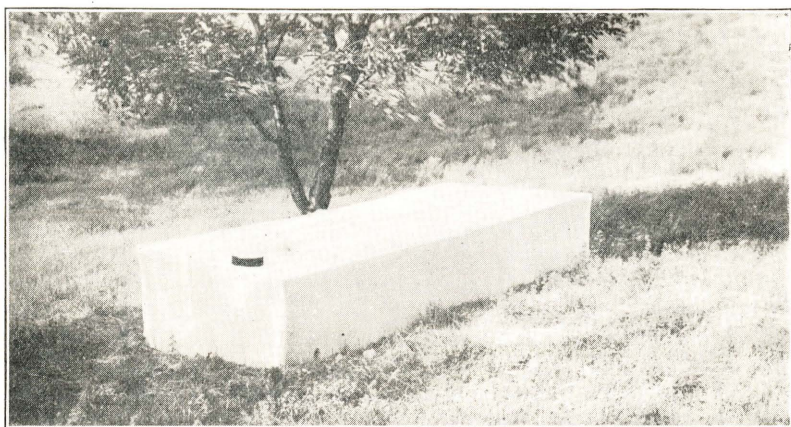


Fig. 7.—Cage for catching cherry fruit-fly after emergence from soil.

picked. Up to the present time, Michigan cherries have not seemed to require any second spray, and, for the present, a second spray is not advised.

It is obvious that a poisonous spray of this nature would be extremely dangerous if used on cherries which were not to be thoroughly washed after harvest in order to remove any residue that might cling to the fruit. **The recommendation therefore applies only to cherries which are to be canned or frozen and which are to be thoroughly washed during the preparation of the fruit for the containers.**

Just after harvest, it is customary to apply a similar spray for the purpose of controlling leaf-spot and slugs. The importance of this spray becomes more apparent when we consider that it undoubtedly destroys many of the adult flies that survive the first spray, thus lessening the number of eggs laid, possibly on other fruit, for the following season.

There is reason to suspect that the cherry fruit-fly may multiply on other fruit for a short time, in the absence of cherries.

All of the foregoing goes to show that the efficiency of a spray such as has just been described depends more on the timeliness of its application than on any one other factor. In order to determine accurately the exact time to apply a spray so as to kill the newly emerged flies, a number of observing stations have been established and will be maintained at different points over the state. At each observing station, a large cage about four by eight or ten feet in size is placed directly on the surface of the soil, and, in this cage, a quantity of maggoty cherries is placed at the time of harvest. These cages are screened in before the advent of the fly the following season, and the cage is carefully watched for the emergence of the fruit-flies. When word is received that the flies are out, the information is immediately wired to the canners in that vicinity, to the county agents, to the local daily press, and is announced over the radio so that every grower in that particular district may be notified in time to apply his spray before egg-laying commences.

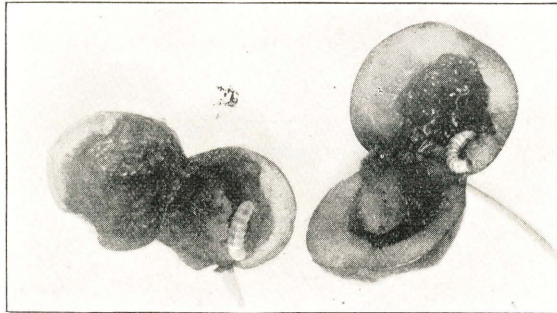


Fig. 8.—Larvae of plum curculio in ripe cherries, slightly enlarged. The larvae of curculio are often mistaken for those of fruit-fly.

The emergence of the adult, winged flies occurs in a wave which progresses more or less regularly northward from the southern border of the State. In other words, the flies in the southern part of the state emerge earlier than those in the central part, and those in the northern part quite a bit later. Thus, during the summer of 1929, the adult flies of the white-banded cherry fruit-fly emerged at Benton Harbor on the 19th of June, at Grand Rapids on the 20th, at Hart on the 25th, at Traverse City on the 27th, and in the Leelanau Peninsula on the 29th and 30th. The Department of Entomology at the Michigan State College has for several years maintained such cages and notified the county agents of the various districts of the exact time of emergence of the flies. This work will be carried on in the future in co-operation with representatives of the State Department of Agriculture, who in the future will carry out such measures as seem to give promise of bringing the fruit-fly under control and will enforce the laws enacted by the Michigan legislature of 1929. The co-operation will also make it possible to increase the number of observing stations and to do the work more efficiently than ever before. It is reasonable to assume

that through this co-operation the destruction of cull fruit and the adoption of other practices inimical to the welfare of the pest will come into general use and that improved methods and refinements of existing methods will be developed. This will gradually bring about a permanent improvement in the entire situation.

## APPENDIX

Commercial cherry orchards in Michigan are practically all under cultivation, few, if any, being kept in grass sod. The constant stirring of the soil unquestionably destroys many pupae in their shallow cells by bringing them to the surface where they are exposed to the hazard of bad weather and to the attacks of their natural enemies.

Michigan canneries invariably use the cold-water storage to hold their fruit in condition for a short period. It has been found by careful investigation, that quite a fair proportion of infested cherries float off during this treatment.

Following is a copy of directions for testing for the larvae of cherry fruit-flies developed by Dr. B. J. Howard of the Bureau of Chemistry, U. S. D. A., revised, and modified by Mr. C. H. Stephenson of the microbiological unit of food control and published in the "Canner."

"Take from each delivery a representative sample equal to about two No. 2 cans full of cherries. Break up the fruit in some manner, as by running it through an Excelsior hand pitter. Place in a No. 10 can, or any other handy vessel, and heat by any convenient means, such as a steam hose. Boil for a minute. Fill a No. 2 can level full with cooked fruit. Fill a dishpan two-thirds full with cold water. Empty half of the can of cooked cherries into a sink strainer or other convenient sieve. Move the strainer around with a rotary motion near the surface of the water in the dishpan for a moment or two. Maggots, if present, will go through and sink to the bottom of the pan. Repeat this process with the rest of the cherries in the can. Run off water slowly from the top of the pan and add fresh water. Repeat until most of the cherry debris has floated off. Transfer the material left at bottom of pan to any black pan, such as a baking pan, when maggots, if present may be very easily seen and counted. Reject any deliveries showing maggots."