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AN ACCOUNT OF EARLY REGULATORY EFFORTS TO CONTROL CHERRY FRUIT FLIES (DIPTERA: TEPHRITIDAE) IN MICHIGAN

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Forty years ago, the amount of fruit produced by the cherry industry in Michigan exceeded that of all other states combined. State and federal regulatory agencies permitted no tolerance for maggots in cherries to be used as human food, and when such fruit was found to be infested, it was seized and ordered destroyed. Two species of fruit flies were known to infest cherries in Michigan, *Rhagoletis cingulata* Loew (cherry fruit fly) and *R. fausta* Osten Sacken (black cherry fruit fly). In 1928, the Federal Food and Drug Administration adopted an improved specific gravity decantation method for separating maggots from fruit, which had been developed by B. J. Howard of the United States Department of Agriculture, Bureau of Chemistry. The occurrence of maggots in fruit became a critical problem to producers and processors because the Food and Drug Administration expanded investigations into food contaminants and improved analytical methods increased the probability that maggots in cherries would be detected. Concerned representatives of the Michigan cherry industry led by Gill M. Dame, a producer and processor at Northport in Leelanau County, sought protective legislation through the Michigan Department of Agriculture. Entomological research provided a substantial biological basis for such legislation.

By means of cages placed over plots where infested cherries were dumped the preceding summer, the time of emergence of adult cherry fruit flies could be accurately determined. The report by Pettit (1928), cited below, describes the cherry maggot service conducted by the Entomology Department of Michigan State College.

CHERRY MAGGOT SERVICE

During the summer of 1928, eight observing stations were maintained for the determination of the dates for optimum results in spraying to control *Rhagoletis cingulata*. Eight cages were maintained at or near Benton Harbor, South Haven, Gobles, Fennville, Hart and Traverse City.

During 1928 these cages produced flies in regular order from the southernmost cage to the northernmost. However, in each case it was possible to collect flies from trees in the vicinity by means of an insect net, before flies appeared in the cages. The earliest flies were captured in this way at each station and the date set so that the spraying in each case was done at the most advantageous time. At least, sprayed fruit was almost fully free from maggots and the service was considered eminently successful.

So far as is known to the writers, the black cherry maggot, *Rhagoletis fausta*, was found in considerable numbers for the first time in Michigan in 1929. On June 19th, *fausta* emerged at Gobles (Van Buren Co.). Previous to this time *R. cingulata* had been the only species found in Michigan cherries. Act No. 86, Public Acts 1929, had empowered the Commissioner of Agriculture to adopt and carry out whatever measures for the control of cherry fruit flies he thought necessary. Commissioner Herbert E. Powell issued regulations on June 26, 1929 which clearly set forth the problem of cherry fruit flies and designed methods for their control. Regarding the control used, Illingworth (1912) had achieved effective results on cherry fruit flies with a bait of arsenate of lead, cheap molasses, and

¹ Retired 1952.

water. He suggested that arsenate of lead without sweetening might possibly control the flies. Due to its interest, the text of Powell's regulations is reproduced totally:

There are two species of cherry fruit fly, namely, the earlier maturing dark fruit fly, and the later white banded species. So far as is known up to the present time, the earlier dark species exists only in the vicinity of Gobles in Van Buren County and of Grand Rapids in Kent County, and the adults of this species started to emerge at Gobles on June 19 of this year.

The time of the emergence of the cherry fruit fly is not the same in all localities and in all seasons. It emerges earlier in the south portion of the State than in counties farther north. Some seasons its emergence is earlier than in other seasons. For this reason it is impossible to arbitrarily fix a calendar date on which effective treatment should commence. Dating from its emergence and until the eggs are all deposited usually covers a period of five or six days. If spraying is to be effective, it must be done during this period. Any later treatment in the way of spraying would seem useless.

The closest cooperation must exist between cherry growers and the State authorities engaged in control work. The State Department of Agriculture and the Entomology Department of the Michigan Experiment Station at the Michigan State College working together will endeavor insofar as is possible to furnish information as to the date of the emergence of the cherry fruit fly in particular sections of the State and this information will be conveyed to the growers through every possible agency, including the press, county agents, canneries, telephone, radio and all other means that are found practicable. The channels above mentioned are hereby declared to be and are hereby made the legal channels through which notice of the emergence of the fly is to be given.

The grower must be alert, prepared and ready to administer the treatment when information comes to him through one or more of the channels mentioned. He, or they, will be expected to spray all cherry trees under his, or their, control and in the manner indicated and prescribed in the rules and regulations of the Commissioner of Agriculture which are herein set forth.

REGULATIONS

By virtue of the power conferred on the Commissioner of Agriculture in Act No. 86, Public Acts of 1929, I, Herbert E. Powell, Commissioner of Agriculture, do hereby make the following rules and regulations for the control of the cherry fruit flies (*Rhagoletis cingulata* Loew) and (*R. fausta* Osten Sacken) and other cherry pests:

1. The owner or persons having charge of cherry trees or cherry orchards shall immediately following the emergence of the cherry fly in the locality in which his trees or orchard is located, cause the same to be sprayed in the manner outlined in the paragraph following and designated as number two.

2. Canning cherries which are to be scrubbed, must receive a spray consisting of two pounds or two and one-half pounds of dry powered arsenate of lead to 100 gallons of water or of dilute lime-sulphur. If dilute lime-sulphur is used with the arsenate of lead, add two and one-half gallons of lime-sulphur to 100 gallons of water for sour cherries. In the case of sweet cherries, lime-sulphur stronger than two gallons to 100 gallons of water should not be used.

3. When cherry trees are found to be infested with cherry fruit fly, the cherries on such trees shall be picked as soon as possible by the owner or person having same in charge, and such cherries buried two feet below the surface of the ground, covering them with quick lime, or they must be completely destroyed by fire. Canning factories or any person or persons into whose possession infested cherries may come, are charged with and will be held responsible for the disposition of cherries containing cherry fruit fly maggots in the manner and form as above described.

4. It is declared to be illegal for any person or persons operating any car, vessel, boat, truck, automobile, aircraft, wagon or other vehicle, to transport from one point to another within the State, cherries infested with the cherry fruit fly in any living stage of its development, and it is further declared to be illegal for any canning factory, dealer or other person to receive for canning, or to can, or have in possession with intent to can or sell, cherries infested with the cherry fruit fly, or cherries taken from cherry trees or cherry orchards located in any area within the State, in which the cherry fruit fly has been found to exist and which has not been sprayed in accordance with these regulations and during the time herein specified.

Act No. 86, Public Acts of 1929, being an act to protect the cherry industry and to provide for the control of the cherry fruit flies, carries with it a penalty as follows:

Any person, copartnership, association or corporation violating any provision of this act or the rules and regulations of the Commissioner of Agriculture issued and promulgated hereunder shall be deemed guilty of a misdemeanor and upon conviction thereof shall be punished by a fine of not less than 25 dollars nor more than 100 dollars or imprisonment in the county jail for not more than 90 days, or both fine and imprisonment in the discretion of the court.

These rules and regulations shall be immediately effective.

The administration of this cherry fruit fly program was delegated to E. C. Mandenberg who was in charge of the Orchard and Nursery Inspection Service of the Bureau of Agricultural Industry. Limited funds became available on July 1, 1929, and during the six weeks which followed, hasty inspections were made during the midst of the cherry harvest. A total of 613 premises were inspected of which 50 were found to be infested. Maggot

infestations were found in Benzie, Berrien, Grand Traverse, Leelanau, Manistee, Mason, and Oceana counties.

A. H. Beyer came to Michigan from Florida where, as a member of the Department of Entomology staff of the University of Florida at Gainesville, he had obtained considerable experience with Mediterranean fruit fly infestations of citrus. In 1929, his participation in the cherry fruit fly program was limited to an advisory capacity because his association with the Michigan Department of Agriculture did not commence until August, when much of the field work had been completed.

In 1930, Beyer assumed responsibility for conduct of Mandenberg's program for controlling cherry fruit flies in Michigan. The assignment included supervising field activities, keeping field notes, and reporting program results which he continued to do until shortly before his retirement in 1952. In March 1930, Pettit and Tolles (1930) published a useful bulletin concerning the appearance, habits, character of injury and control of the insects, as well as the method for testing fruit for maggots. The Michigan Department of Agriculture began its 1930 season in April with a state-wide meeting held in Muskegon in cooperation with canners, county agents, fruit growers, and the Michigan State College Agricultural Experiment Station. During April, 23 meetings were held in the important cherry-producing counties to acquaint the growers with the life histories of the cherry fruit flies, the laws and regulations concerning them, and the methods for their control.

Beginning on May 20, 4'x4'x10" observation cages were constructed. Four one-inch spruce boards, each approximately 4'x10", were placed in the form of a square and nailed together at the corners. The resulting open-ended box was placed on the ground, and the open top was covered with 14-mesh screen. When flies emerged in each cage, one corner of the screen was raised and emerging flies were removed with cyanide bottles.

The cages were distributed in 16 different counties. It is not definitely known which cages set in 1930 were seeded with infested fruit; many cages were simply placed under neglected trees in a manner which would confine any adult flies emerging from the soil beneath the cage. No emergence was recorded from cages set in Antrim, Charlevoix, Ionia, Kent, Manistee, Newaygo, Oakland, and Sanilac counties. Emergence was recorded from cages set in Allegan, Benzie, Berrien, Grand Traverse, Leelanau, Mason, Oceana, and Van Buren counties. The earliest emergence date for both *R. cingulata* and *R. fausta* was June 9 in Van Buren County. Specimens recovered from cages along with naturally occurring specimens taken in orchards by inspectors were sent to the Entomology Department, Michigan State University, for identification. From these specimens it was found that *R. cingulata* and *R. fausta* both occurred in Antrim, Berrien, Grand Traverse, Kent, Leelanau, Oceana, and Van Buren counties. *R. cingulata* was recorded from Allegan, Benzie, and Charlevoix counties, and *R. fausta* was recorded from Mason County.

As soon as cherries began to ripen, cherry fruit fly inspectors started collecting fruit samples from neglected trees and orchards. Well-kept orchards were sampled, and pint paper cartons with lids were used for sample containers. 754 samples were tested in 1930 by the State Analyst who cooperated with representatives of the Michigan Bureau of Foods and Standards and the Federal Food and Drug Administration. The first maggots were recorded from a sample collected at Grand Rapids in Kent County on June 20. The most heavily infested pint sample, from which 145 maggots were recovered, was taken on July 28 at Shelby (Oceana County). Infestations of cherry fruit flies were found on 196 premises and the infested trees were condemned. Control measures were employed according to Powell's 1929 regulations. Because wild cherries were found to be infested and were considered to be a possible hazard, the destruction of wild cherry trees in the vicinity of orchards was recommended. Growers and canning interests cooperated in locating infested premises and assisting clean-up work.

During the first ten years of the cherry fruit fly control program, progressive changes occurred and a number of noteworthy observations were made. In 1931, the Michigan Department of Agriculture placed a motorized traveling laboratory in operation (Fig. 1). This enabled investigators to test samples promptly in the same locality that collections were made. Fig. 2 is a view of the interior of the laboratory, when fitted for testing cherries. Occasionally, unexpected numbers of cherry fruit fly pupae were found in fruit. A pint sample collected in Kent County July 1, 1932, was reportedly infested with 81 maggots and



Fig. 1. Michigan Dept. of Agriculture field laboratory, 1931.



Fig. 2. The interior of the laboratory.

nine pupae. In 1933, no emergence cages were used, but reliance was placed on observing natural populations in orchards. Both *R. cingulata* and *R. fausta* were observed in Van Buren County on June 5, 1933. In 1934, emergence cages were constructed with a 6" square side opening which was fitted with a sliding cover to permit easy access to the interior for removing flies. In 1935, cage emergence of *R. cingulata* in Berrien County was observed on June 19 at Coloma and on July 1 at St. Joseph. It was speculated that the development of the insect was delayed at St. Joseph, on the edge of Lake Michigan, because relative temperatures in early spring were lower than those at Coloma, which is five miles inland.

In 1936, the fruit-fly infested commercial orchard was found to be an unusual problem. Hand-picking of the fruit was found to be out of the question as a maximum amount of work was required at a minimum of expense and the shortest possible length of time, in order that the infested fruit might be removed from the trees and destroyed before becoming over-ripe and falling to the ground, thus menacing the following year's crop. After considerable study, the following method of cleanup was observed to be most practical.

Each control unit was provided with two large canvas sheets or tarpaulins, approximately 12' by 24', one for each side of the infested tree. Both were spread on the ground and lapped together at the trunk to catch all the falling fruit. Inspectors jarred the branches and removed the fruit that fell to the tarpaulin (Fig. 3). The method required six men to a tree. Three men were stationed along the length of each sheet, one at the middle and one at each end. After collection, the sides and ends of each sheet were folded in the middle, so that the infested cherries could be poured into a trailer or dump-truck. Fig. 4 shows a trailer load being dumped into a disposal pit. The pit was filled within two feet of the surface and the fruit was then treated with a thick layer of hydrated lime before covering the pit with two feet of soil.

In 1937, the infested cherries used in emergence cages were lightly dusted with arsenate of lead as a preventive against parasitism and predation by insects and rodents. Emergence was recorded from eight of the 15 cages which were set. These results were identical to those of the previous season when no treatment was applied. In 1938, the first cage emergence

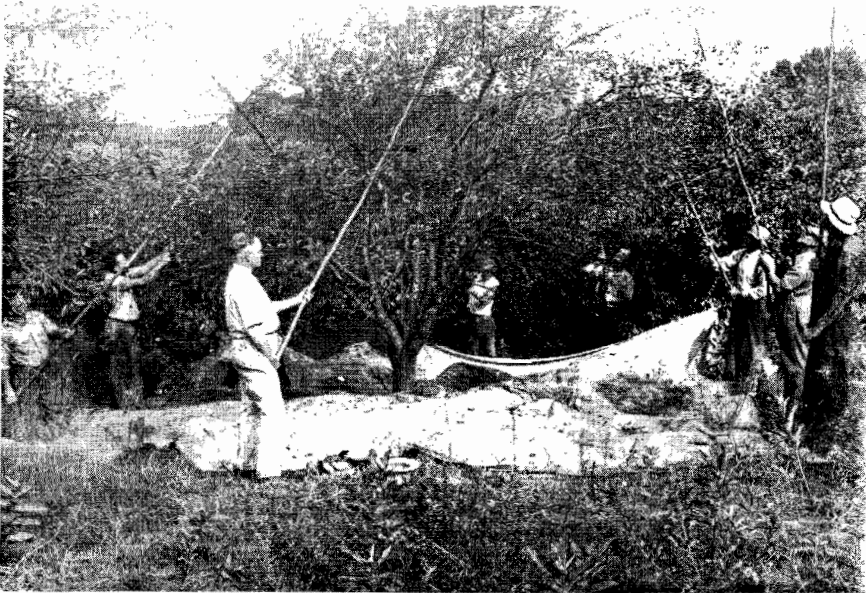


Fig. 3. Beating for cherry fruit fly.



Fig. 4. Infested cherries being dumped into a pit.

observed was *R. cingulata* on June 3 at Niles in Berrien County. This is unusual because *R. fausta*, which usually emerges first, was not reported until June 7 from a cage in Van Buren County. In 1939, the most heavily infested pint sample, from which 211 maggots were recovered, was taken on June 18 in Kent County. Table 1 shows the earliest dates that adult cherry fruit flies were observed during the ten year period 1930-1939.

Table 1. Earliest dates that adult cherry fruit flies were observed during the 10 year period 1930-1939.

<u>Year</u>	<u>Date</u>	<u>County</u>	<u>Species</u>	<u>Population</u>
1930	June 9	Van Buren	<i>R. cingulata</i>	Cage
	June 9	Van Buren	<i>R. fausta</i>	Cage
1931	June 5	Van Buren	<i>R. fausta</i>	Cage
1932	June 7	Van Buren	<i>R. fausta</i>	Cage
1933	June 5	Van Buren	<i>R. cingulata</i>	Natural
	June 5	Van Buren	<i>R. fausta</i>	Natural
1934	June 9	Van Buren	<i>R. fausta</i>	Cage
1935	June 7	Van Buren	<i>R. fausta</i>	Natural
1936	June 5	Van Buren	<i>R. fausta</i>	Natural
1937	June 10	Van Buren	<i>R. fausta</i>	Cage
1938	June 3	Berrien	<i>R. cingulata</i>	Cage
1939	June 7	Berrien	<i>R. cingulata</i>	Cage

Incorporated with these dates are data pertaining to locality, species, and whether observations were on natural populations or cage emergences. There was little variation in the date from season to season; the first observance of adult cherry fruit flies occurred between June 3 and June 10 during the years 1930-1939.

Table 2 indicates the earliest dates that adult cherry fruit flies were observed in Berrien, Charlevoix, Grand Traverse, Kent, Leelanau, Oceana, and Van Buren counties in the years 1930-1939, and indicates the species observed. Earliest recorded emergence is later in more northern localities.

Table 2. Earliest dates that adult cherry fruit flies were observed in important cherry-producing counties, 1930-1939.

<u>County</u>	<u>Date</u>	<u>Species</u>
Berrien	June 3, 1938	<i>R. cingulata</i>
Charlevoix	June 18, 1931	<i>R. cingulata</i>
Grand Traverse	June 12, 1935	<i>R. cingulata</i>
Kent	June 5, 1934	<i>R. fausta</i>
Leelanau	June 15, 1938	<i>R. cingulata</i>
Oceana	June 9, 1933	<i>R. fausta</i>
Van Buren	June 5, 1931	<i>R. fausta</i>

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REVIEWS OF RECENT LITERATURE

Reviews of Recent Literature did not appear in Vol. 3, No. 2, as this was a subsidized issue. Due to the transfer of our editorial office to Washington, D.C., reviews for the present issue, Vol. 3, No. 3, have been delayed. Vol. 3, No. 4 will contain an enlarged review section. Books for review in future issues should be sent to the Editor.

R.S.W.