Interesting Diptera Collected in Indiana Walnut Groves

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Bait traps, designed to capture *Rhagoletis suavis* (Loew), an economic pest of walnuts, were placed in a grove of black walnuts *(Juglans nigra)* on the Glen Berry farm near Monroe City, Indiana, during 1960, 1961, and 1962, to evaluate the relative effectiveness of a series of ammoniacal compounds as attractants for *Rhagoletis* spp. Six species of flies that could be confused with *R. suavis* were also captured and records made as to the dates they were captured and in what numbers.[1] Discovery of a heavy infestation of *R. suavis* in a small grove of Persian walnut *(Juglans regia)*, Carpathian strain, on the Alvin Spitts property near Vincennes, Indiana, made it possible to evaluate the effect of bait sprays for control of this fly. The purpose of this discussion is to record the species and numbers taken, especially with reference to *R. suavis*, and to comment briefly on the injury caused by *R. suavis*, and the control obtained with bait sprays.

The traps used for exposing the lures, designed after those described by Still (17), were sheltered half-pint jars of bait suspended below 6- x 8-inch pieces of yellow masonite, coated with Stikem.[2] Baits were emptied and replenished when deemed necessary, generally at 24- to 34-day intervals.

In the Berry grove the traps were hung at 6-foot intervals on a plastic rope suspended about 7 feet from the ground and connecting four black walnut trees spaced about 50 feet apart, in an approximate square. Enough trees were in the grove to make a canopy of walnut foliage over the traps. The Spitts property contained nine Persian walnut trees on which the branches reached to the ground. Four traps were suspended from branches about 5 feet from the ground. Traps were examined at weekly intervals. Captures of seven species of flies were recorded from July 19 to November 4, 1960, and from June 15 to November 3, 1961. In 1962 captures of *R. suavis* only were recorded from July 6 to October 26. In 1962 two species of flies not taken previously were identified.

Condylostylus sipho (Say), Family Dolichopodidae, the long-legged flies.—This was the most numerous of the species captured, 1,088 being taken in 1960 and 842 in 1961. Peak captures occurred in August, but specimens were taken from the week ending June 23, when traps were first placed, to October 20. Only two references to this species were found in a limited review of the literature. Bray and Triplehorn (3) stated that adults of the species were predacious on aphids infesting giant ragweed, and Boyce and LeRoux (5) observed adults feeding on adults of the European red mite (*Panonychus ulmi* (Koch)) on apple foliage near Hanow, Ontario.

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1. Acknowledgments are made to Richard H. Foote and Curtis W. Sabrosky, dipterists of the Entomology Research Division.

2. Trade name for polymerized butene, isobutene, and butane.

Clusia lateralis (Walker), Family Clusiidae, referred to as the smallbanded flies.—These flies are seldom seen. Only one specimen was picked up on the bait traps and that was between August 5 and 12 in 1960. No references to this species were readily found in the literature.

Rivellia quadrifasciata (Macquart), Family Otitidae, often referred to as the picture-winged flies, because of their pronounced black, brown, and yellow wing markings.—Only nine specimens of this fly were taken during 1960 and 1961. Collections were made from June 30 to August 18. Literature reviewed showed that this species occurs from Alabama northward through the midwestern States into North Dakota and eastward to New York. In Indiana, it has been reported from the sand dunes area and Namba (14) lists it as having been taken at Lafayette and Logansport.

Delphinia picta (F.), Family Otitidae.—Adults of this species were captured frequently, 32 in 1960 and 16 in 1961. Captures were recorded from June 23 through November 13 with peak catches occurring in August. Frost (9, 10) mentioned this species in his notes on Otitidae. It is known to occur from Maine to Minnesota and southward to Florida and Kansas. R. H. Foote, in correspondence, stated that despite its widespread occurrence very little is known about this insect.

Pseudotephritis vau (Say), Family Otitidae.—Only a limited number of these flies were captured, six each year. They were found from August 12 to November 13, but most of them were captured between September 9 and 22. Numerous references to this species are present in the literature. Holmquist (12) and Brues (7) stated that larvae were found under the bark of trees. Townsend (18) observed adults in a woods near Urbana, Illinois, from April 17 through August 4. They were reported by Bray and Triplehorn (3) as present in Delaware.

During the course of the study, four species of Tephritidae, commonly referred to as the fruit flies and peacock flies, were captured. This family contains numerous injurious species, and the literature contains numerous references to the family. One of the better summaries of their biology is that of Christenson and Foote (8). Three of these species captured are recognized as economic pests of plants.

Zonosemata electa (Say), the pepper maggot, was taken in the Spitts grove, which was underplanted with garden vegetables, in 1962. It was discussed by Peterson (15) and others as a pest of peppers and eggplants. It has also been found in tomatoes. Benjamin (2) stated that it is present in Florida and Georgia.

Straussia longipennis (Wiedemann), commonly known as the sunflower maggot, was also collected from traps operated in the Spitts grove in 1962.

Tomoplagia obliqua (Say) was taken in the black walnut grove between August 5 and 12, six specimens in 1960 and three in 1961. This species was originally described from Indiana by Say in 1830 (16). Benjamin (2) reviewed the literature pertaining to this species and listed the flowers of *Vernonia scaberrima*, *V. blodetti*, and *V. gigantea* (Iron-Weeds) as hosts.

Rhagoletis suavis (Loew), sometimes referred to as the walnut husk maggot, is a common pest of black walnuts and butternuts *(Juglans cinerea)* throughout the eastern United States. Its range of habitat is the same as the plantings for the above nut trees. Adults deposit a mass of eggs in the shucks of the nuts and the larvae develop in the shucks, feeding between the shuck and shell. Since they feed in mass, it seems obvious that the quality of the nut is impaired; however, the most severe injury is to the thinner shelled Persian walnuts. Feeding by the larvae causes the shucks of the nuts to stick to the shell. The nut meats are malformed and, in most instances, shriveled and improperly developed so that they cannot be used. A near relative, *Rhagoletis completa* (Cresson), called the walnut husk fly, is enough of a pest to Persian walnuts in lower California to necessitate one to two spray applications a year in order to grow marketable nuts. Fortunately, *R. suavis* has not been introduced into the western areas of the United States where the Persian nut groves are concentrated. A partial review of the literature revealed the following more important referencs: Babb (1), Loew (13), Brooks (6), Gambrell (11), and Boyce (4), who discussed related species attacking walnuts and their general distribution.

In the black walnut grove 419 *R. suavis* adults were captured in 1960, 83 in 1961, and 84 in 1962. Captures were made from between July 22 and 29 into the week ending October 14 in 1960, from between July 28 and August 4 into the week ending November 3 in 1961, and from between July 6 and 13 into the week ending October 26 in 1962. In 1962 four traps in the Persian walnut grove captured 262 *R. suavis* adults, the first between July 6 and 13. Between 50 and 60 adults were taken from the four traps each week from August 1 to 21. For the three seasons, captures increased rapidly the last week in July and reached a peak between August 10 and 31. A second but smaller peak occurred between the middle and last of September.

Several ammoniacal compounds were attractive to the species, more so than the glycine baits. However, none of a number of coded compounds supplied by chemists of the Entomology Research Division were more attractive than dibasic ammonium phosphate or ammonium carbonate. Pyridine was highly effective but volatilized rapidly. Neither Staley's No. 2[3] and 7[4] protein hydrolysate baits nor brown sugar alone or in combination with dibasic ammonium phosphate or ammonium carbonate was more attractive than the dry ammonium compounds. After two seasons' studies, it was concluded that dry lump ammonium carbonate, placed in a ½-pint jar, was the most efficient bait tested. Studies in 1962 showed that the amount of ammonium carbonate used could be reduced by sealing the jar, except for two pieces of plastic hose $\frac{5}{16}$ inch in diameter extended from inside the jar to the center of the trap board.

Fewer flies were taken per trap in the black walnut grove than in the Persian walnut grove. It was believed that this was due, in part, to the location of the traps in relation to the walnut foliage. Traps in the

3. Protein hydrolysate from corn protein.
4. Protein hydrolysate from corn protein and steep water.

Persian walnut grove were hung in the foliage, whereas those in the black walnut grove were about 20 feet below the branches.

For several years prior to 1962, injury by *R. suavis* was severe enough in the Spitts grove to completely destroy the Persian walnut crop. In 1962 malathion-Staley No. 7 protein hydrolysate bait sprays, containing 4 pounds 25-percent wettable-powder malathion with 1 quart Staley's bait in 100 gallons at the rate of 25 gallons per tree, applied to seven of the nine trees in the grove August 1 and 21, reduced injury by this insect to a low level. The sprayed trees averaged 75 pounds of nuts each, more than 99% of which were free of injury. Fly captures were greatly reduced for 2 weeks following each spray.

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