Drosophilidae Found in Tomato Fields in Indiana[1]

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During the past several years importance of Drosophilidae with respect to contamination of tomato products has received increased attention. Several species of this family are readily attracted to tomatoes which serve as excellent oviposition sites. The problem is of particular importance since contamination can take place in the field where large populations of Drosophilidae deposit eggs in and on cracked tomatoes as well as at the cannery. Rather large populations can build up in a relatively short time due to the high biotic potential of some species.

The first step in attacking the problem of Drosophilidae in tomatoes is to determine the abundance of species of Drosophilidae attracted to the tomatoes. Little work has been done along this line, as most investigations have been concerned with control measures. Studies were carried out in three commercial tomato fields located near Klondike, Tippecanoe County, Indiana, during the late summer and early fall of 1956, to determine the species of Drosophilidae laying eggs on or in tomatoes, the species present in tomato fields, and the sex ratio of the adults.

Three types of traps were used at the start of these studies: glass jar, paper cup, and lard can. The glass jar type trap was made by soldering a metal cone in a Kerr ring and inserting it in a quart glass fruit jar. The paper cup trap was prepared by baiting a 12-ounce waxed cup and suspending it two feet above the ground. The cup was tilted at a 45° angle.

The most productive trap was the lard can type. Fifty pound lard cans were used with enough bait to cover the bottom completely. The lid was then placed on two small, inch-wide sticks, so that there was a narrow opening around the rim of the can through which the flies could enter. Since this trap collected many more flies than either of the other types, it was the only one used after the first week.

Two lard can traps were set in each field, one baited with tomato and the other with a banana-yeast mixture. The banana-yeast bait was made by mashing fresh bananas to a smooth pulp. A small amount of fresh yeast solution was added and the mixture allowed to stand for twenty-four hours to increase its attractiveness to the flies.

Flies were removed from these traps by a twelve inch insect net. When the lid was removed, the net was quickly placed over the top of the can. The tip of the net was held up and thus permitted the flies to enter the net. The flies were then killed in a wide mouthed killing jar charged with sodium cyanide and placed in vials to be counted at

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a later time. The traps were checked, weather permitting, six days a week at approximately eight A. M. from August 30 until the end of the canning season, October 10. After that they were examined less frequently.

Trapping with the six traps in the three tomato fields produced a total of 6752 flies representing 13 species in the genera *Drosophila* and *Scaptomyza* (Table 1).

TABLE 1

Comparison of total numbers and species of Drosophilidae captured in traps containing tomato and banana-yeast baits in three tomato fields during September and October. Klondike, Indiana, 1956.

Species	Field A		Field B		Field C		Total	Proportion of Total Catch
	T	B-Y[1]	T	B-Y[1]	T	B-Y[1]		
	No.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*Pct.*
Drosphila								
melanogaster	105	334	617	2413	195	502	4166	61.7
hydei	85	58	395	454	136	103	1231	18.2
busckii	53	14	401	223	80	34	805	11.9
affinis M[2]	3	8	43	121	9	15	199	2.9
tripunctata	0	0	37	28	2	0	67	.99
algonquin M[2]	1	1	7	42	4	11	66	.98
affinis & *algonquin* F[2]	0	2	10	23	0	3	38	.6
putrida	4	6	11	35	3	6	65	.97
quinaria			5	30	1	0	36	.52
immigrans			8	23			31	.46
robusta			2	1	0	1	4	.06
melanica			1	1	0	1	3	.04
Scaptomyza								
graminum	0	2	10	6	14	3	35	.5
adusta			2	3	0	1	6	.08
Total	251	425	1549	3403	444	680	6752	100.00

[1] T—Trap baited with tomato; B-Y—Trap baited with banana-yeast
[2] M—Males; F—Female flies

D. melanogaster Meigen was the most abundant of the species taken and comprised 61.7 per cent of the total number captured. *D. hydei* Sturtevant was the second most numerous species with 18.2 per cent and *D. busckii* Coquillet third with 11.9 per cent. Individuals of these three species represented 91.8 per cent of all the flies collected. Male flies outnumbered the females in all three fields and at each individual trap. Of the total individuals collected, 58 per cent were males to 42 per cent females.

The banana-yeast bait proved significantly more attractive to Drosophilidae than did tomato, as it attracted 66.8 per cent of all the flies taken. It was also significantly more attractive to the following

species: *D. melanogaster*, *D. putrida* Sturtevant, *D. tripunctata* Loew, *D. affinis* Sturtevant, and *D. algonquin* Sturtevant and Dobzhansky. No significant differences were obtained for *D. hydei* and *D. busckii*. The remaining six species were too few in number for the results to be conclusive.

The total number of flies taken from each field differed. The three fields were planted with Kokomo variety tomatoes and varied with respect to the amount of foliage and plant growth, culled and crushed fruits present, and the nearness of possible sources of infestation.

There were some differences throughout the collecting period in the populations of the different species, as the abundance of most species fell into one of three categories. Group 1 includes those species which were abundant in catches throughout the collecting period; Group 2 those which were reasonably abundant when trapping commenced, but declined in numbers until they were completely absent from the daily catches; and Group 3 included the species rarely taken in early collections but more abundant in the late collections.

In Group 1 are placed the following species: *D. melanogaster*, *D. hydei*, and *D. busckii*. *D. melanogaster* was taken in large numbers at the onset but declined somewhat as the season progressed. The condition of the fruit in the field was primarily responsible for this decrease in numbers rather than the decrease in temperature.

The species included in Group 2 are *D. affinis*, *D. algonquin* and *D. putrida*. In Group 3 are *D. immigrans* Sturtevant, *D. quinaria* Loew, and *D. tripunctata*. The remaining species were taken in too few numbers to be classed in any group.

For rearing out adults in the laboratory the following types of tomatoes were selected at random: green; cracked and ripe on the vine; cracked and ripe on the ground; and those in traps infested with eggs and/or larvae. The rearing chambers used were pint ice cream cartons in which a hole had been punched in the side with a cork borer so that a glass vial could be inserted. After the adults had entered the vial, it was removed from the rearing chamber. The flies were chloroformed, identified to species, and counted.

Of the 136 tomatoes collected, 57 were infested (Table 2) and produced 4936 adults belonging to three genera and 10 species. *D. melanogaster* was reared in the greatest numbers making up 58.6 per cent of the total. *D. hydei* was second in abundance and *D. busckii* third. These three species constituted 98.6 per cent of all adults reared. *Chymomyza amoena* Loew was the only species of Drosophilidae reared from tomato, which was not taken in any of the traps. One, however, was sighted in a field but was not taken. The number of females was larger than males by a ratio of 58 to 42.

Of the cracked tomatoes in the fields, those on the vine were the least subject to egg deposition by Drosophilidae. The population increase was in cull and crushed fruit on the ground, fruits damaged in the picking operations, or damaged by the tomato fruit worm. No flies were reared from any green tomatoes, although eggs were present on some of them when taken into the laboratory. A close similarity between trapped and reared can be observed by comparing the number

of *D. melanogaster*, *D. hydei*, and *D. busckii* trapped (Table 1) with the numbers reared (Table 2).

TABLE 2

Number of male and female flies of the family Drosophilidae reared from 57 ripe tomatoes, August 30 to October 12, 1956.

Species	Tomatoes in traps		Cracked from ground		Tomatoes from vine		Total		Grand Total
	M	F	M	F	M	F	Male	Female	
	No.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
Drosophila									
melanogaster	754	1006	389	536	86	122	1229	1664	2893
hydei	315	447	383	491	0	0	698	938	1636
busckii	23	33	90	146	11	39	124	218	342
immigrans	9	20	8	2	3	2	11	28	39
affinis	1	0	3	0	0	0	7	2	9
quinaria	0	0	1	1	0	0	1	1	2
tripunctata	0	0	1	0	0	0	1	0	1
Chymomyza									
amoena	0	0	1	0	0	0	1	0	1
Scaptomyza									
adusta	1	2	6	3	0	0	7	5	12
graminum	1	1	1	0	0	0	2	1	3
Total	1104	1509	883	1179	100	163	2807	2851	4938

Brief Descriptions of Drosophilidae Associated With Field Tomatoes in Indiana

Drosophila affinis Sturtevant

Body length 2.0 mm. Thorax blackish-brown with six rows of acrostichal hairs. Abdomen dark brown, lighter toward the base. Wings clear. Male sex-comb with four to six curved, black bristles. Females practically indistinguishable from those of *D. algonquin*. Eggs with two filaments which have expanded distal ends.

algonquin Sturtevant and Dobzhansky

Body length about 2.0 mm. Thorax blackish-brown with six rows of acrostichal hairs. Abdomen dark brown, lighter toward the base. Wings clear. Male sex-comb with eight to ten stout, curved black bristles. Females extremely difficult to separate from those of *D. affinis*. Eggs with two filaments.

busckii Coquillet

Body length about 2.0 mm. Thorax reddish-yellow with three longitudinal black stripes, one in each dorsocentral line and a median one which is bifed posteriorly. Acrostichal hairs in eight rows. Abdomen

yellow, each segment with a black band that is interrupted in the mid-dorsal line and between that line and each lateral margin. Male with no sex-combs. Eggs with four rather slender filaments.

hydei Sturtevant

Boly length males about 3.0 mm. and females 3.4 mm. Thorax grayish brown, each bristle and hair arising from a dark brown spot. Acrostichal hairs in eight rows. Abdomen yellow, each segment with a black band that is interrupted in the mid-dorsal line. Wings clear. Male with no sex-combs. Eggs with four long tapering filaments.

immigrans Sturtevant

Body length about 2.5 mm. Thorax is brownish-yellow with eight rows of acrostichal hairs. A row of very short stout bristles on the lower apical part of each front femur is characteristic of this species. Abdomen yellow, each segment with an interrupted black band, the band on the fourth sometimes entire. Fifth segment black. Wings clouded at the tips of the first and second veins and on posterior cross vein. Male has no sex-combs. Eggs with four short tapering filaments.

melanica paramelanica Patternson

Body length approximately 2.5 mm. Thorax brownish-black, a darker longitudinal stripe in the median region. Acrostichal hairs are in six rows. Abdomen pale yellow with a medianly interrupted apical brown band on each segment. Wings clear. Males with no sex-combs. Eggs with four long tapering filaments.

melanogaster Meigen

Body length about 2.0 mm. Thorax reddish-yellow and the acrostichal hairs in eight rows. Abdomen black, the males with a reddish-yellow band on the basal half of the first three segments, and the females with the band on the first five abdominal segments. Wings clear. Male sex-comb with about ten stout black bristles. Eggs with two filaments, each with apical half expanded.

putrida Sturtevant

Body length about 2.0 mm. Thorax brownish-yellow, the acrostichal bristles in six rows. A pair of presutural bristles located in the acrostichal rows next to the outer ones. These bristles are often small but definitely larger than the surrounding hairs. Abdomen pale yellow, each segment with a medially interrupted brown band on the posterior margin. Wings clear. Eggs have four curved tapering filaments.

quinaria Loew

Body length about 2.5 mm. The thorax is yellow with six rows of acrostichal hairs. The abdomen is yellow, each segment with four posterior black spots. The wings clouded at tips of second, third, and fourth veins as well as both cross veins. Males with no sex-combs. Eggs with three filaments.

robusta Sturtevant

Body length about 2.5 mm. Thorax dark dull-brown with four faint pollinose longitudinal stripes. Acrostichal hairs in either six or eight rows. Abdomen grayish brown, each segment with an interrupted dark brown band. Wings clear, the posterior crossvein slightly clouded. Males with no sex-combs. Eggs with four tapering filaments.

tripunctata Loew

Body length about 2.5 mm. Thorax yellowish-brown with the acrostichal hairs in six rows. Abdomen is shining yellow with an interrupted dark-brown band on the posterior margin of each of the first three segments which is characteristic of this species. Wings clouded on both cross veins and at tips of second and third veins. No sex-combs on male. Eggs with four tapering filaments.

Scaptomyza adjusta Loew

Body length about 2.0 mm. The body color variable, from pale yellow to nearly black. Wings clear with a dark spot at the tip of the third vein. Thorax with four rows of acrostichal hairs. Eggs with four rather short pointed filaments.

graminum Fallen

Body length about 2.0 mm. Thorax dark brownish with two acrostichal rows of hairs. Abdomen dark brownish. Wings clear. Males with no sex-combs. Eggs with two short thick filaments.

Chymomyza amoena Loew

Body length about 2.0 mm. Thorax yellow with eight rows of acrostichal hairs. Abdomen dark brownish. Wings with three dark areas, one at apex of first vein, one across middle and posterior crossvein, and one below apex of second vein; tip of wings white. Males without sex-combs. Eggs with eight filaments.

Conclusions

1. Of the eight genera and 31 species of Drosophilidae recorded from Indiana, only three genera and 14 species were found to be associated with tomatoes in this study. Of these *D. melanogaster* was the most abundant, comprising 64.9 per cent of all species trapped and 58.6 per cent of the adults reared from tomatoes.
2. Among the flies trapped, the males outnumbered the females, 58 to 42 per cent. However, in the flies reared the females outnumbered the males by the same percentages.
3. The banana-yeast bait was found to be significantly more attractive to Drosophilidae than the tomato bait. It attracted 66.8 per cent of all flies trapped.
4. Drosophilidae collected in this study could be placed into three groups: (1) those taken in sizable numbers throughout the season; (2) those abundant at the start of the season but scarce toward the

end; and (3) those rare in early collections but increasing in abundance as the season progressed.

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