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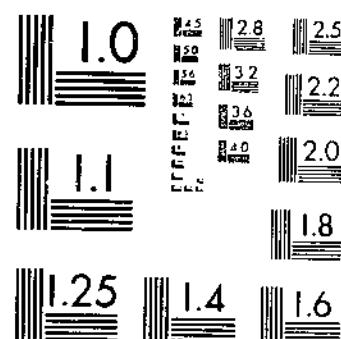
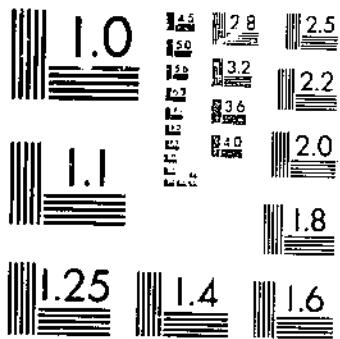
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COLLECTING INSECTS BY AIRPLANE
WITH SPECIAL REFERENCE TO
DISPERSAL OF THE POTATO LEAFHOPPER

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COLLECTING INSECTS BY AIRPLANE, WITH SPECIAL REFERENCE TO DISPERSAL OF THE POTATO LEAFHOPPER¹

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Research Service²

The annual spring appearance of the potato leafhopper (Empoasca fabae Harris) in the Northern States has caused much concern among agriculturists. Medler (1957) reported that the insect was not present in the North-Central States early in the spring but appeared each year as a migrant in April and May. He also found that high populations occurred in Florida and the Gulf States during March and April, and indicated the need for determining the routes and methods of migration from this source. To obtain further information, insect-collecting flights were made during 1957 in certain Southern and North-Central States. Records were made of other insects and spiders collected when their condition permitted identification.

AREA COVERED

Insect-collecting flights were made in sections of five States, extending from northeastern Louisiana into Mississippi, Arkansas, northern Illinois, and Indiana (fig. 1). Of 52 flights, 20 were made in the Louisiana-Mississippi-Arkansas area during the period May 8-16. Sixteen of these flights were round trips from Tallulah, La., and covered areas north along the Mississippi River to Greenville, Miss., or west to Monroe, La. Four were round trips from Helena, Ark., to West Memphis, Ark. In the Illinois-Indiana area, 32 flights were made from May 18 to June 4. Except for two flights from Highland, Ill., all of these northern flights were made from Urbana, and covered areas west to Lincoln and Peoria, north to Chicago and Gary, and southeast to Vincennes, Ind. Insect-collecting traps were exposed at various altitudes for periods of time as shown in table 1.

¹ A contribution to the North-Central Regional Cooperative Project NC-29, Migration of the Potato Leafhopper and Its Causes.

² In cooperation with the Illinois Natural History Survey Division. Most of the insect determinations were made by taxonomists of the Entomology Research Division.

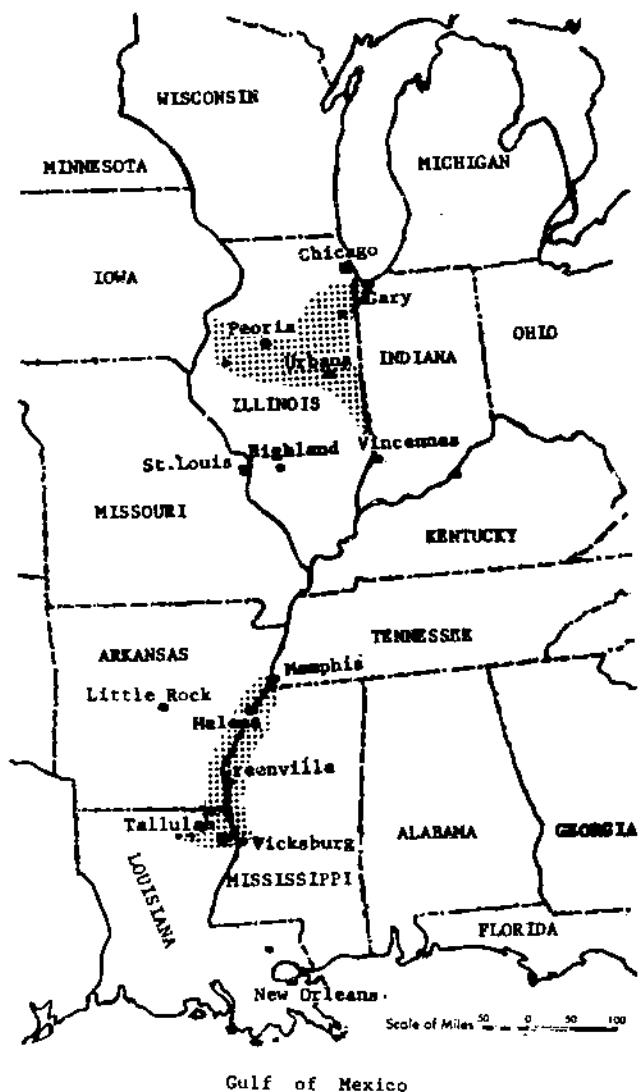


Figure 1.--Map with shaded areas indicating localities in which scheduled flights were made.

TABLE 1. --Insect abundance at various altitudes as indicated by the number taken per 10 minutes

Altitude (feet)	Louisiana-Mississippi area			Illinois-Indiana area		
	Flying time in minutes	Number of insects taken		Flying time in minutes	Number of insects taken	
		Total	Average per 10 minutes		Total	Average per 10 minutes
100.....	18	31	20.6	----	----	----
200.....	270	282	10.4	465	596	12.8
500.....	47	53	5.6	463	340	7.4
1,000.....	128	164	5.9	716	528	6.6
2,000.....	140	107	4.2	630	263	4.1
3,000.....	165	43	2.4	365	42	1.4
4,300.....	70	22	3.1	60	6	0
5,000.....	65	13	4.0	----	----	----

COLLECTION METHOD

The insect-collecting traps used on the airplane were designed by C. N. Husman.³ Two traps were used, one on each side of the plane cabin. Each trap was a net (24-mesh Dacron netting) similar in shape to a conventional sweep net. The nets were 25 inches long and had a mouth area of 1 1/2 square feet. They were fastened with snaps to ferrules inserted in grooves on steel tracks, which extended 57 inches from the fuselage (fig. 2). The upper and lower tracks were 13 inches apart at their extremity, but converged as they extended into the plane cabin. The nets could be reeled in and out of the plane by means of a steel cable controlled by a handcrank within the cabin. Following exposure, the nets were reeled in and replaced. Each net was labeled as to time of exposure and altitude, rolled up to prevent the insects from escaping, and stored in a compartment in the plane cabin. At the conclusion of each flight the nets were carefully examined and the insects removed. The cruising speed of the plane, a Piper Cub PA-12 Super Cruiser, was approximately 50 m.p.h.

INSECTS COLLECTED

Insect abundance at various altitudes, as indicated by the number taken per 10-minute exposure of the collecting traps, is shown in table 1. Collections from all areas flown included 11 orders of insects, and the orders of spiders and mites (table 2). A total of 2,528 specimens were taken, representing 94 known families, 202 genera, and 123 identifiable species, including 3 new species (table 3).

³ Supervisory equipment specialist, Animal Disease Eradication Division, Agricultural Research Service.

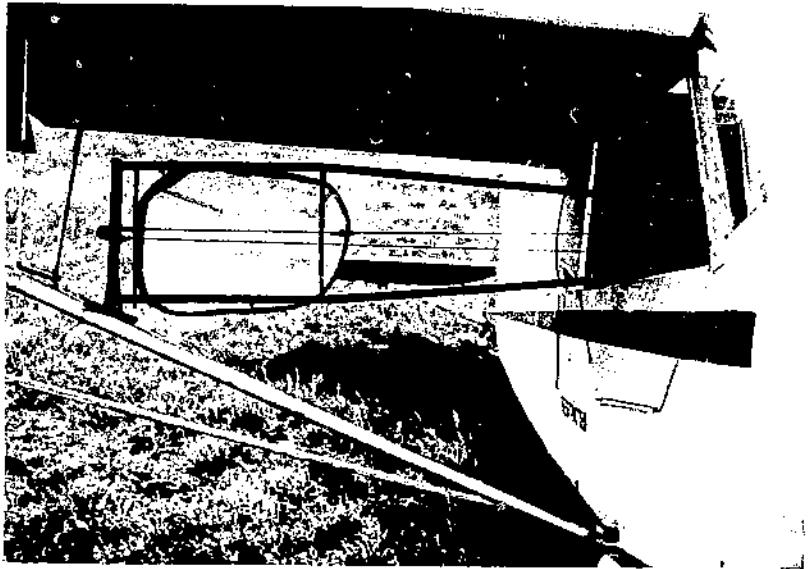


Figure 2.--Insect trap in position on plane; steel tracks extend from rear of cabin to struts of plane, with net in collecting position at end of tracks.

TABLE 2.--Numbers of insects, spiders, and mites collected by airplane, May 8 to June 4, 1957

Order	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Total	Average per 10 minutes	Total	Average per 10 minutes
Araneidae	1	1.1	0	0
Acaridae	1	1.1	0	0
Diptera	1	1.1	0	0
Isopoda	1	1.1	0	0
Pscopidae	1	1.1	0	0
Trichoptera	1	1.1	0	0
Thysanoptera	1	1.1	0	0
Hemiptera	1	1.1	0	0
Homoptera	1	1.1	0	0
Coleoptera	164	16.4	12	1.2
Lepidoptera	1	1.1	0	0
Hymenoptera	1	1.1	0	0
Diptera	102	10.2	0	0
Total	264	26.4	14	1.4
Unrecognizable forms	167	16.7	11	1.1
Grand Total	431	43.1	25	2.5
Total flying time in minutes	142		13	

The flights in the Louisiana-Mississippi-Arkansas area were made a week earlier than those in the Illinois-Indiana area. An average of 6.7 insects were collected per 10 minutes of flying time in the Illinois-Indiana area compared with 5.9 insects in the Louisiana-Mississippi-Arkansas area. Of the total specimens collected, 33 percent were unrecognizable, as compared to only 6 to 10 percent unrecognizable in traps used in the earlier flights (Glick 1939, 1957).

During the period of these flights, temperatures were higher in Louisiana, Mississippi, and Arkansas (southern area) than in Illinois and Indiana (northern area). In the

TABLE 3.--Numbers of insects, spiders, and mites collected by airplane at various altitudes, May 8 to June 4, 1957

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinoian-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
ARACHNIDA (spiders):				
Argopidae:				
Undet. sp. (Imm.).....	----	----	2,000	1
Epeiridae:				
Epeira sp.....	----	----	2,000	1
Undet. sp.....	----	----	2,000	1
Linyphiidae:				
Undet. sp.....	1,000	1	----	----
Lycosidae:				
Undet. sp.....	----	----	3,000	1
Mesaphantidae:				
Undet. sp.....	100	1	----	----
Oscinidae:				
Neon sp.....	----	----	500	2
Undet. sp.....	----	----	500	1
Tetragnathidae:				
Undet. sp.....	100	1	----	----
Theridiosomatidae:				
Undet. sp.....	----	----	200	1
Theridiidae:				
Undet. sp. (imm.).....	----	----	2,000	1
Thomisidae:				
Minixena vatin ("lurek").....	----	----	200	1
Sbo sp.....	100	1	----	----
Undet. family.....	200	1	200	3
	500	2	500	4
	1,000	2	1,000	5
	2,000	2	2,000	5
	3,000	2	3,000	4
	4,000	2	----	----
ACARINA (mites):				
Parasitidae:				
<u>parasitus</u> sp.....	----	----	2,000	1
COLLEMBOLA:				
Undet. sp.....	1,000	1	----	----
ISOPODA:				
Rhynotermidae:				
<u>Reticulitermes virginicus</u> (Banks)	20	1	----	----
DIPTERA:				
Dipteridae:				
<i>Lachesillidae</i> :				
<i>Lachesilla nubilis</i> (Aaron).....	400	3	----	----
<i>Lachesilla nubilis</i> (Aaron) (female).....	300	1	----	----
<i>Lachesilla nubilis</i> (Aaron).....	3,000	1	----	----
Cecidiliidae:				
<u>Cecidilia</u> sp.....	1,000	1	----	----
Liposcelididae:				
<u>Liposcelis</u> (tredecim) sp.....	1,000	1	----	----
TRICHOPTERA:				
Undet. sp.....	500	1	----	----
THYRANOPTERA:				
DEMBIDANTIA:				
Turripidae:				
<u>Frankliniella fusca</u> (Blatchley).....	500	1	----	----
(winged female).....	500	1	----	----
<u>Frankliniella fusca</u> (Blatchley).....	500	1	----	----
(winged male).....	500	1	----	----
Undet. sp. (larva).....	500	1	----	----
TUBULIFERA:				
Phlaeothripidae:				
<u>Elephrothrips tuberculatus</u> (Kirk).....	100	1	----	----
(winged female).....	1,000	1	----	----
<u>Elephrothrips flavipes</u> (Kirk).....	1,000	1	----	----
(winged female).....	1,000	1	----	----

(+ = 1,000,000)

TABLE 3. --Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
HEMIPTERA:				
Pentatomidae:				
<i>Anthonomus spinifrons</i> (Say).....	---	---	200	1
<i>Corisellaena pulicaria</i> (Germ.).....	---	---	200	1
<i>Corisellaena ovalis</i> (Hussey).....	---	---	200	1
	---	---	300	1
	---	---	1,000	1
<i>Geocoris robustus</i> (Wheeler).....	200	1	---	---
Lygaeidae:				
<i>Blissus leucopterus</i> (Say).....	---	---	500	3
	---	---	1,000	1
	---	---	2,000	1
<i>Cymus angustatus</i> Stal.....	---	---	500	1
	---	---	2,000	1
<i>Ischnodemus falcatus</i> (Say).....	---	---	200	1
<i>Lygaeus bimaculatus</i> (Say).....	---	---	200	1
Pleidae:				
<i>Piesma cimurea</i> (Say).....	---	---	200	2
Tingidae:				
<i>Corythucha celtidis</i> C. & R.....	---	---	200	2
Anthocoridae:				
<i>Crius insidiosus</i> (Say).....	1,000	2	500	2
	2,000	1	1,000	2
Miridae:				
<i>Lycus lineolaris</i> (P. de G.)				
(4th instar).....	2,000	1	---	---
<i>Chiayciatus assertatus</i> (Wheeler).....	---	---	200	1
<i>Selenotrichus flavovittatus</i> (Wheeler).....	---	---	200	1
Calidae:				
<i>Micracanthia husseyi</i> Drake & Chapman.....	1,000	2	---	---
	2,000	1	---	---
<i>Salduia pullipes</i> (female).....	---	---	500	1
HOLOPTERA:				
Membracidae:				
<i>Microtalis calva</i> (Say).....	200	1	---	---
Cicadellidae:				
<i>Aceratogallia ulmi</i> V. D.....	2,000	1	---	---
<i>Aceratogallia</i> sp.....	1,000	1	200	1
<i>Gallia constricta</i> V. L. (female).....	---	---	500	1
<i>Diticephalus</i> sp. (undet).....	1,000	1	---	---
<i>Eposcea bifurca</i> Del. (female).....	100	1	3,000	1
	400	1	---	---
<i>Eposcea erigeron</i> Del. (male).....	4,000	1	---	---
<i>Eposcea tubae</i> (Harr.) (male).....	100	1	4,000	1
<i>Eposcea tubae</i> (Harr.) (female).....	100	1	100	2
	1,000	1	500	2
	2,000	1	1,000	7
	4,000	1	1,000	2
<i>Eposcea</i> sp. (male).....	400	1	---	---
<i>Eposcea</i> sp. (female).....	4,500	1	---	---
<i>Epondaea</i> sp. (sex ?).....	200	1	---	---
<i>Psylloborus exticinus</i> (Hbl.) (male).....	2,000	1	---	---
<i>Psylloborus exticinus</i> (Hbl.) (female).....	2,000	1	---	---
<i>Trachinella nigritricta</i> (Forbes).....	4,000	1	---	---
<i>Tatulus</i> sp.	---	---	200	1
<i>Macrosteles</i> sp. (female).....	200	1	---	---
<i>Hesotyles</i> sp.	---	---	1,000	1
<i>Encyrtidae</i> undata (Fab.) (female).....	---	---	500	1
<i>Psamnotettix striatus</i> (L.) (male).....	---	---	100	1
<i>Psamnotettix striatus</i> (L.) (female).....	---	---	100	1
<i>Cyphacolybius</i> sp. undet.....	---	---	500	1
Undet. sp. (female).....	---	---	100	1
Pulicidae:				
Doliphacidae:				
<i>Doliphacodes bacivitta</i> (V.B.) (male).....	200	4	200	2
<i>Doliphacodes pilosus</i> (V.B.) (male).....	---	---	200	1
<i>Doliphacodes pacifica</i> (V.B.) (male).....	100	1	100	1
<i>Doliphacodes</i> sp. (male).....	500	1	---	---
<i>Doliphacodes</i> sp. (female).....	200	1	500	1
	---	---	1,000	1

(continued)

TABLE 3.--Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
HOPOPTERA: (continued)				
<i>Dolphacidae</i> sp. undet. (female).....	200	1	----	----
	500	1	----	----
<i>Liburniella ornata</i> (Stål) (male).....	100	1	200	1
<i>Liburniella ornata</i> (Stål) (female).....	----	----	1,000	1
	----	----	2,000	1
Psyllidae:				
<i>Aphalaria curta</i> Cald.....	----	----	200	1
	----	----	500	1
<i>Neotriozella pyrifolia</i> (Forbes).....	1,000	1	200	1
	----	----	1,000	1
<i>Neotriozella</i> sp.....	----	----	500	1
<i>Triozella diospyri</i> (Asha).....	2,000	2	----	----
	3,000	2	----	----
	4,000	1	----	----
<i>Triozella minute</i> Crumf.....	200	10	500	1
	3,000	6	1,000	1
	4,000	3	2,000	1
Aphididae:				
<i>Aphis</i> sp.....	100	1	----	----
	200	2	----	----
<i>Tribe Aphini</i> sp.....	1,000	1	----	----
	200	3	200	7
	500	1	1,000	1
	1,000	1	----	----
	2,000	1	----	----
	3,000	2	----	----
<i>Capsidaphorus</i> sp.....	200	1	----	----
<i>Eriosoma</i> sp.....	----	----	500	1
<i>Macrosiphum granarium</i> (Aty).....	200	3	----	1
	500	2	500	3
	4,000	1	1,000	5
	----	----	2,000	2
	----	----	3,000	1
<i>Macrosiphum pisi</i> (Barrio).....	200	23	200	1
	500	2	----	----
	1,000	7	----	----
	2,000	3	----	----
	3,000	1	----	----
	4,000	2	----	----
<i>Macrosiphum</i> sp.....	100	1	----	1
	200	1	500	1
	1,000	3	1,000	1
	2,000	1	----	----
	3,000	1	----	----
<i>Myzocallis</i> sp.....	----	1	200	1
<i>Tribe Psyllophini</i> sp. undet.....	----	----	1,000	1
<i>Tribe Psyllophini</i> sp. undet.....	200	1	500	1
<i>Thripsophilum fitz-hii</i> (and).....	2,000	2	1,000	1
<i>Thripsophilum refabdominalis</i> (Kasai).....	----	1	----	----
	500	2	----	----
	1,000	1	----	----
	2,000	1	----	----
	3,000	1	----	----
<i>Thripsophilum</i> sp.....	200	2	500	1
	1,000	1	1,000	1
	2,000	2	----	----
	3,000	1	----	----
<i>Therioaphis (Pterocallidium) trifolii</i> (Kra).....	400	8	200	1
	200	1	----	----
	1,000	1	----	----
<i>Therioaphis</i> sp.....	----	----	200	1
<i>Undet.</i> sp.....	1,000	1	200	1
	----	----	1,000	1
	----	----	2,000	1
	----	----	3,000	1
COLEOPTERA:				
<i>Carabidae:</i>				
<i>Azonum cupripenne</i> Say.....	----	----	500	1
	----	----	1,000	1
<i>Amara</i> sp.....	----	----	1,000	1
<i>Blethisa americana</i> (L).....	----	----	500	1
	----	----	1,000	1
<i>Caenocnemis pennsylvanica</i> L.....	----	----	1,000	2
<i>Harpalus</i> sp.....	----	----	500	1

(cont'd.)

TABLE 3. --Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
COLEOPTERA: (continued)				
<i>Stenolophus conjunctus</i> Say.....	---	---	200	1
<i>Stenolophus</i> sp.....	---	---	2,000	1
Undet. sp.....	---	---	200	1
500			500	3
Hydrophilidae:				
Undet. sp.....	200	1	---	---
Staphylinidae:				
<i>Aleochara</i> sp.....	---	---	500	1
<i>Aleocharinae</i> undet. sp.....	---	---	1,000	11
200			200	5
500			1,000	9
1,000			1,000	2
<i>Carpalinus</i> sp.....	---	---	200	1
<i>Iathrobium</i> sp.....	---	---	200	1
Near <i>Malloim</i> sp.....	---	---	200	1
<i>Paeaderus</i> sp.....	---	---	200	1
1,000			1,000	1
<i>Phrionthrus</i> sp.....	---	---	200	3
<i>Platystethus</i> sp.....	---	---	1,000	1
<i>Scopaeus</i> sp.....	---	---	500	1
<i>Stenus punctatus</i> Fr.....	---	---	200	12
500			500	12
1,000			1,000	18
2,000			2,000	3
<i>Stenus</i> sp.....	---	---	200	3
500			500	4
1,000			1,000	6
2,000			2,000	4
3,000			3,000	4
<i>Tachyporus</i> sp.....	200	1	200	1
500			500	1
1,000			1,000	2
2,000			2,000	15
500			500	3
1,000			1,000	10
2,000			2,000	1
500			200	2
Scaphidiidae:				
<i>Scaphidium</i> sp.....	200	2	---	---
Histeridae:				
<i>Hister</i> sp.....	---	---	200	1
Mordellidae:				
Undet. sp.....	200	1	---	---
Anthicidae:				
Undet. sp.....	---	---	200	1
<i>Notomus</i> sp.....	---	---	3,000	1
Materidae:				
<i>Acilius</i> sp.....	---	---	1,000	1
<i>Conchofera</i> sp.....	---	---	1,000	1
Helodidae:				
Undet. sp.....	200	1	---	---
Lathrididae:				
<i>Melanophthalma</i> (<i>Corbicaria</i>) sp.....	200	1	200	1
500			1,000	1
3,000			1,000	1
<i>Melanophthalma</i> (<i>Melanophthalma</i>) sp.....	---	---	200	1
---			500	1
---			1,000	1
---			2,000	3
---			3,000	1
Nitidulidae:				
<i>Carpophilus</i> sp. <i>dimidiatus</i>	---	---	1,000	1
'complex (female)'	---	---	200	1
<i>Carpophilus</i> sp.....	---	---	1,000	1
Phalacridae:				
Undet. sp.....	---	---	200	1
1,000			1,000	2
Bacchiniidae:				
<i>Golosomella maculata</i> (DeGeer).....	---	---	400	2
---			500	1

(continued)

TABLE 3.--Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Altitude (ft.)	Number	Altitude (ft.)	Number
COLEOPTERA: (continued)				
<i>Cycloneura munda</i> (Say).....	---	---	200	1
<i>Hippodamia convergens</i> Goeze.....	1,000	1	200	2
<i>Hippodamia parenthesis</i> (Say).....	---	---	500	2
<i>Seymous (fulvus) lewisi</i> Muls.....	100	1	1,000	1
	100	1	----	1
Scutaeidae:				
<i>Abrodius granarius</i> (L.).....	----	----	200	1
Chrysomelidae:				
<i>Altica sp.</i>	400	1	----	----
<i>Alticinat undat. sp.</i>	1,000	1	1,000	1
<i>Cerotoma trifurcata</i> (Forst.).....	----	----	500	1
	----	----	1,000	2
	----	----	3,000	1
<i>Chaetocnema pulicaria</i> Walsh.....	----	----	200	1
<i>Epitrix sp. prob. acuminata</i> Harr.....	----	----	200	1
<i>Epitrix sp. prob. hirtipennis</i> Walsh.).....	----	----	200	1
	----	----	500	1
<i>Glyptina sp.</i>	----	----	2,000	1
<i>Mantura floridana</i> L.....	----	----	200	1
Bruchidae:				
<i>Bruchus sp. (femal.)</i>	100	1	----	----
Anthribidae:				
<i>Prochylactes sp.</i>	1,000	1	----	----
Drosophilidae:				
<i>Anthomyzus grandis</i> Boh.....	200	1	----	----
<i>Anthomyzina undat. sp.</i>	----	1	2,000	1
<i>Ceutorhynchus pallidactylus</i> L.....	----	1	1,000	1
<i>Hylobilini undat. sp.</i>	----	----	500	1
<i>Mimobaris sp.</i>	100	1	----	----
<i>Sitona cylindricollis</i> Thun.....	500	1	250	1
Tecolitidae:				
<i>Ips sp.</i>	1,000	1	----	----
Lepidoptera:				
Phalaenidae (Noctuidae):				
<i>Pseudaletia separata</i> Haw.....	----	----	200	1
Pyralidae:				
<i>Undet. sp. (female)</i>	----	----	100	1
Tischeriidae:				
<i>Frob. Tischeria sp.</i>	----	----	1,000	1
HYMENOPTERA:				
Bracidae:				
<i>Apanteles ensiger</i> (Say).....	----	----	1,000	1
<i>Apanteles griffini</i> Viér.....	----	10	200	1
<i>Apanteles militaris</i> (Walsh).....	100	10	200	1
	1,000	10	1,000	1
	1,000	10	1,000	1
	2,000	10	2,000	1
<i>Apanteles sp.</i>	----	----	100	1
	----	----	200	1
	----	----	1,000	1
<i>Aphelinus auripes</i> Prov.....	----	----	1,000	1
<i>Aphytis obscuricornis</i> Ashm.....	1,000	1	100	1
<i>Aphytis sp.</i>	1,000	1	100	1
	1,000	1	1,000	1
<i>Bracon sp.</i>	1,000	1	1,000	1
<i>Bracon fumiferana</i> Ashm.....	----	----	1,000	1
<i>Bracon syringae</i> Prov.....	----	----	100	1
<i>Bracon n. sp.</i>	----	----	100	1
<i>Bracon sp.</i>	1,000	1	100	1
<i>Bucculatrix burkeiatriaria</i> Ashm.....	----	----	100	1
<i>Opius sp.</i>	1,000	1	100	1
	1,000	1	1,000	1
<i>Phaenoserpa s. sp.</i>	200	1	100	1

TABLE 3. --Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
HYMENOPTERA: (continued)				
<i>Phanerotoma fasciata</i> Prov.	1,000	1	---	---
<i>Phanerotoma longicauda</i> Valley.	200	1	---	---
<i>Pruon simulans</i> (Prov.)	---	---	200	9
	---	---	500	4
	---	---	1,000	4
	---	---	2,000	1
	---	---	3,000	1
<i>Praon</i> sp.	---	---	1,000	1
Ichneumonidae:				
<i>Cryptus</i> sp. (female).	---	---	2,000	1
<i>Diplazon laetatorius</i> (F.) (female).	1,000	1	---	---
	2,000	1	---	---
<i>Diplazon</i> sp.	---	---	2,000	1
<i>Echeluryus</i> sp. (female).	---	---	200	1
<i>Hemiteles</i> sp. undet.	1,000	1	---	---
<i>Hormoneurus</i> sp. (female).	---	---	200	1
<i>Melanichneumon</i> sp. (female).	2,000	1	---	---
<i>Macroleptinae</i> sp. undet. (female).	---	---	1,000	1
<i>Platiscinidae</i> sp. undet. (female).	---	---	200	1
<i>Proscus</i> sp. (female).	---	---	1,000	1
<i>Eleopteryx</i> sp.	1,000	1	1,000	1
<i>Ichneumoninae</i> sp. undet. (male).	---	---	500	1
Dipteridae:				
<i>Synolyma</i> sp. (female).	2,000	1	---	---
Bulophidae:				
<i>Bulophorus somaticus</i> New.	2,000	1	---	---
<i>Pringalis</i> sp. (Female).	---	---	500	1
<i>Kleminia breviflora</i> (Ashm.) (female).	500	1	---	---
<i>Sympiesis</i> sp. (Female).	---	---	200	1
<i>Tetrastichus</i> sp. (female).	---	---	500	1
	---	---	1,000	1
	---	---	1,000	1
Empididae:				
<i>Dioplosilus</i> sp. (female).	---	---	1,000	1
<i>Dioplosilidae</i> , unknown genus (female).	1,000	1	---	---
<i>Ind. sp.</i>	---	---	1,000	1
Forficulidae:				
<i>Forficula</i> sp. (female).	---	---	1,000	1
<i>Forficula rostrata</i> (Hab.) (female).	1,000	1	---	---
<i>Forficula</i> sp. (male).	1,000	1	---	---
<i>Torvula</i> sp. (female).	1,000	1	500	1
	---	---	1,000	1
	---	---	1,000	1
Omyiidae:				
<i>Omyia</i> sp. (female).	---	---	500	1
St. cecididae:				
<i>Aegiphilus fletcheri</i> (Whi.) (f. male).	---	---	50	1
<i>Aegiphilus bicarinata</i> (Felt).	---	---	500	1
<i>Microterus pluratus</i> (Sefi.) (female).	---	---	500	1
<i>Microterus</i> sp. (f. male).	1,000	1	---	---
<i>Microterus hantanei</i> (WPD.) (f. male).	---	---	1,000	1
<i>Microterus</i> sp. (f. male).	---	---	50	1
	50	1	500	1
<i>Microterus</i> sp. undet. (f. male).	50	1	500	1
<i>Microterus</i> sp. (f. male).	1,000	1	---	---
<i>Microterus</i> sp. (f. male).	1,000	1	500	1
<i>Microterus</i> sp. (f. male).	1,000	1	500	1
<i>Microterus</i> sp. (f. male).	1,000	1	500	1
<i>Microterus</i> sp. (f. male).	1,000	1	500	1
<i>Microterus</i> sp. (f. male).	1,000	1	500	1
<i>Microterus</i> sp. (f. male).	1,000	1	500	1
Trichogrammatidae:				
<i>Trichogramma evanescens</i> (Litch.) (female).	3,000	1	---	---
<i>Trichogramma grandis</i> (Litch.) (female).	---	---	1,000	1
Yapigidae:				
<i>Psyllophilus</i> sp.	---	---	500	1
<i>Psyllophilus</i> sp. (female).	---	---	500	1

(C.2.311, 201)

TABLE 3.--Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
HYMENOPTERA: (continued)				
Cynipidae:				
<u>Ceropales</u> sp. (females).....	----	----	500	3
----	----	----	2,000	1
----	----	----	200	1
<u>Ceropales</u> sp.....	----	1	----	----
<u>Neuroterus</u> sp. (female).....	1,000	1	----	----
Ceraphronidae:				
<u>Ceraphron</u> sp.....	----	----	200	1
Diespididae:				
<u>Monelina</u> n. sp.....	200	1	----	----
Encyrtidae:				
<u>Trissacantha</u> sp.....	----	----	200	1
Formicidae:				
<u>Crematogaster</u> sp. (males).....	200	4	1,000	1
Halticidae:				
<u>Halticus (Chloralictus)</u> sp. (males).....	2,000	1	----	----
Apidae:				
<u>Apis mellifera</u> L. (male).....	3,000	1	----	----
DIPTERA:				
Agromyzidae:				
<u>Coradontha dorsalis</u> (Lw.).....	200	1	200	3
500	2	500	2	
1,000	2	1,000	4	
2,000	2	2,000	1	
3,000	3	----	----	
4,000	1	----	----	
<u>Agromyza</u> sp.....	1,000	1	----	----
2,000	1	----	----	
3,000	1	----	----	
<u>Triomyza</u> sp.....	----	----	200	1
<u>Melanagromyza</u>	3,000	1	----	----
Anthomyzidae:				
<u>Anthomyza</u> sp.....	1,000	1	1,000	1
<u>Minioptera occipitalis</u> Mel.....	200	6	200	11
500	1	500	11	
1,000	2	1,000	6	
2,000	1	2,000	8	
4,000	1	----	----	
Undet. sp.....	200	1	----	----
Borboridae:				
<u>Scatophora carolinensis</u> R.C.....	----	----	500	1
Chloropidae:				
<u>Chlorops certima</u> Ad.....	----	----	200	1
<u>Miltogramma</u> sp.....	----	1	1,000	1
<u>Elachiptera continua</u> (Lw.).....	200	1	200	3
<u>Elachiptera nigricornis</u> (Lw.).....	----	----	500	1
<u>Elachiptera</u> sp.....	100	1	----	----
<u>Eribolus longulus</u> (Lw.).....	----	----	200	1
<u>Hippelates pallipes</u> (Lw.).....	----	----	200	2
<u>Hippelates particeps</u> (Berk.).....	----	----	1,000	1
100	1	----	----	
500	3	----	----	
1,000	2	----	----	
2,000	2	----	----	
<u>Hippelates pusio</u> Lw.....	----	----	1,000	1
<u>Hippelates</u> sp.....	100	1	----	----
<u>Laelocina</u> sp.....	----	----	200	1
<u>Oscinella carbonaria</u> (Lw.).....	----	----	200	1
<u>Spirifilla neoxenix</u> Adbr.....	100	1	----	----
<u>Oscinella</u> sp.....	100	2	200	2
1,000	4	400	1	
2,000	7	1,000	2	
3,000	1	----	----	
<u>Thaumatomyia glabra</u> (Mg.).....	----	----	200	11
----	----	500	1	
----	----	1,000	1	
<u>Thaumatomyia</u> sp.....	1,000	1	200	1
Undet. sp.....	1,000	1	----	----
Delphacidae:				
<u>Aedes vexans</u> (Mg.).....	----	----	1,000	1
Undet. sp.....	----	----	1,000	1

(L.S. & H.A. 1941)

TABLE 3.--Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinoian-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
DIPTERA: (continued)				
Dolichopodidae:				
<u>Donomylostylus</u> sp.....	----	----	200	1
<u>Dolichopus</u> sp.....	200	1	1,000	1
<u>Litotarsus</u> sp.....	----	----	1,000	1
<u>Unst.</u> spp.....	1,000	1	2,000	1
	3,000	1	200	2
			1,000	2
Drosophilidae:				
<u>Brachyphila</u> sp.....	200	1	200	2
	----	----	500	2
<u>Scaptozyga</u> <u>adjusta</u> (Dr.).....	200	1	1,000	2
<u>Scaptozyga</u> <u>Pratinum</u> (Fallén).....	----	----	1,000	12
<u>Scaptozyga</u> sp.....	200	7	200	7
	1,000	4	500	6
	3,000	1	1,000	13
	----	----	2,000	11
			3,000	6
Empididae:				
<u>Tachytrechus</u> sp.....	----	----	200	2
Iphydriidae:				
<u>Hydina</u> <u>albovenosa</u> Coo.....	1,000	1	----	----
<u>Hydina</u> sp.....	200	2	----	----
	2,000	2	----	----
<u>Hydrellia</u> <u>griseola</u> (Fallén).....	----	----	500	4
<u>Hydrellia</u> sp.....	3,000	1	1,000	3
	----	----	500	5
			1,000	3
<u>Integramaster</u> <u>gravida</u> L.....	----	----	2,000	1
<u>Integramaster</u> sp.....	2,000	2	200	1
<u>Parydra</u> sp.....	1,000	1	500	1
	2,000	1	200	1
<u>Philyzia</u> <u>debilis</u> L.....	200	3	3,000	1
	1,000	3	200	21
	----	----	500	13
			1,000	36
			2,000	12
<u>Seatulla</u> <u>picea</u> (Walk.).....	----	----	3,000	2
			200	5
			500	3
			1,000	4
			2,000	2
<u>Seatulla</u> sp.....	----	----	3,000	1
			200	11
			500	9
			1,000	9
			5,000	1
Polycentropidae:				
<u>Polycentrus</u> sp.....	----	----	1,000	1
<u>Purcilia</u> sp.....	200	1	----	----
<u>Hymosia</u> sp.....	----	----	200	1
Heleidae:				
<u>Atrichopogon</u> sp.....	500	1	200	1
<u>Dasyhylea</u> sp.....	500	1	----	----
Itemidae:				
<u>Anarete</u> sp.....	----	----	200	1
<u>Prob. Torriconymyla</u> sp.....	200	1	----	----
Lycoidae:				
<u>Bremyi</u> sp.....	100	3	200	9
	200	28	500	4
	500	16	1,000	5
	1,000	6	2,000	5
	2,000	2	3,000	1
	4,000	2	----	----
	5,000	1	----	----
Musciidae:				
<u>Geronotus</u> (<u>Geronotus</u>) sp.....	3,000	1	1,000	1
	5,000	1	----	----
<u>Hydomya</u> sp.....	200	1	500	1
	2,000	1	1,000	3
	5,000	2	2,000	5
<u>Hylemya</u> sp. No. 1.....	----	----	1,000	1

(continued)

TABLE 3.--Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
Diptera: (continued)				
<i>Hylemya</i> sp. No. 2.....	---	----	1,000	1
<i>Lipe</i> sp.....	1,000	1	----	----
	5,000	1	----	----
<i>Phoniota</i> sp.....	---	----	200	1
	---	----	1,000	1
Phoniinae, gen. sp. undet.....	200	1	----	----
	5,000	1	----	----
<i>Schoenomyza dorsalis</i> (Lw.).....	1,000	1	500	3
	---	----	1,000	7
	---	----	2,000	6
	---	----	3,000	2
<i>Schoenomyza</i> sp.....	---	----	200	1
Otitidae:				
<i>Chaetopsia fulvifrons</i> (Macq.).....	200	1	200	1
Phoridae:				
<i>Megasselina</i> sp.....	---	----	500	1
	---	----	1,500	1
Undet. app.....	1,000	1	1,000	1
	2,000	1	1,000	2
Scatopsidae:				
<i>Scatops fusipes</i> Ig.....	1,000	1	----	----
Sciomyzidae:				
<i>Dicytus</i> sp.....	---	----	1,000	1
<i>Pherbellia nana</i> (Fall.).....	2,000	1	----	----
	3,000	1	----	----
<i>Pherbellia</i> sp.....	5,000	2	----	----
Sepsidae:				
<i>Sepsis punctum</i> (female).....	200	1	500	1
	1,000	1	4,000	1
	2,000	1	2,000	1
<i>Sepsis</i> sp.....	---	----	500	1
	---	----	1,000	1
Sphaeroceridae:				
<i>Leptocera acutangula</i> (Dett.).....	200	1	----	----
<i>Leptocera fontinalis</i> (Fall.).....	100	1	500	1
	200	1	500	1
	500	1	1,000	1
	1,000	1	2,000	1
<i>Leptocera</i> sp.....	100	1	200	1
	200	1	500	1
	500	1	1,000	1
	1,000	1	2,000	1
	2,000	1	3,000	1
	3,000	1	----	----
Stratiomyidae:				
Indet. sp.....	200	1	----	----
Syrphidae:				
<i>Allograpta obliqua</i> (Say).....	5,000	1	200	1
	---	----	400	1
<i>Mesograpta seminata</i> (Say).....	200	1	1,000	1
	---	----	2,000	1
<i>Mesograpta marginata</i> (Say).....	100	1	200	1
	200	1	500	1
	1,000	13	1,000	10
	2,000	12	2,000	3
	3,000	1	3,000	1
<i>Mesograpta</i> sp.....	4,000	1	----	----
	100	1	200	1
	1,000	1	500	1
	---	----	1,000	1
	---	----	3,000	1
	---	----	4,000	1
<i>Melanostoma</i> sp.....	---	----	200	1
<i>Philygria debilis</i> Lw.....	200	5	----	1
<i>Sphaerophoria</i> sp.....	---	----	1,000	1
Tendipedidae:				
<i>Cricotopus</i> sp.....	100	2	400	1
	200	3	500	1
	2,000	1	1,000	1
	---	----	2,000	1
<i>Pentaneura</i> sp.....	200	2	----	----

(continued)

TABLE 3. --Continued

Order, family, genus, and species	Louisiana-Mississippi-Arkansas		Illinois-Indiana	
	Altitude (feet)	Number	Altitude (feet)	Number
Diptera: (continued)				
<u>Tendipes</u> sp.....	---	---	1,000	5
<u>Under</u> . spp.....	---	---	200	3
	---	---	100	2
	---	---	1,000	1
	---	---	2,000	1
Tephritidae:				
<u>Trupanea</u> sp.....	---	---	200	1
Tipulidae:				
<u>Limonia divisa</u> Alex.	---	---	1,000	4
<u>Limicia</u> sp.....	---	---	500	1
<u>Sciapus curvus</u> (Walker).....	---	---	200	1
	---	---	500	14
	---	---	1,000	21
	---	---	2,000	22
	---	---	3,000	5
Tylidae:				
<u>Paracolletari pallipes</u> (Say).....	---	---	200	1
Mutillidae unidentified insects.....	100	12	100	259
	200	15	200	133
	500	15	500	156
	1,000	27	1,000	102
	1,500	16	1,500	35
	2,000	1	2,000	----
	3,000	1	3,000	----
Total insects collected.....	100	37	100	190
	200	22	200	126
	500	53	1,000	114
	1,000	27	1,500	125
	1,500	10	2,000	51
	2,000	41	2,000	----
	3,000	1	3,000	----
	4,000	1	4,000	----
	5,000	13	5,000	----

northern area there was a wide diurnal variation in temperature. On most days these variations were 25 to 35 degrees; for example, a range from a morning low of 46° to an afternoon high of 75° F. In the southern area, the morning temperatures were higher with less difference between daily extremes. The surface temperatures and average number of insects collected per 10-minute trap exposure are given in table 4.

TABLE 4. --Surface temperature and average number of insects collected per 10-minute exposure of traps

Area and date	Average temperature			Number of insects collected		
	Max. temp.	Min. temp.	Avg. temp.	Max. no.	Min. no.	Avg. no.
Southern, May 4-16.....	70	45	55	4,440	-----	4,440
Northern, May 12-June 4.....	70	45	55	1,020	100	400

Owing to the large and widely separated areas covered in these flights, the meteorological data were not sufficient for any one locality to warrant a detailed discussion and evaluation.

POTATO LEAFHOPPER

Many specimens of Empoasca fabae have been taken in previous airplane collections. In the Louisiana collections during 1926 to 1931 (Glick 1939), 19 were taken at altitudes from 20 to 5,000 feet, and 1 at 7,000 feet. In flights in the lower Rio Grande Valley at Brownsville, Tex., in 1954, one fabae was collected at 500 feet (Glick 1957). In 1956, collecting flights were made from August to October in central and northeastern Texas, in the Red River Valley from Shreveport, La., to Texarkana, Ark., and into southeastern Oklahoma, primarily to determine the dispersal flight of the pink bollworm moth (unpublished). In these flights, 44 specimens of fabae were taken—21 at 200 feet, 4 at 500 feet, 9 at 1,000 feet, and 10 at 3,000 feet. During two flights made on June 17 and 18, 1957, near Brownsville, Tex., three Empoasca spp. were taken, one each at 200, 500, and 1,000 feet.

During the 52 flights reported herein, 28 specimens of Empoasca spp. were taken, 17 in the Illinois-Indiana area and 11 in the Louisiana-Mississippi-Arkansas area. The collections included three known species, of which 21 specimens were fabae, at altitudes from 200 to 4,000 feet (table 3). The majority of these were collected in the morning flights.

Decker (1957) reported that while the number of specimens in the airplane collections was small, the times and elevations at which they were taken correlated closely with other data and thus strengthened the evidence of migration. He reported some apparent potato leafhopper migration out of the lower Mississippi Delta at and below Baton Rouge in late January and early February 1957. Further intermittent migrations northward occurred during April, as indicated by light-trap and air-sock⁴ collections, and by sweepings.

SUMMARY

In a study of the movement of the potato leafhopper (Empoasca fabae Harris), a series of airplane insect-collecting flights were made at altitudes of 100 to 5,000 feet, from May 8 to June 4, 1957, covering areas in northeastern Louisiana along the Mississippi River into Mississippi and Arkansas, and then into central and northern Illinois and Indiana.

During the 52 flights made, 2,528 insects were collected, representing 94 known families, 202 genera, and 123 identifiable species.

Twenty-eight specimens of Empoasca spp. were taken, of which 21 were fabae, collected at altitudes from 200 to 4,000 feet. These potato leafhopper collections strengthened other data obtained by the Illinois Natural History Survey, indicating a definite pattern of dispersal and migration of the insect to the North-Central States from the Mississippi Delta.

⁴ Air-sock collecting nets, as used by the Illinois Natural History Survey Division, were placed as high above the ground as practicable.

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