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BIOLOGICAL STUDIES ON THREE  
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**JOHN JUNE DAVIS**

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TECHNICAL SERIES, NO. 12, PART VIII.

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

MISCELLANEGUS PAPERS.

BIOLOGICAL STUDIES ON THREE SPECIES OF  
APHIDIDÆ.

By JOHN JUNE DAVIS.

*Of the University of Illinois, Urbana, Ill.*

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## MISCELLANEOUS PAPERS.

### BIOLOGICAL STUDIES ON THREE SPECIES OF APHIDIDÆ.

By JOHN JUNE DAVIS,

*Of the University of Illinois, Urbana, Ill.*

#### INTRODUCTION.

This paper deals principally with the biology of three of our commoner species of aphides, and includes descriptions of the different forms in all their various stages, as well as a complete bibliography of these species.

I have carried on these rearing experiments for the past two years in the insectary of the State entomologist of Illinois, Dr. S. A. Forbes. Practically all of the data here given, however, were obtained in 1906.

I am especially under obligations to Doctor Forbes, under whose direction I have made the experiments—those relating to *Aphis maidi-radici* while serving as his assistant; to Dr. J. W. Folsom, who has aided me on all parts of this paper, and to Prof. F. M. Webster, who read the manuscript and made helpful suggestions.

#### THE CORN ROOT-APHIS.

(*Aphis maidi-radici* Forbes.)

#### GENERAL ACCOUNT.

The corn root-aphis was first recognized by Benjamin Dann Walsh, who found it, in 1862, at Rock Island, Ill., where it was doing considerable damage to a small field of corn. At that time it was supposed by Mr. Walsh to be a root form of the common corn leaf-aphis (*Aphis maidis* Fitch), which lives on the upper parts of the corn plant, while the corn root-aphis, as the name would indicate, lives on the roots.

Dr. S. A. Forbes first began the study of this root-aphis in 1883, and most of the facts now known relating to its life history, ecology,

and economic control have been obtained by him or under his supervision. When he began the study of this aphid, it was believed to be merely the root form of the corn leaf-aphid. Failing after many elaborate experiments to breed either from the other, and repeatedly tracing the complete life history of the root-aphid year after year with no appearance of the leaf-aphid at any time in the series, he regarded the corn root-aphid as a distinct species, and described it as such in 1891, in the Seventeenth Report of the State Entomologist of Illinois.

The insect has, of late years, become of great economic importance, not only in Illinois, but also in many other States of the corn belt. Outside of Illinois it has been reported as injuring corn in New York, New Jersey, Maryland, Virginia, West Virginia, Ohio, Indiana, Minnesota, Iowa, Missouri, Nebraska, Kentucky, Mississippi, Louisiana, and Colorado.

#### FOOD PLANTS.<sup>a</sup>

Although corn is its principal food plant, the corn root-aphid attacks also sorghum and broom corn; has been reported as attacking the roots of squash vines in Delaware and Ohio, and what is at present considered as this species has been found on the roots of numerous weeds and grasses, namely, smartweed (*Polygonum incarnatum*), knotweed (*P. persicaria*), crab grass (*Panicum*), purslane (*Portulaca oleracea*), dock (*Rumex crispus* and *R. altissimus*), *Setaria glauca*, *S. viridis*, *S. germanica*, fleabane (*Erigeron canadense*), mustard (*Brassica nigra*), sorrel (*Oxalis stricta*), plantain (*Plantago major* and *P. rugellii*), pigweed (*Amarantus hybridus*), and ragweed (*Ambrosia trifida*). In May, 1907, Mr. E. O. G. Kelly found it on wheat roots in a field which had been in corn the previous year. It has also been collected on the roots of cultivated aster, upon which I have found it to be of much economic importance in Illinois.

#### LIFE HISTORY.

Last year (1906) I obtained the complete life history of this corn root-aphid from the egg stage in spring to the egg in autumn. The vivaria which I used for the rearing and observation of this root aphid consisted of 8-dram or 10-dram glass vials, each containing a ball of moist cotton in the bottom and plugged at the top with a piece of cotton. In this cage a sprouting corn plant was placed, a reserve supply of these food plants being constantly kept for use. The first young and the last young of each generation were placed on corn roots in separate vials, and these vials were kept in closed boxes to exclude

<sup>a</sup> The scientific names of plants throughout this paper are given according to the nomenclature of Gray, in deference to the author's wishes.—Ed.



light, thus giving conditions probably most favorable to the optimum development of the aphid. As soon as the plant began to wilt it was replaced by a fresh one, the aphides being transferred thereto by means of a camel's-hair brush.

During the life cycle of this aphid there appear five different forms, namely, winged viviparous females, wingless viviparous females, oviparous females, males, and eggs. Briefly, the life history is as follows: From the eggs, which have been found hatching in the field between April 8\* and May 22, from 10 to 22 generations may follow. These generations are all viviparous from spring until the latter part of September or in October, according to conditions of temperature, etc. The last generation of the season is known as the oviparous generation, and consists of males—wingless only, so far as known—and oviparous wingless females. The males and females pair, and the females lay eggs, usually during the months of October and November, the eggs not hatching until the following spring.

Now follows a detailed account of the life history as worked out by me in 1906. Eggs collected at Elliott, Ill., April 12, 1906, in the nests of the common brown ant (*Lasius niger* L., var. *americanus* Emery) were placed in a cage in our insectary April 16. They were first noticed to be hatching April 17. Young aphides hatching April 18 and 19 were placed on corn roots in the previously-described vials, and two lines of generations were thus started, both of which were carried through to the egg in the fall. These stem mothers—that is, the aphides hatching from the egg—produced their first young May 1 and 4, respectively, and their last young May 18 and 14, respectively. Taking the *first young of the first young* all the way through the series, 22 generations were obtained, counting the oviparous generation as the last. (See Tables I and II.)

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\* In 1906 Mr. E. O. G. Kelly, a field assistant of the State entomologist of Illinois, searched for eggs and young of *A. maidi-radicis* in the fields, beginning the 1st of April. He did not find eggs until April 12, and on April 17 he found the young stem mothers in the field. The following year Mr. Kelly first found eggs March 24 (these hatched in the insectary March 26), and young stem mothers were found in ants' nests as early as March 29. April 15 he found the young with their beaks inserted in old corn roots, this probably being occasioned by the fact that large numbers of the weeds upon which the aphid usually feeds at this season had been killed by the very cold weather of the preceding week.

TABLE I.—Line of generations of *Aphis maidi-radici* from egg to oviparous generation, 1906.

Generation (from egg).	Date of birth.	Date it became adult.	Date of first young.	Age at birth of first young.	Date of last young.	Productive period.	Life after last young.	Number of young.	Average young per day of productive period.	Largest number of young in one day.	Date of death or disappearance.	Total length of life.
				Days.		Days.	Days.					Days.
1.....	Apr. 18	Apr. 30	May 1	13	May 18	17	2	96	5.5	10	May 20	32
2.....	May 1	May 12	May 13	12	May 27	14	6	74	5.3	10	June 2	32
3.....	May 13	May 19	May 21	8	May 30	9	1	53	5.5	9	May 31	18
4.....	May 21	May 27	May 29	8	June 4	6	0	31	5.3	7	June 6	14
5.....	May 29	June 5	June 6	8	June 24	18	8	89	4.9	9	July 2	34
6.....	June 6	June 14	June 15	8	July 2	17	9	76	4.4	7	July 11	35
7.....	June 15	June 22	June 23	8	July 25	2	0	4	4.8	4	June 25	10
8.....	June 23	.....	June 30	7	July 15	15	0	74	5.9	7	July 22	22
9.....	June 30	.....	July 8	8	July 11	3	0	22	7.3	7	July 11	11
10.....	July 8	July 14	July 15	7	July 23	8	0	53	6.6	7	July 23	15
11.....	July 15	July 23	July 22	7	July 24	2	0	7	3.5	7	July 24	9
12.....	July 22	July 29	July 30	8	Aug. 8	9	1	51	5.1	8	Aug. 9	17
13.....	July 30	Aug. 5	Aug. 5	6	Aug. 9	5	0	0	4.8	6	Aug. 9	15
14.....	Aug. 5	Aug. 12	Aug. 12	7	Aug. 16	4	0	17	4.2	6	Aug. 16	11
15.....	Aug. 12	Aug. 18	Aug. 19	7	Aug. 24	4	0	33	5.5	6	Aug. 24	13
16.....	Aug. 19	.....	Aug. 27	8	Sept. 9	14	0	66	4.7	10	Sept. 9	22
17.....	Aug. 28	.....	Sept. 5	8	Sept. 8	0	0	13	4+	6	Sept. 8	11
18.....	Sept. 5	Sept. 13	Sept. 12	7	Sept. 20	1	0	28	5.9+	6	Sept. 21	17
19.....	Sept. 13	Sept. 19	Sept. 20	7	Sept. 27	1	1	41	3+	9	Sept. 28	16
20.....	Sept. 21	Sept. 28	Sept. 30	9	Oct. 2	3	0	10	3+	4	Oct. 2	12
21.....	Sept. 30	Oct. 13	Oct. 14	14	Nov. 2	19	5	29	1.5	4	Nov. 7	38
22 <sup>a</sup> .....	Oct. 14	Oct. 27	.....	.....	.....	.....	.....	.....	.....	.....	Nov. 22- Nov. 23	39

<sup>a</sup> Oviparous generation.TABLE II.—Line of generations of *Aphis maidi-radici* from egg to oviparous generation, 1906.

Generation (from egg).	Date of birth.	Date of becoming adult.	Date of first young.	Age at birth of first young.	Date of last young.	Productive period.	Life after last young.	Number of young.	Average young per day of productive period.	Largest number of young in one day.	Date of death or disappearance.	Total length of life.
				Days.		Days.	Days.					Days.
1.....	Apr. 19	May 2	May 4	15	May 14	10	1	28	2.6	6	May 15	26
2.....	May 4	May 15	May 16	12	June 4	19	5	64	2.4	8	June 9	35
3.....	May 16	May 23	May 24	8	June 2	9	0	50	5.5+	8	June 2	17
4.....	May 24	June 1	June 2	9	June 9	7	1	41	3.8-	7	June 10	17
5.....	June 2	June 8	June 9	7	June 17	8	1	40	5.	8	June 18	16
6.....	June 9	June 17	June 18	9	June 29	11	0	58	5.2+	8	June 29	30
7.....	June 18	June 26	June 27	9	July 8	11	0	65	5.9+	8	July 8	20
8.....	June 27	July 3	July 4	7	July 13	9	0	38	4.2+	5	July 13	13
9.....	July 4	July 11	July 11	7	July 14	3	0	12	4.	6	July 14	11
10.....	July 11	July 18	July 19	8	July 31	12	0	66	3.3	8	July 31	20
11.....	July 19	July 25	July 26	7	Aug. 10	16	3	70	4.7-	8	Aug. 13	25
12.....	July 26	Aug. 1	Aug. 2	7	Aug. 10	9	1	46	5.1+	8	Aug. 11	16
13.....	Aug. 2	Aug. 8	Aug. 8	7	Aug. 21	14	1	67	4.5	8	Aug. 22	22
14.....	Aug. 9	Aug. 15	Aug. 16	7	Aug. 27	12	0	63	2.5+	8	Aug. 27	19
15.....	Aug. 16	.....	Aug. 22	6	Aug. 24	3	0	13	4.4	6	Aug. 24	9
16.....	Aug. 22	Aug. 29	Aug. 30	8	Sept. 7	9	1	42	4.6+	7	Sept. 8	18
17.....	Aug. 30	Sept. 5	Sept. 7	8	Sept. 23	17	0	40	2.4	5	Sept. 23	25
18.....	Sept. 7	Sept. 13	Sept. 14	7	Sept. 21	8	2	13	1.4	5	Sept. 23	17
19.....	Sept. 14	Sept. 21	Sept. 22	8	Sept. 23	2	0	4	2.	2	Sept. 23	10
20.....	Sept. 22	Oct. 1	Oct. 2	10	Oct. 22	13	16	20	2.4	4	Nov. 7	39
21.....	Oct. 2	Oct. 15	Oct. 17	15	Oct. 29	15	.....	29	1.	8	.....	(d)
22 <sup>a</sup> .....	Oct. 17	<sup>b</sup> Oct. 24 <sup>c</sup> Nov. 5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

<sup>a</sup> Oviparous generation. These aphides were removed to other cages when they became adult.<sup>b</sup> 1 oviparous female.<sup>c</sup> 2 male.<sup>d</sup> Not less than 30 days.

On the other hand, beginning with the last to be borne by the aphid which hatched April 18, and following down the series of the last borne of each generation, there were but 11 generations. From this it

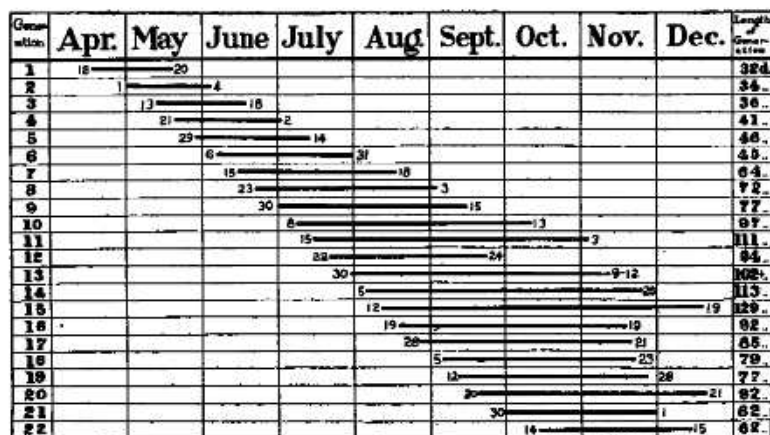


FIG. 31.—Periods and succession of generations in *Aphis maidt-radets*, 1906.

follows that the mean number of complete generations for the year is 16½. The first generation extended over a period of 31 days, from April 18 to May 20; the second, 34 days; and the third, 36 days (figs.

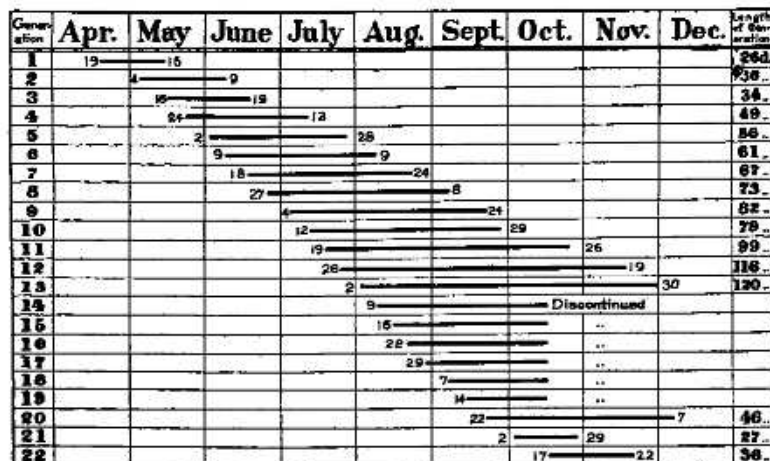


FIG. 32.—Periods and succession of generations in *Aphis maidt-radets*, 1906.

31, 32). The fifteenth generation proved to be the longest, continuing for 129 days. Then the period of each generation diminished gradually. These data, however, were taken from only one line of genera-