

TEXAS AGRICULTURAL EXPERIMENT STATION

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

W. B. BIZZELL, President

BULLETIN NO. 256

DECEMBER, 1919

DIVISION OF ENTOMOLOGY

THE COWPEA WEEVIL

Aug.



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THE COWPEA WEEVIL

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INTRODUCTION.

Most Texans who have ever grown cowpeas are familiar with the cowpea weevil in at least one of its stages. This insect seems to be present in every garden and field in the State, wherever any variety of cowpea is grown. It is a very serious pest, and it is often dreaded by those who are growing the cowpea for table use. The climatic conditions of the State are especially favorable for the development of the weevil as the mild winters result in a low mortality of the insect in stored peas, and since the weevil is not generally attacked by enemies, its control must depend almost entirely upon the efforts of the grower.

The studies recorded in this bulletin were begun by the senior author in March, 1915, and continued throughout the year. During the spring and summer of 1916, the life history notes were taken by O. K. Courtney, then Assistant Entomologist. The junior author is responsible for notes made since September, 1916.

HISTORY.

This insect was first described by Fabricus (1) in 1792 from material collected in Santa Cruz, West Indies. The specimens described were in his collection at that time, but the date of collection is not given. The original home of this species is very much in doubt for it was noted at widely different localities at about the same time. It was undoubtedly of tropical origin, however, since its spread has been more or less confined to the tropical and semitropical regions. The next mention of this species was in 1795 by Olivier (2) when he records it as occurring in peas in "Carolina," which was quite probably Carolina in Spain, although this cannot be said positively. In 1801, the species was again listed by Fabricus (3) in a revision of entomology.

The first mention of this species in the United States was by Say (4) in 1824, recording a specimen from New Orleans, Louisiana. In 1872, Horn (6) in his "Revision of the Bruchidae of the United States," gives the distribution of this species as "West Indies Islands and the Southern States." It was not, however, until 1885 (7) that the insect attracted attention as an economic pest. In that year, black-eyed "table beans" from Texas, which were very badly infested with the cowpea

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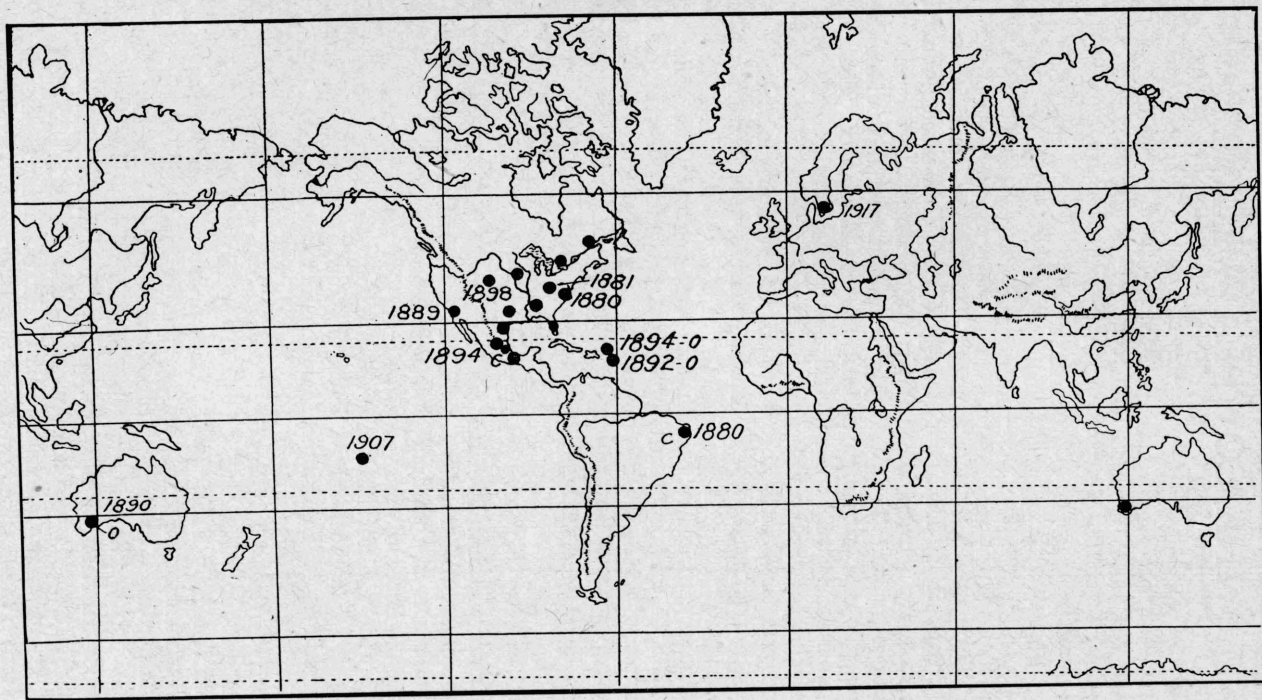


Figure 1. World Distribution of the Cowpea Weevil.

weevil, *B. quadrimaculatus*, were exhibited at the Cotton Exposition in Atlanta, Georgia.

It was not until 1893 (8) that this species again attracted attention, being found in large numbers in beans exhibited by Brazil and Venezuela at the World's Fair in Chicago. At this time the Bureau of Entomology records the species as "common in Southern States." The same year the weevil was reported from Delaware (9) in peas that had been purchased from North Carolina. It was also introduced into New York that year (10) in peas sent from the South, the exact locality of the origin of the peas not being given. The following year it was reported from Georgia, Mississippi, Alabama, and Texas. Hamilton (11) in his "Distribution of Coleoptera" lists southern France and Ethiopia as the habitat of this species. In 1895 it was reported from Ames, Iowa (12) in seed purchased from Virginia. In 1896 Chittenden (13) added British Honduras, Mexico, and Italy, to the distribution of the pest and the following year he added the East Indies and Sierra Leone to its domain. Finally in 1916, a report from Wisconsin indicated the presence of the cowpea weevil in the Northwest, where it had been introduced from the South in seed.

DISTRIBUTION.

In Figure 1 is shown the distribution of the cowpea weevil, as indicated in the available references on this species, but from all the available information it is impossible to ascertain the date of the entrance of this species into the United States or the exact place and manner of its introduction. Nor can the spread of the species be traced from state to state, though it is certain that it is confined by the range of its only food plant, the cowpea, to the Southern States. (See Figure 2.) The weevil has been introduced many times with seed into the Northern States, but has not become established in such locations, and it does not even occur in California or other Western States.

SYSTEMATIC POSITION.

In his original description, Fabricius places this species in the genus *Bruchus*, erected by Linnaeus in 1767. Fabricius defined the genus as follows: *Palpi aequales, filiformes; maxilla membrancea, bifida; labium acuminatum; antennae filiformes*. Say in 1824 lists *B. quadrimaculatus* in the *Curculionides* although no reason is given for changing from the arrangement of Fabricius. In LeConte's revision (5) of this work in 1853 he criticizes the "unnatural classification of this family." Horn, in 1872, places this species in the genus *Bruchus*, in his revision of the *Bruchidae* of the United States. In 1894, Hamilton in his "Catalogue of Coleoptera," lists *quadrimaculatus* in the genus *Bruchus*, of the family *Bruchidae*. Chittenden, in 1897, places *quadrimaculatus* in the genus *Bruchus*. Blatchley, in 1910, in his "Coleoptera of Indiana," places *quadrimaculatus* in the genus *Bruchus* of the family *Bruchidae*.

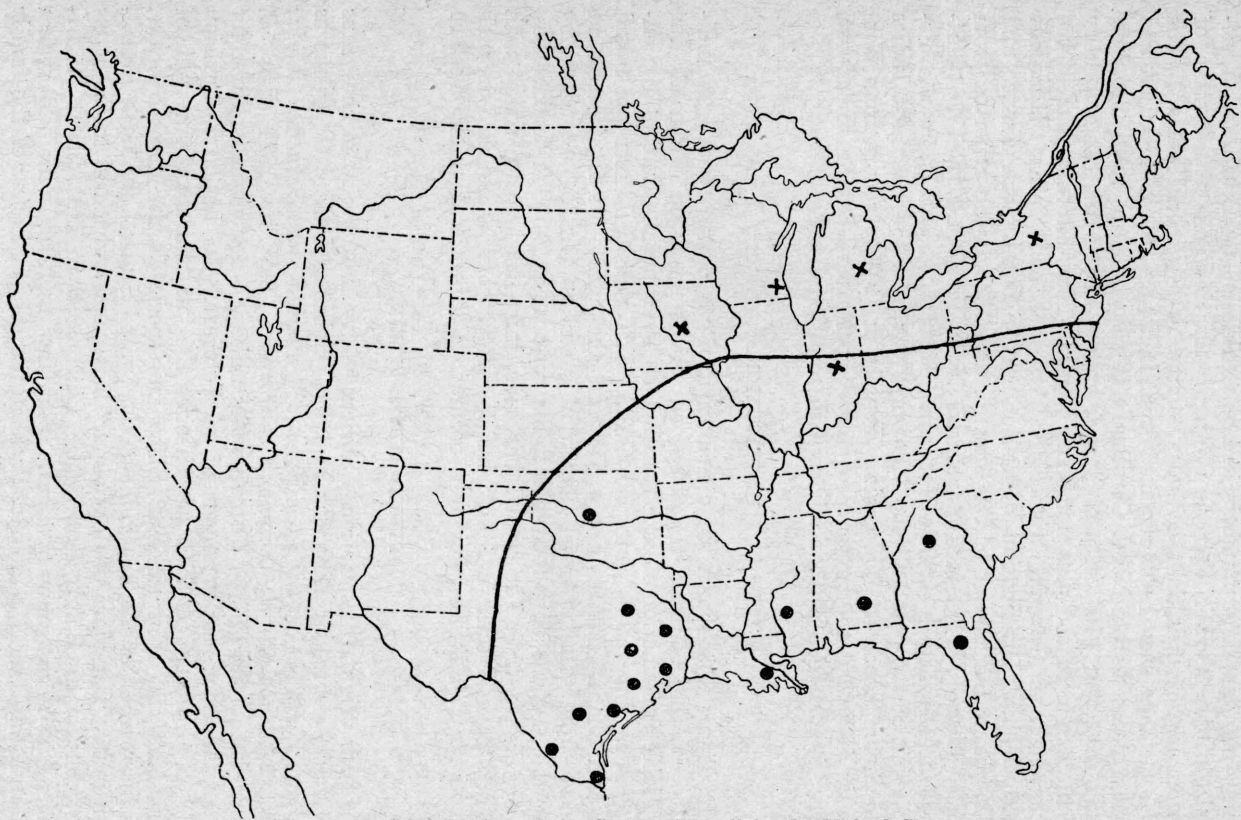


Figure 2. Distribution of the Cowpea Weevil in the United States.

ALLIED SPECIES.

The most closely related species, both from the anatomical and historical standpoint, is *B. chinensis* Linn. This species is separated from *quadrимaculatus* as follows:

- b. Median basal thoracic lobe with elevated ivory-like space: *chinensis*.
- bb. Median basal thoracic lobe with whitish hairs only: *quadrимaculatus*.

These species are confused very often by those who are not specialists in this group. Both of these species feed extensively on the cowpea, and their life history, habits, and control are quite similar. Horn (6) gives the following points wherein *B. quadrимaculatus* differs from *chinensis*:

"The thorax is broader, the sides distinctly arcuate, the basal lobe not eburneous. The scutellum is flat and with a median line. The elytra are longer, and differently spotted and the abdomen is evenly clothed with cinereous pubescence. This species is also larger and much less robust."

COMMON NAME.

The usual name that has been applied to the insect in previous literature is the "four spotted bean weevil." In 1897, Chittenden says, the above name (the cowpea weevil), which is proposed for *Bruchus chinensis*, will sufficiently distinguish it from *B. quadrимaculatus*, since the latter is already known as the "four spotted bean weevil." When the studies here recorded were begun on the weevils infesting cowpeas in this State, it was thought that *B. chinensis* was by far the more abundant species. Collections, however, made over a period of three years from all sections of the State show that *quadrимaculatus* is much the more common. *Bruchus quadrимaculatus* was used in all of the experiments. For our purpose in Texas, then, in spite of the fact that the double use of a common name may prove confusing, the cowpea weevil must be known as *B. quadrимaculatus*.

ECONOMIC IMPORTANCE.

In view of the fact that the cowpea is grown very extensively in Texas, that human food as well as stock food is concerned, and that the weevil is present in every section where the cowpea is grown, it becomes evident that the damage done by this insect is very great and materially affects the agricultural economy of the State. The pest became of paramount importance when the treatment of the black-eyed cowpea for export trade was commenced. This variety of cowpea is especially susceptible to infestation by the weevil, and very few cowpeas are harvested which are not infested. The treatment of such cowpeas presented a very difficult problem and they were therefore, even after treatment, unfit for human consumption. The keeping of cowpea seed has always been a very difficult problem, since the germination percentage of weevil-infested seed is always very low. The importance of the weevil in Texas is indeed very great although it is difficult to place a money

value on the damage done. The cowpea is an important crop, but its value in the State is limited by the work of the weevil. There is hardly a grower who does not have to reckon with the ravages of this pest when considering the production of cowpeas.

FOOD PLANTS.

The primary food plant for this insect, as the common name indicates, is the cowpea. Apparently all varieties of cowpeas are attacked and the insect shows no preference for any particular variety. It has been repeatedly bred in the following varieties of cowpeas: Black-eyed, Old Bokhara, Chinese Red, Chinese Yellow, Red Ripper, Iron, Speckled Cowder, Whippoorwill, Tinkles Holstein, New Era, and Lady Pea. The cowpea weevil has not been observed to feed upon any plant except the cowpea. Laboratory experiments have failed to establish any of the following as food plants for this insect: Navy beans, Mexican Frijole, Lima or butter beans, soy beans, yellow string beans, castor beans, and peanuts. Oviposition proceeded without reduction or delay, but in each case the eggs either failed to hatch or the young larvae perished before entrance into the substituted food supply was accomplished. The active feeding period is confined to the larval stage and it is doubtful if any other plants can be added to the cowpea, as a food for this insect.

METHODS OF STUDY.

For the detailed observations on the life history of the weevil, vials 25x100 mm. were used. A pair of weevils were placed in these with ample peas for oviposition for a 24-hour period. The Chinese Red cowpea was used because any eggs on them were easy to observe. The peas with eggs upon them were removed each day and observations were made on the hatching of the egg, the pupation of the larvae, and the emergence of the adult. The laboratory, in which all life history observations were made, is shown in Plate 1. No heat was available in the laboratory so that conditions were very similar to warehouse or storage conditions. Temperature records were obtained by the use of a recording thermograph placed close to the vials containing the weevils in any stage. In some phases of the work, humidity records were obtained also, by the use of a hygro-thermograph. Seasonal notes were made in the field on the Agronomy Farm and in the experimental plats of the Division of Entomology.

LIFE HISTORY.

The life history of the cowpea weevil has been mentioned by a few of the early writers in a very indefinite way. In 1891, Slingerland (10) made some laboratory notes on the egg stage and the habits of the adults. In 1895, Osborn (12) described all the stages and determined the length of the egg stage. Later papers on weevils assume that the life history of *B. quadrimaculatus* is very much like that of *chinensis*, *obtectus*, or *pisi*. In the following pages are given the results of our detailed observations on all phases of its life history.



Plate I. Laboratory where the Life History studies were conducted.

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From these results it is evident that the life history of the cowpea weevil is not composed of definite seasonal broods. The records show that there is a continuous breeding when food is available, and at this locality there is seldom a cessation of activity. Climatic conditions undoubtedly do restrict the abundance of individuals at certain seasons. The generation series was conducted to determine the number of generations of the weevils that may normally occur in a period of twelve months.

The Egg.

The outline of the egg is generally ovate, varying somewhat at times. Its length is usually one and one-third times its breadth, the posterior end broadly rounded, the anterior end tapering, giving the semblance of a point when viewed with the unaided eye. Under the microscope it likewise appears rounded but much less broad than the posterior end. Viewed laterally the egg is convex in outline, higher at the posterior, sloping sharply toward the anterior end. The whole under surface of the egg is attached to the pea except in some abnormal cases when the female is nearing the end of her quota of eggs. Apparently the supply of sticky material with which the eggs are glued to the peas is exhausted and in such cases the eggs are insecurely fastened to the pea, either on the end or the side. Such eggs have never been observed to hatch. When first laid the egg is glistening white, jellylike, translucent mass, but soon hardens on exposure to the air. The surface is perfectly smooth and shining. Plate II* shows details of the eggs when deposited under natural conditions. The size of the egg varies greatly; measurements of the greatest length and width of eggs gave the figures in Table 1.

Table 1.—Egg Measurements.

	Length	Width
1.....	1.98 mm.	1.38 mm.
2.....	2.64 mm.	1.44 mm.
3.....	2.40 mm.	1.35 mm.
4.....	2.63 mm.	1.45 mm.
5.....	2.40 mm.	1.37 mm.
6.....	2.59 mm.	1.46 mm.
7.....	2.48 mm.	1.80 mm.
8.....	2.49 mm.	1.54 mm.
9.....	2.57 mm.	1.45 mm.
10.....	2.40 mm.	1.39 mm.
11.....	2.40 mm.	1.45 mm.
12.....	2.40 mm.	1.36 mm.
13.....	2.64 mm.	1.35 mm.
14.....	2.53 mm.	1.47 mm.
15.....	2.40 mm.	1.34 mm.

Embryology.—As the developing embryonic larva increases in size, its movements can be very readily detected through the upper part of the egg shell, which remains white and translucent until it is hatched. When matured, with its brown head appearing as a tiny speck near the broader end of the egg, the larva soon begins to eat its way through the egg shell.

Hatching.—The exit is always made on the side of the egg which is attached or glued to the pea. The larva, having eaten through the

shell of the egg and reached the surface of the pea, continues to eat its way into the pea without any apparent delay. The exit hole in the egg shell and the entrance aperture into the pea are very tiny and can hardly be distinguished without magnification. The hole in the egg shell and the entrance hole in the pea, are very nearly round and have a smooth edge. The exit hole in the egg shell is always at the broad end of the egg, the aperture by which the larva gains entrance into the pea always appearing directly beneath it.

As soon as hatching begins, the color of the egg is changed materially. It first becomes mottled with dark yellowish opaque spots, because as the larva feeds, many small particles of food, together with the excreted material, are pushed back under the egg shell. By the time the larva has completely entered the pea, the entire space beneath the egg shell is filled with this material and the egg then is a uniform yellow or straw color, and is wholly opaque.

The length of the hatching period varies considerably, depending upon the temperature and the hardness or dryness of the peas. In fresh peas the period of hatching may comprise only the short period of an hour or two, while several days may elapse before the larva succeeds in entering dried and hardened peas.

Table 2.—Duration of the Egg Stage.

Laid	Hatched	Period	Temperature		
			Max.	Min.	Mean
Nov. 1.	Nov. 7.	6	81	66	76.0
Nov. 2.	Nov. 8.	6	81	66	75.0
Nov. 3.	Nov. 9.	6	82	66	75.1
Nov. 4.	Nov. 10.	6	83	74	76.2
Nov. 5.	Nov. 11.	6	83	74	75.4
Nov. 6.	Nov. 12.	6	83	64	64.2
Nov. 8.	Nov. 12.	4	83	64	77.2
Nov. 9.	Nov. 17.	8	83	54	70.2
Nov. 10.	Nov. 18.	8	84	57	69.7
Nov. 11.	Nov. 18.	7	82	57	68.5
Nov. 12.	Nov. 19.	7	84	57	69.5
Nov. 13.	Nov. 20.	7	84	57	70.8
Nov. 14.	Nov. 21.	7	86	57	72.0
Nov. 15.	Nov. 22.	7	87	58	73.5
Nov. 16.	Nov. 23.	7	87	66	75.7
Nov. 17.	Nov. 24.	7	87	66	76.3
Nov. 18.	Nov. 25.	7	87	66	76.0
Nov. 19.	Nov. 26.	7	87	66	65.5
Nov. 20.	Nov. 27.	7	87	66	76.2
Nov. 21.	Nov. 28.	7	87	66	76.1
Nov. 22.	Nov. 29.	7	82	70	75.6
Nov. 23.	Nov. 29.	6	82	70	76.0
Nov. 24.	Nov. 30.	6	82	70	76.5
Nov. 25.	Dec. 1.	6	86	68	77.0
Nov. 26.	Dec. 3.	7	86	68	76.7
Nov. 27.	Dec. 3.	6	86	67	76.8
Nov. 28.	Dec. 4.	6	86	67	76.5
Nov. 29.	Dec. 5.	6	86	67	77.5
Nov. 30.	Dec. 6.	6	85	67	77.6
Dec. 1.	Dec. 7.	6	85	67	77.3
Dec. 2.	Dec. 8.	6	85	67	76.2
Dec. 3.	Dec. 9.	6	85	57	75.7
Dec. 4.	Dec. 10.	6	83	50	74.9
Dec. 5.	Dec. 11.	6	83	43	71.8
Dec. 6.	Dec. 12.	6	83	43	69.1
Dec. 7.	Dec. 13.	6	83	29	55.8
Dec. 8.	Jan. 4.	27	83	29	55.4
Dec. 9.	Jan. 5.	27	79	29	55.6
Dec. 10.	Jan. 6.	27	79	29	55.4
Dec. 11.	Jan. 7.	27	79	29	55.2
Dec. 12.	Jan. 8.	27	79	29	55.2
Dec. 13.	Jan. 7.	24	79	29	55.2
Dec. 14.	Jan. 7.	23	79	29	55.3
Dec. 15.	Jan. 7.	23	79	29	55.3

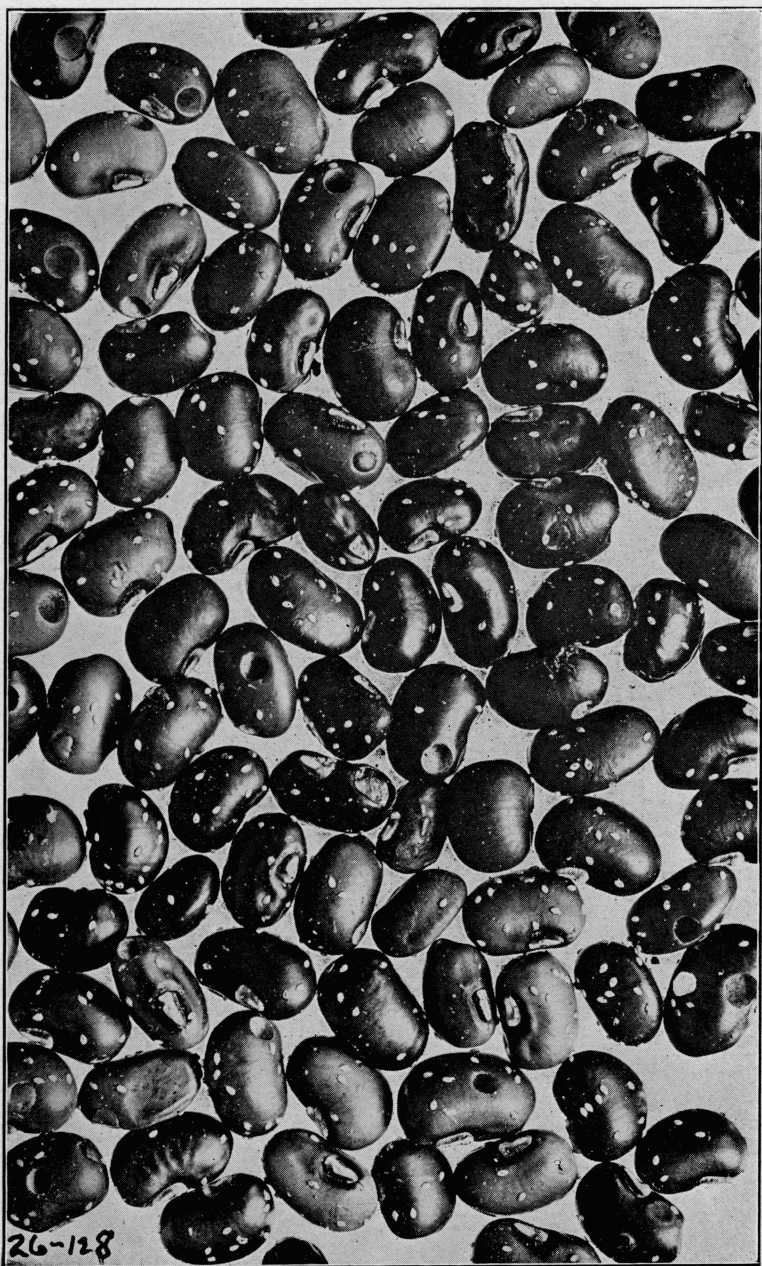


Plate 11. Cowpeas showing extreme weevil infestation. Egg details are shown.

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Table 2.—Duration of the Egg Stage.—Continued.

Laid	Hatched	Period	Temperature		
			Max.	Min.	Mean
1915					
Dec. 16.	Jan. 10.	25	79	29	55.0
Dec. 17.	Jan. 10.	24	79	29	54.0
Dec. 18.	Jan. 11.	24	79	29	54.2
Dec. 21.	Jan. 12.	22	79	29	55.5
Dec. 22.	Jan. 11.	20	79	29	55.8
Dec. 23.	Jan. 11.	19	79	29	56.4
Dec. 25.	Jan. 19.	25	79	22	54.0
Dec. 26.	Jan. 11.	16	79	29	53.4
Dec. 27.	Jan. 10.	14	79	29	57.9
Dec. 29.	Jan. 11.	13	79	22	58.5
Dec. 30.	Jan. 10.	11	79	45	61.0
Dec. 31.	Jan. 11.	11	79	45	61.8
1916					
Jan. 1.	Jan. 11.	10	79	45	62.0
Jan. 4.	Jan. 20.	16	79	22	53.1
Jan. 5.	Jan. 23.	18	79	22	60.5
Jan. 6.	Feb. 3.	28	79	22	53.4
Jan. 8.	Feb. 2.	25	79	22	53.2
Jan. 10.	Feb. 4.	25	79	22	51.9
Jan. 26.	Feb. 23.	28	78	26	54.5
Jan. 28.	Feb. 25.	28	78	26	54.3
Feb. 5.	Feb. 29.	24	81	38	57.8
Feb. 9.	Mar. 1.	21	81	39	59.3
Feb. 10.	Mar. 2.	21	81	39	59.3
Feb. 11.	Mar. 3.	21	81	39	59.7
Feb. 12.	Mar. 4.	21	81	39	59.3
Feb. 17.	Mar. 7.	19	86	39	59.3
Feb. 20.	Mar. 8.	17	86	39	61.2
Feb. 21.	Mar. 9.	17	86	39	61.7
Feb. 23.	Mar. 10.	16	86	39	61.4
Feb. 27.	Mar. 15.	17	86	39	63.2
Mar. 9.	Mar. 18.	9	86	44	64.2
Mar. 10.	Mar. 19.	9	86	44	64.1
Mar. 11.	Mar. 20.	9	86	44	69.2
Mar. 14.	Mar. 22.	8	89	44	68.0
Mar. 15.	Mar. 23.	8	89	44	68.2
Mar. 17.	Mar. 27.	10	89	48	70.9
Mar. 18.	Mar. 28.	10	89	48	70.7
Mar. 19.	Mar. 29.	10	89	48	64.0
Mar. 20.	Mar. 29.	9	89	48	68.8
Mar. 21.	Mar. 31.	10	89	48	69.9
Mar. 22.	April 1.	10	86	48	69.4
Mar. 23.	April 2.	10	86	48	68.4
Mar. 24.	April 5.	12	86	48	67.0
Mar. 25.	April 9.	15	86	40	65.4
Mar. 27.	April 10.	14	86	40	64.2
Mar. 28.	April 11.	14	86	40	64.1
Mar. 29.	April 11.	13	83	40	64.4
Mar. 30.	April 12.	13	83	40	64.0
Mar. 31.	April 13.	13	83	40	64.1
April 1.	April 12.	11	83	40	62.3
April 3.	April 14.	11	83	40	63.7
April 4.	April 14.	10	83	40	64.1
April 5.	April 15.	10	83	40	65.0
April 6.	April 15.	9	83	40	65.0
April 7.	April 15.	8	83	40	64.5
April 8.	April 16.	8	83	40	66.2
April 10.	April 16.	6	83	53	70.4
April 11.	April 17.	6	85	56	71.1
April 12.	April 18.	6	87	56	71.5
April 13.	April 20.	7	87	56	72.7
April 14.	April 21.	7	87	56	72.5
April 15.	April 22.	7	87	56	71.5
April 16.	April 23.	7	87	58	71.4
April 17.	April 24.	7	87	58	73.4
April 18.	April 25.	7	87	58	75.0
April 19.	April 25.	6	87	58	74.8
April 20.	April 26.	6	87	58	74.0
April 21.	April 29.	8	87	52	71.6
April 22.	April 30.	8	87	52	70.8
April 23.	May 1.	8	87	52	70.4
April 24.	May 3.	9	87	52	70.5
April 25.	May 4.	9	87	52	69.7
April 26.	May 4.	8	86	52	69.2
April 27.	May 4.	7	86	52	68.2
April 28.	May 4.	6	86	54	68.8
April 30.	May 6.	6	94	65	73.9
May 1.	May 6.	5	94	65	74.2
May 2.	May 8.	6	99	65	77.7

Table 2.—Duration of the Egg Stage.—Continued.

Laid	Hatched	Period	Temperature		
			Max.	Min.	Mean
1916					
May 3.....	May 8.....	5	99	66	79.2
May 4.....	May 9.....	5	100	73	82.1
May 5.....	May 10.....	5	100	74	86.3
May 6.....	May 11.....	5	100	76	87.6
May 7.....	May 12.....	5	100	80	88.6
May 8.....	May 13.....	5	100	80	89.2
May 9.....	May 14.....	5	98	80	88.9
May 10.....	May 15.....	5	98	80	88.7
May 11.....	May 16.....	5	97	74	88.4
May 12.....	May 19.....	7	97	70	84.7
May 13.....	May 20.....	7	97	70	82.5
May 14.....	May 21.....	7	97	70	81.1
May 15.....	May 22.....	7	97	70	80.3
May 16.....	May 23.....	7	91	70	79.1
May 17.....	May 24.....	7	91	70	78.7
May 18.....	May 24.....	6	91	70	78.5
May 19.....	May 25.....	6	91	71	79.1
May 20.....	May 26.....	6	91	71	80.2
May 21.....	May 27.....	6	89	71	81.8
May 22.....	May 26.....	4	89	71	80.0
May 23.....	May 28.....	5	89	71	80.9
May 24.....	May 29.....	5	89	73	80.5
May 25.....	May 30.....	5	89	73	80.7
May 26.....	May 31.....	5	94	73	81.0
May 27.....	June 1.....	5	94	73	81.6
May 28.....	June 2.....	5	94	73	82.0
May 29.....	June 2.....	4	94	74	82.5
May 30.....	June 3.....	4	94	77	83.5
May 31.....	June 4.....	4	91	77	84.3
June 1.....	June 5.....	4	92	78	84.1
June 2.....	June 6.....	4	93	78	84.2
June 3.....	June 7.....	4	94	78	84.8
June 4.....	June 8.....	4	94	71	84.8
June 5.....	June 9.....	4	94	71	82.4
June 6.....	June 10.....	4	94	71	81.7
June 7.....	June 11.....	4	90	71	81.6
June 8.....	June 12.....	4	90	72	81.5
June 9.....	June 13.....	4	90	73	83.6
June 10.....	June 14.....	4	90	76	84.0
June 11.....	June 15.....	4	90	76	83.7
June 12.....	June 16.....	4	90	72	83.3
June 13.....	June 17.....	4	90	72	82.0
June 14.....	June 18.....	4	89	72	82.0
June 15.....	June 19.....	4	89	72	81.0
June 16.....	June 20.....	4	91	74	80.5
June 17.....	June 21.....	4	95	75	81.7
June 18.....	June 22.....	4	95	75	83.0
June 19.....	June 23.....	4	95	75	84.5
June 20.....	June 24.....	4	95	78	85.5
June 21.....	June 25.....	4	95	80	86.2
June 22.....	June 26.....	4	95	80	86.7
June 23.....	June 27.....	4	95	80	86.7
June 24.....	June 28.....	4	95	75	87.7
June 25.....	June 29.....	4	95	75	87.5
June 26.....	June 30.....	4	95	75	86.2
June 27.....	July 1.....	4	95	75	85.2
June 28.....	July 2.....	4	93	76	84.0
June 29.....	July 3.....	4	93	77	84.2
June 30.....	July 4.....	4	93	76	84.5
July 1.....	July 5.....	4	95	76	84.7
July 2.....	July 6.....	4	95	76	85.2
July 3.....	July 7.....	4	97	76	85.5
July 4.....	July 8.....	4	99	77	86.5
July 5.....	July 9.....	4	99	79	88.0
July 6.....	July 10.....	4	99	79	88.5
July 7.....	July 11.....	4	99	79	89.2
July 8.....	July 12.....	4	98	79	89.0
July 9.....	July 13.....	4	98	79	85.2
July 10.....	July 14.....	4	97	79	87.0
July 11.....	July 15.....	4	95	80	86.5
July 12.....	July 16.....	4	97	79	86.2
July 13.....	July 17.....	4	98	79	87.0
July 14.....	July 18.....	4	99	78	87.5
July 15.....	July 19.....	4	99	78	88.2
July 16.....	July 20.....	4	99	78	87.7
July 17.....	July 21.....	4	99	78	88.0
July 18.....	July 22.....	4	97	80	87.7
July 19.....	July 23.....	4	97	80	88.2
July 20.....	July 24.....	4	99	80	88.2

Table 2.—Duration of the Egg Stage.—Continued.

Laid	Hatched	Period	Temperature		
			Max.	M n.	Mean
1916					
July 21	July 25	4	99	80	88.5
July 22	July 26	4	99	78	89.0
July 23	July 27	4	99	78	87.7
July 24	July 28	4	98	78	87.5
July 25	July 29	4	97	78	86.7
July 26	July 30	4	97	78	86.2
July 27	July 31	4	97	78	86.0
July 28	Aug. 1	4	97	78	86.0
July 29	Aug. 2	4	97	78	86.5
July 30	Aug. 3	4	97	79	86.5
July 31	Aug. 4	4	97	79	87.5
Aug. 1	Aug. 5	4	97	79	88.0
Aug. 2	Aug. 6	4	97	79	88.2
Aug. 3	Aug. 7	4	96	79	86.5
Aug. 4	Aug. 8	4	96	79	85.5
Aug. 5	Aug. 9	4	95	79	85.5
Aug. 6	Aug. 10	4	95	79	84.2
Aug. 7	Aug. 11	4	95	79	84.7
Aug. 8	Aug. 12	4	94	78	85.0
Aug. 9	Aug. 13	4	95	78	85.0
Aug. 10	Aug. 14	4	96	80	85.7
Aug. 11	Aug. 15	4	95	79	87.0
Aug. 12	Aug. 16	4	95	79	87.2
Aug. 13	Aug. 17	4	95	75	87.0
Aug. 14	Aug. 18	4	95	75	85.7
Aug. 15	Aug. 19	4	95	75	85.5
Aug. 16	Aug. 20	4	94	75	85.7
Aug. 17	Aug. 21	4	100	80	85.7
Aug. 18	Aug. 22	4	100	80	87.7
Aug. 19	Aug. 23	4	100	80	88.5
Aug. 20	Aug. 24	4	100	79	88.7
Aug. 21	Aug. 25	4	97	73	88.2
Aug. 22	Aug. 26	4	96	70	85.7
Aug. 23	Aug. 27	4	93	70	84.2
Aug. 24	Aug. 28	4	93	70	83.0
Aug. 25	Aug. 29	4	94	70	83.2
Aug. 26	Aug. 30	4	94	75	84.2
Aug. 27	Aug. 31	4	97	77	85.0
Aug. 28	Sept. 1	4	97	77	86.0
Aug. 29	Sept. 2	4	97	77	86.0
Aug. 30	Sept. 3	4	97	78	86.5
Aug. 31	Sept. 4	4	97	79	87.2
Sept. 1	Sept. 4	3	97	80	87.0
Sept. 2	Sept. 6	4	97	80	88.2
Sept. 3	Sept. 7	4	97	80	88.5
Sept. 4	Sept. 8	4	101	80	88.5
Sept. 5	Sept. 9	4	101	80	89.0
Sept. 6	Sept. 10	4	101	80	89.5
Sept. 7	Sept. 11	4	101	80	89.2
Sept. 8	Sept. 12	4	99	80	89.0
Sept. 9	Sept. 12	3	97	70	88.5
Sept. 10	Sept. 14	4	97	78	88.2
Sept. 11	Sept. 15	4	97	73	87.5
Sept. 12	Sept. 16	4	97	70	85.7
Sept. 13	Sept. 18	5	99	67	82.4
Sept. 14	Sept. 19	5	99	67	81.4
Sept. 15	Sept. 20	5	99	67	80.0
Sept. 16	Sept. 21	5	99	67	79.6
Sept. 17	Sept. 22	5	99	67	80.2
Sept. 18	Sept. 22	4	91	68	80.5
Sept. 19	Sept. 23	4	91	69	80.0
Sept. 20	Sept. 24	4	91	70	80.5
Sept. 21	Sept. 26	5	91	70	81.0
Sept. 22	Sept. 27	5	105	70	80.2
Sept. 23	Sept. 28	5	105	71	80.2
Sept. 24	Sept. 29	5	105	60	83.4
Sept. 25	Oct. 1	6	105	57	79.3
Sept. 26	Oct. 2	6	105	57	76.6
Sept. 27	Oct. 3	6	95	57	76.4
Sept. 28	Oct. 4	6	85	57	74.0
Sept. 29	Oct. 5	6	89	57	72.6
Sept. 30	Oct. 6	6	89	59	73.5
Oct. 1	Oct. 6	5	89	54	74.0
Oct. 2	Oct. 7	5	89	66	77.0
Oct. 3	Oct. 8	5	90	66	77.7
Oct. 4	Oct. 8	4	90	66	77.7
Oct. 5	Oct. 9	4	91	69	78.0
Oct. 6	Oct. 10	4	94	68	79.3
Oct. 7	Oct. 11	4	94	68	81.0

Table 2.—Duration of the Egg Stage.—Continued.

Laid	Hatched	Period	Temperature		
			Max.	Min.	Mean
1916					
Oct. 8.....	Oct. 12.....	4	94	68	80.0
Oct. 9.....	Oct. 13.....	4	94	68	79.5
Oct. 10.....	Oct. 14.....	4	90	68	79.7
Oct. 11.....	Oct. 15.....	4	90	68	79.7
Oct. 12.....	Oct. 16.....	4	90	65	80.0
Oct. 13.....	Oct. 18.....	5	90	61	78.8
Oct. 14.....	Oct. 22.....	8	87	41	70.6
Oct. 15.....	Oct. 23.....	8	87	41	68.6
Oct. 16.....	Oct. 25.....	9	95	41	69.0
Oct. 17.....	Oct. 27.....	10	95	41	68.4
Oct. 18.....	Oct. 28.....	10	95	41	68.1
Oct. 19.....	Oct. 28.....	9	95	41	68.3
Oct. 20.....	Oct. 29.....	9	95	41	68.5
Oct. 21.....	Oct. 29.....	8	95	52	69.3
Oct. 22.....	Oct. 30.....	8	95	53	71.3
Oct. 23.....	Oct. 30.....	7	95	53	72.4
Oct. 24.....	Nov. 1.....	8	90	53	74.6
Oct. 25.....	Nov. 2.....	8	90	53	74.1
Oct. 26.....	Nov. 2.....	7	90	53	74.0
Oct. 27.....	Nov. 2.....	6	90	56	75.6
Oct. 28.....	Nov. 3.....	6	90	60	76.2
Oct. 29.....	Nov. 4.....	6	90	60	77.6
Oct. 30.....	Nov. 5.....	6	89	60	77.4
Oct. 31.....	Nov. 6.....	6	89	60	76.6
Nov. 1.....	Nov. 7.....	6	89	60	75.1
Nov. 2.....	Nov. 8.....	6	87	60	75.5
Nov. 3.....	Nov. 11.....	8	87	51	74.5
Nov. 4.....	Nov. 12.....	8	87	51	73.8
Nov. 5.....	Nov. 16.....	11	87	33	68.1
Nov. 6.....	Nov. 19.....	13	89	33	66.0
Nov. 7.....	Nov. 20.....	13	93	33	65.6
Nov. 8.....	Nov. 21.....	13	94	33	65.4
Nov. 9.....	Nov. 25.....	16	94	33	64.6
Nov. 10.....	Nov. 26.....	16	94	33	64.1
Nov. 11.....	Nov. 27.....	16	94	33	64.0
Nov. 12.....	Nov. 28.....	16	94	33	63.7
Nov. 13.....	Nov. 29.....	16	98	33	63.1
Nov. 14.....	Nov. 29.....	15	98	33	63.0
Nov. 15.....	Nov. 30.....	15	98	39	65.3
Nov. 16.....	Nov. 30.....	14	98	44	66.7
Nov. 17.....	Dec. 1.....	14	98	44	68.1
Nov. 18.....	Dec. 1.....	13	98	44	68.3
Nov. 19.....	Dec. 2.....	13	98	44	69.0
Nov. 20.....	Dec. 3.....	13	98	44	69.3
Nov. 21.....	Dec. 4.....	13	98	44	69.8
Nov. 22.....	Dec. 5.....	13	101	44	69.3
Nov. 23.....	Dec. 5.....	12	101	44	72.0
Nov. 24.....	Dec. 6.....	12	101	44	73.0
Nov. 25.....	Dec. 6.....	11	101	44	73.6
Nov. 26.....	Dec. 6.....	10	101	48	74.5
Nov. 27.....	Dec. 6.....	9	101	48	75.6
Nov. 28.....	Dec. 6.....	8	101	48	77.1
Nov. 29.....	Dec. 7.....	8	101	48	79.6
Nov. 30.....	Dec. 8.....	8	101	48	79.3
Dec. 1.....	Dec. 8.....	7	101	38	80.0
Dec. 2.....	Dec. 11.....	9	101	38	75.2
Dec. 3.....	Dec. 15.....	12	101	34	69.5
Dec. 4.....	Dec. 20.....	16	101	32	66.2
Dec. 5.....	Dec. 26.....	21	99	28	61.9
Dec. 6.....	Dec. 27.....	21	90	28	61.0
Dec. 7.....	Jan. 1, 1917.....	25	90	28	60.3
Dec. 8.....	Jan. 2.....	25	89	28	59.3
Dec. 9.....	Jan. 2.....	24	92	28	58.9
Dec. 10.....	Jan. 3.....	24	92	28	59.9
Dec. 11.....	Jan. 3.....	23	92	28	59.6
Dec. 12.....	Jan. 4.....	23	92	28	60.1
Dec. 13.....	Jan. 4.....	22	92	28	60.4
Dec. 14.....	Jan. 4.....	21	92	28	60.5
Dec. 15.....	Jan. 5.....	21	92	28	61.6
Dec. 16.....	Jan. 5.....	20	92	28	61.2
Dec. 17.....	Jan. 5.....	19	92	28	61.4
Dec. 18.....	Jan. 6.....	19	92	28	58.6
Dec. 19.....	Jan. 7.....	19	92	28	61.7
Dec. 20.....	Jan. 7.....	18	92	28	62.4
Dec. 22.....	Jan. 7.....	16	92	38	63.0
Dec. 23.....	Jan. 8.....	16	92	46	64.4
Dec. 24.....	Jan. 8.....	15	92	46	65.5
Dec. 25.....	Jan. 8.....	14	92	46	65.9
Dec. 26.....	Jan. 9.....	14	93	46	66.2

Table 2.—Duration of the Egg Stage.—Continued.

Laid	Hatched	Period	Temperature		
			Max.	Min.	Mean
1916					
Dec. 27	Jan. 9	13	93	46	66.0
Dec. 28	Jan. 9	12	93	46	63.6
Dec. 29	Jan. 10	12	94	46	66.9
Dec. 30	Jan. 11	12	94	44	68.6
Dec. 31	Jan. 12	12	94	44	67.8
1917					
Jan. 1	Jan. 12	11	94	44	69.0
Jan. 2	Jan. 21	19	94	30	56.4
Jan. 3	Jan. 25	22	94	30	55.0
Jan. 4	Jan. 29	25	94	30	55.2
Jan. 5	Jan. 30	25	100	30	54.6
Jan. 6	Jan. 31	25	100	30	55.4
Jan. 7	Feb. 1	25	100	30	56.4
Jan. 8	Feb. 2	25	100	25	55.9
Jan. 9	Feb. 8	30	100	25	53.9
Jan. 10	Feb. 13	34	100	25	52.7
Jan. 11	Feb. 15	35	100	25	51.4
Jan. 12	Feb. 18	37	100	25	53.2
Jan. 20	Feb. 18	29	100	25	57.0
Jan. 21	Feb. 18	28	100	25	57.1
Jan. 24	Feb. 18	25	100	25	57.2
Jan. 25	Feb. 18	24	100	25	57.6
Jan. 26	Feb. 19	24	100	25	61.0
Jan. 27	Feb. 19	23	100	25	61.0
Jan. 28	Feb. 19	22	100	25	58.0
Jan. 29	Feb. 20	22	100	25	58.4
Jan. 30	Feb. 21	22	103	25	58.5
Jan. 31	Feb. 22	22	103	25	57.9
Feb. 2	Feb. 22	20	103	30	56.6
Feb. 4	Feb. 23	19	103	30	59.4
Feb. 5	Feb. 23	18	103	36	60.4
Feb. 6	Feb. 24	18	103	40	61.3
Feb. 7	Feb. 24	17	103	41	62.2
Feb. 8	Feb. 24	16	103	41	63.2
Feb. 9	Feb. 24	15	103	41	63.9
Feb. 10	Feb. 24	14	103	41	63.7
Feb. 11	Feb. 25	14	103	41	64.9
Feb. 12	Feb. 25	13	103	42	65.0
Feb. 13	Feb. 25	12	103	44	66.1
Feb. 14	Feb. 25	11	103	44	67.9
Feb. 15	Feb. 25	10	103	44	69.2
Feb. 16	Feb. 26	10	103	44	70.9
Feb. 17	Feb. 26	9	103	54	72.6
Feb. 18	Feb. 26	8	103	54	75.2
Feb. 19	Feb. 27	8	103	54	77.0
Feb. 20	Feb. 28	8	103	33	79.3
Feb. 21	Mar. 6	13	102	33	69.5
Feb. 22	Mar. 9	15	102	33	68.4
Feb. 23	Mar. 11	16	102	33	67.3
Feb. 24	Mar. 13	17	102	33	67.5
Feb. 25	Mar. 14	17	102	33	61.5

Duration of Egg Stage.

Detailed observations have been made on the eggs of about 350 weevils covering a period of almost one and one-half years. The records were made in the laboratory where only natural temperature conditions prevailed throughout the entire time. A thermograph was used to record the existing temperatures during the period of observations. The results of the observations are shown in Table 2. For each period the single highest temperature and the single lowest temperature of the entire period are given. The mean temperature is the average of the mean daily temperatures during the period.

The shortest period observed, 4 days, occurred frequently during the warmer portions of 1916. In fact, every period during June, July, and August, 1916, was four days. The mean temperature necessary for this short period ranges from 81 to 89.2 degrees F. During the

period of three months when there was an unbroken record of four days for the length of the egg stage, the mean temperature was 85.8 degrees F. In one instance a period of four days occurred with a mean temperature for the period of only 80 degrees F.

The longest period of the egg stage recorded was from January 12 to February 19, 1917, a period of 37 days. During this period the lowest temperature recorded was 25 degrees F. and the mean temperature for the period was 53.9 degrees F.

The yearly variations in the duration of the egg stage are shown in Table 3. The mean temperature evidently does not have positive influence upon the duration of the egg stage and in such cases continued low temperature influence is evident.

Table 3.—Yearly Variation in Duration of Egg Stage.

Date	Period, Days	Temperature, Mean
November, 1915.....	6.5	75.6
November, 1916.....	12.0	70.0
December, 1915.....	17.4	60.1
December, 1916.....	17.5	63.9
January, 1916.....	22.2	53.8
January, 1917.....	25.2	56.5
February, 1916.....	19.4	60.4
February, 1917.....	14.5	68.2

In Table 4 is given a summary of the duration of the egg stage during the summer months and during the winter months. The average period during the warmest months was about 5 days and during the coldest months the average period was about 15 days. The period during the summer months is quite constant, but during the fall the period increases slowly. During the winter the period is quite variable, probably due to the variations in temperature at that season of the year in this locality.

Table 4.—Summary of Duration of the Egg Stage.

Month	Average Period	Shortest Period	Longest Period	Collections of Eggs Observed
	Days	Days	Days	
June, 1916.....	5	5	5	26
July, 1916.....	5	5	5	26
August, 1916.....	5	5	5	25
September, 1916.....	5	4	7	30
November, 1916.....	12.7	7	17	29
December, 1916.....	18.5	8	25	30
January, 1917.....	25.5	12	37	22
February, 1917.....	14.8	8	19	22

There is quite a close relationship between the duration of the egg stage and existing temperatures. This effect is shown in Table 5. The low temperature at which the vitality of the eggs is destroyed was not determined.

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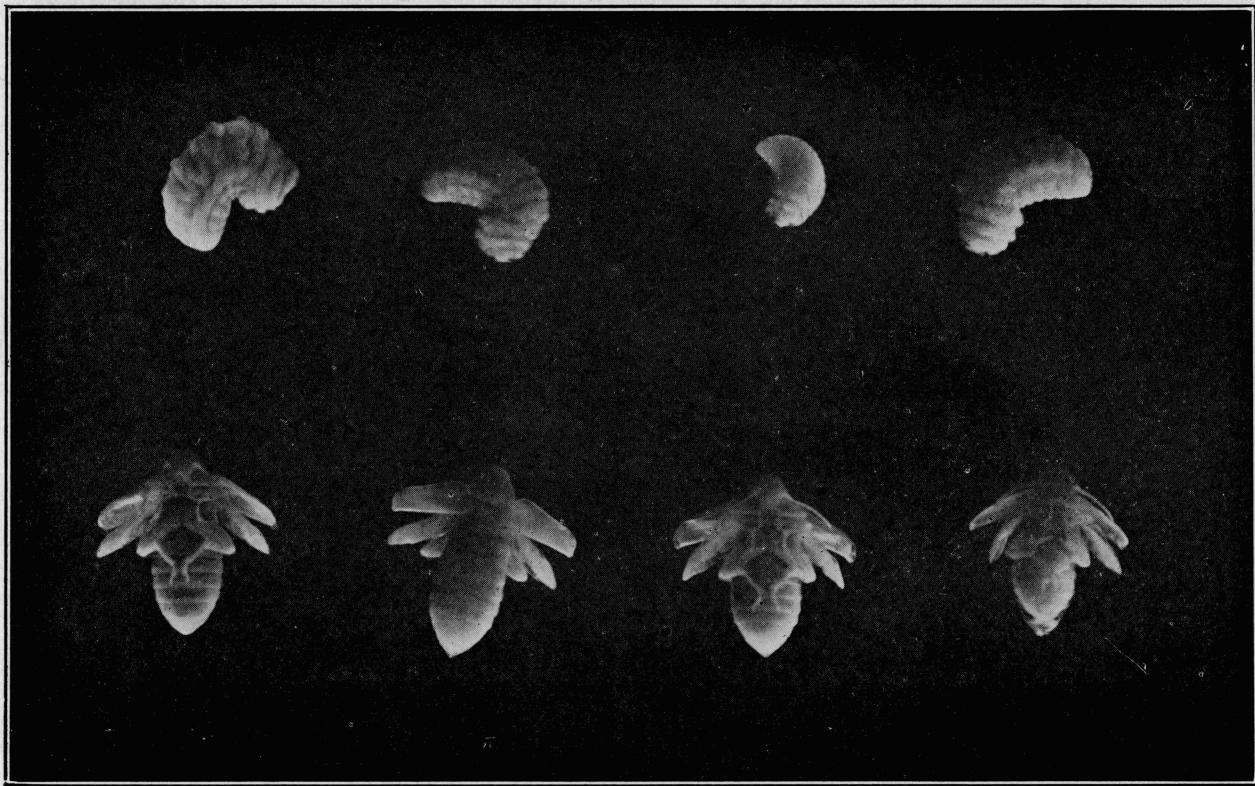


Plate III. Cowpea Weevil; Larva above, Pupa below.

Table 5.—Effect of Temperature on Duration of Egg Stage.

Month	Average Period, Days	Daily Temperature, Degrees F.
June, 1916.....	5	86
July, 1916.....	5	87
August, 1916.....	5	86
September, 1916.....	5.6	83.5
November, 1916.....	12.7	68.5
December, 1916.....	18.5	64.6
January, 1917.....	25.5	60.3
February, 1917.....	14.8	62

Larva.

Description.—The larva of *B. quadrimaculatus* is a fleshy grub; its body is fusiform and yellowish-white in color; its head small and brownish; its trophi dark brown. The length varies from 1 to 5 mm. depending upon the molt; the larva is strongly curved when in natural position, the posterior end being considerably larger and tapering abruptly to a blunt point on the anal extremity. Head small, wider than long, light in color; antennae rudimentary; eye spots well defined. Thoracic segments distinct, prothorax slightly larger; no bristles or hairs present. Views of the larva are shown in Plate III.

Duration of Larval Stage.

Exact records were made on the duration of the larval stage of the cowpea weevil for a period of almost one and one-half years. These observations were made in the laboratory where only natural temperature conditions prevailed throughout the entire time. A thermograph was used to record the existing temperatures during the period of observation. The records made in these observations are given in Table 6. For each period are given its single highest temperature and its single lowest temperature. The mean temperature given is the average of the mean daily temperatures during the period. Normal dry peas were the only food of the larvae.

Table 6.—Duration of Larval Stage.

Hatched	Pupated	Period	Temperature		
			Max.	Min.	Mean
1915					
Nov. 2.....	Nov. 20.....	18	84	57	73.3
Nov. 2.....	Nov. 20.....	18	84	57	73.3
Nov. 2.....	Nov. 21.....	19	86	57	73.3
Nov. 4.....	Nov. 22.....	18	87	57	73.4
Nov. 4.....	Nov. 24.....	20	87	57	73.6
Nov. 5.....	Nov. 24.....	19	87	57	73.6
Nov. 5.....	Nov. 25.....	20	87	57	73.9
Nov. 6.....	Nov. 26.....	20	87	57	73.7
Nov. 7.....	Nov. 26.....	19	87	57	73.5
Nov. 8.....	Nov. 27.....	19	87	57	73.3
Nov. 9.....	Nov. 28.....	19	87	57	73.7
Nov. 10.....	Nov. 28.....	18	87	57	73.4
Nov. 11.....	Nov. 29.....	18	87	57	73.3
Nov. 12.....	Dec. 1.....	19	87	57	73.6
Nov. 12.....	Dec. 4.....	22	87	57	74.2
Nov. 16.....	Dec. 3.....	17	87	66	76.0
Nov. 17.....	Dec. 4.....	17	87	66	76.5
Nov. 18.....	Dec. 3.....	15	87	66	76.5

Table 6.—Duration of Larval Stage.—Continued.

Hatched	Pupated	Period	Temperature		
			Max.	Min.	Mean
1915					
Nov. 18.....	Dec. 4.....	16	87	66	76.5
Nov. 19.....	Dec. 5.....	16	87	66	76.3
Nov. 20.....	Dec. 5.....	15	87	66	76.3
Nov. 21.....	Dec. 5.....	15	87	66	71.2
Nov. 22.....	Dec. 5.....	13	86	66	84.0
Nov. 23.....	Dec. 7.....	14	86	66	76.5
Nov. 24.....	Dec. 9.....	15	86	66	76.4
Nov. 25.....	Dec. 10.....	15	86	57	76.4
Nov. 26.....	Dec. 11.....	15	86	50	75.9
Nov. 27.....	Dec. 31.....	34	86	29	61.5
Nov. 28.....	Jan. 4, 1916.....	37	86	29	61.1
Nov. 29.....	Jan. 5.....	37	86	29	61.1
Nov. 29.....	Jan. 7.....	39	86	29	61.5
Nov. 30.....	Jan. 8.....	39	86	29	61.3
Dec. 3.....	Jan. 12.....	40	85	29	59.5
Dec. 4.....	Jan. 26.....	53	85	22	56.7
Dec. 5.....	Feb. 16.....	73	83	22	55.5
Dec. 6.....	Feb. 18.....	74	83	22	55.2
Dec. 7.....	Feb. 19.....	74	83	22	54.9
Dec. 8.....	Feb. 20.....	74	83	22	54.9
Dec. 10.....	Mar. 1.....	81	83	22	57.0
Dec. 11.....	Mar. 8.....	88	86	22	55.7
Dec. 12.....	Mar. 7.....	86	86	22	55.2
Dec. 13.....	Mar. 5.....	83	81	22	55.8
1916					
Jan. 4.....	Mar. 16.....	72	86	22	57.1
Jan. 5.....	Mar. 17.....	72	86	22	56.9
Jan. 6.....	Mar. 18.....	72	86	22	56.6
Jan. 7.....	Mar. 17.....	70	88	22	56.6
Jan. 7.....	Mar. 19.....	72	86	22	55.1
Jan. 8.....	Mar. 19.....	71	86	22	55.5
Jan. 10.....	Mar. 21.....	71	88	22	54.9
Jan. 11.....	Mar. 19.....	68	86	22	56.7
Jan. 12.....	Feb. 18.....	37	80	22	50.7
Jan. 11.....	Feb. 19.....	39	80	22	50.9
Jan. 19.....	Mar. 19.....	60	86	22	58.0
Jan. 11.....	Mar. 19.....	68	86	22	56.9
Jan. 10.....	Mar. 20.....	70	86	22	56.6
Jan. 11.....	Mar. 20.....	69	86	22	56.5
Jan. 10.....	Mar. 21.....	71	88	22	56.4
Jan. 20.....	Mar. 21.....	61	88	22	58.8
Jan. 23.....	Mar. 22.....	59	89	22	59.3
Feb. 2.....	Mar. 24.....	51	89	26	60.2
Feb. 3.....	Mar. 22.....	48	89	27	60.1
Feb. 4.....	Mar. 25.....	50	89	38	56.3
Feb. 23.....	Mar. 30.....	36	89	39	66.6
Feb. 25.....	Mar. 31.....	35	89	39	67.5
Feb. 29.....	April 6.....	37	89	39	66.1
Mar. 1.....	April 7.....	37	89	39	66.2
Mar. 3.....	April 8.....	36	89	39	66.3
Mar. 7.....	April 8.....	32	89	44	67.5
Mar. 9.....	April 11.....	33	89	40	66.1
Mar. 10.....	April 10.....	31	89	40	66.7
Mar. 15.....	April 12.....	28	89	40	66.0
Mar. 18.....	April 13.....	26	89	40	67.1
Mar. 19.....	April 14.....	26	89	40	67.4
Mar. 20.....	April 15.....	26	89	40	67.5
Mar. 21.....	April 16.....	26	89	40	67.6
Mar. 22.....	April 16.....	25	87	40	67.2
Mar. 27.....	April 20.....	24	87	40	66.7
Mar. 28.....	April 23.....	26	87	40	67.8
Mar. 31.....	April 26.....	26	87	40	68.7
April 1.....	April 29.....	28	87	40	68.4
April 2.....	April 30.....	28	87	40	68.2
April 5.....	May 2.....	27	87	40	68.3
April 9.....	May 3.....	24	87	44	69.3
April 10.....	May 3.....	23	87	52	71.0
April 11.....	May 4.....	23	87	52	71.5
April 11.....	May 4.....	23	87	52	71.5
April 12.....	May 4.....	22	87	52	71.8
April 12.....	May 5.....	23	91	52	72.0
April 13.....	May 5.....	22	91	52	71.9
April 14.....	May 5.....	21	91	52	71.7
April 14.....	May 5.....	21	91	52	71.7
April 15.....	May 5.....	20	91	52	71.4
April 15.....	May 5.....	20	91	52	71.4
April 15.....	May 6.....	21	94	52	71.9
April 16.....	May 6.....	20	94	52	72.5

Table 6.—Duration of Larval Stage.—Continued.

Hatched	Pupated	Period	Temperature		
			Max.	Min.	Mean
1916					
April 16.....	May 7.....	21	96	52	73.0
April 17.....	May 7.....	20	96	52	73.6
April 18.....	May 7.....	19	96	52	74.0
April 20.....	May 8.....	18	99	52	74.2
April 21.....	May 8.....	17	99	52	74.3
April 22.....	May 9.....	17	100	52	75.4
April 23.....	May 9.....	16	100	52	75.5
April 24.....	May 9.....	15	100	52	75.6
April 25.....	May 10.....	15	100	52	76.4
April 25.....	May 11.....	16	100	52	77.2
April 26.....	May 11.....	15	100	52	76.6
April 29.....	May 12.....	13	100	59	79.5
April 30.....	May 13.....	13	100	60	81.5
May 1.....	May 14.....	13	100	65	83.0
May 3.....	May 17.....	14	100	66	85.1
May 4.....	May 18.....	14	100	70	85.8
May 4.....	May 19.....	15	100	70	84.6
May 4.....	May 22.....	18	100	70	84.0
May 4.....	May 22.....	18	100	70	84.0
May 6.....	May 23.....	17	100	70	84.3
May 6.....	May 23.....	17	100	70	84.3
May 8.....	May 24.....	16	100	70	84.1
May 8.....	May 24.....	16	100	70	84.1
May 9.....	May 25.....	16	98	70	83.5
May 10.....	May 27.....	17	98	70	82.8
May 11.....	May 28.....	17	97	70	82.4
May 12.....	May 28.....	16	97	70	82.0
May 13.....	May 29.....	16	97	70	81.4
May 14.....	May 30.....	16	97	70	80.9
May 15.....	May 31.....	16	97	70	80.4
May 16.....	June 1.....	16	94	70	80.4
May 19.....	June 1.....	13	94	71	80.4
May 20.....	June 2.....	13	94	71	81.1
May 21.....	June 3.....	13	94	71	81.6
May 22.....	June 4.....	13	94	71	81.7
May 23.....	June 4.....	12	94	71	82.0
May 24.....	June 5.....	12	94	73	82.2
May 24.....	June 5.....	12	94	73	82.2
May 25.....	June 6.....	12	94	73	82.6
May 26.....	June 6.....	11	94	73	82.8
May 26.....	June 6.....	11	94	73	82.8
May 27.....	June 7.....	11	94	73	83.0
May 28.....	June 8.....	11	94	71	83.5
May 29.....	June 9.....	11	94	71	83.2
May 30.....	June 10.....	11	94	71	83.1
May 31.....	June 11.....	11	94	71	83.6
June 1.....	June 12.....	11	94	71	83.3
June 2.....	June 13.....	11	94	71	83.5
June 3.....	June 14.....	11	94	71	83.2
June 4.....	June 15.....	11	94	71	83.2
June 5.....	June 16.....	11	94	71	83.0
June 6.....	June 17.....	11	94	71	82.6
June 7.....	June 18.....	11	90	71	82.3
June 8.....	June 19.....	11	90	72	81.8
June 9.....	June 21.....	12	95	72	82.5
June 10.....	June 22.....	12	95	72	83.0
June 11.....	June 23.....	12	95	72	83.0
June 12.....	June 24.....	12	95	72	83.1
June 13.....	June 25.....	12	95	72	83.3
June 14.....	June 26.....	12	95	72	83.9
June 15.....	June 27.....	12	95	72	84.1
June 16.....	June 28.....	12	95	74	84.5
June 17.....	June 29.....	12	95	75	85.0
June 18.....	June 30.....	12	95	75	85.3
June 19.....	July 1.....	12	95	75	85.5
June 20.....	July 2.....	12	95	75	85.7
June 21.....	July 2.....	11	95	75	85.9
June 23.....	July 4.....	11	95	75	85.6
June 24.....	July 4.....	10	95	75	85.7
June 25.....	July 5.....	10	95	75	85.6
June 26.....	July 6.....	10	95	75	85.3
June 27.....	July 7.....	10	97	75	85.2
June 28.....	July 8.....	10	99	76	85.3
June 29.....	July 9.....	10	99	76	85.8
June 30.....	July 10.....	10	99	76	86.2
July 1.....	July 11.....	10	99	76	86.7
July 2.....	July 12.....	10	99	76	87.2
July 3.....	July 13.....	10	99	76	87.2
July 4.....	July 14.....	10	99	77	87.3

Table 6.—Duration of Larval Stage.

Hatched	Pupated	Period	Temperature		
			Max.	Min.	Mean
1916					
July 5	July 15	10	99	79	87.5
July 6	July 16	10	99	79	87.6
July 7	July 17	10	99	79	87.8
July 8	July 18	10	99	78	87.8
July 9	July 19	10	99	78	87.6
July 10	July 20	10	99	78	87.4
July 11	July 20	9	99	78	87.2
July 12	July 22	10	99	78	87.3
July 14	July 23	9	99	78	88.0
July 15	July 24	9	99	78	87.0
July 16	July 27	11	99	78	88.0
July 17	July 27	10	99	78	88.1
July 18	July 28	10	99	78	87.7
July 19	July 28	9	99	78	87.6
July 20	July 29	9	99	78	87.7
July 21	July 30	9	99	78	87.7
July 22	July 31	9	99	78	87.0
July 23	Aug. 1	9	99	78	86.6
July 24	Aug. 2	9	99	78	87.1
July 25	Aug. 3	9	99	78	86.8
July 26	Aug. 4	9	99	78	86.6
July 27	Aug. 5	9	99	78	86.8
July 28	Aug. 6	9	97	78	87.3
July 29	Aug. 8	10	97	78	86.6
July 30	Aug. 9	10	97	78	86.5
July 31	Aug. 10	10	97	78	86.6
Aug. 1	Aug. 11	10	97	79	86.2
Aug. 2	Aug. 12	10	97	79	85.9
Aug. 3	Aug. 13	10	96	79	85.8
Aug. 4	Aug. 14	10	96	79	85.7
Aug. 5	Aug. 16	11	96	79	85.7
Aug. 6	Aug. 17	11	96	75	85.5
Aug. 7	Aug. 17	10	96	75	86.0
Aug. 8	Aug. 18	10	96	75	85.8
Aug. 9	Aug. 19	10	96	75	85.8
Aug. 10	Aug. 20	10	96	75	86.0
Aug. 11	Aug. 20	9	96	75	86.2
Aug. 12	Aug. 21	9	100	75	86.4
Aug. 13	Aug. 22	9	100	75	87.0
Aug. 14	Aug. 25	11	100	73	86.9
Aug. 15	Aug. 26	11	100	70	86.3
Aug. 16	Aug. 28	12	100	70	85.8
Aug. 17	Aug. 29	12	100	70	85.7
Aug. 18	Aug. 30	12	100	70	86.0
Aug. 19	Aug. 31	12	100	70	86.0
Aug. 20	Sept. 1	12	100	70	86.0
Aug. 21	Sept. 2	12	97	70	85.9
Aug. 22	Sept. 2	11	97	70	85.4
Aug. 23	Sept. 3	11	97	70	85.4
Aug. 25	Sept. 5	11	97	70	85.7
Aug. 26	Sept. 7	12	97	75	86.4
Aug. 27	Sept. 8	12	101	77	86.9
Aug. 28	Sept. 10	13	101	77	87.7
Aug. 29	Sept. 11	13	101	77	87.7
Aug. 30	Sept. 11	12	101	78	88.0
Sept. 1	Sept. 12	11	101	80	80.3
Sept. 2	Sept. 13	11	101	79	88.5
Sept. 3	Sept. 14	11	101	78	88.5
Sept. 4	Sept. 14	10	101	78	88.6
Sept. 4	Sept. 16	12	101	70	88.4
Sept. 6	Sept. 17	11	101	70	86.7
Sept. 7	Sept. 18	11	101	67	85.7
Sept. 8	Sept. 19	11	99	67	85.2
Sept. 9	Sept. 20	11	99	67	84.1
Sept. 10	Sept. 23	13	99	67	83.0
Sept. 11	Sept. 24	13	99	67	82.4
Sept. 12	Sept. 25	13	99	67	81.8
Sept. 12	Sept. 27	15	105	67	81.5
Sept. 14	Sept. 28	14	105	67	81.2
Sept. 15	Sept. 30	15	105	57	80.7
Sept. 16	Oct. 2	16	105	57	78.7
Sept. 18	Oct. 3	15	105	57	78.6
Sept. 19	Oct. 4	15	105	57	78.2
Sept. 20	Oct. 5	15	105	57	78.2
Sept. 21	Oct. 6	15	105	57	78.0
Sept. 22	Oct. 7	15	105	57	77.8
Sept. 22	Oct. 8	16	105	57	77.6
Sept. 23	Oct. 8	15	105	57	77.6
Sept. 24	Oct. 9	15	105	57	77.6

Table 6.—Duration of Larval Stage.—Continued.

Hatched	Pupated	Period	Temperature		
			Max.	Min.	Mean
1916					
Sept. 26.	Oct. 11.	15	105	57	77.6
Sept. 27.	Oct. 12.	15	95	57	77.5
Sept. 28.	Oct. 13.	15	94	57	76.8
Sept. 29.	Oct. 13.	14	94	57	76.1
Oct. 1.	Oct. 14.	13	94	64	77.5
Oct. 2.	Oct. 15.	13	94	66	78.6
Oct. 3.	Oct. 16.	13	94	65	79.0
Oct. 4.	Oct. 17.	13	94	65	78.9
Oct. 5.	Oct. 18.	13	94	61	78.6
Oct. 6.	Oct. 21.	15	94	61	76.1
Oct. 6.	Oct. 22.	16	94	41	75.0
Oct. 7.	Oct. 23.	16	94	41	74.2
Oct. 8.	Oct. 25.	17	95	41	74.4
Oct. 8.	Oct. 28.	20	95	41	73.6
Oct. 9.	Oct. 29.	20	95	41	73.1
Oct. 10.	Oct. 30.	20	95	41	72.5
Oct. 11.	Oct. 31.	20	95	41	72.6
Oct. 12.	Nov. 1.	20	95	41	73.0
Oct. 13.	Nov. 4.	22	95	41	72.9
Oct. 14.	Nov. 5.	22	95	41	72.5
Oct. 15.	Nov. 5.	21	95	41	72.1
Oct. 16.	Nov. 6.	21	95	41	72.1
Oct. 18.	Nov. 16.	29	95	33	70.1
Oct. 22.	Nov. 18.	27	95	33	70.0
Oct. 23.	Nov. 20.	28	95	33	70.3
Oct. 25.	Nov. 24.	30	94	33	69.7
Oct. 27.	Nov. 25.	29	94	33	69.2
Oct. 28.	Nov. 25.	28	94	33	69.5
Oct. 28.	Nov. 26.	29	94	33	69.4
Oct. 29.	Nov. 26.	28	94	33	69.3
Oct. 29.	Nov. 27.	29	98	33	69.2
Oct. 30.	Nov. 28.	29	98	33	68.5
Oct. 30.	Nov. 28.	29	98	33	68.5
Nov. 1.	Nov. 29.	28	98	33	68.1
Nov. 2.	Nov. 30.	28	98	33	68.0
Nov. 2.	Dec. 1.	29	98	33	68.3
Nov. 2.	Dec. 3.	31	98	33	68.7
Nov. 4.	Dec. 4.	30	98	33	68.4
Nov. 4.	Dec. 5.	31	101	33	68.9
Nov. 5.	Dec. 6.	31	101	33	69.5
Nov. 7.	Dec. 7.	30	101	33	69.5
Nov. 7.	Dec. 8.	31	101	33	69.9
Nov. 8.	Dec. 11.	33	101	33	69.1
Nov. 11.	Dec. 12.	31	101	33	68.5
Nov. 12.	Dec. 17.	35	101	32	66.8
Nov. 16.	Dec. 24.	38	111	28	65.5
Nov. 19.	Dec. 25.	36	101	28	62.8
Nov. 20.	Jan. 2.	43	101	28	65.7
Nov. 21.	Jan. 2.	42	101	28	65.4
Nov. 25.	Jan. 2.	38	101	28	64.6
Nov. 26.	Jan. 3.	38	101	28	65.0
Nov. 27.	Jan. 4.	38	101	28	65.2
Nov. 28.	Jan. 7.	40	101	28	65.4
Nov. 29.	Jan. 8.	40	101	28	65.2
Nov. 29.	Jan. 9.	41	101	28	65.3
Nov. 30.	Jan. 5.	36	101	28	64.7
Nov. 30.	Jan. 6.	37	101	28	64.7
Dec. 1.	Jan. 6.	36	101	28	64.7
Dec. 1.	Jan. 7.	37	101	28	64.7
Dec. 2.	Jan. 10.	39	101	28	63.5
Dec. 3.	Jan. 11.	39	101	28	65.0
Dec. 4.	Jan. 26.	53	101	28	60.9
Dec. 5.	Jan. 27.	53	99	28	60.5
Dec. 5.	Jan. 27.	53	99	28	60.5
Dec. 6.	Jan. 28.	53	94	28	61.0
Dec. 6.	Jan. 29.	54	94	28	61.0
Dec. 6.	Jan. 29.	54	94	28	61.0
Dec. 6.	Jan. 30.	55	100	28	61.1
Dec. 6.	Jan. 30.	55	100	28	61.1
Dec. 7.	Jan. 31.	55	100	28	61.1
Dec. 8.	Feb. 6.	60	100	25	59.2
Dec. 11.	Feb. 13.	64	100	28	58.6
Dec. 15.	Feb. 17.	64	100	28	58.4
Dec. 20.	Feb. 20.	62	100	25	58.7
Dec. 26.	Feb. 21.	57	100	25	59.3
Dec. 27.	Feb. 24.	59	103	25	60.1
1917					
Jan. 1.	Feb. 25.	55	103	25	60.1

Table 6. Duration of Larval Stage—Continued.

Hatched	Pupated	Period	Temperature		
			Max.	Min.	Mean
1 17					
Jan. 2.	Feb. 25.	54	103	25	60.1
Jan. 2.	Feb. 26.	55	103	25	60.4
Jan. 3.	Feb. 26.	54	103	25	60.0
Jan. 3.	Feb. 26.	54	103	25	60.0
Jan. 4.	Feb. 26.	53	103	25	59.9
Jan. 4.	Feb. 27.	54	103	25	60.0
Jan. 4.	Feb. 28.	55	103	25	60.9
Jan. 5.	Feb. 28.	54	103	25	60.5
Jan. 5.	Feb. 28.	54	103	25	60.5
Jan. 5.	Feb. 28.	54	103	25	60.5
Jan. 6.	Feb. 28.	53	103	25	60.6
Jan. 7.	Mar. 1.	53	103	25	60.9
Jan. 7.	Mar. 2.	53	103	25	60.9
Jan. 7.	Mar. 2.	54	103	25	61.0
Jan. 8.	Mar. 2.	53	103	25	60.9
Jan. 8.	Mar. 2.	53	103	25	60.9
Jan. 8.	Mar. 2.	53	103	25	60.9
Jan. 9.	Mar. 2.	52	103	25	60.7
Jan. 9.	Mar. 2.	52	103	25	60.7
Jan. 9.	Mar. 3.	53	103	25	60.5
Jan. 10.	Mar. 3.	52	103	25	60.2
Jan. 11.	Mar. 4.	52	103	25	59.6
Jan. 12.	Mar. 6.	53	103	25	59.1
Jan. 12.	Mar. 8.	55	103	25	59.3
Jan. 21.	Mar. 8.	46	103	25	61.7
Jan. 25.	Mar. 11.	45	103	25	62.7
Jan. 29.	Mar. 12.	42	103	25	63.4
Jan. 30.	Mar. 14.	43	103	25	64.0
Jan. 31.	Mar. 15.	43	103	25	63.3
Feb. 1.	Mar. 15.	42	103	25	63.2
Feb. 2.	Mar. 16.	42	103	30	63.3
Feb. 8.	Mar. 16.	36	103	30	65.8
Feb. 13.	Mar. 20.	35	103	35	67.0
Feb. 15.	Mar. 19.	32	103	35	68.2
Feb. 18.	Mar. 20.	30	103	35	69.3
Feb. 18.	Mar. 20.	30	103	33	69.3
Feb. 18.	Mar. 22.	32	103	33	68.7
Feb. 18.	Mar. 21.	31	103	33	69.0
Feb. 18.	Mar. 20.	30	103	33	69.3
Feb. 19.	Mar. 21.	30	103	33	69.1
Feb. 19.	Mar. 20.	29	103	33	69.3
Feb. 19.	Mar. 20.	29	103	33	69.3
Feb. 20.	Mar. 21.	29	103	35	69.1
Feb. 21.	Mar. 21.	28	103	35	69.1
Feb. 22.	Mar. 22.	28	102	33	69.1
Feb. 22.	Mar. 22.	28	102	33	69.1
Feb. 23.	Mar. 24.	29	102	33	69.2
Feb. 23.	Mar. 28.	33	102	33	69.9
Feb. 24.	Mar. 26.	30	102	33	71.7
Feb. 24.	Mar. 26.	30	102	33	71.7
Feb. 24.	Mar. 24.	28	102	33	71.9
Feb. 24.	Mar. 24.	28	102	33	71.9
Feb. 24.	Mar. 25.	29	102	33	71.7
Feb. 25.	Mar. 28.	31	102	33	71.9
Feb. 25.	Mar. 29.	32	102	33	71.7
Feb. 25.	Mar. 26.	29	102	33	70.9
Feb. 25.	Mar. 25.	28	102	33	68.7
Feb. 25.	Mar. 25.	28	102	33	68.7
Feb. 26.	Mar. 27.	29	102	33	68.0
Feb. 26.	Mar. 29.	31	102	33	69.2
Feb. 27.	Mar. 30.	31	100	33	69.0
Feb. 28.	Mar. 30.	30	99	33	68.7

The shortest larval stage observed, 9 days, occurred frequently during July, 1916. The mean temperature during these periods ranged from 86.6 to 88.2 degrees F. The longest larval period of 88 days was from December 11, 1915, to March 8, 1916. During this period the mean temperature was 55.5 degrees F.; the lowest temperature during the period was 22 degrees F. and the highest temperature recorded was 86 degrees F.

The yearly variation in the duration of the larval stage is shown in Table 7. The mean temperature of the period shows a direct effect

upon the length of the stage. A slight decrease in the mean temperature results in a much increased length of the larval stage.

Table 7.—Yearly Variation in Duration of Larval Stage.

Date	Period, Days	Temperature, Mean
November, 1915.....	17.5	75.0
November, 1916.....	35.5	65.7
December, 1915.....	72.7	55.8
December, 1916.....	53.2	60.4
January, 1916.....	68.2	57.3
January, 1917.....	53.2	61.4
February, 1916.....	42.8	63.7
February, 1917.....	30.3	67.3

In Table 8 is given a summary of the duration of the larval stage during representative summer months and winter months. The average period during the warmest months was 11.5 days and during the coldest months the average period was 45.9 days. The period during the warmer months was quite constant, but during the colder months it was variable, no doubt, because of local variations in climate.

Table 8.—Summary of Duration of Larval Stage.

Month	Average Period	Shortest Period	Longest Period	Number Collections Observed
June.....	11.2	10	12	29
July.....	9.6	9	11	30
August.....	11.6	9	13	29
September.....	13.5	10	16	28
November.....	25.6	13	13	52
December.....	61.2	36	88	29
January.....	60.0	42	72	47
February.....	36.8	28	51	40

The relationship of temperature to the duration of the larval stage is not so noticeable as was the case with the egg stage. The results of the observations made are given in Table 9. Neither the low temperature at which growth ceased nor the vital low temperature were determined.

Table 9.—Effect of Temperature on Length of Larval Stage.

Month	Average Period Days	Mean Daily Temperature Degrees
June.....	11.2	86.0
July.....	9.6	87.0
August.....	11.6	89.0
September.....	13.5	83.5
November.....	25.6	71.9
December.....	61.2	62.2
January.....	60.0	58.6
February.....	36.8	58.5

Pupa.

Description.—Pupa stout and compact, white in color, free from bristles or hairs.

Ventral view: Outline oval, tapering to a blunt point distally, broadly rounded anteriorly. Head distinct, bent closely upon thorax; mouth parts immediately between coxae of first pair of legs; mandibles distinct; palpi free, segments distinct, reaching second pair of legs. Eyes not prominent; antennae strongly curved, passing behind first and second pairs of legs, lying flat upon the elytra, segmentation quite distinct, almost three-fourths as long as elytra; longitudinal ridges of elytra very distinct. First and second pairs of legs about equal in length, folded horizontally over elytra; tarsi parallel with body, segmentation distinct; last pair of legs covered by wings, except tarsi, which reach almost to the base of the last abdominal segment.

Lateral view: Head deflexed, prothorax depressed anteriorly, spiracles inconspicuous; first and second pairs of legs cover basal portion of elytra beneath the antennae; antennae curved ventrally behind the legs to about last one-fourth of elytra; wings prominent, curved ventrally behind second pair of legs and cover all but tarsi of last pair of legs; abdominal segments distinct, spiracles inconspicuous.

Dorsal view: Head concealed by prothorax; thoracic segments distinct, prothorax more or less triangular in outline, much wider posteriorly, terminating in sharp points above base of wings, median line conspicuous, abdominal segments nearly equal in size. Views of the pupa are shown in Plate III.

Table 10.—Measurements of Pupa.
(Measured with steel caliper.)

	Length (greatest)	Width (greatest)
1.....	4.0 mm.	2.0 mm.
2.....	4.5 mm.	2.2 mm.
3.....	4.0 mm.	2.0 mm.
4.....	4.5 mm.	2.2 mm.
5.....	3.5 mm.	1.7 mm.
6.....	4.0 mm.	2.0 mm.
7.....	3.5 mm.	1.7 mm.
8.....	3.7 mm.	1.7 mm.
9.....	3.5 mm.	1.7 mm.
10.....	4.0 mm.	2.0 mm.
11.....	3.5 mm.	1.7 mm.
12.....	4.2 mm.	2.2 mm.
13.....	4.5 mm.	2.2 mm.
14.....	3.2 mm.	1.7 mm.
Average.....	3.9 mm.	1.9 mm.

Duration of Pupal Stage.

Records on the duration of the pupal stage of the cowpea weevil were made over a period of almost one and one-half years. This work was conducted in the laboratory where only natural temperatures prevailed. The existing temperatures of the period were recorded by a thermograph. The results of these observations are given in Table 11. For each period the single highest temperature and the single lowest temperature are given. The mean temperature given is an average of

the mean daily temperatures during the period. Normal dry peas were used.

Table 11.—Duration of Pupal Stage.

Pupated	Emerg'd	Per od	Temperature		
			Max.	Min.	Mean
1915					
Nov. 1	Nov. 5	4	82	66	75.2
Nov. 1	Nov. 9	8	82	66	75.6
Nov. 2	Nov. 9	7	83	66	75.5
Nov. 3	Nov. 10	7	82	66	75.8
Nov. 4	Nov. 9	5	82	74	75.5
Nov. 5	Nov. 9	4	83	74	76.1
Nov. 6	Nov. 11	5	83	76	77.1
Nov. 7	Nov. 15	8	83	57	72.5
Nov. 8	Nov. 15	7	83	57	72.7
Nov. 9	Nov. 17	8	84	57	70.2
Nov. 10	Nov. 19	9	84	57	70.6
Nov. 11	Nov. 20	9	86	57	70.5
Nov. 12	Nov. 21	9	87	57	71.1
Nov. 13	Nov. 22	9	87	57	72.1
Nov. 16	Nov. 22	6	87	57	75.2
Nov. 17	Nov. 23	6	87	69	73.8
Nov. 18	Nov. 24	6	87	66	76.5
Nov. 20	Nov. 24	4	87	66	76.3
Nov. 20	Nov. 24	4	87	66	76.3
Nov. 20	Nov. 23	3	87	69	77.3
Nov. 22	Nov. 26	4	81	66	75.5
Nov. 24	Nov. 28	4	82	66	76.0
Nov. 24	Nov. 28	4	82	72	76.0
Nov. 25	Nov. 28	3	82	72	77.0
Nov. 26	Nov. 29	3	82	73	77.0
Nov. 26	Nov. 30	4	82	72	76.5
Nov. 27	Dec. 3	6	86	70	77.0
Nov. 28	Dec. 4	6	86	70	76.8
Nov. 28	Dec. 5	7	86	67	76.8
Nov. 29	Dec. 5	6	86	67	76.5
Dec. 1	Dec. 7	6	86	68	77.5
Dec. 3	Dec. 7	4	85	67	77.2
Dec. 3	Dec. 11	8	85	50	75.0
Dec. 4	Dec. 30	26	85	29	58.1
Dec. 5	Jan. 2	28	85	29	57.4
Dec. 5	Jan. 2	28	85	29	57.4
Dec. 5	Jan. 2	28	85	29	57.4
Dec. 7	Jan. 3	27	83	29	56.9
Dec. 9	Jan. 2	24	83	29	54.2
Dec. 10	Jan. 10	31	83	29	55.6
Dec. 11	Jan. 10	30	76	29	55.2
Dec. 31	Jan. 11	11	76	45	61.7
1916					
Jan. 4	Jan. 28	24	79	22	55.1
Jan. 5	Feb. 27	53	80	22	56.0
Jan. 7	Feb. 22	46	80	22	53.6
Jan. 8	Feb. 22	45	80	22	54.5
Jan. 12	Feb. 23	42	80	22	53.1
Jan. 26	Mar. 3	37	81	26	54.7
Feb. 16	Mar. 12	25	86	39	61.0
Feb. 18	Mar. 12	23	86	39	62.0
Feb. 19	Mar. 20	30	86	39	62.3
Feb. 20	Mar. 20	29	86	39	62.8
Mar. 1	Mar. 20	19	86	39	63.6
Mar. 5	April 6	32	89	44	67.2
Mar. 7	April 6	30	89	44	67.6
Mar. 8	Mar. 20	12	86	44	65.0
Mar. 16	April 6	21	89	40	67.9
Mar. 17	Mar. 25	8	89	53	71.6
Mar. 17	Mar. 25	8	89	53	71.6
Mar. 18	Mar. 23	5	89	61	74.0
Mar. 19	Mar. 23	4	89	63	75.5
Mar. 19	Mar. 28	9	89	48	71.1
Mar. 19	Mar. 28	9	89	48	71.1
Mar. 19	Mar. 29	10	89	48	70.1
Mar. 19	April 11	23	89	40	66.8
Mar. 20	Mar. 24	4	89	60	75.7
Mar. 20	Mar. 24	4	89	60	75.7
Mar. 20	Mar. 25	5	89	60	74.8
Mar. 21	Mar. 24	3	89	60	76.6
Mar. 21	Mar. 25	4	89	60	75.0
Mar. 21	Mar. 31	10	89	48	69.8
Mar. 22	Mar. 31	9	86	48	69.0
Mar. 22	April 6	15	86	48	68.0
Mar. 24	April 2	9	86	48	67.7

Table 11.—Duration of Pupal Stage.—Continued.

Pupated	Emerg	Period	Temperature		
			Max.	Min.	Mean
1916					
Mar. 25	April 6	12	86	48	66.6
Mar. 30	April 13	14	83	40	64.7
Mar. 31	April 16	16	83	40	66.3
April 6	April 17	11	85	40	65.6
April 7	April 16	9	83	40	65.5
April 8	April 17	9	85	40	65.6
April 8	April 19	11	87	40	66.7
April 10	April 20	10	87	53	70.5
April 11	April 19	8	87	56	71.2
April 12	April 22	10	87	56	72.8
April 13	April 28	15	87	52	72.9
April 14	April 26	12	87	56	73.0
April 15	April 27	12	87	56	73.0
April 16	April 29	13	87	52	71.4
April 20	May 1	11	87	52	71.0
April 23	May 2	9	87	52	71.1
April 26	May 3	7	86	52	69.1
April 29	May 8	9	99	59	75.3
April 30	May 7	7	96	65	75.4
May 2	May 9	7	100	65	79.4
May 3	May 10	7	100	66	82.2
May 3	May 10	7	100	66	82.2
May 4	May 10	6	100	73	84.3
May 4	May 9	5	100	73	83.3
May 4	May 11	7	100	73	85.0
May 5	May 11	6	100	74	86.6
May 5	May 11	6	100	74	86.6
May 5	May 12	7	100	74	87.0
May 5	May 12	7	100	74	87.0
May 5	May 13	8	100	74	87.2
May 6	May 13	7	100	76	88.0
May 6	May 13	7	100	76	88.0
May 7	May 14	7	100	80	88.5
May 7	May 14	7	100	80	88.5
May 8	May 15	8	100	80	88.3
May 8	May 16	8	100	80	88.7
May 9	May 18	9	98	74	88.5
May 9	May 19	10	98	70	89.4
May 10	May 20	10	98	70	86.2
May 11	May 23	12	97	70	84.5
May 12	May 24	12	97	70	83.2
May 13	May 24	11	97	70	82.5
May 14	May 25	11	97	70	82.0
May 17	May 27	10	91	70	81.1
May 18	May 25	7	91	70	79.4
May 19	May 27	8	91	71	78.5
May 22	May 27	5	91	71	79.7
May 22	May 28	6	91	71	80.8
May 23	May 28	5	89	71	80.5
May 23	May 28	5	89	71	80.9
May 24	May 30	6	89	73	80.4
May 24	May 31	7	94	73	80.5
May 25	May 31	6	94	73	80.8
May 27	June 1	5	94	73	80.1
May 28	June 2	5	94	73	82.0
May 29	June 3	5	94	74	82.8
May 30	June 4	5	94	77	83.8
May 31	June 5	5	92	77	84.5
June 1	June 6	5	93	78	83.9
June 1	June 7	6	94	76	84.3
June 2	June 8	6	94	71	84.7
June 3	June 9	6	94	71	83.3
June 4	June 10	6	94	71	82.5
June 4	June 11	7	94	71	83.0
June 5	June 12	7	94	71	82.8
June 5	June 12	7	94	71	82.8
June 6	June 13	7	94	71	83.0
June 6	June 13	7	94	71	83.0
June 6	June 14	8	94	71	83.0
June 7	June 14	7	90	71	82.7
June 8	June 14	6	90	72	82.2
June 9	June 15	6	90	72	81.8
June 10	June 16	6	90	73	83.5
June 11	June 17	6	90	72	84.0
June 12	June 18	6	89	72	82.5
June 13	June 19	6	89	72	82.1
June 14	June 21	7	89	72	81.6
			95	72	82.0

Table 11.—Duration of Pupal Stage.—Continued.

Pupated	Emerg	Period	Temperature		
			Max.	Min.	Mean
1916					
June 15	June 20	5	95	72	81.0
June 16	June 22	6	95	74	82.0
June 17	June 23	6	95	75	83.5
June 18	June 24	6	95	75	84.1
June 19	June 25	6	95	75	85.0
June 21	June 26	5	95	80	86.7
June 22	June 27	5	95	80	86.8
June 23	June 28	5	95	75	87.2
June 24	June 29	5	95	75	87.0
June 25	June 30	5	95	75	86.6
June 26	July 1	5	95	75	85.6
June 27	July 2	5	95	75	85.0
June 28	July 2	4	93	76	84.2
June 29	July 3	4	93	76	84.2
June 30	July 4	4	93	76	84.2
July 1	July 4	3	93	76	84.6
July 2	July 6	4	95	76	85.2
July 2	July 7	5	97	76	85.5
July 4	July 9	5	99	77	87.2
July 4	July 10	6	99	77	87.5
July 5	July 11	6	99	79	88.1
July 6	July 12	6	99	79	88.5
July 7	July 13	6	99	79	88.1
July 8	July 14	6	98	79	87.8
July 9	July 16	7	98	79	87.2
July 10	July 17	7	98	79	87.1
July 11	July 17	6	98	79	86.8
July 12	July 18	6	99	79	87.0
July 13	July 19	6	99	79	87.6
July 14	July 20	6	99	79	87.5
July 15	July 20	5	99	79	85.2
July 16	July 21	5	99	78	88.0
July 17	July 21	4	99	78	88.0
July 18	July 23	5	97	80	88.2
July 19	July 24	5	99	80	87.6
July 20	July 25	5	99	80	88.6
July 20	July 26	6	99	78	88.6
July 22	July 27	5	99	78	88.2
July 23	July 27	4	99	78	87.5
July 24	July 30	6	98	78	85.8
July 27	Aug. 1	5	97	78	85.8
July 27	Aug. 2	6	97	78	86.3
July 28	Aug. 2	5	97	78	86.6
July 28	Aug. 3	6	97	78	86.8
July 29	Aug. 4	6	97	78	87.6
July 30	Aug. 5	6	97	79	88.0
July 31	Aug. 6	6	97	79	87.8
Aug. 1	Aug. 7	6	97	79	87.1
Aug. 2	Aug. 8	6	97	79	86.5
Aug. 3	Aug. 9	6	96	79	86.1
Aug. 4	Aug. 10	6	96	78	85.5
Aug. 5	Aug. 11	6	95	78	85.0
Aug. 6	Aug. 12	6	95	78	84.3
Aug. 8	Aug. 13	5	95	78	85.4
Aug. 9	Aug. 14	5	96	78	85.6
Aug. 10	Aug. 16	6	96	79	86.1
Aug. 11	Aug. 17	6	96	75	86.8
Aug. 12	Aug. 18	6	96	75	86.3
Aug. 13	Aug. 19	6	96	75	86.1
Aug. 14	Aug. 20	6	95	75	86.2
Aug. 16	Aug. 20	4	94	75	85.7
Aug. 17	Aug. 21	4	100	80	85.7
Aug. 17	Aug. 22	5	100	80	86.8
Aug. 18	Aug. 23	5	100	80	88.0
Aug. 19	Aug. 25	6	100	73	87.8
Aug. 20	Aug. 26	6	100	70	87.0
Aug. 20	Aug. 27	6	100	70	86.2
Aug. 21	Aug. 27	6	97	70	86.1
Aug. 22	Aug. 28	6	96	70	84.6
Aug. 25	Aug. 31	6	97	70	84.0
Aug. 26	Aug. 31	5	97	75	84.4
Aug. 28	Sept. 1	4	97	77	86.2
Aug. 29	Sept. 2	4	97	78	86.0
Aug. 30	Sept. 4	5	97	78	86.8
Aug. 31	Sept. 4	4	97	79	87.2
Sept. 1	Sept. 5	4	97	80	87.5
Sept. 2	Sept. 5	3	97	80	88.0
Sept. 2	Sept. 6	4	97	80	88.2
Sept. 3	Sept. 7	4	97	80	88.5

Table 11.—Duration of Pupal Stage.—Continued.

Pupated	Emerg	Period	Temperature		
			Max.	Min.	Mean
1916					
Sept. 5	Sept. 10	5	101	80	89.2
Sept. 7	Sept. 11	4	101	80	89.0
Sept. 8	Sept. 12	4	99	80	89.0
Sept. 10	Sept. 13	3	97	79	88.0
Sept. 11	Sept. 14	3	96	78	88.0
Sept. 11	Sept. 14	3	96	78	88.0
Sept. 12	Sept. 17	5	97	70	84.2
Sept. 13	Sept. 18	5	99	67	82.2
Sept. 14	Sept. 19	5	99	67	81.2
Sept. 14	Sept. 20	6	99	67	80.8
Sept. 16	Sept. 20	4	99	67	79.4
Sept. 17	Sept. 22	5	99	67	80.2
Sept. 18	Sept. 24	6	91	68	80.5
Sept. 19	Sept. 26	7	91	69	80.5
Sept. 20	Sept. 27	7	105	70	80.2
Sept. 23	Sept. 28	5	105	71	80.2
Sept. 24	Sept. 29	5	105	60	85.2
Sept. 25	Sept. 29	4	105	60	83.7
Sept. 27	Oct. 4	7	95	57	77.7
Sept. 28	Oct. 5	7	89	57	74.5
Sept. 30	Oct. 7	7	89	59	74.1
Oct. 2	Oct. 7	5	89	64	77.0
Oct. 3	Oct. 8	5	90	66	77.6
Oct. 4	Oct. 9	5	91	66	78.0
Oct. 5	Oct. 11	6	94	68	79.0
Oct. 6	Oct. 11	5	94	68	79.2
Oct. 7	Oct. 12	5	94	68	79.4
Oct. 8	Oct. 13	5	94	68	79.6
Oct. 8	Oct. 13	5	94	68	79.6
Oct. 9	Oct. 14	5	94	68	79.8
Oct. 11	Oct. 16	5	90	65	79.6
Oct. 12	Oct. 17	5	90	65	79.2
Oct. 13	Oct. 17	4	90	65	79.5
Oct. 13	Oct. 19	6	90	60	76.5
Oct. 14	Oct. 23	9	87	41	70.0
Oct. 15	Oct. 24	9	95	41	68.7
Oct. 16	Oct. 24	8	95	41	67.6
Oct. 17	Oct. 28	11	95	41	68.8
Oct. 18	Oct. 29	11	95	41	68.6
Oct. 21	Oct. 29	8	95	52	69.3
Oct. 22	Oct. 30	8	95	53	71.3
Oct. 23	Oct. 31	8	95	53	73.1
Oct. 25	Nov. 1	7	92	53	73.8
Oct. 28	Nov. 2	5	90	60	76.7
Oct. 29	Nov. 4	6	90	60	76.8
Oct. 30	Nov. 4	5	89	60	77.0
Oct. 31	Nov. 8	8	89	60	76.6
Nov. 1	Nov. 8	7	89	60	75.7
Nov. 4	Nov. 12	8	87	54	74.0
Nov. 5	Nov. 12	7	87	51	72.8
Nov. 5	Nov. 21	16	94	33	67.5
Nov. 6	Nov. 21	15	94	33	66.8
Nov. 16	Dec. 2	16	98	44	67.8
Nov. 18	Dec. 3	15	94	44	69.0
Nov. 20	Dec. 5	15	101	44	76.6
Nov. 24	Dec. 5	11	101	44	71.6
Nov. 25	Dec. 6	11	101	44	73.7
Nov. 25	Dec. 12	17	101	44	72.2
Nov. 26	Dec. 8	12	101	48	75.8
Nov. 26	Dec. 9	13	101	38	75.4
Nov. 27	Dec. 9	12	101	38	76.3
Nov. 28	Dec. 10	12	101	38	75.5
Nov. 28	Dec. 10	12	101	38	75.5
Nov. 29	Dec. 14	15	101	32	77.8
Nov. 30	Dec. 17	17	101	32	73.9
Dec. 1	Dec. 18	17	101	34	68.1
Dec. 3	Dec. 24	21	101	28	63.1
Dec. 4	Dec. 25	21	101	28	62.7
Dec. 5	Dec. 25	20	99	28	61.2
Dec. 6	Dec. 31	25	90	28	61.2
Dec. 7	Jan. 1	25	90	28	59.8
Dec. 8	Jan. 3	26	92	28	60.0
Dec. 11	Jan. 5	25	92	28	58.6
Dec. 12	Jan. 7	26	92	28	59.3
Dec. 17	Jan. 9	23	92	28	59.6
Dec. 24	Jan. 18	25	92	30	59.0
Dec. 25	Jan. 26	32	92	30	57.4

Table 11.—Duration of Pupal Stage.—Continued.

Pupated	Emerg	Period	Temperature		
			Max.	Min.	Mean
1917					
Jan. 2	Jan. 27	25	94	30	55.6
Jan. 2	Jan. 27	27	94	30	56.0
Jan. 2	Feb. 2	31	100	25	57.0
Jan. 3	Feb. 5	33	100	25	58.4
Jan. 4	Feb. 10	37	100	25	60.6
Jan. 5	Feb. 11	37	100	25	60.6
Jan. 6	Feb. 13	38	100	25	60.0
Jan. 6	Feb. 15	40	100	25	60.2
Jan. 7	Feb. 15	39	100	25	59.9
Jan. 7	Feb. 18	42	100	25	59.8
Jan. 10	Feb. 16	37	100	25	63.0
Jan. 11	Feb. 18	38	100	25	60.5
Jan. 26	Feb. 20	25	100	25	65.6
Jan. 27	Feb. 17	21	100	25	69.5
Jan. 27	Mar. 6	38	103	25	56.0
Jan. 28	Feb. 21	24	100	25	53.0
Jan. 29	Feb. 21	23	100	25	53.0
Jan. 29	Feb. 22	24	103	25	53.1
Jan. 30	Feb. 22	23	103	25	52.0
Jan. 30	Feb. 23	24	103	25	53.0
Jan. 31	Feb. 25	25	103	25	55.4
Feb. 6	Feb. 25	19	103	40	57.8
Feb. 13	Feb. 27	14	103	41	58.2
Feb. 17	Mar. 1	12	103	41	65.8
Feb. 20	Mar. 7	15	103	33	64.5
Feb. 21	Mar. 11	18	103	33	65.2
Feb. 24	Mar. 15	19	102	33	66.3
Feb. 25	Mar. 13	16	102	33	66.4
Feb. 25	Mar. 13	16	102	33	66.4
Feb. 26	Mar. 15	17	102	33	61.3
Feb. 26	Mar. 15	17	102	33	61.3
Feb. 26	Mar. 19	21	102	33	66.1
Feb. 26	Mar. 23	25	102	33	67.6
Feb. 27	Mar. 14	15	100	33	67.3
Feb. 28	Mar. 14	14	91	33	64.0
Feb. 28	Mar. 16	16	92	33	64.5
Feb. 28	Mar. 16	16	92	33	64.5
Feb. 28	Mar. 17	17	92	33	65.3
Feb. 28	Mar. 17	17	92	33	65.3
Mar. 1	Mar. 16	15	92	33	63.8
Mar. 1	Mar. 20	19	92	33	63.6
Mar. 2	Mar. 17	15	92	33	63.5
Mar. 2	Mar. 18	16	92	33	63.2
Mar. 2	Mar. 18	16	92	33	63.2
Mar. 2	Mar. 20	18	92	33	64.0
Mar. 2	Mar. 20	18	92	33	64.0
Mar. 2	Mar. 20	18	92	33	64.0
Mar. 3	Mar. 20	17	92	33	63.8
Mar. 3	Mar. 21	18	92	33	64.3
Mar. 4	Mar. 21	17	92	33	64.7
Mar. 6	Mar. 21	15	92	47	66.4
Mar. 8	Mar. 22	14	99	49	66.3
Mar. 8	Mar. 22	14	99	49	66.3
Mar. 11	Mar. 25	14	99	49	69.1
Mar. 12	Mar. 26	14	99	49	69.2
Mar. 14	Mar. 26	12	99	49	70.0
Mar. 15	Mar. 26	11	99	49	69.4
Mar. 15	Mar. 29	14	99	49	67.4
Mar. 16	Mar. 28	12	99	49	68.2
Mar. 16	Mar. 28	12	99	49	68.2
Mar. 19	Mar. 31	12	99	50	70.0
Mar. 20	Mar. 30	10	99	50	69.7
Mar. 20	Mar. 31	11	99	50	69.9
Mar. 20	Mar. 31	11	99	50	69.9
Mar. 20	Mar. 31	11	99	50	69.9
Mar. 20	April 1	12	99	50	75.7
Mar. 20	April 6	17	102	50	71.2
Mar. 21	Mar. 30	9	99	50	69.6
Mar. 21	Mar. 31	10	99	50	70.9
Mar. 21	April 2	12	102	50	71.7
Mar. 21	April 4	14	102	50	71.3
Mar. 22	Mar. 31	9	99	50	69.1
Mar. 22	April 4	13	102	50	70.0
Mar. 22	April 6	15	102	50	70.0
Mar. 24	April 5	12	102	50	74.8
Mar. 24	April 5	12	102	50	74.8
Mar. 24	April 6	13	102	50	62.5
Mar. 25	April 5	11	102	50	69.7
Mar. 25	April 7	13	102	50	62.2

Table 11.—Duration of Pupal Stage.—Continued.

Pupated	Emerg'd	Period	Temperature		
			Max.	Min.	Mean
Mar. 25.....	April 10.....	16	102	50	69.5
Mar. 26.....	April 6.....	11	102	50	69.2
Mar. 26.....	April 8.....	13	102	50	69.5
Mar. 26.....	April 15.....	20	102	50	69.1
Mar. 27.....	April 7.....	11	102	50	70.1
Mar. 28.....	April 10.....	13	102	51	70.7
Mar. 29.....	April 10.....	12	102	51	71.5
Mar. 30.....	April 10.....	11	102	51	70.7
Mar. 30.....	April 12.....	13	102	51	70.0
Mar. 30.....	April 14.....	15	102	51	70.1
Mar. 31.....	April 16.....	16	102	51	70.0
April 3.....	April 19.....	16	90	51	70.9

The shortest pupal period of three days occurred three times in November, 1915, once in March, 1916, and four times in September, 1916. During November this period occurred with a mean temperature of 76.9 degrees F. This period in March occurred with a mean temperature of but 74.4 degrees F. The maximum temperature of the period was 89 degrees F. and the minimum was 60 degrees F. In September, when the pupal stage was but three days, the mean temperature was 87.6 degrees F. The longest pupal period of 53 days occurred from January 5 to February 27, 1916. During this period the mean temperature was 54.8 degrees; the lowest temperature of the period was 22 degrees.

The yearly variation in the duration of the pupal stage is shown in Table 12. The mean temperature of the period does not have a positive effect upon its length. The average length of periods is influenced by a severe low temperature or a few days of warm weather.

Table 12.—Yearly Variation in Duration of Pupal Stage.

Date	Period (Days)	Mean Temperature (Degrees)
November, 1915.....	5.6	75.8
November, 1916.....	12.8	72.3
December, 1915.....	28.1	60.5
December, 1916.....	23.8	58.9
January, 1916.....	41.1	54.4
January, 1917.....	31.1	57.5
February, 1916.....	28.0	61.4
February, 1917.....	18.1	66.7

A summary of the duration of the pupal stage during the representative summer months and winter months is given in Table 13. During the warmest months of the year in this locality the pupal stage comprised an average of 5.3 days. During the coldest months of the year the average pupal stage was 21.2 days. The pupal stage was quite variable throughout each month while the observations were being made.

Table 13.—Summary of Duration of Pupal Stage.

Month	Average Period	Shortest Period	Longest Period	Number Collections Observed
June.....	5.8	4	8	34
July.....	5.5	3	7	32
August.....	5.5	4	7	28
September.....	4.4	3	7	25
November.....	8.3	4	17	48
December.....	24.8	4	53	24
January.....	33.3	24	53	27
February.....	19.3	12	53	23

The relation of temperature to the duration of the pupal stage is quite noticeable. The results of the observations are shown in Table 14.

Table 14.—Effect of Temperature on Length of Pupal Stage.

Month	Average Period, Days	Mean Daily Temperature
June.....	5.8	86
July.....	5.5	87
August.....	5.5	86
September.....	4.4	83
November.....	8.3	71.8
December.....	24.8	62.2
January.....	33.3	58.5
February.....	19.3	58.5

Summary.—From the tables given which show the length of the egg, larval, and pupal stage, it is evident that the length of these periods varies greatly with the seasons of the year. The shortest periods of each stage combined, may consume about 16 days, however, this total was never obtained in any single generation. If all of the long periods were combined, 178 days would be required, but no single generation consumed this much time.

Table 15.—Summary of Development of Cowpea Weevil.

	Egg, Days	Larva, Days	Pupa, Days	Total Days
Shortest.....	4	9	3	16
Longest.....	37	88	53	178

Adults.

Description.—The cowpea weevil is very closely related to a few other species of weevils and can hardly be distinguished from them by those not familiar with technical details. Any popular description that might be given would hardly allow the proper diagnosis of the exact species of weevil infesting cowpeas or other stored products.

The most comprehensive technical description of this species is that by Horn, which is given herewith as it occurred in his paper (6):

“Elongate oval, moderately shining. Beneath equally clothed with whitish pubescence. Elytra ferruginous or pale brown with large lateral spot and apex broadly black. Head dark brown or black, densely

punctured, front sub-carinate. Antennae as long as head and thorax, serrate in both sexes, four basal joints pale rufous, outer joints dark and nearly black. Thorax trapezoidal, broader at base than long, sides distinctly arcuate, base trisinate, basal lobe emarginate and clothed with whitish hairs; color variable from ferruginous to black, coarsely punctured, sub-granulate and feebly shining, sparsely clothed with cinereous hair. Scutellum with median impressed line and clothed with whitish hair. Elytra broader at base than thorax and longer than wide, sides feebly arcuate, humeri moderately prominent; striate, striae punctured, intervals flat densely punctulate; color ferruginous with large lateral spot and apex black, clothed with whitish and cinereous pubescence. Pygidium nearly black with median line of whitish pubescence. Body beneath piceous densely punctulate and sparsely but evenly clothed with cinereous hairs; abdomen pale brown. Anterior and middle legs pale rufous, hind legs pale brown. Hind femora armed with an acute tooth on the inner side and a broad triangular tooth on the outer side. Length .12-.18 inch; 3-4.5 mm."

Most of the specimens are nearly black with four spots of pale brown on the wing covers. Many of these spots are outlined with a band of white. In nearly all specimens the wing covers are clothed with fine hairs. Sometimes the color of the spot is hidden by a patch of very fine hairs.

In Plate IV is shown a series of adult weevils. From this plate it is possible to distinguish the difference in the size of the males and females. It will also be seen that there is a variation in the size of a sex. As a rule the females are much larger than the males, but it is possible to find males that are larger than females. The plates will also show a variation in the color pattern of the wing covers. By selection it was possible to produce individuals of either sex with an absence of spots and with brown wing covers.

Feeding Habits of Adults.

The cowpea weevil has not been observed to feed on any solid food in the adult stage, and the cowpea is injured only by the feeding larva. Observations show that the adult weevil never attacks cowpeas directly, except when emerging, it sometimes gnaws its way through the thin shell covering the exit of the larval burrow. Frequently the adults re-enter the larval burrows in the peas and die, giving rise to an erroneous popular opinion that they feed upon the peas. In the field the adults feed almost exclusively upon nectar secreted by the nectaries located at the base of the green pods. A few adults have been collected from the blossoms of cowpeas. None were observed to visit blossoms of other plants with any regularity. The adults are egregious in feeding. Invariably single individuals were found feeding; occasionally two or three were observed at the base of the same pod, but they never fed in large numbers. The weevils, while feeding, are very active, and seek shelter very quickly upon the slightest disturbance.

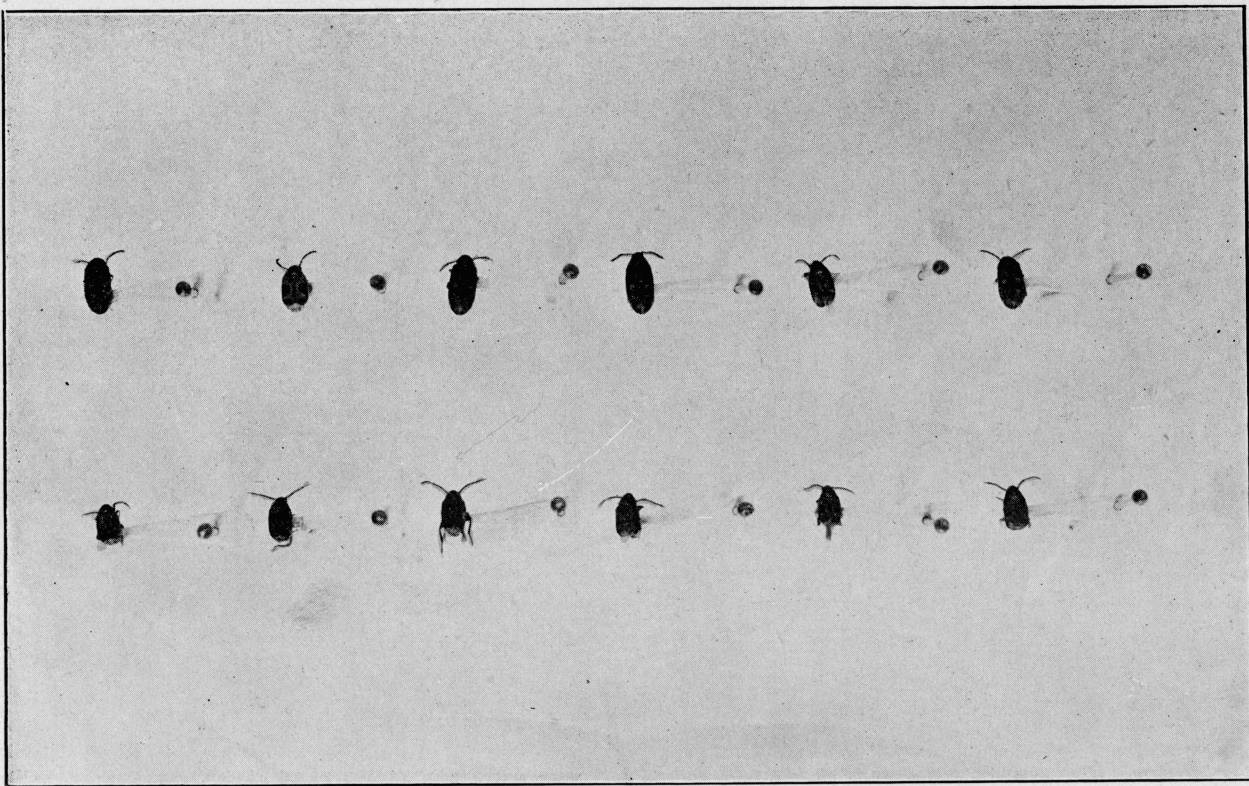


Plate IV. Cowpea Weevil; adults showing variation in size of sex; females above and males below.

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Table 16.—Average Eggs per Female.

Date	Total Eggs	Total Females Ovipositing	Average No. Eggs Per Female	Mean Temp.	Mean Hum.
1916					
January.....	589	23	25	56.9	78.9
February.....	190	6	31	55.0	66.7
March.....	767	14	55	66.4	61.8
April.....	1719	29	59	68.9	73.0
May.....	2459	30	81	79.6	71.7
June.....	2701	32	88	86.0	71.0
July.....	2546	24	106	87.0	69.0
August.....	2411	25	96	86.0	68.5
September.....	2635	29	91	83.5	63.0
October.....	3243	30	108	73.0	63.5
November.....	1988	25	80	68.5	69.5
December.....	1758	26	68	64.6	64.5

Average Eggs Per Female.

The average number of eggs per female, by the month, for 1916, has been compiled from Table 23 and the results are given in detail in Table 16. The smallest average number was 25, occurring in January, with a mean temperature of 56.9 degrees F. The maximum number of 108, was in October, with a mean temperature of 73.0 degrees F. The average number of eggs for the entire year was 73, with a mean temperature of 72.9 degrees F. With a possibility of from 8 to 10 generations of weevils a year and each female capable of producing an average quota of 73 eggs, it is not difficult to realize why this insect becomes such an important economic factor to the cowpea crop in the South.

Period From Last Oviposition to Death of Female.

The time which elapses from the last oviposition to the death of the female varies from 1.7 to 9 days. During the warm season when the rate of oviposition is at its maximum, all the eggs are deposited in a few days and the period from the last oviposition to death of female is very short. The average time for June and July, 1916, was 1.7 days. The average minimum period gradually increases as the temperature decreases. The average maximum period occurred in February, 1916. For this month 9 days was the average time that occurred from the last oviposition to the death of the female. The average period for 1916 was 3.4 days with an average mean temperature of 72.9 degrees F. In Table 17 the detailed results obtained for the period from October, 1915, to March, 1917, are given.

Table 17.—Average Time between Oviposition and Death.

Year	Month	Period Days	Temperature		
			Max.	Min.	Mean
1915.....	October.....	3.0	78.2	72.0	71.5
1915.....	November.....	3.0	79.7	70.7	74.7
1915.....	December.....	8.7	67.1	50.6	59.4
1916.....	January.....	3.6	65.5	48.3	56.9
1916.....	February.....	9.0	65.8	44.3	55.0
1916.....	March.....	3.6	78.1	54.7	66.4
1916.....	April.....	2.7	77.3	59.7	68.9
1916.....	May.....	2.5	89.4	74.5	79.6
1916.....	June.....	1.7	90.3	74.7	86.0
1916.....	July.....	1.7	94.2	79.3	87.0
1916.....	August.....	2.5	93.3	79.0	86.0
1916.....	September.....	3.5	93.0	74.4	83.5
1916.....	October.....	3.1	85.1	61.4	73.0
1916.....	November.....	4.1	84.5	55.5	68.5
1916.....	December.....	3.6	74.8	50.4	64.6
1917.....	January.....	7.3	68.3	48.1	60.3
1917.....	February.....	4.6	76.8	47.0	62.0

Table 18.—Difference in Death Rate of Sexes.

Emerg'd	Male Died First	Female Died First	Period Same	Temperature		
				Mean Max.	Mean Min.	Average Mean
1915						
October.....	9	2	5	79.0	70.1	51.3
November.....	17	0	7	84.1	68.0	63.6
December.....	13	2	9	75.6	38.4	59.5
1916						
January.....	3	1	5	76.5	43.0	56.9
February.....	1	0	1	86.0	39.0	62.5
March.....	5	6	2	84.4	47.3	67.6
April.....	11	7	2	88.2	61.6	75.5
May.....	14	7	3	91.9	74.6	62.0
June.....	15	3	8	91.4	77.0	75.8
July.....	14	9	2	95.8	79.3	84.0
August.....	12	9	4	95.9	78.5	75.5
September.....	19	6	4	93.5	68.4	73.2
October.....	17	4	9	86.7	56.2	63.3
November.....	12	4	6	87.6	50.5	57.0
December.....	11	9	8	79.1	44.0	44.2
1917						
January.....	13	8	2	93.6	40.9	62.8

Difference in Death Rate of Sexes.

The difference in longevity of life in the adult weevils, during the period from October, 1915, to February, 1917, is given in Table 18. Out of a total of 340 observations the male died first 186 or 54.7 per cent. of the time. The female died first in 77 instances or 22.6 per cent. of the time; while both sexes died on the same day in 77 cases out of the total number of observations, or 22.6 per cent. of the time. It is interesting to note that the male dies first more than twice as often as the female. At no time throughout the year do the males live longer consistently, than the females. There was a tendency, however, to approach more nearly an equal number of periods when both sexes died on the same day, during the colder months.

Length of Life of Unmated Adults.

The length of life of the unmated individuals was determined as follows: On August 1, 1916, a pair of unmated weevils were isolated daily and the death of each individual was noted. These notes were

made until June, 1917. The results of this experiment are given in detail in Table 19. The shortest life of the male was 8 days, from September 5 to September 13, 1916; the longest period was 70 days, from December 14, 1916, to February 22, 1917. The shortest period for the female was 10 days, which occurred twice, from September 21 to October 1, 1916, and from May 21 to June 30, 1917; the longest period was 69 days, from January 11 to March 21, 1917. It will be noted that the extremes of the life period for the male are slightly greater, but that the average life of the female is considerably longer than that of the male. It is also very apparent that temperature has a decided influence upon the length of life. During the colder months the period is much prolonged.

Table 19.—Length of Life of Unmated Adults.

Emerged	Male Died	Period Days	Female Died	Period, Days
1916				
Aug. 1	Aug. 18	17	Aug. 24	22
Aug. 2	Aug. 22	20	Aug. 19	16
Aug. 3	Aug. 16	13	Aug. 23	19
Aug. 4	Aug. 16	12	Aug. 21	16
Aug. 5	Aug. 23	18	Aug. 25	19
Aug. 6			Aug. 31	24
Aug. 7	Aug. 28	21	Aug. 12—lost	
Aug. 8	Aug. 19	11	Sept. 3	25
Aug. 9	Sept. 2	24		
Aug. 10	Sept. 17	38	Aug. 30	19
Aug. 11	Sept. 16—lost		Sept. 6	25
Aug. 12	Sept. 28	16	Sept. 5	23
Aug. 13	Sept. 29	16	Sept. 2	19
Aug. 14	Sept. 5	22	Sept. 2	18
Aug. 15	Aug. 29	14	Sept. 11	26
Aug. 16	Aug. 30	14	Sept. 2	16
Aug. 17	Aug. 30	13	Sept. 7	20
Aug. 18	Sept. 2	15	Sept. 11	19
Aug. 19	Aug. 30	11	Sept. 10	21
Aug. 20	Sept. 2	13	Sept. 13	23
Aug. 21	Sept. 3	13	Sept. 15	24
Aug. 22	Sept. 11	20	Sept. 7	15
Aug. 23	Sept. 6	14	Sept. 22	29
Aug. 24	Sept. 11	18	Sept. 9	15
Aug. 25	Sept. 12	18	Sept. 15	20
Aug. 26	Sept. 8—lost		Oct. 4	38
Aug. 27	Sept. 21	25	Sept. 20	23
Aug. 28	Sept. 18	21	Sept. 27	29
Aug. 29	Sept. 7	9	Sept. 18	19
Aug. 30	Sept. 13	14	Sept. 26	26
Aug. 31	Sept. 14	14	Sept. 18	17
Sept. 1			Sept. 15	13
Sept. 2	Sept. 13	11		
Sept. 3	Sept. 16	13	Sept. 21	17
Sept. 4	Sept. 19	15	Sept. 27	22
Sept. 5	Sept. 13	8	Sept. 15—lost	
Sept. 6	Sept. 22	16	Sept. 25	18
Sept. 7	Sept. 18	11	Sept. 27	19
Sept. 8	Sept. 24	16	Sept. 23	14
Sept. 9	Sept. 19	10	Oct. 3	23
Sept. 10	Sept. 23	13	Oct. 4	23
Sept. 11	Sept. 24	13	Sept. 24	12
Sept. 12	Sept. 24	12	Oct. 5	22
Sept. 13	Sept. 26	13	Oct. 3	19
Sept. 14	Sept. 27	13	Oct. 4	19
Sept. 15	Sept. 27	12	Oct. 5	19
Sept. 16	Oct. 11	25	Sept. 29	12
Sept. 17	Sept. 29	12	Oct. 7	19
Sept. 18	Oct. 6	18	Oct. 7	18
Sept. 19	Sept. 30	11	Oct. 8	18
Sept. 20	Oct. 7	17	Oct. 1	10
Sept. 21	Oct. 3	12	Oct. 11	19
Sept. 22	Oct. 11	19	Oct. 1	14
Sept. 23	Oct. 3	10	Oct. 14	20
Sept. 24	Oct. 5	11	Oct. 12	17
Sept. 25	Oct. 12	17	Oct. 10	14
Sept. 26	Oct. 11	15		

Table 19.—Length of Life of Unmated Adults.—Continued.

Emerged	Male Died	Period, Days	Female Died	Period, Days
1916				
Sept. 27.....	Oct. 10.....	13	Oct. 15.....	18
Sept. 28.....	Oct. 7.....	9	Oct. 17.....	19
Sept. 29.....	Oct. 12.....	13	Oct. 16.....	17
Sept. 30.....	Oct. 10.....	10	Oct. 13.....	13
Oct. 1.....	Oct. 22.....	21	Oct. 20.....	19
Oct. 2.....	Oct. 13.....	11	Oct. 25.....	23
Oct. 3.....	Oct. 14.....	11	Oct. 29.....	26
Oct. 4.....	Oct. 14.....	10	Nov. 1.....	28
Oct. 5.....	Oct. 22.....	17	Oct. 18.....	13
Oct. 6.....	Oct. 18.....	12	Nov. 3.....	28
Oct. 7.....	Oct. 24.....	17	Nov. 5.....	29
Oct. 8.....	Oct. 27.....	19	Oct. 31.....	23
Oct. 9.....	Oct. 28.....	19	Nov. 4.....	26
Oct. 10.....	Oct. 29.....	19	Oct. 28.....	18
Oct. 11.....	Oct. 31.....	20	Nov. 3.....	23
Oct. 12.....	Oct. 26.....	14	Nov. 5.....	24
Oct. 13.....	Nov. 1.....	19	Nov. 3.....	21
Oct. 14.....	Nov. 3.....	20	Nov. 2.....	19
Oct. 15.....	Oct. 29.....	14	Nov. 7.....	23
Oct. 16.....	Nov. 7.....	22	Nov. 7.....	22
Oct. 17.....	Nov. 6.....	20	Nov. 11.....	25
Oct. 18.....	Nov. 13.....	26	Nov. 5.....	18
Oct. 19.....	Nov. 5.....	17	Nov. 16.....	28
Oct. 20.....	Nov. 2.....	13	Nov. 6.....	17
Oct. 21.....	Nov. 19.....	29	Nov. 25.....	35
Oct. 22.....	Nov. 6.....	15	Nov. 12.....	21
Oct. 23.....	Nov. 12.....	20	Nov. 9.....	17
Oct. 24.....	Nov. 9.....	16	Nov. 14.....	21
Oct. 25.....	Nov. 7.....	13	Nov. 11.....	17
Oct. 26.....	Nov. 7.....	12	Nov. 21.....	26
Oct. 27.....	Nov. 8.....	12	Nov. 20.....	24
Oct. 28.....	Nov. 26.....	29	Dec. 8.....	41
Oct. 29.....	Nov. 23.....	25	Nov. 16.....	18
Oct. 30.....	Nov. 19.....	20	Dec. 3.....	34
Oct. 31.....	Nov. 23.....	23	Dec. 9.....	39
Nov. 1.....	Nov. 22.....	21	Nov. 25.....	24
Nov. 2.....	Nov. 27.....	25	Nov. 27.....	25
Nov. 3.....	Dec. 9.....	36	Dec. 10.....	37
Nov. 4.....	Nov. 30.....	26	Dec. 9.....	35
Nov. 5.....	Dec. 4.....	29	Dec. 15.....	40
Nov. 6.....	Dec. 9.....	33	Dec. 14.....	38
Nov. 7.....	Dec. 9.....	32	Dec. 10.....	33
Nov. 8.....	Dec. 9.....	31	Dec. 15.....	37
Nov. 9.....	Dec. 8.....	29	Dec. 15.....	36
Nov. 11.....	Nov. 27.....	16	Dec. 14.....	33
Nov. 12.....	Dec. 15.....	33	Dec. 16.....	34
Nov. 13.....	Dec. 4.....	31	Jan. 15.....	63
Nov. 18.....	Dec. 8.....	20	Jan. 16.....	59
Nov. 19.....	Dec. 2.....	13	Jan. 9.....	51
Nov. 20.....	Jan. 1.....	42	Jan. 15.....	56
Nov. 21.....	Dec. 10.....	20	Dec. 21.....	61
Nov. 22.....	Dec. 7.....	26	Dec. 14.....	53
Nov. 23.....	Dec. 16.....	34	Jan. 1.....	39
Nov. 24.....	Dec. 28.....	50	Jan. 10.....	47
Nov. 27.....	Jan. 13.....	47	Jan. 10.....	44
Nov. 28.....	Jan. 7.....	40	Jan. 3.....	36
Nov. 30.....	Jan. 3.....	34	Jan. 8.....	39
Dec. 1.....	Dec. 25.....	24	Dec. 29.....	28
Dec. 2.....	Jan. 3.....	32	Jan. 10.....	39
Dec. 3.....	Jan. 15.....	43	Jan. 13.....	41
Dec. 4.....	Jan. 7.....	34	Jan. 28.....	55
Dec. 5.....	Jan. 24.....	37	Jan. 16.....	42
Dec. 6.....	Feb. 6.....	62	Jan. 15.....	40
Dec. 7.....	Jan. 14.....	38	Jan. 14.....	38
Dec. 8.....	Jan. 21.....	44	Jan. 30.....	53
Dec. 10.....	Jan. 24.....	45	Jan. 26.....	47
Dec. 11.....	Jan. 30.....	50	Jan. 16.....	36
Dec. 13.....	Feb. 17.....	66	Jan. 15.....	33
Dec. 14.....	Feb. 22.....	70	Jan. 23.....	40
Dec. 17.....	Jan. 28.....	42	Jan. 23.....	37
Dec. 18.....	Jan. 28.....	41	Jan. 28.....	41
Dec. 19.....	Feb. 8.....	51	Jan. 19.....	31
Dec. 20.....	Feb. 19.....	30	Feb. 6.....	48
Dec. 21.....	Feb. 6.....	47	Feb. 8.....	49
Dec. 24.....	Feb. 21.....	59	Feb. 23.....	61
Dec. 25.....	Feb. 14.....	51	Feb. 4.....	51
Dec. 26.....	Feb. 6.....	42	Feb. 26.....	62
Dec. 27.....	Feb. 18.....	53	Feb. 21.....	56
Dec. 28.....	Feb. 19.....	53	Feb. 11.....	45

Table 19.—Length of Life of Unmated Adults.—Continued.

Emerg'd	Male Died	Period, Days	Female Died	Period, Days
1916				
Dec. 29	Feb. 18	57	Feb. 11	44
Dec. 31	Feb. 22	53	Feb. 23	54
1917				
Jan. 1	Feb. 18	48	Feb. 23	53
Jan. 2	Feb. 26	55	Feb. 11	40
Jan. 3	Feb. 22	50	Feb. 18	46
Jan. 4	Feb. 23	50	Feb. 25	52
Jan. 5	Feb. 21	47	Feb. 22	48
Jan. 7	Feb. 21	45	Feb. 25	49
Jan. 9	Feb. 26	48	Feb. 27	49
Jan. 10	Feb. 25	46	Mar. 15	64
Jan. 11	Feb. 26	46	Mar. 21	69
Jan. 20	Feb. 20	31	Mar. 7	46
Jan. 21	Mar. 8	46	Mar. 6	44
Jan. 22	Mar. 6	43	Mar. 15	52
Jan. 28	Mar. 7	38	Mar. 29	60
Jan. 29	Mar. 15	45	Mar. 21	51
Jan. 30	Mar. 12	41	Mar. 30	59
Jan. 31	Feb. 28	28	Mar. 22	58
Feb. 5	Feb. 26	21	Mar. 9	32
Feb. 8	Mar. 31	51	April 4	55
Feb. 10	Mar. 20	38	Mar. 21	39
Feb. 11	Mar. 17	34	Mar. 23	40
Feb. 12	Mar. 18	34	Mar. 12	28
Feb. 13	Mar. 16	31	Mar. 27	42
Feb. 14	Mar. 16	30	Mar. 24	38
Feb. 15	Mar. 16	29	Mar. 17	30
Feb. 16	Mar. 18	30	Mar. 17	29
Feb. 17	Mar. 30	41	April 6	48
Feb. 18	Mar. 25	35	April 4	45
Feb. 19	Mar. 20	29	Mar. 26	35
Feb. 20	Mar. 31	39	April 5	44
Feb. 21	Mar. 21	28	April 6	44
Feb. 22	Mar. 21	27	Mar. 30	36
Feb. 23	Mar. 24	29	Mar. 28	33
Feb. 24	Mar. 24	28	April 4	39
Feb. 25	April 1	35	April 12	46
Feb. 26	Mar. 25	27	April 3	36
Feb. 27	April 4	36	April 12	44
Feb. 28	Mar. 22	22	April 14	45
Mar. 1	Mar. 14	13	Mar. 16	15
Mar. 4	Mar. 22	18	Mar. 23	19
Mar. 6	April 9	34	Mar. 27	21
Mar. 7	April 6	30	April 23	16
Mar. 8	Mar. 30	22	April 2	25
Mar. 9	April 9	31	April 16	38
Mar. 10	April 6	27	April 22	43
Mar. 11	Mar. 30	10	April 7	27
Mar. 12	April 23	42	April 23	42
Mar. 13	April 5	23	April 25	43
Mar. 14	April 11	28	April 11	28
Mar. 15	April 15	31	April 22	38
Mar. 16	April 11	26	April 16	31
Mar. 17	April 6	20	April 16	30
Mar. 18	April 13	26	April 28	41
Mar. 19	April 12	24	April 19	31
Mar. 20	April 22	33	April 16	27
Mar. 21	April 11	21	April 29	39
Mar. 22	April 15	24	April 14	23
Mar. 23	April 11	19	April 27	35
Mar. 24	April 11	18	April 8	15
Mar. 25	April 19	25	April 28	34
Mar. 26	April 24	29	May 2	37
Mar. 27	April 23	27	May 1	35
Mar. 28	April 24	27	April 26	29
May 29	April 20	22	April 24	26
Mar. 30	April 23	24	April 24	25
Mar. 31	April 18	18	April 20	20
April 1	April 28	27	April 29	28
April 2	April 28	26	May 1	29
April 3	April 28	25	April 28	25
April 4	May 3	29	May 18	44
April 5	May 5	30	May 6	31
April 6	May 1	25	May 14	38
April 7	May 4	27	May 7	30
April 8	April 28	20	April 29	21
April 9	April 30	21	May 11	32
April 10	May 10	30	May 11	31

Table 19.—Length of Life of Unmated Adults.—Continued.

Emerg'd	Male Died	Period, Days	Female Died	Period, Days
April 11.....	April 30.....	19	May 4.....	23
April 12.....	May 6.....	24	May 15.....	33
April 13.....	May 5.....	22	April 29.....	12
April 14.....	May 2.....	18	May 19.....	35
April 15.....	May 5.....	20	May 24.....	39
April 16.....	May 1.....	15	May 6.....	20
April 17.....	May 4.....	17	May 15.....	28
April 18.....	May 5.....	17	May 11.....	23
April 19.....	May 4.....	15	May 11.....	22
April 20.....	May 10.....	20	May 16.....	26
April 21.....	May 7.....	16	May 18.....	27
April 22.....	May 10.....	18	May 14.....	22
April 23.....	May 12.....	19	May 11.....	18
April 24.....	May 10.....	16	May 19.....	25
April 25.....	May 14.....	19	May 21.....	26
April 26.....	May 13.....	17	May 25.....	29
April 27.....	May 13.....	16	May 24.....	27
April 28.....	May 15.....	17	May 22.....	24
April 29.....	May 17.....	18	May 15.....	16
April 30.....	May 12.....	12	May 24.....	24
May 2.....	June 15.....	44	June 19.....	48
May 3.....	June 13.....	41	June 14.....	42
May 4.....	June 13.....	40	June 14.....	41
May 5.....	June 13.....	39	June 16.....	42
May 6.....	June 18.....	43	June 21.....	46
May 7.....	June 13.....	37	June 18.....	41
May 9.....	June 15.....	37	June 19.....	41
May 10.....	June 18.....	39	June 21.....	42
May 11.....	June 20.....	40	June 22.....	42
May 12.....	June 21.....	40	June 22.....	41
May 13.....	June 23.....	41	June 20.....	38
May 14.....	June 23.....	40	June 24.....	41
May 15.....	June 22.....	38	June 28.....	44
May 16.....	June 22.....	37	June 27.....	42
May 17.....	June 28.....	42	June 30.....	44
May 18.....	June 26.....	39	July 2.....	45
May 19.....	June 27.....	39	July 4.....	46
May 21.....	June 29.....	39	June 30.....	10
May 22.....	June 29.....	38	July 6.....	45
May 23.....	June 23.....	31	July 6.....	44
May 24.....	July 2.....	39	July 1.....	38
May 25.....	July 10.....	46	July 13.....	49
May 26.....	July 7.....	42	July 3.....	38
May 27.....	July 11.....	45	July 15.....	49
May 28.....	July 12.....	45	July 16.....	49
May 29.....	July 13.....	45	July 19.....	51
May 30.....	July 17.....	48	July 19.....	50
May 31.....	July 14.....	44	July 18.....	48

Length of Life of Mated Adults.

The notes recorded in Table 20 were made in order to establish the total length of life of both sexes of mated weevils, and definitely determine the length of the period over which they remain destructive to the cowpea. These notes were begun in September, 1915, continued throughout the year 1916, and January and February of 1917. It will be noted that the average length of life throughout the warm months is much shorter than for the colder months. A total of 5 or 6 days for the life period of each sex occurred frequently during July, August, and September, while the period extends from 30 to 40 days during December and January. The shortest period for the male was 3 days, from June 23 to June 26, 1916; for the female, 4 days, from October 31 to November 4, 1915. The longest period for the male was 40 days, from January 9 to February 18, 1917; for the female, 50 days, from January 13 to March 4, 1917.

Table 20.—Length of Life of Mated Adults.

Emerged	Male Died	Period, Days	Female Died	Period, Days
1915				
Sept. 9	Sept. 16	7	Sept. 15	6
Sept. 9	Sept. 17	8	Sept. 17	8
Sept. 9	Sept. 17	8	Sept. 16	7
Sept. 9	Sept. 18	9	Sept. 17	8
Sept. 12	Sept. 19	7	Sept. 19	7
Sept. 14	Sept. 21	7	Sept. 20	6
Sept. 15	Sept. 23	8	Oct. 5	20
Sept. 15	Sept. 21	6	Oct. 1	16
Sept. 15	Sept. 24	9	Sept. 24	39
Sept. 21	Sept. 26	5	Oct. 1	10
Sept. 21	Oct. 4	13	Oct. 4	13
Sept. 21	Sept. 28	7	Sept. 28	7
Sept. 29	Oct. 10	11	Oct. 11	12
Oct. 5	Oct. 17	12	Oct. 17	12
Oct. 5	Oct. 13	8	Oct. 13	8
Oct. 13	Oct. 25	12	Oct. 25	12
Oct. 13	Oct. 24	11	Oct. 24	11
Oct. 14	Oct. 25	11	Oct. 26	12
Oct. 16	Oct. 24	8	Oct. 25	9
Oct. 17	Oct. 29	12	Oct. 30	13
Oct. 18	Oct. 30	12	Nov. 5	18
Oct. 20	Oct. 30	10	Oct. 29	9
Oct. 22	Nov. 2	11	Nov. 7	16
Oct. 22	Nov. 3	12	Nov. 3	16
Oct. 23	Nov. 7	15	Nov. 7	16
Oct. 24	Nov. 3	10	Nov. 8	9
Oct. 25	Nov. 2	8	Nov. 7	9
Oct. 26	Nov. 7	12	Nov. 3	12
Oct. 27	Nov. 9	13	Nov. 7	15
Oct. 28	Nov. 9	12	Nov. 11	12
Oct. 30	Nov. 8	10	Nov. 8	5
Oct. 31	Nov. 8	9	Nov. 4	4
Nov. 1	Nov. 10	9	Nov. 14	13
Nov. 2	Nov. 21	19	Nov. 16	14
Nov. 5	Nov. 17	12	Nov. 22	17
Nov. 6	Nov. 10	4	Nov. 11	5
Nov. 8	Nov. 21	13	Nov. 21	13
Nov. 8	Nov. 22	14	Nov. 22	14
Nov. 9	Nov. 22	13	Nov. 23	14
Nov. 10	Nov. 21	11	Nov. 21	11
Nov. 11	Nov. 21	10	Nov. 23	12
Nov. 12	Nov. 22	10	Nov. 22	10
Nov. 13	Nov. 22	9	Nov. 23	10
Nov. 14	Nov. 22	8	Nov. 22	8
Nov. 15	Nov. 25	10	Nov. 25	10
Nov. 16	Nov. 22	10	Nov. 22	6
Nov. 17	Nov. 26	9	Nov. 27	10
Nov. 18	Nov. 28	10	Nov. 29	11
Nov. 19	Nov. 29	10	Nov. 29	10
Nov. 20	Nov. 28	8	Nov. 30	10
Nov. 21	Nov. 30	9	Dec. 3	12
Nov. 22	Nov. 29	7	Dec. 1	9
Nov. 23	Nov. 30	7	Dec. 2	9
Nov. 24	Dec. 2	8	Dec. 3	9
Nov. 25	Dec. 4	9	Dec. 5	10
Nov. 26	Dec. 4	8	Dec. 8	12
Nov. 27	Dec. 7	10	Dec. 7	10
Nov. 28	Dec. 5	7	Dec. 8	10
Nov. 29	Dec. 20	21	Dec. 7	8
Nov. 30	Dec. 10	10	Dec. 12	12
Dec. 1	Dec. 11	10	Dec. 12	11
Dec. 2	Dec. 15	13	Dec. 22	20
Dec. 3	Dec. 26	23	Dec. 29	26
Dec. 4	Dec. 27	23	Jan. 4	31
Dec. 5	Jan. 4	30	Dec. 29	24
Dec. 6	Jan. 2	27	Jan. 2	27
Dec. 7	Jan. 3	27	Jan. 9	33
Dec. 8	Jan. 3	26	Jan. 14	37
Dec. 9	Jan. 7	29	Jan. 14	36
Dec. 10	Jan. 11	32	Jan. 11	32
Dec. 11	Jan. 11	31	Jan. 11	31
Dec. 12	Dec. 25	13	Jan. 11	30
Dec. 13	Jan. 9	27	Jan. 11	29
Dec. 14	Jan. 9	26	Jan. 11	28
Dec. 15	Jan. 11	27	Jan. 11	27
Dec. 16	Jan. 11	26	Jan. 11	26
Dec. 17	Jan. 11	25	Jan. 19	33
Dec. 19	Jan. 19	31	Jan. 4	16
Dec. 21	Jan. 11	21	Jan. 9	19

Table 20. Length of Life of Mated Adults—Continued.

Emerg'd	Male Died	Period, Days	Female Died	Period, Days
1915				
Dec. 22.....	Jan. 15.....	24	Jan. 15.....	24
Dec. 25.....	Jan. 15.....	21	Jan. 15.....	21
Dec. 26.....	Jan. 9.....	14	Jan. 9.....	14
Dec. 29.....	Jan. 15.....	17	Jan. 15.....	17
1916				
Jan. 2.....	Jan. 15.....	13	Jan. 18.....	16
Jan. 10.....	Jan. 22.....	12	Jan. 22.....	12
Jan. 16.....	Jan. 24.....	8	Jan. 24.....	8
Jan. 18.....	Jan. 24.....	6	Jan. 24.....	6
Jan. 19.....	Feb. 21.....	33	Feb. 21.....	33
Jan. 23.....	Feb. 20.....	28	Mar. 8.....	37
Jan. 24.....	Jan. 27.....	34	Jan. 27.....	34
Jan. 29.....	Feb. 27.....	29	Mar. 8.....	39
Feb. 8.....	Feb. 24.....	16	Mar. 8.....	29
Feb. 14.....	Mar. 8.....	23	Mar. 8.....	23
Mar. 4.....	Mar. 24.....	20	Mar. 20.....	16
Mar. 5.....	Mar. 17.....	12	Mar. 21.....	16
Mar. 5.....	Mar. 21.....	16	Mar. 21.....	16
Mar. 6.....	Mar. 24.....	18	Mar. 24.....	18
Mar. 8.....	April 2.....	25	Mar. 21.....	13
Mar. 15.....	April 7.....	23	April 12.....	18
Mar. 18.....	April 4.....	17	April 13.....	26
Mar. 19.....	April 13.....	25	April 4.....	16
Mar. 21.....	April 12.....	22	April 5.....	15
Mar. 22.....	April 17.....	26	April 10.....	19
Mar. 25.....	April 23.....	39	Mar. 31.....	6
Mar. 27.....	April 16.....	20	April 25.....	29
Mar. 28.....	April 12.....	15	April 16.....	19
Mar. 30.....	April 20.....	21	April 18.....	19
April 2.....	April 26.....	24	April 18.....	16
April 5.....	April 20.....	15	April 23.....	18
April 6.....	April 23.....	17	April 20.....	14
April 9.....	April 18.....	9	April 23.....	14
April 10.....	April 23.....	13	April 24.....	14
April 11.....	April 23.....	12	April 24.....	13
April 12.....	April 23.....	11	April 24.....	12
April 13.....	April 30.....	17	April 23.....	10
April 15.....	April 23.....	8	April 24.....	9
April 16.....	April 27.....	11	May 3.....	17
April 17.....	May 4.....	17	April 30.....	13
April 18.....	May 1.....	13	May 5.....	17
April 19.....	May 3.....	14	May 10.....	21
April 20.....	May 5.....	15	May 3.....	13
April 22.....	May 6.....	14	May 7.....	15
April 23.....	April 30.....	7	May 8.....	15
April 24.....	May 9.....	15	May 9.....	21
April 25.....	May 4.....	9	May 16.....	11
April 26.....	May 7.....	11	May 7.....	12
April 27.....	May 8.....	11	May 9.....	11
April 30.....	May 9.....	9	May 11.....	10
May 1.....	May 9.....	8	May 11.....	13
May 3.....	May 14.....	11	May 14.....	10
May 4.....	May 12.....	8	May 18.....	12
May 6.....	May 16.....	10	May 18.....	11
May 7.....	May 17.....	10	May 25.....	17
May 8.....	May 21.....	13	May 23.....	13
May 10.....	May 22.....	12	May 22.....	11
May 11.....	May 22.....	11	May 29.....	16
May 13.....	May 21.....	8	May 17.....	13
May 14.....	May 29.....	15	May 26.....	11
May 15.....	May 26.....	11	May 26.....	10
May 16.....	May 28.....	12	May 25.....	8
May 17.....	May 27.....	10	May 29.....	11
May 18.....	May 28.....	10	May 30.....	10
May 20.....	May 29.....	9	June 1.....	11
May 21.....	May 29.....	8	May 29.....	7
May 22.....	May 30.....	8	May 30.....	7
May 23.....	June 1.....	9	June 3.....	10
May 24.....	June 4.....	11	June 4.....	10
May 25.....	June 3.....	9	June 9.....	13
May 27.....	June 5.....	9	June 6.....	9
May 28.....	June 6.....	9	June 4.....	5
May 30.....	June 7.....	8	June 7.....	6
May 31.....	June 14.....	13	June 11.....	10
June 1.....	June 11.....	10	June 13.....	10
June 3.....	June 11.....	8	June 12.....	9
June 3.....	June 11.....	8	June 14.....	10
June 4.....	June 13.....	9		

Table 20.—Length of Life of Mated Adults.—Continued.

Emerged	Male Died	Period, Days	Female Died	Period, Days
1916				
June 5	June 12	7	June 15	10
June 6	June 12	6	June 17	11
June 7	June 15	8	June 16	9
June 8	June 16	8	June 17	9
June 10	June 18	8	June 18	8
June 12	June 21	9	June 20	8
June 13	June 18	5	June 23	10
June 14	June 22	8	June 22	8
June 15	June 24	9	June 24	9
June 17	June 24	7	June 26	9
June 18	June 26	8	June 27	9
June 19	June 26	7	June 26	7
June 20	July 1	11	June 30	10
June 21	June 28	7	July 1	10
June 22	July 1	9	June 30	8
June 23	June 26	3	June 26	3
June 24	July 3	9	July 3	9
June 25	July 3	8	July 3	8
June 26	July 2	6	July 7	11
June 27	July 6	9	July 7	10
June 28	July 6	8	July 7	9
June 30	July 7	7	July 8	8
July 1	July 10	9	July 10	9
July 2	July 9	7	July 10	8
July 4	July 10	6	July 12	8
July 5	July 11	6	July 13	8
July 6	July 15	9	July 14	8
July 8	July 16	8	July 19	11
July 9	July 16	7	July 17	8
July 10	July 18	8	July 16	6
July 11	July 16	5	July 19	8
July 12	July 20	8	July 22	10
July 13	July 20	7	July 22	9
July 15	July 24	9	July 23	8
July 16	July 24	8	July 26	10
July 17	July 25	8	July 24	7
July 18	July 27	9	July 26	8
July 19	July 27	8	July 25	6
July 20	July 29	9	July 28	8
July 22	July 29	7	July 30	8
July 23	July 29	6	Aug. 1	9
July 24	Aug. 2	9	Aug. 1	8
July 25	Aug. 1	7	Aug. 2	8
July 26	Aug. 3	8	Aug. 4	9
July 27	Aug. 4	8	Aug. 4	8
July 29	Aug. 7	9	Aug. 6	8
July 31	Aug. 8	8	Aug. 11	11
Aug. 1	Aug. 10	9	Aug. 12	11
Aug. 2	Aug. 12	10	Aug. 11	9
Aug. 3	Aug. 11	8	Aug. 11	8
Aug. 5	Aug. 14	9	Aug. 13	8
Aug. 7	Aug. 13	6	Aug. 16	9
Aug. 9	Sept. 8	30	Aug. 29	20
Aug. 9	Aug. 17	8	Aug. 27	18
Aug. 10	Aug. 18	8	Aug. 19	9
Aug. 12	Sept. 3	22	Aug. 24	12
Aug. 13	Aug. 21	8	Aug. 22	9
Aug. 14	Aug. 23	9	Aug. 24	10
Aug. 15	Aug. 22	7	Aug. 25	10
Aug. 16	Aug. 25	9	Aug. 24	8
Aug. 17	Aug. 27	10	Aug. 26	9
Aug. 19	Aug. 28	9	Aug. 27	8
Aug. 20	Aug. 28	8	Aug. 28	8
Aug. 21	Aug. 29	8	Sept. 3	11
Aug. 22	Sept. 1	10	Aug. 29	7
Aug. 23	Sept. 4	12	Sept. 5	13
Aug. 24	Sept. 5	12	Sept. 6	13
Aug. 26	Sept. 6	11	Sept. 6	11
Aug. 27	Sept. 6	10	Sept. 6	10
Aug. 28	Sept. 8	11	Sept. 9	12
Aug. 29	Sept. 8	10	Sept. 8	8
Aug. 30	Sept. 6	7	Sept. 10	11
Aug. 31	Sept. 8	9	Sept. 10	10
Sept. 1	Sept. 8	9	Sept. 10	9
Sept. 2	Sept. 12	10	Sept. 16	14
Sept. 3	Sept. 8	5	Sept. 14	11
Sept. 4	Sept. 13	9	Sept. 14	10
Sept. 5	Sept. 16	11	Sept. 14	9
Sept. 6	Sept. 16	10	Sept. 21	15

Table 20.—Length of Life of Mated Adults.—Continued.

Emerg'd	Male Died	Period, Days	Female Died	Period, Days
1916				
Sept. 7	Sept. 18	11	Sept. 19	12
Sept. 8	Sept. 18	10	Sept. 17	9
Sept. 9	Sept. 18	9	Sept. 25	16
Sept. 10	Sept. 20	10	Sept. 20	10
Sept. 11	Sept. 20	9	Sept. 22	11
Sept. 12	Sept. 20	8	Sept. 22	10
Sept. 13	Sept. 22	9	Sept. 26	13
Sept. 14	Sept. 24	10	Sept. 25	11
Sept. 15	Sept. 25	10	Sept. 24	9
Sept. 16	Sept. 27	11	Oct. 8	22
Sept. 17	Sept. 26	9	Sept. 27	10
Sept. 18	Sept. 29	11	Sept. 26	38
Sept. 20	Sept. 28	8	Oct. 3	13
Sept. 21	Oct. 1	11	Sept. 30	9
Sept. 22	Oct. 2	10	Oct. 5	13
Sept. 23	Oct. 4	11	Oct. 7	14
Sept. 24	Oct. 4	10	Oct. 7	13
Sept. 25	Oct. 7	12	Oct. 6	11
Sept. 26	Oct. 8	12	Oct. 7	11
Sept. 27	Oct. 8	11	Oct. 9	12
Sept. 28	Oct. 9	11	Oct. 9	11
Sept. 29	Oct. 6	7	Oct. 11	12
Sept. 30	Oct. 8	8	Oct. 22	22
Oct. 1	Oct. 8	7	Oct. 12	11
Oct. 2	Oct. 12	10	Oct. 11	9
Oct. 3	Oct. 14	11	Oct. 14	11
Oct. 4	Oct. 14	10	Oct. 14	10
Oct. 5	Oct. 15	10	Oct. 16	11
Oct. 6	Oct. 16	10	Oct. 16	10
Oct. 7	Oct. 17	10	Oct. 17	10
Oct. 8	Oct. 19	11	Oct. 24	16
Oct. 9	Oct. 19	10	Oct. 23	14
Oct. 10	Oct. 22	12	Oct. 21	11
Oct. 11	Oct. 24	13	Oct. 25	14
Oct. 12	Oct. 24	12	Oct. 27	15
Oct. 13	Oct. 25	12	Oct. 27	14
Oct. 14	Oct. 29	15	Nov. 2	19
Oct. 15	Oct. 28	13	Nov. 2	18
Oct. 16	Oct. 30	14	Oct. 31	15
Oct. 17	Oct. 29	12	Nov. 2	16
Oct. 18	Oct. 31	13	Nov. 2	15
Oct. 19	Oct. 30	11	Nov. 4	16
Oct. 20	Nov. 2	13	Nov. 5	16
Oct. 21	Nov. 2	12	Nov. 5	15
Oct. 22	Nov. 6	15	Nov. 5	14
Oct. 23	Nov. 5	13	Nov. 8	16
Oct. 24	Nov. 2	9	Nov. 11	18
Oct. 25	Nov. 6	12	Nov. 8	14
Oct. 26	Nov. 9	14	Nov. 6	11
Oct. 27	Nov. 21	25	Nov. 8	12
Oct. 28	Nov. 10	13	Nov. 10	13
Oct. 29	Nov. 14	16	Nov. 18	20
Oct. 30	Nov. 14	15	Nov. 13	14
Oct. 31	Nov. 21	21	Nov. 20	20
Nov. 1	Nov. 21	20	Nov. 21	20
Nov. 2	Nov. 21	19	Nov. 21	19
Nov. 3	Nov. 20	17	Nov. 22	19
Nov. 4	Nov. 23	19	Nov. 25	21
Nov. 5	Nov. 28	23	Nov. 23	18
Nov. 6	Dec. 1	25	Dec. 3	27
Nov. 7	Dec. 3	26	Dec. 4	27
Nov. 8	Dec. 1	23	Nov. 29	23
Nov. 10	Dec. 2	22	Dec. 3	23
Nov. 11	Dec. 2	21	Dec. 2	21
Nov. 12	Dec. 1	19	Dec. 2	20
Nov. 17	Dec. 3	16	Dec. 5	18
Nov. 18	Dec. 8	20	Dec. 7	19
Nov. 19	Dec. 6	17	Dec. 6	17
Nov. 20	Dec. 8	18	Dec. 9	19
Nov. 21	Dec. 14	23	Dec. 7	16
Nov. 22	Dec. 7	15	Dec. 9	17
Nov. 23	Dec. 11	18	Dec. 12	19
Nov. 26	Dec. 9	13	Dec. 12	16
Nov. 27	Dec. 11	14	Dec. 11	14
Nov. 29	Dec. 19	20	Dec. 23	24
Nov. 30	Dec. 15	15	Dec. 19	19
Dec. 1	Dec. 28	27	Dec. 24	23
Dec. 2	Dec. 15	13	Dec. 19	17
Dec. 3	Dec. 24	24	Jan. 6	34

Table 20.—Length of Life of Mated Adults.—Continued.

Emerg'd	Male Died	Period Days	Female Died	Period, Days
1916				
Dec. 4.....	Dec. 30.....	26	Dec. 30.....	26
Dec. 5.....	Jan. 4.....	30	Jan. 8.....	34
Dec. 6.....	Jan. 9.....	34	Jan. 6.....	31
Dec. 7.....	Jan. 2.....	26	Jan. 4.....	28
Dec. 8.....	Jan. 10.....	33	Jan. 9.....	33
Dec. 9.....	Jan. 3.....	25	Jan. 5.....	27
Dec. 10.....	Jan. 10.....	31	Jan. 10.....	31
Dec. 11.....	Jan. 8.....	28	Dec. 30.....	19
Dec. 12.....	Jan. 6.....	28	Jan. 9.....	28
Dec. 13.....	Jan. 6.....	27	Jan. 9.....	27
Dec. 14.....	Jan. 11.....	28	Jan. 9.....	27
Dec. 16.....	Jan. 11.....	26	Jan. 12.....	27
Dec. 17.....	Jan. 10.....	15	Jan. 17.....	31
Dec. 18.....	Jan. 16.....	29	Jan. 12.....	25
Dec. 19.....	Jan. 13.....	25	Jan. 13.....	25
Dec. 20.....	Jan. 22.....	33	Jan. 19.....	30
Dec. 21.....	Jan. 13.....	23	Jan. 12.....	22
Dec. 22.....	Jan. 18.....	27	Jan. 19.....	28
Dec. 23.....	Jan. 21.....	29	Jan. 27.....	35
Dec. 24.....	Jan. 19.....	34	Jan. 27.....	34
Dec. 25.....	Jan. 19.....	32	Jan. 19.....	32
Dec. 26.....	Jan. 11.....	32	Jan. 29.....	32
Dec. 27.....	Jan. 21.....	25	Jan. 20.....	24
Dec. 30.....	Jan. 19.....	20	Jan. 20.....	21
1917				
Jan. 1.....	Jan. 27.....	26	Jan. 21.....	20
Jan. 2.....	Jan. 30.....	28	Feb. 5.....	34
Jan. 3.....	Jan. 29.....	26	Feb. 5.....	33
Jan. 4.....	Feb. 11.....	38	Feb. 7.....	34
Jan. 6.....	Feb. 5.....	30	Jan. 28.....	22
Jan. 7.....	Feb. 3.....	27	Feb. 24.....	48
Jan. 8.....	Feb. 10.....	29	Feb. 19.....	40
Jan. 9.....	Feb. 18.....	40	Feb. 20.....	42
Jan. 10.....	Feb. 16.....	37	Feb. 21.....	42
Jan. 11.....	Feb. 17.....	37	Feb. 27.....	37
Jan. 12.....	Feb. 9.....	28	Feb. 22.....	41
Jan. 13.....	Feb. 5.....	23	Mar. 4.....	50
Jan. 17.....	Feb. 19.....	33	Feb. 22.....	36
Jan. 18.....	Feb. 13.....	26	Feb. 27.....	40
Jan. 19.....	Feb. 21.....	33	Feb. 13.....	25
Jan. 20.....	Feb. 22.....	33	Feb. 24.....	35
Jan. 21.....	Feb. 16.....	26	Feb. 22.....	33
Jan. 23.....	Feb. 22.....	30	Feb. 21.....	29
Jan. 25.....	Feb. 14.....	20	Feb. 22.....	28
Jan. 26.....	Feb. 21.....	26	Feb. 25.....	30
Jan. 27.....	Feb. 26.....	30	Feb. 24.....	28
Jan. 28.....	Feb. 27.....	30	Feb. 26.....	29
Jan. 29.....	Feb. 27.....	29	Feb. 26.....	28
Jan. 30.....	Feb. 28.....	29	Mar. 3.....	31
Feb. 12.....	Feb. 28.....	26	Feb. 26.....	24

Temperature apparently is an important factor in the length of the life period. When the temperature drops there is a corresponding increase in the length of the life period. The fatal low temperature has not been determined.

Proportion of Sexes.

Of the 2942 individuals which emerged in the laboratory from January, 1916, to May, 1917, 1494, or slightly more than 50 per cent., were males, while 1448, a little less than 50 per cent., were females. Table 21 shows the proportion of sexes by months. It is interesting to note that the numbers are very nearly equal throughout the entire period. There is a slight increase in females during the cold period and males are more abundant during the warmer period. In the field the proportion of sexes is likewise very nearly equal. Out of 243 weevils collected at various dates during the summer of 1916, 117, or

about 48 per cent., were females; 126, slightly less than 52 per cent., were males. The male is readily attracted to the female, and in the field the active female is usually attended by one and occasionally by several. Of the inactive weevils or those in places of hiding, approximately an equal number of males and females were collected.

Table 21.—Proportion of Sexes.

Date	Number Emerged	Males	Females	Mean Temp.	Mean Humidity
1916					
January.....	77	36	41	56.9	78.9
February.....	34	14	20	55.0	66.7
March.....	140	73	67	66.4	61.8
April.....	125	61	64	68.9	73.0
May.....	350	190	160	79.6	71.7
June.....	284	146	138	86.0	71.0
July.....	201	111	90	87.0	69.0
August.....	194	98	96	86.0	68.5
September.....	226	122	104	83.5	63.0
October.....	209	105	104	73.0	63.5
November.....	96	49	47	68.5	69.5
December.....	175	91	84	64.6	64.5
1917					
January.....	87	35	52	60.3	70.9
February.....	194	93	101	62.0	58.7
March.....	330	165	165	68.7	63.0
April.....	220	105	115	71.4	63.7

Location of Food.

The adult weevil has fully developed wings but cannot be considered a strong flier. If disturbed it will take to flight very readily, but the distance of a continuous flight has rarely been observed to exceed 100 yards and is usually much shorter. By intermittent flights, the weevil is able to cover considerable distance, and doubtless flight is an important means of dissemination in the field. The most isolated patches of cowpeas are usually found to be infested with the insect. The cowpeas grown on the experimental plats of the Division of Entomology were infested during the summers of 1915, 1916, and 1917, notwithstanding the fact that no other cowpeas were growing nearer than a mile away. The infestation was particularly severe during the summer of 1916. Owing to a lack of rain, the cowpeas in the immediate vicinity were to a large extent a failure, and the weevils seemed therefore to concentrate on the cowpeas growing on the experimental plats; these cowpeas had been irrigated and produced a normal growth. No migration in pronounced numbers has been observed to take place, as is often the case with other insects. If the food is depleted the number of weevils gradually decreases, but as long as any cowpeas remain in the field, a few isolated individuals can usually be found, and weevils have been collected in patches after the peas have been harvested. In confinement the weevil is likewise very aggressive in its search for food, peas left exposed in the laboratory were discovered and attacked with an uncanny precision. Even a single isolated pea in the most remote corner or nook if accessible to the weevil is attacked and will soon have eggs adhering to it. Mating is conducive to a more insistent search for food.

Adaptive Capacity.

There is a very little flexibility in the habits of this insect to adapt itself to a strange environment. This is particularly true with respect to its food plant. Changing the food from one variety of cowpea to another did not apparently affect the weevil, but when a nearly related food plant, such as certain varieties of beans, navy, and lima, were repeatedly tried, the weevil could not complete its life cycle. In all experiments egg deposition took place readily enough, as has been elsewhere stated. The eggs hatched in a large percentage of cases, but the larvae could not subsist in the substituted food, and all were dead within three days after hatching. In the field the cowpea weevil has not been collected consistently on any plant except cowpeas. When the food is removed the weevils probably disseminate from that point to other patches of cowpeas, instead of attacking other plants growing adjacent to infested patches. The weevil is restricted to the cowpea as a food plant.

Copulation.

Copulation is generally of short duration, rarely comprising more than three or four minutes. In the laboratory on September 8, 1916, ten pairs of weevils were timed while copulating. The average time was three minutes and twenty seconds. The male normally is aggressive and insistent and continues to follow the female about very closely. The attraction of the male to virgin females two or three days old is much more pronounced than to the newly emerged individuals. When the female is in a receptive mood she remains very quiet; usually is motionless and exhibits no excitement, while the male appears to be very nervous. At the beginning of coitu the male strokes the female with his antennae. Without exception the female makes the initial attempt at release; the male appearing helpless to extricate himself. The separation is accomplished by the female's pushing against the male with her hind legs, a few vigorous backward strokes usually sufficing. The male during this time remains perfectly quiet. Sometimes, however, several minutes are required before the separation is completed. In the laboratory copulation took place freely in any temperature sufficient to maintain activity among the weevils. The total number of copulations occurring during the life of a female varies under different conditions.

As many as three often occur and have been observed at various times in the life history studies on the insect. Intermating is a common occurrence. The female will readily unite with any male, at a propitious time even if she has already mated to another male. The male is no more pronounced in his instinct for choosing a mate and will unite with any female regardless of any previous mating with other individuals.

The total number of females that a single male can fertilize has been determined by laboratory experiments. The average of ten males mated in each case to virgin females, resulted in eight females fertilized in five days. Sometimes mating will take place after the male is no longer capable of fertilizing the female. The average time that these males lived was seven days.

Period Between Maturity and Copulation.

The period between maturity and copulation is very short. On August 20, 1916, in the laboratory, Courtney noted a pair of weevils in copulation one minute after they had emerged. This was doubtless an extreme case and does not occur frequently. During the warm season when the activity of the weevils is at a maximum, the actual time which elapses between maturity and copulation ranges from five minutes, which was frequently observed in the laboratory throughout the summer of 1916, to a maximum that is determined only by the ability of the male to come into contact with the female. It might be said that the insect is ready to mate and begin reproduction almost immediately after maturity and emergence. The average time occurring between maturity and copulation was not definitely determined, but it is safe to assume that it is not over 24 hours and probably less. In Table 23 it will be noted that egg deposition took place invariably on the day following mating, over the entire period. No eggs were deposited by an unmated female.

Fertility.

One mating is sufficient to fertilize the entire egg quota of the female. If the male dies or is removed after copulation has taken place, all the eggs deposited by the female are fertile and will hatch. However, successive matings seem to stimulate the female to further egg deposition. The per cent. of normally deposited eggs that were unfertile or that did not hatch, over the entire period of the life history notes, was very small, in fact, it could well be considered negligible. Sometimes the egg is insecurely stuck to the pea and is brushed off, or it may be stuck at only one side or on the end and lifted away from the surface of the pea. These eggs were not observed to hatch. All experiments conducted in the laboratory attempting to induce unmated females to deposit eggs produced negative results.

Oviposition.

Oviposition is usually a short simple process. The female crawls about the seed in search of a favorable place for egg deposition. When the pea has been selected, the female explores the surface with her antennae. She stops and remains quiet for a few moments. The tip of the abdomen, which is protruded, is then bent well under the body and rubbed on the surface and immediately a clear sticky fluid is exuded; the egg follows shortly and is placed in the midst of this material which soon hardens and attaches the egg firmly to the surface of the pea. Sometimes the female turns about and examines the egg with her antennae. The entire operation is often completed within a minute. Sometimes after resting a few seconds, the female repeats the operation; usually, however, three or four minutes, often a much longer time elapses between deposition of eggs. When the supply of seed is abundant one egg is usually placed on a pea, but very often two or three, and occasionally more may be found on a single pea. When the supply of seed is small, however, or the infestation of weevils great,

very often a single seed containing twenty or thirty eggs may be found. On October 19, 1916, a medium sized cowpea of the Chinese Red variety was found in the field, with forty-four eggs adhering to it.

The minimum average mean temperature at which oviposition took place was 33 degrees F. Only a few eggs were deposited in a temperature below 50 degrees. When the temperature drops below 70 degrees there is, however, a noticeable decrease in oviposition. The optimum temperature for oviposition ranges between 85 and 95 degrees F. Females will oviposit on any foreign objects if cowpeas are inaccessible. Frequently the eggs adhered to the sides of the vials. Temperature greatly influences the rate of oviposition and the total number of eggs deposited. The average number of eggs produced per female for the year 1916 was 73. The average mean temperature for the year was 72.9 degrees F.

Age at Beginning of Oviposition.

The age at which the female begins ovipositing varies greatly with the season. The relationship of temperature to the age at beginning of oviposition is very pronounced. In Table 23 the daily egg production with the maximum, minimum, and mean daily temperature and humidity, is given. The longest period recorded, 16 days, occurred but once. Female No. 371, mated on January 10, 1917, deposited her first eggs on January 26, 1917. During this period the mean temperature ranged from a maximum of 76 degrees to a minimum of 30 degrees F., with a daily mean average of 53 degrees F. A period of from 3 to 5 days occurred frequently during the winter months of December, January, and February of both 1916 and 1917. When the mean temperature was 65 degrees F. or above, oviposition invariably took place on the same day that mating occurred.

Throughout the summer months of 1916 frequent observations were made in the laboratory, in which cases the female began oviposition in from 3 to 5 minutes after mating. On October 16, 1915, Courtney noted an extreme case, a female depositing an egg in less than one minute after mating. The average period is much longer.

In a temperature of 70 degrees F. or above, the female will always begin oviposition within a period of 24 hours if she has been mated with an active male. When a female has been mated and does not have access to cowpeas the time until oviposition begins is much prolonged. On September 12, 1916, fifteen females were placed in separate empty vials and the average time until eggs were deposited on the sides of the vials was slightly over three days. Showing that the female can control, within certain limits, the time at which oviposition begins.

Period of Oviposition.

The length of the period of oviposition, from October 1, 1915, to February 1, 1917, is given in Table 22. The period ranges from a minimum of 4 days, which occurred frequently throughout the warm months, to a maximum of 34 days, which was noted on January 10, 1917. This long period occurred but once in the entire studies. The daily mean temperature for this period ranged from 34 to 83 degrees

F., with an average mean temperature of slightly less than 56 degrees F. Eggs were deposited over a period of 28 days by three females during December, 1916. In a warm temperature activity is much more pronounced and the rate of oviposition is larger. When a female has laid her entire quota of eggs she becomes sluggish and usually dies in a few days. This greatly decreases the period for the warm months. In the cold season when the mean temperature is 50 degrees F. or below, activity is likely to cease altogether, and the weevils will seem dead to all outward appearances. With a rise in temperature, however, they quickly resume a normal activity and egg laying continues. Within certain limits the length of the period of oviposition varies in direct proportion to the concurrent temperature.

Table 22.—Period of Oviposition.

First Egg	Last Egg	Period, Days	Temperature		
			Max.	Min.	Mean
1915					
Oct. 1.....	Oct. 9.....	9	85	69	77.3
Oct. 7.....	Oct. 15.....	9	86	70	78.6
Oct. 7.....	Oct. 12.....	6	85	69	79.3
Oct. 15.....	Oct. 21.....	7	85	70	78.3
Oct. 15.....	Oct. 19.....	5	85	70	79.6
Oct. 17.....	Oct. 26.....	10	85	68	75.5
Oct. 18.....	Oct. 23.....	6	84	68	76.2
Oct. 19.....	Oct. 30.....	12	83	68	74.4
Oct. 20.....	Oct. 29.....	10	78	68	73.9
Oct. 22.....	Oct. 29.....	8	78	68	73.6
Oct. 24.....	Nov. 2.....	10	80	69	74.9
Oct. 24.....	Nov. 2.....	10	80	69	74.9
Oct. 25.....	Nov. 1.....	8	79	71	74.7
Oct. 26.....	Oct. 31.....	6	79	72	75.0
Oct. 27.....	Oct. 30.....	4	79	72	75.3
Oct. 28.....	Nov. 2.....	6	80	72	76.3
Oct. 29.....	Nov. 4.....	7	81	66	75.5
Oct. 30.....	Nov. 7.....	9	81	66	75.4
Nov. 1.....	Nov. 8.....	8	81	66	75.6
Nov. 3.....	Nov. 9.....	7	82	66	75.8
Nov. 4.....	Nov. 11.....	8	83	66	75.8
Nov. 8.....	Nov. 11.....	4	83	76	78.2
Nov. 8.....	Nov. 8.....	1	80	77	79.5
Nov. 10.....	Nov. 16.....	7	83	57	68.8
Nov. 10.....	Nov. 21.....	12	86	57	72.0
Nov. 11.....	Nov. 21.....	11	86	57	71.5
Nov. 12.....	Nov. 19.....	8	84	57	70.3
Nov. 13.....	Nov. 19.....	7	84	57	70.8
Nov. 14.....	Nov. 19.....	6	87	57	71.1
Nov. 15.....	Nov. 21.....	7	86	57	73.0
Nov. 16.....	Nov. 21.....	6	86	58	74.2
Nov. 17.....	Nov. 21.....	5	86	69	75.6
Nov. 18.....	Nov. 21.....	4	86	69	75.4
Nov. 19.....	Nov. 24.....	6	87	66	75.6
Nov. 20.....	Nov. 26.....	7	87	66	76.2
Nov. 21.....	Nov. 26.....	6	87	66	76.1
Nov. 22.....	Nov. 28.....	7	87	66	76.1
Nov. 23.....	Dec. 1.....	9	86	66	76.7
Nov. 24.....	Nov. 30.....	7	82	70	76.0
Nov. 25.....	Nov. 30.....	6	82	70	76.5
Nov. 26.....	Dec. 2.....	7	86	68	77.0
Nov. 27.....	Dec. 2.....	6	86	68	76.7
Nov. 28.....	Dec. 6.....	9	86	68	77.1
Nov. 29.....	Dec. 5.....	7	86	67	77.1
Nov. 30.....	Dec. 5.....	6	86	67	77.5
Dec. 1.....	Dec. 5.....	5	86	68	77.8
Dec. 2.....	Dec. 8.....	7	85	68	76.7
Dec. 3.....	Dec. 9.....	7	85	68	75.7
Dec. 4.....	Dec. 14.....	11	85	43	67.7
Dec. 5.....	Dec. 10.....	6	85	43	75.0
Dec. 6.....	Dec. 18.....	11	83	39	74.6
Dec. 7.....	Dec. 27.....	21	83	35	56.5
Dec. 8.....	Dec. 23.....	16	83	35	56.8
Dec. 9.....	Jan. 8.....	31	83	29	64.5
Dec. 10.....	Jan. 11.....	33	83	29	56.0
Dec. 13.....	Jan. 11.....	30	79	29	55.5

Table 22.—Period of Oviposition.—Continued.

First Egg	Last Egg	Period, Days	Temperature		
			Max.	Min.	Mean
1915					
Dec. 14.....	Jan. 9.....	27	79	29	62.6
Dec. 14.....	Jan. 5.....	23	74	29	54.5
Dec. 14.....	Jan. 5.....	23	74	29	54.5
Dec. 15.....	Jan. 9.....	26	74	29	54.9
Dec. 16.....	Jan. 5.....	21	74	29	54.3
Dec. 22.....	Jan. 11.....	21	79	29	56.3
Dec. 23.....	Jan. 6.....	15	79	29	57.0
Dec. 21.....	Jan. 11.....	22	79	29	56.0
Dec. 27.....	Jan. 6.....	11	79	29	58.5
Dec. 27.....	Jan. 11.....	16	79	29	58.1
Dec. 28.....	Jan. 5.....	9	75	29	56.6
Dec. 31.....	Jan. 11.....	12	79	30	62.3
1916					
Jan. 1.....	Jan. 11.....	11	79	45	62.7
Jan. 4.....	Jan. 12.....	9	79	45	62.0
Jan. 12.....	Jan. 21.....	10	79	22	48.0
Jan. 20.....	Jan. 21.....	2	71	38	59.0
Jan. 21.....	Feb. 20.....	31	80	26	54.7
Jan. 26.....	Feb. 21.....	27	80	26	54.2
Jan. 26.....	Jan. 26.....	1	73	59	66.0
Feb. 11.....	Feb. 24.....	14	80	39	58.8
Feb. 17.....	Mar. 8.....	21	84	39	60.8
Mar. 7.....	Mar. 19.....	13	86	39	66.0
Mar. 7.....	Mar. 19.....	13	86	39	66.0
Mar. 9.....	Mar. 17.....	9	86	44	64.1
Mar. 10.....	Mar. 21.....	12	88	44	67.6
Mar. 10.....	Mar. 19.....	10	86	44	66.0
Mar. 17.....	Mar. 30.....	14	89	45	69.3
Mar. 20.....	Mar. 31.....	12	89	48	70.4
Mar. 21.....	Mar. 31.....	11	89	48	70.1
Mar. 23.....	April 4.....	13	86	48	67.5
Mar. 24.....	April 4.....	12	86	48	67.1
Mar. 29.....	April 22.....	25	87	40	68.1
Mar. 30.....	April 12.....	14	83	55	64.7
April 2.....	April 14.....	13	83	40	64.8
April 4.....	April 16.....	13	83	40	65.7
April 7.....	April 19.....	13	87	40	66.6
April 8.....	April 19.....	12	87	40	67.6
April 11.....	April 20.....	10	87	53	72.3
April 12.....	April 21.....	10	87	56	72.8
April 13.....	April 23.....	11	87	56	72.9
April 14.....	April 23.....	10	87	56	72.6
April 15.....	April 23.....	9	87	56	72.1
April 17.....	April 23.....	7	87	58	73.4
April 18.....	April 30.....	13	87	52	71.9
April 19.....	April 25.....	7	87	58	74.5
April 21.....	April 30.....	10	87	52	70.7
April 22.....	May 4.....	13	87	52	71.3
April 24.....	May 3.....	10	87	52	70.4
April 25.....	May 4.....	10	87	52	70.3
April 26.....	May 6.....	11	94	52	72.2
April 27.....	May 7.....	11	96	52	73.2
April 29.....	May 6.....	8	94	54	74.0
May 2.....	May 8.....	7	99	65	79.4
May 3.....	May 8.....	6	99	65	81.0
May 5.....	May 5.....	1	91	73	82.0
May 5.....	May 13.....	9	100	73	87.3
May 6.....	May 13.....	8	100	74	88.0
May 8.....	May 14.....	7	100	80	89.0
May 9.....	May 18.....	10	100	70	86.1
May 10.....	May 19.....	10	98	70	84.4
May 12.....	May 22.....	11	97	70	82.4
May 13.....	May 21.....	9	97	70	82.1
May 15.....	May 25.....	11	97	70	81.1
May 16.....	May 16.....	1	97	74	85.5
May 17.....	May 25.....	9	91	70	79.1
May 18.....	May 25.....	8	91	70	79.0
May 19.....	May 24.....	6	91	70	79.1
May 20.....	May 27.....	8	91	71	80.6
May 22.....	May 29.....	8	87	71	80.5
May 23.....	May 30.....	8	89	71	80.8
May 24.....	May 29.....	6	89	71	80.5
May 25.....	May 30.....	6	89	73	80.8
May 26.....	June 2.....	8	94	73	82.3
May 27.....	June 2.....	7	94	73	82.1
May 29.....	June 5.....	8	94	73	83.3
May 30.....	June 5.....	7	94	74	83.8
May 31.....	June 4.....	5	94	77	84.6

Table 22.—Period of Oviposition.—Continued.

First Egg	Last Egg	Period, Days	Temperature		
			Max.	Min.	Mean
1916					
June 1.....	June 6.....	6	93	77	84.3
June 3.....	June 8.....	6	93	71	83.3
June 5.....	June 12.....	8	94	71	83.0
June 5.....	June 11.....	7	94	71	82.8
June 6.....	June 13.....	8	94	71	82.8
June 7.....	June 13.....	7	94	71	82.3
June 8.....	June 14.....	7	90	71	82.4
June 9.....	June 14.....	6	90	72	83.5
June 10.....	June 15.....	6	90	73	84.0
June 12.....	June 17.....	6	90	72	82.1
June 14.....	June 19.....	6	90	72	81.8
June 15.....	June 21.....	7	95	72	82.1
June 16.....	June 20.....	5	95	72	81.1
June 17.....	June 23.....	7	95	75	83.4
June 20.....	June 25.....	6	95	75	86.1
June 21.....	June 25.....	5	95	78	86.8
June 22.....	June 28.....	7	95	75	86.8
June 23.....	June 29.....	7	95	75	87.3
June 24.....	June 29.....	6	95	75	86.7
June 25.....	June 25.....	1	95	81	88.0
June 26.....	July 2.....	7	95	75	85.4
June 27.....	July 2.....	6	95	75	85.1
June 28.....	July 5.....	8	95	75	84.6
June 29.....	July 5.....	7	95	76	84.5
June 30.....	July 5.....	6	95	76	84.5
July 1.....	July 5.....	5	95	76	84.8
July 3.....	July 9.....	7	99	76	87.1
July 4.....	July 8.....	5	99	76	87.2
July 6.....	July 11.....	6	99	79	88.5
July 7.....	July 12.....	6	99	79	88.3
July 8.....	July 13.....	6	99	79	87.8
July 10.....	July 16.....	7	98	79	87.1
July 11.....	July 15.....	5	97	79	86.6
July 12.....	July 15.....	4	95	80	86.2
July 13.....	July 17.....	5	98	79	87.4
July 14.....	July 21.....	8	99	78	87.5
July 15.....	July 19.....	5	99	78	87.8
July 17.....	July 22.....	6	99	78	88.3
July 18.....	July 23.....	6	99	78	87.8
July 19.....	July 24.....	6	99	80	88.1
July 20.....	July 24.....	5	99	80	88.6
July 21.....	July 24.....	4	99	80	88.6
July 22.....	July 26.....	5	99	80	88.2
July 24.....	July 29.....	6	99	80	87.6
July 25.....	July 28.....	4	98	80	87.0
July 26.....	July 30.....	5	97	80	86.0
July 27.....	July 31.....	5	97	78	86.0
July 28.....	Aug. 3.....	7	97	79	86.8
July 29.....	Aug. 3.....	6	97	79	86.9
July 31.....	Aug. 5.....	6	97	79	87.3
Aug. 1.....	Aug. 7.....	7	97	79	86.9
Aug. 3.....	Aug. 9.....	7	97	79	86.0
Aug. 4.....	Aug. 10.....	7	96	78	85.3
Aug. 5.....	Aug. 10.....	6	96	78	84.9
Aug. 7.....	Aug. 12.....	6	95	78	85.3
Aug. 9.....	Aug. 12.....	4	94	80	85.2
Aug. 11.....	Aug. 17.....	7	96	75	87.1
Aug. 12.....	Aug. 16.....	5	96	79	87.1
Aug. 12.....	Aug. 18.....	7	96	75	86.2
Aug. 14.....	Aug. 23.....	10	100	75	87.1
Aug. 15.....	Aug. 20.....	6	95	75	85.8
Aug. 16.....	Aug. 22.....	7	100	75	87.1
Aug. 17.....	Aug. 23.....	7	100	75	87.2
Aug. 18.....	Aug. 24.....	7	100	79	87.5
Aug. 19.....	Aug. 24.....	6	100	79	87.7
Aug. 21.....	Aug. 26.....	6	100	70	86.0
Aug. 22.....	Aug. 27.....	6	97	70	84.6
Aug. 23.....	Aug. 29.....	7	96	70	84.5
Aug. 24.....	Aug. 27.....	4	93	70	83.0
Aug. 25.....	Sept. 2.....	9	97	70	85.0
Aug. 26.....	Sept. 2.....	8	97	70	85.3
Aug. 28.....	Sept. 3.....	7	97	77	87.5
Aug. 29.....	Sept. 4.....	7	97	77	86.8
Aug. 30.....	Sept. 4.....	6	97	77	87.0
Sept. 1.....	Sept. 7.....	7	97	79	88.0
Sept. 2.....	Sept. 8.....	7	101	80	88.7
Sept. 3.....	Sept. 7.....	5	97	80	88.6
Sept. 4.....	Sept. 12.....	9	101	80	88.7
Sept. 5.....	Sept. 11.....	7	101	80	88.8

Table 22.—Period of Oviposition.—Continued.

First Egg	Last Egg	Period, Days	Temperature		
			Max.	Min.	Mean
1916					
Sept. 6	Sept. 11	6	101	80	89.0
Sept. 7	Sept. 12	6	101	80	88.8
Sept. 8	Sept. 15	8	101	73	87.3
Sept. 9	Sept. 13	5	99	79	88.4
Sept. 10	Sept. 14	5	97	78	87.6
Sept. 11	Sept. 21	11	99	67	82.8
Sept. 12	Sept. 17	6	97	70	83.3
Sept. 13	Sept. 20	8	99	67	81.7
Sept. 14	Sept. 20	7	99	67	80.8
Sept. 15	Sept. 23	9	99	67	80.2
Sept. 16	Sept. 21	6	99	67	79.8
Sept. 17	Sept. 22	6	99	67	80.1
Sept. 18	Sept. 25	8	99	67	80.8
Sept. 19	Sept. 25	7	91	68	80.5
Sept. 20	Sept. 25	6	91	69	81.0
Sept. 22	Sept. 29	8	105	60	81.2
Sept. 23	Sept. 28	6	105	70	82.8
Sept. 24	Oct. 1	8	105	57	77.8
Sept. 25	Oct. 6	12	105	57	77.2
Sept. 26	Oct. 4	9	105	57	76.5
Sept. 27	Oct. 3	7	105	57	76.1
Sept. 28	Oct. 5	8	95	57	74.8
Sept. 29	Oct. 7	9	89	57	73.9
Sept. 30	Oct. 7	8	89	57	74.5
Oct. 1	Oct. 8	8	90	59	75.8
Oct. 3	Oct. 9	7	91	66	78.5
Oct. 4	Oct. 9	6	91	66	78.7
Oct. 5	Oct. 12	8	94	66	78.7
Oct. 6	Oct. 12	7	94	68	78.9
Oct. 7	Oct. 14	8	94	68	79.7
Oct. 8	Oct. 13	6	94	68	80.0
Oct. 9	Oct. 15	7	94	68	80.0
Oct. 10	Oct. 19	10	94	60	76.4
Oct. 11	Oct. 18	8	90	61	76.8
Oct. 12	Oct. 18	7	90	61	76.6
Oct. 13	Oct. 22	10	90	41	71.3
Oct. 14	Oct. 22	9	90	41	70.1
Oct. 15	Oct. 26	12	95	41	69.9
Oct. 16	Oct. 30	15	95	41	70.3
Oct. 17	Oct. 30	14	95	41	69.9
Oct. 18	Oct. 30	13	95	41	70.2
Oct. 19	Oct. 31	13	95	41	70.7
Oct. 20	Nov. 1	13	95	41	71.5
Oct. 21	Nov. 1	12	95	41	72.3
Oct. 22	Oct. 31	10	95	52	73.1
Oct. 23	Nov. 2	11	95	53	73.5
Oct. 24	Nov. 1	9	95	53	74.8
Oct. 25	Nov. 5	12	92	53	74.8
Oct. 26	Nov. 9	15	92	53	74.8
Oct. 27	Nov. 5	10	92	53	75.3
Oct. 28	Nov. 4	8	90	56	75.2
Oct. 29	Nov. 5	8	90	60	76.3
Oct. 30	Nov. 7	9	90	60	76.4
Oct. 31	Nov. 10	11	89	60	74.6
Nov. 1	Nov. 9	9	89	58	75.7
Nov. 2	Nov. 10	9	89	51	74.5
Nov. 3	Nov. 11	9	87	51	74.0
Nov. 4	Nov. 11	8	87	51	74.0
Nov. 5	Nov. 19	15	89	33	67.0
Nov. 6	Nov. 23	18	94	33	66.6
Nov. 7	Nov. 21	15	94	33	66.6
Nov. 8	Nov. 28	21	98	33	65.2
Nov. 9	Nov. 30	22	98	33	65.8
Nov. 10	Nov. 28	19	94	33	63.6
Nov. 12	Dec. 1	20	98	33	65.8
Nov. 15	Nov. 28	14	94	33	64.1
Nov. 15	Nov. 28	14	94	33	64.1
Nov. 19	Dec. 4	16	98	44	70.5
Nov. 20	Dec. 4	15	98	44	70.6
Nov. 21	Dec. 3	13	98	44	69.2
Nov. 23	Dec. 7	15	101	44	72.8
Nov. 24	Dec. 6	13	101	44	74.0
Nov. 26	Dec. 8	13	101	44	75.3
Nov. 28	Dec. 10	13	101	38	75.0
Nov. 30	Dec. 8	9	101	48	78.4
Dec. 1	Dec. 14	14	101	32	70.1
Dec. 2	Dec. 12	11	101	34	71.7
Dec. 3	Dec. 16	14	101	32	67.7
Dec. 4	Dec. 17	14	101	32	67.0

Table 22.—Period of Oviposition.—Continued.

First Egg	Last Egg	Period, Days	Temperature		
			Max.	Min.	Mean
1916					
Dec. 5.....	Jan. 2.....	29	101	28	62.5
Dec. 6.....	Dec. 29.....	24	99	28	61.6
Dec. 7.....	Jan. 3.....	28	92	28	60.9
Dec. 8.....	Jan. 4.....	28	90	28	60.8
Dec. 9.....	Jan. 1.....	24	92	28	60.0
Dec. 11.....	Jan. 3.....	24	92	28	60.0
Dec. 12.....	Jan. 5.....	25	92	28	60.8
Dec. 13.....	Dec. 27.....	15	89	28	58.9
Dec. 14.....	Jan. 4.....	22	92	28	60.9
Dec. 15.....	Jan. 4.....	21	92	28	61.0
Dec. 17.....	Jan. 6.....	21	92	28	61.3
Dec. 18.....	Jan. 9.....	23	93	28	63.0
Dec. 24.....	Jan. 12.....	20	94	46	66.4
Dec. 24.....	Jan. 9.....	17	93	46	66.4
Dec. 24.....	Jan. 9.....	17	93	46	66.4
Dec. 25.....	Jan. 10.....	17	94	46	67.3
Dec. 25.....	Jan. 8.....	15	92	46	66.1
Dec. 26.....	Jan. 9.....	15	93	46	67.1
Dec. 26.....	Jan. 12.....	18	94	44	67.0
Dec. 26.....	Jan. 12.....	18	94	44	67.0
Dec. 27.....	Jan. 10.....	15	94	46	67.2
1917					
Jan. 2.....	Jan. 12.....	11	94	44	69.6
Jan. 2.....	Jan. 12.....	11	94	44	69.6
Jan. 3.....	Jan. 12.....	10	95	44	68.8
Jan. 5.....	Jan. 28.....	24	94	30	56.0
Jan. 6.....	Jan. 29.....	24	94	30	55.7
Jan. 8.....	Jan. 29.....	22	94	30	55.0
Jan. 9.....	Jan. 30.....	22	100	30	55.5
Jan. 10.....	Feb. 13.....	34	100	25	56.5
Jan. 21.....	Feb. 13.....	24	100	25	57.5
Jan. 21.....	Feb. 15.....	26	100	25	57.4
Jan. 21.....	Jan. 26.....	6	82	40	56.3
Jan. 24.....	Feb. 12.....	20	100	25	58.1
Jan. 25.....	Feb. 17.....	24	100	25	57.4
Jan. 27.....	Feb. 14.....	19	100	25	57.7
Jan. 28.....	Feb. 23.....	27	103	25	61.2
Jan. 29.....	Feb. 17.....	20	100	25	57.1
Jan. 29.....	Feb. 20.....	23	100	25	58.6
Jan. 30.....	Feb. 23.....	25	103	25	61.0
Jan. 31.....	Feb. 23.....	24	103	25	60.1

Rate of Oviposition.

The rate of oviposition is shown in Table 23. The maximum number of eggs produced in 24 hours was 58, by female No. 251, on September 12, 1916. This maximum occurred but a single time during the entire studies. From 50 to 55 eggs for a 24-hour period occurred frequently during the warm months. Generally the maximum number of eggs for a 24-hour period is deposited immediately after mating. In a few instances the female deposited her entire egg quota during the first day after mating, and during the summer, it frequently happened that she deposited all her eggs in the first two or three days. During the second 24-hour period the number is reduced by about one-third. In the succeeding periods there is a considerable fluctuation in the number of eggs deposited. In a few instances, usually during the cold periods, more eggs were deposited on the fourth and fifth day than on the preceding days. During the warm season, however, the decline in rate of oviposition after three days is very abrupt. Temperature has a very important influence as will be seen from Table 23. In cold weather the period of oviposition is greatly increased, while the rate of oviposition suffers a corresponding decrease. No regularity appears in the number of eggs deposited for any given period. In fact, the num-

ber of eggs deposited depends directly upon the prevailing temperature for the period. The female may begin oviposition with a single egg and gradually or suddenly increase this to many times the number. Sometimes two weeks or more may pass after mating before a single egg is deposited, and occasionally it happens that the female will not deposit any eggs during the period of her life. Records on the rate of oviposition are given in detail in Table 23.

Table 23.—Rate of Oviposition.

Date	Temperature			1	2	3	4	5	6	7	8	9	12	13	14	Humidity		
	Max.	Min.	Mean													Max.	Min.	Mean
1915																		
Sept. 10.																		
11.				20	22	23	29									100	46	73
12.				20	21	23	29									100	52	76
13.				11	12	12	19									100	52	76
14.				0	2	2	6	46								98	53	75.5
15.				1	6	3	4	17								100	55	77.5
16.					1		0	14	48							100	51	75.5
17.								5	14	0	3	13				100	56	78
18.								2	0	0	0	11				99	45	72
19.								1	1	0	0	11				99	45	72
20.										1	9	0				100	40	70
21.										5	4	1				99	57	78
22.										0	8	0				96	52	74
23.										0	7	0	21	30	17	99	64	86.5
24.										0	6	0	22	17	20	99	64	86.5
25.										0	2		10	5	5	99	53	76
26.										0	2		11	5	4	99	47	73
27.										0	1		10	4	4	99	46	72.5
28.										3	0		0	0	4	100	42	71
29.										0	0		0	0		94	44	70
30.										0	0		0	0		99	55	77

Death of female occurred on day following last record in each column.

Table 23—Rate of Oviposition—Continued.

Date	Temperature			7	8	9	12	13	14	16	17	18	21	22	23	24	25	26	27	29	30	31	32	33	34	35	36	Humidity		
	Max.	Min.	Mean																									Max.	Min.	Mean
1915																														
Oct. 1				0				0		39																		100	38	69
2				0				0		7																		100	35	62.5
3				0				0		7																		100	44	72
4				0				0		7																		100	48	74
5										0																		67	34	50.5
6										0																		80	28	54
7										0	40	38																89	35	62
8										0	6	5																83	27	55
9										0	4	0																89	33	61
10										8	8	6																99	35	67
11										0	6	7																98	43	70.5
12										4	3	5																97	46	76.5
13										3																		99	37	68
14	80	66	73																									99	40	64.5
15	78	73	75.5								3																	99	43	69
16	80	70	75								1		26	35														99	48	73.5
17	83	75	78								0		28	17														99	58	78.5
18	85	80	82.5										22	10	54													99	48	73.5
19	84	81	82.5									9	7	10	41													99	44	71.5
20	83	74	78.5									11	3	14	17		47											100	68	94
21	78	71	74.5									8	0	13	15	10	26											100	40	70
22	77	74	75.5									4	0	8	9	4	8	18										99	34	66.5
23	77	73	75									0	0	6	7	8	5	14	15									96	27	61.5
24	74	68	71									0	0	0	2	1	0	7	8									92	47	69.5
25	73	69	71									0			1	0	3	11	4	9	32							99	33	66
26	73	71	72												1	4	4	12	7	17	15	15						100	31	65.5
27	74	72	73												1	5	6	11	22	14	18	4						100	37	68.5
28	77	72	74.5													1	10	5	16	7	18	2	28					96	37	66.5
29	78	74	76													0	1	13	16	8	8	1	20	28				100	35	67.5
30	78	72	75													2	6	1	8	8	19	1	1	11	15	18	0	100	37	68.5
31	79	73	76													1	0		12	12	1	1	1	11	15	18	23	99	31	65
31	78	74	76														0			6	6	6	2	0	5	19	5	99	34	66.5

THE COWPEA WEEVIL.

Table 23—Rate of Oviposition—Continued.

[illegible]

Table 23—Rate of Oviposition—Continued.

Date	Temperature			60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	88	89	90	91	92	Humidity																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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THE COWPEA WEEVIL.

Table 23—Rate of Oviposition—Continued.

Date	Temperature			73	74	75	76	77	78	79	80	81	82	83	84	85	86	88	89	90	91	92	93	94	95	97	98	99	102	Humidity			
	Max.	Min.	Mean																											Max.	Min.	Mean	
1916																																	
Jan. 1.	75	61	68	0	...	0	0	0	4	1	3	3	6	9	7	7	2	4	5	5	5	4	...	...	...	...	...	...	...	100	72	86
2.	75	60	68.5	0	...	0	0	0	4	1	4	4	6	9	7	7	2	4	5	5	0	4	...	...	...	...	...	...	...	98	72	85
3.	72	60	66	0	...	5	0	0	5	2	4	4	6	10	8	8	3	7	7	5	7	0	4	...	...	...	...	...	...	99	66	82.5
4.	69	59	64	...	...	0	0	0	8	0	4	4	5	3	5	9	6	7	2	10	5	1	7	14	...	...	...	...	...	99	67	83
5.	74	59	66.5	...	...	0	0	0	3	1	1	3	4	1	6	3	4	0	10	9	1	4	6	...	...	...	...	...	...	97	57	77
6.	79	66	71.5	...	...	0	0	0	1	0	0	0	0	1	0	1	3	1	6	2	0	1	6	...	...	...	...	...	...	98	56	77
7.	76	54	65	...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	...	...	...	...	...	96	58	77
8.	55	45	50	...	...	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	...	...	...	...	...	...	100	73	86.5
9.	54	45	49.5	...	...	...	0	0	0	1	0	0	1	0	1	0	3	...	2	1	1	2	7	...	...	...	...	...	...	100	82	91
10.	64	51	52.5	...	...	...	0	0	0	0	0	0	0	0	0	0	0	...	2	0	0	15	...	...	...	...	...	...	100	92	96	
11.	75	64	69.5	...	...	...	3	2	...	...	...	...	...	...	4	...	3	...	8	6	...	2	14	...	...	...	...	...	...	98	63	80.5
12.	79	61	70	...	...	...	0	0	...	...	...	...	...	...	...	...	0	0	0	0	0	0	1	...	...	...	...	...	...	93	56	74.5
13.	61	22	41.5	...	...	...	0	0	...	...	...	...	...	...	...	...	0	...	0	0	0	0	0	...	...	...	...	...	...	87	58	72.5
14.	40	22	31	...	...	...	...	...	...	...	...	...	...	...	...	...	0	...	0	0	0	0	...	...	...	...	...	...	...	89	39	64
15.	54	33	43.5	...	...	...	...	...	...	...	...	...	...	...	...	...	0	...	...	...	...	0	0	...	...	...	...	...	...	88	28	58
16.	63	44	53.5	...	...	...	...	...	...	...	...	...	...	...	...	...	0	...	...	...	...	0	3	...	...	...	...	...	...	99	66	82.5
17.	58	30	44	...	...	...	...	...	...	...	...	...	...	...	...	...	0	...	...	...	...	0	0	...	...	...	...	...	...	94	58	76
18.	44	30	38	...	...	...	...	...	...	...	...	...	...	...	...	...	0	...	...	...	...	0	0	...	...	...	...	...	...	57	38	47.5
19.	48	31	39.5	...	...	...	...	...	...	...	...	...	...	...	...	...	0	...	...	...	...	0	0	...	...	...	...	...	...	99	35	67
20.	64	38	51	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	3	...	...	...	...	...	...	100	81	90.5
21.	71	64	67.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	0	...	...	...	...	...	...	100	78	89
22.	64	47	56.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	99	51	75
23.	65	43	54	0	0	93	30	66.5
24.	67	43	55	100	30	65
25.	72	47	59.5	100	49	74.5
26.	73	59	66	99	52	75.5
27.	71	62	66.5	100	87	93.5
28.	64	46	55	100	89	94.5
29.	64	45	54.5	100	97	98.5
30.	74	63	68.5	97	60	78.5
31.	66	44	55	100	74	87

Table 23—Rate of Oviposition—Continued.

Date	Temperature			95	98	99	102	103	104	Humidity		
	Max.	Min.	Mean							Max.	Min.	Mean
1916												
Feb. 1.....	48	32	40	0	0	0	0	.....	.....	99	69	84
2.....	35	26	30.5	0	0	0	0	.....	.....	80	51	65.5
3.....	44	26	35	0	0	0	0	.....	.....	79	29	54
4.....	51	27	39	0	0	0	0	.....	.....	78	30	54
5.....	56	38	47	5	4	5	2	.....	.....	99	66	82.5
6.....	73	51	62	0	0	0	0	.....	.....	100	47	73.5
7.....	60	38	49	0	0	0	0	.....	.....	98	65	81.5
8.....	56	38	47	0	0	0	0	.....	.....	100	60	80
9.....	70	47	58.5	3	2	8	10	.....	.....	100	57	75.5
10.....	68	47	57.5	3	4	5	4	0	.....	100	63	81.5
11.....	74	57	65.5	3	4	4	10	1	.....	100	54	77
12.....	76	62	69	0	0	0	0	0	.....	99	46	72.5
13.....	80	43	61.5	0	0	0	0	0	.....	97	46	71.5
14.....	53	39	46	0	0	0	0	0	.....	90	37	68.5
15.....	60	39	49.5	1	1	0	1	0	.....	91	34	62.5
16.....	66	40	53	0	0	0	0	0	.....	97	26	61.5
17.....	71	44	57.5	1	3	3	9	4	24	90	20	55
18.....	76	47	61.5	0	0	0	2	0	0	96	22	59
19.....	68	43	55.5	0	0	0	8	0	0	91	35	63
20.....	66	43	54.5	1	1	3	0	5	2	100	27	63.5
21.....	73	44	58.5	.....	.....	3	0	2	3	100	22	61
22.....	78	54	66	.....	.....	0	3	0	0	98	45	71.5
23.....	74	59	66.5	.....	.....	0	3	0	9	99	51	75
24.....	71	48	59.5	.....	.....	0	0	2	0	85	25	55
25.....	77	48	62.5	.....	.....	0	0	0	0	90	22	56
26.....	71	51	61	.....	.....	0	0	0	0	73	28	50.5
27.....	64	51	57.5	.....	.....	0	0	0	11	76	38	56.5
28.....	70	54	62	.....	.....	0	0	0	0	94	42	68
29.....	81	48	64.5	.....	.....	0	0	0	0	90	27	58.5

Table 23—Rate of Oviposition—Continued.

Date	Temperature			99	102	103	104	106	107	108	109	110	111	112	113	114	115	117	118	Humidity		
	Max.	Min.	Mean																	Max.	Min.	Mean
1916																						
Mar. 1.....	65	48	56.5	0	0	0	0													100	47	73.5
2.....	78	57	67.5	0	0	0	0													96	27	62.5
3.....	71	43	57	0	0	0	0													95	37	66
4.....	57	39	48	0	0	0	0													72	27	49.5
5.....	74	40	57	0	0	0	0													99	34	66.5
6.....	84	58	66	0	0	0	0	0												92	40	66
7.....	86	68	78	0	0	0	0		4	4										99	40	69.5
8.....	75	49	62					0	0	19	0									98	12	55
9.....	68	47	57.5					1	1	19	0									98	27	62.5
10.....	80	48	64					8	2	9	3	10								96	32	64
11.....	86	60	73					8	2	5	3	10								97	40	68.5
12.....	71	53	62					8	2	5	4	10								99	39	69
13.....	82	53	67.5					3	0	5	0	9								97	41	69
14.....	86	65	75.5					3	0	5	8	9								96	22	59
15.....	80	49	64.5					2	1	0	0	2								88	37	62.5
16.....	64	44	54					3	0	0	0	3								66	24	45
17.....	74	45	59.5					3	0	4	5	4	12							97	22	59.5
18.....	82	53	67.5					0	0	2	3	6	11							98	28	63
19.....	84	61	72.5					0	0	1	4	6	11							98	35	66.5
20.....	84	63	73.5					0	0	6	10	0	14	21						98	35	66.5
21.....	88	67	77.5								5		9		45					96	38	67
22.....	82	69	79								0		3	12	11					98	27	62.5
23.....	83	64	73.5								0		4	10	10	24				91	17	54
24.....	81	60	70.5					4	10	12			4	10	12	11	36			95	45	70
25.....	85	64	74.5										1	5	2	3	8			100	47	73.5
26.....	73	50	61.5										0	5	2	3	8			82	28	55
27.....	67	48	57.5										0	7	6	2	4			85	33	59
28.....	72	50	61										0	9	0	4	7			77	22	49.5
29.....	86	55	70.5										0	3	0	8	11	19		99	18	58.5
30.....	83	62	72.5										1	4	0	3	10	25	24	98	28	63
31.....	83	64	73.5										0	4	1	3	7	10	13	97	64	65.5

Table 23—Rate of Oviposition—Continued.

Date	Temperature			111	112	113	114	115	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	Humidity																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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Table 23.—Rate of Oviposition—Continued.

Date		Temperature																					Humidity																	
		Max.	Min.	Mean	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	Max.	Min.	Mean		
1916																																								
June	1.	88	77	82.5	8	7	24	20	21	30																											98	46	72	
	2.	90	78	84	4	1	21	13	16	27																											82	46	64	
	3.	92	78	85		0	11	8	8	12		27																									96	46	71	
	4.	91	78	85			11	8	7	11		27																									93	45	69	
	5.	88	78	83			3	4		9	40	21	46																								88	49	73.5	
	6.	93	80	86.5			0			1	17	12	32																								98	73	70.5	
	7.	94	76	85							6	2	6	12	29																						99	47	72	
	8.	80	71	75.5			0				10	3	11	19	27	46																					97	71	84	
	9.	88	72	80							5	0	7	15	18	22	30																				98	41	69.5	
	10.	89	73	86							0	0	2	8	15	18	25	25																			98	48	73	
	11.	90	79	84.5							0		1	8	16	15	25	25																			93	43	68	
	12.	89	79	84							3			3	8	16	15	20	30																		98	44	71	
	13.	87	76	81.5								3		3	8	16	16	20	30																		98	50	74	
	14.	90	80	85										0	1	3	9	11	43																		97	58	77.5	
	15.	89	77	83											0	0	6	9	24	31																	98	60	79	
	16.	85	72	78.5											0	0	6	12	18	36																	98	54	76	
	17.	89	74	81.5													2	11	21	16	27																97	42	69.5	
	18.	87	75	81														11	21	16	27																97	46	71.5	
	19.	88	75	81.5														3	13	12	20	39															97	38	67.5	
	20.	91	75	83														0	8	7	15	21	53														98	40	69	
	21.	95	78	86.5														6	0	13	24	19	55														98	40	69	
	22.	93	81	87															8	7	15	24	19	55													95	43	69	
	23.	90	81	85.5															4	23	20	30	38														98	40	69	
	24.	93	80	86.5															1	15	12	25	27	49													95	56	75.5	
	25.	95	81	88																6	10	22	46														98	44	71	
	26.	95	80	87.5															1	1	2	12	17	28													97	39	68	
	27.	95	82	88.5																6	10	22	46														98	38	68	
	28.	95	75	85																1	1	2	12	17	28												92	39	65.5	
	29.	93	76	84.5																1	4	9	21	37													97	40	68.5	
	30.	88	78	83																0	1	1	1	12	17	22	33										97	44	70.5	
																																						97	59	78

Table 23.—Rate of Oviposition—Continued.

Date		Temperature			184	185	186	187	188	189	190	191	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	Humidity																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
		Max.	Min.	Mean																															Max.	Min.	Mean																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Table 23.—Rate of Oviposition—Continued.

Date	Temperature			211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	Humidity				
	Max.	Min.	Mean																														Max.	Min.	Mean		
1916																																					
Aug.1	96	81	88.5	0	7	8	23	32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	37	66.5
2	97	80	88.5	...	7	8	23	32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	38	67
3	97	79	88	...	2	1	8	14	39	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	99	38	68.5
4	94	81	87.5	...	...	...	3	10	25	26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	97	40	68.5
5	96	82	89	...	...	...	1	4	15	21	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	95	40	67.5
6	84	79	81.5	...	...	...	...	4	15	21	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	95	76	85.5
7	89	79	84	...	...	...	...	1	8	14	15	35	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	95	50	72.5
8	95	77	87	...	...	...	...	0	8	14	15	35	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	45	70.5
9	90	80	85	...	...	...	...	0	1	6	9	19	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	95	43	69
10	89	78	83.5	...	...	...	...	0	0	3	5	12	23	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	43	69.5
11	90	80	85	...	...	...	...	0	...	...	...	6	15	...	17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	48	72
12	94	80	87	...	...	...	...	...	...	...	...	1	1	8	4	34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	45	70.5
13	95	81	88	...	...	...	...	...	...	...	...	0	0	8	3	34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	37	67.5
14	96	80	88	...	...	...	...	...	...	...	...	0	0	1	1	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	95	37	66
15	92	79	85.5	...	...	...	...	...	...	...	...	...	0	1	0	16	39	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	95	36	65.5
16	95	79	87	...	...	...	...	...	...	...	...	...	2	0	7	17	42	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	38	67
17	90	75	82.5	...	...	...	...	...	...	...	...	...	0	2	16	26	25	29	41	...	...	...	...	...	...	...	...	...	...	...	...	...	95	52	73.5
18	93	80	86.5	...	...	...	...	...	...	...	...	...	0	0	0	1	13	19	27	39	...	...	...	...	...	...	...	...	...	...	...	...	94	43	68.5
19	92	82	87	...	...	...	...	...	...	...	...	...	0	0	0	...	8	5	13	24	27	27	...	...	...	...	...	...	...	...	...	89	43	66	
20	94	80	87	...	...	...	...	...	...	...	...	...	0	0	0	...	...	5	13	24	27	27	...	...	...	...	...	...	...	...	...	90	29	59.5	
21	100	83	91.5	...	...	...	...	...	...	...	...	...	0	0	0	...	2	0	5	14	...	...	...	...	...	...	...	...	...	...	...	...	97	39	68
22	97	80	88.5	...	...	...	...	...	...	...	...	...	0	0	0	...	1	1	4	5	6	15	42	...	...	...	...	...	...	...	...	...	97	40	68.5
23	96	80	88	...	...	...	...	...	...	...	...	...	0	0	0	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	49	77.5
24	91	79	85	...	...	...	...	...	...	...	...	...	0	0	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	44	70
25	91	73	82	...	...	...	...	...	...	...	...	...	0	0	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	90	30	60
26	93	70	81.5	...	...	...	...	...	...	...	...	...	0	0	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	97	29	63
57	92	75	83.5	...	...	...	...	...	...	...	...	...	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	97	42	69.5
28	92	80	86	...	...	...	...	...	...	...	...	...	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	98	37	67.5
29	94	78	86	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	98	37	67.5
30	93	77	85	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	42	69
31	97	78	87.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	96	38	67

Table 23.—Rate of Oviposition—Continued.

Date	Temperature			232	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	Humidity						
	Max.	Min.	Mean																																					Max.	Min.	Mean				
1916																																														
Sept. 1	92	79	85.5	0	0	2	10	11	17	26	20	97	45	71
2	95	81	88	0	1	1	7	6	3	27	29	34	31	97	40	68.5
3	96	80	88	..	0	0	3	2	2	8	18	27	25	23	96	34	65
4	97	80	88.5	..	0	0	0	1	1	4	7	23	25	23	96	35	65.5
5	97	80	88.5	0	0	0	8	15	22	28	38	96	36	66
6	97	81	89	0	0	0	3	10	8	22	15	42	97	29	63	
7	96	81	88.5	0	0	0	2	4	3	12	17	24	36	96	34	65
8	101	80	90.5	0	0	0	2	4	0	13	11	18	28	26	96	35	65.5
9	99	80	89.5	0	0	0	7	6	7	23	26	47	97	35	66
10	96	80	88	5	4	4	12	19	24	36	96	43	69.5	
11	97	80	88.5	3	5	2	8	22	18	25	23	97	46	71.5	
12	96	80	88	1	0	0	2	8	11	17	33	58	95	36	65.5	
13	97	79	88	0	0	0	0	1	5	10	19	21	43	95	34	64.5		
14	92	78	85	0	0	0	0	3	0	7	12	20	20	42	97	44	70.5	
15	91	73	82	0	1	0	10	0	6	8	13	16	3	85	39	62		
16	86	70	78	0	0	0	0	0	0	3	9	19	10	26	85	40	62.5		
17	86	71	78.5	0	0	0	0	0	4	8	11	10	10	33	77	38	59.5			
18	99	67	83	0	0	0	0	0	0	6	9	12	16	23	70	24	47			
19	89	68	78.5	0	0	0	0	1	0	6	5	10	11	15	33	80	27	53.5			
20	91	69	80	0	0	0	0	1	0	9	5	13	3	3	35	90	27	58.5			
21	91	71	81	0	0	0	0	0	..	1	1	1	1	19	36	96	29	62.5			
22	91	70	80.5	0	0	0	0	1	..	0	0	10	2	2	5	12	32	96	21	58.5				
23	91	70	80.5	0	0	0	0	0	..	0	2	0	0	3	9	10	5	12	24	96	22	59				
24	90	73	81.5	0	0	0	0	0	..	0	0	0	0	5	7	17	20	28	95	25	60					
25	91	73	82	0	0	0	0	0	..	0	2	2	1	10	14	19	26	95	30	67.5					
26	83	71	77	0	0	0	0	0	..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..	96	59	77.5		
27	105	75	90	0	0	0	0	0	..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..	96	41	68.5		
28	95	77	86	0	0	0	0	0	..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..	96	36	66		
29	85	60	72.5	0	0	0	0	0	..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	33	54			
30	80	57	68.5	0	0	0	0	0	..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	21	43			

THE COWPER WEEVIL.

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Table 23--Rate of Oviposition--Continued.

[illegible]

Table 23—Rate of Oviposition—Continued.

Date		Temperature			364	365	366	369	370	371	372	374	375	379	380	381	382	383	385	387	388	389	390	391	392	393	Humidity			
		Max.	Min.	Mean																							Max.	Min.	Mean	
1917																														
Feb.	1	94	30	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	76	36	56	
	2	43	25	34	0	0	0	0	2	0	2	3	0	1	1	3	3	3	0	0	3	2	2	6	0	...	56	29	42.5	
	3	77	32	54.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	...	66	15	40.5	
	4	51	33	42	0	0	0	0	1	0	5	4	0	6	0	5	6	4	4	7	4	6	7	7	3	1	99	41	70	
	5	93	30	66.5	...	...	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	77	11	44	
	6	57	36	46.5	...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	1	49	8	28.5	
	7	52	40	46	...	...	0	0	0	0	0	1	0	0	0	20	0	0	1	0	2	0	0	0	0	3	95	47	71	
	8	56	50	53	...	...	0	0	2	0	0	0	0	7	4	1	3	7	3	10	11	3	15	9	5	15	92	69	80.5	
	9	86	46	66	...	...	0	0	0	0	0	2	0	0	0	0	0	0	1	3	2	2	2	4	8	7	3	89	35	62
	10	76	49	62.5	...	...	0	0	0	0	0	0	0	0	3	4	0	1	5	0	2	8	6	7	6	7	11	96	20	61
	11	75	53	64	...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	95	38	66.5
	12	61	41	51	...	...	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	93	86	89.5
	13	52	42	47	...	...	0	1	0	6	0	0	3	0	3	0	0	1	0	0	4	2	0	3	4	0	5	97	68	82.5
	14	63	47	55	...	...	0	0	0	0	0	3	0	1	3	0	2	3	1	2	2	6	5	5	9	8	8	95	63	79
	15	74	44	59	...	...	0	0	0	0	0	0	1	1	2	0	0	0	0	0	4	2	0	4	1	3	1	82	51	66.5
	16	68	42	55	...	...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	88	45	66.5
	17	60	44	52	...	...	0	0	0	0	0	0	0	0	0	0	1	0	1	3	1	1	6	5	5	5	5	94	29	61.5
	18	70	59	69.5	...	...	0	0	0	0	0	2	0	0	0	1	0	2	0	0	0	4	5	8	13	7	11	95	62	78.5
	19	80	61	70.5	...	...	0	...	0	0	0	0	0	0	0	1	0	1	0	0	0	4	5	3	3	7	1	91	25	58
	20	80	54	67	...	...	0	...	...	...	0	0	0	0	0	0	0	2	0	0	0	4	5	6	5	6	6	61	19	40
	21	90	54	72	...	...	0	...	...	...	0	0	0	0	0	0	...	2	0	0	0	0	0	7	5	8	8	66	15	40.5
	22	103	68	85.5	...	...	0	...	...	...	...	...	...	0	...	0	...	4	...	...	...	1	0	4	4	9	7	93	15	54
	23	95	69	82	...	...	0	...	...	...	...	...	...	0	...	0	...	1	...	...	...	1	0	2	3	6	3	99	47	73
	24	100	59	79.5	...	...	...	...	...	...	...	...	...	0	...	0	...	1	...	...	...	0	0	0	0	2	1	71	18	44.5
	25	96	56	76	...	...	...	...	...	...	...	...	...	0	...	0	...	...	...	...	...	0	0	0	0	0	0	94	27	60.5
	26	101	66	83.5	...	...	...	...	...	...	...	...	...	0	...	0	...	...	...	...	...	...	0	0	0	0	0	92	30	61
	27	102	67	89.5	...	...	...	...	...	...	...	...	...	0	...	...	...	...	...	...	...	...	...	0	0	0	0	91	36	63.5
	28	100	60	80	...	...	...	...	...	...	...	...	...	0	...	...	...	...	...	...	...	...	...	...	...	0	0	65	43	54
Mar.	1	72	47	59.5	...	...	...	...	...	...	...	...	0	...	...	...	...	...	...	...	...	...	...	...	0	...	99	45	72	
	2	48	43	45.5	...	...	...	...	...	...	...	...	0	...	...	...	...	...	...	...	...	...	...	...	0	...	97	91	84	
	3	47	42	44.5	...	...	...	...	...	...	...	...	0	...	...	...	...	...	...	...	...	...	...	...	...	...	96	79	87.5	

Generation Series.

In March, 1916, notes were begun on the number of generations that are produced in a year under natural conditions. These notes were made without interruption until March, 1917, and appear in detail in Fig. 3. Two pairs of weevils, Nos. 1 and 2, were mated March 14, 1916, and the first weevils of the first eggs and the last weevils of the last eggs are represented by the A and B series, respectively. A1 and B1 indicate origin from the pair No. 1; F1, F2, F3, etc., represent the filial generation. The last number to the right indicates the collection of eggs from which the next generation was produced. This number, in case of the first weevils of the first eggs, would of course always be one as will be seen in the A series in Fig. 3. In the last weevils of the last eggs produced, however, the number varies from 3 to 11 because all the pairs do not produce the same number of collections of eggs even under the same conditions. Two pairs of weevils were used for two reasons: to insure completion of notes for an entire year, and to check the results. The above explanation applies to pair No. 2 also.

It will be seen in the chart that under the best conditions, by mating the first female of each generation, nearly ten generations became possible in a year; and under the most adverse conditions, by mating the last female of each generation, eight generations might be produced. According to the average, it is safe to assume that normally nine generations are produced in a year in this locality.

Protection.

While the egg adheres to the external surface it is nevertheless protected to some degree by its semi-translucent color, which is not readily observed on any of the light colored or mottled varieties of cowpeas. The eggs are often placed in a depression or among other irregularities on the surface of the peas. As has been stated, when the egg is deposited it is covered by a sticky fluid secreted by the female, which hardens on exposure, forming a hard shell coating for the egg. Doubtless this affords much protection from crushing as the peas are moved about.

The entire under surface of the egg is glued securely to the pea, and the larva's access to the food supply is thus insured. The larva enters the pea from the under side of the egg, and matures wholly within the pea, which affords an excellent protection against parasites, climatic conditions, or similar influences.

Adults protect themselves in several ways—feigning death being the most common. Upon the slightest disturbance, they immediately drop and remain motionless, sometimes feigning death for three or four minutes. The weevils can run rapidly, and in nature it is difficult to follow an individual which has been disturbed. They seek shelter quickly and are greatly aided in this respect by their inconspicuous brownish-black markings. Flight is another important protection. The weevil will take to the wing very quickly if disturbed, and while it cannot be classed as a strong flier, it is able to fly rapidly for short distances. This without doubt enables it to elude many of its enemies.

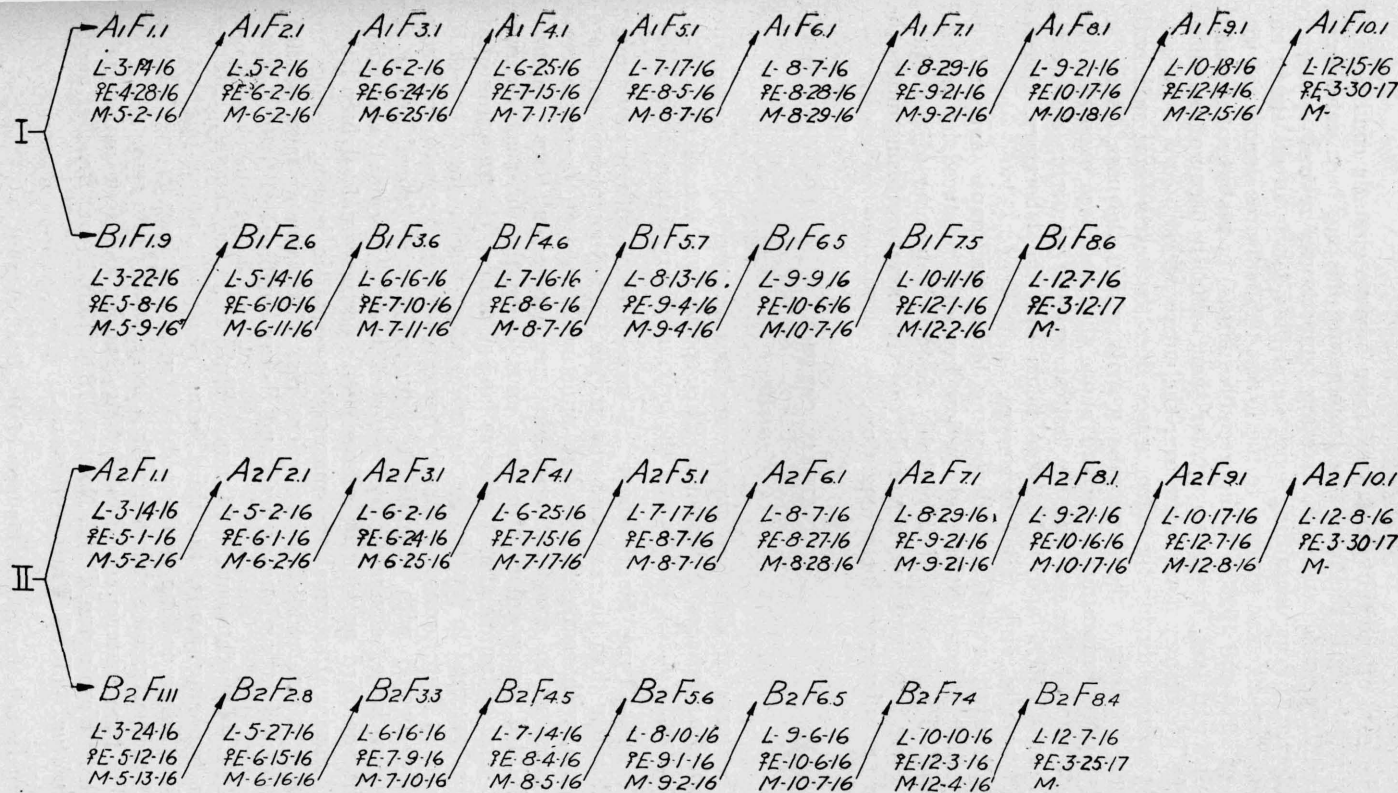


Figure 3. Generation Series Studies.

Mortality.

The rate of mortality resulting from adverse climatic conditions, is very low. While the fatal low temperature has not been determined, the adult weevils exposed to freezing temperatures revived apparently unaffected. Peas containing eggs, developing larvae in all stages and pupae were likewise exposed to the lowest temperatures during the winters of 1916 and 1917. No appreciable increase in the rate of mortality resulted; in fact, it was no greater than normally occurred, as shown in the life history notes taken over the entire period.

At no time during the warm season does the heat become sufficiently intense to destroy the developing weevils within the peas. Many infested peas containing larvae and pupae that had been exposed to the direct rays of the sun and the hottest weather occurring during the summer of 1916 and 1917, were taken into the laboratory, and the adult weevils rarely failed to emerge.

Both adult weevils and developing larvae and pupae appear to be very little affected by a high or low humidity produced by artificial means. Excessive rainfall probably destroys a number of the adults, but there is no increase in mortality of the immature forms unless the peas are submerged for a long time.

NATURAL CONTROL.

Parasites.

The larva of *Bruchus quadrimaculatus* is attacked by a parasite, *Bruchobius laticeps* Ashmead.*. This species was described in Proc. Nat. Mus., Vol. 45, p. 250, and the original description is given below:

Female.—Type, length about 2.5 mm. Green, with brassy tinges; head wider than thorax, head and thorax, including pleurae and propodeum, with coarse thimble-like punctures, those on the mesonotum so coarse as to somewhat resemble irregular reticulations; antennae 13-jointed, honey color, with three ring joints, the third subquadrate; first joint of funicle almost twice as long as pedicel, the following joints almost subequal in length, the second joint of funicle about two-thirds as long as first; pronotum sharply truncate anteriorly; propodeum completely covered with thimble-like punctures, with lateral folds, the spiracles large, elongate-ovate, situated basad; marginal vein short, about one-third as long as submarginal; postmarginal slightly longer than marginal; stigmal and marginal subequal in length; femora and bases of tibiae reddish-honey color; rest of tibiae and tarsi whitish; abdomen about as long as head and thorax combined.

Male.—Length about 1.75 mm. Similar to the female; antennae with two ring joints, the third being elongated into a joint of the funicle, being as long as the pedicel, but not as long as the following joint of the funicle; abdomen with a large basal white spot.

The type material consists of four females and four males and is labeled "Washington, D. C., Nov. 12, 1896"; bred from *Bruchus quadrimaculatus*. (F. C. Pratt, collector.)

*Determined through the kindness of Dr. L. O. Howard.

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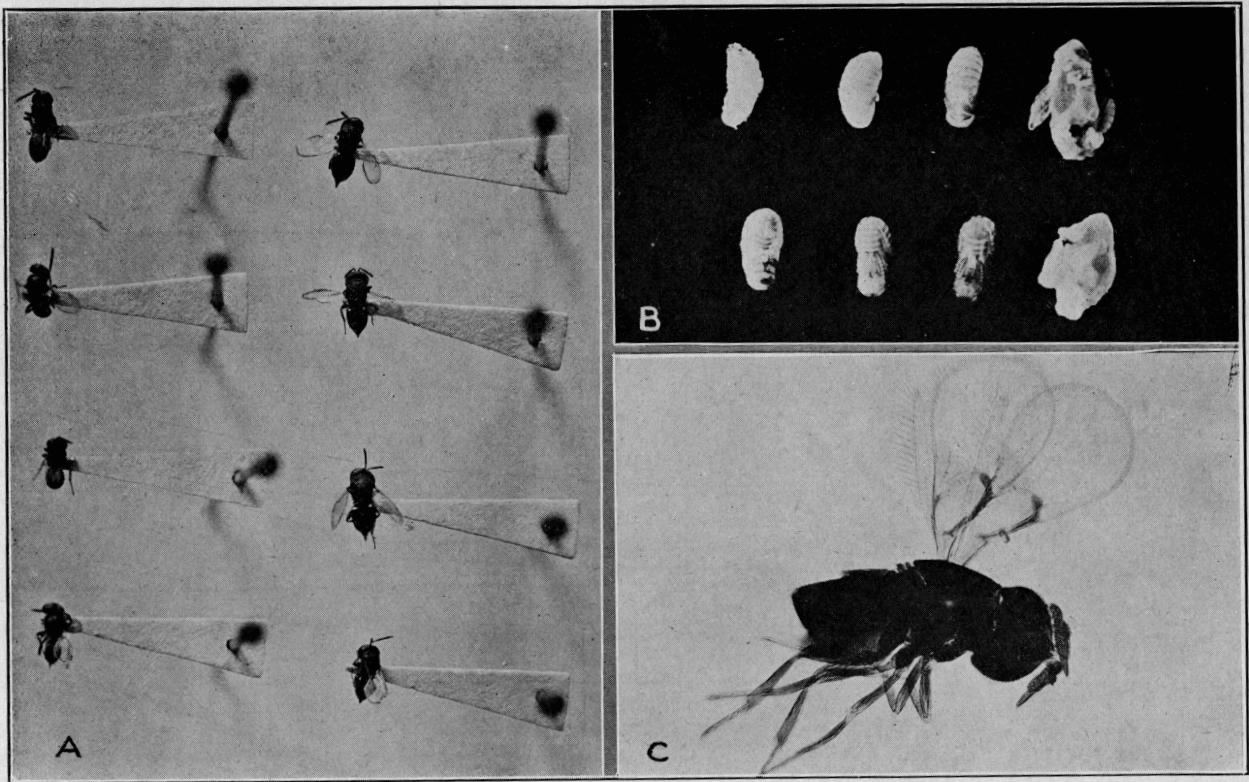


Plate V. Parasites: adult larval parasite (a), larval and pupal stage (b), and adult egg parasite (c).

This parasite was first observed in the laboratory in August, 1916, in some cowpeas heavily infested with the weevil, and collected during July in the field at College Station, Texas. This parasite is shown in Plate V (a); the males are on the right and the females on the left of the photograph. The parasites were numerous and examination at that time showed at least 10 per cent. of the weevil larvae parasitized. Efforts to collect adult parasites in the field, however, resulted in the taking of only a few specimens. This parasite was also observed in infested cowpeas collected at Lubbock, Texas. During the summer of 1917 no parasites were found at College Station, Texas, although careful search was made for them. As efforts to induce oviposition by adult parasites proved unsuccessful, complete life history notes were not made. The eggs are doubtless placed on the weevil larva or in the larval burrow by means of a strong ovipositor with which the female is equipped. The egg stage was not observed.

After hatching, the tiny parasite larva attaches itself to the weevil larva and feeds externally. This is shown in Plate V (b) at the left side of the photograph. The parasite increases in size very rapidly and the host is usually not killed until it is nearly developed. By the time it is fully matured and ready for pupation the entire body of the host, except the head, has usually been consumed. Pupation takes place within the larval burrow of the weevil. The adult parasite emerges through a round hole similar to the weevil's exit, except it is much smaller. One parasite larva was observed to pupate September 23, 1916, and emerged as an adult October 1, 1916. The importance of *Bruchobius laticeps* Ashmead, as a natural control, is questionable. Though it undoubtedly destroys many weevil larvae, it does not appear to be abundant enough to produce an appreciable reduction in the number of weevils in this locality.

Egg Parasite.

The most important natural enemy of *Bruchus quadrimaculatus* is *Uscana semifumipennis* Girault,* a minute egg parasite which destroys the weevil eggs in great numbers. The adult parasite is shown enlarged in Plate V (c). The description of this species is given as it originally appeared in Trans. Amer. Ent. Soc., Vol. 37, pp. 23-24.

Uscana semifumipennis Girault.

Female.—Length, 0.80 mm. Moderately small, visible easily to the naked eye, but not casually even to the trained eye. General color tawny yellow, the abdomen usually deep black, in some specimens varying to dusky yellowish, the legs dusky excepting the pallid yellow knees, the tarsi (excepting the very slightly dusky terminal joint) and the cephalic and intermediate tibiae; antennae dusky to pallid yellow; eyes bright pinkish red; wings hyaline excepting the proximal halves of the fore wings, that portion proximad of the discal end of the venation, which is distinctly though not pronouncedly, fumated; the fumated area extends to a point opposite the end of the stigmal knob and its

*Determined through the kindness of Dr. L. O. Howard.

distal bounding line is nearly straight. Venation dusky. Body sculpture inconspicuous. Colors of legs somewhat variable. Tegulae dusky yellowish.

Fore wings with short marginal fringes along the cephalic margin, which gradually slightly lengthen along the apex, becoming twice longer at the disto-caudal apex of the wing, then gradually shortening again caudad and proximad; the longest cilia are not more than an eighth of the greatest wing width, which is near to, but not at the apex. The discal ciliation is short and moderately close, arranged in about from 16 to 20 lines across the widest portion of the wing. Marginal vein broad, straight, twice the length of the stigmal and nearly a half shorter than the submarginal vein, truncate distad; submarginal vein narrow, straight, but distad where it curves cephalo-distad to join the marginal, abruptly broader but not quite so broad as the latter. Caudal wings normal, the blade moderate in width, acuminate, the marginal cilia normal, those of the caudal margin as usual much longer, here gradually lengthening distad where they are distinctly longer than the greatest wing width, those of the cephalic margin usual, short; discal ciliation of the caudal wings consisting of three longitudinal lines of cilia, the cephalic two paired, slightly converging distad, originating at the apex of the marginal vein or nearly, the caudal line slightly fainter, originating farther proximad, gradually converging on the others toward the apex, nearer to, but not on, the caudal wing margin.

Antennae short and moderately stout, the club forming half of their length, the scape short, not as long as the club, cylindrical, curved, the pedicel shorter than the scape, not much longer than wide, conic to subquadrate, subequal in length to the proximal club joint; ring joint minute, flat, abruptly narrower than the pedicel or club; the three club joints distinct, the intermediate joint longest and widest (base), the apical joint small, conic, acute; the club itself pointed conic-ovate in shape. Pubescence of the antennae sparse, consisting of scattered long hairs, mostly on the club.

From 30 specimens, $\frac{3}{8}$ inch objective, 1 inch optic, Bausch and Lomb.

Male.—The same; the antennal club shorter, not as pointed.

From 13 specimens, $\frac{3}{8}$ inch objective, 1 inch optic, Bausch and Lomb.

Described from 13 males and 30 females mounted in balsam and forming a series of slides in the collections of the Bureau of Entomology, U. S. Department of Agriculture, kindly loaned for study by Dr. L. O. Howard and labelled as follows: "Bred from Bean-weevil parasite material from Beeville, Texas.—Honolulu, Hawaii, October 30, 1909, D. T. Fulloway." Habitat.—United States: Beeville, Texas.

This tiny insect, which is scarcely visible to the unaided eye, deposits its egg inside the weevil egg. The parasite larva feeds upon the contents of the weevil egg, which furnishes a sufficient food supply to reach maturity. The adult parasite emerges from the host egg through a minute round aperture, usually at the broad end of the egg.

The parasitized weevil egg first appears reddish yellow and gradually turning darker as the parasite develops, finally takes on a shiny black color. The eggs on both the pods and seed are attacked, and where they are grouped together it is unusual to find normal eggs on the same seed with those that have been parasitized. One seed with

twelve and another with eight parasitized eggs were collected, the numbers ranging from three to five were much more common.

This parasite was first observed in the field in October, 1916, and at that time appeared to be very abundant. Out of a total of 1621 weevil eggs examined during October, 1916, 1098, or over 67 per cent., were parasitized, and 554 were normal.

Without question, this species, the importance of which is indicated by the above figures, is the most effective factor in reducing the natural increase of the pea weevil in this locality.

REMEDIAL MEASURES.

Harvesting.

Proper harvesting of the cowpea crop will result in a reduction of from 50 to 90 per cent. of the infestation of weevils. Where the crop is permitted to remain in the field after it is fully matured, the tips of the dry pods usually part sufficiently to expose the first two or three seeds to weevil attack. Examination of a field of cowpeas in this condition in October, 1916, showed that over 90 per cent. of the peas thus exposed were infested by the weevil. The adult prefers to confine its attack to the exposed seed; obviously, if the crop is harvested at the proper time, that is, before the pods open and the seeds are exposed, the infestation can be materially checked. This may necessitate several pickings and thus increase the cost of harvesting, but the reduction in injury to the crop will more than justify the additional expenditure of time and labor.

Experiments conducted with the proper harvesting of cowpeas in accordance with the recommendations given above, showed that 100 per cent. weevil free seed could be obtained. Where the operations are carried on in a commercial way, however, an infestation of from 2 to 5 per cent. may result from eggs that are deposited on the pods. This cannot be eliminated because this insect cannot be combated by any direct control measures in the field. It is therefore important to remember that proper harvesting is not recommended as a complete control measure for the weevil. In this connection, the crop should be treated with either carbon bisulphide or heat as soon as possible after it is harvested in order to destroy any weevils not eliminated by precautions taken in harvesting the crop.

Storage.

No matter how efficiently the preventive measures have been carried out, complete success depends upon the proper storage, since cowpeas are always subject to reinfestation with the weevil. The popular belief that "processed" (heated or fumigated) cowpeas will not become reinfested, is erroneous. The cowpea weevil has been repeatedly bred in hard, dry, processed cowpeas, and apparently experienced no difficulty, except that the period of development was greatly prolonged. Regardless of the method employed in destroying the weevils in infested seed, it should always be stored in a weevil-proof bin or other containers. Seed in sacks is subject to infestation and should never be kept in this condition exposed to the weevil. This was determined in an ex-

perimental way by exposing uninfested peas in a canvas sack to weevils. Oviposition took place readily on the outside of the sack, and the larvae succeeded in working through and infesting the seed within. Weevil-proof bins constructed of tightly-fitted matched lumber, or tight-fitted metal containers have proved to be the most satisfactory method of storing seed. The cost of such equipment varies with the size and quality. The prevention of weevil injury makes it an economical investment.

Fumigation With Carbon Bisulphide.

Carbon bisulphide, which has been extensively used against insects which infest stored seed, is, when properly used, one of the cheapest and most effective methods of controlling the cowpea weevil. Chemically pure liquid carbon bisulphide is colorless and completely volatile, though the usual commercial product is yellowish in color because of the presence of excess sulphur. It has a strong disagreeable odor and evaporates rapidly on being exposed. The fumes of carbon bisulphide are over twice as heavy as air and therefore will diffuse rapidly downward. This is an important point to remember in the application of this material. It should always be exposed above the seed to be treated. The rapidity of volatilization depends upon the surface of liquid exposed to the air. Since rapid evaporation is desirable because the material is an effective insecticide only in the gas form, the liquid should always be exposed in large shallow containers to expedite evaporation. The fumes have such penetrative power that it is possible to use this material for treating seed in large quantities. Since it is confined space and not the contents that determines the dosage, the seed to be treated should be placed in as small a space as possible.

Temperature has an important influence upon the effectiveness of carbon bisulphide fumes, and unless the fumigation is conducted under favorable conditions with respect to this factor, the results obtained will not be satisfactory. The effectiveness of the fumes is materially reduced at temperatures below 60 degrees F. Temperature governs the amount of carbon bisulphide gas that is necessary to saturate the air. The higher the temperature, the more carbon bisulphide is necessary to saturate it, within certain limits. Evaporation of the liquid takes place more slowly in lower temperatures, and more time will therefore be required for the total dosage to become effective. It has been found that active insects are more susceptible than inactive ones to the effects of the gas, and insect activity varies directly with the increase of temperature within certain limits.

Though the fumes from carbon bisulphide are highly inflammable, and under certain conditions explosive, there is practically no danger involved, if the proper precautions are taken. There must be no fire or source of fire near, while the fumigation is being done. If the vapor is sufficiently dense, an explosion might result from even a small source of fire like a lighted cigar, or a spark from an electric light or fan. In a temperature above 297 degrees F., the fumes may ignite without the presence of flame. The extensive discussion of the danger of the use of carbon bisulphide as a fumigant has resulted in a popular opinion that many accidents occur by its use. When the danger in-

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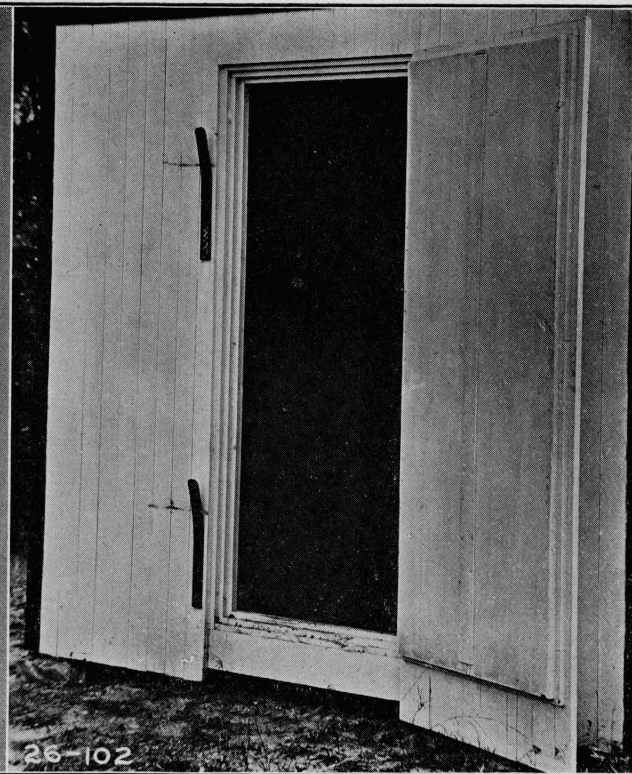
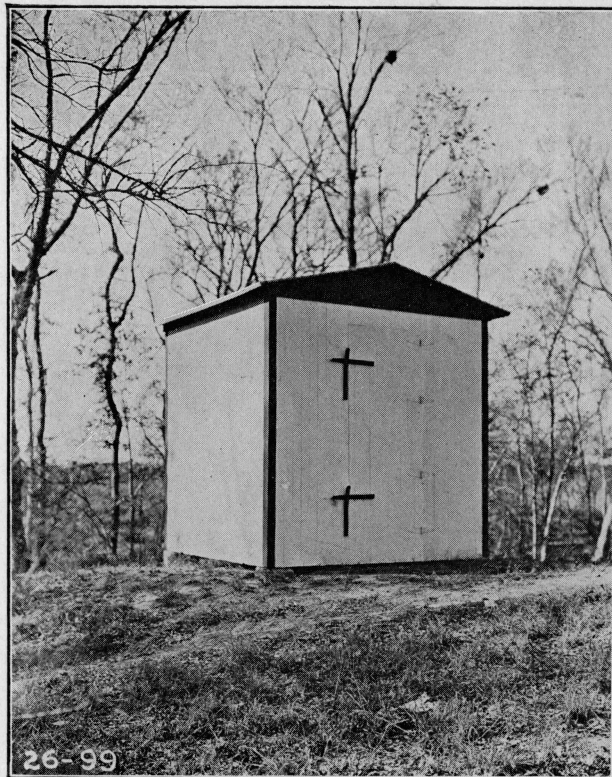


Plate VI. Fumigator: left, general view; right, detail of door construction.

volved is understood, however, and the proper precautions in its use are observed, the likelihood of any accident is removed.

The experiments giving the best results were conducted in a mean average temperature ranging from 75 to 81 degrees F. This work was done in the fumigation house shown in Plate VI. The inside measurements of this building are 8 feet by 8 feet by 8 feet, giving it a contents of 512 cubic feet. It is tightly constructed throughout with matched lumber. The sides and ceiling within are lined with beaver board. The floor is constructed with a double layer of matched lumber, and covered with a heavy coat of paint to make it impervious. The total cost of material and construction was \$70.00.

Table 24.—Fumigation with Carbon Bisulphide.

Charge 1,000 Cu.Ft.	Exposure	Stage	Numbers	Temperature			Humidity			Emerged	Killed
				Max.	Min.	Mean	Max.	Min.	Mean		
9 pounds.....	24 hours.....	E	43	88	63	75.5	58	44	51.0	0	100
9 pounds.....	24 hours.....	L	474	88	63	75.5	58	44	51.0	0	100
9 pounds.....	24 hours.....	P	134	88	63	75.5	58	44	51.0	0	100
Check.....	Untreated.....	E	28	88	63	75.5	58	44	51.0	92.5	.....
Check.....	Untreated.....	L	130	88	63	75.5	58	44	51.0	100.0	.....
Check.....	Untreated.....	P	60	88	63	75.5	58	44	51.0	100.0	.....
6 pounds.....	24 hours.....	E	133	94	63	78.5	54	13	33.5	0	100
6 pounds.....	24 hours.....	L	246	94	63	78.5	54	13	33.5	0	100
6 pounds.....	24 hours.....	P	67	94	63	78.5	54	13	33.5	0	100
Check.....	Untreated.....	E	38	94	63	78.5	54	13	33.5	92.1	.....
Check.....	Untreated.....	L	116	94	63	78.5	54	13	33.5	100	.....
Check.....	Untreated.....	P	106	94	63	78.5	54	13	33.5	100	.....
4 pounds.....	24 hours.....	E	44	99	63	81	58	36	47	0	100
4 pounds.....	24 hours.....	L	470	99	63	81	58	36	47	0	100
4 pounds.....	24 hours.....	P	267	99	63	81	58	36	47	0	100
Check.....	Untreated.....	E	48	99	63	81	58	36	47	89.8	.....
Check.....	Untreated.....	L	50	99	63	81	58	36	47	98.0	.....
Check.....	Untreated.....	P	47	99	63	81	58	36	47	100.0	.....

The advantages of fumigating in a building of this type are many, and few of the most important ones may be mentioned here. First: it is cheaper because a large quantity of seed may be treated in a single operation with the same dosage of carbon bisulphide. Second: the building can be utilized for the storage of treated seed; it is particularly adaptable for this purpose because it is weevil-proof and treated seed will not become reinfested. Third: the results obtained are more satisfactory because leakage is reduced to a minimum. Temperature remains nearer the normal, which is desirable to get the best penetration of the fumes.

The results that were obtained from experiments conducted in this fumigator are given in detail in Table 24. The different stages in which the weevil was exposed are represented by E for eggs, L for larvae, and P for pupae.

The temperature and relative humidity were taken by a recording hygro-thermograph placed on the floor beside the exposed cowpeas. It should always be remembered that the treated cowpeas are subject to reinfestation if they are not stored properly in weevil-proof containers or bins.

Heat.

It is a long-established fact that heat is a satisfactory insecticide where it can be employed economically. It is particularly applicable to species of insects attacking stored grains which are not seriously affected by temperatures sufficiently high so as to destroy the insects and not injure the texture or the germination of the seed.

Table 25.—Effect of Heat on Egg Stage.

Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed	Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed
120	5	1	85	15	120	10	1	0	100
120	5	2	80	20	120	10	2	65	35
120	5	3	90	10	120	10	3	75	25
120	5	4	85	15	120	10	4	60	40
120	5	5	85	15	120	10	5	75	25
126	5	1	75	25	126	10	1	0	100
126	5	2	95	5	126	10	2	40	60
126	5	3	60	40	126	10	3	85	15
126	5	4	55	45	126	10	4	60	40
126	5	5	60	40	126	10	5	40	60
130	5	1	80	20	130	10	1	10	90
130	5	2	30	70	130	10	2	45	55
130	5	3	90	10	130	10	3	65	35
130	5	4	70	30	130	10	4	45	55
130	5	5	85	15	130	10	5	35	65
136	5	1	25	75	136	10	1	0	100
136	5	2	25	75	136	10	2	0	100
136	5	3	0	100	136	10	3	5	95
136	5	4	55	45	136	10	4	20	80
136	5	5	60	40	136	10	5	0	100
140	5	1	0	100	140	10	1	0	100
140	5	2	0	100	140	10	2	0	100
140	5	3	5	95	140	10	3	0	100
140	5	4	0	100	140	10	4	0	100
140	5	5	5	95	140	10	5	0	100
146	5	1	0	100	146	10	1	0	100
146	5	2	0	100	146	10	2	0	100
146	5	3	0	100	146	10	3	0	100
146	5	4	0	100	146	10	4	0	100
146	5	5	0	100	146	10	5	0	100
150	5	1	0	100	150	10	1	0	100
150	5	2	0	100	150	10	2	0	100
150	5	3	0	100	150	10	3	0	100
150	5	4	0	100	150	10	4	0	100
150	5	5	0	100	150	10	5	0	100

Effect of Heat on Larval Stage.

Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed	Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed
120	5	1	85	15	120	10	1	90	10
120	5	2	90	10	120	10	2	85	15
120	5	3	90	10	120	10	3	90	10
120	5	4	70	30	120	10	4	80	20
120	5	5	100	0	120	10	5	100	0
120	5	6	95	5	120	10	6	75	25
120	5	7	76	24	120	10	7	95	5
120	5	8	75	25	120	10	8	85	15
120	5	9	95	5	120	10	9	90	10
120	5	10	85	15	120	10	10	80	20
120	5	over 10	85	15	120	10	over 10	90	10
126	5	1	85	15	126	10	1	15	85
126	5	2	70	30	126	10	2	0	100
126	5	3	80	20	126	10	3	15	85
126	5	4	80	20	126	10	4	80	20
126	5	5	80	20	126	10	5	55	45
126	5	6	55	45	126	10	6	20	80
126	5	7	100	0	126	10	7	60	40
126	5	8	95	5	126	10	8	91	9
126	5	9	75	25	126	10	9	85	15
126	5	10	95	5	126	10	10	95	5

Effect of Heat on Larval Stage—Continued.

Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed	Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed
126	5	over 10	75	25	126	10	over 10	85	15
130	5	1	80	20	130	10	1	0	100
130	5	2	85	15	130	10	2	25	75
130	5	3	75	25	130	10	3	0	100
130	5	4	80	20	130	10	4	80	20
130	5	5	100	0	130	10	5	10	90
130	5	6	85	15	130	10	6	0	100
130	5	7	85	15	130	10	7	10	90
130	5	8	81	19	130	10	8	15	85
130	5	9	85	15	130	10	9	10	90
130	5	10	80	20	130	10	10	70	30
130	5	over 10	100	0	130	10	over 10	100	0
136	5	1	30	70	136	10	1	0	100
136	5	2	20	80	136	10	2	0	100
136	5	3	0	100	136	10	3	0	100
136	5	4	25	75	136	10	4	0	100
136	5	5	50	50	136	10	5	0	100
136	5	6	67	33	136	10	6	0	100
136	5	7	70	30	136	10	7	0	100
136	5	8	50	50	136	10	8	0	100
136	5	9	95	5	136	10	9	0	100
136	5	10	100	0	136	10	10	30	70
136	5	over 10	100	0	136	10	over 10	75	25
140	5	1	0	100	140	10	1	0	100
140	5	2	0	100	140	10	2	0	100
140	5	3	5	95	140	10	3	0	100
140	5	4	0	100	140	10	4	0	100
140	5	5	0	100	140	10	5	0	100
140	5	6	0	100	140	10	6	0	100
140	5	7	15	85	140	10	7	0	100
140	5	8	0	100	140	10	8	0	100
140	5	9	10	90	140	10	9	0	100
140	5	10	0	100	140	10	10	0	100
140	5	over 10	0	100	140	10	over 10	0	100
146	5	1	0	100	146	10	1	0	100
146	5	2	0	100	146	10	2	0	100
146	5	3	0	100	146	10	3	0	100
146	5	4	0	100	146	10	4	0	100
146	5	5	0	100	146	10	5	0	100
146	5	6	5	95	146	10	6	0	100
146	5	7	0	100	146	10	7	0	100
146	5	8	0	100	146	10	8	0	100
146	5	9	0	100	146	10	9	0	100
146	5	10	0	100	146	10	10	0	100
146	5	over 10	0	100	146	10	over 10	0	100
150	5	1	0	100	150	10	1	0	100
150	5	2	0	100	150	10	2	0	100
150	5	3	0	100	150	10	3	0	100
150	5	4	0	100	150	10	4	0	100
150	5	5	0	100	150	10	5	0	100
150	5	6	0	100	150	10	6	0	100
150	5	7	0	100	150	10	7	0	100
150	5	8	0	100	150	10	8	0	100
150	5	9	0	100	150	10	9	0	100
150	5	10	0	100	150	10	10	0	100
150	5	over 10	0	100	150	10	over 10	0	100

Effect of Heat on Pupal Stage.

Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed	Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed
120	5	1	85	15	120	10	1	90	10
120	5	2	100	0	120	10	2	85	15
120	5	3	95	5	120	10	3	90	10
120	5	4	100	0	120	10	4	100	0
120	5	5	90	10	120	10	5	100	0
120	5	over 5	100	0	120	10	over 5	85	15
126	5	1	95	5	126	10	1	95	5
126	5	2	90	10	126	10	2	90	10
126	5	3	95	5	126	10	3	86	14
126	5	4	75	25	126	10	4	85	15
126	5	5	90	10	126	10	5	90	10
126	5	over 5	85	15	126	10	over 5	80	20

Effect of Heat on Pupal Stage—Continued.

Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed	Temp. (degrees)	Exposure (min.)	Age (days)	Per Cent Emerg'd	Per Cent Killed
130	5	1	100	0	130	10	1	90	10
130	5	2	90	10	130	10	2	35	65
130	5	3	90	10	130	10	3	25	75
130	5	4	90	10	130	10	4	80	20
130	5	5	85	15	130	10	5	85	15
130	5	over 5	95	5	130	10	over 5	95	5
136	5	1	85	15	136	10	1	10	90
136	5	2	80	20	136	10	2	35	65
136	5	3	100	0	136	10	3	0	100
136	5	4	100	0	136	10	4	22	78
136	5	5	85	15	136	10	5	85	15
136	5	over 5	55	45	136	10	over 5	5	95
140	5	1	0	100	140	10	1	0	100
140	5	2	60	40	140	10	2	0	100
140	5	3	35	65	140	10	3	0	100
140	5	4	50	50	140	10	4	0	100
140	5	5	0	100	140	10	5	0	100
140	5	over 5	0	100	140	10	over 5	0	100
146	5	1	0	100	146	10	1	0	100
146	5	2	5	95	146	10	2	0	100
146	5	3	0	100	146	10	3	0	100
146	5	4	0	100	146	10	4	0	100
146	5	5	0	100	146	10	5	0	100
146	5	over 5	0	100	146	10	over 5	0	100
150	5	1	0	100	150	10	1	0	100
150	5	2	0	100	150	10	2	0	100
150	5	3	0	100	150	10	3	0	100
150	5	4	0	100	150	10	4	0	100
150	5	5	0	100	150	10	5	0	100
150	5	over 5	0	100	150	10	over 5	0	100

A series of experiments to determine the effect of heat on the various stages of the cowpea weevil were conducted and the results are given in detail in Table 25. All this work was done under laboratory conditions and every possible precaution was taken to obtain results uninfluenced by other factors. A double-lined, two-hole Boss oven with a tight-fitting base to prevent undue circulation of air, was used. The bottom of the oven was lined with a sheet of asbestos to insure a more uniform temperature from the source of heat applied beneath it. With this arrangement the temperature within the oven could be held practically constant, at most varying not more than one degree. Only dry heat was employed, the source being a gas flame. The temperatures were recorded from a thermometer suspended on a level with the infested cowpeas exposed in thin wire baskets.

Cowpeas containing a normal moisture content were used in all cases. It will be noted that only short time exposures were used with a large variation in temperature. This was done for two reasons: first, it was found by preliminary experiments, that a sufficiently high temperature and short exposure could be employed to kill the weevil without seriously affecting the germination of the seed; second, if heat is to be employed for weevil control in a commercial way, it appears very desirable to turn over the produce in as short time as possible.

In order to determine the exact temperature which will destroy all stages of the weevil, the eggs, larvae, and pupae at a difference in age of 24 hours, were exposed. It was found that greater mortality occurred in the younger material, the resistance to withstand heat increasing with age. Referring to Table 25, it will be noted that no temperature for either a five or ten minute exposure produced satisfactory results under 140 degrees F. At a temperature of 140 degrees F. for ten

minutes exposure the point at which nearly all weevil life is destroyed is being approached; in fact, no emergence took place in any stage at this temperature and exposure. However, a temperature of 146 degrees F. for five minutes' exposure did not destroy all the developing weevils, but when the exposure was increased to ten minutes all the weevils in each stage were destroyed. It should be remembered that since these experiments were conducted under most favorable conditions, which might not be readily duplicated in a practical way, due allowance must be made for variations in results obtained. The germination of the seed is not affected by this temperature and it is advisable to increase the exposure to twenty or thirty minutes in all cases where the temperature cannot be held constant and large quantities of cowpeas are being treated.

Effect of Heat on Germination.

Uninfested cowpeas of the same lot used in the experiments on heat control, were exposed in a similar manner for five and ten minutes' exposures to temperatures ranging from 120 to 200 degrees F. In order to obtain complete information relative to the effect of heat on the seed, they were planted in the field and notes were taken on the character of plants produced, while the per cent. of germination was obtained. The results are given in Table 26. It will be noted that the per cent. of germination did not seem to be seriously affected at any temperature under 190 degrees F., though weak plants occurred consistently from exposure to a temperature of 170 degrees F. Everything below 150 degrees F. with four exceptions produced normal and vigorous plants.

Table 26.—Effect of Heat on Germination.

Temperature, Degrees	Exposure, Min.	Number Planted	Number Germ.	Strong	Weak	Per Cent Germ.
120.....	5	20	20	20	0	100
120.....	10	20	19	19	0	95
126.....	5	20	18	18	0	90
126.....	10	20	20	20	0	100
130.....	5	20	20	20	0	100
130.....	10	20	19	19	1	100
136.....	5	20	18	18	0	90
136.....	10	20	19	18	1	95
140.....	5	20	20	20	0	100
140.....	10	20	18	17	1	90
146.....	5	20	19	19	1	95
146.....	10	20	20	20	0	100
150.....	5	20	19	19	0	95
150.....	10	20	20	20	0	100
156.....	5	20	20	18	2	100
156.....	10	20	20	19	1	100
160.....	5	20	20	20	0	100
160.....	10	20	19	19	0	95
166.....	5	20	19	18	1	95
166.....	10	20	18	18	0	90
170.....	5	20	20	17	3	100
170.....	10	20	17	15	2	85
180.....	5	20	19	17	2	95
180.....	10	20	18	16	2	90
186.....	5	20	19	17	2	95
186.....	10	20	18	16	2	90
190.....	5	20	18	15	3	90
190.....	10	20	17	15	2	85
196.....	5	20	19	16	3	95
196.....	10	20	16	14	2	80
200.....	5	20	13	8	5	65
200.....	10	20	13	8	5	65

SUMMARY.

The most common species of weevil infesting cowpeas in Texas is *Bruchus quadrimaculatus* Fabr. It is found in all localities of this State where cowpeas are grown. The climatic conditions of Texas are especially favorable for the development of this insect. All varieties of cowpeas grown in this locality are subject to attack, and no preference is shown by the weevil to any particular variety. The annual loss in Texas to the cowpea crop, resulting from this insect, is very great.

Under favorable conditions the life cycle from egg deposition to emergence of the adult may be completed in less than three weeks. The weevil is very prolific. An average of 106 eggs have been produced by females during the warm season. Temperature has a positive influence on the rate of oviposition and the length of the various stages of the weevil. In stored seed breeding is practically continuous throughout the year. Most weevils undoubtedly hibernate in stored seed. Nine generations of weevils occur in a year at College Station.

Three natural enemies of the immature stages of the weevil were found: a predacious mite, a chalcid, and an egg parasite. The weevil, however, is not sufficiently checked by its natural enemies, and remedial and artificial control measures must be employed. Proper harvesting will greatly reduce the initial infestation of the field. To prevent seed from becoming reinfested it must be stored in tight bins or containers. The weevil can be destroyed in any stage by heating the infested seed to a temperature of 146 degrees F. for an exposure of fifteen minutes, which will not affect the germination of the seed. Fumigation with carbon bisulphide is an effective means of destroying the cowpea weevil and, used at the rate of four pounds for a thousand cubic feet of space with a 24-hour exposure, it will kill the insect in all of its stages. Fumigated and "processed" or heated seed is always subject to reinfestation by the weevil.

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