NYSIUS ERICAE, THE FALSE CHINCH BUG

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INTRODUCTION

The false chinch bug, *Nysius ericae* Schilling (*angustatus* Uhler), has been recognized for many years as a serious pest, especially in the semi-arid regions of the United States, where it causes great damage to sugar beets and cruciferous garden crops, settling upon them suddenly in enormous numbers and sucking so much sap from them that the plants wilt beyond recovery in one or two days.

When the writer was first stationed at Garden City, Kansas, in March, 1913, he could get no information regarding the life history and habits of the insect on which to base control measures. Work was therefore begun to determine these points, and the following account is prepared from data collected during that and the three following years.[1] The closest field study of the insect was made during 1913 and 1914, and the rearing work was done during 1914 and 1916.

DESCRIPTION

THE ADULT

The female is about 4 mm. long by 1.5 mm. wide. The greatest width is through the posterior edge of the prothorax and base of the wings. From this point the body tapers rapidly forward with a slight curve. The eyes project prominently on the sides at the posterior margin of the head, and the antennæ arise between the eyes and the base of the beak. The abdomen is elongate, its sides almost parallel and its apex rounded. It is entirely covered by clear membranous wings which project a little at the anal extremity. The ovipositor arises on the ventral surface of the tip of the abdomen, and is carried folded in a groove below the posterior abdominal segiments, the basal portion extending forward and the distal backward just beneath.

The males are perceptibly smaller than the females, or about half the length and half the width of a grain of wheat. Their form is similar to that of the female, excepting the tip of the abdomen, which is more pointed and without the groove on the venter.

The newly matured adult is dull whitish, but in a short time this changes to dirty gray with dark or black spots. Old adults (Pl. 60) are nearly black, except the ventral portions of the posterior abdominal segments of the female, which are gray or light brown. The wings remain transparent. The antennæ are uniform brownish, the legs and tarsi light brown with black spots, and the claws black.

[1] During the summers of 1914, 1915, and 1916 the writer was assisted by Mr. F. M. Wadley. Besides rendering assistance on the entire project, he alone collected the data for the topics, "Rate of oviposition at various hours of the day" and "Seasonal variation in oviposition."

Schilling's original description, in Beiträge zur Entomologie, p. 86–87, Breslau, 1829, has been translated by Messrs. C. H. Popenoe and Gerson Garb as follows:

Heterogaster ericae. Grayish yellow; thoracic line transverse, hemelytra with discoidal punctures and posterior margin black. Membrane with smoky spots.

Lyg. thymi Fallen. Var. *a.*—Body smaller than in preceding; shape less narrow, lgt. 1¾ in., lt. ½ in. Head with black spots, median stripe pallescent. Antennæ dark, lighter at joints; thorax bears at the apex a line of black spots interrupted at the middle. The elytra cover the sides and apex of the abdomen; veins of hemelytra sprinkled with black punctures; membrane with indistinct smoky spots. Scutellum as in *thymi*. Abdomen beneath sprinkled with black, posteriorly with pale spots. Habitat on *Erica vulgaris* and allied plants.

FIG. 1.—*Nysius ericae:* Eggs, highly magnified.

THE EGG

The egg (fig. 1) is about 1.5 mm. long and 0.4 mm. wide, and tapers toward each end, one side being curved and the other nearly straight. It is of a translucent pinkish white color.

THE NYMPH

The body of the newly hatched nymph (Pl. 61, A) is about 0.7 mm. long by 0.3 mm. wide, and oval or pear-shaped, being widest behind the middle of the abdomen. Its color is translucent pinkish white, which on high magnification is seen to be due to irregular brownish opaque areas on an almost transparent background. The eyes are black and the segments of the antennæ shade almost to a flesh color at the distal ends. The dorsal portions of the fourth and fifth abdominal segments contain a large red mass which becomes indistinct after the first molt.

The nymphs become darker with age, but appear fresh and bright after each molt. After the first one (Pl. 61, B–E) there are dark areas on the sides of the thorax and anterior abdominal segments where the wing pads develop. These areas enlarge during the later instars and, with other sections of the body wall, become almost black.

The fifth instar (Pl. 61, E) is the pupa period. In it the insect is pear-shaped, and displays as much activity as is exhibited during earlier nymphal life.

LIFE HISTORY

OVIPOSITION

WHERE EGGS ARE PLACED.—The eggs are deposited in loose soil; among clods or rubbish; in composite flowers like the great-flowered gaillardia (*Gaillardia pulchella* Foug.); between the glumes in grasses like stink-grass or strong-scented love-grass (*Eragrostis major* Host.); and among the clustered parts of plants such as thyme-leaved spurge (*Chamaesyce serpyllifolia* Pers.), and carpet-weed (*Mollugo verticillata* L.); among the down from cottonwood (*Populus* spp.) wherever this down lodges in quantities; and in other similar places.

MANNER OF OVIPOSITION.—For egg-laying the female elevates the abdomen, straightens the ovipositor, and thrusts it almost vertically downward into the substance or among the parts chosen to receive the

eggs. Usually several trials are made before the female is satisfied and deposits the eggs, and sometimes the attempt is discontinued, to be resumed shortly afterwards.

Females have been observed to remain occupied at oviposition for as long as 9½ minutes, and as many as eight eggs have been found where a single female has been at work.

INCUBATION

Early in the incubation period a red spot appears near one end of the egg and at about the middle of the period two spots appear near the other end. The egg remains a translucent pink, and with proper magnification the developing nymph is plainly visible through the transparent shell.

NYMPHAL INSTARS

In conducting these experiments, after many unsuccessful attempts to rear the nymphs by ordinary laboratory methods, the newly-hatched nymphs were placed singly in bags of thin muslin or India linen which were slipped over the tips of growing plants and tied securely. This method proved more nearly successful than any other which was tried, though the handling necessary during examinations resulted in considerable loss through accidental injury to the nymphs or to their escape. At Garden City, Kans., in 1914, five individuals were held under close observation from hatching until death. At Wichita, Kans., in 1916, three individuals, one of which was kept until its death, were reared to maturity from eggs of known oviposition. The number which reached maturity, however, represents only about ½ of 1 per cent of the individuals used in the rearing experiments.

NUMBER AND LENGTH OF INSTARS

In Table I are given the number and length of instars obtained from five nymphs reared at Garden City in 1914.

TABLE I.—*Number and length of nymphal instars of Nysius ericae, Garden City, Kans., 1914*

Specimen No.	Number of days in each instar.						Length of nymphal life.	Sex.
	First.	Second.	Third.	Fourth.	Fifth.	Sixth.		
							Days.	
1	4	3	3	2	10	0	22	Male.
4	4	2	4	3	5	0	18	Do.
29	2	4	2	4	2	5	19	Female.
33	5	4	4	4	4	0	21	Male.
35	2	3	4	3	5	0	17	Do.

The only female reaching maturity (No. 29 in Table I) passed through six molts, aside from which nothing unusual was observed about her life cycle. There is slight chance for error, as the exuviæ in all cases were examined with a powerful magnifier.

Data were secured from other nymphs which remained under observation for only a portion of their life cycle, and during this period the average length of each instar was computed from these data on the basis of a much larger number. This is done in Table II which gives the average length of instars for the false chinch bug at Garden City.

TABLE II.—*Average length of nymphal instars of Nysius ericae, Garden City, Kans., 1914*

Instar.	First.	Second.	Third.	Fourth.	Fifth.
Number of nymphs	21	12	10	9	7
Days in instar (average)	4	3.75	3.2	3.1	6.3

Thus calculated, the length of the nymphal period is 20.35 days.

Data on the number and length of instars which were secured at Wichita during the rearing work of 1916 are presented in Table III.

TABLE III.—*Number and length of nymphal instars of Nysius ericae, Wichita, Kans., 1916*

Specimen No.	Number of days in each instar.					Sex.	Length of nymphal life.
	First.	Second.	Third.	Fourth.	Fifth.		
76	6	3	3	1	5	Female	18
149	7	7	3	5	15	Male	37
250	9	5	3	6	5	...do	28

Other data secured during 1916 permit averages to be presented for each instar with numbers as in Table IV, which gives the average length of instars for the false chinch bug at Wichita.

TABLE IV.—*Average length of nymphal instars of Nysius ericae, Wichita, Kans., 1916*

Instar.	First.	Second.	Third.	Fourth.	Fifth.
Number of nymphs	54	25	13	6	6
Days in instar (average)	5	3.76	3.6	4.5	3.83

This gives the length of the nymphal period as 20.69 days.

Tables I and III indicate great variation in the duration of the instars, both actually and relatively in proportion to the length of the entire nymphal period. The record of No. 29 in Table I indi-

cates a possible variation, also, in the number of instars. Further evidence of such variation was secured during 1916 from some males that apparently matured in 4 molts. Apparently 5 molts is normal; but the variation in the actual as well as the relative length of instars leads the writer to believe that a greater or a less number is not only possible but probable.

Only a portion of the process of molting has been observed—the completion of a transformation from pupa to adult. The pupa had assumed a position head downward on the underside of a leaf which was inclined at an angle of about 15°. The legs were extended well apart, and the old exuvium was holding securely. When discovered, the adult was about half disclosed, escaping through a longitudinal slit in the dorsal median line of the pupal skin. It wriggled out until only the tips of the wings and of the third pair of legs were holding, then rested two or three minutes. When activity was resumed, the legs were repeatedly touched to the leaf. To obtain a better view, the writer then attempted to move the potted plant, upon which the insect hastily secured a footing on the leaf and turned around beside the cast skin, moving with quick nervous starts, and assumed an attitude of alert expectancy, waving its antennæ excitedly. The wings were crumpled and folded, but quickly assumed the shape and position normally found in the adult.

Adult coloration developed in less than two hours.

LENGTH OF ADULT LIFE

The males reared in 1914 were held without mating until death. They lived, respectively, 33, 8, 11, and 18 days. The female was mated, producing 8 eggs and living 6 days. This gives an average adult life of 15.2 days. In 1916 only one reared adult, a male, was confined until death. It was kept unmated and lived 39 days after maturity.

Thirteen females, collected in 1913 and confined with males for eggs, lived an average of 12 days, ranging from 9 to 19. Ten collected males that were mated gave an average also of 12, varying from 9 to 18.

LENGTH OF LIFE CYCLE

At Garden City, during 1914, the average temperature being 79.78° F., the different stages from deposition of the egg to death of the resulting individual were determined as follows:

	Days.
Egg stage	4
Nymphal stage	20.35
Maturity to mating	3
Mating to oviposition	1
Beginning oviposition to death	12
Total	40.35

The period from beginning of oviposition to death, to which reference is made on page 575 under "Length of adult life," is the average of the 23 collected individuals. To give an average for the period, an insufficient number of specimens were reared and kept under observation after being mated.

REPRODUCTIVE HABITS

Newly matured females have never been observed to mate in less than three days. Eggs are not secured until one day later. Subsequent mating is frequent and promiscuous, though a female often rejects a male.

A study was made of the reproductive activities for one day, of the rate of oviposition at various hours of the day, and of the seasonal variation in oviposition.

Five pairs of *Nysius ericae* were collected and each pair was confined in a cotton-stoppered vial. They were watched continuously for eight hours, remaining in the vials during the succeeding night. Table V is a typical record. Observations began at 7.45 a. m.[1]

TABLE V.—*Twenty-four-hour record of the reproductive activities of Nysius ericae, pair 3*

Paired 9.43.	Paired 11.57.	Paired 1.15.
Parted 9.46.	Parted 11.59½.	Parted 1.17½.
Paired 10.21.	Oviposited 12.45 to 12.59 (4 eggs).	Paired 1.27.
Parted 10.25.	Paired 1.02.	Parted 1.29.
Paired 10.56½.	Parted 1.07.	Paired 1.33.
Parted 11.01.	Paired 1.09½.	Parted 1.35.
Oviposited 11.22 to 11.24½ (8 eggs).	Parted 1.10.	Paired 3.35.
		Parted 3.37.

When examined the next morning at 7.45, both insects were living, but no more eggs had been deposited.

To ascertain the rate of oviposition at various hours of the day, several pairs were confined and the eggs removed daily at 8 a. m., 1 p. m., and 5 p. m. The experiment continued from June 6 to August 5, the pairs being replaced as they died, and by the latter date a total of 463 eggs had been secured. Of this number 239 were secured at 8 a. m., 145 at 1 p. m., and 79 at 5 p. m., or in about the ratio of 3 : 2 : 1. As nearly as can be determined, feeding and reproductive activity cease during darkness. This indicates that as many eggs are deposited during the late evening and early morning as are deposited from 8 a. m. to 5 p. m., and that twice as many eggs are deposited from 8 a. m. to 1 p. m. as from 1 p. m. to 5 p. m.

This decrease in reproductive activity during the afternoon has been observed under field conditions, the insects feeding less and seeking shade through the hot part of the afternoon.

[1] References to clock time refer to standard time.

To secure data on the seasonal variation in oviposition, females were collected and confined with males, and a record kept of the egg production and of the length of life of each female. The experiment was begun on May 6 and continued until September 18. Fifty-four females collected during May deposited 260 eggs in 295 days of life; 48 females collected during June deposited 231 eggs in 166 days of life; 39 females collected during July deposited 28 eggs in 216 days of life; 10 females collected during August deposited 17 eggs in 55 days of life, and 21 females collected during September deposited 113 eggs in 119 days of life. This is at the rate during May of 1 egg per female in 1.13 days; during June, 1 egg per female in 0.718 days; during July, 1 egg per female in 7.86 days; during August, 1 egg per female in 3.235 days; and during September, 1 egg per female in 1.05 days.

These figures coincide with the reproductive activity of the species as observed in the field. During May and June and again during September and October the females mate and oviposit frequently. Beginning in July and continuing into August they are much less prolific, it being sometimes difficult to secure sufficient eggs for rearing experiments. This decreased activity is exhibited only by the adults, there being no lengthening of the incubation period or nymphal instars.

EFFECT OF TEMPERATURE ON DEVELOPMENT

With an average temperature of 79.78° F. at Garden City, Kans., eggs hatched in about 4 days, and the average nymphal period (calculated from the averages of the largest number available in each instar) is 20.35 days. The average time, therefore, from oviposition to maturity is 24.35 days.

With an average temperature of 74.75° at Wichita, eggs hatched in 3.5 days, and the average nymphal period was 20.69 days. This gives the time from oviposition to maturity as 24.19 days.

Of 6 eggs deposited October 16 and 17, 1914, two hatched November 25, one November 28, and one November 30, making the shortest possible incubation period 39 days and the longest 44 days. Twenty-six times during this period the temperature was below 32° F., the minimum being 18° and the average 49.8°. This shows an average difference of 1.16 days in the length of the incubation period for each degree of difference in average temperatures.

From the data in the preceding paragraphs it appears that development at a temperature of 74.75° requires only 0.34 of a day longer than development at a temperature of 79.78°, but at 79.78° incubation requires only 4 days, while at a temperature of 49.8° 39 days are required, or $1\frac{1}{6}$ days for each degree of difference in temperature.

Of the 6 eggs under observation at a temperature of 18° four survived, and it is not certain that the other two were killed by the cold.

NUMBER OF GENERATIONS ANNUALLY

From the data on "Length of life cycle," p. 575, the time from oviposition by one generation to oviposition by the next succeeding generation is found to be 28.35 days, the temperature being 79.78° F. In some individuals this time is shortened in the nymphal period alone by at least two days.

These figures indicate that during the period in which they were collected a generation might become mature in less than one month. During the preceding April and May the temperatures averaged respectively 53.48° and 61.9°, and during the succeeding October 58.27°. These temperatures were above the average of 49.8° at which incubation proceeded late in October and during November of the same year.

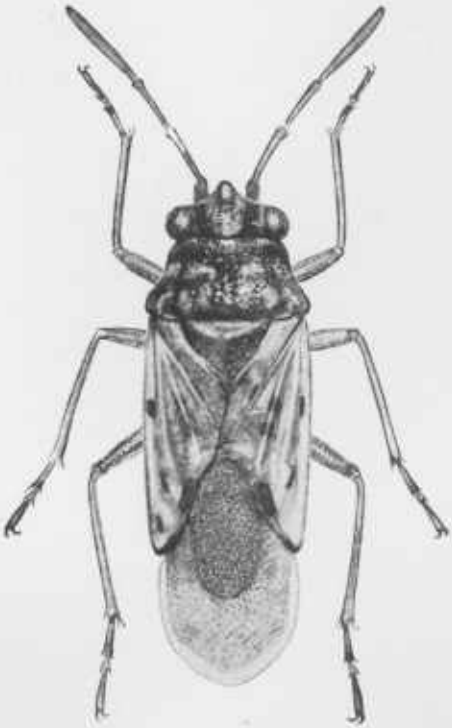
Observations of 1913 showed that five generations matured after June 1. Hibernating nymphs from 1913 or overwintered eggs that hatched early in 1914 gave rise to a generation that completed development during the last two weeks of April and oviposited early in May. As the species was not reared continuously throughout the year the number of generations annually must be deduced from the data given.

The writer regards it as conclusive that five generations of the false chinch bug matured at Garden City, Kans., during 1913 after June 1. It is safe to regard this number as the minimum for seasons of the same length. The species hibernates either as an egg or as a young nymph which completes development very early the next spring. At Garden City the overwintering forms matured during April and deposited their eggs early in May. In seasons having temperatures above the average at Garden City the generation hatching from these eggs would become nearly mature by June.

To summarize: To the minimum of five generations, an overwintering generation and a possible generation in the spring may be added, making seven in all. In seasons in which the average temperature falls below that under which these studies were pursued the number of generations will be less, and with higher average temperatures may become greater.

PLATE 60

Nysius ericae: Adult. ×24



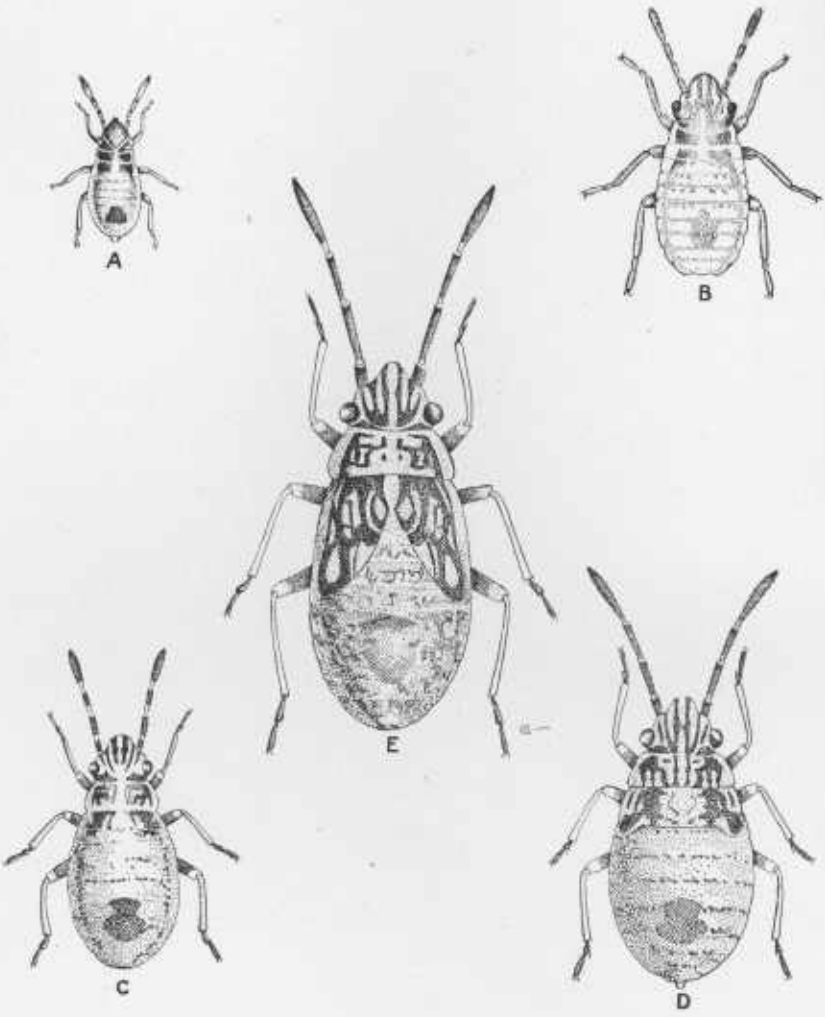

A
B
E
C
D

PLATE 61

Nysius ericae: Nymphal instars, greatly enlarged

A.—First-instar nymph.
B.—Second-instar nymph.
C.—Third-instar nymph.
D.—Fourth-instar nymph.
E.—Fifth-instar nymph, or pupa.