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BIONOMICS OF THE CLOVER LEAF WEEVIL,
(HYPERA PUNCTATA (FABR.))
IN UTAH.

BY LORIN C. FIFE

A THESIS
SUBMITTED TO THE GRADUATE FACULTY
FOR THE DEGREE OF MASTER OF SCIENCE.

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TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. HISTORICAL.....	1
III. DISTRIBUTION.....	3
IV. LIFE HISTORY AND HABITS.....	4
A. Egg.....	4
B. Larvae.....	7
C. Cocoons.....	10
D. Pupa.....	10
E. Adult.....	11
F. Oviposition.....	12
V. DESCRIPTION OF <i>HYPERA PUNCTATA</i>	13
VI. MIGRATION AND DISPERSAL.....	16
VII. ECONOMIC IMPORTANCE.....	17
VIII. FOOD PLANTS.....	18
IX. CONTROL MEASURES.....	19
A. Natural Control.....	19
B. Artificial Control.....	23
X. SUMMARY.....	24
XI. LITERATURE CITED.....	26

BIONOMICS OF THE CLOVER LEAF WEEVIL,
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INTRODUCTION

The Clover Leaf Weevil, Hypera punctata (Fabr.),* is a foreign pest introduced from Europe into New York, which first became noticeable in 1881. The insect has rapidly spread westward reaching Utah at least by 1912. Since this time several out-breaks have occurred. In 1927 the injury to alfalfa, Medicago sativa, was severe in limited areas in Hooper, Weber County, and in 1927 and 1928 the infestation was very pronounced in certain parts of Salt Lake City.

HISTORICAL

The insect was first described by Fabricius in 1775 from Sweden as Curculio punctatus. The genus dates back to 1821 when Germar published descriptions of several genera. Among these was the genus Hypera. Hypera punctata was one of these species included by Germar in the original description of the genus and hence should stand as a type. So far as is known, this is the only species of Hypera to reach this country.

*Order Coleoptera, family Curculionidae.

The Glover Leaf Weevil has caused considerable alarm in the United States since it was introduced from Europe.

Folsom (8) in Michigan, was one of the first in the United States to make a detailed study of its life history. Herrick (14-15) has shown that two generations may occur in New York and further south during mild winters. Tower and Fenton (39) have detailed accounts on life history in Indiana, showing only one generation a year. This species has been studied by many European workers. The following is the synonymy according to Titus (37)

1. <i>Curculio punctatus</i>	Fabricius	1775
2. <i>Curculio austriacus</i>	Schrank	1781
3. <i>Curculio pictus</i>	Fourcroy	1785
4. <i>Curculio linzensis</i>	Gmelin	1790
5. <i>Rhychoenus punctatus</i>	Fabricius	1802
6. <i>Curculio medius</i>	Morsham	1802
7. <i>Brachyrhinus punctatus</i>	Latreille	1804
8. <i>Brachyrhinus austriacus</i>	Latreille	1804
9. <i>Rhynchaenus austreacus</i>	Panzer	1810
10. <i>Hypera punctata</i>	Germar	1817
11. <i>Phytonomus punctatus</i>	Schonkerr	1826
12. <i>Phytonomus proximus</i>	Carmagnola	1833
13. <i>Phytonomus rufus</i>	Boheman & Schonheer	1834
14. <i>Phytonomus punctatus</i> Var. <i>hostilis</i>	Dejean	1837
15. <i>Hypera punctata</i> Var. <i>austriaca</i>	Gemminger & Harold	1871

16. <i>Hypera punctata</i> Var. <i>lingensis</i>	Gemminger & Harold	1871
17. <i>Hypera punctata</i> Var. <i>picta</i>	Gemminger & Harold	1871
18. <i>Hypera punctata</i> Var. <i>proxima</i>	Gemminger & Harold	1871
19. <i>Hypera punctata</i> Var. <i>rufa</i>	Gemminger & Harold	1871
20. <i>Phytonomus opimus</i>	Leconte	1876
21. <i>Hypera opimus</i>	Austin	1880
22. <i>Phytonomus fallacicus</i>	Desbrochers	1896
23. <i>Phytonomus punctatus</i> Var. <i>austriacus</i>		
	Petri	1901
24. <i>Phytonomus punctatus</i> Var. <i>lingensis</i>		
	Petri	1901
25. <i>Phytonomus punctatus</i> Var. <i>rufus</i>		
	Petri	1901

DISTRIBUTION

The Clover Leaf Weevil is quite a cosmopolitan species and seems to have no difficulty in meeting the varying meteorological conditions existing over so large an area, but has thrived and has become, at times, noticeably injurious in widely separated regions.

This species is common over all Europe, Northern and Central Asia and occurs along the Northern coast of Africa and in Asia Minor.

Already, it exists on both coasts of North America and from the southern part of Canada to as far south as Texas, Tennessee,

and Mississippi. In the United States the species has been reported from every state except Montana, Wyoming, North Dakota, Colorado, Arizona, Nevada, New Mexico and Florida. In Canada it has been reported from Victoria and Vancouver, British Columbia.

When and how the Clover Leaf Weevil was first introduced into Utah is not known. The first known record is given by Webster (42) who states that Mr. E. J. Vosler of the United States Department of Agriculture, Bureau of Entomology found specimens near Ogden, Utah, on May 14, 1912. Other specimens were found during the same year by Mr. H. T. Osborn about Malad, Idaho.

LIFE HISTORY

The Egg

Where the eggs are laid:

By far the greatest number of eggs of Hypera punctata are laid in the dry hollow stems lying upon the ground among the stubble. They are usually laid in a linear fashion crosswise of the stem. In large stems, where the length of the eggs are not as long as the interior width of the stem, the eggs are placed in two rows. See Plate I Fig. D., and plate II Fig., D., E. and F.

Also, eggs have been found upon the ground, in clusters varying from 10 to 12. They are placed on their ends in the damp soil and glued together by a sticky secretion ejected by the female. Adults kept in large jars deposit eggs on the bottom and sides of the jar, when supplied with green and dry stems. Single eggs were not found on the ground in the field, but these could have been easily overlooked.

Eggs are sometimes laid at the base of the leaf petiole, the egg puncture being made through the stipules as a small round hole.

Eggs are occasionally deposited in the center of small green stems. To some extent eggs are glued singly to the green and dry stems, under side of the leaves and on the leaf petioles. In cages the eggs were laid preferably in small wheat stems or dry stems of alfalfa in which the wall was thin and pliable.

Total and daily egg production:

The number of eggs in different clusters were as follows: 18, 12, 13, 24, 17, 6, 10, 25, 28, 7, 13, 17, 25, 33, 25, 11, 6, 5 and 8. This gives an average of 10.6 eggs per cluster.

The total egg production of the individual females was not obtained in my work. Herrick and Hadley (15) gives the total egg production for one female at 473 eggs, with an average of 179 eggs. The longest egg-laying period extended from August 25, to November 20, a total of 87 days. Tower and Fenton (39) gives the total egg production at 287 eggs as a maximum, with an average of 159 per female.

Incubation period:

There is both a long and a short period of incubation for the eggs, depending upon the temperature. The majority of the eggs hatch in the fall before cold weather hinders their development. Eggs laid after October 31, 1928, did not hatch until the following spring. The following table shows the records for incubation:

Table I

Date of oviposition	Date hatched	Period in days	Number that hatched
October 10	October 30	20	11
October 10	November 1	22	1
October 10	November 2	23	12
October 10	November 3	24	11
October 10	November 5	26	3
October 22	November 10	19	6
October 24	November 10	17	17
October 11	October 31	20	9
October 11	November 1	21	12
October 11	November 1	21	2
November 1	April 15	166	5
November 2	April 20	171	8
November 3	April 18	169	2

The shortest period of incubation was 17 days, the longest period for those hatching before October 31 was 26 days. Eggs that pass the winter were on the average 169 days in incubation. Eggs began hatching in Salt Lake City on April 14, 1929. Eggs that over-winter all hatch before the last of *May*. Tower and Fenton (39) at Lafayette, Indiana in 1919, found the shortest period to be 13 days, the eggs being laid September 10. The longest period except for over-wintering eggs was 46 days. In this case the eggs were laid October 21. The average incubation period for 50 lots of eggs between September 8 and October 21, 1919 was 25.8 days. Falsom (8) at Urbana, Illinois in 1909, found the average incubation period to be 29 days.

Hatching:

A distinct round black spot may be seen beneath the egg-shell several days before hatching. This is due to a rapid pigmentation of the head of the embryo. The larvae are active

inside the egg and may be seen moving around previous to hatching. The egg-shell is broken at one end by means of the mandibles from which the larvae escape.

Hibernation:

Only a small percentage of the total number of eggs laid, pass the winter in the egg stage. This includes the eggs laid late in the fall, from October 31 to November 20 in 1928. From 682 eggs collected on March 15 and April 14, 1929, 180 hatched. Only 275 per cent of the over-wintering eggs hatch. This low percentage is due to a very large extent to a Nymmarid egg parasite, Anaphes praetensis, which appeared in the breeding cages on March 23, 1929.

Larvae

Habits:

The larvae feed both day and night, but when not feeding are found coiled at the base of the plant, hiding under the debris and dead leaves. The young larvae ascend the plants by moving around the stems in a spiral motion, using the mouthparts in aiding it in gaining new holds on the stem. Larvae disturbed when feeding, suddenly drop to the ground and remain motionless. They feed only a very little during the first two instars. They may be found in the second instar still inside of the ^{stems,} and make their exit from the stems through the egg punctures.

Duration of Instars:

The larvae pass through four molts, the period between molts

varies much according to the temperature, food and humidity. The larval stages may be found from September 30 to June 20. The last hatching date in the fall of 1928 occurred on October 31. The eggs begin hatching as early as April 14. The durations of the instars as observed from larvae reared in the laboratory at 25° C. are given in the following table:

First Instar	12, 8, 10, 9, 14, 14, 15, 14, 14, 13, 11. <i>days</i>
Second Instar	8, 22, 13, 22.
Third Instar	16, 18, 12, 7, 16, 16.

Herrick and Hadley (13) gives the durations of the instars in the following table:

Stage	Length of Stage (days)
First Instar	9, 9, 9, 9, 11, 14, 12, 11, 9, 10, 10, average 10.3
Second Instar	9, 14, 14, 14, 14, 11, 13, 11, 7, 8, 15, Aver. 11.8
Third Instar	14, 11, 13, 13, 9, 12, 10, 9, 8, 8, 9, " 10.5
Fourth Instar	14, 13, 11, 13, 13, 12, 14, 17, 12, 11, 10, 12" 12.5
Prepupal	3, 3, 2, 2, 3, 4, 5, 5, 3, 3, 4, " 3.3
Cocoon	8, 9, 9, 9, 8, 11, 10, 6, 7, 7, 8, " 8.1

Tower and Fenton (39) gives the following results for the duration of the different stages: first instar $18\frac{2}{3}$ days; second instar 10 days; third instar $8\frac{1}{2}$ days; fourth instar $14\frac{1}{8}$ days; spinning cocoon one day; prepupa 4 days; the length of time remaining in the cocoon after the adult $2\frac{1}{2}$ days and pupa 14 days.

Method of Ecdysis:

The first signs of moulting the larvae becomes quiet. A splitting of the cuticula begins to occur along the epicranial stem and continues along the epicranial arms toward the eyes. The rectangular dark band of cuticula on the prothorax moves forward toward the head. The splitting continues along the white stripe of the body. The process requires from one to several hours. The color of the body just after moulting is a light pale green, turning to a darker green with increase in age and the head is a lemon yellow color turning to a light brown.

Hibernation:

The larvae reach the third instar before cold weather hinders their development. From larvae collected in the field on March 9, 1929, the following larval instars were found; first instar, 56.5 per cent; second instar 37.8 per cent; and third instar, 5.7 per cent. Dry hollow stems, containing first instar larvae were cut open on October 10. These stems were tied together with a string and examined again on December 20, 71 days after, the larvae were still alive inside the stems. Literature states that larvae may be found in the dry hollow stems during the early spring. However, no larvae were found by the author as early as March 9, 1929.

All through the winter larvae may be found in the debris at the base of the plants. A few warm days that start the new growth of alfalfa also revive the larvae. The first feeding

injury by the larvae in 1929 was as early as April 14, 1929.

Cocoons

Length 7 to 8.5 (mm) average 7.8 (mm). Width 5 to 5.5 (mm) average 5.1 (mm). The cocoons consist of a fine network of coarse threads, oval in shape and of a light brown color. When the larva become full grown, they form a cocoon just beneath the surface of the soil. The spinning is done from the mouth, turning around and around with its body, but the bulk of the material is drawn from the anus. Knab is states that the silk comes from enormously developed malpighian tubes. Usually only one day is required in spinning the cocoon.

Pupa

Description *

Length 5.5 to 7 (mm). Width 3.5 to 4.5 (mm). Abdomen dark green with a distinct pale dorsal line that extends onto the prothorax. Frontal row of hairs rather distinct from margin; central pairs close together, three following pairs form a curved line ending near the posterin outer edge; a few hairs on remainder of thorax. See Plate I, Fig. B.

The duration of this period is about 8.1 days according to Herrick and Hadley (15) and 11.5 days according to Tower and Fenton (39). The stage extends over a period of two months, beginning about the middle of May.

* Taken from Tower and Fenton (39)

Adult

Habits:

The beetle emerge by eating a circular hole in one end of the cocoon. Their color upon emergence is of light brown color, but changing to a dark brown after being exposed for several days. Tower and Fenton (39) gives the period for emergence from May 25 to June 26. The adults may be seen feeding during any time of the day and at night. There are two distinct feeding periods, separated by one of inactivity during the month of August.

Mating:

The adults may be found copulating during any time of the day or night. The periods of copulation are intermittent and occur many times during the mating season. The adults appear in June and begin copulating during the latter part of August, when they are about two months old. The male climbs upon the female working the penis back and forth within the vagina. One copulation period may last for several hours. The mating continues until late in November. Copulation has not been observed by over-wintering adults.

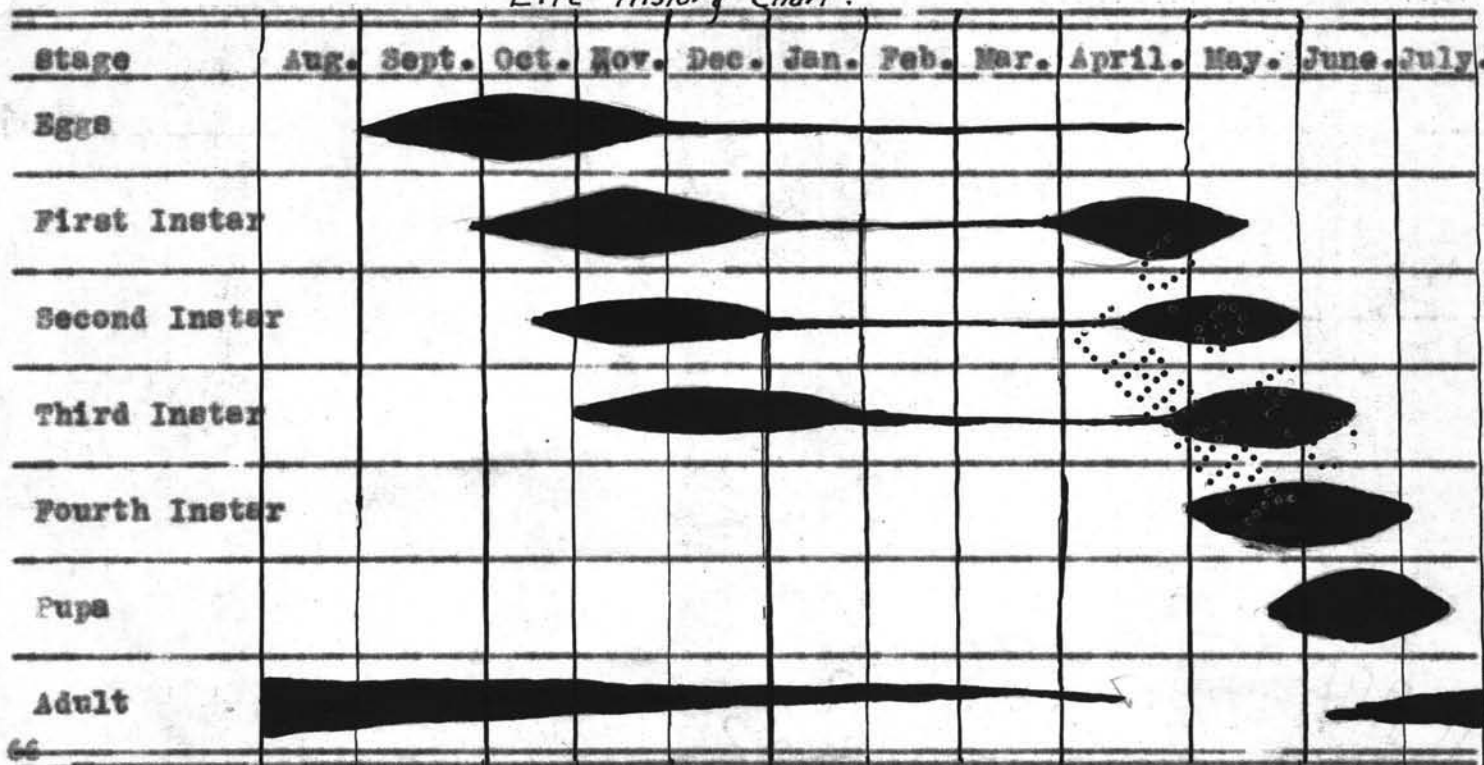
Longevity of the Adults:

The adults may be found from June 1 to April 15 of the following year. Adults that emerge late in the fall may overwinter, but the majority die before December 1. Two females and one male were collected on April 14, 1929 from an area of 15 square rods that was badly infested in 1928. From 53 adults placed in an outside cage on November 9, five remained alive until March 16; two males and three females.

Oviposition:

The eggs are normally laid at night but sometimes they are laid in the daytime. Hudson and Wood (17) records beetles ovipositing at 8:24 A. M. and at 12:45 P. M. under insectary conditions. They only observed oviposition during the day time, when approached with a light at night, the females would instantly leave the plant and seek seclusion. The egg punctures are made by cutting holes into the stems by the mandibles. The female then places her ovipositor into the opening and eject the eggs, which are pushed up and down the stem by the ovipositor. Egg punctures may be seen on Plate I. Figs. A. B. & C. The beetles take about one minute in making the egg puncture. The time required in placing nine eggs was seven minutes. Another mass of 24 eggs required 25 minutes. Each egg mass is coated with a glue like fluid which is used to secure the eggs to the plant and to hold them together. The cementing process occupies two to three minutes. Almost all of the eggs are laid during the fall, between August 25 and November 20.

Three females taken from an outside cage to the laboratory on March 16, 1929 laid one egg on March 17, six eggs on March 18, and four eggs on March 20. Five of these eggs were about half the size of normal eggs. However none of these eggs hatched. Herrick(14) records adults passing the winter in 1918-19 and laying fertile eggs in the spring. That winter was above the normal in temperature and below the normal in precipitation.

Life History Chart.

DESCRIPTION OF HYPERA PUNCTATA

THE EGG:

Size: length 1 to 1.7 (mm) Average 1 (mm). Width .55 to .65 (mm) average .58 (mm). The eggs when first laid are lemon yellow in color with a very smooth surface, after several days they darken in color to a dull or dirty yellow. Under the microscope, the surface of the egg becomes very slightly roughened or hexagonally sculptured, after being exposed to the weather for several days. After the eggs have developed for 15 days one end of the egg becomes black, which is due to the rapid pigmentation of the head of the embryo, which appears under the egg-shell as a distinct round black spot.

The Larva:*

First Stage: length 1.9 to 3.4 (mm). Width of head 0.2 (mm). Thickest at the middle, tapering toward both ends; head dark brown or black; eyes very small, circular, projecting; mandibles terminating in two large sharp teeth; palpi pale yellow; dorsum of first thoracic segment with a rectangular dark band interrupted by a paler dorsal line which is the continuation of an inverted "Y" on the face, this dorsal band becomes wider on the abdominal segments and extends to the tip of anal segment. Color varies from lemon yellow to pale green. Head of the larva. See Plate I, Fig. E.

Second Stage: length 1.8 to 5.9 (mm). Width of head .55 (mm). Color greener, head dark brown, front and sides of rectangular plate on first thoracic segment dark, the remainder greenish; dorsal median line with a fine dark border, darker than the remainder of the larva. Side line below spiracles indistinct.

Third Stage: length 3.8 to 5.9 (mm). Width of head 0.8 (mm). Black lines on each side of dorsal line very distinct; head brown or yellowish brown, eyes densely black, antennae darker; color of larvae pale green.

Fourth Stage: length 5.1 to 13.1 (mm). Width of head 1.2 (mm). Dorsal line very white or pinkish, bordered by rose color, usually rather pale but sometimes rosy black, the outer borders of this coloration are black and form distinct lines, interrupted on the margin of each segment; head brown or yellowish brown;

* Taken from Titus (38).

larva much darker green; lines below the spiracles dark both showing a tendency be brown or blackish; posterior segments yellowish; the surface of the body much rougher in this stage than in others. The triangular point of the cuticle standing out prominently; tubercles on thoracic segments below very strong and the hairs more prominent than in earlier stages. See Plate I, Fig. C.

Adult:*

Length 7 to 8.31 (mm). Width 3 to 4 (mm). Stout brownish black, clothed with blackish brown pale brown, yellow-brown pale brown, yellow-brown scales which are short, broad, and emarginate at the tips, and with short erect bristles, edge of elytra yellow brown or at least paler than remainder of scales.

Head clothed with yellowish scales; front not as wide as breadth of eye; eyes elongate oval, rather prominent; beak scarcely two-thirds the length of the prothorax, and one-half thicker at tip than width of front; antennae groove black, deep, punctured; antennae reddish black, scape reaching to the middle of the eyes, not as long as funicle, not greatly enlarged at the tip; first joint of the funicle distinctly longer than the second, enlarged at the apex so that it is about one-half as thick as long, second joint equal to three and four united joints three to seven regularly shorter and broader, seven as wide as long; club elongate oval, pointed at tip and four jointed; antennae with many fine hairs. Mandibles dull red, not emarginate at tip, maxillae and all the palpi pale yellow. Plate I, Fig. F.

*Taken from Titus (38).

Prothorax broader than long, broader in female than in male, in the female broadly widened in front of the middle, in the male converging more behind than in female; dorsum rather coarsely punctured, densely covered with scales and bristles.

Elytra very broad, sides especially in the male nearly parallel, deeply striately punctured. In the male the outer interspaces have paler scales even in the darkest specimens, in the female this pale coloration is sometimes but rarely, entirely absent.

Venter with lighter colored scales, and many light hairs front coxae slightly separated, coxae of the mesothorax by more than their width. Stem of male genitalia nearly quite as broad as long. Legs short, stout, especially the femora; black, tarsi often ferruginous, claws long curved, red and darker at tips; front tibiae and hind femora distinctly curved; legs usually clothed with lighter scales and hairs than the body. See Plate I., Fig. A.

MIGRATION AND DISPERSAL

THE Clover Leaf Weevil has become distributed throughout the United States in rather a short period of time. The beetles are rather strong fliers and by following the air currents are able to fly long distances.

This specie floats freely on the surface of the water and are doubtless disseminated to some extent in this way.

The hauling of hay from infested regions to other parts of the state, and the carrying of feed for horses, sheep and other

stock by persons driving through the region, will materially aid in the distribution of the insect. In fact, every vehicle traveling through an infested region becomes a possible means of distribution for weevils which may fly and alight upon it. Trains have probably been important in aiding dissemination of the species.

Many orchards are surrounded by alfalfa fields, and in many cases clover or alfalfa grow in the orchards. The migrating weevil often crawl into fruit packages, which are being shipped to other sections of the state and to other states.

ECONOMIC IMPORTANCE

This insect is ordinarily held in check by many adverse influences and seldom does serious or prolonged injury.

Athur (1) records the first destructive work of Hypera punctata in America at Barrington, Yates County, New York in 1881. This severe infestation was controlled by a fungus disease Empusa sphaerasperma Pres. Other out-breaks have occurred in the eastern states but none of these have caused much injury.

The larvae cause the most injury because they consume a large amount of foliage in such a short time. They eat circular holes in the leaves and buds and when infestation is heavy may keep the plants eaten to the ground. The first instar larvae are very hardy and may live for the entire period without feeding. First instar larvae injury. See Plate III Fig. A. Tower and Fenton (29) shows from feeding experiments on red clover, at

Lafayette, Indiana, that the fourth instar larvae do approximately 80 per cent of the damage. The larvae, during development consume 3.09 square inches of red clover, which is the average for 25 individuals. Of this amount 2.49 square inches are consumed during the fourth instar, which occupies a period, on the average, of about 14 days. This large amount of foliage consumed in so short a period greatly increases the liability of injury.

The adults start feeding on the outer edges of the leaves, eating large circular areas from them. See Plate III, Fig. C. Many of the stems are eaten until they break and permit the tops to fall over. See Plate III Fig. B. Where severe infestations occur considerable damage may be caused. Tower and Fenton (39) state that the adults consume 4.76 square inches of leaf surface, during a feeding period of 5 months. The feeding is, therefore, very slow and gradual, seldom doing an appreciable amount of injury except when the adults occur in large numbers.

FOOD PLANTS.

In Utah the greatest damage caused by Hypena punctata is to alfalfa, Medicago sativa. Tower and Fenton (39) lists as food plants: Red Clover, Trifolium pratense; White Clover, T. repens; Alsike Clover, T. hybridum; and Sweet Clover, T. repens. Both larvae and adults will feed upon beans and the adults have been observed eating Timothy-Phleum pratense, burdock and soy beans, Glycine hispida, and the flowers of the golden rod. Larrimer (23) observed beetles feeding on corn foliage in Kansas, August 10, 1915. Wheat and cabbage have also been reported. Titus (38)

states that Jerusalem Artichoke, Helianthus tuberosus, has been reported from Europe. Webster (40) reported White Clover being eaten in preference to Red in Ohio, but Herrick and Hadley (15) in New York, and Tower and Fenton (39) in Indiana have noted that Red Clover and alfalfa are more often chosen.

CONTROL MEASURES

Natural Control

Fungus Disease, Empusa sphaerasperma Fres.

In the East, a fungus disease Empusa sphaerasperma Fres. is reported as one of the most important checks of Hypena punctata which kills the larvae off in large numbers in April and May. The disease is epidemic and disseminated so rapidly that it is most impossible to find any living larvae within two or three weeks. The conditions necessary for the development of this disease as stated by Herrick (15) is fairly cool and abnormally humid. The records at the station when the disease was most active averaged 62.3° F. Moreover the rainfall was above normal and totaled 8.39 inches for the month.

The sick larvae crawl up the blades of grass and stubble during the night and coil themselves in a horizontal position about the apex of the blade. By noon most of them are dead. The larvae change to a velvety gray by late afternoon and the next morning there is only a small, blackened, shriveled mass remaining; while the surrounding foliage is powdered with a

whitish clinging dust composed of spores of the fungus. These are summer spores and retain their vitality for only a short period.

Each spore bears a pedicel, which makes it possible to be carried long distances by the wind. The mycelium of the fungus hibernates in the bodies of the young larvae during the winter, thus avoiding the necessity for producing resting spores. The fungus appears twice during the season, once in the spring and again in the fall. The fungus develops in the body as a branching mycelium which absorbs the body fluids. Some of the branches push through the ventral body wall and attach themselves to the nearest objects as holdfasts. Other hyphae pierce the skin to form a gray velvety coating on the body of the larva, and the tips of each one of these hyphae forms a conduit.

This fungus is also parasitic on many other insects. The list includes the cabbage-worm, yellow butterfly, house flies, bees, yellow butterfly, gnats, plant lice, leaf-hoppers and thrips. J. C. Authur (1).

Webster (42) states that this fungus, Empusa sparsasperma Pres. was introduced into Salt Lake City, Utah, in 1912 with the hope of controlling the alfalfa weevil. The experiment was a failure and it was thought that the climate was too dry to enable the fungus to survive.

Fungus-Sporotrichum globuliferum Speg.

During the fall of 1928, adults were found in the field covered with a white fungus growth, Sporotrichum globuliferum Speg.*

* This was determined by Vera K. Charles, the U. S. Bureau of Plant Industry Div. of Mycology. Washington, D. C.

This is the first time that Hypera punctata has been reported as a host of this fungus. The fungus is common on many other insects.

Hymenid Parasite, Anaphes praetensis:

This parasite appeared in the breeding cages, which were kept in the laboratory, on March 26, 1929. The parasitised eggs of Hypera punctata do not retain their normal color, but turn black all over, several days before the parasites emerge. Normal eggs, when nearly ready to hatch are black at one end only. Some of the eggs contain two parasites, which can be seen through the egg-shell. From 599 eggs, 243 parasites emerged. Forty-seven parasites, that did not emerge, were obtained by a dissection of the eggs that would not hatch. This totals 290 parasites taken from 599 eggs. One hundred and fifty-five eggs hatched and 444 did not hatch. By a dissection of many of the eggs, some of them were found to contain two parasites. From 31 parasitised eggs 48 parasites were obtained giving 54.8 percent of the eggs that are parasitised contain two parasites. This gives a total of 21.8 per cent of the eggs that are parasitised. From 276 parasites, 75.8 per cent of them were females.

Bathyplectes exiguus (Gra.)

Rockwood (34) reported that Bathyplectes exiguus(Gra.) has been reared from the larvae of Hypera punctata at Mechanicsburg, Pa. This parasite has been reported as parasitising Hypera nigricornis as high as 50 per cent at Forest Grove, Oregon. He stated that it was especially adapted to prey upon the larvae of Hypera punctata. Essig (7) states that it is an European species introduced into various parts of the United States.

Titus (38) reports that Callopa quadrimaculatus, a small beetle in the larval stage, was found feeding upon the eggs and Cicindela repanda and probably preying upon the larvae.

Amphibia:

Toads and frogs sometimes prey upon the weevils. Mr. T. S. Wilson, of the Bureau of Entomology, found one adult in a toad's stomach at Wellington, Kansas, July 18, 1915, and Mr. H. L. Parker found 11 adults and one pupa of Hypera punctata in the stomachs of four frogs at Bridgeport, N. Y. December 6, 1925, out of 14 examined.

Birds:

Birds are valuable and important natural checks on this insect and according to Tower and Fenton (39) the following species prey upon the weevil. All of these species, except the wood pewee, occur in Utah.

1. American crow *Corvus brachyrhynchus*
2. Boblink *Dolichonyx oryzivorus*
3. Bobwhite..... *Galina virginianus*
4. Cat bird..... *Dumetella carolinensis*
5. Crow-blackbird..... *Tuiscalus quiscula*
6. Flicker *Coleptes auratus*
7. Horned lark..... *Otocoris alpestris flova*
8. King-bird..... *Tyrannus tyrannus*
9. Highthawk..... *Chordeiles virginianus*
10. Meadow-lark..... *Sturnella magna*
11. Purple martin..... *Progne subis*

12. Red-headed woodpecker.....*Melanerpes erythrocephalus*
 13. Robin..... *Planesticus migratorus*
 14. Sparrow
 English *Passer domesticus*
 Savannah *Passerculus, sandwichensis savanna*
 Vesper *Poocetes gramineus*
 15. Wood pewee..... *Contapus virens*
 16. Starling..... *Sturnus vulgaris*

It has been shown that poultry, especially chickens and turkeys, will eat many of the adult weevils and larvae if the fields are accessible to the fowls.

Artificial Control

The outbreaks of this insect has been quite successfully controlled by the fungus disease mentioned above and only in rare cases has it become necessary to use artificial means of control. Larrimer (23) advocates spraying the crop with arsenate of lead at the strength of two pounds of the powder to 50 gallons of water, including one pound of laundry soap as a sticker. The mixture being applied at the rate of 100 gallons to the acre.

In the general the most practical method of dealing with outbreaks of this insect is to either cut back the clover in May or use it for pasture in the spring. Usually, serious injury does not occur until the clover is in its second years growth, and cutting it or using it for pasture does not injure the seed crop and does aid in controlling the more serious pests that

prevent the production of seed. It is advocated to rotate every two years. Fall plowing will kill the insects which are in the adult, larva, and egg stages.

SUMMARY

1. The Glover Leaf Weevil is a foreign insect introduced from Europe sometime before 1881.
2. Utah and Idaho are the only states in the Rocky Mountain region where it exists. However, the insect is generally distributed throughout the southern and eastern United States and Southern Canada.
3. The majority of the eggs are laid in the dry hollow stems, between August 25 and November 20.
4. Each female lays on the average of about 175 eggs.
5. Eggs laid after October 31, 1928, do not hatch until April 15 of the following year.
6. Only 27.7 per cent of the over-wintering eggs hatch.
7. The larvae molt four times during their development with an average of 12.5 days for the first instar; 11.7 days for the second instar; 10.5 days for the third instar and 12.5 days for the fourth instar.
8. Ecdysis is accomplished by a splitting of the cuticula, starting along the epicranial arms and continuing back along the epicranial stem and mid-dorsal line.
9. Fifty-six and five tenths percent of the larvae over-winter as the first instar, 37.8 per cent as second instar and 5.7 per

cent as the third instar.

10. The cocoons are formed just beneath the surface of the soil
11. The average length of the pupa period being 8.2 days.
12. The adults appear by June 1st and may be seen until April 14 of the following year.
13. Mating starts the last of August and continues until the latter part of November.
14. Oviposition normally occurs at night but sometimes occurs during the day. The egg punctures are made by the mandibles in the dry stems. The eggs are glued together and to the plants by a sticky secretion ejected by the female.
15. Migration and dispersal is effected by flight of the adults, irrigation water, the hauling of hay from infected regions to other parts of the state and by other vehicles passing through the infected regions.
16. The fourth instar larvae cause 80 per cent of the damage due to larval feeding.
17. The adults cause injury by feeding upon the leaves and stems.
18. Principle food plants include all kinds of clover and alfalfa.
19. The eastern part of the United States Hypera punctata is effectively held in check by a fungus disease, Empusa sphaerosperma Fres.
20. Hypera punctata is the host of a fungus disease Sporotrichum globuliferum Speg.
21. A Hymenoptera parasite, Anaphes praetensis is an effective control of this insect. Percentage of parasitism upon the over-wintering eggs was 21.8 per cent.

22. Bathyplectes exiguus (Gra.) is a larvae parasite of the Clover Leaf Weevil.
23. Birds are important natural checks.
24. The most effective artificial means of control are pasturing in the spring, late fall, plowing, and spraying with arsenate of lead.

LITERATURE CITED

- (1) Arthur J. C.
1886. Disease of the Clover Leaf Weevil. Entomophthora
Phytonoma Arth. Fifth Annual Rept. N. Y.
Agri. Pp. 274.
- (2) _____
1885. Report of the Botanist.
Fourth Ann. Rept. N. Y.
in Agri. Exp. Sta., Geneva, Pp. 285-289.
- (3) Blatchley W. S. and Leng C. W.
1916. Rhynchophora or Weevils of North Eastern America.
pp. 146-147.
- (4) Chamberlin T. R.
1924. Introduction of Parasites of the Alfalfa Weevil
into the United States U. S. Dept. Agri. Dept.
Cir. 301. p. 3.
- (5) Davis J. J.
1921. Insect Problems in Indiana Jour. Econ. Ent. Vol. 15
pp. 277.
- (6) _____
1921. Insect Problems in Indiana. Jour. Econ. Ent. Vol. 4.
- (7) Essig E. O.
1926. Insects of Western North America. pp. 495-496, 791.
- (8) Folsom J. W.
1909. Insect Pests of Clover and Alfalfa, Ill. Agr. Exp.
Sta. Bul. 134. pp. 155-164.
- (9) Cassard H. A.
1918. Important clover pest Mo. Bul. Chic. Exp. Sta. Vol 3.
No. 2. pp. 104-106

- (10) 1918. Important Clover Insects. Review of App. Ent. Vol. 7
p. 145.
- (11) Hamilton, John
1891. The clover leaf beetle in Western Pennsylvania.
Insect life vol 4. pp. 270.
- (12) Haseman, Leonard
1920. Insects pests of Field Crops Missouri. Agr. Exp. Sta.
Bul. 170 ;pp. 25-26.
- (13) 1915. Injurious insects of Legumes, Mo. Bul. 134. pp.25-26.
- (14) Herrick G. W.
1920. The Winter of 1918-19 and the activities of Insects
with special reference to the Clover Leaf Weevil.
Ann. Ent. Soc. Amer. Vol. 13. pp. 101-107.
- (15) Herrick G. W. and Hadley C. H.
1922. The Clover Leaf Weevil, Cornell Univ. Agri. Exp.
Sta. Vol. 411.
- (16) Hudson H. F.
1919. Report of the insects of the Year. Ann. Rept.
Ent. Soc. Ont. pp. 83-85.
- (17) Hudson H. F. and Wood A. A.
1922. Oviposition of Hypera punctata, Fifty Third Ann.
Rept. Dept Agri. Ont. pp. 70-72.
- (18) 1923. Fifty Fourth Ann. Rept. Ent. Soc. pp. 104.
- (19) 1924. Notes on The Life History of the Clover Leaf Weevil
Ann. Rept. Ent. Soc. Ont. pp. 45-47.
- (20) Iddings E. J.
1925. Work and Progress of the Agri. Exp. Sta. Ida. Agri.
Exp. Sta. Bul. 135 pp. 28.
- (21) Jaques H. E.
1921. An Outbreak of the Clover Leaf Weevil in Iowa. Iowa
Acad. Sci. Proc. Vol. 28. pp. 127.
- (22) Johnson W. G.
1900. Notes on insects of Importance. U. S. Dept Agri. Bul.
26 No. pp. 81.

- (23) Larrimer W. H.
1926. The Clover Leaf Weevil and Its Control. U. S. Dept.
Agri. Farmers Bul. 1484 pp. 1-5.
- (24) Luggar, O.
1889. Beetles Injurious to Fruit Producing Plants Minn.
Agri. Exp. Sta. Bul. 66. pp. 274.
- (25) Kalmback E. R. and Sabielson I. N.
1921. Economic Value of the Starling in the United States.
U. S. Dept. Agri. Bul 868 pp. 16-18.
- (26) Kalmback E. R.
1918. The Crow and Its Relation to Man. U. S. Dept.
Agri. Misc. Bul. 621. pp. 18.
- (27) McCollock J. W.
1916. Notes on the Distribution of the Clover Leaf Weevil
(*Hypera punctata*) in Kansas Jour. Econ. Ent.
Vol. 9. pp. 445.
- (28) Parks T. H.
1914. Scientific notes on the Clover Leaf Weevil Jour.
Econ. Ent. Vol. 7. pp. 297.
- (29) Riley C. V.
1883. The Clover Leaf Weevil (*Phytonomus punctata* Fabr.)
Rept. U. S. Dept. Agri. 1881-1882. pp 171-179.
- (30) Riley C. V. and Howard L. O.
1890. The Clover *Phytonomus* Insect Life Vol. 3. pp. 70-71.
- (31) 1892. The Clover Leaf Weevil in Connecticut Insect Life
Vol. 4. pp. 401.
- (32.) 1893. The Westward Spread of the Clover Leaf Weevil.
Insect life Vol. 5. pp. 279.
- (33) 1893. Clover Leaf Weevil in Maryland Insect Life Vol. 6.
pp. 328.
- (34) Hockwood L. R.
1920. Can. Ent. Vol. 52. pp 39.
- (35) Ross W. A.
1920. Insects of the Season in Ontario Ann. Rept. Ent.
Soc. Ont. pp. 95-104.

- (36) Sanderson E. D.
1921. Insect Pests pp. 192.
- (37) Titus E. G.
1910. The Life History of the Alfalfa Weevil Jour. Econ.
Vol. 3 pp. 460.
- (38) ~~1911.~~ The Genera *Hypera* and *Phytonomus* in America, North
of Mexico Ann. Ent. Soc. Amer. Vol. 4 pp. 383-495.
- (39) Tower D. G. and Fenton F. A.
1920. Clover Leaf Weevil. U. S. Dept. Agri. Bul. 922.
pp. 1-18.
- (40) Webster F. M.
1894. Some Destructive Insects in Ohio Insect life vol. 4.
pp. 203.
- (41) ~~1896.~~ Some Destructive Insects in Ohio. Ohio Agri.
Exp. Sta. Bul. 68. pp 27-31.
- (42) ~~1912.~~ Preliminary Report on the Alfalfa Weevil, U. S.
Dept. Bureau of Ent. Bul. 112. pp 41.
- (43) Webster R. L.
1903. Insects of the year in Iowa Jour. Econ. Ent. Vol. 3
pp. 502.
- (44) ~~1916.~~ The Clover Leaf Weevil in Iowa. Jour. Econ. Ent.
Vol. 10 pp 225.
- (45) Wheeler C. F.
1894. Insects Destructive to Clover Mich. Agril. Exp. Bul.
116 pp 47-52.
- (46) Wilson T. S.
1916. The Clover Leaf Weevil from Kansas. Jour. Econ.
Ent. Vol. 10. pp. 445.

PLATE I

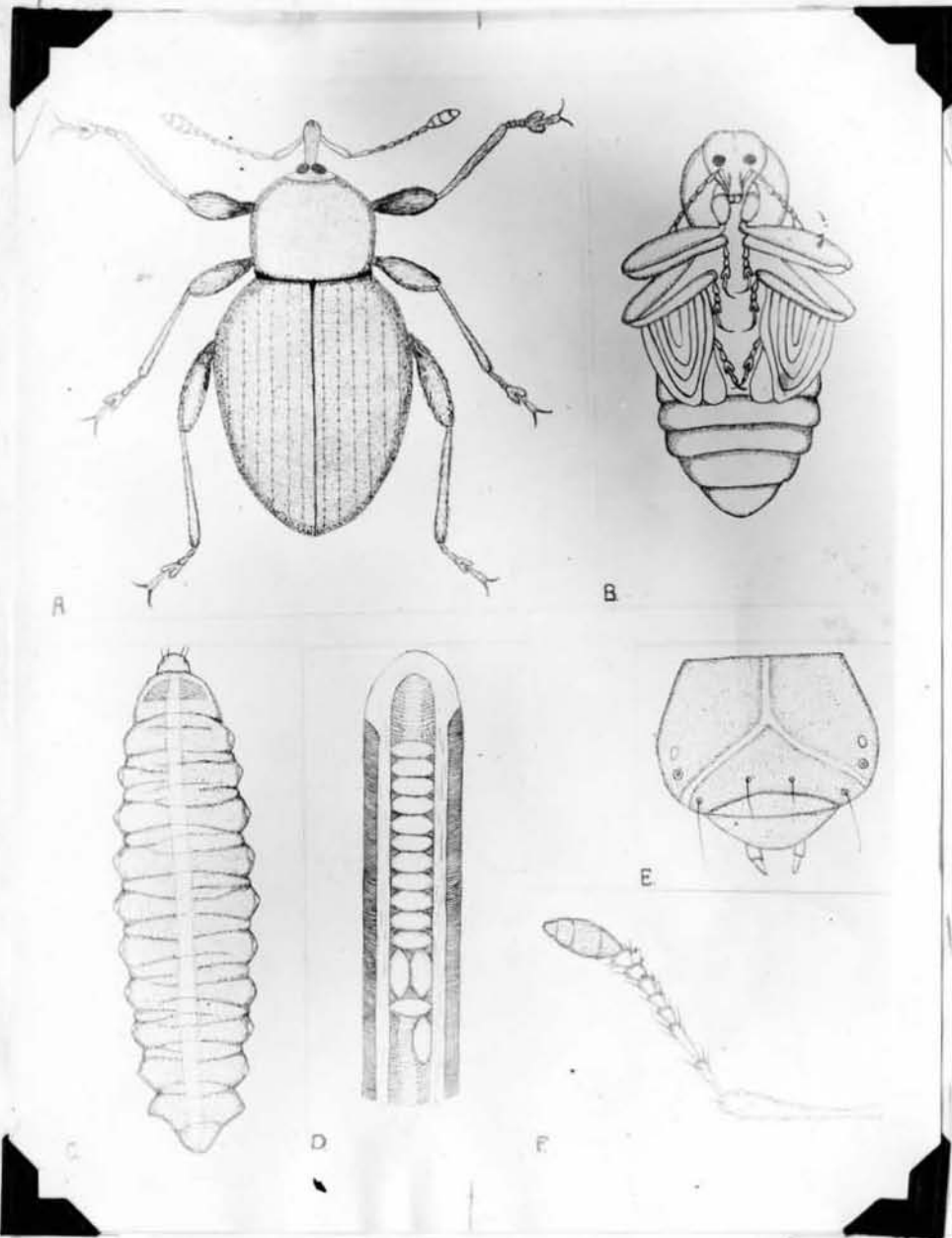


Fig.A. Adult σ (Dorsal View) Fig.D. Eggs inside of Stem.
" B. Pupa (Ventral View) E. Head of larva (Front view)
" C. Full Grown larva (Dorsal View) Fig.F. Antenna of the Adult.

PLATE II



Fig. A.B. & C. Egg punctures in dry stems.
Fig. D.E. & F. Eggs inside of Hollow Stem.

PLATE III

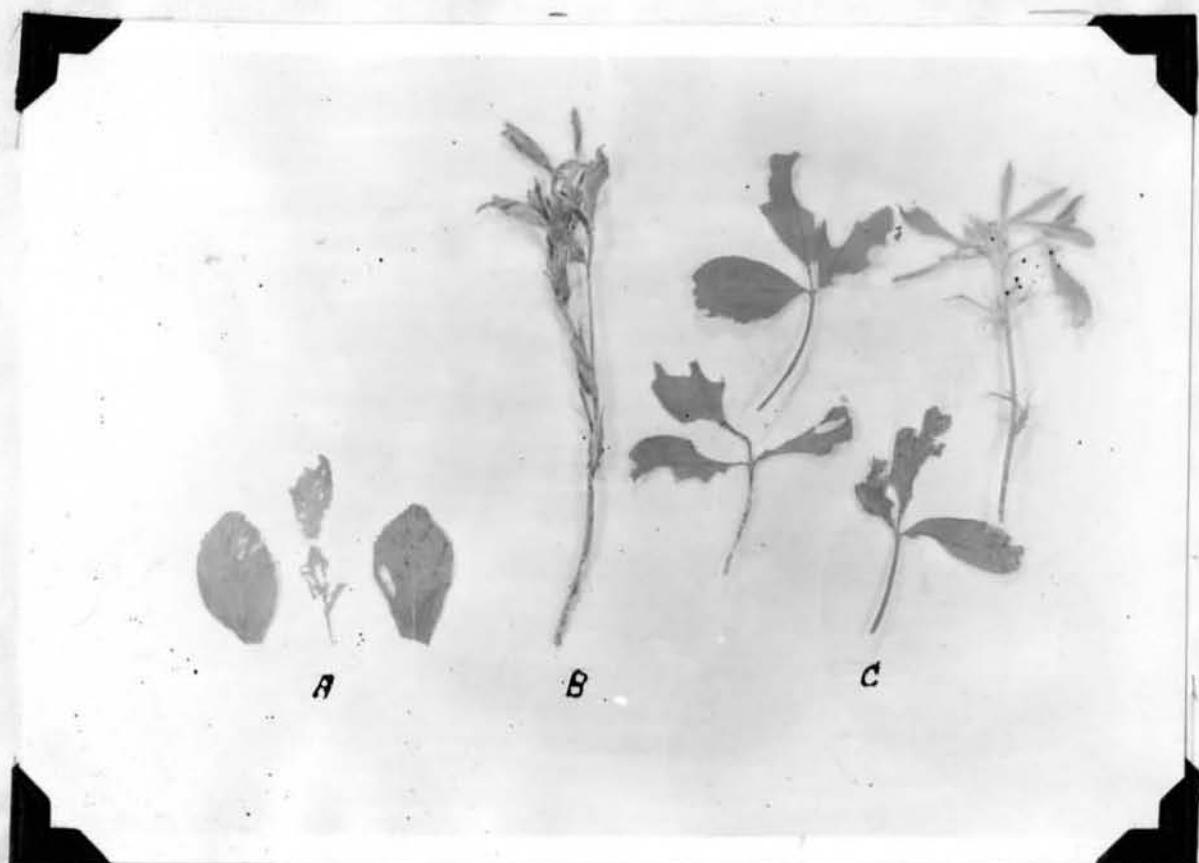
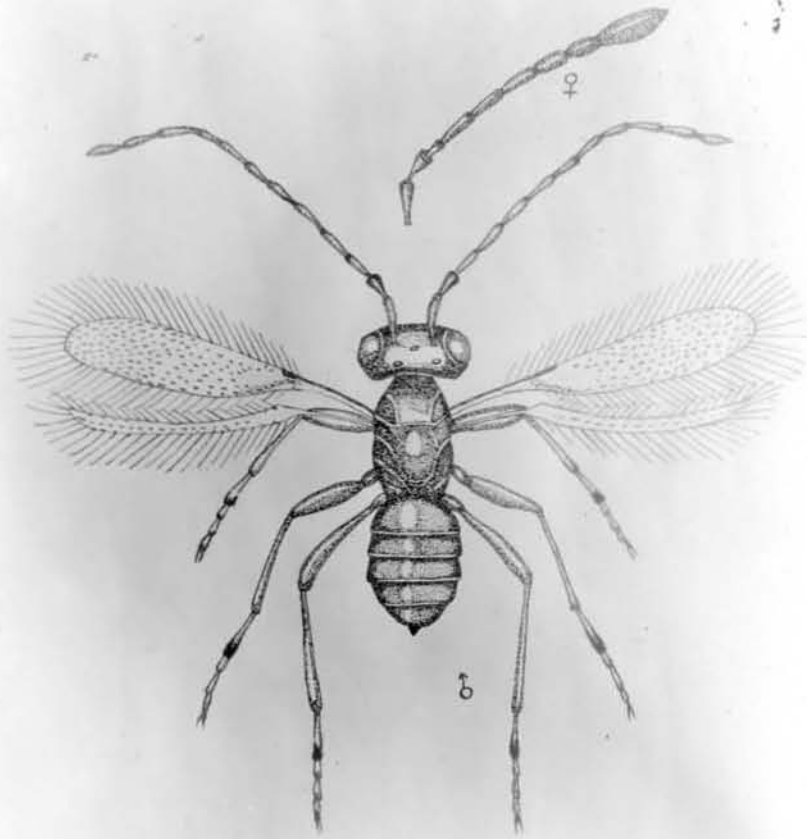


FIG. A. First Instar Larva Injury.
FIG. B. Stem injury caused by Adults Feeding.
FIG. C. Leaf Injury Caused by Adults Feeding.

PLATE IV



Anagrus praetensis