

July 2017

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Herbert Osborn
Iowa State College

H. A. Gossard
Iowa State College

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Recommended Citation

Osborn, Herbert and Gossard, H. A. (2017) "Reports on injurious insects," *Bulletin*: Vol. 2 : No. 18 , Article 6.
Available at: <http://lib.dr.iastate.edu/bulletin/vol2/iss18/6>

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REPORTS ON INJURIOUS INSECTS.

HERBERT OSBORN.

H. A. GOSSARD.

CORN BILL BUGS.

During the last few years there has been considerable loss experienced in some of the states to the east of us from the attacks of certain weevils, known commonly as "Bill Bugs," upon corn when it is just coming above ground, but up to the present year we have had no information of injuries from these insects in this state. It seems, however, that we are no longer to be favored in this respect as reports and specimens from a number of localities as well as a considerable abundance of the insects in the vicinity of Ames points to the increase of the pests and probable serious losses another year.

There are several different species concerned in the work in the states east of us, and as most of these occur in Iowa it is probable that we will have to consider most of them in time as destructive species, but during the present season we have had but two species sent to us or collected here in such numbers as to indicate any serious abundance.

In the present article we will therefore consider in detail only these two species, but it may be stated that in a general way the habits of the different species is much the same and in their attacks on corn they cause the same kind of injuries, but they differ in the plants on which they feed in the early stages and on this account it is necessary to know their habits in the immature stages in order to arrive at methods of rational treatment.

Some of the species attack valuable crop plants in the immature stages and are important to other crops than corn, but as it is the attack in the adult form upon corn that has attracted the most notice and it is for this damage that all inquiries have come to us this spring, we shall treat them mainly from the standpoint of corn pests.

THE CLAY COLORED BILL BUG.

(*Sphenophorus ochreus.*)

This is one of the most conspicuous beetles of the group, its large size and light clay color making it prominent wherever seen. While well known for many years it is only within a few years past that it has been reckoned as a serious corn pest and still later that its life history has been recorded. In the November, 1889, number of *Insect Life* published by the U. S. Dept. of Agriculture, Prof. F. M. Webster gives the essential facts of its life history with illustrations, which are reproduced here by the kindness of the department officials.

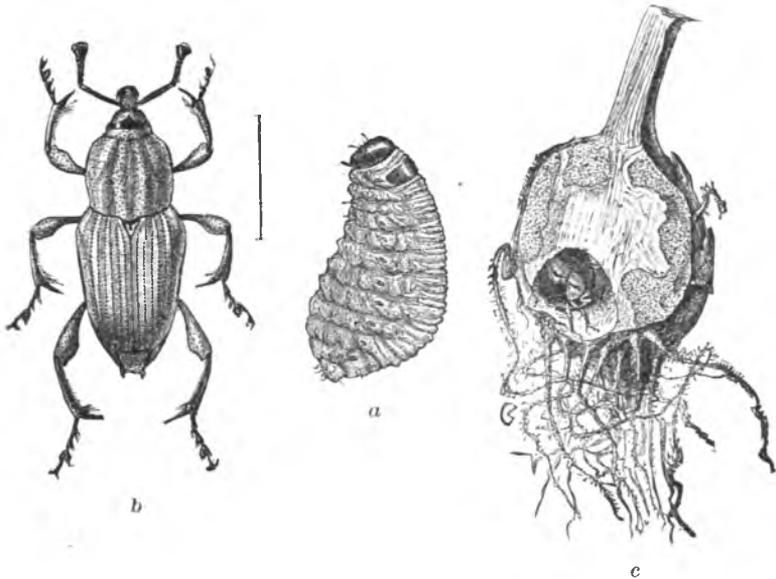


FIG. 1. *Sphenophorus ochreus* a, larva: b, Adult enlarged. c, Work of *Sphenophorus ochreus* in roots of *Scirpus*, natural size. (From *Insect Life*.)

“The insect passes the winter in the adult stage, coming forth from its hiding places in spring, and feeding upon the tender portion of the stems of the reeds and rushes, and later on the same parts of the young corn plants, if the field has been planted to that grain. Late in May and early in June the female deposits her eggs in or about the bulbous roots of *Scirpus*, the roots of this plant consisting of bulbs connected

by smaller slender roots. The larvæ burrow in these bulbs, which are many of the size of an ordinary hen's egg and very hard, and transform to the adult beetle therein, appearing on the rushes, reeds or corn in August and September, and feeding after the manner of their ancestors. The large size of the larva and the diminutive size of the corn at the period of oviposition renders it very unlikely that this species will ever breed in the roots of corn, and indeed no trouble has been experienced after the natural flora of the land has been eradicated." (Webster.)

Prof. Forbes, State Entomologist of Illinois, states that "Elaborate experiments made at the office and on the University farm, failed to show that this beetle could breed in corn. Hills of corn with which imagos had for several weeks been enclosed and upon which they fed with the greatest freedom were not infested with the larvæ of this species, neither could eggs be found upon or about them, although the beetles were pairing when imprisoned."

It may be considered from these observations that there is no danger whatever of this species becoming a pest to corn, except as the adult beetle attacks it for the purpose of getting food and it will naturally follow that the injuries occur in fields adjacent to low or swampy ground where the rushes which furnish the natural food for the immature stages occur.

It would be well wherever it is desired to plant corn upon land that has been recently drained or closely adjacent to wet ground where the rushes abound to examine the bulbs of these and if the larvæ occur in any numbers to make a warfare upon them at the time or to adapt cultivation so as to avoid the injury they may inflict. The larva living in the bulb is a whitish grub, of the form shown in the figure at *a*. It is described by Prof. Webster as "white, with brown head, the latter small, the body becoming very robust posteriorly, so much that it appears to be fully two thirds as broad as long and very much wrinkled. Feet wanting."

Where recently drained or swampy land is to be broken and planted the following year to corn it would be best to break as early in summer as possible before June 1st, so as to prevent if possible the growth of the larvæ and later, if beetles

appear, to starve them out before the time for the injury to corn the following spring. With regard to the prospect of treating them in this direction Prof. Webster says: "At the commencement of investigations, and after learning the habits of the larvæ, it looked as though breaking the ground in June or July and throwing roots and larvæ up the scorching rays of midsummer sun might destroy the pest. But having reared adults from the egg in bulbs kept in dry earth from the middle of June to the 25th of August, it would seem that little can be accomplished in that direction, and the only plan which now promises success, is to destroy all traces of their native food plants long enough before planting to corn to starve the adults, or compel them to seek other uncultivated localities."

THE LITTLE BROWN BILL BUG.

(*Sphenophorus parvulus*.)

This species is much smaller than the preceding, but on account of its greater diversity of food plants and its attacks in the immature stages on important crops it is liable to prove a much more permanent and serious pest. It is only about one fourth of an inch or a trifle more in length, of a dark brown, almost black color, but with the general form of the other species in the genus, and with numerous small punctures on the surface of the body. Prof. Forbes states that it is "certainly single brooded, is known to hibernate an imago, appearing in spring as early as March and April and occurring also in that stage in May, June and July. It has been seen to lay eggs July 1; occurs in the larval stage certainly from June 11 to July 21; has pupated by July 24; and has emerged as an adult from August 11 to October 5. Also that the larva eats into the grass bulb, commonly from beneath, completely hollowing it out, and scattering a fine meal-like excrement through the earth." Prof. Webster has shown that the eggs are laid in stems of wheat and rye, and the larvæ develop therein till half or two thirds grown, occupying the first or second joint above the ground and after consuming the substance within the stem burrows out and feeds upon the roots in the ground till full grown.

It is evident, therefore, that there can be no lack of food for the development of this species, and that it is ordinarily destructive to pastures, meadows, and grain fields, though so far as we know no extensive injuries have been noted in this direction. It is not unlikely, however, that occasional wilting and dying of stocks of wheat and other grain where no insects are to be found are due to this larva, it having left the stem before the injury was observed. The losses in corn are however often serious and the following letter from the Newton Bros., Massena, Iowa, will give the extent and character of damage as reported us from different localities.

MASSENA, IOWA, August 5, 1892.

Dear Sir: Your letter of the 30th ult., just received and contents noted. The bugs shown you by Mr. Kaufman were taken from our field July 9th. The field in question lies on high ground, forty acres on a ridge or divide, and slopes to a small living stream. There are no stagnant pools, rushes, or cat-tails along the stream. The east part or twenty acres is cut part way with two draws. About one hundred yards of the larger one was too wet to break at the outlet, or where it continues into the next farm. Both draws are drained by a mole ditch. The drainage, however is not thorough or satisfactory as they break through from the top and clog or stop up in places and the water comes to the top of the ground. The field was seeded to timothy eight years ago, being used as hay land for four years, since for sheep pasture. It contained quite a sprinkling of blue grass when we broke it up. The eighty joining on the east is native grass and has been used both for hay and pasture. This eighty is cut in two by a large draw or rather by a springy slough. West of this slough and joining, sixty acres were broken this spring and planted to corn, but the bugs did not work on it till after they had finished our field and not then to do serious damage. North of the sixty acres is old ground planted to corn, which was damaged some, but not much. A field of oats was lying on the south.

We commenced plowing as soon as the frost was out of the ground in March. Prepared the ground for planting by using a disk harrow, going over the field twice with this then fol-

lowing with a smoothing harrow and planter, May 30th being the date of the first planting. This the bugs took entirely, except a small strip along the creek on the west. For the second planting we used the disk and smoothing harrow once and finished planting June 17th. The late planting is seriously injured, but not entirely destroyed. They attacked the corn about the time one can begin to row it. They work mostly in pairs, with their heads downward, insert their bills into the tender stalk, sucking the life out of it, the leaves wilting. One can almost see the rows melt away. They work below the surface where the stalk is bleached. The hole or puncture is oblong, and where the plant is not entirely destroyed these holes show up on the leaves after they roll out and are about one-sixteenth of an inch in length.

We had also another field of thirty acres of timothy sod broken and handled in the same manner, which lies along the creek mentioned above. This field the bugs did not molest with the exception of just a few rows on the side next to the large field. There is a strip of pasture about fifteen rods wide between the two fields. Both fields were in splendid condition, being thoroughly pulverized and entirely free from weeds. The soil is black sandy loam.

NEWTON BROS.

It seems very evident that the bill bugs in this case had developed in the timothy or perhaps in other grasses in the vicinity of the affected corn fields. The bugs have well developed wings and could doubtless fly some little distance if necessity demanded, but probably in most cases feed largely in the immediate locality where issuing. The fields formerly in grass probably contained a considerable number of the beetles, but not enough to cause noticeable injury there, but when the crop was changed and they had to depend on scattering hills of corn their numbers were sufficient to destroy every young plant in the field.

It will be readily seen that methods of treatment for this species are made difficult by its varied food plants, and as no natural enemies are yet known for it, the outlook is by no means encouraging. It may be of some service, however, to bear in mind that since the worst injuries to corn are likely to follow planting on land that was previously in grass or ad-

jacent to such land, to break the land to be planted in corn the following year as early in the season as possible, and finally to plant such ground late and pretty heavy at first and be prepared to replant at once on first indication of destruction by bugs.

In case a crop of sod corn is desired it would probably work very well to break the first of June and plant at once for sod corn.

STRAWBERRY SLUGS.

There are two species of Strawberry slugs, but the common one here is not the one that has been usually referred to in articles on the insects affecting this plant. In fact, until about three years ago but a single species had been recognized. At that time Mr. F. W. Mally, a graduate student in the entomological department of this college, while working upon the subject, established the fact that our common form differed from the one ordinarily described both in respect to some points of structure and of habit.

The species formerly recognized was the *Harpiphorus maculatus*, Norton, while the new pest was *Monostegia ignota*, Cresson. The principal point of difference in the larvæ and the one by which they may be easily distinguished is that the *maculatus* larvæ have black patches on the face while the *ignota* larvæ are without these patches. The *ignota* larvæ appear somewhat earlier than the stated time for the *maculatus* larvæ and only one brood has so far been observed each year.

It may serve to distinguish these two forms where necessary, to call the unmarked species the Green Strawberry slug and the marked one the Black marked Strawberry slug. *Harpiphorus maculatus* has, however, been called the "Strawberry False worm," and if that name be retained for the old species it might suffice to simply call the new species the Strawberry slug.

The Green slugs are more or less troublesome to strawberry vines here every year, and sometimes they seriously threaten particular patches with destruction. It is doubtless this species that occurs commonly through the state. In ordinary seasons the worms have matured and entered the earth by

the first of June, according to Mr. F. W. Mally, but insect life was unusually late in appearing this season and the worms were working their greatest injury from the 6th to the 12th of June. At the latter date hardly a leaf could be found in a small patch upon the experimental grounds that was not greatly eaten by them.

On the 9th of June this patch was thoroughly sprayed with London Purple, one lb. of powder to 200 gallons of water. Two and one-half gallons of the mixture was applied to a patch containing very nearly one square rod. At this rate about 400 gallons of the mixture would be required per acre. Injury ceased within two or three days, and that the insects were destroyed by the poison and did not merely enter the earth to pupate seems proved by the fact that some larvæ caged in the same patch and from which the poison was excluded, were feeding greedily for several days afterwards. Also, on examination of the earth in the patch at this date, August 2d, fails to discover any signs of larvæ that may have escaped.

London purple containing 47 per cent of arsenic, we must have distributed about 40 grains of arsenic upon the plot. If we suppose that the fruit received one-tenth of the spray and the foliage the remainder we have four grains of arsenic upon the entire yield of fruit from the patch. As the fruit was only partially grown at the time of application it is safe to say that more than half of this amount had dissipated before the berries ripened. If we call the yield from such a patch six quarts (extremely small) and two grains of arsenic a dangerous dose, it will be readily seen what a quantity of fruit would have to be consumed at a single meal to get a dangerous dose. We believe that an application of one-half the quantity of spray actually used would have been practically effective in destroying the worm, and upwards of twelve quarts of the ripe fruit would then be required to give a fatal dose of arsenic, even under conditions the most favorable for its retention by the fruit, and under an almost certainly exaggerated supposition as the proportion of spray which the fruit can receive.

Within a week after the application was made the Assistant Entomologist and other employes of the department ate

very heartily of the ripened fruit with the intent of proving whether or not any ill effects would follow the freest use of the same. No injury whatever was experienced. When carefully applied we regard London purple or Paris green as perfectly safe and reliable insecticides to use upon strawberry vines infested by the slug. Injury by this species is almost always noticeable soon after the plants bloom and spraying at this time would be absolutely safe. On account of the possibility of carelessness in the use of poison we much prefer recommending that spraying be done at this time and not at the time when the fruit is actually ripening. We would consider it a good practice to give a careful spray of London purple or Paris green to strawberry beds every spring as soon as the bulk of the bloom is past.

The adult samples were taken here on the 5th and 6th of May this year, though they usually appear from the 1st to the 25th of April. There is one brood per year, the slugs entering the earth to the depth of an inch or so and remaining unchanged in the larval stage for a long period in a frail earthen cocoon. They probably pupate in the fall and they appear as adults in spring. *Coriscus ferus*, a hemipterous insect, is the only recorded natural enemy of this species, being recorded by Mr. Mally as feeding upon the slugs.

THE DIAMOND-BACK TURNIP MOTH.

(*Plutella cruciferarum*.)

The caterpillars of this insect feed upon cabbage, cauliflower, turnips, rape and other plants belonging to the Mustard Family. They are small greenish worms, about half an inch long, thickest in the middle, slightly tapering towards each end.

The rape upon the College Farm has been seriously damaged by them this season and as there is a succession of broods, adults appearing at all times from July till October, their injuries for the year are doubtless unfinished. They sometimes become sufficiently numerous to waste the entire crop. They feed chiefly upon the under side of the leaves, sometimes on top, usually eating irregular holes entirely through the leaf, but sometimes leaving the epidermis on the

side opposite to that upon which they are feeding, thus giving the leaf a diseased appearance as if affected with some fungus. Damage of the latter character is probably done by the caterpillar in its earlier stages of growth.

When disturbed they are violently agitated, wriggling vigorously about or dropping several inches and remaining suspended for a time by means of a silken thread which they spin for the occasion.

When full grown they encase themselves in thin gauze-like, white cocoons, fastened to the leaves of their food plant and of sufficient transparency to allow the chrysalis within to be distinctly seen. The chrysalis is grayish white with streaks of dark brown or black down the back and sides.

The moth hatches in from ten to eighteen days. It is about one-third of an inch long, with a wing expanse of over half an inch and in general is of an ash gray color. The forewings are dotted with black and the hind margin of each has a wavy white line, the two lines coalescing to form a string of two or three white diamonds along the back when the insect is at rest.

Remedies: Natural Enemies. A small blackish Ichneumon fly (*Campoplex paniscus*) is parasitic upon the *Plutella* larvæ and its tough brownish, paper-like cocoons may be found scattered about among the flimsier cocoons of the caterpillar, but is easily distinguished from them, being of smaller size, darker color and greater toughness. The parasite almost annihilates every vestige of its host before spinning its cocoon and what one day may appear to be only a *Plutella* caterpillar may have entirely disappeared the next day and in its stead will be found the Ichneumon cocoon. About 20 per cent of the caterpillars are destroyed by this parasite at this time and place.

Coriscus ferus, a carnivorous bug was also observed among the caterpillars, and from its well fed look and known habits we have no doubt it is a valuable ally in destroying the worms.

Podisus spinosus, the common soldier-bug, also destroys the worms, we having caught it in the act of so doing.

Artificial remedies. London purple and Paris green. London purple mixed with water at the rate of one pound to 200 gallons and applied with a good spray pump, operated

either by hand or horse power, at the rate of about 100 gallons per acre would doubtless be both safe and effective. Paris green should be used in the proportion of one pound to 150 gallons of water.

One hundred gallons of the London purple mixture contains 1645 grains of arsenic (counting London purple as 47 per cent arsenic). If we suppose four-fifths of the spray to alight on the foliage and the remainder to be wasted on the ground we will have 1316 grains of arsenic on not less than 15 tons of rape. Assuming 10 grains of arsenic as a dangerous dose for a cow or a horse, such an animal would have to eat about 220 pounds of forage immediately after the application to get a fatal dose. If the forage be allowed to remain standing a week or ten days or until after a rain before using there can be no danger at all in feeding the rape as a daily ration and if the rape is to be fed immediately there is no necessity for spraying.

Paris green contains a greater per cent of arsenic than London purple and is used in a stronger mixture so that it is a much more dangerous poison than London purple and a longer time should therefore be allowed to intervene between the date of application of the spray and the use of the forage.

Some field tests made by us with London purple, Paris green and Pyrethrum powder have not as yet given positive results, but we judge this to be due to the advanced stage of growth of the caterpillars, the density of the foliage and the manner of application, rather than to any lack of killing power possessed by the poisons. We believe that a fine mist-like spray carefully applied at the time when the first damage appears will reduce the pest sufficiently to make rape growing possible and so far as insect damage is concerned, profitable as well.