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Reports of entomological work

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REPORTS OF ENTOMOLOGICAL WORK.

HERBERT OSBORN. H. A. GOSSARD.

THE CLOVER-SEED CATERPILLAR.

(*Grapholitha interstinctana*, Clem.)

On the evening of the twenty-third of May many small dark brown moths were noticed flying about a clover field upon the College Farm. They were resting upon the blossoms and among the leaves and upon being disturbed would

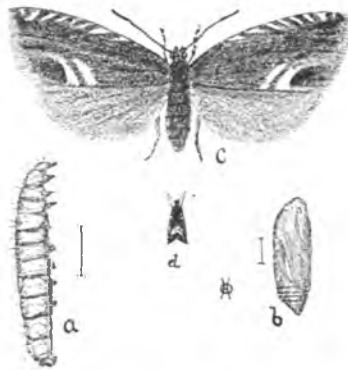


FIG. 1. *Grapholitha interstinctana*. a. larva. b. pupa. c. adult, all enlarged, d. adult natural size. (Original.)

fly a few paces and then settle again. These moths proved upon examination to be *Grapholitha interstinctana*, Clemens, the parent forms of the Clover-Seed Caterpillar mentioned in the Entomologist's report to the Commissioner of Agriculture in 1880.

We had during the past winter received specimens of clover-seed which we suspected of being damaged by this pest which has been reported as injurious in some of the states east of us in

the last year or two, and the moths are remembered as occurring here in numbers some eight or ten years ago, but they were not at that time connected with any damage observed in clover fields.

The moths this spring increased in number from the time they were first observed until by the third of June, in the early evening, when the field lay between the observer and the sun, a perfect cloud of them could be seen hovering over the blossoms as far as the eye could reach. They would spring up from under the foot like grasshoppers in a meadow on a sunny day. It was also noticed that they were pairing freely at this time.

The moths are very small and may be generally described as dark brown or nearly black in color. The wing expanse is from .31 to .39 of an inch. The majority are marked by two small parallel, excurved, short, silvery lines at the middle of the hind border of each fore wing so that when the wings are closed the lines form a double crescent over the back. (See Fig. 1, *c* and *d*) Some, however, are found to have all traces of the crescents obliterated. Eight white, silky lines are disposed along the front border of each of the fore wings which in common with the hind wings are delicately fringed. The wings beneath are shining and silky and have a greenish tinge in certain lights.

On the 24th and 25th of June an examination of 177 heads of clover taken from the field before mentioned showed ninety-one heads infested with the caterpillar of the moth as against eighty-six not infested. Many of the larvae were full grown and some were spinning their cocoons. The hay was cut at this date. An examination the next day (June 25th) of forty-eight clover heads taken from scattered bunches on the college campus showed eight, or sixteen and two-thirds per cent, of the whole infested. Examining forty-two heads from a different field cut on the 23d and 24th of June only three were found infested.

The damage was done by eating into the young florets and later into the seed vessels causing the heads to dry up and the flowers to shell from the receptacles like chaff.

The larva (Fig. 1, *a*) is a small, greenish-white caterpillar with a dark brown head and is about twenty-five to thirty hundredths of an inch long when full grown. Many of them become tinged with red toward the hinder extremity as they approach the time of pupating. About the 24th of June the adults had nearly all disappeared, a few stragglers only being found by diligent search. Of a number of larvæ preserved in a breeding cage the first pupa was found July 14th, but a visit the same day to the field before mentioned proved the second brood of the adults to have already appeared. An examination of dried bunches of hay left on the field disclosed some larvæ in the heads which had spun their cocoons to pupate, from which it is concluded that the caterpillars can live in the cut hay for a considerable time if not hamp-

ered in their movements. An examination of the hay from the same field stored in the barn showed all the larvæ to be dead. A dead pupa was also found, but nothing living. There were no empty pupa cases found to indicate that any moths had escaped from the hay thus stored. It seems certain therefore that everything that was subjected to the pressure and heat incident to storage was killed. The remedy then for this pest, which has caused the destruction of probably fifty per cent of the clover seed in the field observed, is to cut the hay soon after the first brood of larvæ appears, or in early June. The hay should be carefully cleaned from the field so that no larvæ will find harbor in stray bunches which have not been gathered up. Scattered clover growing by the roadsides and in the fence corners should also be carefully mown at this time and the heads, at least, disposed of in some manner to ensure the destruction of the larvæ they may contain. This method cannot but prove effective in reducing the second brood of the moths and will also operate against the clover-seed midge, (*C. leguminicola*,) mentioned in previous Bulletin, No. 13, and which has been plentiful and destructive here this season.

The track of the larva is very uniformly from the base of the blossom upward and the younger larvæ are almost invariably found near the base and beginning their work on the florets there. It would seem therefore that the eggs are deposited at the base of the receptacle and the larvæ upon hatching may begin at once upon the older florets. In working upward, roughly speaking, they usually form an irregular spiral track around the receptacle.

The delicate white silken cocoons of this insect are spun in the head among the dried florets, frass, and bits of eroded but undevoured flowers, so covering them with brown as to make them difficult of detection. The pupæ work their way entirely out of their cocoons and drop to the ground before bursting their pupæ cases, which may be found in abundance on the ground from which a brood has just issued.

The second brood were observed pairing during the last week of July, and August 5th, the larvæ were found in great numbers, one having at that time spun its cocoon preparatory

to pupating. The rate of growth would seem to establish that there are three broods per year here, and possibly, though not probably four.

Observations upon this species will be continued through the year and it is hoped that some points in its economy yet in question will be definitely settled.

EXPERIMENTS WITH THE HOPPER-DOZER FOR GRASS LEAF-HOPPERS.

Following up the work indicated in last bulletin we report some experiments with the Hopper-dozer for leaf-hoppers. The larvæ of some species of the leaf-hoppers, notably *Deltocephalus debilis* and *D. inimicus* appeared in great numbers upon the college campus about the eleventh of May. About two weeks later a frame six feet long and about two and one-half feet high was mounted upon runners so that it made an angle of about sixty five degrees with the horizontal, and was covered with heavy paper which was then coated with coal tar. The runners were about one and one-fourth inches high so that the lower edge of the frame would scrape the grass when it was pushed forward by means of two handles so fastened that the operator could walk behind. This machine was somewhat unsatisfactory. The insects would be caught upon the lower part of the dozer and be brushed off on the grass together with the tar which not only prevented our knowing the results we were getting, but injured the grass to a slight extent for feeding purposes. It was also noticed that many of the insects upon rising in front of it would swerve from its path too quickly to be caught by its motion. However, many of the insects were destroyed and an unexpected result was that multitudes of mites (*Bryobia pratensis*), were captured, probably being thrown on the dozer by the backward spring of the plants upon which they were feeding, from beneath a wire fastened two or three inches before the dozer for the purpose of scaring up the leaf hoppers. Another form of the dozer was next tried. A piece of sheet iron, eight and one half feet long and two feet wide, was coated on the upper side with coal tar and,

lying flat on the lawn, was dragged along by means of three cords, one fastened at each end and one in the center. The advantage of this form of machine over the preceding was at once apparent. It was more easily operated, no tar was wasted, and the insects upon springing into the air were almost certain to fall upon it in their descent. Two plats of blue grass upon the college lawn, having as nearly as possible the same natural advantages, were selected for experiment. May 29th one of these plats, which for convenience we will call plat 1, was run over with the dozer, letting it at each round of the plat run over about half its width on the track of the preceding round, so that the entire plat was run over twice with the dozer. This plat, a triangle, was bordered by a grape patch on one side and by roadways about twelve feet wide on the other sides, so that the migration of the leaf-hoppers into it from adjacent parts was in some degree prevented. The second plat, directly adjoining, was left untouched, and in this the insects pursued their work. The difference in growth and vigor of grass on the two plats was very noticeable in a short time, though no advantage of one over the other could be detected at the beginning of the experiment. This difference was more marked during an extended dry period than at other times, thus indicating that the grass upon the untreated plat was materially sapped by the insects. Any possible natural advantage which plat 1 may have had over plat 2 we think insufficient to account for all the difference noticed. In order to ascertain the comparative numbers of insects at work in the plats, on the ninth of June, the dozer was dragged three rods on plat 1. By actual count three hundred leaf-hoppers were taken. On plat 2 in moving the dozer the same distance, one thousand five hundred and sixty-four (1564) leaf-hoppers were taken; that is, more than five times as many as upon the plat which had been treated ten days previously.

Upon the same day we attempted to clear plat 1 the second time with the dozer, but were compelled to stop by the interference of the grass pollen which soon covered the tar and enabled the insects to leap from the dozer back into the grass again. Hence, the dozer must be used before the grass blossoms, if grass is allowed to go to seed. On the twentieth

day of June, we again tried the dozer, the insects at this time for the most part being well developed and able to fly. Two men operated the dozer, each holding a string fastened at the end and one fastened to the center, four strings in all. The advantage in having two men is that when alarmed by approaching footsteps on either side they will move centerward and be caught by the dozer, whereas, when one man draws it and walks in front of the center they fly outward from his path on both sides and thus tend to escape.

In moving fifty-five feet with the dozer the number of leaf-hoppers taken was estimated by counting the insects on three sections of the dozer, each six inches long and extending the entire width of the dozer. The counts were 183, 319, and 226, respectively, which averages 243 for each section, or 4,131 on the whole pan. At this rate about 376,000 insects would be caught per acre.

Another test was made at the same time, dragging the dozer over sixty-six feet of lawn. This time five sections of six inches each were counted off and averaged instead of three, which resulted in giving 2,805 insects on the dozer, or 213,089 would be taken on an acre.

Their wings at this time were so developed that many would fly entirely over the pan. At this stage the dozer should be of greater dimensions than ours, or used at hours of the day when hoppers are less active. The difference in numbers on the ground run over with the dozer and that not cleared was not very noticeable and there can be no doubt that over one million leaf-hoppers can, and often do, live on an acre of ground.

The dozer will be found most effective while the insects are still immature and unable to fly readily.

Other insects captured at the same time, and worth noting, were several of the *Elateridæ*, or click beetles, the parent forms of the destructive wire-worms; some Tineids; sod web-worm moths, and numerous *Capsidæ*.

July 2, the hay upon plats 1 and 2 was cut and the product of two equal triangles, carefully surveyed with a surveyor's chain, and each containing 39-100 of an acre, was weighed and compared. The hay from the triangle on plat 1 weighed 338 pounds, or yielded at the rate of 876 per acre. The hay

from the triangle on plat 2 weighed 252 pounds, or yielded at the rate of 646 pounds per acre. The difference in weight from the triangle on plat 1 and the triangle on plat 2 was eighty-six pounds or at the rate of 221 pounds per acre, thirty-four per cent in favor of the treated plat.

Our experiments seem to us to strengthen our previous opinion that by using this simple form of the Hopper-dozer the yield of hay or pasture land may be increased from one-fourth to one third, at a cost not exceeding ten cents per acre, even if all help employed is hired. We would recommend the use of the simple flat dozer and advise that it be used in the spring just as soon as young hoppers appear, and then if either these or young grass hoppers appear numerous at time of hay cutting, that the treatment be repeated.

KEROSENE EMULSION FOR PLANT LICE.

The present year has been a remarkable one for the great numbers of plant lice that have covered fruit trees, shrubs, bushes, and other vegetation. The dry autumn of last year followed by a winter so mild that insect life was astir during the whole period seems to have been very favorable for the preservation and development of the eggs of plant lice. The season had hardly opened before they began to appear in great numbers upon such fruit trees as plum and cherry. May 27th we had the plum orchard sprayed with kerosene emulsion, but by mistake an unsuitable nozzle was used, which together with the inexperience of the operator, did very imperfect work. The emulsion used also proved unsatisfactory, in other work as well as this. An examination of the trees a few days later indicated that some of the lice had been killed, but the majority were unaffected. They continued to live and multiply until the blades of the leaves and the leaf and fruit petioles were covered with them, the fruit on many trees being much shrivelled and stunted from their presence. However, we made no further effort to destroy them at this time, since we regarded the certainty of their destruction by means of kerosene emulsion, as having been conclusively established by previous experience. Inquiries, however, pouring in upon this and the Horticultural

Department for information regarding remedial measures, and many reports indicating poor success in the use of the emulsion, induced us to make another and thorough attempt at their destruction. An emulsion was made according to the standard formula, and June 10th, two plum trees about twelve feet high were sprayed with this mixture until every part of the tree dripped from the application. About six gallons of the mixture, or three gallons per tree was used. The next day many of the lice were dead, the living ones much affected. June 13, the application was repeated upon the two trees and a third tree was thoroughly sprayed for the first time since May 10. About the same amount of liquid was applied per tree as on the tenth of June. Also many branches of other trees including plum, apricot and cherry, were thrust into a pail containing the dilute emulsion and marked for further identification. June 15th, nearly all the lice upon the treated trees were dead, those upon the tree that had been treated once being as nearly destroyed as those which were treated the second time. The lice were killed perfectly upon all the branches that were dipped, but some damage to the foliage was noticed due to the action of free kerosene which rises to the top of these mixtures in small quantities. When this method of application is wanted the free kerosene should be carefully skimmed off or removed by dipping some absorbent, like paper, into it; after the free kerosene had been taken up by the first branches dipped no damage was done even to the tender apricots. No damage whatever resulted to the foliage from the application with the pump. By the twentieth of June every louse upon the trees thus treated was dead and the leaves and stems were black with the withered remains. We concluded that kerosene emulsion is a perfect remedy against plant lice if the application is thoroughly made and that it need not be repeated to give certain results.

The failure with this remedy may be due to poor emulsions, lack of thorough application and, in cases where the leaves have become considerably curled, by the fact that so many lice are so perfectly protected that the liquid does not reach them. We believe attention to these points will insure certain results.

First, have a good emulsion and dilute it with twelve to fifteen times its bulk of water.

Second, use a good nozzle, one that will give a fine mist-like spray and apply thoroughly so that every leaf is wet.

Third, if leaves are curled remove any free oil from the surface of liquid and then dip branches bearing curled leaves directly into the pail and brush them around until the liquid has had opportunity to penetrate to every corner.

NOTE ON GRASSHOPPERS.

The recent rumors regarding the probable invasions of the Rocky Mountain Grasshopper and the actual abundance of our native species this season will make some items on this subject timely.

The Rocky Mountain Locust or Grasshopper (*Caloptenus spretus*) which caused such extensive devastation in Colorado, Kansas, Nebraska, Dakota, Minnesota, Iowa, and Missouri about fifteen years ago has been reported abundant and likely to repeat the invasion of that time. This has naturally excited great interest not only in the localities near their present limits but all through the region previously visited. The matter has been promptly investigated by experts in Colorado, Dakota, Nebraska and Kansas and it seems safe now to draw some inferences as to the possible danger for Iowa.

In North Dakota there has been a local outbreak covering a considerable area but reports from that region do not indicate any probable migration since the area is too limited and vigorous measures have been adopted to suppress the insects. So far as Iowa is concerned this is the only direction from which there need be any fear as all the breeding grounds and all known areas infested west or southwest are too remote for any possible invasion for a long time.

The reported invasions in southeast Colorado which have been carefully investigated by Profs. Snow and Popenoe, of Kansas, prove to be by an entirely different species and one which has never been known to migrate any great distance or to cause serious loss for any length of time. The reports from

southwest Kansas have been based entirely on the presence of common native species.

In a recent trip for the Division of Entomology of the United States Department of Agriculture the writer examined three counties in southwest Kansas and in all the region examined and the territory observed enroute saw no grasshoppers in exceptional numbers except the Differential Grasshopper. This is a species common in the entire eastern part of the United States, which was causing severe damage to alfalfa, to orchards and gardens in the irrigated tracts in Finney, Kearney and Hamilton counties. No danger threatens us therefore from that direction. We have in Iowa, however, several common native species usually plentiful every year and which cause a constant loss to the agriculture of the state. They seldom cause entire destruction of a crop even in limited areas and hence attract less attention but the injury they do must amount to millions every year. Occasionally they prove very destructive in oat fields by stripping the heads. Were it impossible to do anything to lessen their numbers it would perhaps do little good to call attention to this loss but there is no question that measures may be adopted that will aid materially in reducing the injury.

The two species which are probably most universally distributed and injurious are the red legged grasshopper and the differential grasshopper.

The Red Legged Grasshopper (Caloptenus femur-rubrum) is perhaps the most common one we have and an almost invariably occupant of our meadows and pastures. It is a rather small species, only about one inch long and rather slender. It occurs all through the eastern and central parts of the United States and since it is present every year and a hearty feeder must greatly reduce the amount of grass growing on any particular field.

The Differential Grasshopper (Caloptenus differentialis) is a large olive green or greenish yellow species that becomes conspicuous in mid-summer the adults at this time gathering on garden plants and along the borders of fields. It was this species which was found so numerous and destructive in western Kansas this summer.

Means of Destroying Grasshoppers.—These grasshoppers usually select rather firm ground for the deposition of their eggs and where it is noticed that they are depositing freely along the margins of fields it will be profitable to run a harrow or cultivator late in fall along a space ten or twelve feet from fences to break up the earth and expose the egg masses to the weather. A harrow of the Acme pattern would do this we should think very effectually. In meadows and pastures this is of course impracticable and for these we believe the use of the hopper dozer the most practicable plan that can be recommended. In many cases it can be used to capture these and the leaf hoppers at the same time, especially if used when the grasshoppers are still quite small and can be held by the thin layer of coal tar used on the simple flat sheet of sheet iron. When larger they need a deeper layer of coal tar or a pan of water with a covering of kerosene.

A simple and cheap plan for this purpose, costing but from one dollar and a half to two dollars was described many years ago by Prof. Riley. It consists of a strip of sheet iron eight or ten feet long, turned up one inch in front and one foot behind with pieces soldered in at the ends, and hooks placed in front at the ends for the attachment of ropes. If to run on rough ground it will be bettered by putting runners an inch and a half or two inches high underneath. Into this put a layer of coal tar a half inch deep or water and kerosene. It can be drawn by a boy at each end or by horse power if preferred. Where a large area is to be treated it can be done very rapidly by putting a series of four or five such dozers together covering a strip forty feet wide, one boy serving to draw the adjoining ends of two dozers except at the outer ends.

To treat pastures and meadows for these and leaf hoppers it would seem from present experience the best plan to run over all grass lands early in May with the simple dozer described for leaf hoppers, and in pastures a second time about the middle of June. For meadows the second treatment may follow hay cutting if insects are abundant and then if grasshoppers appear in numbers in July resort to the deeper hopper dozer described above.

THE FLAVESCENT CLOVER WEEVIL.

(*Sitones flavescens*, Allard.)

About the middle of June a few specimens of a small rusty brown curculio which proved to be *Sitones flavescens*, Allard, were swept from red clover (*T. pratense*), and have since been found very abundant. This is an imported species injurious to clover in Europe and reported as injurious to the white and Alsike clovers (*T. repens* and *T. Hybridum*) further east but not partial to red clover. The species is probably widely distributed throughout the west and feeds very readily upon red clover in this locality. From their numbers here they must do a considerable amount of damage. They love to secrete themselves beneath the rubbish about the roots of the plants and it is only by careful searching for them here that their numbers can be discovered. An estimate of five per square foot of ground in the field examined we think is not exaggerated. From the nature of the damage they do they must be as injurious to clover as any one species of grasshopper in this section in a year of average abundance and doubtless they have been responsible for some of the damage that has been charged against some of these insects. Their favorite method of feeding is to take position near the edge of a clover leaf and while the body remains stationary to move the head and thorax as far as possible in every direction thus eating out a semi-circle whose diameter is the edge of the blade. Several of these discs may be eaten from one blade. If the leaf is folded and the curculio happens to feed on the midrib side the semi-circle eaten from the two adhering halves form a complete circle in the center of the leaf when it expands. Several of the insects have been confined in a cage for some time, but no eggs have been deposited yet so far as discovered.

The insect is a little less than one-fourth of an inch long, and about one-tenth of an inch wide, and has a faint light brown stripe running the length of the head, between and over the eyes, continued over the lateral edges of the thorax and dimly discernible on the wing covers. In some specimens this stripe is not easily seen. The wing covers are grooved and finely punctured in series.

We desire to learn as much as possible regarding the abundance and distribution of this insect in the state, and would ask all who may have noticed it, or can find it by looking, to report it and send specimens to the Experiment Station.

THE WHEAT-BULB WORM.

(*Meromyza americana*, Fitch.) •

The larvæ of this widely known fly were found working in the wheat upon the Experimental grounds about the 20th of June. Perhaps not over one-fourth of one per cent of the heads were infested but their whitened, blighted appearance rendered them very conspicuous among the healthy green ones around. Heads of wheat and rye prematurely ripened by injuries inflicted by this insect withdraw from their sheaths readily and from one-half an inch to two inches above the the upper joint a pale watery-green maggot about one-fourth of an inch in length will be found. The stem of the grain will be eaten and withered about two inches above the joint. Pupæ greatly resembling the larvæ, are found in the same position, encased in the skin cast of the larva which serves as a puparium. No kernels develop in heads of grain infested in this manner.

It is pretty well established that there are three broods of the insect, the summer brood developing in the upper part of the stems of wheat, rye and perhaps some grasses, the adult flies emerging from about the fourth of July to the fifth of August, a brood from volunteer rye in September, and a winter brood working at the base of the stalk, just above the root, between the bases of the inner leaves, sometimes entirely within the stalk in October and November, continuing their work in spring and coming forth as adults in May.

The fly is preyed upon by an abundant parasite, *Cælinius meromyzæ*, Forbes and probably by two undetermined species that we have recently reared. *Cælinius* is a minute, shining black, wasp-like insect, which thrusts its ovipositor into the burrows of the maggot and deposits an egg upon the growing larva, which is devoured by the young *Cælinius* hatched from the egg just mentioned. This parasite has been reared by us this season from infested wheat heads and was found very

abundantly here last year by Prof. Gillette. From twenty-eight heads of rye infested with the maggot and from which the heads were removed, placed in the breeding jar July 7, we have secured at this date, August 8, three *meromyzæ* flies, and three and six specimens, respectively, of the undetermined parasites above mentioned. While it is possible that one or both of these may be secondary parasites, the probability is that they attack the *meromyza*.

With such efficient enemies it does not seem probable that the wheat-bulb worm need become a subject of alarm in this section. We would be glad to hear from other sections of the state, however, as to its abundance, and if it has caused any extensive injuries we will follow it up and if possible send parasites to sections of the state where they may not as yet occur.

FORMULÆ FOR THE PREPARATION OF KEROSENE EMULSION, LONDON
PURPLE AND PARIS GREEN.

Kerosene Emulsion.—Dissolve half a pound hard soap in one gallon water (rain water preferred) and while still boiling hot, remove from fire and add two gallons of kerosene, stir violently together by driving through a force pump back into the vessel containing the mixture, or by using an egg beater, until it forms a creamy mass with no oil on the surface. This requires usually from five to seven minutes. The mixture should not separate but form a jelly like mass that mixes readily with water and that can be kept indefinitely. When using mix with nine to fifteen parts of water to one part of the emulsion, the former proportion for bark lice and the better protected insects, the latter for delicate insects such as plant lice. It is applicable to all insects that are exposed so that the liquid can be made to cover their bodies and is especially serviceable for suctorial species that can not be destroyed by arsenical poisons or where such poisons are inapplicable.

London Purple and Paris Green.—In general use one pound of the poison to two hundred gallons of water. The foliage of apple trees will stand a solution slightly stronger and plums, peaches and other trees with specially tender foliage are safer with a solution still more dilute. •

SUMMARY OF ENTOMOLOGICAL ARTICLES.

The Clover Seed Caterpillar, (*Grapholitha interstinctana*) which has been abundant and destructive, is described and figured in different stages, and the conclusion reached that cutting the clover and storing it while the caterpillars are still in the clover heads results in the entire destruction of the insect.

Experiments with hopper dozers for grass leaf hoppers show that this method can be used very successfully in capturing the insects, that the simplest form, a flat sheet of sheet iron, was most satisfactory, that one application resulted in adding thirty-four per cent of crop of hay on a plat experimented on, and in one experiment leaf hoppers were captured at the rate of 376,000 per acre.

Kerosene emulsion for plant lice was used once with poor success, but later an application of a good emulsion by thorough methods resulted in complete success.

Grass hoppers are mentioned as troublesome this season and the reports of Rocky Mountain grasshoppers referred to. No present damage to Iowa is apprehended from this latter species, and methods of controlling the common native species when numerous are discussed.

The Flavescent Clover Weevil is found abundant at Ames. Its distribution is referred to and its method of work described. Information regarding its occurrence in other parts of the state is requested.

The Wheat-Bulb Worm has occurred in moderate numbers, but abundant parasites have been found to attack it at Ames and its serious multiplication is not considered probable.

Directions for making kerosene emulsion and arsenical solutions are given briefly.