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The Mexican Cotton Boll Weevil.

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THE MEXICAN COTTON BOLL-WEEVIL.

By Edwin Mead Wilcox.

Introduction.

In twenty years the Mexican cotton boll-weevil (*Anthonomus grandis* Boh.) has developed from a rather obscure species to one of supreme importance with respect to the production of the world's supply of cotton. The infested regions are taking desperate measures to destroy the pest or to adjust and modify the present methods of cultivation in such manner that cotton may still be grown at a fair profit in the infested regions. The recent appropriation of $250,000.00 by the Congress of the United States for the exhaustive study of the boll-weevil problem from all points of view has given to the boll-weevil a national importance.

It seems desirable to present to Alabama cotton growers our present information upon this very important subject together with the suggested methods of controlling the boll-weevil should it ever become established within the borders of our State. This bulletin may therefore be said to result from an application of the old adage, "forewarned is forearmed." No claim for originality is made as to the facts stated, but the reader is referred to the papers mentioned in the Bibliography at the close of the bulletin for the most recent original investigations of this subject. The facts given in the papers cited have been freely drawn upon in the preparation of this bulletin.

Introduction and Present Distribution of the Boll Weevil.

The boll-weevil probably crossed the Rio Grande river into Texas about 1892—at least that is the opinion of the

planters in that region. By 1894 it had spread to a half dozen counties in southern Texas bordering upon the Rio Grande river and the Gulf of Mexico. At this time it was brought to the attention of the United States Department of Agriculture; the Division of Entomology commenced late during 1894 the investigation of the weevil and has continued this investigation to the present time. The Department of Entomology of the Texas Experiment Station has also rendered efficient aid in the investigation. The recent appropriation by Congress has made it possible to concentrate upon the boll-weevil problem the efforts of a large number of persons and the weevil is now receiving more attention than probably any other insect pest in the world.

Fig. 1. *Map showing the distribution over Texas and Louisiana of the boll weevil at intervals since its first appearance in Texas.* *Bull. 45, Div. Ent., U. S. Dept. Agr.*)

The map shown as Fig. I presents graphically the present known distribution of the weevil as well as the advance it has made over the area indicated since its first appearance in 1892. From a study of the insect's means of reaching new territory it has been estimated that the weevil will be at work throughout the entire cotton belt of the South in 15 to 18 years. In Texas during the past ten years the weevil has made an annual advance of about 50 miles.

Having this danger in mind and to prevent the accidental or intentional introduction of the pest into the State the last Legislature passed the following law, which is here quoted in full:

An act to prevent and prohibit the importation of seed from cotton affected with Texas boll weevil.

SECTION 1.—*Be it enacted by the Legislature of Alabama,* That no person shall import or bring into the State of Alabama any seed from any cotton affected with what is known as the Texas boll weevil, nor the seed from any place where the cotton has been affected with said boll weevil.

SEC. 2.—Any person who violates the provisions of Section 1 of this act shall be guilty of a misdemeanor, and, on conviction, shall be fined not less than ten dollars ($10.00) and not more than five hundred dollars ($500.00). [H. 877. No. 559. Approved Oct. 6, 1903.]

Legislation can, after all, however, do nothing more in this case than build up public sentiment and arouse interterest in the weevil problem and if cotton planters permit the weevil to become established in this State it will be the result of their own neglect. Planters and others will confer a great benefit upon themselves and upon the State by promptly reporting and sending specimens of any suspected boll-weevil to the Alabama Experiment Station. All such insects should be killed with chloroform or other means before being forwarded through the mails and then be enclosed in tin or wooden boxes.

Amount of Damage Due to Boll-Weevil.

There is frequently a tendency to greatly exaggerate crop losses, but a very conservative estimate shows that the damage done by boll-weevil in Texas amounts annually to about $15,000,000. The loss in the weevil-infested counties of Texas is certainly fully one-half of the crop. If we assume that the total cotton crop of the United States has a value of $500,000,000 it will be seen that when the boll-weevil is found throughout the whole cotton belt the annual loss will be at least $250,000,000 annually. All these estimates are based upon the failure of the planters to adopt any measures to check the spread of the pest or particularly to reduce the extent of its damage. We shall see that there is much hope that cotton may be grown at a profit in the infested regions if the planters will adopt the modern methods of planting and cultivation suggested and urged by the Bureau of Entomology of the Department of Agriculture.

Life History of Insect.

EGG.

The female weevil deposits the egg in a hole made by eating into either the square or boll. These cavities are made usually between the middle and the tip in the case of squares, but seem to occur at random in the case of bolls. The length of the egg stage in the vast majority of cases varies from 2 to 5 days. It has been observed that but a single egg is usually deposited in a boll if the female is able to find bolls not punctured. This habit of selecting a fresh boll for the oviposition of each egg accounts for the large number of bolls injured by a single female. It is probable that a single female may deposit as high as 200 eggs during the season.

Larva.

The larva when it escapes from the egg is a delicate white grub about 1-25 of an inch long, and without legs. (See Figs. 2 and 3.). If it were not for the brown head and mandibles the larva would be quite as inconspicuous as is the egg itself. In the squares the larva probably molts but twice while growing, but it is almost certain that in the bolls, and perhaps also in squares, there is also a third molt.

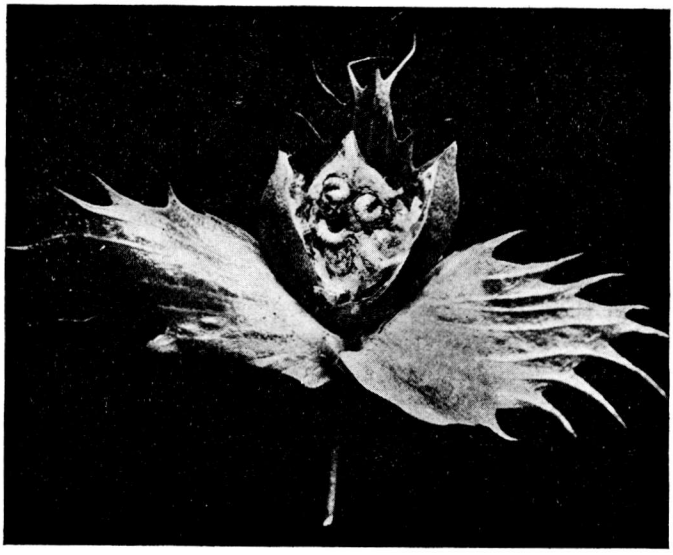

Fig. 2. *Three large larvae in a boll.* $x\frac{3}{4}$. (*Bull. 45, Div. Ent., U. S. Dept. Agr.*)

During the warmer parts of the summer it is probable that the larval stage in the squares lasts not over 6 days, but in colder weather the period is of course longer. Even frosts do not kill the larva in the bolls, and they may continue their growth and complete their development after the occurrence of a frost.

In the bolls the larval stage last probably much longer and here 6 to 7 weeks is near the length of the larval period.

As the boll reaches maturity the mature larva, now 1-4 to 1-3 of an inch long, ceases feeding and becomes surrounded by a sort of cell composed of larval excrement mixed with the lint, etc. Within this cell the pupation and formation of the adult occurs. The cells are shorter and thicker than cotton seeds, with which they are at times confused.

PUPA.

When the insects enters this stage it has much the form of the adult, but its color is pure white or cream. (See Fig. 3.) The pupa stage lasts in squares on the average three to four days in warm weather, but may reach a maximum of 15 days in cold weather. The pupal stage is certainly longer in bolls than in squares, but no definite data are at hand on this point.

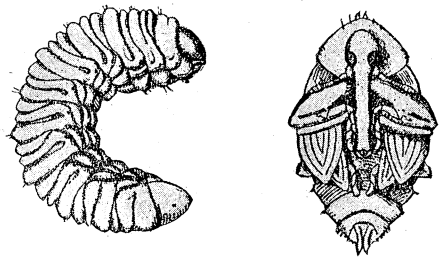

Fig. 3. *Larva, to the left, and pupa, to the right. x6. (Farmers' Bull. 189, U. S. Dept. Agr.)*

The final molt of the pupa requires about a half hour.

ADULT.

About 2 or 3 days are required for the adult to assume the color typical of the species and to acquire sufficient strength to enable it to walk. The weevils may vary much in size dependent largely upon the question of

available food supply. With the proboscis extended they vary from 1-8 to 1-3 of an inch in length and in the middle of the body are from 1-25 to 1-8 of an inch broad. (See Fig. 4.)

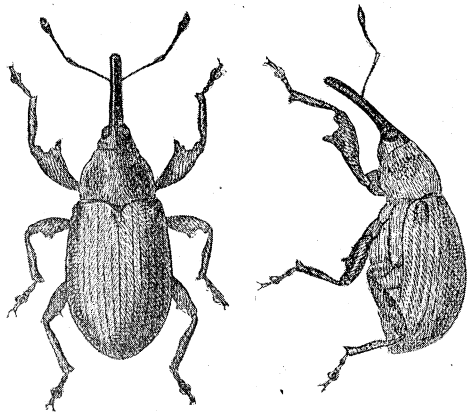

Fig. 4. *Mexican cotton boll weevil* (*Anthonomus grandis*). *x*3 (*Bull. 45, Div. Ent., U. S. Dept. Agr.*)

The color of the boll weevil varies with the size—the smaller weevils being darker brown and the larger weevils being light yellowish brown. The average color between these two extremes is a gray brown or dark yellow brown. The yellowish color of the larger specimens is due to the presence of numerous yellowish scales that are more conspicuously formed in large than small weevils. These scales, however, often become rubbed off, leaving the dark brown color of the chitin. The sexes, however, cannot be distinguished as is often supposed by any question of either size or color.

The average length of life of the adult weevils on squares is about 10 weeks for males and 9 weeks for females. On the bolls it is nearly 3 weeks for males, but only about 2 weeks for females.

Feeding Habits.

Until the females begin to oviposit the feeding habits of both sexes are alike. Bolls and leaves are seldom fed

upon so long as squares are available. The puncture from the outside is only large enough to admit the proboscis, to the tip of which the mouth parts are attached. The principal part of the square eaten consists of the anthers and pollen sacs. When these are reached the cavity is broadened out to give to the whole cavity much the shape of a flask.

The males are known to make on an average about 3 feeding punctures per day, though during the first few days of adult feeding existence they may make as high as 6 to 9 punctures per day. They average, however, about 3 punctures to a square, and hence really do very little damage. The males, unlike the females, more frequently chose to puncture the square very near the top.

After the females begin to oviposit they eat less on one square or from a single puncture than before. Since as we have said that as a rule a female oviposits but once on a square and since most of her eating is done in connection with oviposition, it becomes clear that the amount of damage done by the females is much greater than that due to the males.

It has been demonstrated by experiment that the American upland cottons are much less subject to attack by the weevils than any others, and that the Egyptian (Mit Afifi) cotton is more subject to attacks than any other variety. It is now known also that the boll weevil has no food plant, native or cultivated, other than the various species and varieties of cotton.

Number of Generations.

No hard and fast line can be drawn between the different broods of the weevil—not even between the hibernated weevils and those of the first spring generation.

It is probable that in the southern part of Texas five broods occur between 1 May and 1 December—this is on the assumption that the average life cycle of a generation from egg to egg is about 42 days. In northern Texas and probably also in this region not more than 4 broods would occur.

Hibernation.

Even after the cotton has been entirely killed by frost adult weevils may be seen moving about in the fields. In southern Texas the weevil may hibernate as either larva, pupa or adult, but they most commonly hibernate in the adult condition. The majority of weevils that successfully hibernate over winter are those developed latest in the fall—whose vitality was consequently not exhausted by oviposition or otherwise before the approach of winter.

The average hibernation period is from 1 December to 1 April, or about 4 months. Given a dry sheltered place and as high as 1-6 of the weevils will live through the winter.

Dissemination.

The search for food or new squares is the principal agency leading to the migration of the weevils from one place to another. Prevailing winds may assist if these occur when the weevils are naturally most active, as does occur in Texas.

Artificial dissemination will take place most commonly along railways and water courses. The shipment of cotton baled or for ginning is nearly certain to mean shipment of the boll weevil. And the same is true of shipments of seed for planting and other purposes. Our State law already quoted (page 93) should receive the support of every person living in the State and having the slightest concern for the welfare of the State. In regard to pests of this and all other types legislative enactment may develop public sentiment, but certainly can never replace it.

Methods of Control.

The methods of control may roughly be divided into two classes (a) natural, and (b) artificial.

Among the first group we mention in the first place climatic control. The factors of highest importance in determining the development, distribution and destructiveness of the boll weevil are temperature, precipitation and food supply. We have stated that the weevil has but a single food plant—the cotton—and it is remarkable how thoroughly adjusted to the condition of the food plant the weevil has become. Conditions favoring the growth of the cotton plant are also favorable to the development of the weevil.

High temperatures and abundant rainfall are the two climatic factors distinctly favorable to weevil development, and hence it is that at such times their injury is most noticeable. Rains tend to increase formation of squares by the cotton plant and the squares, we have seen, are the feeding places and oviposition structures for the weevils. Rains also indirectly favor weevil development by the injury they do to the natural enemies of the weevil.

Too heavy rains during the winter are very apt to kill many of the hibernating weevils and hence following a comparatively dry winter one would expect to see a larger brood of hibernated adult weevils appear in the spring than following a rainy winter.

Experiments have shown that overflows will not injure enough weevils to be of any great service. Even the larvae and pupae in equares that have been under water for some time were found to be uninjured. Adult weevils may float several days in the water and yet not be injured. It is very probable that the floating of adult and infested squares by means of high water will prove one of the most important natural agencies for widely distributing the pest.

PARASITES, PREDATORY INSECTS, AND DISEASES.

The very recent announcement by an officer of the United States Department of Agriculture of the discovery in Guatemala of an ant that preys upon the boll weevil has called forth renewed interest in this subject of parasites or rather predatory insects. However,

it seems certain that the ant discovery has already been overworked and its importance much exaggerated. Hunter & Hinds, 1904, say: "There is at present, therefore, no promise of any considerable assistance in the control of the weevil by any parasite now known. * * * Even should one be found which could attack the weevil in some stage, it would probably still fail to be an efficient means of control. * * *"

Certain predatory insects other than the Guatemalan ant may serve to check the weevil, but the work of all such insects combined is comparatively of little importance when compared with the cultural methods mentioned below.

And there seems to be but little hope of securing a fungus parasite that will be of any service in killing weevils. A study of the history and outcome of the use of the "chinch bug" fungus and later the grasshopper fungus shows how utterly impracticable any such method is certain to be.

In connection with the appearance of such an important pest as the boll weevil there is certain to be a host of useless remedial and preventive measures suggested. It would be a waste of space to even mention all these schemes here. Considerable attention has been devoted to devising some method of spraying the cotton plants in hopes of killing the weevils. We may for the present dismiss any spraying scheme with a quotation from Hunter & Hinds, 1904, who say: "Spraying of a field crop has never been a success, and, unless entirely new methods are eventually perfected, never will be of any practical importance."

Of course the suggestion made from time to time that some substance may be mixed with the fertilizer which will be distasteful to the weevil when absorbed by the plant is absurd.

It has proven impossible to devise a machine that will enable one to collect from the ground the fallen squares.

And it is even more absurd to hope to find any sort of cotton that the boll weevil will not care to eat. There is a limit to the profitable variation in the cotton plant to be induced by breeding and selection and there is cer-

tainly no hope of securing a strain of upland cotton that will prove resistant to the boll weevil, or to any other insect.

Cultural Methods.

It has been demonstrated that improved methods of cultivation will enable one and does enable many Texas planters now to grow cotton at a fair profit in weevil infested areas. If the weevil can force cotton planters throughout the cotton belt to adopt more civilized and modern methods of cultivation we may be forced to look upon the weevil as a "blessing in disguise."

It is impossible better to present the desirability and certainty of results from the cultivation methods recommended by the Division of Entomology, United States Department of Agriculture, than to quote the recommendations given by W. D. Hunter, the official agent in charge of the cotton boll weevil investigation.

"1. Plant early. If possible plant seed of the varieties known to mature early, or at least obtain seed from as far north as possible. It is much better to run the risk of replanting, which is not an expensive operation, than to have the crop delayed. The practice of some planters of making two plantings to avoid having all the work of chopping thrown into a short period is a very bad policy from the weevil standpoint.

Under identical conditions early cotton if improved varieties has invariably yielded from two to three times as much as native cotton under the same conditions, and in many cases much more. Planted at the same time the early varieties begin to bloom from twelve to eighteen days sooner than native cotton.

Early planted fields of either native or improved varieties have almost invariably yielded twice as much as late planted ones.

The early varieties in general, having a small stalk and a short tap root, are adapted only for rich soil. They also fail to grow well in the very light sandy loams of many of the river valleys of Texas which, in long seasons before the advent of the boll-weevil, often produced the largest yields. In these situations early varieties

will yield but little more than native cotton.

2. Cultivate the fields thoroughly. The principal benefit in this comes from the influence that such a practice has upon the constant growth and consequent early maturity of the crop. Very few weevils are killed by cultivation. Much of the benefit of early planting is lost unless it is followed by thorough cultivation. In case of unavoidably delayed planting, the best course for the planter to pursue is to cultivate the fields in the most thorough manner possible. Three choppings and five plowings constitute as thorough a system of cultivation as is necessary in cases where the land has previously been kept reasonably clear.

3. Plant the rows as far apart as experience with the land indicates is feasible, and thin out the plants in the rows thoroughly. On land which in normal seasons will produce from 35 to 40 bushels of corn the rows should be 5 feet apart. Even on poor soil it is doubtful if the distance should ever be less than 4 feet.

4. Destroy, by plowing up, windrowing, and burning, all the cotton stalks in the fields as soon as the weevils become so numerous that practically all the fruit is being punctured. This will generally not be later than the first week in October. Merely cutting off the stalks by means of the triangular implement used for that purpose throughout the south is by no means as effective as plowing, because the stumps remaining give rise to sprouts which furnish food until late in the season to many weevils that would otherwise starve. The plowing, moreover, serves to place the ground in better condition for early planting the following spring. In some cases turning cattle into the fields is advisable. Aside from amounting to a practical destruction of the plants, grazing of the cotton fields furnishes considerable forage at a time when it is generally much in demand. Nevertheless, cattle should never be turned into cotton fields in which Johnson grass has become started.

5. It is known that at present fertilizers are not used to any considerable extent in cotton producing in Texas. There is, nevertheless, no doubt that they should be; not that the land is poor, but that earlier

crops may be procured. At present it is sufficient to call attention to the fact that it has been the uniform experience of experiment stations and planters in the eastern part of the belt that certain fertilizers, especially those involving a large percentage of phosphoric acid, have a strong tendency towards hastening the maturity of the plants."

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