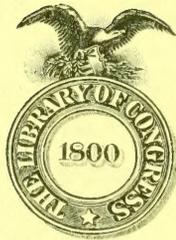


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BOLL WEEVIL

REPORT
OF THE
SOUTH CAROLINA BOLL WEEVIL
COMMISSION

RICHARD I. MANNING, Chairman

PREPARED BY

WALTER M. RIGGS

PRESIDENT OF CLEMSON AGRICULTURAL COLLEGE
OF SOUTH CAROLINA



21-26994

PRESENTED BY MR. DIAL

OCTOBER 20 (Calendar day, OCTOBER 26), 1921.—Referred to
the Committee on Printing

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SENATE RESOLUTION NO. 158.

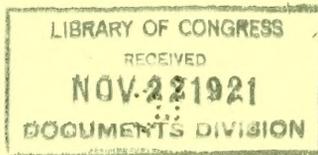
REPORTED BY MR. MOSES.

IN THE SENATE OF THE UNITED STATES,
October 20 (calendar day, November 2), 1921.

Resolved, That the manuscript entitled "Report of the South Carolina Boll Weevil Commission, Bulletin Numbered 20, of the Clemson Agricultural College, of South Carolina," be printed with accompanying illustrations and corrections to date as a Senate document.

Attest:

GEORGE A. SANDERSON, *Secretary.*
By H. M. ROSE, *Assistant Secretary.*



7.0 d. 12/1/21.

PREFACE TO REVISED EDITION, 1921.

In July, 1915, a committee of trustees and officials of Clemson College visited the boll-weevil section in order better to advise the farmers of this State in advance of the coming of the weevil to South Carolina. Their findings and recommendations were embodied in a bulletin, several editions of which appeared during 1915 and 1916.

In spite of war conditions and the high price of cotton during several of the intervening years, the warnings and advice contained in this timely bulletin have had much to do with preparing South Carolina for the inevitable infestation. Our people are not fully prepared, but are not wholly unprepared.

Through the kindness of Senator N. B. Dial this bulletin is being reprinted as a Senate document. It has been found advisable to make some additions to the original manuscript in order to embody conclusions that have been reached during the last three or four years. It is now put out in revised form with the hope that the good work it has accomplished thus far in preparing our people for the boll weevil will be continued until the struggle for adjustment and supremacy over the boll weevil is fully won.

W. M. RIGGS,

President Clemson Agricultural College.

CLEMSON COLLEGE, S. C., *October 20, 1921.*

PERSONNEL OF COMMISSION.

REPRESENTING CLEMSON AGRICULTURAL COLLEGE.

Trustees: Richard I. Manning, governor, Columbia, S. C. (chairman); Alan Johnstone, president of board, Newberry, S. C.; B. H. Rawl, Chief Dairy Division, United States Department of Agriculture, Washington, D. C.

Officers: W. M. Riggs, president Clemson College, South Carolina; J. N. Harper, dean agricultural department, Clemson College, South Carolina; W. W. Long, director extension, Clemson College, South Carolina; A. F. Conradi, State entomologist, Clemson College, South Carolina.

REPRESENTING OTHER ORGANIZATIONS.

W. D. Hunter, Bureau Entomology, Washington, D. C., and J. A. Evans, States Relations Service, Washington, D. C., representing the United States Department of Agriculture.

A. C. Moore, professor of biology, Columbia, S. C., representing the South Carolina University.

Bright Williamson, Darlington, S. C., representing the South Carolina Bankers Association.

B. F. Taylor, secretary Cotton Seed Crushers' Association, Columbia, S. C., representing the South Carolina Cotton Seed Crushers' Association.

H. T. Morrison, president Farmers' Union, McClellanville, S. C., representing the State Farmers' Union.

Joe Sparks, Columbia, S. C., representing the South Carolina Press Association.

FARMERS' READING COURSE.

[Bulletin No. 20.]

CLEMSON AGRICULTURAL COLLEGE OF SOUTH CAROLINA—THE EXTENSION DIVISION, IN COOPERATION WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE.

W. W. LONG, *Director of Extension.*

REPORT OF BOLL WEEVIL COMMISSION.¹

PRELIMINARY STATEMENT.

ORGANIZATION.

At a meeting of the agricultural committee of the board of trustees of Clemson College at Drainland in July, 1915, a committee of trustees and college officials was organized to visit the boll-weevil section in order to give to the farmers of South Carolina first-hand impressions of conditions and to suggest methods of preparedness. Circumstances prevented this committee making its trip in the summer or fall of 1915.

At a meeting of the agricultural committee at Clemson College, July, 1916, it was decided to enlarge the commission by inviting State-wide organizations to furnish each a representative on the commission. An invitation was sent to the following organizations:

- The University of South Carolina.
- The State department of agriculture.
- The United States Department of Agriculture.
- The South Carolina Bankers' Association.
- The South Carolina Cotton Seed Crushers' Association.
- The South Carolina State Farmers' Union.
- The State Press Association.

The personnel of the commission as finally constituted is shown on the preceding page, and includes in addition to the college officials the representatives of those organizations accepting the invitation of the agricultural committee.

THE VISIT TO THE BOLL-WEEVIL TERRITORY.

The commission set out on its trip of inspection on September 30. A day was spent in New Orleans in consultation with merchants, cotton factors, bankers, and other business men. Six days were spent in traveling over the State of Louisiana. One day was spent in Mississippi and one day in Alabama.

Louisiana was selected as the principal field for investigation because the boll weevil had been in that State long enough to permanently affect its agricultural and economic conditions. Furthermore, through the courtesy of Prof. W. R. Dodson, director of the Louisiana Agricultural Experiment Station, the commission was assured of exceptional advantages for its study of conditions.

¹ The passages printed in italics are revisions substituted for passages in the original report.

The itinerary of the commission included visits to typical boll-weevil sections, in some of which the raising of cotton has been practically abandoned and others in which fair crops of cotton are still being produced. An inspection of the experimental laboratories of the United States Department of Agriculture at Tullulah, La., and the accompanying field experiments near the same place was included in the commission's investigations. Most of the commission's time was spent in the open country, and many individuals of all classes and pursuits were interviewed. The commission sought by industry and the use of every available source of information in the territory visited to arrive at conclusions at once conservative and accurate.

THE BROOKHAVEN REPORT.

On October 7, the commission held a meeting at Brookhaven, Miss. After careful consideration of every word the following preliminary report was adopted:

1. That the invasion of the State of South Carolina by the boll weevil within a year, and the general infestation of the State probably within three years, is a certainty. No means have yet been discovered that promise to check or prevent the advance of this insect pest. When it arrives it must be regarded as a permanent factor in our agriculture, to be dealt with accordingly.

2. That wherever the boll weevil has become established the result has been agricultural and economic panic and resulting demoralization. Advances to farmers by banks and merchants on the cotton crop have been greatly curtailed and values have been greatly depressed; the Negro labor has largely left the country, and the cotton crop, the basis of credit and profit, has been, for the first few years at least, almost completely destroyed. The result has been the loss of lands and homesteads by owners, inability by tenants to pay out, and a period of great poverty and distress among all classes of agricultural people.

3. That it will be impossible to depend entirely as heretofore on the cotton crop, although some cotton of an early maturing variety may be successfully grown on soils especially adapted to quick growth under frequent and intensive cultivation.

Given ample labor and fertilizers and favorable climatic conditions, a profitable crop on reduced acreage may be made. With unfavorable season the boll weevil may destroy practically the entire crop.

4. That to prepare for the coming of the boll weevil, merchants, bankers, and farmers should cooperate. Intelligent community action is necessary to prevent the disaster due to the initial panic following the first crop failure.

Farmers should begin now to live at home, to cut down expenses, to get free of debt, and lay by a small capital to tide over the inevitable period of readjustment. Wherever practicable, the small farmer should have or obtain a milk cow and a brood sow, should plant a garden for the subsistence of the family, and practice upon a small scale the raising of substitute money crops, and should support and patronize the cooperative creameries and the packing houses at Orangeburg and Greenville, which enterprises are established to furnish the farmers of the State a ready market for dairy and meat products.

The approaching problem should be explained to the Negro labor, so that designing agents may not succeed in enticing it away.

Merchants, cotton-oil manufacturers, and other business men should begin now to provide easy markets for these products that must in a large measure substitute the raising of cotton.

5. That with the coming of the weevil, the first consideration should be to retain the labor on the farm and to produce all possible food supplies at home. The people of all classes should be prepared to face with courage and faith a period of readjustment. At least one year must be lived with restricted credit, and this first year will be a very hard one unless provision has been made to meet it on some more substantial basis.

In the case of owners, debt may mean a sacrifice of their holdings, for the basis of credit will be temporarily impaired by the depression of farm values.

6. That to the merchant whose business has been principally that of advancing to farmers, the coming of the boll weevil has meant one year of practically no business and the practical abandonment of the present advancing system on the cotton crop. Afterwards a business of reduced volume on a cash basis has been built up with satisfactory profits.

It can not be too strongly emphasized that cotton production on the basis of advances to the tenant has proven uniformly disastrous to both parties, but especially to the merchant.

7. That the degree of permanent disaster is dependent upon the cooperation and determination with which the people of infested territory meet the situation.

Where people have recognized a common problem and met the situation firmly and with sane business conservatism; where the merchants have restricted advances on the cotton crop as collateral and insisted on rigid economy; where the farmers have practiced this economy and diversified their agriculture, producing first a living from the farm, the general testimony is that agriculture under such conditions promises a readjustment on a sounder basis than existed before the coming of the weevil. Those who have prepared for the weevil's coming have suffered little of financial embarrassment. But for the man in debt, the improvident, and the unbeliever, the boll weevil has spelled a disaster almost inconceivable in its completeness.

It is the purpose of this report to go into greater detail as to the conditions to be expected and the remedies to be applied.

THE BOLL WEEVIL.

Since this report is concerned chiefly with the agricultural and economic aspects of the boll weevil, no attempt will be made to give a detailed or strictly scientific statement regarding its habits or life history.² Only such information as will aid in a better understanding of the necessary methods of control will be attempted, and this in simple and popular form. However, the facts are taken mainly from Dr. Hunter's bulletin (Farmers' Bulletin No. 512), and are to be relied upon.

LIFE HISTORY.

A full-grown Mexican boll weevil is from one-eighth inch to one-fourth inch in length. Its snout is about one-half its body length. In color it varies from light yellowish when young to a grayish brown or black when fully matured.

There are so many insects resembling very closely the Mexican boll weevil that the only sure way to determine whether an insect is a boll weevil or not is to send it to the State entomologist for examination. If a cotton field shows an unusual number of falling squares, the bracts of which flare out instead of closing in closely upon the bud, it is a good indication that weevils are present. The boll weevil lives through the winter only in the adult stages. With the first cold weather the weevils seek shelter under logs, in high grass and weeds, in old fences, and anywhere that will furnish protection during hibernation. The moss that hangs from the trees in the low country is an ideal place of refuge. In these sheltered positions the weevils try to live out the winter, but only about 3 per cent survive. Since a conservative estimate of the possible progeny of a single pair of weevils during the season is above

² Those interested in a scientific study of the weevil should write to the United States Department of Agriculture for Bulletin No. 358, entitled "Study of the Mexican Cotton-Boll Weevil in the Mississippi Valley."

3,000,000, it can readily be seen that only a small per cent of those that go into winter quarters need survive in order to give the farmer a large amount of trouble.

With the coming of the early spring the weevils begin to emerge and seek food after their long winter nap. The young cotton just appearing above ground is likely to be attacked. Unless the plants are strong and hardy, many of them will be killed, and this killing of young plants is the first indication of the season that weevils are present. The weevils suck also the tender shoots and young leaves of the cotton plants until the first squares appear. These constitute the favorite food of the weevil, and many of the squares are killed or are badly deformed by injury to feeding punctures.

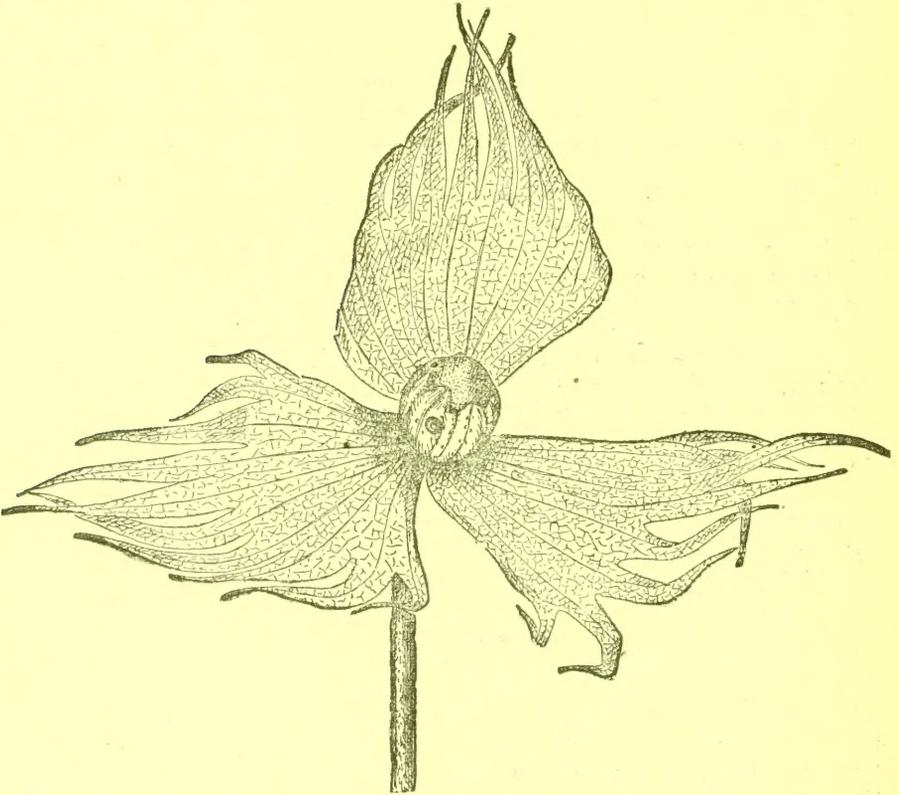


FIG. 1.—Cotton square showing egg puncture of boll weevil and "flaring" of bracts. Natural size. (Author's illustration.)

As soon as the young squares form, the female weevils also begin to puncture them and to lay eggs in the hole. The flaring of the leaflets of the square, which under ordinary conditions close tightly around the bud, is a symptom that there is an egg in the square.

The average time for the egg to hatch out is about four days. The larva, which emerges from the egg in the form of a small white grub, feeds upon the inside of the square, and in seven or eight days is ready to change to the pupa stage. In another seven or eight days it is ready to emerge as a fully grown weevil and ready for its life's

business, which is principally that of reproduction. The entire time from the laying of the egg until the emergence of the fullgrown weevil varies with temperature and humidity, but is usually three or four weeks or longer.

During the early growing season the weevils move about from plant to plant, but no general flight takes place until late in the season, probably not earlier than the middle of August. The weevils then sometimes move as far as 40 miles in short successive flights. As soon as the weather begins to get cold all adult weevils begin to seek shelter, so as to pass the winter in safety. Many of the eggs laid in the squares continue their development if sufficiently protected from the cold. The weevils thus produced hibernate during the winter and are ready to join their parents in the campaign against the farmers the following spring.

SPREAD OF WEEVIL.

The boll weevil's first invasion of the United States was in 1892 in the vicinity of Brownsville, Tex. Since that time it has advanced from year to year in practically concentric curves. There have been some interruptions due to climatic conditions, but an annual average advance of more than 50 miles per year has been made.

The pest crossed the Savannah River in November, 1917, and by spreading over additional territory in succeeding seasons it had covered the entire cotton-producing area of this State in the fall of 1920.

COMPARISON OF SOUTH CAROLINA AND LOUISIANA.

Many people maintained that the conditions in this State were different from those in the other States where the greatest damage was done by the weevil. However, a careful comparative study of conditions as well as the evidence of destructiveness already exhibited in the lower counties during 1920 and 1921 have shown that this is not the case.

Careful study would indicate that such is not the case. There may be less damage in the Piedmont sections on account of the elevation and the lower winter temperatures, but over against these advantages must be put the disadvantage of the heavy soil type and the large amount of hibernating shelter furnished by terraces and woodland.

Except in the upper Piedmont section, the situation in South Carolina approaches very closely to that of central and northern Louisiana, where the recent investigation of boll-weevil conditions shows the most disastrous results.

CHIEF CONTROLLING FACTORS.

The two most important climatic factors which affect the boll weevil are minimum winter temperature and maximum summer rainfall. Winter temperatures have the effect of controlling the number of weevils which pass through the winter. Summer rainfall has an important effect upon the reproduction of the weevils. A heavy summer rainfall is most favorable to a large hatch of the weevil eggs laid in the squares. A hot dry summer has the opposite effect. In

Texas it is the low rainfall during spring and summer, especially in the western part of the State, which enables it to maintain its production of cotton. Such conditions do not apply in South Carolina and Louisiana.

COMPARISON OF MINIMUM TEMPERATURE.

In a map prepared by the Weather Bureau a line indicating minimum absolute temperatures of zero runs across South Carolina from Marlboro to Aiken County, which is practically through the center of the State. This same line passes across the State of Louisiana about two-thirds the distance from the southern boundary. It is thus evident that throughout the most important cotton zone of South Carolina the winter conditions are similar to those in that portion of Louisiana where the production of cotton has been very greatly reduced. A typical parish in this section of Louisiana showed a falling off of from 21,000 bales to 6,000 bales on account of the coming of the weevil. This reduction was due in part to the destructive effects of the insect itself and partly to the reduction of acreage occasioned. On the score of winter temperature there is no other conclusion but that South Carolina will suffer practically as did northern Louisiana.

COMPARISON OF RAINFALL.

The important rainfall, so far as the boll weevil is concerned, is from about June 1 to July 31, this being the period of fruiting. Weather Bureau figures show an average precipitation for this period in South Carolina of 16.9 inches and Louisiana 16.2 inches. The total annual precipitation in Louisiana is about 53.4 inches as against 49.5 inches for South Carolina, but the excess in Louisiana occurs largely in winter, when it is of no especial importance in the matter of weevil control. The zone throughout the State of South Carolina in which the summer precipitation is 16 inches or more comprises practically 75 per cent of the important cotton-producing counties of the State. This same zone of rainfall extends over the lower third of Louisiana, passing through the neighborhood of Baton Rouge, and includes parishes in which there has been a reduction of at least 75 per cent of the cotton crop on account of the weevil. Here again we find conditions in South Carolina and Louisiana similar.

CONCLUSIONS.

There are several factors other than minimum winter temperatures and maximum summer rainfall which have a bearing on the weevil problem. Among them is the length of the growing season—that is, the number of days between the last killing frost in the spring to the first killing frost in the fall. In this respect South Carolina is similar to the northern counties of Louisiana and the southern counties of Arkansas, where the damage has been material. The obvious conclusion from the above facts is that in South Carolina there will be a condition very similar to that in Louisiana and in Mississippi, with an added difficulty, viz, that the cotton crop in South Carolina can not be made without the use of con-

siderable amount of commercial fertilizers, while in Louisiana little or no fertilizers need be used.

The above explanation is made in order that the people of South Carolina may not feel that there are any special conditions of soil or climate that can be expected to make the boll-weevil problem in this State less serious than it has been in other States. As a matter of fact, when the fertilizer situation is considered, Georgia and South Carolina are liable to suffer greater loss than any other States thus far invaded. In South Carolina an additional danger lies in the attraction which the cotton mills hold out to the family of the small farmer.

METHODS OF CONTROL.

Through heat and sunshine, ants, insect parasites, birds, and the crushing effect of the injured square on the eggs and larva nature keeps up its warfare against the boll weevil.

Technical investigations are still on the way, and while soil building and agricultural operations may always be expected to be fundamental in producing a cotton crop under weevil conditions, experimental work of recent years has shown that the boll weevil can be poisoned with profit whenever conditions are favorable for this work and correct methods are employed. Unfortunately during 1920 and 1921 the weather conditions in South Carolina were extremely adverse for poisoning and generally no profitable results were secured. The evidence at hand from other States would indicate that boll-weevil poisoning in South Carolina would be profitable on good land, with more favorable weather conditions than those of 1921, and provided that poisoning is correctly done. The Delta Laboratory, Tallulah, La., which has been chiefly instrumental in developing the poisoning method to its present status, makes the following recommendations:

HOW TO POISON.

Use only pure calcium arsenate in the form of a dry powder. Apply this in the dust form.

Purchase this to conform to the following specifications:

Not less than 40 per cent of total arsenic pentoxid.

Not more than 0.75 per cent water-soluble arsenic pentoxid.

Density not less than 80 or more than 100 cubic inches per pound.

Have your county agent send a sample of your calcium arsenate to the Delta Laboratory, Tallulah, La., for free analysis, to make sure it is satisfactory.

Use only dusting machinery especially constructed for cotton dusting.

Poison only when the air is calm and the plants are moist. This practically means only night applications.

Use about 5 to 7 pounds of calcium arsenate per acre for each application.

Start poisoning when the weevils have punctured from 10 to 15 per cent of the squares.

Keep your cotton thoroughly dusted until the weevils are under control. This usually means about three applications at the rate of one every four days.

Then stop poisoning until the weevils again become abundant. If the weevils become abundant early enough to injure your young bolls, make one or two more applications late in the season.

If you have a heavy rain within 24 hours after dusting, repeat this application immediately.

Do not expect to eradicate the weevils. Poisoning merely controls them sufficiently to permit a full crop of cotton, and you can always find weevils in the successfully poisoned field.

Keep your cotton acreage low and do everything possible to increase your yield per acre, as it costs just as much to poison one-quarter bale per acre cotton as bale per acre cotton.

Always leave an occasional portion of a cut unpoisoned for comparison with the adjoining poisoned tract. This will show how much you have increased your yield by poisoning.

If you are considering poisoning, write the Delta Laboratory, at Tallulah, La., for more detailed information; also ask the advice of your county agent.

Do it right or not at all.

The chief artificial means of controlling the boll weevil are found in cultural methods. The weevils can not be exterminated. The only hope lies in reducing their number to the point where injury to the cotton crop will be a minimum.

EFFECTS OF THE BOLL WEEVIL.

EFFECT ON COTTON PRODUCTION.

Of the disastrous effect of the boll weevil on cotton production there can be no question.

Many have cited the fact that Texas now produces more cotton than ever before to prove that the boll weevil is not really the menace that some believe it to be. However, the explanation in the case of Texas is found in the dry, hot climate; the large area of prairie land affording little winter shelter to the weevil; the severe winters in the western and northwestern portions of the State; and the gradually increasing acreage, most of which has been in that part of the State least favorable to the multiplication of the boll weevil. In 1900 Texas was planting 7,041,000 acres and producing 3,438,386 bales of cotton. In 1914 the average had increased to 11,921,000 acres and the crop to 4,592,112 bales. An analysis of the Texas situation by counties shows that the boll weevil seriously reduced the crop in those counties which were in cotton before the weevil appeared.

In Louisiana where the acreage remained practically the same during the same 14-year period the cotton production fell from 0.55 bale per acre to 0.34 bale per acre, and from a total of 705,767 bales to 449,458 bales. In East Feliciana Parish, a section which in elevation and summer rainfall corresponds exactly to central South Carolina, the production in 1902 was 29,549 bales; in 1915, 2,836 bales. In the adjoining parish of East Baton Rouge the production in 1908 was 27,864 bales and in 1915 was 1,844 bales. In Madison Parish the production in 1902 was 21,844 bales; in 1915, 3,892 bales.

These figures prove more eloquently than can any argument the net results of the boll-weevil invasion on cotton production.

However, there is a bright side of this Louisiana picture, for while the cotton crop of the State was greatly reduced, the total value of all crops produced in the State greatly increased. This is shown by the following figures, which are taken from Dr. Hunter's compilations: For the four years prior to the invasion by the boll weevil (1899 to 1902) the average value of all crops was \$68,394,150 per year. For the first five years of infestation (1903 to 1907, inclusive) the average value was \$88,776,272. For the next five years (1908 to 1912, inclusive), during which the effects of the weevil were most serious, the average was \$78,111,000. During 1913 and 1914 the average was \$94,884,472. These figures teach the important lesson that while the boll weevil may reduce the cotton yield of a State, it does not necessarily reduce its ability to produce equal and even greater wealth.

EFFECT ON OIL MILLS AND GINNERIES.

No industries in the State are more seriously threatened by the coming of the weevil than are the cotton oil mills and ginneries. It will be interesting to note the effects of the boll weevil on these industries in several States where the boll weevil has been present for a number of years.

In 1906 there were 2,076 operating ginneries in Louisiana and 149 idle. In 1915 there were only 1,086 operating ginneries and 351 idle. During this period, therefore, 788 ginneries entirely disappeared. Putting the average value of a ginnery at \$2,500, the loss in ginneries alone to the State of Louisiana was \$1,960,000. In 1906 there were 25 oil mills in operation. This year there are only 14, showing 11 mills either idle or abandoned. The average value of an oil mill is about \$30,000, making a total loss on ginneries and oil mills of \$2,290,000.

In Mississippi in 1906 there were 3,780 active ginneries and 372 idle. In 1915 there were only 2,204 active ginneries and 534 idle. During this same period, therefore, in Mississippi, 1,414 ginneries disappeared, entailing a loss to the State of \$3,535,000. In the same State there were 84 oil mills before the advent of the boll weevil, and this year there are only 54 operating, showing 30 oil mills abandoned or destroyed. The total loss on ginneries and oil mills in Mississippi was approximately \$4,435,000.

In South Carolina there are 60 oil mills, owned by local capital. These mills crush one-fourth of the seed produced in the State. The other three-fourths is bought and crushed by corporations, such as the Cotton Oil Co., the Buckeye Cotton Oil Co., and the Union Seed & Fertilizer Co. These corporations own large mills and can better tide over a bad situation. The small mills owned by South Carolinians do not occupy such a position.

So far as the oil mills are concerned, therefore, the matter resolves itself into the proposition of raw material. The mills are worthless unless they have something to work, and if the boll weevil materially reduces the raw material available some other seed that it is possible to work in oil mills must be provided. Otherwise there will result the same series of failures and abandonments that have taken place in the States cited. Peanuts, and especially soy beans, offer the best solution. The soy bean can be grown successfully in all parts of

South Carolina, especially in the coastal plain section. Peanuts can be grown on many light soils in this State. Therefore every effort should be made to educate the farmer to begin now to grow in a small way peanuts, and particularly soy beans. Such a beginning could be greatly stimulated if the cotton-oil mills would offer prizes for the best acres of soy beans. These premiums should be large enough to create considerable interest in the State. A liberal buying policy should also characterize the beginnings of the really important branch of agricultural production.

So far as the ginneries are concerned, there must necessarily result considerable loss, inasmuch as substitute raw materials can not be supplied, as in the case of oil mills. While it will be many years before South Carolina makes sufficient corn to supply its own needs, there are many individual farmers who make a surplus of corn. Machinery for husking, shelling, and sacking corn, oats, and other grains could be added to the equipment for ginneries. In this way at least a part of the machinery could be utilized to some advantage.

EFFECT ON BANKS AND ADVANCE MERCHANTS.

In States invaded by the boll weevil the banks and advance merchants were among the first to realize the economic danger and among the first to suffer. The diminished value of the cotton crop as a collateral and the serious depreciation in land values, the basis of a large amount of credit, caused considerable financial demoralization, and in some cases the added disaster of credit withdrawal ensued.

In the main, however, bankers have shown themselves thoroughly posted and able both to protect and assist their customers. By limiting credit, insisting on diversification, and recognizing farm products other than cotton as satisfactory collateral, the situation during the first few years of boll-weevil infestation has been considerably relieved.

In some cases banks suffered severe losses, but bank failures were remarkably few. Banks and other creditors who refrained from a policy of foreclosure and continued to furnish restricted credit to their customers fared best. Some who adopted the policy of foreclosure found themselves with a large amount of depreciated property, difficult to dispose of, on their hands.

During the second year of boll-weevil infestation bank deposits were but slightly affected, but for the following two or three years deposits were greatly reduced. It usually took banks from five to six years after the arrival of the weevil to gain what had been lost in the way of deposits.

The first effect of the boll weevil is to increase the bankers' responsibility to the public. The entire withdrawal of credit would be much more disastrous than the effect of the weevil itself. At the same time, extravagant use of credit would be bad business for the banks and a mistaken kindness to the farmers.

The general experience of advance merchants was that they continued making advances on the cotton crop one year too long, with disastrous effects. The general testimony was that the second year of boll-weevil infestation was a very lean year, with practically no advance business and only a small cash trade. In the course of two

or three years the volume of business increased, and although smaller than when conducted on an advance basis was more satisfactory, both as to collections and profits. The condition of the small farmer in those States where the advance system has practically disappeared is much better than it was before. The coming of the boll weevil will put an end to the present advance system of the cotton crop now so generally practiced in South Carolina.

It would be well if every merchant and banker would require as a fundamental condition to extending credit that the farmer raise, first of all, his living on the farm.

EFFECT ON LABOR.

In Louisiana and Mississippi a large number of the young and able-bodied Negroes left the State to seek employment elsewhere. This emigration was chiefly due to inability to get credit, and therefore inability to make a living under the tenant system of farming. There seemed to be a general lack of appreciation on the part of the white people of the importance of retaining their Negro labor. With no capital and no credit on which to make another crop nothing remained for many Negro farmers but to move away and seek employment in other agricultural sections, or in other lines of business. Many went to Oklahoma and western Texas, and carloads of them were moved north to supply the deficit in Italian laborers due to the European war. Throughout Louisiana and Mississippi labor agents, sometimes cleverly disguised, planned these movements of the Negroes and furnished the necessary money to transport them.

The white people of the State should make the situation clear to the Negroes and by helpfulness and consideration seek to retain them against the enticements which will undoubtedly be offered in this State, as it has been in other States.

EFFECT ON LAND VALUES.

In every section where the boll weevil has become active the values of farm lands have been greatly depressed. In many of the richest cotton sections of Louisiana the land has been sold at a low price for raising live stock. Usually the lowest level in land values is reached during the second and third years of infestation, after which there is a gradual recovery. The greatest danger is that farmers will become discouraged when unable to raise cotton successfully and dispose of their holdings. This is especially to be feared in those sections of the State where cotton mills offer remunerative work for all grown members of the family. Often after lands have changed hands a new system of agriculture, with diversification as its keynote, has restored their value. It is a sad fact that in the boll-weevil sections much of the land is no longer in possession of the original owners.

Our people should realize that land is the ultimate basis of value, and that it is only necessary to handle it properly to make it valuable, regardless of the type of agriculture practiced. It is too often the case that in the transition from cotton planting to a diversified system a new owner appears to reap the benefits of the change.

CHANGES IN AGRICULTURAL METHODS DUE TO THE WEEVIL.

Under boll-weevil conditions cotton can not be produced profitably on the old basis of supplying the tenant with provisions and equipment. The serious objection to the old credit basis is that it has encouraged the tenant system and has taken away the intelligent supervision of the landlord. As a result the soil has been depleted and much of it washed away.

The most successful farmers under boll-weevil conditions will raise all provisions, keep out of debt, and cultivate cotton by improved methods on a restricted area of the best lands. That the one-crop system has failed in nearly every section of our country is evidenced by the poverty of a large per cent of our agricultural people after 50 years under such a system. Our farmers should be made to understand that intelligent diversification and proper rotation of crops is sound economy and the best remedy for boll-weevil conditions. Under such conditions it is absolutely necessary that the cotton planter establish a system of rotation that will in a large measure keep up the supply of nitrogen. Cotton should always follow a summer legume, such as cowpeas, soy beans, or velvet beans. The effect of these legumes will be to force the cotton to early fruiting, and this is essential in fighting the boll weevil.

The following rotation is recommended:

First year: Cotton.

Second year: Corn, with soy beans, cowpeas, or velvet beans.

Third year: Grain—the grain to be cut off and the land to be planted in peas; the peas to be cut off for hay or turned under in the fall preparatory to a second cotton crop.

In addition to the crops mentioned in this rotation, many other crops should be grown. Where the soil types and climatic conditions are favorable and where suitable markets are accessible, tobacco, soy beans, sweet potatoes, Irish potatoes, tomatoes, watermelons, cantaloupes, and various other truck crops can be profitably raised. There are many sections of our State where fruit growing can be profitably engaged in.

To properly utilize all of the products produced on the farm by the proper system of diversification, it is necessary to raise live stock. The keeping of live stock, especially dairy cattle, can be made a profitable occupation for the small farmer, especially those who do all of their own work. Every farmer should raise his own mules. The raising of beef cattle is also profitable if land is cheap and suitable pasturage can be had. The same is true of sheep. In the northern section of our State, where much of the land is too steep to cultivate, these side lines of farming should be found profitable.

For the small farmer no form of live stock is more profitable than hogs. Pork can be produced cheaper in the South than in the North, especially where proper grazing crops are grown.

More attention should be paid by our farmers to poultry, in the way of having better breeds and giving them more intelligent care.

RAISING COTTON UNDER BOLL-WEEVIL CONDITIONS.

The problem of cotton production under boll-weevil conditions resolves itself into hastening the growth of plants so as to insure a large crop of bolls by the middle of July and certainly by the 1st of

August. Infestation will likely be too great for any large number of squares formed after that time to survive.

It has been demonstrated conclusively that cotton can be grown with fair success under boll-weevil conditions, provided improved methods are followed and favorable weather conditions prevail. It will be well for the farmers of South Carolina to practice in advance of the boll weevil's coming those principles of scientific cultivation which would represent a good investment even were no boll weevils present. The following simple directions will accomplish the best results when the boll weevil reaches South Carolina, and with the exception of those processes particularly designed to destroy the weevil, and to prevent its multiplication should be practiced now as well as later.

SOILS.

The value of a well-drained, fertile soil can not be overestimated in fighting the boll weevil. In the first place, a well-drained soil is absolutely necessary to success, as cotton will not make an early growth on a cold wet soil. In the second place, it has not been found profitable to raise cotton on poor land under boll-weevil conditions because the overhead expenses are so great that it makes the cost of production very high per pound of cotton.

The first and most important factor in raising cotton profitably under boll-weevil conditions is a fertile soil.

The best practices to follow in order to secure a fertile soil are:

1. Plant winter cover crops. These not only help to conserve the fertility of the land and prevent washing and leaching, but they also are valuable because the boll weevil can not live through the winter in a green cover crop.

2. Plant summer legumes everywhere possible and plow under all such crops as are not needed to feed the live stock. This will reduce the fertilizer bill and add much valuable organic matter to the soils.

3. Rotate crops so that cotton will not be planted on the same land two years in succession.

4. Use commercial fertilizer judiciously and all the barnyard manure possible.

PREPARATION.

Where a cover crop is grown on land during the fall and winter, it should be plowed under early in the spring so that the land will have ample time to settle before planting. Cotton comes up more quickly and starts growth earlier if planted on a firm, well-settled seed bed than if planted on a loose one.

Where no cover crop is used the land should be plowed in the fall or early winter, if a heavy clay soil, or early in the spring in the case of a sandy soil, and the seed beds should be made up early in the spring so that they will have ample time to settle before planting. Clay soils when plowed in the fall should be plowed deep to give more room for root development. No soil should be plowed deep in the late spring or just before planting.

PLANTING.

Cotton should be planted as early as possible after danger of killing frost is over and the ground is warm enough to insure quick germination and rapid growth. More seed should be used than has been the custom in the past, in order to insure a good stand without replanting. It is well to use from 1 to 2 bushels of seed per acre depending on the condition of the land. It is a distinct advantage when practicable to delint the seed because delinted seed will germinate more quickly by several days, under adverse conditions, than will undelinted seed.

SPACING.

The width of the rows and the distance between plants in the row should be regulated according to the fertility of the land. The width of row should vary from about $3\frac{1}{2}$ feet on our thin soils to 4 feet on our good cotton soils which have been producing up to a bale and more per acre, and to $4\frac{1}{2}$ feet on some of our extremely rich soils. The distance between plants in the row should be much less than has generally been used. It has been the almost universal experience of good farmers that they get the best results with thick spacing under boll-weevil conditions. The experiments conducted by different experiment stations have all resulted favorably to thick spacing.

FERTILIZATION.

Our best cotton soils are those that are well filled with humus or decaying organic matter. They are earlier and warmer and they give a more rapid and more uniform growth to the plants because they hold more water and more available plant food. It is, therefore, very important to provide an abundance of humus in our soils. After humus, nitrogen is the first limiting factor on nearly all the soils of this State. Both humus and nitrogen are most economically supplied by plowing under summer legumes or green manure crops such as velvet beans, cowpeas, and soy beans, and winter cover crops such as crimson clover, rye and vetch, and oats and vetch. A liberal application of commercial fertilizer is also advisable, and this fertilizer should contain an abundance of phosphoric acid, as this ingredient hastens the maturity of the crop up to a point where the plant has all it requires in its growth. On most soils in this State about 300 pounds of acid phosphate per acre will give most profitable results. A liberal amount of ammonia should also be used, as it has been found that ammonia also hastens the maturity of the crop up to a certain point. Too much ammonia delays the crop as does too little; hence the importance of having the correct amount of ammonia for each soil. Each farmer should study the needs of his soil and use the amount of ammonia which he finds best for his land. Potash is necessary on most of our sandy soils and some of our Piedmont soils. Where a good system of farming is practiced in the Piedmont section, where the crops are rotated, and organic matter supplied, no potash should be required. An excess of potash also tends to delay the maturity of the crop, and for this reason moderate applications generally give best results. A well-balanced fertilizer which supplies the needs of the soil to which it is applied gives the earliest crop and the largest crop.

All of the phosphorus and potash and most of the nitrogen should be applied at or before planting time and the rest of the nitrogen should be applied by the time the first squares begin to form. On very light sandy soils it is advisable to apply more of the nitrogen after the cotton is up, but in no case should this application be delayed until late in the season. Where large applications of fertilizer are made at planting time, it is important to mix the fertilizer with the soil thoroughly, so that it will not interfere with the germination and early growth of the cotton.

CULTIVATION.

From the very start cotton should be cultivated intensively to prevent weeds and grass from ever getting a start. To accomplish this, frequent shallow cultivation is advisable. Cotton should never be cultivated so deep as to destroy the roots of the plants, and under no condition should weeds and grass be allowed to get a start in the cotton, for they will delay the growth.

VARIETIES.

Numerous experiments in the boll-weevil infested area of this and other States have amply justified the recommendation of the following varieties for the conditions designated:

A. Short staple varieties.

1. Cleveland Big Boll for wilt-free land.
2. Dixie Triumph for wilt-infested land.

B. Long staple varieties.

1. Webber No. 49.
2. Delta-type Webber.

It is important to have an early fruiting variety, but it is also important to have a variety which continues to fruit throughout the season. The boll weevil prefers to puncture squares and will do so if they are present on the plants, but if none are to be found he will then puncture the half-grown bolls. This explains why it is important for a variety to continue fruiting throughout the season.

It should be understood that other varieties may in a given season and under favorable conditions yield more than these, but when taken for a period of years these varieties have proved their superiority.

PLOWING UNDER OF STALKS.

Remembering that the weevils which survive the winter are the parents of the destructive army of the next year, every effort should be made to reduce the number of those which go into hibernation with the coming of the cold weather. It is the number of adult weevils alive when the time for hibernation comes that counts. It is, therefore, best to destroy the green cotton stalks just as soon as the cotton is harvested. This can be accomplished by turning under. This process, if done in time, will destroy a large number of adults and weevils in process of development, and will also, through lack of food, cause many remaining adults to migrate or perish. The effectiveness of stalk destruction depends on the length of time before frost that it is accomplished.

Experiments in Louisiana show that when cotton stalks were destroyed before October 15 only 3 per cent of the weevils survive

the winter, whereas destruction of stalks on October 27 allowed 15 per cent to survive; November 25, 22 per cent; between December 15 and January 15, 43 per cent. It is clear, therefore, that the earlier the stalks are destroyed, the more effective the results will be, but where early destruction is impossible, it is better late than never.

COVER CROPS.

If for any reason the stalks can not be plowed under early in the fall, then the land should be seeded to a cover crop by planting in the middles with a three-tube drill. After frost, when the stalks are dry, they may be chopped up with a stalk cutter and thus thrown down into the green cover crop. The boll weevil can not survive in this cover crop, because he can not evaporate sufficient moisture from his body. The cover crop is, therefore, both a means of controlling the boll weevil and other serious farm pests, and of building up the fertility of the land.

Having followed all of the above directions, there will still remain those factors over which the farmer has no control. A rainy June and July may make it impossible for him to do his full part and he will have to suffer in consequence. Under boll weevil conditions cotton is no longer the certain crop that it once was, and no farmer is any longer safe in making it his sole reliance. Only by raising his food supplies for man and beast and making other crops for sale can he be secure against disaster.

COLLECTING WEEVILS.

It may be helpful to pick weevils from the young cotton plants before the squares appear whenever cheap labor that costs practically nothing in cash is available. If weevil collecting is done with the utmost care, giving special attention to places where the greatest number of weevils hibernated, the majority of weevils may be caught before they lay their eggs. It is estimated that weevil collecting, when upon thorough search less than 50 weevils per acre are found, is not profitable.

COLLECTING SQUARES.

When low-priced labor is available, square collecting will be helpful if properly done. Collecting should be begun about 10 days after the first bloom is seen in the field. Unless it is done thoroughly it is unprofitable. About every five days every square must be picked, not only those on the ground, but also those that have dried on the plants, as well as those which show yellow color or are flared. This should be continued during the first few weeks of the square-forming period. During wet seasons, when cultivation is impossible, plow labor may be used until cultivation can be resumed. Special attention should be given to places where a large number of weevils passed the winter, such as bottom lands near woods, and in fields adjoining waste land or other places where rubbish occurs.

DESTRUCTION OF STALKS.

Remembering that the weevils which survive the winter are the parents of the destructive army of the next year, every effort should be made to reduce the number of those which go into hibernation

with the coming of cold weather. It is the number of adult weevils alive when the time for hibernation comes that counts. It is, therefore, best to destroy the green cotton stalks just as soon as the cotton is harvested. This can be accomplished by plowing up the stalks and burning them or by plowing them under. Either of these processes if done in time will destroy a large number of adults and weevils in process of development, and will also, through lack of food, cause many remaining adults to migrate or perish. The effectiveness of stalk destruction depends on the length of time before frost that it is accomplished.

Having followed all of the above directions there will still remain these factors over which the farmer has no control. A rainy June and July may make it impossible for him to do his full part and he will have to suffer in consequence. Under boll-weevil conditions cotton is no longer the certain crop that it once was, and no farmer is any longer safe in making it his sole reliance. Only by raising his food supplies for man and beast and making other crops for sale can he be secured against disaster.

CONCLUSIONS.

Having covered as best it could in limited space the general aspect of the boll-weevil question, the commission begs leave to make the following observations, suggestions, and recommendations:

1. The commission regards as an imperative first condition that every farmer, whether an owner or a tenant, shall at once begin or continue to raise all possible food supplies for the family and feed for all farm animals. This first condition having been fulfilled, in view of the high price of cotton likely to prevail next year as well as this, and the pressing necessity to get free of debt and have some capital with which to purchase live stock, build fence, and otherwise prepare for the coming of the weevil, the commission recommends that the farmers of South Carolina plant all suitable remaining acreage in cotton and that the crop be highly fertilized and intensively cultivated, in order to produce a maximum yield with a maximum profit.

2. The commission can not too strongly urge upon farmers the need of economy in every line to the end that some capital may be put aside with which to readjust agriculture to meet new conditions. All possible food and feed supplies, including meat, dairy, and poultry products, should be raised on the farm. The surplus in every line should be sold to the best advantage and the money saved. Nothing should be purchased that can await a more convenient season.

3. The commission respectfully submits that the business man and not the farmers must be responsible for the creation of markets for products other than cotton; and recognizing the intimate relation between uniformity and quality in production and successful and profitable marketing, suggests hearty, intelligent, and patriotic cooperation between chambers of commerce and the other business organizations and the farmers of the surrounding territory. All such business relations and resulting enterprises should be planned on conservative lines in order that there may result neither disappointment on the one hand nor failure on the other.

4. Comparable only with the disaster due to the boll weevil itself would be the withdrawal of credit to the farmers by merchants and bankers. The commission would respectfully recommend that there be such a continuation of credit as sound business considerations will permit, and that live stock and other farm commodities be made the basis of credit as well as cotton. At no time in the history of the State will bankers and merchants (who by virtue of their business relations are closer to the farmers than any other class of citizens) have so great an opportunity to be of service and the chance to exercise so wise a leadership as in the coming boll weevil crisis.

The commission suggests that in the near future the merchants and bankers through their State organizations discuss, determine, and announce the policies

they will follow under boll-weevil conditions, so that farmers may make their plans accordingly.

5. The commission suggests that the farmers of the State seek to insure themselves against the wholesale loss of labor which has occurred in other States. To that end the landlords or employers should make plain to laborers and tenants that they will be provided for if they will remain, and will be given an opportunity to raise their food supplies. It would be wise as a part of this program to advance to each family at least one brood sow and a milch cow. Such a policy will be well worth while if it serves to hold the labor on the farm during the first two or three years of the boll-weevil invasion, when the temptation and inducements to migrate from the State will be at a maximum.

6. Despite hardships and serious depreciation in values, the commission strongly urges upon landowners not to sacrifice their holdings. Freedom from debt, when the weevil reaches the State, is the first consideration of safety, and every farmer in debt should make a special effort in the next two years of grace to pay off mortgages on his land.

In this connection the commission would direct the attention of farmers to the recently established Federal land banks, and urge the formation of farm-loan associations through which money can be obtained cheaply on long-term paper.

7. The commission suggests that cotton oil mills should begin at once to foster the growing of peanuts and soy beans by offering prizes and by a liberal buying policy; and that gineries should equip to husk, shell, clean, and sack corn, and clean and sack oats and other grains.

8. The intensive cultivation of cotton and of many of the substitute crops, especially truck crops, will still require a large amount of commercial fertilizers. It is the opinion of the commission that the fertilizer industries will not suffer materially under boll-weevil conditions if cotton prices remain high and proper care is taken in extending credit. Fertilizer companies can materially aid in the policy of diversification by a sympathetic attitude toward the changing conditions and by cooperating with the county demonstration agents and farmers' organizations and individual farmers.

9. Recognizing that in the cooperative demonstration and extension work organized and conducted jointly by Clemson College and the United States Department of Agriculture there exists an efficient State-wide organization of specialists and agents prepared to do effective work in every county, the commission urges this agency to take the lead in carrying on a campaign for preparedness against the coming of the boll weevil. It is not too soon to begin this work in every county in the State, but there is special need of immediate action in the counties bordering the Georgia line.

The people are urged to utilize to the utmost the resources of their agricultural college, the State department of agriculture, the bulletins of the Federal Department of Agriculture, and all other agencies that can be of assistance in the coming campaign.

There is great necessity for concerted action all along the line, because the weevil will prove itself to be not only the farmers' burden, but an economic problem common to all classes and all lines of business in the State.

10. In conclusion the commission would urge the wisdom of conservatism, even in diversification. It is best to make small beginnings along new lines rather than risk too much. In the time remaining before the boll weevil becomes established in this State our farmers should learn on a small scale how to care for live stock and how to produce and market substitute crops. If this is not done, discouragements and serious loss may be the only result of diversification.

That they attempted to raise one crop of cotton too many is the general testimony of farmers in the infested territory. It was the last attempt that ruined many. The commission hopes that the farmers of South Carolina may be wiser than their brothers in Louisiana and Mississippi, and by prudent foresight find it not necessary to carry once too often all their eggs in one basket.

Respectfully,

RICHARD I. MANNING, *Chairman.*

COLUMBIA, S. C., November 23, 1916.

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