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TWENTY-EIGHTH ANNUAL REPORT

OF THE

South Carolina

Experiment Station

OF

Clemson Agricultural College

J. N. HARPER, Director

For the Year Ending June 30, 1915.

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W. M. HARRIS, JR., S. C. AGRICULTURAL EXPERIMENT STATION

EXPERIMENT STATION STATE

TWENTY-EIGHTH ANNUAL REPORT

OF THE

# South Carolina Experiment Station

OF

## Clemson Agricultural College

J. N. HARPER, Director

For the Year Ending June 30, 1915.

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## EXPERIMENT STATION STAFF.

J. N. HARPER, B. S., M. Agr., Director and Agronomist.  
C. C. NEWMAN, B. S., Horticulturist.  
H. W. BARRE, B. S., M. A., Botanist and Plant Pathologist.  
A. F. CONRADI, B. Agr., M. S., Entomologist.  
T. E. KEITT, B. S., Chemist.  
R. L. SHIELDS, B. S. A., Animal Husbandman.  
R. O. FEELEY, D. V. S., Consulting Veterinarian.  
W. L. HUTCHINSON, M. S., Associate Agronomist.  
W. W. LONG, M. S., Director of Extension.  
F. C. HARE, Extension Poultry Husbandman.  
PAUL H. CALVIN, B. S. A., Extension Animal Husbandman in  
Cooperation with U. S. Department of Agriculture.  
JOHN O. WILLIAMS, B. S. A., Extension Animal Husbandman,  
in Cooperation with U. S. Department of Agriculture.  
R. C. FAULWETTER, B. A., Associate Botanist and Plant Pathologist  
F. J. CRIDER, M. S., Associate Horticulturist.  
O. M. CLARK, B. S., Assistant Agronomy.  
W. A. THOMAS, B. S., Assistant Entomologist.  
SIDNEY S. RITTENBERG, Agricultural Publicist.  
W. B. AULL, B. S., Assistant to Botanist.  
C. A. McLENDON, Assistant to Botanist and Plant Pathologist.  
T. A. ROUSE, B. S. A., Assistant in Animal Husbandry.  
C. J. KING, B. S., Assistant in Chemistry.  
J. A. GOODWIN, B. S., Supt. of Coast Experiment Station, Sum-  
merville, S. C.  
R. E. CURRIN, Supt. of Pee Dee Expt. Station, Florence, S. C.  
BURNS GILLISON, Foreman of Experiment Station Farm.  
MISS HELEN C. BRADFORD, Stenographer.

Main and Telegraph: Clemson College, S. C.

Freight and Express: Calhoun, S. C.

The Bulletins and Circulars of the Station are issued at irregular intervals and are sent free to all citizens of the State who apply for them.

LETTERS OF TRANSMITTAL.

Clemson College, S. C., December 1, 1915

Hon. Alan Johnstone, President Board of Trustees, The  
Clemson Agricultural College.

Dear Sir:—I beg to submit herewith the Twenty-eighth  
Annual Report of the South Carolina Agricultural Experiment  
Station, which, in accordance with the law, must be  
submitted to the Governor on or before February 1, 1916.

Yours very truly,

W. M. RIGGS,  
President.

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Clemson College, S. C., December 1, 1915.

Hon. Richard I. Manning, Governor of South Carolina.

Sir:—I have the honor to submit herewith the Twenty-  
eighth Annual Report of the South Carolina Experiment  
Station in accordance with the requirements of an Act of  
Congress, approved March 2, 1887, for the establishment  
of Agricultural Experiment Stations in connection with  
the colleges of the several States, organized under the pro-  
vision of an Act approved July 2, 1862.

Respectfully submitted,

ALAN JOHNSTONE,

President Board of Trustees

## REPORT OF THE DIRECTOR OF THE SOUTH CAROLINA EXPERIMENT STATION

Clemson College, S. C., July 1, 1915

Dr. W. M. Riggs, President,  
Clemson College, S. C.

Dear Sir:—

I have the honor of submitting herewith a brief report of the work of the South Carolina Experiment Station for the fiscal year ending June 30, 1915.

During the year the Station has made notable progress, especially with its work in plant diseases and in its fertilizer experiment work at the main Station at Clemson College and at the Coast and Pee Dee Stations.

As heretofore, the Station officers assisted the Extension Division in conducting Farmers' Institutes in various parts of the State.

The Station made a splendid exhibit at the Panama-Pacific Exposition in San Francisco. This Station was selected out of the many Southern Stations to get up an exhibit on cotton.

Following is a list of the Adams projects:  
Temperature in its relation to insect activity.

(Division of Entomology and Zoology.)

Physiological and pathological effect of feeding large amounts of cottonseed meal to cows.

(Division of Animal Husbandry and Division of Chemistry.) This problem will be discontinued.

An experiment to determine the cause of cottonseed meal poisoning in hogs.

(Division of Animal Husbandry and Division of Chemistry.) This problem will be discontinued.

Effect of pollen from barren stalks of corn on the yield of corn.

(Division of Agronomy.)

A study of the relation that exists between soil types and the length of the fibre of cotton.

(Division of Agronomy.)

Experiments to determine the effect of foreign pollen on the productiveness of the varieties of *Rotundifolia* grapes.

(Division of Horticulture.)

A study of the life history of the fungus which causes anthracnose of cotton and experiments relative to controlling same.

(Division of Botany and Bacteriology.)

The biological study of the slender wire-worm.

(Division of Entomology and Zoology.)

Causes of shedding in cotton.

(Division of Botany and Bacteriology.)

Causes of the partial insolubility in water of potash salts when mixed with basic slags.

(Division of Chemistry.)

A study to determine the influence of different soil types on the composition of certain plants.

(Division of Agronomy and Division of Chemistry.)

The Station continues to co-operate in experimental work with the Department of Agriculture along a number of lines. As heretofore, the most important co-operative work being conducted is with the Bureau of Plant Industry. This is mainly with the cotton wilt.

### Horticultural Division.

As heretofore, the work of the Horticultural Division has been mainly with the *Rotundifolia* grape. The main Hatch experiments conducted by this Division are as follows:

Variety tests with grapes, peaches, plums, tomatoes, apples, etc.

Cultural test of strawberries, tomatoes, and Irish potatoes.

Fertilizer tests with Irish potatoes.

Control of pear blight by cultural methods.

Breeding a new resistant variety of tomatoes.

Breeding a new variety of okra.

### **Division of Entomology.**

The Entomologist has devoted most of his time to the Adams projects listed above. His Hatch work consisted largely in working out control measures for the boll worm, bill bug, and corn stalk borer, and continuing his experiments with various orchard sprays. He made a comparative test of lime-sulfur wash, soluble sulfur compound, heavy oils, and another form of powder originated by the Thomsen Chemical Co., selling under the name of "B. T. S." This material is a barium sulfide instead of a calcium sulfide on which the other lime-sulfur compounds are based. Barium does not deteriorate so quickly as calcium. The results obtained in regard to the dry powders have not yet been tabulated, but the heavy oil has continued to give most satisfactory results.

Professor Conradi continued his experiments in fly extermination. The arsenate of soda has given variable results, owing to the fact that so much of it oxidized, after which it was of practically no value as a fly destroyer.

### **Division of Botany and Bacteriology.**

The work of this Division during the year has been principally with anthracnose and with the problem of cotton shedding. These tests have been conducted along the same lines as heretofore. Professor Barre has continued the hot water treatment for cotton anthracnose, and now has about ten acres planted in diseased Cook cotton seed, treated with hot water at 75 degrees Centigrade for fifteen minutes. This cotton is planted on the college farm. While the stand is poor, the cotton is growing rapidly, and otherwise seems very promising.

The most interesting research work of the Station during the year is the investigational work conducted by Dr. Rolfs with the bacterial diseases of cotton. His work so far shows conclusively that *Bacterium Malvacearum* is a serious seedling disease of cotton. It appears that there is no limit to the amount of damage this disease can do to

cotton during the first two months of the growing season, when conditions are favorable for development and spread. Reports from a number of localities in the State indicate that the disease is widespread. From data which we have on hand it looks as if this is one of the most destructive diseases of cotton. We have submitted an Adams project with this disease, and it has been accepted by Dr. True's office, and we will devote much time to the study of this disease during the coming fiscal year. Dr. Rolfs is making considerable progress with his investigations.

The co-operative experimental work has progressed very satisfactorily during the past year. The principal project under this work is the cotton and cowpea wilt work. Professor Barre has a larger number of co-operators and a much larger area in wilt-resistant cotton and cowpeas than he has ever had before. The work has increased to such an extent that it is rather hard for the man who has it in charge to keep up with it with his headquarters at Clemson. We have, therefore, decided to make Florence Mr. McLendon's headquarters at the beginning of the new fiscal year.

#### Division of Chemistry.

Work by this Division on Adams projects has been prosecuted as rapidly as time from other work would permit.

During the year there has been considerable agitation on the soil fertility question, and the scarcity of potash salts has called for an unusual number of analyses of miscellaneous materials. Among materials analyzed are soils, mucks, peat, river mud, various forms of lime, ashes, organic waste materials, and animal manure, aggregating 105 samples in all.

This Division has approximately thirty acres of land under fertilizer tests at the various Stations. We are accumulating data from these tests that will be of inestimable value to the farmers of the State.

Three years' results at the Coast Station were published as Bulletin 178.

### Division of Agronomy.

This Division has made satisfactory progress during the year. The following is a list of the Hatch and miscellaneous tests conducted by this Division:

Tests with about thirty varieties of wheat, twenty varieties of corn, a number of varieties of grasses, about fifty varieties of cotton, and a number of varieties of oats and cowpeas.

Breeding a new type of oats.

Breeding work with long staple cotton.

Experiments to determine the limiting factors of crop reduction.

Experiments to determine the best paying system of crop rotation with a view to keeping up the fertility of the soil.

Corn breeding work with a view to increasing the size of the ear, uniformity of the grain, and increasing the yield of corn and obtaining a stronger stalk.

Experiments to determine the influence of cultural methods on the morphology of the corn plant.

Breeding work with barley.

This Station has made notable progress with breeding an awnless or beardless barley, which is a splendid yielder and is extra early, affording splendid pasturage in December if planted in September.

Experiments with alfalfa.

Experiments to determine the value of hairy vetch when planted with various grain crops for hay.

Experiments in applying nitrate of soda at different times.

Experiments with different kinds of grasses for the purpose of holding terrace banks.

Experiments on the application of commercial fertilizers to corn at different periods of its growth.

**Division of Animal Husbandry.**

The work of this Division during the year has been principally with the Adams projects listed above and with hog grazing crops. This Division hopes to get out a bulletin in the near future, giving the results of these tests.

A detailed report of all the work of the various Divisions will be found appended.

Respectfully submitted,

J. N. HARPER,

Director of the Expt. Station.

**THE SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH UNITED STATES APPROPRIATIONS, 1914-1915.**

	Dr.	Hatch Fund.	Adams Fund.
To balance from appropriations for 1913-1914 .....			
Receipts from the Treasurer of the United States, as per appropriation for fiscal year ended June 30, 1914, under acts of Congress approved March 2, 1887 (Hatch Fund), and March 16, 1906 (Adams Fund) ..		\$15,000.00	\$15,000.00
Cr.	Abstract		
By Salaries .....	1	\$7,045.20	\$8,998.48
Labor .....	2	3,564.34	3,090.87
Publications .....	3	1,151.51	-----
Postage and stationery .....	4	240.05	184.53
Freight and express .....	5	147.45	45.18
Heat, light, water and power ..	6	74.83	195.30
Chemicals and laboratory supplies .....	7	-----	602.90
Seeds, plants, and sundry supplies .....	8	300.95	332.97
Fertilizers .....	9	628.31	57.00
Feeding stuffs .....	10	1,090.87	941.79
Library .....	11	60.65	44.77
Tools, machinery & appliances ..	12	278.59	118.85
Furniture and fixtures .....	13	152.50	2.64
Scientific apparatus and specimens .....	14	-----	308.15
Live stock .....	15	-----	-----
Traveling expenses .....	16	106.70	60.72
Contingent expenses .....	17	-----	-----
Buildings and land .....	18	158.05	15.85
Balance .....		-----	-----
<b>Total .....</b>		<b>\$15,000.00</b>	<b>\$15,000.00</b>

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Treasurer of the South Carolina Experiment Station for the fiscal year ending June 30, 1915; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was \$0.00 on the Hatch fund, and \$0.00 on the Adams fund; that the receipts for the year from the Treasurer of the United States were \$15,000.00 under the Act of Congress of March 8, 1887, and \$15,000.00 under the Act of Congress of March 16, 1906; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving balances of \$0.00 and \$0.00

And we further certify that the expenditures have been solely for the purpose set forth in the Act of Congress approved March 2, 1887, and March 16, 1906, and in accordance with the terms of said Acts, respectively.

(Signed) W. W. BRADLEY,  
For Finance Committee, Auditors.

Attest:—

S. W. EVANS,  
Custodian.

**SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION, 1914-1915.**

(Supplementary Statement)

(This supplementary statement, while not required by law, is desired as an aid in interpreting the account rendered for the United States appropriation. While it will be more useful if made in conformity with the schedule fixed for that appropriation, if this is not practicable, such a summary of receipt and expenditures from the sources indicated below as can be conveniently prepared from the books of the Station may be substituted. Whenever practicable it should be for the fiscal year ending June 30.)

**Debtor**

To balance on hand -----	\$ 154.90
Receipts from other sources than the United States for the year ended	\$ 2,247.76
	<hr/>
Total -----	\$2,402.66

**Credit**

By Salaries -----	816.20
Labor -----	510.76
Publications -----	246.43
Postage and stationery -----	31.97
Freight and express -----	31.10
Heat, light, water and power -----	210.32
Chemicals and laboratory supplies--	-----
Seeds, plants and sundry supplies--	241.16
Fertilizers -----	106.41
Feeding stuffs -----	23.50
Tools, machinery and appliances----	62.50
Furniture and fixtures -----	-----
Scientific apparatus and specimens--	-----
Live Stock -----	30.00
Traveling expenses -----	12.84
Contingent expenses -----	15.00
Buildings and land -----	-----
Balance -----	13.00
	<hr/>
Total -----	\$2,402.66

## REPORT OF HORTICULTURIST.

Clemson College, S. C., December 13, 1915  
Prof. J. N. Harper, Director,  
S. C. Experiment Station.

Dear Sir:—

I respectfully submit the following report of the Horticultural Division of the Experiment Station for the fiscal year ending June 30, 1915.

The work during the past year has been very much along the same lines as outlined in the annual report of last year.

### Apple Breeding.

During the last few years, while pursuing this problem, we have secured some valuable data regarding the variation of individual trees of certain standard varieties of apples. It was found that apples from certain trees keep better and remain firm and crisp much longer than apples from other trees of the same variety. To verify this variation by actual tests, two boxes of apples from each of three distinct types of the Black Twig variety were gathered on October 26. On October 20 two boxes of Kinnard (Black Winesap) apples were gathered from two distinct types of this variety. These apples were carefully inspected for any blemish or mechanical injury, wrapped in paper and placed in boxes, and stored away in a cool cellar. At the same time two boxes each of Rabun, Albermarle Pippin and Ben Davis were gathered, carefully inspected and packed away in the same manner as were the other varieties. The object of this test was to determine if there was any difference in the keeping quality of certain distinct types of the Black Twig and Kinnard apples. The Albermarle Pippin, Rabun and Ben Davis varieties were used for comparison only. These apples were carefully inspected and re-packed every thirty days, beginning on Dec. 15, and the condition of the fruit carefully recorded.

The following table shows the results of this test. It will be noted from this table that type "A" of the Black Twig variety kept until May 1, with only 3 percent loss, while type "B" lost 40 percent by the same date, and type "C" showed a loss of 14 percent. There is also noted a great difference in the keeping quality of two types of Kinnard. Type "A" of this variety was in perfect condition on December 15. Type "C" of same variety showed a loss of 2 percent on this date, while an inspection of the fruit on February 15 showed 13 percent loss for type "A" and 38 percent loss for type "C". The results of this test for the two seasons indicate that we should propagate only from those trees that prove to possess the most desirable characteristics. It is yet to be determined whether or not these particular characteristics will be inherited. This phase of the work is now under way.

TABLE I.

Variety	Gathered Date	Per cent Color.	CONDITION OF FRUITS						
			Dec. 15.	Jan. 15.	Feb. 15.	March 15.	April 15.	May 1st.	
Black Twig Type A	Oct. 26th.	92 per cent	Perfect	Perfect	Perfect Fruit Firm	Perfect. Fruit Firm.	2 per cent rotten. Fruit firm.	3 per cent rotten. Fruit firm,	
Black Twig Type B	Oct. 26th.	80 per cent	1 per cent rotten	1 per cent rotten.	3 per cent rotten.	5 per cent rotten. Slightly Shriveled.	26 per cent rotten. Fruit shriveling badly.	40 per cent rotten. Fruit shriveled badly.	
Black Twig Type C	Oct. 26th.	90 per cent	Perfect	Perfect	2 per cent rotten.	2 per cent rotten. Fruit firm.	10 per cent rotten Slightly shriveling.	14 per cent rotten. Shriveling badly.	
B. Wine-sap Type A	Oct. 20th.	100 per cent	Perfect Firm Juicy	6 per cent rotten. Firm-Slightly mealy.	13 per cent rotten. Shriveling-mealy.	24 per cent rotten. Fruit too mealy to use.			
B. Wine-sap Type C	Oct. 26th.	95 per cent	2 per cent rotten Slightly mealy but firm	18 per cent rotten. Shriveling-mealy.	38 per cent rotten. Shriveling. badly-mealy.	74 per cent rotten Fruit no good.			
Rabun	Oct. 26th.	88 per cent	Perfect	Perfect	2 per cent rotten. Fruit firm.	4 per cent rotten. Fruit firm.	12 per cent rotten. Fruit shriveling badly.		
Alb. Pip-pin	Oct. 27th.	Typical Greenish-Yellow	Perfect	Perfect	2 per cent rotten. Firm.	10 per cent rotten. Slightly shriveling.	81 per cent rotten. Badly shriveling. No good.		
Ben Davis	Oct. 26th.	90 per cent	1 per cent rotten	3 per cent rotten. Firm.	8 per cent rotten. Firm but mealy.	23 per cent rotten. Shriveling slightly very mealy. No good.			

It was also noted that certain trees of the Kinnard or Black Winesap fruited regularly, while other trees of the same variety fruited only every other year. In order to get some data on this subject a record has been kept of individual trees since 1909. This irregularity of fruiting occurred in other varieties as well as with the Kinnard, but on account of all varieties except the Kinnard being more or less injured by frost during this period our records throw very little light on their behavior. This fact is clearly brought out by studying the table given below, which records the yield for each year on trees Nos. 1, 5, and 8. These three trees produced annual crops from 1909 to 1915 inclusive, while trees Nos. 2, 4, 6, and 7 produced fruit only every other year. These trees were all the same age, being six years old when the test was begun in 1909. They were all in the same orchard, planted on the same type of soil, and as far as could be determined were exactly alike in every respect.

TABLE II.

Trees.	Fruit in Bu. 1909	Fruit in Bu. 1910	Fruit in Bu. 1911	Fruit in Bu. 1912	Fruit in Bu. 1913	Fruit in Bu. 1914	Total yield for 6 years
B. Winesap No. 1	3 Bu.	4½ Bu.	6 Bu.	Did not bloom	10 Bu.	13½ Bu.	37 Bu.
B. Winesap No. 2	Did not bloom	5 Bu.	Did not bloom	8½ Bu.	Did not bloom	14 Bu.	27½ Bu.
B. Winesap No. 3	Did not bloom	6½ Bu.	Did not bloom	8 Bu.	Did not bloom	12½ Bu.	27 Bu.
B. Winesap No. 4	Did not bloom	4 Bu.	Did not bloom	7½ Bu.	Did not bloom	10 Bu.	21½ Bu.
B. Winesap No. 5	1½ Bu.	¾ Bu.	4¾ Bu.	6 Bu.	8¾ Bu.	6 Bu.	40 Bu.
B. Winesap No. 6	Did not bloom	2½ Bu.	Did not bloom	5 Bu.	Did not bloom	7 Bu.	14½ Bu.
B. Winesap No. 7	Did not bloom	¾ Bu.	Did not bloom	6½ Bu.	Did not bloom	8¾ Bu.	18 Bu.
B. Winesap No. 8	1½ Bu.	¾ Bu.	6½ Bu.	7 Bu.	7½ Bu.	6½ Bu.	31 ¼ Bu.

### Tests of Varieties of Fruits

We have continued testing the standard varieties of apples, peaches, plums, Japanese persimmons, grapes and various types of small fruits as well as the newly introduced varieties. We now have more than one hundred varieties of peaches, seventy-five varieties of apples, one hundred and twenty varieties of grapes, and many varieties of small fruits. Quite a number of the new varieties of fruits growing in the orchards have been collected from all parts of the State from the Coast to the Mountains. Some of those originating in the State appear to be especially valuable for this particular section and are now being tested at the branch stations.

#### Irish Potatoes.

We have continued our experiments in breeding and selecting desirable types of Irish Potatoes, the idea being to secure a variety that is especially adapted for growing as a second or fall crop. By selecting different strains of those varieties that give best results for the second crop, we now have on hand a number of types well adapted for growing in the late summer and early fall. We have one strain of the Lookout Mountain variety that appears particularly valuable as it keeps perfectly in ordinary storage from the time it is harvested in November till time for planting the following July. In our tests this season 98 percent of the tubers planted produced strong plants. This strain of potatoes is being propagated for the purpose of distribution in small quantities thruout the State to those who care to co-operate with us in testing it out in different localities. Unlike other varieties this potato produces large clusters of seed pods on every flower stem and, therefore, offers excellent opportunities for breeding work.

#### Adams Project.

Project No. 8 with the *Rotundifolia* grape has been continued with remarkable results. The work done last sea-

son under glass, forcing the Scuppernong and James varieties to bloom and set fruit during the month of April when there was no possible chance to obtain foreign pollen, led us to continue this experiment. The Scuppernong, James, Eden, La Salle, and Flowers have been forced to bloom from mid summer to early fall with remarkable results. As soon as the fruit had set on certain vines in the vineyard, all of it was removed and the young canes spurred back to from one to four buds, forcing them to produce young shoots from this season's growth. These shoots produced normal flower clusters after all other grape flowers had disappeared, and no pollen from male vines was available, yet these flowers produced normal bunches of grapes. The fruit ripened and had as many seed in the individual berries as did those that bloomed earlier in the season under normal conditions. Vines were pruned regularly every three weeks from the first of June to the first of September, and in every case where the vines produced flowers, they set a normal crop of fruit. There were no male flowers available at this season. Therefore, it was absolutely necessary for these vines to use either their own pollen or pollen from some other variety in the vineyard that bloomed at the same time. Clusters of flowers that bloomed as late as the middle of September set a normal crop of berries, varying from eight to twenty-four to the bunch. Daily observations of the male vines were made during the entire summer in order to be absolutely certain that no flowers were produced. In only a few cases did any bloom clusters appear on the male vines, and these were removed as soon as formed, fully two weeks before they were ready to open. It was interesting to note that throughout the blooming period of the *Rotundifolia* grapes, daily observations were made and no bees were found on these flowers. In order to make a thoro test of this point, a hive of bees was placed in the vineyard. It was noted that, while the bees visited clover and other flowers in the vicinity of the grape vines, they absolutely ignored

the grape flowers. Not only did they ignore the flowers of the *Rotundifolia* grapes, but they only occasionally visited the flowers of the *Labrusca* grapes. The results of this experiment seems to show that bees play little if any part in the pollinization of our grapes in this section, and that varieties of the *Rotundifolia* grapes are not dependent on the pollen from male vines. A complete report of this work will be published later.

#### **Pee Dee Experiment Station.**

The work at this Station has been continued along the same lines as last year. The work at this time is progressing nicely. We have now growing at this Station about two acres in grapes, three acres in peaches, and one-half acre in plums, also one acre in strawberries. We are now preparing to plant one acre in asparagus, composed entirely of male plants and one acre in female plants. This is for the purpose of verifying our tests made on a small scale which was very much in favor of the male plants. A variety of staple vegetables were grown at this Station during the past year.

#### **Coast Station.**

Fruits grown at the Coast Experiment Station show that grapes, peaches, and plums can be produced in this section of the State as well as in other sections. The grape seems to be especially adapted to this region, and I believe the Delaware, Brighton, Moore's Early, Concord, Niagara, Armalage, and a few other varieties could be grown with profit on a commercial scale. Some of the varieties of peaches have given excellent results, as well as a few varieties of plums. No experiments with vegetables have been conducted at this Station during the past year, all of the Horticultural work being done along the line of fruit growing.

Respectfully submitted,

C. C. NEWMAN,

Horticulturist.

## REPORT OF THE BOTANIST AND PLANT PATHOLOGIST.

Clemson College, S. C., November 29, 1915

Prof. J. N. Harper, Director,  
S. C. Experiment Station,  
Clemson College, S. C.

Dear Sir:

I respectfully submit the following report for the Botany Division of the Experiment Station for the fiscal year ending June 30, 1915.

The lines of investigation previously reported have been continued and one additional problem has been undertaken. A summary of each phase of the work is given below:

### **Cotton Anthracnose.**

#### Adams Project No. 10.

Cotton anthracnose continues to be the most serious disease of cotton in the state and was more widespread and more destructive the past season than ever before. The total loss was probably not so large in the state as in 1913 but the percentage of loss, I believe, was greater this year than ever before. In many fields as much as 50 percent of the cotton was destroyed by the disease.

The hot water treatment which was reported last year has been continued and we have some interesting data relative to it. We treated about ten bushels of diseased Cook cotton seed in water at 75 degrees C for fifteen minutes and planted these on land that had not been in cotton for one year. There were about 12 acres in the field and no anthracnose was observed in it until late in August. At this time the disease was observed at five different places in the field. As the season advanced anthracnose appeared in other sections of the field and spread from the first centers observed until at the end of the season diseased bolls occurred here and there over the entire field.

From counts made at the end of the season, however, we found that much less than one percent of the bolls had been injured by the disease. Where the same seed without treatment were planted, 15 percent of the bolls were destroyed and in one field where the same cotton was grown the previous season and planted back this season 45 percent of the bolls were destroyed. This makes it look as if the treatment is going to prove to be a very effective control measure. It is evident from this season's results, tho, that it does not eliminate the disease entirely as we had at first hoped. This seems to be due to an occasional seed passing thru the treatment without having the disease in it killed. The disease then spreads during the season from the diseased stalks which these seed produce and by the end of the season it might be widespread in the field. The disease does not become general early enough, however, to cause serious loss. We feel that the seed selection practiced in connection with this treatment will successfully eliminate anthracnose.

One very interesting feature of the hot water treatment is the effect that the same treatment has on seed of different varieties of cotton. Some varieties will be killed at 72 degrees C while others will stand 76 degrees C. Before general recommendations can be made for the use of this method of seed treatment careful tests will have to be made with the different varieties of cotton in order to determine just how much heat each will stand.

Seed treated with hot water were planted in four other fields besides the one mentioned above but the results in these were about the same as in the large field referred to.

During the past season we have sprayed cotton successfully with Bordeaux mixture, and have made some preliminary tests with this as a method of control. In connection with the angular leaf spot problem certain plots were sprayed thruout the season with Bordeaux, lime-sulfur and bichloride of mercury. Since the seed with

which these plots were planted were infected with anthracnose, this gave us a chance to observe the effect of these solutions on this disease. In addition to this we sprayed two rows in a field which was planted in diseased seed and which had diseased cotton on it the previous year. This was, of course, a severe test and while anthracnose was not prevented entirely it was reduced to 3.3 percent on the sprayed rows while the adjoining rows averaged 15 percent diseased bolls. From results obtained this season we feel justified in making a more thoro test of these spray solutions next season. We never expect, of course, to spray cotton except as an additional means of securing clean seed for future planting.

The variety test for anthracnose resistance conducted in cooperation with the other Southern experiment stations has been conducted along the same lines as reported last year. The data have not been tabulated yet but the results seem to be about the same as reported last year.

### **Cotton Physiological Work.**

Adams Project Number 16.

This problem has been continued along the same lines as previously reported and results obtained during the past year conform pretty closely to those already reported. We had hoped to publish on this project before this time but there are so many factors to be taken into consideration in a study of this kind that a number of important points do not seem clear and we feel that it is well to delay publishing until additional data are secured. We now have two seasons' results on shedding and soil moisture at the Pee Dee Station for comparison with results obtained here. These data indicate that the lack of sufficient soil moisture is the principle factor in causing cotton shedding at Florence as well as at Clemson. From plants grown in large cans we find that it takes from 300 to 417 pounds of water to produce a pound of dry matter in cotton—depending upon the fertility of the soil and quantity of fertilizer used.

An important point brought out in the pot work during the past three years is the time in the season that cotton needs most water. The results of the past season are typical of the three years and are interesting in this connection. The twenty pot plants used a total of 44.5 gallons of water in June, 179 gallons in July, 233 gallons in August, 155.6 gallons in September and 23.7 gallons in October. The facts that cotton requires more water during August than it does during any other month and requires almost as much water during September as it does during July ought to be more widely known and ought to be made use of in our farm operations. The common practice is to treat cotton as if it could take care of itself after the middle or the latter part of July. These data indicate that it would be profitable to cultivate cotton as late in the season as it can be done without breaking off too many limbs and bolls.

We also have data with reference to the length of time that it takes cotton to mature in this climate. It takes from 24 to 30 days from the first appearance of the squares until the flowers open and from 55 to 65 days from blooming to the opening of the bolls. This, of course, means that buds that open after September first rarely mature bolls. With reference to the relation of leaf area to yield and to shedding and with reference to the inheritance of high and low percentage of shedding we are not yet ready to report.

### Bacterial Diseases of Cotton.

Adams Project No. 19.

During the past year Dr. F. M. Rolfs, of this Division, has been devoting considerable time to the study of angular leaf spot of cotton caused by *Bacterium malvacearum* (Erw. Smith). He has found that this disease causes serious damage to seedlings and that it deforms and in many instances kills the plants after they are half grown. Angular leaf spot was found causing serious loss in practi-

cally every field examined and is believed to cause considerable damage in every cotton field in South Carolina. The disease attacks the leaves, stems, and bolls and gets into the seed. It seems to spread from one place to another largely by the seed. A large number of seeds were inoculated in the laboratory and planted in the field and the disease followed thru the season. Seed treatment and spraying tests were conducted and some very satisfactory results obtained. Dr. Rolfs has just about completed a bulletin on this subject and the manuscript will be submitted within a few days for publication.

### Plant Disease Survey.

The corn disease caused by *Physoderma* sp. as mentioned in the report last year has caused serious loss again this year. This disease was collected during the past season at a number of widely separated points in the state and seems to be more widespread than ever before. This disease certainly deserves some attention and it is hoped that an investigation of its life history and habits can be undertaken in the near future.

A species of *Sclerotinia* was found causing a serious disease on alfalfa in Greenville County last winter. The disease occurred at several points in Greenville County and reports received from other points in the state indicate that it is present in a number of other places. If we are going to continue to advocate the growing of alfalfa over the Piedmont section of South Carolina it seems that it might be well for us to attempt to find out something more about this disease. In places where it occurred it killed out the alfalfa in spots all over the field.

Additional data have been collected with reference to a number of the more common plant diseases but these will be published elsewhere.

### Cotton and Cowpea Wilt and Root-Knot Work.

This work which is carried on in cooperation with the Bureau of Plant Industry of the United States Department

of Agriculture has been continued along the same lines as heretofore. In spite of the reduction in the cotton acreage there was a good demand for the wilt resistant seed and all that were available last year were sold. This season more than 5000 bushels of pedigreed wilt resistant seed that our breeders have grown will be for sale. Many of our cooperative breeders had fields of from 30 to 50 acres planted in pedigreed seed this season. Our Dixie cotton continues to stand at the top in the variety tests conducted on wilt infected land and stands well up towards the top on tests conducted on non-infected land. The careful breeding of this variety of cotton during the past four or five years has made it one of the best varieties in existence. The people of the state continue to show a great interest in this work as is evidenced by the large number of inquiries which are received and the great demand for our seed. Mr. C. A. McLendon, who assumed charge of the work in July, 1914, has enlarged the field operations to some extent and has shown marked ability in handling the breeding work.

The root-knot work which Mr. L. P. Byars, of the Office of Cotton and Truck Diseases, is carrying on in cooperation with this station has been continued. During the past season variety tests of cotton and cowpeas have been conducted on badly infested land. Resistance has been noted in several varieties of cowpeas and valuable data have been collected with reference to the different varieties of cotton. Mr. Byars is making careful study of the effect of fertilizers and different crop rotations on root-knot at the Pee Dee Station. This work will be continued over a long period of years and the data collected in this way certainly ought to be of great value in solving this difficult and very important problem.

Very truly yours,  
H. W. BARRE,  
Botanist and Plant Pathologist

## REPORT OF THE ENTOMOLOGIST.

Clemson College, S. C., November 29, 1915.

Prof. J. N. Harper, Director,  
S. C. Experiment Station,  
Clemson College, S. C.

Dear Sir:

I herewith hand you my report for the Division of Entomology of the Experiment Station for the fiscal year ending June 30, 1915.

#### Adams Projects.

Project No. 2A., Relation of temperature-moisture to insect activity, has progressed better than heretofore. From the records so far obtained, we were led to study the correlation of weather conditions and insect outbreaks. Our studies so far indicate that this subject may develop into a very important economic problem.

To foretell with reasonable certainty insect outbreaks is a great step toward controlling them. Our records are complete since October 11, 1907, for since that date complete records have been kept of insect outbreaks in the State. Further studies have been made of hibernation and a series of experiments are now in progress which we believe will give us a much clearer insight into the factors governing hibernation. The records of this project are now being prepared to be submitted as a second bulletin in this series.

The work with project No. 15A has continued satisfactorily. Bulletins 179 and 180 have been issued, also a popular account for general distribution. The work of this project had its major experiments located near Columbia, where we are dealing with a species that we have not identified thus far. Mr. Anderson who is in charge of this work has recorded a series of very important observations giving the activities of the species for the entire season. This work has continued in co-operation with the section

of Southern Field Crop Insects of the Bureau of Entomology.

### Hatch Projects.

Several of these projects had to be suspended owing to financial conditions, and suspension of one of the positions of this Division. Mr. Berley continued his work with the scale insects, and has made excellent progress. We have at present the material and records for a very complete report of South Carolina Scale Insects. This will be issued as soon as we can get the illustrations completed.

The work with sprays against various scale insects has been continued, and we now have records that enable us to control with safety a large number of species, including the purple scale on citrus, oyster shell scale on apple, and Osborne's scale on maple.

The study of cotton root louse we continued as well as we could. Mr. Thomas is in charge of this investigation. Bulletin 175 was issued some time ago to meet the demands for information. This is merely a popular edition and Mr. Thomas is about to submit a manuscript recording the work during a period of six years. This work is in co-operation with the section of Southern Field Crop Insects, Bureau of Entomology, and will be issued shortly for publication as a scientific bulletin in a limited edition.

The correspondence of this Division has been more active than usual. A large number of inquiries are handled by means of circulars and other office forms.

There has been no change in the personnel of the staff except the creation of a vacancy which discontinued the work in the Pee Dee section. Mr. M. R. Smith was appointed Graduate Assistant, and has given most excellent service in the Division during the year.

Yours very truly,

A. F. CONRADI

Entomologist.

## REPORT OF SOILS AND CHEMISTRY

Clemson College, S. C., December 1, 1915.

Prof. J. N. Harper, Director,  
S. C. Experiment Station.

Dear Sir:

I respectfully submit the following report of the work of the Chemical Division:

The time devoted to investigations under the Adams fund has been largely spent on a further prosecution of project 17, to determine if all the potash and lime soluble in 1.115 Sp. Gr. hydrochloric acid is accounted for by the official method for soil analysis. The basis for this work is detailed in bulletin 173 of this Station. So far, our results indicate that there is more lime and more potash present in solution than is accounted for in the determination. The difference seems to be due to the occlusion of a part of the lime and potash by the heavy gelatinous precipitate of iron and aluminum hydroxides formed when ammonia is added to precipitate out the iron and aluminum. We are now engaged in developing a simple method to accomplish this separation completely.

Some time was spent on project 5 and a large quantity of data was accumulated on the analysis of the urine of cows on different feeds and at different times during the period of gestation. This work will be published in bulletin form.

The fertilizer test work is being continued along comprehensive lines at each of our Stations. Results of the work at the Coast Experiment Station were published in bulletin 178, October, 1914, which bulletin is made a part of this report. The work at the Pee Dee Station is progressing most satisfactorily, largely due to the highly efficient work and hearty co-operation of the Superintendent, Mr. R. E. Currin. An outstanding feature of the fertilizer tests at Clemson is the increased fertility of the field (G) in rotation as compared with the field (E) in

cotton continuously. The results of the fertilizer tests at Clemson will be published in bulletin form at an early date.

A large number of soil analyses have been made in connection with the plot work at the Pee Dee Station. A number of miscellaneous samples have been analyzed since June 30, 1914, among which are 78 of soil, 16 of muck and marsh mud, 7 of limestone (ground), 2 of lime (agricultural), 2 of land plaster, 7 of ashes, 4 of marsh grass, 9 of animal manure, 1 of seaweed, 1 of tobacco stems, 2 of pulverized manure, and 1 of ground phosphate rock. A total of 130 samples. Other materials were sent in for identification and some analyses were made for other divisions of the Station.

Many of the samples enumerated above were examined with special reference to their use as sources of potash. We have accumulated enough data on this subject to warrant its publication in bulletin form, as bulletin 182, which bulletin is made a part of this report.

Publications: Bulletin 178 "Results of Fertilizer Experiments Conducted at Summerville, S. C." by T. E. Keitt; bulletin 182, "Potash" by T. E. Keitt and C. J. King, and an article entitled "Rapid Method for the Removal of the Solid Residue Left after Digestion in the Determination of Nitrogen in Soils", by C. J. King.

Correspondence: The correspondence of the Chemist has increased during the past year and now requires a considerable amount of his time.

Before closing this report, I wish to call attention to the highly efficient work of the Assistant Chemist, Mr. C. J. King.

Respectfully submitted,

T. E. KEITT,  
Chemist.

## REPORT OF ANIMAL HUSBANDRY AND DAIRYING.

Clemson College, S. C., December 1, 1915.

Prof. J. N. Harper, Director,  
S. C. Experiment Station,  
Clemson College, S. C.

Dear Sir:

I respectfully submit the following annual report of the Division of Animal Husbandry and Dairying for the fiscal year ending June 30, 1915.

The Adams projects were discontinued at the close of the fiscal year. These projects were based on the feeding of excessive amounts of cottonseed meal to dairy cows, and also to hogs. A special report of this work, which was done in cooperation with the Division of Chemistry, will be submitted.

Conditions during the year proved quite favorable for our work in comparison of various forage crops for pork production. Valuable data were obtained relative to the following crops: rape, Abruzzi rye, common rye, wheat, oats, and barley. Pigs of like breeding and age were used in the experiment. A concentrate ration of 20 percent of weight of pigs was fed to all pigs thruout the experiment, the weights being taken at regular intervals of one week and readjustment of amount of ration made on basis stated. Additional forage crops will be included in this experiment, the object being both to obtain the relative value of the different forage crops that can be grown in the State and to emphasize the importance of forage crops in reducing the cost of pork production. Data covering period of several years will be necessary in obtaining the desired information on the subject.

Two rations for dairy cows were compared with the object of determining the relative value of certain carbohydrates when fed with cottonseed meal as the basal ration. The entire herd was used in the test.

A comparison of two different rations was made with work horses and yearlings, in which cottonseed meal constituted a part of one ration.

All the Hatch problems will be continued with several additional ones.

The livestock breeding projects are demonstrations of value of purebred sires rather than experimental problems. However, the importance of such work deserves emphasis in this report. By the use of a Percheron stallion mated to mares commonly found on Southern farms, we desire to raise mares that can produce mules of better type for farm purposes.

A beef herd is being developed by use of purebred Hereford bull mated to common native cows as foundation stock.

Since our last report there has been established at the College a Co-operative Creamery which is proving an excellent factor in the development of dairy interests in the State. This Creamery will afford the Station splendid facilities for experimental work in butter making, etc.

Some experiments of especial value to the dairy interests will be inaugurated at once.

Very sincerely,  
R. L. SHIELDS,  
Chief of Division of Animal  
Husbandry and Dairying.

## REPORT OF DIVISION OF AGRONOMY.

Clemson College, S. C., December 1, 1915.

Prof. J. N. Harper, Director,  
S. C. Experiment Station,  
Clemson College, S. C.

Dear Sir:

I have the honor to submit the Annual Report of the Agronomy Division of the South Carolina Experiment Station for the fiscal year ended June 30, 1915.

Investigations along agronomy lines have progressed satisfactorily during the period covered by this report. Effort is made, by field trials, to obtain certain definite information concerning field crops and soil management. The data obtained, bearing on the information sought, appear to be accurate and reliable.

In conducting field trials, weather and soils always offer more or less difficulties. The weather at Clemson College for the summer season of 1914 was so unfavorable for cotton and corn as to dominate completely all other factors and no matter what the object of the experiment was, the weather was the controlling influence. But this condition at Clemson College did not prevent the securing of good results with parallel experiments at the Pee Dee Station, where the weather conditions were very favorable for cotton and fairly good for corn. The weather factor during 1915 has been such as to give normal conditions for the study of most crops. Lack of moisture in the spring perceptibly influenced the yield of the small grain crops.

Tests are in progress with sundry field crops to see if any of them might, with profit, be substituted for some of our standard crops, or if they might supplement them in such a way as to give the farmer a more profitable year's business. The usual crops grown, cotton, corn, oats, wheat, cowpeas, sorghum, rye, crimson clover, tobacco, peanuts, sweet potatoes, etc., have won their way to such universal use by a superior combination of qualities.

Usually any other crop must compete with these, tho it may fill a place in the year's work not yet satisfactorily provided for. A few good crops that do not compete with each other for labor are all that is needed for a successful farm business. For general use no other crop seems to be in the same class with cotton as a cash crop but cotton also interferes with most other crops that might otherwise be used at least as minor cash crops. Corn and oats are superior crops for grain. Cowpeas and sorghum are not easily excelled for supplying the home demand for hay. Rye and crimson clover rank high as winter cover crops and Bermuda, lespedeza, and white and bur clovers make a combination for pasture that is hard to beat anywhere.

**Cotton.** All the varieties grown at the Pee Dee Station in 1914 were good but not equally so. The poorest variety made nearly a bale to the acre but the yield of the best variety was nearly a bale more. The early types did not yield so well as the medium and late types. Medium things often suit the general farmer best. In this case the medium early types of cotton were best.

For 1915 the cotton crop at Clemson College and the Pee Dee Station is good and we should obtain the information sought, and I hope this will be true of the limiting factor tests at the Coast Station.

**Corn.** Corn is the second most valuable crop for this state. The climate seems to suit the crop well but we do not have as a rule good corn soils. Fertilizers must be depended on quite largely for making a satisfactory yield and this makes the cost of producing corn relatively high. The average yield of corn per acre in this state is in the neighborhood of twenty bushels to the acre, which does not give a very high total value for the crop. If it had to go on the market and sell for the same price that Illinois corn sells for in Illinois, the margin of profit might be a minus quantity. We do not have much trouble in growing thirty-five to forty bushels to the acre at the stations and it would appear to be feasible for the farmers of the

state to make a higher average yield. The lack of organic matter in the soil is the principal trouble and this may be remedied by a cropping system that provides more material to be plowed under.

On good corn land we have a number of varieties that yield well. The season is long enough to accommodate any variety and this makes it comparatively easy to have many varieties that yield well when other necessary conditions are favorable. All varieties that we have tested show much variation.

Our work with corn shows plainly the course of procedure that farmers may follow profitably. The soil is the weak link. Get more organic matter into the soil and a score of varieties will yield well. A dent corn of medium size that will yield about 85 percent grain is a good type to plant.

**Oats.** Oats make about the best winter-season crop. Fulghum, a recently introduced variety, apparently appearing as a mutant in the field of Mr. Fulghum of Georgia, is about two weeks earlier than the Appler and other widely grown strains of the red rust-proof type. This is a variation in the right direction as it tends to lessen the damage from spring drouth and tends also to lessen the amount of interference with cotton and corn at harvest time.

**Rye and Barley:** Rye makes a good cover crop for winter, Abruzzi being a good variety to plant. Awnless barley continues to make a very good showing and may prove to have some value as an early hay crop.

**Wheat.** A yield of twenty to twenty-five bushels of wheat per acre can be made on the heavier clay types of soil in the Piedmont section. Blue Stem, Purple Straw, Red May, and Leap's Prolific do well and these indicate the types that should be sown.

**Hay.** Cowpeas and sorghum, alone and in combination, are widely grown for hay. They are well adapted to con-

ditions, make good yields and for home use the quality of the hay is satisfactory.

Sudan grass and Rhodes grass are promising hay plants. Sudan grass may become one of the important hay plants in this country. The seed have been scarce and very high priced but they are more plentiful now and less expensive, so that farmers may begin to try this plant out. It appears to have many valuable qualities as a hay plant with no particularly bad qualities.

Soy beans do remarkably well at the Coast Station but thus far they have not done well at the College.

**Maintaining the Fertility of the Land.** This is one of the large farm problems but not necessarily a very difficult one. Farmers have shown, however, that it is easier to let the fertility decrease; the trouble seems to be in keeping a good supply of organic matter in the soil. It is easy to increase the productiveness of the soils in this state. A rotation of cotton, oats followed by cowpeas, rye for winter cover, and corn with cowpeas as a companion crop will double the productiveness of land in this state in six years if the four crops of cowpeas that appear in rotation do well.

**Limiting Factors** Nitrogen, soil moisture, and phosphorous appear to be limiting factors of crop production in this state.

**Effects of Pollen.** The study of the effects of pollen from barren stalks of corn on the amount of barrenness in the progeny may have progressed some during the last year. It is so easy for environment to prevent corn from forming the ear that you may not know whether you are dealing with inherited barrenness or not. Apparently we have reached the point where we have a small amount of inherited barrenness, and it may show in the progeny next season.

Respectfully,  
W. L. HUTCHINSON,  
Professor of Agronomy.

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