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AUBURN

Poisoning the Boll Weevil

PART I
Results for 1918 and 1919

PART II
Results for 1920

By
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POISONING THE BOLL WEEVIL

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PART I.

The idea of applying arsenical poison to cotton in order to control the boll weevil is by no means new. There have been numerous publications of the U. S. Bureau of Entomology on the subject[1].

Paris Green Experiments.

The first suggestion in this line recommended the use of Paris green in solution for application to the young cotton plants before the squares begin to form for the destruction of hibernated weevils. After thorough experimental work it was found that so much water soluble arsenate was contained in the Paris green that more injury resulted therefrom than from the boll weevil itself. The failure of this early work with Paris green was summed up in Farmers' Bulletin No. 211 in the following statement: "The use of Paris green in boll weevil control is absolutely futile."

Arsenate of Lead Experiments

Prof. Wilmon Newell, as Entomologist of the Crop Pest Commission in Louisiana, devoted much attention from 1906 to 1909 to the development of poisoning by powdered arsenate of lead.[2] He laid much stress upon the driving of the dust through the plants very thoroughly instead of relying upon the settling of the dust upon the foliage. His rate of application was from 2 to 5 pounds per acre, making five applications at intervals of seven days apart and beginning at the time the first squares appeared in the field. Using the improved hand duster then on the market this work usually showed a high degree of profit.

On a total treated area of 49 acres he obtained an increase of 71 per cent in yield over untreated check

1. 1895, Circular No. 6; 1897, Circular No. 18; Farmers' Bulletin No. 47; 1898, Circular No. 33; 1904, Farmers' Bulletin No. 211.
2. See Louisana Crop Pest Commission Circulars Nos. 23 and 33.

areas. This amounted to an average of 281 pounds of seed cotton increase per acre. The average cost of each application was only $1.08.

Cotton Dusting with Calcium Arsenate

Starting about 1913 one of the most notable results of experimental work conducted by B. R. Coad of the U. S. Bureau of Entomology in the Delta section of Louisiana and Mississippi, has been the development of this new insecticide material having a higher percentage of arsenate than has arsenate of lead and being more suitable for dusting work. Mr. Coad has also been instrumental in developing new types of hand and mechanical devices for distribution of poison. Although appearing quite certain to those who have studied boll weevil control that Mr. Coad's methods had merit under conditions of the Mississippi Delta where the work was done, it remained, however, to show that similar profitable results might be obtained in other sections and under the different climatic and cultural conditions to be found in other states.

COTTON DUSTING IN ALABAMA, 1918

Anticipating that the heaviest weevil infestation in Alabama would be in the Southeastern corner of the State in 1918, the cotton dusting work was located at Auburn, Hartford, Headland, and Smyrna. The experimental plats were located just before blooming began. Among the objectives in this work were to determine: (1) The best time for beginning dusting: (2) the number of applications giving the most profitable results: (3) the effectiveness of late applications: (4) a comparison of the effectiveness of arsenate of lead and calcium arsenate in weevil control, etc.

The size of plots varied from one-half acre to approximately one acre each, and special care was taken to insure as much uniformity as could be found in the size of plants, the evenness of the stand, uniformity of soil, fertility, drainage, etc.

No other method of weevil control, such as collecting adults or infested squares, was practiced by the owners of the fields. The applications were made during the day, either forenoon or afternoon, as the man in charge of applications found to be more convenient. The ar-

senate of lead as used in most of the tests was of an especially fine grade prepared for dusting work. The poison was applied to one row at a time, using a hand gun. The rate of application varied from one and one-half to five pounds per acre, and the time interval between applications was usually about fourteen days. The number of applications varied from one to six and the time of beginning work ranged from before blooming to about the middle of August, by which time infestation is usually complete in this section of Alabama.

CLIMATIC CONDITIONS AFFECTING DUSTING, 1918

As no special records were kept at the test fields in 1918, we took the records for the nearest Weather Bureau reporting point as indicating approximately the conditions prevailing in the treated fields. This may be far from the truth especially with regard to actual rainfall which may vary decidedly within a few miles. The most significant records are given below.

MAXIMUM TEMPERATURE AND RAINFALL RECORDS

Table 1.

Month	Record Station	Maximum Temperatures					
		No. of Days		Maximum for month	Mean		Departure from normal
		90° or Higher	100° or Higher		Max. for month	Av. Temp. for month	
June	Auburn	13	0	97	89	78.4	+0.5
	Alaga						
	Ozark	25	3	103	93.6	81.2	+1.8
July	Auburn	12	0	96	88.1	77.8	—2.0
	Alaga						
	Ozark	26	3	100	93.6	81.2	+0.5
August	Auburn	22	0	97	90.1	80.2	+1.3
	Alaga						
	Ozark	22	5	105	92.7	81.4	+0.5

Table 2.

Month		Rainfall				
		Total for Month	Departure from Normal	Maximum in 24 hours	No. days with rain	Dates rain fell
June	Auburn	4.68	+0.41	1.07	11	5, 8, 11, 13, 18, 21, 26, 27, 29, 30,
	Alaga	2.68	—2.48	0.65	6	5, 8, 12, 18, 26, 29
	Ozark	2.65	—1.14	1.19	7	5, 8, 12, 13, 18, 23, 26
July	Auburn	4.63	—0.79	1.45	7	9, 20, 22, 24, 25, 26, 28
	Alaga	3.35	—3.34	1.30	8	20, 21, 24, 25, 27, 28, 29, 31
	Ozark	3.38	—1.89	0.92	8	20, 22, 23, 26, 28, 29, 30, 31
August	Auburn	5.23	—0.57	3.03	7	2, 3, 11, 19, 20, 28, 29
	Alaga	4.05	—1.13	1.15	8	1, 2, 3, 11, 12, 17, 20, 29
	Ozark	4.65	+0.38	1.38	10	1, 2, 3, 11, 17, 18, 19, 20, 29, 30

A study of the records shows that while the rainfall at Auburn, was nearly normal in total amount during this period of three months, its distribution was not at all uniform. Nearly 40 per cent of the total rainfall occurred in three rains, and the remainder was scattered in more than twenty very light showers. In the extreme Southeastern corner of the State at Alaga, the rainfall was only half of the normal during June and July, while at Ozark it amounted to about four-fifths of normal during this period. Under these conditions the temperature naturally ran extremely high, exceeding 100 degrees on numerous days. The temperature records for Alaga are lacking, but it is likely that the maximums were above 100 degrees at that point even more frequently than at Ozark. The dusting work at Hartford, Headland, and Smyrna was located about half way between these two points, and an average of the two will represent in a fair degree the temperature and rainfall conditions prevailing at the experimental fields. As a result of this unusual condition, the weevils were so thoroughly controlled by heat and drought that cotton fruited nearly normally, and the dusting had little opportunity to show control of the weevil.

COTTON DUSTING EXPERIMENTS—1918.

A summary of this 1918 work is shown in Tables 3, 4, 5 and 6, on Page 58.

In the work at Auburn one field showed a slight increase in yield, but not sufficient to pay the expense for the dusting applied. This was in a field yielding approximately one bale per acre. Weevil damage was very slight until late in the season. In the other fields yielding better than one-half bale per acre, no evidence of gain was obtained. The first applications were made about the time that blooming began, and three applications given in each field. Neither field had many weevils until after the dusting had been completed.

At Smyrna signs of weevil damage were very few until late in the season. Here also light rains occurred at fairly frequent intervals, but did not interfere with a normal adhesion of the poison to the plants. Studying the records as a whole, there appears to be no evidence of increased yields as a result of the dusting. Plot 1 receiving five applications showed the lowest yield for the series while Plot 4, receiving only one application and that at the beginning of blooming, shows the highest yield. There is little likelihood that this increased yield was due to the dust applied.

In the Experiment Station Plat, Auburn, effort was made to determine the value of a single late application, and an excellent opportunity seemed to be at hand with heavy weevil infestation and very fruitful cotton. However, the dusting did not seem to affect the percentage of infestation at all, and no increase in yield was evident.

In the work at Hartford, with seven plots, two of which were checks, the number of dustings varied from one to five. No evidence of increase as a result of dusting can be seen, as in fact the plot receiving five applications gave the lowest yield of any in the field. In this particular locality no rain occurred from June 24th until July 20th. After the latter date occasional light showers fell. The drought caused the shedding of many squares and small bolls, and apparently prevented the dusting work from having any beneficial effects on the yield.

At Headland, weevils were more numerous than in the other locations, but did not become abundant until about August 1st. Two check plots were located at

TABLE 3 — AUBURN

Plot No.	Av. yield seed cotton per acre	Gain over check: Lbs. seed cotton per acre	Gain over check: Value of Gain @ 10½c	Applications: No.	Applications: Date: First	Applications: Date: Last	Applications: Total average Cal. Ars. per A.	per A. treated Profit or Loss: Total Cost	per A. treated Profit or Loss: Net profit or loss
1	1493	42	4.41	3	7-1	8-5	6 lbs.	5.17	0.76
2.chk	1451								
3	832	no G.		3	6-29	8-5	7½ lbs.	5.50	—5.50
4.chk	890								
Plots on Experiment Station Farm.									
41 Dusted	0.7 A.*								
Chk 50	0.7 A.*							1.85	

*No picking records obtained. No evident gain from dusting.

TABLE 5 — HEADLAND

Plot No.	Av. yield seed cotton per acre	Gain over check: Lbs. seed cotton per acre	Gain over check: Value of Gain @ 10½c	Applications: No.	Applications: Date: First	Applications: Date: Last	Applications: Total average Lead Ars. per A.	Profit or Loss per A. treated: Total Cost	Profit or Loss per A. treated: Net profit or loss
1.chk	509.8								
2	650.5	26	2.73	1	7-18		3 lbs.	1.33	1.40
3	681.0	57	5.98	4	6-20	8-1	11.5	4.65	1.33
4	1001.6	377	39.58	2	6-20	7-18	4.5	3.20	36.38
5	734.0	110	11.55	2	7-18	8-1	7.0	1.56	8.94
6	724.1	100	10.50	1	6-20	only	4.0	2.83	8.72
7.chk	739.5								
Av. ck.	624.6								

TABLE 4 — HARTFORD

1	777	60	$6.30	2	6-21	7-19	5*	1.95	4.35
2. Chk.	748								
3	718	1	.10½	1	7-19	only	3 1-3	1.70	—1.60
4	606	None		5	6-21	8-14	19¼	6.87	—6.87
5. Chk.	686								
6	651	None		2	7-19	8-3	8¾	3.15	—3.15
7	666	None		1	6 21	only	1½	.60	— .60
	717								

*Lead Arsenate.

TABLE 6 — SMYRNA

1	649.0			5	6-18	8-13	34.3	28.29	—28.29
2.chk	786.2								
3	760.7			2	6-18	7-17	5.25	5.58	— 5.58
4	835.3	49.1	5.15	1	only	6-18	1.75	.98	4.17
5	672.5			1	only	7-17	3.5	1.45	— 1.45
6	677			2	7-17	8-2	7.75	2.68	— 2.68
				11			45.7		

diagonally opposite corners of the field, one of these giving the lowest yield and the other the highest in the entire field. An average of the two is considered to represent a fair average for the entire field, and this average has been used in determining increases in other plots. In this locality each plot showed some gain over the average of the checks. The occurrence of rain was more uniform in this locality, and the third dusting which was given to four plots was washed off within about twenty-four hours. The results at Headland were more encouraging than at any other locality in 1918.

At Headland also, but in another field, a test was made of the value of a single late application where the infestation was heavy in top growth following the occurrence of rain early in August. One-half of a very rank patch of cotton was dusted heavily on August 13th. Examination made about two weeks later failed to show any difference in percentage of infestation or in the setting of young bolls as a result of this dusting, and no evidence of increased yield could be found.

CONCLUSIONS FROM 1918 FIELD DUSTING WORK IN ALABAMA.

Considering this work as a whole and in light of subsequent information also, it appears that several factors entered into the practically complete failure of the work, and these may be stated as follows: (1) The weevils were controlled in a large degree by heat and drought continuing for several weeks during the early part of the fruiting season. This repressed the infestation to such a degree that dusting was hardly needed. (2) The applications were not correctly timed for effective results in any case: First the treatment was started before there was sufficient evidence of weevil infestation to justify beginning the work; second, the interval between treatments was so great that any control effect would have been lost before the next application was made; third, in the case of late applications where single treatments were given, the work was not continued long enough for the results to become cumulative under the conditions where the infestation was sufficiently heavy to have justified the application.

This work is of value only as indicating some of the factors making dusting inadvisable and some of the conditions and practices to be avoided when dusting is advisable.

FUNCTION OF DEW IN WEEVIL POISONING

These experiments were suggested by the statement by Coad of the Bureau of Entomology (U. S. D. A. Bul. No. 731) that in his poisoning experiments the boll weevil obtained the poison by drinking the dew or rain. The following experiments were to test this point.

In these experiments small breeding cages were used about one and one-half feet square. Growing tops, bearing several squares and small bolls were placed in small jars of water and placed in the cages. The experiments were run in series with four cages to a series. The plants in the four cages were treated as follows: The first was dusted thoroughly with arsenate of lead and moisture was added every night and morning; the second was treated with arsenate of lead but no moisture was added; the third was treated with moisture twice daily but no poison; the fourth plant received no moisture and no poison. In order to duplicate dew as nearly as possible a small throat atomizer was used in adding the moisture. The poison was applied with a hand duster. The number of weevils used in each cage in the different series of experiments was 25 and 35. In some of the later experiments the moisture was added 3 times per day instead of twice. The dead weevils were removed from the cages daily. The experiments were usually run for about a week. At the end of a week the plants would usually begin to wilt which necessitated the stopping of the experiment. There were 785 weevils used in all of the experiments.

In order to duplicate field conditions more accurately large cages were built and placed over plants in the field. The same series of tests with four cages, as was used inside, was repeated in the field. The two cages in which there was to be no moisture were covered by canvass at night and during rains. This experiment was not satisfactory for three reasons:—very little dew occurred during the experiment; there was a period of heavy rainfall; and sickness of the observer prevented daily observations. Fifty weevils were placed in each cage.

The following table gives a summary of all the experiments during seven days.

Cage Tests of Relation of Moisture to Poisoning of Boll Weevil.

Table 7. WEEVIL COUNTS

Condition in Cage	In Laboratory				In Field				
	No. in Cage	No. Dead	No. Alive	Per cent. Killed	No. in Cage	No. Dead	No. Alive after 30 days	Unaccounted for	Per cent. Found Dead
Poison and Moisture	280	140	135	50	50	40	1	9	80
Poison. No Moisture	210	116	93	55	50	46	1	3	92
Moisture	135	12	121	9	50	5	16	29	10
No Moisture No Poison	160	14	112	9	50	9	31	10	18

From the table it is seen that the killing efficiency was no greater where moisture was added to the poisoned plants. In fact a *slightly higher efficiency was obtained on the dry plant,* but this was probably due to chance. By these results it seemed conclusively demonstrated that dew is not indispensable in poisoning the weevil. The last two tests in which no poison was used were to find out whether moisture was necessary for the weevil. It is seen that there is *no difference whether moisture was added* or not. However, the period of the experiment was short but it shows that weevils will live at least a short period without water.

The results of the field experiments only substantiate the results of those carried on in the laboratory. From this limited work it appears that the occurrence of dews or moisture on the plants after the poison has been applied does not increase the mortality among the weevils.

COTTON DUSTING PLANS FOR 1919.

Realizing the necessity for continuing cotton dusting field work through a number of years to cover variations in climatic conditions, and also to include as wide a variety of soil and cultural conditions as might be possible, the test areas for 1919 were located in four representative localities in the Southern half of Alabama. The first of these was near Dothan upon a fine, sandy loam type of soil. The second location at Prattville, Ala. represented the red clay lands which are among the most highly valued for cotton production in the State, and also the river bottom land lying along

the Alabama River, between Prattville and Montgomery. The third was at Orrville in Southwestern Dallas County where the red clay soils were again represented with those of a more sandy type. At Allenville in Marengo County, the prairie soils of the Black Belt were represented, both in the upland and in the lower bottom lands.

In each locality some of the most productive cotton soils were chosen as well as some of medium fertility. In the beginning of this work it was realized that soils naturally producing largest yields per acre would be most certain to yield a profit in cotton dusting, whereever the weevil infestation was sufficiently heavy to justify the poisoning at all. It was necessary also to have data showing something as to the possibilities of profitable cotton dusting with less than average yields per acre.

In each locality standard Weather Bureau apparatus was installed to give accurate data on rainfall and maximum and minimum temperatures particularly. Summer rainfall is of such local nature that this information must be gotten for the plantation on which the work is located to have the data even fairly accurate in detail. Uniform instructions were given to all men supervising this work so that the results in different localities might be as comparable as possible.

In studying the results of this work it is necessary on some points to consider the work in each locality by itself on account of the variation in soil conditions and in other local factors which affect yields, profits, etc. But for many subjects the work in all localities may be considered together, as for example, in determining the average cost of dusting, etc. For the sake of brevity the general records in regard to yields, treatment, costs, etc. have been grouped in tables bringing in all localities and reference may be made to the tables in considering the work for any special locality.

CLIMATIC CONDITIONS DURING DUSTING PERIOD OF 1919.

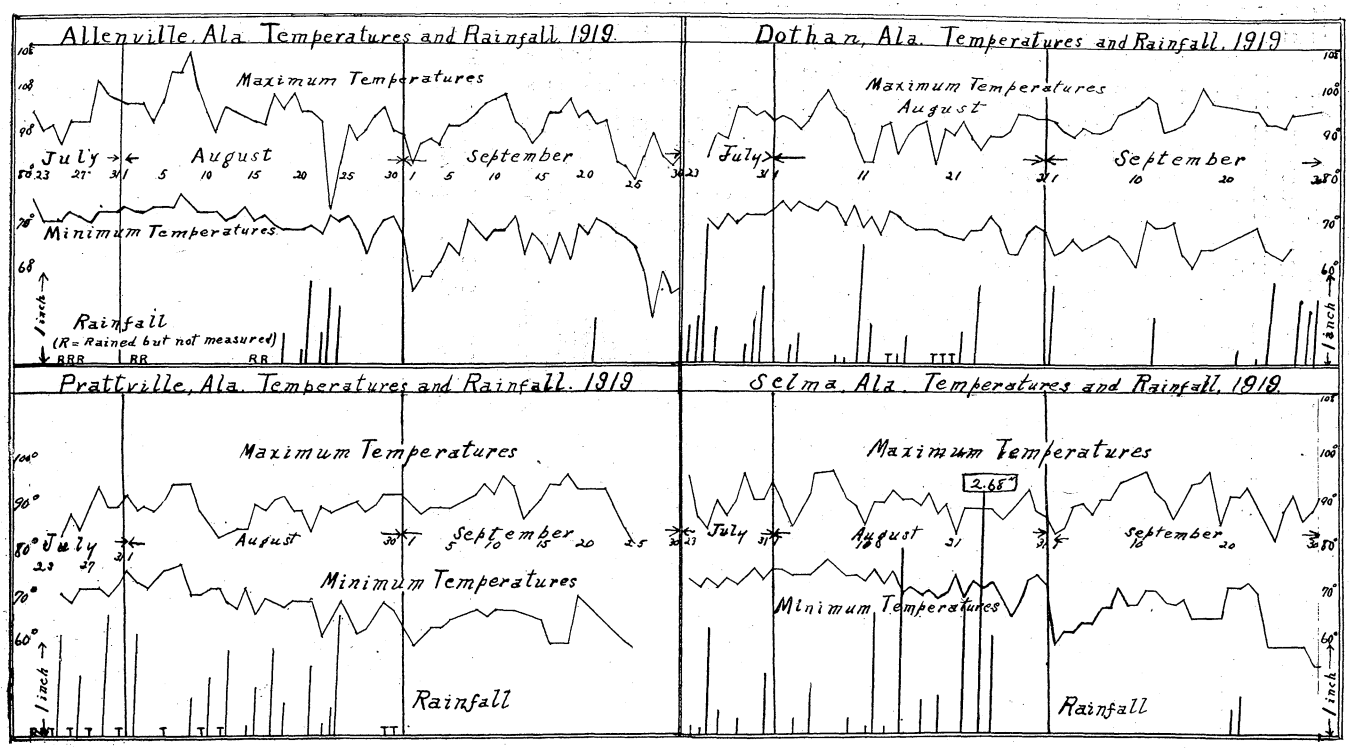
In their effects upon both plant-growth and weevil multiplication, the temperature and rainfall occurring during the summer months are of supreme importance. Accurate records can be obtained only in the immediate vicinity of the fields studied but it is hardly feasible to duplicate sets of apparatus in each field. There-

fore the records taken at a central point upon the plantation are considered as applying to all of the fields studied on that plantation. Standard types of Weather Bureau maximum and mininum thermometers and rain gauge were used in each locality and records made at 6 P. M. daily.

In contrast with the unusually hot, dry weather experienced in June and July 1918, we had during the entire period of 1919, extending from the latter part of July until the first of September, the wettest similar period in the history of the Alabama Weather Bureau. Rains occurred on more than half of the days during this period making it very difficult to keep poison upon the plants for a sufficiently long time to effect boll weevil control in a satisfactory degree. In many instances applications were washed from the plants within a few hours of the treatment and the work had to be repeated immediately. One of the most valuable results of the season's work appears to be the demonstration that it is possible to secure a very satisfactory profit from dusting work even under conditions of extremely frequent rains. It was noticable, however, that the dusting treatment checked the weevil much more satisfactorily where several rainless days followed the application of the poison. In cotton dusting work the quantity and character of the rain are important. Mid-day showers destroy open blooms by preventing pollination and therefore may do very serious damage to the crop and make it difficult to increase yields no matter how thoroughly the dusting may be done.

A graphic summary of the weather records during the dusting season is shown on Plate I. (p. 64.)

Plate I. CLIMATIC CONDITIONS, DUSTING PERIOD, 1919



GENERAL INFORMATION REGARDING PLOTS

As a basis for plot work the history of the field for preceding years should be known as thoroughly as possible. The crops grown, fertilizer used, etc. for the preceding year, at least, must be considered. In all essential respects such as variety of cotton grown, date of planting, frequency of cultivation, and picking of squares, the conditions of the treated and check areas should be the same. The only varying factor desired is that of the treatment applied. Where other factors vary decidedly it may be necessary to discard the data entirely.

Something of this basic information is shown in Tables 8, 9 and 10 for three of the four locations used in 1919.

In order to economize in printing we have omitted the records for plots which were started but for some reason discarded at the end of the season.

DETAILED RESULTS OF DUSTING IN 1919.

In the work at Allenville, Plot 11 with its check followed cotton in 1918, and on both plots the only fertilization in the past two years was one hundred pounds of nitrate of soda per acre each year. Here the increase in value of the crop due to the dusting amounted to a net profit of only $8.42 per acre. In contrast with this on plot 12, on similar soil, but where in addition to the nitrate of soda a top dressing of stable manure had been given in 1918 and also in 1919, the increase in crop gave a net profit of $33.91 per acre, or four times as much increase as on the plot that had no stable manure. The check plot was located between the treated plots, 11 and 12. Evidently the application of stable manure more than doubled the increase in yield and quadrupled the increase in profit.

At Dothan the value of a well arranged system of rotation and thorough cultivation is evidenced by the yield of practically every plot. Here cotton follows corn and velvet beans, potatoes, etc. grown in 1918. In no rotation does cotton follow cotton. The fertilization given was a complete fertilizer in the amount of two hundred to three hundred pounds per acre. The infested squares were collected from this area by the tenants from the earliest falling of squares until after the first of July. Here upon the most fertile soil the largest yield was made for any crop included in our work. It is evident that on plots 1 and 2 an unusually

TABLE 8

POWER DUSTING EXPERIMENTS, 1919

ALLENVILLE

Plot No.	Fertilization per acre				Last Cultv.	First Blooms	Bolls	First Pick'g	Last Pick'g	Ave. Yield Seed Cotton per acre	Total Av. Cal. Ars.	Value of Gain @ 13c.	Total Cost per A.	Net Profit per A.	Date first ap.	Date last ap.
	1918 Amt.	Material	1918 Amt.	Material												
	Lbs.		Lbs.								Lbs.					
11	100	Nitrate	100	Nitrate	8-23	6-15	8-13	9-2	11-19	333	Per A. 34	$17.29	$8.87	$8.42	8-5	9-4
Check	100	of Soda	100	of Soda	8-23	6-15	8-13	9-2	11-19	200	Tot. 183					
12	100	Soda	100	Nit. Soda				8-29	11-19	501	Per A. 19	$39.13	$5.22	$33.91	8-5	8-28
Check	100	Stable Manure	100	Stable Manure			8-15	9-2	11-19	200	Tot. 152					8-28

Plot 11, contained 5.38 acres. Plot 12 had 8 acres, both a Black Prarie Upland of fair fertility, growing cotton the previous year. Seed chosen was Cooks variety, planted March 25, with 10 day intervals of cultivation. Plot 11 had 5 and Plot 12 had 3 applications.

TABLE 9

PRATTVILLE

Plot No.	Fertilization per acre				Date Pltd.	First Bloom	Picking		Applications			Av. yield per A.	Tol. Av. Cal. Ars.	Value Gain at 13c.	Tot. cost per A.	Net Profit per A.
	1919 Amt.	Material	1919 Amt.	Material			First	Last	No.	first	Last					
	Lbs.												Lbs.			
1	800	11-3-0	Cattle	Fed	4-20	6-15	9-2	10-15	3	8-6	8-20	864	21	$17.55	$5.76	$11.73
		Nit. soda														
Chk.	100	11-3-0	Cattle	Fed	4-20	6-15	9-2	10-14	0			729				
6	800	11-3-0	Cattle	Fed	4-20	6-15	9-2	11-9	4	8-5	9-13	678				
	100	Nit. soda														
Chk.		11-3-0	None	None	4-10	6-15	9-2	10-15	0			603				
2	800	11-3-0	None	None	4-10	6-15	9-1	10-16	3	8-11	8-20	844				
Chk.	800	Nit. soda			4-10	6-15	8-28	10-14	0			1057				
11	Stable Manure		None	None	5-26	7-20	9-20	12-7	?	8-21	9-9	267	24.5	$14.56	$5.92	$8.64
Chk.	Stable Manure		None	None	5-26	7-20	9-20	10-1	0			155				
16	Stable Manure		None	None	5-26	7-20	10-1	12-7	6	8-19	9-24	391				
Chk.	Stable Manure		None	None	5-26	7-20	10-1	11-15	0			156				

NOTE: Areas of plots varied from .71 to 7.85 acres. Soil was red clayupland, excepting plots 11 and 16, both of which were River Bottom with heavy silt. Previous year crops were corn and velvet beans, except plots 11 and 16 had corn only. Ground was broken 8 inches and Covington Toole variety of cotton was planted with cultivations of 7 day intervals,—the last one on July 20. Bolls opened Aug. 15.

TABLE 10 — POWER DUSTING EXPERIMENTS 1919

DOTHAN

Plot No.	Fertilization per acre: 1918 Amt.	1918 Material	1919 Amt.	1919 Material	Crop previous year	First Bolls	First picking	Last picking	Applications: No.	First	Last	Av. yield per A.	Tot. Av. Cal. Ars.	Value gain @ 13c	Tot. cost per A.	Net profit per A.
			lbs.													
1	300	Guano 10-2		Compost Ac. Phos.	Corn & Beans	8-1	8-18	10-20	6	7-30	8-20	1228	31	$30.81	$ 8.33	$22.50
Chk	300	Guano 10-2		Compost Ac. Phos.	Corn & Beans	8-1	8-18	10-20				990				
2	200	Guano Manure	Broadcast 300	Manure Guano	Corn & Potato	8-1	8-18	10-6	5	7-26	8-20	1300	36	11.96	9.81	2.15
Chk	200	Guano Manure	Broadcast 300	Manure Guano	Corn & Potato	8-1	8-18	10-6				1208				
11	0		200	Manure Guano	Oats Peas Corn	8-10	8-17	10-17	3	8-5	8-21	947	99	57.46	4.33	53.13
Chk	2				Oats Peas Corn	8-1	8-18	10.25				505				
16	2				Corn	8-1	8-18	10-3	6	8-21	8-16	745	97.5	31.33	9.43	21.90
Chk	2				Corn	8-1	8-18	10-3				505				
13			200	Guano	Peanuts	8-5	8-21	10-7	3	8-9	8-22	367	15	2.73	3-93	—1.20
Chk	0		200	Guano	Peanuts	8 5	8-21	10-7				346				

TABLE 11 — ORRVILLE

2									5	7-30	8-29	1100	27	44.98	12.50	32.48
Chk												754				
1									4	7-29	8-27	985	35¼	32.89	9.38	23.26
Chk												732				

Note:—Areas of Plots varied from 3 to 9.7 acres. Soils of Plots 1 and 2 were rich,—others of medium fertility broken from 7 to 10 inches deep. Covington Toole variety was planted from March 27 to April 5, receiving cultivation to June 1 at 14 day intervals and later at 7 day intervals, up to last one on July 16, except Plot 13 which occurred August 9. First bloom appeared June 1.

good crop was made regardless of the dusting work. On plot 2 especially where the conditions had been practically ideal and the plants had set a full crop before dusting was started, the increase in yield on account of the dusting was comparatively small, amounting to only 92 pounds of lint cotton per acre, and with a yield on the check of over 1200 pounds without any dusting treatment. This shows the value of good cultural methods on good soil. Five and six applications were made to plots 1 and 2 respectively, and after deducting expense, the net profit ranges from $2.15 per acre on plot 2 to $53.13 per acre on plot 11.

At Dothan upon less fertile soil and with a stand considerably broken, a slight loss was incurred in the treatment of plot 13, amounting, however, to only $1.20 per acre. While plot 11 shows the largest increase in yield over its check, it was discovered at the end of the year that the check area followed corn in 1918 while the treated area followed oats and peas. The influence of the peas is undoubtedly shown in part by the increased yield obtained.

At Orrville, the work was conducted on an extensive rather than intensive basis and full records as to the preceding history of the crop were not obtained. The results, however, are entirely reliable because they represent comparable areas and also because the results are confirmed by the fact that the increase secured consisted almost entirely of top crop that was formed after the weevils had reached the condition of complete infestation so that no further yield would have been secured without the dusting. The results in this case indicated more clearly than in any other way what may be expected on a commercial scale. The increase in yield was sufficient to have purchased outright the entire dusting equipment and to have paid for all the poison secured for the season, labor, etc., involved, and still have left a handsome profit for the season's work.

The work at Prattville was in some respects less satisfactory than at other locations, primarily because the upland and bottom land plots were located too far apart so that the machinery could not be moved readily from one location to the other. It happened, therefore, that the dusting equipment was moved from the upland plot too soon and dusting was begun on the bottom land plot too late to secure the best results. In this locality the work on plot 1 was on red upland of good

fertility and yielded better than one-half bale per acre.

Three applications were given at intervals of seven days. Between August 6 and 26, rain occurred on twelve days and a total of 6.82 inches fell. This excessive rainfall undoubtedly decreased the effectiveness of the applications given, and occurring on so many days there was little chance for the setting of bolls on account of the weather, regardless of weevil condition. In spite of these facts, however, a net profit of $11.73 per acre was made upon this upland plot.

At Prattville also, and in comparison with the upland work, plot 11 was located upon river bottom close to the Alabama river and consisted of late planted cotton. The stand was poor but uniform and was very grassy on account of the impossibility of working the land because of the wet weather. Here the yield upon the treated area amounted to only 267 pounds per acre, which was, however, an increase of 112 pounds per acre over the check. On the treated area there were two full and a partial third applications of dust. A net profit of $8.64 per acre was obtained in spite of the very low yield. This demonstrates clearly the value of dusting work on late planted cotton under very unfavorable conditions.

The hand dusting work was of so much smaller extent and less significance than the power dusting that it is omitted in this connection.

COST OF DUSTING.

One of the objectives in the 1919 work was to determine the average cost for treating cotton with calcium arsenate for boll weevil control. The main factors involved would necessarily be the original cost for machinery and expenses for operation, upkeep and depreciation. The cost for poison and the labor involved in making the application also figure largely in the costs.

The machinery factor was very uncertain in 1919. The gas engine power dusters which were used principally were a modification of orchard dusting equipment adapted to cotton dusting work. This was the first use of such machinery in Alabama and the experience of the season demonstrated that a discontinuance of that type was advisable on account of the difficulties of operating gas engines with negro labor, and

because of the complexity of the equipment which required two men to operate.

The factor of initial cost would vary decidedly according to the acreage treated, and should be divided between the maximum acreage that the machinery can well handle. As our work was conducted on a smaller scale than this, we have not included a charge for initial cost of machinery or for depreciation, in the expense for dusting, but have included all time spent in the field, including delays involved in repairing machines while at work, but not the work that might be done on the engine at other times. The expense for operation is so small that it is considered as included in the charge of fifty cents per hour for the operation of the machines with the cost for two men and team.

The cost for poison is practically a fixed charge and varies only a few cents per pound and depends largely upon the quantity in which the poison is purchased.

The labor item is based upon an average of the estimates for cost for mules and man labor in different sections. This item might vary considerably with different planters, but we believe that fifty cents per hour is a fair allowance on this point.

Believing that the general range of cost in different localities with power and hand dusting machines may be shown as well by general summary as by presenting the figures for each locality, we have condensed these records into Table 12. The only really comparable basis for these records is the cost per acre for one application. The records show that power machines distribute as a rule somewhat more poison than do the hand guns, and for this reason the expense for treating an acre with power has run higher than by hand. It is entirely possible however, that with improvements in feed adjustment the amount of poison distributed by power machines may be reduced so that the expense will be fully as low, and possibly lower in the future with power machines than it is likely to be with hand guns.

GRAND SUMMARY COST OF DUSTING COTTON DUSTING PROFITABLE

The main objective in cotton dusting work must necessarily be the demonstration of profit as a result of the work done. Alabama cotton farmers were very loath to undertake dusting work in 1919, because of doubt as to the applicability of the results found in the Delta section of Mississippi and Louisiana to Alabama

TABLE 12

GRAND SUMMARY: COST OF DUSTING

SECTION A: POWER MACHINE

Locality	Area in acres dusted	Number of applications	Total "acre applications"	Total cost for areas treated				Cost per acre one application		
				For Cal. ARS. @ 25c per lb.	For labor @ 50c per hr.	Total for area	Aver. per A. as treated	For Poison	For Labor	Total per A. Application
Dothan	17.70	4.80	85.25	$ 132.50	$ 9.12	$ 141.62	$ 8.00	$1.55	$0.11	$1.66
Prattville	17.91	2.67	47.93	97.63	6.26	103.89	5.80	2.04	0.13	2.17
Allenville (1) ..	41.88	3.67	153.40	246.19	15.25	261.44	6.24	1.60	0.10	1.70
Orrville	75.00	4.47	335.00	763.75	49.00	812.75	10.84	2.28	0.15	2.43
14 Fields	152.49	4.10	621.58	1240.07	79.63	1319.70	8.65	2.00	0.13	2.13

(1) Most of these plots had to be discarded because extremely heavy rainfall "drowned them out".

SECTION B: HAND MACHINE

Dothan	5.30	6.43	34.10	46.62	8.48	55.10	10.42	1.37	0.25	1.62
Prattville	1.70	5.16	8.78	17.19	5.10	22.29	13.11	1.96	0.58	2.54
Allenville	11.00	3.32	36.50	53.00	4.34	57.34	5.21	1.45	0.12	1.57
7 Fields	18.00	4.40	79.38	116.81	17.92	134.73	7.49	1.47	0.23	1.70

conditions. The results however, were found to be highly satisfactory in practically all localities in spite of the exceptionally heavy rainfall, which had made it very difficult to retain the poison upon the plants and had forced the repetition of treatment in many cases, thus increasing the expense materially. A summary of the work in four localities is shown in Table 13. Most of the hand dusting work had to be discarded on account of the evident unreliability of results due in many cases to a difference of a few inches in elevation whereby the standing water seriously affected the growth of the plant or the rotting of bolls after they had been formed, so that conditions were not uniform between treated areas and checks.

The results of the power dusting work on 120 acres are exceptionally interesting. Here the yield on check plots was about 700 pounds of seed cotton per acre and the increase produced by the dusting amounted to 35 per cent. As a general thing therefore on this area where the yield of the check was approximately one-half bale per acre, the yield on the treated area was increased to about two-thirds of a bale per acre; a difference amounting actually to 247½ pounds of seed cotton. A net profit of nearly $23.00 per acre resulted, and for the entire area as treated a total profit of $2755.59 is shown.

In the hand dusting work, while the area is small, amounting to approximately 5 acres and the yield on the average is less than in the power dusted plots, the percentage of increase is even greater, amounting to 50 per cent. In spite of the increased percentage, however, the margin of profit shown is slightly less than in the more productive plots that were dusted with power machines.

Relation of Yields to Profits and Costs.

While it may be generally anticipated that the amount of profit from dusting operations is likely to be greater as the productivness increases, there are other factors concerned which may influence the results decidedly. This fact is most clearly shown by comparing the highest yielding areas with those of comparatively low yields. (Tables 14 and 15, on page 75). It is evident that the more promising the cotton the more carefully the dust application should be made, and this was evidently done as shown by a comparison

TABLE 13

GRAND SUMMARY YIELDS AND PROFITS 1919

SECTION A: POWER DUSTING

Locality	Plot No.		Yield Seed Cotton		Gain over Check Per acre lbs.	Total gain on area treated lbs.	Value total gain @13c per lb. seed cotton	Total cost for area as treated	Total net profit for area	Aver. net profit per acre
	No.	area acres	Total for area lbs.	Aver. per acre lbs.						
Dothan	1	9.7	11,918	1228	237	2,299.	$ 298.87	$ 80.75	$ 218.12	$22.50
	2	5.0	6,500	1300	92	460	59.80	49.07	10.73	2.15
	13	3.0	1,100	367	21	63	8.19	11.80	*3.61	*1.20
Totals and Averages		17.7	19,518	1103	160	2,822	366.86	141.62	225.24	12.73
Prattville	1	3.2	2,766	864	135	432	56.16	18.63	37.53	11.73
	11	11.5	3,161	267	112	1,288	167.44	68.13	99.31	8.64
Totals and Averages		14.7	5,927	403	117	1,720	223.60	86.76	136.84	9.31
Orrville	1	40.0	39,397	985	253	10,120	1315.60	375.25	940.35	23.26
	2	35.0	38,501	1100	346	12,110	1574.30	437.50	1136.80	32.48
Totals and Averages		75.0	77,898	1039	296.4	22,230	2889.90	812.75	2077.15	27.67
Allenville	11	5.38	1,791	333	133	715.5	93.02	47.71	45.31	8.42
	12	8.0	4,009	501	301	2,408	313.04	41.79	271.25	33.91
Totals and Averages		13.38	5,800	433.5	233.5	3,123.5	406.06	89.50	316.56	23.66
Grand Totals and Averages ..		120.78	109,143	904.00	247.5	29,895.5	$3886.42	$1130.63	$2755.79	$22.82

SECTION B: HAND DUSTING

Dothan	16	3.0	2,236	745	241	723	$ 93.99	$28.29	$65.70	$21.90
Prattville	6	0.71	517	728	125	88.75	11.54	6.50	5.04	7.00
	16	0.99	387	391	235	233	30.29	9.34	20.95	21.16
Totals and Averages		1.70	904	532	189.3	321.75	41.83	15.84	25.99	15.29
Grand Totals and Averages ..		4.70	3,140	668	222.3	1,044.75	$135.82	$44.13	$91.69	$19.51

*Loss

of the average cost for treatment per acre in high and low yielding plots. The average was $10.35 per acre on 93 acres in high-yielding and $6.08 for 28 acres of low-yielding cotton.

Low-yielding cotton may be due to any one of several factors, among the most important of which would be infertile soil, but yields may be greatly reduced even upon fertile soil by late planting and heavy weevil infestation. This happened to be the case with some of the low-yielding plots referred to above. We find that the average amount of poison applied per acre at each application was fully as great with the low-yielding cotton as with the high-yielding. The number of applications given, however, were fewer on the low-yielding plots and the average cost for treatment is therefore less than the high-yielding plots. Possibly the increased number of treatments may be responsible in a considerable degree for the increased yields shown, but the two groups are very distinct in total yields. We have therefore an average cost for treatment of $10.35 per acre for the high yielding cotton, as against $6.08 for the low-yielding. The number of applications average 4.55 for high-yielding against 3.18 for the low-yielding cotton.

The effect of the factor of productiveness is evident when we come to a consideration of the average net profit per acre resulting. The increased yields of treated areas over checks with high yielding cotton was 273.6 pounds of seed cotton per acre, as compared with 160 pounds with the low yielding cotton, and the net profit with high yielding was $25.23 per acre as compared with $14.72 with the low yielding cotton.

A study of these considerations leads inevitably to the conclusion that in boll weevil control work in the future it is going to be recognized as increasingly advisable to keep the acreage of cotton within very moderate limits and to make that acreage then as fertile as may be done with well-balanced fertilizers so as to increase the productiveness while decreasing the area that must be cared for. Under these conditions if boll weevil infestation is heavy, a maximum of profit from cotton dusting work is very certain to be obtained. It is true that there is evidence of a very satisfactory profit in this case with yields as low as one-fourth bale per acre, but this was largely due to the fact that several of the plots were late planted cotton on fertile soil, and

TABLE 14

RELATION OF YIELD TO PROFIT AND COST

HIGH YIELDING COTTON

Locality	Plot No.	Area	Total yield	Aver. lbs. per acre	Gain over check	Total gain for area	Val. of gain @.13 lb.	Total cost treatment	Total net profit	Aver. net profit per acre
Dothan	2	5.0	6,500	1300	92	460	$ 59.80	$ 49.07	$ 10.75	$ 2.15
Dothan	1	9.7	11,918	1228	237	2,299	298.87	80.75	218.12	22.50
Prattville	1	3.2	2,766	864	135	432	56.16	18.63	37.53	11.73
Orrville	1	40	39,397	985	253	10,120	1315.60	375.25	940.35	23.51
Orrville	2	35	38,501	1100	346	12,110	1574.30	437.50	1136.80	32.48
Totals and .... Averages		92.9	99,082	1066	273.6	25,421	$3304.73	$961.20	$2343.53	$25.23

Average cost for treatment $10.35 per acre. High Yielding Cotton.

TABLE 15

LOW YIELDING COTTON

Dothan	13	3	1,100	367	21	63	8.19	11.80	3.61	1.20
Prattville	11	11.5	3,161	267	112	1,288	167.44	68.13	99.31	8.64
Allenville	11	5.38	1,791	333	133	715.5	93.02	47.71	45.31	8.42
Allenville	12	8.0	4,009	501	301	2,408,0	313.04	41.79	271.25	33.91
Totals and .... Averages		27.88	10,061	361	160	4,474.45	$581.69	$169.43	$412.26	$14.72
Grand Total and Averages...		120.78	109,143	903.5		29,895.5	$3886.42	$1130.63	$2755.79	

Average cost for treatment $6.08 per acre. Low Yielding Cotton.
Average $9.36 per acre on completed area of 120.78 acres.

TABLE 16. WHERE DUSTING WILL BE NEEDED MOST.

Counties and years first infested	Aver. yield 1910-1914	Lint. lbs. per acre 1915-1919	Ratio of yield 1915-1919 to 1910-1914 per cent.
GROUP 1—			
First infested 1915;			
Jackson	207	167	87
DeKalb	221	168	76
Cherokee	221	176	80
Lauderdale	181	159	74
Limestone	184	147	80
Madison	185	173	93
Marshall	207	184	90
The group	202	168	83
GROUP 2—			
First infested 1915:			
Colbert	168	149	89
Lawrence	197	174	88
Morgan	196	165	84
Etowah	218	176	81
Calhoun	218	189	88
Cleburne	198	142	71
Cullman	193	163	88
Blount	208	170	82
St. Clair	219	156	71
Talladega	205	135	66
Clay	192	117	61
Randolph	194	132	68
Chambers	191	116	61
Lee	169	106	63
Russell	174	112	64
Coosa	202	95	47
Tallapoosa	189	107	57
Elmore	184	119	65
Macon	179	124	69
Bullock	179	98	55
Barbour	162	95	59
Henry	193	101	52
The group	193	140	73
GROUP 3—			
First infested 1914:			
Franklin	189	170	90
Marion	207	166	80
Winston	196	177	90
Walker	208	121	58
Jefferson	218	148	68
Shelby	218	115	53
Chilton	216	111	54
Autauga	189	92	49
Montgomery	156	79	50
Houston	183	94	51
The group	198	127	64
GROUP 4—			
First infested 1913:			
Fayette	197	119	60
Tuscaloosa	187	86	46
Bibb	199	95	48
Lowndes	160	72	45
Pike	191	109	45
Dale	184	84	46
The group	186	94	50
GROUP 5—			
First infested 1912:			
Lamar	192	128	67
Pickens	171	71	41
Greene	172	69	40
Hale	176	56	37
Perry	172	83	48
Dallas	167	82	49
Butler	198	89	45
Crenshaw	206	122	59
Coffee	194	93	48
Geneva	205	122	59
Marengo	187	86	46
Wilcox	160	75	47
Monroe	173	83	48
Conecuh	212	95	45
Covington	218	97	44
Escambia	211	115	55
The group	188	92	49
GROUP 6—			
First infested 1911:			
Sumpter	177	69	39
Choctaw	167	66	39
Clarke	168	81	48
The group	171	72	42

the yielding capacity was therefore decidedly higher than that of the average cotton field in the State as represented by a yield of one-fourth bale per acre.

Where Cotton Dusting Is Most Needed.

Inasmuch as dusting work depends primarily upon the severity of weevil infestation for its margin of profit, a study of the areas in the State that are most seriously affected by the weevil will indicate where dusting will generally be needed. This is indicated most clearly by the effect of the weevil upon the yield of lint per acre as shown by the statistics of the U. S. Bureau of Crop Estimates and compiled in Alabama by F. W. Gist, Field Agent. In the Table 16 as here given the variations in acreage are eliminated and yields in numbers of bales per county are entirely disregarded. A comparison of the past five-year period during which the weevil has occurred through most of the State with the preceding five-year period, will give a fair basis for these conclusions. It should be remembered, however, that during the past five years there has been a marked decrease in the use of fertilizers generally, and therefore the average yield in uninfested territory has not been equal to that of the preceding five years when much larger amounts of commercial fertilizer were used.

A casual examination of Table 16 reveals the fact that weevil infestation is primarily responsible for a reduction of nearly one-half in the southern half or two-thirds of the State. During the period from 1910 to 1914 the southern half of the State produced as much cotton per acre as did the northern half, but during the last five-year period it has been producing only 7-10 as much, or a decrease that may be attributed directly to boll weevil work of 30 per cent. in yield of lint per acre.

It should be evident that in all counties where the weevil during the past five years has caused an average decrease in yield of more than 20 per cent. dusting is likely to be needed regularly each year. This includes all counties lying South and West of a line running along the northern edges of Pickens, Tuscaloosa, Bibb, Chilton, Elmore, Montgomery, Bullock, and Barbour Counties. In all parts of the State it may be needed during certain seasons.

The most recent information regarding machines and supplies of poison may be had at any time by addressing the Entomologist, Auburn, Alabama.

PART II.

PREFACE

A word of explanation may assist the reader in understanding the reasons for the arrangement of this bulletin. The material contained in Part I was prepared for the printer in the spring of 1920. Owing to scarcity of paper and printing funds the data were condensed as much as possible. Part I was not in page proof form until the fall of 1920 when the burning of the Agricultural Building destroyed the entire stock of Experiment Station publications. Much of the data from the 1920 cotton dusting work was also destroyed and cannot be replaced. It has seemed best therefore to include such information as is available from the past seasons work as Part II of the present bulletin since Part I was already in form to be printed.

COTTON DUSTING WORK IN 1920

The work in Alabama for 1920 was intended to be similar in outline to that described in Part I for 1919. The locations for the work were Geneva, Geneva County, on a level tract of fine sandy loam of medium fertility. This area was typical of the Lower Coastal Plain section. On low rolling hills with sandy surface soil and red clay subsoil, at Notasulga was found a location fairly typical of the Upper Coastal Plain section of East Central Alabama. A third location was in the Chattahoochee River bottom land of Russell County where the use of twelve traction machines on one plantation gave an unusual opportunity for the study of this machinery in actual use.

Unfortunately unforseen emergencies made it impossible to carry all of the observations through to the end of the season in these three locations. But still much valuable information has been gained from the seasons work and some of it is here presented to aid in establishing a solid basis of information regarding the value and practicability of cotton dusting for weevil control.

COTTON DUSTING AT NOTASULGA, 1920

The location was heavily infected with wilt but the seed used was a selection from Cooks which was being bred on this place for wilt resistance and proved to be very satisfactory.

In a traction-machine-dusted plot of 3 acres with 1½ acres check, four applications were made on July 29, August 3, 7 and 21. Total calcium arsenate used was 84 lbs., or an average of 7 lbs. per acre per application. The first application, applied in the early morning with a heavy dew on the plants and no wind, was made when the infestation was about 20 per cent. and was followed by several days of fair weather. This was very effective in checking the infestation. The second and third applications were both followed by rains after about twenty-four hours but still the infestation fell steadily until on August 10, it was only 3 per cent. in the dusted area while the check continued steadily higher. From August 7 to 19 rain fell daily except on the 13 and 14. No dusting was needed until the latter part of the period when on August 20 the infestation was found to have risen to 68 per cent. in the treated area and 100 per cent. in the check. The fourth application was made on August 21 to protect the small bolls as adult weevils had become very abundant.

Picking records gave an average of 1260 lbs. of seed cotton per acre for the dusted and 888 lbs, per acre for the check plot. Dusting evidently increased the yield by 372 lbs. or 42 per cent. over the untreated check area. The value of the increase in yield is figured at 6½ cents per lb. for seed cotton and accordingly amounted to $24.18 per acre.

The cost of treatment amounted to $8.16 per acre, thus leaving a very fair margin of profit of $16.00 per acre with a yield of over four-fifths bale per acre.

On another plot of five acres on this plantation, with less fertile soil, the crop was made on both treated and check areas too early in August to show as much value from the dusting. However, the effect of the treatment on weevils may be judged by the infestation records which show a very fair decrease for the treated but a steady increase for the check areas. Three dustings were applied and the third was washed off by heavy rains following on the same and three succeeding days.

The cost of treatment here averaged $1.88 per acre, per application. The yield on the tested plot averaged 678 lbs. of seed cotton per acre while the check gave 596 lbs. The increase in yield from dusting with these yields below one-half bale per acre was 82 lbs. per acre worth $5.33, while the cost of treatment averaged $5.65.

The loss was apparently $0.32 per acre. But as a matter of fact the infestation on the treated area at the start was higher than on the check, being on August 3, 20 per cent. as against 12.7 per cent. and at that time the check averaged nearly a boll per stalk more bolls than the treated area. To have overcome this initial handicap and increase the yield on treated cotton by about 14 per cent. shows that the treatment actually paid a small profit.

On a small hand-dusted plot which was a special seed-breeding patch, there was an area of one-half acre planted late so that the first bloom appeared July 1. Here six applications were made between July 20 and August 30, using a total of 24 lbs. of poison. This shows an average rate of 8 lbs. per acre per application. The labor required was a total of 4 hours and applications were made in the early morning hours while dew was on. Here the yield was 1312 lbs. of seed cotton, or at the rate of practically 2 bales per acre.

Very little weevil damage occurred in this plot. Many stalks matured over 100 bolls each. Fruit setting continued until well into September.

Considering the late planting and heavy infestation around this plot, the proximity to buildings, etc., it is very conservative to estimate that dusting saved at least 50 per cent. of the crop on this plot. Value of increase per acre would be, at 6½ cents per lb. for seed cotton, $85.28. Cost of treatment per acre (6 applications) $14.00. Rate of net profit per acre $71.28 where the yield reached a rate of 2 bales per acre.

Dusting is likely to pay best where the rate of yield per acre is highest and weevil infestation heavy.

COTTON DUSTING AT GENEVA, 1920

On a 30 acre tract of fine sandy loam, level and free from stumps, planted in corn in 1919, Covington-Toole cotton was planted early in April, 1920. The tract was divided into three plots of 10 acres each. The outer plots were dusted with a traction machine while the middle plot was kept as a check. Here four applications were made between July 6 and August 10, and an examination of the field on August 27 showed very marked benefit from the dusting in both plots. Dusting enabled a very fair top crop to be set while there was practically none on the check or other untreated

areas nearby. The owner was well pleased with the results and states that he will continue dusting in the future. The average yield for the entire tract was three-fifths bale per acre.

Unfortunately the detailed data for this location were destroyed by fire so only the general conclusions can be drawn that dusting was satisfactory and profitable on this tract.

COTTON DUSTING MACHINERY

The gas-engine-driven type of duster on a 4-wheeled wagon operated by two men as used in 1919 was almost entirely superseded in 1920 by the 2-wheeled, traction-driven type operated by one man. Machines of this traction type were manufactured by several companies, but all were produced in haste and with little opportunity for the field testing and gradual development that must necessarily accompany the development of the ideal cotton dusting machine. One objective in the work was therefore to study the field operation of these various makes of machines with a view to securing improvements in future models.

The traction-driven type of machine has demonstrated its practicability, reliability and economy of operaton in spite of the minor weaknesses which, naturally, developed under field use. These weak points will undoubtedly be eliminated by manufacturers in their future models. Only three manufacturers succeeded in getting traction machines ready for use in 1920 but several others will be ready for 1921. Costs of construction should also decline for the future. We may rest assured therefore of increasing efficiency, reliability and economy for the future supply of dusting machinery.

But the difficulties with machinery cannot all be charged to manufacturers. Far too many of the users allow these expensive machines to operate without frequent and proper oiling and adjustment of chains, etc. Often machines stand in the fields where used without the slightest protection from the weather during weeks or months and rust develops rapidly. Breakage, delays and ultimate loss follow naturally.

On large plantations, especially, where a number of such machines are used it will certainly pay to have a good mechanic to go over the machines daily, or after each use in the field, to see that they are properly oiled,

adjusted and repaired. Thus the first investment in machinery may be reduced and the acreage dusted per machine may be greatly increased with final economy on all accounts. The possibility in this direction was clearly shown on one Alabama plantation in 1920 where there were operated twelve traction machines including some of each make on the market. The total investment for machinery was about $4750, and for poison over $9000. These machines actually dusted an average of about 20 acres per night when they could be operated. This acreage might have been increased by 50 per cent. had the machines been maintained constantly in the best of running condition, or the same acreage that was actually dusted might have been protected with a machinery investment of only $3,000 to $3,300. The difference in either item would far more than have paid for the most careful mechanical care and also for expert supervision of the operation of the machines during the six or eight weeks of the dusting period.

In all makes of machines yet tested, it would seem that there is opportunity for reduction in weight by refinement in materials used, and in the draft by better cutting of gears and the use of roller chains, etc. Apparently there is an advantage in the distribution of the dust and a possible economy in the amount required for weevil control by maintaining the direction of the discharge of the dust cloud constantly downward through the plants and to the ground rather than shooting it out horizontally over the plants and trusting to its settling through them. There also seem to be good reasons for providing for some adjustment between outlets for various widths of planting so as to conform approximately to the prevailing width of rows.

GENERAL CONCLUSIONS

Weather conditions will always affect the dusting problem. If sufficiently hot and dry for a period of more than a month, and especially during the first part of the fruiting season, the weevils may be controlled thereby so fully that dusting will not be needed, or will not pay. On the other hand during periods of frequent rains it may appear to be impossible to dust or that the poison will be washed from the plants too quickly to allow it to affect the weevils. Experience

thus far in Alabama indicates that every effort should be made to continue dusting at the usual four or five day intervals in spite of threatening weather. No natural factor of control checks the weevils at such times. They multiply therefore with great rapidity. Many squares and small bolls are caused to shed by mid-day rains even without weevil attack and the work of the weevils is, therefore, concentrated upon the reduced number of squares and bolls remaining. These must be given protection by poisoning if they are to escape. As a matter of fact, in most cases, dusting continued under the foregoing rainy conditions has paid while if discontinued the possible benefit from one, two or three early dustings may be lost.

Many hundreds of cotton farmers during 1920 undertook cotton dusting without sufficient information as to the conditions essential to success, or without an adequate supply of machines or poison, or continued for only a portion of the season and then quit before there was a possibility of profit from the work. In a large majority of cases also no check areas have been kept and no complete records of either cost or yield so that the very large majority of those who have tried dusting in some measure are not yet able to speak with any degree of accuracy as to the merits of dusting. General opinions from such men as to the value or lack of value of dusting can be given but little weight. Their experience constitutes a warning, however, as to errors or methods to be avoided rather than a guide to be followed by serious-minded farmers who consider dusting their cotton.

In some cases also failure in the work undertaken has been due to dusting cotton fields that were so low in yielding capacity that there was little likelihood of profit in their treatment.

As the price of cotton falls faster than the costs for labor, poison and machines, it will require a corresponding increase in the amount of yield resulting to pay the cost of treatment and assure a margin of profit therefrom.

Therefore now, more than formerly, cotton growers must be careful about cotton dusting under conditions that indicate only a narrow possible margin between profit and loss.

DO IT RIGHT OR DO NOT DUST

MORE ECONOMICAL PRODUCTION FUNDAMENTAL

As the margin of profit per acre decreases there must be a *prospect* of *higher yield* to justify dusting.

While yields of 1/3 bale per acre paid a profit in 1919 with seed cotton worth 13c and 14c per lb., we would not now recommend dusting with seed cotton at 6½ cents per lb. (lint at 16c and seed at $20.00 per ton) with prospective yields of less than 800 to 900 lbs. of seed cotton per acre and a prospect for heavy weevil damage also. In the foregoing work for 1920 it is plain that in most cases profit from dusting increased rapidly as the margin of yield increased above ½ bale per acre.

With the present information as to the value of dusting and with the present outlook as to the market for the cotton crop, we believe that there is one sound program for the cotton planters, subject of course, to many variations in details for different sections of the State and for farmers of different capacity and for varying conditions of climate and of weevil infestation:

Reduce the acreage in cotton to a little less than the average that can be given the exceptionally good care needed under the weevil conditions usually prevailing in any section of Alabama. Make that smaller acreage increasingly fertile through deeper plowing and a rotation system that includes the plowing under of frequent legume crops, and by well balanced fertilization with stable manure or commercial fertilizers. Then if there is prospect of heavy weevil infestation, the crop may be protected by dusting it with calcium arsenate every fifth day so as to keep weevil infestation below 30 percent until after a full crop of bolls is beyond weevil damage. This program will give, generally, the most economical production of cotton and the utmost possible assurance of profit in its production.