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Chemical Dust Treatment of Cottonseed for Planting Purposes

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
T. O. WALTON, President

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Studies were begun in 1930 by the Texas Agricultural Experiment Station to determine the effect on stands and yields of cotton of different methods of delinting and treating the seed. In these studies tests were made to determine the influence of date and rate of planting and the best depth of listed furrow in which to plant cotton. The field work in these experiments was done at the U. S. Cotton Breeding Field Station at Greenville, at College Station, Angleton, Lubbock, and Temple, and in the Brazos River Bottoms near College Station. This bulletin reports the results of the work up to the present time.

Treating fuzzy cottonseed with Ceresan increased the number of seedlings that emerged from 11 to 65 per cent and the yields from 4 to 25 per cent when the cottonseed were planted at the optimum rates and dates. In the early planting of fuzzy cottonseed treated with Ceresan for a three-year period at Lubbock a smaller number of seedlings emerged and a smaller percentage of seed germinated, with no significant difference in yields. Ceresan treatment of mechanically delinted cottonseed planted at the optimum rate and date gave a larger number of seedlings emerging at College Station, Temple, Lubbock, and in the Brazos River Bottoms, than did untreated seed. At Greenville seedlings from cottonseed treated with Ceresan and Bayer Dust 502 and delinted with hydrochloric acid gas and sulphuric acid had a smaller number of plants infected with angular leaf spot disease in the early seedling stage than did those from untreated seed. Ceresan treated seed planted at Temple had a smaller percentage of seedlings affected with angular leaf spot.

Bayer Dust treatment of fuzzy seed planted at the optimum date and depth of furrow gave fewer seedlings, but slightly higher yields than untreated seed. Mechanically delinted seed treated with Bayer dust gave more seedlings but slightly lower yields than untreated seed.

Copper carbonate treatment of both fuzzy and mechanically delinted seed did not prove beneficial.

When cotton was planted at Lubbock on April 25, May 5, May 15, and May 25, the total number of plants obtained generally increased with the lateness of planting.

There was a general tendency for the stand of plants to increase as the rate of planting increased.

Cottonseed planted in a four-inch furrow at Lubbock gave a larger number of seedlings than either the surface planting or the seven-inch listed furrow.

At Lubbock cotton thinned to a 12-inch spacing gave higher yields than unthinned cotton.

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Every spring the cotton grower wonders while he is carefully planting his cottonseed whether he will get a good stand of plants or have to replant. No doubt he has carefully prepared the seed bed and hopes to secure a good stand of plants by putting down large quantities of seed. Even so, he may have to plant his crop a second, and sometimes even a third time, before a satisfactory stand of plants is secured. Since the advent of the boll weevil, it is very important to plant early. Planting before the soil has become warm enough to enhance quick germination increases the risk of a poor stand, however, and, as a consequence, replanting is often necessary. Young seedlings from early plantings are often killed by fungus diseases, the most common of which are the anthracnose fungus (*Colletotrichum Gossypii*) and the sore shin fungus (*Rhizoctonia Solani*). The anthracnose fungus is often present on the surface of cottonseed in the form of spores and attacks the cotton seedling at the time of germination. If weather conditions become unfavorable for the rapid growth of cotton seedlings, many of them are killed by the fungus. Sore shin fungi under certain conditions of temperature and moisture that may exist at the time of planting, kill large numbers of the seeds before germination is hardly begun. Other seedlings are killed between the beginning of germination and emergence, and many may die after they have emerged and attained a height of two or three inches. A high percentage of the fungi spores are destroyed when the seed are delinted or treated with chemical dusts, and this makes it possible for more of the seeds to germinate and for the seedlings to emerge and survive.

The literature on this subject indicates that better stands were secured in the eastern part of the Cotton Belt by the delinting and treating of cottonseed. As the soil and climatic conditions in Texas are quite different from those in the cotton growing states east of the Mississippi River, it was considered advisable to conduct experiments on this phase of cotton culture under conditions prevailing in Texas. Investigations, therefore, were begun in different parts of the state to study the effects of the delinting and treating of cottonseed on germination and stand. The objects of the investigation were to determine the effects of various methods of treating fuzzy and delinted cottonseed with chemical dust preparations on germination, rate of emergence, and control of seedling

*Credit is due Messrs. C. H. McDowell, R. H. Stansel, Henry Dunlavy and G. T. McNess, superintendents of substations at Iowa Park, Angleton, Temple and the Main Station Farm at College Station, respectively, for their assistance in conducting the field experiments and in supplying data reported in this bulletin.

diseases when the seed were planted at different dates and in listed furrows of different depths. The cottonseed used in these experiments was delinted by three methods—cottonseed oil mill delinting machinery, concentrated sulphuric acid, and hydrochloric acid gas.

Care should be used in selecting planting seed to see that they have a high percentage of germination. Dropping the seed, opening the seed furrow, and covering the seed are factors that may have a material influence on the stand of plants even when good seed are used. One of the biggest factors, therefore, in getting a stand of cotton plants without replanting is the ability of the individual to prepare a good seed bed and to select a time when soil moisture and temperature conditions are suitable for good germination. Treating the cottonseed before planting helps to meet adverse conditions that may occur.

REVIEW OF LITERATURE

Lyman (14) in his book on Cotton Culture, published in 1868, mentions the desirability of rolling cottonseed in a fertilizer to hasten germination. He recommended a compound of two parts of ashes to one of common salt. He also stated that some farmers practiced soaking cottonseed in a solution of salt dissolved in liquid manure and then rolling in a plaster.

Watkins (21) of Australia found that rolling cottonseed in superphosphate paste delayed germination. Experiments by Hall and Armstrong (8) of South Carolina showed that rolling cottonseed in nitrate of soda delayed germination. Similar results were secured by Briggs (2) of Arizona with sodium nitrate, lime, and flour paste.

Results of investigations with chemical dusts to secure better stands of cotton indicate that certain chemical dusts increase stands. Wallace (19) of the Raymond Branch Station in Mississippi secured increased germination and yield by giving the planting seed dust treatments. Brown (3) and Neal (15) of Louisiana secured better stands but no significant increase in yield. Treatment of cottonseed with certain chemical dusts gave increased stands in Georgia (22).

Lehman (11, 12) of North Carolina has found from experiments beginning in 1928 that when cotton is planted under cold soil conditions, treatment with chemical dusts is beneficial in securing better stands. Experiments by Hall (9) of South Carolina show similar results.

Ludwig (13) states that the minimum temperature for the germination of cottonseed is approximately 12° C or 53.6° F. Camp and Walker (5) found that the optimum soil temperature for the germination of cottonseed was 33° to 34° C or 91° to 93° F and that no germination was secured at 40° C or 104° F.

EXPERIMENTAL METHODS

The results on yield reported in this bulletin were computed to the acre basis from experimental plats. The plats varied in size and consisted of rows 25, 50, and 132 feet in length spaced 36 inches apart.

The preparation of the land and the cultivation were always in keeping with good farm practices.

At most locations three plant counts were made. The first was made when a few plants had begun to emerge, the second two to three days later, and the third just before thinning.

The percentage stand is the ratio of the actual number of plants obtained to the desired number of plants, expressed in percentages. The percentage of germination is the actual number of plants obtained calculated from the number of seed planted.

At Lubbock plantings were made on four different dates and in listed furrows of three different depths, designated as surface, four-inch, and seven-inch. Data from all other locations were for the optimum date of planting.

SEASONAL PLANTING CONDITIONS UNDER WHICH THE TESTS WERE MADE

The amount of moisture in the soil, the temperature of the soil, and the rainfall occurring at planting time influence the germination of cottonseed. Naturally, these conditions vary from year to year and the following is a summary of conditions for each spring at the locations where the cottonseed treatment tests were conducted.

At Lubbock: The Lubbock Station is located in the High Plains Region of Texas and near the center of what is known as the South Plains. The average rainfall over a period of 25 years is 18.60 inches, 82 per cent of which falls during the months from April to October, inclusive. The average date of the last killing frost in the spring is April 9. The soil is of the Amarillo and Richfield fine sandy loam types, which are typical of a considerable portion of this area.

Excellent planting conditions existed in the spring of 1930, but moisture became deficient by July. Heavy rains, falling the last of April 1931, caused the April 25 planting to be abandoned, although soil moisture became deficient in May. Favorable moisture conditions existed throughout the year of 1932, but cold rains during the latter part of April prevented good germination. Good planting conditions existed in the early spring of 1933, but soil moisture became low the latter part of May. Hot winds in June retarded the growth of cotton. Precipitation was far below normal in the fall of 1933 and early spring of 1934, and conditions for good germination of cottonseed did not exist

until late May and early June of 1934, after which there was not sufficient moisture for good plant growth. The spring of 1935 was dry and rains during May and June interfered with seed germination. Moisture was poor throughout the growing season.

At College Station: This station is located on Lufkin fine sandy loam soil, which crusts easily. The average annual rainfall is 38.5 inches.* The average date of the last killing frost is March 12.

Weather conditions in the spring of 1930 were very unfavorable for the germination of cottonseed. The excessive and continuous rainfall after planting caused a poor and uneven germination, particularly of seed not treated with Ceresan. Conditions in 1931 were generally favorable for germination and relatively good stands of plants were obtained. In 1932 moisture conditions were excellent at planting time. A heavy rain fell just as the cottonseed were germinating and caused rapid emergence. Soil moisture was favorable in 1933, but rains falling before the seeds germinated and emerged packed the soil and interfered with the emergence of seedlings. This accounts for the low plant counts in 1933. Excellent conditions existed for germination in the spring of 1934 and of 1935. The average planting date for these tests for the six years was April 24.

On the Brazos River Soils: The seed treatment test conducted in the Brazos River Bottoms was on the George Chance Farm, which is about eight miles west of College Station. The soil is alluvial and classed as Yahola clay. It is quite sticky when wet, and crust forms easily on the surface after rains. When the soil is stirred by seed furrow openers and covering shovels, it dries rapidly to a depth of approximately one inch. The average annual rainfall and date of last killing frost are the same as for College Station.

The tests were planted each year on April 18 under favorable moisture conditions. Every year sufficient rain fell between the time of planting and emergence of the seedlings to form a crust on the surface of the soil. This interfered somewhat with the emergence of the seedlings. Many seed that germinated were unable to break through the thick hard soil crust.

At Temple: The tests at Temple were planted on Houston black clay soil. This soil is sticky when wet and crumbly when dry. When disturbed, it dries rapidly, so that cottonseed must be covered with one and one-half to two inches of soil.

The average annual rainfall at Temple is 35.28 inches. The date of the last killing frost is March 22.

Tests at Temple were conducted one year and favorable conditions existed for the germination of the cottonseed.

*Texas Station Bulletin, No. 484.

EFFECT OF TREATING COTTONSEED WITH CHEMICAL DUST PREPARATIONS

In these tests four kinds of chemical dust preparations were used—Ceresan, Bayer Dust, copper carbonate, and commercial hydrated lime.

Results with Ceresan

Ceresan was tested with cottonseed planted at College Station, Lubbock, Temple, and in the Brazos River Bottoms. At College Station and in the Brazos River Bottoms Ceresan was used on fuzzy seed,* sulphuric acid delinted seed, and mechanically delinted cottonseed. Mechanically delinted and fuzzy seed were used at Lubbock, and fuzzy seed only were used at Temple. All seeds were treated with Ceresan at the rate of three ounces of Ceresan per bushel. The seed are most effectively covered with Ceresan when they are rolled or agitated in a barrel or drum, mounted so that it may be easily turned with a crank.

Effect of Ceresan on Fuzzy (gin-run) Cottonseed: A study of Table 1 shows that treating fuzzy cottonseed with Ceresan increased both the number of seedlings emerging and the yield at all locations when the cottonseed were planted at optimum dates. The average increase in seedlings ranged from 11 per cent at Lubbock to 65 per cent at Temple.

The seedlings of each treatment were examined at Temple in 1932 to determine the percentage showing infection, such as anthracnose and black arm diseases. The untreated fuzzy seed showed an infection of 28.7 per cent, but the Ceresan treated fuzzy seed showed infection of only 1.2 per cent.

Average increases in yield ranged from 4 per cent at Lubbock, over a three-year period, to 25 per cent at College Station (Table 1).

Planting early for a period of three years at Lubbock resulted in the emergence of fewer seedlings and in a smaller percentage of germination for the Ceresan treated cottonseed (Table 2). There was no significant difference in the yields from the treated and untreated seed.

The late planted cotton at the heavy rate at Lubbock for the same period gave a slightly increased emergence of seedlings, a slightly larger percentage of seed germinating, and slightly larger yields for the Ceresan treatment (Table 2).

It is estimated that fuzzy cottonseed can be treated with Ceresan at ten cents per bushel, including materials and labor. For College Station the average increase in yield for Ceresan treated seed was 64 pounds of lint per acre over the untreated seed. Figuring ten cents a pound as

*Fuzzy seed used in these discussions means cottonseed as they come from the gin, or gin-run seed.

Table 1. Effect of Ceresan Treatment on Stands and Yields of Fuzzy, Sulphuric Acid Delinted, and Mechanically Delinted Cottonseed.

Location of Tests	Year	Fuzzy Seed				Acid Delinted Seed				Mechanically Delinted Seed			
		No. plants in 50 ft. of row		Acre yield of lint —#		No. plants in 50 ft. of row		Acre yield of lint —#		No. plants in 50 ft. of row		Acre yield of lint —#	
		Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated
College Station	1930	46	100	121	289	...	...	...	...	...	...	...	...
	1931	...	...	369	455	...	...	...	...	...	...	...	...
	1934	370	458	183	191	724	...	190	...	334	...	191	...
	1935	494	586	337	334	588	543	367	369	633	664	388	334
	Av.	303	381	253	317	656	...	186	...	484	...	290	...
Brazos Bottoms	1934	231	229	172	171	422	...	185	...	143	...	166	...
	1935	478	578	385	440	554	566	406	423	657	800	392	421
	Av.	355	404	279	306	488	...	296	...	400	...	279	...
Lubbock	1933	118	92	282	287	...	...	...	...	79	86	268	267
	1934	244	300	28	27	...	...	...	...	160	170	31	31
	1935	266	302	89	99	...	...	...	...	136	156	92	91
	Av.	209	231	133	138	...	...	...	...	125	137	130	130
Temple	1930	104	236	315	366	...	...	...	...	...	...	...	...
	1932	185	262	197	232	221	...	242	...	...	...	...	...
	1934	176	271	269	285	...	...	...	...	...	...	...	...
	Av.	155	256	260	294	...	...	...	...	...	...	...	...
Treatment with Lime													
Temple	1934	83	101	199	221	...	...	...	...	...	...	...	...

Table 2. Effect of Ceresan Treatment on Heavy and Light Rates of Planting of Fuzzy and Mechanically Delinted Cottonseed Planted Early and Late—Lubbock, 1933-1935 (3 years).

Seed Treatment	Average number of seed planted in 25 ft. row	Plant counts	Plants Emerging and Yield					
			Early planting			Late planting		
			Plants in 25 ft.		Acre yield of lint-lbs.	Plants in 25 ft.		Acre yield of lint-lbs.
			Number	Per cent of germination		Number	Per cent of germination	
Heavy Planting Rate—Thinned (12" apart in row)								
Fuzzy, none	223	1st	73	32.7	...	50	22.4	...
	"	2nd	116	52.0	...	90	40.4	...
	"	3rd	126	56.5	109	125	56.1	133
Fuzzy, Ceresan	223	1st	63	28.3	...	41	18.4	...
	"	2nd	105	47.1	...	94	42.2	...
	"	3rd	111	49.8	111	131	58.7	138
Delinted, None	147	1st	61	41.5	...	30	20.4	...
	"	2nd	97	66.0	...	56	38.1	...
	"	3rd	102	69.4	105	76	51.7	130
Delinted, Ceresan	147	1st	62	42.3	...	29	19.7	...
	"	2nd	92	62.6	...	59	40.1	...
	"	3rd	97	66.0	107	83	56.5	130
Light Planting Rate—Not Thinned (5" apart in row)								
Fuzzy, None	118	1st	48	40.7	...	31	26.3	...
	"	2nd	70	59.3	...	65	55.1	...
	"	3rd	75	63.6	91	90	76.3	117
Fuzzy, Ceresan	118	1st	36	30.5	...	31	26.3	...
	"	2nd	63	53.4	...	48	40.7	...
	"	3rd	67	56.8	90	60	50.8	96
Delinted, None	86	1st	28	32.6	...	18	20.9	...
	"	2nd	45	52.3	...	36	41.9	...
	"	3rd	49	57.0	85	47	54.7	113
Delinted, Ceresan	86	1st	28	32.6	...	9	10.5	...
	"	2nd	46	53.5	...	20	23.3	...
	"	3rd	51	59.3	97	29	33.7	103

an average price for cotton, this would amount to $6.40 per acre. Deducting the cost of treating the seed, a net profit of $6.30 per acre is realized from the use of Ceresan treated cottonseed.

Effect of Ceresan on Mechanically Delinted Cottonseed: The data in Table 1, showing the effects of treating mechanically delinted cottonseed, are not as complete as those for fuzzy cottonseed. This table does show, however, more seedlings emerging from the treated seed than from the untreated seed. One year's results in the Brazos River Bottoms gave the only increase in yield for the treated seed.

The heavy rate of planting at the early date at Lubbock (Table 2) indicated a smaller number of seedlings and a smaller percentage of germination, but the late planting gave more seedlings and a larger percentage of germination for the Ceresan treatment. There was no difference in the yields.

For such conditions as existed at Lubbock during 1933 to 1935, Ceresan did not appear to be beneficial when used on mechanically delinted cottonseed.

Effects of Ceresan on Sulphuric Acid Delinted Cottonseed: The one year's results on the effects of treating acid delinted cottonseed with Ceresan did not indicate any benefits (Table 1).

Results with Bayer Dust

Fuzzy and mechanically delinted cottonseed were treated with Bayer Dust at Lubbock for a three year period, 1930 to 1932 inclusive. The seed were treated at the rate of two ounces of Bayer Dust to the bushel of seed.

Effect of Bayer Dust on Fuzzy Cottonseed: Referring to Table 4 and comparing only the May 25 planting and the four-inch furrow, which is the optimum date and depth of furrow at Lubbock, it is seen that for the three year period, fewer seedlings but a higher yield were obtained from the Bayer Dust treatment, or 433 seedlings for the treated against 448 seedlings for the untreated seed, and 302 pounds of lint per acre for the treated seed against 255 pounds for the untreated seed.

The average for all dates of planting gave 345 seedlings for the untreated and 265 seedlings for the treated seed, while the yields of lint cotton per acre were 223 and 226 pounds for the untreated and treated seed, respectively.

Results of Bayer Dust on Mechanically Delinted Cottonseed: Table 3 gives the results obtained when mechanically delinted cottonseed were treated with Bayer Dust and planted May 25 in furrows of four inches. The results are just the reverse of those obtained for fuzzy seed. There were more seedlings and a smaller yield for the Bayer Dust treatment, or 346 seedlings for the treated against 318 seedlings for the untreated seed, and 331 against 356 pounds of lint per acre for the treated and untreated seed, respectively.

When the seedlings and yields for all four dates of planting are averaged, it is found that the Bayer Dust treatment gave 281 seedlings for the treated and 233 seedlings for the untreated seed, while the yields of lint cotton per acre were 258 and 253 pounds for the treated and untreated seed, respectively.

Table 3. Effect of Date of Planting and Depth of Furrow on Treated and Untreated Mechanically Delinted Cottonseed—Lubbock, 1930-1932 (3 years).

Treatment	Depth of listed furrow	Year	Total No. Plants Emerging*				Acre Yield of Lint—# 1930-31†			
			Dates of Planting							
			Apr. 25	May 5	May 15	May 25	Apr. 25	May 5	May 15	May 25
Untreated	Surface	1930	254	181	248	136	155	96	114	104
	"	1931	0	248	430	567	473	416	451	488
	"	1932	7	53	53	482	.....	.....	.....	.....
		Av.	87	161	244	395	314	256	283	296
	4 in.	1930	320	294	267	131	137	166	132	178
	"	1931	0	429	480	446	0	515	361	534
	"	1932	0	26	26	376	.....	.....	.....	.....
		Av.	107	250	258	318	69	341	247	356
	7 in.	1930	114	120	209	84	168	116	115	131
	"	1931	0	293	487	284	0	557	452	504
	"	1932	0	13	7	132	.....	.....	.....	.....
		Av.	38	142	234	167	84	337	284	318
Copper Carbonate	Surface	1930	218	298	235	140	134	128	133	129
	"	1931	0	693	305	489	611	419	418	494
	"	1932	20	53	59	396	.....	.....	.....	.....
		Av.	79	348	200	342	373	274	276	343
	4 in.	1930	175	307	228	106	81	162	147	125
	"	1931	0	676	327	330	0	425	392	469
	"	1932	7	33	26	343	.....	.....	.....	.....
		Av.	61	339	194	260	41	294	270	297
	7 in.	1930	61	141	144	104	72	120	163	153
	"	1931	0	203	328	215	0	462	631	496
	"	1932	7	33	13	99	.....	.....	.....	.....
		Av.	23	126	162	339	36	291	397	325
Bayer Dust	Surface	1930	382	314	254	156	146	136	156	128
	"	1931	0	695	358	542	662	426	464	523
	"	1932	7	66	53	462	.....	.....	.....	.....
		Av.	130	358	222	387	404	281	310	326
	4 in.	1930	343	258	252	186	161	155	132	144
	"	1931	0	522	899	430	0	541	411	518
	"	1932	13	26	20	422	.....	.....	.....	.....
		Av.	119	269	390	346	81	348	272	331
	7 in.	1930	115	107	209	120	166	133	165	133
	"	1931	0	277	408	305	0	635	608	531
	"	1932	0	13	7	106	.....	.....	.....	.....
		Av.	38	132	208	180	83	384	387	337

*Data from rows 132 ft. long.
†No yield obtained in 1932.

From the results obtained on fuzzy and mechanically delinted cottonseed, it did not appear to be beneficial to treat planting cottonseed of either kind with Bayer Dust at Lubbock.

Results with Copper Carbonate

Copper carbonate was used to treat fuzzy and mechanically delinted cottonseed at Lubbock during the three year period 1930 to 1932 inclusive. Seed were treated at the rate of two ounces of copper carbonate to the bushel of seed.

Effect of Copper Carbonate on Fuzzy Cottonseed: Comparing again only the May 25 date of planting and four-inch furrow at Lubbock, it is seen from the data in Table 4 that fewer seedlings but a slightly higher yield were obtained for the copper carbonate treated cottonseed, or 215 seedlings for the treated against 448 for the untreated seed, and 262 pounds of lint per acre for the treated against 255 for the untreated seed.

For all dates of planting the average number of seedlings was 345, for the untreated and 147 for the treated seed. The average yields were 223 and 184 pounds of lint per acre for the untreated and treated seed, respectively.

Copper carbonate treatment of fuzzy cottonseed for planting purposes was not beneficial under conditions at Lubbock.

Effect of Copper Carbonate on Mechanically Delinted Cottonseed: When mechanically delinted seed were treated with copper carbonate and planted at the optimum date and depth of furrow, May 25 and four-inch depth, fewer seedlings and a lower yield were obtained (Table 3). The untreated seed gave 318 seedlings, while the treated gave 260. The yields were 356 pounds of lint per acre for the untreated seed against 297 for the treated. The average number of seedlings for all dates of planting was 232 for the untreated and 214 for the treated. The average yields were 253 and 226 for the untreated and treated seed, respectively.

Results with Lime

In 1934 a small quantity of commercial hydrated lime was used to treat cottonseed at the rate of three ounces per bushel. The method of treating the seed was the same as for Ceresan. The results of this test are shown in Table 1. The untreated seed gave 83 seedlings, but the lime treated seed gave 101, an increase of 22 per cent. Yields were increased from 199 pounds of lint per acre for the untreated to 221 for the treated seed.

For the same year these results are slightly less than those obtained with Ceresan. Consequently, further work should be done with lime to

Table 4. Effect of Date of Planting and Depth of Furrow on Treated and Untreated Fuzzy Cottonseed—Lubbock, 1930-1932 (3 years).

Treatment	Depth of listed furrow	Year	Total No. Plants Emerging*				Acre Yield of Lint —# 1930-31†			
			Dates of Planting							
			Apr. 25	May 5	May 15	May 25	Apr. 25	May 5	May 15	May 25
Untreated	Surface	1930	187	178	558	452	135	142	128	151
	"	1931	0	457	367	498	334	469	486	422
	"	1932	99	409	257	792	.....	.....	.....	.....
		Av.	95	348	394	581	235	306	307	287
	4 in.	1930	203	179	536	351	125	101	140	162
	"	1931	0	695	241	326	0	424	482	348
	"	1932	112	389	436	667	.....	.....	.....	.....
		Av.	105	421	404	448	63	263	311	255
	7 in.	1930	52	77	308	267	49	96	132	180
	"	1931	0	131	232	148	0	463	615	356
	"	1932	7	205	59	363	.....	.....	.....	.....
		Av.	20	138	200	259	25	280	374	268
Copper Carbonate	Surface	1930	178	175	211	86	129	128	137	111
	"	1931	0	232	271	237	245	397	460	441
	"	1932	59	271	343	436	.....	.....	.....	.....
		Av.	79	226	275	253	187	263	299	276
	4 in.	1930	164	132	116	71	130	118	99	113
	"	1931	0	132	225	237	0	288	309	410
	"	1932	20	125	198	337	.....	.....	.....	.....
		Av.	61	130	180	215	65	203	204	262
	7 in.	1930	22	85	91	91	35	85	99	118
	"	1931	0	67	68	154	0	250	237	493
	"	1932	20	53	66	145	.....	.....	.....	.....
		Av.	14	68	75	130	18	168	168	306
Bayer Dust	Surface	1930	205	262	270	138	102	117	147	161
	"	1931	0	490	126	502	426	436	449	530
	"	1932	86	475	469	772	.....	.....	.....	.....
		Av.	97	409	288	471	264	277	298	346
	4 in.	1930	213	131	306	124	107	109	149	157
	"	1931	0	348	432	449	0	498	336	446
	"	1932	99	297	53	726	.....	.....	.....	.....
		Av.	104	259	264	433	54	304	243	302
	7 in.	1930	50	69	133	71	82	97	112	94
	"	1931	0	129	130	272	0	506	370	449
	"	1932	86	191	172	290	.....	.....	.....	.....
		Av.	45	130	145	211	41	302	241	272

*Data from rows 132 ft. long.
†No yield obtained in 1932.

determine its value as a fungicide in the treatment of cottonseed for planting purposes.

EFFECT OF MECHANICALLY DELINTING COTTONSEED

When cottonseed are delinted mechanically with oil mill equipment, there is no disinfection of the seed, as is the case when sulphuric acid and hydrochloric acid gas are used. It is also claimed by some that earlier germination of the seed is obtained when the fuzzy seed-coat is removed, thereby permitting soil moisture to come in direct contact with the seed-shell. Tests were conducted at Lubbock, College Station, and in the Brazos River Bottoms to compare stands and yields obtained with untreated fuzzy seed and untreated mechanically delinted seed.

Table 1 shows an average of 484 seedlings for the delinted seed and 432 seedlings for the undelinted or fuzzy seed at College Station for 1934 and 1935; and 400 seedlings for the delinted seed against 355 seedlings for the fuzzy seed in the Brazos Bottoms. The average acre yield of lint at College Station was 290 pounds for the delinted against 260 pounds for the undelinted seed. In the Brazos Bottoms there was no difference in the yields obtained. At Lubbock the fuzzy untreated seed produced 209 seedlings against 125 for the delinted untreated seed (Table 1). The tests with fuzzy untreated seed yielded three pounds more lint per acre than the delinted untreated seed for the three year period 1933 to 1935.

Plant counts made at Lubbock at the time of the first emergence for the years 1933 to 1935 showed a higher percentage of germination of the delinted seed over undelinted seed at the early date and heavy rate of planting, but not at the late planting. Similar results were obtained for the total emergence (Table 2). For the three year period 1933 to 1935, the results of which are shown in Table 2, the untreated fuzzy seed planted at the heavy rate gave a better stand of seedlings at both the early and late dates of planting. Yields for both the early and late dates at the heavy rate of planting were slightly in favor of the fuzzy untreated seed, although the difference was not significant. For the light planting rate the fuzzy untreated seed gave higher percentages of germination and yields than the delinted seed for both the early and late planting dates.

EFFECT OF CULTURAL METHODS IN RELATION TO COTTONSEED TREATMENT

Cultural methods appear to affect the germination of cottonseed as well as the various methods of treatment. The cultural methods discussed are date and rate of planting and depth of listed furrow.

Influence of Date of Planting: When fuzzy untreated cottonseed were planted at Lubbock on April 25, May 5, May 15, and May 25, the number

of plants generally increased as the date of planting became later for the three depths of furrows (Table 4).

Untreated mechanically delinted cottonseed planted on the same dates and at the same depths as the fuzzy seed generally gave an average increase in the number of plants as the date of planting became later (Table 3).

Influence of Rate of Planting: When untreated fuzzy cottonseed were planted at the rates of 16, 20, 24, 28, and 32 pounds per acre at College Station, Temple, Iowa Park, and Angleton, there was a general tendency for the stand of plants to increase as the rate of planting increased. The same was true for the hydrochloric acid gas delinted seed when planted at the rates of 4, 6, 8, 10, and 12 pounds per acre.

Under normal conditions a good stand of plants may be expected when 20 to 28 pounds of fuzzy and 10 to 20 pounds of delinted seed per acre are planted. One variety of cotton showed an average of 14,130 more seed in 30 pounds of sulphuric acid delinted seed than in 30 pounds of undelinted fuzzy gin-run seed.

Influence of Depth of Listed Furrow: During the three year period 1930-1932, tests were made at Lubbock to determine the best depth of listed furrow in which to plant both fuzzy and mechanically delinted cottonseed.

Three depths of furrows were used: surface, four-inch, and seven-inch. At the present time a four-inch furrow is the usual practice in this region where the lister planter is used. This method allows the seed to be deposited upon the firm surface of the furrow-bottom, which provides better moisture, as often the topsoil is dry. It affords protection during the early stage of plant growth from heavy winds, eradicates a crop of weeds, allowing the plants to get at least an equal start, and fits in with the general tillage system of the region where the lister cultivator is normally used in the first two cultivations. In addition, as the dirt is brought to the plant, it provides adequate bracing. The lister planter was used in making the surface planting, but the point was run only deep enough to afford good conditions for covering the seed, which in most instances approximated two inches. This often provides a little better seed bed as the ground will be warmer, and the practice is growing somewhat. On account of the varying amounts of soil moisture at planting time, however, the four-inch furrow is more generally used. The seven-inch furrow usually places the seed on soil that is too cool and is little used.

Table 4 shows that when fuzzy untreated seed were planted on April 25, May 5, and May 15, the four-inch furrow gave a larger average number of plants, while the May 25 planting was in favor of the surface planting. The seven-inch furrow was inferior at all dates of planting.

Mechanically delinted and untreated cottonseed gave better stands when planted in four-inch furrows for April 25, May 5, and May 15 dates of planting. The May 25 planting was in favor of the surface planting. Surface plantings were superior to the seven-inch on all dates (Table 3).

Bayer Dust treatment of mechanically delinted seed appeared to increase the stand of plants for the surface and four-inch furrow plantings (Table 3). At all furrow depths fuzzy seed treated with Bayer Dust generally gave inferior stands as compared with untreated fuzzy seed.

These data indicate that when the soil has become warm and there is ample topsoil moisture, cottonseed will germinate better when planted shallow. In 1931 at the April 25 planting the stand of plants was lost for the seven-inch furrow. The cold ground retarded germination, and the few seedlings that did emerge were covered by blowing sand and soil washed over them by rains. One disadvantage to the planting of cottonseed on the surface at the early dates is that strong winds blow sand against the young seedlings, either injuring them so severely that they are stunted or causing them to be cut down by the sand.

Effect of Thinning: It is a common practice in the region about Lubbock to plant cotton and leave all the plants that emerge, not thinning them to any regular spacing.

Results given in Table 2, covering a three year period (1933-1935), show that the seedlings of both untreated and treated, fuzzy and delinted seed, when thinned to a uniform spacing of 12 inches, gave increased yields in every case. This was true for both the early and late plantings. Thinning seedlings of late planted untreated fuzzy seed resulted in an increase of 16 pounds of lint per acre, while the increase from Ceresan treated fuzzy seed was 42 pounds. Untreated mechanically delinted seed gave an increase of 17 pounds for the late planting and 20 pounds for the early planting, while the Ceresan delinted seed gave an increase of 10 pounds of lint per acre for the early planting and 27 pounds for the late planting. Such increases in yield, however, would probably not pay for the labor required to hand thin the crop, but in a region where moisture is at a premium, it may be that thinnings of the plants would be profitable.

EFFECT OF TREATING COTTONSEED ON MORTALITY OF SEEDLINGS AND PERCENTAGE OF ANGULAR LEAF SPOT ON COTTON SEEDLINGS

Experiments were made at Greenville, Texas, by the Bureau of Plant Industry of the United States Department of Agriculture to determine the effects of several different seed and soil disinfectants on germination, mortality and blackarm infection.

Cottonseed were treated with Ceresan at the rate of four ounces per bushel. Bayer Dust No. 502 mixed with five parts sand by weight was applied in the drill with the seed at the rate of 18 pounds per acre. Sulphuric acid and hydrochloric acid gas were used to delint cottonseed for planting purposes. The delinted seed were not given any treatment other than that of delinting.

Mortality of Seedlings

Table 5 shows that the seedling mortality for Ceresan treated seed in 1931 (as indicated by the difference between the total number of seedlings at the last two counts) was 3.3 per cent for the treated and 11.7 per cent for the untreated planting. Seedling mortality for Bayer Dust was 11.6 per cent for the treated and 14.0 per cent for the untreated. Germination of the hydrochloric acid gas delinted seed was inferior to that of the fuzzy seed and makes the comparison of seedling mortality of little value. Sulphuric acid delinted seed germinated more promptly than the fuzzy seed but were surpassed by the latter in total number of seedlings. A greater loss of seedlings occurred in the delinted than in the untreated planting, the final percentage of mortality being 9.4 per cent for untreated seed and 18.0 per cent for the delinted seed (Table 5).

Table 5. Summary of Mortality and Comparative Percentages of Angular Leaf Spot on Cotton Seedlings from Seed Given Different Treatments Before Planting. U. S. Cotton Field Station, Greenville, Texas, 1931-1934.

Treatment	Year	Percentage mortality		Percentage seedlings showing angular leaf spot infection			
				First count		Last count	
		Treated	Untreated	Treated	Untreated	Treated	Untreated
Ceresan	1931	3.3	11.7	*....	.....	15.5	84.7
	1932	.7	2.0	.1	22.6	7.6	100.0
	1933	.....	.....	1.5	9.0	26.7	87.3
	1934	.....	.....	3.6	24.7	90.4	91.7
Bayer Dust 502	1931	11.6	14.0	*....	.....	85.3	87.9
Hydrochloric acid gas delinted	1931	.....	.....	*....	.....	13.3	91.3
	1932	5.3	2.8	.8	86.8	98.3	100.0
Sulphuric acid delinted	1931	18.0	9.4	*....	.....	29.8	81.2
	1934	.....	.....	7.0	24.7	85.4	91.7

*In 1931 young seedling cotyledon leaves badly damaged and comparative counts could not be taken.

In 1932, the percentage of mortality was slightly lower for the Ceresan treated blocks than for the untreated blocks, being 0.7 per cent for the treated and 2.0 for the untreated. Hydrochloric acid gas

delinted seed showed a mortality of 5.3 per cent as compared with 2.8 per cent for the fuzzy seed.

Effect of Treatments on Angular Leaf Spot

The effect of the various treatments on the presence of angular leaf spot in 1931 was determined by counting the number of infected seedlings in a population of 50 consecutive plants from two sections of four rows of each treatment. In 1932, 1933, and 1935, counts were made on replicated 25-foot row sections.

Effect of Ceresan: In 1931, Ceresan treated seed showed a 15.5 per cent infection at the last count as compared with an 84.7 per cent infection for the untreated seed (Table 5). The percentage of plants infected with angular leaf spot at the first count made on May 12, 1932, was 0.1 per cent for the Ceresan treated seed and 22.6 per cent for the untreated (Table 5). The last count, made on May 25, showed 7.6 per cent infection for the treated and 100 per cent for the untreated. After thinning to approximately one plant to the foot, the percentage of plants with broken main stalks, due to angular leaf spot lesions, was 0.5 per cent for the Ceresan treated seed and 1.5 per cent for the untreated seed. On May 23, 1933, the percentage of seedlings infected with angular leaf spot at the first count was 1.5 per cent for the Ceresan treatment and 9.0 per cent for the untreated. By June 11, these percentages had increased to 26.7 and 87.3 per cent, respectively (Table)5. Before thinning on May 1, 1934, Ceresan treated seed showed an infection of 3.6 per cent as compared with 24.7 per cent from the untreated seed (Table 5). At the last count on May 29, the infection had increased to 90.4 per cent for the treated seed and 91.7 for the untreated.

Effect of Bayer Dust 502: Bayer Dust applied in the drill did not give any significant difference in the percentage of infected seedlings, being 85.3 per cent for the treated and 87.9 per cent for the untreated seed at the last count (Table 5). This treatment was used only in 1931, as it showed no advantage over Ceresan.

Effect of Delinting with Hydrochloric Acid Gas: On June 2, 1931, seed delinted with hydrochloric acid gas showed an infection of angular leaf spot of 13.3 per cent as compared with 91.3 per cent of infection for the undelinted. Angular leaf spot infection on May 27, 1932, before thinning, was 0.8 per cent from the delinted seed and 86.8 per cent for the fuzzy seed (Table 5). By June 15, the infection had spread to 100 per cent of the plants from the fuzzy seed and to 98.3 per cent of the plants from the delinted seed, assuming that none had died since the May 27 count. Counts were also made on June 15 of the percentage of stalks broken as a result of angular leaf spot lesions, the delinted seed showing 0.3 per cent of broken main stalks while the plants from the undelinted seed showed 1.6 per cent broken.

Effect of Delinting with Sulphuric Acid: In 1931, the sulphuric acid delinted cottonseed were planted on May 16, while the hydrochloric acid gas delinted seed were planted on April 13. The percentage of plants showing angular leaf spot on June 11 was 29.8 per cent for the sulphuric acid delinted seed and 81.2 per cent for the fuzzy seed. The first angular leaf spot counts made on May 1, 1934, showed 7.0 per cent infection for the sulphuric acid delinted seed and 24.7 per cent for the fuzzy seed. By May 29, the infection had spread until 85.4 per cent of the plants from the sulphuric acid delinted seed and 91.7 per cent of the plants from the fuzzy seed were infected.

These treatments appear to be beneficial in reducing the number of plants infected by angular leaf spot disease in the early seedling stage.

The Effect of Treating Cottonseed on Yield of Seed Cotton

For the four years 1931-34, Ceresan treated seed produced slightly higher yields than untreated seed, although the difference is not considered significant (Table 6). Bayer Dust treated seed in 1931 made slightly lower yields than did the untreated seed. Sulphuric acid delinted seed in 1931 did not yield as well as the untreated seed, although in 1934 the delinted seed produced higher yields. Seed delinted with hydrochloric acid gas in 1932 produced higher yields of seed cotton per acre than did the untreated seed.

Table 6. The Effect of Treating Cottonseed on Yield of Seed Cotton, U. S. Cotton Field Station, Greenville, Texas.

Treatment	1931 lbs.	1932 lbs.	1933 lbs.	1934 lbs.	Average
Ceresan	785	230	378	283	419
Check	781	214	353	259	402
Bayer Dust 502	837				
Check	856				
Delinted (Sulphuric acid)	665			300	
Check	688			259	
Delinted (Hydrochloric acid)		758			
Check		700			
Delinted (Sulphuric acid)*.....				326	
Check				289	

*1932 seed used in 1934 planting.

While the treated seed in some instances produced slightly higher yields than the untreated seed, the differences are probably not significant.

SUMMARY AND CONCLUSIONS

In these experiments it was found that when fuzzy cottonseed were treated with Ceresan, at all locations there was an increase in both the number of seedlings emerging and the yield obtained. The average increase in seedlings ranged from 11 per cent at Lubbock to 65 per cent at Temple when the cottonseed were planted at optimum rates and dates. The average increases in yield ranged from 4 per cent at Lubbock to 25 per cent at College Station.

At Lubbock early planted Ceresan treated fuzzy cottonseed gave fewer seedlings and a lower percentage of germination than untreated seed. There was no significant difference in the yields obtained from the treated and untreated seed.

Ceresan treatment of mechanically delinted seed planted at the optimum rate and date gave a larger number of seedlings emerging at College Station, Temple, Lubbock, and in the Brazos River Bottoms than no treatment. At Greenville seedlings from cottonseed treated with Ceresan and Bayer Dust 502, and delinted with hydrochloric acid gas and sulphuric acid, had a smaller number of plants infected with angular leaf spot disease in the early seedling stage.

Treating fuzzy seed with Bayer Dust over a three year period gave fewer seedlings but slightly higher yields than did untreated seed.

Mechanically delinted seed treated with Bayer Dust gave more seedlings but slightly lower yields than did untreated seed.

Copper carbonate treatment of fuzzy seed and mechanically delinted seed did not prove beneficial under conditions existing at Lubbock.

When cotton was planted at Lubbock on April 25, May 5, May 15, and May 25, the total number of plants obtained generally became larger as the date of planting became later.

When untreated fuzzy cottonseed were planted at the rates of 16, 20, 24, 28, and 32 pounds per acre at College Station, Angleton, and Temple, there was a general tendency for the stand of plants at thinning time to become larger as the rate of planting increased.

In most cases untreated cottonseed planted in a four-inch listed furrow averaged more plants than either surface planting or the seven-inch listed furrow at Lubbock.

Thinning cotton at Lubbock to a 12-inch spacing gave a higher yield than unthinned cotton for both untreated and treated fuzzy and delinted seed.

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