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DIVISION OF AGRICULTURAL ENGINEERING

Calibration of Cotton Planting Mechanisms

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Tests were made with different types of planting mechanisms on cotton planters to determine the number of cottonseed planted per acre and the percentage of seed hulled. Different speeds and adjustments of the planting mechanisms and different sizes of seed were used.

Cell-drop planting mechanisms dropped an average of 39,776 cottonseed at low plate speed and 254,724 cottonseed at high plate speed, or 8.61 and 55.16 pounds per acre, respectively. Picker wheel-drop planting mechanisms dropped an average of 33,996 cottonseed at the smallest adjustment and 549,064 when wide open, or approximately 7.36 and 118.87 pounds per acre, respectively.

From 47,596 to 87,043 more medium-sized Truitt cottonseed than large-sized Ducona cottonseed were dropped per acre by cell-drop planting mechanisms with the same plates operated at the same speeds. Picker wheel-drop planting mechanisms dropped from 43,085 to 151,068 more Truitt medium-sized cottonseed than large-sized Ducona cottonseed per acre.

The percentage of cottonseed hulled by cell-drop planting mechanisms ranged from .001 to 1.47 per cent, while the highest percentage of seed hulled by the picker wheel-drop planting mechanisms was .46 per cent.

At an estimated germination of 70 per cent, cell-drop planters dropped sufficient seed per acre to give an average ranging from 2 to 12 plants per foot. To obtain a perfect stand of one plant to the foot, a minimum of 1 to a maximum of 11 plants per foot would have to be thinned out. The number for picker wheel-drop planting mechanisms ranged from a minimum of 2 to a maximum of 27 plants per foot, requiring the removal of from 1 to 26 plants per foot to leave one plant per foot.

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CALIBRATION OF COTTON PLANTING MECHANISMS

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The selection of a cotton planter equipped with a planting mechanism that will drop the desired quantity of cottonseed and distribute them uniformly in the seed furrow is often a problem. The individual has no way of knowing in advance the quantity of seed a cotton planter will distribute per acre. The manufacturer does not put a seeding rate gauge on the planter because cottonseed of different varieties vary in size and the planter will not drop a uniform quantity of seed per acre of each variety. For this reason the individual who desires to know with some degree of accuracy the quantity of seed the planter will distribute per acre should calibrate it each year with some of the seed he intends to plant.

The cotton planter equipped with the cell-drop type of mechanism is usually provided with three plates, and when any plate is used, it can be operated at three different speeds. This range of speeds and this number of plates permit the selection of nine different rates of seed distribution, which should be sufficient to meet the requirements of most field conditions.

Planters equipped with the picker-wheel type of planting mechanism permit a choice of a wide range of seed distribution rates. The slightest movement of the shutter will vary the size of the opening through which the picker wheel picks the seed from the hopper and will give a different seeding rate per acre.

Because of the different types of planting mechanism on the various cotton planters on the market and because of the fact that the seed of different varieties of cotton vary greatly in size, it was considered desirable to conduct tests to determine the amount of seed that may be planted with different types of machines when seed of various sizes are used.

The results reported in this bulletin cannot be taken as the actual quantity of seed of all varieties of cotton the planters tested will distribute. The data should, however, enable the individual user to have some idea as to the number of seed and the quantity of seed that will be planted per acre and the adaptability of the different types of planting mechanisms to the planting requirements on his farm.

HISTORY OF COTTON PLANTER DEVELOPMENT

Primitive Cotton Planters: The first attempt to improve upon the hand method of planting cotton was made by filling a cow horn full of seed and scattering them along the furrows. Other early and ingenious

arrangements consisted of barrels or kegs with holes bored at intervals around the middle through which the seed dropped as the barrel or keg rolled along the furrow.

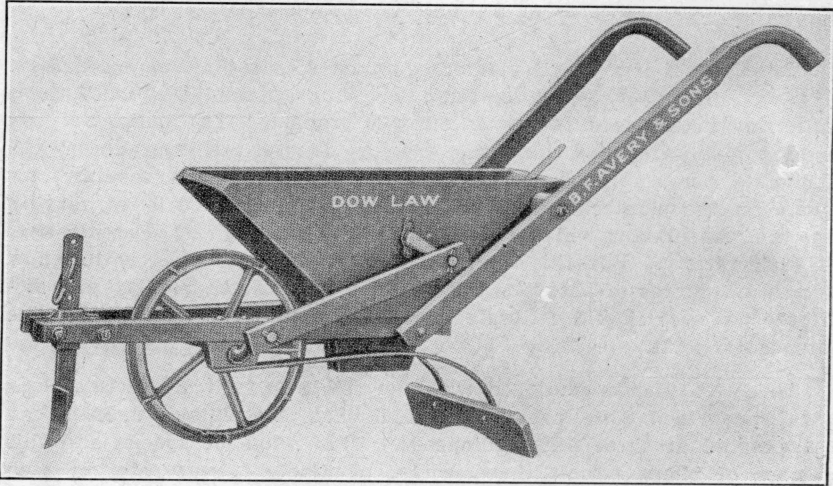


Figure 1. Dow Law Cotton Planter.

First Improved Cotton Planters: The first great forward step in cotton planters was the invention of the Dow-Law Planter about 1870. This planter (Fig. 1) included a trapezoidal hopper mounted upon a wooden frame, at the front end of which was a steel furrow opener blade. The

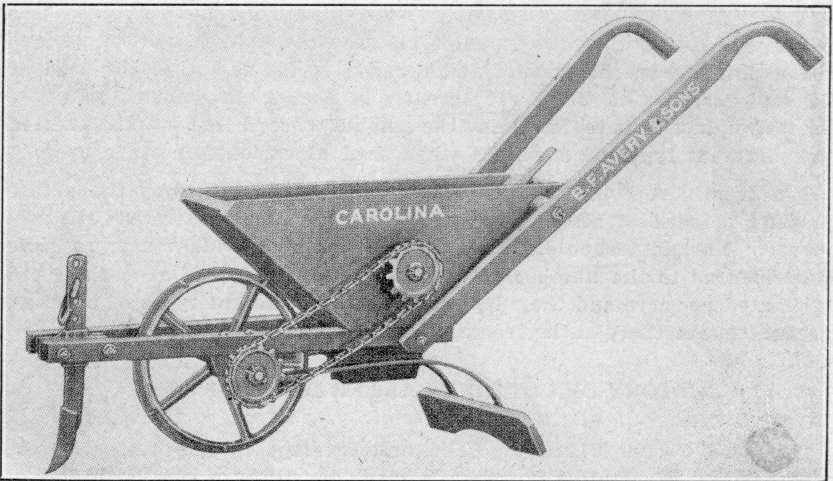


Figure 2. Carolina Cotton Planter.

drive wheel was located between the opener and hopper. This wheel, about two inches wide, was made of wood; it rolled in the furrow behind the furrow opener, pressing the loose soil, upon which the seed were dropped, into a firm seed bed. In the center and at the bottom of the hopper was an adjustable feed-gate, which could be regulated to give any

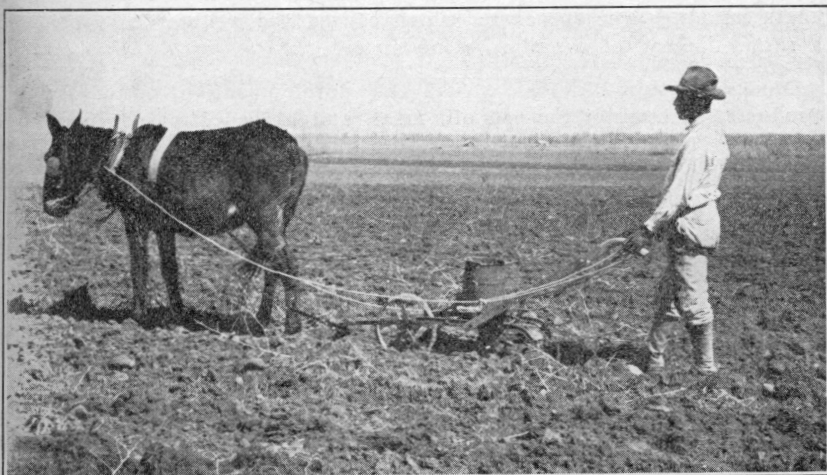


Figure 3. One-row walking mule-drawn cotton planter.



Figure 4. One-row riding mule-drawn cotton planter.

desired flow of seed. The seed were covered by a drag-board attached to two springs suspended from the rear of the frame.

A slight improvement over the Dow-Law Planter was known as the Carolina Cotton Planter (Fig. 2). The main difference between the two was the method of driving the seed agitator. In the Dow-Law Planter the agitator was driven by a pitman, while the Carolina Planter used a chain running over sprockets, which caused the agitator to work with a rotary instead of a reciprocating motion.

Modern Cotton Planters: With the development of cottonseed by-products, such as cottonseed oil, meal, and hulls, cottonseed became a

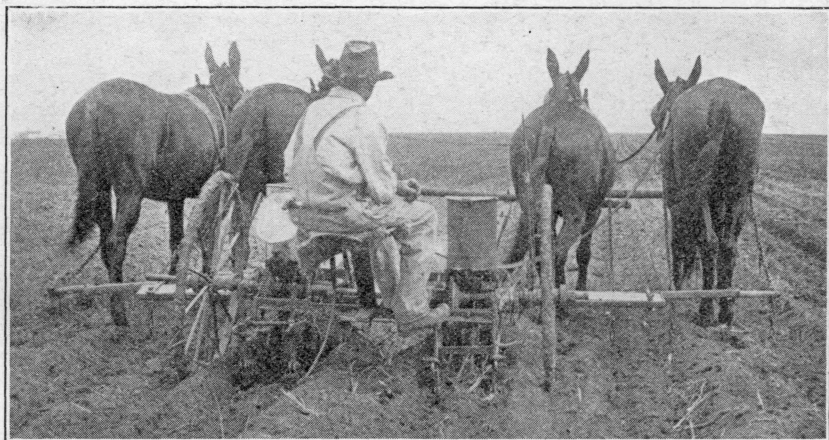


Figure 5. Two-row riding mule-drawn cotton planter.

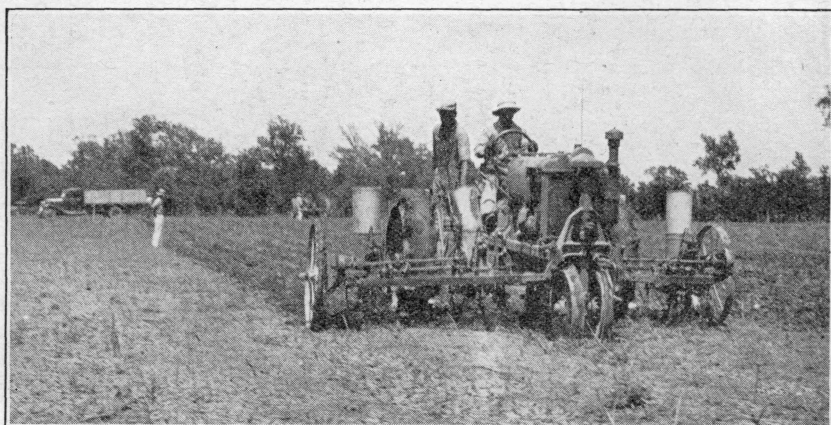


Figure 6. Four-row tractor cotton planter.

very valuable marketable commodity instead of an encumbrance about the farms and gins. Hence, inventors studied economy in seed planting. Gradually, beginning somewhere in the 80's, the principle used in corn drills was adopted and force-feed cotton planting mechanisms were developed. Since 1900 cell-drop and picker-wheel planting mechanisms, which enable the cotton farmer to plant almost any quantity of seed his conditions require, have been designed. Some mechanisms, however, will plant more seed per acre than others. Hill-drop attachments are of recent origin, having been developed within the past ten years. Today cell-drop or picker-wheel drop planting mechanisms and hill-drop attachments can be obtained on all types of planters, including the one-row walking (Fig. 3), the one-row riding, mule drawn (Fig. 4), the

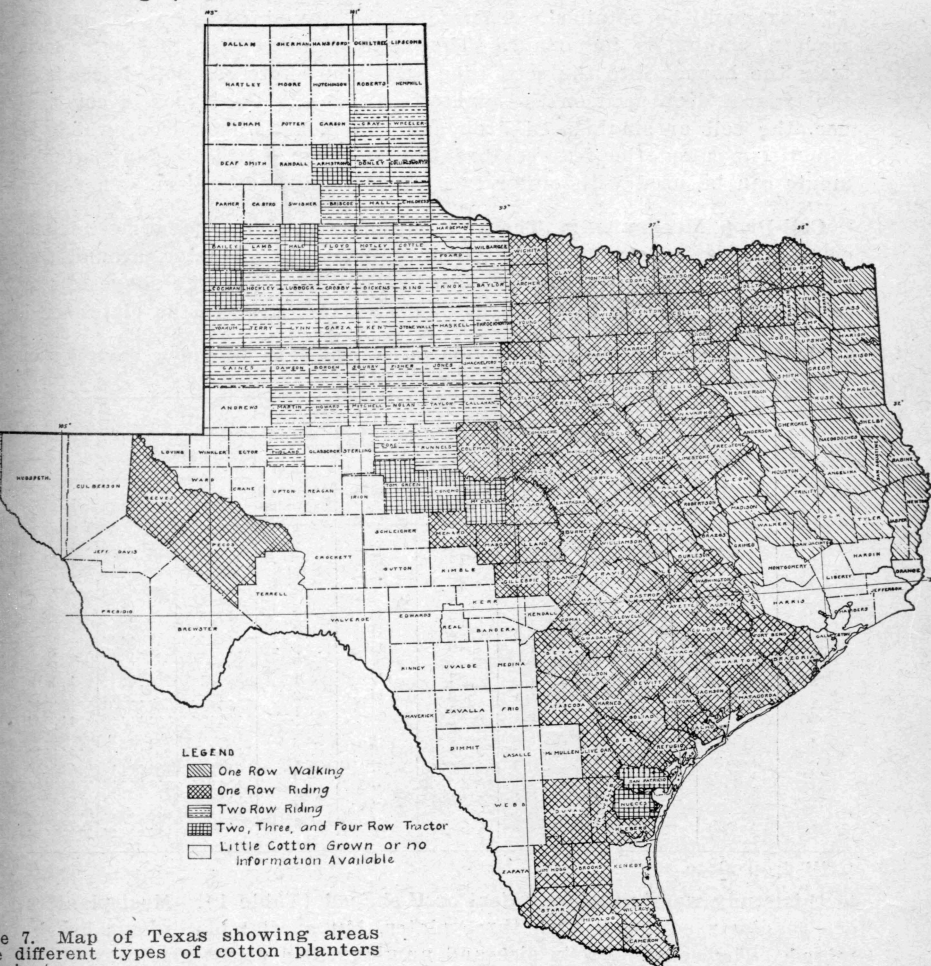


Fig. 7. Map of Texas showing areas of different types of cotton planters in 1930.

two-row riding, mule drawn (Fig. 5), and the four-row tractor mounted (Fig. 6).

It appears that the type of planter used is influenced by soil type, type of farming, and climatic conditions, as there are definite areas in the state of Texas where different types of planters predominate. Figure 7 shows the areas where each type of planter is most used.

COTTONSEED PLANTING MECHANISMS

Good cultural practice and good seed may be of little consequence unless the seed are placed in the ground in such a way that a good stand of plants will be obtained. Therefore, the dropping mechanism on the modern planter is important. The method of getting the cottonseed from the hopper into the seed tube and thence into the soil determines the type of drop used on the planter. There are two types in common use, the cell or single seed drop and the picker-wheel drop, which is sometimes called the reverse feed type of drop. Hill-dropping attachments can be used with either type of dropping mechanism.

Cell-Drop Mechanism: The cell or single seed dropping mechanism consists of a metal plate about 8 or 9 inches in diameter, around the outer edges of which are holes called cells (Fig. 8). The shape of the cells varies according to the ideas of designers. Cells in the plates used

Table 1. Characteristics of seed plates of cell type dropping devices for cotton planters.

Planter Number	Plate ^a Number	Plate Diameter in inches	Thickness of plate	Cell			Ratio of plate travel to planter wheel travel (Plate Speed)		
				Number per plate	Shape	Capacity Average size seed	Low	Medium	High
1	1832	8 $\frac{3}{8}$	thick	25	U	2 ¹	.8	1.33	1.71
1	1754	"	medium	25	U	2 to 3	.....	.....	.....
1	1768	"	"	25	U	3 to 4	.....	.....	.....
2	378A	8 $\frac{1}{4}$	medium	20	U	2	1.23	1.38	1.60
2	7980A	"	thick	32	U	3	.....	.....	.....
2	7942A	"	thin	40	U	3	.....	.....	.....
3	M-17	9 $\frac{3}{8}$	thin	52	U	1	.71	1.08	1.4
3	M-17A	"	medium	50	U	2	.....	.....	.....
3	*M-17B	"	thick	15	U	1	.....	.....	.....
4	G391A	9 $\frac{3}{8}$	thick	.....	Elliptical	3	.....	1.33	.....
4	G596	"	"	.....	"	2	.....	.....	.....
4	G393	"	"	.....	"	3	.....	.....	.....
4	G576	"	"	.....	"	4	.....	.....	.....
4	G597	"	"	.....	"	4	.....	.....	.....
4	G392	"	"	.....	"	3	.....	.....	.....

*Hill-drop plate.

in this study were either elliptical or U-shaped (Table 1). Most planters are regularly equipped with three plates, but special plates may be obtained. The cells differ in size and number. The plates also may be of

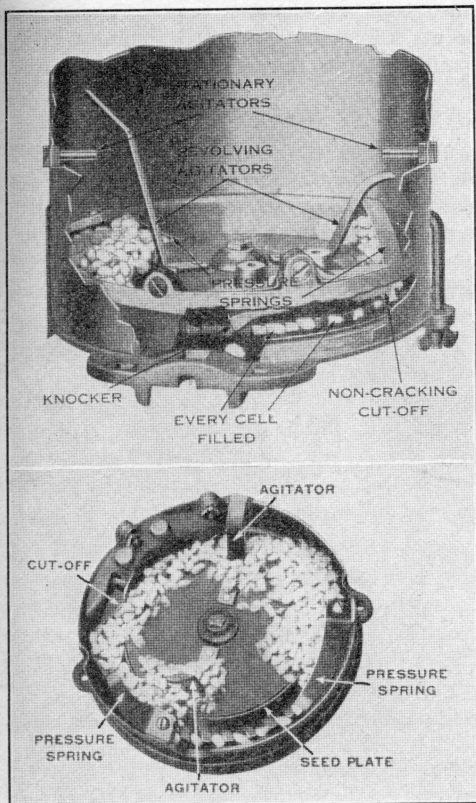


Figure 8. A typical cell-drop planting mechanism for planting cotton.

under and separates all surplus seed that may be resting on the sections of the plate between the cells and on the seed in the cells. As the cells pass over the seed tube, a knockout under spring pressure partially drops into each of them (Fig. 8) forcing the seed downward through the cells into the seed tube, through which they fall into the seed furrow.

Some cell-drop planters use a rigid cut-off, which sets at

different thickness (Figs. 15, 17, 18, and 19). This variation in number and size of cells and thickness of plate makes it possible to plant cottonseed at different rates and to handle seed of different sizes. Provision is made on most cell-drop planters for operating the plate at three speeds, thus changing the seeding rate without changing the plate. Table 1 shows the ratio of plate travel to the planter wheel travel for four planters.

To get cottonseed into each cell as the plate rotates, feed springs are attached to projections inside the hopper just above the cells. As the plate turns, an agitator stirs and separates the seed, causing them to work down under the feed springs, which gently press one or more seed into each cell (Fig. 8). Just before a cell reaches the point above the seed tube, a yielding cut-off slips

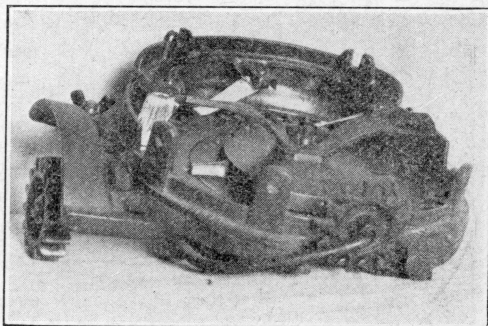


Figure 9. Cell-drop planting mechanism with plate mounted eccentrically with the hopper. (Note the spur wheel knockout.)

an angle across the cells to push back the surplus seed. These planters also use spur-like wheel knockouts, the prongs of which extend down into the cells, punching the seed out through the plate into the seed tube (Fig. 9 and 10b).

Picker Wheel Mechanism: This type of dropping mechanism uses a horizontal rotating agitator plate with radial fins or fingers and a picker wheel, located under the fingers on the rear side over the seed tube. The picker wheel is set at right angles to the radial fingers and rotates in the opposite direction against them. For this reason, it is sometimes termed a reverse feed. There are three distinct types of picker wheels used in

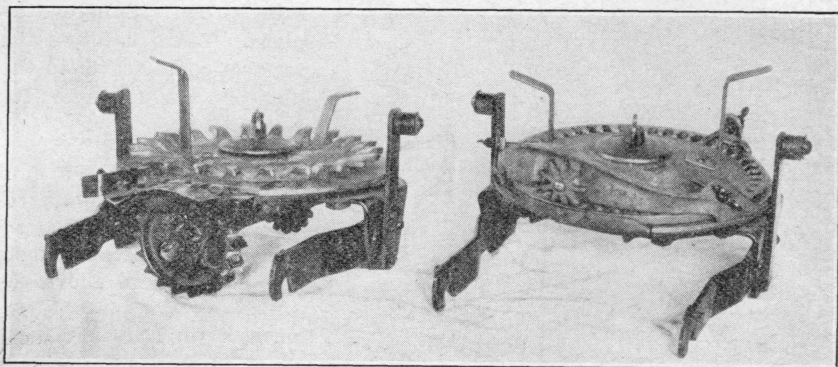


Figure 10. Cell-drop and picker-wheel drop planting mechanisms used on planters Nos. 4 and 7.

- A. Picker-wheel drop.
- B. Cell-drop with spur wheel knockout.

this dropping mechanism, the narrow wheel with recessed teeth (Fig. 11), the wide wheel with uniformly spaced teeth (Fig. 10a), and the wide wheel with staggered teeth (Table 2). The quantity of seed discharged by the dropping mechanism is regulated by a shutter, which may or may not cover the wheel. As the shutter is opened, increasing the open area about the picker wheel, more seed are dropped. Table 2 shows the size of shutter openings used in three planters.

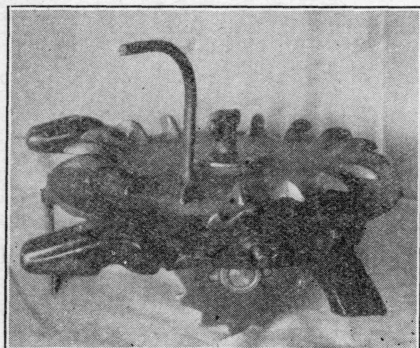


Figure 11. Picker-wheel drop used on planter No. 6.

In operation, one or two stirring arms (fastened to and extending upward from the agitator plate) keep the seed loose and in contact with

the fingers, which press the seed downward on the picker wheel that in turn picks them out of the hopper and feeds them into the seed tube.

Table 2. Characteristics of picker-wheel dropping devices for cotton planters.

Planter	Picker-Wheel Type	Diameter of picker wheel in inches	Width of rim in inches	No. of teeth	Height of teeth	Ratio of picker-wheel to planter wheel travel	Shutter		
							Length in inches	Width in inches	Distance above or below wheel
6	narrow...	3 1/2	1/8	12	1/4"	5.25	2 3/4	3/4	- 3/8"
7	wide....	3 11/16	3/8	18	1/2"	3.33	2 5/8	1	1/4"
8	narrow...	3 1/8	1/8	14	1/4"	3.92	2 5/8	1	3/8"

Hill-Drop Mechanism: The earliest hill-drop mechanisms consisted of cells spaced at suitable intervals in the planter plate and large enough to hold sufficient seed for one hill (Fig. 18), or of picker wheels with notches cut in their surfaces so spaced as to drop the seed in hills (Fig. 12). These hill drops were located in the bottom of the planter hopper, and it was necessary for the seed for each

hill to fall from the hopper through the seed tube to the soil. In falling a distance of some 18 or 20 inches the seed became separated and scattered along the furrow to such an extent that it was difficult to distinguish one hill from another. Later someone conceived the idea of placing a valve in the lower part of the seed boot close enough to the ground to prevent the seed from scattering when they were dropped (Fig. 13). Walking and riding horsedrawn planters and tractor planters equipped with hill-drop mechanisms are now available. Horsedrawn planters are equipped with a trip valve in the boot, while tractor planters are equipped with a rotary valve type of hill drop. The trip valve type will not withstand the strain of the higher speeds attained by tractors.

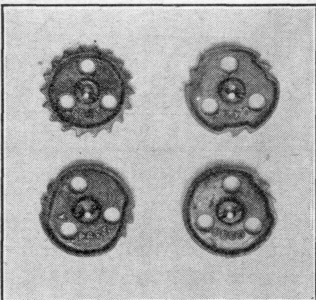


Figure 12. Regular and hill-drop picker wheels used on planter No. 7.

Walking and riding horsedrawn planters and tractor planters equipped with hill-drop mechanisms are now available. Horsedrawn planters are equipped with a trip valve in the boot, while tractor planters are equipped with a rotary valve type of hill drop. The trip valve type will not withstand the strain of the higher speeds attained by tractors.

REQUIREMENTS OF PLANTING MECHANISMS

Most planting seed are used as they come from the gin. More or less lint is left adhering to them. Small sticks, leaf trash, and bur sections are also found among the seed. The amount of lint and trash present will greatly influence the rate at which seed will be dropped and the frequency with which the hopper will have to be cleaned. The size of the seed is also an important factor. The picker-wheel drop is less affected by trash and lint than the cell drop. The picker-wheel tends to pick the trash out along with the seed, while in the cell drop trash may accumulate to such an extent as to keep some of the cells from being properly filled.

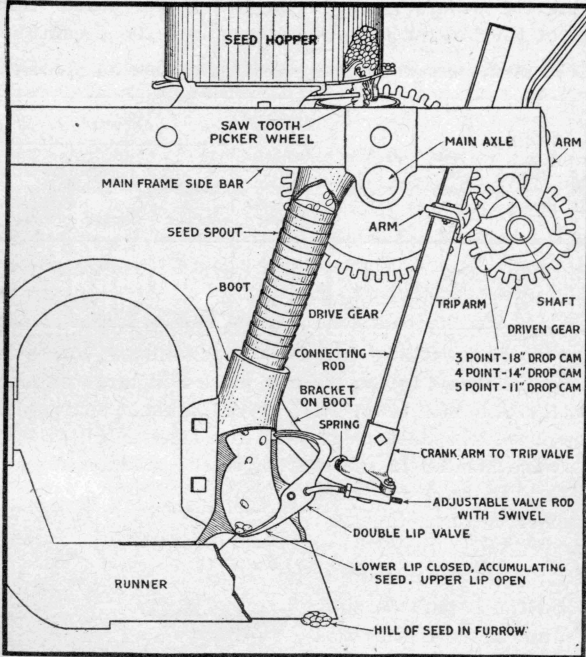


Figure 13. Cutaway view of hill-drop installed in seed boot.

Quantity of Seed Required: The nature of the cottonseed, the type of soil in which they are to be planted, and climatic conditions largely determine the quantity of seed planted. A recent survey revealed that from ten to fifty pounds of seed per acre are planted in the cotton growing areas of Texas. From sixteen to thirty pounds is generally used, while twenty-one pounds is the average for the state. Tests reported in this bulletin were undertaken to determine to what extent the various

planters on the market would meet the requirements of the cotton growers of Texas.

Number of Plants Per Acre: It has been found that cotton plants spaced twelve inches apart give the best yields under most conditions in Texas.* This would require 14,520 plants per acre, when the rows are three feet apart, or 12,408 when they are three and one-half feet apart (Table 3). From three to five pounds of seed would be sufficient to produce the required number of plants, provided they were properly distributed and germinated 100 per cent.

Table 3. Number of plants per acre with different row and hill spacing.

Width of row in feet	One Plant to Every					
	4 inches	8 inches	12 inches	16 inches	20 inches	24 inches
3	43,560	21,780	14,520	10,890	8,712	7,260
3½	37,338	18,669	12,446	9,334	7,468	6,223
4	32,670	16,335	10,890	8,168	6,534	5,526
4½	29,670	14,825	9,213	7,417	5,934	4,945
5	26,136	13,068	8,712	6,534	5,227	4,356

* Texas Agricultural Experiment Station Bulletins No. 340 and No. 360.

The young cotton plant, however, is very susceptible to disease and insect injury, and frequently plants die in large numbers. This and the fact that not more than an average of 70 per cent of the cottonseed planted will germinate make it necessary to distribute a much larger quantity of seed than the number of plants required.

METHOD OF CALIBRATING COTTON PLANTERS

To calibrate or test a cotton planter to determine the quantity of seed of a certain variety of cotton that will be planted per acre with a particular plate or setting, the following directions should be observed:

- (1) Determine the width in feet between rows.
- (2) Divide 43,560 (the number of square feet in an acre) by the width between rows. The result will be the distance the planter must travel to plant one acre.
- (3) Find the circumference of the planter wheel in feet. Divide the distance to be traveled in planting an acre by the circumference of the wheel. This will give the number of revolutions the wheel must make to plant an acre. Wheel slippage is not considered.
- (4) Fill the seed box with cottonseed and place a box under the seed spout.
- (5) Jack up one of the wheels. Tie a rag around one of the spokes so the revolutions can be counted.
- (6) Engage the clutch and turn the wheels, counting each revolution. Turn at about the speed the planter will travel in the field. To determine the quantity that will be planted per acre, when the wheel has been turned the equivalent of $\frac{1}{4}$ to $\frac{1}{2}$ an acre, weigh the cottonseed that have been dropped and multiply the amount by 4 if $\frac{1}{4}$ acre was selected, or by 2 if $\frac{1}{2}$ acre was sown.

At least three trials should be made and the results averaged.

EQUIPMENT AND PROCEDURE

Methods of Making Tests: Truitt seed were used in five tests for each plate and speed combination possible with the cell-drop planters, and in five tests at each of four settings of the shutter (that is, one-fourth open, one-half open, three-fourths open, and wide open) with the picker-wheel drop. All tests were for the equivalent of one-fourth acre with the rows spaced three feet apart. The results of the five tests were totaled and averaged and the result multiplied by four to obtain the quantity dropped per acre. Similarly, three tests were run in each of the planter combinations with Ducona seed.

The seed were thrown from the seed belt into a box, after which they were weighed. To determine the percentage of injury caused by the planting mechanism of each planter tested, all seed of each test made with Truitt seed were screened to remove the seeds that were hulled. The hulled seed were counted and the percentage of injury calculated. The percentage of injury to Ducona seed was not determined.

Equipment Used in Tests: The one-row riding type planter was selected for calibrating the dropping mechanism because it could be readily mounted on a stand and operated by means of an electric motor and belts, the arrangement of which is shown in Figure 14. A belt six inches

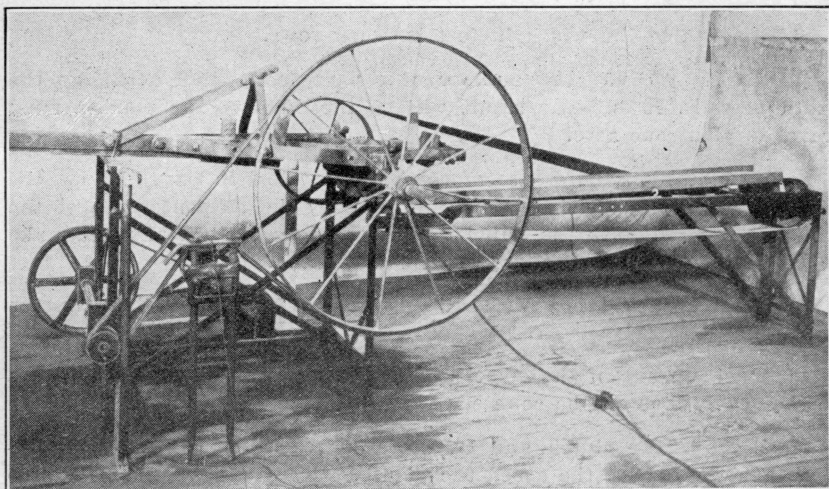


Figure 14. Stand used in testing cotton planters with planter mounted on stand.

wide and six feet long was mounted in an auxiliary frame attached to the stand in such a way that the seed passing through the planter would drop upon it as they normally drop in the seed furrow.

The planter wheel was belted to the motor so that it would turn an equivalent of two and one-half miles an hour. The seed belt moved under the seed tube at the same speed. A revolution counter was mounted on the end of the planter axle to count the revolutions of the planter wheel so that each planter could be tested for the same equivalent part of an acre.

Several typical commercial one-row riding planters were selected for testing; some of these could be converted from the cell-drop to the picker-wheel drop by changing the hopper mechanism.

As a general rule, cell-drop planters are made so that the plate can be operated at three speeds termed low, medium, and high. The picker-wheel drop can be operated at one speed only.

Kinds of Cottonseed Used: As the size of seed varies for different varieties of cotton, the Truitt and Ducona varieties were selected to test. The Truitt has representative small seed averaging 4,619 seed to the pound. The Ducona is a fair representative of the large seed varieties, averaging about 3,780 seed to the pound. The seed were used as they came from the gin; that is, they were not delinted, recleaned, or graded.

EXPERIMENTAL RESULTS

Cell-Drop Planting Mechanisms

Planting Mechanism Number 1

The complete dropping mechanism of this planter with all accessories is shown in Figure 8. The seed plate has the seed cells on the outer edge; these cells are U-shaped (Table 1). A sloping by-pass permits seed that cling to the plate to pass back into the hopper. Two flat stirring arms keep the seed agitated and fed down under the feed springs into the seed cells.

Results with Truitt Seed: Table 4 shows the actual number of seed dropped per acre, the equivalent in pounds, and the percentage of seed hulled, while Table 5 shows the number of seed dropped in relation to the number of plants obtained when 70 per cent of the dropped seed germinate.

Table 4 shows that plate No. 1832 (Figure 15) dropped 63,916 Truitt seed at low speed, while plate No. 1768 (Figure 15) dropped 254,724

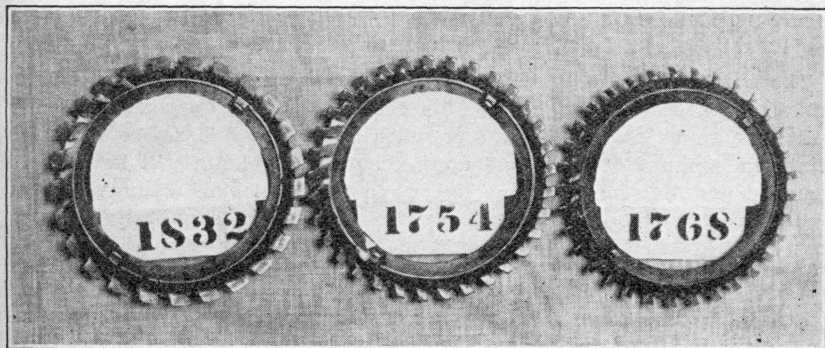


Figure 15. Plates tested with planter No. 1.

seed at high speed. The equivalent in pounds was 13.84 for plate No. 1832 and 55.16 for plate No. 1768. The percentage of seed hulled ranged from .59 per cent at low speed to 1.47 per cent at high speed for plate No. 1832.

Figure 16 shows the regularity with which this planter dropped the seed. It will be noted that while there was a tendency to bunch the seed to some extent, this was not enough to be an objectionable feature.

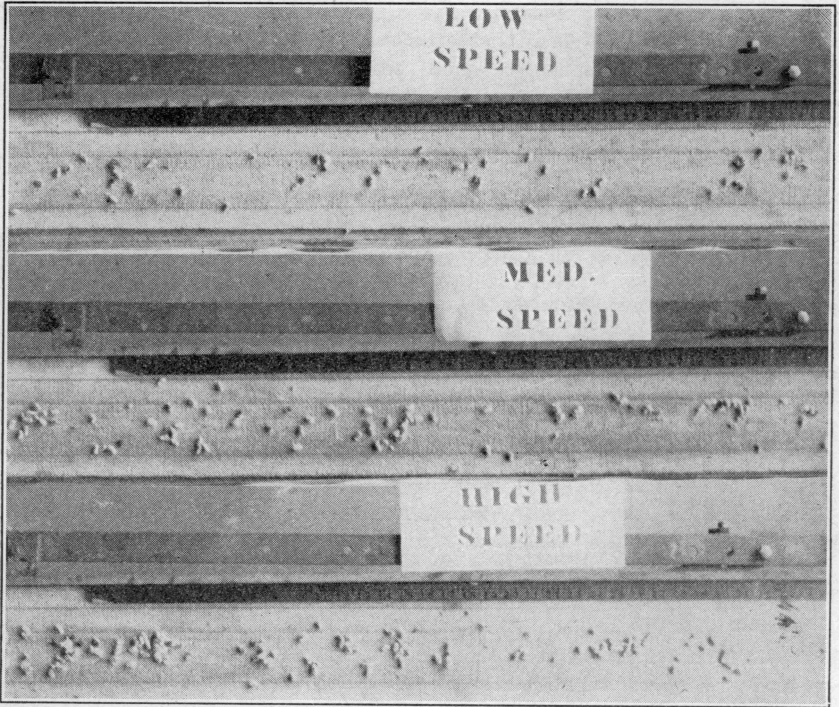


Figure 16. How seed were distributed by plate No. 1768 on planter No. 1 at low, medium, and high speeds.

The number of plants per foot at 70 per cent germination ranged from 3.08 to 12.28. In other words, for every plant left approximately two will have to be removed per foot when the planter is set to drop the minimum amount of seed, and approximately 11 plants will have to be removed per foot for each one left when the maximum amount of seed are dropped. This gives a rather wide range in the quantity of seed that can be distributed and should make the planter adaptable for use under most conditions.

Results with Ducona Seed: The tests on planter No. 1 with Ducona seed revealed that the larger seed could be handled by the dropping mechanism as readily and efficiently as the smaller Truitt seed. A larger quantity of the Truitt seed was dropped in every test. Plate No. 1832 at low speed dropped 4.52 pounds of seed per acre more Truitt than Ducona (Table 4). With each plate and at each speed the quantity gradually increased until with plate No. 1768 at high speed 10.80 pounds more Truitt seed were dropped. The number of plants removed per foot for each plant left ranged from less than one for plate No. 1832 at low speed to 7.08 for plate No. 1768 at high speed (Table 5).

Table 4. Number of seed and pounds of cottonseed planted per acre and the number and percentage of seed hulled by cell-drop planting mechanism.

Planters Mechanism No.	Plate No.	Plate Speed											
		Low				Medium				High			
		Seed Planted		No. seed hulled	Per cent of seed hulled	Seed Planted		No. seed hulled	Per cent of seed hulled	Seed planted		No. seed hulled	Per cent of seed hulled
		Number	Pounds			Number	Pounds			Number	Pounds		
Truitt Cottonseed													
1	1832	63,916	13.84	374	.59	94,348	20.43	1,221	1.29	121,052	26.21	1,788	1.47
1	1754	88,444	19.15	716	.81	149,160	32.29	1,315	.88	183,740	39.78	2,256	1.23
1	1768	123,216	26.68	870	.71	196,716	42.59	1,451	.74	254,724	55.16	2,685	1.05
2	378A	39,776	8.61	131	.33	44,316	9.60	108	.24	50,152	10.86	108	.21
2	7980A	71,336	15.44	51	.07	83,876	18.16	94	.11	106,420	23.04	105	.01
3	17	50,812	11.00	13	.03	74,180	16.06	31	.04	89,220	19.32	40	.04
3	17A	56,904	12.32	4	.007	81,496	17.64	18	.02	99,384	21.52	13	.001
3	17B*	22,356	4.84	13	.06	30,892	6.69	13	.04	40,648	8.80	22	.05
4	G596	.....	.....	.....	.....	48,496	10.50	67	.14	.....	.....	.....	.....
4	G591A	.....	.....	.....	.....	64,020	13.86	134	.21	.....	.....	.....	.....
4	G576	.....	.....	.....	.....	95,376	20.65	80	.08	.....	.....	.....	.....
4	G392	.....	.....	.....	.....	112,440	24.34	134	.12	.....	.....	.....	.....
4	G597	.....	.....	.....	.....	131,916	28.56	139	.11	.....	.....	.....	.....
4	G383	.....	.....	.....	.....	152,880	33.10	109	.07	.....	.....	.....	.....
Ducona Cottonseed													
1	1832	35,229	9.32	.....	.....	49,745	13.66	.....	.....	73,483	19.44	.....	.....
1	1754	49,442	13.08	.....	.....	87,545	23.16	.....	.....	119,599	31.64	.....	.....
1	1768	84,370	22.32	.....	.....	133,963	35.44	.....	.....	167,681	44.36	.....	.....
2	378A	42,941	11.36	.....	.....	43,999	11.64	.....	.....	46,570	12.32	.....	.....
2	7980A	69,250	18.32	.....	.....	85,428	22.60	.....	.....	105,840	28.00	.....	.....
2	7942A	95,407	25.24	.....	.....	109,469	28.96	.....	.....	122,623	32.44	.....	.....

* Hill-drop plate.

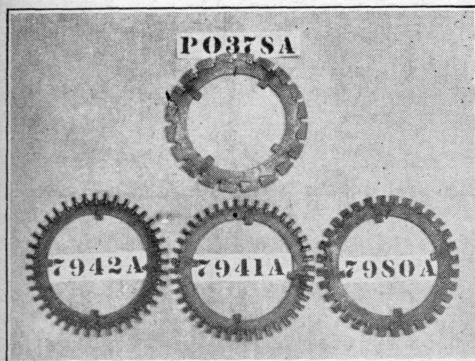
Table 5. Relation between the number of seed planted, seed germinating, and the number of plants required for a stand when the plants are spaced 12 inches apart for cell-drop planting mechanisms.

Planting Mechanism No.	Plate No.	Plate Speed								
		Low			Medium			High		
		No. seed planted per acre	No. plants per acre at 70% germination	No. plants per foot at 70% germination	No. seed planted per acre	No. plants per acre at 70% germination	No. plants per foot at 70% germination	No. seed planted per acre	No. plants per acre at 70% germination	No. plants per foot at 70% germination
Truitt Cottonseed										
1	1832	63,916	44,471	3.08	94,348	66,044	4.55	121,052	84,736	5.84
1	1754	88,444	61,911	4.26	149,160	104,412	7.19	183,740	128,618	8.86
1	1768	123,216	86,251	5.94	196,716	137,701	9.48	254,724	178,307	12.28
2	378A	39,776	27,843	1.92	44,316	31,021	2.14	50,152	35,106	2.42
2	7980A	71,336	49,935	3.44	83,876	58,132	4.00	106,420	74,494	5.13
3	17	50,812	35,568	2.45	74,180	51,926	3.58	89,220	62,454	4.30
3	17A	56,904	39,833	2.74	81,496	57,047	3.93	99,384	69,569	4.79
3	17B*	22,256	15,649	1.08	30,892	21,624	1.49	40,648	28,314	1.95
4	G596	.....	.....	.....	48,496	23,947	2.34	.....	.....	.....
4	G591A	.....	.....	.....	64,020	44,814	3.09	.....	.....	.....
4	G576	.....	.....	.....	95,376	66,763	4.60	.....	.....	.....
4	G392	.....	.....	.....	112,440	78,708	5.42	.....	.....	.....
4	G597	.....	.....	.....	131,916	92,341	6.36	.....	.....	.....
4	G393	.....	.....	.....	152,880	107,016	7.37	.....	.....	.....
Ducona Cottonseed										
1	1832	35,229	24,660	1.70	49,745	34,822	2.40	73,483	51,438	3.54
1	1754	49,442	34,609	2.38	87,545	61,282	4.22	119,599	83,719	5.77
1	1768	84,370	59,059	4.07	132,963	93,774	6.46	167,681	117,379	8.08
2	378A	42,941	30,059	2.07	43,999	30,799	2.12	46,570	32,599	2.25
2	7980A	69,250	48,475	3.34	85,428	59,800	4.12	105,840	74,088	5.10
2	7942A	95,407	66,785	4.60	109,469	76,628	5.28	122,623	85,836	5.91

* Hill-drop plate.

Planting Mechanism Number 2

The second cell-drop planter tested was similar to the first. The shape and arrangement of the cells in the plate were different. Four seed plates were available (Figure 17), each having a different number of seed cells of different size (Table 1).



Each plate could be operated at three speeds, giving an option of 12 rates of planting. Two flat stirring arms kept the seed in the hopper agitated and fed down under the feed springs into the cells.

In order to force the seed into the cells as uniformly as possible, the upper portion of the partition between the cells was made somewhat in the shape of saw teeth. In other words, the leading edge of the cell partition was raised and

pointed. This serrated or rough upper surface helped the agitator to separate and loosen the seed. Spring shoes forced the separated seed into the cells. The yielding cut-off, which pushed back the surplus seed, and the spring knockout, which ejected them from the cell, differed on the first planter tested in that they were fastened to the hopper, while in the second they were fastened to a special casting.

Results with Truitt Seed: A study of Table 4 shows that plate No. 378A dropped 39,776 seed per acre at low speed, 44,316 at medium speed, and 50,152 at high speed, while plate No. 7980A dropped 71,336 seed at low speed, 83,876 at medium, and 106,420 seed at high speed. The equivalent in pounds of seed for plate No. 378A was 8.61 pounds at low speed, 9.60 at medium, and 10.86 at high speed. Plate No. 7980A dropped 15.44 pounds at low speed, 18.16 pounds at medium speed, and 23.04 pounds at high speed. The quantity of seed dropped increased as the speed of the plate was increased from low to high speeds and as the size and number of the cells in the plates increased; this ranged from approximately one-fourth to two-thirds of a bushel of seed per acre. Plates Nos. 7941A and 7942A were not tested. The percentage of seed hulled was higher with plate No. 378A than with plate No. 7980A, which dropped a larger quantity of seed (Table 4). The number of plants removed per foot would range from .92 for plate No. 378A at low speed to 4.13 for plate No. 7980A at high speed.

Results with Ducona Seed: The quantity of seed dropped was in fairly uniform increments and increased as the plate speed was increased, or as the size and number of cells per plate were increased. There were two

exceptions to this. It will be noted that plate No. 7980A dropped 28.00 pounds of seed per acre at high speed, while plate No. 7942A dropped 28.96 pounds at medium speed (Table 4). These settings are so much alike that one or the other is not necessary. There was a six pound interval between the high speed test of plate No. 384A and the low speed test of plate No. 7980A. This interval would probably be decreased by plate No. 7941A, which was not available for testing. The three plates tested in the planter would enable the operator to plant from 11.36 to 32.44 pounds of Ducona seed per acre (Table 4).

With a 70 per cent germination, approximately one plant would have to be removed for each plant left when the minimum quantity of Ducona seed was dropped, and approximately 5 plants would have to be removed for the maximum quantity.

The highest percentage of seed hulled was with plate No. 378A at low speed, when an average of .33 per cent was hulled (Table 4). The smallest percentage hulled was with plate 7980A at high speed, when a .01 per cent was hulled. A greater part of the seed damage probably occurred between the sharp edges of the top part of the cells and the cut-off.

Planting Mechanism Number 3

Although this planter was of the single seed or cell-drop type, it differed radically from those on planters Nos. 1 and 2. The plates (Fig. 18) were similar to the conventional type, but the cut-off and knockout were

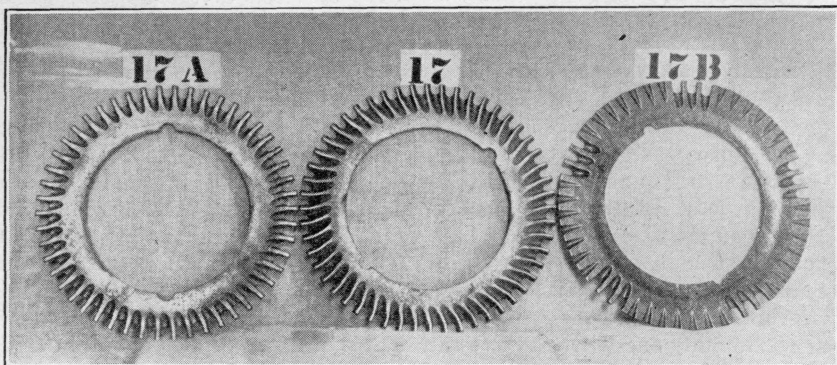


Figure 18. Plates used on planter No. 3. 17B is a hill-drop plate. entirely different. The hopper was mounted eccentrically with the plate in such a way that a portion of it extended outside the hopper. The lower portion of the hopper acted as a cut-off and pushed the surplus seed back up fluted grooves that led into the cells.

The knockout acted on the portion of the plate that was outside of the hopper (Fig. 9). It consisted of a spur wheel mounted on an arm

and was held in position on the plate by spring tension. The pitch of the teeth on the wheel must correspond to the cell pitch on the plate so that the two work together in a manner similar to spur gears; that is, the teeth on the spur wheel dropped into the cells and ejected the seed into the seed tube, which was placed directly underneath.

Two cottonseed plates were furnished as standard equipment with this planter. A special hill-drop plate, No. 17B (Fig. 18), was tested along with the two standard plates. Results of these tests are shown in Tables 4 and 5.

Results with Regular Drop and Truitt Seed: The number of seed dropped by plate No. 17 was 50,812, 74,180, and 89,220 for low, medium and high speeds, respectively (Table 4). The pounds of seed dropped were 11.00, 16.06, and 19.32 for low, medium, and high speeds, respectively (Table 4). Plate 17A dropped 56,904 seed at low speed, 81,496 at medium speed, and 99,384 seed at high speed (Table 4), or 12.32, 17.64, and 21.52 pounds, respectively. At 70 per cent germination, the

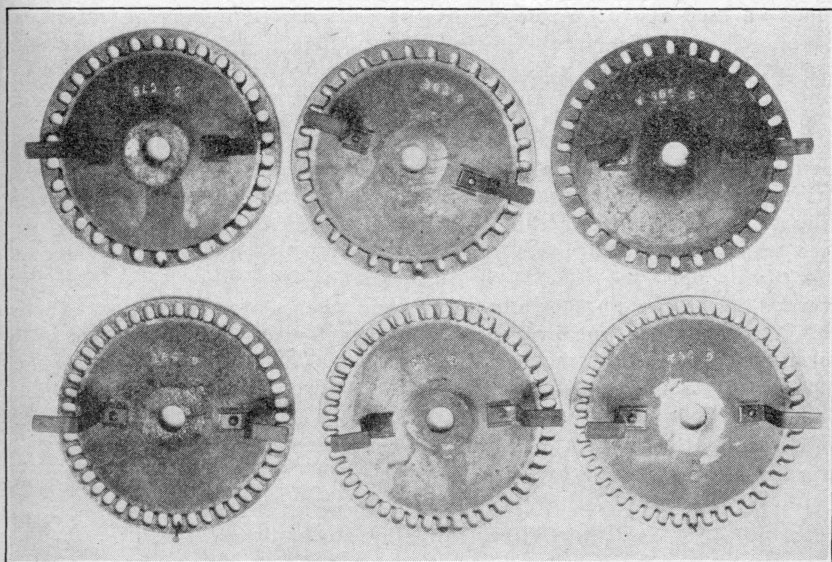


Figure 19. Plates tested on planter No. 4.

number of plants would range from 2.45 to 4.79 plants per foot at low and high plate speeds, respectively, and would require the removal of 1.45 to 3.79 plants per foot.

With the plates set to drop the smaller quantities of seed, many 15 to 20 inch spaces without any seed were noted. The knockout was frequently lifted by seed which got under it on top of the cell division. Frequently at the higher speeds seed were lodged in the cell tight enough to raise the knocker. Occasionally the knocker teeth would ride on top of the cell divisions and no seed would be ejected until this condition was remedied.

Planting Mechanism Number 4

The dropping device for this planter consisted of a series of six plates (Fig. 19) having elliptical cells of suitable size cut inside of the outer edge of the rim, which was thicker than the inner part (Table 1). The inner side of this extra thickness was cut away to allow seed to enter the cells or be pushed away by the cut-off, which was rigidly bolted to the side of the hopper in such a way that the plate would turn under it (Fig. 10b).

The seed were separated and forced into the cells by the agitators fastened to the plate and three stationary fingers projecting from the hopper about an inch above the plate. As the cells moved under the cut-off, a wheel with spur-like prongs projected into them and forced the seed out and into the seed tube, which was placed directly underneath. The dropping device could be driven at only one speed.

Results with Truitt Seed: Truitt cottonseed was the only kind of seed used in testing this planter. Since the plates could be operated at only one speed, it was necessary to change plates to change rates of seed dropped. Table 4 shows that the smallest quantity of seed dropped per acre was 48,496 with plate No. G596, or 10.50 pounds. The largest quantity dropped was 152,880, or 33.10 pounds, with plate No. G383. The average increase in number of seed dropped when plates were changed was 20,877 seed per acre, or 4.52 pounds. The number of plants at 70 per cent germination ranged from 2.34 for plate No. G596 to 7.37 for plate No. G393 (Table 5) of which from 1.34 to 6.37 would need to be removed. The lowest percentage of seed hulled was .07 per cent with plate No. G383, while the highest was .21 per cent with plate No. G591A. The average for all six plates was .12 per cent.

Picker-Wheel Dropping Mechanisms

Planting Mechanism Number 5

The first picker-wheel dropping device was of the wide staggered-tooth type. The agitator consisted of a plate with curved spoon-like fingers radiating from it (Fig. 20). Two flat stirring arms were fastened to the agitator plate and extended upward from 6 to 8 inches to keep the

Table 6. Number of seed and pounds of cottonseed planted per acre and the number and percentage of seed hulled by picker-wheel drop planting mechanisms.

Planting Mechanism No.	Type of Picker Wheel	Shutter Opening															
		One-fourth				One-half				Three-fourths				Full			
		Seed Planted		No. seed hulled	Per cent of seed hulled	Seed Planted		No. seed hulled	Per cent of seed hulled	Seed Planted		No. seed hulled	Per cent of seed hulled	Seed Planted		No. seed hulled	Per cent of seed hulled
		Number	Pounds			Number	Pounds			Number	Pounds			Number	Pounds		
Truitt Cottonseed																	
5	Regular....	36,747	7.96	168	.46	118,892	25.74	552	.46	216,168	46.80	632	.29	335,420	72.62	1147	.34
6	Regular....	33,996	7.36	129	.38	142,356	30.82	189	.13	302,064	65.40	273	.09	549,064	118.87	315	.06
7	Regular 588	91,496	19.81	76	.08	232,796	50.40	140	.06	411,276	89.04	119	.03	504,396	109.20	71	.01
Ducona Cottonseed																	
6	Regular....	55,490	14.68	.....	.....	93,442	24.72	.....	.....	149,839	39.64	.....	.....	267,078	70.92	.....	.....
7	Regular 588	56,851	15.04	.....	.....	127,915	33.84	.....	.....	231,034	61.12	.....	.....	397,996	105.29	.....	.....
8	Regular....	97,675	25.84	.....	.....	175,846	46.52	.....	.....	327,197	86.56	.....	.....	461,311	122.04	.....	.....

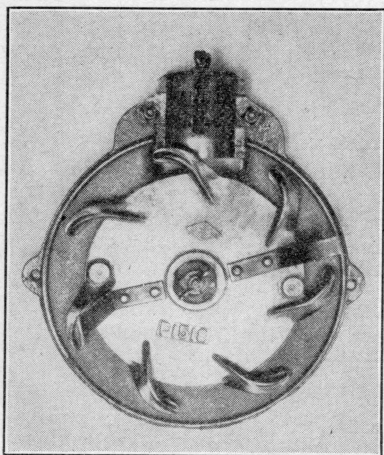


Figure 20. Picker-wheel drop mechanism used on planters Nos. 1 and 5.

seed loose and in contact with the fingers and force them downward on the picker wheel. This dropping mechanism could be operated at one speed only, but tests were made at four shutter settings; namely, one-fourth, one-half, three-fourths, and wide open.

Results with Truitt Seed: This planting mechanism was tested with cottonseed of the Truitt variety only. The planter was not available for tests with seed of other varieties. From the results shown in Table 6 it is seen that the quantity of seed dropped varied from 36,747 per acre with the shutter one-fourth open to 335,420 per acre when it was

wide open. This is equivalent to 7.96 and 72.62 pounds, or approximately one-fourth and two and a half bushels of seed per acre (Table 6).

It was observed that the seed were distributed fairly regularly. Frequently there were no seed in spaces 12 inches long when the shutter was one-fourth or one-half open. There was some tendency at these settings for the seed to fall in bunches. As the shutter opening was increased, the skips or spaces without any seed decreased, but the tendency to bunch increased. The tendency to bunch can possibly be attributed to two causes, uneven pressure of the seed on the picker wheel and the fact that the lint caused the seed to cling together.

It should be pointed out that although only four settings of the shutter were tested, it could be set at any desired position between completely closed and wide open. Thus it is possible with this planter to distribute any quantity of seed desired up to the maximum of 72.62 pounds per acre (Table 6).

A study of Table 6 shows that the percentage of seed hulled is less in most cases than with cell-drop planters. There was a tendency for this percentage to decrease as the shutter was opened more. The number of plants per foot at 70 per cent germination ranged from 1.77 at the one-fourth shutter opening to 16.17 when the shutter was wide open (Table 7); this would call for the removal of from .77 to 15.17 plants per foot to leave a perfect stand spaced 12 inches apart in three-foot rows.

Planting Mechanism Number 6

This dropping device used a narrow type picker-wheel (Table 2) and had a decided hook to the tips of the pickers (Fig. 11). The picker-wheel extended up into the bottom of the hopper, and the seed control gate closed against the side of the wheel. The fingers on the agitator plate

were radial and spaced closer than they were on planter No. 5. One round rod-like stirring arm, fastened to the agitator plate, extended upward with its upper part curved outward toward the side of the hopper. This planter was tested with both Truitt and Ducona cottonseed.

Results with Truitt Seed: Results with Truitt seed are shown in Table 6 and 7. It is seen that 33,996 seed, or 7.36 pounds, were dropped per acre with the shutter at its smallest opening, when the shutter was almost touching the side of the picker wheel. When the shutter was one-half open, 142,356 seed, or 30.82 pounds, were dropped per acre. The quantity of seed dropped at the three-fourths opening was 302,064, or 65.40 pounds, per acre. When the shutter was wide open, 549,064 seed, or 118.87 pounds, were dropped; this was approximately three and one-half bushels of seed per acre. According to Table 7, if 70 per cent of the seed germinated, there would be 26.50 plants per foot, so that 25.50 plants would have to be thinned out. Table 6 shows that a very small percentage of the seed were injured by the planting mechanism, the lowest being .06 per cent with the shutter wide open and the highest .01 per cent with the shutter three-fourths open.

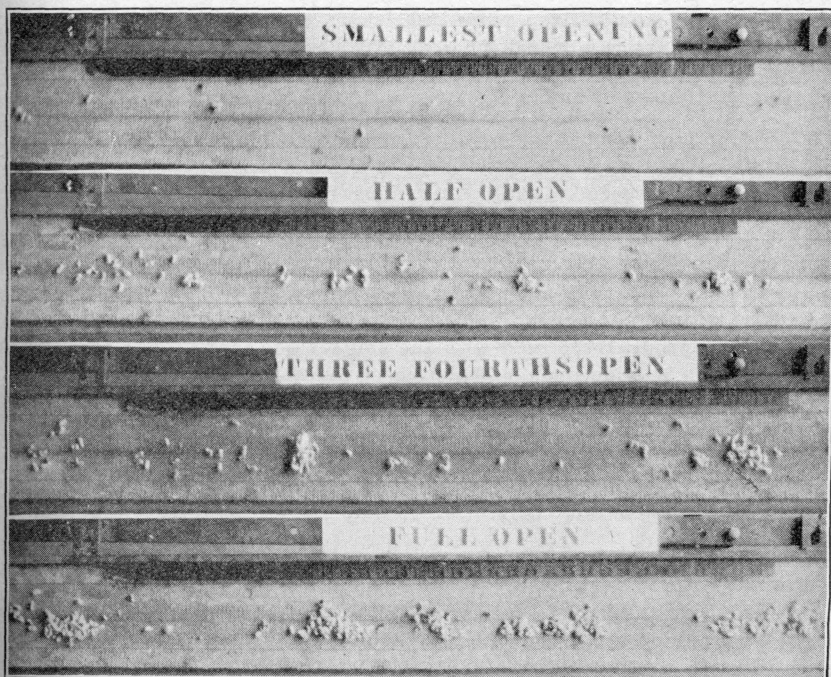


Figure 21. How picker wheel shown in Figure 11 and used on planter No. 6 distributed cottonseed at the different settings of the shutter.

Results with Ducona Seed: In the tests with Ducona seed the shutter at the one-fourth setting was open a little more than it was when tested with Truitt seed, and this accounts for the greater number of seed dropped at that opening with the larger Ducona seed (Table 6). For one-half, three-fourths, and full openings, 93,442, 149,839, and 267,078 seed were dropped respectively. The maximum quantity of seed dropped was considerably less with the large Ducona seed than with the medium sized Truitt seed.

The number of plants per foot at 70 per cent germination ranged from 2.67 for the one-fourth shutter opening to 12.88 when the shutter was wide open (Table 7), and from 1.67 to 11.88 plants would need to be cut out.

A study of the droppping mechanism while in operation with either kind of seed showed that as the shutter opening increased the seed developed a decided tendency to fall in bunches (Fig. 21). This left spaces several inches in length with no seed at all. The bunching was apparently due to seed hanging together and working out at the side of the narrow picker wheel instead of being separated by it. As a result, a large percentage of the seed dropped were never touched by the wheel in passing through the planting mechanism.

This planter should drop more seed than it would ever be necessary to plant under any condition.

Planting Mechanism Number 7

This dropping mechanism was of the wide picker-wheel type. The picker wheel was approximately three-fourths of an inch wide with the teeth uniformly spaced (Table 2). This picker wheel was the same diameter as those used in other planting mechanisms, but it had more teeth. The shutter or seed gate slid over the wheel and completely covered it when closed.

Results with Truitt Seed: Table 6 shows that the regular picker-wheel No. G588 dropped 91,496 seed with the shutter one-fourth open and 504,396 seed with it wide open. The highest percentage of seed hulled was .08 per cent when the shutter was only one-fourth open. The lowest percentage hulled was .01 per cent with the shutter wide open. The number of plants at 70 per cent germination ranged from 4.41 for the one-fourth shutter opening to 24.32 for the complete opening (Table 7). To leave one plant per foot, from 3.41 to 23.32 plants per foot would have to be thinned out.

Results with Ducona Seed: Since Ducona seed are larger than Truitt seed, a smaller number of the former were dropped for each shutter opening. The numbers for the one-fourth, one-half, three-fourths, and full open shutter settings were 56,851, 127,915, 231,034, and 397,996, respectively. The equivalent in pounds for the same shutter openings was 15.04, 33.84, 61.12, and 105.29 pounds, respectively, as shown in Table

Table 7. Relation between the number of seed planted, seed germinating, and the number of plants required for a stand when the plants are spaced 12 inches apart for picker-wheel drop planting mechanisms.

Planting Mechanism No.	Type of Picker Wheel	Shutter Opening											
		One-fourth			One-half			Three-fourths			Full		
		No. seed planted per acre	No. plants per acre at 70% germination	No. plants per foot at 70% germination	No. seed planted per acre	No. plants per acre at 70% germination	No. plants per foot at 70% germination	No. seed planted per acre	No. plants per acre at 70% germination	No. plants per foot at 70% germination	No. seed planted per acre	No. plants per acre at 70% germination	No. plants per foot at 70% germination
Truitt Cottonseed													
5	Regular . . .	36,747	25,723	1.77	118,892	95,114	6.55	216,168	151,318	10.42	335,420	234,794	16.17
6	Regular . . .	33,996	23,797	1.64	142,356	99,649	6.86	302,064	211,445	14.56	549,064	384,745	26.50
7	Regular 588	91,496	64,047	4.41	232,796	162,957	11.22	411,276	287,893	19.83	504,396	353,077	24.32
Ducona Cottonseed													
6	Regular . . .	55,490	38,836	2.67	93,442	65,409	4.50	149,839	104,887	7.22	267,078	186,955	12.88
7	Regular 588	56,851	39,796	2.74	127,915	89,541	6.17	231,034	161,724	11.14	397,996	278,597	19.19
8	Regular . . .	97,675	68,373	4.71	175,846	123,092	8.48	327,197	229,038	15.77	461,311	322,918	22.24

6. The number of plants thinned out for each plant left, 12 inches apart in the row, ranged from 1.74 for the one-fourth shutter opening to 18.19 at full opening. The number and percentage of hulled seed were not obtained for Ducona seed.

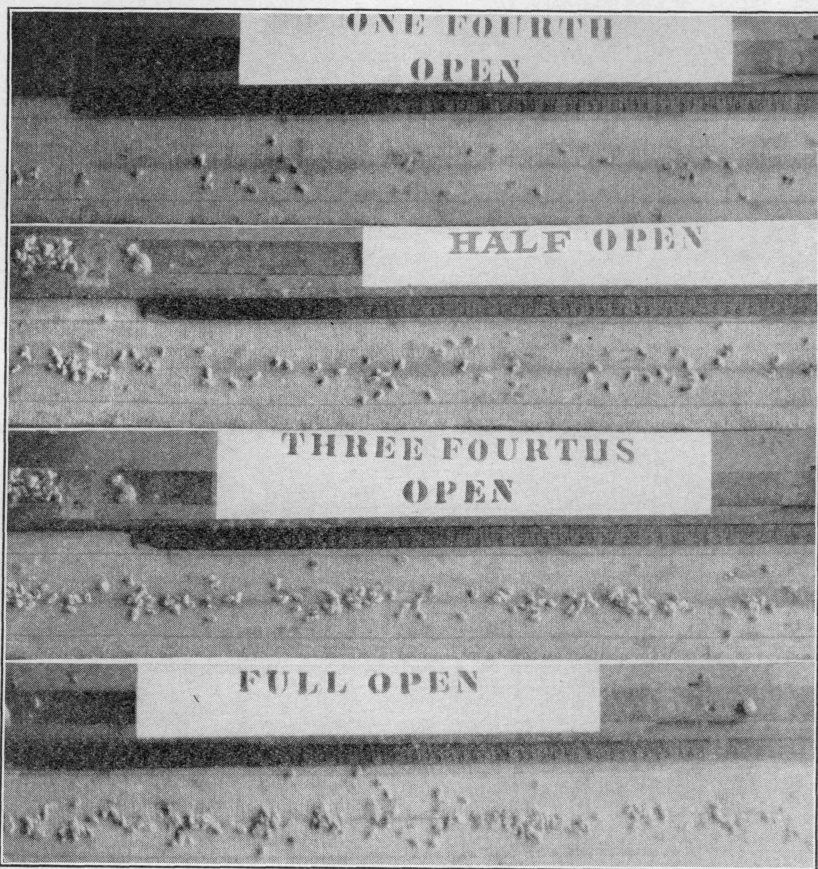


Figure 22. How picker wheel shown in Figure 10A and used on planter No. 7 distributed cottonseed at the different settings of the shutter.

The seed were dropped regularly at all shutter openings (Fig. 22). Very few blank spaces were noted on the seed belt. The uniformity of drop was probably due to the wide picker wheel, which permitted no seed to get out of the hopper except those picked out by the picker-wheel teeth.

Planting Mechanism Number 8

This dropping device was equipped with a narrow picker wheel similar to that used by planter No. 6 (Fig. 11). The seed control shutter opened

slightly wider, and the picker wheel did not project as far into the hopper.

This planter was tested only with Ducona seed.

Table 6 shows that the number of Ducona seed dropped at each of the settings was slightly greater than for planter No. 6, and that the plant ratios were correspondingly greater (Table 7). The number of seed dropped ranged from 97,675 for the one-fourth shutter opening to 461,311 for the full opening, or 25.84 and 122.04 pounds, respectively. The small one-fourth shutter opening permitted almost a bushel of seed to be dropped, while the maximum was about four bushels per acre. At 70 per cent germination the number of plants ranged from 4.71 per foot for the one-fourth setting to 22.24 per foot at the wide open setting, requiring the removal of from 3.71 to 21.24 plants per foot to leave one plant per foot.

HILL DROPPING

At the time these tests were made no hill-drop attachments for the seed boot were available. Tests were made with three picker-wheel drops and one plate hill drop. Results for the hill-drop plate No. 17B for planter No. 3 are shown in Table 4. The table shows that considerably less seed were dropped with the hill-drop plate than with the regular plates Nos. 17 and 17A. The tests indicated that when the hills were formed by the planting mechanism, the seed separated in dropping and scattered on the belt until it was hard to distinguish the hills. Experience in the field has proved that this type of hill drop is not satisfactory. All planters are now equipped with a valve in the seed boot near the ground.

The hill-dropping mechanism is placed in the boot of the seed tube, and the regular planting mechanism is used to extract and drop the seed from the seed hopper. The number of seed per hill is varied in cell-drop planters by three methods: (1) by running the seed plate slower or faster, (2) by changing the plate to drop a different number of seed, and (3) by varying the speed at which the valve operates. The rate at which the valve opens and closes also determines the spacing of the hills.

The number of seed dropped per hill can be obtained from Table 3, which shows the number of hills per acre for different row and hill spacings. For example, if the rows are spaced 3 feet apart and the hills are to be spaced 12 inches apart, there will be 14,520 hills to the acre. If the planter is dropping 94,348 seed to the acre (Table 4, planter No. 1, plate No. 1832 at medium speed), by dividing the number of seed the planter drops per acre by the number of hills desired per acre, the number of seed per hill is obtained; in this case 94,348 divided by 14,520 gives 6.50, or approximately 7 seed to the hill. If 70 per cent of these seed germinate, approximately 5 plants per hill may be expected (Table 5).

SUMMARY AND CONCLUSIONS

Tests were made on cell-drop and picker-wheel drop cotton planting mechanisms to determine the quantity of cottonseed planted per acre and the percentage of seed hulled in passing through the different types of planting mechanisms.

The smallest number of cottonseed dropped per acre by the cell-drop planting mechanisms tested was 39,776 at low plate speed, while the largest number was 254,724 seed at high plate speed. This is equivalent to 8.61 and 55.16 pounds, or approximately $\frac{1}{4}$ and $1\frac{3}{4}$ bushels per acre.

Picker-wheel drop planting mechanisms had a wider spread than the cell-drop planting mechanisms between the minimum and maximum quantities of seed dropped, ranging from 33,996 to 549,064 seed per acre. The equivalent in pounds is 7.36 and 118.87, or approximately $\frac{1}{4}$ and $3\frac{1}{2}$ bushels per acre.

The size of the seed materially influenced the quantity of seed dropped. When the same plates and speeds were used to drop medium-sized Truitt cottonseed, from 47,569 to 87,043 more seed were planted per acre than with the larger-sized Ducona seed. Seed dropped by picker-wheel drop mechanisms ranged from 43,085 to 151,068 more medium-sized Truitt seed than large Ducona seed per acre.

The percentage of seed hulled by cell-drop planting mechanisms ranged from .001 per cent to 1.47 per cent. The highest percentage of seed hulled by picker-wheel drop planting mechanisms was .46 per cent.

If 70 per cent of the smallest and largest number of seed dropped by cell-drop planting mechanisms germinated, the number of plants obtained would range from approximately 2 to 12 per foot. To obtain a perfect stand of 14,520 plants per acre, from 1 to 11 plants per foot would have to be thinned out. The number of plants per foot for picker-wheel drop mechanisms ranged from 2 to 27, requiring the removal of from 1 to 26 plants per foot to leave one plant per foot.

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