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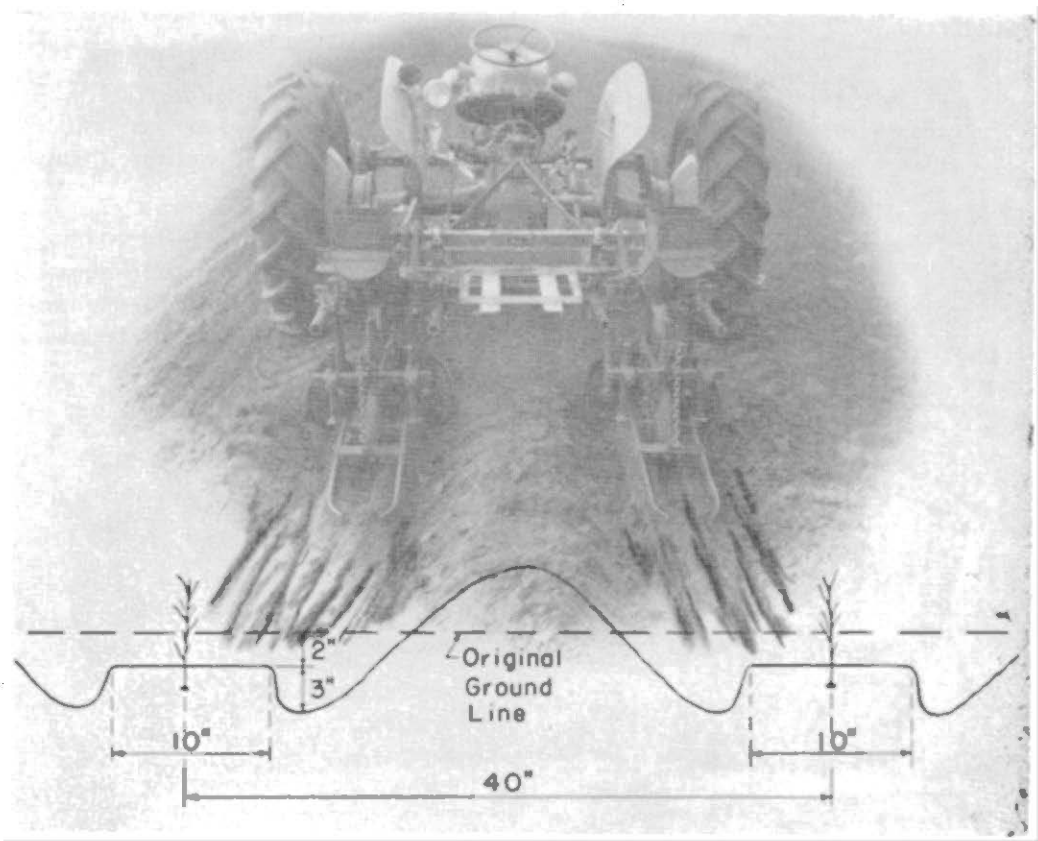
Development and Test Performance of
A New Seedbed for Cotton
Progress Report for 1954



By J. Porterfield and E. M. Smith
Department of Agricultural Engineering

Agricultural Experiment Station
DIVISION OF AGRICULTURE
Oklahoma A & M College, Oklahoma

At a Glance . . .

A cotton seedbed which will give a satisfactory stand at the first planting is important in cotton production. With mechanized production gaining in importance each year, it is even more important to have good stands of uniformly distributed plants.

This bulletin reports results of an attempt to determine the desirable characteristics of a good seedbed and then to combine those qualities into a single seedbed.

As a result of these efforts a new seedbed was developed which combines furrow and bed planting. This new seedbed increased plant stands substantially in two comparisons with four other seedbeds. When compared with shallow furrow planting for six planting dates, the new seedbed increased stands in each case.

THE RESEARCH on which this report is based is in cooperation with the state agricultural experiment stations in other cotton-growing states with the Agricultural Engineering Research Branch of the U. S. Department of Agriculture as part of a regional research project on cotton mechanization (S-2), and with the Oklahoma Cotton Research Foundation.

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Development and Test Performance of

A NEW SEEDBED FOR COTTON

Progress Report for 1954

By Jay Porterfield and E. M. Smith

Department of Agricultural Engineering

ESTABLISHING a satisfactory stand is an important part of mechanized cotton production. When uniformly distributed, 20,000 to 50,000 plants per acre are satisfactory for high yield and best harvester performance. Replanting to obtain an adequate stand is expensive and time consuming. It should be avoided if possible.

Many factors influence satisfactory stand establishment. This bulletin contains information on the seedbed requirements for establishing a satisfactory stand, and reports the test performance of a new seedbed.

Preliminary Trials

IN 1952, a series of tests were begun to evaluate stand establishment on different seedbeds. These tests were of a randomized block design, using four types of seedbeds and four replications. Figure 1 shows the profile of these typical seedbeds. Soil moisture at the time of planting was adequate. Following the planting there was no rain of consequence for more than 30 days. The results of emergence from this test are shown in Table I. It appears that, when soil moisture is adequate and when no rains of either long duration or high intensity occur shortly after planting, the emergence from one type of seedbed is not significantly different from emergence from any other type of seedbed.

When this test was repeated in 1953, two different conditions influenced the results. First, the planting date was advanced. Second, a hard, dashing, three-inch rain fell immediately following planting. This was followed by several days of cool weather. The emergence of cotton from the four different types of seedbeds is shown in Table I. These data show that a very significant difference in emergence existed among the four seedbeds. The only seedbed to produce a stand satisfactory for yield and stripper harvesting was the bed type seedbed. The results in 1953 showed, very strikingly, some of the hazards involved in planting cotton early on a flat seedbed or in furrows.

WHAT MAKES A GOOD SEEDBED?

A CRITICAL examination of the previous work done at the Oklahoma Agricultural Experiment Station and at other stations led to a theoretical examination of the type of seedbed which might insure a satisfactory stand of cotton. From observation, and from conversations with cotton farmers, it was found there were advantages attributed to each particular type of seedbed. In the theoretical analysis, an attempt was made to evaluate the potentially desirable characteristics of each type of seedbed and to investigate the possibility of incorporating the advantages of more than one type into a new seedbed. In reviewing the requirements of a satisfactory seedbed, the desirable characteristics appeared to be:

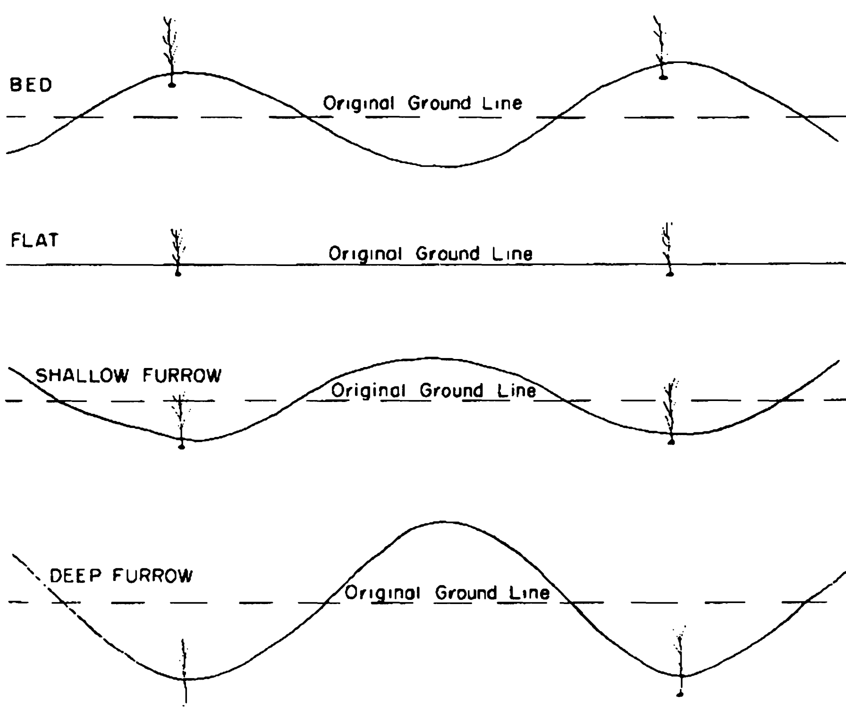

Figure 1.—Profile of some conventional seedbeds. From top to bottom. they are bed, flat, shallow furrow, and deep furrow seedbeds. In practical use the departure of each type from the original ground line will vary with soil and climatic conditions.

Firmness.—A desirable seedbed for cotton should be firm. Many investigators have tried to measure quantitatively the optimum degree of firmness of a seedbed, but the results are inconclusive. However, in broad terms, a cotton seedbed should be firm enough to support plant growth and to minimize moisture losses, yet loose enough to promote plant growth, root penetration, infiltration rate and water holding capacity of the soil. The relative firmness at various locations within the seedbed profile is perhaps more important than the overall firmness of the seedbed.

Carnes* found that at low soil moistures a definite firming action under the seed produced surprisingly good emergence of cotton plants. As the pressure applied to the soil under the seed increased, the percent emergence also increased. He found that the pressure or firming action under the seed becomes relatively less important as the moisture content of the soil increases. This may be a relatively new concept of the importance of firmness in a specific region of the seedbed. Firming devices are generally run on the surface of the ground and firm the surface directly over the seed. No attempt, until recently, has been made to move the firmest part of the seedbed from ground level down to the seed level.

*Carnes, A., "Soil Crusts," *Agricultural Engineering Journal*, Vol. 15, No. 5, May 1934.

Adequate Moisture.—Adequate moisture in the germination zone is desirable. The seeding time may be delayed until sufficient rainfall has accumulated in the germination zone, or the surface layer of soil may be removed to a level of adequate moisture.

Protection from Winds.—Other factors being equal, a good seedbed for cotton should protect emerging plants from destructive winds and blowing soil. This may be accomplished by some type of

Table I.—The Emergence of Cotton Plants from Four Types of Seedbeds.

Type of Seedbed	1952* Plants/Acre	1953** Plants/Acre	1953** Percent Emergence
Bed	17,700	20,620	49.8
Flat	19,000	11,120	26.9
Shallow Furrow	21,800	4,880	12.0
Deep Furrow	19,300	890	2.4

* Planted June 19
** Planted May 6

mechanical barrier in the form of a ridge. Of the existing seedbeds studied, it was observed that best protection for the plants was afforded by planting in a furrow. No evaluation has been made of the relative importance of this particular characteristic of cotton seedbeds. If tradition and custom are good criteria, this is perhaps an important characteristic of a good cotton seedbed.

Warm Soil.—A number of investigators have evaluated the possible advantage of having the soil at a certain minimum temperature before cottonseed is planted. In general, cold seedbeds have produced poor stands. In order to minimize the effect of cold temperatures on cotton seedling emergence, the seedbed should warm up early in the season. Measurements taken at the Chickasha Station showed a slight temperature difference among different types of seedbeds. The coldest seedbed was the deep furrow, and the warmest seedbed was the bed type. No attempt was made to evaluate the importance of this small difference.

Protection from Heavy Rains.—Other hazards to stand establishment are dashing rains and washing soil. Transported soil tends to form a crust which reduces the emergence of cotton. Crusts may also be formed by hard rain. In a study mentioned earlier, Carnes found that the modulus of rupture of soil crusts was greater in cotton middles than on ridges. Water running over the seedbed or standing on the seedbed may be detrimental to stand establishment. Observations indicate that cottonseeds are very sensitive to continuous or extended immersion in water. Water standing on planted cottonseed may tend to promote cotton diseases and reduce emergence. The most desirable type of seedbed is the one which would least likely allow water to stand or run or to deposit soil over the cotton row. The bed type of seedbed should provide the greatest protection against these stand establishment hazards.

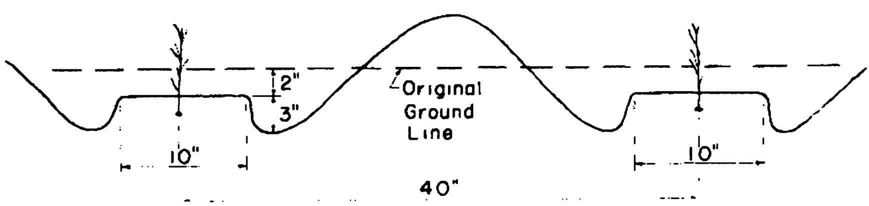

Figure 2.—Cross section of the new seedbed. The dimensions given are approximately those of the test seedbed. Further test work may indicate different dimensions for best performance.

Easy Cultivation. — Other characteristics of cotton seedbeds become important after the cotton emerges and a satisfactory stand is established. The most important is the weed and grass populations that occur on different types of seedbeds, and the ease with which these undesirable plants may be controlled. The mechanical control of weeds is easiest on furrow plantings. The type of seedbed which permits the least volume of soil to be moved during cultivation is the bed type of planting. Although it is possible to have a smaller weed population on bed plantings than on furrow plantings, control is easier on furrow planting than on the bed. Generally speaking, after the first, or possibly the second mechanical cultivation, there exists little or no difference in weed control on the various types of seedbeds.

Different seedbeds for cotton may permit different root development. It is undesirable to have shallow roots on cotton plants, as such plants are easily pulled up by mechanical harvesters. Cotton planted further below the original ground line may develop a stronger root system. Cotton planted on a bed type of seedbed tends to have the shallowest root development.

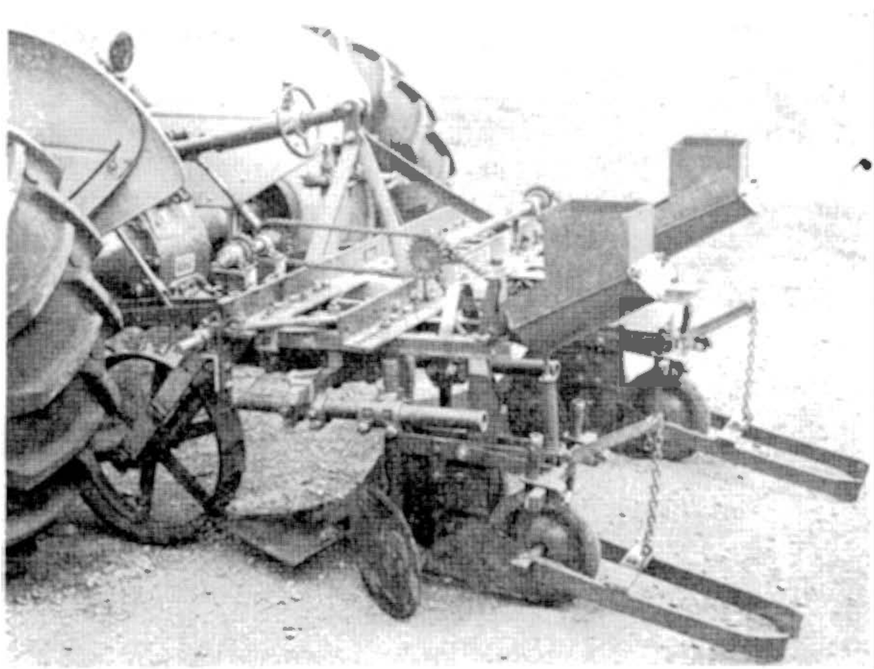

Figure 3.—Side view of planter used to make the new seedbed. Notice the positioning of disks relative to the lister bottom.

Developing of a New Seedbed

AFTER AN examination of the desirable characteristics of cotton seedbeds, it was felt that the desirable characteristics of two or more existing seedbeds could be combined into a single seedbed. A cross section of this new seedbed is shown in Figure 2. The planter used to make this seedbed is shown in Figures 3 and 4.

In order to make this new seedbed, the soil is prepared for planting in the customary manner and left flat. The first function performed by the planter is that of removing the top two inches of soil from over the row. This is done by the modified lister bottom. Figures 5 and 6 show the position of component parts of the planter. A disk runs along each side of the

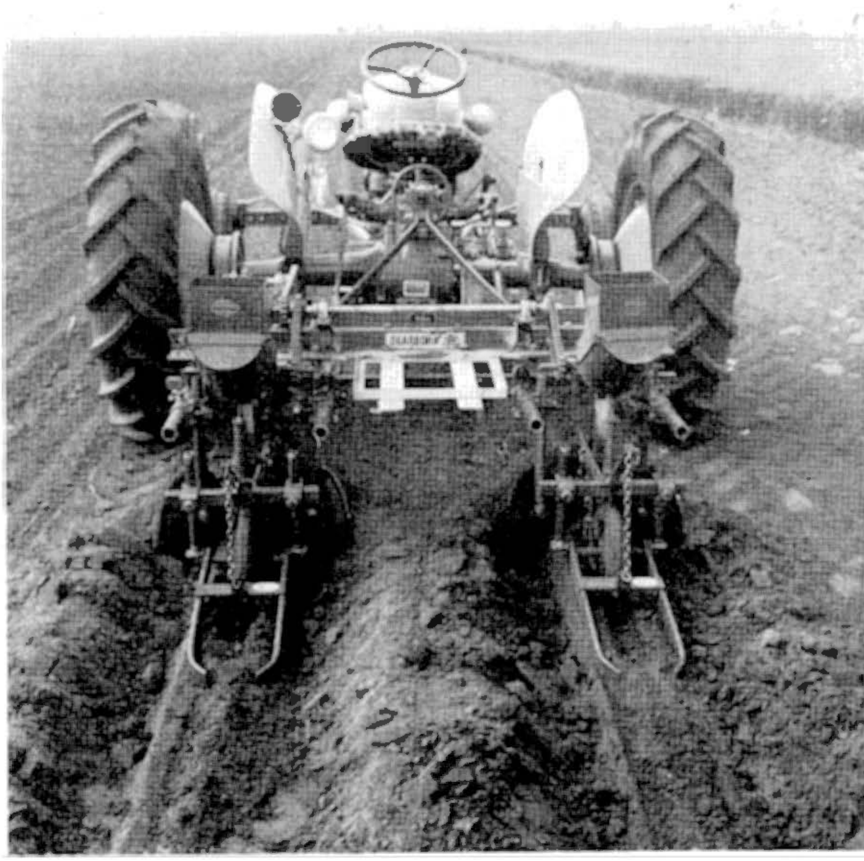

Figure 4.—Rear view of planter used to form new seedbed profile. Note the ditch produced by the disks on the side of the seedbed. The small rubber presswheel is shown just ahead of the open center covering drag.

seedbed directly behind the modified lister bottom. These disks below the original ground line and three inches below the bottom of the new seedbed. This leaves an elevated section about ten inches wide with a ditch about three inches deep on each side.

Between the two disks is a small furrow opener and directly behind it a seed tube. Behind the seed tube is a small rubber-tired presswheel that is spring loaded to give maximum firming of the seed in the furrow bottom. Behind the seed presswheel is an open end type of drag that brings loose soil in from the shoulders of the seedbed, covering the seed and rounding out the surface over the seed row. Water is not likely to stand on the seedbed because of the small ditch on each side. Sufficient soil is moved from the ditch on each side of the row in toward the middle to provide considerable protection from wind and blowing soil. Heavy crust formation directly over the row is reduced because water will not transport soil onto the row, nor will water stand on the row. The seed is four inches below the original ground line, two inches deep in the new seedbed, and generally in moist soil.

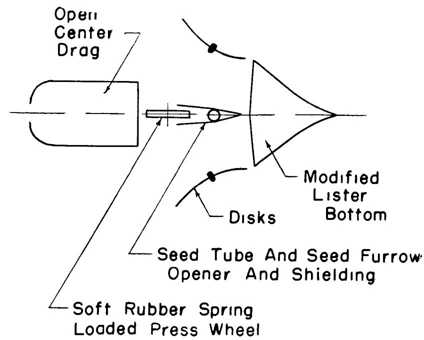

Figure 5—Top view of machine components required to make new seedbed.

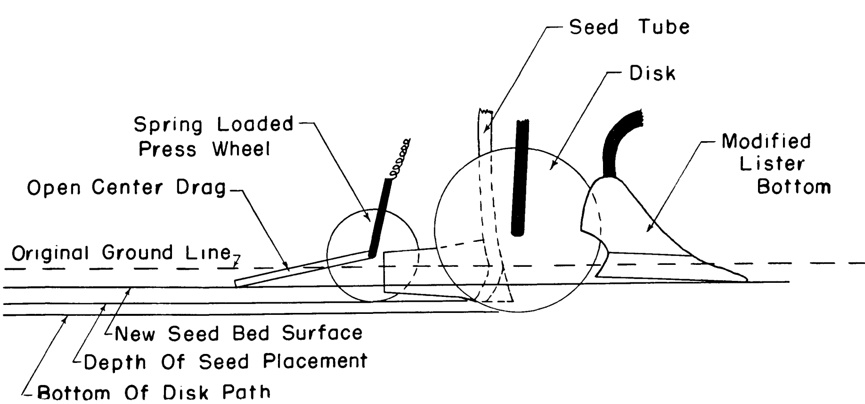

Figure 6.—Side view of machine components required to make new seedbed. Notice the vertical positioning of all components.

FIELD TESTS WITH NEW SEEDBEDS

Plant Emergence

FIELD TESTS were initiated at Chickasha in 1954 to evaluate this new seedbed profile. Table II shows a comparison of the plant population and percent emergence from a shallow furrow type of seedbed and from the new seedbed. Plantings were made on six different dates. The first planting was made in the early part of the planting season and the last planting was made after the regular planting season. The first planting date was followed by a period of freezing temperatures, which is not particularly conducive to good cotton emergence. No evidence of any plant emergence was found in the shallow furrow. On the new seedbed a small number of plants emerged, although a specific plant count was perhaps inaccurate because of the partial emergence and subsequent freezing of a good many of the plants.

After the second date of planting on May 7, there was a hard dashing rain on the two seedbeds. The cotton planted in the shallow furrow did not emerge satisfactorily while that planted on the new seedbed gave a plant population sufficiently large for satisfactory yield and machine harvesting. Figure 7 shows these two seedbeds after the rain of May 7.

The last four planting dates, both shallow furrow and new seedbed, provided a plant population sufficiently large for satisfactory yield and possibly large enough for machine harvesting. On all four dates, however, the new seedbed gave a higher percent emergence and a higher plant population than did the shallow furrow. The last planting was in very dry soil. Even under dry conditions the new seedbed gave better emergence than did shallow furrow planting. There was no indication that the new seedbed dried faster or more than did the shallow furrow.

Table II.—Emergence and Final Stand from New Seedbed and Shallow Furrow Plantings in 1954.

Planting Date	Shallow Furrow		New Seedbed	
	Plants/Acre	Percent Emergence	Plants/Acre	Percent Emergence
April 26*	0	0	3,900	8.30
May 7	1,300	2.77	27,100	57.41
May 21	25,800	54.65	32,000	67.79
June 8	13,100	27.67	17,600	37.35
June 19	25,500	53.96	26,900	57.05
June 28	20,900	44.27	22,500	47.73

* Cotton froze during emergence period.

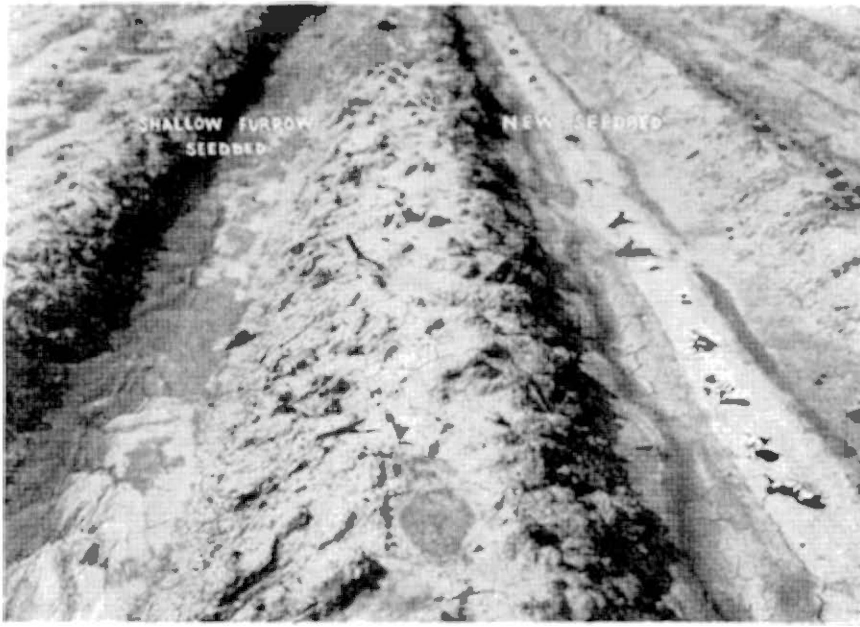

Figure 7.—A shallow furrow seedbed (left) and the new seedbed (right) several days after an intense rain. Water did not stand on the new seedbed as indicated by the light strip between the two side ditches. Plants are emerging from the new seedbed.

The second test of seedbed emergence is shown in Table III. This test included the five seedbeds and two planting dates. The des'gn of the experiment was a randomized block with four replications at each date. At both dates, the new seedbed had an emergence considerably above any other type of seedbed. The five seedbeds can be broken down into three general categories. The bed and flat seedbeds performed essentially the same and the furrow seedbeds performed essentially the same. The new seedbed performed better than either of the other two gronps.

Cultivation Practices

IN ADDITION to the measured plant emergence from the various seedbeds, observations were made on other aspects of seedbed performance. No new equipment is required nor alteration of present equipment needed for cultivating the new seedbed. Cultvation studies showed that considerable soil was available for movement toward the row at various cultivations. Althongh the weed problem in 1954 was not serious on this particular test, there was still opportunity to make ob-

Table III.—The Emergence of Cotton Plants from Five Seedbeds in 1954.

Type of Seedbed	Plants Per Acre	
	Planted May 22	Planted June 8
Bed	24,600	21,400
Flat	22,100	22,400
Shallow Furrow	20,300	16,900
Deep Furrow	17,100	18,000
New	27,900	30,500

servations on the effectiveness of the equipment in moving soil and in protecting the plant from damage during cultivation.

In order to evaluate the possibility of using a pre-emergence chemical on the new seedbed, part of the central elevated sections of the seedbeds was left undisturbed during the first two cultivations. This could be done with regular cultivating equipment. It was possible to move considerable soil toward the row later in the season.

SUMMARY

OBSERVATION and many years of farmer experience have shown that the chances of getting a cotton stand satisfactory for yield and machine harvesting in one planting are not good. There are many reasons for the desirability of getting a stand with one planting. Among them are the timeliness of the operation, the cost of the operation, the cost of seed, fertilizer, and the loss of any pre-emergence chemical that may be applied.

The stand establishment for best yield and best machine harvesting performance is one that is well distributed along the row with the minimum number of skips.

A theoretical analysis was made of the advantages both claimed and measured for the various seedbeds now being used throughout Oklahoma. Many of the advantages of presently used seeedbeds and few of the disadvantages were incorporated into a new seedbed. A machine was modified to prepare this seedbed, and studies were made to compare the field performance of this seedbed with various types now being used. The results of the tests in 1954 showed encouraging performance for the new type of seedbed. No disadvantages as far as crusting, emergence, or weed control were observed for the new seedbed. This work will be continued and expanded in 1955 to further evaluate the new seedbed.

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