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TEXAS AGRICULTURAL EXPERIMENT STATION

A. B. CONNER, DIRECTOR
COLLEGE STATION, BRAZOS COUNTY, TEXAS

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DIVISION OF AGRONOMY

SUDAN GRASS FOR HAY, SEED, AND PASTURE

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
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**In cooperation with U. S. Department of Agriculture.
***In cooperation with the School of Agriculture.

Sudan grass is an annual grass sorghum introduced into this country in 1909 by the United States Department of Agriculture. It was grown at Chillicothe that year and thereafter the seed were widely distributed to farmers over the State by the Texas Station. This Bulletin reports the results, since the introduction of the crop, of experiments with Sudan grass at substations in various regions of the State. Sudan grass is adapted as a hay and pasture crop to practically all farming sections in Texas. The South Plains is the principal seed-producing area for the United States.

Sudan grass is the most important cultivated pasture crop in Texas. When grown in rows, it furnishes more continuous pasture than broadcast plantings, especially if the season be unfavorable. Growing in rows for pasture also allows cultivation to control weeds. Heavier rates of seeding than are necessary for hay production are desirable when planting for pasture, since thicker planting will allow earlier grazing and tends to reduce trouble from weeds. In Texas, small grain for winter pasture and Sudan grass for summer pasture furnish a combination that provides grazing throughout practically the entire year. Sudan grass pasture should not be grazed until the plants are 15 to 18 inches tall. It can be grazed heavily without damage but it is advisable to have two or more pastures that are grazed in succession, thus allowing each pasture a period of rest for making new growth. When the plants become coarse and woody, or when weeds become large, the pasture should be mowed.

The crop should be planted for hay early enough to allow the production of three or more cuttings in southern parts of the state and two in the northern parts. The optimum planting dates for the state range from March 1 to May 1. Date-of-planting experiments at Lubbock show that the yields decline when planting is delayed past the latter part of April, and at Chillicothe the best yields were made by planting on or before the first of May. Sudan grass may be planted for hay, broadcast, in 18-inch rows, or in 36-inch rows without any appreciable influence on yield. At Lubbock, narrow rows produced about 8 per cent more hay than wide rows, while at Chillicothe, wide rows yielded 13 per cent more than narrow rows. Yields at both stations favored planting in rows rather than broadcast for hay. Sudan grass tillers freely and is able to adjust itself to various rates of seeding. When it is grown for hay, 15 to 20 pounds of seed is a sufficient amount for broadcast plantings, and five pounds is adequate for row plantings.

Sudan grass cut for hay before heading, at time of first head, in full bloom, and when the seed were in the milk, proved to be palatable and nutritious at all these stages but the heaviest yields resulted from harvesting at the time of first heads and in full bloom. Cutting at the earliest stage reduced the yield of each individual cutting, and delaying the harvest until the seed was in the milk resulted in a reduction of the number of cuttings obtained without a compensating increase in yield per cutting.

Growing Sudan grass for seed has, since the introduction of the crop, been an important factor in the development of new farm lands in the western part of the state and the bulk of the seed grown in the United States is now produced in this region. Planting in cultivated rows has proven the best method for seed production. When grown as a seed crop, over a ton of straw to the acre was produced as a by-product, and in addition, a crop for pasture or hay was frequently obtained. Uniform maturity of the seed crop is essential when it matures late in the fall. Ten to fifteen pounds of seed to the acre, when planted broadcast, and 5 to 10 pounds to the acre, when planted in rows, for seed production were the best rates.

A comparison of the yields of forage produced by Sudan grass, cowpeas, and Sumac sorgo, at Lubbock and Chillicothe, indicates that, over a period of years, cowpeas will produce from one-fourth to one-third as much forage per acre as Sudan grass. During the period from 1913 to 1925 Sudan grass produced approximately 65 per cent as much forage as Sumac sorgo at these two stations.

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SUDAN GRASS FOR HAY, SEED AND PASTURE

R. E. KARPER, J. R. QUINBY, AND D. L. JONES

The first Sudan grass grown in the United States was planted in a small rod row plat at the Chillicothe Station in 1909 and practically all the Sudan in the United States at the present time came from this small beginning. This introduction was made from the Sudan region of Africa by the Office of Foreign Seed and Plant Introduction at the instigation of Dr. C. V. Piper, Office of Forage Crops, U. S. Department of Agriculture. At that time and throughout the period of the results reported in this Bulletin the work at the Chillicothe Station has been conducted cooperatively by the Texas Agricultural Experiment Station and the Office of Forage Crops. Sudan grass stands as an example of the effectiveness of cooperative effort by State and Federal agencies in the introduction, increase, and distribution of seed of a valuable agricultural crop.

The Texas Station realized immediately the possible value of Sudan to the agriculture of the State and began the rapid increase and distribution of high-quality seed through several of its Substations. The work was particularly effective at the Lubbock Station, where a number of cooperating farmers were furnished seed to be grown under the supervision and inspection of the Station. This initial effort laid the foundation for the building of a valuable seed-growing business for the farmers in the South Plains of Texas. For this region, then a new farming area beginning a transition from ranching to farming, was found a new and profitable cash crop. The crop proved especially well adapted to this section for the production of abundant seed of good quality. As this new agricultural land opened up, Sudan grass was grown for seed as a cash crop on sod land, and it has played an important part in the agricultural development of this region ever since. Sudan grass seed production has moved westward in the Plains Region as new lands were opened up and has continued in the vanguard of a more intensive agriculture. The bulk of the Sudan grass seed grown in the United States is produced in this region, and the crop is grown for pasture or hay in practically every county in Texas. Its introduction was a distinct contribution to the agriculture of the state.

DESCRIPTION OF SUDAN GRASS

Sudan grass (*Andropogon sudanensis*) is a Grass Sorghum, closely related botanically to other sorghums. Johnson grass is another Grass Sorghum, but unlike Johnson grass, which is a perennial with root

stocks, Sudan grass is an annual having no root stocks, is easily eradicated, and can never become a pest.

It is an erect-growing plant which reaches a height of 5 to 6 feet under ordinary conditions. Like other sorghums, Sudan has an extensive root system which allows it to draw heavily on soil moisture and

Fig. 1.—The original planting of Sudan grass in the United States at Chillicothe Station in 1909.

plant food and which contributes to its high capacity for the production of forage and pasture. The stems rarely grow larger than 3/16 of an inch in diameter even when planted in cultivated rows; are pithy, not hollow; and have from 10 to 14 leaves. The seed head ranges from 10 to 16 inches in length and frequently attains a breadth of 10 to 12 inches when the panicle is spreading. The seed head when unripe is green in color but turns straw yellow at maturity. The glumes may vary in color from cream to reddish black, may be either smooth or hairy, and are awned. The awns break off in threshing and commercial seed rarely have awns. The seed coat is golden brown in color. The seed are one-half to two-thirds the size of Amber sorgo seed and similar in shape.

ADAPTATION OF THE CROP

Sudan grass is adapted to a large area including the entire southern half of the United States and much of the Great Plains region as far north as the Dakotas. It is unimportant in Southeastern United States on account of its susceptibility to Red Spot or Blight (*Bacillus Sorgi*), a bacterial disease which causes elongated red blotches on the leaf and stem. It is well suited to the entire State of Texas wherever other agricultural crops will grow. Like other sorghums it prefers a warm summer climate of relatively low humidity, is sensitive to frost, and the growing season is limited to the warmer months of the year.

Sudan grass is not exacting as to its soil requirements as it grows well on all soil types from sand to heavy clay provided they are reasonably fertile and well drained.

The characteristic of Sudan grass which contributes most to its value as a forage and pasture crop is its ability to produce good yields under unfavorable distribution of summer rainfall. A crop of hay is produced in 60 days and a comparatively short period of favorable-growth conditions will produce a hay crop. After the grass is well established it can be pastured heavily during periods of drought without appreciable damage, and will resume rapid growth immediately the conditions become favorable. Under favorable conditions three or even four cuttings are not unusual in many parts of the State. In addition to being a good pasture and hay grass under dry-land conditions Sudan grass is a successful crop under irrigation.

Sudan grass hay yields at eleven substations in various regions of the State show the wide adaptability of the crop in Texas. Hay-yield records at some points cover only a short period but where continuous yields over a period of years have been secured it will be seen that two to three tons of hay to the acre are produced (Table 1).

The seed-producing area of the crop in Texas is limited by the ravages of the sorghum midge, a small insect the larvae of which suck the juices from the ovary about the time of blooming. The ovary fails to develop and a sterile flower results. The damage in some instances is practically 100 per cent. The ravages of this insect are confined largely to the

region east of the line of 30-inch rainfall. In general, Sudan grass will produce seed consistently wherever sorghums produce dependable grain yields. The South Plains of Northwest Texas is particualrly adapted to seed production and is the chief source of Sudan grass seed for the United States.

Fig. 2.—A typical individual plant of Sudan grass.

EXPERIMENTAL METHODS

The yields to be found in the tables of this Bulletin are computed to the acre basis from experimental plats. The plats in most instances were either 1/10, 1/20, or 1/22 of an acre in size and were duplicated. The yields of hay and straw are field-cured weights in tons to the acre. At Chillicothe, results from 1915 to 1917, inclusive, were air-dry weights, the shrinkage from field-cured to air-dry approximating 25 per cent. Seed weights are given in pounds to the acre of threshed seed.

Broadcast plantings were made with a grain drill which sows the drills about 8 inches apart. Row plantings were usually made with a single- or two-row planter in use on the Stations and equipped with sorghum plates. The 18-inch row plantings were made by driving back and planting the middles after the 36-inch rows had been planted. At Chillicothe all plantings were made with a grain drill, the wide rows being made by stopping all but the desired holes of the drill.

The widths of rows at Chillicothe were not the same as that of the other stations. Both 16- and 24-inch rows were used in place of 18-inch rows, and 40-inch rows were used instead of 36-inch rows. It is considered that these differences in width of row would not materially affect the reliability of the results when grouped into a summary table for comparison with yields at other stations.

The length of season is the number of days from date of emergence until the crop was harvested.

Row plantings were cultivated to destroy weed growth early in the season before the plants were large enough to shade the ground fully and occasionally one cultivation was given after the first cutting was made.

Hay crops were harvested with the mower and cured in the swath and cock. Seed crops were harvested with the row binder or broadcast binder and threshed in small experimental threshers.

SEEDBED PREPARATION, PLANTING AND CULTIVATION

Sudan grass should be planted in a seedbed as well prepared as for other crops. When planted in rows the seedbed should be prepared in any particular section of the State in the same manner as for cotton or grain sorghums; when planted broadcast the seedbed should be similar to that for small grain. Sudan grass plants when young are small and delicate and grow off slowly. It is essential where planted in rows that the seedbed be loose and free from clods so that the stand will not be injured at the time of first cultivation, which must be done early when weed seeds germinate and come up in the row with the Sudan grass.

Row plantings may best be made by using an ordinary planter equipped with sorghum plates. In the event that no sorghum plates are to be had a corn plate will suffice if a small chain or other impediment is hung in the grain spout to check part of the seed as they fall from the hopper to

Table 1.—The yield of Sudan grass hay in 36-inch rows at various Texas stations.

Station	Yield per acre (tons)														
	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	Average for years grown
Angleton	3.14	1.13	1.79	2.63	4.42	4.43	2.51	5.07	2.05	2.02	2.29	2.93	3.07	1.84	2.81
Chillicothe	1.37	5.28	3.62	1.53	.84	.62	2.07	2.49	1.41	1.93	.80	3.42	3.02	.....	2.18
Lubbock	.....	.....	.....	3.67	.32	.37	4.00	5.42	4.00	2.96	3.38	1.82	3.76	2.36	2.91
Temple	.....	.....	3.33	1.05	.....	.....	1.47	1.09	1.59	3.79	.....	.....	.....	.....	2.05
Pecos	.....	.....	2.26	.98	.87	.....	1.47	1.18	1.97	.....	.....	.....	.....	.....	1.46
Nacogdoches	.28	1.61	.41	1.02	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.83
Beaumont	.....	2.29	2.50	.....	1.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.98
College Station	.....	.....	.....	.....	.....	.....	3.44	3.63	.....	.....	.....	.....	.....	.....	3.54
Denton	1.28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.28
Beeville	5.63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.63
Spur	.....	4.21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.21

Table 4.—Effect of date of planting Sudan grass broadcast on yield of hay at Chillicothe, 1913-1919.

Dates	Yield per acre (tons)														
	1913		1914		1915		1916		1917		1918		1919		Average
	No. cuttings	Yield	No. cuttings	Yield	No. cuttings	Yield	No. cuttings	Yield	No. cuttings	Yield	No. cuttings	Yield	No. cuttings	Yield	
April 4	3	1.19	3	5.75	3	2.02	4	.89	2	.66	.....	.....	.....	.....	2.10
April 16	2	.97	3	5.09	3	2.37	3	1.17	2	.61	2	1.04	3	1.91	1.88
May 2	2	1.62	3	4.72	3	2.37	3	1.11	2	1.13	2	.92	3	2.37	2.03
May 17	2	1.50	.....	.....	2	2.79	3	1.05	2	1.32	2	.75	2	1.96	1.56
June 1	1	.44	.....	.....	2	2.48	2	1.36	2	1.09	1	.18	2	2.31	1.31
June 15	1	.62	2	3.37	2	3.76	2	1.67	2	.53	1	.79	2	1.63	1.77
July 2	1	1.11	2	3.45	2	4.06	1	1.02	1	.47	1	.42	2	.95	1.64
July 15	.....	.....	2	3.18	.....	.....	.....	.....	.....	.....	.....	.....	1	.51	1.85

produce a fairly even distribution of seeds along the furrow. The lowest rates of seeding can not be made by this method but it is effective when as much as five pounds of seed to the acre is planted. Broadcast plantings may be made with an ordinary drill, or, on small areas, can be done by hand and harrowed in.

Clean cultivation similar to that given row crops will suffice for Sudan grass when planted in rows and should be prolonged in the case of production for hay until the plants shade the ground. Following each cutting the crop may be cultivated once to control weeds but after the crop has a good start additional cultivations are unnecessary. Under pasture conditions, when the seed are planted in rows it is necessary to cultivate from time to time to control weeds, and more cultivations are desirable than when grown for hay.

DATE OF PLANTING

While Sudan grass permits of a rather wide range in planting dates it should be planted early enough to allow time to mature two cuttings in the northern part of the state and three in the southern part if it is to be used to the best advantage. It is, however, a warm weather crop and grows slowly as long as the weather is cool, so that no advantage is to be gained by planting too early before the ground warms up thoroughly. Sudan grass seedlings during the first two to four weeks develop slowly at best and growth is retarded, particularly, if planted too early before warm weather opens up. There is, of course, considerable variation from season to season in the optimum date for seeding but delaying until the soil is warmed up results in better stands, more uniform growth, less

Table 2.—The effect of date of planting Sudan grass on yield of hay at various Texas stations

Station	No. of years tested	Yield per acre (tons)							
		April		May		June		July	
		1–15	16–30	1–15	16–31	1–15	16–30	1–15	16–31
Lubbock	7	.....	3.50	.....	2.72	1.91	.....	.....	1.07
Chillicothe	7	2.10	1.88	2.03	1.56	1.31	1.77	1.64	1.85
Pecos	5	.....	1.35	.....	1.83	.....	1.75	.....	1.68
Denton	1	.....	1.61	2.29	1.50	.....	.50	.....	.....
Average	.....	2.10	2.09	2.16	1.90	1.61	1.34	1.64	1.53

Table 3.—Effect of date of planting on yield of Sudan grass hay at Lubbock.

Average planting date	Yield per acre (tons)							
	1913	1914	1915	1916	1917	1918	1919	Average
April 21	.....	4.37	.....	2.78	.....	.....	3.35	3.50
May 16	1.77	4.30	3.85	2.65	.53	.....	3.19	2.72
June 13	1.24	4.12	3.24	1.33	.72	.62	2.09	1.91
July 18	.98	2.05	.....	.....	.22	.....	1.04	1.07

trouble from weeds, and usually as early a first cutting as when the crop is planted too early.

Date of planting experiments have been conducted at four Substations (Table 2) involving plantings from April to July, inclusive. These results show that April 15 to May 15 is the optimum time of seeding, that nothing is gained by planting earlier, and that June and July plantings produce materially lower yields. This lowering in yield is due to the fact that one cutting less is obtained. At Lubbock the yields fall off rapidly from the earliest to the latest planting. May plantings yielded 30 per cent more than June plantings and June plantings 45 per cent more than the July plantings (Table 3). In the southern part of the State the optimum time of planting will be a month to six weeks earlier.

At Chillicothe the highest yields were made by planting at or before the first of May. Seedings made the last 15 days in April averaged about one-third of a ton of hay to the acre more than the plantings made the last half of June. When the crop was planted between April 15 and May 15, three cuttings were usually obtained; when planted between May 15 and June 15, only two cuttings were secured; and after June 15 only one cutting (Table 4).

METHOD OF PLANTING

For Hay and Pasture: Method of seeding experiments have been conducted at six substations, three of which are located in the western part of the state, one in the Blacklands in central Texas, one in south Texas, and one in the Gulf Coast region. The crop was planted with a grain drill in narrow drills (8 inches apart), and referred to as broadcast, in 18-inch rows, and in 36-inch rows. A summary of the results shows an increase in yield for the 18-inch rows over both broadcast and 36-inch rows. Yields from 36-inch rows were slightly larger than from broadcast plantings (Table 5).

Similar experiments on the methods of seeding Sudan grass for hay production were conducted continuously over an eight-year period at both Lubbock and Chillicothe. The plan was the same except that 24-inch rows were used at Chillicothe instead of 18-inch rows. At both Stations row plantings were cultivated early in the season but not after the first cutting.

While the results from neither Station are entirely consistent from year to year, the yields, on the average, favor planting in rows rather than broadcast. The greatest differences in favor of row plantings over broadcast are evident in dry years such as 1917, 1918, and 1921. Narrow rows yielded about eight per cent more than wide rows at Lubbock but the reverse was true at Chillicothe, where wide rows averaged about 13 per cent more hay than narrow rows (Tables 6 and 7).

Differences in yield between these three methods of planting have been comparatively small at both Stations but the row plantings were found

to remain green longer and to recover from drought more rapidly. Aside from slightly better yields on the average, the cultivated rows have considerable advantage in dry seasons when pasture and forage are badly needed. Therefore, planting in 36-inch rows is recommended for the western part of the state. When seed is cheap and plentiful and where there is difficulty in curing the coarser hay produced from the wide-row plantings, such as is often the case in the more humid sections of the state, broadcast plantings may be used to advantage. There seems to be no reason, however, for planting in narrow rows for hay since they are more difficult to plant and cultivate and the wide rows yield almost as well.

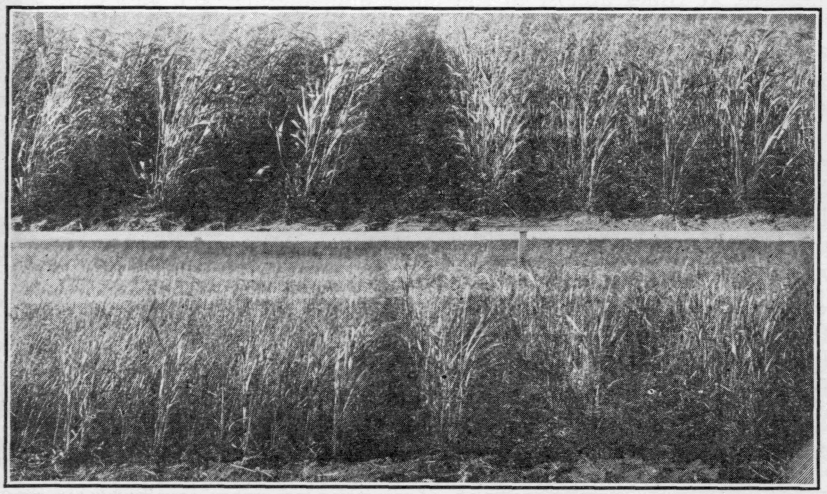

Fig. 3.—Method of growing Sudan grass for hay in wide rows (top left), narrow rows (top right), and broadcast (lower left), at Chillicothe.

The dates of planting this test varied from the last of April to the latter part of June. Seeding was usually done as soon as the ground warmed up sufficiently and the soil-moisture conditions were favorable. Variations in the dates of planting indicate that no definite date is feasible but that it will be governed entirely by prevailing conditions in a particular season. The average date of planting at Lubbock was May 19 while at Chillicothe it was May 16. Sudan grass germinates quickly, and under favorable conditions of temperature and moisture, will come up in five or six days. On the average for these eight years, it required ten days to emerge at Lubbock and seven days at Chillicothe.

The number of days required from the date of emergence to the date of first cutting was 72 at Lubbock and 61 at Chillicothe, while the days from first cutting to second cutting were 61 and 71, respectively. Forty-nine days intervened between the second and third cuttings at Chilli-

cothe, where a third cutting was made three out of the eight years. At least two cuttings were obtained at both Stations every year except one, which was unusually dry. The first cutting was usually the heaviest and the last the lightest. During the eight years, 61 per cent of the total hay crop was harvested from the first cutting, 28 per cent from the second cutting, and 11 per cent from the third cutting at Chillicothe.

When planted in 3-foot rows, at Lubbock, 57 per cent of the total hay, on the average, was obtained from the first cutting and 43 per cent from the second cutting, while broadcast plantings, as will be seen later, produced 70 per cent and 30 per cent of the total hay at the first and second cuttings, respectively. The broadcast plantings draw heavily on soil moisture, at times almost to the point of depletion, and following the first cutting, favorable conditions must occur for the second crop to develop well. Row plantings seem to recover more rapidly after harvesting and the yields of the first and second crop are more nearly equal.

When grown for pasture the crop may be planted in wide rows, narrow rows, or broadcast. Each method has advantages under certain conditions, but in general, cultivated row plantings are recommended. Where the rainfall is abundant and soil fertility is adequate to produce vigorous growth throughout the season and little trouble is encountered from weeds, broadcast plantings will furnish more pasture. In Texas, favorable distribution of summer rainfall is uncertain and spring and summer weeds are usually abundant, making cultivation desirable and either 18-inch or 36-inch row plantings preferable. Sudan grass, planted in rows, will continue growth longer during dry weather and recover more rapidly after a drought than when planted broadcast.

Table 5.—The effect of method of planting Sudan grass upon yield of hay at various Texas Stations.

Station	No. of years tested	Yield per acre (tons)		
		Broadcast	18-in. rows	36-in. rows
Lubbock	8	2.10	2.33	2.16
Chillicothe	8	1.96	1.97	2.23
Angleton	8	3.11	3.69	3.17
Temple	4	2.10	2.47	1.89
Spur	1	4.55	4.93	4.21
Beeville	1	4.70	5.21	5.62
Average		3.09	3.43	3.21

Table 6.—Effect of method of planting Sudan grass on yield of forage, days to each cutting, and per cent of crop harvested at each, 1916-1923, at Lubbock.

Year	Date		Length of season, days			Yield of forage per acre (tons)			Per cent of crop harvested	
	Planted	Up	to 1st cutting	to 2nd cutting	From 1st to 2nd cutting	Broadcast	18-in. rows	36-in. rows	1st cutting	2nd
1916	6/14	6/21	61	.....	.....	3.56	3.43	3.05	33.32	66.68
1917	6/26	7/24	87	.....	.....	.76	.84	.72	100.00	0
1918	5/ 8	5/15	73	120	47	1.87	2.23	2.10	35.86	64.14
1919	5/ 3	5/10	70	124	54	2.13	2.75	2.28	55.14	44.86
1920	5/22	5/28	57	103	46	2.68	2.66	2.47	50.86	49.14
1921	5/ 3	5/10	76	140	64	2.92	3.57	3.55	56.92	43.08
1922	5/11	5/20	61	148	87	1.60	1.69	1.53	72.96	27.04
1923	4/30	5/10	88	154	66	1.30	1.50	1.55	52.53	47.47
Average	5/19	5/29	71.6	132	61	2.10	2.33	2.16	57.20	42.80

Table 7.—Effect of method of planting on yields of hay, days to each cutting, and per cent of crop harvested at each, 1913-20, at Chillicothe

Year	Date		Length of season, days				Average per cent of crop harvested at			Yield of hay per acre (tons)		
	Planted	Up	to 1st cutting	from 1st to 2nd cutting	from 2nd to 3rd cutting	to last cutting	Cuttings			Broadcast	24-in. drills	40-in. rows
							1st	2nd	3rd			
1913	4/29	5/ 6	58	144	.....	199	64.0	36.0	0	.77	*1.49	†1.37
1914	5/ 6	5/15	54	58	51	163	33.6	43.6	22.8	5.48	*4.75	‡5.28
1915	5/ 8	5/15	58	43	59	160	37.8	36.3	25.9	2.93	3.06	3.62
1916	4/29	5/ 5	54	40	36	130	41.8	21.6	36.6	1.26	1.25	1.53
1917	5/22	5/28	64	58	.....	122	69.4	30.6	0	.43	.69	.84
1918	5/24	5/30	122	.....	.....	122	100.0	0	0	.40	.37	.62
1919	6/10	6/16	49	97	.....	146	67.5	32.5	0	2.70	2.22	2.07
1920	5/29	6/ 7	31	58	.....	89	74.6	25.4	0	1.74	¶ 1.95	2.49
Av.	5/16	5/23	61	71	49	141	61.1	28.2	10.7	1.96	1.97	2.23

*18-inch rows. †44-inch rows. ‡36-inch rows. ¶16-inch rows.

For Seed: Production of Sudan grass seed on a commercial scale holds an important place on many Texas farms. Tests in methods of planting the crop for this purpose at six Substations indicate that higher yields of seed may be expected from planting in rows than from planting broadcast (Table 8). At Spur broadcast plantings yielded more seed per acre than row plantings but this was the results of only one year and in a season of high rainfall.

Table 8.—The effect of method of planting Sudan grass upon yield of seed at various Texas Stations.

Station	No. of years tested	Yield of seed per acre (pounds)		
		Broadcast	18-in. rows	36-in. rows
Chillicothe	8	128	180	258
Lubbock	5	379	405	405
Temple	3	205	288	226
Spur	1	990	847	974
Pecos	1	366	740	624
Nacogdoches	1	0	240	220
Average	.....	344.7	450	451.2

A test comparing broadcast, narrow rows, and ordinary rows was conducted at the Lubbock and Chillicothe stations for five years and eight years, respectively. The rows were 18 inches and 36 inches apart at Lubbock and 24 inches and 40 inches at Chillicothe. Practically no difference was found in seed yields from wide and narrow rows at Lubbock but 36-inch rows produced 25 pounds more seed to the acre than broadcast plantings (Table 9). At Chillicothe the advantage was decidedly in favor of the wider rows. The broadcast planting yielded 50 per cent and the narrow rows 70 per cent as much as the wide rows (Table 10).

It may be concluded, therefore, that Sudan grass for seed can be planted most profitably in cultivated rows of the ordinary width and that there is nothing to be gained by planting in narrow rows. Furthermore, the wider rows require less seed for planting, and are cultivated and harvested more easily and economically.

Records at both Stations covering the five- and eight-year period show the seed crop grown in rows also produces over a ton of straw to the acre. This straw is valuable forage and an important by-product of a seed crop. It should be saved and fed to livestock, as it is palatable and eaten readily.

In addition to a crop of seed, a hay crop usually can be produced anywhere in Texas or the second crop can be pastured. At Chillicothe a seven-year average of hay production in addition to a seed crop was one ton to the acre. Ordinarily the first crop is the best crop to allow to seed but it sometimes happens that the first crop is checked by drought and if allowed to stand the seed production would be low and the crop would mature unevenly. In such an instance it is well to mow

the first crop for hay and the second crop may grow off evenly and mature a seed crop under more favorable conditions.

The per cent of seed to total forage at Lubbock averaged 12 to 15 per cent. Seed crops grown in 36-inch rows threshed out 15.3 per cent; when sown broadcast they threshed out about 3 per cent less. Straw yields are slightly higher in broadcast and narrow-row plantings but undoubtedly the wider rows are more favorable for the development of a seed crop.

The average number of days required to mature a seed crop was 113 at Lubbock and 89 at Chillicothe.

RATE OF PLANTING

For Hay and Pasture: The common methods of planting are broadcast and in cultivated rows of the ordinary width. Rate of planting experiments for broadcast, 36-inch rows and 18-inch rows, will be discussed in that order.

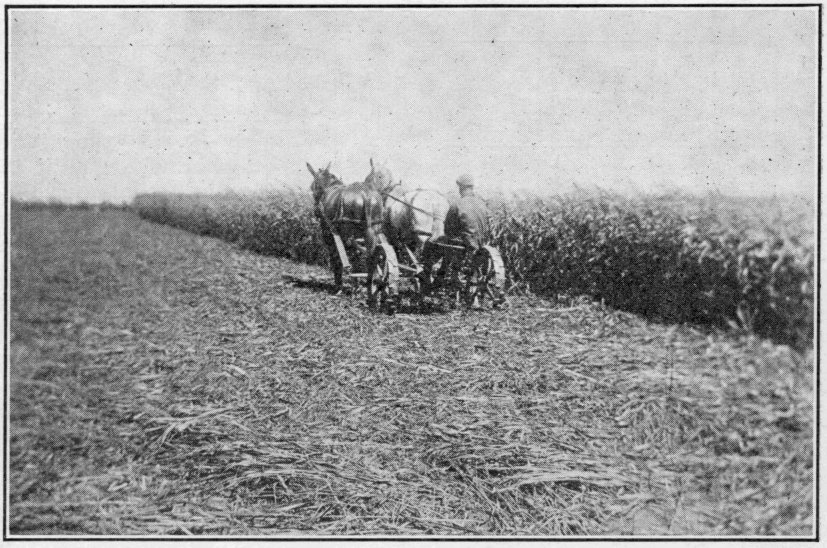

Fig. 4.—Mowing Sudan grass sown broadcast for hay at Lubbock.

Trials of different rates of planting Sudan grass broadcast were carried out at seven substations and at some of them the tests covered a number of years. The results are not continuous for the same period of years and the seeding rates at the various stations were not always the same. In order to summarize these data the planting rates have been placed into groups differing by ten pounds, beginning with the 10- to 19-pound rate and ending with the 40- to 49-pound rate. The yields

Table 9.—Effect of method of planting Sudan grass on yield of seed and straw, 1916, 1919-1922, at Lubbock.

Year	Date		Season days from emergence to harvest	Yield of straw and seed per acre					
				Broadcast		18-in. rows		36-in. rows	
	Planted	Harvested		Straw, tons	Seed, pounds	Straw, tons	Seed, pounds	Straw, tons	Seed, pounds
1916	6/14	10/18	118	2.65	202	3.02	162	1.44	228
1919	5/ 3	8/ 9	91	1.46	507	1.37	589	1.51	652
1920	5/22	9/ 7	102	.62	322	.73	379	.56	320
1921	5/ 3	8/25	107	1.01	537	1.08	615	1.25	518
1922	5/11	10/15	148	.98	330	.82	279	.98	308
Average	5/17	9/14	113	1.34	379.6	1.41	404.8	1.15	405.2
Average per cent seed of total forage					12.37		12.86		15.30

Table 10.—Effect of method of planting upon yields of seed, hay, and straw at Chillicothe, 1913-1920.

Year	Date					Season days to seed harvest	Yield of seed, hay and straw per acre								
	Planted	Up	Harvested for forage		For seed		Broadcast			24-in. rows			40-in. rows		
			1st	2nd			Seed, lbs.	Straw, tons	Hay, tons	Seed, lbs.	Straw, tons	Hay, tons	Seed, lbs.	Straw, tons	Hay, tons
1913	5/21	5/29	8/28	10/27			0	0		0	0	1.74	0	0	1.59
1914	5/ 8	5/15	8/18	9/22	8/18	95	90	1.59	1.87	105	1.67	2.52	215	1.75	1.75
1915	5/10	5/16	8/23	10/27	8/23	99	300	2.60	.61	487	2.10	1.38	475	2.34	1.11
1916	4/29	5/ 5	7/22	9/26	7/22	88	127	1.13	.25	226	.75	.64	241	.69	.70
1917	5/22	5/28	7/31	9/27			0	0	.68	0	0	.94	0	0	1.30
1918	5/23	5/30	8/20	9/23			0	0	.52	0	0	.17	0	0	.18
1919	6/10	6/16	8/29	11/ 3	8/29	74	83	1.10	.46	167	.99	.21	173	.78	.39
1920	5/29	6/ 7	9/ 4		9/ 4	89	424	2.24		456	2.01		960	4.68	
Average	5/19	5/26				89	128	1.08	.73	180	.94	1.09	258	1.28	1.00

Plantings were in 18-inch rows in 1914 and 16-inch rows in 1920 instead of 24-inch rows, and in 44-inch rows instead of 40-inch rows in 1914.

from the average of all these tests varied from 2.94 to 3.26 tons of hay to the acre but a close study of the results reveals little consistent difference in yield due to different seeding rates. The heaviest rate of seeding shows the highest yield but this increase is due entirely to including the results of a single year from Spur and Beeville, and a year when the yield was large. When the yields from the first three groups of seeding rates are averaged on a comparative basis, by omitting Pecos there seems to be no significant difference in hay produced from broadcast plantings at 10, 20, or 30 pounds of seed to the acre (Table 11).

Table 11.—The effect of rate of seeding Sudan grass broadcast upon yields of hay at various Texas Stations.

Station	No. of years tested	Yield per acre (tons)			
		Rate of seeding, pounds			
		10–19	20–29	30–39	40–49
Lubbock	11	2.30	2.29	2.47	2.16
Chillicothe	7	2.27	2.44	2.37	.....
Temple	5	2.61	2.20	2.02	2.29
Beaumont	3	1.87	1.70	1.66	1.80
Spur	1	4.88	5.03	5.02	5.05
Beeville	1	4.84	4.77	5.58	5.01
Pecos	1	2.28	2.14	.....	.....
Average	.....	3.01	2.94	3.19	3.26

The longest and most continuous results in broadcast rate of planting Sudan grass for hay were obtained at Lubbock and Chillicothe and cover eleven and seven years, respectively (Tables 12 and 13). Six rates of seeding between 10 and 40 pounds to the acre were included at Lubbock and the tests extended over a sufficiently long period of time to bring out any increase or decrease in yield due to seeding rate. The experiments at Chillicothe included five different rates of seeding for seven years. In neither of these experiments were there any consistent and significant differences in yield which may be charged to the rate of planting. It seems safe to conclude that under the conditions prevailing at Lubbock and Chillicothe rates of seeding between 10 and 40 pounds to the acre broadcast do not materially affect the yield of hay produced one way or the other. Sudan seed is usually of high viability, comes up readily, and when conditions for germination are good 15 or 20 pounds of seed should be ample. Heavier rates of seeding will help hold early weeds in check, but, if seed are high in price, as little as 10 pounds of seed to the acre may be the more profitable.

Sudan grass tillers freely and has the ability and tendency to thus adjust itself to the original stand. This characteristic of the plant enables it to compensate for lack of stand by tillering and probably largely accounts for the negligible differences found when the crop is planted at either light or heavy rates.

Two cuttings of hay were obtained from broadcast plantings in all

Table 12.—Effect of rate of seeding Sudan grass broadcast upon yields of hay, days to each cutting, and per cent of crop harvested at each, 1913-23, at Lubbock.

Year	Date		Length of season, days			Average per cent of hay crop harvested at		Yield of hay per acre (tons)					
								Rate of seeding					
	Planted	Up	to 1st cutting	to 2nd cutting	from 1st to 2nd cutting	1st cutting	2nd cutting	10	15	20	25	30	40
1913	5/16	5/22	55	103	48	63.41	36.59	.....	2.48	2.53	.....	2.73	2.70
1914	6/ 2	6/ 7	62	104	42	81.22	18.78	.....	4.46	4.08	.....	3.80	4.01
1915	5/18	5/24	.....	.....	.....	64.13	35.87	.....	2.58	3.27	.....	3.52	2.96
1916	6/13	6/20	66	120	54	44.38	55.62	3.94	2.65	3.24	3.40	2.80	2.85
1917	6/23	7/ 5	77	None	None	100.00	0	.05	.05	.09	.10	.09	.07
1918	6/17	6/20	70	127	57	79.05	20.95	1.26	.82	.87	.91	.86	.85
1919	5/14	5/22	69	160	91	72.92	27.08	3.93	3.68	3.72	3.48	4.05	3.81
1920	5/24	5/29	62	132	70	59.09	40.91	3.78	3.24	3.60	3.36	3.57	3.57
1921	5/28	6/ 9	54	110	56	65.32	34.68	3.17	2.84	3.13	3.14	2.99	2.81
1922	5/12	5/18	63	150	87	84.71	15.29	2.10	1.96	2.23	2.51	1.78	2.08
1923	6/ 1	6/10	57	123	66	59.33	40.67	1.58	1.70	1.55	1.33	1.59	1.25
8 year average (1916-23)	June 1	June 9	64.7	131.7	68.7	70.60	29.40	2.48	2.12	2.30	2.28	2.47	2.16
11 year average (1913-23)	May 29	June 6	63.5	125.4	63.4	70.32	29.68	.....	2.41	2.57	.....	2.71	2.45

Table 13.—Effect of rate of seeding Sudan grass broadcast upon yields of hay, days to each cutting, and per cent of crop harvested at each, 1913-1919, at Chillicothe.

Year	Date		Length of season, days				Average per cent of crop harvested at			Yield of hay per acre (tons)				
							Cutting			Rate of seeding				
	Planted	Up	to 1st cutting	from 1st to 2nd cutting	from 2d to 3rd cutting	to last cutting	1st	2nd	3rd	10	15	20	25	35
1913	4/29	5/ 6	58	109	.....	167	61.5	38.5	0	.....	1.51	1.26	.....	.....
1914	5/ 8	5/16	58	56	49	163	38.8	35.2	26.0	4.31	5.57	5.01	5.18	4.84
1915	5/ 8	5/15	58	43	90	191	50.8	27.0	22.2	2.90	2.90	2.97	2.88	2.98
1916	4/29	5/ 5	54	40	50	144	54.6	15.3	30.1	1.21	1.25	1.38	1.27	1.18
1917	5/26	6/ 2	62	56	.....	118	65.6	34.4	0	1.56	1.74	1.76	2.16	1.98
1918	5/24	5/30	128	.....	.....	128	100.0	0	0	.11	.16	.17	.22	.54
1919	6/10	6/16	49	94	.....	143	66.9	33.1	0	2.64	2.84	3.10	3.18	2.70
6 year average	5/18	5/24	68	58	63	148	62.8	24.2	13.0	2.12	2.41	2.40	2.48	2.37
7 year average	5/15	5/22	67	66	63	151	62.6	26.2	11.2	.....	2.28	2.23	.....	.....

except one year of the test at both Lubbock and Chillicothe and a third cutting was made at the latter station during three of the seven years. On the average, 70 per cent of the total hay crop was harvested at the first cutting and 30 per cent at the second cutting at Lubbock. At Chillicothe, 63 per cent of the total hay was produced at the first cutting. A growing period of 63 to 67 days was required between cuttings.

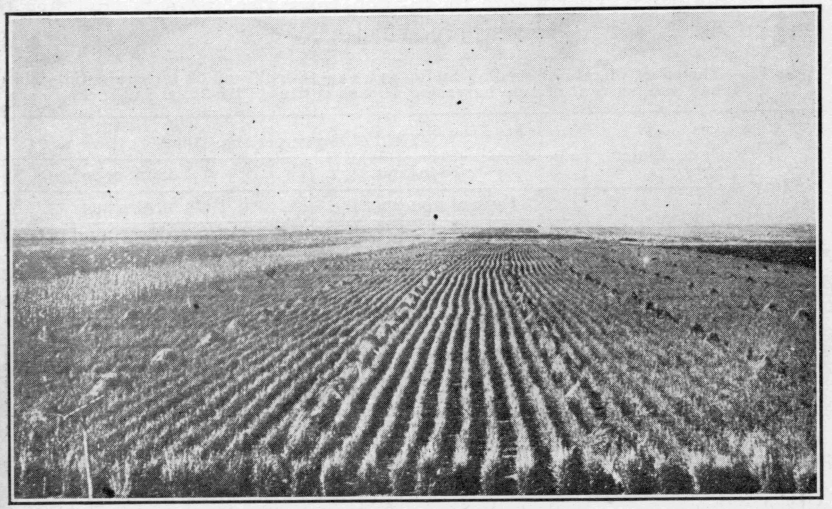

Fig. 5.—Texas produces the bulk of Sudan grass seed for the United States. A seed crop in the shock and a second crop growing for hay or pasture in the South Plains.

Sudan grass in Texas is usually planted in cultivated rows. Rate of seeding tests at four substations (Table 14) have been placed in four groups ranging from 5 pounds to 20 pounds of seed to the acre. These tests were grown in 3-foot rows and cultivated when necessary to keep down weed growth. The yields produced from various rates of planting indicate that 5 to 10 pounds of seed are sufficient. At Lubbock, differences in yield between 5-, 10-, and 15-pound rates of seeding are very slight but favor the lower rates. At Temple, a 10-pound rate of seeding proved the best.

Table 14.—The effect of rate of seeding Sudan grass in three-foot rows on yield of hay at various Texas Stations.

Station	No. of years tested	Yield of hay per acre (tons)			
		Rate, pounds			
		1–5	6–10	11–15	16–20
Lubbock	8	2.18	2.15	2.14	.....
Pecos	5	1.29	.88	1.42	1.13
Temple	3	1.76	1.99	1.67	1.07
College Station	2	.....	3.61	.....	3.56
Average	.....	1.74	2.16	1.74	1.92

The effect of rate of seeding in 3-foot rows on the yield of hay at Lubbock for each of the eight years from 1916 to 1923 is rather consistently in favor of the lighter rates. The differences are small, on the average, but it seems clear that seeding more than 5 pounds to the acre is unnecessary and unprofitable (Table 15). Practical experience has also demonstrated the fact that 3 or 4 pounds to the acre will suffice. Rate of planting experiments in 18-inch rows also indicate that five to ten pounds of seed to the acre are sufficient.

Table 15.—The effect of rate of seeding Sudan grass in 18-inch and 36-inch rows on yield of hay and per cent of crop harvested at each cutting, 1916-23, at Lubbock.

Year	Date		Yield of forage per acre (tons)								
			18-in rows					36-in. rows			
			Rate of planting				Aver-	Rate of planting			Aver-
	Plant- ed	Up	5 lb.	10 lb.	15 lb.	20 lb.	age	5 lb.	10 lb.	15 lb.	age
1916.....	6/14	6/21	2.51	4.96	3.28	2.98	3.43	2.80	2.84	3.51	3.05
1917.....	6/26	7/24	.86	.82	.85	.84	.84	.66	.77	.72	.72
1918.....	5/ 8	5/15	2.27	2.00	1.70	2.94	2.23	1.88	2.19	2.22	2.10
1919.....	5/ 3	5/10	3.26	2.16	1.78	3.78	2.75	2.16	2.46	2.23	2.28
1920.....	5/22	5/28	3.53	2.90	2.15	2.05	2.66	2.60	2.75	2.05	2.47
1921.....	5/ 3	5/10	3.61	3.66	3.29	3.70	3.57	3.85	3.33	3.46	3.55
1922.....	5/11	5/20	1.84	1.14	1.92	1.84	1.69	1.71	1.44	1.44	1.53
1923.....	4/30	5/10	1.38	1.44	1.54	1.64	1.50	1.74	1.45	1.46	1.55
Average...	5/19	5/29	2.41	2.39	2.06	2.47	2.33	2.18	2.15	2.14	2.16
Average per cent of total crop harvested:*											
At 1st cutting.....			48.84	50.59	54.04	55.96	52.35	51.42	49.47	48.86	49.91
At 2nd cutting.....			51.16	49.41	45.96	44.04	47.64	48.58	50.53	51.14	50.08

*Exclusive of 1917.

The 10-pound seeding rate in 3-foot rows produced almost exactly equal quantities of hay at each of the two cuttings, while the 5-pound or lighter rate yielded slightly the most hay from the first cutting and the 15-pound rate produced a little more of its crop at the second cutting. In 18-inch rows, the per cent of total crop produced at the first cutting increased as the rate of planting increased.

It is desirable to use heavier rates of seeding for pasture than for hay production, since, with a thick stand, awaiting the development of tillers to thicken up the stand is not essential and earlier grazing can be obtained. Thick planting, furthermore, tends to suppress weeds and this feature is more important where Sudan is used as a grazing crop since the grass is frequently eaten close to the ground and weeds have the advantage of ample sunlight to make for vigorous growth. Ten to 20 pounds of seed to the acre should be planted when grown in rows for pasture and 20 to 30 pounds to the acre when sown broadcast.

For Seed: Data from the Lubbock Station on the effect of rate of planting broadcast and in cultivated rows on seed production extend over five years (Table 16). In the broadcast plantings, the yields of seed decreased directly as the rate of planting increased. Ten pounds

Table 16.—The effect of rate of seeding Sudan grass on yield of seed and straw, 1916, 1919-22, at Lubbock.

Year	Yield of seed, hay and straw, per acre															
	Broadcast, rate of planting								36-inch rows, rate of planting							
	10 lbs.		15 lbs.		20 lbs.		Average		5 lbs.		10 lbs.		15 lbs.		Average	
	Straw, tons	Seed, lbs.	Straw, tons	Seed, lbs.	Straw, tons	Seed, lbs.	Straw, tons	Seed, lbs.	Straw, tons	Seed, lbs.	Straw, tons	Seed, lbs.	Straw, tons	Seed, lbs.	Straw, tons	Seed, lbs.
1916	3.31	145	2.06	160	2.58	300	2.65	201.7	2.33	145	1.05	170	.94	370	1.44	228.3
1919	1.59	618	1.51	488	1.29	416	1.46	507.3	1.71	680	1.52	763	1.29	513	1.51	652.0
1920	.66	385	.59	325	.62	255	.62	321.7	.68	350	.70	410	.30	200	.56	320.0
1921	.96	575	1.14	520	.94	515	1.01	536.7	1.18	545	1.29	593	1.27	415	1.25	517.7
1922	1.14	390	.95	320	.85	280	.98	330.0	.98	300	1.00	328	.96	298	.98	308.7
Av...	1.53	422.6	1.25	362.6	1.26	353.2	1.34	379.5	1.38	404.0	1.11	452.8	.95	359.2	1.15	405.3

of seed to the acre, when sown broadcast for seed production, undoubtedly is more profitable than a heavier rate. This rate produced 60 pounds more seed to the acre than when 15 pounds of seed were planted and 70 pounds more than when the rate was 20 pounds to the acre. The 10-pound rate also produced larger straw yields.

Seed crops in cultivated rows also gave the highest yields from a 10-pound rate of seeding, yielding 50 pounds to the acre more than the 5-pound rate and 100 pounds more than the 15-pound rate. Probably the optimum rate for seed production lies somewhere between 5 and 10 pounds of seed per acre. Ten pounds of seed produces a stand thick enough to discourage stooling, and as a consequence, a crop of seed very uniform in maturity and height is produced. Large yields of seed have been produced from planting two or three pounds of seed to the acre. This permits heavy stooling of the plants and uneven ripening so that greater care must be used in harvesting at the proper time to avoid loss from shattering.

Ten pounds of seed to the acre gave the highest yield both in 3-foot rows and broadcast. The yield of seed from 3-foot rows, however, exceeded the broadcast planting by 30 pounds to the acre during the five years. The average yield of all rates in rows was 25 pounds of seed to the acre more than the average of the broadcast rates.

STAGE OF HARVESTING

Sudan grass was harvested at four different stages of growth, namely: before heading, first heads, full bloom, and seed in the milk. During the six years of this experiment there was on the average eight to ten days' interval between each of the successive stages for the first cutting of the season. Cutting for hay when the first heads began to appear and when the plants were in full bloom showed no appreciable difference in the yield of hay obtained. Waiting until full bloom seemed to slightly increase the hay per cutting but in delaying to this stage one less cutting was secured in the six years. Delay of harvesting until the seed were in the milk stage reduced the yield on the average, approximately, one-third of a ton to the acre, due to the loss of a third cutting. Harvesting before the crop had headed reduced each individual cutting and following harvest the crop failed to grow as vigorously as when cut at the more mature stages. Yields of hay were reduced by almost two-thirds of a ton to the acre when harvested before the crop began to head.

When the grass was cut in full bloom, the average yield per acre was 2.47 tons compared with 2.44 tons at the stage first heads appeared, 2.12 tons when seed were in the milk, and 1.84 tons at the earliest stage, or about a week before the first heads appeared (Table 17).

If only two cuttings are desired in the northern part of the state the first cutting should be made at any time from full bloom to the stage of seed in the milk or soft dough. In certain seasons additional growth will come on after the second cutting but the more economical practice is to pasture it off. In the southern half of the state three cuttings may

be obtained when harvested at this stage and a similar aftermath produced for grazing.

Sudan grass hay is nutritious and palatable when cut at any of the stages mentioned and it is occasionally advisable to mow the crop in whatever stage of development it may be if growth is checked by drought or a frost. Usually, however, Sudan grass should be harvested for hay at the time of heading or in the bloom.

Table 17.—Effect of stage of harvesting Sudan grass upon yields of hay at Chillicothe. Summary of years 1916-1922, inclusive.

Stage cut	Length of season, days			No. of years with			6 year average yield in tons	Total No. cuttings during 6 years
	to 1st cutting	from 1st to 2nd cutting	from 2d to 3rd cutting	One cutting	Two cuttings	Three cuttings		
Before heading	45.0	58.0	40.0	1	3	2	1.84	13
First heads	52.8	54.8	41.5	1	3	2	2.44	13
Full bloom	61.5	54.5	46.0	2	2	2	2.47	12
Seed in milk	71.5	70.3	.....	2	4	0	2.12	10

When the crop is grown for seed it may best be harvested when the seed in the main heads or first heads are ripe and if it is before cool nights prvail in the fall harvesting may await the maturity of the seed borne on the more advanced tillers. Later in the fall when cool weather sets in and high winds may intervene it is advisable not to delay harvesting. At this time of the year the tillers mature their seed slowly and a large part of the main crop may be shattered by a few hours of high winds while one is waiting for the tillers to mature.

HARVESTING AND THRESHING

The hay crop usually can be more economically harvested by cutting with the mower; however, the row-binder may be used. With the latter method the hay is tied in bundles and may be shocked immediately and allowed to cure. The bundles will shrink a great deal and are usually somewhat difficult to handle. The stubble should be cut as low as possible. It is more practical to harvest with the mower, cure a day or two in the swath, rake into windrows, and allow to cure dry enough to put into the stack or mow, or to bale. Better quality of hay will result if not left too long in the swath. Sudan grass hay cures readily in the western part of the state where there are drying winds but in the more humid sections of the state, or if rain intervenes, it may become necessary to turn the windrows or cocks to hasten drying-out.

If the crop is grown for seed the best method of harvesting is with the row-binder. Less seed are shattered from the heads by this method of harvesting than any other. The grain binder may be used and will handle the crop satisfactorily. Rather large shocks should be made, as small shocks are apt to twist and blow down.

Ordinary threshers handle the whole bundles of the seed crop readily,

but if the small farm unit thresher is used, it is sometimes found desirable to feed the upper half of the bundle into the machine until the seed are threshed off and then the bundle butts are thrown aside. It is important to properly regulate the air blast in threshers to prevent loss of seed due to their blowing over with the straw.

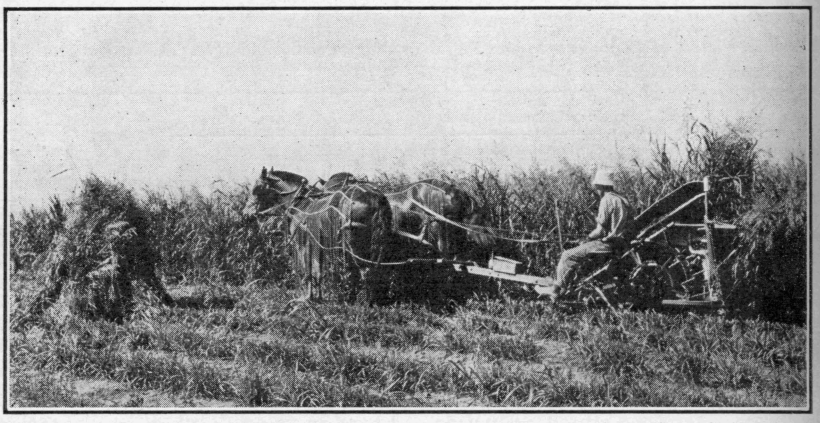

Fig. 6.—Harvesting a crop of Sudan grass for seed with the row binder at Dalhart. Photographed by Office of Forage Crops.

COMPARISON OF SUDAN GRASS, SUMAC SORGO, AND COWPEAS

The area devoted to Sudan grass, both for hay and pasture, depends not only on the production of the crop but also upon the other crops with which it has to compete. In a large part of the state, Sudan grass has no successful competitor as a summer pasture and hay crop. In other sections, alfalfa, sorgo, and perennial pastures or meadows of native Bermuda grass delegate Sudan grass to a minor place. In a section such as the Coastal Plains region, Sudan grass hay is relatively unimportant because it is difficult to cure on account of climatic conditions. In the western part of the state, sorgo, Sudan grass, and the grain sorghums are the principal forage crops and cowpeas are the legume with the widest adaptation as a forage crop. A comparison of the forage yields (Table 18) of these crops at the Lubbock and Chillicothe Stations, from 1913 to 1925, shows that cowpeas produced only about 24 and 47 per cent, respectively, as much forage as Sudan grass. Therefore, cowpeas cannot compete with Sudan as a hay crop and they are not valuable for pasture.

Sumac sorgo produced over a ton of forage to the acre more than Sudan grass at both Stations during these thirteen years. In view of the fact that Sudan, as a hay crop, cures readily and is eaten without waste by livestock, the comparative yield of Sudan with that of sorgo is very favorable.

Table 18.—Comparative yield of Sudan grass, sorgo, and cowpea hay at Lubbock and Chillicothe.

Year	At Lubbock, yield per acre (tons)				At Chillicothe, yield per acre (tons)			
	Sudan grass		Sorgo forage	Cowpea hay	Sudan grass		Sorgo forage	Cowpea hay
	No. cuttings	Hay			No. cuttings	Hay		
1913	3	1.65	1.43	.87	2	1.37	1.28	.32
1914	2	4.17	9.46	1.46	3	5.28	7.23	0
1915	3	4.66	7.92	.79	3	3.62	6.85	1.75
1916	2	3.67	11.00	1.37	3	1.53	2.29	.67
1917	2	.32	.67	.20	2	.84	2.50	.74
1918	2	.37	2.20	.37	1	.62	2.91	.29
1919	2	4.00	6.10	.96	2	2.07	3.05	.99
1920	2	5.42	6.02	.80	2	2.49	4.56	1.15
1921	2	4.00	3.62	.50	1	1.41	2.54	.95
1922	2	2.96	2.43	.53	1	1.93	2.25	.83
1923	2	3.38	3.12	.67	1	.80	3.37	.67
1924	3	1.82	2.65	.83	3	3.42	3.49	.94
1925	3	3.76	3.43	.85	3	3.02	3.27	1.35
Average	.....	3.09	4.62	.78	.....	2.18	3.51	.82

Sudan is a more valuable pasture crop than sorgo since it withstands continuous grazing better and apparently only in rare instances is there danger of prussic acid poisoning from Sudan grass. It was found by grazing live stock on Sudan and sorgo growing side by side at Chillicothe that Sudan grass was more palatable.

SUDAN GRASS FOR PASTURE

Value of Pasture: Sudan grass is the most important cultivated pasture crop in Texas and, of the sorghums, occupies approximately 50 to 60 per cent of the acreage devoted to pasture. Johnson grass perhaps occupies one-half as much and is an important pasture crop in localized areas. However, Johnson grass is not wilfully planted on uninfested land and is not important in comparison to Sudan grass except where already established.

A survey of the state has shown that Sudan pasture is used in all farming sections. It is not used extensively in the flat coastal plain of southeast Texas, where soil drainage conditions, insects, and Red Spot are unfavorable to the crop. Other pasture crops, particularly the legumes, native pasture, and Bermuda grass make Sudan pasture less necessary in certain sections of the state but its use can be increased to advantage in practically all sections wherever conditions on the individual farm permit.

Undoubtedly the use of Sudan grass for pasture has contributed considerable impetus to the dairy and poultry industries since it furnishes cheap and abundant summer pasture. Hogs do well on Sudan pasture and to make hog production profitable Sudan grass pasture is essential if other summer pasture is not provided.

In the dairy industry, and to a lesser extent in the poultry and hog industries, Sudan grass pasture has already found its rightful place,

but on farms not principally devoted to livestock production, and where the livestock on the farm consists only of work stock and two or three milch cows, the value of Sudan grass for summer pasture is by no means given proper recognition. Each individual farm in purely farming sections should have enough Sudan grass pasture to carry the farm work stock and milch cows through the summer and fall months.

Fig. 7.—The principal value of Sudan grass in Texas is its use as a summer pasture. Dairy cows grazing on Sudan.

No accurate data on the carrying capacity of Sudan grass pasture in Texas with the various kinds of livestock are available but observation and experience would indicate that, under ordinary conditions and when the pasture is supplemental to the usual grain ration, one acre of Sudan grass pasture, under proper management, should furnish pasture for one to three cows, three to five brood sows, or 15 to 25 growing and fattening shoats. It should be added that in the case of dairy cows greater profit is likely to result if still more pasture is provided so as to replace a part of the grain ration. An acre of Sudan will carry 150 to 200 chickens.

Growing Sudan Pasture: The proper planting date for pasture is about the same as for hay production and varies with the temperature in the various sections of the state. Too early planting may be more damaging to a pasture crop than to a hay crop since land devoted to pasture is more likely to be foul with weeds. Since the crop grows off slowly when cool weather prevails and the ground is cold, Sudan grass for pasture should not be planted until the ground is thoroughly warm. However, the value of a summer pasture depends upon the length and the continuity of grazing as well as the total volume of pasture and when feed is scarce and forage is unavailable, planting should be moved up to as early a date as possible. Sudan will furnish good pasture when planted

as late as July and should not be dispensed with if very late planting is necessary for any reason.

The common methods of growing Sudan grass for pasture are to plant it in wide rows, in narrow rows, or broadcast. Each method has advantages under particular conditions but, in general, cultivated row plantings are recommended. Where the rainfall is heavy and the soil-moisture supply is adequate to produce vigorous growth throughout the season and little trouble is encountered from weeds, broadcast plantings will furnish slightly more pasture. However, in practically all parts of the state ideal distribution of summer rainfall is uncertain and the season is rare when plant growth is not checked at one time or another by scarcity of soil moisture. Under those conditions, row plantings are more desirable since they are better able to continue growth under drought conditions and furnish more continuous pasture, or at least, for a longer time after severe drought conditions prevail. In addition, where weeds are prevalent, early cultivation is essential and later cultivation is ofttimes desirable.

Fig. 8. Sudan grass pasture growing in three-foot rows at about the proper stage to begin grazing.

It is desirable to use heavier rates of planting for pasture than for hay production since a thick stand obviates the necessity of tillering and allows earlier grazing. Thicker planting has a tendency to suppress weeds since the ground is more completely occupied by the Sudan grass plants. This feature is more important where Sudan is being pastured than where it is being used for hay since it frequently happens that the grass is eaten close to the ground and weeds have the advantage of plenty of sunlight to allow vigorous growth.

When grown in rows, ten pounds of seed to the acre should be planted and rates as high as twenty pounds are sometimes desirable. Since a thick stand is necessary for best results, the rate will depend somewhat upon the earliness of the planting, the soil conditions that affect germination and early growth, and the prevalence of weed seeds in the soil.

Ten to thirty pounds of seed to the acre should be used for broadcast plantings, the amount depending upon the same conditions as affect the rate of planting in rows.

Pasture Management: In Texas, farms without any kind of livestock are rare. Wherever animals are kept, year-around pasture should be produced in so far as possible. Small grain for winter pasture and Sudan grass for summer pasture fit well into a plan for continuous pasture throughout the year in Texas. Usually the small grains will furnish green pasture from October to May or June, when Sudan pasture will become available and will continue until frost. Continuous grazing will be best supplied if separate pastures are maintained for Sudan and small grain each year. Sudan can be grown on land which grew any of the winter pasture crops but it is better, under ordinary conditions, to grow it on land which has been lying idle during the winter. Moreover, it is often profitable to stop pasturing the small grain in the early spring and allow a grain and straw crop to mature.

Sudan may be pastured very closely without damage but a good practice, which allows more livestock to the acre, is to have two or more alternating Sudan pastures which are grazed in succession, thus allowing each pasture a period of rest for making new growth. Such unpastured periods are not feasible with poultry since they can eat only the tender leaves, but the lots should be small enough for the chickens to keep the grass eaten close to the ground. If they are unable to keep the grass eaten close, it is advisable to mow the pasture from time to time.

Livestock may be turned in on Sudan pasture when the plants are 15 to 18 inches high, have a well established root system, and are able to continue rapid growth. When the original stand is thin and an insufficient number of tillers have developed, grazing may begin at the same stage but immediately the pasture is eaten to the ground, the livestock should be taken off for a few days to allow the Sudan to tiller as much as possible.

It frequently happens during an especially favorable growing season that the growth is greater than the animals can consume. In such a case the livestock will eat only the leaves and the stems get progressively more tough and woody and only the leaves continue to grow. When the pasture is in such a condition it is advisable to mow and take the stock off for a few days until new tillers are growing vigorously. Occasional mowing will tend to control weed growth and in the southern and eastern parts of the state where the Red Spot disease is prevalent, mowing will reduce the damage of this disease. Sometimes enough hay will be secured from such mowings to be well worth raking and curing.

Adverse seasonal conditions affect the growth of Sudan grass pasture

and since adequate pasture is important, it is advisable to plant a slightly larger acreage than is needed in a normal year to insure sufficient grazing in a poor year. Then, if the season is normal or unusually favorable, the excess above the needs for pasture can be harvested for hay. Too much emphasis cannot be placed upon planting an adequate acreage to Sudan for pasture whether it is on farms where dairying, hog raising, or poultry raising is the leading enterprise, or whether it is to be used only for the general farm livestock. The acreage and management of this summer pasture crop should be planned so as to provide a luxuriant growth of grass throughout the season.

SUMMARY

Sudan grass is an annual grass sorghum, and has high value as a forage and pasture crop. It was introduced into this country in 1909 by the United States Department of Agriculture, was first tested at Chillicothe, Texas, and the seed were widely distributed over the state by the Texas Station.

Sudan grass is adapted to the entire southern half of the United States, much of the Great Plains area, and is well suited to practically the whole of Texas. The crop grows well on all types of soil, provided they are comparatively fertile and well drained. It prefers a warm summer climate of relatively low humidity, and grows only during the warmer months of the year.

In Texas, Sudan is a good pasture and hay crop in all farming sections and the South Plains is the principal seed-producing area for the United States.

Sudan grass for hay should be planted early enough to allow the production of three cuttings in southern parts of the state and two in the northern parts. The optimum planting date for the state ranges from March 1 to May 1, the earlier date being about the optimum for the southern parts and the latter being the optimum for the northern parts of the state. Date-of-planting experiments at Lubbock show that yields decline when planting is delayed past the latter part of April, and at Chillicothe the best yields were made by planting on or before the first of May.

Sudan grass may be planted for hay, broadcast, in 18-inch rows, or in 36-inch rows without an appreciable influence on yield. Narrow rows yielded about 8 per cent more hay than wide rows at Lubbock, while at Chillicothe wide rows yielded about 13 per cent more than narrow rows. Yields at both Stations favor planting in rows rather than broadcast. Planting in cultivated rows is the best method for seed production.

Sudan straw is a valuable by-product of seed production, which should be fed to livestock. A seed crop produces over a ton of straw to the acre, and in addition, a crop for pasture or hay may frequently be produced.

On account of the tillering habit of the crop, rates of seeding above the minimum requirement have little influence on yield of hay. Fifteen

to twenty pounds is a sufficient amount for broadcast plantings and five pounds is sufficient for row plantings.

Even maturity of the crop is essential in the production of seed when the crop matures late in the fall. Ten to fifteen pounds to the acre was best when planted broadcast, and five to ten pounds to the acre was the optimum seeding rate when planted in rows at Lubbock.

Sudan grass hay cut at any of the premature-to-mature stages is palatable and nutritious but the heaviest production resulted from cutting when the crop was heading or was in the bloom. Earlier cutting reduced the yield of each individual cutting and later cutting resulted in a reduction of the number of cuttings obtained without a compensating increase in yield per cutting.

In comparison with cowpeas Sudan grass has produced approximately four times as much forage at Lubbock and two and one-half times as much at Chillicothe. During this same time Sudan produced 67 and 62 per cent, respectively, as much forage as Sumac sorgo at these Stations. Considering the fact that Sudan grass is a hay crop, cures readily, and is eaten without waste by livestock, it compares favorably with Sumac sorgo for the production of forage.

Sudan grass is the most important cultivated pasture crop in Texas and the acreage for pasture should be increased. Growing Sudan grass pasture in rows furnishes more continuous pasture, especially if droughts are prevalent, but broadcast planting may yield slightly more pasture over a shorter period. Growing in rows for pasture also allows cultivation to control weeds.

Heavier rates of seeding are more desirable in planting for pasture than for hay production since heavier rates allow earlier grazing and less trouble from weeds. Ten to fifteen pounds may be planted in rows and ten to thirty pounds broadcast.

In Texas, small grain for winter pasture and Sudan grass for summer pasture furnish a combination that provides grazing throughout practically the entire year. Continuous pasture can only be supplied if separate fields are provided for growing the summer and winter pastures.

Sudan grass pasture should not be grazed until the plants are 15 to 18 inches tall. Sudan can be grazed heavily without damage but it is more profitable to have two or more pastures that are grazed in succession, thus allowing each pasture a period of rest for making new growth. When the plants become coarse and woody, or when weeds become large, the pasture should be mowed.

It is advisable to plant a larger acreage for pasture than is needed in a normal year to insure sufficient grazing in a poor season. Then, if conditions are normal or unusually favorable, the crop above the needs for pasture can be harvested for hay.