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TEXAS AGRICULTURAL EXPERIMENT STATION

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

BULLETIN NO. 496 OCTOBER, 1934

DIVISION OF AGRONOMY
IN COOPERATION WITH BUREAU OF PLANT INDUSTRY,
UNITED STATES DEPARTMENT OF AGRICULTURE

FORAGE SORGHUMS IN TEXAS

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**In cooperation with U. S. Department of Agriculture.
‡In cooperation with Texas Extension Service.
†As of October 1, 193

The sorghums are the most important source of roughage from cultivated crops in Texas since they furnish the bulk of the hay, bundle forage, and silage, and are also used extensively for pasture. Yields of forage from sorghums in Texas, according to census reports, are only about 1½ tons to the acre but experiments show that this low production on Texas farms might easily be materially increased through the use of better varieties and better cultural practices.

Sumac, Honey, and Sourless are among the best varieties for Texas conditions and have produced good yields of forage at substations in all regions of the State. Sumac, sometimes called Red Top, is the most extensively grown variety, both for bundle feed and for hay.

The sorghums cannot be successfully planted until the soil is thoroughly warm in the spring. Late May and June plantings of sorgo for forage are recommended for West Texas; April 15 to May 15 plantings are recommended for Central Texas, and late March and early April plantings are recommended for the region south and west of San Antonio. A favorable period for planting sorghums for forage covers a range of about six weeks in all areas of the State except the northern Panhandle.

Close spacing of 1 to 4 inches apart in the row is recommended for forage production while 5- to 6-inch spacings are best for seed production. Five pounds of seed to the acre of any of the sorgos gives sufficiently thick stands. A 2-inch stand may ordinarily be expected from plantings at the rate of 5 pounds to the acre in rows. Five- to six-inch stands will be obtained from planting at the rate of 2 pounds to the acre. Sorgo planted broadcast for hay is an important crop in all except the western part of the State. Recommended rates of planting, which will give maximum yields of good quality hay, are 1 to 2 bushels to the acre. One bushel is sufficient but when planted on rich soil and where moisture is adequate two bushels to the acre may be sown.

Silage yields from row plantings of sorgo in Texas have averaged 9 tons to the acre in the western part of the State and 13 tons in other regions where rainfall is greater. The better forage varieties of grain sorghums produce 2 to 4 tons to the acre less than the sorgos.

From 100 to 130 bundles of air-dry sorgo forage will weigh a ton while around 170 bundles of the better forage varieties of grain sorghums, when air-dry, will weigh a ton. About 20 to 25 per cent fewer field-cured bundles than air-dry bundles are needed to weigh a ton. A good crop of Blackhul kafir, producing around 3 tons of forage to the acre, will yield approximately 1.6 tons of heads to the acre and around 600 bundles requiring about one-third of an 8-pound ball of binder twine per acre for binding.

When sorghum seed that are infected with smut or that are of unknown origin are to be planted they should be treated with copper carbonate or some other seed disinfectant at the rate of 2 to 3 ounces per bushel.

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FORAGE SORGHUMS IN TEXAS

J. R. QUINBY, J. C. STEPHENS,* R. E. KARPER, AND D. L. JONES

The sorghums are, with the exception of native grass, by far the most important source of roughage in Texas since they furnish the bulk of the hay, bundle forage, and silage, and are, in addition, used extensively for pasture. Over two million acres are devoted to sorghums for silage, hay, and forage annually on more than one hundred and sixty thousand farms in Texas. The acreage devoted to sorghums for forage has been increasing during the last 15 years, as may be seen by comparing Figures 1 and 2. No statistics are available to show what part of the forage sorghum acreage

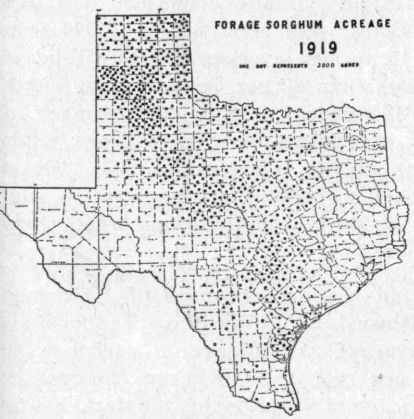

Fig. 1. Distribution of acreage in sorghums harvested for forage in 1919. One dot represents 2000 acres.

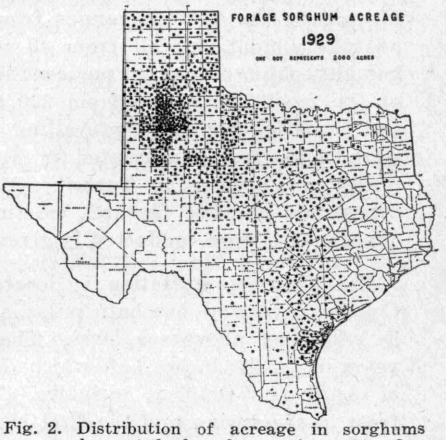

Fig. 2. Distribution of acreage in sorghums harvested for forage in 1929. One dot represents 2000 acres.

is occupied by sorgos and what part by grain sorghums, but apparently the increase in acreage devoted to sorghums for forage has been brought about largely by increased planting of grain sorghums to be harvested in the bundle.

Sorghums are grown for forage to some extent in all agricultural areas in the State but since the entire crop is fed to livestock its actual value is ordinarily underestimated and is difficult to arrive at. Census reports and crop estimates place the farm yields of forage from sorghums at only about one and one-half tons to the acre. With such low acre production, there is evidently an opportunity to raise the yields to a more profitable level through the use of the better varieties and proper rates of planting, and through good farming practices. This Bulletin reports the results with varieties, rates and dates of planting, and other practices affecting production of forage sorghums in Texas.

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The experimental work at Chillicothe is conducted cooperatively by the Texas Station and the Division of Forage Crops and Diseases, U. S. Department of Agriculture. The results of the experiments at Big Spring and Dalhart are included in this publication through the courtesy of Dr. C. E. Leighty and E. F. Chilcott, of the Division of Dry-Land Agriculture, U. S. Department of Agriculture, and F. E. Keating and B. F. Barnes, Superintendents, who conducted the experiments at the two Stations.

CLIMATIC CONDITIONS AND LOCATION OF EXPERIMENTS

Since sorghums are grown for forage in all farming regions of the State, the crop encounters many different climatic conditions. In this large area the altitude ranges from almost seal level to over 4,000 feet, average annual rainfall from 40 to 15 inches, average monthly relative humidity from almost 80 per cent to less than 60 per cent, and the length of the frost-free period from 290 to 175 days. A complete summary of the climatic conditions prevailing at the substations when these trials were conducted is presented in Texas Station Bulletin No. 459, "Grain Sorghum Varieties in Texas". A brief discussion of the location, soil types, and climatic features existing at the various stations when these experiments were conducted is given here.

The Chillicothe Station is located in the eastern part of Hardeman County, five and one-half miles southwest of Chillicothe. The altitude is 1,406 feet above sea level. The average rainfall over a period of 2[illegible] years is 25.33 inches, of which 79 per cent falls between the months of April and October, inclusive. The average dates of the last killing frost in the spring and the first in the fall are March 25 and November 8 respectively. The soils in this, The Rolling Plains region, have been developed from the Red Beds formations and on the Station farm are fine sandy loams, loams, and clay loams.

The Lubbock Station is located three miles east of Lubbock in the High Plains Region of Texas and near the center of what is known as the South Plains. The altitude is 3,106 feet above sea level. The average rainfall over a period of 21 years is 19.23 inches, 82 per cent of which falls between the months of April and October, inclusive. The average date of the last killing frost in the spring and the first in the fall are April 9 and November 2, respectively. The soils on this Station are fine sandy loams of the Amarillo and Richfield series and are typical of much of the South Plains. Insects are not destructive to sorghums at Lubbock; however, the corn ear worm (*Heliothis obsoleta*) occasionally does some damage to compact-headed varieties. Kernel smut may be destructive if diseased infected seed are used but infection in the field rarely occurs.

The Spur Station is located in Dickens County one mile west of Spur. Spur is in the Rolling Plains Region, being 14 miles east of the Cap Rock

escarpment, which divides the Low from the High Plains. The elevation is 2,274 feet above sea level. The average rainfall for a period of 21 years is 21.17 inches, 82 per cent of which falls during the growing season of summer crops. The average dates of the last killing frost in the spring and the first in the fall are April 2 and November 3, respectively. Abilene and Miles clay loams, two representative soils of the Rolling Plains Region, comprise the soil types of the Station land. No insects are destructive to sorghums at Spur except the corn ear worm, which, in wet seasons, may cause considerable damage to yield and quality, particularly among the varieties with compact heads. No diseases other than red spot and kernel smut are present. The former does some damage to forage, but the latter is readily controlled.

The Big Spring Field Station, of the Division of Dry-Land Agriculture, U. S. Department of Agriculture, is located one mile north of Big Spring, Howard County, in the South Plains Region at the southern edge of the High Plains. The altitude is 2,400 feet above sea level. The average annual rainfall over a period of 16 years is 18.61 inches, 80 per cent of which falls during the months from April to October, inclusive. The average dates of the last killing frost in the spring and the first in the fall are March 30 and November 2, respectively. The principal soil type is Amarillo fine sandy loam.

The Dalhart Field Station, of the Division of Dry-Land Agriculture, U. S. Department of Agriculture, is located in Hartley County in the northern Panhandle. The altitude is 3,978 feet above sea level. The average annual rainfall over a period of 26 years is 18.80 inches. The distribution of rainfall during the summer months has been more favorable than at any other western station, 87 per cent of the total falling from April to October, inclusive. The average dates of the last killing frost in the spring and the first in the fall are April 23 and October 17, respectively. Amarillo fine sandy loam predominates on this Station.

The Temple Station is located in Bell County, and before its removal to a new site in 1927, and during the duration of the experiments reported here, was located about four and one-half miles southwest of Temple. The elevation is 740 feet above sea level. The average annual rainfall for the period of 18 years is 36.35 inches, about 61 per cent of which falls from March to September, inclusive. The average dates of the last killing frost in the spring and the first killing frost in the fall are March 24 and November 11. The soils on this old location are dark-brown to black clays of the Simmons and Lewisville series and are not strictly typical of the Blackland Region.

The Beeville Station is located in Bee County, in the Interior Black Prairie Region, at an altitude of 240 feet above sea level. The average annual rainfall for a period of 28 years is 30.56 inches, 75 per cent of which falls between the months of March and October, inclusive. The average dates of the last killing frost in the spring and the first in the

fall are February 20 and December 7, respectively. Victoria and Goliad sandy loams and clay loams are the principal soils comprising the land on this Station.

The Balmorhea Station is now located at Balmorhea in Reeves County, but when the results reported in this Bulletin were obtained the Station was located three and one-half miles west of Pecos. The elevation was 2,580 feet. The average annual rainfall in this region is around 14 inches and the crops were all grown under irrigation, but the soils and water used for irrigation at this point were not conducive to as high yields as can ordinarily be expected in the Pecos and Toyah Valleys, where the farming is now concentrated.

EXPERIMENTAL METHODS

Plat Size

The yields reported in this Bulletin were computed to the acre basis from experimental plats. The plat sizes have varied, depending upon the nature of the experiment and the amount of land available at the different stations. The most usual size has been about 1/20-acre but plats in some tests have been as small as 1/110-acre and in some cases as large as 1/10-acre. Usually there has been no replication of plats unless plats of identical variety or treatment on different dates is so considered.

Planting and Spacing of Plants

Different row widths are in use at the different Stations. The ordinary row width on all Texas Substations, except Chillicothe, is 36 inches. At Chillicothe the row width is 40 inches, and at Big Spring and Dalhart, 44 inches. The preparation of the land and the cultivation were always in keeping with good farming practices and as uniform from one plat to another as the nature of the experiment would allow. When planted in rows, sorgo plants in the variety and date tests reported here were spaced 6 inches apart. Plant spacing for grain sorghums in the test reported in Table 13 varied according to the tillering and growth habit of the variety. Non-tillering varieties, such as kafir and Chiltex, were spaced 8 inches. Moderately tillering varieties were spaced 12 inches, and the tillering varieties, such as milo, were spaced 18 inches in the row. Except where the outline of the experiment called for planting on designated dates, as in date-of-planting experiments, planting was done during the favorable planting period for the region. Row plantings were made in lister furrows at all stations except Temple and Beeville, where planting was done behind a large sweep. Broadcast plantings were made with a grain drill at Chillicothe and by hand at Beeville.

Forage yields are the total plant production of stalks, leaves, and heads in tons of air-dry matter to the acre. Stover, as used in this publication, refers to the forage with the heads removed.

Grain yields are presented in bushels of 56 pounds. The grain was weighed just as it came from the thresher and test weight per bushel was determined at that time. Threshing percentages were computed by dividing the grain weight by the head weight of the sample or plat and multiplying by 100.

Plant height was measured from the ground to the tip of the panicle of an average plant. The number of stalks to plant was determined by dividing the number of stalks by the number of plants growing on a plat. Number of leaves is the modal number arrived at by counting the leaves on several consecutive plants. Length of growing season is the number of days that elapsed between planting and maturity. Except in broadcast plantings, a variety was considered mature when 90 per cent of the grain in the head was ripe. Sorgos might well be harvested for forage from 10 to 15 days prior to this date of maturity under some circumstances. The broadcast plantings were considered mature when they had made all the growth possible and were cut for hay.

All possible care was taken to insure good stands on the experimental plats. Planting was done at heavy rates, and throughout the experiments reported here any poor stand that was obtained resulted from inability of the seed planted on a particular plat to germinate under the unfavorable conditions existing. When poor stands were obtained over the entire area of an experiment, due to an untimely rain or some other cause beyond control, the test was replanted if the outline of the experiment allowed; otherwise, the results for the planting were omitted. There is an exception to this in the case of the date-of-planting experiments, where failures to obtain stands have been included in the tables as zeros.

When grain weights are given, heads were harvested with a pocket knife and cured until dry enough to thresh. The stover was cut by hand, with a sled, or with a row binder. Broadcast plantings for hay were cut with a mower, and were cured in the swath and in cocks. Forage weights, when heads and stover were harvested separately, were obtained by adding the air-dry head weights to the air-dry stover weights.

Methods of Obtaining Dry Forage Yields

Various methods have been resorted to in an effort to obtain accurate air-dry forage yields and at each Station the best method, considering the available equipment and the prevailing climatic conditions, has been used. The most usual method has been to take samples of the green forage, cut the forage into short lengths, and dry in burlap sacks by hanging the samples under a shed. Frequent stirring of the forage was necessary and the samples were moved into the sun when occasion offered. This method, although the best available at some Stations, does not give shrinkage percentages as accurate as is desirable, but the various samples were given identical treatments. At Lubbock both green and field-dry forage weights were recorded previous to 1928, but shrinkage percentages from green to air-dry forage were obtained from samples in the years 1928

to 1931, inclusive, and the average shrinkage figures arrived at for these years were applied to the green weights of previous years to obtain air-dry yields. At Chillicothe the method used since 1928 has been to take a representative sample of green forage from each plat as harvested and dry this sample beyond the point of air-dry moisture content in a forage drier that uses natural gas as a source of heat. After drying, these samples are hung under a shed to take up moisture until air-dry; and when all harvesting is completed, and after several days of dry weather with considerable wind movement, all samples are weighed. Shrinkages are then calculated and air-dry stover and forage yields computed. Although it was evident that this method in use at Chillicothe was as good as could be used under the circumstances, it was desirable to know the magnitude of the error introduced into forage yields when this method of arriving at shrinkage percentages was used. It was necessary to know, first, if air-dry samples of different varieties contain appreciably different percentages of moisture; and second, when samples are weighed only after several days of dry windy weather, if such weights will vary appreciably from month to month or from year to year. For information on the first question, three 500-gram samples each of Red kafir, Sumac, Spur feterita, and Dwarf Yellow milo were drawn from air-dry samples of the 1932 crop; and the second, four 500-gram samples of Sunrise kafir were drawn from an air-dry sample of stover on three different dates, October 24, 1932, November 22, 1932, and January 4, 1933. These samples were sealed in jars, and were dried individually at 98° C. for 24 hours in an electric drying oven in the laboratory of the Division of Forage Crops and Diseases, U. S. Department of Agriculture in Washington, D. C. Several hours before this 24-hour period of drying had elapsed the weights of the various samples had become constant. Three jars were broken in transit and results from these jars are, therefore, lacking.

The results obtained in determining whether or not air-dry samples of different varieties contain unlike amounts of moisture are shown in Table 1. The average percentages of dry matter in the samples of the various varieties fall between the extremes of 91.7 and 90.9, which are the figures for Sunrise kafir and for Dwarf milo, respectively. It may

Table 1. Percentage of moisture-free material in air-dry samples of stover of various varieties.

Sunrise kafir	Red kafir	Sumac	Spur feterita	Dwarf Yellow milo
92.0	92.0	90.2	92.0	91.1
91.2	92.0	91.2	91.2	90.7
92.0	90.7	91.6	90.7	
91.6				
Average 91.7	91.6	91.0	91.3	90.9

be that these slightly different percentage figures represent actual differences in moisture content between certain of the varieties, particularly between milo and the other three. Assuming the differences to be actual, there is a slight error if air-dry forage yields of Sunrise kafir and Dwarf Yellow milo are compared directly. The magnitude of that error may be arrived at if certain assumptions and calculations are made. Assuming identical yields of green stover of three tons per acre for both Sunrise kafir and Dwarf Yellow milo and identical shrinkage percentages of 70, the air-dry stover yield of each variety would be .90 ton per acre. In terms of moisture-free stover, however, the yield of Sunrise kafir would be 91.7 per cent of .90 ton, or .8253 ton. The moisture-free stover yield of Dwarf Yellow milo arrived at in like manner is .8181 ton. In yield of moisture-free stover per acre the two varieties differ by .0072 ton, or 14.4 pounds whereas their air-dry yields are identical. An error of such size is too small to be important and it is concluded that air-dry stover and forage yields arrived at by the method in use are, for all practical purposes in comparing varieties or treatments in any one year, as good as moisture-free yields; and have the advantage of being immeasurably easier to obtain.

The results obtained in determining if moisture content of air-dry samples varies from time to time are given in Table 2. Assuming a yield as before and the same shrinkage in the sample from green to air-dry stover, the Sunrise kafir yield of moisture-free stover would be .8253, .8280, or .7956 ton, depending on whether the sample was weighed on October 24, on November 22, or on January 4. The difference between the two extreme figures is .0324 ton, or 64.8 pounds to the acre. This error is small in comparison to the other errors of field trials but indicates that it would be a questionable practice to make small distinctions between air-dry stover or forage yields obtained by using air-dry stover samples that are weighed at different times. Comparison between yields, such as the yields taken in different years, from which this error cannot be eliminated are rarely made, and the errors that enter into forage yields from this source were not a hindrance to drawing any conclusions arrived at in this publication. These results point out the importance of weighing samples from all plats to be compared in any one year on the same day.

Table 2. Percentage of moisture-free material in air-dry samples of Sunrise kafir drawn on different dates.

Oct. 24	Nov. 22	Jan. 4
92.0	92.0	88.4
91.2	92.0	88.4
92.0	92.0	88.4
91.6		
Av. 91.7	92.0	88.4

Method of Obtaining Comparable Yield

It has been the policy in conducting the varietal experiments reported here to make the tests as comprehensive as possible and an effort has

been made to protect the continuity of the experiments where forage sorghums are of particular importance. There are many varieties of sorghums, however, and new ones have appeared from time to time that had to be included in the tests. As new ones were added others whose worth had been determined were necessarily dropped. Since there is no long period of years common to many of the varieties, the average yields are not a fair basis of comparison. In order to present the yields on as nearly a comparable basis as possible the following method has been used in calculating an average percentage rating and a comparable yield.

Varieties which were grown for the entire period were considered as "standard", or check, varieties and the average yield of these varieties in any year is considered to be the yield of the standard, or check, varieties for that year. The percentage rating of any particular variety was computed by dividing the total production of this variety by the total average production of the "standard" varieties for the same years and multiplying by 100. This percentage rating is, therefore, based on the behavior of the particular variety in question as compared to that of the "standard" varieties in the identical years when each was grown. For convenience in comparing the production of different varieties, since one ordinarily thinks of yield in terms of bushels or tons instead of percentages, a yield figure called "comparable yield" has been computed. This figure was obtained by multiplying the average production of the "standard", or check, varieties for the entire period by the percentage rating of each variety. Therefore, the percentage rating and the "comparable yield" figures are equivalent to each other, one being expressed in percentage and the other in tons or in bushels. These calculated yields allow all the varieties to be compared in terms of tons or bushels to the acre and for this reason are used as the basis of discussion of the yields throughout this Bulletin.

DESCRIPTION, HISTORY, AND YIELDS OF VARIETIES

Yield data on varieties are presented from eight points: Chillicothe, Lubbock, Spur, Big Spring, Dalhart, Temple, Beeville, and Balmorhea. The results at several stations go back more than 15 years, and with the exception of the results with a few varieties that were not grown for enough seasons to give a good trial, all yield data are shown in Tables 4 to 12. The majority of the varieties are grown only to a very limited extent in Texas at present, but it is considered to be important to record the behavior of all varieties. Included in Table 3 are figures that describe the varieties grown in recent years as to height, number of leaves, number of stalks to plant, length of growing season, threshing percentage, and test weight.

The authors are indebted to Mr. H. N. Vinall, Senior Agronomist, Division of Forage Crops and Diseases, and to Dr. J. H. Martin, Senior Agronomist, Division of Cereal Crops and Diseases, U. S. Department of Agriculture who very kindly allowed the use of information concerning the

origin of varieties contained in a manuscript which they have in preparation for publication which deals with the classification, description, and origin of varieties.

Sumac, commonly called Red Top, occupies the preponderance of the acreage devoted to sorgos in Texas and its popularity is justified as shown by the behavior of this variety at all points tested. The quality of the stover of this variety is excellent, and its seed production is well above the average. Its production is good in broadcast plantings as well as in rows, and Sumac is the variety ordinarily used in Texas for sowing broadcast for production of sorghum hay. There are a number of strains of this variety in existence and seed of a good strain should be obtained. Of the five strains tested at Lubbock, T. S. No. 6650 (F.P.I.35038), has been markedly superior. This strain (Fig. 3) has been distributed for about 15 years from the Chillicothe and Lubbock Stations, and undoubtedly is the strain now most commonly grown in Texas. Early Sumac, T. S. No.

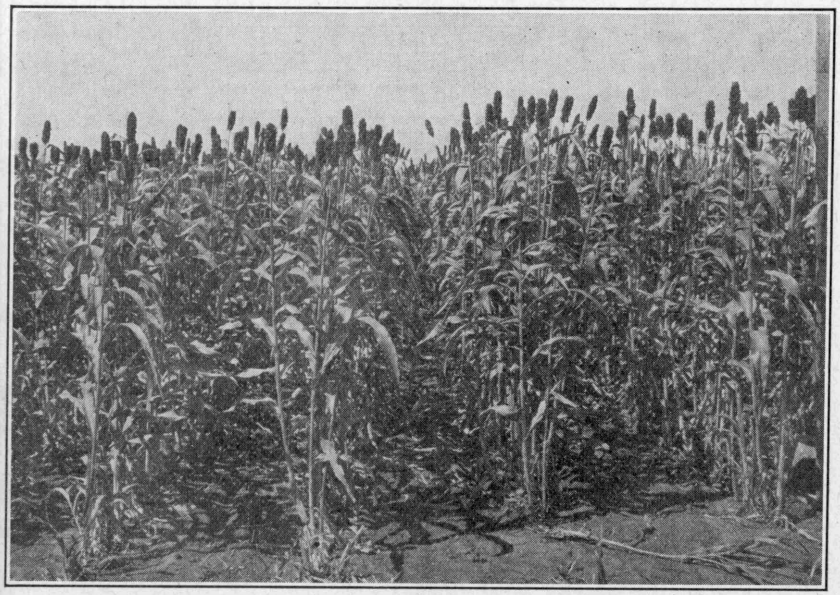

Fig. 3. Sumac sorgo is the most widely grown and most important forage sorghum in Texas. It produces 3 to 4 tons of forage to the acre in the western part of the State and 4 to 5 tons in the central and eastern parts.

8720 (F.C.6611), is a selection made at the Fort Hays Experiment Station, Hays, Kansas and is valuable in Kansas on account of its earliness. Since earliness is of no particular value in Texas, this variety is not as valuable as the ordinary Sumac. Sumac is strictly a forage variety, for, in spite of its good seed production, the grain is considered to be of little value in

Table 3. Summary of height, number of leaves, stalks per plant, length of growing season, threshing percentage, and test weight of sorgo varieties at Chillicothe, 1924 to 1933.

T. S. No.	Variety	Plant height, inches				No. of leaves	Stalks to plant				Length of growing season, days				Threshing percentage				Test weight			
		May 15	June 1	June 15	Ave.		May 15	June 1	June 15	Ave.	May 15	June 1	June 15	Ave.	May 15	June 1	June 15	Ave.	May 15	June 1	June 15	Ave.
1921	White African	101	98	108	102	15	1.1	1.1	1.1	1.1	113	108	110	110	69	69	62	67	55	54	55	55
8721	Kansas Orange	82	83	87	84	15	1.5	1.3	1.3	1.4	114	107	114	112	64	67	63	65	56	57	56	56
8718	Sourless	69	72	70	70	14	1.5	1.3	1.4	1.4	114	110	111	112	63	69	64	65	56	56	56	56
21001	Honey	93	98	95	95	15	1.3	1.4	1.4	1.4	139	132	126	132	56	53	48	52	48	45	41	45
6550	Sumac	74	76	76	75	15	1.2	1.2	1.2	1.2	111	104	107	107	70	72	69	70	58	58	58	58
42	Red Amber	75	79	81	78	12	1.4	1.3	1.3	1.3	98	91	92	94	64	67	63	65	49	50	50	50
1933	Orange	69	76	79	75	13	1.3	1.1	1.2	1.2	100	92	98	97	69	77	77	74	53	53	53	53
8717	Leoti	72	76	74	74	11	1.1	1.1	1.2	1.1	102	96	101	100	69	73	68	70	49	50	50	50
21003	Saccaline	91	89	89	90	15	1.2	1.3	1.2	1.2	113	106	109	109	68	69	69	55	55	56	56	56
8720	Early Sumac	64	68	72	68	11	1.3	1.2	1.2	1.2	101	93	97	97	61	65	65	64	56	57	57	57
21006	Atlas	75	75	70	73	15	1.6	1.2	1.4	1.4	114	106	111	110	64	70	66	67	58	57	57	57
21004	Saccaline	82	82	78	81	15	1.3	1.3	1.1	1.2	119	110	117	115	62	64	66	64	54	55	52	54
21005	Straight-neck	83	83	77	81	15	1.2	1.3	1.2	1.2	119	109	111	113	63	70	68	67	54	55	55	55
21002	Colman	75	70	67	71	15	1.1	1.0	1.1	1.1	117	107	110	111	63	66	64	64	54	55	55	55

feeding unless ground, as the seed are small and hard and pass through livestock undigested.

Sumac is one of the original 15 varieties brought into the United States indirectly from Natal, South Africa by Mr. Leonard Wray in 1857. This variety is easily recognized, as the heads are relatively small, compact, and cylindrical, being brownish-red in color with the seeds prominently exposed. The glumes are black to reddish-black but on mature heads are sometimes straw-colored or have straw-colored edges. There are no awns. The seed are small, dark reddish-brown and often show black or nearly black spots. In addition to there being pigment in the pericarp, there is a brown undercoat or nucellar layer. Sumac is a variety of medium height, around 6 feet, tillers less than some other varieties, and has an average length of growing season of about 110 days. Its threshing per cent is as high as that of any variety, being 70 at Chillicothe. The test weight of threshed grain is usually about 58 pounds to the bushel.

Dwarf Ashburn, sometimes called Dutch Boy, is grown to some extent in Texas by those who want a dwarf variety. Its production of forage is below that of Sumac at all points where they have both been grown. It has about as many leaves, however, and its lower production comes from its shorter stalks. The short internodes of this and other varieties of short stature and numerous nodes make it difficult for livestock to consume the stalks. Its forage is, therefore, not considered to be of as good quality as that of Sumac.

Dwarf Ashburn resembles Sumac in appearance except that it is more dwarf, tillers more, and there is a tendency for the heads to taper at the top. It has all the appearance of being of hybrid origin, Sumac probably being one of its parents.

Honey, sometimes called Japanese Seeded Ribbon cane, is, with the possible exception of Gooseneck, the heaviest-producing forage variety that has been tested. The variety is late in maturing, will not produce seed consistently on the High Plains, and fails to mature seed in June plantings at Chillicothe on occasion. No other variety, except Gooseneck, has approached it in yield of forage at Chillicothe, Spur, Dalhart, and Balmorhea, and at Lubbock and Big Spring its yield is as high as any (Fig. 4). Honey grows extremely tall and its size makes it difficult to handle during and after harvest. It will lodge during wind storms but is not bad in this respect, considering its height. Honey is probably the most important variety used in Texas in producing sorghum syrup; but is grown much less for forage than Sumac because of its low seed production, which makes good seed of this variety relatively expensive, and because the stalks grow to such size as to be hard to harvest and slow to cure. The average height of Honey is about 8 feet. The variety tillers about as readily as any. Its average length of season has been 133 days but there were seven times during ten years when June 15 plantings failed to mature seed at Chillicothe. These seven are not included in the average season days

Table 4: Forage yields of sorgo varieties grown in rows at Chillicothe, 1915 to 1933.

T. S. No.	Variety	Forage yield in tons to the acre																		No. of years grown	Average			Comparable yield, tons
		1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933		Tons: Actual	Tons: Standard varieties for same period	Percentage rating	
21001	Honey*	9.81	2.02	2.58	3.71	4.98	8.81	5.66	3.71	4.67	7.98	6.26	5.90	4.84	2.63	4.90	3.06	3.50	6.37	5.93	19	5.12	3.86	132.6	5.12
6550	Sumac*	6.85	2.29	2.50	2.91	3.05	4.56	2.54	2.25	3.37	4.44	4.64	5.21	4.45	3.02	3.78	2.03	3.76	4.71	4.64	19	3.74	3.86	96.7	3.73
8720	Early Sumac										3.99	3.28	4.45	3.98	2.35	3.16	1.75	3.47	4.49	3.59	10	3.45	4.19	82.4	3.18
1930	Dwarf Ashburn	4.85	1.92	1.75	3.65	2.42	4.35	2.41	2.32												8	2.96	3.48	85.0	3.28
1933	Orange	6.80	2.26	1.95	2.29	2.49															5	3.16	3.31	95.4	3.68
1919	Orange	4.20	1.48	1.10	1.63	2.28	2.55	1.85	1.56	1.60	3.50	2.86									11	2.24	3.79	59.1	2.28
8721	Kansas Orange									1.75	4.92	4.98	4.67	4.74	2.50	4.05	2.37	3.99	5.10	4.88	11	4.00	4.14	96.5	3.72
21002	Colman														3.19	4.32	2.57	3.97	5.27	4.95	6	4.05	3.76	107.7	4.16
1921	White African	5.30	2.35	2.33	2.89	4.02	6.00	4.74	2.83	3.25	5.52	3.85	4.44	3.58							13	3.93	3.91	100.5	3.88
1355	Gooseneck						5.29	6.56	4.57												3	5.47	3.76	145.4	5.61
21003	Saccaline										4.34	4.36	5.14	3.99	3.34	4.19	2.94	3.89	5.31	5.15	10	4.27	4.19	101.9	3.93
21004	Saccaline														3.64	4.30	2.88	4.12	5.19	5.52	6	4.28	3.76	113.8	4.39
21005	Straight-neck														3.36	3.87	2.82	3.63	5.20	5.12	6	4.00	3.76	106.5	4.11
8718	Sourless										4.47	5.65	4.68	4.57	2.59	4.28	2.16	3.84	4.46	4.91	10	4.16	4.19	99.4	3.84
1931	McLean	2.50	1.37	1.60	2.46	3.90															5	2.37	3.31	71.5	2.76
21006	Atlas												5.18	4.01	2.52	3.79	2.32	3.82	5.15	5.05	8	3.98	3.97	100.3	3.87
42	Red Amber*	2.83	1.55	1.26	.93	2.39	2.42	1.67	2.27	3.05	3.80	3.16	3.85	3.42	2.87	3.66	2.28	2.86	4.13	3.48	19	2.73	3.86	70.7	2.73
1924	Dakota Amber	2.32	1.08	1.03	.94	2.39															5	1.55	3.31	46.9	1.81
1932	Collier	4.00	1.34	1.33	2.22																4	2.22	3.27	68.0	2.62
2758	Clubhead				1.52	2.21	2.57	1.56	1.78												5	1.93	3.46	55.8	2.15
8717	Leoti									3.14	4.59	3.44	3.32	3.49	2.45	3.76	1.75	3.08	4.18	3.57	11	3.34	4.14	80.7	3.12
21007	White African x Sumac															5.05	2.50	4.02	5.76	5.14	5	4.49	3.94	114.1	4.40
21008	White African x Sumac															5.15	2.42	—	5.96	5.38	4	4.73	4.08	115.9	4.47
21009	White African x Sumac															3.95	2.11	3.41	4.36	4.25	5	3.62	3.94	91.8	3.54
21010	White African x Honey															4.63	2.49	3.68	5.62	5.20	5	4.32	3.94	109.8	4.24
21011	White African x Honey															5.39	2.62	4.10	5.28	4.61	5	4.40	3.94	111.7	4.31
21012	White African x Honey															4.75	2.67	4.51	5.09	4.96	5	4.40	3.94	111.6	4.31
21013	White African x Honey															4.78	2.58	4.31	5.04	5.16	5	4.37	3.94	111.1	4.29
21014	White African x Orange															4.76	2.64	4.28	5.05	5.26	5	4.40	3.94	111.7	4.31

*Standard variety.

of 133. The heads are long with long seed branches that are sparsely seeded. The glumes are brownish-red and adhere to the seed even after threshing. The variety is awned.

The origin of Honey has not been definitely determined but it is thought that this variety is another of those introduced from Natal, South Africa in 1857.

Gooseneck is, along with Honey, one of the two largest producers of forage. It is even later than Honey in maturing and seed of this variety is frequently hard to obtain on the market. Gooseneck is used to

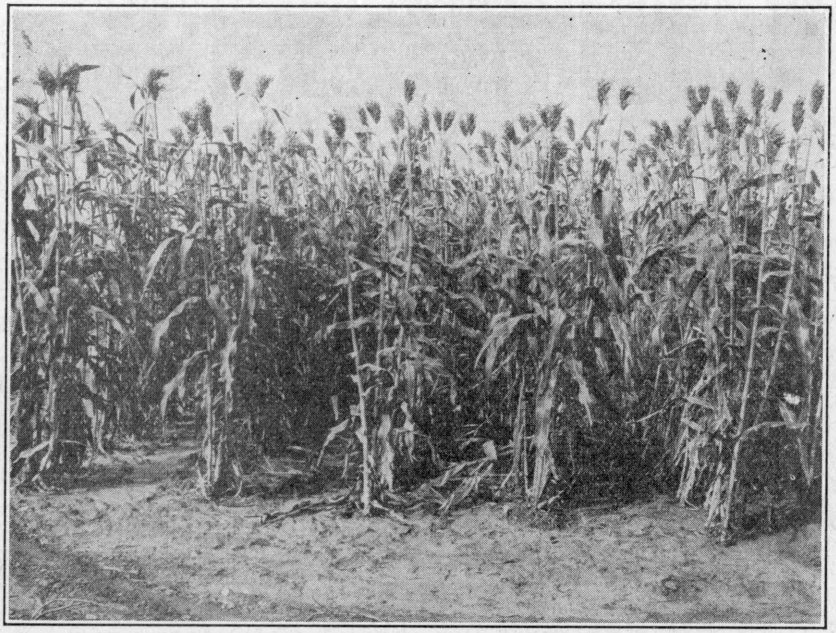

Fig. 4. Honey is the highest yielding variety of sorgo producing a large tonnage for silage and is a valuable syrup sorgo. Photograph shows yield of more than 20 tons of green and 8.7 tons of dry forage to the acre at Chillicothe in 1920.

some extent in making syrup. It is extremely tall and was at one time grown to a considerable extent but its size, which makes it difficult to harvest, together with its lateness, has relegated it to a place of little importance.

As indicated by its name, the heads are inclined or recurved and have a tendency to be larger at the tip than at the base. The glumes are black with reddish-brown tips. The lemmas are awned. The seed are dark reddish-brown and a nucellar layer is present. Some strains of this variety have seed with waxy endosperm.

The Gooseneck variety is considered to be another of those introduced by Leonard Wray in 1857 from Natal.

Table 5. Grain yields of sorgo varieties grown in rows at Chillicothe, 1915 to 1933.

T. S. No.	Variety	Grain yield in bushels to the acre																		No. of years grown	Average			Comparable yield, bushels
		1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933		Bushels			
																					Actual	Standard varieties for same period	Percentage rating	
21001	Honey*	2.3	0	.3	.8	0	13.2	2.8	4.6	11.4	5.1	10.9	8.1	4.7	3.5	8.8	9.2	12.1	17.0	10.6	19	6.6	16.3	40.6	6.6
6550	Sumac*	21.3	0	1.5	4.1	18.7	21.8	18.7	11.9	15.4	27.5	35.4	48.1	38.3	18.7	22.3	5.2	16.9	31.7	27.5	19	20.3	16.3	124.5	20.3
8720	Early Sumac										34.2	26.1	46.4	34.1	14.8	18.2	5.4	20.8	26.6	16.8	10	24.3	20.5	118.6	19.3
1930	Dwarf Ashburn	27.3	0	1.4	2.6	12.8	23.0	13.1	3.4												8	10.5	11.0	95.3	15.5
1933	Orange	31.3	0	2.8	5.7	17.2															5	11.4	8.4	135.4	22.1
1919	Orange	28.2	13.8	2.2	5.2	19.4	25.7	20.4	20.8	7.8	34.6	18.3									11	17.9	13.4	133.4	21.7
8721	Kansas Orange									8.7	29.9	27.1	42.7	38.4	8.7	18.2	7.4	14.5	31.3	30.6	11	23.4	20.1	116.3	19.0
21002	Colman														16.7	24.1	8.9	14.1	23.0	24.8	6	18.6	17.9	103.7	16.9
1921	White African	22.6	0	1.1	1.1	24.3	31.0	23.9	7.6	6.2	33.2	26.5	31.4	19.9							13	17.6	15.5	113.5	18.5
1355	Gooseneck						15.4	6.8	3.2												3	8.5	15.2	55.7	9.1
21003	Saccaline										37.3	30.0	42.2	24.0	23.6	24.9	10.2	14.3	35.7	26.8	10	26.9	20.5	131.1	21.4
21004	Saccaline														20.4	16.1	4.6	8.6	26.5	26.3	6	17.1	17.9	95.3	15.5
21005	Straight-neck														17.4	15.5	8.9	9.2	29.9	25.1	6	17.7	17.9	98.5	16.1
8718	Sourless										34.0	38.3	42.8	41.8	18.2	20.6	5.1	14.3	31.4	34.0	10	28.1	20.5	136.7	22.3
1931	McLean	21.2	0	2.4	.3	17.8															5	8.3	8.4	99.0	16.1
21006	Atlas												44.5	31.1	15.6	23.5	3.2	8.6	33.6	36.1	8	24.5	20.3	121.1	19.7
42	Red Amber*	32.9	13.7	5.2	3.3	22.3	27.6	21.8	14.3	22.0	33.3	17.4	37.9	26.1	27.2	21.9	15.0	23.9	32.1	19.2	19	22.0	16.3	134.9	22.0
1924	Dakota Amber	26.2	14.1	4.6	6.3	23.5															5	14.9	8.4	177.4	28.9
1932	Collier	26.7	8.8	4.3	4.1																4	11.0	7.1	154.6	25.2
2758	Clubhead				7.4	16.6	27.5	21.8	17.5												5	18.2	12.4	146.5	23.9
8717	Leoti									8.2	38.0	24.5	35.4	29.4	24.0	27.6	13.0	30.8	37.6	27.1	11	26.9	20.1	133.5	21.8
21007	White African x Sumac															18.6	3.1	14.5	32.1	24.7	5	18.6	18.2	102.1	16.6
21008	White African x Sumac															15.5	3.3	—	29.4	24.9	4	18.3	18.4	99.5	16.2
21009	White African x Sumac															27.6	7.1	22.1	25.4	21.4	5	20.7	18.2	113.7	18.5
21010	White African x Honey															15.3	11.7	22.5	20.9	28.9	5	19.9	18.2	109.0	17.8
21011	White African x Honey															19.6	11.4	24.5	30.7	33.0	5	23.8	18.2	130.8	21.3
21012	White African x Honey															27.6	4.3	21.6	24.1	24.2	5	20.4	18.2	111.7	18.2
21013	White African x Honey															27.0	7.5	25.3	25.9	26.4	5	22.4	18.2	123.1	20.1
21014	White African x Orange															18.6	8.1	15.1	24.2	31.0	5	19.4	18.2	106.5	17.4

*Standard varieties.

Colman has been grown at Chillicothe and at Big Spring. The variety has produced more forage but less grain than Sumac at Chillicothe, and less of both forage and grain at Big Spring.

Colman originated as a selection from the progeny of a natural hybrid grown in 1887, whose parents were thought to have been Kansas Orange and Early Amber. Selection by A. A. Denton at the sugar sorghum experiment station of the U. S. Department of Agriculture, located at Sterling, Kansas, resulted in the variety which was named in honor of the Hon. Norman J. Colman, Commissioner of Agriculture.

The strain which was grown at Chillicothe is slightly shorter than Sumac and tillers more than that variety. The heads are of medium size, erect, dense to mid-compact, and cylindrical to tapering at base and tip. The glumes are an intense dark red and the seed are light buff to reddish-brown.

White African has been grown at several Stations and has usually produced well. Its grain production is practically as good as that of Sumac, and its forage production has frequently been as good or better (Fig. 5).

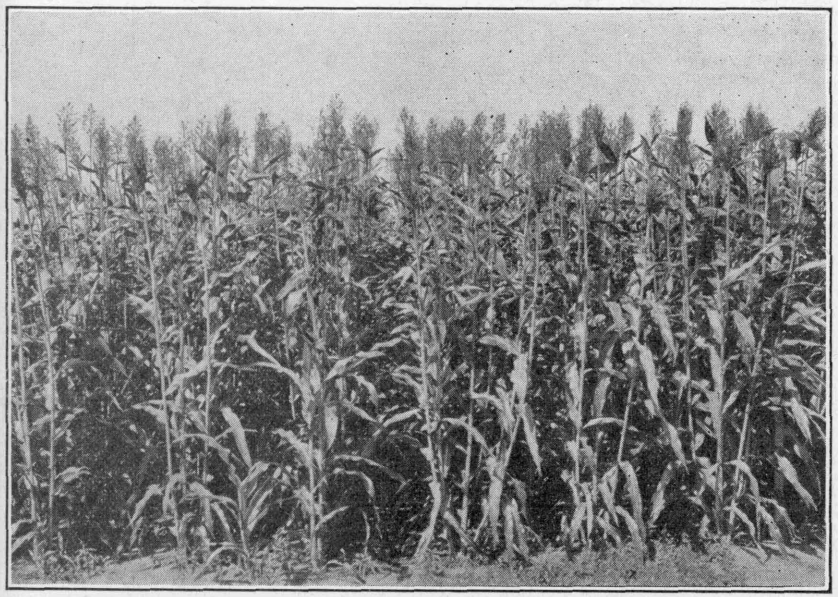

Fig. 5. White African sorgo, yielding 13.5 tons of green forage and 4.6 tons of dry forage to the acre.

The quality of its forage is not particularly good, however. Its good production is a reflection of its great height and there are relatively few leaves, considering its height.

Table 6. Forage yields of sorgo varieties grown in rows at Lubbock, 1912 to 1931

T. S. No.	Variety	Forage yield in tons to the acre																			No. of years grown	Average			Comparable yield, tons
		1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931		Tons			
																						Actual	Standard varieties for same period	Percentage rating	
1660	Honey			8.47	6.68	4.48	.98	.96	7.89	6.17	4.79	1.55	3.87	1.29	2.99	3.00	3.14	4.07	2.72	.69	1.97	18	3.65	2.59	141.0	3.55
1661	Sumac*	3.05	1.43	10.83	6.66	4.62	.40	.41	5.20	3.93	2.86	1.69	2.43	1.30	2.05	2.87	2.41	3.49	2.44	1.31	2.10	20	3.07	2.52	122.0	3.07
1664	Sumac				6.87	5.24	.75	.66	7.59	3.88	3.54	1.77	3.49	1.10	3.39	4.06	2.86	4.17	2.52	.98	2.58	17	3.26	2.34	139.1	3.51
2896	Sumac							.76	5.10	2.71	2.81	1.91	3.15	1.56	2.12	3.34	2.58	3.16	2.22	.62	2.21	14	2.45	2.28	107.1	2.70
6550	Sumac											2.23	3.32	2.00	2.96	3.04	3.44	4.61	3.07	1.10	2.78	10	2.86	1.98	144.3	3.64
8720	Early Sumac															3.05	2.83	3.73	2.19	1.10	2.32	6	2.54	2.18	116.5	2.94
1930	Dwarf Ashburn					3.28	.45	.82	7.10	4.68	1.92	2.29	3.10	1.41	2.62	3.37	2.98	4.57	2.74	1.05	2.27	16	2.79	2.20	126.9	3.20
1657	Orange*	4.07	.99	5.73	5.94	3.22	.54	1.27	7.89	6.02	2.85	2.07	3.02	1.86	3.17	3.59	2.12	4.67	2.87	1.16	2.36	20	3.27	2.52	129.8	3.27
8721	Kansas Orange															3.92	3.20	4.61	2.95	1.32	2.39	6	3.07	2.18	140.8	3.55
1921	White African					4.07	.30	.26	3.54	5.27	3.33	1.62	2.95	2.01	3.31	4.13	3.24	4.25	3.04	1.21	2.20	16	2.80	2.20	127.1	3.20
1659	Gooseneck			6.23	6.39	4.00	.56	.58	6.57	5.95	4.96	1.84	2.60	1.36	1.44	3.87	3.09	5.01	2.70	.87	2.59	18	3.37	2.59	130.0	3.28
1667	Orange					3.64	.81	.92	6.62	5.91	1.78	1.96	3.47	2.25	3.51	4.12	2.90	5.05	3.07	1.24	2.59	16	3.12	2.20	141.7	3.57
8718	Sourless															3.30	3.82	4.64	2.73	.95	2.27	6	2.95	2.18	135.6	3.42
1768	Planter			8.95	6.51	4.21	.74	1.45	8.82	5.56	2.74	1.96	2.55	1.86	2.48	3.62	2.93	4.59	2.77	1.17	2.76	18	3.65	2.59	140.9	3.55
10475	Atlas																	4.71	3.18	.98	2.27	4	2.79	2.17	128.5	3.24
42	Red Amber*	2.75	1.51	7.30	3.74	2.81	.66	.57	7.42	4.16	1.59	1.39	2.28	1.52	2.04	2.22	2.56	3.50	3.04	1.24	2.43	20	2.74	2.52	108.6	2.74
1656	Black Amber*	1.94	.63	5.89	4.36	1.36	.41	.43	5.64	2.36	1.85	1.29	1.48	.71	1.29	1.86	2.05	2.30	2.32	1.32	2.04	20	2.08	2.52	82.4	2.08
1932	Collier					2.06	.68	.67	6.45	2.70	2.87	1.64	2.02	1.50	1.95	2.54	2.20	3.18	2.86	1.17	2.42	16	2.31	2.20	104.9	2.64
6928	Collier															4.12	2.82	4.07	2.91	.99	2.94	6	2.98	2.18	136.7	3.44
8717	Leoti															3.12	2.76	3.92	3.05	1.25	1.94	6	2.67	2.18	122.8	3.09
41	Freed*	1.50	1.16	3.98	2.70	1.46	.55	.32	4.49	1.12	.60	1.10	1.61	.57	.75	1.30	.97	1.00	1.80	.80	1.17	20	1.45	2.52	57.4	1.45

*Standard variety.

White African is one of the varieties introduced by Wray in 1857. The variety is quite late but not as late in maturing as Honey. It tillers very sparsely. The heads are erect; the glumes are brownish-black; lemmas are not awned; and the seed are white with no undercoat present.

Saccaline and **Straightneck** are considered together because they probably have a common origin and are quite similar in growth habit, the distinguishing characteristics being botanical. The two strains of Saccaline and Straightneck have produced as well at Chillicothe as Sumac. At Big Spring, however, Saccaline performed rather poorly. These varieties are probably variations of the old variety, Sapling, which is of undetermined origin but probably arose from one of Leonard Wray's introductions. Saccaline was obtained under that name from Australia in 1919, where it apparently originated as a selection of the Sapling, since it is quite similar to it in all important characteristics. Saccaline is slightly later to mature than Sumac. The heads are erect, long, mid-compact, and cylindrical. The glumes are black. The seed are dark reddish-brown in color and a nucellar layer is present.

Sourless, or **African Millet**, has been grown at Chillicothe, Lubbock, Big Spring, and Dalhart. Its production at Chillicothe and Lubbock has been good, its behavior at Big Spring has been disappointing, and it has not been outstanding at Dalhart. The consistency with which this variety yields in certain areas and the exellence of its forage makes it the most serious competitor that Sumac has. This variety is less susceptible to attack from Sorghum red spot (*Bacterium andropogoni*) than any common variety except Leoti. Sourless is remarkable for its ability to retain its lower leaves even through periods of prolonged drought, and its resistance to the red spot disease is responsible. The disease is most virulent on the leaf sheaths and when the infection becomes bad enough on the ordinary susceptible varieties to hinder the flow of plant fluids, the death of the leaves results.

The grain yield of Sourless has been above that of Sumac at Chillicothee, but below that of Sumac at Lubbock. This variety deserves a thorough trial all over Texas but appears particularly adapted to Northwest Texas below the Cap Rock. In that territory its good grain yield and excellent quality of stover, along with the fact that the variety does not grow too tall to be easily handled, make it a valuable forage variety (Fig. 6).

African Millet is an unfortunate name to be applied to a sorghum because of the likelihood of confusion with the true millets, particularly so as this variety is the same as the variety Sourless, which was grown 20 to 25 years ago. Sourless had its origin as one of the 15 varieties introduced from Natal by Wray in 1857.

Sourless is shorter than most other sorgo varieties and, as an average, has been about 4 inches shorter than Sumac. It suckers as much as any variety. On the average it has been 5 days later in maturing than

Table 7. Forage yields of sorgo varieties grown in rows at Spur, 1913 to 1921.

T. S. No.	Variety	Forage yield in tons to the acre									No. of years grown	Average			Comparable yield, tons
												Tons		Per-centage rating	
		1913	1914	1915	1916	1917	1918	1919	1920	1921		Actual	Standard varieties for same period		
3257	Honey						2.30		6.28		2	4.29	3.41	125.8	6.99
161	Sumac*	4.41	7.69	10.68	5.37	7.56	2.15	6.03	4.48	5.13	9	5.94	5.56	106.9	5.94
1930	Dwarf Ashburn				4.70	2.68				3.53	3	3.64	5.62	64.7	3.60
1706	Orange*	4.17	7.97	6.09	4.76	5.26	2.45	5.68	4.56	5.63	9	5.17	5.56	93.0	5.17
1919	Orange				2.96	4.98	2.80	5.30			4	4.01	4.91	81.7	4.54
1931	McLean				4.31	3.56					2	3.94	5.74	68.6	3.81
3256	Straight head						2.55		4.25		2	3.40	3.41	99.7	5.54
42	Red Amber	2.81	5.15	5.83	2.46	4.06	1.90	5.30			7	3.93	5.74	68.5	3.81
175	Black Amber	1.64	5.94	5.81	1.68	2.95					5	3.60	6.40	56.3	3.13
2758	Clubhead				1.76	4.53	1.95	3.01	4.02	3.98	6	3.21	4.92	65.2	3.63
1932	Collier				3.16	3.20	1.95		2.82		4	2.78	4.58	60.8	3.38
1924	Dakota Amber				1.82	3.34	1.55	4.06	2.94	2.89	6	2.77	4.92	56.2	3.12
41	Freed			6.19	1.23	2.51					3	3.31	6.62	50.0	2.78

*Standard varieties.

Sumac. Its threshing percentage has been 65, which is 5 per cent below that of Sumac. The heads of Sourless are erect, cylindrical, but tapering toward the tips; glumes are straw-colored or have reddish-brown spots;

Fig. 6. Sourless, or African Millet, is a high-yielding and valuable sorgo variety, resistant to sorghum red spot, and should be more extensively grown in Texas. Yield: 15 tons of green and 5.2 tons of dry forage per acre.

lemmas are not awned. The seed are buff to light brown in color. A nucellar layer is present.

Orange sorgo, of which there are a number of strains, is not nearly as important a variety in Texas as in several other states. The grain and forage production of the strains that are as late or later than Sumac in maturity is usually as high or higher than that of Sumac, but the early strain, T. S. No. 1919 (F.C.6609), is much lower in production. The strains that compare with Sumac in yield will lodge more than Sumac. The plants are relatively tall, have about 15 or 16 leaves, and tiller more than most varieties. Panicles are erect and are usually cylindrical in shape, but sometimes taper toward the tip and base, have seed branches of medium length, and are considerably larger than heads of Sumac Glumes are dark reddish-brown or reddish-black, depending upon the

Table 9. Yields of foraae from sorghum varieties at Dalhart, 1919 to 1932.

Variety	Forage yield in tons to the acre														No. of years grown	Average			Comparable yield, tons
																Tons			
	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932		Actual	Standard varieties for same period	Per-centage rating	
Honey*	7.30	6.65	4.15	1.80	4.48	5.07	6.13	3.23	4.38	8.80	7.28	4.05	4.24	3.25	14	5.06	3.91	129.3	5.06
Sumac	5.90	5.48	7.46	1.45	3.76	4.94									6	4.83	3.93	122.8	4.80
Early Sumac							3.20	3.40	2.75	2.78	4.64	2.58	2.67	2.27	8	3.04	3.90	78.0	3.05
Kansas Orange			4.22	2.08	3.87	3.80	3.98	4.75	3.60	3.73	6.41	3.31	3.74	2.47	12	3.83	3.68	104.1	4.07
Colman			4.43	1.50	4.65	4.56									4	3.79	3.25	116.5	4.56
Sourless			3.95	1.70	3.33	3.98	5.80	3.50	4.33	3.93	5.51	3.04	3.47	2.40	12	3.75	3.68	101.8	3.98
Atlas										4.33	6.15	3.05	3.35	2.67	5	3.91	3.99	98.0	3.83
Red Amber	3.58	3.61	3.06	1.53	2.30	1.40									6	2.58	3.93	65.6	2.56
Leoti						3.31	4.20	3.43	3.68	3.90	5.28	2.94	3.35	2.42	9	3.61	3.87	93.4	3.65
Darso*	3.62	3.63	3.91	1.35	3.00	2.22	3.00	3.08	2.58	2.50	4.29	2.22	1.89	1.35	14	2.76	3.91	70.6	2.76
Freed	3.35	3.00	2.78	1.79	1.38										5	2.46	3.99	61.7	2.41
Sudan grass	2.98	2.10	1.74		1.75	1.38	1.95	2.13	1.90	1.68	1.39	1.53	1.61	1.26	13	1.80	4.09	44.0	1.72
Drilled:																			
Leoti										4.68	6.21	4.36	4.26	3.00	5	4.50	3.99	112.8	4.41
Sudan grass	3.40	1.08	1.63	.63		1.23	1.85	2.65	1.25	1.63	2.48	1.38	2.34	1.42	13	1.77	3.92	45.0	1.76

*Standard variety.

strain. Lemmas are not awned. The seed are dark to light reddish-brown and Kansas Orange has dark spots on the seed coat. There is pigment in the pericarp and a nucellar layer is present.

The history of the Orange variety is obscure, particularly so as the variety does not resemble any variety in Wray's descriptive catalog. It is probable that it originated from a hybrid in the early years after Wray's varieties were introduced into the United States.

Planter, also known as Planter's Friend, has been grown at Lubbock, and its production at Lubbock has been quite good. The variety is quite similar to Sourless except that it is slightly later in maturity and taller. The head shape is the distinguishing characteristic of Planter. The rachis is short and the seed branches are relatively long. The head is, therefore, relatively short and the seed branches droop at the tip producing a head that is quite similar to that of Schrock in shape.

Although similar to the Sourless variety in many respects, Planter evidently was not one of Wray's introductions, and its history is not known. Planter's Friend was grown in India as early as 1875 and Australia before 1888. It had been introduced into those countries from South Africa.

McLean has been grown at Chillicothe, Spur, Temple, and Balmorhea, and has been below the better varieties in production at all points. The variety is about as tall as Sumac and matures with that variety, or a few days earlier. The heads are erect, cylindrical, and relatively loose. The glumes are black with straw or reddish-brown apices and the lemmas are not awned. The seed are reddish-brown and are somewhat narrow and pointed toward the apex. A nucellar layer is present.

The McLean variety was received by the U. S. Department of Agriculture from Australia in 1890.

Atlas has been grown at Chillicothe, Lubbock, and Big Spring. Its production at Chillicothe has been relatively better than at either of the other points. While the yields of this variety have been fairly satisfactory at Chillicothe, Atlas is not considered to be of particular value in Texas because of certain shortcomings. The stems of Atlas are coarse and in most respects, except sweetness, resemble kafir more than a sorgo. The variety is particularly sensitive to adverse moisture conditions during the several weeks prior to booting and the variety rarely produces a good seed crop from the main heads. However, a good seed crop is usually produced from numerous branch heads, but if the crop is permitted to stand until the grain is mature, the stover will have deteriorated in quality. The variety is valuable in Kansas for its ability to stand without lodging, and for its white tannin-free seeds that resemble kafir and will sell on the market as kafir.

This variety was originated by Dr. J. H. Parker of the Kansas Station through selection from the progeny of a Blackhul kafir-Sourless sorgo cross made by I. N. Farr of Stockton, Kansas.

Atlas matures a few days later and is slightly shorter than Sumac. It tillers about as much as any sorgo and has a relatively high threshing

Table 8. Yields of forage from sorgo varieties grown in rows at Big Spring, 1915 to 1933.**

Variety	Forage yield in tons to the acre																			No. of years grown	Average			Comparable yield, tons
	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933		Tons: Actual	Tons: Standard varieties for same period	Percentage rating	
Honey*	7.87	6.53	0	.30	4.60	9.88	2.49	4.63	3.25	2.65	3.19	7.65	4.08	3.91	5.88	3.29	2.00	7.00	4.68	19	4.41	3.21	137.6	4.42
Sumac	10.01	—	0	.39	4.53	7.75	3.30	4.39	3.58	2.35	2.58	6.16	2.94	4.53	3.82	4.28	1.25	4.72	4.49	18	3.95	3.15	125.3	4.02
Orange	6.48	1.88	0	.36	4.78	4.67	2.36	1.88	1.30	1.11										10	2.48	3.14	79.0	2.54
Kansas Orange							2.14	2.37	2.38	2.81	2.20	3.53	2.35	3.70	3.32	2.60	2.25	2.63	2.24	13	2.66	3.03	87.7	2.82
Colman								2.70	2.94	2.23										3	2.62	2.52	104.2	3.34
White African		3.38	0	.31	5.30	8.55	3.14	3.51	2.44	3.00		6.30	2.63	3.80	3.38	2.93	3.25	3.53	4.19	17	3.51	3.09	113.6	3.65
Seeded Ribbon					5.32	4.88	2.30	2.28	1.90	1.93										6	3.10	3.42	90.6	2.91
Sourless							2.04	2.75	1.66	2.51	1.46	3.19	1.94	3.89	2.75	2.22	2.25	3.05	2.44	13	2.47	3.03	81.7	2.62
Sourless												4.15	2.84	3.43						3	3.47	3.71	93.5	3.00
Saccaline												3.36	2.89	3.05	2.82	1.79	2.50	4.35	3.09	8	2.98	3.41	87.4	2.81
Atlas														3.25	2.69	2.33	2.25	2.99	3.25	6	2.79	3.27	85.5	2.74
Red Amber*	4.56	2.00	0	.50	3.41	3.60	1.98	2.00	1.63	.93	1.31	2.35	1.31	2.96	1.00	1.90	2.63	2.20	1.72	19	2.00	3.21	62.3	2.00
Freed	2.34	2.71	0		3.02	2.20	1.74	1.68	.99	1.06	.28	1.56	.82	1.68						13	1.54	3.42	45.2	1.45
Leoti									1.23	1.28	1.06	2.24	.98	3.18	1.00	1.94	3.25	2.24	1.40	11	1.80	3.07	58.6	1.88
Black Amber	3.03	1.65	0	.43	3.56	3.49	1.87													7	2.00	3.41	58.8	1.89

*Standard varieties.

**These results in different form have been published in U.S.D.A. Circular No. 202, February 1932, by F. E. Keating.

percentage. The test weight of the grain has averaged 57 pounds. The heads are erect and resemble kafir except that they are not as long. The glumes are black and the lemmas are not awned. The seed are white with fewer dark spots than are found on seed of Blackhul kafir. There is no nucellar layer present.

Collier has been grown at Chillicothe, Lubbock, Spur, and Temple, and its yield was low at each Station. The variety is easily recognized as the panicles resemble broomcorn somewhat since the rachis consists usually of one node and the rachis seed branches are long. The glumes are straw-colored to reddish-brown or black, lemmas are not awned, and the seed are reddish-brown in color.

Collier was received by the U. S. Department of Agriculture from Natal, South Africa in 1881.

The Amber varieties, as considered here, include the black-glumed types such as Chinese Amber, Dakota Amber, and Clubhead, any of which may frequently be called Black Amber, and the red-glumed type such as Red Amber and Leoti. From the standpoint of the origin of the varieties

Table 10. Yields of sorgo varieties grown in rows at Temple, 1916 to 1919.

T. S. No.	Variety	Yield of forage in tons per acre				
		1916	1917	1918	1919	Ave.*
1921	White African	6.08	6.39	3.02		5.16
2896	Sumac				7.15	
1933	Orange	4.41	3.00	.55	7.15	2.65
1931	McLean	4.59	4.46	1.92		3.66
1932	Collier	3.86	2.23	.58	7.98	2.22
1930	Dwarf Ashburn	4.14	2.80	1.38		2.77
1941	Freed	3.09	1.71	1.10	3.58	1.97
1919	Orange	3.33		1.10		
1924	Dakota Amber	2.48	1.13			

*Not including 1919.

these should probably not be considered together, but their many other points of similarity make it convenient to so consider them.

All of these varieties, whenever grown in Texas, have been much lower in production than Sumac and Honey. They are the earliest of the sorgos, but since earliness is ordinarily of no benefit in Texas, they are not considered to be of particular value. Black Amber and Red Amber are used for broadcast plantings in Central Texas to some extent, however.

Chinese Amber was the first sorgo introduced into America. It came from Tsungming Island, China by way of France in 1853. The panicles are erect, and seed branches are long. The glumes are black or brownish-black. Some strains have awned lemmas and some do not. Chinese Amber seed has a waxy endosperm as the starch reserves stains red with iodine, whereas the non-waxy starch in the endosperm of other common varieties stains blue.

Table 11: Forage yields of sorgo varieties from broadcast plantings at Beeville, 1925 to 1931.

T. S. No.	Variety	Forage yield in tons to the acre							No. of years grown	Average Tons Actual	Average Tons Standard varieties for same period	Average Percentage rating	Comparable yield, tons
		1925	1926	1927	1928	1929	1930	1931					
8454	Sumac*	4.43	4.66	5.02	2.09	8.99	9.70	5.41	7	5.76	5.25	109.6	5.75
8453	Early Amber	1.82	4.51		1.96	8.67	9.97	5.09	6	5.34	5.29	101.0	5.30
8452	Early Orange*	1.21	4.11	5.12	2.37	6.16	8.07	6.18	7	4.75	5.25	90.3	4.74
	Sugar Drip			5.78	2.05	7.46	7.13	7.46	5	5.98	5.91	101.0	5.30

*Standard varieties.

Table 12. Forage yields of sorgo varieties grown in rows at Balmorhea.

T. S. No.	Variety	Forage yield in tons to the acre								No. of years grown	Average Tons Actual **	Average Tons Standard varieties for same period**	Average Percentage rating	Comparable yield, tons
		1912	1914	1916	1917	1918	1919	1920	1921					
1352	Honey		7.1	7.67	1.24		10.03	13.08	5.15	5	7.43	3.90	190.5	7.43
176	Sumac	8.00	8.90	6.13	.86	10.40				3	5.80	3.41	169.8	6.62
1930	Dwarf Ashburn			5.17	2.34	6.73				3	4.75	3.41	139.1	5.42
1350	Orange*			6.87	1.05	2.59	5.68	3.88	3.28	6	3.89	3.90	99.9	3.90
1933	Orange*			4.78	2.27	5.01	7.10	5.63	3.92	6	4.79	3.90	122.8	4.79
1931	McLean*			3.41	2.96	4.88	3.67	6.78	3.83	6	4.26	3.90	109.2	4.26
1921	White African			5.74	2.28	6.94				3	4.99	3.41	146.1	5.70
5831	Silver Top							5.53	3.45	2	4.49	4.10	109.6	4.27
1355	Gooseneck			10.73						1	10.73	4.51	237.9	9.28
42	Red Amber	3.31	6.80	3.42			5.07	6.55	2.65	4	4.42	4.41	100.3	3.91
175	Minnesota Amber	4.00	8.20	4.21	1.93	2.26				3	2.80	3.41	82.0	3.20
1924	Dakota Amber*			2.99	1.20	2.97	3.32	3.10	2.33	6	2.65	3.90	68.1	2.66
1348	Dakota Amber			3.16	1.20	2.90	3.44			4	2.68	3.80	70.5	2.75
41	Freed	1.49	3.40	2.04	1.03					2	1.54	3.19	48.1	1.88

*Standard variety.
**Not including 1912 and 1914.

Red Amber is quite similar to Black Amber but is slightly taller and somewhat later. Red Amber is distinguished from Black Amber by its reddish-brown glumes, which give the heads a shiny reddish-brown appearance. Red Amber was probably selected from seed introduced from Australia in 1903, but its history previous to then is not known definitely. The endosperm of Red Amber, unlike that of Chinese Amber, is starchy.

Dakota Amber is an early Amber, evidently of hybrid origin, since its endosperm, unlike Chinese Amber, is starchy. The parent variety from which selection was made was Minnesota Amber. Selection took place at the U. S. Experiment Farm, Newell, S. D., and it was distributed from there in 1915.

Clubhead is grouped with the Ambers because it resembles them in its growth habit and earliness of maturity; but it is a more leafy type than certain of the other Ambers. Its origin is unknown, but since it has a waxy endosperm, Chinese Amber is probably in its parentage.

Leoti, or **Leoti Red**, is a variety that originated in Kansas and is named for the city of Leoti. It is evidently of hybrid origin, and, since its endosperm is waxy, probably has Chinese Amber in its parentage. The variety is later in maturing than Red Amber and is slightly shorter. The heads have relatively long seed branches that have a tendency to droop. The glumes are dull yellowish-red and the lemmas are awned. The seed are buff in color. Leoti is the best of the Amber varieties for Texas, but has produced less than Sumac, White African, Honey, and Orange in practically all tests. Its chief claim to distinction is that it is the variety most resistant to sorghum red spot, a disease that causes leaves to fall from the plant before maturity. As far as Texas is concerned, the variety is of itself not of great importance, but it is of value as a parent for breeding disease-resistant varieties (Fig. 7).

Freed is not a sorgo in the strict sense of the term. Its production has been below that of any sorgo ever grown in Texas, but has never failed to produce seed even in the poorest seasons. It is extremely early and will mature in as few as 70 days in some instancees. It grows 5½ to 6 feet tall and has few leaves, usually 8. Panicles are erect and loose, glumes straw-colored, lemmas have long awns, and the seed are white.

Seed of Freed was obtained by the U. S. Department of Agriculture in 1910 from J. K. Freed, of Scott City, Kansas, who stated that he had grown the variety for two or three years but that its origin was unknown to him.

Hybrid Varieties: Yields of eight hybrid varieties that have resulted from sorghum breeding work at Chillicothe have been included in the Sorgo Variety test there since 1929 (Tables 4 and 5). These varieties have not, with one exception, been distributed. The production of these hybrid varieties show that varieties of superior yielding ability can be produced through hybridization and selection.

The White African x Honey strains are quite similar to Honey in type, but are slightly earlier and are considerably better than Honey in grain production but slightly poorer than that variety in forage yield. These strains are not considered to be outstanding enough to justify distribution.

Fig. 7. Leoti is a leafy and fairly early sorgo which is highly resistant to sorghum red spot.

The White African x Sumac and White African x Orange strains are, from the standpoint of yield and quality of forage, good enough to be distributed were it not for the fact that even better strains than these are in the process of development. The early strain of White African x Sumac, T. S. No. 21009, is quite early and may find a place in the northern part of the sorghum belt where Early Sumac is valuable. This strain has pearly-white or pink seeds but otherwise bears a close resemblance to Early Sumac. White African x Sumac strains, T. S. Nos. 21007 and 21008,

have colored and white seeds, respectively. Their yields show them to be good forage-producing varieties. The seeds have no nucellar layer and the seed of the two strains resemble Red and Blackhul kafir, respectively. White African x Orange, T. S. No. 21014, resembles White African x Sumac, T. S. No. 21007, but is slightly earlier.

The results of several years of breeding work with these and other strains point to the possibility of developing varieties with good forage characteristics that have grain as suitable for market and feeding purposes as kafir or milo. Sourless and Leoti are being used as parents in the development of such strains so as to incorporate resistance to the red spot disease.

FORAGE YIELDS OF GRAIN SORGHUM VARIETIES

Forage and grain yields of grain sorghum varieties at twelve Stations are reported in Texas Station Bulletin No. 459, "Grain Sorghum Varieties in Texas", and will not be repeated here, since this publication is chiefly concerned with sorgos. Nevertheless, the acreage in Texas devoted to grain sorghums that are harvested for forage, although no statistics are available, is known to be great, and, therefore, production of the common and several new varieties of grain sorghums which have been grown during the past three years at Chillicothe is reported. The results cover the period 1931 to 1933, inclusive (Table 13), and the value of the varieties from the standpoint of forage and grain production may be arrived at by comparing the yields of the newer varieties with those of the familiar and commonly grown varieties such as Texas Blackhul kafir, Dwarf Yellow milo, and Hegari. Also the forage yields reported in Table 13 may be compared with those of sorgo varieties in Table 4 to determine the relative value of the grain sorghum varieties as producers of forage.

As forage varieties none of the newer varieties are superior to Hegari or Texas Blackhul kafir if quality and yield are both considered; but Ajax, a hybrid variety of feterita and kafir parentage developed at Chillicothe, Kalo, a hybrid of kafir and milo parentage from the Fort Hays Station, and the selection from Bishop, known as Algeria, are recommended for trial in those parts of the State where the average annual rainfall is 30 inches or more and where the land is fertile. Of the several varieties included in the test which have been developed primarily for grain at the Southern Great Plains Field Station, Woodward, Oklahoma, or at the Fort Hays Experiment Station, Hays, Kansas, and as varieties to be harvested mechanically, none has produced as much grain as the common varieties. Wheatland and Day milo appear to have greatest merit and may be expected to make a better showing in areas free from chinch bugs than was made at Chillicothe. A dwarf early, yellow milo of hybrid origin whose parents were Early White milo and Double Dwarf Yellow milo is being distributed as a variety to plant late, on wheat stubble for instance. This variety has produced well but will fall down at or before maturity if planted early enough to ripen in August.

When the better forage varieties of grain sorghums are compared with sorgos in yield, the sorgos are seen to produce only slightly more forage per acre.

DATE OF PLANTING

The growing season for sorghum in Texas is sufficiently long to allow a considerable range in the date of planting even in the northern Panhandle. The ease of obtaining stands, the amount of cultivation required

Table 13 .Forage and grain yields of grain sorghum varieties at Chillicothe, 1931 to 1933.

T. S. No.	Variety	Grain yield in bushels to the acre				Forage yield in tons to the acre			
		1931	1932	1933	Ave.	1931	1932	1933	Ave.
13619	Ajax	36.4	62.7	40.2	46.4	3.08	4.60	3.37	3.68
9626	Beaver	9.4	49.8	27.1	28.8	1.95	3.51	2.19	2.55
18010	Bishop	30.0	64.1	44.0	46.0	2.80	5.36	3.78	3.98
9765	Bishop (Algeria)	19.2	67.7	43.8	43.6	2.21	5.34	3.25	3.60
8219	Chiltex		62.2	35.5			4.32	2.83	
13612	Club	31.9	60.3	31.1	41.1	2.90	4.48	2.73	3.37
21025	Custer	12.8	50.9	23.2	29.0	1.76	3.86	2.06	2.56
21015	Darso x Fargo			32.7				2.74	
8989	Desert Bishop	15.0	47.7	31.2	31.3	2.73	5.09	3.15	3.66
2840	Feterita	34.6	56.5	26.7	39.3	2.30	4.86	2.75	3.30
3232	Spur feterita		56.7	19.8			5.44	2.78	
21022	(Feterita x kafir) x feterita	36.4	57.0	33.0	42.1	2.44	4.00	2.43	2.96
21023	(Feterita x kafir x kafir)	28.9	45.1	30.7	34.9	2.55	3.64	2.82	3.00
18007	Dwarf Freed	32.3	55.2	25.8	37.8	1.75	3.90	1.84	2.50
13841	Grohoma	13.6	57.5	29.2	33.4	2.48	5.94	3.50	3.97
1942	Hegari	0	54.0	40.0	31.3	1.87	5.61	5.23	4.24
6022	Bh. kafir	10.5	60.2	27.2	32.6	2.54	5.35	3.47	3.79
9195	Texas Bh. kafir	32.7	54.9	32.4	40.0	3.11	4.66	3.11	3.63
13613	Western Bh. kafir	28.6	51.7	29.9	36.7	2.97	4.37	3.07	3.47
18006	Dwf. Bh. kafir	33.8	56.8	33.7	41.4	2.51	3.96	2.39	2.95
18005	Pink kafir	25.6	53.4	30.2	36.4	2.19	4.25	2.84	3.09
13615	Dawn Selection	32.3	52.0	24.0	36.1	3.19	4.78	3.14	3.70
13611	Kalo	26.7	69.0	36.4	44.0	2.54	5.49	2.73	3.59
	Early Kalo			25.9				1.61	
18002	Manko	12.8	57.7	38.9	36.5	2.45	6.25	3.96	4.22
43	Dwf. Yellow milo	17.7	59.1	28.6	35.1	1.96	4.98	2.69	3.21
17998	Early Dwf. Yellow milo	29.3	60.1	28.5	39.3	1.90	4.60	2.09	2.86
13617	Day milo	22.9	55.2	22.5	33.5	1.20	3.34	1.25	1.93
21024	Midget milo		51.1	22.9			3.20	1.35	
13618	Dwf. Yel. milo x Pink kafir	9.4	48.1	26.5	28.0	1.83	4.31	2.89	3.01
18001	Milo x kafir	27.1	52.3	23.7	34.4	1.63	3.74	2.00	2.46
13614	Modoc Pink Freed	33.8	51.7	25.8	37.1	2.28	4.39	2.63	3.10
1923	Schrock	32.3	56.8	34.9	41.3	2.84	5.10	3.47	3.80
17999	Wheatland	20.3	57.4	21.6	33.1	1.52	3.63	1.73	2.29
18000	Wheatland x Dwf. Yel. milo	20.3	50.7	24.4	31.8	1.43	3.49	1.61	2.18
8964	Wonder	36.4	60.2	37.8	44.8	2.51	4.18	2.91	3.20

by the crop, and the yield and the quality of the forage obtained all have a bearing on the selection of a planting date. In most of the State where sorghums are grown, the dates of planting most favorable for stover production are also most favorable for grain production. Large stover yields are not necessarily correlated with large grain yields in Southwest Texas, however, where the sorghum midge prevents grain production in the late summer.

If sorghums are planted too early there is difficulty in obtaining good stands because the soil is not thoroughly warm. As a rule, good stands are not as difficult to obtain with most sorgos as with some grain sorghums, notably feterita and Hegari; nevertheless, conditions for germination are occasionally so unfavorable early in the season that stands of no sorghum variety can be readily obtained. Also, too early planting may prolong the growth period throughout a longer season and expose the crop to more hazards of unfavorable weather conditions. In all of Texas where sorghums are an important crop a period of low rainfall exists in midsummer. Since the sorghums are not planted until the soil is warm in the spring, they are not planted early enough to mature before this season of low rainfall. Nor can sorghums be expected to produce a large yield of forage on moisture stored in the soil from winter and spring rainfall There is a rather complete discussion of the relationship between the distribution of summer rainfall and production of grain sorghums in Texas Station Bulletin No. 424. The discussion there applies equally well to sorgos.

Date-of-planting experiments with sorgos have been conducted at Chillicothe, Big Spring, Amarillo, and Dalhart, and the results are given in Tables 14, 16, and 17. In addition, the variety test at Chillicothe has been planted on three dates each season and the results from this test from 1924 to 1933, inclusive, excepting 1929 and 1931, are shown in Table 15. The dates on which this last test was planted cover just a month, being May 15, June 1, and June 15. These planting dates are within the favorable planting period at Chillicothe and the results of this test are given to show the influence of planting date on the different varieties.

The results at Chillicothe show the favorable planting period to be in May and June (Table 14). As shown by the average dates of maturity, all of the plantings matured within the period from September 25 to October 16, and the maturity date of most of the plantings fell within a still narrower range. It is apparent, therefore, that nothing is to be gained by too early planting, and, in addition, the forage from the later dates of planting is of better quality. Forage from the later plantings is considered to be better because of the fewer leaves lost from late-planted sorghums. An early-planted crop is almost certain to encounter a period when there is a lack of soil moisture and during such periods when development is retarded the bottom leaves will die and be lost. It is not an infrequent occurrence to find the leaves of late-planted crops to be green at maturity within a node or two of the ground surface. Of the five years in which the date-of-planting test with Sumac was conducted (Table 14), three were particularly poor seasons, as is indicated by the low production of grain. Fair yields of forage were produced, however, since the production of the vegetative portion of the crop is much more certain than the production of seed.

The results from the variety tests at Chillicothe, which included three plantings, on May 15, June 1, and June 15, are shown in Table 15. The varieties were quite similar to one another in response to planting date

Table 14. Yield of forage from date plantings of Sumac and Red Amber grown at Amarillo and Chillicothe, 1913 to 1917.**

Date of planting	Amarillo								Chillicothe							
	Forage yield in tons to the acre						Average		Forage yield in tons to the acre						Average	
	1913	1914	1915	1916	1917	Ave.	inches Height,	Date of maturity	1913	1914	1915	1916	1917	Ave.	Height, inches	Date of maturity
Sumac:																
April 1									2.18	8.63	4.53	2.16	1.94	3.89	65	Oct. 11
April 15	.64	3.45	9.14	3.26	4.44	4.19	57	Sept. 21	1.55	5.90	6.18	2.30	2.02	3.59	69	Sept. 25
May 1	.88	3.10	8.51	3.03	4.74	4.05	56	Sept. 24	.95	7.95	6.78	2.81	2.26	4.15	71	Sept. 27
May 15	.57	3.05	8.76	4.46	3.88	4.14	60	Sept. 28	.72	7.61*	6.15	3.47	3.09	4.21	68	Oct. 2
June 1	1.25	3.65	9.71	4.34	2.96	4.38	60	Oct. 12	2.89	8.90*	8.18	3.93	2.39	5.26	65	Oct. 9
June 15	1.45	3.10	12.13	3.51	3.40	4.72	56	Oct. 17	1.55	7.55	9.68	3.42	1.87	4.81	72	Oct. 15
July 1	1.35	1.85	11.88	.24	3.63	3.79	57	Oct. 23	1.23*	7.70	8.63	0	2.73	4.06	83	Oct. 16
Red Amber:																
April 15		2.75	1.66	1.06	2.15	1.91	60	Aug. 24								
May 1		2.55	2.44	1.54	2.38	2.23	58	Sept. 1								
May 15		2.05	1.80	1.96	3.88	2.42	62	Sept. 12								
June 1		2.20	4.44	1.63	2.11	2.60	62	Sept. 17								
June 15		2.15	5.03	1.54	3.11	2.96	69	Sept. 23								
July 1		1.50	5.53	.46	2.81	2.58	62	Oct. 17								

*Interpolated.

**These results have been published previously in U.S.D.A. Dept. Bul. 1260, 1924, Sorghum Experiments on the Great Plains, by H. N. Vinall, R. E. Getty, and A. B. Cron.

as a rule; and, if in a particular season an early variety produced best in the June 1 planting, the late varieties usually did also. The best planting date for all varieties, whether early or late, falls within this favorable period. It should be kept in mind, however, that varieties of long growing season, such as Honey, will not mature seed consistently when planted as late as June 15. When necessity demands planting in July or early August, the earlier-maturing varieties, such as Black or Red Amber, are recommended. However, Sumac in such late plantings will produce good forage but is apt not to produce grain. There is no consistency about which one of the three planting dates produces best results, and the variation was such from season to season that the extreme difference in average production of forage for 11 varieties in the three dates of planting was only .15 ton. There is a tendency for high forage and high grain yields to be correlated and, in fact, the differences in forage yield between the three planting dates are due laregly to differences in grain production. There is, therefore, not much choice between planting dates within the six weeks, May 10 to June 20, which are most favorable for planting.

The results at Big Spring (Table 16) show that, as at Chillicothe, a favorable planting period for Sumac exists in the last half of May and in the month of June. The zeros shown in Table 16 for several plantings indicate instances when stands could not be obtained on account of dry soil or were lost on account of washing rains before or following the emergence of seedlings. Omitting the failure to obtain stands, the yields from the various dates of planting do not differ greatly, but even in this instance late May or June plantings are the best.

The results at Amarillo (Table 14) with both Sumac and Red Amber are quite similar to those at Chillicothe and Big Spring except that the best planting dates are about two weeks later. July 1 appears slightly too late a date for planting Sumac at Amarillo but is a fairly good date for planting Red Amber, since the latter is an early variety. Although 76 days elapsed between the plantings on April 15 and on July 1, on the average the plants matured within 22 days of one another, and the May 15 plats matured within a week of the April plats. This longer growing season from early planting is the usual result anywhere in the State and the last 30 days of the growing season of early and medium early plantings almost coincide. Late-planted crops require the least work to produce, as late planting reduces cultivation to a minimum.

The results at Dalhart (Table 17) are quite consistent in showing June 15 to be within the most favorable planting period for sorgos. All varieties, whether early or late, produced the most in late plantings and Sudan grass did also. Dalhart, located as it is in the northwestern part of the Panhandle, has a shorter growing season than that of any other Station. The better production resulting from late planting which is more marked at this Station than at others is due to the fact that favorable temperatures for growth of sorghums do not exist until well into June at Dalhart, and because late-planted crops are in the stage of growth

Table 15. Yields of forage and grain from date of plantings of sorgo varieties planted at Chillicothe, 1924 to 1933, not including 1929 and 1931.

Yield of forage in tons to the acre

Variety	May 15									June 1									June 15								
	1924	1925	1926	1927	1928	1930	1932	1933	Ave.	1924	1925	1926	1927	1928	1930	1932	1933	Ave.	1924	1925	1926	1927	1928	1930	1932	1933	Ave.
Kansas Orange	4.23	5.22	5.11	4.94	2.38	2.20	4.97	4.95	4.25	6.35	4.05	4.61	5.40	2.98	2.82	5.32	4.97	4.56	4.19	5.67	4.28	3.87	2.14	2.08	5.01	4.72	4.00
Sourless	4.15	4.69	4.53	5.49	2.46	1.81	4.24	4.97	4.04	4.56	5.40	4.78	4.11	3.29	2.69	4.26	4.61	4.21	4.69	6.87	4.73	4.11	2.01	1.99	4.87	5.15	4.30
Honey	6.20	5.50	5.68	5.99	4.13	3.19	7.33	5.11	5.39	8.64	6.33	6.10	5.04	1.66	3.03	5.95	6.27	5.38	9.10	6.94	5.91	3.49	2.10	2.97	5.84	6.40	5.34
Sumac	3.38	4.14	6.38	4.62	2.83	1.84	4.33	4.58	4.01	5.37	4.70	4.67	4.64	3.74	2.34	4.45	4.40	4.29	4.58	5.08	4.58	4.09	2.50	1.93	5.34	4.94	4.13
Red Amber	2.83	3.28	4.29	3.61	3.13	2.02	4.29	3.16	3.33	4.51	3.40	4.14	3.80	3.00	2.32	3.45	3.12	3.47	4.07	2.79	3.12	2.84	2.48	2.51	4.64	4.15	3.33
Leoti	3.37	3.49	3.02	3.64	2.02	1.79	4.48	3.05	3.11	4.77	3.38	3.29	4.12	3.44	1.87	3.64	3.25	3.47	5.62	3.45	3.64	2.71	1.88	1.60	4.41	4.40	3.46
Saccaline	3.86	4.51	5.44	4.47	4.25	2.54	5.66	5.30	4.50	3.84	4.42	5.37	4.98	2.33	3.46	4.61	5.29	4.29	5.32	4.14	4.61	2.53	3.45	2.81	5.65	4.86	4.17
Early Sumac	3.38	3.05	5.11	3.95	1.95	1.94	4.42	3.31	3.39	3.88	2.90	4.43	4.41	2.90	2.07	3.78	3.89	3.53	4.72	3.88	3.81	3.58	2.21	1.23	5.27	3.57	3.53
Average	3.93	4.24	4.95	4.59	2.89	2.17	4.97	4.30	4.00	5.24	4.32	4.67	4.56	2.92	2.58	4.43	4.48	4.15	5.29	4.85	4.34	3.40	2.35	2.14	5.13	4.77	4.03

Yield of grain in bushels to the acre

Kansas Orange	19.9	28.5	42.6	44.3	12.6	8.6	32.6	20.2	26.2	32.6	21.8	48.4	49.0	7.1	11.6	25.5	28.1	28.0	37.1	31.1	37.1	21.8	6.4	2.1	35.8	43.4	26.9
Sourless	18.8	30.8	39.6	49.1	22.4	2.5	29.0	23.0	26.9	40.5	34.5	50.6	43.4	24.0	11.3	25.7	33.2	32.9	42.8	49.5	38.3	33.0	8.3	1.5	39.6	45.7	32.3
Honey	12.4	12.0	7.9	4.6	10.5	8.0	26.5	11.0	11.6	30.0	14.3	12.3	4.9	0	11.0	12.1	10.5	11.9	0	6.4	4.1	4.5	0	8.6	12.4	10.4	5.8
Sumac	22.1	28.9	59.3	34.5	21.8	3.7	35.4	21.2	28.4	26.6	42.8	45.0	41.0	26.3	7.4	33.2	22.3	30.6	33.8	34.5	40.1	39.4	7.9	4.6	26.6	39.0	28.2
Red Amber	28.5	13.9	33.2	30.4	28.1	12.9	36.3	16.2	24.9	36.8	18.0	43.1	34.4	27.6	13.8	33.4	17.2	28.0	34.9	20.3	37.5	13.5	25.9	18.4	26.7	24.1	25.2
Leoti	24.0	19.5	29.7	33.8	18.8	12.9	39.9	19.0	24.7	47.6	24.8	36.0	39.5	36.2	11.9	38.1	24.3	32.3	42.4	29.3	40.5	15.0	16.9	14.1	34.8	38.0	28.9
Saccaline	30.0	25.9	48.0	23.3	26.4	9.2	37.2	24.3	28.0	39.8	29.3	44.6	32.2	11.3	15.0	33.8	25.6	29.0	42.4	34.9	34.1	16.5	33.0	6.4	36.0	30.4	29.2
Early Sumac	26.6	22.5	51.5	29.3	13.9	4.6	30.7	9.9	23.6	39.8	22.1	42.4	35.9	22.0	5.5	23.6	17.2	26.1	36.4	33.8	45.4	37.1	8.6	6.1	25.6	23.3	27.0
Average	22.8	22.8	39.0	31.2	19.3	7.8	33.5	18.1	24.3	36.7	26.0	40.3	35.0	19.3	10.9	28.2	22.3	27.4	33.7	30.0	34.6	22.6	13.4	7.7	29.7	31.8	25.4

that allows full advantage to be taken of the early fall rains that usually occur at this point.

In West Texas, although June is a favorable planting season for sorghums on the whole, there are two dangers that should be recognized in waiting until well into June before planting. The first is that the driest period of the summer is usually from June 20 to July 10, and although the average rainfall of June is the highest of any month in the year, it not infrequently happens that after a period of 10 or 15 days without rain and with high temperatures prevailing, the surface soil is dried out beyond the point that will allow stands to be obtained. If precaution is taken to control weeds, however, stands can usually be obtained at any time during June. The other difficulty not uncommonly met in June plantings made in lister furrows is the condition that exists following a rain after the plants have been up about a week. Under ordinary circumstances in June the seedlings come up, grow off rapidly, and start permanent root growth from a crown just beneath the surface of the soil. If a rain falls at this stage in the growth of the plant, the soil settles away from the crown and leaves the plant with no attachment to the soil except the mesocotyl. If rapid drying of the soil occurs, as frequently happens, the permanent roots from the crown are unable to penetrate the crusted soil, the plants lie prostrate, and finally die. In extreme cases, replanting is necessary but, usually, in cultivation when a little dirt is thrown to the plants a sufficient number will straighten up and survive to make replanting unnecessary. This difficulty, although occasionally encountered in June plantings, is not frequent or serious enough, in the light of several advantages of such plantings, to discourage delay in planting until June in the western part of the Stage.

Favorable planting dates for sorgos in areas of the State not represented by any of the Stations from which experiments have been reported coincide with optimum dates of planting grain sorghums. At Temple, April 15 to May 15 plantings are recommended. Late March and early April plantings are considered to be the best for the Beeville area.

The fact that no definite best date of planting exists, or that the favorable planting season in most of the State covers a period of at least six weeks, accounts in some measure for the high regard in which sorghums are held by farmers. It is this characteristic of the crop, along with consistent ability to produce, that allows such effective use to be made of sorghums in Texas.

SPACING OF PLANTS IN THE ROW

Sorgos are grown principally for the stover produced, the amount of grain being a secondary consideration. The production of stover is much more certain than that of grain because the stover-producing period of the crop almost invariably occurs when soil moisture is ample, whereas the fruiting or grain-producing period coincides with that period of the summer when the distribution of rainfall is most uncertain. It is obvious,

Table 16: Yields of forage from date plantings of Sumac sorgo at Big Spring, 1919 to 1929*.

Date of planting	Acre yields of forage in tons											
	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	Ave.
April 15	8.16	0	5.55	0	3.14	2.80	0	6.21	3.63	3.07	4.06	3.33
May 1	9.20	0	0	5.78	3.88	2.00	2.71	4.56	3.88	3.82	4.06	3.63
May 15	10.70	0	0	4.74	3.31	2.46	3.33	4.61	0	4.68	4.13	3.45
June 1	8.80	7.00	4.06	3.67	3.19	3.75	2.94	5.36	3.45	4.57	4.06	4.62
June 15	7.39	7.25	2.92	3.32	4.29	0	3.79	5.81	3.54	4.45	3.32	4.19
July 1	7.20	7.40	2.42	1.35	6.44	0	3.85	5.56	2.88	4.14	3.69	4.08

*These results have been published previously in U.S.D.A. Circular No. 202, 1932, Agronomic Work of the Big Spring, Texas, Field Station, 1915-1929, by F. E. Keating.

Table 17. Date of planting forage sorghum varieties at Dalhart, 1927 to 1932.

Variety	Forage yields in tons to the acre																			
	May 15							June 1							June 15						
	1927	1928	1929	1930	1931	1932	Ave.	1927	1928	1929	1930	1931	1932	Ave.	1927	1928	1929	1930	1931	1932	Ave.
Early Sumac	1.50	2.15	4.19	2.07	1.94	1.59	2.24	1.90	2.78	4.88	2.31	2.53	1.94	2.72	2.75	3.70	4.85	3.36	3.53	3.28	3.58
Honey	4.86	6.28	5.97	3.72	3.53	2.41	4.46	4.72	8.80	7.88	3.22	4.31	2.41	5.22	4.38	8.08	8.00	5.22	4.88	4.94	5.92
Darso	1.92	2.55	3.60	1.78	1.72	1.06	2.11	2.45	2.50	4.88	2.00	1.59	1.22	2.44	2.58	2.55	4.41	2.88	2.34	1.75	2.75
Kansas Orange	3.90	4.48		2.47	2.91	2.03	3.16	3.80	3.73		3.19	4.00	1.88	3.32	3.60	3.50		4.28	4.31	3.50	3.84
Sourless	2.45	4.13	5.41	2.75	2.81	1.94	3.25	2.43	3.93	5.97	2.60	3.56	1.88	3.40	4.33	3.63	5.16	3.78	4.03	3.38	4.05
Leoti	2.18	3.23	5.00	2.44	2.63	1.63	2.85	2.28	3.90	5.94	2.63	3.19	2.00	3.32	3.68	4.53	4.91	3.75	4.22	3.63	4.12
Atlas			5.50	2.16	2.75	2.22	3.16			6.19	2.56	3.22	2.00	3.49			6.75	4.44	4.06	3.78	4.76
Sudan grass			1.31	1.31	1.28	.94	1.21			1.33	1.13	1.59	1.03	1.27			1.53	2.16	1.94	1.81	1.86
Drilled:																					
Leoti			5.64	3.99	3.99	2.54	4.04			6.30	3.03	3.85	1.72	3.73			6.69	6.05	4.95	4.74	5.61
Sudan grass			2.27	.90	1.79	.89	1.46			2.48	.83	2.48	1.17	1.74			2.68	2.41	2.75	2.20	2.51
Average	2.80	3.80	4.32	2.36	2.54	1.73	2.79	2.93	4.27	5.09	2.35	3.03	1.73	3.07	3.55	4.33	5.00	3.83	3.70	3.30	3.90

therefore, that if consistent yields of seed are to be expected the plants must enter the fruiting period with a reserve supply of moisture in the soil; otherwise a lack of rain would prevent the production of a grain crop. A thick spacing of plants exhausts the supply of soil moisture during the vegetative period of growth and thus tends to reduce the possibilities of a grain crop; and if a seed crop is desired, a lighter rate of planting is recommended than if the desire is for a forage crop.

The results of thinning Sumac sorgo planted in rows at Chillicothe during five years, 1913 to 1917, inclusive, are given in Table 18. No one of the plant spacings of 2, 4, 8, or 12 inches consistently produced the

Table 18. Yield of forage of Sumac sorgo from plants given different spacings in 40-inch rows at Chillicothe*.

Row space per plant, inches	Yield of forage in tons to the acre					
	1913	1914	1915	1916	1917	Ave.
2	.70	7.68	6.35	2.73	2.73	4.04
4	.86	6.15	7.50	2.17	3.06	3.95
8	.83	5.73	8.40	2.58	3.03	4.11
12	.64	6.53	7.90	1.89	2.69	3.93

*These results have been published previously in U. S. D. A. Dept. Bul. 1260, 1924, Sorghum Experiments on the Great Plains, by H. N. Vinall, R. E. Getty, and A. B. Cron.

greatest yield of forage; in fact, the average yields are quite close to one another. It appears that, in general, the supply of soil moisture and plant food available to a crop in any particular season will support only a certain amount of vegetative growth irrespective of the rate of seeding. The results at Chillicothe indicate the truth of this hypothesis and those at Lubbock do also, within certain limits. As in the case of broadcast plantings, quality of forage is of prime importance. Forage of better quality, the stalks being finer, resulted from spacing the plants 2 or 4 inches in the row than when the plants were given more space.

At Lubbock a greater range of spacing was included in the experiment (Table 19). One plat was not thinned each year and in other plats the plants were given spacings of 3, 6, 9, 12, 15, and 18 inches. As an average of 10 years, the unthinned plantings produced the most forage but only slightly more than 3- and 6-inch spacings. Beyond the 6-inch spacing there was a more marked reduction in yield. As at Chillicothe, the best quality of stover was produced from the closer spacings.

This recommendation of close spacing of sorgos in rows for forage production does not hold true for the varieties of grain sorghums used for forage. In the case of the grain sorghums the quality of the forage is dependent upon the grain content as well as on the quality of the stover. The best spacings for grain sorghum depends largely upon the tendency of the particular variety to produce tillers. The matter of the best spacing for grain sorghums is discussed in Texas Station Bulletin No. 424. A

Table 19. Forage yields of Sumac sorgo from plants given different spacings in 36-inch rows at Lubbock.

Row space per plant, inches	Yield of forage in tons to the acre										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	Ave.
Not thinned	2.87	2.50	3.83	6.74	4.79	3.47	3.63	2.48	2.35	3.25	3.51
3	1.81	1.94	3.80	7.07	4.64	3.29	3.33	2.43	2.50	3.66	3.45
6	1.81	1.89	3.98	6.44	5.39	3.58	3.02	2.29	2.25	3.79	3.44
9	1.01	1.72	3.50	6.51	5.18	3.44	3.14	2.32	2.00	3.41	3.22
12	.88	1.79	3.09	6.04	5.21	3.11	3.70	2.30	1.83	3.24	3.11
15	.93	1.83	3.27	6.66	5.06	3.00	3.34	2.35	1.75	3.48	3.17
18	1.21	1.59	3.26	5.21	4.94	3.08	3.02	2.12	1.61	3.69	2.97

6- to 8-inch spacing is recommended for kafir and a 6-to 12-inch spacing for Hegari.

RATE OF SEEDING IN ROWS

There being certain plant spacings of sorgos more desirable than others, proper rates of planting should be used to obtain the desired stands without thinning. It is helpful also to know the amount of seed to purchase in preparation for planting a certain acreage. Orange and Sumac sorgos have been planted at Chillicothe at the rates of 1, 2, 3, 4, and 5 pounds to the acre during the years from 1925 to 1932, inclusive. Plantings were made on two dates in each of the first four years and on three dates in each of the last three years. The distances between plants obtained from each of the different rates of seeding are averages of 17 plantings. When stands were prevented or damaged by heavy washing rains before or immediately following emergence, the test was replanted. No results are shown for 1928 because, in each of several plantings, stands were reduced by rains and soil crusting. As a matter of convenience, the plantings were made in duplicate rows with a two-row planter of the shoe, or runner type, run in lister furrows.

The distances between plants obtained from planting at the different rates are shown in Table 20. Counts in 1925 showed Sumac seed to contain 29,880 to the pound and orange 19,060 to the pound. Since seed

Table 20. Stands obtained from planting different amounts of Sumac and Orange sorgo seed in rows at Chillicothe.

Rate planted, lbs. per acre	Space between plants, inches							
	1925	1926	1927	1929	1930	1931	1932	Ave.
Sumac:								
1	6.70	5.65	7.75	12.81	10.03	14.42	9.70	9.58
2	3.90	4.26	5.47	5.62	4.54	8.58	4.49	5.27
3	2.10	3.32	2.84	3.84	3.21	5.09	2.39	3.26
4	1.80	1.33	2.11	3.00	2.44	3.22	2.15	2.29
5	1.60	1.29	1.89	2.02	1.83	2.57	1.85	1.86
Orange:								
1	11.80	12.62	11.71	20.39	10.91	14.25	7.41	12.73
2	7.80	6.91	6.99	6.85	5.54	6.26	4.08	6.35
3	3.70	3.45	3.96	5.72	4.18	4.17	2.94	4.02
4	2.70	1.96	2.77	3.95	3.26	3.02	2.24	2.84
5	1.90	1.93	2.39	3.14	2.33	2.43	1.76	2.27

of Sumac are smaller than seed of Orange more plants of Sumac than of Orange were obtained from plantings at identical rates. Two-inch stands of Sumac were obtained from 4- and 5-pound rates. Five- to 6-inch stands of both varieties were obtained with 2-pound rates of planting. Some farmers make a practice of planting as much as 10 pounds of Sumac seed to the acre in rows but such a high rate of planting is unnecessary, as the stems of the forage from a 5-pound rate of planting are sufficiently fine to produce forage of excellent quality.

For the production of grain a 2-pound rate of planting of either Sumac or Orange is recommended.

RATE OF SEEDING BROADCAST

Yields of forage from broadcast plantings made at different seeding rates have been taken at Chillicothe and Beeville. Two varieties, Sumac and Red Amber, were used at Chillicothe, and Sumac was used at Beeville.

At Chillicothe, results with both varieties (Table 21) indicate that considerations other than average yield are the determining factors in deciding upon a rate of planting. Average production from the 15-pound rate of planting was lower than from higher rates of planting with both varieties, and is considered to be too low a rate of planting to be recommended. The higher rates of planting do not differ greatly in their average yields, but it will be observed that the heavier rates of planting had a tendency to produce very poorly in bad crop years. The quality of the hay was good from the three highest rates of planting, except in poor crop years and then the hay from the heaviest rate was the poorest. Measurements of stalk size at the ground surface in 1914 and 1915 showed Sumac stalks to have a diameter of 5/8 inch in the 15-pound rate, 3/8 inch in the 45-pound rate, and 1/4 inch in the 75-pound rate. The Red Amber stalks were practically the same size as those of Sumac in identical plantings.

Considering both the quality of the hay produced and consistency of production, it is believed that 45 pounds to the acre is about the best planting rate for Sumac in the western part of the State. Red Amber, since it contains less seed per bushel, will stand planting at heavier rates, but it would appear unnecessary to plant at a rate higher than 60 pounds to the acre.

The hay crop of Sumac was mature in 84 days from planting as an average for 9 years and Red Amber was mature in 73 days as an average of 7 years. In favorable seasons there was a tendency for Sumac to yield more hay than Red Amber, but the reverse was true in poorer years.

The danger of an almost complete failure of hay crop is less at Beeville than at Chillicothe; and in spite of extremely high production at Chillicothe in certain years, broadcast plantings are not recommended for the western part of the State, where drouth periods are apt to be encountered in any year. Sorgo planted in rows is not so seriously affected by such dry periods and recovers when rain comes, whereas broadcast plantings are likely to burn up and die. Furthermore, row binders to handle forage grown in rows are available on most farms in the western part of the State but haying implements are not so common.

The results from planting Sumac broadcast at Beeville are quite similar to those at Chillicothe, there being no rate of planting that consistently produced more hay than the others (Table 22). Here, also, quality of hay is more important than yield in determining the rate of seeding.

Table 21. Yield of forage from broadcast plantings at different rates of Sumac and Red Amber sorgos at Chillicothe, 1914 to 1925.

Rate, pounds per acre	Forage yield in tons to the acre													Average		Plants per sq. ft. in 1915
	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	Ave.	Height, inches	Season days	
Sumac:																
15	8.50	6.30	1.10	.88	1.58	3.74	4.63	4.13	3.53	1.46	2.92	3.68	3.54	52	84	3.7
30	8.70	6.05	1.15	.92	1.68	5.16	4.92	4.52	3.92	1.54	3.95	3.96	3.87	50	84	8.2
45	9.35	6.68	1.01	.97				4.23	3.93	1.71	3.65	3.68				13.5
60	9.88	6.25	.74	.74	1.15	4.89	4.93	4.01	3.88	1.98	2.91	3.59	3.75	46	84	17.8
75	9.85	6.75	.38	.83	.69	4.65	5.12	4.14	4.08	3.02	3.27	3.60	3.87	43	84	22.0
Red Amber:																
15	6.13	5.25	1.35	.87	1.82	4.28	4.28	2.94	2.90				3.31	53	73	2.2
30	6.83	5.95	1.48	.99	1.39	5.13	4.15	3.41	3.56				3.65	55	73	3.7
45	7.23	6.25	1.26	.92				4.57	3.48							8.1
60	7.28	6.05	1.27	.93	1.73	5.69	4.64	3.95	3.34				3.88	47	73	11.1
75	6.98	5.50	1.21	1.01	1.21	5.38	4.43	4.25	3.73				3.74	46	73	15.1

In all parts of the State except the western part, sorgo planted broadcast for hay is an important crop. Recommended rates of planting which will give maximum yields of good-quality hay are one to two bushels to the

Table 22. Yields of forage from broadcast plantings at different rates of Sumac sorgo at Beeville, 1925 to 1931, inclusive.

Rate, lbs. per acre	Yield of forage in tons to the acre							
	1925	1926	1927	1928	1929	1930	1931	Ave.
20	5.83	4.27	4.65	2.42	6.33	3.98	5.11	4.66
30	6.35	4.37	4.76	2.31	6.22	4.10	4.83	4.71
40	6.71	4.54	4.98	2.15	7.02	3.78	5.55	4.96
50	6.72	4.66	4.59	1.43	5.64	3.72	5.25	4.57
60	7.23	4.32	5.34	2.27	5.72	4.04	5.44	4.91
70	7.73	4.81	4.70	1.98	5.07	3.51	5.28	4.73

acre. One bushel is usually sufficient but when planted on rich soil and where moisture is adequate two bushels to the acre may be sown.

THRESHING PERCENTAGE OF SORGOS

As shown by the summary of threshing percentages included in Table 3, the per cent of grain in the head of sorgo varieties at Chillicothe usually falls between 65 and 70. Honey, with a threshing per cent of 53, is the variety of lowest percentage. Sumac, Orange, and Leoti are varieties of high threshing percentage, as each of the three have averages of 70 per cent or more. The threshing percentage of sorghum varieties on the High Plains may be expected to be about 5 per cent higher than the figures shown, as indicated by results at the other Stations.

TEST WEIGHT PER BUSHEL

The test weight of sorgo seed of different varieties varies from 45 to 58 pounds, the weight being dependent largely upon whether or not the glumes remain on the seed after threshing. Varieties such as Sumac, Atlas, and African Millet thresh out of the glumes almost completely, and their test weight is as high as that of grain sorghums. Varieties such as Honey, Red Amber, and Leoti have test weights of 45 to 50 since the seeds of these varieties are retained within glumes even after threshing. The seed yields are reported in this publication in bushels of 56 pounds.

SORGHUMS FOR SILAGE

Average yields of green forage for silage of sorgo varieties grown at Lubbock and Big Spring, which cover periods of 20 and 10 years, respectively, are shown in Table 23. Honey was the highest variety in point of yield at each Station with a yield in both cases of almost 9 tons to the acre. The better of the other varieties at both Stations produced average

yields of 6 tons or more. Yields that averaged as low as 1.5 tons of silage to the acre occurred only once, in 1917, in the 20 years of the test at Lubbock. Yields of about 2 tons to the acre were obtained in 1918, and

Table 23. Average yields of green forage at Lubbock, 1912 to 1931, and at Big Spring, 1924 to 1933, and at Chillicothe, 1931 to 1933.

Variety	Lubbock		Big Spring		Chillicothe
	Yield of green forage to the acre, tons	No. of years grown	Yield of green forage to the acre, tons	No. of years grown	Yield of green forage to the acre, tons
Honey	8.93	18	8.95	10	15.66
Sumac	6.22	20	7.33	10	13.00
Kansas Orange	7.06	6	6.02	10	12.31
Sourless	6.35	6	5.66	10	10.80
Atlas	6.18	4	6.22	5	12.88
Red Amber	5.71	20	4.76	10	
White African	6.88	16	7.23	8	
Leoti	5.12	6	4.34	10	
Freed	3.28	20			
Black Amber	4.74	20			
Orange	6.84	20			
Planters	7.61	18			
Gooseneck	7.92	18			
Sumac	7.01	17			
Old Mexican	7.28	16			
Dwarf Ashburn	6.09	16			
Collier	4.97	16			
Sumac	5.04	14			
Sumac	6.42	10			
Sumac	5.41	6			
Collier	6.38	6			
Hegari					12.52
Bh. kafir					9.63

in the remaining years yields of 4 tons or more were the usual thing. In 1914 Sumac and Honey produced more than 20 tons of green forage to the acre, and in several other years yields of 10 tons to the acre were recorded.

Average green forage yields at Chillicothe for the three years, 1931 to 1933, of sorgos and the two most important forage varieties of grain sorghums, Hegari and Blackhul kafir, are also included in Table 23. The figures show Hegari to be a heavy producer of forage; in fact, this variety may be expected to produce but very little less forage than the sorgo varieties. The production of Blackhul kafir, although less than that of Hegari, compares favorably with that of Hegari or the sorgos when its higher production of grain is considered. Forage yields at Chillicothe, since rainfall is greater than at Lubbock and Big Spring, are greater than at those points and green forage yields over a long period have been about 12 tons to the acre for sorgos and 9 to 11 tons for grain sorghum varieties. Average yields of green forage of sorgos at Temple and Beeville are about 12 to 13 tons. Grain sorghum varieties have produced average green forage yields of 9 to 12 tons at Denton, Temple and Beeville.

THE RELATIONSHIP BETWEEN GREEN, FIELD-CURED, AND AIR-DRY FORAGE YIELDS

Sorghum forage, after being cured in the bundle in the field, contains moisture in considerable amount. At Big Spring the necessary data were obtained during the 10-year period, 1924 to 1933, inclusive, to determine what part by weight the field-cured and air-dry forages were of the green forages. The results (Table 24) show field-cured weights

Table 24. Per cent of stalks and leaves in green and air-dry stover and per cent of air-dry matter in green stalks and leaves at Chillicothe in 1933 and average percentages of field-cured and air-dry forage in green forage at Big Spring, 1924 to 1933.

Variety	Chillicothe						Big Spring	
	Green stover		Air-dry stover		Per cent of air-dry matter in		Per cent of green forage when	
	Per cent							
	Stalks	Leaves	Stalks	Leaves	Green stalks	Green leaves	Field-cured	Air-dry
Honey	90.6	9.4	86.4	13.6	30.2	46.3	51.9	32.5
Saccaline	95.1	4.9	92.2	7.8	30.3	50.2		
Kansas Orange	87.7	12.3	83.1	16.9	30.6	44.4	47.5	32.4
Sumac	91.5	9.5	88.6	11.4	29.9	41.4	53.3	32.5
Colman	88.0	12.0	85.3	14.8	32.7	41.8		
Red Amber							39.5	30.7
White African							49.4	29.5
Sourless							45.8	34.1
Leoti							42.8	32.6
Atlas							45.2	33.0
Average	90.6	9.4	87.1	12.9	30.7	44.8	46.9	32.2

of sorgos to be between 39.5 and 53.2 per cent, and air-dry weights to be between 29.5 and 33.0 per cent of green weights. Air-dry forage usually contains about 10 per cent moisture (Table 1), and field-cured forage as it is usually hauled from the field to be stacked contains 30 to 40 per cent moisture by weight.

Air-dry forage yields given in this publication are about 70 per cent as great on the average as field-cured yields would have been. Air-dry forage yields have been obtained since such yields are entirely comparable, whereas field-cured yields are not because the moisture content of field-cured forage varies considerably.

THE PRODUCTION OF FORAGE MEASURED IN BUNDLES

In Texas, sorghum forage is frequently sold by the bundle rather than by weight. The number of bundles in a ton varies, of course, depending primarily upon the height of the plants and the excellence of the grain crop. Also, such varieties as Sourless and Sumac, and all grain sorghums that have many leaves in relation to height, have a tendency to produce many bundles per acre and few plants per bundle. In 1933 the production

of bundles by different sorgo varieties in all three plantings of the variety test at Chillicothe (Table 25), and by the different grain sorghums in a June 15 planting (Table 26), was determined. From these figures along with the yields in tons to the acre of air-dry forage, the number of bundles in a ton was calculated. In addition, for the grain sorghums, the number of bundles required to produce a ton of heads was determined. An ordinary row binder produces bundles quite uniform in circumference, irrespective of the height of plant. The binder in this instance used approximately 36 inches of twine for a bundle and the 50 twines measured from bundles of very short, as well as tall varieties, all fell within the extremes of 34 and 38 inches in length. About 7 inches of twine is used in the knots. As shown by the figures, one-third to one-half of an 8-pound ball of binder twine to the acre is necessary to tie a good crop of sorghum forage producing around 4 to 5 tons to the acre. In the three plantings of sorgos, all ten varieties considered the extremes in number of bundles per ton of air-dry forage are 123 and 163, the average being 142. One hundred and seventy bundles of the better forage varieties of the grain sorghums when air-dry weighed a ton. About 130 field-cured bundles would have weighed a ton. Among the most interesting figures are those that show the number of bundles of different varieties required to yield one ton of heads (Table 26). In spite of the better grain production of Hegari in the particular planting used, a ton of heads was obtained from 99 fewer bundles of Texas Blackhul kafir than of Hegari. This instance is typical, and the point should be kept firmly in mind when forage is being purchased or sold in the bundle that forage of grain sorghums does not differ as much in quality of stover as in grain content. Also, when grain production is average or better, grain is usually sold for much less in the bundle than threshed or in the head.

LEAF AND STALK CONTENT OF SORGHUM FORAGE

The leaf and stalk contents of sorghum forages vary to a considerable degree depending upon the spacing of the plants, the seasonal conditions which affect the height to which the crop grows, and the variety which is being grown. It is apparent that any condition that will reduce the height or the size of the stalk will increase the percentage of forage that consists of leaves. The leaves and stalks from duplicate samples from a June planting of five varieties of sorgos were weighed in 1933 at Chillicothe and the results are shown in Table 24. The sorgos were a little past maturity when harvested and weighed. Plants were spaced singly about 12 inches apart in the row. On a percentage basis, forage of Kansas Orange and Colman contained twice as many leaves as that of Saccaline when grown under these conditions. Although important, high leaf content is not the most important factor influencing quality of forage; otherwise, certain of the grain sorghums would be grown to the exclusion of the sorgos.

Table 25. Yields of forage, number of bundles per acre, number of bundles per ton, and number of 8-pound balls of twine used per acre of sorgo varieties at Chillicothe in 1933.

Serial No.	Variety	May 17 planting				June 2 planting				June 15 planting			
		Yield per acre		No. bundles per ton	Part of 8-lb. ball of twine used per acre	Yield per acre		No. bundles per ton	Part of 8-lb. ball of twine used per acre	Yield per acre		No. bundles per ton	Part of 8-lb. ball of twine used per acre
		No. bundles	Forage, tons			No. bundles	Forage, tons			No. bundles	Forage, tons		
F.C. 6605	Honey	720	5.11	141	.43	892	6.27	142	.53	892	6.40	139	.53
S.P.I. 48191	Saccaline	720	5.30	136	.43	754	5.29	143	.45	686	4.86	141	.41
F.C. 13498	Saccaline	686	5.44	126	.41	754	5.73	132	.45	754	5.39	140	.45
F.C. 13490	Straight-neck	686	5.05	136	.41	686	4.98	138	.41	686	5.33	129	.41
F.C. 9108	Kansas Orange	686	4.95	139	.41	686	4.97	138	.41	617	4.72	131	.37
F.C. 9111	Sourless	789	4.97	159	.47	686	4.61	149	.41	754	5.15	146	.45
F.C. 9112	Atlas	823	5.37	153	.49	754	4.64	163	.45	823	5.15	160	.49
S.P.I. 35038	Sumac	652	4.58	142	.39	686	4.40	156	.41	617	4.94	125	.37
F.C. 13350	Colman	617	5.01	123	.37	617	4.63	133	.37	686	5.21	132	.41
F.C. 6610	Leoti					514	3.25	158	.31	686	4.40	156	.41

Green stalks shrink about 70 per cent from the green to air-dry condition and green leaves about 55 per cent. The difference in moisture content of green stalks and leaves accounts for the fact that slightly over 9 per cent of green stover is leaves and almost 13 per cent of air-dry stover is leaves.

SEED TREATMENT WITH COMMERCIAL SEED DISINFECTANTS

Treatment of sorghum seed with commercial seed disinfectants is sometimes used to control kernel smut of sorghum and to produce better stands.

Sumac seed germinates quite well under planting conditions considered to be poor for some other varieties such as feterita and Hegari. Nevertheless, as a usual thing, germination and emergence of Sumac is greater

Table 26. Yields of heads and forage, number of bundles per acre and per ton, number of bundles per ton of heads, and number of 8-pound balls of twine used per acre of grain sorghum varieties at Chillicothe from the June 15 planting in 1933.

T. S. No.	Variety	No. bundles per acre	Acre yields air-dry, tons		No. bundles required for a ton of		Part of 8-lb. ball of twine used per acre
			Forage	Heads	Forage	Heads	
43	Dwarf Yellow milo	504	3.58	1.72	141	293	.30
17998	Early Dwarf Yellow milo	504	2.88	1.55	175	325	.30
9626	Beaver	756	2.81	1.39	269	544	.45
13618	Dwf.Yel.milo x Pink kafir	504	3.43	1.43	147	352	.30
13611	Kalo	588	2.96	1.60	199	368	.35
13612	Club	630	2.88	1.64	219	384	.38
1923	Schrock	672	3.54	1.93	190	348	.40
6022	Bh. kafir, Line 153	714	3.77	1.85	189	386	.42
9195	Texas Bh. kafir	588	3.34	1.68	176	350	.35
13613	Western Bh. kafir	588	3.27	1.64	180	359	.35
13615	Dawn Selection	630	3.15	1.30	200	485	.38
18006	Dwarf Bh. kafir	504	2.09	1.55	241	325	.30
18005	Pink kafir	546	2.60	1.26	210	433	.33
13614	Modoc Pink Freed	714	2.65	1.01	269	707	.42
8964	Wonder	588	2.88	1.64	204	359	.35
8219	Chiltex	630	3.14	1.68	201	375	.38
13619	Ajax	672	3.66	2.10	184	320	.40
21015	Darso x Fargo	504	2.68	1.47	188	343	.30
18002	Manko	546	4.18	2.10	131	260	.33
18011	Desert Bishop	714	4.04	1.81	177	394	.42
18010	Bishop	672	4.08	2.39	165	281	.40
9765	Bishop (Algeria)	672	3.75	2.23	179	301	.40
13841	Grohoma	798	3.95	1.68	202	475	.48
1942	Hegari	924	5.36	2.06	172	449	.55
2840	Feterita	546	3.56	1.18	153	463	.33
3232	Spur feterita	630	3.35	.97	188	649	.38

from seed treated with any of the commercial dust disinfectants, such as copper carbonate, Ceresan, Semesan, and Semesan Jr. Considering the emergence of plants from untreated seed in an April 15, a May 15, and a June 15 planting in 1932 at Chillicothe as 100, the emergence from seed treated with copper carbonate was 111, with Ceresan, 105; with Semesan, 109; and with Semesan Jr., 107. The results were typical of what has

occurred when grain sorghum seed is treated, as emergence was aided in two plantings and not benefited in the other. Ordinarily, treatment is of greatest benefit under any condition that delays germination, such as exists early in the planting season.

As indicated by yields taken from plats planted with seed treated with the various seed disinfectants in 1932, there is no appreciable stimulation in growth after emergence of seedlings.

The better germination and the control of kernel smut resulting from the use of seed disinfectants is due to the fact that these fungicides create a sterile zone on and about the seed which prevents fungi from developing. Such seed disinfectants are quite inexpensive to use, as only small amounts are necessary. No one of the disinfectants is recommended above the others for treating sorghum seed. Probably copper carbonate will be found easiest to obtain in local stores. Sorghum seed should be treated with this dust at the rate of two to three ounces to the bushel of seed. The mixing of the dust and seed should be thorough to insure a good covering of all the seed. Whenever sorghum seed infected with smut or seed of unknown origin are to be planted, they should be treated for smut.

SUMMARY

Census reports show the forage production of sorghums in Texas to be only about one and one-half tons to the acre. This low production, as is shown by these experiments, can be raised materially by the use of the best varieties and by good cultural practices.

Sumac, Honey, and Sourless are the best of the varieties for Texas, as they have produced consistently and well at all Stations. New hybrid varieties that have resulted from artificial hybridization have produced as well or better than the best of the common varieties, and good forage varieties, resistant to the red spot disease and with seed as suitable for feeding as that of grain sorghums will ultimately be distributed.

Sorghums cannot be planted successfully until the soil is thoroughly warm in the spring. The date of planting has an important bearing on the length of the growth period of the sorghum crop. Early planting results in retarded early growth with a consequent lengthening of the growing period. Late May and June plantings of sorgos for forage are recommended for West Texas. April 15 to May 15 plantings are recommended for Central Texas, and late March and early April plantings are considered to be best for the area south and west from San Antonio. The favorable planting for sorghums for forage covers a period of about six weeks in all areas of the State except the Northern Panhandle, where the period is about three weeks in length.

Sorgos are grown principally for the forage produced, the grain being a secondary consideration. Close spacing, one to four inches apart in the row, is recommended for forage production, and five-to six-inch spacings are best for production of seed. Five pounds of seed to the acre of any of the sorgos gives sufficiently thick stands. A two-inch stand may ordi-

narily be expected from planting at the rate of five pounds to the acre in rows. Five- to six-inch stands will be obtained from planting at the rate of two pounds to the acre.

In all parts of the State except the western part, sorgo planted broadcast for hay is an important crop. Recommended rates of planting which will give maximum yields of good-quality hay are one to two bushels to the acre. One bushel is sufficient but when planted on rich soil and where moisture is adequate, two bushels to the acre may be sown. In western Texas, where broadcast plantings can not be highly recommended, 45 pounds to the acre is sufficient seed to sow.

Silage yields from row plantings of sorgo in Texas have averaged 9 tons to the acre in the western part of the State and 13 tons in other areas of the State where rainfall is greater. The better forage varieties of grain sorghums produce 2 to 4 tons per acre less silage than do sorgos.

Field-cured forage as it is usually hauled from the field to be stacked contains 30 to 40 per cent moisture. Air-dry forage contains about 10 per cent moisture.

Air-dry sorgo forage will average 130 to 160 bundles to the ton. Approximately one hundred and seventy bundles of the better forage varieties of grain sorghums, when air-dry, will weigh a ton. About 20 to 25 per cent fewer field-cured bunddles than air-dry bundles are needed to weigh a ton. On account of the large difference in stover production between varieties that produce about equal amounts of grain, many less bundles are required by some varieties than by others to contain a ton of heads.

Whenever sorghum seed is infected with smut or seed of unknown origin are to be planted they should be treated with a dust disinfectant. The various fungicides on the market have a beneficial effect on emergence when conditions for germination are unfavorable.

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