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SORGHUMS for GRAIN AND FORAGE

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SORGHUMS FOR GRAIN AND FORAGE

INTRODUCTION

A wide diversity of climatic conditions and extreme variations in soil types preclude definite and generalized recommendations concerning the production of sorghums in Oklahoma.

Experimental work related to the production of grain and forage sorghums has been carried on over a long period of years at various state and federal experiment stations, and this report attempts to assemble, summarize, and present the results obtained in such a manner as may be applicable to the various sections of the State with as much accuracy as possible.

No attempt is made to elaborate fully upon any one phase of the subject. For more complete data and information, the reader is referred to the list of publications in the back of this bulletin.

IMPORTANCE AND USES

Sorghums are used for several purposes. The crop is an important cereal crop in parts of India, Northern China, Manchuria, Africa, and the United States. The grain is used for human food in some countries in place of wheat and other grains. With the exception of broomcorn very little sorghum is grown in Europe but some is produced in the Mediterrannean countries. Grain sorghum is India's third most important crop. Sorghums are widely grown in Africa and are used by the natives for human food, for forage, and for fermented drinks.

The sorghums have attained considerable value in the United States. The grain sorghums are well adapted to the Southern Great Plains, including parts of Texas, Oklahoma, Kansas, Colorado, and New Mexico. Sweet sorghums and Sudan grass are more widely adapted and are found to be useful crops over a large area of the country. Broomcorn has become important locally, reaching its maximum importance in Oklahoma and Illinois.

According to the 1930 Census of Agriculture, grain is the most important use for which sorghums are grown in Oklahoma. There were 747,624 acres devoted to this purpose in 1929. There were 693,664 acres of sorghums used for hay, silage, and fodder; 124,990 acres of broomcorn; and 4,303 acres of sorghums used for syrup.

Sorghum is fourth in importance as a grain crop in Oklahoma, being exceeded in both production and acreage by wheat, corn, and oats. The crop is the leading hay and forage crop of the State, however, and has a greater acreage than even native grass for hay. The broomcorn type of sorghum is grown locally in rather large acreages. Nearly twice as many acres of broomcorn are grown in Oklahoma as in any other one state.

ADAPTATION

Adaptation as to Use. Figs. 1, 3 and 4 show that grain sorghum reaches its maximum importance in Oklahoma in Regions 1, 3, 2, and 4 respectively on the basis of percentage of cultivated land occupied. The rest of the State depends more extensively on other crops such as corn and oats for grain.

Sorghums used for hay, fodder and silage reach their maximum importance in Regions 3, 1, and 5 respectively on the basis of percentage of cultivated land occupied. Regions 4 and 2 also produce considerable sorghum for forage. Region 6 depends more upon prairie hay and Region 7 more upon corn for feeding purposes.

Sorghums for syrup are found for the most part in Regions 5, 6, and 7.

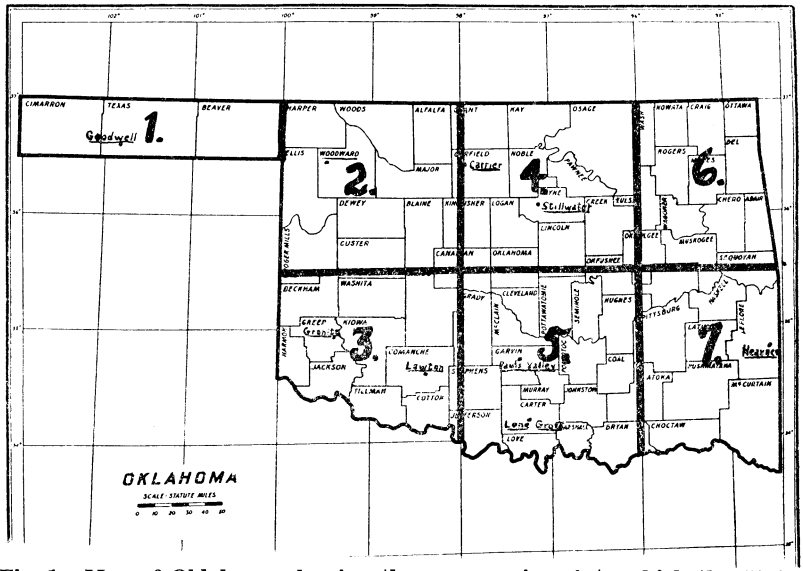

Fig. 1.—Map of Oklahoma showing the seven regions into which the State was divided for purposes of this study. The 96th, 98th, and 100th meridians were used for the north to south division lines. The 35° 30′ longitude line was used for the east to west division.

Adaptation as to Climate. The charts in Figs. 3 and 4 show that in general sorghums for grain and forage are found in the parts of the State with the least rainfall, and for syrup in the regions with the most rainfall.

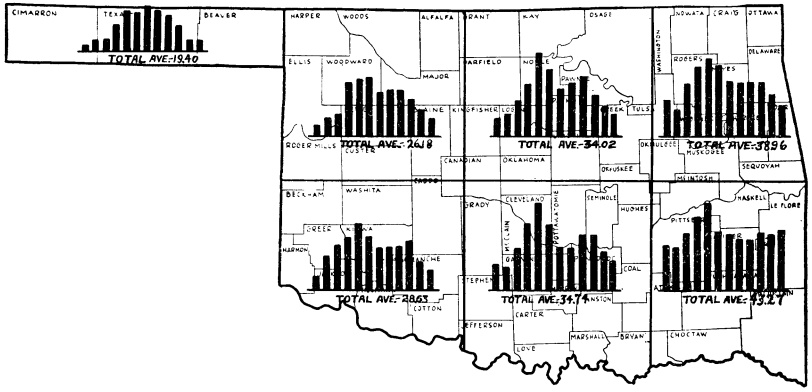

Fig. 2.—Precipitation map of Oklahoma showing the quantity and distribution of rainfall in each region. (See Fig. 1.) The vertical bars represent the average rainfall for each section for each month of the year, beginning on the left with January.

Fig. 2 shows graphically the amount and distribution of rainfall in each district. These graphs represent averages of five to eight stations in each

district for periods of from 14 to 39 years each. It will be noted that Western and Central Oklahoma have rainy summers and dry winters, typical of the plains and prairies of the United States. Eastern Oklahoma has a fairly well distributed rainfall with considerable rain during the winter, approaching the distribution typical of the forested regions of this country. The distribution in all districts except 1, 6, and 7 shows somewhat lower rainfall during July and August than for the fall months.

Adaptation as to Pests. The chinch bug is the most important pest

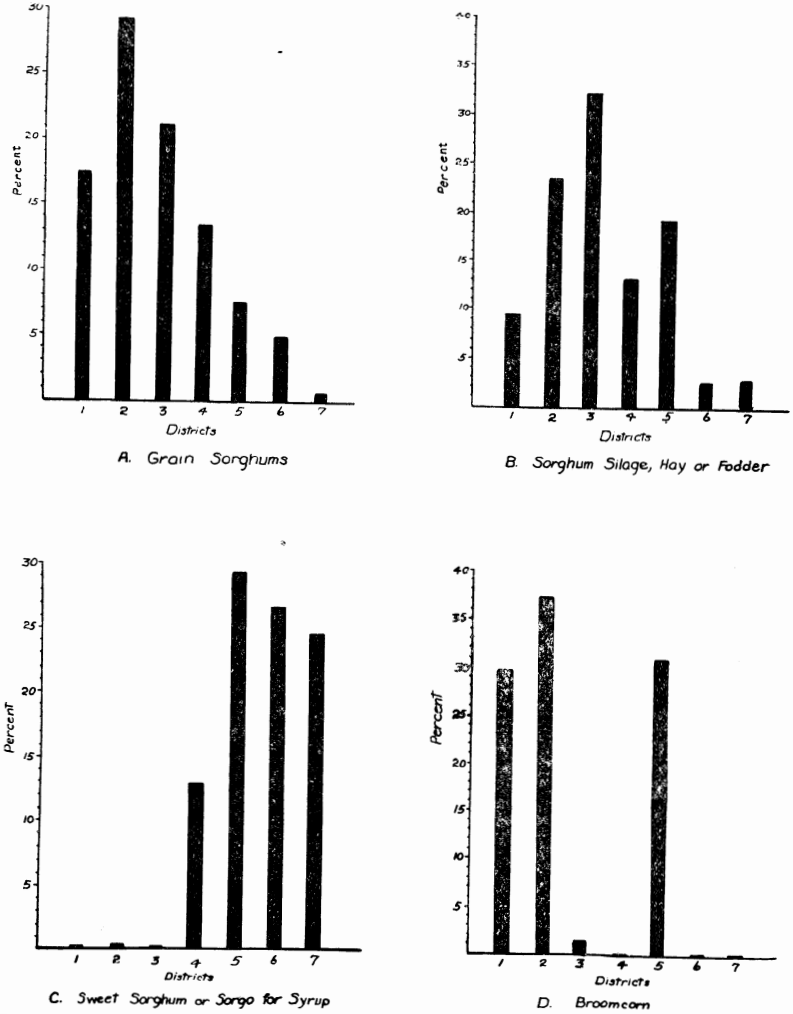

Fig. 3.—Per cent of total acreage of (A) Grain Sorghums, (B) Sorghums for Silage, Hay, or Fodder, (C) Sweet Sorghums or Sorgo for Syrup, and (D) Broomcorn found in each region shown on map in Fig. 1.

controlling sorghum acreage in Oklahoma. The insect lives over winter in native grass and in crop stubbles and rubbish. It then infests small grains, passing on to sorghums when the grain is harvested. The chinch bug infests a rather wide belt extending from the north-central to the southwestern part of the State. The reasons for the position of this belt are not clear, but the correct balance between rainfall and dry weather, the presence of numerous fields of small grain, and the presence of an abundance of bunch grass for winter quarters are no doubt important. Regions 3 and 4 are the most heavily infested in the State. Regions 1, 2, 7, and a fairly high percentage of Regions 5 and 6 have very little difficulty.

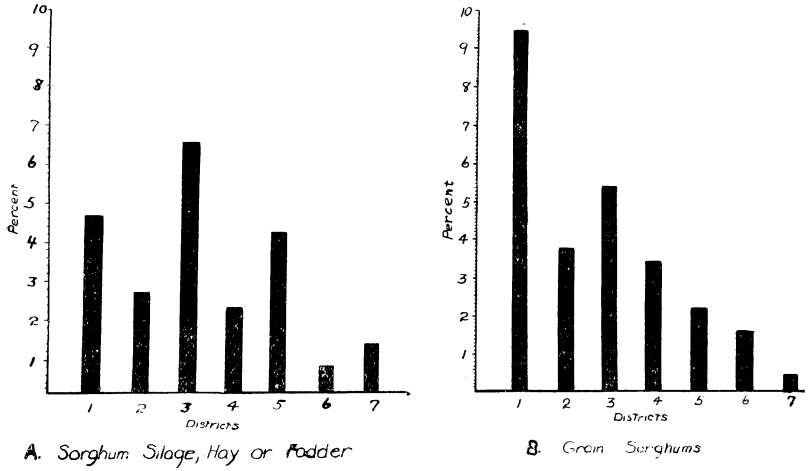

Fig. 4.—Per cent of all harvested crop acreage devoted to (A) Sorghum Silage, Hay, or Fodder, and (B) Grain Sorghums in each region shown on map in Fig. 1.

Because of chinch bug injuries, the growing of milos and to a lesser extent the feteritas is not recommended in the infested area. Hybrids of those two groups are often susceptible also. All true kafirs, Darso, and Schrock are fairly dependable. Most of the sweet sorghums are fairly resistant. Honey sorgo is more susceptible than most of the others.

TABLE I.—Averages of Climatic Factors for Each Region of Oklahoma.

Region	No. of stations in ave.	Ave. No. of years per station	Ave. date of last frost in spring	Ave. date of first frost in fall	Ave. length of growing season in days	Ave. annual rainfall in inches	Ave. rainfall May to October in inches	Ave. altitude in feet
1	5	27	Apr. 19	Oct. 24	188	19.40	14.18	3368
2	8	28	Apr. 6	Oct. 29	206	26.18	17.68	1664
3	8	27	Apr. 1	Nov. 7	220	28.63	18.86	1423
4	8	34	Apr. 4	Oct. 27	206	34.02	22.10	945
5	8	31	Mar. 29	Nov. 8	222	34.74	20.92	959
6	8	26	Mar. 30	Oct. 29	213	38.96	22.64	666
7	5	18	Mar. 25	Nov. 5	225	43.27	21.94	568

Control measures include: (1) Planting sorghum as far from small grain as possible; (2) cutting nearby grain fields early enough to force im-

mature bugs to crawl rather than to allow bugs to mature and fly; (3) the use of barriers of cresote, oil, cotton seed, coal tar, or dust mulch; (4) planting one or two drill widths of cane or other sorghum about the edges of the field to feed the chinch bugs (The bugs in the strip may be poisoned with cyanogas dust or with nicotine dust to prevent them from moving into the row crop.); (5) planting the crop early to allow the plants to attain good size before the chinch bugs arrive; (6) use of chinch bug resistant varieties such as kafirs, Darso and Schrock.

Some of these methods are, of course, not practical or effective under many conditions. For more detail, write to the Entomology Department of the Oklahoma Agricultural Experiment Station, at Stillwater. Kansas Experiment Station Circular 113 gives some excellent suggestions for the control of chinch bugs.

Creosote has been found to be especially valuable as a barrier. Erect a narrow ridge with a hoe, patting it smooth on top. Put the creosote in a can with a nail hole in the bottom. Run the stream of creosote along this ridge every three days, or oftener on spots needing it. Flake calcium cyanide or other poisonous chemicals may be used at intervals to kill the bugs collecting along the barrier. This method has been generally unsuccessful in Southwestern Oklahoma due to the early flight of the bugs.

Adaptation as to Soil. Sorghums do best on a sandy loam soil but may be grown on any soil on which other crops grow. A sandy loam allows better penetration and a greater availability of the light showers which are often responsible for carrying the crop through periods of drouth.

INTRODUCTION OF SORGHUM VARIETIES

Broomcorn was probably the first sorghum to be introduced into this country. These importations began as early as the latter part of the 18th century. The crop has been grown in Europe for over 300 years. A Chinese sorgo or sweet sorghum was imported from France in 1853. The Black Amber, an early variety now grown in the northern states for forage and syrup, was developed from this importation. A collection of sweet sorghums was imported from South Africa by Leonard Wray, an English planter, about 1856. Sumac, Orange, and Gooseneck probably originated from this collection. Kafir was on exhibit from South Africa at the Centenial Exposition in Philadelphia in 1876. Durras were introduced from North Africa; Kaoliangs were brought from China and Manchuria. Additional importations were made from time to time. Shallu was introduced from India about 1890 and sold as Egyptian wheat. Feterita, Hegari, and Sudan grass are more recent introductions. These were made in 1906, 1908, and 1909, respectively, from the Sudan region of North Africa.

GRAIN SORGHUMS

Grain sorghum varieties are divided botanically into six groups: Milo, kafir, feterita, durra, kaoliang, and shallu. Of these six, only three are of any importance in Oklahoma, namely, milo, kafir, and feterita. In addition, however, many selections and hybrids, many of them of unknown origin, are grown in the State.

Description of Grain Sorghum Varieties

The following varieties are not all of importance agriculturally as yet. Some of them are quite new, while others have never become popular.

Milo. This group of varieties is thought to have originated in Africa. It made its appearance in this country soon after 1880 and has since spread over the Great Plains Region. The original variety was six or seven feet tall, but it has been reduced by selection to four or five feet in height. Milos have dry, pithy stalks, rendering them relatively unimportant for forage. The original variety is known as Standard Milo. The Dwarf strain

is more productive and has replaced the taller one to a large extent. Dwarf Yellow milo is doubtless the most important variety of sorghum in Oklahoma on the basis of acreage and production. Milo heads are ovoid, compact, and may be either erect or pendent. The spikelets have awns and dark glumes. Dwarf Yellow milo seed is buff to orange in color and has the obovate shape characteristic of all milos.

White Milo. This variety is similar to the Yellow milos except in the color of the seed. The variety is represented by the Standard and the Dwarf strains, neither of which yield as well as the Dwarf Yellow milo. For this reason the variety has never become popular.

Fargo Milo or Straight-neck Milo. This variety is a selection found near Fargo, Oklahoma. It was probably originated by H. Willis Smith of Garden City, Kansas, as Buff kafir. The variety is somewhat taller and later than Dwarf Yellow milo and has longer and looser heads, with "straight necks." The variety is not as susceptible to chinch bug injury as most milos but does not appear to be generally adapted outside the milo belt.

Beaver Milo and Wheatland Milo. These varieties are crosses between milo and kafir developed at the Woodward Field Station. The varieties are very dwarf, seldom averaging more than three feet in height, making them more suitable for combining than the taller milos. Their yields are usually similar to those of Dwarf Yellow milo.

Blackhull Kafir. Various strains of kafir have been grown in the State since settlement. The Standard Blackhull strain is a selection with short black glumes and an ovate shaped white seed. The heads are cylindrical and semi-compact. The variety requires a longer growing season than milo and sometimes fails to mature following prolonged drouths. The plants are normally four to six feet in height, with juicy, somewhat sweet stalks.

Reed Kafir. This strain was probably selected by John Crammer, of Blaine county, from seed samples obtained from the Oklahoma Agricultural Experiment Station and later increased and distributed by E. M. Reed, of Elk City, from whom it derives its name. The variety has rather long black glumes and an elliptical shaped white seed. The yields of this variety have been very good in nearly all tests made. The variety is earlier than

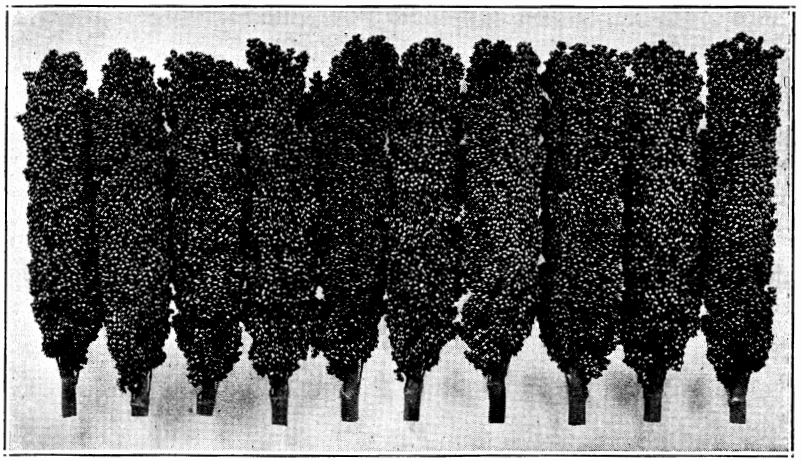

Fig. 5.—Ten heavy, uniform heads of Hydro kafir.

Standard Blackhull, allowing it to be grown successfully over the entire State.

Hydro Kafir. This variety has been rather generally distributed as Reed kafir. It has apparently had its source from the same original seed samples as Reed kafir and has similar characteristics. The variety is later maturing, however, and does not have such wide adaptation. The variety is widely used as a show kafir because of its heavy, well formed heads. (See Fig. 5.)

Sunrise Kafir. This variety is valuable to be used for both forage and grain. The strain was developed at Amarillo, Texas, as a selection from Blackhull by the United States Department of Agriculture. The variety is taller and earlier than the Standard Blackhull and often gives greater forage yields.

Dawn Kafir. This variety originated from the same head selection as Sunrise. The characteristics and adaptation are very similar except that the plants are much more dwarf in habit.

Pearl Kafir. This variety is similar to Standard Blackhull in height and appearance of head and seed. The origin of the plant is not known, but it is no doubt a selection from the Blackhull. The seeds are often hard and vitreous, the characteristic for which it is named. This variety often gives good yields in tests in Central Oklahoma but apparently does not have as wide adaptation as many kafirs due to its somewhat later maturity.

Santa Fe, Western Blackhull, Texas Blackhull, Sharon Kafir, or Dwarf Kafir. This variety is apparently a selection of the Blackhull and is very similar to it. It is somewhat earlier than the original strain and often gives greater yields. The variety apparently has appeared in different parts of the sorghum belt from separate selections, resulting in several names in common use. The strains may vary in minor respects, but they are in general very similar.

Pink Kafir. This variety was selected by the Kansas Agricultural Experiment Station at Hays, Kansas, from a Department of Agriculture introduction. The heads are longer than those of Blackhull and the seed has a pink tint. The variety is one to two weeks earlier than Blackhull and more commonly grown in Kansas than in Oklahoma.

Red Kafir. This variety was introduced from South Africa along with other kafirs in the early days. It was grown more extensively in former years, but it has been replaced quite largely by other varieties due to a demand for white grain. The heads are long and cylindrical and the seed is a light red in color, ovate in shape and commonly hard and vitreous in texture. It is similar in height and maturity to the Blackhull. Early strains have been developed.

Bishop Kafir or Algeria. The origin of this variety is not clear. It was introduced and distributed by George Bishop of Washita county, from whom it derives its name. The variety is apparently a cross between kafir and milo and retains the white seed color from its kafir parent. It has milo characteristics with regard to the awns, shape of seed, and sensitiveness to chinch bug injury.

Feterita. The feteritas belong to one of the earliest groups of grain sorghums commonly grown. Where short seasons are common or long drouths prevail, feteritas give comparatively good yields. The Standard feterita is the most common variety. The only other variety that has had wide distribution is Spur feterita, a leafy variety developed by the Texas Experiment Substation at Spur, Texas. The head is compact, oval, and awnless. The seed of feterita is large, soft, and starchy, and has a characteristic blue-white appearance. Since the seed is subject to rotting in cold soils, early planting often results in poor stands.

Dwarf Hegari. This variety was selected from original seed importations from Africa. The heads are somewhat shorter and more compact than kafir and are oval to cylindrical in shape. The seed is similar in color to that of feterita but is not so soft in texture. Dwarf hegari tends to sucker heavily under favorable conditions. Rather heavy yields of both forage and grain are sometimes obtained, especially when grown on bottom land or other soils well supplied with moisture and fertility.

Chiltex was developed by the United States Department of Agriculture at Amarillo and Chillicothe, Texas, as a cross between feterita and kafir. The variety is very early. Some very good results have been reported with it. This variety was first distributed in 1923.

Premo also originated at Amarillo and Chillicothe, Texas, at about the same time as Chiltex. It is a cross between feterita and kafir. The variety is considerably later than Chiltex. Short tests in Southern and Eastern Oklahoma with this variety have been quite promising.

Darso. The origin of this variety is not definitely known. It has been grown since 1912, at which time it appeared in Logan county. The variety is doubtless a cross between some grain sorghum and some sweet sorghum. It is earlier and somewhat more dwarf than Standard Blackhull. The heads are loose and the seeds are reddish brown. The spikelets have black glumes and awns. The grain is not so palatable as many other sorghums but gives good results in feeding tests. The bitter flavor is sometimes an advantage near towns and on farms where sparrows and other birds are abundant, since birds seldom damage Darso seriously.

Schrock. This variety apparently has an origin similar to that of Darso. The variety was selected in Garfield county by Roy Schrock in 1912. The heads are more compact and the seed is more uniformly brown than Darso.

Grohoma. This variety is a hybrid selected by Fred Groff of Oklahoma county and was first distributed in 1930. The true parents are not known, but it is thought to be a hybrid between feterita and some sweet sorghum. The heads are loose and the seed is typically buff to light brown in color with a characteristic feterita shape. The variety lacks uniformity, readily breaking up into various forms each year, a condition that may eventually be corrected by selection.

Producing the Crop

Selection of Seed. Most fields of grain sorghum in the State have far too many mixtures and hybrids. Growers who take pride in their fields are careful to plant pure seed. There are few crops in which hybrids show up more conspicuously than in sorghums.

Pure seed may be maintained by careful use of the thresher when it is moved from another farm growing sorghums and by growing a seed block from selected heads for two or three years. When sorghums are badly mixed new seed of known purity is to be preferred, even though it is just enough to plant a small isolated patch for seed increase.

In addition to being pure, the seed should be plump, bright, and clean. Good stands are difficult to obtain under many conditions, and every precaution should be used to insure good germination. Much of a plant's vigor depends upon good, sound, viable seed.

Testing and Treating Seed. In order to be sure of good seed, some system of testing is often advisable. Strips of heavy cloth, marked into squares to separate the seed from different sources, may be rolled up, dipped into water to moisten it thoroughly, and then left in a warm place. This roll will need to be moistened from time to time to keep it from drying out. If 100 seeds are used in each square, the determination of the per cent germination is easily made simply by counting the sprouted seed.

If desired, samples may be sent to the State Seed Analyst, Capitol

Building, Oklahoma City, for germination and purity tests. A small number of samples will be tested free of charge.

The use of copper carbonate dust, Ceresan, or other mercuric preparations sold by local drug stores and seed houses is often advisable in order to control kernel smut and also to encourage germination under unsuitable soil or temperature conditions by reducing the loss from rotting in the soil.

Rate and Method of Planting. Grain sorghums may be planted with a lister or with a corn planter. Experimental results have shown that the 40- to 44-inch row is satisfactory for sorghums and that the use of wide or alternate rows is seldom profitable.

The spacing in the row usually recommended is 6 to 9 inches for kafirs, Darso, and Schrock; 9 inches for the feteritas; and 18 inches for Dwarf Yellow milo. Table II gives an idea as to the yield variations that may be expected under different conditions.

Date of Planting. Late May and early June plantings are usually recommended except where chinch bugs are serious, in which areas April 15 to May plantings give the better yields. June plantings are late enough to allow the seed bed to warm up thoroughly before planting, to allow spring rainfall to be stored in the soil to encourage rapid growth, and to allow time for the eradication of many weeds before planting.

Summarized data showing the results of date of planting tests of grain sorghums at Woodward, Lawton, Dalhart, and Stillwater are shown in Tables III and IV.

TABLE II.—Results of Spacing Tests With Milo and Kafir*

Spacing in row (Inches)	WOODWARD		LAWTON		DALHART, TEXAS		STILLWATER	
	Years in ave.	Yield in bu. per acre	Years in ave.	Yield in bu. per acre	Years in ave.	Yield in bu. per acre	Years in ave.	Yield in bu. per acre
Dwarf Yellow Milo								
6	10	25.0	---	---	8	33.2	---	---
12	10	25.0	---	---	8	32.5	---	---
18	10	27.3	---	---	8	31.1	---	---
24	10	28.7	---	---	8	30.3	---	---
30	10	25.9	---	---	8	---	---	---
Blackhull Kafir**								
6	5	38.0	10	19.6	2	25.2	5	29.0
12	5	31.7	10	17.7	2	21.5	2	26.8
18	5	27.2	10	16.8	2	22.1	5	23.1
24	5	24.2	10	15.1	2	18.5	5	22.9
30	5	19.9	10	13.1	2	16.1	5	20.4

*Adapted from United States Department of Agriculture Tech. Bul. 131, U. S. D. A. Field Station data, and from Oklahoma Agricultural Experiment Station data.

**Santa Fe kafir at Dalhart, Standard Blackhull at Stillwater and Lawton, Reed kafir at Woodward.

Cultivation. Sorghums may be cultivated in much the same way as other row crops. Shallow cultivation, sufficient to keep down weeds and to maintain the soil in a receptive condition for rains that follow, is necessary. Careful weed control before the crop is planted helps a great deal in controlling weeds. Since young sorghum plants grow slowly, a clean, well prepared seed bed is important.

Harvesting the Crop. Some difficulty is involved in harvesting grain sorghums by machinery, because of the uneven ripening. Late varieties and varieties that develop numerous suckers are often the most difficult to harvest with machinery. These are usually harvested by hand, cutting the heads off with a knife and gathering them in a wagon; or a row binder is used to gather the whole plant. These plants may be fed in the bundle or the heads may be removed later after drying. Mechanical devices such as headers and combines are in common use where wheat is extensivly grown. Planting pure seed in a uniform seed bed, and the use of dwarf varieties that mature early, all contribute to favorable conditions for mechanical harvesting. Kafirs, especially the Dawn variety, are usually quite easily harvested by machinery. The very dwarf forms of milo such as Beaver and Wheatland are comparatively easy to harvest in this way.

TABLE III.—Results of Date of Planting Tests With Kafir, Feterita and Milo*

Date of seeding	WOODWARD		LAWTON		DALHART, TEX.	
	Years in average	Yield in bushels per acre	Years in average	Yield in bushels per acre	Years in average	Yield in bushels per acre
Reed Kafir						
April 15	2	22.9	5	20.6		
May 1	6	23.8	5	21.3	3	30.8
May 15	6	24.3	5	16.9	3	33.5
June 1	6	28.1	5	10.8	3	29.2
June 15	6	33.1	5	10.5	3	22.6
July 1	3	30.5	5	8.8	3	0.0
Dwarf Feterita						
April 15			3	11.2		
May 1	2	9.4	3	18.5	2	18.9
May 15	2	14.2	3	18.2	2	25.2
June 1	2	14.2	3	16.9	2	25.6
June 15	2	25.5	3	16.3	2	25.8
July 1	2	19.9	3	10.0	2	16.5
Dwarf Milo						
April 15	10	17.3	3	20.3		
May 1	10	18.3	3	22.6	4	28.4
May 15	10	24.7	3	23.7	4	28.2
June 1	10	27.6	3	19.1	4	31.8
June 15	10	33.2	3	14.1	4	35.2
July 1	10	27.3	3	10.7		

*Data adapted from United States Dept. of Agri. Tech. Bul. 131.

Outside the wheat belt, where the combine is not commonly found, hand heading is more widely used. Much of the sorghum is bound into bundles which may be fed with or without heading. When the sorghum is headed the heads are either piled in low ricks or are stacked in compact stacks something on the order of small grain stacks. Ricks are often satisfactory in Western Oklahoma where rainfall is light, but stacks are preferable in the central and eastern parts of the State. Fig. 6 illustrates a well made stack of grain sorghum heads.

The stack is built on large posts or poles covered with straw. A pole about 10 inches in diameter is erected in the center of the stack and the heads are stacked about it. After the stack is complete the pole is removed to use for another stack. The hole remaining serves as a ventilator. The

stack should not be more than 10 feet in diameter and should be carefully capped to prevent the entrance of moisture.

Fig. 6.—A well-made stack of Darso built in such a way as to cure well before threshing.

Green or damp heads should be piled in low ricks and turned over occasionally until dry, then threshed as soon as possible to prevent loss from rains.

Threshing. Either the grain thresher or a combine may be used to thresh the headed grain. Since most sorghums crack readily, the machines should be adjusted to reduce this as much as possible. Lowering the concave, removing concave teeth, and reducing the speed of the cylinder one-third to one-half by special pulleys and sprockets is often necessary. When the combine is used for headed grain the sickle and reel are removed and the machine is used as a stationary thresher.

Storing. Grain sorghum is more difficult to store in the bin than many grains because the seed heats readily and quickly. The presence of a large percentage of cracked kernels encourages spoiling as does the presence of finely chopped pieces of the stalk and the head. Threshing grain before it is thoroughly cured contributes to such loss. Grain that is too damp to store safely should be piled in long, shallow piles for a time before putting it in the bin. These piles may be left in the field for a short period and shovelled over every few days until dry. Bins with screened ventilators at the bottom have also been used with success.

TABLE IV.—Results of Date of Planting Tests With Grain Sorghums, Stillwater, Oklahoma

Date of Planting	HYDRO KAFIR		FETERITA		HEGARI	
	Years in average	Yield in bushels per acre	Years in average	Yield in bushels per acre	Years in average	Yield in bushels per acre
April 15	5	19.7	6	13.8	5	10.4
May 1	5	21.8	6	19.5	5	15.2
May 15	5	22.6	6	18.4	5	18.0
June 1	5	8.7	5	14.3	5	8.4

TABLE IV.—(Continued)

Date of Planting	SCHROCK		DARSO		FARGO MILO	
	Years in average	Yield in bushels per acre	Years in average	Yield in bushels per acre	Years in average	Yield in bushels per acre
April 15	5	26.3	6	25.5	4	22.5
May 1	5	27.5	6	26.8	4	16.1
May 15	4	21.5	6	23.9	4	16.5
June 1	3	19.0	6	27.1	4	9.5

SWEET SORGHUMS

SWEET SORGHUM VARIETIES

Most varieties of sweet sorghum are selections of the original varieties introduced into the United States at various times beginning about 1856. A few promising strains have been developed as hybrids.

Sweet sorghums are usually tall growing, leafy plants with sweet, juicy stems. Late varieties often produce the greatest yields of forage but are usually rather coarse for fodder and are not always reliable for seed production. Medium maturing varieties are the most valuable for most conditions, giving good yields of fine stemmed forage and dependable yields of seed. The early varieties are preferred by some, but the forage yields are usually lower while the seed yields are relatively high.

Late Varieties

Honey. This is the most common late variety. The variety is used for syrup more than for fodder and silage since the yields of sweet, juicy stalks are very high. The heads of this variety are very open and spreading. The seed is nearly covered with reddish glumes which are usually retained on the threshed seed.

Gooseneck. This variety is even later than the Honey. The Gooseneck has brown seed and black glumes. The head is rather loose but not spreading, and tends to droop from a crook neck. It is one of the best syrup varieties for Southern and Eastern Oklahoma.

White African. This is a medium to late variety, having white seed and long black glumes that may or may not be retained on the threshed seed. The head is rather compact and small.

Medium Maturing Varieties

Orange. The Orange variety is one of the most common varieties in the State. Several strains have been developed from the variety. As ordinarily found on the seed market, the variety does not develop a uniform type of plant. Even when fairly uniform seed is planted the variety seldom retains its uniformity unless previous selections have been made. Some growers have selected heads and increased the seed, resulting in the appearance of pure strains of considerable value for forage and for syrup. The variety may have red or black glumes with elliptical seed of various shades of brown.

Kansas Orange is a selection of considerable merit that has been developed at the Kansas Experiment Station at Manhattan. This variety has brown seed and red glumes. Its principal fault is its tendency to lodge.

African Millet or Sourless Cane is another strain or hybrid selection that has given good results. This variety has brown seed shading to yellow or even white at the base where it has been covered with the black glumes.

Sumac. Sumac is another very common forage variety in Oklahoma. The plants are usually somewhat shorter than most other sweet sorghums, but the yields are usually good. The head is small and compact with small dark red, ovate seed. The variety is sometimes called "Redtop" because of the appearance of the head.

There are two distinct strains of the Sumac, a medium maturing strain, and an early one. The early one, known as Early Sumac, was developed by the Hays Branch Experiment Station, Hays, Kansas. It is of value where the seasons are too short for the regular Sumac to mature. Some prefer it as a broadcast cane, believing it to be somewhat finer stemmed. The forage yields of the later maturing variety are nearly always the greater.

Various other selections have been made, but most of them are very similar to the common Sumac.

Atlas. This variety was originally developed by I. N. Farr, of Stockton, Kansas, as a cross between Sourless and Blackhull kafir. It was later selected and improved by the Kansas Agricultural Experiment Station. The variety is medium in maturity, having white ovate seed and black glumes. It produces good yields and is superior to many varieties in its lodging resistance. The grain is very similar to kafir, allowing the variety to be used for both grain and forage.

Early Maturing Varieties

Most of the early maturing varieties of sweet sorghums have but limited use in Oklahoma and are better adapted farther north where the growing season is shorter. During very unfavorable seasons or when planted broadcast, the early varieties sometimes excel the later maturing ones. Red Amber, Black Amber, Leoti Red, and Folger are typical of this group.

PRODUCING THE CROP

Rate of Planting. Sorghums for forage may be planted in rows, broadcast, or with a wheat drill. The yields are often somewhat higher when broadcasted or drilled. (See Table V.) As to the method of seeding, much of course depends upon the use to which the crop is put. When silage or fodder is desired the row type of planting is the most desirable. On unterraced, washing soils, on areas where chinch bugs are likely to be a pest, or where a fine stemmed hay is desired, the broadcast or drilled method is very useful.

Rates of seeding as high as one to three bushels are sometimes recommended for drilled sorghum. Experiments indicate that little is gained by increasing the planting rate over 30 to 45 pounds per acre. Even less is permissible on thin soils. Four to six inch spacings have given the best results for row plantings. This will require about four or five pounds of seed per acre.

Date of Planting. Like grain sorghums, sweet sorghums yield best when planted fairly late except in those sections where chinch bugs are numerous. The forage yields are not so sensitive to the dates of planting as are grain yields, since there is not such a short critical growth period in the production of forage. (See Table VI.)

Harvesting the Crop. Sweet sorghums or grain sorghums harvested for forage are harvested in several ways for different purposes. The crop may be cut with a mower, raked up, and stacked as with other kinds of hay. This is especially true when the crop has been planted broadcast or drilled. Cutting the crop about the time the seed is well formed gives the best yields. If dry weather or frost prevents its reaching this stage, cutting as soon as growth ceases is desirable.

The crop may be used for fodder or silage, in which event the row binder is used as a rule. When the crop is to be used for silage the plants should be fairly mature so that they will have lost some of their succulence. Sweet sorghums ensiled too green tend to become wet, sour, and less palatable. Since most grain sorghums are relatively pithy and dry, many growers prefer using them instead of the sweet sorghums as silage. When the crop is to be used for fodder it should be harvested as soon as the seed is well formed to get the maximum yield and at the same time retain the most of the nutrients in the stalk.

TABLE V.—Comparison of Row Planting and Drilling Sorgos and Sudan Grass

	Method of planting	DALHART, TEXAS		LAWTON, OKLA.	
		Years in average	Tons per acre	Years in average	Tons per acre
Sorgo*	Rows	4	3.87	7	3.16
	Drilled	4	4.87	7	3.51
Sudan grass	Rows	11	1.85	13	1.69
	Drilled	11	1.90	13	2.08

*Leoti Red at Dalhart; Sumac at Lawton.

TABLE VI.—Results of Date-of-Seeding Experiment With Sumac Sorgo

Date of seeding	WOODWARD		LAWTON		STILLWATER	
	Years in average	Tons per acre	Years in average	Tons per acre	Years in average	Tons per acre
April 15	9	2.72	13	4.41	4	3.99
May 1	9	2.84	11	3.05	4	4.08
May 15	9	2.85	11	3.05	4	4.08
June 1	9	2.76	12	2.96	4	3.84
June 15	9	2.93	13	2.49	--	--
July 1	9	2.47	12	2.43	--	--

STATIONS FROM WHICH EXPERIMENTAL WORK IS REPORTED IN THIS BULLETIN WITH A BRIEF RESCRIPTION OF THE SOILS OF EACH.

1. Goodwell: The station is located on the heavy soils typical of much of the High Plains. Records extend for the most part from 1924 to 1931. Variety tests all made at one date of seeding.
2. Dalhart (Texas): The station is located on the sandy loam soils typical of part of the High Plains. Records extend from 1919 to 1931. Variety tests all made at one date, except for 1929 to 1931 inclusive which are averages of three dates of seeding.

TABLE VII.—Yearly Rainfall Records for 20 Years at Four Experiment Stations Where Sorghums Have Been Under Test

(Total inches per year)

Year	Woodward*	Lawton**	Stillwater*	Goodwell*
1912	23.84		30.48	17.47
1913	24.25	42.48*	32.75	18.99
1914	17.04	28.07*	20.04	22.51
1915	39.98	39.93*	49.10	26.75
1916	21.65	21.52*	27.34	11.66
1917	17.58	17.28	25.56	16.56
1918	21.99	30.95	36.51	20.13
1919	31.44	43.65	36.28	----
1920	26.26	34.89	43.94	14.79
1921	30.81	20.51	40.58	----
1922	26.74	26.17	34.11	----
1923	47.19	40.43	44.29	24.12
1924	30.05	21.49	25.00	12.12
1925	18.90	28.98	23.26	15.93
1926	30.88	33.96	29.91	17.29
1927	25.92	28.85	40.21	16.34
1928	32.11	25.74	30.50	23.57
1929	27.55	30.72	38.59	18.37
1930	22.58	30.54	23.96	18.53
1931	29.81	28.06	32.60	16.24
AVERAGE	27.33	30.22†	33.25	18.32‡

*Records from U. S. Weather Bureau.
**Records from Experiment Station data.
†Nineteen-year average.
‡Seventeen-year average.

3. Woodward: The station is located on the sandy loam soils typical of a large area of Region 2. Records extend from 1914 to 1931. Variety tests made at one date except 1927, which is an average of two dates of seeding.
4. Lawton: The station is located on a reddish-brown clay loam that has a high clay content and a medium supply of organic matter. This soil is representative of an isolated area in the Red prairies. The records extend from 1917 to 1929. The variety tests were made on one date except in 1927, 1928, and 1929, when each grain sorghum variety was planted on 3 dates of seeding.

5. Granite: The station is located on silt loam soil typical of parts of Region 3. Records extend from 1926 to 1931. Variety tests all made at one date of seeding.
6. Carrier: The station is located on level, fine sandy loam soil typical of much of the wheat belt. Records extend from 1927 to 1931. Variety tests all made at the same date of seeding.
7. Stillwater: Station is located on fine sandy loam typical of much of Region 4. Records given here extend from 1915 to 1931. Variety tests averaged are all made at one date. Tests for 1930 and 1931 were made at the Perkins Farm on soil approaching a sandy loam.
8. Lone Grove: The station is located on medium loam prairie soil typical of parts (especially western) of Region 5. Record extends through 1930 and 1931.
9. Pauls Valley: The station is located on fine sandy loam to silt loam soils typical of parts of Region 5. Record extends through 1930 and 1931.
10. Heavener: The station is located on the fine sandy loam upland, forest soils typical of the mountainous areas of Region 7. Records extend through 1930 and 1931.

RECOMMENDATIONS FOR REGION 1, BASED ON RESULTS AT DALHART, TEXAS

B. F. BARNES

Results from Dalhart, Texas, are presented in this bulletin because they apply to the sandy loam soils of the Oklahoma Panhandle as contrasted to the heavier soils represented at Goodwell, Oklahoma.

For grain production in Region 1, Dwarf Yellow milo, Santa Fe kafir (Dwarf kafir), and Reed kafir have given the highest yields. (See Table VIII.) Dwarf Yellow milo is the highest and the most dependable yielder of the grain sorghums. This variety seems to be rather peculiarly adapted to the soil and climate of the region. The length of the growing season, the distribution of the rainfall, and the character of the soil meet the requirements for this crop. Because of the ability of Dwarf Yellow milo, locally known as "maize," to adapt itself to different spacings in the row, it is better able than other grain sorghums to produce maximum yields according to the amount of moisture available during the growing season. Santa Fe kafir sometimes grows a trifle too tall for convenient hand heading. While the variety matures slightly later than Sunrise kafir it does not lodge as easily nor offer the difficulties of hand heading. Reed kafir gives almost identical yields with Santa Fe. Reed kafir should be planted earlier than Santa Fe kafir, which, in turn, should be planted earlier than Dwarf Yellow milo for its maximum yield.

Fargo (Straight-Neck) milo will give excellent yields on the sandier soils of the region and on the tighter soils in seasons where the moisture supply is ample for the crop needs. Dwarf hegari will compete with Dwarf Yellow milo in yield only when planted towards the latter part of the planting season, the 15th to 20th of June.

For combine purposes or machine heading Wheatland milo is the most promising variety. A few seasons of preliminary work indicates that Wheatland milo is rather a close yield competitor of Dwarf Yellow milo, and lodging tests indicate a higher resistance to lodging than other varieties. Wheatland milo matures a few days later than Dwarf Yellow milo. Beaver milo lodges more readily than Wheatland milo and does not yield with Dwarf Yellow milo.

TABLE VIII.—Yields of Sorghums Harvested for Grain at Dalhart, Texas, 1919 to 1931 Inclusive.

Variety	C. I. No.	YIELDS IN BUSHELS PER ACRE							
		1919	1920	1921	1922	1923	1924	1925	1926
Dwarf Yellow milo	332	55.6	38.6	37.3	16.1	27.5	22.3	29.5	27.0
Santa Fe kafir (Dwarf)		26.1	27.7	25.7	13.6	31.8	28.9	31.3	23.9
Sunrise kafir	472	38.6	28.0	30.9	23.0	27.3	11.8	28.4	28.6
Standard feterita	182	33.6	28.6	27.9	22.1	26.8	26.8	31.1	29.3
Spur feterita	623	36.4	25.0	29.3	11.4	15.2	22.3	16.1	24.5
Dwarf hegari	620	47.1	25.8	40.7	0.0	20.9	32.0	25.0	26.8
Pink kafir	432	---	---	30.0	2.7	20.4	24.8	29.6	16.6
Reed kafir	628	---	---	34.8	6.8	---	28.6	41.3	24.3
Dwarf feterita	810	---	---	---	---	31.3	22.3	20.4	25.9
Double Dwarf milo	868	---	---	---	---	---	---	---	---
Fargo (Sraight-neck) milo	809	---	---	---	---	---	---	---	---
Texas Blackhull kafir	865	---	---	---	---	---	---	---	---
Early Red kafir	836	---	---	---	---	---	---	---	---
Premo	873	---	---	---	---	---	---	---	---
Chiltex	874	---	---	---	---	---	---	---	---
Beaver milo	871	---	---	---	---	---	---	---	---
Wheatland milo	918	---	---	---	---	---	---	---	---
Grohoma	920	---	---	---	---	---	---	---	---
Club kafir	901	---	---	---	---	---	---	---	---
Ajax	968	---	---	---	---	---	---	---	---
Wonder kafir	872	---	---	---	---	---	---	---	25.4
Bishop kafir	814	---	---	---	---	---	---	---	---

TABLE VIII.—(Continued)

Variety	C. I. No.	YIELDS IN BUSHELS PER ACRE					No. years	Average yield	Cor. yield*
		1927	1928	1929	1930	1931			
Dwarf Yellow milo	332	23.2	47.9	46.6	38.6	41.8	13	34.8	34.8
Santa Fe kafir (Dwarf)	---	24.8	42.9	49.1	33.7	30.4	13	30.0	30.0
Sunrise kafir	472	25.0	43.9	36.9	30.0	34.5	13	29.8	29.8
Standard feterita	182	26.3	26.3	40.9	19.8	25.3	13	28.1	28.1
Spur feterita	623	20.0	21.4	44.4	22.5	30.6	13	24.6	24.6
Dwarf hegari	620	26.1	0.0	45.1	24.5	21.8	13	25.8	25.8
Pink kafir	432	23.2	20.4	42.1	21.8	22.6	11	23.1	24.7
Reed kafir	628	22.1	39.5	46.4	30.4	32.8	10	30.7	37.1
Dwarf feterita	810	20.5	25.0	36.4	21.7	27.0	9	25.6	26.3
Double Dwarf milo	868	19.5	30.9	42.4	39.2	37.4	5	33.9	29. 8
Fargo (Sraight-neck) milo	809	18.0	31.6	50.0	43.3	34.9	5	35.6	31.3
Texas Blackhull kafir	865	21.8	32.0	45.3	24.3	24.8	5	30.0	26.4
Early Red kafir	836	17.7	27.1	41.0	24.4	26.4	5	27.5	24.2
Premo	873	25.0	27.9	48.8	26.0	24.1	5	30.4	26.7
Chiltex	874	25.5	28.2	46.7	26.7	26.3	5	30.7	27.0
Beaver milo	871	---	22.9	38.6	31.0	35.2	4	31.9	25.4
Wheatland milo	918	---	---	---	---	38.3	1	38.3	31.9
Grohoma	920	---	---	---	---	17.4	1	17.4	14.5
Club kafir	901	---	---	---	---	30.1	1	30.1	25.1
Ajax	968	---	---	---	---	20.2	1	20.2	16.8
Wonder kafir	872	19.8	27.3	43.9	24.9	---	5	28.3	26.8
Bishop kafir	814	10.2	30.0	35.9	14.3	---	4	22.6	27.1

*Corrected yield based on yields of Dwarf Yellow milo for same years.

TABLE IX.—Yields of Sorghums Cut for Forage at Dalhart, Texas, 1919 to 1931 Inclusive

	YIELDS IN TONS OF CURED FORAGE PER ACRE							
	1919	1920	1921	1922	1923	1924	1925	1926
Santa Fe kafir (Dwarf)	2.30	3.33	3.09	1.65	4.18	2.45	2.92	2.20
Reed kafir	---	---	---	---	---	3.50	3.88	3.00
Sunrise kafir	---	---	---	---	---	---	2.74	2.80
Dwarf hegari	---	---	---	---	---	---	---	---
Early Red kafir	---	---	---	---	---	---	---	---
Red Amber	3.08	3.00	3.06	---	---	---	---	---
Sumac	6.55	5.63	7.46	1.28	4.85	4.98	4.38	---
Sudan	---	---	---	0.85	1.83	1.50	2.25	1.53
Early Sumac	---	---	---	---	---	---	---	4.10
Leoti Red	---	---	---	---	---	---	---	---
African millet	---	---	---	---	---	---	---	---
Darso	---	---	---	---	---	---	---	---
Honey	---	---	---	---	---	---	---	---
Kansas Orange	---	---	---	---	---	---	---	---
Atlas	---	---	---	---	---	---	---	---

TABLE IX.—(Continued)

	YIELDS IN TONS OF CURED FORAGE PER ACRE					No. years	Average yield	Cor. yield*
	1927	1928	1929	1930	1931			
Santa Fe kafir (Dwarf)	1.70	2.73	4.03	2.56	2.66	13	2.75	2.75
Reed kafir	2.03	2.93	3.75	2.53	3.06	8	3.09	3.20
Sunrise kafir	1.88	2.73	2.88	2.78	3.31	7	2.73	2.79
Dwarf hegari	1.85	2.08	4.03	2.63	2.88	5	2.69	2.70
Early Red kafir	1.63	2.44	4.85	2.38	2.28	5	2.72	2.73
Red Amber	---	---	---	---	---	3	3.05	2.88
Sumac	---	---	---	---	---	7	5.02	4.84
Sudan	---	---	1.53	2.16	1.94	8	1.70	1.65
Early Sumac	2.75	3.70	4.85	3.36	3.53	6	3.72	3.86
Leoti Red	3.68	4.53	4.91	3.75	4.22	5	4.22	4.24
African millet	4.33	3.63	5.16	3.78	4.03	5	4.19	4.20
Darso	2.58	2.55	4.41	2.88	2.34	5	2.95	2.96
Honey	4.38	8.08	8.00	5.22	4.88	5	6.11	6.13
Kansas Orange	3.60	3.50	6.28	4.28	4.31	5	4.39	4.41
Atlas	---	---	6.75	4.44	4.06	3	5.08	4.53

*Corrected yield based on yields of Santa Fe kafir for same years.

Varieties recommended for combination grain and forage production, or for bundle feed, are Sunrise kafir, Santa Fe kafir, Dwarf hegari, and Early Red kafir. Sunrise kafir is a tall, slender, early, and high yielding kafir. While Sunrise kafir makes its highest yield of grain when planted the first of June, it matures easily when planted the middle of the month and a better quality of feed is secured. For bundle feed the later planting is recommended. The later planting also assists in preventing lodging. Santa Fe gives a satisfactory quality of bundle feed. It does not lodge as freely as Sunrise kafir and does not produce as palatable a stover.

Dwarf hegari is the most popular, and deservedly so, of the grain sorghums for bundle feed. For the best results, for both grain and bundle feed, Dwarf hegari should be planted around the middle of June. In the earlier plantings it is difficult to secure a stand; neither does the plant grow so vigorously when planted early. Dwarf hegari produces an excellent quality of forage and is a standard by which other combination grain and forage sorghums may be compared.

Early Red kafir probably should be ranked second to Dwarf hegari as a combination grain and forage sorghum. The yields of grain are usually not as high as Santa Fe kafir, which has the same growing season, but the quality of the forage is better. Several communities prefer this grain sorghum for bundle feed.

RECOMMENDATIONS FOR REGION 1, BASED ON RESULTS AT GOODWELL, OKLAHOMA

H. H. FINNELL

Among the older varieties of sorghum which have been tested for a period of eight years at Goodwell, Oklahoma, Dwarf Yellow milo made the highest yield of grain. Spur feterita, Dwarf White milo and Desert Bishop approached the milo in grain yield.

Of newer varieties introduced in 1927 none exceeded Dwarf Yellow milo in grain yield nor Sunrise kafir in total yields; but Double Dwarf milo equalled the Dwarf Yellow milo, with Beaver milo and Heileman milo producing about 100 pounds of grain per acre less during the five-year period. For forage production none of the varieties listed in Table XI proved to be a serious competitor of Sunrise kafir.

So far as grain production is concerned the choice of high yielding varieties is limited for the Panhandle region to the milos and milo-related hybrids. Various types of sorghums are available for satisfactory forage production.

The most favorable time of planting applicable to all varieties has proved to lie between the first and twentieth of June. Milo showed the widest range of adaptability to different dates of planting while such varieties as Fargo milo and Darso made more satisfactory yields when planted by the 15th of May.

All the forage varieties made the best yields when closely spaced, but the foremost grain producing varieties required variable spacing for maximum grain production on heavy types of High Plains soil. This practice involves the estimation of soil moisture stores present at planting time and adjusting the rate of planting to the amount of initial soil moisture found. A more detailed discussion of the principles of variable spacing may be found in Oklahoma Experiment Station Bulletin No. 192. General problems of sorghum production in the Panhandle area are discussed in Oklahoma Experiment Station Bulletin No. 191.

TABLE X.—Yields of Sorghums Harvestested for Grain at Goodwell, Oklahoma

	YIELDS IN BUSHELS PER ACRE									Cor. Yield*
	1924	1925	1926	1927	1928	1929	1930	1931	Ave.	
Dwarf Yellow milo	28.0	7.4	8.6	22.9	20.5	29.6	29.4	17.5	20.5	20.5
Dwarf White milo	30.2	12.4	7.8	20.5	17.7	3.6	16.4	23.9	16.6	16.6
Fargo milo	10.3	2.8	0.0	11.1	19.9	0.8	17.8	9.8	9.1	9.1
Standard Yellow milo	28.2	3.8	2.4	19.6	11.0	9.4	15.9	17.7	13.5	13.5
Double Dwarf milo	---	---	---	---	---	23.9	22.9	26.7	24.5	19.7
Heileman milo	---	---	---	---	---	18.6	23.7	23.1	21.8	17.6
Smith milo	---	---	---	---	---	29.8	17.4	22.1	23.1	18.6
Spur feterita	24.3	6.8	0.0	13.0	19.9	25.2	20.5	28.9	17.3	17.3
Standard feterita	19.7	3.2	2.8	14.7	20.7	---	---	---	12.2	14.3
Desert Bishop	25.3	1.8	0.0	17.7	17.7	15.6	21.1	33.7	16.6	16.6
Dwarf hegari	9.3	1.8	0.0	23.7	24.0	2.1	16.2	16.8	11.7	11.7
Sunrise kafir	17.4	2.5	1.1	8.9	18.7	10.1	9.8	33.8	12.8	12.8
Dawn kafir	20.1	1.3	2.0	8.9	21.5	8.9	12.1	23.9	12.3	12.3
Reed kafir	16.3	2.1	0.0	6.6	17.4	13.7	9.4	46.1	13.9	13.9
Santa Fe kafir	11.1	1.4	0.0	10.0	24.3	15.0	14.1	21.2	12.1	12.1
Red kafir	12.7	1.3	0.0	8.9	17.4	---	---	---	8.1	9.4
Schrock	16.0	1.3	0.0	5.4	21.8	13.3	15.7	34.2	13.5	13.5
Darso	22.1	2.4	0.0	5.0	20.7	20.3	12.8	24.1	13.4	13.4
Early Red kafir	---	---	---	---	---	13.2	12.0	31.2	18.8	15.1
Beaver milo	---	---	---	---	---	21.2	29.5	17.4	22.7	18.2
Pink kafir	---	---	---	---	---	---	---	14.9	14.9	17.4
Club kafir	---	---	---	---	---	---	17.0	38.7	27.8	24.4
Grohoma	---	---	---	---	---	---	18.1	9.7	13.9	12.2

*Corrected yields based on yields of Dwarf Yellow milo for same years.

TABLE XI.—Yields of Sorghum Cut for Forage at Goodwell, Oklahoma, 1924 to 1931 Inclusive

	YIELDS IN TONS OF DRY MATTER PER ACRE									Cor. Yield*
	1924	1925	1926	1927	1928	1929	1930	1931	Ave.	
Sumac	1.56	.88	.89	1.92	1.39	1.17	.89	1.79	1.31	1.31
Black Amber	1.02	1.12	.96	1.73	1.07	.72	.71	1.30	1.08	1.08
African millet	1.68	1.17	1.22	2.17	1.60	1.26	1.10	1.53	1.47	1.47
Clubhead	1.05	.53	.83	1.72	1.10	1.10	.73	1.20	1.03	1.03
Sunrise kafir	1.34	1.30	.98	2.44	1.15	1.00	1.00	2.12	1.42	1.42
Dwarf hegari	1.43	.93	.96	1.78	1.28	1.38	2.23	1.37	1.42	1.42
Darso	1.29	1.28	.77	1.72	1.50	1.13	.79	1.18	1.21	1.21
Dwarf Yellow milo	1.30	.96	.81	1.59	1.03	1.48	1.43	.91	1.19	1.19
Red Amber	---	---	---	---	---	.91	.78	1.41	1.03	1.05
Kansas Orange	---	---	---	---	---	2.17	1.06	1.76	1.66	1.70

*Corrected yields based on yields of Sumac for same years.

RECOMMENDATIONS FOR REGION 2, BASED ON RESULTS AT WOODWARD, OKLAHOMA

JOHN B. SIEGLINGER

For grain production in Region 2, Dwarf milo, Reed kafir, and Feterita are the outstanding sorghum varieties. (See Table XII.) Dwarf Yellow milo is a dependable variety. Variations in stand do not influence its yield as much as other varieties. Because of suckering and crooking, Dwarf Yellow milo is usually hand headed. It also lodges soon after ripening, which adds to the difficulty of harvesting. Reed kafir is a high yielding and vigorous growing kafir. It is of little value for stover because most of the leaves are broken off by ripening time. Reed kafir often grows too tall for convenient hand heading, and it has a tendency to lodge or at times the heads break off at the top joint. In dry seasons it is difficult to thresh clean of the glumes. Feterita is valuable because it matures a grain crop in a shorter period than other grain sorghums. It is used as a catch, or emergency crop, and often ripens before the period of severe drouth; or, when planted late, it can mature grain when other varieties would be destroyed by frost. Feterita lodges and shatters badly.

For harvesting with a wheat header or combine, Beaver milo and Wheatland milo are dwarf, erect-headed, milo-like varieties. Beaver milo has not yielded with Dwarf Yellow milo, but it threshes clean, stands up, and matures in the same period. Wheatland milo has yielded slightly more than Dwarf Yellow milo and matures as early or earlier. In very dry seasons the seed of Wheatland milo is small and does not thresh free of hulls.

Varieties recommended for combination grain and forage production or bundle feed are Sunrise, Santa Fe, and Bishop kafir, Spur feterita, Dwarf hegari, and Chiltex.

Sunrise kafir is a tall, medium early, high yielding kafir. It is best harvested by a row binder, as it grows too tall to be headed by hand. The stalk is medium juicy and sweet, while the grain yield compares favorably with the strictly grain producing sorghums. Santa Fe kafir is a leafy kafir of medium height suitable for hand heading or harvesting with a row binder. Santa Fe kafir threshes clean, stands up well, and its grain yield averages close to dwarf milo. Bishop kafir is also known as "half and half," Algeria, or "kafir-maize." The stalks are heavy and well leaved; the grain yield compares favorably with Dwarf milo. Bishop kafir is later in maturing than Sunrise or Santa Fe.

Spur feterita has a heavier stalk and more leaves than common feterita. It is also a week later in maturing grain. Though not rated high as a forage producer, Spur feterita is used extensively as a bundle feed. In grain yield, Dwarf Yellow milo has averaged over a bushel per acre higher. Dwarf hegari is extensively grown as a combination grain and forage crop. The grain yield of Dwarf hegari has averaged two-thirds that of Dwarf milo, but it produces a good quantity of leafy forage every season. Chiltex is used as a bundle feed for grain alone. It is short to medium in height and not overly leafy. The forage yields are comparatively light, but in grain Chiltex has averaged about the same as Dwarf Yellow milo.

RATE OF SPACING AND SEEDING

Spacing experiments (See Table II) at Woodward, Oklahoma, with Dwarf Yellow milo, Feterita, Sunrise kafir, and Reed kafir showed that the varieties which do not sucker much (Reed kafir in particular, and most kafirs) must have a thick stand to produce highest grain yields. One plant

TABLE XII.—Yields of Grain Sorghums in Bushels Per Acre at Woodward, Oklahoma

Variety	C. I. No.	1914	1915	1916	1917	1918	1919	1920
Dwarf Yellow milo	332	10.3	38.7	10.3	15.8	2.9	26.7	27.3
Standard Yellow milo	234	18.8	20.8	13.2	20.1	2.5	42.6	30.3
Fargo milo	809	---	---	---	---	---	---	---
Beaver milo	871	---	---	---	---	---	---	---
Wheatland milo	918	---	---	---	---	---	---	---
Standard feterita	182	10.3	26.0	7.9	14.2	6.6	40.7	30.3
Spur feterita	623	---	---	---	---	---	35.3	29.2
Dawn kafir	340	12.6	41.5	3.8	36.0	8.3	32.6	34.8
Sunrise kafir	472	11.0	41.8	6.6	39.5	10.3	40.4	37.9
Standard kafir	71	---	---	---	31.4	2.2	31.8	37.6
Sharon kafir	813	---	---	---	---	---	---	---
Reed kafir	628	---	---	---	---	---	---	40.6
Pink kafir	432	---	---	---	---	---	---	---
Bishop kafir	814	---	---	---	---	---	---	---
Red kafir	34	9.0	37.2	3.1	32.1	7.8	23.1	28.2
Early Red kafir	866	---	---	---	---	---	---	---
Dwarf hegari	620	---	---	---	---	2.3	25.6	23.5
Dwarf hegari	750	---	---	---	---	---	---	---
Chiltex	874	---	---	---	---	---	---	---
Premo	873	---	---	---	---	---	---	---
Shallu	85	6.3	24.0	4.6	23.6	0.3	20.1	18.9
Darso	615	---	---	---	26.6	5.4	28.1	25.7
Schrock	616	---	---	---	30.3	2.7	20.9	29.9
Grohoma	920	---	---	---	---	---	---	---

TABLE XII.—(Continued)

Variety	C. I. No.	1921	1922	1923	1924	1925	1926*	1927**
Dwarf Yellow milo	332	43.1	21.2	8.8	33.3	28.2	33.8	45.8
Standard Yellow milo	234	40.2	19.7	5.7	31.0	32.1	---	---
Fargo milo	809	---	---	5.3	39.4	27.1	26.3	48.2
Beaver milo	871	---	---	---	---	---	31.1	41.1
Wheatland milo	918	---	---	---	33.5	33.2	36.6	44.9
Standard feterita	182	42.8	24.1	17.1	20.3	28.3	24.2	40.8
Spur feterita	623	41.7	17.7	15.1	28.7	24.1	25.4	41.0
Dawn kafir	340	34.2	13.7	9.4	22.1	27.3	40.2	39.6
Sunrise kafir	472	37.7	15.3	10.8	30.1	27.5	36.2	39.4
Standard kafir	71	41.3	16.7	12.9	37.9	33.5	39.0	40.6
Sharon kafir	813	---	---	12.1	28.5	32.8	41.4	39.8
Reed kafir	628	39.2	21.3	20.3	38.6	28.2	44.2	46.0
Pink kafir	432	38.8	11.7	14.7	24.3	23.4	40.8	37.2
Bishop kafir	814	---	---	2.3	31.1	31.0	43.6	44.2
Red kafir	34	37.4	7.4	10.3	24.3	27.5	34.6	---
Early Red kafir	866	---	---	---	---	---	---	33.0
Dwarf hegari	620	11.5	3.4	0.3	29.9	23.0	29.7	47.6
Dwarf hegari	750	---	---	---	---	---	32.2	52.4
Chiltex	874	---	---	---	---	---	---	40.9
Premo	873	---	---	---	---	---	---	44.6
Shallu	85	29.7	0.8	4.2	39.4	27.7	32.1	---
Darso	615	23.5	13.3	14.9	27.3	27.8	43.4	40.2
Schrock	616	25.7	6.8	11.1	35.3	31.0	43.2	43.8
Grohoma	920	---	---	---	---	---	---	---

*1926 yields are average of duplicate plots.

**1927 yields are average of duplicate plots on two dates.

TABLE XII.—(Continued)

Variety	C. I. No.	1928†	1929†	1930†	1931†	No. years	Ave. yield	Cor. yield‡
Dwarf Yellow milo	332	23.3	30.3	23.8	22.8	18	24.8	24.8
Standard Yellow milo	234	---	---	---	---	12	23.1	25.7
Fargo milo	809	24.0	23.4	13.6	12.4	9	24.4	21.8
Beaver milo	871	21.9	25.9	16.4	18.9	6	25.9	21.4
Wheatland milo	918	27.4	38.3	22.9	23.9	8	32.6	26.8
Standard feterita	182	23.2	30.0	17.4	27.6	18	24.0	24.0
Spur feterita	623	23.2	28.8	16.4	24.8	13	27.0	23.7
Dawn kafir	340	24.3	32.0	13.7	21.0	18	24.8	24.8
Sunrise kafir	472	23.2	28.2	13.8	19.2	18	26.1	26.1
Standard kafir	71	21.6	33.3	9.6	20.3	15	27.3	26.2
Sharon kafir	813	26.2	32.5	11.7	23.1	9	27.6	24.6
Reed kafir	628	28.1	31.3	17.3	23.4	12	31.5	27.4
Pink kafir	432	23.8	29.7	12.0	24.9	11	25.6	22.2
Bishop kafir	814	25.2	34.5	13.9	23.8	9	27.7	24.7
Red kafir	34	---	---	--	-	13	21.7	23.3
Early Red kafir	866	27.0	33.5	15.7	27.3	5	27.3	23.2
Dwarf hegari	620	15.7	---	---	--	11	19.3	
Dwarf hegari	750	17.5	12.8	2.8	6.0	6	20.6	
Chiltex	874	27.3	32.8	19.5	28.3	5	29.8	25.3
Premo	873	25.0	31.4	---	---	3	33.7	25.2
Shallu	85	---	---	---	---	13	17.8	19.1
Darso	615	26.7	33.5	13.8	24.5	15	25.0	24.0
Schrock	616	---	---	---	---	11	25.5	24.2
Grohoma	920	---	---	8.3	18.0	2	13.2	14.1

†1928 to 1931 (inclusive) yields are average of duplicate plots on three dates.
‡Corrected yield based on yields of Dwarf milo for same years.
Bushel is figured at 56 pounds.

TABLE XIII.—Yields of Sorghums Cut for Forage at Woodward, Oklahoma, 1921 to 1931 Inclusive

	YIELDS IN TONS OF CURED FORAGE PER ACRE											No. years	Ave. yield	Cor. yield*
	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931			
Sumac	2.09	2.20	2.28	2.99	2.79	3.28	2.53	2.40	2.41	1.88	2.38	11	2.52	2.52
African millet	2.62	1.81	1.72	2.43	2.09	2.53	2.06	1.96	2.54	1.81	2.09	11	2.24	2.24
Leoti Red	---	---	1.24	2.47	3.16	2.55	2.19	1.82	1.99	1.59	1.90	9	2.10	2.08
Sunrise kafir	---	0.98	1.23	2.00	3.09	3.74	2.87	1.73	1.85	1.51	1.83	10	2.08	2.09
Sudan grass	2.79	1.49	1.60	2.42	1.79	2.01	1.90	1.34	1.52	1.36	2.01	11	1.84	1.84

*Corrected yield based on yields of Sumac for the same years.

to each 5 to 8 inches of row space produced the highest yields. Varieties which sucker freely when thin in the row, such as Dwarf Yellow milo and feterita, made their highest grain yields from spacings of 18 to 24 inches between plants in the row. Feterita has made higher yields from the thinner stands; yet in these thin stands the ripening was not uniform, due to the later development of the sucker heads.

There are intermediate varieties of sorghum which will yield about the same from stands of 12 inches between plants as from 6 inch stands. These include, 1st varieties such as Sunrise kafir, Dawn (Dwarf) kafir and Dwarf hegari, which produce suckers when the stand is thin, and 2nd Standard kafir, Bishop kafir, and Darso, which produce much larger heads from thin than thick stands.

In general a thick stand averaging one plant for six to nine inches of row space will produce the most satisfactory grain yields except for Dwarf Yellow milo, which should be thinner—a plant each 18 inches or two feet. Larger heads will be produced from thinner stands.

To obtain the desired stands is often difficult and the best procedure is to have clean, uniform, viable (high germination) seed, and to regulate the planter to drop twice as many seed as plants are desired. If a six-inch stand is wanted, be sure that the planter drops a seed for each three inches, as field germination, pests, and cultivation will account for at least one-half of the seeds planted.

DATE OF PLANTING

Extensive experiments at Woodward, Oklahoma, (See Tables I and VI) with Dwarf milo, Feterita, Sunrise kafir, Dawn (Dwarf) kafir, Reed Blackhull kafir, Red Amber sorgo, Sumac sorgo, and Sudan grass proved that the best date to plant sorghums is the middle of June. The recommendations, based on these results, for Region 2 are: plow the land in April or early May, keep weeds killed, and plant the sorghums after a rain from June 5 to June 25. In this delayed planting it is important to have the land in good condition. Everyone will agree that it is easier to kill weeds before than after the crop is planted.

A possible exception to the delayed planting is in the case of a large acreage to be handled with limited help. Due to the risk of washing out by hard, dashing rain, it is advisable to start planting during the last week of May; and, in case the stand is washed out or covered too deep to grow, there is time to replant. This applies especially to lister planting.

RECOMMENDATIONS FOR REGION 3, BASED ON RESULTS AT LAWTON, OKLAHOMA

W. M. OSBORN

The sorghums included in this report of date-of-seeding, variety, and spacing tests, and other cultural practices, represent those of local importance as well as those that are adapted and grown over a large region of the southwest.

The production of sorghums in Southwestern Oklahoma differs in several respects from that of the extensive milo growing sections in Western and Northwestern Oklahoma. The main differences are a lower altitude, greater annual rainfall with more erratic seasonal distribution, wider diversity of soils, a longer growing period, and a greater array of destructive crop insects. Experiment station records and observations of general farm practices indicate that yields are generally lower and subject to wider fluctuations in the southwestern part of the State.

Experimental results extending over a period of 13 years show quite clearly that in Southwestern Oklahoma the chinch bug constitutes as great

a hazard to the successful growth of sorghum crops as is any climatic factor. Not only does this insect place production on a precarious basis, but it largely determines the group of sorghums that may be grown. These facts are not only supported by experimental evidence, but they are clearly recognized and accepted in general farm practice in this section of the State.

It is probable that the combination of two factors—climatic and insect hazards—are responsible for the fact that sorghums in this section are grown almost wholly for feed instead of as cash crops. Considerable importance naturally is attached to a satisfactory growth of a good quality of forage, as well as a dependable supply of grain.

With these factors in mind it is readily seen why several varieties of kafir, darso, and some feterita are grown to the exclusion of most of the other grain sorghums.

As long as the purpose for which these crops are grown remains unchanged, or the kinds that can be grown are restricted by climate and destructive crop insects, there will be but little demand for new types that are adapted to combine harvesting and commercial production, such as exists in Northwestern Oklahoma.

These factors also insure a prominent place in farm management for such sweet sorghums as Sumac, Orange, African millet, and Sudan grass, all of which are recognized as valuable producers of coarse roughage, hay or pasture.

Although the general type of sorghums grown in this section has changed but little in the last 15 to 20 years, new varieties have been introduced and old ones have been improved in their ability to yield a superior quality of grain and forage.

Grain Sorghum Variety Tests. The average yields of 16 varieties of grain sorghums are shown in Table XIV. During the seven years, 1917 to 1923, the yields of three varieties of milo include four failures in grain production, one year of low yields, and two years of fair to good yields. In this same period the average yields of four varieties of kafir ranged from 14.3 to 20.6 bushels per acre with three years of failure or very low grain yields. Failures and low yields of milo were largely due to chinch bug damage. Reed kafir and Darso produced the highest yields of grain in the seven-year period, 1920 to 1926, and in the six-year period 1921 to 1926, when the greatest number of variety comparisons were available. Common feterita and Dwarf hegari produced the lowest average yields of all varieties tested. Although Dwarf hegari has been grown extensively at various times in Southwestern Oklahoma, it has shown a high degree of susceptibility to chinch bug injury and has never proved to be a consistently good yielding variety.

Feterita also is highly susceptible to chinch bug injury and is subject to wide fluctuation in yields. Spur feterita appears to have a higher resistance to chinch bug injury than common feterita. It demonstrated its superiority by an increased grain yield of 3.7 bushels per acre over a period of 10 years. Although the grain yields of Sunrise kafir were considerably less than those of Reed kafir and Darso, it is valuable for the large tonnage of good forage produced.

Grain Sorghum Date-of-Seeding Tests. The results with Reed kafir and Dwarf feterita planted on six dates for five consecutive years are shown in Table III. The advantage in early planting of grain sorghums in Southwesetrn Oklahoma is shown by the consistently higher yield of all varieties obtained from the first planting date. The results with Dawn (Dwarf) kafir, Standard Blackhull kafir, and Reed kafir planted at half-month intervals from April 15 to July 1, during the six years, 1921 to 1926 inclusive,

TABLE XIV.—Yields of Grain Sorghum Varieties at the Lawton Field Station for the Years Specified

Variety	C. I. No.	YIELDS IN BUSHELS PER ACRE							
		1917	1918	1919	1920	1921	1922	1923	1924
Standard Blackhull kafir	71	24.5	0.0	51.7	33.7	29.4	2.3	2.3	18.8
Red kafir	34	18.3	0.0	41.3	31.0	26.9	5.0	4.2	23.3
Dawn kafir	340	14.5	0.0	44.8	30.9	26.3	8.0	3.8	20.4
Sunrise kafir	472	---	0.0	37.0	27.5	18.3	6.3	4.8	22.3
Reed kafir	628	---	---	---	46.7	42.1	5.8	11.5	32.9
Pink kafir	432	---	---	---	---	22.9	7.1	4.0	29.8
Standard kafir	207	16.0	0.0	33.3	26.5	22.1	2.3	0.0	---
Shallu	85	21.4	0.0	44.5	21.7	12.9	0.0	0.0	22.9
Darso		---	3.3	53.1	43.1	30.9	12.2	8.3	35.1
Common feterita	182	11.7	0.0	41.3	28.6	0.0	4.5	3.1	25.4
Spur feterita	623	---	---	---	28.8	8.0	11.4	7.3	28.1
Dwarf hegari	620	---	---	---	---	14.7	0.0	0.0	9.5
Barchet kaoliang	310	---	---	---	---	15.2	12.1	8.6	26.1
Dawrf Yellow milo	332	11.0	0.0	43.4	28.6	0.0	0.0	0.0	---
Standard Yellow milo	234	8.6	0.0	39.5	19.8	0.0	0.0	0.0	---
White milo	352	8.4	0.0	36.7	16.4	0.0	0.0	0.0	---
Texas Blackhull (T. S. 9195)		---	---	---	---	---	---	---	---
Early Red kafir No. 1		---	---	---	---	---	---	---	---
Pearl kafir		---	---	---	---	---	---	---	---
Wonder kafir		---	---	---	---	---	---	---	---
Kaferita	812	---	---	---	---	---	---	---	---
Premo (F. C. 8929)		---	---	---	---	---	---	---	---
Chiltex (F. C. 8917)		---	---	---	---	---	---	---	---

TABLE XIV.—(Continued)

Variety	C. I. No.	1925	1926	1927**	1928**	1929**	No. years	Ave. yield	Cor. yield†
Standard Blackhull kafir	71	0.0	25.2	9.3	31.5	17.2	13	18.9	18.9
Red kafir	34	0.0	26.3	8.1	25.0	22.9	13	17.9	17.9
Dawn kafir	340	0.0	24.0	8.6	32.2	27.2	13	18.5	18.5
Sunrise kafir	472	0.0	26.3	12.7	34.3	23.9	12	17.8	18.2
Reed kafir	628	0.0	26.9	12.9	26.9	26.3	10	23.2	25.8
Pink kafir	432	0.0	29.4	9.0	31.1	25.7	9	17.7	22.2
Standard kafir	207	---	---	---	---	---	7	14.3	13.1
Shallu	85	0.0	25.0	---	---	---	10	14.8	14.9
Darso		0.0	31.3	8.1	36.8	21.7	12	23.6	24.1
Common feterita	182	0.0	11.2	0.0	32.9	14.6	13	13.3	13.3
Spur feterita	623	0.0	20.7	4.7	33.6	27.0	10	17.0	18.9
Dwarf hegari	620	0.0	20.7	1.6	35.6	2.1	9	9.4	11.8
Barchet kaoliang	310	0.0	23.9	---	---	---	6	14.3	20.8
Dwarf Yellow milo	332	---	---	---	---	---	7	11.9	10.9
Standard Yellow milo	234	---	---	---	---	---	7	9.7	8.9
White milo	352	---	---	---	---	---	7	8.8	8.1
Texas Blackhull (T. S. 9195)		---	---	8.9	32.7	27.9	3	23.2	22.7
Early Red kafir No. 1		---	---	7.2	34.4	25.5	3	22.4	21.9
Pearl kafir		---	---	0.0	22.7	10.8	3	11.2	11.0
Wonder kafir		---	---	7.4	37.7	26.6	3	23.9	23.4
Kaferita	812	---	---	6.6	48.7	23.5	3	26.3	25.8
Premo (F. C. 8929)		---	---	6.2	26.4	11.6	3	14.7	14.4
Chiltex (F. C. 8917)		---	---	4.8	25.9*	14.2	3	15.0	14.7

*Interpolated yield.

**Yields are an average of three planting dates, April 15, May 1, and May 15.

†Corrected yields based on yields of Standard Blackhull kafir C. I. No. 71 for same years.

show that the average grain yield of the last three planting dates is 43.6 per cent less than the average yield of the first three planting dates. The low yield of the later dates may be attributed almost wholly to chinch bug injury.

TABLE XV.—Yields of Sorghum Varieties at Lawton (Forage)

	YIELDS IN TONS PER ACRE							
	1917	1918	1919	1920	1921	1922	1923	1924
Orange	2.52	2.52	7.93	8.66	6.66	1.75	1.16	4.88
Sumac	2.13	2.77	7.53	9.03	5.72	2.16	1.78	4.19
Honey	1.58	1.99	7.93	12.13	7.34	0.97	0.00	6.19
Black Amber	1.09	1.53	3.85	3.58	4.22		1.56	4.03
Red Amber	0.97	0.89	3.85	3.28	2.81	1.53	1.28	4.03
African millet	---	---	---	7.25	4.94	2.03	1.69	4.31
Colman	---	---	---	---	5.03	1.38	0.69	3.82
Leoti Red							1.22	3.21
Darso	1.53	1.13	4.48	4.42	3.84	1.18	1.16	2.41
Standard								
Blackhull kafir	1.53	2.08	3.40	4.03	2.63	1.03	0.81	3.16
Hussar				5.44	3.91	1.50	1.16	3.51
Freed	0.66	0.73	3.20	1.60	3.19	0.97	0.78	2.13
Sudan grass	1.42	0.92	4.74	4.45	0.00	1.06	0.66	1.61
Corn, June	---	---	---	---	2.56	0.78	0.00	1.06

TABLE XV.—(Continued)

	YIELDS IN TONS PER ACRE					No. years	Ave. yield	Cor. yield*
	1925	1926	1927	1928	1929			
Orange	1.22	4.88	0	6.60	3.32	13	4.05	4.05
Sumac	1.66	5.94	0	5.94	2.60	13	3.96	3.96
Honey	0.00	5.41	0	4.03	0.00	13	3.66	3.66
Black Amber	1.19	2.45	0	2.88	1.13	12	2.29	2.22
Red Amber	0.28	1.94	0	3.07	1.13	13	1.93	1.93
African millet	1.97	4.51	0	4.78	2.13	10	3.36	3.48
Colman	1.19	4.44	0	5.75	1.91	9	2.69	3.22
Leoti Red	1.25	2.72	0	3.88	0.94	7	1.89	2.43
Darso	0.41	1.84	0	3.07	1.13	13	2.05	2.05
Standard								
Blackhull kafir	0.00	1.78	0	3.69	0.66	13	1.91	1.91
Hussar	1.03	2.78	0	3.88	0.88	10	2.41	2.49
Freed	0.00	1.19	0	2.19	0.82	13	1.34	1.34
Sudan grass	0.59	1.44	0	3.03	2.07	13	1.69	1.69
Corn, June	0.00	1.00	0	---	---	7	0.77	1.09

*Corrected yields based on yields of Orange sorgo for same years.

Spacing Tests with Kafir. Optimum spacing of plants is one of the important cultural practices upon which profitable yields of grain sorghums are dependent. Important factors which add to the difficulty of local determination of the best spacing methods are irregularity of temperature and moisture conditions, varietal differences in time required for maturity,

habits of tillering, and insect injury. Spacing experiments with kafir were conducted 10 years, 1917 to 1926, and the average results are shown in Table II.

Chinch bug damage made it difficult to attain the actual space desired between plants in the row. It also accounted for many of the low yields, and for a total crop loss in 1925. The seedings with 6-inch spacing between the plants in 44-inch rows consistently produced more grain and stover than those at any other rate that was tried. In the 44-inch rows, plants spaced 30 inches apart produced the lowest average yield, this being 6.5 bushels per acre less than the 6-inch spacing. The small difference of 1.9 bushels per acre between the yields from the 6-inch and the 12-inch spacings permits some variation in stand under general farm practice.

When grown in rows 88 inches apart the kafir plants in the row were spaced one-half the distance of those in the 44-inch rows. The arrangement provided for an equal number of plants to the acre at both row widths. The thick spacing produced the highest yields of both grain and stover. When the number of plants per acre provided a direct comparison, the acre yields obtained in the 88-inch rows did not equal those of the 44-inch rows for any spacing. In the drier years the wide spacings did not prove to be a safeguard in production. Crop maturity was not hastened or retarded by the distance between plants or rows. Large, coarse stalks, and larger heads usually resulted from the wide spacings.

Forage Sorghum Variety Tests. In the varietal test with forage sorghums (See Table XV), five varieties of sorgos, or sweet sorghums, and a miscellaneous group of sorghums including Darso, Standard Blackhull kafir, Sudan grass, and Freed sorgo, were grown 13 consecutive years, 1917 to 1929. Additional varieties were added in 1920, 1921, and 1923.

Orange, Sumac, and Honey produced the outstandingly high yields of all varieties grown for 13 years. The difference in the average yields of these three leading varieties is not sufficient to form a basis upon which a choice of one of the three might be made for general farm use. Honey is a large, coarse growing, very late maturing variety that produced seed but once in 13 years. It is highly susceptible to chinch bug injury, being entirely destroyed in 1923, 1925, and 1927. In favorable growing years it will yield a tonnage as large or larger than any other variety, but in drier years the yields are less than those of either Orange or Sumac. The behavior in growth and yield of Sumac and Orange are similar. Orange matured on an average about seven days earlier than Sumac but produced considerably less seed. When a heavy production of forage is required, either of these two varieties may be relied upon.

Black Amber sorgo, Red Amber sorgo, Darso, and Standard Blackhull kafir comprise a group somewhat similar in total yield, but the average yield of each was approximately one-half that of Sumac, Orange, or Honey. Black Amber and Red Amber are earlier maturing varieties that may be best utilized when climatic conditions make late planting necessary.

Cropping Practices and Methods of Tillage. Experiments including Sumac sorgo, kafir, and feterita in crop rotations and continuous cropping on different methods of tillage have been in progress at Lawton since 1917. Some of the results obtained in these experiments from 1917 to 1930, inclusive, are given below.

Kafir: Fall plowing for kafir increased the yield less than three bushels per acre over spring plowing, irrespective of the preceding crop. Land previously cropped to cowpeas that were harvested for hay averaged during the 12 years, 1919 to 1930, 2.2 bushels more when plowed in the fall than it did when spring plowed. Kafir did not yield as heavily on either fall plowing or spring plowing following cowpeas as it did following kafir. On spring plowed cotton land it yielded an average of 2.6 bushels per acre

less for 14 years than on land continuously spring plowed and cropped to kafir. The former method proved to be one of the poorest tested. As a method of seed bed preparation, listing resulted in lower yields than either spring plowing or fall plowing during the 14 years it was tested.

Subsoiling was ineffective in overcoming drouth and did not satisfactorily increase the yields. The extra expense involved and the addtional power required to perform such tillage off-set the small benefit that might have accrued from such a practice. Manure applied as a top dressing on spring plowed land continuously cropped to kafir increased the stover yields 1,271 pounds per acre, but the grain yield showed a loss of 132 pounds per acre.

Sumac Sorgo: This crop was grown in rows continuously for 14 years on a series of plots under different methods of tillage. There was but little difference in yields on spring plowing and on fall plowing, but when spring plowing was top-dressed with manure the average yield of grain was 8.7 bushels per acre more than the average of spring plowing and fall plowing without manure. The yield of stover was likewise increased 3,125 pounds per acre. Subsoiling did not show any appreciable effect. The 14-year average of listing differed but little from the averages of spring plowing and fall plowing.

Feterita: The difference in average yields between spring plowing and fall plowing on land continuously cropped to feterita amounted to 2.2 bushels per acre in favor of fall plowing. The small variation in yields of feterita on spring-plowed kafir, cotton, and cowpea land for seven years, 1924 to 1930, was not important. On fall plowing where feterita followed both kafir and cowpeas, the difference in yields was also negligible, but in both instances the yields exceeded those on spring plowing under the same crop sequence.

TABLE XVI.—Average Yields of Kafir, Sumac Sorgo, and Feterita Continuously Cropped by Different Methods of Seed-bed Preparation and on Fallow at Lawton Field Station, 1917 to 1930.

	GRAIN IN POUNDS PER ACRE			TOTAL CROP IN POUNDS PER ACRE		
Tillage	Kafir	Sorgo	Feterita	Kafir	Sorgo	Feterita
Spring plowed	1,159	737	808	3,969	5,562	2,839
Spring plowed, top dressed	1,016	1,269	----	5,097	9,294	----
Fall plowed	1,336	826	936	4,542	5,801	3,417
Fall plowed subsoiled	1,300	933	----	4,553	6,466	----
Listed	866	829	----	3,616	6,020	----
Fallowed	1,514	1,040	964	5,323	7,210	3,459
Average	1,199	939	903	4,517	6,726	3,238

VARIETY RECOMMENDATIONS FOR REGION 3, BASED ON RESULTS AT GRANITE, OKLAHOMA

B. F. KILTZ

Grain Sorghum Varieties (See Table XVII). Darso has led in grain production at Granite. Schrock and Standard Blackhull have also produced good yields. Beaver milo and Sunrise kafir have given comparatively good yields but have not been tested long enough to allow comparisons.

Dwarf Yellow milo gives rather poor yields at Granite due to occasional chinch bug injury. This station is apparently near enough to the border of the chinch bug belt to receive rather severe infestation some seasons.

Sweet Sorghum Varieties (See Table XVIII). Honey and Gooseneck have produced the highest yields of forage. Both of these varieties usually produce some seed but the yields are often very low, especially with respect to the Gooseneck variety. Other varieties producing good yields of forage and also satisfactory yields of seed are Orange, Sumac, African millet, and Red Amber.

TABLE XVII.—Yield of Sorghums Harvested for Grain at Granite, Oklahoma, 1925 to 1931 Inclusive*

	YIELD IN BUSHELS PER ACRE							No. years in average	Average yield	Cor. yield**
	1925	1926	1927	1928	1929	1930	1931			
Standard Blackhull	13.3	34.0	22.7	17.9	9.7	0.0	7.5	7	15.0	15.0
Hydro kafir	9.7	24.7	18.0	17.6	...	0.0	16.3	6	14.4	14.3
Texas Blackhull	...	...	...	...	...	...	11.1	1	11.1	13.9
Pearl kafir	1.2	25.5	22.0	7.8	...	0.0	6.8	6	10.6	10.5
Sunrise kafir	18.0	21.7	...	...	...	...	9.6	3	16.4	16.0
Pink kafir	5.0	25.0	29.5	6.0	...	0.0	17.5	6	13.8	13.7
Early Red kafir	...	...	17.0	17.3	10.0	0.0	...	4	11.1	11.3
Bishop kafir	...	...	19.3	7.2	1.5	0.0	15.4	5	8.7	9.2
Dwarf Yellow milo	4.2	28.5	25.3	4.0	1.2	0.0	18.7	7	11.7	11.7
Fargo milo	3.3	16.5	20.9	14.0	5.0	0.0	8.3	7	9.7	9.7
Beaver milo	...	...	...	...	...	...	13.3	1	13.3	16.8
Spur feterita	5.4	24.5	22.5	15.5	...	0.0	14.7	6	13.8	13.7
Standard feterita	5.4	25.5	23.0	12.4	...	0.0	...	5	13.3	12.7
Grohoma	...	...	...	...	...	0.0	5.8	2	2.9	5.6
Dwarf hegari	3.3	19.3	29.6	16.6	4.7	0.0	6.9	7	11.5	11.5
Darso	16.7	31.7	32.1	26.5	20.0	5.1	16.9	7	21.3	21.3
Schrock	7.5	32.0	33.5	16.0	...	...	13.6	5	20.5	17.6
Chiltex	1.7	31.5	19.5	14.0	...	...	...	4	16.7	13.3
Premo	4.2	18.0	31.0	9.8	...	...	16.0	5	15.8	13.6

*Yields all taken from a single date of planting.

**Corrected yield based on yield of Darso for same years.

TABLE XVIII.—Yield of Sorghums Cut for Forage at Granite, Oklahoma, 1925 to 1931 Inclusive*

	YIELD IN TONS OF FIELD CURED FORAGE PER ACRE							No. years in average	Average yield	Cor. yield**
	1925	1926	1927	1928	1929	1930	1931			
Sumac	5.40	5.37	3.08	4.39	3.44	2.43	1.61	7	3.67	3.67
Orange	5.48	5.33	3.44	3.82	4.78	1.80		6	4.11	3.75
African millet	5.38	3.95	2.78	3.53	3.69	2.10	1.13	7	3.22	3.22
Red Amber	3.02	7.66	3.29	2.81	2.96	1.29		6	3.51	3.20
Gooseneck		9.68	5.29	5.58	5.14	1.37	1.15	6	4.70	5.09
Honey	9.00	11.57	7.22	5.68	5.82	1.74	1.69	7	6.10	6.10
Darso	3.14	3.91	2.90	2.45	1.69	1.19	1.77	7	2.44	2.44
Standard Blackhull	3.97	4.69	2.60	2.98	1.06	1.57	1.34	7	2.60	2.60
Sunrise kafir	4.29	3.29					1.60	3	3.06	2.71
Standard feterita	2.31	3.69	3.00	1.83		1.52		5	2.47	2.19
Dwarf hegari	2.93	4.97	3.30	2.30	2.38	2.14	1.44	7	2.78	2.73

*Yields all taken from a single date of planting.
**Corrected yield based on yield of Sumac for same years.

RECOMMENDATIONS FOR REGION 4, BASED ON RESULTS AT STILLWATER, OKLAHOMA

B. F. KILTZ

Varieties. (See Tables XIX and XX.) The highest yielding variety of grain sorghum at Stillwater has been Darso. This variety has been quite popular because of its sweet stalk and its ability to resist insect and bird injury more than some varieties. Some of the kafirs are not significantly lower in yield than Darso. Pearl kafir, Red kafir, and Schrock yield well also. Standard Blackhull, Hydro kafir, Sunrise, Dawn, and Pink kafir have all yielded somewhat less than the first four named. Their yields have, at times, been greater than those of Darso but have all averaged somewhat lower. Feteritas, Dwarf hegari, Bishop kafir, and the milos have all been inferior to the above named varieties. This reduction in many cases is believed to be due to chinch bug injury.

Sumac and Orange varieties are good varieties for forage. The Kansas Orange strain has yielded somewhat better on the average than the other Orange varieties and is a more uniform type of sorghum than most of the others. Other varieties that have yielded well are Atlas, White African, and African millet.

Atlas, Sunrise kafir, and Darso are satisfactory for a combination of grain and forage. Dwarf hegari is no doubt suitable on good bottom land for both forage and grain, especially if planted at a considerable distance from small grain.

TABLE XIX.—Yields of Sorghums Harvested for Grain at Stillwater, Oklahoma, 1915 to 1931 Inclusive**

	YIELDS IN BUSHELS PER ACRE									
	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Standard Blackhull	14.4	16.4	21.1	6.5	5.5	45.5	53.2	42.5	10.0	27.4
Hydro kafir	----	----	----	----	----	----	----	36.8	6.0	----
Texas Blackhull	----	----	----	----	----	----	----	----	----	----
Sunrise kafir	----	----	12.4	----	9.3	38.0	41.5	33.1	8.2	22.8
Dawn kafir	----	----	----	----	----	32.3	29.5	25.7	8.7	18.4
Pearl kafir	----	----	----	----	----	----	----	----	----	21.4
Red kafir	----	----	----	----	----	----	----	----	----	----
Pink kafir	----	----	----	----	----	----	----	----	----	13.7
Bishop kafir	----	----	----	----	----	----	----	34.4	6.5	24.4
Dwarf hegari	15.4	7.7	22.9	4.7	3.5	28.1	6.2	3.1	4.4	21.4
Dwarf Yellow milo	2.7	----	2.1	----	6.1	2.6	25.3	6.7	----	----
Fargo milo	----	----	----	----	----	----	----	----	4.3	27.5
Beaver milo	----	----	----	----	----	----	----	----	----	----
Darso	14.4	24.2	14.7	12.6	13.5	52.7	61.6	42.9	12.3	21.4
Schrock	----	----	15.2	9.0	22.6	46.1	35.3	25.2	9.0	25.9
Grohoma	----	----	----	----	----	----	----	----	----	----
Standard feterita	12.4	21.4	3.6	4.4	9.6	20.0	23.3	13.6	8.1	28.9
Spur feterita	----	----	----	----	12.6	25.1	39.4	16.6	10.0	25.9
Chiltex	----	----	----	----	----	----	----	----	----	----
Premo	----	----	----	----	----	----	----	----	----	----

TABLE XIX.—(Continued)

	YIELDS IN BUSHELS PER ACRE							No. years	Ave. yield	Cor. yield*
	1925	1926	1927	1928	1929	1930	1931			
Standard Blackhull	14.3	21.7	23.2	19.5	30.6	10.2	27.7	17	22.9	22.9
Hydro kafir	16.4	18.8	25.3	11.5	43.2	18.1	32.9	9	23.2	22.8
Texas Blackhull	...	...	...	...	...	25.2	29.2	2	27.2	29.6
Sunrise kafir	17.9	20.6	28.2	6.7	37.1	16.9	27.5	14	22.9	21.1
Dawn kafir	14.3	21.0	29.0	11.5	38.6	16.0	25.2	12	22.5	19.2
Pearl kafir	31.4	20.6	22.2	34.2	35.9	13.1	27.6	8	25.8	26.0
Red kafir		19.9	22.7	32.4	38.0	12.3	30.3	6	25.9	24.1
Pink kafir	20.0	17.1	20.4	3.1	35.5	20.6	26.3	8	19.6	19.8
Bishop kafir	14.3	18.8	20.7	32.4	25.1	12.8	0.0	10	18.9	19.0
Dwarf hegari	5.7	17.4	10.4	4.0	25.1	12.2	22.8	17	12.6	12.6
Dwarf Yellow milo	0.0	...	...	...	23.5	0.0	0.0	10	6.9	6.2
Fargo milo	0.0	...	17.4	24.0	14.2	6.7	24.3	8	14.8	15.4
Beaver milo	...	...	...	...	...	1.8	0.0	2	.9	1.3
Darso	20.0	18.5	28.0	44.0	35.3	14.6	35.8	17	27.4	27.4
Schrock	23.5	21.3	30.3	43.5	30.6	27.6	32.8	15	26.5	25.5
Grohoma	...	...	...	...	...	18.6	24.2	2	21.4	23.3
Standard feterita	18.6	...	33.8	20.4	31.2	13.3	18.0	16	17.5	17.2
Spur feterita	11.4	18.5	6.8	...	...	12.5	23.0	11	18.3	17.2
Chiltex	...	...	...	...	...	...	20.5	1	20.5	15.7
Premo	14.2	...	...	...	...	24.2	26.2	3	21.5	25.1

*Corrected yield based on yields of Darso for same years.

**Yields taken from a single date of planting.

Date of Planting. Sorghums in this region should be planted as late as safety will permit to avoid heavy chinch bug injury. In general, the best date of planting for both sweet sorghums and grain sorghums appears to be from May 1 to May 15, with good results from the April 15 date. June plantings have been too late because of chinch bugs except during exceptional years. Fargo milo has given somewhat higher yields for the April 15 plantings due to greater chinch bug injury with this variety.

Rate of Planting. Spacing tests with sorghums verify the thorough and careful work done by the members of the United States Department of Agriculture, at Woodward, Lawton, and other stations. (See Table II.) Kafirs have given the best yields in Stillwater tests at spacings varying from 3 to 8 inches. Darso has given best yields at the 6-inch spacing, but it has been only slightly lower at the 12-inch spacing. Very few tests have been made with the feteritas at Stillwater, but 6- to 12-inch spacings are satisfactory as indicated by tests elsewhere.

TABLE XX.—Yields of Sorghums Cut for Forage at Stillwater, Oklahoma, 1918 to 1931 Inclusive

	YIELDS IN TONS OF CURED FORAGE PER ACRE**							
	1918	1919	1920	1921	1922	1923	1924	1925
Sumac	3.38	1.32	4.97	3.42	2.74	4.39	4.56	2.97
Early Sumac								1.60
Orange	3.70	1.96	4.28	3.22	2.93	3.98	4.40	3.10
Kansas Orange						4.91	4.40	
African millet				3.51	2.40	3.93	3.55	4.47
Sugar Drip								1.90
Atlas								
Honey						1.25	2.54	1.77
Gooseneck								3.62
Black Amber	1.44	1.16	2.90	2.85	1.78	1.78	2.53	1.35
Red Amber	1.76	1.33	2.66	2.14	1.63	1.57	2.86	1.62
White African								
Leoti Red						1.02	2.86	1.15
Standard Blackhull								2.50
Sunrise kafir								2.40
Darso								2.00
Dwarf hegari								.90

TABLE XX.—(Continued)

	YIELDS IN TONS OF CURED FORAGE PER ACRE**						No. years	Ave. yield	Cor. yield*
	1926	1927	1928	1929	1930	1931			
Sumac	3.50	5.66	4.77	2.70	2.31	2.95	14	3.55	3.55
Early Sumac		2.29		1.75	.92	1.84	5	1.68	1.80
Orange	3.11	5.18	4.70	2.47		3.07	13	3.55	3.46
Kansas Orange	2.81	6.54	5.69	2.71	2.94	2.28	8	4.04	3.71
African millet	3.46	4.72	5.20	2.15	2.33	2.74	11	3.50	3.42
Sugar Drip		3.23		2.29	3.40	3.17	5	2.80	2.99
Atlas				2.03	3.54	3.31	3	2.96	3.97
Honey	2.26	2.63	9.09			2.81	7	3.19	2.75
Gooseneck	4.70	1.90		4.75	1.27	3.29	6	3.26	3.45
Black Amber	2.18	2.18	3.86	1.45	1.19		13	2.05	2.03
Red Amber	2.12	2.46	4.82	1.93	3.08		13	2.31	2.28
White African		3.25	5.85	2.99	2.61	3.85	5	3.71	3.58
Leoti Red		2.35	4.11	1.97	1.86	2.10	8	2.18	2.04
Standard Blackhull	1.93	2.25	2.95	1.87	3.08	2.29	7	2.41	2.41
Sunrise kafir	1.92	3.11	3.26	2.73	1.71	3.25	7	2.63	2.63
Darso	1.31	2.71	3.41	2.16	2.57	1.84	7	2.29	2.29
Dwarf hegari	1.61	.74	2.57	1.92	2.77	2.55	7	1.87	1.87

*Corrected yield based on yield of Sumac for same years.

**Yields from 1918 to 1928 based on field cured forage. Yields from 1929 to 1931 reduced to 15 per cent moisture. Yields all taken from a single date of planting.

RECOMMENDATIONS FOR REGIONS 5, 6 AND 7, BASED ON VARIOUS OUTFIELD EXPERIMENTS AND ON RESULTS AT LONE GROVE, PAULS VALLEY, AND HEAVENER, OKLAHOMA

B. F. KILTZ

Experiments have all been of short duration in these regions, allowing only indefinite recommendations. With the exception of Region 5, other crops such as corn and oats can usually be used in place of sorghums for feeding purposes. On upland soils in many sections, sorghums can no doubt be relied upon to give better average yields than corn. Under such conditions sorghums have a definite place.

Varieties. The highest yielding grain sorghum at Lone Grove (Region 5) for the two-year average was Hydro kafir. Darso, Reed kafir and Pearl kafir were second, third and fourth respectively.

The highest yielding grain sorghum at Pauls Valley (Region 5) for the two years was Schrock, with Darso, Hydro kafir and Pearl kafir as second, third and fourth, respectively. Only the one year's results are available.

The highest yielding grain sorghum at Heavener (Region 7) for 1931 was Premo, with Hydro kafir, Schrock and Dwarf Yellow milo as second, third, and fourth, respectively. Only the one year's results are available.

Only one year's results are available for date of planting at Pauls Valley and Lone Grove, so that no conclusions are possible.

Two years' results with sorghums for syrup at Lone Grove are summarized in Table XXI. The Gooseneck variety has led in syrup production. Sugar Drip, Honey, and White African are also good syrup varieties.

The highest yielding forage variety at Lone Grove for the two years has been Gooseneck. Honey, Dwarf hegari, and Orange have been second, third, and fourth, respectively.

Only one year's results are available at Pauls Valley. Honey was the leading variety in yields at Heavener for the two years. Very few varieties were included in the first year's test, however.

TABLE XXI.—Results of Sorghum Syrup Variety Test at Lone Grove, Oklahoma

	YIELDS IN GALLONS OF SYRUP PER ACRE		
	1930	1931	Average
Orange	25.5	89.4	57.4
Black Amber	7.7	43.9	25.8
White African	25.9	96.4	61.1
Sugar Drip	33.5	122.6	78.0
Red X	14.3	90.7	52.5
Honey	43.3	100.7	72.0
Gooseneck	43.9	163.4	103.6
Sumac	23.7	---	---
Kansas Orange	33.4	---	---
African millet	23.0	---	---
Red Amber	22.0	---	---

RECOMMENDATIONS FOR REGIONS 2 AND 4, BASED ON RESULTS AT CARRIER, OKLAHOMA

B. F. KILTZ

Carrier is situated approximately on the boundary between Regions 2 and 4, as shown in Fig. 1. The station is typical of quite a large part of the North Central wheat growing area of the State. Experiments at this station have been in progress since 1927, allowing only short tests.

Since the only tests carried on at this station have been variety tests of grain and sweet sorghums, little can be said concerning dates of planting and spacing. Since chinch bugs are but mildly injurious at this station, relatively late plantings would no doubt be advisable. Sorghums are ordinarily planted in May and early June with success by farmers of the section.

Variety Tests. (See Tables XXII and XXIII.) Darso has been the leading sorghum of the station with Standard Blackhull and Hydro kafir also giving fair yields. Other varieties in the test that yield well have not been tried long enough for definite comparisons.

The Orange sorgo has been the leading variety of sweet sorghum. Only four varieties have been included for more than two years.

TABLE XXII.—Yields of Sorghums Harvested for Grain at Carrier, Oklahoma, 1927 to 1931 Inclusive*

	YIELDS IN BUSHELS PER ACRE					No. years	Ave. yield	Cor. yield**
	1927	1928	1929	1930	1931			
Standard Blackhull	25.4	35.8	23.9	2.6	19.5	5	21.4	21.4
Hydro kafir	†	35.0	31.2	0.0	34.1	4	25.1	25.0
Sunrise kafir	†	25.1	27.7	___		2	26.4	22.6
Dawn kafir	___	___	___	1.8	16.6	2	9.2	12.5
Pearl kafir	___	___	21.9	0.0	15.6	3	12.5	14.8
Red kafir	___	___	___	3.4	33.5	2	18.5	25.2
Dwarf hegari	†	25.0	17.7	0.0	20.6	4	15.8	16.6
Dwarf Yellow milo	†	†	___	0.0	25.9	2	13.0	17.7
Darso	34.3	36.6	30.6	7.2	34.9	5	28.7	28.7
Grohoma	___	___	___	1.4	21.9	2	11.7	15.9
Spur feterita				†	28.9	1	28.9	23.8

*Yields taken from a single date of planting.
**Corrected yield based on yields of Darso for same years.
†Eaten by birds.

TABLE XXIII.—Yields of Sorghums Cut for Forage at Carrier, Oklahoma, 1927 to 1931 Inclusive†

	TONS OF FIELD CURED FORAGE PER A.					No. years	Ave. yield	Cor. yield*
	1927	1928	1929	1930**	1931			
Sumac	3.7	4.02	3.60	___	2.61	4	3.48	3.48
Orange	6.4	3.90	3.20	___		3	4.50	4.16
African millet	3.9	5.97	3.35	___	2.03	4	3.81	3.81
Red Amber	2.9	4.08	1.65	___	___	3	2.88	2.66

†Yields taken from a single date of planting.
**No yield data available for 1930.
*Corrected yield based on yield of Sumac for same years.

SOME REFERENCES USEFUL TO THOSE INTERESTED IN SORGHUMS AND THEIR CULTURE

NOTE: The U. S. D. A. Bulletins can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a nominal cost, and the other bulletins can be obtained from the Oklahoma Agricultural and Mechanical College and Experiment Station free of charge.

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