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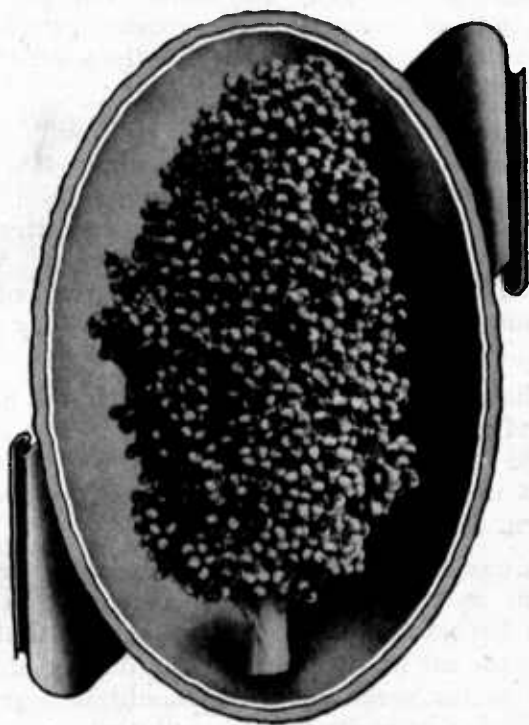
# HOW TO USE SORGHUM GRAIN

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**T**HE most important groups of grain-producing sorghums are kafir and milo. The grain sorghums are of comparatively recent introduction. They are now extensively grown in the southern half of the Great Plains area.

Sorghum grain is feed for stock and food for man. It also may be used in making alcohol. The grain has about 90 per cent of the feeding value of corn. It is a profitable feed, therefore, when the price is not more than 90 per cent of the price of corn. Where the yield is 10 per cent more than the yield of corn, grain sorghums are as profitable crops to grow as corn.

Sorghum grain is relished by all stock and poultry and if of good quality is readily eaten. For human food the meal can be used in every way that corn meal is used, and the grain may be popped like pop corn.

The thrashed grain should be thoroughly dry and as clean as possible before it is stored in bins. Broken kernels and dirt pack so closely that they exclude the air and so increase the danger of spoiling. Bins for sorghum grain should be equipped with simple and easily made ventilators.

The acreage of grain sorghum is increasing steadily. More of the grain should be used in the section where it is grown.

# HOW TO USE SORGHUM GRAIN.

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## THE GRAIN SORGHUMS.

**T**HE SORGHUMS first attracted attention because they were drought resistant. When the first wave of settlement swept across the southern Great Plains there was much difficulty in obtaining suitable crops. Corn was found to be well suited to the more humid parts and the more favorable seasons, but in the drier parts of the Plains and in dry seasons it failed.

All members of the sorghum family were found to be very drought resistant; in the favorable seasons they made profitable yields, and in dry seasons they were much better than corn. The grain sorghums, therefore, have come to be extensively used in place of corn for grain production, especially in the drier districts.

The grain sorghums are made up of several different groups of sorghums which produce good yields of feeding grain. Among these groups are kafir, milo, durra (including feterita), and kaoliang. Seeds of these groups are shown in figures 1, 2, and 3. Nearly all of the grain-sorghum crop grown in this country is kafir or milo (see illustration on title-page and figs. 4 and 5).

## SORGHUM GRAIN FOR FEED AND FOOD.

The natural uses of sorghum grains are as feed for stock, including poultry; as food for people; and in making industrial alcohol. The value of any feeding stuff or foodstuff depends on at least four

NOTE.—This bulletin is suitable for general distribution in the southern part of the Great Plains area and in California, and to grain dealers, poultry raisers, and alcohol manufacturers anywhere.

factors. The first is the chemical composition, which tells what different substances it contains and how much of each. The second is

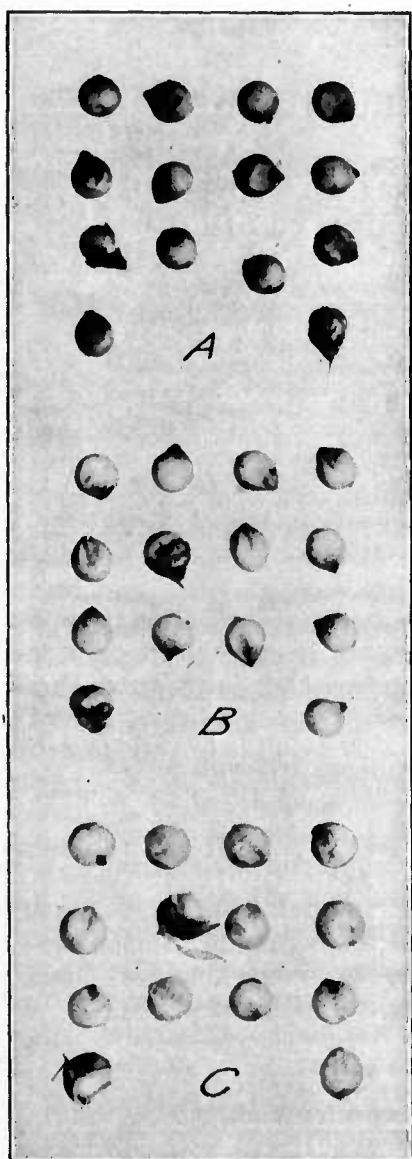


FIG. 1.—Seeds of three varieties of grain sorghum. About one and one-quarter times natural size. (A) Milo; (B) Alba (white) milo; (C) feterita.

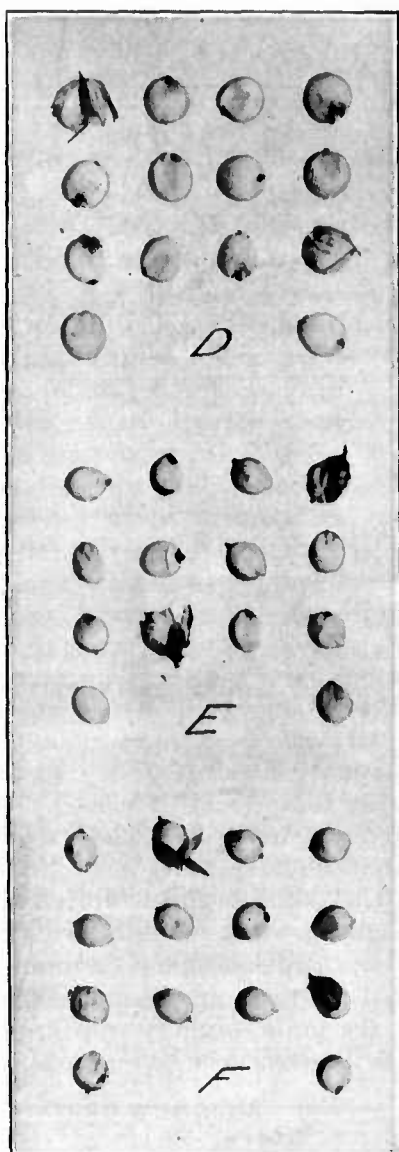


FIG. 2. Seeds of three varieties of grain sorghum. About one and one-quarter natural size. (D) White durra; (E) durra-kafir hybrid; (F) Blackhull kafir.

digestibility, or how easily or completely these different substances are digested, which may determine how profitably it can be fed. The

third is palatability, or how well it is liked, which may determine how successfully it can be fed. The fourth is preparation and storage, or how readily and safely it can be handled and shipped.

#### CHEMICAL COMPOSITION OF SORGHUM GRAINS.

The chemical composition of a large number of samples of sorghum grain is shown in Table I. The varieties analyzed were milo, Dwarf milo, feterita, Blackhull kafir, Dawn (dwarf) kafir, Red kafir, and shallu.

TABLE I.—Averages of chemical analyses<sup>1</sup> of air-dry samples of various grain-sorghum varieties grown at the Amarillo Cereal Field Station, Amarillo, Tex., in the eight years, 1908 to 1912 and 1914 to 1916, both inclusive, with the average for each group in all years and the average for 309 analyses in all groups combined in all years, compared with 86 analyses of dent corn.

Varieties.	Number of samples.	Water.	Ash.	Nitrogen.	Protein.	Carbohydrates.	Fat.	Fiber.	Weight per—	
									1,000 kernels.	Bushel.
Milo.....	74	9.30	1.61	2.03	12.65	71.80	3.17	1.48	35.8	58.2
Dwarf milo.....	65	9.32	1.61	1.95	12.33	71.99	3.28	1.48	31.1	58.4
Average of two milos....	139	9.31	1.61	1.99	12.49	71.88	3.22	1.48	33.6	58.3
Feterita.....	15	9.14	1.66	2.26	14.15	70.74	2.92	1.45	32.5	56.2
Blackhull kafir <sup>2</sup> .....	85	9.46	1.78	2.26	14.18	69.38	3.50	1.58	21.5	58.0
Dawn (dwarf) kafir.....	19	9.53	1.67	2.11	13.23	70.69	3.30	1.56	17.1	58.7
Average of two kafirs....	104	9.47	1.76	2.24	14.00	69.62	3.47	1.57	20.7	58.1
Red kafir <sup>2</sup> .....	40	9.49	1.72	1.93	12.04	72.04	3.19	1.51	18.6	58.3
Average of three kafirs....	144	9.47	1.75	2.15	13.46	70.29	3.39	1.56	20.0	58.2
Shallu <sup>3</sup> .....	11	10.16	1.96	2.44	15.23	67.00	3.72	1.92	15.1	57.8
Grand average of all varieties.....	309	9.41	1.69	2.09	13.13	70.91	3.30	1.53	20.6	58.1
Dent corn <sup>4</sup> .....	86	10.60	1.50	.....	10.30	70.40	5.00	2.20	.....	.....

<sup>1</sup> The analyses were made by the Plant-Chemical Laboratory of the Bureau of Chemistry, United States Department of Agriculture.

<sup>2</sup> No grain matured in 1916.

<sup>3</sup> Grown only in the years 1911, 1912, and 1914.

<sup>4</sup> Jenkins and Winton, Compilation of Analyses of American Feeding Stuffs, United States Department of Agriculture, Office of Experiment Stations Bul. 11, 1892.

The average composition of all samples of each variety is shown in Table I. Then the average composition of both milos, of both black-hulled kafirs, and of all three kafirs is given. Finally, the average composition of all varieties in all groups—a total of 309 samples—is presented. There are no striking differences in composition among the varieties grown. In general, they have the same feeding value, so far as analyses show.

The Blackhull kafirs and milos are the staple sorghum crops. When these are directly compared it is seen that the kafirs have more protein and less starch than the milos, with about the same quantities of fat. Red kafir, however, has very nearly the same average composition as the milos. Feterita is a durra closely related to milo. In its slightly higher protein content and lower starch content, how-



FIG. 3.—Seeds of three varieties of grain sorghum. About one and one-quarter times natural size. (G) Red kafir; (H) Mukden (white) kaoliang; (I) Manchu (brown) kaoliang.

were grown in different years in different States and were analyzed in various places. They are not exactly comparable, therefore, with the analyses of the sorghums, which were all grown at one place and analyzed in one laboratory. However, they probably are fairly representative of the average corn used for feeding purposes and there-

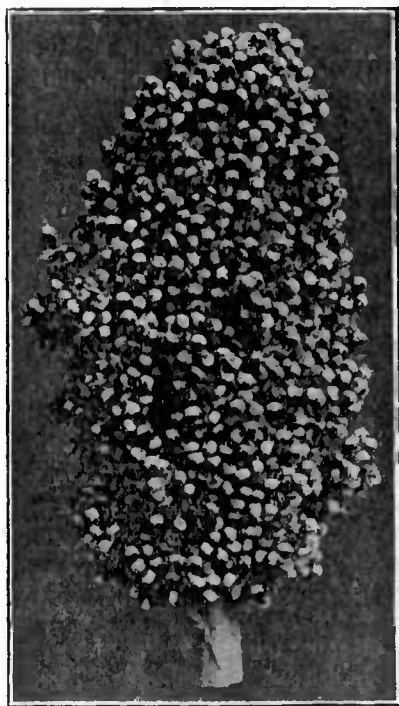


FIG. 4.—Head of milo, about one-half natural size.

ever, it is more like the Blackhull kafirs than it is like milo. Its fat content is lower than that of either milo or kafir. The analyses of shallu are not numerous enough to be conclusive. They seem to show, however, that it is relatively high in protein and fat and comparatively low in starch. They are based on the grain produced in only three years, 1911, 1912, and 1914.

Since the sorghum grains come into direct competition with corn for feeding purposes, the analyses of 86 samples of dent corn are given for comparison. These samples of corn

fore may be compared with the analyses of the sorghums. This comparison shows some small differences.

The sorghums are seen to be distinctly higher in protein content than corn. The carbohydrate content is practically the same. The fat content is much lower in the grain sorghums, while the fiber content also is somewhat lower. Since fat in the feeding ration has an effect similar to that of a concentrated carbohydrate, corn may be said to be distinctly richer in carbohydrates, or starchy matter, and the sorghums definitely better in protein content.

#### DIGESTIBILITY OF SORGHUM GRAINS.

Several experiments have been conducted in the past 18 years to determine the digestibility of sorghum grains, especially kafir. Most of these experiments have been made with stock, chiefly cattle and hogs, but some have used human subjects.

In general, all the results of experiments with animals agree in showing that the starch of the sorghum grains is less digestible than that of corn. It is found that this difference averages about 10 per cent. In other words, the sorghum grains have about 90 per cent of the feeding value of corn. In the early experiments a difference considerably greater than 10 per cent sometimes was recorded. Later experiments tend to show that the difference really is not so large as this figure.

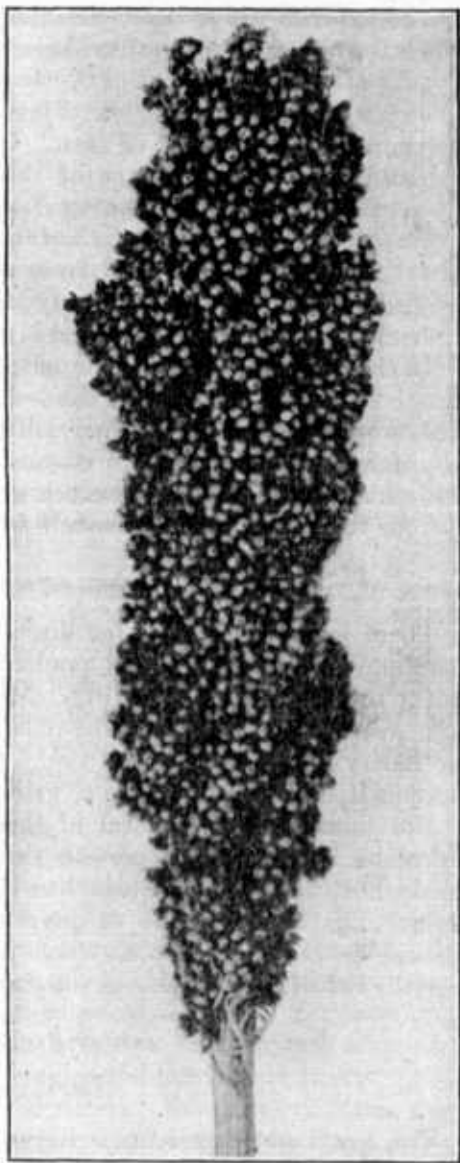


FIG. 5.—Head of Blackhull kafir, about one-half natural size.



Let 10 per cent be allowed as a fair average of the difference in value. The grain sorghums still are profitable feeding grains when the price is not more than 90 per cent of the price of corn of the same grade.

The experiments to determine the digestibility of sorghum grains when fed to human beings have been made by the Office of Home Economics of the Department of Agriculture. They show that from 96 to 98 per cent of the starch was digested. This is practically the same percentage as in the case of corn. In these same experiments a considerably smaller percentage of the protein of the sorghums than of corn was digested. The total protein content of the sorghum grains is considerably larger than that of corn. Therefore, the total quantity of protein digested from a pound of sorghum grain may be fully as large as the quantity digested from a pound of corn, although the percentage digested is smaller.

If the farmer growing kafir or milo is at a disadvantage in the relative value of his grain he has several advantages in compensation. His crop is grown on cheaper land. He is close to the source of cottonseed meal as a protein concentrate for his feeding ration. If he is himself the feeder, his stock are fed under milder winter conditions than those of the corn-belt feeder.

#### PALATABILITY OF SORGHUM GRAINS.

There seems little need for discussion of the palatability of the sorghum grains. Stock and poultry of all kinds eat them readily when they are of good quality. Moldy or wormy heads or musty and weeviled grain will not be palatable, any more than corn, oats, or barley in the same condition. Owing to the hardness of the kernels it is always desirable to grind or chop them for feeding.

For human food the meal of these grains has a distinctive and agreeable flavor. Some persons think the flavor resembles that of buckwheat flour more than it does the flavor of corn meal or wheat flour. The best methods of preparing these meals for the table should be studied, since no food is palatable unless well cooked. See the list of publications at the end of this bulletin.

#### PREPARATION AND STORAGE OF SORGHUM GRAINS.

##### PREPARATION.

The grain-sorghum crop is harvested in three general ways. It is cut and bound with the corn binder, or headed with the kafir header, or ordinary grain header, or it is headed by hand.

That which is bound may be fed in the bundle or shocked and headed later in the season or as needed. Grain sorghums are fed in

the bundle usually only as a maintenance ration for horses not at work or for cattle not producing milk or not being fattened for market.

One problem in the handling of grain sorghum when the crop is headed is the proper curing and storage of the heads. Usually these heads are thrown out in long, shallow piles to cure, especially if the crop is at all green or if it is wet from recent rains. This is a satisfactory way of curing in favorable weather, if the piles are not made too large.

If the crop is fully mature and thoroughly dry the heads may be hauled direct to a well-ventilated granary or crib. This can be done more safely in the case of milo and feterita than with kafir. The kafir heads (fig. 5) are more slender, and the straight stem is still green and somewhat juicy when the grain is ripe. This crop is more likely to heat, therefore, when piled in quantity. The short, broad heads of milo (fig. 4), with their somewhat crooked stems, do not pack so tightly together.

Headed kafir or milo may be sold or fed in the head, or the heads may be ground into head chops, or they may be thrashed and only the grain used. The thrashed grain should never be fed whole to stock, but always crushed or ground coarsely, in which form it is known as kafir or milo chops.

The grain should be allowed to become thoroughly dry, if possible, before thrashing or grinding. In ordinary thrashing a high percentage of the grain is cracked. Cracked grain packs more closely and spoils more readily than whole grain. Great care should be taken to crack as little as possible in thrashing. The proportion of cracked kernels can be much decreased by reducing the speed of the cylinder or by removing part of the concaves.

#### STORAGE.

One of the principal problems in connection with the use of sorghum grains is the storage of the heads or thrashed grain or chops. Like corn, they may get out of condition in the crib or bin and become damaged if special care is not taken. Excessive moisture content probably is the most common cause of damage. The average moisture content of sorghum grain is not as high as that of corn. This is due partly to the smaller size of the kernel and partly, perhaps, to its being produced in dry districts. Nevertheless, when the water content is above normal the grain will heat readily if not carefully handled. The grain should be thoroughly dry before being stored in bins, and it should be watched while storage continues.

Bins used in storing sorghum grains should be well ventilated. Free circulation of air through the mass of grain is the best insur-

ance against heating. Some principles which affect the storage of these grains are stated briefly below:

(1) The more moisture the grain contains when put in storage, the more readily it will heat.

(2) The larger the quantity stored in a single bin, the greater the risk of damage by heating.

(3) The warmer and damper the climate, the quicker the grain will get out of condition.

(4) The more cracked kernels and dirt the grain contains, the closer it packs, the less the air can circulate, and the greater the danger of loss.

(5) Weevils working in grain increase its temperature and decrease the spaces for air circulation, thus making conditions favorable for further damage from heating.

In elevators it usually is possible to prevent damage from heating when it first starts by running the grain from one bin to another. In this way it is aired and cooled. This shifting of the grain must be repeated whenever rising temperature in the grain makes it necessary.

Most farms are not equipped with machinery for handling grain. The farm bin, therefore, should be provided with ventilators if these grains are to be stored. Different kinds of ventilating devices have been described. Of these, only one of the most practical is described and illustrated in this bulletin.

The simplest and cheapest ventilator was devised by Mr. George Bishop and fully described by him in the issues of the Oklahoma Farm Journal during the autumn of 1915. The following description is adapted from that source.

This ventilator (fig. 6) is a long, narrow box of wood and wire screen, extending from side to side of the bin and opening to the outer air. To make it, take two pieces of 1-inch board (*a*) 4 inches wide and as long as the bin is wide. Place these on edge about 4 inches apart. Take cleats or strips of wood (*b*) 1 inch thick and  $1\frac{1}{2}$  or 2 inches wide, and mortise them into the upper edges of the boards (*a*), flush with the surface and about 1 foot apart.

Take galvanized wire screen, either ordinary fly screen or similar screen with a mesh too small to permit kafir seeds to pass through. Cover the ends of the ventilator with pieces of screen (*c*) cut large enough to lap over on to the sides for an inch or so and tack tightly. Then cut the screen into strips wide enough (about 19 or 20 inches) to go completely around the ventilator box. Fasten all the screen (*d*) tightly with tacks or small staples.

The ventilator now has two wooden sides and a wire screen top, bottom, and ends. Across the bottom, nail several cleats (*e*) or strips of 1-inch lumber. These will lift the ventilator an inch from the floor and permit air to circulate freely in the lowermost layer of grain.

These ventilators should be placed 3 or 4 feet apart on the floor of the bin. The ends should fit into or set flush against holes cut in the outer walls of the bin. The joining of the ventilator and the hole should be made grain tight by strips of wood if necessary. If the grain begins to heat, the hot air rises and cold air is drawn in from

below through the ventilator and upward through the mass of grain, which is cooled thereby. The wire screen across the ends of the ventilator prevents the entrance of rats and mice. When the bin is

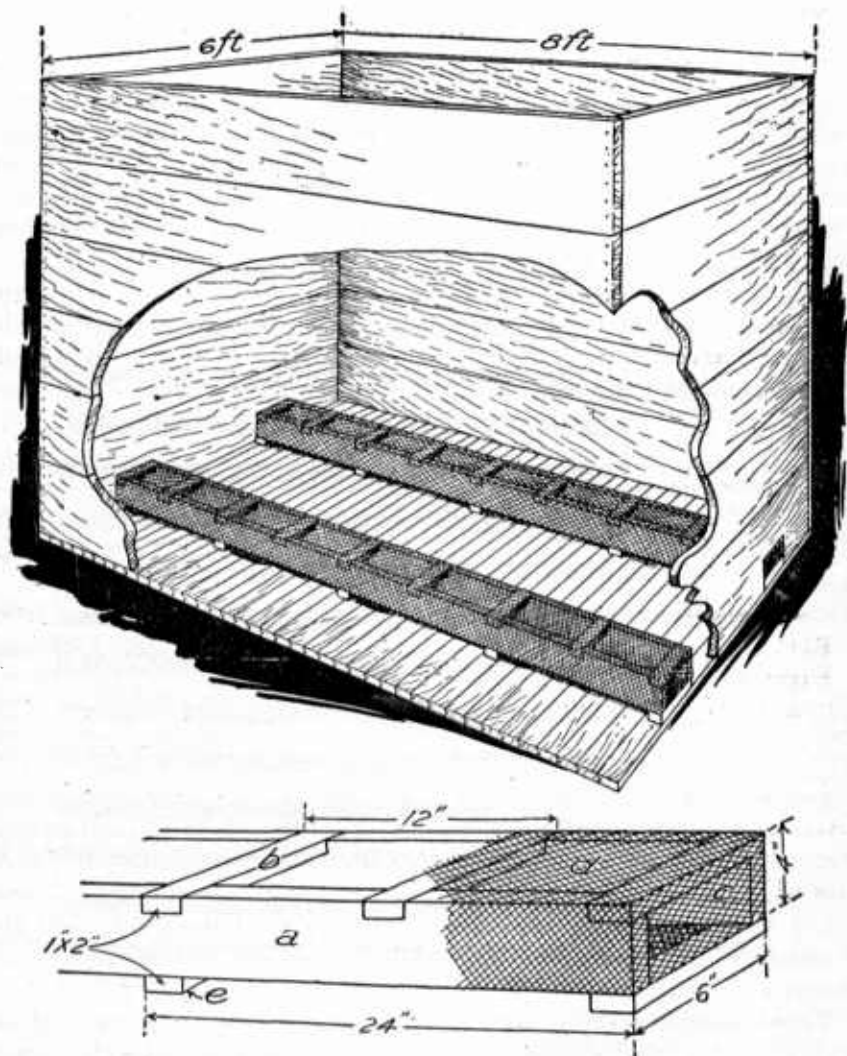


FIG. 6.—Ventilator for a bin containing sorghum grain. Upper figure, view of two ventilators in position on floor of bin, showing opening in side of bin. Lower figure, detailed structure and dimensions: (a) Side of ventilator; (b) cleat mortised in upper edge of a; (c) wire screen over end of ventilator; (d) wire screen covering top and bottom, also sides; (e) cleat on bottom to raise ventilator from floor.

not in use, the ventilators should be removed and placed where the wire screen will not be broken.

In wide and deep bins, it may be desirable to place a row of upright ventilators through the middle of the bin. The lower screen-

covered end should rest on the horizontal ventilator, thus making a sort of chimney up through the mass of grain and giving still better circulation of air.

### ACREAGE AND VALUE OF GRAIN SORGHUMS.

A very large acreage of grain sorghums is grown in the States of Kansas, Oklahoma, and Texas. Smaller areas are raised in Colorado, New Mexico, Arizona, and California. The Bureau of Crop Estimates has published figures showing the estimated acreage and production of these crops during the last three years in the first six States named above. These figures are shown in Table II, together with the farm price per bushel on December 1 of each year.

The small reduction in acreage in 1916 was due in part to the very low price obtained for the very large crop of 1915. The large increase in acreage in 1917 was caused partly by the necessity of growing spring-sown crops on large areas where winter wheat was killed.

TABLE II.—*Acreage, average acre yield, total production, and farm value per bushel and total value, on December 1, of grain sorghums grown in the States of Kansas, Oklahoma, Texas, Colorado, New Mexico, and Arizona in the three years from 1915 to 1917, inclusive.*

Year.	Acreage.	Production (bushels).		Farm value on Dec. 1.	
		Per acre.	Total.	Per bushel.	Total.
1915.....	4,153,000	27.6	114,460,000	\$0.45	\$51,157,000
1916.....	3,812,000	13.2	50,340,000	1.06	53,269,000
1917.....	4,894,000	14.7	75,866,000	1.61	121,842,000

Kansas was one of the first States to grow grain sorghums extensively and is now one of the three States leading in their production. For many years the Kansas State Board of Agriculture has published annual statistics of crop production and value. In figure 7 are given the comparative acreages of grain sorghums and corn in Kansas in the 15 years from 1903 to 1917, inclusive, taken from these reports.

This illustration shows the steady increase of corn acreage to 1910 and a considerable decrease for 5 years thereafter. At the same time, there was a considerable increase in the acreage of grain sorghums in the three years from 1911 to 1913, inclusive. This was due to dry seasons in which the superiority of these crops over corn was clearly demonstrated. In 1915, extraordinarily high yields on a large acreage resulted in a bumper crop of grain sorghums. The price, however, was very low, due to enormous production and the fact that much of it was thrown directly on the market instead of being fed where grown. This low price tended to reduce the acreage

somewhat in 1916. Owing to the winterkilling of millions of acres of wheat in Kansas and Oklahoma in the winter of 1916-17, there was a very large increase in the acreage of grain sorghums in 1917. The area sown was the largest ever known in Kansas.

### INCREASING THE USE OF SORGHUM GRAINS.

As already shown, the acreage devoted to grain-sorghum crops has grown rapidly in recent years. In the early years of production the

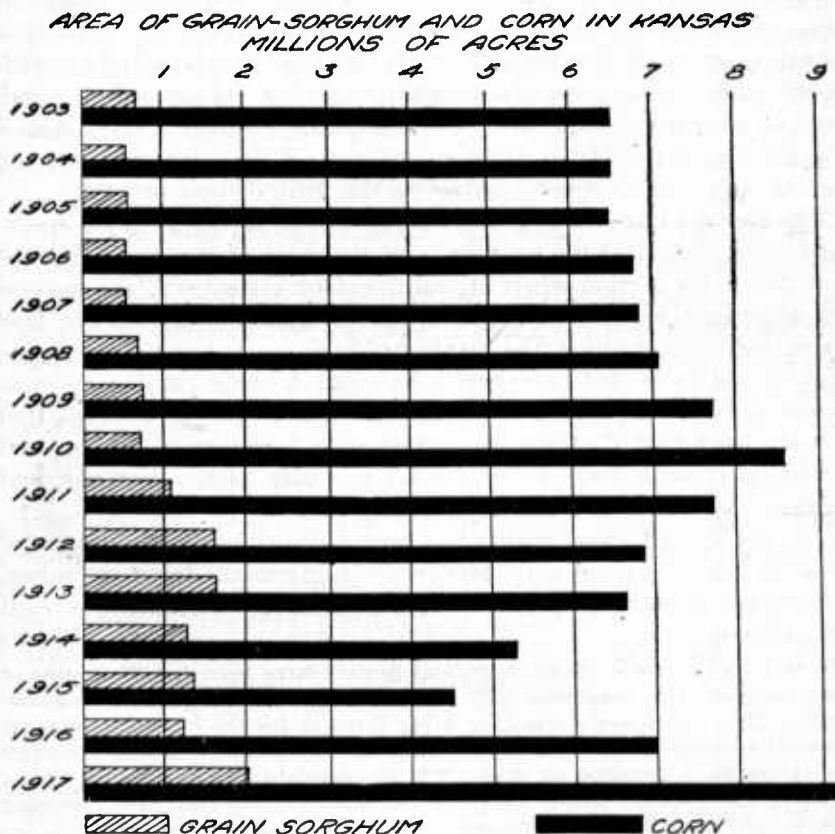


FIG. 7.—Diagram showing the comparative acreage of grain sorghum and of corn in Kansas during the 15 years from 1903 to 1917, inclusive.

crop was wholly used on the farms where it was grown. As the merits of these crops became better known and the acreage increased, there has been a growing surplus to dispose of commercially. There has always been some difficulty in marketing this surplus promptly at profitable prices.

The value of sorghum grain for feeding in beef, milk, pork, and egg production and for human food is not yet fully recognized. In some seasons of large production the grain has been almost a drug on

the market during the fall. In the following spring, however, the price has increased as the increasing price of feeding corn turned the attention of feeders toward it. If it is to be in any sense the money crop of certain districts it must be readily and profitably convertible into cash. This means that the surplus must be able to move freely at good prices soon after being thrashed.

#### SORGHUM GRAIN FOR FEEDING STOCK.

The chief use for sorghum grain is as feed for various classes of stock, including horses, cattle, sheep, swine, and poultry. Since it is a feeding grain, it is reasonable to believe that it can be fed as profitably where it is grown as elsewhere, other things being equal. Freight charges on the crop shipments are avoided thereby, as is also the wagon haul from farm to railroad. It is much more readily and cheaply transported to market in the form of beef or pork.

These crops have been grown in the midst of the greatest stock-producing section of the country, and yet most of the grain has not been fed in the section where it and the stock are grown. To reverse the statement, both cattle for feeding and grain sorghums for feed are raised extensively in the southern Plains area, but the cattle are shipped out to be fed elsewhere. In stock feeding lies the greatest opportunity for expansion in the use of sorghum grain. It is realized that the financing of extensive stock-feeding operations is a slow and somewhat difficult matter. The start has been made, however, and progress should be aided and encouraged.

The feeding of these grains has been fully discussed in Farmers' Bulletin No. 724, from which the following general facts are taken. For suggested rations and results obtained the reader should consult the bulletin.

Horses, mules, cattle, sheep, hogs, and poultry have been fed the grains of these nonsaccharine sorghums with very satisfactory results. Breeding animals or those which are working or being fattened for the block eat properly prepared sorghum grains with much relish. However, as the grains are small and rather hard, grinding or crushing is recommended before feeding, except for sheep and poultry. Sheep masticate the small kernels well, thus rendering them readily accessible to the digestive juices, while poultry feed upon the unbroken grain, which is especially palatable to them in this form. If the grain is not ground for other stock it is less palatable and much of it passes through the digestive tract unbroken; thus much of the total feeding value is lost.

Very often the entire heads are ground up, producing a feed of greater bulk. The resulting meal, called head chop, resembles corn-and-cob meal in food value. It is recommended especially where the supply of roughage is limited, and usually is economical for feeding stock not being finished for market. Head chop is valuable in producing a high finish when supplemented by a rich concentrate such as cottonseed meal.

The quantities to be fed to the different kinds of animals depend upon many factors, such as the amount and kind of roughage and of other con-

centrates available, the age, type, and size of the animals, and for what purpose the stock is being fed. Rations for various classes of stock are hereinafter suggested.

The feeder always should remember that sorghum grains alone do not form a balanced ration, and the same care which is exercised in feeding corn should be applied when feeding grains of the sorghums. This applies with particular emphasis to the rations for young and growing stock. Some feed which is rich in protein must also be given if favorable results are to follow heavy feeding of this class of grains.

The increasing number of silos in the States of the southern Great Plains area will be a direct aid to cattle-feeding operations. The combination of home-grown silage and feeding grain, with readily accessible cottonseed meal, ought to aid in making feeding profitable in the grain-sorghum belt.

#### SORGHUM GRAIN FOR FEEDING POULTRY.

The sorghum grains, especially Blackhull kafir (see fig. 2), are excellently adapted for poultry feed. In size they are small enough so that they are readily fed without cracking or crushing. It probably is a safe estimate that kafir or other grain-sorghum seed forms fully 25 per cent of the prepared poultry feed sold in this country. It is used mostly in mixture with other grains, such as corn, wheat, and screenings.

There is a steady demand for these grains in the manufacture of poultry feed. When the crop in this country has been short, as in 1909, similar varieties have been imported from as far away as India and China. The poultry industry is increasing steadily in this country. It is probable that kafir grain would form a still larger proportion of the total poultry feed manufactured if it were always available at satisfactory prices. This avenue for extending the use of these grains should not be neglected.

#### SORGHUM GRAIN FOR HUMAN FOOD.

Ever since grain-sorghum crops were first grown in the dry-land West they have been used to some extent for human food. Ground at the local gristmill, they have been turned into batter cakes in the farm kitchen on many a winter's morn. In the making of corn bread or johnnycake they have taken the place of corn meal with satisfaction to the consumer. The grain also may be used successfully for pop corn.

Only in recent years, however, have scientific tests been made to determine their value in the human diet. The results of these experiments show that the meal of kafir and milo is comparable with corn meal. It can be used alone or in mixture with wheat flour in varying proportions in such ways as corn meal is used.



Owing to the absence of gluten in the protein, grain-sorghum flour can not be used alone for making raised bread. It should not be ground into flour, therefore, but into meal instead. In this form it can be used for pancakes, bread, mush, puddings, etc., just as corn meal is used.

The use of kafir as human food has been discussed in Farmers' Bulletin 559. The following statements concerning it are quoted from that bulletin:

Since kafir resembles corn closely in composition and nutritive value, it is unnecessary to treat of these subjects in detail here. Something, however, must be said about special precautions necessary in preparing it for the table. In making mush for use alone, or as a foundation for other dishes (yeast bread, gingerbread, etc.), the ingredients should be thoroughly mixed before being heated. Cooking should always be more thorough than for Indian corn. In making gingerbread with corn meal, for example, it has been found sufficient to heat the meal and water for 10 minutes in a double boiler; but in making the same dish with kafir meal it is necessary to cook the mush at least half an hour.

#### **SORGHUM GRAIN FOR MAKING ALCOHOL.**

The principal material from which alcohol is produced is starch. The demand for industrial alcohol was increasing rapidly even before the outbreak of the war. During the continuation of the war the demand for alcohol in munitions manufacture is expected to be enormous. The sorghum grains, with their 70 per cent or more of starch, are excellent alcohol producers. Following the production of a bumper crop of grain sorghums in 1915, considerable quantities of sorghum grain were used in making alcohol. The location of factories in the producing area would do much to promote a larger use for this purpose.

#### **FOREIGN MARKETS FOR SORGHUM GRAIN.**

One other factor in the situation should not be overlooked. This is the possibility of developing a larger export trade in these grains. Occasional cargoes have left Galveston or New Orleans for European ports. Very little has been done, however, to stimulate this line of trade expansion. There is some difficulty in keeping these grains from heating during ocean voyages, especially in hot weather. It is probable, however, that means can be found to overcome this difficulty, along the lines already discussed in the paragraphs on storage.

Investigations have been conducted in Germany to determine the feeding value of grains very similar to these. It will be remembered that most of the grain sorghums are of African origin. Various sorghum crops were grown extensively in the German East African

colonies. The investigations in Germany were started in connection with the development of this industry in those colonies.

European countries are importers of enormous quantities of American feeding grains. This is likely to continue in spite of colonial developments of this kind. If the facts concerning the value and profitable use of American grain sorghums can be brought to the attention of exporters here and importers abroad, a considerable demand for these crops ought readily to result. Fortunately, the States producing sorghum grains are fairly well situated for getting the crop to the Gulf coast for ocean shipment.

### PUBLICATIONS ON GRAIN SORGHUMS.

In the list that follows, those publications to which no price is attached may be obtained without charge upon application to the Secretary of Agriculture; publications having a price attached may be obtained by remitting the stated sum to the Superintendent of Documents, Government Printing Office, Washington, D. C.

#### UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

##### FARMERS' BULLETINS.

Milo as a Dry-Land Grain Crop. Farmers' Bulletin 322. Price, 5 cents.  
 Better Grain-Sorghum Crops. Farmers' Bulletin 448. Price, 5 cents.  
 Kafir as a Grain Crop. Farmers' Bulletin 552.  
 Use of Corn, Kafir, and Cowpeas in the Home. Farmers' Bulletin 559.  
 The Feeding of Grain Sorghums to Live Stock. Farmers' Bulletin 724.  
 Cereal Crops in the Panhandle of Texas. Farmers' Bulletin 738.  
 Shallu, or "Egyptian Wheat." Farmers' Bulletin 827.

##### DEPARTMENT BULLETINS.

Corn, Milo, and Kafir in the Southern Great Plains Area: Relation of Cultural Methods to Production. Department Bulletin 242. Price, 5 cents.  
 Studies on the Digestibility of the Grain Sorghums. Department Bulletin 470.

##### BUREAU OF PLANT INDUSTRY CIRCULARS.

Feterita, a New Variety of Sorghum. Bureau of Plant Industry Circ. 122-C. Price, 5 cents.  
 Three Much-Misrepresented Sorghums. Bureau of Plant Industry Circ. 50. Price, 5 cents.

##### BUREAU OF PLANT INDUSTRY BULLETINS.

The History and Distribution of Sorghum. Bureau of Plant Industry Bulletin 175. Price, 10 cents.  
 The Importance and Improvement of the Grain Sorghums. Bureau of Plant Industry Bulletin 203. Price, 10 cents.  
 Grain-Sorghum Production in the San Antonio Region of Texas. Bureau of Plant Industry Bulletin 237. Price, 5 cents.

The Kaollangs: A New Group of Grain Sorghums. Bureau of Plant Industry Bulletin 253. Price, 15 cents.

Cereal Experiments in the Texas Panhandle. Bureau of Plant Industry Bulletin 283. Price, 10 cents.

BUREAU OF CHEMISTRY BULLETIN.

The Feeding Value of Cereals as Calculated from Chemical Analyses. Bureau of Chemistry Bulletin 120. Price, 10 cents.

YEARBOOK SEPARATE.

The Grain Sorghums: Immigrant Crops That Have Made Good. Yearbook (1913) Separate 625. Price, 5 cents.

