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USES OF SORGHUM GRAIN.

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CONTENTS.

INTRODUCTION.

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, and kaoliang. In most of them the forage value is not large. The kafirs, however, have a comparatively high forage value because of their semijuicy stems and large and abundant leaves.

The sorghums are of recent introduction. The kafirs and durras were brought to this country about 40 years ago, milo about 30 years ago, and the best kaoliang about 10 years ago. However, the grain sorghums first became important in this country about 25 years ago. Kafir was brought to Kansas about 1890 and spread rapidly to the South and West. Milo was brought into Texas about the same time or a little later, and spread rapidly to the West and more slowly to the North.

These crops 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

NOTE.—This bulletin is suitable for distribution in the southern part of the Great Plains area.

crops. Corn was found to be well suited to the more humid parts and the more favorable seasons; 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.

SORGHUM GRAIN FOR FEED AND FOOD.

The two natural uses for these grains are as feed for farm stock and food for people. The value of any feeding stuff or foodstuff depends on at least four factors. The first is the chemical composition, which tells what and how much of different food substances each contains.

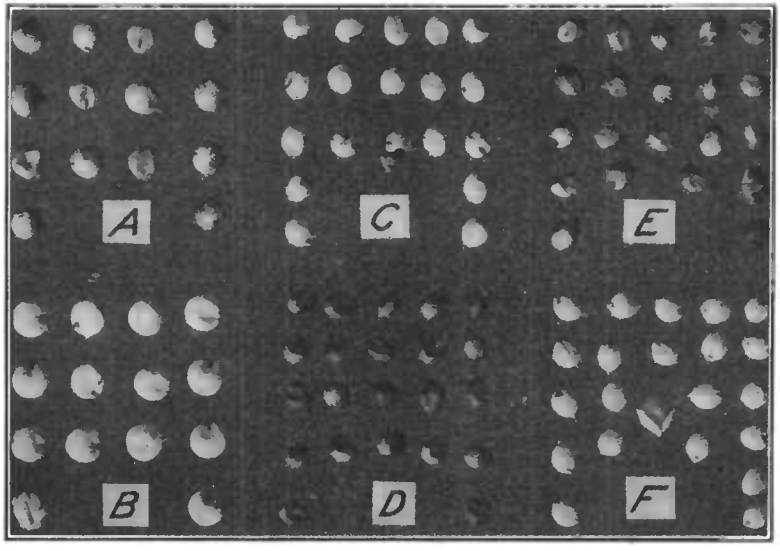

FIG. 1.—Seeds of grain sorghums: *A*, Milo; *B*, White durra; *C*, Blackhull kafir; *D*, Red kafir; *E*, Brown kaoliang; *F*, shallu. (Slightly reduced.)

The second is digestibility, or how easily or completely it is 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 results of a large number of chemical analyses are shown in Table I. This work was done cooperatively, the Office of Cereal Investigations growing the crops and furnishing the samples and the Plant Chemical Laboratory of the Bureau of Chemistry making the analyses. The crops were all grown at the Amarillo Cereal Field Station, at Amarillo, Tex. The varieties (fig. 1) analyzed were milo,

Dwarf milo, feterita, Blackhull kafir, Dwarf Blackhull kafir, Red kafir, and shallu.

TABLE I.—*Averages of chemical analyses*[1] *of air-dry samples of grain-sorghum varieties grown at the Amarillo Cereal Field Station, for each of the years stated.*

Crop and year.	Number of analyses.	Water.	Ash.	Nitrogen.	Protein.	Carbohydrates.	Fat.	Fiber.	Weight per—	
									1,000 kernels.	Bushel.
Milo:									*Grams.*	*Lbs.*
1908	8	8.76	1.69	1.79	11.20	73.75	3.20	1.40	37.2	57.6
1909	11	8.34	1.66	2.13	13.30	72.23	2.99	1.48	36.7	57.9
1910	11	8.54	1.70	2.15	13.47	71.61	3.14	1.54	36.2	58.0
1911	19	9.92	1.48	1.78	11.08	72.69	3.34	1.49	35.6	58.5
1912	18	10.02	1.66	2.17	13.60	70.17	3.04	1.47	35.7	58.2
Average	67	9.32	1.62	2.01	12.54	71.89	3.15	1.48	36.1	58.1
Dwarf milo:										
1908	6	8.68	1.66	1.81	11.34	73.57	3.33	1.42	32.8	57.6
1909	5	8.56	1.57	2.10	13.10	71.91	3.37	1.49	34.4	58.0
1910	6	8.34	1.77	2.10	13.17	71.80	3.32	1.60	33.5	57.8
1911	18	9.40	1.58	1.62	10.55	73.72	3.32	1.43	29.5	58.6
1912	20	10.10	1.63	2.13	13.30	70.25	3.19	1.48	31.4	58.1
Average	55	9.38	1.63	1.92	12.16	72.09	3.27	1.47	31.4	58.2
Feterita:										
1908	1	8.72	1.58	2.08	13.00	72.08	3.32	1.30	35.5	56.9
1909	1	8.94	1.60	2.24	14.00	70.72	3.27	1.47	34.8	55.8
1910	1	8.48	1.78	2.26	14.12	70.91	3.21	1.50	27.1	55.2
1911	1	10.46	2.06	2.26	14.13	68.80	2.98	1.57	27.6	54.7
1912	4	10.01	1.69	2.27	14.20	69.97	2.61	1.50	33.2	56.2
Average	8	9.58	1.72	2.24	14.00	70.32	2.90	1.48	32.2	55.9
Blackhull kafir:										
1908	13	8.90	1.64	1.98	12.42	71.85	3.59	1.60	25.0	58.8
1909	16	9.91	1.84	2.38	14.90	68.47	3.44	1.44	22.3	58.1
1910	16	8.84	1.84	2.35	14.70	69.28	3.67	1.67	19.5	57.5
1911	17	10.18	1.77	2.19	13.73	69.17	3.49	1.66	22.5	57.7
1912	16	9.90	1.83	2.31	14.40	69.14	3.15	1.52	19.4	58.2
Average	78	9.58	1.78	2.25	14.10	69.49	3.47	1.58	21.6	58.0
Dwarf Blackhull kafir:										
1908	1	9.38	1.57	1.81	11.31	72.65	3.55	1.54	22.1	58.5
1909	2	9.82	1.74	2.14	13.40	70.25	3.39	1.40	18.6	59.6
1910	2	8.97	1.85	2.20	13.78	70.02	3.58	1.80	13.8	57.4
1911	2	10.82	1.59	1.95	12.21	70.94	3.06	1.38	17.4	59.3
1912	6	10.13	1.69	2.13	13.30	70.17	3.12	1.53	15.7	58.7
Average	13	9.95	1.70	2.09	13.09	70.49	3.25	1.52	16.6	58.7
Red kafir:										
1908	4	9.12	1.57	1.81	11.31	73.18	3.41	1.41	22.7	59.3
1909	9	9.59	1.74	2.00	12.50	71.39	3.40	1.38	19.0	59.4
1910	9	8.89	1.76	1.90	11.88	72.84	3.01	1.62	16.6	57.7
1911	7	10.27	1.61	1.81	11.32	72.29	3.05	1.46	19.7	58.1
1912	8	9.87	1.87	2.01	12.50	70.99	3.05	1.64	16.8	57.7
Average	37	9.56	1.73	1.92	12.01	72.03	3.16	1.51	18.5	58.3
Shallu:										
1911	4	10.84	1.87	2.13	13.32	68.51	3.72	1.74	14.9	58.9
1912	6	10.07	2.05	2.62	16.40	64.08	3.67	2.05	15.3	57.2
Average	10	10.38	1.98	2.42	15.17	66.86	3.69	1.92	15.1	57.9

[1] The analyses were made by the Plant Chemical Laboratory of the Bureau of Chemistry, U. S. Department of Agriculture.

A study of Table I shows that there are no striking differences in chemical content among the varieties tested. The differences from year to year in any one variety are nearly as great as the differences between varieties. However, it is noted that feterita is higher in

protein content, lower in fat content, and a little lower in starch content than is milo (fig. 2), to which it is most similar. In protein content it is more like the Blackhull kafirs, though having less fat than these.

The milos and Blackhull kafirs are the staple grain-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. 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.

In Table II the averages are grouped for greater convenience in study. The averages of all analyses for each variety are shown. The analyses of all samples of both varieties of milo, and of both

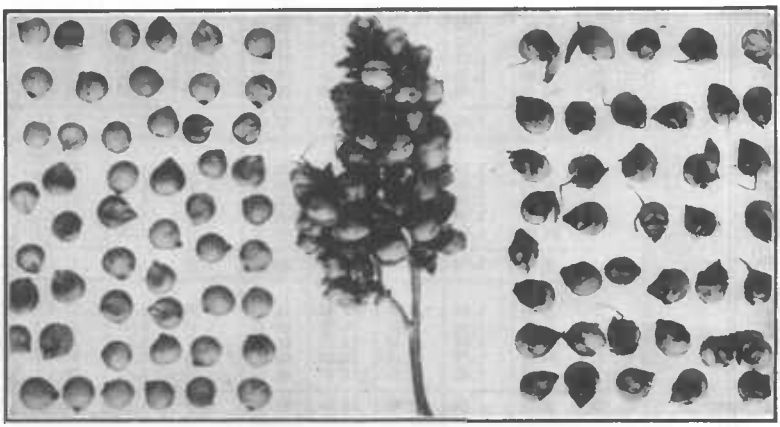

FIG. 2.—Milo seeds, hulled and unhulled, and a small branch of a head. (Natural size.)

varieties of Blackhull kafir, and then of all three varieties of kafir are averaged. Finally, the average of the analyses of all varieties of all grain sorghums—a total of 268 samples—is given.

Since these 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 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 therefore 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 is also somewhat lower. Since fat is really a concentrated

carbohydrate, this shows corn to be distinctly richer in carbohydrates, or starchy matter, and the sorghums definitely better in protein content.

TABLE II.—*Averages of chemical analyses*[1] *of air-dry samples of various grain-sorghum varieties grown at the Amarillo Cereal Field Station, Amarillo, Tex., 1908 to 1912, inclusive, with the average for each group in all years and the average for 268 analyses in all groups combined in all years, compared with 86 analyses of dent corn.*

Sample.	Number of analyses.	Water.	Ash.	Nitrogen.	Protein.	Carbohydrates.	Fat.	Fiber.	Weight per—	
									1,000 kernels.	Bushel.
									Grams.	*Lbs.*
Milo	67	9.32	1.62	2.01	12.54	71.89	3.15	1.48	36.1	58.1
Dwarf milo	55	9.38	1.63	1.92	12.16	72.09	3.27	1.47	31.4	58.2
Average of 2 milos.	122	9.35	1.62	1.97	12.37	71.97	3.21	1.48	34.0	58.1
Feterita	8	9.58	1.72	2.24	14.00	70.32	2.90	1.48	32.2	55.9
Blackhull kafir	78	9.58	1.78	2.25	14.10	69.49	3.47	1.58	21.6	58.0
Dwarf Blackhull kafir	13	9.95	1.70	2.09	13.09	70.49	3.25	1.52	16.6	58.7
Average of 2 kafirs.	91	9.63	1.77	2.23	13.95	66.65	3.43	1.57	20.9	58.1
Red kafir	37	9.56	1.73	1.92	12.01	72.03	3.16	1.51	18.5	58.3
Average of 3 kafirs.	128	9.61	1.76	2.14	13.39	70.33	3.35	1.55	20.1	58.2
Shallu[2]	10	10.38	1.98	2.42	15.17	66.86	3.69	1.92	15.1	57.9
Grand average of all varieties	268	9.52	1.70	2.07	13.01	70.95	3.29	1.53	26.6	58.1
Dent corn[3]	86	10.60	1.50	.....	10.30	70.40	5.00	2.20	.....	.....

[1] The analyses were made by the Plant-Chemical Laboratory of the Bureau of Chemistry, U. S. Department of Agriculture.
[2] Grown only in the years 1911 and 1912.
[3] Jenkins and Winton, Compilation of Analyses of American Feeding Stuffs. U. S. Dept. Agr., Office of Experiment Stations Bul. 11, 1892.

DIGESTIBILITY OF THE SORGHUM GRAINS.

Several experiments have been conducted during the past 15 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 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.

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

If the farmer growing kafir and 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 THE SORGHUM GRAINS.

There seems no need for discussion of this question. Stock and poultry of all kinds eat the sorghum grains 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.

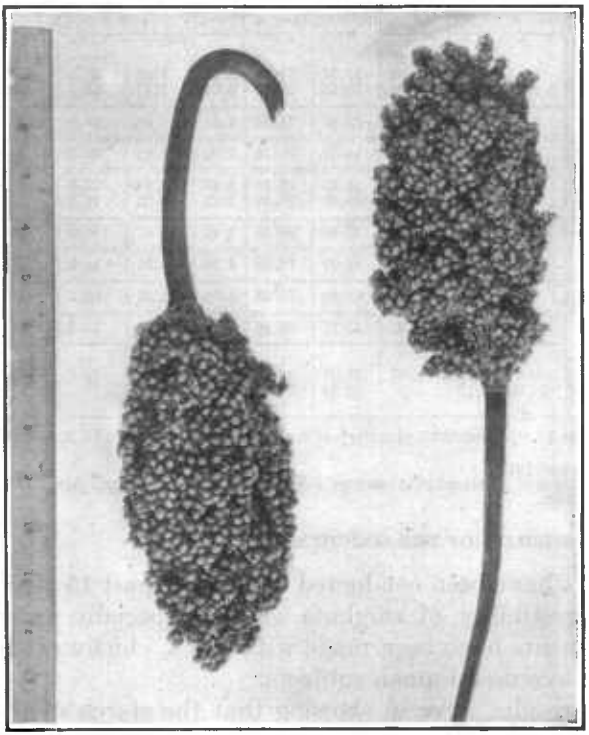

FIG. 3.—Milo heads; one pendent, one erect.

For human food the meal of these grains has a somewhat distinctive flavor. This is not nearly as different from that of corn as, for instance, the flavor of buckwheat is from that of wheat flour.

PREPARATION AND STORAGE.

PREPARATION.

The grain-sorghum crop is harvested in three general ways. It is cut 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. Feeding in the bundle usually is practiced only as a maintenance ration for horses not at work or cattle not producing milk or 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, 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 the granary or crib. This can be done more safely in the case of milo and feterita than in the case of kafir. The short, broad heads of milo (fig. 3), with their somewhat crooked stems, do not pack tightly together. The kafir heads (fig. 4) 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.

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, but always ground coarsely, in which form it is known as kafir or milo chops.

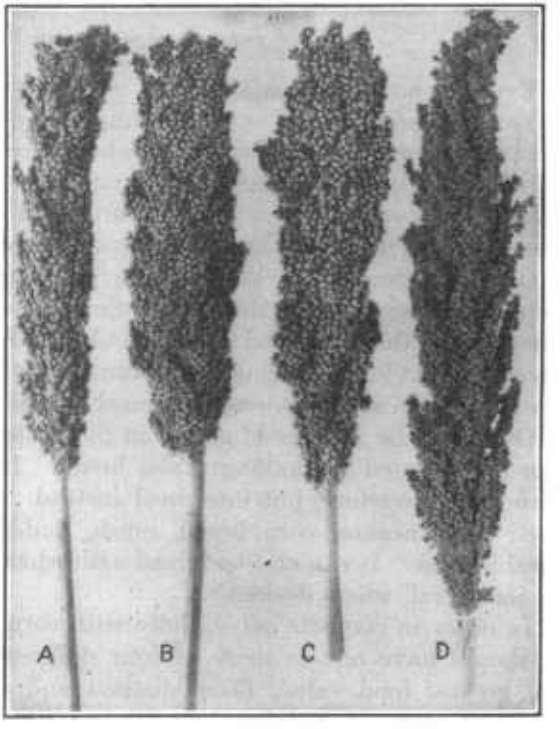

FIG. 4.—Heads of four varieties of kafir: *A*, White kafir; *B*, Guinea kafir (Guinea corn of the West Indies); *C*, Blackhull kafir; *D*, Red kafir. (About one-fifth natural size.)

STORAGE.

One of the problems in connection with the use of these grains is in the storage of the heads or thrashed grain or chops. Like corn, they may get out of condition and become damaged if special care is not taken. Cribs and bins used for storing the heads should be well ventilated. They should be examined from time to time to make sure that the contents are not being damaged by heating.

The grain should always be allowed to become thoroughly cured before thrashing or grinding. In ordinary thrashing a high percentage of the grain is cracked. Cracked grain will absorb moisture and spoil 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.

The grain should be thoroughly dry before being stored in bins and it should be watched while storage continues. The average moisture content of sorghum grain is not as high as that of corn. This is due 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. Excessive moisture content is probably the most common cause of damage.

USE FOR HUMAN FOOD.

Ever since these 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 morning. In the making of corn bread or johnny-cake 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 mixtures 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 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, corn bread, mush, puddings, etc., just as corn meal is used. It can also be mixed with wheat flour in the same way as corn meal, where desired.

In order to compete successfully with corn meal as a human food it should have one or more of four different qualities. These are (1) greater food value, (2) a distinct and attractive flavor, (3) a different range of usefulness, or (4) lower cost. It does not appear that grain sorghum possesses any one of these four to a marked degree. Chemical analysis does not indicate a higher food value, and lower digestibility disproves it. The flavor is rather distinct, but apparently it is not sufficiently attractive to be remembered, craved, and sought. As has just been seen, its uses are much the same as those of corn meal. Finally, there is no reason to believe that it can be produced much more cheaply in proportion to its actual value.

A varied diet is desirable. Sorghum grain can be and should be used for human food. Doubtless it will be used to some extent whenever it can be produced and sold at a figure which will make it profitable to dealer and consumer alike. It seems, however, that no large new demand is likely to be created for this crop by reason of its use as human food.

INCREASING THE USE OF GRAIN SORGHUMS.

As has been seen, the acreage devoted to these crops has been growing rapidly in recent years. While the annual increase of the present and future may not average as large as it was in 1912 and 1913, it is likely to be rather steady. It is probable that the acreage for 1915 has been very largely increased, especially in the cotton-producing States of Oklahoma and Texas. Owing to the very low price of cotton and the carrying over of a considerable part of the 1914 crop, there has been a marked reduction in cotton acreage. Part of the area thus released from cotton has been devoted to winter and spring grains. Part of it will be devoted to summer forage crops. Another, and a considerable part of it in the two States named, will be sown to the grain sorghums. If seasonal conditions are favorable, there should result a bumper crop of these grains in the fall of 1915. The problem of the profitable disposal of such a crop merits careful attention.

GRAIN SORGHUMS FOR FEEDING TO STOCK.

In the early years of grain-sorghum production the 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 this grain for feeding in beef, milk, pork, and egg production is not yet fully recognized. In some seasons it has been almost a drug on the market until the following spring, when the growing scarcity and increasing price of feeding corn turned attention 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.

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 thereby avoided, 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.

It seems especially unfortunate that these crops should be grown in the midst of the greatest stock-producing section of the country and yet not be fed on the farms where they 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 this direction lies the greatest opportunity for expansion in their use. 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 by every commercial agency concerned.

At the present time a large part of the cattle grown in the grain-sorghum-producing districts are fed in corn-belt States farther north and east. They are fed likewise on corn. As conditions now exist, the cattle proceed to market on a feeding-in-transit rate. If sorghum grain is to be used largely in feeding these cattle, it must follow them by rail to the feeding districts. There is no feeding-in-transit rate for grain sorghums. They must not only compete with corn in feeding favor, but must bear heavier transportation rates because of the longer distances from which they come. This can be remedied only by encouraging local feeding.

The recent rapid increase in the number of silos in the States of Oklahoma and Texas 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.

FINDING A MARKET ABROAD FOR GRAIN SORGHUMS.

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 now leave Galveston or New Orleans for European ports. Very little has been done, however, to stimulate this line of trade expansion.

For several years 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 are 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.

Germany and other 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 producing States are situated fairly well for getting the crop to the Gulf coast for ocean shipment.

GRAIN SORGHUMS FOR FEEDING TO POULTRY.

The sorghum grains, especially Blackhull kafir, are excellently adapted for poultry feed. In size they are small enough so that they are readily fed without cracking or crushing.

An investigation made in 1908 showed more than 100 firms engaged in the manufacture of over 200 brands of poultry feed. Figures furnished at that time by 33 of these firms showed an annual output of about 30,000 tons of these products. Approximately one-third of this quantity, or 10,000 tons, consisted of the seed of Blackhull kafir. This was used mostly in mixture with other grains, such as corn, wheat, screenings, etc. 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.

There is a steady demand for these grains in the manufacture of poultry feed. When the crop in this country has been short, similar varieties have been imported from as far away as India and China. Such importations occurred four years ago as a result of the short crop of 1909. The poultry industry is steadily increasing 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.

ACREAGE AND VALUE OF GRAIN SORGHUMS.

At the present time very large acreages of grain sorghums are grown in the States of Kansas, Oklahoma, and Texas. Smaller quantities are raised in New Mexico, Colorado, and California. The

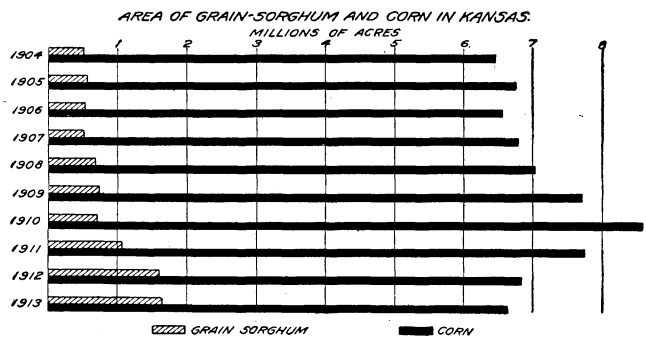

FIG. 5.—Graphic comparison of the area in millions of acres of grain sorghum and of corn in Kansas for the 10 years 1904–1913, inclusive.

total acreage is not known, because no complete statistics of these crops are taken. Estimates based on such statistics as are available indicate that three or four million acres of grain sorghums are grown annually in the three States first mentioned. It is certain that the acreage of grain sorghums has increased enormously in the last two or three years, while that of corn has decreased.

Figures 5 to 12, inclusive, are diagrams, or graphs, showing the comparative acreage and acre value of grain sorghums and corn in Kansas and Oklahoma. This is shown first for each State as a whole.

The same facts are then shown for the western part of each State. For this purpose the counties lying wholly west of the ninety-eighth meridian are chosen in each case.

In Kansas this includes the counties, from north to south, of Smith, Osborne, Russell, Barton, Stafford, Pratt, and Barber, and all lying west of them. As a matter of fact, the east line of these counties is almost exactly halfway between the ninety-eighth and ninety-ninth meridians. In Oklahoma this line lies a few miles west of Enid, El Reno, and Chickasha.

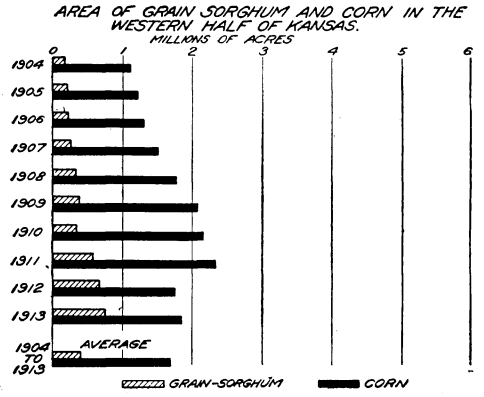

FIG. 6.—Graphic comparison of the area in millions of acres of grain sorghum and of corn in the 46 counties comprising the western half of Kansas and lying wholly west of the ninety-eighth meridian, for the 10 years 1904–1913, inclusive, and average area for the 10-year period.

In these figures three things are to be noted: (1) There has been a steady increase recently in the acreage of the grain sorghums as compared with that of corn. (2) The acre value of the grain sorghums compares very favorably with that of corn. (3) The increase in acreage of grain sorghums over corn has been most rapid in the drier western portions of these States, and the difference in acre value also is greatest there.

The coincidence of the declining corn area and the increasing acreage of kafir and milo in Kansas can be seen at a glance in figures

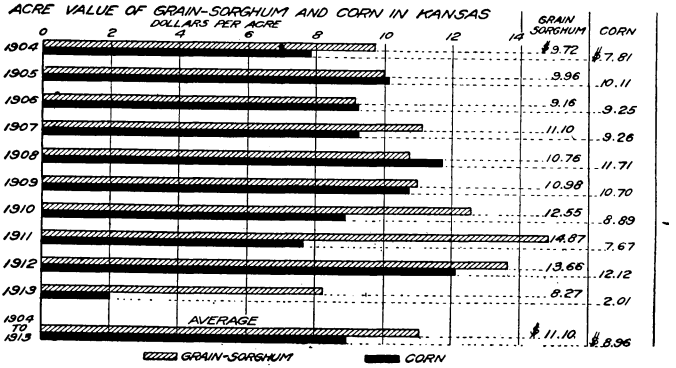

FIG. 7.—Graphic comparison of the annual acre value in dollars per acre of grain sorghum and of corn in Kansas for the 10 years 1904–1913, inclusive, and average acre value for the 10-year period.

5 and 6. Figure 5 tells the story for Kansas as a whole and figure 6 for the 46 counties comprising the western half. In this State the grain-sorghum area jumped to 1,093,000 acres in 1911, 1,605,000

acres in 1912, and 1,633,000 acres in 1913. The maximum area devoted to corn in Kansas was 8,590,000 acres grown in 1910. In 1911 and 1912 the area decreased nearly 1,000,000 acres a year.

What caused the rapid change in comparative acreage? A growing knowledge of comparative acre values? Mere acres count for little unless they produce profits. Figure 7 shows the acre value of both crops in Kansas during the last 10 years. For the entire State the average acre value of kafir and milo was $2.14 greater than that of corn. The production of these crops is also more regular and evenly distributed. These statistics, taken from the reports of the Kansas State Board of Agriculture, are not wholly fair to corn, however. They include the value of both grain and stover in grain sorghums, but only the grain value of the corn. If the stover value of corn were included, the average values would be more nearly equal.

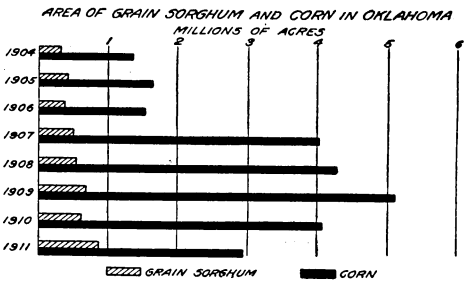

FIG. 8.—Graphic comparison of the area in millions of acres of grain sorghum and of corn in Oklahoma for the 8 years 1904–1911, inclusive.

While this was being done in Kansas, Oklahoma also was making history. Figure 8 tells the story of Oklahoma's acres, while figure 9 shows what happened in the 21 counties contained in the western third of the State. She produced 625,000 acres of grain sorghums in 1910 and 873,000 acres in 1911, an increase of a quarter million acres. No data for 1912 and 1913 are available, but there is every reason to believe, from the vigorous campaign waged, that the increase was proportional to that in Kansas. Oklahoma reached her maximum corn area in 1909 with 5,135,000 acres. In 1910 and 1911 the decline was at the rate of more than a million acres a year, as shown in figure 8.

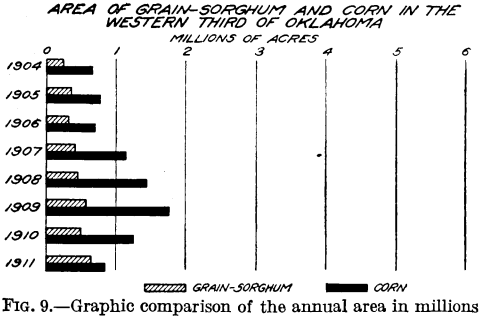

FIG. 9.—Graphic comparison of the annual area in millions of acres of grain sorghum and of corn in the 21 counties comprising the western third of Oklahoma and lying wholly west of the ninety-eighth meridian, for the 8 years 1904–1911, inclusive.

Figure 10 shows the acre value of both crops in Oklahoma for eight years, beginning in 1904. Corn has an average advantage of $2.26 per acre for the period. This reversal of the Kansas figures is due to three or four things which profit corn. Oklahoma lies in a more southerly latitude than Kansas. The Oklahoma statistics include

the stover value or only a small part of the grain sorghum. The grain sorghums are largely restricted to the drier western third of Oklahoma. (See fig. 9.) The very unfavorable season of 1913 is not included, for lack of data.

Half of Kansas, 46 of the 105 counties, lies west of the ninety-eighth meridian. Figure 6 shows the area of grain sorghum and corn

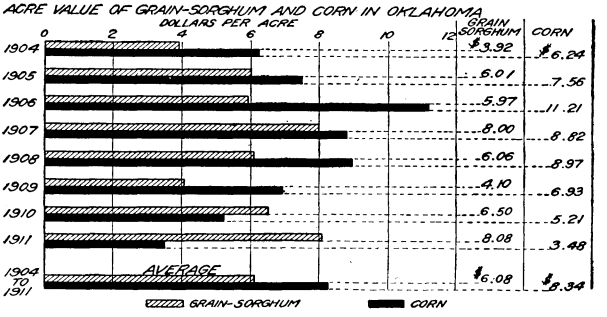

FIG. 10.—Graphic comparison of the annual acre value in dollars per acre of grain sorghum and of corn in Oklahoma for the 8 years 1904–1911, inclusive, and average acre value for the 8-year period.

in those counties. Nineteen of them already grow more kafir and milo than corn. The average acre value for this area, as shown in figure 7, proves the grain sorghum to be the more profitable crop.

A comparison of figure 6 with figure 5 shows that fully half of the Kansas grain sorghum is grown in the eastern half of the State. The

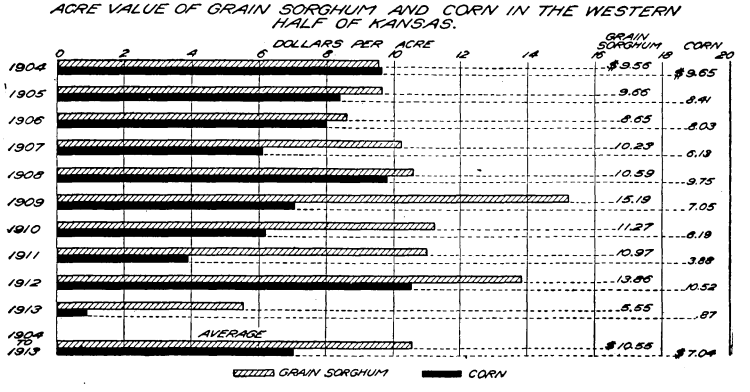

FIG. 11.—Graphic comparison of the annua lacre value in dollars per acre of grain sorghum and of corn in the 46 counties comprising the western half of Kansas and lying wholly west of the ninety-eighth meridian, for the 10 years 1904–1913, inclusive, and average acre value for the 10-year period.

acre value for the entire State indicates, moreover, that it pays to grow it in eastern Kansas, at least on the uplands.

Similarly, one-third of Oklahoma, containing 21 counties, lies west of the ninety-eighth meridian. Figure 9 shows the acreage in this area of the two crops under discussion. Nine of these counties in 1911 grew more kafir and milo than corn. Figure 12 tells why they did it

and why more of them probably were doing it in 1913. In sharp contrast to Kansas, a comparison of figure 9 and figure 8 shows only about one-fifth of the grain-sorghum crop grown in the eastern two-thirds of the State. When the acre values given in figure 10 for all Oklahoma and in figure 12 for the western third are considered, there is developed a presumption that it would be very profitable to grow kafir and milo farther east in Oklahoma.

Meanwhile what of Texas, the great dry-farming empire of the South? It is known that during the years when the kafir industry

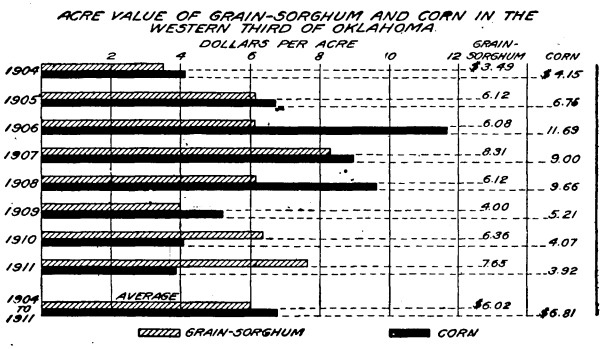

FIG. 12.—Graphic comparison of the annual acre value in dollars per acre of grain sorghum and of corn in the 21 counties comprising the western third of Oklahoma and lying wholly west of the ninety-eighth meridian, for the 8 years 1904–1911, inclusive, and average acre value for the 8-year period.

was developing in Kansas, milo had been carried into Texas by westward-faring emigrants. Gradually it became established on the farms and ranches of the drier western portions of the State. No statistical data are to be had, but it is known that it increased steadily and also that the kafirs were soon introduced and became popular. There is every reason to believe that the area devoted to these two crops in Texas has more than equaled the area grown in Kansas, at least until the recent enormous increase.

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 the United States Department 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.

The Nonsaccharine Sorghums. Farmers' Bul. 288. Paper, 5 cents.
Milo as a Dry-Land Grain Crop. U. S. Dept. Agr., Farmers' Bul. 322.
Better Grain-Sorghum Crops. U. S. Dept. Agr., Farmers' Bul. 448.
Kafir as a Grain Crop. U. S. Dept. Agr., Farmers' Bul. 552.
Use of Corn, Kafir, and Cowpeas in the Home. U. S. Dept. Agr., Farmers' Bul. 559.

BUREAU OF PLANT INDUSTRY CIRCULARS.

Feterita, a New Variety of Sorghum. U. S. Dept. Agr., Bur. Plant Indus. Circ. 122-C. Paper, 5 cents.

Three Much-Misrepresented Sorghums. U. S. Dept. Agr., Bur. Plant Indus. Circ. 50. Paper, 5 cents.

BUREAU OF PLANT INDUSTRY BULLETINS.

The History and Distribution of Sorghum. U. S. Dept. Agr., Bur. Plant Indus. Bul. 175. Paper, 10 cents.
The Importance and Improvement of the Grain Sorghums. U. S. Dept. Agr., Bur. Plant Indus. Bul. 203. Paper, 10 cents.
Grain-Sorghum Production in the San Antonio Region of Texas. U. S. Dept. Agr., Bur. Plant Indus. Bul. 237. Paper, 5 cents.
The Kaoliangs: A New Group of Grain Sorghums. U. S. Dept. Agr., Bur. Plant Indus. Bul. 253. Paper, 15 cents.
Cereal Experiments in the Texas Panhandle. U. S. Dept. Agr., Bur. Plant Indus. Bul. 283.

BUREAU OF CHEMISTRY BULLETIN.

The Feeding Value of Cereals as Calculated from Chemical Analyses. U. S. Dept. Agr., Bur. Chem. Bul. 120. 10 cents.

YEARBOOK SEPARATE.

The Grain Sorghums: Immigrant Crops That Have Made Good. U. S. Dept. Agr., Yearbook (1913) Separate 625.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1915