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# AGRICULTURAL EXPERIMENT STATION

KANSAS STATE AGRICULTURAL COLLEGE

## GROWING SORGHUM IN KANSAS

MANHATTAN, KANSAS

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## SUMMARY

1. The sorghums are more resistant to heat and drouth than corn. They are, therefore, more profitable in those sections where, because of drouth, hot winds, and shallow soils, corn is not a reliable crop.

2. Sorghum will outyield corn as a forage or silage crop in any part of the state.

3. Sorghum leaves the ground in poor condition for the following crop, and is therefore commonly considered hard on the ground. Pound for pound of material produced, sorghum does not remove more fertility than other crops.

4. Crops that make their growth during the latter part of the growing season should follow sorghum rather than fall or early spring seeded crops like wheat or oats.

5. The varieties of grain sorghum most extensively grown in Kansas are: Blackhull kafir, Pink kafir, Dwarf Blackhull kafir, Dwarf milo, and feterita. Blackhull kafir gives best results with favorable conditions. Pink kafir yields better than the Blackhull variety on poor soils or in unfavorable seasons, or where the growing season is too short for the latter. Dwarf milo and feterita and other early varieties are grown where the season is too short, or the rainfall too deficient, for Pink kafir.

6. The varieties of the sorgos or sweet sorghums most extensively grown in Kansas are: Black Amber, Red Amber, Orange and Sumac. The Red Amber is the best variety for western Kansas. Kansas Orange and an early strain of Sumac are best for eastern Kansas.

7. Three methods of planting the sorghums are employed in Kansas: surface planting, open furrow planting, and listing. Surface planting is best on heavy, poorly drained soils in eastern Kansas. The open furrow method usually gives the best results in eastern Kansas, where drainage is good and rainfall abundant. Listing is practical, and generally the best method in western and central Kansas.

8. Careful preparation of the seedbed for sorghum pays. Cultivation of the ground to kill weeds before the crop is

planted is important, since the sorghums are likely to grow slowly and weeds are often difficult to control.

9. Fall listing for sorghum is good farm practice in western Kansas. The furrows hold the snow and prevent blowing. The ridges may be worked down during the spring or the grain may be planted in the same furrow, depending on conditions.

10. The sorghums should not be planted until the ground is thoroughly warm. Usually they should be planted about ten days later than corn.

11. Rowed sorghum for grain should be seeded at the rate of 4 to 8 pounds per acre, depending on the soil and rainfall. If grown for forage or silage, this amount should be doubled.

12. Sorghum broadcasted or drilled for hay should be seeded at the rate of 1 to 2 bushels per acre. It should be sown later than sorghum for grain.

13. Rowed sorghum should receive as thorough cultivation as corn.

14. The proper stage to harvest rowed sorghum is governed by the purpose for which it is intended. Sorghum for feed should be cut when the grain is in the dough stage. For silage it should be cut when in the hard dough stage, or nearly ripe. For grain, it should be cut when fully mature. For sirup it should be harvested in the dough stage. Sorghum drilled or broadcasted for hay should be cut in the milk or soft dough stage. It makes the best quality of feed when it reaches the proper stage for cutting just before frost.

15. Sorghum cross-fertilizes readily, which almost always results in deterioration. Continual roguing to remove hybrid and foreign heads is necessary to maintain a pure variety. Sorghum seed for home use should be field selected and kept in the head until planting time.

16. Sweet sorghum is utilized to a limited extent in Kansas for sirup production. This industry is increasing.

17. The grain sorghums, kafir, milo and feterita, when properly fed, are but slightly inferior to corn for feeding livestock. They are similar to corn in composition, but are not as palatable, and a smaller percent of the nutrients is digestible. Feeding tests indicate that they have from 85 to 90 percent of the feeding value of corn for fattening hogs and cattle and

from 90 to 95 percent for fattening sheep. The grain sorghums are extensively used for poultry feed. Sweet sorghum and kafir make excellent forage. Sorghum silage is about equal to corn silage.

18. The sorghums are comparatively free from diseases and insect enemies. Kernel smut is the only serious sorghum disease in Kansas. This can be readily controlled by treating the seed with formaldehyde. Chinch bugs, grasshoppers and the kafir ants are the only insect enemies that seriously damage sorghum in Kansas.

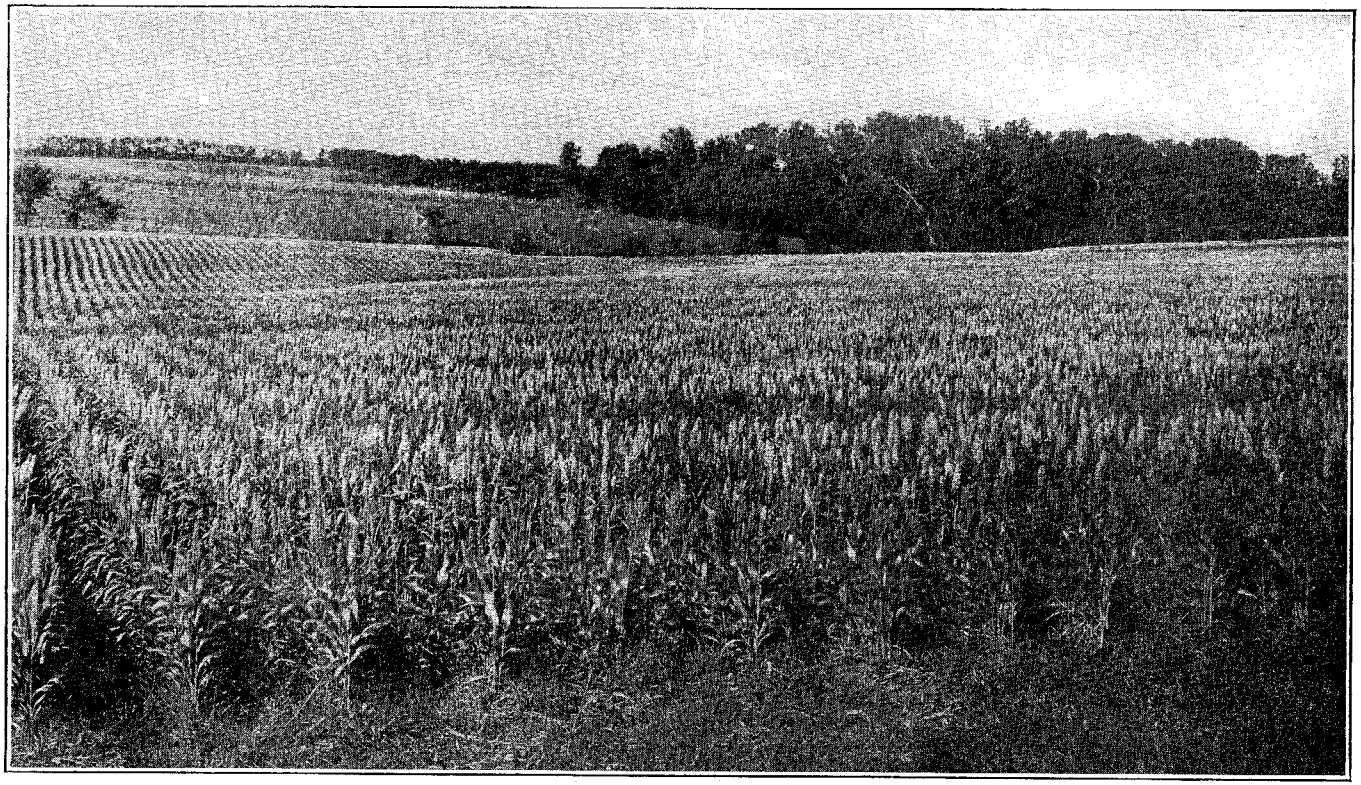

FIG. 1.—A field of Blackhull kafir, College Farm, Manhattan, Kansas

# Growing Sorghum in Kansas

C. C. CUNNINGHAM AND RALPH KENNEY

FROM a crop of comparative insignificance, the sorghums[1] have increased in importance in Kansas until the acreage is more than double that of alfalfa and second only to that of wheat and corn. Careful tests and general farm experience show that the sorghums are more profitable than corn in certain sections of Kansas. There is no doubt but that the substitution of certain varieties for corn on many farms in the drier sections of the state would yield a greater and more certain income. On the other hand, to grow the sorghums without regard to the variety, the climate or the soil would result in loss quite as often as it would increase the profit.

Whether the crop is to be marketed directly, or used for feed, the effect on the following crop and the cost of production in relation to other crops must be considered. This bulletin is intended to give this information as briefly and as clearly as possible. The statements are based on experimental data and the experience of practical farmers in all parts of the state. It is believed that they are as accurate as the present knowledge of sorghum permits.

This bulletin is written for a large area of country. In this area there is a wide variation in soil, rainfall, length of season, temperature, and elevation. Statements applying to one set of conditions do not necessarily apply to others.

## HISTORY

The sorghums have been cultivated since prehistoric times. They were grown in Egypt and southern Asia at the time of our earliest records.

Broom corn, which was brought to America during colonial times, was the first sorghum grown in this country, Sweet sorghum was introduced in 1853, kafir in 1875, and milo probably in 1884 or 1885. Since that time many varieties of sorghum have been obtained from other parts of the world, largely through the United States Department of Agriculture.

1. The term sorghum, as used in this bulletin, includes all plants of the sorghum family, such as kafir, milo, sorgo or sweet sorghum, and feterita.

Sweet sorghum was one of thefirst crops grown in Kansas. In 1880 to 1884 two varieties of grain sorghums, known as white Egyptian corn and brown Egyptian corn, but now called White durra and Brown durra, respectively, were grown some but not extensively. In 1886 kafir was introduced by the Kansas Agricultural Experiment Station and has gradually increased in importance since that time. Milo was not much grown in Kansas before 1900. Among the more recent arrivals is feterita, which first attracted attention during the dry season of 1913, because it produced grain when other crops failed.

The greatly increased importance of these crops in recent years is indicated in Table 1, which shows the average annual acreage and value of sorghum by five-year periods from 1886 to 1916.

Table 1.—*Average annual acreage and value of sorghums in Kansas for five-year periods, 1886 to 1916*

| PERIOD | Acres | Value |
|---|---|---|
| 1886–1890 | 242,137 | $3,657,519 |
| 1891–1895 | 398,037 | 3,748,861 |
| 1896–1900 | 1,004,827 | 8,049,767 |
| 1901–1905 | 1,226,553 | 10,723,209 |
| 1906–1910 | 1,151,910 | 11,608,795 |
| 1911–1915 | 2,130,032 | 23,708,579 |

The average acreage for the five years 1886 to 1890 was 242,137. Ten years later this had increased to over one million acres, where it remained practically stationary until 1910. For the five years 1911 to 1915 there was another large increase, the average for this period being nearly double that of the preceding five-year period.

The acreage could still be greatly increased with profit. It is expected that this will occur when the natural adaptability of the sorghums to Kansas conditions, their varietal adaptations and methods of growing are better understood.

## CORN VERSUS SORGHUMS FOR GRAIN

Most Kansas sorghum competes with corn, Both are cultivated crops, occupy the same place in the rotation, and are used primarily as feed for stock. Which one should be grown

depends largely on their relative productiveness. This varies for different parts of the state.

The sorghums are adapted to somewhat warmer and drier conditions than corn. They are more resistant to heat and drouth and are more profitable on poor soil. They are, therefore, adapted for those portions of Kansas where corn is not a reliable crop because of drouths, hot winds and shallow soil.

The ability of sorghum to grow better than corn where conditions are not favorable is probably due to several characteristics. It has been shown that there are approximately twice as many secondary roots per unit length of primary roots in sorghums as in corn. This produces a more extensive fibrous root system, which probably increases the ability of the plants to absorb moisture from a dry soil. Sorghum will frequently remain dormant during periods of drouth that kill corn, and when rain comes later revive and mature a crop.

Sorghum at first grows more slowly than corn and uses the moisture stored in the soil less rapidly, thereby leaving more of it for maturing the grain. Finally, sorghum uses less water, pound for pound of material produced, than any other grain crop.

On the other hand, the slow growth following germination makes sorghum less productive as a grain crop than corn where the rainfall is ample and the soil fertile. Where the seasons are short corn is often to be preferred, as it can be planted earlier and germination is more certain.

Where the first consideration is to produce a cash crop, corn is sometimes more profitable than sorghum, even where the latter gives slightly larger yields, for the reason that sorghum grains (kafir, milo, etc.) usually sell at a discount on the market as compared with corn. It is usually considered that it costs more to produce an acre of sorghum than an acre of corn, which is important where the yields are nearly the same.

A clearer understanding of the relative value of corn and sorghum can be obtained by a reference to a map of Kansas (Fig. 2), in which the state is roughly divided into five districts based on the relative value of corn and sorghum for grain.

In the northeastern part of the state (Section 1, Fig. 2) corn is usually a more profitable grain crop than sorghum.

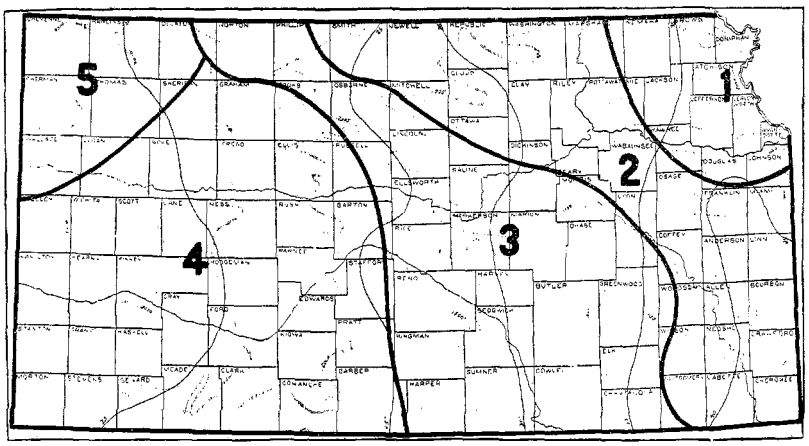


FIG. 2.—Map of Kansas divided into sections according to their adaptability to growing the grain sorghums

The soil and climate of this area are well adapted to corn, and the rainfall is usually sufficient to mature good crops.

Directly west and south of this area (Section 2) corn is the better crop on rich bottom land and on deep, upland soils, but on the infertile, shallow uplands, certain shale types in southeastern Kansas excepted, sorghum produces larger yields and is generally more profitable.

In central Kansas (Section 3) sorghums usually yield more than corn and are more profitable except on the best land.

In all of western Kansas (Section 4) except the northwest corner, and sandy creek and river bottoms, corn will very seldom produce as large yields as the grain sorghums. Sorghum is especially adapted for growing after alfalfa in central and western Kansas. Corn is injured more by drouth when grown after alfalfa because of the rank growth it is likely to make.

In the extreme northwestern corner of the state (Section 5) corn and sorghums are about equal in productiveness and value. The seasons are too short for all but the earliest sorghums, and since corn can be planted earlier than sorghum, it has an advantage that it does not possess farther east and south. Generally speaking, corn is more profitable than sorghum, especially when grown as a cash crop or when grown in a rotation with winter wheat.

## SORGHUM VERSUS CORN FOR SILAGE OR DRY FORAGE

As a silage crop or for dry fodder, sorghum is more productive than corn in all parts of the state, regardless of rainfall, soil, elevation, or length of the growing season. The feeding value is approximately the same as for corn, as will be shown later, hence it is to be preferred whenever the primary object is the production of feed. The relative productiveness of corn, kafir and sweet sorghum (cane) when grown on fertile bottom land with a fairly high rainfall (over 30 inches) is shown by tests conducted at the Agricultural College, at Manhattan, in Riley County. The results are given in Table 11.

Table II.—*Silage yields of sweet sorghum (cane), corn and kafir*

| Variety | Yield, tons per acre | | | | | |
|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1914 | 1915 | 1916 | Average |
| Sweet sorghum | 24.63 | 10.35 | 15.49 | 23.6 | 16.05 | 18.02 |
| Corn | 10.96 | 4.0 | 14.6 | 15.4 | 14.10 | 11.81 |
| Kafir | 15.54 | 5.95 | 8.73 | 16.6 | 12.20 | 11.88 |

It will be seen that the average yield of sweet sorghum was over 18 tons of green feed per acre, or 50 percent greater than the yield of corn or kafir. Kafir gave practically the same yield as corn. On infertile soil and in drier parts of the state kafir is superior to corn, as is shown in Table 111. These results were obtained in tests conducted in cooperation with farmers in many localities in the state.

Table III.—*Silage yields of sweet sorghum (cane), kafir, and corn*

| Crop | Yields per acre—tons | | | |
|---|---|---|---|---|
| | 1914 | 1915 | 1916 | Average |
| Number of tests | 4 | 7 | 8 | ..... |
| Sweet sorghum | 12.6 | 14.2 | 10.3 | 12.3 |
| Kafir | 10.8 | 9.9 | 8.1 | 9.6 |
| Corn | 10.2 | 8.7 | 6.3 | 8.4 |

## EFFECT ON THE SOIL

The sorghums are generally thought to be hard on the land, owing to the fact that low yields of other crops are often obtained from the ground the following year. They are not

more exhaustive of fertility than other crops. Pound for pound, they remove no more plant food, but they do leave the ground in poor condition. They grow so late in the fall that little, if any, available water and plant food are left at the end of the growing season. The effect is apparent in the next crop, but by the second or third year it has disappeared. The soil is not permanently injured any more than would result from growing an equal crop of any other grain.

## SORGHUM IN THE ROTATION

Crops like wheat or oats, which make much of their growth during the fall or early spring, are most likely to suffer when grown after sorghum. Better results are secured if there is an opportunity for the soil to recuperate. Late-planted crops, like corn, cowpeas, soybeans, millet and sweet clover, which make their greatest growth during the latter part of the growing season, should follow sorghum.

Unfortunately but few of these crops are profitably grown in western Kansas where the sorghums are most abundantly produced. In this part of the state, where wheat is the principal crop, it is often good farm practice to plow the sorghum stubble in the spring, leaving it fallow during the summer and seed it to wheat the following fall. This is especially satisfactory where wheat pasture during the winter months is desired. A rotation of wheat, 2 or 3 years, sorghum (kafir, milo or feterita), 1 or 2 years, and summer fallow 1 year is probably the most satisfactory way in which to include sorghum in the rotation in western Kansas. If desired, corn or sorghum planted in wide-spaced rows, 7 feet apart, may be substituted for the summer fallow.

## THE KIND OF SORGHUM TO GROW

Sorghum varies more than any other crop in the type and character of the plants, and in the purposes for which it is used, Four distinct groups of sorghums are usually recognized. They are (1) the grain sorghums, (2) sorghums for forage or sirup, (3) sorghums for hay, and (4) broom corn. The first two groups only are discussed in this bulletin. The

principal varieties of these groups are indicated in the following outline:

1. Grain sorghums (those grown primarily for grain)
   - A. Kafir
     1. Blackhull kafir
     2. Pink kafir
     3. Dwarf Blackhull kafir
     4. Red kafir
     5. White kafir
   - B. Milo
     1. Standard Yellow milo
     2. Dwarf Yellow milo
     3. White milo
   - C. Feterita
   - D. Freed sorghum
   - E. Koaliang
   - F. Jerusalem corn
   - G. Brown durra
   - H. Shallu
2. Sorgo or sweet sorghum (those used for forage and sirup)
   - A. Red Amber
   - B. Black Amber
   - C. Orange
   - D. Sumac
   - E. Western Orange, Coleman, Goose Neck, Collier, McLean, etc.

## THE GRAIN SORGHUMS

The grain sorghums include all those varieties that are grown primarily for their grain. The most important in Kansas are Blackhull, Dwarf Blackhull and Pink kafir, Dwarf

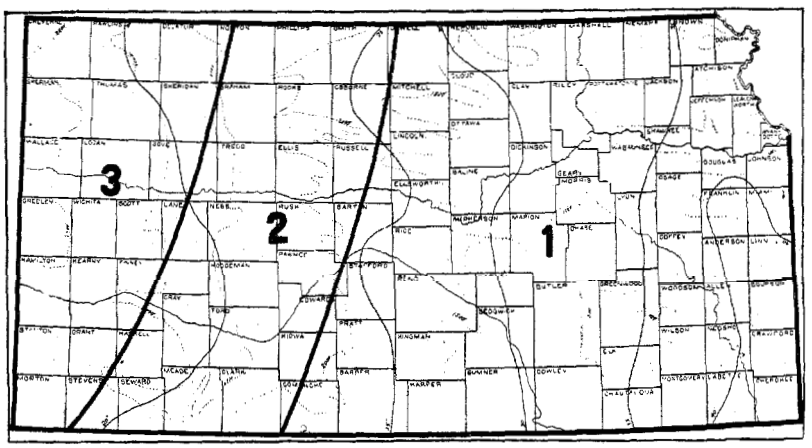


FIG. 3.—Map of Kansas, showing sections adapted for growing late (1), medium (2), and early (3) varieties of sorghum

milo, and feterita. Other varieties less extensively grown are Red, White and African kafir, Standard milo, Jerusalem corn, Brown durra, Koaliang and Shallu. Freed sorghum, though sometimes classed with the sweet sorghums, is frequently grown for its grain.

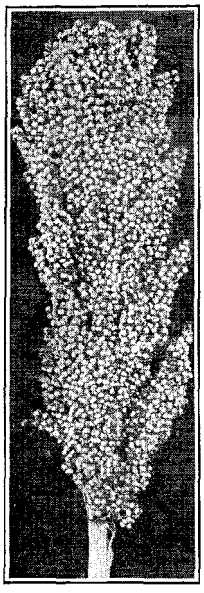

FIG. 4.—Blackhull kafir

BLACKHULL KAFIR.—BlackhulI kafir is grown more extensively than any other variety, and it will usually outyield other grain sorghum in eastern and central Kansas as far west as Jewell, Mitchell, Russell, Barton, Stafford, and Comanche counties (Section 1, Fig. 3). It ripens in from 110 to 120 days from planting time, but usually matures too late for western Kansas. On poor soils earlier varieties frequently give better yields.

Blackhull kafir plants are stout, rather leafy, and grow from 5 to 8 feet high, depending on the soil, locality, and season. The heads are club shaped and 10 to 14 inches long when fully developed. The seeds are white with pink to purple spots on the tip. The glumes or hulls are black, hence the name Blackhull White kafir, or more commonly, Blackhull kafir.

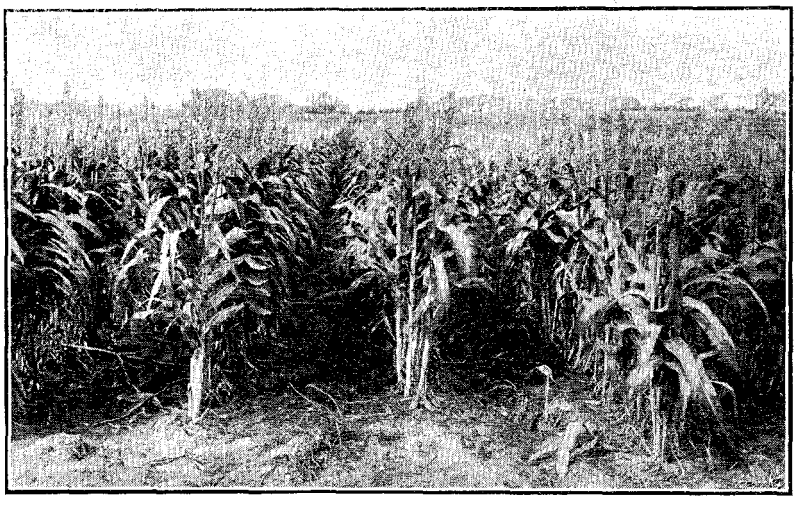

FIG. 5.—Blackhull kafir in the field

PINK KAFIR.—Pink kafir matures from one to two weeks earlier than the Blackhull kafir. Consequently it is adapted to shorter seasons and drier conditions. It appears to grow better than other varieties if cool weather prevails during the early stages of growth. It is well adapted for growing in the area from Smith, Phillips and Norton counties south and west to Clark, Meade, Seward and Stevens counties (Section 2, Fig. 3). Pink kafir is also better than Blackhull on poor soil in central and eastern Kansas.

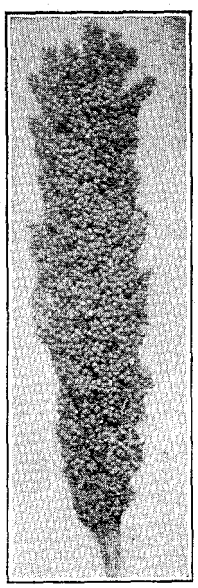

FIG. 6.—Pink kafir

Pink kafir plants grow to a height of four to seven feet. They are more slender than the Blackhull kafir, the heads are longer and not so heavy or compact, the seeds are tinged with pink and the seed hulls are pink, being intermediate in color between those of the white- and red-seeded varieties. It shatters more readily than the Blackhull variety, and if the stand is thin the heads are likely not to be fully extended from the boot.

The Pink kafir now grown in western Kansas was developed at the Hays Branch Experiment Station from a mixed lot obtained for Mr. Wm. Rockefeller, of Russell County. Mr. Rockefeller's seed came from kafir probably introduced into Russell County in 1905 by the United States Department of Agriculture.

DWARF BLACKHULL KAFIR.—Dwarf Blackhull kafir was selected by the United States Department of Agriculture from an early-maturing strain of the Standard Blackhull variety. It is similar to Blackhull kafir but smaller, being only about four feet in height. With favorable conditions it will ripen in about one hundred days, and for that reason it is a valuable crop for western Kansas, or wherever the season is too short to ripen the later-maturing Pink and Blackhull varieties. It is inferior to these varieties as a forage crop because of its small size. It is grown in Graham, Trego, Gove and Lane counties and the counties south and west to the southwestern

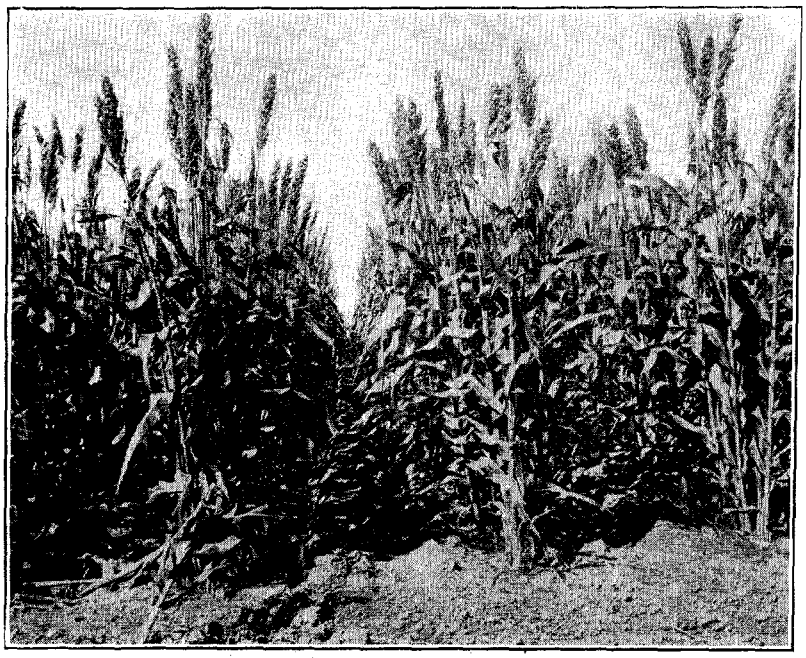

FIG. 7.—Blackhull kafir

part of the state (western part of Section 2 and eastern edge of Section 3, Fig. 3).

RED KAFIR.—This variety differs from the Blackhull kafir in that the head is longer and more slender and the seeds are

FIG. 8.—Dwarf Blackhull kafir

red. It was formerly grown quite extensively in central and western Kansas. It does not yield as well as the Pink or Blackhull kafir where these varieties are well adapted. At present it is not grown extensively.

WHITE KAFIR.—White kafir was the first grain sorghum grown in Kansas, but it was soon superseded by the Blackhull and Red varieties. The heads of this variety are more slender and the plants not so leafy and tall as in the case of Blackhull kafir. The seed hulls are white instead of black. White kafir is inferior to the Blackhull, Pink and Dwarf varieties.

FIG. 9.—Red kafir

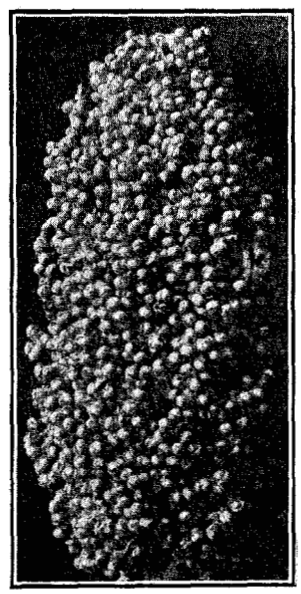

FIG. 10.—Dwarf milo

AFRICAN KAFIR.—Two strains of kafir were recently brought from Africa, one in 1913 and one in 1914. They are known as African kafir. Both strains proved to be very uneven in size, type and maturity, and much inferior to other varieties in yield of grain. They are not extensively grown and appear to have no place in the agriculture of the state.

MILO.—Milo is distinguished from the other sorghums by the compact, ovate heads and the large, somewhat flattened seeds. The heads are usually recurved or "goose-necked," especially if the stand is thin or in seasons of heavy rainfall.

The stalks are stout, rather pithy, and scantily supplied with leaves as compared with kafir. It is inferior to kafir for forage, but because of its earliness it is extensively grown for grain when the seasons are too short for kafir. Chinch bugs prefer milo to most of the other grain sorghums, hence it is usually not profitable where these insects are numerous. Milo is apparently immune to kernel smut.

Three varieties of milo are grown in Kansas, viz., Dwarf milo, Standard milo, and White milo. Dwarf milo is the only one extensively grown.

Dwarf milo matures in from 90 to 100 days and is well adapted for growing where drouth is frequent and severe. Where the production of grain is the first consideration, Dwarf milo is the best crop to grow in the western third of the state, except in the extreme northwestern corner, where it can not be depended upon to mature grain in unfavorable seasons. It is especially adapted to the southwestern part of the state, *i. e.,* from Ness to Clark counties west and from Ness to Greeley counties south. Where both grain and forage are desired, kafir is better than milo for all but the extreme western part of the state (Section 3, Fig. 3).

FIG. 11.—Dwarf milo in the field

White milo is similar to Dwarf milo in size, time required to mature, and leafiness: The only difference of importance is the color of the grain, which is white as contrasted with the

yellow grain of the Dwarf milo. Its area of growth and adaptation is the same as that of Dwarf milo.

Standard milo is similar to Dwarf milo except in size. It grows from 2 to 3 feet taller. Standard milo has practically been superseded by the Dwarf variety.

FETERITA.—Feterita is an early grain sorghum belonging to the durra group. It will ripen in from 80 to 95 days, maturing a few days earlier than the Dwarf milo. It was obtained in 1906 from Sudan, Africa, a hot, dry country south of the

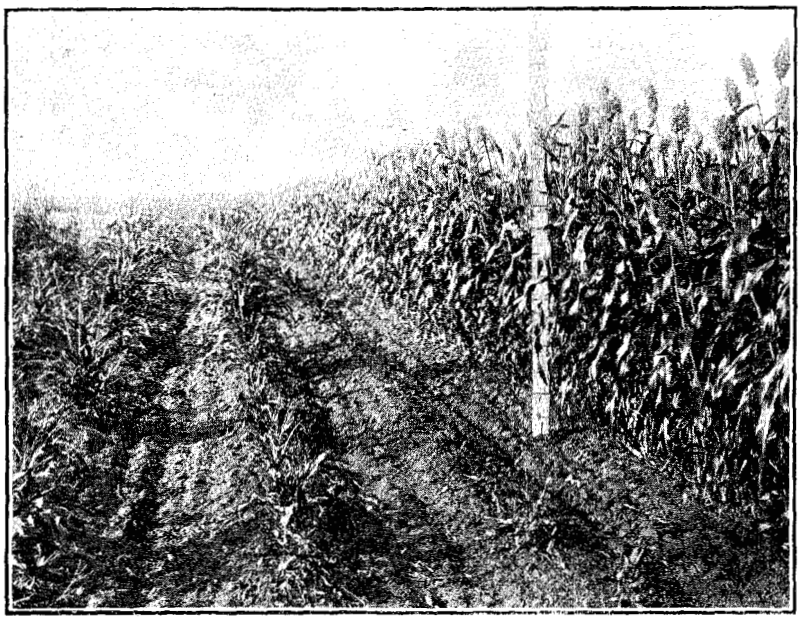

FIG. 12.—Milo at the left, feterita at the right. (Chinch bugs have destroyed the milo, while they have injured the feterita very little)

Sahara desert. It will survive more heat and drouth than most other sorghums. It is adapted to practically the same area as Dwarf milo, being superior to that variety when drouth is exceptionally severe.

Chinch bugs do not damage feterita as readily as milo, and consequently it is a better crop to grow where these pests are numerous. Because of its early maturity, feterita is of value as a catch crop to grow after wheat and oats on good soil in southeastern Kansas.

Feterita heads and grain resemble milo in size and shape. The heads are longer, generally more pointed at the tip end, and grow erect. The seeds are softer, larger, slightly more flattened than milo, and have a bluish-white color. The seed shatters readily after the crop matures, and the plants are likely to blow down. The stems are slender, rather dry and slightly sweet. There are few leaves, hence it is inferior to most sorghums as a forage crop.

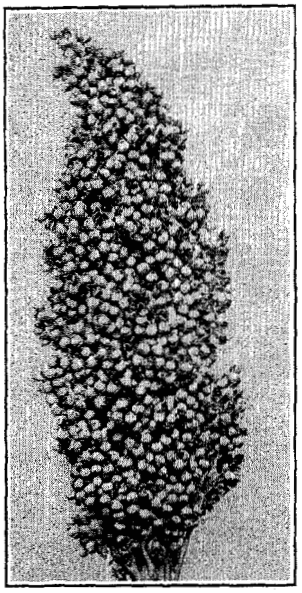

FIG. 13.—Feterita

FIG. 14.—Freed sorghum

When conditions for growth are favorable, as on a rich soil and with a high rainfall, feterita branches and suckers considerably. The suckers and side branches often produce heads which mature much later than those on the main stalk, causing unevenness in ripening, which is very objectionable. It is often difficult to obtain good stands of feterita because of the soft seed which absorb water and rot quickly if the ground is not warm enough to cause germination. For this reason feterita should not be planted until the ground is thoroughly warm.

FREED SORGHUM.—Freed sorghum is named for Mr. J. K. Freed, of Scott City, Kan., on whose farm it was first grown.

FIG. 15.—Freed sorghum in the field

Its origin further than this is unknown. It is intermediate between grain and sweet sorghums. It resembles the amber sorghums in appearance of stems, leaves and heads, but differs from them in that the stems are not as juicy and only slightly sweet. Unlike the sweet sorghums, the seeds do not contain tannin, and hence are good feed for stock. The plants grow from 3½ to 7 feet in height. The seeds are plumper and somewhat more flattened than those of the amber varieties, but are not so long. They have a chalky white color. The seed hulls are yellowish white and nearly inclose the seed.

Freed sorghum matures in from 70 to 90 days. It is well adapted for short seasons and for late planting. It is a dependable grain sorghum in the extreme western part of the state (Section 3, Fig. 3). In central Kansas this variety can be planted the middle of July and still mature seed before frost if growing conditions are favorable.

OTHER VARIETIES.—Other grain sorghums, such as Koaliang, Shallu, Jerusalem corn and Brown durra, are of little economic importance in Kansas, Koaliang, of which there are several varieties, was introduced from Manchuria. The plants are slender and have few leaves. They mature early, thrive fairly well in cool seasons, and can be grown farther north than the other grain sorghums.

Shallu is a grain sorghum which has often been exploited by seedsmen. It has been sold under the name of Egyptian wheat, California wheat, California Rice corn, Chicken corn, Chinese Golden sorghum, Mexican wheat and Rice corn. Shallu grows tall, has pithy stalks and narrow leaves. The head is long and very open, with drooping branches. The center stem is as long as the head. The seed is cream white and similar to Freed sorghum in shape. The seed shatters readily and the stalks do not stand up well after the grain is ripe. Shallu produces fair yields, but is not as good as kafir for eastern and central Kansas, and is much inferior to milo for western Kansas.

Jerusalem corn and Brown durra are early, small-growing, recurved or "goose-necked" sorghums. The plants are somewhat similar to those of milo, but are less leafy, while the heads are not as compact and are somewhat flattened in shape. The seeds are more flattened than those of milo, but are otherwise similar, except in color. Jerusalem corn and Brown durra differ only in that the grain of the former is white, while that of the latter is brown.

## VARIETY TESTS OF THE GRAIN SORGHUMS

Tests of the different varieties of sorghums have been conducted at the Kansas Agricultural Experiment Stations since 1905, to determine their relative value. During this twelve-year period, 1905-1916, inclusive, twenty varieties and strains of kafir and twelve of durra have been tested. Many of these proved worthless and were discontinued. Table IV gives the yield of grain and stover for each year. Only varieties that have been grown for 3 years or more are included.

Similar tests have also been conducted in cooperation with farmers in various parts of the state. The results of these tests are given in Table V.

Table IV.—*Variety tests of grain sorghums, Manhattan, Kansas*

| Variety | Yield per acre | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1905 | | 1906 | | 1907 | | 1908 | | 1909 | | 1910 | | 1914 | | 1915 | | 1916 | |
| | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. |
| Blackhull kafir | 68.8 | 12,684 | 61.4 | 14,066 | 47.5 | 12,348 | 46.8 | 10,120 | 42.6 | 10,504 | 49.0 | 13,500 | ..... | 6,620 | 54.4 | 19,480 | 45.1 | 10,555 |
| Red kafir | 63.9 | 14,568 | 56.5 | 12,140 | 45.1 | 12,193 | 46.7 | 8,948 | 29.8 | 8,732 | 45.0 | 10,115 | 22.5 | 4,880 | ..... | ..... | 23.8 | 8,000 |
| Pink kafir | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 44.6 | 10,710 | 27.3 | 5,560 | 23.1 | 10,680 | 43.0 | 7,389 |
| Standard milo | 62.9 | 12,042 | 54.3 | 11,940 | 35.7 | 9,105 | ..... | ..... | 52.8 | 10,097 | 44.6 | 10,710 | 27.3 | 5,560 | 23.1 | 10,680 | 43.0 | 7,389 |
| Dwarf milo | 48.8 | 10,895 | 54.3 | 13,800 | 39.2 | 11,475 | 36.4 | ..... | 62.8 | 15,214 | 33.3 | 7,810 | 22.5 | 5,320 | 14.7 | 9,740 | 50.8 | 6,962 |
| Jerusalem corn | 46.4 | 6,264 | 26.7 | 4,860 | 37.4 | 6,736 | 9.3 | 3,191 | 10.2 | 4,037 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Brown durra | 51.4 | 8,307 | 38.5 | 10,560 | 32.7 | 9,605 | 19.3 | 12,034 | ..... | ..... | ..... | ..... | ..... | ..... | 21.6 | 6,860 | ..... | ..... |
| Freed sorghum | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 39.1 | 9,060 | 34.7 | 7,560 | 13.8 | 4,800 |
| Feterita | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 29.8 | 7,600 | 25.4 | 10,780 | 12.04 | 19,210 |

Table V.—*Variety tests of grain sorghums*

| Variety | Average yield per acre in bushels | | | | | |
|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1914 | 1915 | 1916 | Average |
| Eastern and Central Kansas (Section 1, Fig. 3) | | | | | | |
| *Number of tests* | 1 | | 9 | 7 | 3 | |
| Blackhull kafir | 27.2 | ..... | 22.4 | 43.9 | 21.5 | 28.8 |
| Pink kafir | 18.7 | ..... | 24.2 | 37.4 | 28.1 | 27.1 |
| Dwarf milo | 18.7 | ..... | 21.7 | 27.6 | 31.1 | 24.8 |
| Feterita | 12.5 | ..... | 21.3 | 23.9 | 19.2 | 19.2 |
| West Central Kansas (Section 2, Fig. 3) | | | | | | |
| *Number of tests* | 3 | | 8 | 5 | 3 | |
| Blackhull kafir | 14.7 | ..... | 22.3 | 16.4 | 0.0 | 13.4 |
| Pink kafir | 19.4 | ..... | 23.6 | 23.6 | 0.4 | 16.8 |
| Dwarf milo | 18.1 | ..... | 25.5 | 23.5 | 5.3 | 18.1 |
| Feterita | ..... | ..... | 23.5 | 16.6 | 7.7 | ..... |
| Extreme Western Kansas (Section 3, Fig. 3) | | | | | | |
| *Number of tests* | 2 | 2 | 5 | 2 | 4 | |
| Blackhull kafir | 0.0 | 5.0 | 5.6 | 10.6 | 0.0 | 4.2 |
| Pink kafir | 0.0 | 5.0 | 9.3 | 13.3 | 0.0 | 5.5 |
| Dwarf milo | 22.5 | 5.5 | 26.1 | 13.8 | 9.4 | 15.5 |
| Feterita | ..... | 10.0 | 23.1 | 13.1 | 3.0 | ..... |

The results agree with the statements already given concerning the relative value of different varieties for different parts of the state.

Blackhull kafir proved the best yielder where the conditions were favorable. In dry seasons and in the western part of the state Pink kafir and milo were more productive. In the extreme western part of the state Dwarf milo gave decidedly the best yields. Feterita proved superior to the other varieties in only one season, which was the very dry one of 1968. Usually it was inferior to milo.

Freed sorghum was included in some of the tests conducted in the western one-fourth of the state, but is not reported in the tables. In 26 tests, conducted during 5 years, it produced an average yield of 14.2 bushels, as compared with 11.5 bushels formilo. Because of its earliness, the Freed sorghum often produced grain when the later-maturing varieties failed. For

this reason it is of value for growing in the western one-fourth of the state.

The low average yield for feterita is partly due to the poor stands secured in 1916. This was because of the cold, unfavorable weather during the spring.

## SORGOS OR SWEET SORGHUMS

The sorgos, or sweet sorghums as they are commonly called, differ from the grain sorghums principally in having sweet, juicy stems, and seed which when ripe contain considerable quantities of tannin. The latter makes them undesirable for feed. The plants are usually more leafy than the grain sorghums. They are grown principally for silage and to a limited extent for sirup. There are numerous varieties which differ greatly in the length of the periods required for maturing, productiveness, and value for feed.

BLACK AMBER SORGO.—Black Amber sorgo was one of the first varieties grown in Kansas and is still extensively grown where less-known varieties are more productive. It will mature in from 80 to 100 days, and is especially adapted to states north of Kansas where early maturity is of first importance.

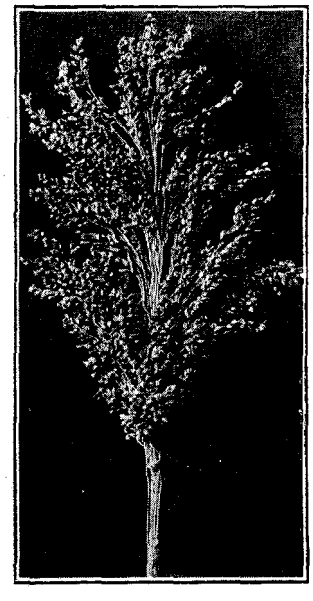

FIG. 16.—Red Amber sorgo

Black Amber sorgo is characterized by slender stalks, few narrow leaves, and open branched heads. The heads vary in size and shape, but are always loose and open, bent over a little at the tip. The branches droop. The seeds are elliptical in shape, yellowish brown in color, and nearly inclosed by large, pointed black hulls. Black Amber sorgo does not yield as well as other varieties where conditions are favorable, and should be grown extensively only where early maturity is of first importance. In central and eastern Kansas it is grown for early feed and as a catch crop.

FIG. 17.—A field of Red Amber sorgo

RED AMBER SORGO.—This is a comparatively new variety brought from Australia. It differs from Black Amber mainly in having red seed hulls, being more leafy, sweeter, and maturing somewhat later. It is superior to Black Amber wherever it will mature, and its culture in western Kansas is rapidly increasing. It is probably the best sorgo for western Kansas (Sections 2 and 3, Fig. 3), where the production of forage and seed is desired. It is not as reliable as Black Amber in the northwestern part of the state for seed production.

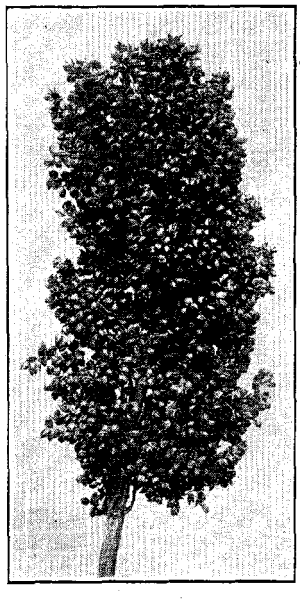

FIG. 18.—Kansas Orange sorgo

ORANGE SORGO.—Orange sorgo is especially adapted to the eastern and central parts of the state (Section 1, Fig. 2), and is suitable in this area for forage, silage, seed, and sirup. An improved strain, known as the Kansas Orange, is grown more extensively in Kansas than any other sorgo. It

matures too late for seed in the western part of the state (Sections 2 and 3, Fig. 3), but is entirely satisfactory for forage alone. It requires from 100 to 110 days to mature.

WESTERN ORANGE.—An early-maturing strain of Orange. known as Western Orange, is grown to some extent in western Kansas. It is not equal to the Red Amber as a forage crop in that section, but is better for seed production and for sirup. It is adapted to the same area as the Red Amber.

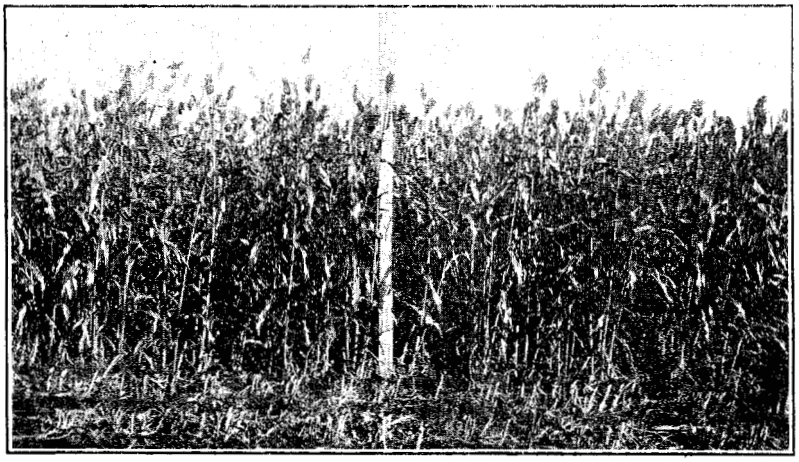

FIG. 10.—Kansas Orange sorgo in the field

SUMAC SORGO.—Sumac sorgo, also known as Redtop or Redhead, because of the characteristic red color of the heads, is a large, late-maturing variety, requiring from 115 to 125 days to ripen. The plants are stocky, very leafy, and sweet. The heads are very compact and the hulls and seeds are dark red in color. The seeds are nearly round and smaller than those of the other sorgos. Sumac sorgo is grown to a limited extent in the southern part of the state as far west as Comanche County, and is an excellent variety for this section. This variety matures too late for other parts of the state.

An early strain of Sumac has been developed which is about equal to Orange in value and is adapted to the same territory.

OTHER VARIETIES.—Numerous other varieties of sorgos are grown in Kansas. Among these are Planter, Sourless, Honey, and Gooseneck or Texas Ribbon cane. The Planter and Sourless are similar to Kansas Orange. They are less sweet than

the latter variety and have a popular reputation for being less likely to sour than the other sorgos.

The Honey and Gooseneck are large, leafy, sweet varieties, adapted to the production of sirup and forage, but mature too late for any but fertile soil in the southeastern part of the state. Because of their size they produce heavy yields of forage when the season is long enough for them to mature.

### VARIETY TESTS OF SORGHUMS FOR FORAGE AND SILAGE

Tests to determine the relative values of the different varieties of sorghum for forage and silage have been conducted at the Experiment Station at Manhattan and in coöperation with farmers in different parts of the state. The results are given in Tables VI and VII.

Table VI.—*Variety tests of sweet sorghums, Manhattan, Kansas*

| Variety | Yield per acre | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1905 | | 1906 | | 1907 | | 1908 | | 1909 | | 1910 | | 1914 | | 1915 | | 1916 | |
| | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. |
| Kansas Orange | 45.5 | 20,220 | 37.1 | 17,580 | ..... | 18,523 | 28.5 | 20,546 | 51.3 | 27,129 | 38.2 | 22,100 | ..... | 15,760 | 21.4 | 27,600 | 23.0 | 8,539 |
| Sumac | 25.4 | 14,200 | 23.5 | 17,640 | ..... | ..... | ..... | ..... | 49.9 | 23,502 | 40.2 | 19,150 | 20.5 | 15,640 | 4.9 | 18,720 | 21.0 | 9,896 |
| Amber | 22.6 | 17,800 | 36.6 | 16,900 | 24.3 | 15,996 | 19.2 | 18,135 | 41.3 | 15,825 | 34.3 | 18,020 | 30.8 | 10,060 | 20.2 | 13,040 | 42.5 | 18,907 |
| Coleman | 27.8 | 17,320 | ..... | ..... | 33.0 | 18,086 | 32.3 | 20,193 | 36.0 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 21.0 | 15,251 |
| Planter | ..... | ..... | ..... | ..... | 28.4 | 15,280 | 20.9 | 10,008 | 46.6 | 18,150 | 58.8 | 18,750 | ..... | ..... | 21.0 | 15,120 | ..... | ..... |
| Texas Honey | ..... | ..... | ..... | ..... | ..... | ..... | 45.4 | 22,685 | 32.9 | 15,437 | 38.0 | 26,000 | ..... | ..... | ..... | ..... | ..... | ..... |

Table VII. *Variety tests of sorghum for forage*

| Variety | Average yield of stover in pounds per acre | | | | |
|---|---|---|---|---|---|
| | 1912 | 1914 | 1915 | 1916 | Average |
| **Eastern and Central Kansas (Section 1, Fig. 3)** | | | | | |
| *Number of tests* | *1* | *3* | *3* | *5* | |
| Orange or Sumac | 7,100 | 13,437 | 12,172 | 9,564 | 10,568 |
| Blackhull kafir | 3,140 | 6,969 | 10,506 | 62,002 | 6,704 |
| Pink kafir | 2,240 | 5,028 | 9,387 | 6,050 | 5,541 |
| Dwarf milo | 1,040 | 4,741 | 6,818 | 4,024 | 4,156 |
| Feterita | 1,700 | 5,108 | 7,341 | 4,412 | 4,640 |
| **West Central Kansas (Section 2, Fig. 3)** | | | | | |
| *Number of tests* | | *6* | *4* | *2* | |
| Red Amber | | 7,644 | 7,590 | 7,070 | 7,435 |
| Blackhull kafir | | 5,758 | 5,782 | 3,900 | 5,143 |
| Pink kafir | | 5,035 | 6,226 | 4,730 | 5,330 |
| Dwarf milo | | 4,422 | 5,005 | 2,520 | 3,982 |
| Feterita | | 5,274 | 4,799 | 3,410 | 4,494 |
| Freed sorghum | | | 5,976 | | |
| **Extreme Western Kansas (Section 3, Fig. 3)** | | | | | |
| *Number of tests* | *1* | *3* | *2* | *3* | |
| Red Amber | 5,500 | 3,307 | 9,830 | 3,600 | 5,559 |
| Blackhull kafir | 1,500 | 4,555 | 10,385 | 2,400 | 4,710 |
| Pink kafir | 4,000 | 4,440 | 10,910 | 3,200 | 5,387 |
| Dwarf milo | 2,200 | 3,366 | 6,225 | 1,453 | 3,811 |
| Feterita | 2,200 | 2,488 | 4,250 | 1,600 | 2,634 |
| Freed sorghum | 2,000 | 2,364 | 2,930 | 1,307 | 2,150 |

These data emphasize the value of the sweet sorghums or sorgos for forage, as already pointed out. In central and eastern Kansas sweet sorghum has produced decidedly larger yields of stover (*i.e.,* fodder alone) than kafir, milo, or feterita. The average yield at Manhattan is over 50 percent greater for the sweet sorghums, and an equally great increase was secured in cooperative tests with the farmers. In western Kansas better yields of forage were secured from adapted varieties of sweet sorghum than from any of the grain sorghums, except Pink kafir, and the yields of this variety and Red Amber sorgo were practically the same. The Red Amber

appears to be decidedly superior to milo or feterita in yields and produces a much better quality of feed.

The relative value of different sorghums for silage has been determined in tests in cooperation with the farmers. The results are given in Table VIII.

Table VIII.—*Variety tests of sorghum for silage*

| Variety | Average yield per acre in pounds | | | |
|---|---|---|---|---|
| | 1914 | 1915 | 1916 | Average |
| Eastern and Central Kansas (Section 1, Fig. 3) | | | | |
| *Number of tests* | 8 | 3 | 3 | |
| Sweet sorghum | 22,207 | 24,768 | 17,287 | 21,420 |
| Blackhull kafir | 16,255 | 16,756 | 11,800 | 14,937 |
| Pink kafir | 13,766 | 14,588 | 8,400 | 12,251 |
| West Central Kansas (Section 2, Fig. 3) | | | | |
| *Number of tests* | 2 | 1 | | |
| Sweet sorghum | 15,945 | 11,140 | ..... | 13,542 |
| Blackhull kafir | 16,065 | 8,080 | ..... | 12,073 |
| Pink kafir | 12,333 | 7,220 | ..... | 9,775 |

As would be expected, sweet sorghum has proved decidedly more productive than either Blackhull or Pink kafir. Its superior yield as compared with corn has already been pointed out.[1]

## GROWING SORGHUM

The method of growing sorghum differs with the locality, kind of soil and the purpose for which the crop is produced. Sorghum sowed in rows for grain, forage or silage is handled in practically the same way as corn. If sowed for hay it is grown and handled like small grains or millet.

Listing.—There are two methods of growing sorghum in rows, namely, surface planting and listing. Listing is the best method where the rainfall is light and on medium or light soils. It is used almost exclusively in the western part of the state. For most of this area listing has many advantages over surface planting. It is cheaper, as the ground is not plowed before planting. Cultivation is easier and less expensive and

1. See sorghum vs. corn for silage or dry forage, page 11.

a larger acreage can be handled. Where high winds prevail during the spring the ridges greatly protect the plants, especially if the rows run east and west. Listed sorghum stands dry weather better and will give better yields where moisture is deficient during the latter part of the growing season. On the other hand, listed sorghum does not germinate as well as that which is surface planted. Since stands of sorghum are at best difficult to obtain, this advantage is important. There is more danger of plants being washed out or covered by heavy, dashing rains in listed furrows, or drowned out if the fields are level. For this reason listing is not a good practice for eastern Kansas.

SURFACE PLANTING—On wet, heavy soils, and in localities where the rainfallis abundant, surface planting is better than listing. In those parts of the state where the annual precipitation is more than 30 inches the sorghums can usually be grown to the best advantage by this method. They germinate better and make a more rapid, vigorous growth during the early part of the season, and there is less danger of the young plants being destroyed by heavy, dashing rains. The plowing which is necessary for surface planting puts the soil in better condition than listing, which is important where the rainfall is heavy.

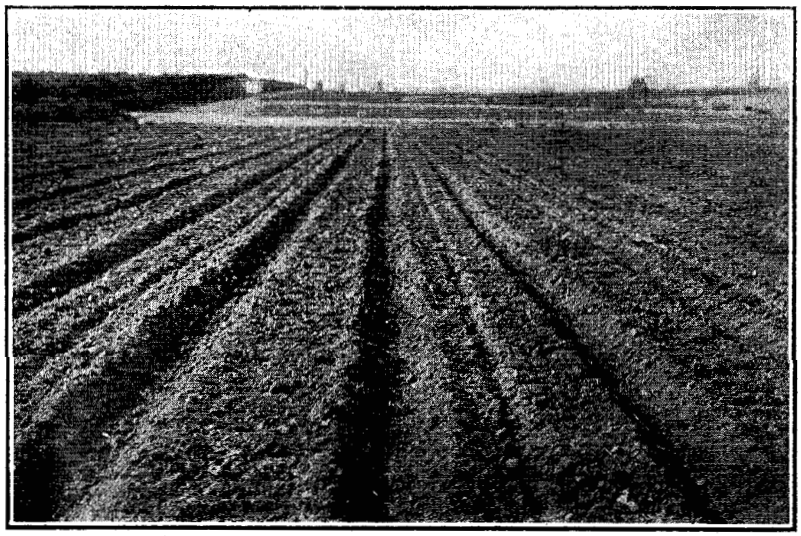

FIG. 20.—Sorghum planted with furrow openers attached to the planter. (This is the best method of seeding sorghum in eastern Kansas)

FURROW OPENERS.—Another method of planting, known as the "furrow-opener" method, is used to some extent in eastern Kansas. It is a modification of surface planting that is well adapted for growing sorghum. It consists of seeding in rather shallow furrows made by two disks set on either side of the planter shoe. This is a superior method for sorghum because it may be cultivated more easily; the spike-tooth harrow can be used without injury to the young plants, and weeds in the row can be covered more readily by early cultivation.

PREPARATION OF THE GROUND.—Since sorghum will grow, better than most crops with poor methods, it is often the most neglected crop on the farm. However, good methods usually pay as well as with other crops.

The preparation of the ground for sorghum varies with the soil, the preceding crop, the precipitation, the seasonal conditions and the method of planting employed.

PREPARING THE LAND FOR LISTED SORGHUM.—No general rule for preparing the ground for listed sorghum that will fit all cases can be given. The usual method, though probably not the most profitable, is to plant with no preparation whatever. Listing the ground in the fall or early spring, or disking in the early spring, usually pays. The best practice will depend mainly on the kind of soil and the seasonal conditione.

An experiment to show the best method of preparing the ground for kafir was begun at the Fort Hays Branch Experiment Station at Hays, Kan., in 1914, and seven methods are compared. The results for 1914, 1915 and 1916 are given in Table IX.

The best yields of grain and stover have been obtained from fall listing and the lowest yields when there was no preparation previous to planting. There was no difference whether the ridges were split at planting time or the grain planted in the old furrows (Plots 3 and 4, Table IX). Working the ridges down after fall listing reduced the yield somewhat (Plot 2), as did also disking the ground before it was planted in the fall (Plot 1). Harrowing the fall-listed ground early in

1. This work was conducted in coöperation with Office of Dry-land Investigations, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

Table IX.—*Results from a seedbed preparation test for kafir, Fort Hays Experiment Station*

| Plot | Method of preparation | 1914 | | 1915 | | 1916 | | Average | |
|---|---|---|---|---|---|---|---|---|---|
| | | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. | Grain, bu. | Stover, lbs. |
| 1. | Double disked July or August, fall listed, listed at planting time | 6.4 | 4,795 | 46.8 | 7,140 | 11.4 | 7,225 | 21.5 | 6,387 |
| 2. | Fall listed, ridges worked down, listed at planting time | 5.9 | 4,795 | 52.2 | 7,520 | 14.7 | 7,460 | 24.3 | 6,593 |
| 3. | Fall listed, harrowed in spring, ridges split at planting time | 5.8 | 5,800 | 50.3 | 7,750 | 21.3 | 8,155 | 25.8 | 7,235 |
| 4. | Fall listed, harrowed in spring, listed in same furrows at planting time | 6.5 | 4,705 | 53.8 | 7,690 | 17.0 | 6,505 | 25.8 | 6,300 |
| 5. | Fall listed, ridges split at planting time | 6.9 | 5,335 | 37.5 | 7,005 | 14.6 | 7,275 | 19.7 | 6,555 |
| 6. | Early spring listed, planted in furrows | 8.1 | 4,395 | 42.6 | 6,670 | 11.3 | 7,115 | 21.0 | 6,060 |
| 7. | Spring disked, listed at planting time | 4.8 | 4,590 | 32.6 | 5,210 | 8.5 | 7,230 | 15.3 | 5,677 |
| 8. | Listed at planting time | 4.6 | 4,175 | 32.4 | 5,560 | 2.8 | 6,815 | 13.3 | 5,513 |

the spring, however, proved decidedly beneficial, as shown by Plots 3 and 5.

Listing early in the spring gave considerably better yields than no preparation previous to planting, but much less than fall listing. Disking early in the spring proved slightly better than no preparation, but not as good as listing early in the spring or in the fall.

In general the results agree with farm practice. Fall listing is usually best because it prevents soil blowing, keeps the snow on the field, and increases the amount of moisture absorbed by the soil. It is better to list east and west, because the ridges then provide more effective protection from the prevailing north and south winds. Listing may be done in the fall, early winter or early spring. As a rule, the earlier it is done the better.

Whether one should list in the old furrows or split the ridges appears to depend on conditions at the time the grain is planted. If the ground, especially the subsoil, is moist, and the weeds abundant, splitting the ridges is likely to give the best results. If the ground is dry, or moist near the surface only, listing in the old furrows is preferable, since splitting of the ridges results in a considerable loss of moisture from the soil.

FIG. 21.—Contour-listed, sloping land in western Kansas. (Note how the furrows prevent the snow from drifting off the field)

Disking early in the spring usually pays if the ground has not been listed. Disking cuts up the stubble and trash and works it into the soil. It kills weeds that have started and puts the soil in excellent condition to absorb moisture.

The best time to disk depends on a number of conditions. If alternate thawing and freezing has left the soil loose on top, very early disking is not necessary and probably not advisable. It should be delayed until weeds have started. However, if the surface is badly crusted from melting snow or heavy rains, disking as early as the condition of the ground will permit is advisable.

DEPTH TO LIST.—Listing for sorghum should always be shallower than for corn in the same section. Deep listing usually results in poor germination and slow early growth. It also increases the danger of damage from early rains.

PREPARING THE GROUND FOR SURFACE-PLANTED SORGHUM.—The preparation of the ground for surface-planted sorghum is practically the same as for corn. On most soils fall or early winter plowing gives the best results. Fall-plowed land is more thoroughly weathered during the winter. This puts the soil in better condition and more plant food is liberated. Fall plowing aIso kills many insects injurious to sorghum.

If it is necessary to delay plowing until spring, it should be done as soon as tlie condition of the ground will permit. Winter plowing is usually advisable when practicable. However, ground should not be plowed when it is too wet. This is especially true on heavy clay soil or when the plowing is done in the spring. In southeastern Kansas, in heavy clay soil spring plowing usually gives better results than fall plowing. Possibly this is due to the fact that the soil becomes too compact by planting time.

THE DEPTH OF PLOWING.—The right depth to plow varies with the nature of the soil and the time that the work is done. Deep fall plowing (7 to 8 inches) is advisable on nearly all good land. On thin soil, especially when the top soil has been largely eroded, deep plowing may not be advisable. In many cases it may even be injurious. Where the ground has not been plowed to a depth of more than 4 or 5 inches it is best to increase the depth gradually.

This is especially true in areas of heavy rainfall and heavy soil. If a considerable amount of unweathered soil is turned

up under these conditions, the yield is likely to be reduced for one or two years,

DISKING PLOWED GROUND.—Disking after plowing is usually necessary. Early spring disking of fall-plowed ground is often desirable to kill weeds. The ground should be disked and harrowed sufficiently to keep the weeds under control, especially just before planting. Weeds then growing will get ahead of the sorghum and be too large to be easily killed by the time the crop is high enough to cultivate. Spring plowing should be disked for the same reasons, and to put the ground in proper condition for planting.

PLANTING SORGHUM.—Sorghum for grain, stover or silage is always planted in drill rows. The check-row method of planting has been tried with kafir, but with unsatisfactory results, because stands sufficient to produce maximum yields are difficult to obtain in that way.

Sorghum sowed for hay is usually broadcasted and harrowed in or seeded with a grain drill. The latter is the best method. The seed is placed at a uniform depth and better germination and more uniform growth are obtained.

TIME TO PLANT.—The time to plant varies with the season, the locality and the variety. The growing season in southern Kansas is from two to three weeks earlier than in the northern part of the state. In western Kansas planting must be somewhat later than in the eastern part of the state, because of the altitude. In the northeastern and north central parts of Kansas the sorghums are planted from the middle to the last of May, while farther south they may be planted from two to three weeks earlier. In northwestern Kansas it is not safe to plant sorghum until the last of May, and in cold wet seasons it may be planted as late as the first of June. The sorghums are all hot-weather crops and will not germinate and grow satisfactorily in any part of the state until the ground is warm. When planted too early the plants make a slow growth, and weeds are likely to outgrow them, making it difficult or impossible to keep the crop clean. As a rule, sorghum should be planted about ten days later than corn in the same locality. The early sorghums may be planted later than those that mature late. Sorghum may be pianted on dry soils earlier than on wet soils, because a dry soil warms up earlier in the spring.

It is largely for this reason that they may be planted earlier in western than in eastern Kansas. In southern Kansas, especially on thin upland, planting as early as conditions will permit is usually advisable in order that the plants will be well along toward maturity before the hot, dry weather of midsummer. Early planting also often avoids injury from kafir ants, which are likely to attack the germinating seed.

The grain sorghums with soft seeds, such as feterita and milo, are more easily injured by cool weather during the germinating period than other varieties. Feterita seed rots very quickly and should not be planted until the ground is thoroughly warm.

Sorghum for hay is usually planted later than for grain or silage. It can not be cultivated, and if weeds get started they are likely to crowd out the sorghum. It is good practice to plant so the crop will be in the right stage for cutting late in the growing season; preferably just before frost,

RATE OF PLANTING.—It is often difficult to obtain a good stand of sorghum. The general tendency is to plant much too thick, with the hope that enough will survive to furnish a satisfactory stand. This practice is not the best, since if conditions for germination are favorable the stand will be too thick for the best results. A good practice is to plant from 50 to 100 percent thicker than the desired stand, since there is almost always a considerable loss of plants from insect injury, rains and covering during the early cultivation. A small early-maturing variety should be planted much thicker than a large late-maturing one. The rate of planting should be thicker on rich, fertile soils than on poor soils, and where the rainfall is heavy than where the annual precipitation is light. Sorghum for grain is seeded at the rate of 6 to 8 pounds per acre in eastern Kansas and from 3 to 4 pounds per acre in western Kansas. When grown for stover or silage, twice the amount of seed is used. When planted for hay broadcast or with a grain: drill, from 1 to 2 bushels per acre is used, depending on the size of the seed and the type of the soil. A smaller amount of seed of Sumac sorghum than of other varieties may be used, because the seeds are smaller. Less than a bushel to the acre of any variety is usually not advisable. If seeded too thinly the stalks grow so large that they cannot be handled conveniently, and a coarse hay of poor quality results.

DEPTH TO COVER SORGHUM.—Sorghum seedlings are not as vigorous as those of corn or the other cereal crops. The seeds, therefore, should usually not be planted as deep. They should be placed in moist soil if possible, and covered deep enough to prevent drying out. The depth necessary to insure this is governed largely by the nature of the soil and by its moisture content at the time of planting. As a rule, 1 or 2 inches is about the right depth. On wet, heavy soils, 1 inch is usually sufficient, while on light sandy soils, 2 inches and possibly more is necessary for the best results. Comparatively deep covering is necessary in western Kansas to prevent drying. Feterita is more easily injured by deep planting than other varieties. No sorghum should be planted deeper than is necessary to insure germination.

CULTIVATION.—The cultivation for sorghum should be the same as for corn in the same section. The principal purpose is to kill the weeds. If the ground is crusted by heavy rains, cultivation to break this crust is advisable. Otherwise considerable moisture may be lost by run-off or through evaporation. More cultivation than is necessary to kill the weeds and to keep the surface soil in condition to absorb moisture usually does not pay. Many weeds may be killed by good preparation of the ground and by disking and harrowing before planting. The rotation of crops also reduces the damage from weeds. Proper attention to these matters will greatly reduce the amount of cultivation necessary.

During the early stages of growth the spike-toothed harrow can often be used to advantage on sorghum planted in furrows. Sorghum planted on the surface in the usual way is likely to be seriously injured by harrowing, especially if a heavy steel harrow is used. An ordinary corn cultivator may be used after the sorghum is too high to harrow. Six-shovel cultivators are considered better than those with only four shovels. Listed sorghum is usually cultivated with the lister cultivator, such as is used for corn. The lister cultivator is used twice, first with the disks set to throw the soil away from the plants, and second with them set to throw the soil to the plants. An extra cultivation is sometimes advantageous, throwing the soil either in or out. The cultivator should be set to kill or cover all the weeds in the row, as those which escape the early cultivation are difficult to destroy later. This

applies to all early cultivation of sorghum, regardless of the method of planting or the kind of implement used.

The proper depth of cultivation depends on the time when the work is done; usually 2 or 3 inches deep is best. While the plants are small, and before the roots occupy the space between the rows, the ground may be stirred deep with good results. Deep cultivation early is often necessary where the ground has been single listed without any previous preparation, as it is important that the ridge between the row be thoroughly loosened. After the roots spread through the soil it should not be stirred to a depth of more than 3 inches, preferably less. Practically all tests show that deep cultivation at this time does more harm than good.

TIME TO HARVEST.—The proper time to harvest sorghum depends on the use to be made of the crop. If it is to be fed in the bundle without threshing it should be cut in the milk or soft-dough stage. If both grain and fodder are wanted, or if the crop is to be placed in the silo, the best results are obtained by cutting when the seed is hard enough so it can just be cut between the thumb nail and finger. If grown primarily for seed it should be allowed to become thoroughly ripe. When headed in the field, sorghum should be allowed to stand until the stem at the base of the head is dry. If headed while the stems contain moisture, heating will occur if the heads are stored in piles or in bins.

When sown broadcast or drilled for hay, sorghum is usually cut when the seeds are in the milk or the soft-dough stage. Where they fail to head because of drouth or from too thick planting, they should be allowed to make as much growth as possible. Very often late-seeded sorghum or late-maturing varieties fail to reach the proper stage to cut before frost. In that case it is a good plan to allow the crop to grow until frost and then cut as soon as possible, Frosted sorghum, if promptly cut, is damaged very little, and the advantage obtained by letting the crop grow as long as possible usually offsets the loss.

METHOD OF HARVESTING.—In eastern Kansas, where sorghum is grown for grain only, it is often opped in the field. The heads are cut from the standing stalks after the grain becomes thoroughly ripe, and stored in ricks until they are threshed. They may be topped by hand or with implements

for this purpose. When done by hand, a heavy butcher knife or a light, short corn knife may be used. Sorghum headers are manufactured which can be attached to a wagon box and driven by a sprocket on the hind wheel of the wagon.

In western Kansas, where small varieties are grown, a header is usually used. The heads are elevated into a header box the usual way and stacked in ricks to cure until threshed. Sorghum is cheaply and rapidly harvested by this method. One machine will harvest from 18 to 20 acres per day.

FIG. 22.—Pink kafir in the shock, Fort Hays Branch Experiment Station, Hays, Kansas

Where both the fodder and grain are saved, sorghum is usually cut with a corn binder and shocked in the field. The crop may be fed in the bundle, but the usual practice is to head the bundles and feed the grain and stover separately. The heading is done either by hand with a broadax, or with the use of a long blade clipper attached to the side of the wagon box or barge.

Three men are necessary to operate the clipper to the best advantage—two to handle the bundles and one to operate the knife. The heads, as they are cut, fall inside the wagon box. The bundles are then reshocked and left in the field until used for feeding or hauled to the yards and stacked.

HARVESTING BROADCASTED OR DRILLED SORGHUM.—Sorghum grown for hay is usually cut with a mower, and occasionally with a grain binder. In the latter case the stalks are bound. Sorghum for hay should not be exposed to the sun longer than is necessary to become thoroughly wilted. This

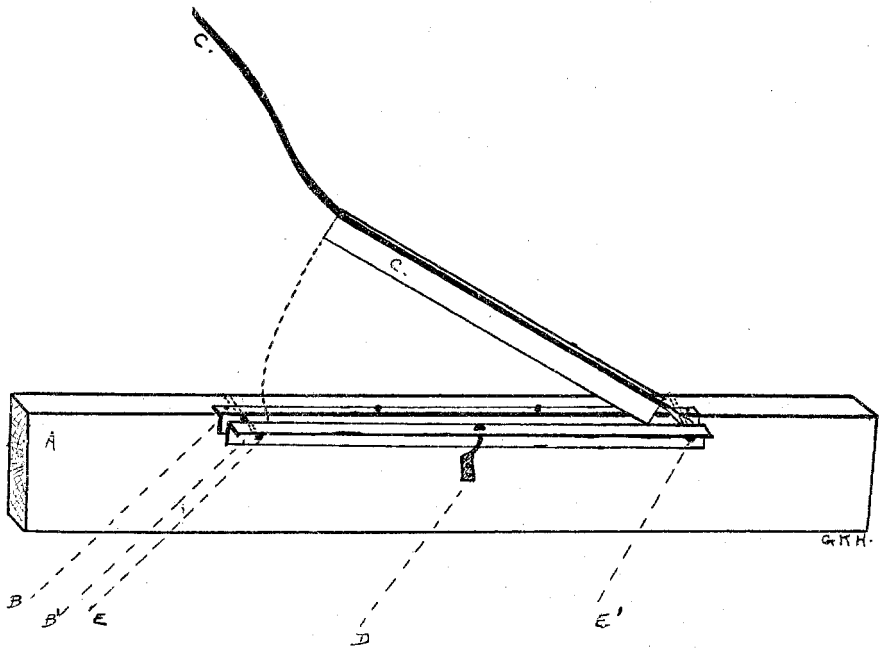


FIG. 23.—Kafir or sorghum bundle header

Key:

A, a 3 x 6-in. plank (or 2 x 10-in.).

B, B′, angle irons. Length optional. 24 to 30 in. B fastened with lag screws through top to the plank. B′ bolted to B with the bolts, E and E′, so that a ½-in. space separates two irons.

D, iron bracket, or brace, to support B′ and keep it rigid.

C, blade of clipper.

C′, iron bar handle, onto which blade is bolted. End of handle has eye through which bolt (E′) passes.

Equipment may be bolted to side of header barge by passing bolts through plank and wagon side; or it may be mounted on standards to place upon rear of wagon or header barge.

*By courtesy of Geo. K. Helder.*

will be from one to several days, depending on the kind of weather and size of the plants. The hay may then be put in shocks to complete the curing process, and later stacked. A practical method is to put the hay in large, well-formed shocks, each containing from 1,000 to 2,000 pounds, and leave it in the field until fed. Shocking can readily be done with two or three men and a two-horse rake. The hay is drawn to the shock with the rake, the first few rakefuls being dumped together to form the foundation of the shock. The remainder is then dumped by the side of the shock and pitched onto it. The shock should be well stacked and combed down with the fork to remove all loose stalks, leaving the sides in condition to turn water.

Sorghum hay does not stack-burn readily, and large shocks may be made with safety, even though the stalks contain considerable moisture. As a usual thing it is better to take the chance of some stack burning than to let the quality deteriorate from exposure in the field or from weathering in small shocks. Properly cured sorghum makes excellent roughage which is well relished by livestock.

Sorghum sown for hay should be seeded at such a time that it will be in the proper stage to cut at the end of the growing season, preferably just before frost. This is an important factor in the production of the best quality of forage. Sorghum cut early is likely to be damaged by the heat and early fall rains. Sweet sorghum, especially, is likely to ferment or sour during warm weather. Because of the variation in the length and nature of the growing seasons, this matter is a difficult one to govern. The proper time to plant will vary with the variety grown and the locality, It will have to be based largely on the experience of the grower.

THRESHING.—Sorghum is usually threshed from the headed grain with the ordinary grain thresher. Occasionally the entire crop is run through the machine, but the process is expensive, hard on the machine and otherwise unsatisfactory. In threshing the sorghum, especially the grain sorghums, feterita, milo and kafir, a large percentage of the kernels may be cracked. This is not objectionable when the grain is used for feed on the farm, but if it is marketed, maximum prices cannot be secured. Cracked seed is more likely to heat and mold in storage than that which is whole. It packs more closely, thus reducing the circulation of the air in the bin. If the machine is run at the lowest possible speed to properly handle the straw, and the number of concaves reduced to the minimum, cracking is greatly reduced.

Sorghum should not be threshed until thoroughly dry, nor during damp weather if it can be avoided. At best the seed is difficult to keep in bins or in large quantities, and unless it is dry when stored, heating is likely to occur. Threshing should be delayed until late in the season if a threshing outfit can be obtained at that time.

STORING SORGHUM SEED.—As a rule, sorghum stored in the head, if properly cured, will keep well without any trouble from heating. Cribs or bins suitable for ear.corn are also

satisfactory for storing sorghum heads. Threshed sorghum seed stored in large bins is likely to heat, even though completely dry when threshed, unless the bins are well ventilated. Sufficient moisture may be absorbed during damp weather to start heating.

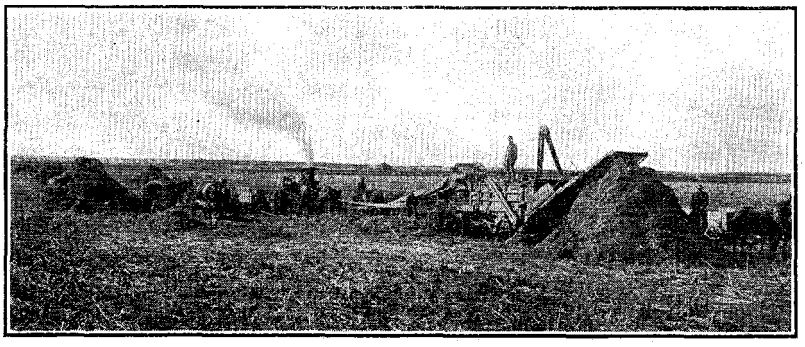

FIG. 24.—Threshing kafir

SELECTION AND CARE OF SORGHUM SEED—The use of pure seed of good quality for planting purposes is more important for sorghum than for most crops. As one bushel of seed will plant from 6 to 15 acres, the acre cost is very small even if the seed costs two or three dollars a bushel.

Sorghum cross-fertilizes readily. This almost always results in deterioration. Sweet sorghum or Sudan grass crossed with the grain sorghums will render the latter unfit for grain production. Hybrids, though often desirable as individuals, are always objectionable because their seed never produces plants true to type. Very little of the sorghum seed produced in Kansas is pure, and most of it is mixed sufficiently to reduce its value for seed and for market. The mixture is largely due to growing different varieties in adjoining fields and to careless methods of selecting and handling the seed.

Different varieties of sorghum grown for seed should be separated at least 40 rods. Even then, bees and other insects that visit the heads at blooming time may cause a little cross-fertilization by carrying pollen from one field to another. Foreign heads and hybrids should be removed each season. To accomplish this, the field should be inspected carefully once or twice, preferably just before blooming time, and all mixed heads and hybrids removed. A man on horseback with a butcher knife can do this work very rapidly.

SELECTING SEED.—There is only one right time to select sorghum seed, and that is in the field when the majority of the heads are mature and before there is danger of frost. This method, however, is practical only for small quantities of seed for home use. There are several advantages in selecting heads in this way. The grower has an opportunity to note the stalk characters as well as those of the head. With the forage sorghums this is especially important.

Heads somewhat above average size should be selected, but no advantage is gained by selecting heads that owe their size to a thin stand or to extra fertile soil. Hybrid heads should always be avoided, even though they are large and appear better than others, as is frequently the case. Loose, open heads of grain sorghum should be avoided, as well as those which are too compact. The latter type may have poorly developed grain in the interior of the heads and is also more susceptible to mold and to insect injury. Heads that shatter readily should be avoided. Grain-sorghum heads should be selected from strong, sturdy, upright stalks without suckers and side branches, and with a maximum number of leaves. The heads should also extend well out of the boot or top leaf sheaf. Partly inserted heads are likely to be damaged by insects and molds.

In selecting seeds of the sweet sorghums, stalk and leaf characters, rather than type of head, should be the basis of selection. Seed should be secured from stalks that stand up well and have a maximum number of broad, heavy leaves. Suckering in forage sorghum is desirable, hence plants that sucker profusely should not be avoided. Plants that produce suckers that develop and mature uniformly are preferred. Heavy, sturdy stalks, however, that make coarse forage are to be avoided.

MATURITY.—In many parts of Kansas there is difficulty in getting kafir to mature, while in northwestern and the extreme western part of the state milo and feterita often fail to ripen. This is sometimes due to unusual weather or poor cultural conditions, but usually to the use of late-maturing varieties and strains. For these conditions it is very necessary to increase the earliness of the variety as much as possible by selection. Much can often be done by selecting the earliest-maturing heads each year. For best results this should be

done as soon as the early heads are mature and before the entire crop ripens. If frost is likely before the crop is ripe, saving the best-developed heads is preferable to obtaining a new supply of seed. If the heads are protected from freezing until they become thoroughly dry, the seed will usually grow even though harvested when no further advanced than the soft dough stage.

In eastern Kansas it is possible to obtain strains that mature too early. Varieties should be grown that mature by the time the earliest frosts occur. If they are selected to mature earlier than necessary, the yield will be reduced. On poor soils, or where summer drouth limits the growing season, earlier strains should be selected than where soils are fertile and rainfall abundant.

STORING SORGHUM SEED.—Sorghum seed should be stored in the head until planting time. This applies especially to the grain sorghums and to late-maturing sweet sorghums. As a rule, no difficulty is had in keeping well-matured seed of the early varieties of sweet sorghums of the Amber type. The heads selected should be thoroughly dried and loosely stored in boxes or crates or in loose-woven gunny sacks and hung where there is a free circulation of air, out of reach of birds and rodents. The vitality of seed that is thoroughly dried will not be injured by freezing, but damp seed is easily damaged. The heads can be threshed by hand when needed for planting.

Threshed sorghum to be used for seed should never be stored in large bins without ventilators, unless it can be elevated or otherwise stirred frequently. The seed can be safely kept when sacked or when stored in bins where the grain is not more than 2 or 3 feet in depth.

## SORGHUM FOR SIRUP

The manufacture of sorghum sirup in Kansas is a comparatively small industry. The average annual production during recent years is valued at between three and four million dollars. The industry, however, is increasing and may become important.

Sorghum for sirup is grown in the same way as sorghum for forage and silage, except that it is planted somewhat thinner, The plants should be from about 5 to 7 inches apart in the row.

The varieties most commonly used in Kansas are the Kansas Orange and Red and Black Amber. Sumac, Collier, Coleman, and Black Gooseneck or Texas Ribbon cane are used to a slight extent. A number of strains with a high sugar content have been developed by firms making a specialty of sorghum sirup.

Several plantings, at intervals of a week or more, should be made when large acreages of sorghum are grown for sirup, or varieties maturing at different times should be used. This is advisable in order to lengthen the manufacturing period, which may be made to extend through August, September, and a part of October if the season permits.

Sorghum for sirup should be cut when the seed is in the late milk or dough stage. Ripe or overripe sorghum produces juice that is difficult to clarify, while the flavor of both overripe and green sorghum is poor, The sorghum crop should be cut with a corn binder and bound into bundles, though it may be cut by hand. The best grade of sirup is obtained when the leaves, head and suckers are removed and the main stalk only is used. When this practice is followed the stripping is done by hand. Harvesting should be managed so that the sorghum will be milled within two days after it is cut, since the juices are likely to ferment, particularly during warm weather. In cold weather the stalks may be kept for some time without injuring their value for sirup. Where there is danger of frost it is a good practice to cut the crop and store it in shocks or piles until it can be milled. Frosted sorghum is not injured for sirup if milled promptly, unless it is immature.

In Kansas sorghum yields vary from 2 to 15 tons per acre. An average crop is about 7 or 8 tons. A ton of sorghum will furnish from 700 to 1,200 pounds of juice, from which 8 to 30 gallons of sirup may be made, depending on the sugar content of the juice. The production of sirup per acre will vary from a few to as much as 300 gallons, depending on the variety grown, the season, soil, and method of growing and manufacturing. A fair average is about 100 gallons per acre.

Parties wishing information regarding the various processes involved in manufacturing sorghum sirup should write to their senator, representative or delegate in Congress, and request a copy of U. S. Farmers' Bulletin, No. 477, "Sorghum Sirup Manufacture."

## FEEDING VALUE

Sorghum has been used extensively for forage in Kansas for the past 40 years. Sorghum fodder or stover of good quality is generally recognized as being practically equal to that of corn. Table X, from Henry and Morrison's "Feeds and Feeding," shows the average composition of various forage crops common in the sorghum-growing section.

Table X.—*Comparing the average composition of sorghum fodder and stover with some other forage crops*

| Crop | Number of analyses | Water | Ash | Crude protein | Carbohydrates | | |
|---|---|---|---|---|---|---|---|
| | | | | | Fiber | N. F. ex. | Fat |
| Kafir fodder | 20 | 9.0 | 9.4 | 8.9 | 26.8 | 43.1 | 2.8 |
| Kafir stover | 3 | 16.3 | 8.3 | 5.1 | 27.4 | 41.2 | 1.7 |
| Milo fodder | 5 | 11.1 | 9.9 | 12.0 | 18.4 | 44.1 | 4.5 |
| Sweet sorghum fodder | 22 | 9.7 | 7.8 | 7.4 | 26.1 | 65.9 | 3.1 |
| Corn fodder | 56 | 9.0 | 6.5 | 7.8 | 27.2 | 47.3 | 2.2 |
| Corn stover | 183 | 9.4 | 5.8 | 5.9 | 30.7 | 46.6 | 1.6 |
| Prairie hay | 42 | 6.5 | 7.7 | 8.0 | 30.5 | 44.7 | 2.6 |
| Alfalfa hay | 250 | 8.6 | 8.6 | 14.9 | 28.3 | 27.3 | 2.3 |

It will be noticed that the analyses for sorghum stover and corn stover are very similar. Experience in feeding these crops indicates that they are of about equal value.

Many farmers report conflicting results regarding the use of sorghum for forage. Their value depends primarily on the stage at which they are cut and their care in curing. If harvested too early or when overripe they may be deficient in feeding value and give unsatisfactory results. Forage of good quality, however, almost always gives satisfactory results. The stover is low in protein and should be fed in connection with other feeds supplying an abundance of this constituent, especially when fed to growing stock or to dairy cows. Kafir or milo stover containing a few heads of grain makes excellent feed for maintaining mature horses and mules.

## GRAIN SORGHUM FOR FEED

The use of sorghum seed, especially kafir and milo, for feed for livestock is rapidly increasing. The value of these grains for the production of beef, milk, pork, and poultry and eggs is

not fully recognized. Table XI shows the chemical composition of corn and the various sorghums.

**Table XI.**—*Comparing average composition of grain sorghums and corn*

| Crop | Number of analyses | Water | Ash | Crude protein | Carbohydrates | | |
|---|---|---|---|---|---|---|---|
| | | | | | Fiber | N. F. ex. | Fat |
| Kafir | 135 | 11.8 | 1.7 | 11.1 | 2.3 | 70.1 | 3.0 |
| Kafir-head chops | 21 | 12.5 | 2.8 | 9.7 | 6.4 | 65.9 | 2.7 |
| Milo | 125 | 10.7 | 2.8 | 10.7 | 2.4 | 70.5 | 2.9 |
| Milo-head chops | 40 | 10.3 | 3.1 | 10.0 | 5.9 | 68.1 | 2.6 |
| Feterita | 1 | 10.8 | 1.5 | 11.5 | 1.2 | 71.7 | 3.3 |
| Sweet sorghum seed | 13 | 12.7 | 1.9 | 9.2 | 2.0 | 70.8 | 3.4 |
| Broom-corn seed | 4 | 11.8 | 2.9 | 10.2 | 8.2 | 63.5 | 3.4 |
| Corn | 440 | 10.5 | 1.5 | 10.1 | 2.0 | 70.9 | 5.0 |
| Corn and cob meal | ..... | 10.4 | 1.5 | 8.5 | 7.9 | 67.6 | 4.1 |

It will be noticed that corn and the important grain sorghums, kafir and milo, vary but little in composition except that the corn contains more fat. Corn, however, is more palatable and a higher percent of the nutrients are digestible. Feeding tests indicate that the grain sorghums have from 85 to 90 percent of the feeding value of corn for fattening hogs and cattle, and from 90 to 95 percent for fattening lambs.

A test was conducted by the Animal Husbandry Department of the Kansas Agricultural Experiment Station at Manhattan, in which five lots of ten pigs each were fed corn, kafir, milo, feterita and koaliang, respectively. The grains were supplemented with 2.3 pounds of shorts and 0.4 pounds of tankage for each pig, daily. The results are shown in the Table XII.

**Table XII.**—*Grain sorghums compared with corn for fattening pigs*

| Principal feed | Daily feed | Daily gain | Concentrates for 100 lbs. gain |
|---|---|---|---|
| | *Lbs.* | *Lbs.* | *Lbs.* |
| Lot 1—Ground kafir | 4.9 | 1.40 | 534 |
| Lot 2—Ground milo | 4.9 | 1.43 | 523 |
| Lot 3—Ground feterita | 4.9 | 1.36 | 549 |
| Lot 4—Ground koaliang | 4.9 | 1.31 | 572 |
| Lot 5—Ground corn | 4.9 | 1.46 | 514 |

The feeding value of corn, milo and kafir varied but slightly, ranking in the order named. Feterita and koaliang gave satisfactory results, but did not equal the other grains.

In two other tests sweet-sorghum seed was compared with corn, kafir and milo for pigs. Results similar to those given in Table XI1 were obtained for corn, kafir and milo, while sweet-sorghum seed proved decidedly inferior to the other grains, considerable more feed being required to make 100 pounds of gain.

Corn and kafir were compared in fattening lots of 15 calves each. Each of these grains were supplemented with 1.79 pounds of cottonseed meal, 17.05 pounds sorghum silage, for each animal daily. For two months of the 180 days' feeding period each calf received, in addition, 4.5 pounds of alfalfa hay. The results of the test are given in Table XIII.

Table XIII.—*Corn versus kafir for fattening calves*

| PRINCIPAL FEED | Average daily grain ration | Average daily gain | Concentrates for 100 lbs. gain |
|---|---|---|---|
| | *Lbs.* | *Lbs.* | *Lbs.* |
| Lot 1—Corn | 11.4 | 1.96 | 674 |
| Lot 2—Kafir | 11.4 | 1.74 | 763 |

It will be noted that the kafir-fed calves made a smaller daily gain than those corn fed, and that more grain was required for 100 pounds of gain.

Table XIV gives results of a feeding test in which shelled corn and whole kafir and kafir meal were compared for fattening lambs, The test consisted of three lots of fifty lambs each, fed, respectively, shelled corn, whole kafir, and ground kafir, supplemented with an average daily ration of 0.19 pounds cottonseed meal, 1.36 pounds alfalfa hay and 1.09 pounds sweet sorghum silage.

Table XIV.—*Shelled corn, kafir, and ground kafir for fattening lambs*

| PRINCIPAL FEED | Average daily grain ration | Average daily gain | Concentrates for 100 lbs. gain |
|---|---|---|---|
| | *Lbs.* | *Lbs.* | *Lbs.* |
| Lot 1—Corn | 0.80 | 0.40 | 269 |
| Lot 2—Kafir | 0.90 | 0.34 | 308 |
| Lot 3—Ground kafir | 0.90 | 0.36 | 303 |

The kafir did not produce as rapid gains as the corn, and more grain was required for 100 pounds gain. Kafir meal was slightly superior to whole kafir.

Similar results were obtained in a number of comparisons of corn and the grain sorghums for cattle. While no experimental data are available regarding the use of grain sorghum for horse and mule feed, these crops, when fed in the head, give satisfactory results.

Where grain sorghum can be grown to better advantage than corn, it is the logical crop to grow for grain feed. The difference in the feeding value is not sufficient to warrant the growing of corn if this crop consistently fails to yield more than 80 percent of the sorghums. Because of the small size and hardness of the seed, grain sorghum, especially kafir, should be ground. Where grinding is not possible, feeding in the head to horses and cattle is better than feeding the threshed grain. Grain sorghum makes excellent feed for poultry. There is a steady and increasing demand for kafir, milo and feterita for use in the manufacture of numerous brands of poultry feeds. Grain sorghum, like corn, is deficient in protein, and for best results should be supplemented with feed high in protein, such as alfalfa hay, linseed oil meal or cottonseed meal, tankage, or blood meal.

## SORGHUM SILAGE

Feeding tests conducted by the Dairy Department of the Kansas Agricultural Experiment Station show that kafir silage when fed with hay and grain is practically equal to corn silage. In two tests in which corn and sweet sorghum silage were compared as a feed for dairy cows, the former produced 3 percent more milk and 1 percent more butter fat than the sweet sorghum silage.

Feeding tests conducted by the Animal Husbandry Department for a three-year period, 1912,1913, 1914, show that corn, kafir and sweet sorghum silage are about equal as a maintenance ration for calves. In these tests each kind of silage was fed to 42 calves for a period of 107 days. In 1912 and 1914 the ration consisted of 1 pound of cottonseed meal in addition to the silage, while in 1913 silage was supplemented with 1 pound each of corn and linseed oil meal. The results are given in Table XV.

Table XV.—*Corn, kafir, and sweet sorghum silage for calves*

| Daily feed | Daily gain, lbs. | Feed for 100 lbs. gain | |
|---|---|---|---|
| | | Grain, lbs. | Silage, lbs. |
| Lot 1—Corn silage 28.8 lbs | 1.15 | 113 | 2,330 |
| Lot 2—Kafir silage 26.3 lbs | 1.25 | 104 | 2,104 |
| Lot 3—Sweet sorghum silage 26.6 lbs | 1.08 | 127 | 2,467 |

The best gain was made with kafir silage and the poorest with sweet sorghum silage, but the difference was not great in any case. These results were obtained during seasons that were more favorable for the production of sorghum than for corn, and possibly the superiority of the kafir over corn was due partly to seasonal conditions.

Since equal quantities of silage from corn, kafir and the sweet sorghums have practically equal feeding value, the most profitable crop is the one that produces the most silage per acre. Variety tests, as previously pointed out, show that sweet sorghums outyield corn and kafir, and that they will produce the greatest amount of feed nutrients per acre. When the principal purpose is to grow crops for silage it would seem to be more profitable to grow kafir or sweet sorghum rather than corn on most Kansas soils.

## DISEASES OF SORGHUMS

KERNEL SMUT—Kernel smut is the only sorghum disease of economic importance in Kansas. This disease affects the individual kernels, usually all the kernels of an infected plant. The kernels have a grayish-brown appearance, are longer than normal, and when broken or crushed are found to contain a mass of smut spores. These spores correspond to the seeds of other plants. They become attached to the sorghum kernels and germinate with them, producing a new smut plant, which grows within the sorghum plant and produces smutted kernels as before.

Kernel smut can be prevented by treating the seed with formaldehyde. Formaldehyde (40 percent solution) is added to water in the proportion 1 pound to 30 gallons. The seed is soaked in this solution for one hour and dried immediately. It is best to treat the seed just before planting. If treated

before seeding time it should not be sacked until it is completely dry. Damp seed will heat within twenty-four hours if sacked. Only new sacks, or old ones dipped in the formaldehyde solution, should be used.

Milo and feterita are not known to be affected with kernel smut, and treatment is therefore unnecessary.

HEAD SMUT.—The head smut of sorghum differs from the kernel smut in that it affects the head as a whole. The entire sorghum head becomes a mass of smut somewhat similar to the smut of corn. There is no practical way of treating this disease. Fortunately, it is not very prevalent in Kansas.

SORGHUM BLIGHT.—Sorghum blight is recognized by red and purple spots on the stems and leaves of affected plants. It is more prevalent in wet seasons, but rarely causes noticeable injury. Sudan grass is more susceptible to this disease than other sorghums. There is no known means of combating sorghum blight.

## INSECT ENEMIES

The sorghums are not as subject to insect injury as most of the other crops. While there are a number of insects which affect sorghum, only three are likely to cause serious damage in Kansas, namely, the grasshopper, the chinch bug, and the kafir ant.

GRASSHOPPERS.—Grasshoppers sometimes seriously injure sorghums when the plants are small, but after the plants are 6 or 7 inches tall they are not bothered much, as long as other crops, such as alfalfa, corn and other cereals and grasses, are available. This pest prefers to feed upon the latter crops. Grasshoppers can be effectively controlled in sorghum fields by means of the poisoned bran mash. This mash is made according to the following formula:

| | |
|---|---|
| Bran | 20 lbs. |
| Paris green | 1 lb. |
| Sirup | 2 qts. |
| Oranges or lemons | 3 |
| Water | 3½ gals. |

In preparing the bran mash, thoroughly mix the bran and paris green dry, in a washtub. Squeeze the juice of the oranges or lemons into the water, and chop the remaining pulp and the peel to fine bits and add them to the water. Dis-

solve the sirup in the water and wet the bran and poison with the mixture, stirring at the same time so as to dampen the mash thoroughly.

The damp mash should be sown broadcast in the infested areas early in the morning, or about the time the grasshoppers are beginning to move about. It should be scattered so as to cover from 4 to 5 acres with the amount made by using the quantities of ingredients given in the formula above.

CHINCH BUG.—The sorghums are subject to attacks from chinch bugs. Milo is very susceptible to injury from this pest. The other sorghums, however, are comparatively resistant to chinch bugs and are less easily damaged than corn. With favorable growing conditions, the sorghums, milo excepted, will withstand considerable chinch-bug infestation and produce a fair crop. The most effective means of controlling the chinch bug is to burn over all grass and trash along the roadsides, hedges and other such places where the great majority of bugs hibernate in the fall.

KAFIR ANT.—The kafir ant is one of the most serious pests of germinating sorghum throughout the eastern half of Kansas. Within a day or two after planting the ants attack the seed, hollowing out the kernel, generally preventing germination.

The kafir ant is reddish in color and is one of the smallest ants known. It is found nesting under rocks in pastures and in the soil of cultivated fields.

From the information thus far accumulated, the most practical measures of control against this insect are good cultural methods in preparing the seedbed, namely, fall plowing, thorough spring cultivation, and early seeding, preferably by the surface planter method.

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