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VINALL, H.N., STEPHENS, J.C., MARTIN, J.H.

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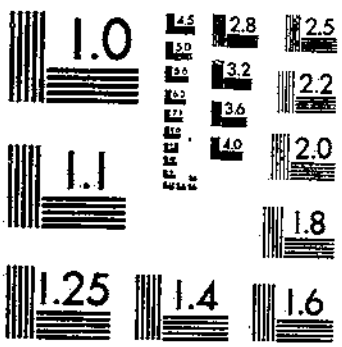

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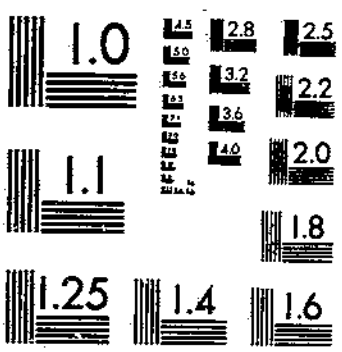

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NATIONAL BUREAU OF STANDARDS-1963-A

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IDENTIFICATION, HISTORY, AND DISTRIBUTION OF COMMON SORGHUM VARIETIES

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CONTENTS

INTRODUCTION

There is perhaps no important staple crop which varies so widely as sorghum. In Africa, the continent generally considered its native home, there are hundreds of distinct varieties, and in India and China almost as many more. After its introduction into the United States the continued cross-pollination of sorghums in the field has resulted in many additional varieties. This development

[1] In conducting varietal tests the writers were assisted by field representatives of the Bureau of Plant Industry. The following workers rendered valuable assistance in collecting data regarding the varieties: In the Division of Cereal Crops and Diseases, J. B. Sieglinger, agronomist, Woodward, Okla., and A. F. Swanson, associate agronomist, Hays, Kans.; in the Division of Forage Crops and Diseases, R. E. Getty, formerly associate agronomist at Hays, Kans., 1913–28; H. R. Reed, formerly assistant agronomist at Bard and Chula Vista, Calif., 1915–18; and A. B. Cron, formerly assistant agronomist at Chillicothe, Tex., 1918–23. These local men took descriptive notes and physical measurements of the plants in the field. The descriptions were first prepared by Stephens from detailed descriptive notes taken in the field at Chillicothe, Tex., in 1927. The sorgo descriptions were then revised by Vinall and the grain sorghum descriptions by Martin. All descriptions were rechecked in the field in 1932, the object being to make them as complete and accurate as possible from a taxonomic standpoint. J. R. Quinby, superintendent of Texas substation no. 12, Chillicothe, Tex., cooperated in the orginal preparation and checking of the descriptions.

of new forms through the operation of natural forces has been augmented by the work of plant breeders, who in the last 10 or 15 years have, through hybridization, created numerous distinct varieties.

The sorghum crop has four uses—forage, grain, sirup, and industrial (such as the manufacture of brooms, wallboard, etc.). Besides the wide differences in climatic adaptations of varieties, those best suited for grain production are of little value for sirup and, notwithstanding that all sirup varieties and most of the grain sorghums may be used as forage, there are wide differences in the quantity as well as in the quality of the forage obtained. It is quite important, therefore, not only to choose carefully the variety for planting in any particular location, but also to be sure of getting that variety when purchasing seed. Confusion in the names of sorghum varieties is common. The same variety is grown and the seed marketed under many different names, and the same name is often applied to several varieties. Honey sorgo, an important sirup variety, was reported in a sorghum varietal survey (p. 84) under 24 different names, and the name "Honey Drip" was used for at least five distinct varieties of sorgo. Such confusion results in many errors in interpreting experimental data and in endless waste throughout that section of the United States where the sorghums are grown extensively.

The confusion now existing demands some effort to provide descriptions of the common varieties and the association of variety names with types so definitely that growers, seed dealers, and experimenters will be able to identify the varieties with precision and reasonable certainty. It is the purpose of this bulletin to provide (1) descriptions of commercial varieties, (2) a key to assist in the identification of varieties, (3) estimated acreage and distribution of the important varieties, and (4) the known history of all varieties described. It is also planned to have each variety represented by a head specimen located at some point where it will be accessible for examination by those interested in studying and handling the crop.

In describing a variety, plant characters as well as panicle characters have been considered, to assist in establishing a definite type of plant for each name and to enable growers to judge the suitability of any variety for their conditions and needs. The names chosen have been standardized whenever possible in accordance with the code of nomenclature adopted by the American Society of Agronomy (*21, 31*).[2]

REVIEW OF LITERATURE

FOREIGN INVESTIGATIONS

Sorghum, being indigenous to Egypt, was probably among the earliest of the wild plants to be domesticated and utilized as human food and as feed for livestock. Ball (*26, p. 10*) calls attention to the statement of Woenig that a harvest field frescoed on the walls of the tomb of Amenembes built at least 2,200 years before the Christian Era represents a form of sorghum. There is considerable doubt as to whether this fresco really represents sorghum. Reproductions of it by Newberry (*107, pl. 11*) show reapers harvesting a crop which,

[2] Italic numbers in parentheses refer to Literature Cited, p. 92.

because of the marked lack of detail, may just as fairly be interpreted as flax or some other cereal.

Piedallu (*114, pp. 21–28*) discusses at length the question of whether the scene on the walls of the tomb of Amenemhat in Beni Hasan, cited by several authors (Woenig, *170, pp. 171–174*; Wilkinson, *166, pp. 402, 426, 427, figs. 469, 478, 499*) as representing doora (durra) is intended to signify the harvesting of this crop. He supports very ably the contention that this scene and others like it represent the harvesting of flax, and concludes that there is no proof that the ancient Egyptians knew sorghum. Piedallu's logic is probably sound, since all writers apparently agree that the human figures in the picture are engaged in pulling the plants, a method of harvesting long employed on flax, but not, so far as known, on sorghum. Piedallu raised the question as to why the Egyptians harvested their wheat by cutting it just below the heads and troubled themselves to pull the sorghum with its long tough roots and dry rigid stems. The method of threshing represented for this crop was also that of flax rather than sorghum, and inscriptions (hieroglyphics) in connection with similar scenes are said to refer definitely to flax. Piedallu makes an additional observation to the effect that the grain of sorghum has been used commonly as food by the poorer classes and may have been grown and used thus in Egypt without having been represented in the tombs of the kings, who used wheat for bread and linen for clothes.

What has been said of the decorations on the Amenembes tomb is not true, however, of a carving taken from the palace of Sennacherib in Nineveh.[3] This carving, in the British Museum at London, presents an unusually accurate picture of a field of some compact-headed sorghum such as milo or durra. A different carving in the palace of Sennacherib represents a field of pearl millet, thus eliminating this crop as a possible subject for the first mosaic. Granting that this carving does represent a field of sorghum, it indicates that sorghum was an important crop about 700 B. C. Excellent illustrations of these two carvings will be found in Piedallu's book (*114, pl. 1*).

There are records also of the presence of sorghum in India in the first century A. D. and in China in the third century. No doubt there were numerous varieties in existence even at the beginning of the Christian Era, but no serious attempt seems to have been made to classify and describe these varieties until much later. Sorghum is semitropical in its climatic adaptations and never attracted much attention in Europe except along the Mediterranean coast.

All the earlier descriptions of sorghums were of a botanical nature, and Ball's rather complete summary of these (*26, pp. 35–50*) makes it unnecessary to repeat them here. There are, however, two features of Ball's presentation that require comment in the light of present knowledge. The copy of an illustration after Arduino (*22, fig. 1, pl. 4*) reproduced in Ball's publication as figure 12 shows as *Holcus sorghum* what is most surely pearl millet (*Pennisetum glaucum*). The description of this species by Arduino recorded by Ball (*26, pp. 43–44*) does not apply to pearl millet, however, since

[3] Nineveh, ancient city of Assyria, located on the banks of the River Tigris in what is now Mosul, Turkey.

the colors of the seed are described as "various shades of red and yellow." Just how this evident mistake in the illustration occurred is difficult to explain, since Arduino is supposed to have grown these varieties in field culture for several years.

Ball's figure 13 illustrating Arduino's *Holcus cafer* is an almost exact reproduction of a sorghum (S. P. I.[4] 51972) collected by H. L. Shantz at Rejaf, Anglo-Egyptian Sudan, in 1920. This is the only sorghum coming under the observation of the senior writer that has all the panicle branches radiating from practically the same point on the axis of the inflorescence. Piedallu (*114*), however reproduces this illustration of Arduino as figure 22, and in plate 4, *B*, gives a picture showing a sorghum reported from Sudan by Chevalier with a head like a parasol, very similar to S. P. I. no. 51972 and the *Holcus cafer* of Arduino. He considers this Sudan form as representative of Arduino's *H. cafer*, but accepts Ball's statement that it is also equivalent to Planter sorgo.

At that date (1786), it is reported, Cafreria was an immense and poorly defined territory not at all circumscribed as Natal is today. Most probably it represented the European idea of that part of Africa inhabited by the kafirs (Negroes) and thus extended well up into Sudan. Arduino's *Holcus cafer* might well have been this Sudan sorghum, which has sweet, juicy stems and heads "like a parasol." In the very extensive test of sorghum varieties at Bard, Calif., in 1915, there were many loose-panicled forms of Planter sorgo, but none in which the panicle branches were all attached at approximately a single focus on the axis. Ball's conclusion that the *H. cafer* of Arduino represented the Planter sorgo grown in the United States does not, therefore, appear well founded.

The fact that these early descriptions, with few exceptions, were based on dried specimens and often only fragmentary material explains their inadequacy and the difficulty now experienced in identifying them with any of the modern varieties. It was not until about 1850 that writers adopted the practice of describing the cultivated forms of sorghum as horticultural and botanical varieties rather than species. The descriptions, however, in European publications continued to be based largely on botanical rather than agronomic characters.

Two Germans, Koernicke and Hackel, were the first to make any notable contribution to sorghum classification subsequent to that of Arduino (*22*), who in 1786 published descriptions of six species based on his studies of these in field cultures. Avellar Brotero (*24, pp. 88–89*) in 1804 had transferred the *Holcus sorghum* and *H. halepensis* of Linnaeus to the genus *Andropogon*, while Persoon (*112, p. 101*) in 1805 accepted the generic name *Sorghum*, first suggested by Micheli, and christened the cultivated sorghums *Sorghum vulgare*. Although the sorghums have been cataloged for many years quite generally as Andropogons, the practice suggested by Brotero, there is now a fairly definite agreement among botanists to accept the Persoon plan and separate the sorghums from *Andropogon* under the genus *Sorghum*.

[4] S. P. I. denotes Seed and Plant Introduction accession number, Bureau of Plant Industry.

Koernicke (*96*) in 1885 accepted Avelar Brotero's action in placing the sorghums in the genus *Andropogon*, but considered them all as 1 species, *A. sorghum* (L.) Brot. In his proposed classification of the cultivated sorghums he divided them into 2 groups, Effusus and Contractus, based on the characters of the panicle. His Effusus or lax-panicled group comprised 5 varieties, including the *cafer* and *niger* of Arduino, the *saccharatus* of Linnaeus, and 2 new ones, *leucospermus* and *technicus*, the latter being applied to what we now call broomcorn. In the Contractus or close-panicled group there were 4 varieties with erect heads and 3 varieties with recurved peduncles. Among these 7 varieties there were 5 (*usorum* Nees, *Arduini* Gmel., *bicolor* L., *cernuus* Ard., and *truchmenorum* Koch) that had been described previously. Koernicke added 2 of his own, *aethiops* and *neesii*. The *cernuus*, *truchmenorum*, and *neesii* had recurved peduncles; the others were erect-headed. Without an opportunity to examine type specimens of these varieties described by Koernicke, it is impossible to associate them with the modern varieties.

Hackel (*72*) in 1889 divided *Andropogon sorghum* Brot. into two subspecies, *halepensis* and *sativus*. He seems to have been the first to distinguish between the groups that are now called grass sorghums and the more robust forms known as sorgos and grain sorghums. In the former group, however, he included as varieties forms with rootstocks and forms without rootstocks, namely, *effusus*, *virgatus*, and *aethiopicus*.

Hackel's subspecies *sativus* includes a total of 37 varieties divided into 9 groups. He used as the basis for such divisions the following characters: Shape and size of the spikelets; shape and character of the glumes; comparative length of pedicels of staminate spikelets; relation of the size of the glumes to the size of the seed; density of the panicle and position and length of its branches in relation to the axis; color of seeds; and presence and length of awns. While Hackel's work represented a considerable advance over that of preceding authors, there are several marked inconsistencies in his classification from an agronomic standpoint, because of the fact that he did not have an opportunity to study the growing plants and therefore did not consider the size or qualities of the culms, leaves, and roots.

Other Europeans who have published botanical descriptions and classifications of African sorghums include Schumann (*130*) in 1895, Busse and Pilger (*41*) in 1902, and Lambrecht (*99*) in 1903. All of these efforts are subject to the same criticism as applies to Hackel's work; they were based largely on botanical characters of the panicle and were of little agronomic value because they failed to take into account those habits of growth which determine the value of plants from an economic viewpoint.

The Schumann key to east African varieties is interesting because he bases his primary divisions on the degree to which the caryopses are covered by the glumes. Of these three primary groups, Obtectae are those in which the caryopsis is entirely covered, Seminudae those in which the glumes are shorter than the caryopsis and only partially cover it, and Nudae with glumes as long as the caryopsis but expanding at maturity with inflexed edges, thus exposing the caryopsis, as in our shallu, the variety *roxburghii* of Hackel. He places

only one variety each in the Obtectae and Nudae groups, while in the Seminudae he has seven varieties. This group is subdivided into Effusae or those with lax panicles, Contractae with somewhat condensed panicles, and Compactae with very compact, recurved panicles. Cowgill (*55, p. 5*) in his discussion of the panicle characters of sorgo reproduces a translation of Schumann's key and follows it to a certain degree in his excellent descriptions of this group of sorghums.

In 1915 Dudgeon (*61*) described several varieties of sorghums grown in Egypt. The seasons recognized in Egyptian cultivation, he says, are sêfi (summer), nîli (autumn), and shetwi (winter), and the grain sorghums are divided by cultivators into two groups, (1) the durra sêfi, or Ghedi varieties, those grown in the summer, and (2) the durra nîli, or Nabari varieties, those seeded late and cultivated during the autumn months. There are, he claims, some references to a durra shetwi or winter variety, but since no varieties are cultivated during the winter, such varieties are to be classed with the nîli durras. The sêfi and nîli durras are each subdivided into four varieties or varietal groups. Descriptions of these groups, valuable from an agronomic viewpoint, are given. The sweet sorghum variety *saccharatum* L. is mentioned as being grown only for fodder. Evidently a single variety, one with black glumes, was the sole representative of this group. Variety *technicum* (broomcorn) is mentioned, although he says it is not systematically cultivated in Egypt. One of the chief elements of value in Dudgeon's work is the extended list of references to publications on Egyptian agriculture in connection with his discussion of the early history of sorghums in Egypt. He attempts also to associate the botanical varieties of earlier authors, especially those listed by Ascherson and Schweinfurth (*23*) and Sickenberger (*135*), with varieties then (1915) being grown in Egypt. It is helpful to have the opinions of these authors as to the identity of such varieties as *arduini* Gmel., *bicolor* L., *aethiops* Koern., and *cernuum* Ard.

The most comprehensive subsequent article on the sorghums of Africa is that by Stapf (*143*). Having access to the collections from the British colonies at the Kew herbarium, Stapf, in his classification, presents the most complete and accurate picture that has yet been published of the botanical relationships of the African sorghums, including both the wild and cultivated forms.

Stapf accepts Piper's contention (see p. 19) that the annual grass sorghums rather than the perennial *Sorghum halepensis* were the progenitors of our cultivated sorghums. To the units or divisions of these spontaneous annual forms, which Piper made subspecies, Stapf gives the rank of species under the genus *Sorghum* as established by Persoon. Piper did not attempt to classify botanically the cultivated forms, but Stapf placed these in 14 groups or species, of which he says (*143*):

> Concerning the species admitted here it may be remarked that they have been found to coincide to some extent with the groups which the American cultivators have empirically learned to distinguish. This seems to justify the hope that in a general way they may prove sound, however much correction in detail they may need and will no doubt undergo.

Stapf indicates that his primary groups (species) were based on comparisons made in the flowering stages of the plant rather than

when mature, his reason for this being that man's influence in the evolution of sorghums was aimed toward the production of more grain for food. Inherent phylogenetic differences would, therefore, he assumes, be more apparent in the immature inflorescence. While this appears to be good logic, there are certain quite specific differences in the size, color, and shape of the seeds which are useful in distinguishing varieties of cultivated sorghums, and these differences are not discernible in the immature spikelet. Stapf recognizes this in his final descriptions of the cultivated species, where he includes the characteristics of the mature caryopsis. These descriptions, although of a botanical nature, are much more complete and detailed than those of Stapf's predecessors. They take account of the characters of the culm and leaf as well as those of the panicle. As a rule his species groups are broader than those represented by our milos, durras, and kafirs. For example, *Sorghum roxburghii* Stapf, to which our shallu belongs, also includes a variety *semiclausum* Stapf with "panicles fairly dense" and the glumes clasping the grain "so that only its top or upper half is exposed." The same condition is apparent in the *S. durra* and *S. cafforum*, species including our durra and kafir, respectively. While not altogether satisfactory from an agronomic standpoint, Stapf's classification is very useful as a basis for such.

The cultivated sorghums and the grass sorghums are all included by Stapf in his group Eu-sorghums, described as having the "primary branches of the panicle whorled (at least at the lower nodes)." Under this group is a class in which the primary branches are divided and the racemes are both terminal and lateral. This second class is subdivided on the basis of whether the spikelets are deciduous or persistent. Those with deciduous spikelets include what he terms "spontaneous grasses" (our grass sorghums), while the cultivated sorghums are arranged under 14 species in the class with persistent spikelets. This division is not wholly correct, because Sudan grass (*Sorghum sudanensis* Stapf), placed by Stapf in the class with deciduous spikelets, has, in fact, spikelets that are quite persistent.

In his group having persistent spikelets, our cultivated sorghums, Stapf places 8 species in a class having the glumes wholly coriaceous or with only the triangular tip herbaceous. The 6 other species are placed in a class with glumes thinly crustaceous to papery. Within these two main groups the descriptions are founded in order of descending importance of the following characters: Density of panicle; position of glumes in respect to the caryopsis; shape of sessile spikelets; shape, nervation, and awnedness of glumes; color of glumes and pubescence; color, shape, and degree of exposure of caryopsis.

The French, like the English, are interested in sorghums primarily because of their African colonies. This crop has never been important in France, and not until recent years has there been any earnest effort made by French botanists to study the sorghums. There are numerous references to sorghum in French writings, listed rather fully in Piedallu's bibliography (*114*).

The earliest important French work from a classification standpoint is perhaps that of Sagot, which was published by Raoul (*119*)

after Sagot's death. This appears to be intended for Algerian agriculture, and there is a lack of specific descriptions which prevents the reader from identifying the varieties, which are designated in most cases simply by the locality where they originated and the native name, as "sorghum shalagoava from Zululand." The three groups or main divisions are based on the size and comparative density of the panicle and the position of the panicle branches in respect to the rachis (axis of inflorescence). Secondary divisions are founded on the degree to which the caryopsis is covered by the glumes. Within these secondary groups divisions are made on the basis of glume color.

Dumas (*62*) and Jumelle (*87*) have both published descriptions of varieties grown by the natives along the Niger and its tributaries in Senegal, neither contributing much in the field of classification. Jumelle separated his 15 varieties into two groups, 9 varieties with loose panicles and 6 with compact panicles. Within these groups his first division is based on the glume color. In the descriptions he includes comparative size of seed and glumes and the shape and pubescence of the glumes.

Gèze (*69*) in 1923 published an article which appears to be largely a discussion of the classifications of other authors. Piedallu (*114*) also in 1923 gives a chapter on the early history of sorghums, indicating extensive research in European libraries. His classification, however, evidences a lack of field knowledge concerning the crop, resulting in several inconsistencies such as the grouping of Sumac and Orange sorgo with kafir. His main divisions are based on the density of the panicle and the secondary divisions on the length of the axis of the panicle, and within these a third division or grouping is based on the shape of the panicle and color of the glumes.

In his classification of sorghum, Piedallu accepts the two species of Persoon, *Sorghum halepense* and *S. vulgare*. In the latter he includes all the cultivated sorghums as horticultural or botanical varieties. In the former he places all "wild" sorghum with aggressive rootstocks ("rampante stolonifera"), but later makes this class include the annual grass sorghums ("*S. halepense* et ses variétés annuelles"), an action not in accord with Piper's more logical arrangement.

The sorghums have from the earliest times been an important food and fodder crop in India. Because of their wide distribution and early culture there, Watt (*157, pp. 277–292; 158*) and other authors have considered India as the native home of the sorghums, or at least that it shared with Africa this distinction. If Piper's (*116*) contention is accepted that the cultivated sorghums were developed from the grass sorghums rather than from Johnson grass, the conclusion follows naturally that sorghums originated in Africa, because these grasslike sorghums are found growing spontaneously in equatorial and South Africa, while only the rootstock forms (*Sorghum halepense*) appear indigenous in India. Whatever the conclusion may be regarding the origin of this crop, there is no one who will dispute the importance of the sorghums in India or the fact that the Indian sorghums form a group rather distinct from

those in Africa, China, and the United States. Very few of the varieties imported from India have proved to be adapted to the United States.

Among the earlier writers who have published discussions of the "juars" or sorghums of India, perhaps Roxburgh (*127, pp. 268–273*), Duthie (*63*), Hooker (*81, pp. 183–184*), Watt (*157, pp. 277–292; 158*), and Church (*43, pp. 80–86*) are the best known. The most extensive of these are the works of Watt. He (*157, pp. 277–292*) discusses at length the botany of sorghums, particularly the arrangement of Indian varieties in the species established by Hackel and other authors. Considerable attention is also given to botany in his later article (*158*). There is but little to be learned, however, from his treatment. In fact, in his earlier work (*157*) he seems only to have added to the confusion, as witness his use of the term "broomcorn" as a synonym of sugarcane in a group along with sorgo, Planter's Friend, etc., under *Sorghum saccharatum* Pers., and the placing of the shallu of Bombay under *S. halepense* var. *roxburghii*, while "shalu" of Deccan is included under *S. saccharatum*. He gives an impressive array of arguments supporting the independent origin of sorghum in India and a remarkably long list of references which is valuable particularly in the field of early botanical history. In his later article (*158*) Watt apparently adopts the more rational system of grouping all the cultivated sorghums under *Sorghum vulgare* Pers., synonymous with *Holcus sorghum* L., *Andropogon sorghum* Brot., and *A. sorghum* subspecies *sativus* Hackel. The only other species recognized in this article by Watt is *S. halepense* Pers., which he properly limits to the rootstock forms such as the Johnson grass of the United States and the Baru grass of India. This action of Watt is in agreement with the final judgment of present-day botanists.

Watt's suggestion (*158, p. 110*) that the name "imphee" be applied to the sweet sorghums and sorgo reserved for the grain sorghums is an interesting idea whether or not he is correct in his belief that the name sorgo, originating in southern Italy, was first applied to "grain and fodder varieties." The practice of referring to the sweet-stemmed sorghums as sorgo has become so well established in the United States that it could not well be changed. There is, however, a recognized need for a suitable class name for the grain sorghums.

One of the first serious attempts to classify the sorghums in India was that of Benson and Subba Rao (*37, pp. 64–91*), and this was confined to the Province of Madras. The authors published (in part) as a footnote the tentative classification made by I. H. Burkhill in 1902 based on a collection of sorghums from the whole of India. Of this collection only six of the varieties were common to Madras. Unfortunately, Burkhill's complete classification appears never to have been published. Benson and Subba Rao omit most of his groups because they were not represented in Madras. From the three group descriptions given, Burkhill evidently made his primary division on the comparative length of the glumes and seed and his secondary divisions on the position of the glumes, the density of the panicle, and the shape of the seed. Within these groups the color, shape, and pubescence of the glumes are used in describing varieties. Burkhill's classification, while lacking in many particulars, impresses

one as having certain elements of fundamental value in a descriptive sense. He is reported to have arranged the sorghums of India in 8 groups containing 22 varieties.

According to Benson and Subba Rao, the situation regarding varietal names in India is much like that in the United States. They say:

> Whilst the cultivators in a majority of cases recognise the varieties of sorghum they know locally by specific names, sometimes these names are in themselves only vaguely descriptive, and sometimes the same name is applied to different sorts in different localities.

They indicate that the varieties are distinguished by the growers in the Madras Presidency according to the following characters:

1. Color of seed coat, glumes, and hilum.
2. Season at which sown.
3. Duration of growth.
4. Character of the inflorescence.
5. Number of nodes or leaves.
6. Flavor of stem and grain.

The authors do not seem to have developed any definite classification system of their own, but adopt an arrangement of Madras varieties in the groups established by Burkhill. The descriptive notes on 63 varieties by Subba Rao are rather complete from an agronomic standpoint, including statements as to soil preferences and suitability for use as fodder or grain in addition to a description of plant characters. This is a valuable bulletin for the student because of the opportunity it affords to become acquainted with the characteristics of Indian sorghums and their varietal names. Only the botanical variety Hians (shallu) is certainly represented among the varieties in the United States.

An interesting feature of the descriptions is the use of the transverse wrinkle on the glumes of the Irungiformis group as a distinguishing feature of these varieties. This would appear to indicate an alliance between this group and our milos, but this wrinkle in the Irungiformis group is near the middle. Below this wrinkle the glume is hard, and above it the glume is soft or thin with the nerves plainly marked. Such conditions do not apply to milo where the wrinkle is below the middle and the glume is neither especially soft nor thin above the wrinkle. In addition the panicles of these Indian sorghums are described as "much elongated", which definitely separates them from the milos with their short, compact heads.

Several previously unpublished names appear in this bulletin as applied by Burkhill to his sorghum groups. Some of these, like Irungu, Burmanicus, Irungiformis, and Combaticorus, have a distinctly Indian flavor, while others such as Eois, Medicoris, Compactus, and Agricolarum are apparently original with the author.

It was not until 1919 that a really effective classification of Indian sorghums appeared, and this applied only to those of one Province in that immense country. Kottur (*97*) published what seems to be a logical and simple arrangement of the principal varieties. His object, as stated in the introduction, was to classify each type studied so that its relationship to types met in another part of the country would be apparent. He has based his classes chiefly on panicle characters,

which he believes are "fairly constant when the different varieties are self-fertilized."

In India, as in Egypt, there are two essentially different seasons for planting and growing the sorghums. The kharif jowars are grown during the monsoon season (June to October) and the rabi jowars in the period after the rains (September to March) during the cooler weather. Kharif sorghums can be grown in the rabi season and vice versa, Kottur says, but the growth is not normal when the sorghums of either group are planted out of their season. The most frequent expression of this off-season effect is an extraordinary vegetative growth when the seeding time of a variety is changed.

Kottur in his studies of the sorghums in Bombay found "their agricultural characters so indefinite that they have had to be looked upon as secondary" for classification purposes. He has relied principally on three characters in his classification, explaining them as—

(1) The characters of the ear: The length of the rachis and its mode of branching give the ear a definite shape which can be easily identified. These characters seem to be constant.

(2) The character of the grain: The size, shape, and color of the grain seem important. It is sometimes difficult to determine the differences, but there is no doubt as to the constancy of these characters.

(3) The characters of the glumes: The color of the glumes and their hairiness are constant characters, but it is often difficult to distinguish the differences.

Using a more or less idealistic key, Kottur has placed in it 33 varieties designated by their local names with brief agronomic notes regarding each and has added a statement as to their local distribution and importance. The value of his publication is enhanced by excellent plate illustrations showing a typical head of each of the seven "groups."

While evident deficiencies appear in Kottur's classification, such as the markedly incomplete color descriptions, it has in its logical arrangement, simplicity, and clarity much to recommend it. The author has achieved in this work a pronounced advance toward the goal of giving a clearer conception of the situation existing in respect to the cultivated varieties of sorghum in India.

Kottur and Chavan (*98*) in 1928 supplemented the classification work with a report on their studies of variation within varieties. This variation study, pursued with the idea of making selections of higher yielding types, has a decided value for classification purposes in showing the stability of any given character. The authors determined for the progeny of close-pollinated plants the variation in height, number of nodes per stem, length of peduncles, length, thickness, and weight of head, weight of grain per head, and size of grain (determined by the weight of 100 grains).

The studies are limited to three kharif varieties, and the range of variation in all eight characters is wide. The means and modes, however, show a distinct varietal difference. The correlation of each character with yield was determined and was found highest for the length of the head. Differences between varieties in the amount of cross-pollination and the time of day in which the flowers open are also shown.

Later Patel and Patel (*110*) presented a very commendable statistical study of the sorghums grown in the Surat district of Gujarat. After a brief discussion of the acreage of sorghums and characteristics of the principal varieties in this part of India, a botanical description of the sorghum plant is given, together with notes on the natural cross-pollination which occurs in field cultures. The authors then present detailed data on the hereditary nature of certain characters in Surat sorghums. The characters included are leaf area, hairiness and color of leaves, height of plant, diameter of stem, number of nodes in stem, color of shriveled anthers, period from germination to flowering, length of rachis, density of head, and character of the seed. These data are useful in showing the extreme variability in most of these characters.

AMERICAN INVESTIGATIONS

Sorsby (*142*) claims he saw durra growing in Georgia in 1838. Outside of indicating that there were two varieties, the "White" and the "Reddish-brown", he contributes but little to our knowledge of classification. Most of his article is devoted to culture and uses.

Browne (*39*), in listing "seeds and cuttings recently introduced into the United States" in a report dated February 5, 1855, mentions "Dourah corn" as having been received from St. Martin in the West Indies and "sorgho sucré" from China via France. In a later article (*40*) in the same report he tells something of the characteristics of this sorgho sucré, particularly of its sweet juice, and intimates that it is related to broomcorn and the varieties of sorghum collected by Leonard Wray in Natal, South Africa. This article is accompanied by a full-page illustration of the plant showing six stems approximately 7 feet tall with loose panicles like those of the Minnesota Amber variety.

Olcott (*108*, *pp. 204–212*) in 1857 was among the earliest to publish descriptions of the sorgo varieties imported from South Africa by Leonard Wray. These descriptions by Wray, like those he supplied for the publications of Hedges (*74*, *pp. 19–53*) and Stewart (*144*, *pp. 210–222*), are complete for only 8 of the 15 varieties that he brought over from Africa. From the description supplied by these three authors it seems quite probable that the Nee-a-za-na of Wray is the parent variety of what is now being grown under the name of Sourless or White Orange.

Hedges (*74*) in his book published in 1863 gives an account of the introduction of 15 varieties of sorgo from South Africa by Leonard Wray. He also relates the circumstances connected with the introduction of Chinese sorgo by an agent of the United States Patent Office in November 1854. This variety was obtained from Vilmorin, Andrieux & Co., Paris, France, it having been sent to France in 1851 by Count de Montigny, then consul in Shanghai, China. Hedges quotes Wray's descriptions of the varieties, which he introduced under their native names. The descriptions are not specific enough to assure their identification with our present-day varieties. Wray places sorgo in the botanical group *Holcus saccharatus* L. and kafir in *Sorghum vulgare* Pers.

Hedges appears to have been fully aware of the tendency of sorghums to cross-pollinate in the field, and he warns growers that they

must give much attention to the purity of their seed if they hope to maintain a high sugar content in the juice. He speaks especially of the unreliability of seed produced in close proximity to broomcorn. It is to be regretted that he did not illustrate more of the varieties introduced by Wray. His figures of the panicles of Eanamoodee, Neeazana, and Oomseeana are more helpful than descriptions in identifying these.

Collins (*49*) in 1865 was commissioned by the United States Department of Agriculture to investigate the production and utilization of sorgo in China. The history of the introduction of this sorghum to France he recounts thus: Seed of a sorgo was sent by Count de Montigny in 1851 to the Geographical Society of Paris. This seed was given to M. Roberts, director of the Marine Gardens at Toulon, for propagation. He obtained only a single plant from the seed, but this flourished and produced seed so that "large crops" were gathered later in France and Algiers. In 1854 W. J. Browne, acting as agent for the United States Patent Office, obtained some of this seed and took it back to the United States, where it finally became widely distributed.

Pech (*111*) in 1866 discussed the botanical history of sorghum and included a synoptical table or scheme of classification along with illustrations of the panicles of seven varieties. Pech's classification was the basis of that later published by Collier (*48*). In this scheme the sorghums are divided into two groups, one in which the ripe seeds are longer than the glumes, and a second in which the ripe seeds are equal with or shorter than the glumes. The first group is represented by Liberian, which the author indicates includes six of Wray's varieties, viz, Ekothla, Koombana, Boomowana, Eengha, Booeana, and Eednomoodon. The second group is subdivided into a group with glumes equaling the length of the seed and one with glumes longer than the seed. "Black Imphee" is indicated as the sole representative of the last group. In the group with seed and glumes of equal length he has one, "Red Imphee" (Shlagoova), with the glumes closed, hiding the seed, and a contrasting group with open glumes, showing the seed. In this group the first division is based on glume color, the second on the density and shape of the panicle, and the third on the presence or absence of pubescence on the glumes. An interesting point is that he described the Neeazana, which he calls "White Imphee", as having glumes "greenish white or ash color", thus adding evidence to support the theory that Sourless and not Orange is the modern representative of Neeazana.

The classification presented by Pech leaves much to be desired. Judging from Wray's descriptions, there are wide differences among the six African varieties which Pech places in a single class as equivalents of Liberian. The pen drawings of the panicles and spikelets are crude and do not agree with illustrations of the same varieties in other publications.

Stewart (*144, pp. 210–222*) in 1867 published a book similar to that of Hedges (*74*). He has included Wray's description of the South African varieties. These descriptions should apparently be identical with those published earlier by Hedges, but do not agree exactly in several essentials. There is little in addition to the quotation from Wray of interest from a classification standpoint, ex-

cept the author's comment on the intermediates between the different groups of sorghums. This, he points out, indicates a close relationship and evidence that all the sorghums belong in a single botanical species.

Le Duc (*101, p. 233*) in 1877 included in his annual report some notes regarding the introduction of "Chinese sorgo" and the development of Minnesota Amber therefrom. These are for the most part unauthenticated reports from individuals who had a personal acquaintance with these varieties. Some of these claims are obviously inaccurate, but others appear to have a basis of fact and are fully possible.

C. D. Aldrich, Morristown, Minn., suggested that "Minnesota early amber" had been developed from Wray's Oomseana sorgo. This is highly improbable if not impossible, because the Oomseana had a long, narrow panicle with stiff branches, not likely to give rise to a type of panicle like that of Minnesota Amber, except through crossing with a loose-panicled variety.

E. Y. Teas, Dunreith, Ind., claimed that he obtained seed of the Chinese sorgo from Vilmorin, Andrieux & Co., Paris, France, in 1859, and that he selected an early-maturing plant from the resulting crop grown in Indiana. Seed of this plant named by him "Early Amber" was increased and later distributed in Minnesota and other States.

Edwin Henry stated that his father-in-law, William R. Prince, Flushing, Long Island, N. Y., imported seed of a "black-seed" sorgo from France in 1853 and offered a small quantity of the seed to the public in 1854.

Collier (*47*) in 1881 summarized the work of his division of the United States Department of Agriculture with sorghum. Thirteen plate figures showing panicles of certain varieties then being grown are very helpful in understanding the gross appearance of these varieties. A "synoptical table of the varieties of sorghum cultivated at the Department of Agriculture during the summer of 1880" provides some useful descriptive notes. A key or synoptical table follows that of Pech (*111*) in the use of characters in the following ranks: (1) Comparative length of ripe grain and glumes; (2) density of panicle; (3) color of glumes; (4) color of seed; and (5) shape of head, size and shape of seed, shape of glumes, etc.

Collier (*48*) in 1884 contributed the most pretentious account of the introduction and development of sorghum in the United States that had yet been published. In this book, most of which is devoted to an exposition of the possibilities of utilizing sorghum as a source of sugar, the author records many interesting observations regarding the introduction of sorgo varieties in the United States, and in addition presents a valuable discussion of the botany of sorghum with quotations from early botanical works and finally gives a description of the varieties included in his experiments. Connected with the varietal descriptions is a key for the identification of the varieties and 15 plate illustrations of what are presumed to be typical panicles of certain varieties.

He indicated that his key is based upon a similar one prepared by "F. Peck" and published in the United States Department of Agriculture Report for 1865. This publication only adds to the confusion regarding the characteristics of the Natal varieties introduced by Wray. Neither his descriptions nor his illustrations agree with those of Hedges (*74*). For example, compare the illustrations of Neeazana. This variety, claimed by Ball (*26, p. 34*) to be the progenitor of Orange sorgo, is described by Collier as having "seed

yellowish brown", while Hedges gives it white seed. The fact that an early synonym for Neeazana was "White Imphee" inclines one to believe that Hedges was more correct than Collier, in which case the Sourless would more probably be the modern representative of Neeazana.

In Collier's key the primary division is based on the comparative length of the caryopsis and the outer glumes, the second division on the density of the panicle, and the third on glume color. An interesting feature of Collier's illustrations are two varieties, the panicles of which resemble those of Collier sorgo in having a very short central axis of the inflorescence. He listed these as having been obtained from Cawnpore, India. If they did come from India, they are about the only valuable sorgos obtained there and are not truly representative of the Indian sorghums. Wray claimed these were represented in the varieties he introduced. Other varieties claimed by Wray (*172*) as his introductions were the one figured by Collier as Liberian, now represented by our Sumac (this was Wray's Koombana), and White Mammoth (Wray's Enyama), now being grown as White African. Wray's contentions in respect to these two varieties proved correct when he supplied some "old seed" of his Koombana and Enyama. These were, Collier states, identical with those of Liberian and White Mammoth.

Wiley and his coworkers (*160*, *161*, *162*, *163*, *164*, *165*) from 1887 to 1892 published a series of bulletins showing the sucrose and glucose content of the juice of different varieties of sorgo. In connection with other data there are a limited number of varietal descriptions. Though incomplete, these descriptions are of value as a record of varietal names and characteristics at that time. For example, the name White India was used for White Mammoth or Enyama, and both White African and Black African were mentioned with two other white-seeded varieties, White Enfield and Honey Dew, the latter represented by S. P. I. nos. 2368 and 2369. Both of these were grown in the varietal test at Bard, Calif., in 1915, and proved to be distinct varieties of no promise commercially.

Georgeson (*65*) in 1896 prepared for the United States Department of Agriculture a bulletin which was devoted chiefly to a discussion of the culture and uses of the kafirs. He speaks briefly of their introduction 10 years previously and describes three varieties—Red, White, and Black-hulled White kafirs. The descriptions are not sufficiently detailed for classification purposes.

Shaw (*133*) in 1900 divided the sorghums into two main classes—saccharine and nonsaccharine. He states: "This classification is based on the presence of sugar in considerable quantities in the matured cane or on its almost entire absence." Among the varieties named are Early Amber, Folger's Early, and Early Orange. He describes Minnesota Early Amber as a subvariety of Early Amber, and Kansas Orange as a subvariety of Early Orange. In the nonsaccharine class he includes as varieties "Kaffir corn, Milo maize, Dhourra, and Jerusalem corn." He speaks of red and white kafir corn, yellow and white Milo maize, and brown and white Dhourra. Brief descriptions of these varieties are given. The white Milo maize, as illustrated by the author in figure 11, is not the white milo now being grown in the southern Great Plains, but is a sorghum

introduced from the West Indies, under the name "Guinea corn." The plants in the photograph are immature, but where the heads are exserted they are plainly not those of milo. In this discussion the author reveals no very complete knowledge of the crop. There were at the time his book was written many other varieties of sorghum being grown.

Denton (*58*) in 1901 published the first farmers' bulletin discussing the manufacture of sorghum sirup, as a result of experiments conducted by the Department of Agriculture at Medicine Lodge, Kans. He includes very little regarding varieties, but names Early Amber as the best early sorghum, Collier as the richest in sugar, and Colman as one with larger, shorter stems and more seed than the others, yet having a satisfactory juice. The illustrations, while not very good, are from actual photographs of the panicles and are useful in indicating the shape and density.

An interesting feature of Denton's publication is his comment on the variation found in the quantity of the juice in a given variety from year to year. He says:

> A variety may be selected in one season because it produces good sirup; it may be rejected the next season because it produces poor sirup. Planted early it may produce good sirup, and when planted late it may produce poor sirup in the same season and on the same soil, yet in both seasons it may produce ample and good sirup-making material. The impurities vary in amount, according as the growing seasons are favorable or unfavorable.

Winton (*169*) in 1903 gave valuable assistance to later investigators by his study of the morphology of the seed of sorghums. In this study he found the seeds of certain varieties to possess a nucellar layer underneath the mesocarp and distinct from the aleurone layer. This layer of colored cells, which is entirely absent in some varieties, is therefore a character useful in distinguishing the varieties of sorghum.

Hartley (*73*) in 1903 published information concerning broomcorn, most of his bulletin being devoted to the culture and uses of the crop. He indicates that broomcorn belongs to the same botanical species as kafir and sorgo, and divides the varieties into two groups known as "Standard" and "Dwarf." Standard he describes as growing to a height of 10 to 15 feet, with a brush 18 to 28 inches long, and Dwarf as growing 4 to 6 feet high, with a fine brush 10 to 18 inches long.

Hunt (*83*) in 1904, in his book on cereals, devotes a few pages to a discussion of the botany, plant characters, and varietal differences of sorghums.

Ball (*25*) in 1906, in a bulletin devoted primarily to the sweet sorghums, discusses in a brief way the classification of sorghums and gives some useful information regarding the history and characteristics of a few of the most important sorgo varieties. He divides the sorghums into three groups, (1) broomcorns, (2) saccharine or sweet sorghums, and (3) nonsaccharine sorghums. The sweet sorghums he separates into four groups—Amber, Orange, Sumac, and Gooseneck. The nonsaccharine sorghums are placed in two groups—the kafirs, including Red, White, and Black-hulled White kafirs, and "White milo" (not the white milo of the present day but Guinea kafir), and the dhouras, including Jerusalem corn, Brown dhoura,

and Yellow milo. As synonyms of the durras, he records Egyptian corn, branching dhoura, rural branching dhoura, and dhoura corn.

Warburton (*155*) in 1907, in discussing the grain sorghums, supplements the earlier work of Hartley (*73*) on broomcorn and of Ball (*25*) on the sorgos. He follows Ball in dividing the sorghums into three groups—broomcorn, saccharine sorghums, and nonsaccharine sorghums. He also accepted Ball's divisions of the nonsaccharine sorghums into two classes—the kafircorns and the durras.

Scott (*132*) in 1908 published a short paper in which he suggested that all sorghums originated from a single species, and divided them into three classes, (1) saccharine, (2) nonsaccharine, (3) broomcorn. In a list of the varieties tested the only new one is Cigne, which is evidently a local name applied to a variety that he failed to describe.

Ball (*27*) in 1910 published a short circular to provide authentic information as to the identity of certain sorghum varieties which were at that time being widely advertised in the newspapers under fictitious and misleading names. This publication supplies information regarding the history and characteristics of shallu, "chocolate corn", and Gooseneck sorgo. The latter variety was then being sold as "Texas seeded ribbon cane", a name which, with variations, has continued in our agricultural literature down to the present day.

Ball's discussion of "chocolate corn" is interesting as indicating the presence of a "black-seeded" (probably indicates black glume) sorghum in western Pennsylvania and eastern Ohio in 1830. The author's conclusion that this variety was one of the black-panicled forms of Arduino which in some way was imported into the United States hardly seems justified in the light of more recent information. The "chicken corn", a black-panicled sorghum much like Minnesota Amber sorgo in appearance, was collected by Drummond at New Orleans, La., in 1832. Piper (*115, p. 42*) says that "chicken corn" was undoubtedly brought into the United States by Negro slaves from the Guinea coast of Africa. If so, it no doubt came in several years before the date Drummond collected it. This variety is still found along the Ohio River in southern Indiana and northern Kentucky, where it is considered a weed in cornfields.

Ball (*26, p. 8*) in 1910 presented a more complete classification of the sorghums. In the preceding decade he had devoted much time to a study of sorghums and thus was in a position to indicate more accurately than had previous authors the range of forms and natural relationships of the different groups. He says: "During the past 6 years more than 1,200 different lots of domestic and foreign sorghums have been brought together and grown experimentally." His key to the principal groups of sorghum includes sorgo, kafir, milo, broomcorn, shallu, and kaoliang. This key for the groups is the most satisfactory of all published up to that time.

Ball (*28*) in 1911 discussed the improvement of the grain sorghums, which by that time had assumed an important position among the farm crops grown in the semiarid sections of Kansas, Oklahoma, and Texas. In this bulletin the only important contributions to the knowledge of varieties are the statements made respecting the history of certain ones and the influence of selection on others.

Conner (*50*) in 1911 published a bulletin on the use of sorgos for forage. In his discussion of classification and varieties he divides the sorghums into two classes based on use, (1) "those that are grown primarily for forage and sirup", and (2) "those that are grown for grain." The author says the sorghums in group 1 are characterized by a high percentage of sugar in the stems, rather small heads, and the presence of tannin in the seed. Group 2 is made up of varieties with pithy or semipithy stems having little saccharine matter and rather large heads with seeds containing little or no tannin. He names seven varieties belonging to group 1 in the order of their commercial importance at that time, namely, Sumac, Amber, Orange, Planter, Gooseneck, Honey, and Sapling. Each of these is described in some detail.

Ball (*29*) in 1912 presented a suggested classification in which he divides the sorghums into five groups, broomcorn, shallu, sorghum, kafir, and durra, after which he considers these groups separately. A key to the groups is given first, followed by keys for varieties in each group. This method is well suited to a classification limited to the most important varieties, as it simplifies considerably the task of differentiating the varieties within a group. It is not adapted, however, for the identification of all varieties now being grown in the Sorghum Belt. Intermediate forms are continually appearing, either through natural crossing in the fields, e. g., Schrock and darso, or through directed effort at experiment stations, like Beaver and Chiltex. These intermediates cannot be definitely placed in any of the groups by the use of the suggested group key.

The characters used in separating the groups are in descending importance (1) juiciness of pith, (2) density of panicle, (3) rachis length compared with head length or position of head, and (4) minor characters such as spikelet shape, seed color, and shape of panicle. Keys for identifying varieties within a group make use of the above characters and several others such as the color, thickness, and presence of pubescence on the glumes, the diameter of the stems, the overlapping of the leaf sheaths, and the length of the seed as compared with that of the outer glumes.

Ball (*30*) in 1913 published a somewhat technical discussion of the kaoliangs, a group of sorghums which are grown to the practical exclusion of other varieties in northern China, Manchuria, and Chosen (Korea), but which never succeeded in the United States in competition with the sorghums originating in Africa. This profusely illustrated bulletin of 64 pages leaves little to be desired in the way of information on kaoliangs. The author classifies 58 separate introductions into 27 varieties; 5 of these had white seeds and 22 brown seeds. Color of seeds is the basis of the primary division; color of glumes secondary; the third rank is dependent on the shade of color and shape of the seed; and the fourth rank on the size, density, and shape of the panicle. The varietal names applied are evidently improvised and more or less descriptive.

Ball and Rothgeb (*32*) in 1913 collaborated in a publication on the kafirs. A simple key for the identification of the five varieties is given, and detailed descriptions of each variety are included. Pink kafir is listed along with White, Blackhull, Dwarf, and Red.

Churchill and Wright (*44*) in 1914 issued a bulletin in which considerable space is devoted to varietal descriptions. The illustrations are very helpful, providing visual comparisons of milos, kafirs, durras, kaoliangs, and shallu. White milo, similar to the yellow milo except for the seed and glume colors, as well as darso, a new hybrid, was described, perhaps for the first time. This white milo is entirely distinct from the variety first described by Ball (*26, p. 32*) under this name. The "white millo maize" of Ball did not in fact belong to the milo group, but was more closely related to the kafirs. Ball recognized this and suggested the name Guinea kafir for this variety. The white milo of Churchill and Wright is a true milo.

Piper (*117*) in his book published in 1914 (revised in 1924) included a brief statement regarding the botany of sorghums and their classification by groups. In his proposed key for these groups he adopted the classification proposed by Ball (*29*) with minor modifications and the addition of another group to include Sudan grass and Tunis grass. In the first edition he places sorghum in the genus *Andropogon*, but in the revised edition he accepts the Persoon genus *Sorghum*, separating this group from other Andropogons. The cultivated sorghums are listed as *Sorghum sorghum*, Sudan grass as *S. sorghum* var. *sudanese*, and Johnson grass as *S. halepense*. Stapf (*143*) regarded the wild forms of grass sorghums in Africa as distinct species, but Piper contended that they together with the cultivated sorghums represented one species because "all the wild forms cross with the cultivated varieties with great readiness."

Piper (*115*) early in 1915 presented a critical analysis of the botanical relationships of *Andropogon halepensis* and *A. sorghum*. Keys for the identification of different subspecies in the grass sorghum and Johnson grass group are provided. He followed this later in the same year with an article (*116, p. 110*) supporting the theory that the grass sorghums of Africa are the prototype of the cultivated sorghums. This theory was first propounded by Hackel in 1886, but in such manner that a majority of botanists considered that he referred to the rootstock forms like Johnson grass. Piper clears up this misunderstanding, showing that Hackel really referred to the group of wild sorghums that did not possess rootstocks, which are now called grass sorghums, designated by Hackel as *Andropogon sorghum effusus*, *A. sorghum virgatus*, and *A. sorghum aethiopicus*. The theory of Hackel and Piper has been confirmed by Longley (*102*) and others in cytological investigations showing that the grass sorghums have the same number (10 haploid) of chromosomes as the cultivated sorghums, while Johnson grass has twice that number.

Vinall and Edwards (*151*) in 1916 described certain sorghum varieties recently introduced into the United States. Information regarding the history and brief but detailed descriptive notes are given for Dwarf hegari, "Improved feterita", Dwarf feterita, white milo, and "Schrock kafir." The feterita (F. C. 811) described as Dwarf feterita has been shown later not to be a true dwarf.

Rothgeb (*123*) in 1916 published a short bulletin on dwarf broomcorn. He introduces the new name Acme (Dwarf Standard) for a variety resembling Standard in the length of the brush but more like dwarf broomcorn in its height and the manner in which the

brush (panicle) can be disjointed from the stem by jerking it. This feature contributes to the ease and lessens the expense of harvesting the brush.

Conner and Karper (*52*) in 1917 published a brief note giving the results of measurements of the internodes and leaf sheaths of milo and kafir at Lubbock, Tex., in 1916. The data showed that while environmental conditions had a marked effect on the length of the internodes, the length of the leaf sheath did not vary to any extent. The overlapping of the leaf sheath is of course dependent on the relative lengths of the internode and its accompanying sheath. The authors conclude, therefore, that this character is not a reliable one to use as a classification factor.

Madson (*104*) in 1917 gave directions for the production of grain sorghums in California. He also gave a few pages to descriptions of types and varieties, including 6 varieties of kafir, 3 of milo, 4 kaoliangs, and 2 durras, besides feterita and shallu.

McArthur (*103*) in 1918 described a number of varieties then being grown in New Mexico and included a "key for the identification of grain sorghums." This publication was intended for the extension worker, and, although the recommendations regarding soil adaptations and rules for selecting to improve the type are no doubt useful, the descriptions are incomplete and the key for identification of varieties wholly inadequate and in some respects inaccurate.

Rothgeb (*124*) in 1918 published a treatise on standard broomcorn, supplementing his previous bulletin (*123*). Very little attention is given to classification. The author says that there are two chief kinds of broomcorn, the Standard and the Dwarf, and he lists nine varietal names that have been applied to standard broomcorns.

Ball and Rothgeb (*33*) in 1918 published results of grain sorghum experiments in the Texas Panhandle and included a key to the principal varieties within the groups. These keys were based on those previously developed by Ball (*29*) and Ball and Rothgeb (*32*).

Hensel (*77*) in 1919, in a publication wherein he disclaims any credit for original ideas, suggests that the more than 200 so-called "varieties" may be very largely local names for forms derived from Amber, Orange, Sumac, Gooseneck, and Honey.

Willaman, West, and Bull (*168*) in 1919 proposed a key for the classification of a limited number of sorgo varieties. In addition the botany of sorghum is discussed briefly. In their key the primary division is based on the position of the peduncle, whether erect or recurved; the secondary division on the density of the panicle; the third ranking on the comparative length of the rachis (central axis of inflorescence) and the panicle; and final divisions within these groups were based on glume and seed color.

Beeson and Daane (*36*) in 1919 described a new variety, darso sorghum, which had originated in Oklahoma. This publication provides the first authentic statement regarding the history and characteristics of this variety.

Rothgeb (*125*) in 1920 described some new varieties in his bulletin discussing the culture of grain sorghums. Dawn and Sunrise kafirs had been originated several years previously by A. H. Leidigh and had by this time become more or less standardized.

Rothgeb (*126*) in 1920 in discussing milo presented some information regarding its introduction into the United States and also the characters of this group of sorghums.

Vinall and Getty (*152*) in 1920 discussed the use of sorghums for forage. It is suggested that the sorghums may be divided into four broad groups, (1) sorgos, (2) grain sorghums, (3) grass sorghums, and (4) broomcorns. Only sorgos and grain sorghums are considered in this bulletin, and the important varieties of each group are listed.

Conner and Dickson (*51*) in 1921 reported on the origin and characteristics of Spur feterita and gave a detailed account of its performance at several stations in Texas.

Vinall and Getty (*153*) in 1921 published a résumé of information regarding Sudan grass, including information on the introduction of this grass sorghum and its botanical relationships with other species of sorghum belonging to this group and their distribution in Africa. Tunis grass (*Sorghum virgatum* (Hack.) Stapf), Kamerun grass (*S. effusum*),[5] Tabucki grass (*S. verticilliflorum*),[6] Hewison grass (*S. vulgare hewisonii*),[7] and "chicken corn" (*S. vulgare drummondii* (Nees) Hitchc.) are included in the discussion. A brief statement regarding sorghum-Johnson grass hybrids calls attention to their close resemblance to the grass sorghums. Illustrations of representative panicles of the different species are given.

Thompson (*148*) in 1923 reported on the production of sorghum in Arizona, naming the most important varieties of the grain sorghums and sorgos with brief descriptions of each. The author includes Standard and Dwarf broomcorn and mentions Sudan grass, Johnson grass, and Tunis grass as belonging to the sorghum family.

Sieglinger (*136*) in 1923 used the same key with minor modifications as that used earlier by Ball and Rothgeb (*33*). In their inclusion of grass sorghums, however, these authors, unfortunately, added Johnson grass, which is now properly placed in a different species from the sorghums.

Vinall, Getty, and Cron (*154*) in 1924 reported on experiments with sorghums at various points in the Great Plains. The grouping of the sorghums is the same as that proposed in a previous publication of Vinall and Getty, and no classification of the varieties is attempted. There are, however, extensive records respecting the growing season, height, grain yields, and forage yields of numerous varieties, together with illustrations showing the habit of growth and general appearance of certain ones.

Sieglinger (*137*) in 1924 called attention to the presence of a brown subcoat or nucellar layer in feterita, Dwarf hegari, Blackhull kaoliang, and certain brown-seeded sorgo varieties; also the absence of this nucellar layer in White and Red kafirs, White and Yellow milos, and White durra. Data respecting the manner of inheritance of this factor are presented.

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[5] **Sorghum effusum** (Hack.) Vinall. *Andropogon sorghum* subsp. *halepensis* var. *effusus* Hack., in DC., Monog. Phan. 6: 503. 1889.

[6] **Sorghum verticilliflorum** (Steud.) Vinall. *Andropogon verticilliflorus* Steud., Syn. Pl. Gram. 393. 1854.

[7] **Sorghum vulgare var. hewisonii** (Piper) Vinall. *Andropogon sorghum hewisonii* Piper, Biol. Soc. Wash. Proc. 28: 41. 1915.

Gibbons (*70*) about 1924 published a bulletin discussing the production of broomcorn in Oklahoma which included a brief section on classification and varieties. He states the classification proposed was suggested by Sieglinger (*138*).

Cowgill (*55*) in 1926, after several years spent in observation of sorgo varieties under field conditions at Fort Smith, Ark., published a study of the panicle characters of these varieties which adds greatly to the knowledge concerning the details of these characters. The illustrations in this bulletin are especially commendable and contribute much to a clear understanding of the details of structure in the spikelets. After describing the chief panicle characters which differentiate the varieties, the author discusses varietal groups and presents a synoptical key of varieties and finally a detailed description of those varieties grown under his observation at Fort Smith. The rank or value of characters used in classifying the varieties are as follows:

(1) Relative compactness of the panicle, (2) comparative exsertion of the caryopsis, (3) relative degree of thickening of the glumes, (4) form of spikelets, and (5) color of spikelets or caryopses or special features of the panicle or spikelets.

The three main groups under this system are, according to the compactness of the panicle, (1) effuse, (2) contracted, and (3) compact.

The chief criticism of this otherwise excellent work is perhaps that the sorghums studied were not in all cases truly representative of the varieties as commonly grown in the sorghum belt; in addition, the climate at Fort Smith, Ark., was such as to cause the panicle branches to assume unnatural positions when mature.

Sieglinger (*138*) in 1928 published the first comprehensive classification of broomcorn varieties grown in the United States. His key to groups and varieties of broomcorn establishes 4 groups—standard, European dwarf, western dwarf, and whisk dwarf. There are 5 varieties of standard, 1 of European dwarf, 2 of western dwarf, and 1 of the whisk dwarf. Acme, the dwarf-standard mentioned by Rothgeb (*123*), is placed in the western dwarf group as a synonym of Evergreen Dwarf. In his key the author made the height of the stalk the basis of his primary division into groups. His secondary division is based on the length of the peduncle and the firmness with which it was attached at the base. Varieties within these groups were separated on the basis of glume color, time required for maturity, and certain other characters, such as position of seeds on the panicle and quality or fineness of the brush. Detailed descriptions of individual varieties are given, as well as brief statements regarding the history of each.

Cowgill (*56*) in 1929 followed his earlier publication (*55*) with a more popular treatment of the subject for general distribution. The descriptions of varieties are based on the study of panicle characters reported in the earlier publication, but in addition the certain characters of the stem, such as height and diameter, are mentioned, and a list of synonyms is given.

Swanson (*146*) in 1929, in an article devoted primarily to the genetics of seed color in sorghums, explains and illustrates the morphology of the seed coats in different varieties. The chief point of interest and value from a classification standpoint is the presence in certain varieties of a pigmented subcoat or nucellar layer which

is not found in other varieties. Winton (*169*) first pointed out this difference, but did not associate the character with as many varieties as did Swanson. Swanson also developed the fact that the nucellar layer was more or less visible through the pericarp when the mesocarp layer was thin or poorly developed. In such cases the nucellar layer became a contributing factor in the seed color.

Martin and Washburn (*106*) in 1930 provided the latest information regarding broomcorn. Like preceding publications, this one devotes most attention to culture, uses, and marketing. In addition, however, they record interesting facts concerning the introduction of this crop into the United States and the characteristics and relationships of the principal varieties being grown. The classification follows closely that given by Sieglinger (*138*) in 1928. The authors divide the broomcorns into three groups—standard, western dwarf, and whisk dwarf. Evergreen, Black Spanish (Black Jap), and California Golden (Aksarben) are listed as the standard varieties; Evergreen Dwarf (Oklahoma Dwarf, Acme), Scarborough, and Black Spanish Dwarf as dwarf varieties; and Japanese Dwarf as the whisk dwarf representative.

Karper et al. (*93*) in 1932 reported agronomic experiments with grain sorghums in Texas, and Quinby et al. (*118*) in 1934 reported the experiments with forage sorghums. While they do not give classifications of the sorghums, they do give partial descriptions of the varieties grown in the State and useful information regarding the history and distribution of varieties.

A similar treatment of the more important sorghums grown in Oklahoma was given by Kiltz et al. (*94*) in 1933.

Recommendations for cultural practices under California conditions were published by Hendry (*76*) in 1933. He gives brief descriptions and rather complete histories of the varieties important in California, but many of rather wide distribution in other parts of the country are not grown there.

Getty (*68*) in 1934 included sorghums in his publication of experiments with forage crops at Hays, Kans., and gave brief descriptions of some varieties along with the agronomic data.

Swanson and Laude (*147*) in 1934 also reported experiments with sorghums in Kansas and included a classification which was proposed for "practical purposes" and "agronomic rather than botanical" (*147, p. 12*). In this classification there are 4 primary groups and either 1 or 2 ranks of subdivisions in each group; following the subdivisions the varieties are listed. Their discussion includes the description, history, and distribution of each variety.

Hume and Franzke (*82*) in 1934 reported the results of agronomic experiments in South Dakota, but relied largely on previous publications for their descriptions of varieties.

BOTANICAL RELATIONSHIP OF THE GENUS SORGHUM

Sorghum belongs to the grass family, Poaceae (or Gramineae), the subfamily Panicatae, and the tribe Andropogoneae. The genus *Sorghum* Moench (Meth. Pl. 207, 1794), which is so closely related to the native American wild grasses in the genera *Andropogon* and *Sorghastrum*, has the spikelets in pairs, one sessile and fertile, the other pedicellate, sterile, usually staminate, the terminal sessile spike-

let with two pedicellate spikelets. The sorghums are usually tall, robust grasses with flat leaf blades and terminal panicles. The two natural divisions of the genus grown as field crops in the United States are *Sorghum halepense* (L.) Pers., in which the plants are perennial with creeping rhizomes and 20 chromosomes (Johnson grass), and *S. vulgare* Pers., annual plants with 10 chromosomes (sorghums, Sudan grass, etc.) (*85*, *91*, *102*).

The name given this genus was adopted by Hitchcock (*79*, *p. 695*; *80*) in accordance with the rules of the International Botanical Congress. Earlier he had applied the name *Holcus* to the genus (*78*, *p. 226*), in accordance with the American code of nomenclature. The cultivated sorghums all belong to *Sorghum vulgare* (*Holcus sorghum* L.; *Andropogon sorghum* Brot.).

Stapf (*143*) in his discussion of the genus *Sorghum* recognizes a great many species. Cytological investigations by Longley (*102*), Karper (*91*), and Huskins and Smith (*84*, *85*) indicate that the wild grass sorghums (annuals) of Africa, so far as they have been examined, have, with one exception, the same number of chromosomes as the ordinary cultivated sorghums. This certainly indicates a common origin and close relationship between these two groups. Since the botanical species are intended to indicate close relationship and similarity in plants, it is suggested that the taxonomist can make good use of the cytologist's findings in regard to the number of chromosomes. The one exception to the 10-chromosome number in the annual sorghums is *S. versicolor* Anderss., which has only 5 chromosomes.[6] It would appear logical, therefore, to give this a species rank but to consider all the 10-chromosome forms as *S. vulgare*, listing the variations as subspecies or varieties.

DESCRIPTION OF THE SORGHUM PLANT

The sorghum plant is a coarse annual with culms 2 to 15 feet and sometimes more in height. The culms consist of a hard cortical layer or shell filled with pith interspersed with vascular bundles and are made up of 7 to 18 or more nodes and internodes. Each internode is channeled on one side, the channels of adjacent internodes being on opposite sides of the culm. The surface of the culms, sheaths, and leaves is glaucous. A leaf arises at each node, alternating on opposite sides, and the leaves thus appear approximately in a plane. The leaf blades are glabrous with a glossy or waxy surface, although some hairs occur on the upper surface at the base of the leaf blade. The margins of the leaves bear sharp, curved teeth. Numerous motor (hygroscopic) cells are located near the midrib on the upper side of the leaf, and these facilitate rapid folding of the leaf blades during dry weather.

A bud is formed at each node of the culm except the terminal one, and when small lies within the channel of the internode. These buds under some conditions give rise to side branches.

The inflorescence of sorghum is a panicle of varying size and density with many primary branches borne on a hairy axis. The

[6] This discovery of a 5-chromosome species was made first by A. E. Longley, associate botanist, Division of Genetics and Biophysics, Bureau of Plant Industry, U. S. Department of Agriculture. The drawings published in 1932 (*102*, *fig. 3*) were prepared by Longley in November 1925. He first reported his findings in an unpublished paper presented at a meeting of the Botanical Society of America in December 1928. Longley's observations were verified by Karper in 1930 (*91*).

spikelets are ellipsoidal, of varying length and diameter, and usually somewhat compressed dorsiventrally. The sessile spikelets are perfect and usually fertile, but the pedicellate are sterile or staminate. The lemma and palea are thin and translucent. The lemma may be either awned or awnless.

DEVELOPMENT OF THE SORGHUM PLANT

Upon germination of a sorghum seed, the radicle elongates and produces a single seminal root. The coleoptile elongates to a certain extent and, together with the plumule enclosed within it, is pushed up to the surface of the soil by the elongation of the subcrown internode below the coleoptile. The plumule then grows out of the coleoptile, and the crown begins to form at the base of the coleoptile. At high soil temperatures the subcrown internode sometimes extends above the surface of the soil and the crown is formed there. Permanent roots develop from the crown and push downward and outward into the soil. Some rootlets are found on the subcrown internode scattered throughout its length. The secondary roots are rather fibrous and numerous.

Buds are formed at each node of the sorghum stem both above and below the surface of the soil. Below the soil surface the nodes are closely crowded together. The buds are formed on opposite sides of the culm at each successive node. Each plant produces eight or more crown buds. When conditions are favorable for tillering, one or more of these crown buds elongates to produce the tiller or sucker stalks. The tillers may be the same height as the main stalks or considerably taller or shorter, depending upon the growing conditions at the time the tillers are elongating. Each plant, as time and opportunity permit, can produce as many tillers as there are tiller buds in the crown. Each tiller develops an independent root system and also the usual number of crown buds. If satisfactory growing conditions continue, the tillers can themselves produce secondary tillers, permitting the development of a large number of stalks from a single seed.

VARIETAL STUDIES

The present investigations are the outgrowth of a long series of variety tests conducted by the United States Department of Agriculture on field stations in the Great Plains. In 1915 all of the foreign introductions, as far as viable seed was available, were grown at Bard, Calif., under irrigation. This test was designed to provide material for classification studies and a determination of the limits of variation in sorghums. A fairly complete herbarium of pressed specimens representing portions of the stem with leaves attached and corresponding mature heads of these plants was collected, and detailed descriptive notes were recorded from growing plants in the field. This extensive comparison of types from practically all countries where the sorghums are grown proved rather conclusively that there are no distinct lines of demarcation between the different groups of sorghums; the sorgos grade insensibly into the kafirs through intermediates with more or less juicy stems, and, on the other hand, certain kafirs are almost indistinguishable from hegari, and the hegari blends with feterita, which in turn is connected by intermediates with durra,

and the latter in the same way with milo. This condition is perhaps a natural one in a crop which cross-pollinates as freely as the sorghums. With this in mind, and also the fact that crosses of the groups are being made in considerable numbers, and these hybrids obviously cannot be placed in either of the parent classes, it has seemed undesirable to emphasize the groups in a varietal key intended for identification purposes. A discussion of all the numerous intermediates would only result in confusion; therefore this study is limited to the varieties that have been grown in the United States and have assumed some importance in practical agriculture.

The principal tests were located at Hays, Kans., Woodward, Okla., and Chillicothe, Tex., stations fairly representing the northern, middle, and southern sections of the principal sorghum-growing area of the United States. The varietal tests have been in progress at these points from 15 to 20 years. Data obtained under these conditions are believed to represent accurately the normal behavior of each variety. The extensive series grown in southern California, beginning at Bard in 1915 and continued at Chula Vista, were irrigated. While the growth measurements were no doubt relatively correct, they did not represent so accurately as the tests in the Great Plains the natural behavior of the plants. Figures 1 and 2 show field cultures of Minnesota Amber sorgo at Hays, Kans., and Blackhull kafir at Chillicothe, Tex., respectively.

Efforts were begun in 1924 to compile the data from the several stations, and arrangements were made with the Division of Crop and Livestock Estimates of the Bureau of Agricultural Economics, United States Department of Agriculture, for a survey of the acreage and distribution of the principal varieties being grown commercially. These survey data, collected in 1925, provide the basis for the distribution maps.

The history of each variety was compiled from publications of the United States Department of Agriculture, State experiment stations, books, agricultural papers, and other published and unpublished material. The origin of some of the early varieties will always remain in doubt, but the records of those originating after the Department of Agriculture and the State experiment stations began to observe and study the crop are fairly authentic. Several unknown varieties were encountered in the varietal survey, but in each case these apparently had a very limited distribution and their omission from this bulletin therefore seems warranted.

ESTABLISHING VARIETAL TYPES

In the test made at Bard, Calif., 1915–18, approximately 800 separate lots or numbers obtained from domestic and foreign sources were seeded in 12-foot rows 42 inches apart. Much of this seed was old, and perhaps not over 75 percent of the lots produced stands. Many of the sorgos were grown from seed that had been preserved through successive generations by the Department of Agriculture from the early work with this crop at Medicine Lodge, Kans., and other points. Most of the varieties were represented by from 10 to 20 strains, all of a similar type and differing only in minor character-

FIGURE 1.—Experimental plot of Minnesota Amber sorgo at Hays, Kans., showing appearance in the field and the usual variation in panicle characters due mainly to differences in stage of maturity.

FIGURE 2.—Experimental plot of Blackhull kafir at Chillicothe, Tex., showing appearance in the field and the slight variation in panicle characters of this variety.

istics. This extensive collection served to fix in the minds of observers the distinctive characteristics of each variety and to form a basis for choosing the varietal type as described here.

In the tests conducted on field stations in the Great Plains, numerous introductions from foreign countries as well as many accessions from domestic sources were included first in rod-row tests and later in plots if they exhibited any promise of usefulness. By a process of elimination the number of varieties was gradually reduced to about 50 or 60. These were grown in $\frac{1}{10}$- or $\frac{1}{20}$-acre plots usually replicated 2 or 3 times. Constant attention was given to the purification and improvement of the variety by bagging heads and selecting seed from the best typical plants.

In establishing varietal types an attempt has been made to have them conform to early descriptions when such were available. The type concept for each variety as indicated in the illustrations and descriptions is a product of these early descriptions and later observations made on experiment stations at Bard, Calif., and in the Great Plains as well as on farms throughout the Sorghum Belt. It is of the greatest importance that the descriptions of varieties should be based on authentic material grown under conditions favorable to the production of the crop where a normal development of the plants is assured.

CHARACTERS USED TO DESCRIBE VARIETIES

Unfortunately, only a few of the characters of sorghum are definite and uninfluenced by environment. Such differences as white contrasted with colored kernels, starchy as contrasted with waxy endosperms, or the presence as contrasted with the absence of a nucellar layer are definite and easily determined. On the other hand, shape of panicle, size of kernels, height of plant, and many other characters, while inherently different in different varieties, are so influenced by environment that their value in descriptions is very limited. Since there are not enough definite characters to distinguish between all the varieties, it is necessary to use the less definite characters also.

PLANT CHARACTERS

MATURITY

The time of maturity is an important varietal characteristic in sorghums. This character varies widely in different seasons and is affected also by date of planting, early planting usually resulting in a longer growing season than late planting, unless the planting is so late that maturity is retarded by cool weather in autumn. The relative order of maturity of varieties is fairly constant, although occasional shifts in the usual order occur under different environments resulting from different dates of planting at the same location. Some varieties are more sensitive than others to environmental differences, insofar as time and maturity are concerned. In classifying varieties for maturity, averages for a considerable period of years have been used, except for varieties grown only a few years, and these latter have been compared with standard varieties of known maturity. Considering the number of days as the period between

planting and maturity under average conditions, the following arbitrary classes have been used in the descriptive notes of varieties:

Very early	90 days or less.
Early	91 to 100 days.
Early to midseason	101 to 108 days.
Midseason	109 to 114 days.
Midseason to late	115 to 120 days.
Late	121 to 124 days.
Very late	125 or more days.

These averages are subject to considerable environmental fluctuation, and under extreme conditions a variety may be as much as 25 days earlier or later than the average period. Comparative periods of maturity or dates of heading are a reliable measure of the relative maturity of sorghum varieties when varieties of known growth habits are included in the tests.

HEIGHT

The height of sorghum plants varies widely with environment and shows some fluctuation of relative heights under different conditions. The comparative heights are rather consistent, however, except when a tall or a late variety is stunted by drought or other factors and prevented from making a normal development. In general, varieties more than 72 inches in average height are regarded as tall, whereas those less than 48 inches are regarded as dwarf. A few very short or extra-dwarf varieties seldom reach 40 inches and often are 30 inches or less. Height is determined by both the length and the number of internodes, but chiefly by the length.

STEM CHARACTERS

DIAMETER

The thickness of stem is of some value in identification. Varieties described as thick-stemmed have a stem diameter at the lower internodes of 1 inch or more, whereas the stem diameter of varieties classed as slender does not exceed five-eighths of an inch. Early varieties usually have slenderer stems than late varieties.

JUICINESS

All sorghum stalks contain considerable juice before maturity. As the plants approach maturity and thereafter, the moisture content of the stalks gradually decreases.

Sorghums differ widely in the apparent juiciness of the pith of the stalks although the range in actual moisture content of the pith may not exceed 20 percent. The pith of stalks regarded as juicy has a watery appearance and yields considerable juice under pressure. The pith of the so-called dry-stemmed varieties has a somewhat dry, white appearance and yields much less juice under pressure. As a class, the sorgos are very juicy; the kafirs are mid-juicy; and broomcorn, kaoliang, durra, and shallu are ordinarily regarded as dry. The milos are somewhat intermediate in juiciness between durra and kafir. In determining the juiciness of the stalk of sorghum varieties, it is not necessary to examine the interior of the stems because the juiciness or lack of juiciness of the stems is indi-

cated in a broad way by the midrib of the leaf. Juicy varieties have a dull gray or cloudy midrib, due to the presence of the abundant juice. Dry-stalked varieties, on the other hand, have a pure white midrib, owing to the lack of juice.

SWEETNESS

The juice of the sorgos is sweet, whereas that of grain sorghums is not sweet or only slightly sweet. The differences are due to the relative quantity of sugar accumulated in the juice of the stem. In determining sweetness of varieties for the descriptions, sugar analyses were not made, but relative sweetness was estimated by taste.

TILLERING

The number of tillers formed is to some extent a varietal characteristic. Certain kafirs and kaoliangs tiller rather sparsely, whereas most sorgos, milos, feteritas, and hegari tend to tiller freely. Favorable growing conditions with an abundance of moisture and ample space for individual plants favor the development of tillers. Certain varieties, like Reed kafir, produce few tillers even under very favorable conditions. Tillering varieties that do not develop any tillers in an unfavorable environment may produce as many as 8 or 10 primary tillers per plant under good conditions. As an average for an entire field, however, three tillers per plant are about the maximum, unless the stand of plants is thin. The number of tillers developed depends upon both the environment and the varietal tendency in the development of crown buds.

BRANCHING

All sorghums can produce branches, since buds are borne at all nodes except the upper one, which produces the terminal leaf. The buds ordinarily do not develop into branches until the stem is approaching maturity, and under ordinary conditions not more than one or two branches are produced. The upper bud usually produces the first branch, and the succession of branches proceeds down the stalk. Varieties of sorghum differ considerably in the tendency to branch, early varieties being more subject to branching because they reach maturity before the close of the growing season. In the Sorghum Belt of the United States the frost-free period is not sufficiently long to permit the development of branches in the late varieties. All varieties will branch eventually if the plant is not killed, and the branching may proceed down the stalk until all of the nodal buds have developed.

LEAF CHARACTERS

NUMBER

The number of leaves has long been regarded as a varietal characteristic. The number of leaves at maturity is also a measure of the number of nodes in the stem above the surface of the soil. Each node produces a leaf, but the small leaves produced by the nodes in the crown usually have dried and disappeared before the plant is mature. Early varieties of sorghum have about 7 to 9 leaves above the crown,

while late varieties may produce 15 or more. The number of leaves is directly correlated with the period of maturity of varieties. In the variety descriptions, those varieties which on the average have 10 leaves or less to the stalk are classed as sparsely leaved, those with 11 to 13 leaves as mid-leafy, and those with 14 or more leaves as leafy.

MIDRIB COLOR

The color of the midrib is of value in descriptions. The white and cloudy (dull gray) midrib color has been previously mentioned in connection with the juiciness of the stalk. In addition to these two colors, there is a yellow midrib characteristic of milo, caused by the presence of a yellow pigment (carotin) in the pith immediately underlying the cortical layers of the midrib on the upper leaf surface. These outer layers of the midrib are translucent and permit the expression of colors or juice in the underlying pith.

In the descriptions varieties are classified as having white, cloudy, or yellow midribs. In varieties having white midribs the whole midrib of a mature leaf is pure white, and usually the white appearance has completely developed in half-grown leaves, but in the leaves of seedlings or very young leaves of older plants the midribs usually are cloudy. The cloudy characteristic, as previously noted, is due to the presence of juice or sap in the midrib. This juice may extend entirely across the midrib and usually does in young leaves, but as the plant nears maturity the amount of juice diminishes, leaving a white streak in the center of the midrib. The width of this white streak varies in different leaves, plants, varieties, and seasons, but all varieties that have leaf midribs with cloudy margins—that is, with midribs not totally white—are classed as cloudy. Yellow pigment in the midribs is variable, and frequently it is apparent only in a few leaves or portions of leaves. The yellow does not cover up the cloudy appearance, but those varieties in which some yellow coloring develops are classified as having yellow midribs.

OVERLAPPING OF SHEATHS

Varietal differences occur in the number of leaves, length of leaf sheaths, and length of internodes in the sorghums, with consequent differences in the overlapping of the sheaths. The leaf sheath attached at one node may not reach the next node above in some varieties, while in others it may overlap the sheaths attached at several higher nodes.

Conner and Karper (*52*) have shown that the length of internode is influenced much more than the length of sheath by environment, and that overlapping of sheaths is of minor value in describing varieties. Since there are varietal differences, however, when the compared varieties are grown under either normal or like conditions, this character has been used. The degrees of overlapping shown in the descriptions are: None if the leaf sheath does not reach the node above that to which it is attached, slightly or little if it extends just beyond the first node, moderately if it extends to the second node, and much if it extends beyond the second node.

COLEOPTILE COLOR

Reed (*120*) separated the color of the coleoptiles of sorghum seedlings into either red or green, although the green coleoptiles of some varieties may show traces of pink or purple color. The red color may sometimes extend to other seedling tissues. It is controlled by a simple dominant factor and is of value in distinguishing between some varieties or hybrids.

PANICLE CHARACTERS

LENGTH

The panicles of the cultivated varieties of sorghums, except broomcorn, average from about 5 to about 12 inches in length, extreme lengths of normal panicles ranging from 3 to 18 inches. Most varieties of milo, feterita, and durra and also Sumac sorgo have relatively short panicles, usually less than 8 inches in length; kafirs usually have long panicles, more than 9 inches in length; while different varieties of sorgo may have either long or short panicles. The panicle length depends mainly upon the length of the rachis and the upper panicle branches and to a less extent upon the position of the branches, whether appressed or spreading. Environmental factors modify the panicle length in all varieties.

POSITION

The position of the panicle is described as (1) erect or (2) inclined or recurved. Recurving is the bending of the peduncle during the heading period, caused, as shown by Conner and Karper (*53*) and by Martin (*105*), by a thick heavy panicle being forced out the side of the sheath, followed by the bending of the young soft peduncle, which has not yet become sufficiently lignified to provide the stiffness to support the panicle. After recurving occurs the peduncle becomes lignified and stiff and thus is permanently recurved. Recurved peduncles in the sorghums cultivated in the United States are confined to certain varieties of milo and milo hybrids, durra, and Gooseneck sorgo. Recurving is most abundant when the plants are thinly spaced and growing under favorable conditions at heading time. Under such conditions large, heavy heads are produced, and the rapidly elongating peduncle is not stiff enough to hold the heads erect when they emerge from the sheath. The rachis branches of long, rapidly growing broomcorn panicles sometimes recurve, but this is different from the recurving of the peduncle.

DENSITY

The density of the panicle is here divided into three arbitrary classes—effuse, mid-compact, and compact. Effuse panicles have long branches usually spread out in open, treelike fashion but often drooping to one side as in shallu and broomcorn. In compact panicles the branches and branchlets are shortened to such an extent that the mature seeds seem to be crowded together. Panicles classed as mid-compact are intermediate between the effuse and compact classes in the length and position of the rachis branches.

SHAPE

The shape of the sorghum panicle is determined by the combined effects of the number and position of the panicle branches and the length of branches in different parts of the panicle.

RACHIS LENGTH

The length of the rachis (axis of the inflorescence) with reference to the total length of the panicle constitutes an important character in determining the shape of the panicle. In a panicle having a rachis nearly the full length of the inflorescence the branches toward the tip are usually progressively shorter and the panicle is tapering at the tip. If the rachis is much shorter than the panicle the tip branches obviously are long and tend to give the panicle a clavate shape. The extreme case of a short rachis is in a well-formed broomcorn panicle in which the branches arise in a compressed series of whorls and extend far beyond the end of the rachis.

The rachis of a sorghum panicle is furrowed throughout its length, the number of furrows and ridges varying from 5 to 9. Some varietal differences also exist in the depth of the furrows, and in the abundance of pubescence on the rachis as pointed out by Cowgill (*55*).

RACHIS BRANCHES

The branches of the rachis are arranged in more or less definite whorls with a few branches arising between the whorls. Each panicle consists of 4 to 16 whorls with 3 to 9 branches arising at each whorl. The rachis branches range in length from a half inch to occasionally as much as 7 or 8 inches in sorghums other than broomcorn, while in the latter they range from about 12 to 24 inches or even longer. Compact-headed varieties have short branches. In the descriptions of varieties the branches are classed as short, mid-long, and long.

The position of the rachis branches varies among the sorghum varieties and is listed under three classes—appressed, spreading, and drooping. Appressed branches lie close to the rachis at an angle not greater than 30°. Drooping branches have tips lower than the base. Spreading branches are intermediate between the other two classes.

GLUME CHARACTERS OF SESSILE SPIKELETS

PUBESCENCE

The glumes of nearly all sorghums are at least partly pubescent, although some are nearly glabrous. In the very pubescent types, such as some durras and broomcorns, the pubescence is dense over the entire surface of the glume. This extremely pubescent type of glume also is expressed in the plants by excessive hairiness on the upper surface at the bases of the leaves. Most of the pubescence is found on the upper half of the glumes and along the edges. At maturity the pubescence tends to become detached from the glumes and mature glumes of some varieties are nearly free from pubescence. Threshing also detaches much of the pubescence, and excessively

22613—36——3

pubescent types are disagreeable to thresh because the pubescence causes an irritation of the eyes and skin which is sometimes called "broomcorn itch."

COLOR

Glumes of sorghum varieties are of various colors, including white (or straw colored) and shades of red and brown, shading into reddish black and black. The colors can usually be distinguished without much difficulty if it is borne in mind that they are not fully developed in the immature panicle and that after maturity weathering often results in fading and uneven distribution.

SHAPE

The shape of the glume surface as viewed from the exterior is described according to common descriptive terms, such as elliptic, ovate, and obovate. Those having a pronounced bulge or outward swelling at or near the middle are described as gibbous. Some have a narrow transverse depression across the glume, as in milo. This has long been regarded as a characteristic typical of milo, although some milo hybrids, such as Beaver, Wheatland, and Fargo, do not possess this character. The development of the large obovoid kernels pushes the upper portion of the glumes outward as the kernels enlarge. This outward bending greatly accentuates the crease. If the kernel is removed from the spikelet while still small, the glume is only slightly wrinkled.

The tip of the sorghum glume is usually either acute (sharp) or obtuse (dull), but occasionally is rounded or nearly truncate (square). The glume tips of many varieties are somewhat intermediate between the acute and obtuse type, and often the tips split or break off, making exact description difficult.

TEXTURE

The texture of glumes is described as indurate (hard), coriaceous (leathery), or chartaceous (papery). Most varieties have indurate glumes, which in some cases are thicker than in others. Thickness of the glume is difficult to measure and therefore is of little value in description.

There are varietal differences in the venation of sorghum glumes, as pointed out by Cowgill (*55*), but these differences are too variable and difficult to determine for general use in these descriptions.

AWNEDNESS

The lemma of sorghums is very thin, papery, and fragile and is of little value for identification purposes except for the presence or absence of awns. Sieglinger, Swanson, and Martin (*140*) divided the awned character into four genetically and morphologically different classes, namely, strong awned, weak awned, tip awned, and awnless. The classes used here for descriptive purposes are awned and awnless. The base of the awn is attached at about the middle of the lemma, and the awn extends considerably beyond the lemma and glumes, rarely less than 4 or 5 mm. In most awned varieties the awn is twisted and also geniculate (bent). Awnless glumes are of two

types. The lemma of kafirs has only a short rib extending from the middle not quite to the tip of the lemma. Feterita and hegari lemmas, on the other hand, bear a short awn or pointed structure extending to or a little beyond the tip of the lemma. These tip awns sometimes are exposed but rarely are more than 2 mm long.

PEDICELLATE SPIKELETS

Sterile or staminate spikelets are borne on pedicels at the base of each fertile or sessile spikelet. The pedicellate spikelets lie along the face of the glumes of the sessile spikelets and may or may not be staminate; sometimes they produce pollen, but they never contain pistils and therefore do not produce seeds. Two pedicellate spikelets are attached to the sessile spikelets at the tip of each secondary branch, but single pedicellate spikelets are attached in a cluster to all of the other sessile spikelets. The characters of the pedicellate spikelet of value in describing varieties are size, color, and deciduousness. In many varieties the pedicellate spikelets are small and rather inconspicuous, while in other varieties they are considerably longer than the sessile spikelets. The color of the glumes of the pedicellate spikelets may be the same as the sessile spikelets, but often they are of a lighter color, frequently being straw colored. In some varieties the pedicellate spikelets are largely deciduous at maturity, while in others they remain attached to a large extent.

STIGMA COLOR

Stigmas of sorghum flowers vary in color from pure white in Blackhull kafir to yellow in milo. Contrasts in stigma color are of some use in distinguishing varieties during the blooming period.

KERNEL CHARACTERS

EXPOSURE

The exposure of the kernel is a rather important varietal characteristic. It is determined by the relation between the size of the glume and the size of the seed. In some varieties, such as broomcorn and Amber sorgo, the glumes are as long as the kernels and cover them entirely or nearly so. Kernels in some of the grain sorghums are exposed beyond the ends of the glumes for more than half their length. The width of the glumes near the tip determines the opening between the glumes and affects the proportion of the kernel that is exposed in the angle of the glumes. In general, the more the kernel is exposed the easier it is separated from the glumes in threshing. Shallu kernels differ from those of other sorghums by rotating a quarter turn so that they are at maturity in a plane perpendicular to the glumes.

SIZE

The size of the kernel in sorghums varies widely. Small-seeded varieties weigh only about 8 to 10 g per thousand seeds. Mid-sized seeds weigh from 12 to 24 g per thousand seeds on the average. Large seeds usually weigh 25 to 35 g per thousand seeds, with occasional lots of large-seeded feterita or milo weighing more than 40 g

per thousand seeds. Some of the sorgos, particularly Sumac, have very small seeds; most of the kafirs and many of the sorgos have mid-sized seeds. The milos as a group have large seeds and the feteritas very large seeds.

COLOR

The colors listed in the descriptions of sorghum kernels are white, chalky white, pink, yellow, red, buff or brownish yellow, brown, and reddish brown. Some white-seeded varieties also have red or brown spots. The pigment of sorghum kernels is formed in two distinct layers, (1) the epicarp (or outer layer of the pericarp), and (2) the nucellar layer, which lies next to the aleurone layer of the endosperm. The presence or absence of a nucellar layer can be detected by scraping off the outer layers. The nucellar layer is lacking in many varieties but is always colored brown when present. Between the two colored regions are other layers of cells, but the only one of consequence in descriptions is the mesocarp. In most varieties the mesocarp is thin, but in some sorghums (feterita, hegari, and Wonder) it is thick. Yellow and red seeds have color in the epicarp only. In the buff or light-brown varieties the nucellar layer is present. In the dark-brown or reddish-brown varieties the nucellar layer is present and the epicarp is colored. Chalky white varieties have the brown nucellar layer but no color in the epicarp.

SHAPE

The shape of the kernel, as viewed from the dorsal (embryo) or ventral (hilum) surfaces with the basal or hilum end below, usually is oboviod, although some are more or less ovoid or ellipsoid. A few varieties have kernels almost orbicular in outline. The seeds also differ in the degree of dorsoventral flattening, durra seeds being particularly flat, and others, such as feterita and milo, somewhat so. In most of the sorghums the flattest surface is on the same side as the embryo and the seeds most frequently come to rest with the embryo underneath. Seeds of feterita and Grohoma, however, are most flattened on the side opposite the embryo and usually come to rest with the embryo above. A few varieties have a large scutellum that extends above the endosperm, making the embryo region appear very large.

ENDOSPERM

The endosperm of sorghum seeds may give either a starchy or a waxy reaction when the iodine test is applied. Karper (*92*) determined the segregation of progenies resulting from crosses between the two types and found the starchy character to be completely dominant over the waxy.

The endosperm giving the starchy reaction consists of an outer corneous portion and an inner chalky or soft starch portion. The relative thickness of the corneous layer is to some extent a varietal characteristic, although it is highly influenced by environment (fig. 3).

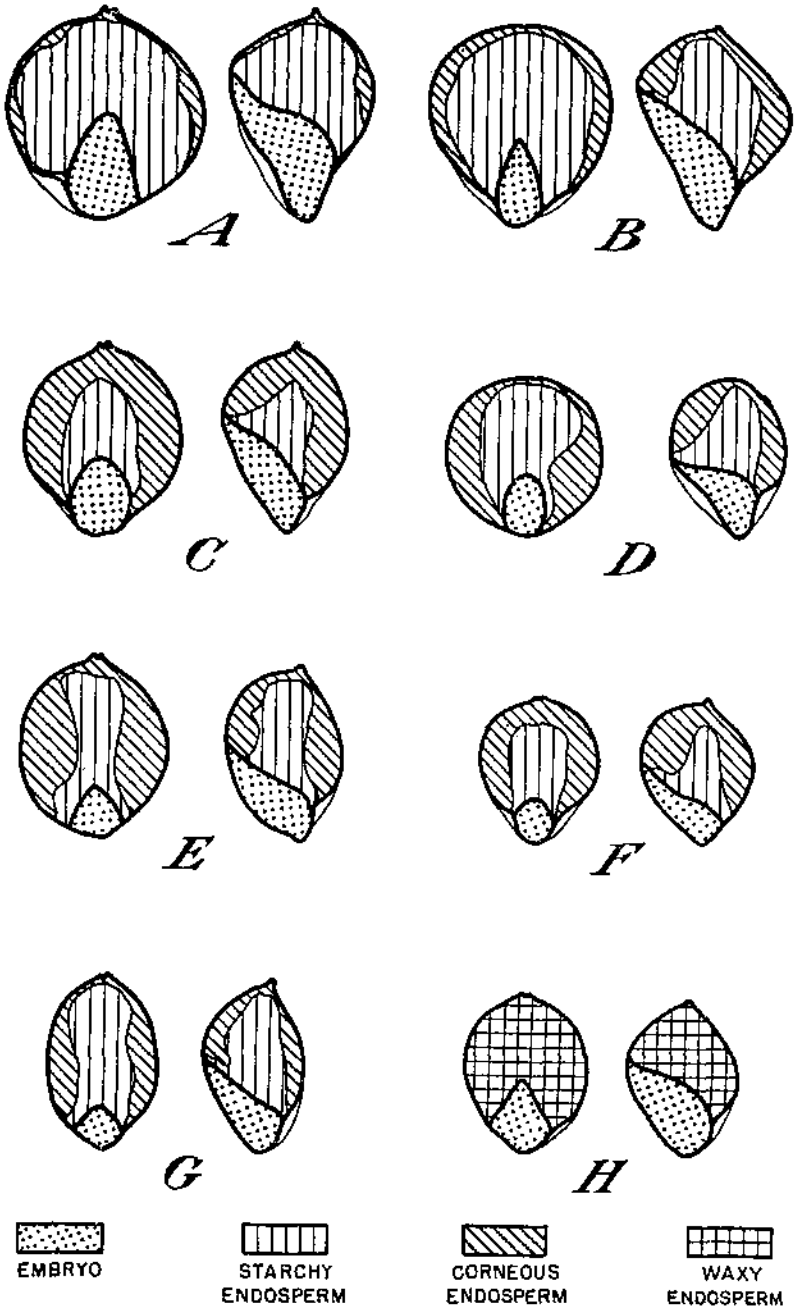


FIGURE 3.—Outline drawings of dorsoventral and lateral cross sections of sorghum seed, showing variations in (1) size and shape, (2) proportion of outer corneous and inner soft starch in endosperm, and (3) size and shape of embryo: *A*, Standard feterita; *B*, Standard Yellow milo; *C*, Blackhull kafir; *D*, hegari; *E*, Orange sorgo; *F*, Sumac sorgo; *G*, Sapling sorgo; *H*, Gooseneck sorgo (endosperm waxy).

KEY FOR IDENTIFICATION OF COMMON SORGHUM VARIETIES

A key for the identification of sorghum varieties should preferably be based on easily distinguished kernel characters, so that the varieties can be determined from seed samples, and otherwise on panicle characters which allow for identification from head specimens. Plant characters such as relative dates of maturity, height, and juiciness of the stems, while very important from an agronomic standpoint, are undesirable in an identification key unless taxonomic differences sufficiently definite to distinguish between varieties from seed and panicle characters do not exist.

In the key here presented, those kernel and panicle characters which allow for the greatest contrast are given primary importance and are used in regular order. Minor characters are used when necessary to bring out varietal differences, and in no regular order. With a number of closely related varieties and strains within varieties no distinctions other than agronomic could be indicated.

	Description No.
1a. Panicle branches less than 8 inches long.	
2a. Nucellar layer absent.	
3a. Awns absent.	
4a. Kernels white.	
5a. Glumes straw-colored or yellowish white.	
Panicles mid-compact, cylindroid, not well exerted from upper sheath.	WHITE KAFIR..... 21
5b. Glumes black or brownish black.	
Kernels approximately same length as or slightly longer than glumes.	
Panicles cylindroid; plants midseason, mid-tall; stems mid-juicy, not sweet.	REED KAFIR..... 18
Panicles obconoid to cylindroid, relatively short; plants midseason to late, very tall; stems mid-juicy to juicy, sweet.	WHITE AFRICAN SORGO. 60
Kernels much longer than glumes.	
Panicles ellipsoid to cylindroid, usually tapering at apex and base.	
Plants mid-tall to tall (average 70 inches), midseason to late; stems juicy and sweet.	ATLAS SORGO 61
Plants mid-tall to tall (average 70 inches), midseason; stems slightly sweet to sweet.	SUNRISE KAFIR..... 16
Plants dwarf to mid-tall (average 48 inches), early to midseason; stems not sweet.	DAWN KAFIR..... 17
Panicles cylindroid to clavate, usually slightly flaring at apex.	
Kernels white with dark spots.	
Plants midseason (average 114 days), mid-tall (average 56 inches).	STANDARD BLACKHULL KAFIR. 12
Plants early to midseason (average 106–110 days), mid-tall (slightly shorter than Standard).	DWARF BLACKHULL KAFIR. 13
	WESTERN BLACKHULL KAFIR. 14
	TEXAS BLACKHULL KAFIR. 15

		Description No.
Kernels pearly white.		
Panicles rather thick and shaped like Blackhull kafir.	PEARL KAFIR	19
Panicles narrower than those of Blackhull kafir.	RICE KAFIR	20
4b. Kernels colored.		
5a. Glumes straw-colored to reddish brown.		
Kernels small to mid-size; panicles cylindroid, rather long and narrow; coleoptiles green.		
Kernels pink or nearly white with pink flecks; stigmas creamy white.	PINK KAFIR	22
Kernels reddish brown to yellowish red; stigmas yellow.	RED KAFIR	23
5b. Glumes dark reddish brown.		
Kernels mid-size to large; panicles cylindroid (shorter and thicker than in Red or Pink kafir); coleoptiles red.		
Kernels yellow; stigmas pale yellow	WHEATLAND	32
3b. Awns present.		
4a. Kernels white.		
5a. Glumes straw-colored or yellowish white.		
Panicles effuse, erect (but in shallu usually drooping).		
Glumes involute and spreading; kernels usually rotated and much exposed.	SHALLU	37
Glumes not involute, appressed and usually adhering to kernel.		
Plants mid-tall to tall	FREED	38
Plants dwarf	DWARF FREED	39
Panicles compact, inclined to recurved.		
Glumes pubescent; kernels much flattened.		
Plants mid-tall	WHITE DURRA	1
Plants dwarf (30–38 inches)	DWARF WHITE DURRA.	2
5b. Glumes black or brownish black.		
Transverse wrinkle present; panicles inclined to recurved; coleoptiles red.		
Plants midseason, mid-tall.		
Stems mid-stout; stigmas yellow	STANDARD WHITE MILO.	28
Stems mid-stout to stout; stigmas creamy white (panicles slightly longer and more pointed than in Standard White milo).	DESERT BISHOP	35
Plants midseason, dwarf (about 48 inches); stigmas yellow.	DWARF WHITE MILO.	29
Plants early to midseason, mid-tall. Stems mid-slender; stigmas yellow.	EARLY WHITE MILO.	30
Transverse wrinkle absent; panicles not recurved; coleoptiles green.	BISHOP	36
4b. Kernels colored (salmon yellow or reddish yellow).		
5a. Glumes straw to reddish brown, not transversely wrinkled.		
Coleoptiles red.		
Panicles mid-compact to effuse, peduncle erect but panicle often drooping.	FARGO	33
Plants late, mid-tall.		
Panicles compact, occasionally inclined or recurved.		
Plants early to mid-season, very dwarf (about 30 inches).	BEAVER	31

		Description No.
Coleoptiles green.		
Panicles mid-compact, erect.		
Plants late, mid-tall	MANKO	34
5b. Glumes black to dark reddish brown, transversely wrinkled.		
Panicles inclined to recurved, coleoptiles red.		
Plants mid-tall (about 62 inches)	STANDARD YELLOW MILO.	25
Plants dwarf (about 48 inches)	DWARF YELLOW MILO.	26
Panicles occasionally recurved, usually not exerted well from upper sheath; coleoptiles red.		
Plants very dwarf (about 30 inches)	DOUBLE DWARF YELLOW MILO.	27
2b. Nucellar layer present.		
3a. Awns absent except for "tip awns" in feterita and hegari.		
4a. Kernels white.		
5a. Glumes black.		
Tip awns absent; kernels dull white.		
Kernels approximately same length as or only slightly longer than glumes, mid-size; rachis branches appressed.		
Panicles cylindroid; stems dry	CHILTEX	8
Panicles ellipsoid; stems mid-juicy	PREMO	9
Kernels extending beyond apices of glumes and well exposed; glumes not so prominent as in Chiltex and Premo; stems dry.		
Panicles cylindroid to ellipsoid; rachis branches appressed.	WONDER	11
Panicles ovoid to obovoid; rachis branches appressed to sometimes partly spreading.	AJAX	10
Tip awns present.		
Kernels very large and flattened on hilum side, chalky white; coleoptiles green; stems dry or only slightly juicy.	STANDARD FETERITA	4
Plants early, mid-tall; stems mid-slender to mid-stout.		
Plants early to midseason, mid-tall; stems mid-stout.	SPUR FETERITA	5
Plants early to midseason, dwarf; stems mid-stout.	DWARF FETERITA	6
Kernels small to mid-size, not appreciably flattened on hilum side, white; coleoptiles green; stems mid-juicy.	HEGARI	7
4b. Kernels colored.		
5a. Glumes black.		
Endosperms starchy.		
Kernels extending well beyond apices of glumes, much exposed.		
Kernels intense, very dark reddish brown; coleoptiles red; stems juicy.		
Panicles compact, cylindroid, short; kernels small, nearly globose.		
Plants midseason to late, tall	SUMAC SORGO	43
Plants early to midseason, mid-tall.	EARLY SUMAC SORGO	44
Kernels reddish brown; coleoptiles red; stems juicy.		
Panicles mid-compact, cylindroid.		

		Description No.
Kernels mid-size, obovoid, relatively broad and extending almost half of length beyond apices of glumes; glumes short, broadly ovate.	SUGAR DRIP SORGO	66
Kernels small to mid-size, ellipsoid, relatively long and extending less than half of length beyond apices of glumes; glumes relatively narrow, ovate, or ovate-elliptic.	SAPLING SORGO	55
Kernels buff or light brown (not red); coleoptiles green; stems mid-juicy.		
Panicles mid-compact, cylindroid to fusiform, usually tapering at apex.	GROHOMA	40
Kernels usually equal to or not so long as glumes.		
Coleoptiles red.		
Panicles small, mid-compact to effuse, ellipsoid to fusiform; rachis branches mid-long and appressed or slightly spreading.		
Plants very early, mid-tall	DAKOTA AMBER SORGO	48
Panicles large, effuse, conoid to ellipsoid; rachis branches mid-long to long and spreading.		
Plants early, tall	MINNESOTA AMBER SORGO	46
Panicles mid-compact, cylindroid or approaching cylindroid; rachis branches mid-long, appressed or slightly spreading; glumes sometimes very dark reddish brown.		
Plants midseason, tall	FOLGER SORGO	59
Coleoptiles green.		
Panicles small, sometimes effuse and umbelliform, but more often with rachis branches lying close together and drooping to one side; rachis very short; rachis branches long and fruited only near outer ends.	COLLIER SORGO	64
Endosperms waxy.		
Kernels usually equal to or shorter than glumes; apices of glumes straw-colored.		
Coleoptiles red.		
Panicles cylindroid or approaching cylindroid; pedicellate spikelets long, persistent, conspicuous.	McLEAN SORGO	62
Kernels usually longer than glumes.		
Coleoptiles green.		
Panicles cylindroid to obconoid and various shapes; pedicellate spikelets not conspicuous.	SCHROCK	42
5b. Glumes mostly straw or reddish straw colored but frequently with black streaks, spots or bases.		
Panicles compact; kernels longer than glumes, brown, much flattened; glumes straw-colored, pubescent; stems dry.	BROWN DURRA	3
Panicles mid-compact; stems juicy.		
Kernels dull reddish brown, well exposed.		

		Description No.
Rachis branches mid-long, loosely appressed.		
Panicles mid-size to small, approaching cylindroid but sometimes ellipsoid; plants midseason, mid-tall to tall.	ORANGE SORGO	50
Panicles mid-size, thick, cylindroid to ellipsoid or tending to be clavate; plants midseason to late, tall.	KANSAS ORANGE SORGO.	51
Kernels buff or light brown, well exposed.		
Rachis branches mid-long.		
Panicles ellipsoid to cylindroid; glumes occasionally somewhat red or with black spots but mostly straw-colored; coleoptiles green.	SOURLESS SORGO	54
Rachis branches mid-long to long, frequently drooping to one side.		
Panicles ellipsoid to obconoid or variable in shape and tending toward effuse; glumes frequently black at base and sometimes second glume entirely black; pedicellate spikelets large, persistent and conspicuous; coleoptiles red.	PLANTER SORGO	56
5c. Glumes red or reddish brown.		
Panicles mid-compact, cylindroid to fusiform, rather narrow; rachis branches short to mid-long; glumes usually with straw-colored margins; coleoptiles green.		
Kernels undeveloped in many sessile spikelets; embryos not prominent.	DENTON SORGO	65
Kernels developed normally in sessile spikelets; embryos prominent.	REX SORGO	63
Panicles mid-compact, cylindroid to ellipsoid; rachis branches short to mid-long; glumes usually without straw-colored edges; coleoptiles green.		
Glumes intense red	COLMAN SORGO	52
Panicles effuse, ellipsoid, mid-size to large; rachis branches long; coleoptiles red.		
Glumes deep red	RED AMBER SORGO	49
3b. Awns present.		
4a. Kernels colored (buff or reddish brown).		
5a. Glumes black.		
Endosperms starchy.		
Kernels usually equal to or sometimes shorter than glumes; glumes intense black and shiny; coleoptiles red; stems juicy.		
Panicles mid-compact, obovoid, erect to inclined or recurved; plants very late, very tall.	GOOSENECK SORGO	57
Panicles effuse, conoid to ellipsoid, erect; plants early, tall.	MINNESOTA AMBER SORGO.	46
	WACONIA AMBER SORGO.	47
Kernels longer than glumes; glumes reddish black to brown; coleoptiles green; stems mid-juicy; midribs sometimes yellow.		
Panicles mid-compact, ellipsoid, erect; plants midseason, dwarf to mid-tall.	DARSO	41

		Description No.
Endosperms waxy.		
Kernels usually equal to or sometimes shorter than glumes; glumes intense black and shiny; coleoptiles red; stems juicy.		
Panicles mid-compact, obovoid, erect to inclined or recurved; plants very late, very tall.	GOOSENECK SORGO	57
Panicles effuse, conoid to various shapes, erect; plants early, tall.	CHINESE AMBER SORGO.	45
5b. Glumes red.		
Endosperms starchy.		
Panicles mid-compact, ellipsoid to ovoid; glumes reddish brown to yellow or straw; stems dry; plants very early, mid-tall.	MANCHU BROWN KAOLIANG.	24
Panicles effuse, ellipsoid, mid-size to large; glumes deep red; stems juicy; plants early, mid-tall to tall.	RED AMBER SORGO	49
Panicles very effuse, conoid, large; glumes brownish red; stems juicy; plants late, tall.	HONEY SORGO	53
Endosperms waxy.		
Panicles mid-compact tending toward effuse, cylindroid to obconoid; glumes dull yellowish-red; stems juicy; plants early to midseason, mid-tall to tall.	LEOTI SORGO	58
1b. Panicle branches more than 8 inches long; rachis very short with branches much extended and usually lying close together, forming a brush; stems dry.		
2a. Nucellar layer present.		
3a. Long awns present.		
4a. Kernels reddish brown, usually shorter than glumes.		
5a. Glumes chocolate or dark brown to black.		
Panicles usually completely exerted from sheath.		
Peduncles usually 8 inches or longer, firmly attached at base.		
Plants early[9] (82 days), tall (90 inches); rachis branches 16–22 inches long.	BLACK SPANISH BROOMCORN.	68
Panicles usually enclosed by upper sheath one-half to two-thirds of length.		
Peduncles usually less than 8 inches long, weakly attached base.		
Plants early, mid-tall; rachis branches 16–22 inches long.	BLACK SPANISH DWARF BROOMCORN.	72
5b. Glumes tan or straw colored.		
Panicles usually completely exerted from sheath.		
Peduncles usually 8 inches or longer, firmly attached at base.		

[9] The descriptive terms used in connection with maturity and height are relative only within the broomcorn group and are not in harmony with the same terms as applied to other sorghums. The number of days is from planting until heading.

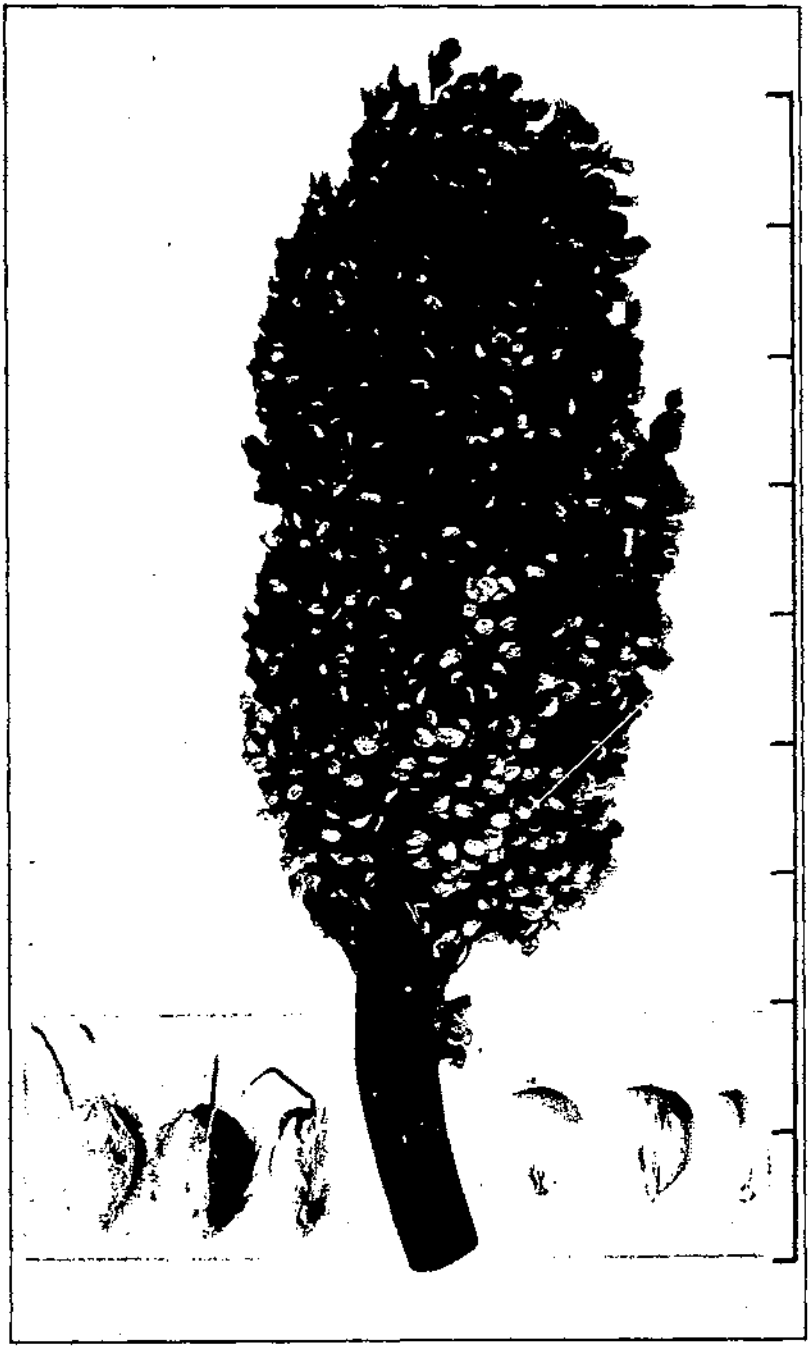
		Description No.
Plants early (84 days), tall (88 inches); rachis branches 16–22 inches long.	CALIFORNIA GOLDEN BROOMCORN.	69
Plants midseason (89 days), tall (95 inches); rachis branches 16–24 inches long.	EVERGREEN BROOMCORN.	67
Plants late (99 days), very tall (101 inches); rachis branches 18–32 inches long.	LATE EVERGREEN BROOMCORN.	67
Panicles usually enclosed by upper sheath from one-half to two-thirds of length.		
Peduncles usually less than 8 inches long, weakly attached at base.		
Plants midseason (91 days), mid-tall (58 inches); rachis branches 16–24 inches long; seed borne mostly near tips of branches.	SCARBOROUGH BROOMCORN.	71
5c. Glumes red or tinged with red.		
Panicles usually enclosed by upper sheath from one-half to two-thirds of length.		
Peduncles usually less than 8 inches long, weakly attached at base.		
Plants midseason (90 days), mid-tall (55 inches); rachis branches 16–22 inches long; seed borne mostly on upper third of branches.	EVERGREEN DWARF BROOMCORN.	70
Panicles usually enclosed by upper sheath from two-thirds to three-fourths of length.		
Peduncles short and weakly attached at base.		
Plants early (89 days), dwarf (41 inches); rachis branches 12–18 inches long.	JAPANESE DWARF BROOMCORN.	72

DESCRIPTIONS, HISTORY, DISTRIBUTION, AND SYNONYMY OF COMMON SORGHUM VARIETIES

1. WHITE DURRA

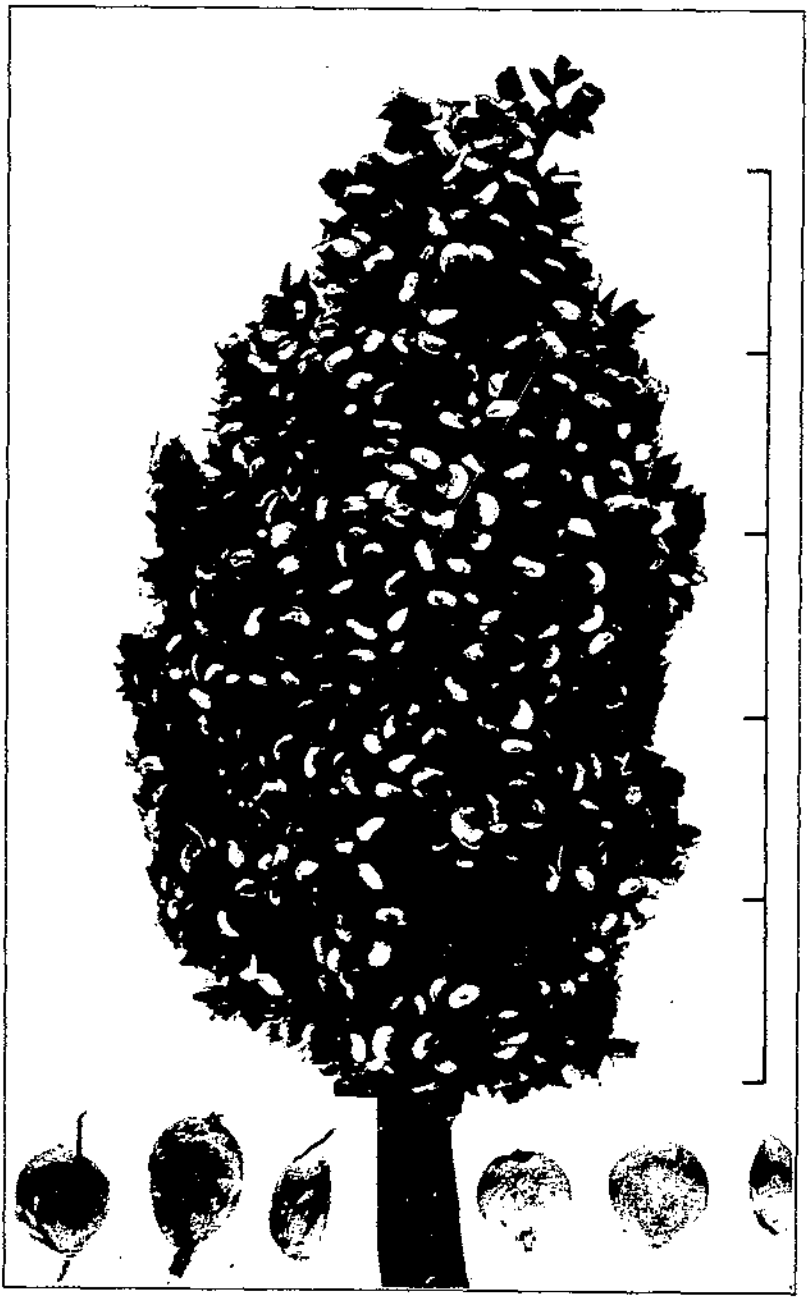
Description.—Plants early, mid-tall; stems mid-slender, dry, not sweet; tillers sparsely; branches freely; leaves few (8 to 12); midribs white; leaf sheaths overlapping slightly; panicles inclined to recurved, compact, obovoid to broadly ellipsoid; rachis usually 70 to 80 percent of head length; rachis branches short to mid-long; glumes very pubescent, straw-colored, somewhat chartaceous, obovate to elliptic, apices usually obtuse; lemmas bearing long geniculate awns; stigmas white; kernels moderately to well exposed, mid-size to large, white, ellipsoid to globose, much flattened, endosperm starchy, corneous layer thin, nucellar layer absent; pedicellate spikelets large, straw-colored, often deciduous at maturity; coleoptiles green. Seeds shatter easily. A panicle, spikelets, and kernels are shown in plate 1.

History.—Grown in Arabia, Turkistan, India, and northern Africa. In Egypt the word "durra" means sorghum. In the United States the name durra was first applied to the Guinea kafir (Guinea corn, Rural Branching sorghum, or "White Milo maize"). True durras doubtless were introduced into the United States during the colonial period but were never widely grown. According to Sorsby (*142*), "It is called in the United States 'Dourah corn' and 'Tennessee rice.' * * * I first saw this plant growing in Georgia in 1838. The year following I introduced its culture into this county [Greene County, Ala.], where it has been somewhat extensively cultivated since. There are two distinct varieties of this corn cultivated with us, namely, the 'white' and the 'reddish-brown.'"



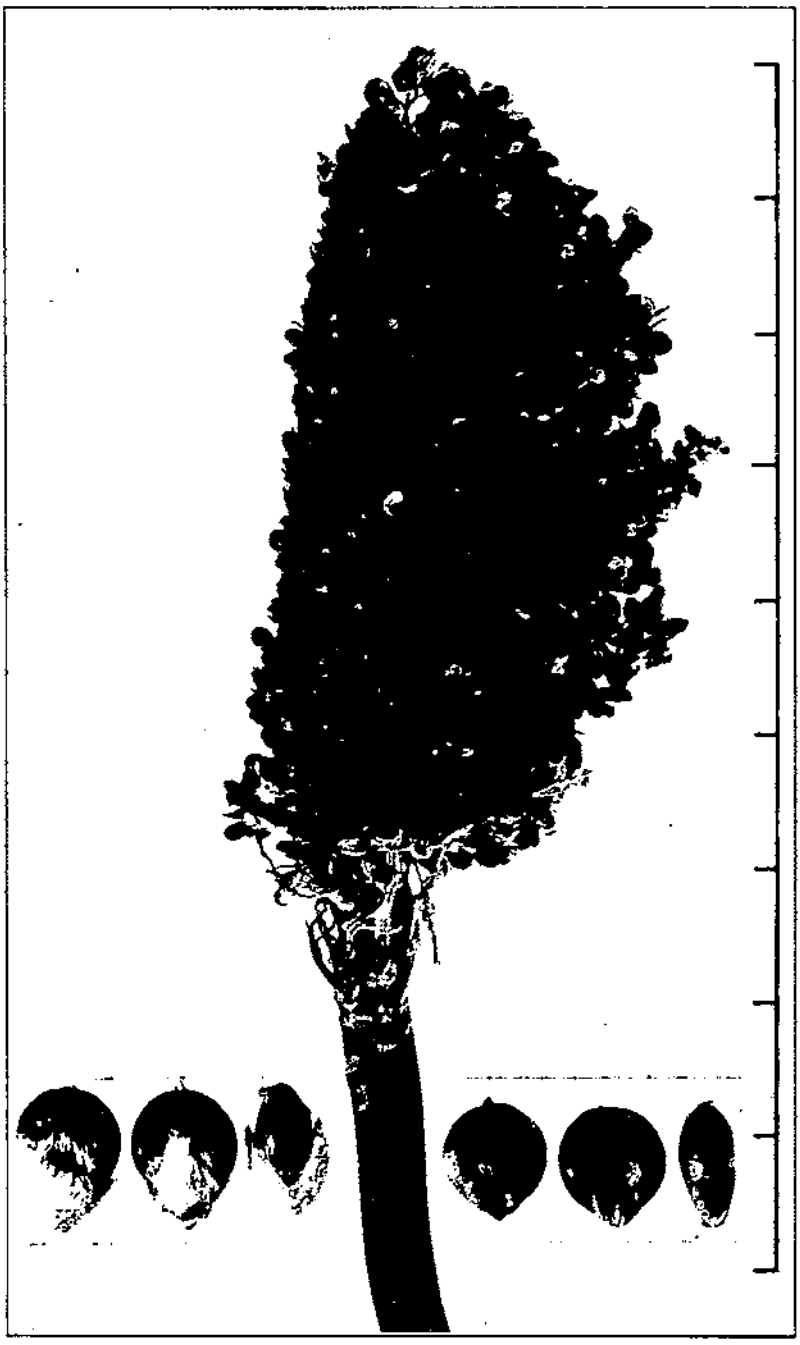
WHITE DURRA.

Panicle, scale indicates size in inches, spikelets and kernels in three positions, × 3.



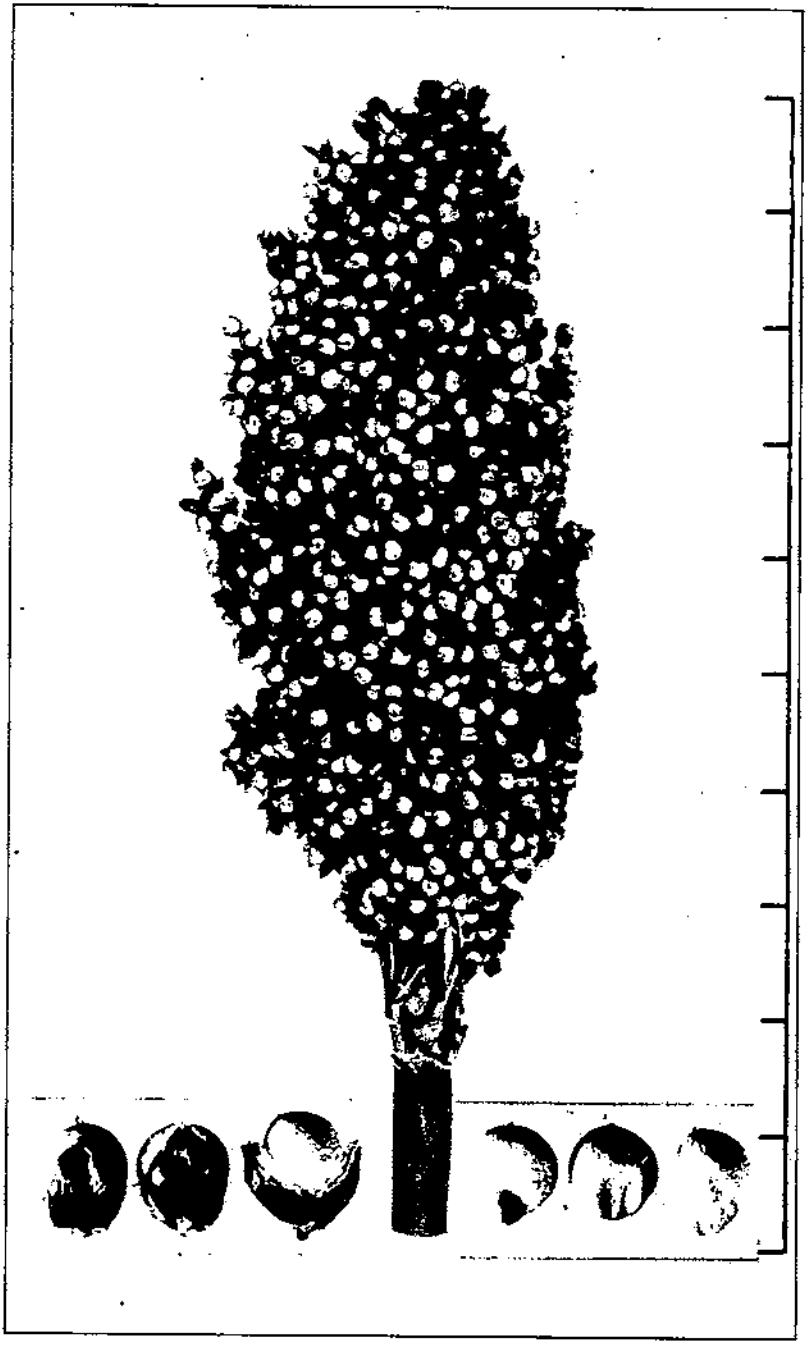
DWARF WHITE DURRA.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



BROWN DURRA.

Panicle, stem indicates size in inches, spikelets and kernels in three positions, × 3.



STANDARD FETERITA.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.

In 1860 small packets of seed of a sorghum from Egypt were being offered to the public in Illinois at $1 each under the name "Egyptian corn." "The corn was produced from some procured directly from Mr. Jones, our consular agent, directly on his return from Egypt. * * * It grows in the form of a tree, and 22 ears have grown upon one stalk, and will average from 5 to 15."

This crop may have been a loose-panicled durra or some other sorghum, and not the White durra now being grown in the United States. Apparently it was not a new crop in this country. According to an editorial in the American Agriculturist (*5*), "Two or more parties are distributing plausible handbills advertising to send, for a dollar, a little parcel of seed they call Egyptian corn. * * * It is the Dourah corn, or what was a few years since called 'Egyptian Wheat.'"

The first definite reference to the White durra now being grown appeared in 1874 (*11*): "Mr. R. J. Trumbull brings to the offices of the Rural Press samples of the Egyptian or Mediterranean corn, grown by him at his nursery at San Rafael, Calif.—not in Egypt. * * * The top of the stalk has a unique and rather picturesque look, forming a goose-neck curve. * * *"

The apparent introducer of this durra, Sanders (*129*), states: "I called it Egyptian corn for the reason that it certainly was a 'corn', and I obtained the seed of two varieties of it from the land of the Pharaohs."

In the Pacific Rural Press (*12*) in 1877 it was stated that "Dr. J. S. Silver * * * was so strongly impressed with the good qualities of the grain that he introduced it to Mr. Trumbull's attention, and the result was the importation of the seed."

Although the evidence of the importation of White durra from Egypt into California, where it was grown in 1874 and later distributed, seems rather authentic, there is considerable doubt about this being the first importation. A communication by Beckwith (*35*) in 1880 states:

As much as 15 or 20 years ago I received a package of seed (from the United States Agricultural Department, I think) under the name of Dhoura corn. It was white and identical, no doubt, with what you describe as Egyptian corn. A few days since I sent to a seedsman in Philadelphia for seed of white Doura corn, and have received exactly the same thing.

Probably durra was grown in California previous to 1874. According to the Pacific Rural Press (*14*) in 1878:

It appears that this grain has been in cultivation in this State longer than many have thought, and it is a valuable fact that the longer growing brings the stronger testimonials of the value of the plant. Our southern exchange, The San Diego News, states that a party in that county has been growing it in a small way since 1863.

Soon after White durra was distributed in California it was tried all over the United States. It soon reached the Great Plains and became popular in Kansas during the late eighties. It was grown at the Kansas Agricultural Experiment Station in 1889 (*67*) under the name Egyptian rice corn, and at other experiment stations shortly thereafter. Durra has never been grown on a large acreage in this country and now is confined almost exclusively to California. Hundreds of durra introductions have been grown on experiment stations in this country since 1900, but they have never compared favorably with kafir, milo, and feterita except in the Sacramento Valley of California.

Distribution.—Grown in California, Kansas, and New Mexico.

Synonyms.—Egyptian corn, Gyp corn.

2. DWARF WHITE DURRA

Description.—This variety is similar to White durra except in being much shorter (usually 30 to 38 inches in height), in having panicles with a less blunt apex, and in having slightly smaller kernels. The leaves have a peculiar habit of rolling or curling upward at each side. A panicle, spikelets, and kernels are shown in plate 2.

History.—Selected from White durra by J. W. Hoefling, of Chico, Calif., in 1925 (*17*):

"At the same time that Hoefling Brothers began their experiments in harvesting 'Gyp' corn they recognized the need for a type or strain better adapted to machine work, and so they started to make selections, and now have a strain that meets the requirements.

"The ideal was a uniform erect-headed dwarf White Egyptian corn that would stand up when dry and ripe and turn off good yields. This goal has now

been attained in all respects except erectness of head. * * * Last year [1927] 15 acres were planted to this selection. This year 60 acres were planted as a final check against other strains."

Probably this dwarf strain originated as a height mutation from the White durra. It was first distributed for seed in 1929 under the name of Hoefling's Curly Leaf or Superior strain of White Gyp.

Distribution.—Grown in California and experimentally in other States.

Synonym.—Hoefling's Curly Leaf White Gyp.

3. BROWN DURRA

Description.—Brown durra is nearly identical with White durra except in having brown kernels with a nucellar layer present and in having awnless lemmas. A panicle, spikelets, and kernels are shown in plate 3.

History.—The history of Brown durra is largely given in the history of White durra, and apparently it was introduced at the same time. Brown durra never became as popular as the white-seeded variety, owing to the bitterness of the seed.

Distribution.—Grown to a limited extent in California.

Synonym.—Brown Egyptian corn.

4. STANDARD FETERITA

Description.—Plants early (100 days, average of 30 crop years), mid-tall (59 inches, average of 39 crop years); stems mid-slender to mid-stout, dry or only slightly juicy, slightly sweet; tillers freely; branches freely; leaves few (7 to 12); midribs white; leaf sheaths overlapping slightly to moderately; panicles erect, compact, ovoid to ellipsoid; rachis usually continuous; rachis branches short to mid-long, appressed; glumes pubescent but pubescence partly deciduous at maturity, usually black but at times straw-colored or reddish brown, indurate, elliptic, apices acute to obtuse; lemmas usually appear awnless but have very short tip awns which usually do not extend beyond the glumes; stigmas creamy white; kernels much exposed in angles and extending well beyond apices of glumes, very large, chalky white, and usually with red and black spots, nearly globose but flattened on side opposite the embryo, endosperm starchy, corneous layer thin, nucellar layer present, seed coat checked; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 4.

History.—The introduction of feterita into this country is given by Vinall and Ball (*150, p. 25*) as follows:

"The name 'feterita' is used for a variety of sorghum first obtained in 1901 by the Office of Foreign Seed and Plant Introduction as 'Feterite' from B. Nathan & Co., Alexandria, Egypt. Only a small quantity of seed was secured, and this was distributed under Seed and Plant Introduction No. 6691 to three persons in Arizona and Kansas, but no records of the results obtained are available. It is certain, however, that the variety did not become established at that time. The second importation, assigned S. P. I. No. 19517, was received November 1906 from Mr. V. F. Naggiar, of Alexandria, Egypt, who obtained the seed from Sudan. In 1908 an additional supply, S. P. I. No. 22328, was secured through Mr. R. Howison from Khartum, Sudan, in which region it is commonly grown under the name 'feterita.'"

Most of the feterita grown in this country at the present time is from the introductions of 1906 and 1908.

Feterita has been known in Sudan for many years. "Fatareetah, a pure white thin-skinned grain" was observed in the market at Khartum in 1868 (*131*).

Distribution.—Important in Texas, Oklahoma, and Kansas, and grown in Georgia, Alabama, Arkansas, Missouri, Nebraska, Colorado, Arizona, and California (fig. 4).

Synonym.—Schribar corn.

5. SPUR FETERITA

Description.—Similar to Standard feterita, but slightly later and more leafy with somewhat stouter stems, panicles more often truncate, and rachis more often discontinuous; plants early to midseason (103 days, average of 16 crop years); mid-tall, slightly shorter than Standard. A panicle is shown in plate 5.

History.—Conner and Dickson (*51, p. 9*) give this history of the development of the strain:

"Spur feterita was originated by the Texas Experiment Station at Substation No. 7, Spur, Tex., as a result of selection and head-row planting of more than one hundred feterita plants. These selections were made by the junior author

in 1914 from a feterita grown by the Texas Station under Texas Station No. 40, original seed of which was secured from the Office of Forage Crops, United States Department of Agriculture, Washington, D. C., which carried it under Seed and Plant Introduction No. 19517. * * * At the close of the season of 1916, selection No. 40-3-6-15 was considered sufficiently outstanding to warrant its increase, and so it was assigned Texas Station No. 3232 and increased as rapidly as possible for distribution to farmers. Twelve thousand pounds of seed were grown under contract during the season of 1918 and purchased by the Office of Dry Land Seed Distribution, United States Department of Agriculture, Washington, D. C., for distribution. This seed was sent to farmers in Texas, in Oklahoma, in Kansas, and in other States."

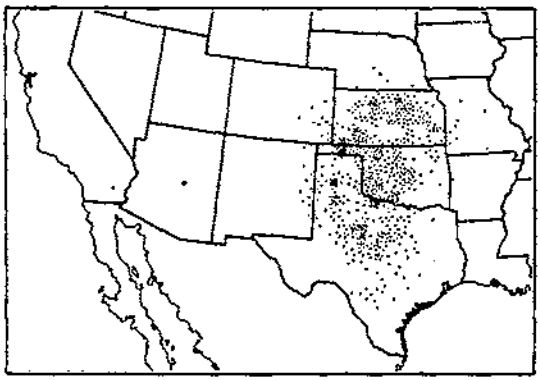


FIGURE 4.—Distribution of feterita (Standard, Spur, and Dwarf) in the United States in 1924. Each dot represents 500 acres. Estimated area, 325,100 acres.

Distribution.—Most widely grown variety of feterita in Texas and also grown in Oklahoma, Kansas, and New Mexico.

6. DWARF FETERITA

Description.—Like Spur feterita but dwarf (42 inches, average of 22 crop years). In number of leaves and date of maturity it is about the same as Spur, being slightly later than Standard.

History.—Several strains have been selected and distributed by the Texas Agricultural Experiment Station and the United States Department of Agriculture. One of these was derived from the same original group of heads from which Spur feterita was selected at Spur, Tex. Two others were selected at the San Antonio Field Station, one in 1909 and one in 1917, and both grown and distributed to some extent from Chillicothe, Tex.

Distribution.—Reported only from Texas, but some grown in Oklahoma and Kansas as well.

Synonym.—Dwarf Spur.

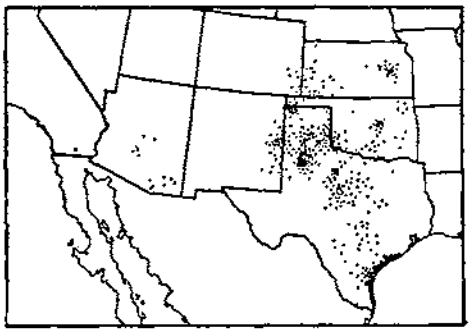


FIGURE 5.—Distribution of hegari in the United States in 1924. Estimated area, 210,800 acres.

7. HEGARI

Description.—Plants midseason (113 days, average of 32 crop years); character of season affects date of maturity markedly; dwarf to mid-tall (48 inches, average of 33 crop years); stems mid-slender to stout, mid-juicy, slightly sweet; tillers freely; branches sparsely; mid-leafy to leafy (8 to 16); midribs cloudy; leaf sheaths usually overlapping much; panicles erect, mid-compact, ellipsoid or approaching ellipsoid; rachis average 85 to 100 percent of head length; rachis branches short, appressed; glumes pubescent but pubescence largely deciduous at maturity, black or reddish black, indurate, ovate to elliptic, apices generally acute; lemmas tip-awned and awns often deciduous at maturity; stigmas creamy white; kernels much exposed (more than Blackhull kafir), seed in grapelike clusters, small to mid-size, white with reddish brown to black spots, obovoid to globose, endosperm starchy, corneous layer thin to mid-thick, nucellar

layer present; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 6.

This variety shatters easily; it is especially sensitive to seasonal conditions and varies widely as to time of heading, maturity, height, and yield.

History.—The first seed of this variety was received by C. V. Piper from Khartum, Sudan, Africa, in March 1908, and given the number S. P. I. 22326. It was planted that season at Chillicothe, Tex. Practically all of the hegari grown in the United States is from the increase of a selection made at Chillicothe by A. B. Conner in 1910. Limited distributions to experiment stations and to farmers were made during the next few years, and by 1915 a considerable acreage was being grown in the vicinity of Chillicothe. In the spring of 1916 the Bureau of Plant Industry, United States Department of Agriculture, distributed some 17,000 pounds of seed.

Distribution.—The most widely grown sorghum in Arizona and important in Texas, Oklahoma, Kansas, and New Mexico. A small acreage is grown in California, Colorado, and Arkansas (fig. 5).

Synonyms.—Hilgeur, Hilgeary, Higrain wheat.

8. CHILTEX

Description.—Plants early to midseason (105 days, average of 10 crop years), dwarf (47 inches, average of 10 crop years); stems mid-slender, to mid-stout, dry, not sweet; tillers sparsely; branches sparsely; mid-leafy (8 to 13); midribs white; leaf sheaths overlapping moderately; panicles erect, mid-compact, cylindroid; rachis about 70 percent of head length but sometimes continuous; rachis branches short, appressed; glumes pubescent, brownish black, indurate, elliptic, apices acute; lemmas not awned; stigmas white; kernels well exposed but less than Blackhull kafir, mid-size, white with brown to black spots, obovoid to globose, endosperm starchy, corneous layer thin to mid-thick, nucellar layer present, seed coat usually checked; pedicellate spikelets straw-colored to dark brown and persistent at maturity; coleoptiles green; glumes often persistent in threshed seed. A panicle, spikelets, and kernels are shown in plate 7.

History.—Selected by H. N. Vinall from a cross of feterita (S. P. I. 22329) and Blackhull kafir (S. P. I. 17569) made at Amarillo, Tex., by A. B. Cron in 1914. The name Chiltex was assigned and seed first distributed to a few other stations from Chillicothe, Tex., in 1923. Local distributions to farmers and experiment stations have been made each year since, and in 1925 over 4,000 pounds were sent out through the Bureau of Plant Industry. Chiltex is the first sorghum variety produced from a definite breeding program of selection from the progeny of hybrid plants secured by artificial hybridization.

Distribution.—Grown locally in Texas and southwestern Oklahoma.

Synonym.—Chiltex kafir.

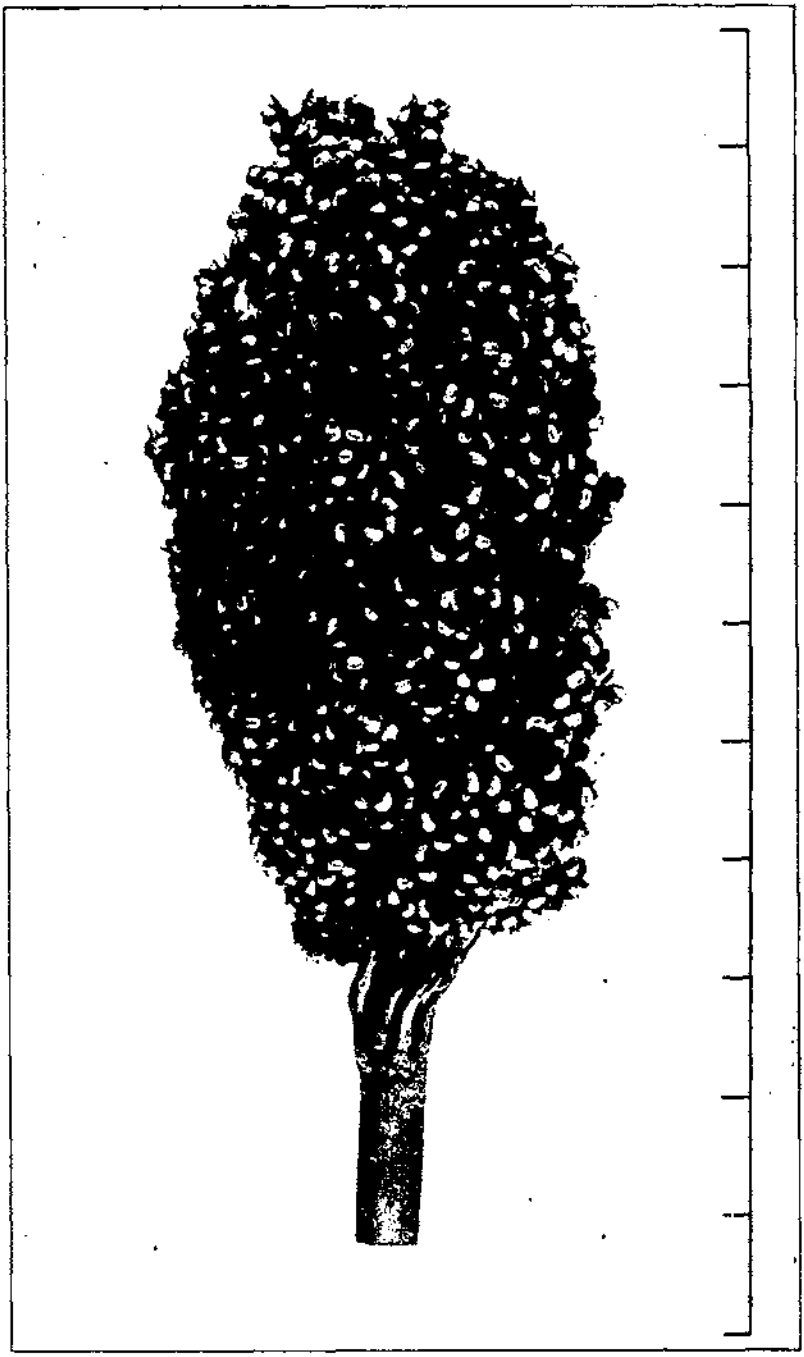
9. PREMO

Description.—Plants midseason (109 days, average of 10 crop years), dwarf to mid-tall (50 inches, average of 10 crop years); stems mid-stout, mid-juicy, not sweet; tillers sparsely; branches sparsely; leafy (12 to 16); midribs cloudy; leaf sheaths overlapping much; panicles erect, compact to mid-compact, ellipsoid, usually poorly exerted; rachis 60 to 100 percent of head length; rachis branches mid-long, appressed; glumes pubescent but pubescence partly deciduous at maturity, black or brownish black, indurate, elliptic, apices acute; lemmas not awned; stigmas white; kernels much exposed but less than Blackhull kafir, mid-size, white with brown to black spots, ellipsoid to obovoid, endosperm starchy, corneous layer mid-thick, nucellar layer present, seed coat usually checked; pedicellate spikelets straw-colored to dark brown, persistent at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 8.

Premo differs from Chiltex in being later, in being mid-juicy, and in having thicker panicles. The pericarp of the kernel also shows less distinct checking.

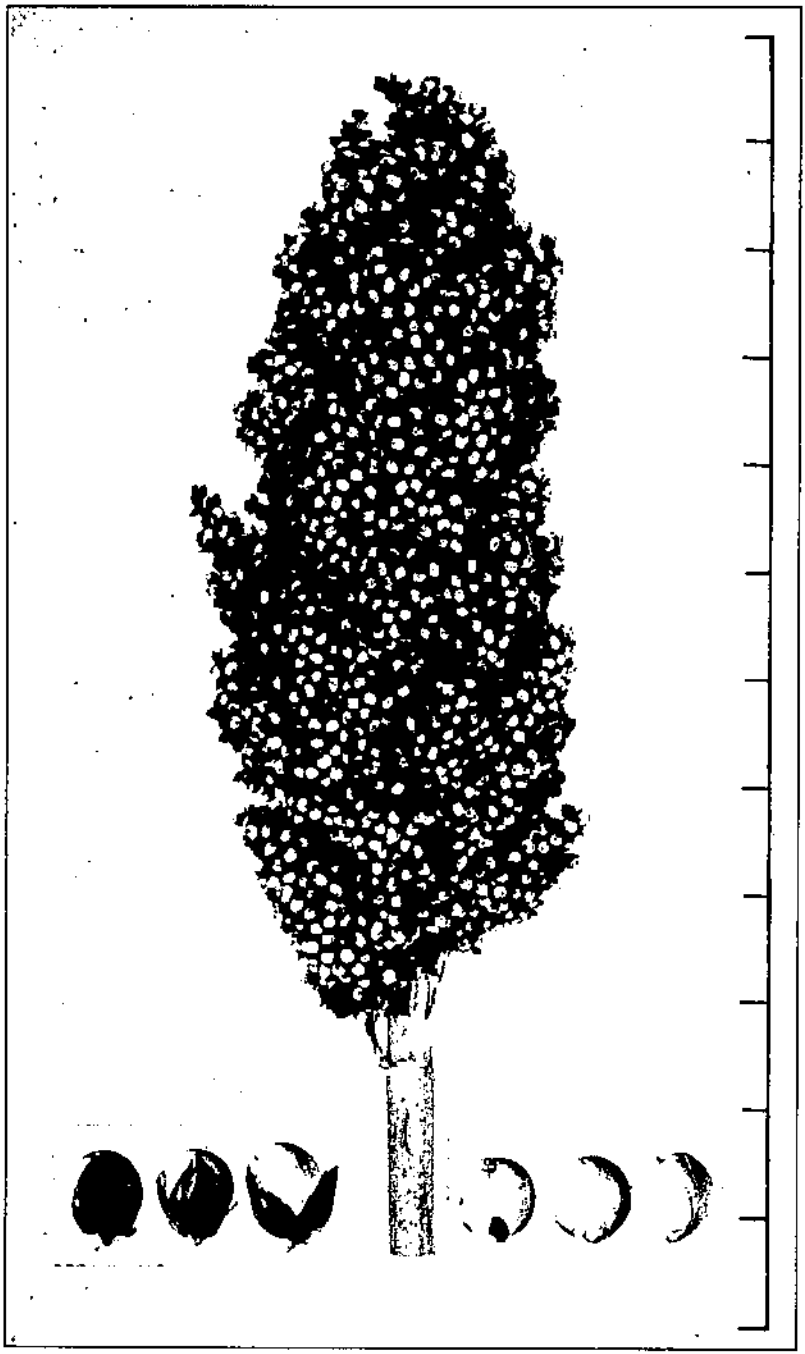
History.—Premo is a selection from a cross of feterita (S. P. I. 22329) × Blackhull kafir (S. P. I. 17569) made by A. B. Cron. It has been distributed locally from Chillicothe, Tex., since 1923, and about 3,500 pounds were distributed by the Bureau of Plant Industry in 1925.

Distribution.—Grown locally in Texas and southwestern Oklahoma.



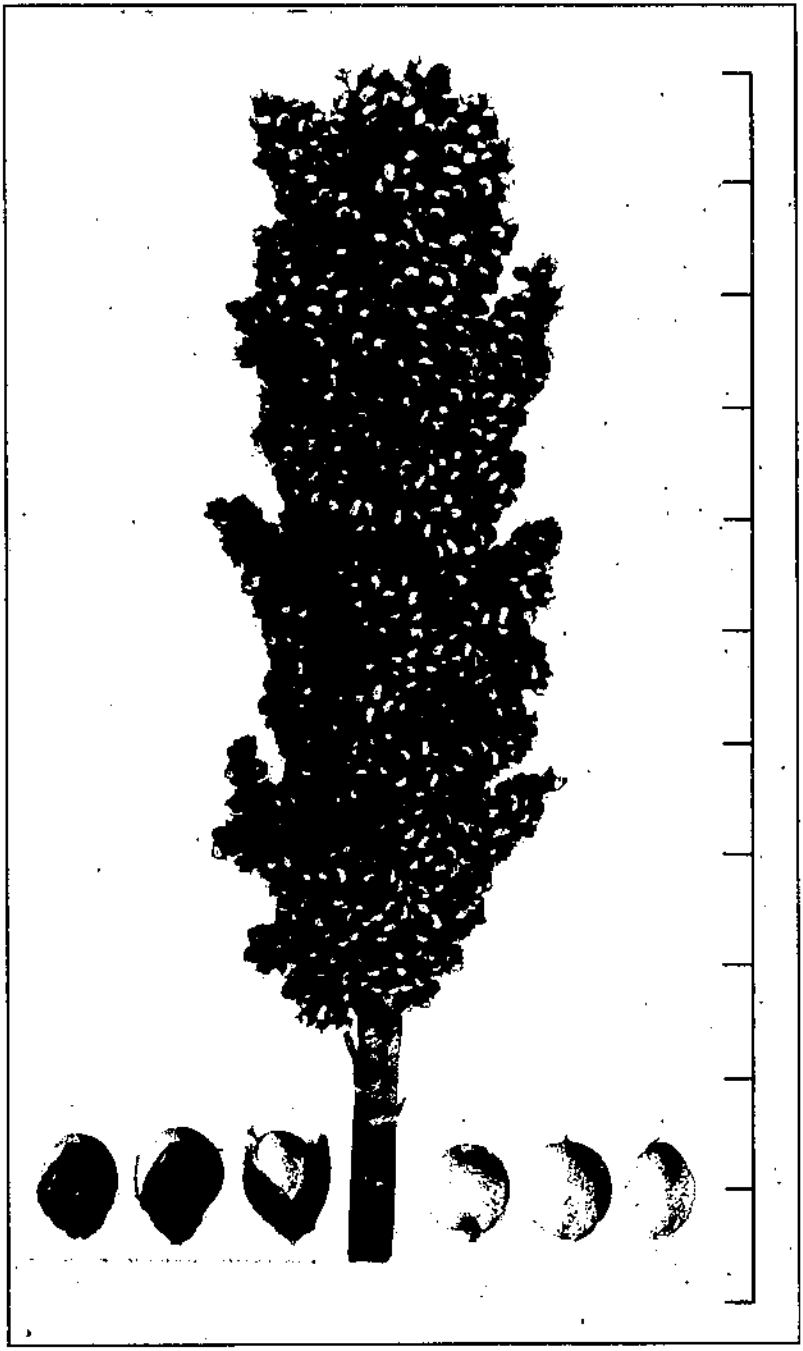
SPUR FETERITA.

Panicle, scale indicates size in inches.



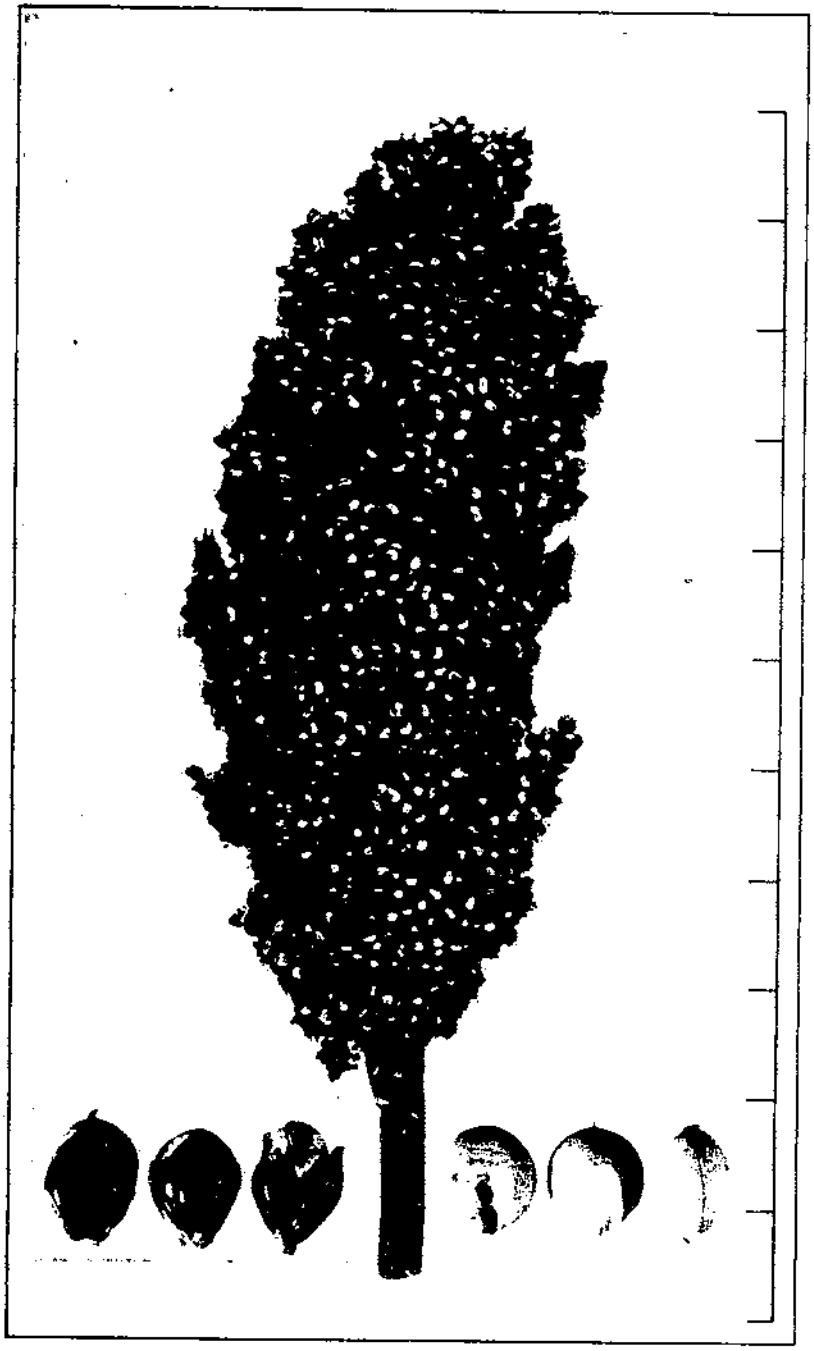
HEGARI.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



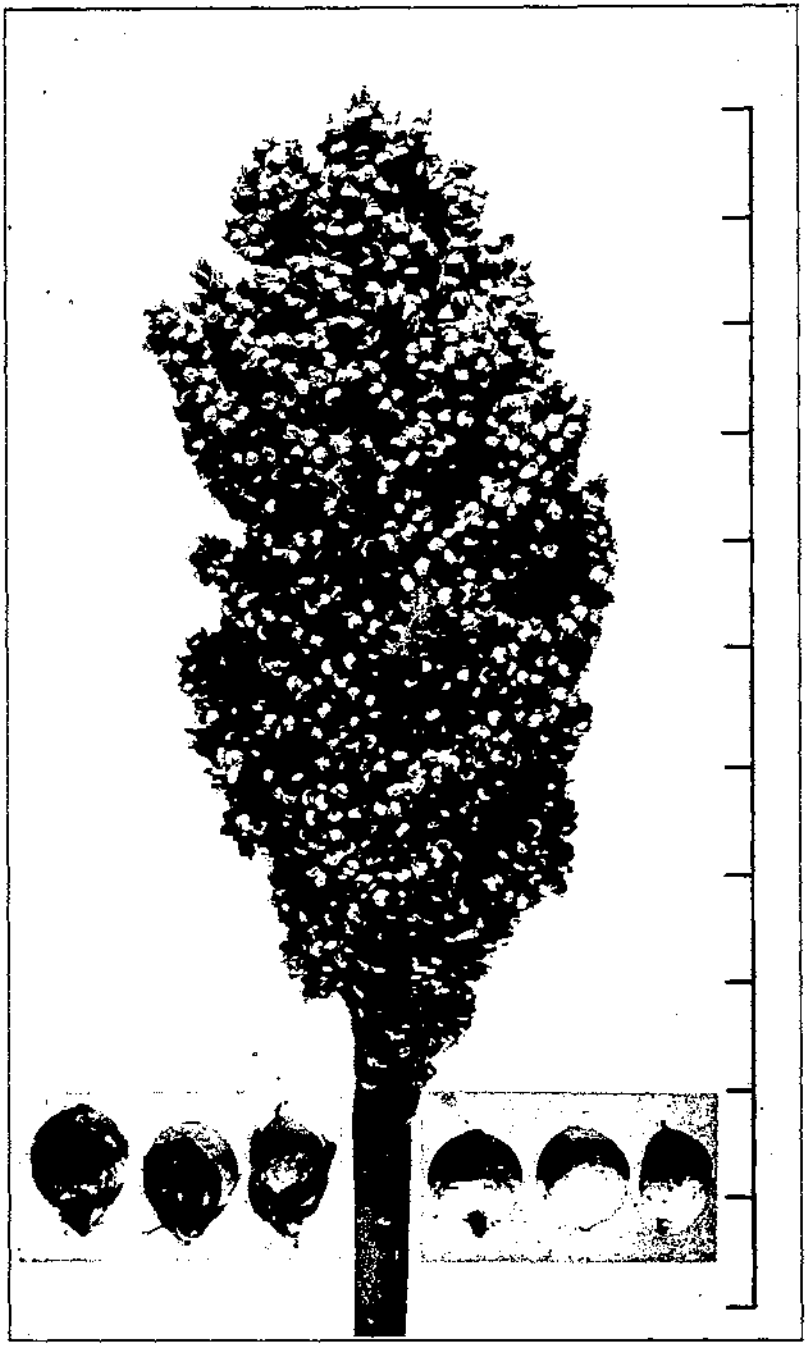
CHILTEX.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, X 3.



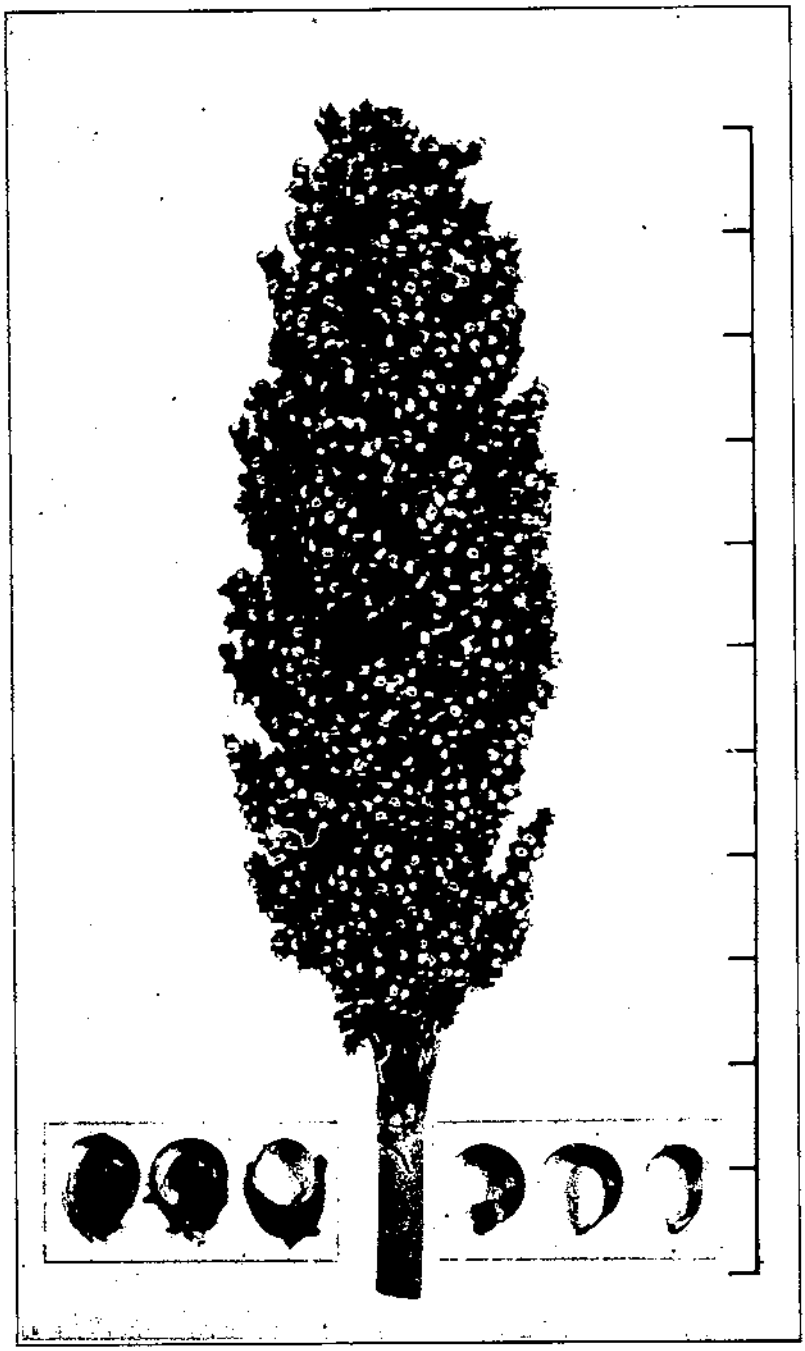
PREMO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



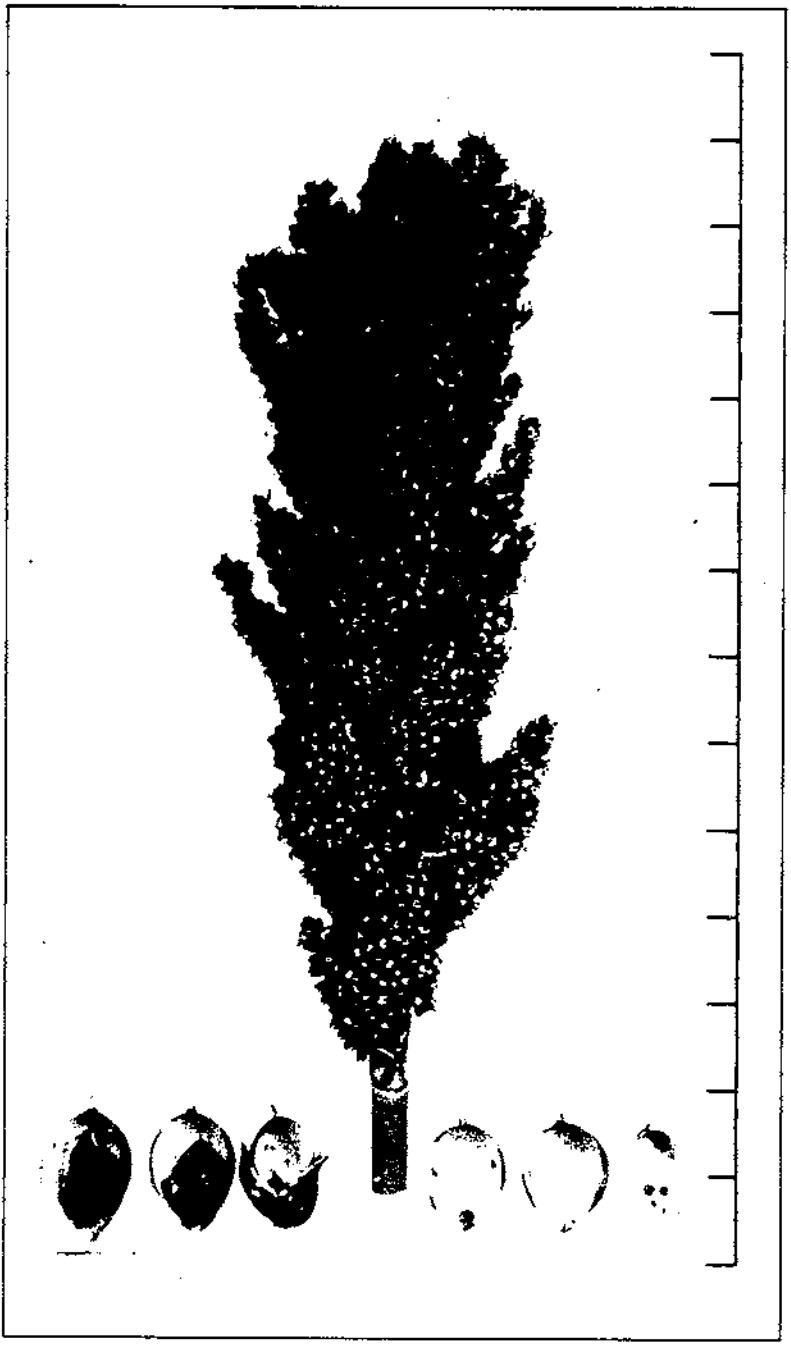
AJAX.

Panicle scale indicates size in inches; spikelets and kernels in three positions, × 3.



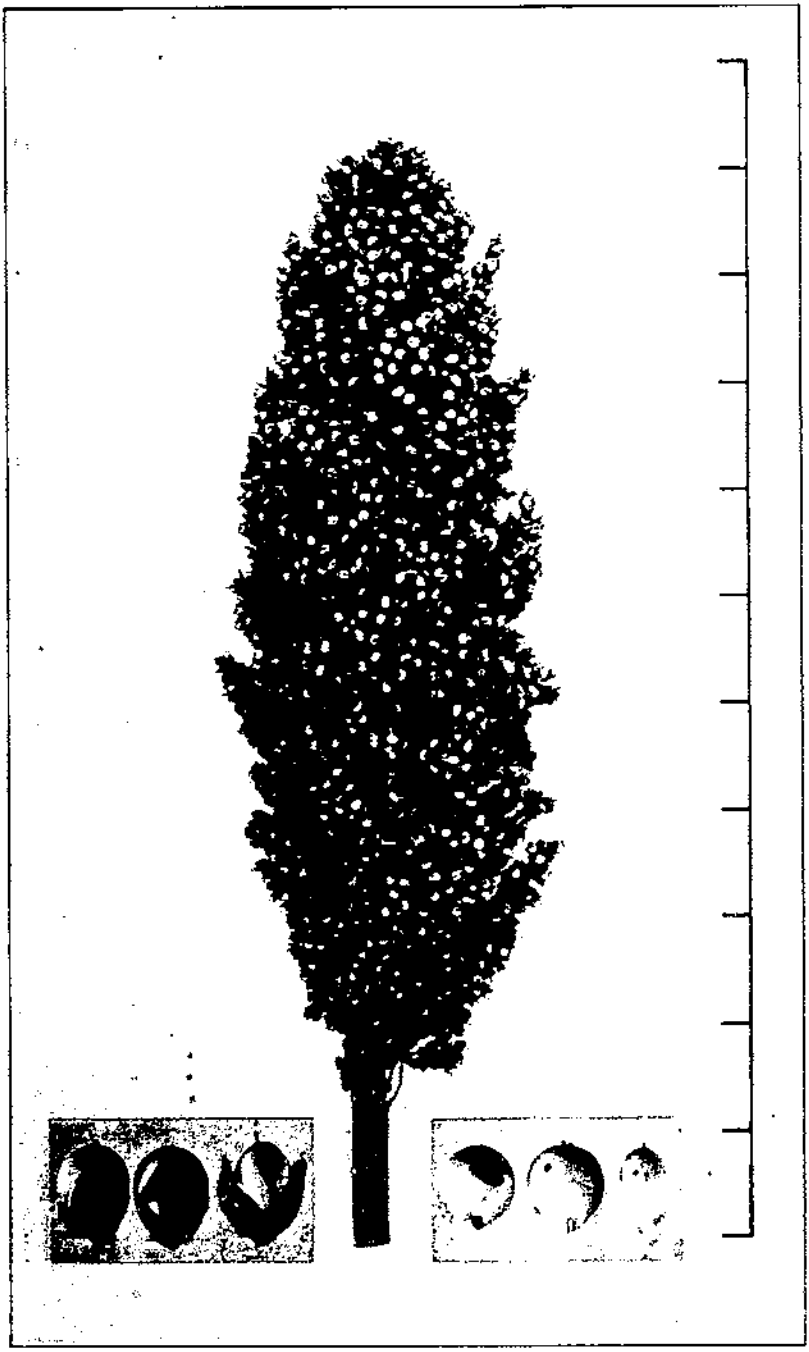
WONDER.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3



BLACKHULL KAFIR.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, X 3.



SUNRISE KAFIR.

Panicle, scale indicates size in inches; spikelets and kernels in three positions. X 3.

10. AJAX

Description.—Plants midseason, dwarf (mode 46 inches); stems mid-stout to stout, dry, slightly sweet; tillers mid-freely; branches sparsely; leafy (12 to 13); midribs white; leaf sheaths overlapping much; panicles erect, compact to mid-compact, shape variable, ranging from ovoid to obovoid; rachis 50 to 100 percent of head length but usually discontinuous in main heads; rachis branches mid-long, appressed to sometimes partly spreading; glumes pubescent, black to reddish brown, indurate, ovate, apices acute to sometimes acuminate; lemmas not awned; stigmas creamy white; kernels well exposed in angles and extending well beyond apices of glumes, mid-size, white with reddish brown to black spots, globose, endosperm starchy, corneous layer thin to mid-thick, nucellar layer present; pedicellate spikelets straw-colored to brown, mid-size, persistent and rather conspicuous at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 9.

History.—Selected from the progeny of a cross of Premo (F. C. 8929) × Spur feterita (F. C. 6601) made by H. N. Vinall in 1923. A limited distribution of seed in 1929 and general distributions in subsequent years were made from Chillicothe, Tex.

Distribution.—Grown locally in Texas and southwestern Oklahoma.

11. WONDER

Description.—Plants early to midseason (about 105 days), dwarf (about 47 inches); stems mid-stout to stout, dry, not sweet; tillers mid-freely; branches sparsely; mid-leafy (9 to 15); midribs white; leaf sheaths overlapping much; panicles erect, mid-compact, cylindroid to ellipsoid; rachis 50 to 80 percent of head length; rachis branches mid-long, appressed; glumes pubescent but pubescence partly deciduous at maturity, black, indurate, elliptic, apices acute; lemmas not awned; stigmas white; kernels much exposed and extending beyond apices of glumes, mid-size, white with brown or reddish-black spots, globose to broadly obovoid, endosperm starchy, corneous layer mid-thick to thin, nucellar layer present, seed coat checked as in feterita; pedicellate spikelets straw colored to reddish black, usually persistent at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 10.

Distinguished from Blackhull kafir by the dry stalk and presence of the brown nucellar layer, and from Chiltex and Premo by shorter glumes with greater exposure of kernel and by a larger germ area on the kernel.

History.—Originated by C. A. Bower, Wallace, Kans., from a single head selected from a field of kafir in 1934. It apparently is the progeny of a natural hybrid between kafir and feterita. Several distinct selections of this cross were grown at the Fort Hays Branch Station, Hays, Kans., in 1922, and one having the characters as described above has been continued in experiments. A quantity of seed of Wonder grown by the Garden City Branch Station, Garden City, Kans., was sold to the Wheat Farming Co., with headquarters at Hays, Kans., for growing on its lands in northwestern Kansas in 1931.

Distribution.—Variety has a limited distribution in the western half of Kansas (*147, p. 20*).

12. STANDARD BLACKHULL KAFIR

Description.—Plants midseason (114 days, average of 21 crop years), mid-tall (56 inches, average of 25 crop years); stems mid-stout to stout (⅞ to 1 inch), mid-juicy, not sweet; tillers sparsely; branches sparsely; leafy (12 to 16); midribs cloudy; leaf sheaths overlapping much; panicles erect, often not well exserted from the sheath under dry conditions, mid-compact, cylindroid to clavate; rachis usually 60 to 80 percent of head length but sometimes continuous; rachis branches mid-long, appressed; glumes pubescent but pubescence partly deciduous at maturity, black or brownish black, indurate, elliptic or approaching elliptic, apices acute or sometimes obtuse; lemmas not awned; stigmas white; kernels much exposed in wide angle of glumes (60 to 90 degrees) and extending well beyond apices of glumes, mid-size, white with reddish-brown to black spots, obovoid to ellipsoid, endosperm starchy, corneous layer mid-thick to thick, nucellar layer absent; pedicellate spikelets usually straw colored or with reddish-brown spots and persistent but inconspicuous at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 11.

History.—Origin undetermined. Rice (*122*), of Winview, Okla., stated: "This year I sent to F. Barteldes & Co., Lawrence, Kans., for African millet seed. They sent me two lots, one marked 'home grown', the other 'western grown.' The 'home grown' proved to be nearly the same as what we have for 6 years grown as Black Chaff kafir corn."

Another writer (*128*) stated: "From Mr. Johnson [Mark W. Johnson, Atlanta, Ga.] we obtained 5 pounds of seeds of these 2 plants and 3 other nonsaccharine sorghums, among which was one called 'African millet.' The seeds were nearly the same as kafir, and we planted the millet along by the side of the kafir. It grew much taller than the kafir, it had a firmer head, and yielded more seed per head. The kafir had nearly a white cap. The millet had a black cap. The next year, 1888, we grew a crop of millet, kafir, and milo at Waxahachie [Tex.], and noted that the kafir had nearly half black capped heads. These took much the form of the millet, came better out of boot, and were about a head taller than the strictly white kafir. A part of this crop was sold to Mr. Barteldes, of Lawrence, Kans. The remainder was disseminated all over the West, then this was and is how the black cap got on the kafir."

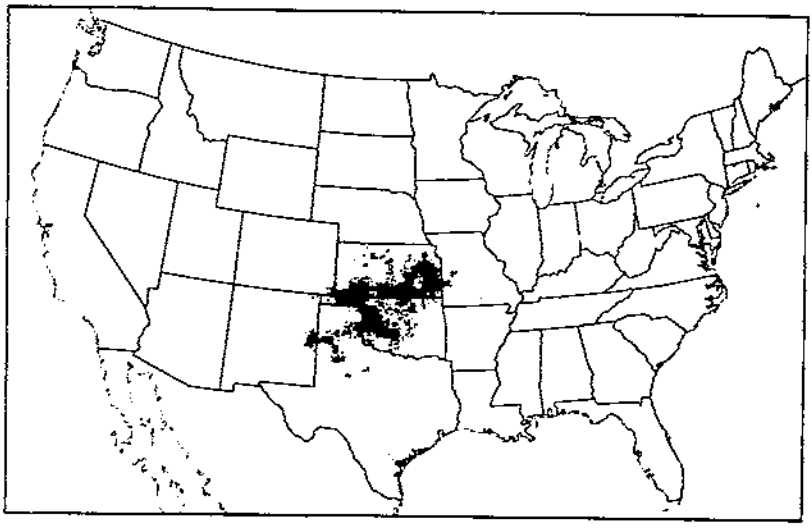


FIGURE 6.—Distribution of Blackhull kafir (Standard and Dwarf) in the United States in 1924. Each dot represents 500 acres. Estimated area, 1,801,400 acres.

Blackhull kafir was first grown at the Kansas Experiment Station in 1895 (*65*). This variety was then also referred to as African millet. There is no positive evidence that Blackhull kafir was obtained as a mixture in the original importations of either White kafir or Red kafir, although this appears to be the most reasonable explanation of its origin. Black-hulled kafirs have been obtained from South Africa by the Department of Agriculture during the past 30 years, but no record is available of the importation of Blackhull kafir prior to 1895, when it was first grown at the Kansas Agricultural Experiment Station.

Since the original Blackhull kafir was distributed other strains have been selected from it. Most of these are similar but differ slightly in height or maturity or in the type of exsertion of the panicle. Strains that are materially different from the typical Standard Blackhull are described elsewhere.

Distribution.—The most widely grown grain sorghum in Kansas and Oklahoma, and second to Yellow milo in Texas, New Mexico, Missouri, and Colorado; also grown in Alabama, Arizona, Arkansas, California, Georgia, Nebraska, Tennessee, and to a small extent in Kentucky, Mississippi, and other States. About 91.5 percent of the approximately 1,800,000 acres is grown in Kansas, Oklahoma, and Texas. The total acreage of Blackhull kafir in the United States exceeds that of any other variety of sorghums (fig. 6).

Synonyms.—Black-chaff kafir corn, Blackhull white kafir.

13. DWARF BLACKHULL KAFIR

Description.—The strains of Dwarf Blackhull kafir in normal seasons average about 4 inches shorter than Blackhull and 4 to 5 days earlier in maturity (111 days, average of 25 crop years). In other respects they are very similar to the Blackhull described previously. This similarity is particularly marked in the size and shape of the panicle.

History.—Several strains have been distributed by experiment stations and others. Among the most important of these selected strains are the Texas Blackhull, Western Blackhull, and Santa Fe kafir. At the present time the most of the Blackhull kafir is dwarf in comparison with the earlier types grown in the nineties, but except for a few strains to which specific names have adhered, it is generally known as "Blackhull kafir." However, Blackhull in one community may be called "Dwarf Blackhull" in another.

Distribution.—Grown in Kansas, Oklahoma, Texas, New Mexico, and Missouri.

Synonyms.—Texas Blackhull, Western Blackhull, Santa Fe (in part).

14. WESTERN BLACKHULL KAFIR

Description.—A strain of Dwarf Blackhull kafir.

History.—This strain was obtained from P. E. Crabtree, Scott City, Kans., by R. E. Getty, and found to be of sufficient value at Hays, Kans., in 1921 to warrant further test. It was distributed by Mr. Crabtree through the Barteldes Seed Co. in the spring of 1921 under the name of Western Blackhull kafir.

Distribution.—Grown in Kansas.

15. TEXAS BLACKHULL KAFIR

Description.—A selection from Blackhull kafir maturing in about 106 days, which is somewhat earlier than Dawn kafir; it is also somewhat taller than Dawn. Very similar to Western Blackhull kafir.

History.—Developed from a small lot of seed received as Dwarf Blackhull kafir, from B. B. Perdue, Fairfurrias, Tex., in April of 1916. It was selected, inbred, and named by R. E. Karper, then superintendent of Texas substation no. 8, Lubbock, Tex., and first distributed to farmers in 1924.

Distribution.—Texas, Oklahoma, and New Mexico; at present the predominant kafir in Texas.

16. SUNRISE KAFIR

Description.—Plants midseason (112 days, average of 22 crop years), mid-tall to tall (70 inches, average of 20 crop years); stems mid-stout (three-fourths to seven-eighths inch) but more slender than Blackhull, mid-juicy to juicy, slightly sweet to sweet; tillers mid-freely; branches mid-freely; mid-leafy (10 to 14); midribs cloudy; leaf sheaths overlapping slightly; panicles erect, mid-compact, ellipsoid to cylindroid; rachis 80 to 100 percent of head length; rachis branches mid-long to short, appressed; glumes pubescent but pubescence partly deciduous at maturity, black or reddish black, indurate, elliptic, apices acute or rarely obtuse; lemmas not awned; stigmas white; kernels much exposed laterally in angle of glumes and beyond apices of glumes, mid-size, white with reddish-brown to black spots, ellipsoid, endosperm starchy, corneous layer mid-thick to thick, nucellar layer absent; pedicellate spikelets straw-colored to dark reddish brown, usually persistent at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 12.

This strain tillers and branches more freely than ordinary Blackhull kafir; the stems are not so stout and are somewhat sweeter; the heads are usually shorter and tend more to the ellipsoid; the glumes are more often straw-colored or with straw edges, and the pedicellate spikelets are a little more persistent; the kernels are not quite so broad in relation to length and are usually a little smaller.

History.—Ball and Rothgeb (*34, p. 58*) describe the origin as follows:

"The Sunrise, or Early, kafir (C. I. No. 472) was developed from a single head, which bore the selection number 30. It was selected in the autumn of 1906 by Mr. A. H. Leidigh, then superintendent of the Amarillo [Texas] Cereal Field Station. The Dawn (dwarf) kafir (C. I. No. 340) has been developed from the same head, the exact origin of which is not known. Probably it was selected in one of the Blackhull kafir plats on the station at Amarillo, or at Channing, Tex., where the station was located previous to 1906, but it may have been found on some nearby farm.

"Head No. 30 was used to sow a head row in 1907. The resulting plants were like ordinary Blackhull kafir in nearly all respects except earliness and stature."

The head row segregated for height in 1907.

The earliness, variable stature, and sweet stalks indicate hybridization of Blackhull kafir with some early variety of sorgo.

The tall strain when purified was first called Early Blackhull kafir but was later named Sunrise. The dwarf strain selected was called Dwarf kafir until later named Dawn.

Distribution.—Grown in Kansas and Oklahoma, and to a small extent in Missouri, New Mexico, and Texas.

Synonym.—Early Blackhull kafir.

17. DAWN KAFIR

Description.—Plants early to midseason (110 days, average of 23 crop years), dwarf to mid-tall (48 inches, average of 26 crop years); stems mid-stout, mid-juicy, not sweet; tillers sparsely; branches sparsely; mid-leafy (10 to 14); midribs cloudy; leaf sheaths overlapping much; panicle erect, mid-compact, ellipsoid to cylindroid; rachis 80 to 100 percent of head length; rachis branches short to mid-long, appressed; glumes partly pubescent but pubescence partly deciduous at maturity, black or reddish black, indurate, elliptic, apices acute to sometimes obtuse; lemmas not awned; stigmas white; kernels much exposed laterally in angle of glumes and extending beyond apices of glumes, mid-size, white with reddish-brown or black spots, ellipsoid to obovoid, endosperm starchy, corneous layer mid-thick to thick, nucellar layer absent; pedicellate spikelets straw-colored to purplish, usually persistent at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 13.

Dawn kafir differs from Sunrise in being shorter, having a less sweet stalk, and in tillering somewhat less. It is shorter and earlier than Blackhull, the seeds are smaller, and the panicles taper more toward the apex.

History.—A dwarf type selected from the progeny of the same original head from which Sunrise kafir was obtained. (See Sunrise kafir, p. 51.) Seed of Dawn kafir was first distributed by the Amarillo (Tex.) Cereal Field Station under the name Dwarf Kafir. The distribution of this variety, which was a new and superior type at the time, had an important influence upon the development of a new agricultural region in northwestern Texas. Considerable quantities of seed were later distributed in western Texas by the Santa Fe Railway, resulting in its being called Santa Fe kafir in that section. For many years Dawn kafir was the predominating grain sorghum and almost the only kafir grown in this new section. Since about 1927 it has been largely displaced by other types, a considerable portion of the kafir acreage now being devoted to Texas Blackhull.

Distribution.—Grown in Kansas, Oklahoma, Texas, New Mexico, and Missouri.

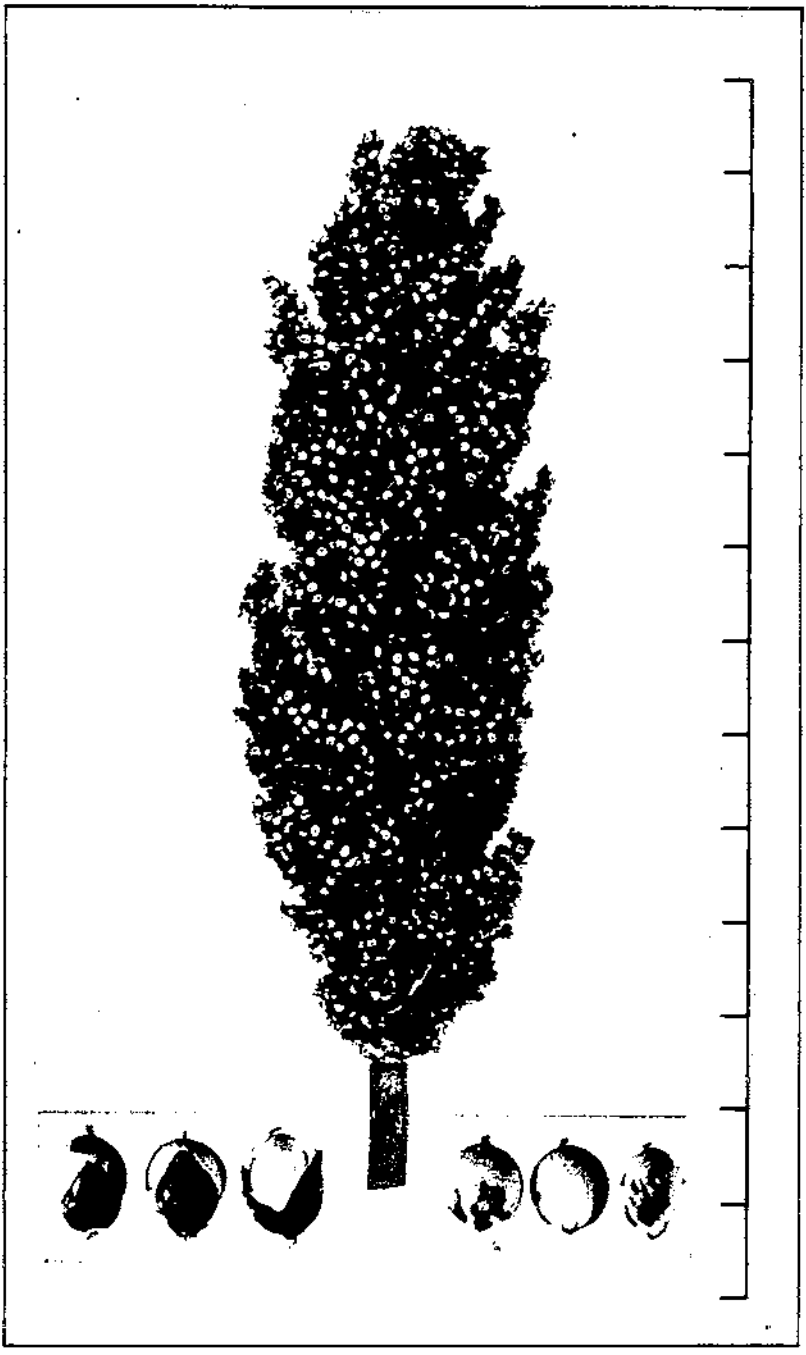
Synonyms.—Dwarf kafir, Dwarf Blackhull, Santa Fe.

18. REED KAFIR

Description.—Plants midseason (113 days, average of 10 crop years), mid-tall (63 inches, average of 10 crop years); stems mid-stout (thirteen-sixteenths to fifteen-sixteenths inch), mid-juicy, not sweet; tillers sparsely; branches sparsely; mid-leafy (10 to 13), leaves fragile and easily broken from stalk; midribs cloudy; leaf sheaths overlapping much; panicles erect, mid-compact, cylindroid; rachis average 85 percent of head length but sometimes continuous; rachis branches mid-long, appressed; glumes pubescent on upper half, black, indurate, obovate to elliptic, apices acute to sometimes obtuse; lemmas not awned; stigmas white; kernels somewhat exposed but less than Blackhull, mid-size, white with reddish-brown or black spots, ellipsoid to obovoid, endosperm starchy, corneous layer mid-thick to thick, nucellar layer absent; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 14.

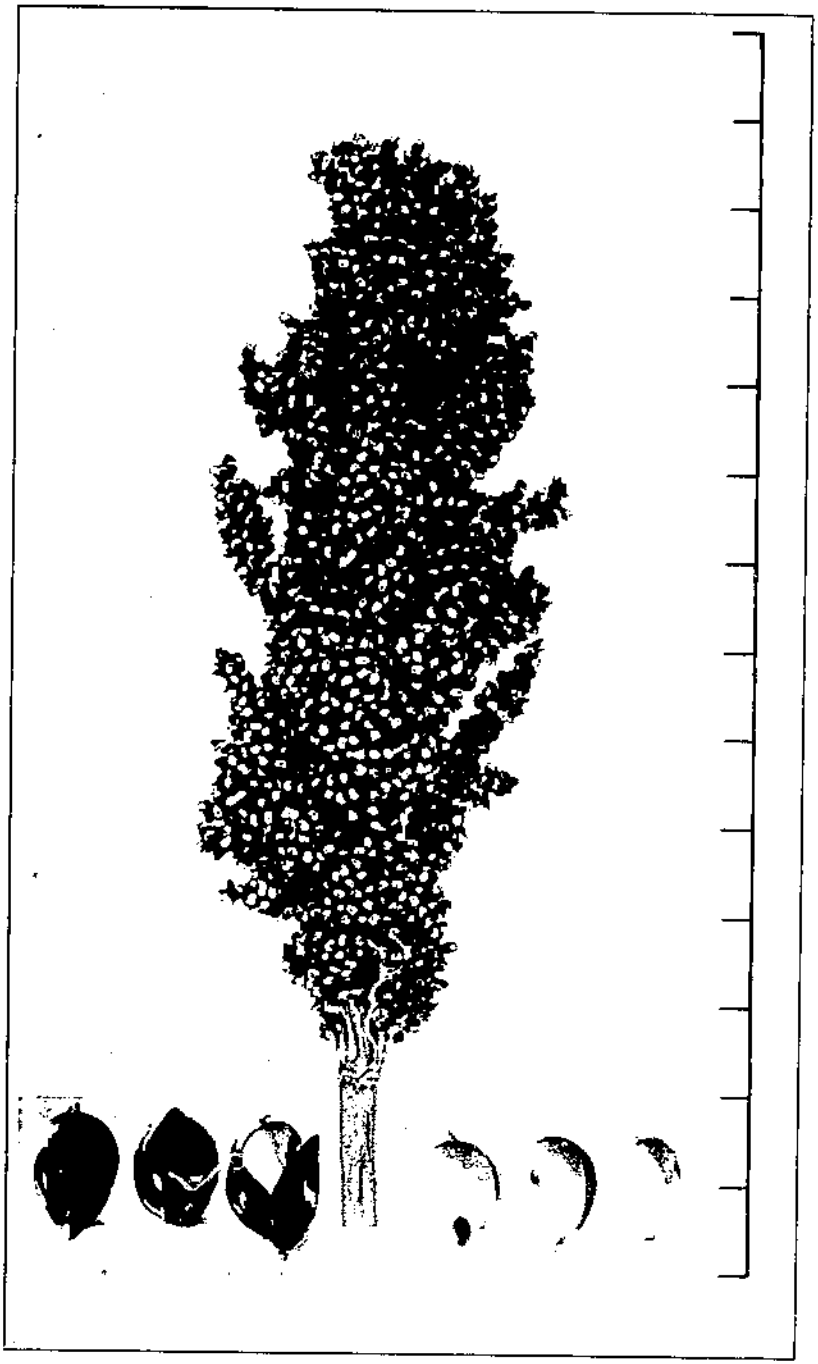
Distinguished from ordinary Blackhull kafir by the long, dull-black glumes, extending to or nearly to apex of seed, and greater persistence of pubescence on the glumes. The glumes have a distinctly yellow appearance during the blooming period and are somewhat persistent in the threshed seed. The stalks tend to lose their leaves at maturity.

History.—Reed kafir as grown is of two types. The one described (C. I. 628) was distributed by the United States Department of Agriculture from Woodward, Okla. Hydro kafir (also called Reed) is about a week later and slightly



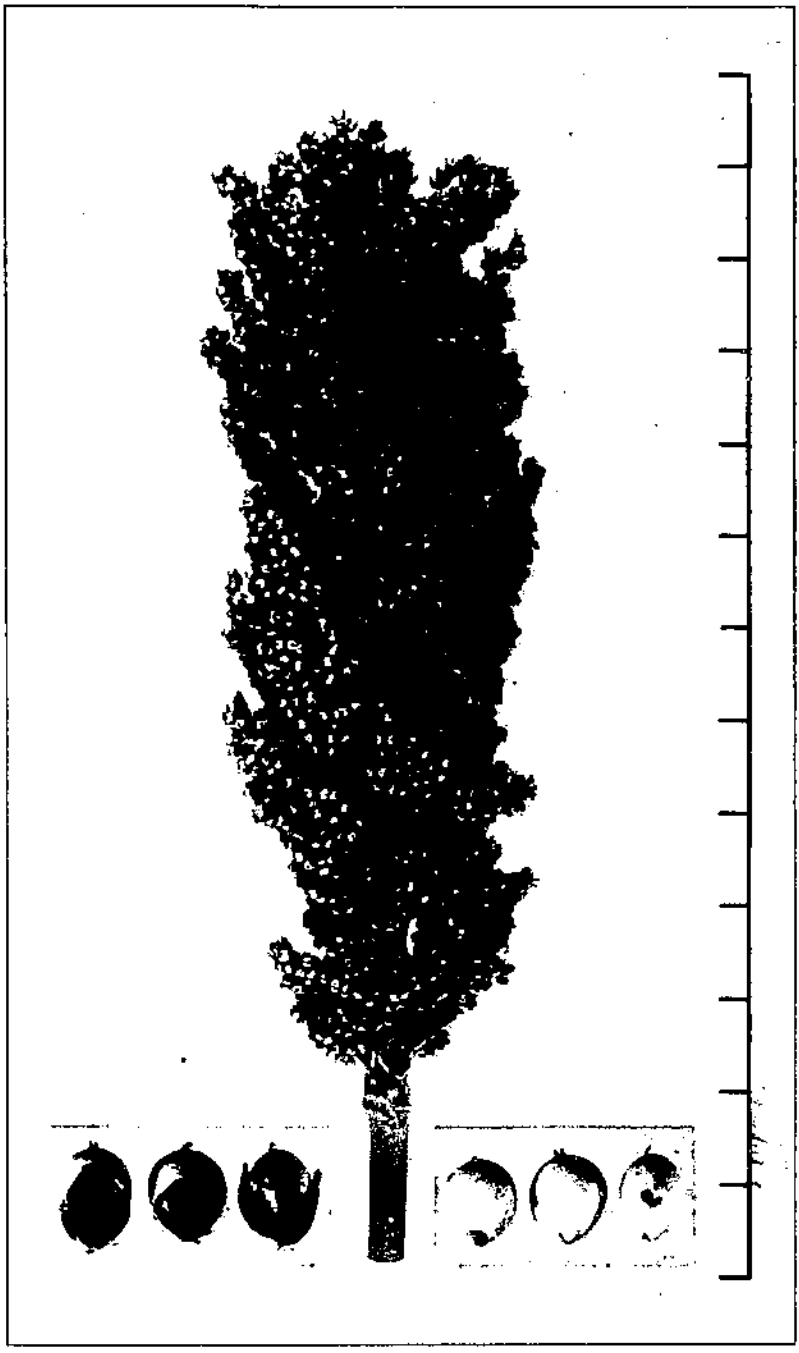
DAWN KAFIR.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, X 3.



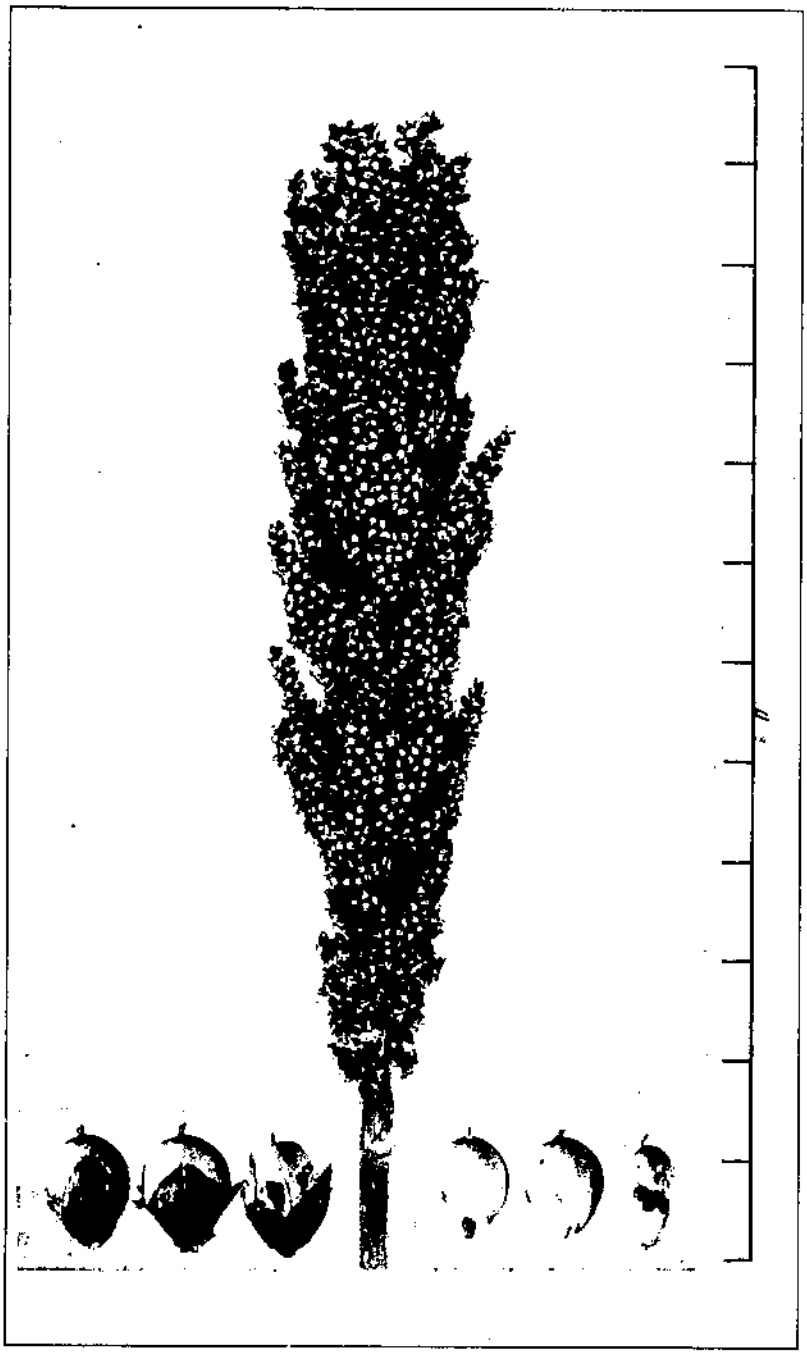
REED KAFIR

Panicle, scale indicates size in inches; spikelets and kernels in three positions, ⅔.



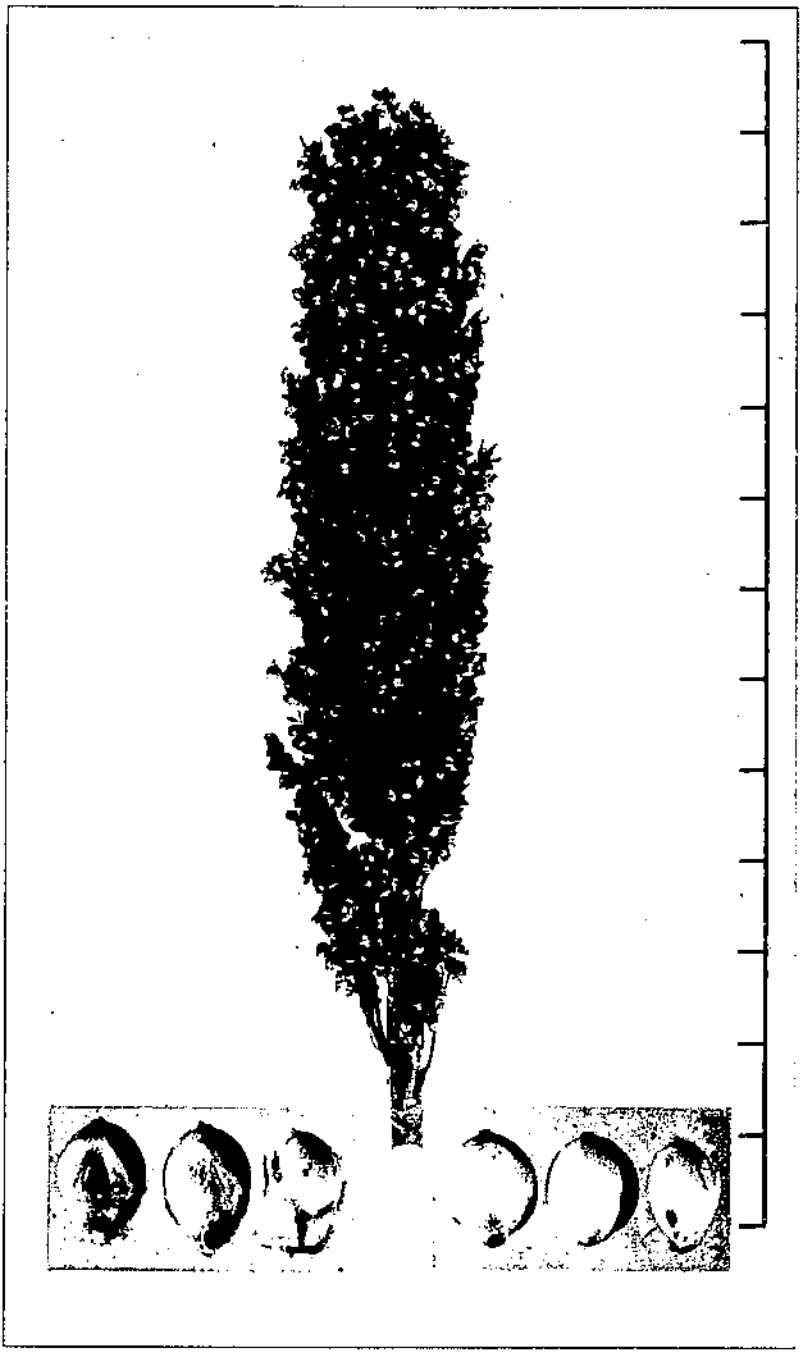
PEARL KAFIR

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



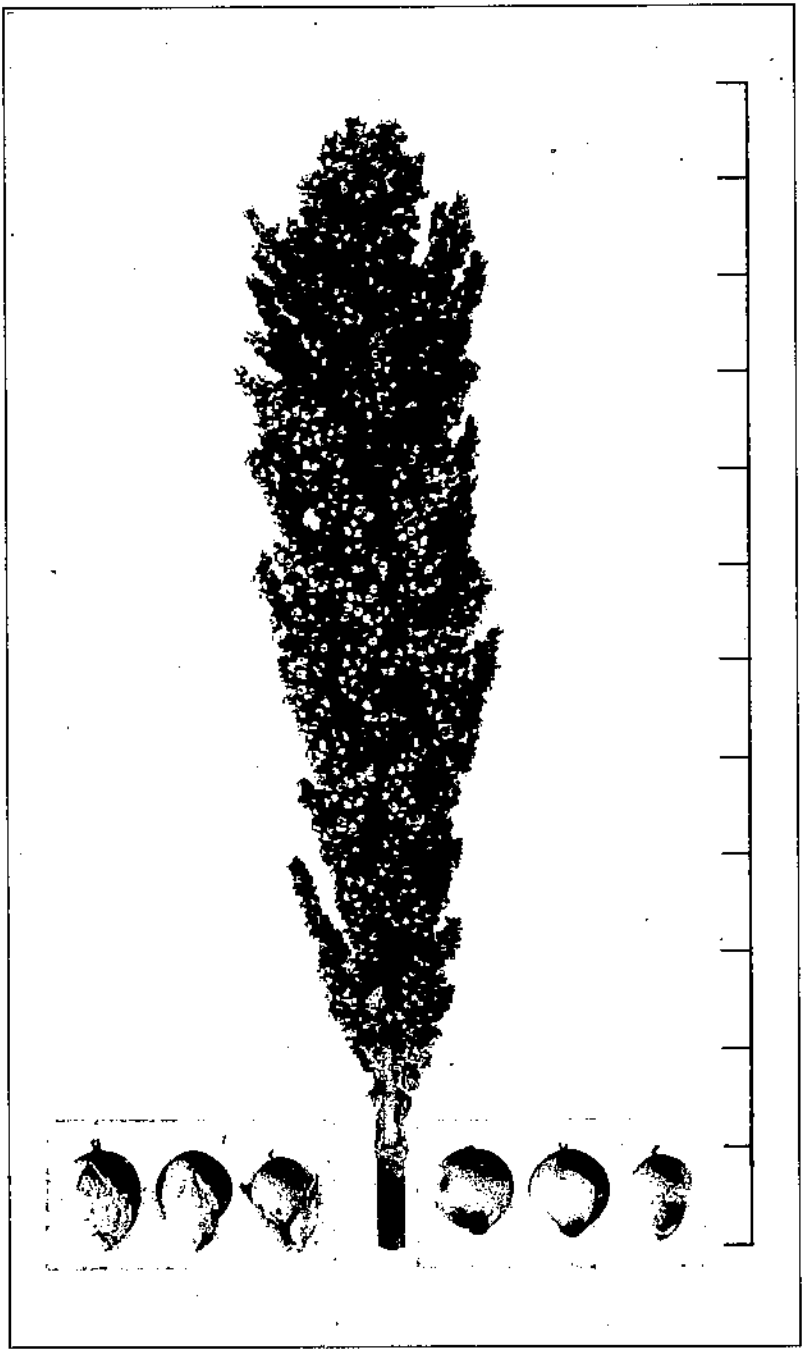
RICE KAFIR.

Panicle, scale indicates size in inches, spikelets and kernels in three positions, × 3.



WHITE KAFIR.

Panicle, scale indicates size in inches, spikelets and kernels in three positions, × 3.



PINK KAFIR.

Panicle, scale indicates . . e in inches; spikelets and kernels in three positions, × 3.

shorter. The panicle is larger and of a more clavate shape. The kernels of Hydro bear stiff, sharp style remnants, which cause the panicle to feel prickly.

The following history of Reed kafir is reported by the Oklahoma Crop Improvement Association:[30]

"Reed's Blackhull White kafir is somewhat indefinite, but its history apparently traces to a very Blackhull strain distributed by John Crammer of Okeene, Blaine County, Okla. As a cooperator of the Oklahoma A. & M. College, Mr. Crammer received several lots of kafir seed for trial sometime during 1912 to 1914. During this period and later he sold pure seed, which included the Blackhull strain. It is likely that some of his sales to the Hydro district account for the Hydro strain. In 1916 two bushels were brought into the Elk City district. This kafir proved high yielding, and eventually was increased and sold from Elk City in large quantities by E. M. Reed. A selected strain of the variety has been developed and distributed by the Woodward Field Station, Woodward, Okla. Reed's Blackhull has proved a consistently high yielder in variety tests in central and western Oklahoma. Because of its large, compact head and excellent type, the Hydro strain has become the leading kafir shown in Oklahoma fairs."

Distribution.—Grown in Oklahoma and Texas.

19. PEARL KAFIR

Description.—Pearl kafir is similar to Blackhull except in being later and in having smaller, nearly globose seeds with a translucent (pearly) appearance due to the thick corneous layer. A panicle, spikelets, and kernels are shown in plate 15.

History.—The history has not been determined. It may possibly have been derived from the old Guinea kafir, which also has corneous seeds.

Distribution.—Pearl kafir was being grown in the vicinity of McLean, Tex., in 1920, and later spread from there to other parts of Texas and Oklahoma. It was handled by commercial seedsmen as early as 1924.

20. RICE KAFIR

Description.—Rice kafir is similar to Blackhull except in having long, slender panicles similar in shape to those of Red and Pink kafirs. The seeds do not extend so far beyond the apices of the glumes as in Blackhull and have a somewhat corneous or pearly appearance. A panicle, spikelets, and kernels are shown in plate 16.

History.—The history is not known. Probably it is a selection from the Blackhull variety or from a Blackhull hybrid.

Distribution.—Grown in western Oklahoma for at least 10 years and "to some extent in the deep, sandy soils in the southeastern part of the Panhandle" (*93, p. 18*) in Texas.

21. WHITE KAFIR

Description.—Plants early to midseason, mid-tall; stems mid-stout to stout, mid-juicy, or in some strains rather dry, not sweet; tillers sparsely; branches sparsely; mid-leafy (10 to 14); midribs cloudy or in dry strains white; leaf sheaths overlapping much; panicles erect, mid-compact, cylindroid, usually not fully exserted from the sheath; rachis usually 60 to 90 percent of head length; rachis branches mid-long, appressed; glumes pubescent but pubescence partly deciduous at maturity, straw-colored, indurate to somewhat chartaceous, ovate to obovate, apices acute to obtuse; lemmas not awned; stigmas white; kernels much exposed (like Blackhull), mid-size, white with reddish-brown to black spots, ellipsoid to obovoid, endosperm starchy, corneous layer mid-thick to thick, nucellar layer absent; pedicellate spikelets straw-colored, persistent at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 17.

Distinguished from Blackhull kafir by its straw-colored glumes and earlier maturity.

History.—Originally exhibited by the Orange Free State, South Africa, at the Centennial Exposition, Philadelphia, Pa., in 1876 (*156*). A General Graves, of Egypt, attended the Centennial and later, while traveling in the South, left some seed of the White kafir with Thomas P. James, commissioner of the Department

[30] Oklahoma Certified Seeds, Seed List. Feb. 1931.

of Agriculture of Georgia.[11] In February 1877, R. J. Redding, then a clerk in the Department of Agriculture of Georgia, but later director of the Georgia Experiment Station, Experiment, Ga., sent about a thimbleful of the seed to J. H. Watkins, Palmetto, Campbell Co., Ga., who grew it for several years and first brought it to the attention of the public about 1885.[12] Mr. Watkins' supply of seed was sold to the J. H. Alexander Seed Store, Augusta, Ga., in 1886 (*19*). Some seed was donated by Mr. Watkins to the University of California College of Agriculture, and the crop was grown in California in 1886 (*159*). From 1887 to 1889 White kafir was distributed in small test lots, both by the United States Department of Agriculture and the Georgia State Department of Agriculture. In 1887 it also was distributed in California by the College of Agriculture (*16*). It was first grown in Kansas in 1886 by the Barteldes Seed Co., Lawrence, Kans., and distributed in Kansas by that firm (*34*). The seed had been obtained from Georgia. White kafir was first grown at the Kansas Agricultural Experiment Station in 1888 from seed "obtained from a local seedsman" (*66, p. 161*).

After 1887 and later White kafir was grown rather widely. By 1895, however, it began to be replaced by Blackhull kafir and has now largely been discontinued from cultivation. White kafir is earlier than the ordinary Standard Blackhull kafir, but usually yields less, and is undesirable because the panicles frequently are not exserted well from the sheath.

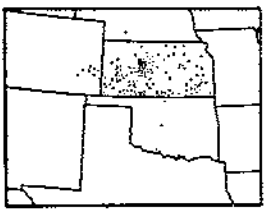


FIGURE 7.—Distribution of Pink kafir in the United States in 1924. Each dot represents 500 acres. Estimated area, 81,300 acres.

Distribution.—Grown in Kansas, Missouri, Nebraska, Colorado, Oklahoma, Texas, Arkansas, and occasionally in Kentucky and other States. The variety occupies a little less than 1 percent of the grain-sorghum acreage in the United States.

Synonym.—White-hulled kafir corn.

22. PINK KAFIR

Description.—Plants midseason (113 days, average of 24 crop years), mid-tall (56 inches, average of 27 crop years); stems mid-stout (three-fourths to seven-eighths inch), usually dry, but mid-juicy strains have been developed, not sweet; tillers sparsely; branches sparsely; leafy (10 to 15); midribs white or in mid-juicy strains cloudy; leaf sheaths overlapping much; panicles erect, mid-compact, long, cylindroid; rachis 85 to 100 percent of head length; rachis branches mid-long, appressed; glumes pubescent or partly pubescent, straw-colored, somewhat chartaceous, elliptic to sometimes ovate, apices acute to obtuse; lemmas not awned; stigmas creamy white; kernels much exposed, small to mid-size, pink or nearly white with pink flecks, usually with some small dark-red or brown spots, ellipsoid to globose, endosperm starchy, corneous layer mid-thick, nucellar layer absent except thin remnants; pedicellate spikelets straw-colored, mostly persistent at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 18.

History.—Specimens have been introduced from South Africa by the United States Department of Agriculture from time to time. Seed of one of these was sent to William Rockefeller, of Russell County, Kans., in 1905, who sent seed to the Fort Hays Branch Experiment Station, Hays, Kans., in 1907. A selection of this variety made in 1908 by A. D. Colliver was continued at Hays by C. C. Cunningham the following year and later distributed under the name "Pink kafir." Considerable quantities of seed were distributed by the station during a 15-year period.

Probably nearly all of the Pink kafir now being grown in this country is of the strain distributed from Hays, Kans. Other Pink kafirs were introduced by the United States Department of Agriculture from Cedra, Natal, South Africa, in 1907, and were subsequently distributed, but it is not known that any of these are being grown at the present time.

The direct introductions of Pink kafir from South Africa, such as S. P. I. 19742, were larger and much later in maturing, with seeds of a darker pink, than the Pink kafir developed at Hays, Kans. None of these late strains has ever been grown commercially.

Distribution.—Well distributed over Kansas and to some extent in eastern Colorado, Nebraska, New Mexico, Oklahoma, and Texas. Over 90 percent of the Pink kafir acreage is in Kansas (fig. 7).

[11] Letter from R. J. Redding, Experiment, Ga., September 1904.
[12] Letter from J. H. Watkins, Palmetto, Ga., July 24, 1906.

23. RED KAFIR

Description.—Plants midseason (113 days, average of 25 crop years), mid-tall (55 inches, average of 37 crop years); stems mid-stout (three-fourths to seven-eighths inch), mid-juicy and dry strains are being grown, slightly sweet; tillers sparsely; branches sparsely; leafy (11 to 15); midribs cloudy except in dry strains; leaf sheaths overlapping much; panicles erect, mid-compact, slender, long, cylindroid; rachis average about 80 percent of head length but sometimes continuous; rachis branches mid-long, appressed; glumes pubescent but pubescence partly deciduous at maturity, straw-colored to often reddish brown, somewhat chartaceous, elliptic to ovate, apices acute to obtuse; lemmas not awned; stigmas yellow; kernels much exposed laterally in angle of glumes and extending well beyond apices of glumes, small to mid-size, reddish brown to yellowish red and often with dark spots, ellipsoid to obovoid or globose, endosperm starchy, corneous layer mid-thick to thick, nucellar layer absent; pedicellate spikelets straw-colored to dark reddish brown, mostly deciduous at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 19.

Distinguished from other kafirs by red color of head due to red seed and straw or reddish brown glumes, and from sorgos by sparse tillering, erect habit of growth, long, cylindroid, semicompact (kafir type) heads, and absence of nucellar layer in seed.

History.—Two varieties from South Africa were exhibited at the Centennial Exposition at Philadelphia in 1876 (*156*). One of these was White kafir, previously described. The other was probably, although not certainly, the Red kafir described here. Red kafir doubtless was grown, but apparently did not become established during this early period, and nothing certain is known of its existence until 12 years later.

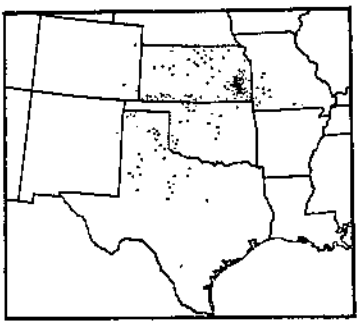


FIGURE 8.—Distribution of Red kafir in the United States in 1924. Each dot represents 500 acres. Estimated area, 92,700 acres.

In 1888, seed of a red kafir which had been sent to this country from South Africa nearly 10 years before was grown in Kansas by A. A. Denton, of the United States Department of Agriculture, and found to be the same as some received in 1887 from a French physician residing in Algeria (*57*). Red kafir was grown in experiments at Manhattan, Kans., (*66*) in 1889, and at Garden City, Kans., (*54*) that year or shortly thereafter. The seed had been furnished by the United States Department of Agriculture. Seed of this variety was obtained from the agricultural college at Manhattan in 1891 by the Barteldes Seed Co., Lawrence, Kans., and was distributed by them in 1892 (*34*).

By 1893 Red kafir had become popular throughout the region in which kafir was grown.

Other introductions of Red kafir have been received from Africa since 1887, but none has been known to become established. Selection of Red kafir has resulted in securing strains somewhat earlier than the variety as originally introduced. At least two such distinct types have been found growing in western Kansas, one of which has dry stalks.

Distribution.—Grown principally in Kansas, Missouri, Colorado, Oklahoma, and Texas, and to some extent in Alabama, Georgia, Tennessee, Arkansas, New Mexico, and Nebraska. A little over 2 percent of the grain sorghum acreage is devoted to Red kafir (fig. 8).

24. MANCHU BROWN KAOLIANG

Description.—Plants very early (average about 90 days), mid-tall (average about 67 inches); stems mid-slender, dry, not sweet; tillers sparsely; branches mid-freely; leaves few (7 to 10), small; midribs white; leaf sheaths overlapping slightly; panicles erect, mid-compact, ellipsoid to sometimes ovoid; rachis usually continuous; rachis branches short to mid-long; glumes thinly pubescent or glabrous at maturity, dark reddish brown to yellow and straw, chartaceous, ovate, apices acute; lemmas with short awns; stigmas yellow; kernels much

exposed and extending well beyond apices of glumes, mid-size, reddish brown, ellipsoid, endosperm starchy, corneous layer thin, nucellar layer present; pedicellate spikelets reddish brown and persistent at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 20.

History.—Ball (*30, p. 22*) gives the first recorded introduction of kaoliang as about 1805 and lists a few other lots of seed received previous to 1898, when the United States Department of Agriculture began importations. These early introductions were probably discarded.

The variety named and described by Ball (*30, p. 52*) as Manchu Brown was received first in 1898 from Siberia, and later (1906 and 1907) from Manchuria. Distributions by the United States Department of Agriculture were made from time to time and by the South Dakota Agricultural Experiment Station from 1913 to 1915.

Distribution.—Small acreage grown in Oklahoma. Formerly grown in South Dakota and other States where it was distributed.

Synonyms.—The name is often translated from Chinese literature as kowliang and gaolan.

25. STANDARD YELLOW MILO

Description.—Plants midseason (112 days, average of 21 crop years), mid-tall (62 inches, average of 20 crop years); stems mid-stout, mid-juicy to dry, not sweet; tillers freely; branches mid-freely; mid-leafy (11 to 14); midribs yellow (pl. 3); leaf sheaths overlapping slightly to moderately; panicles inclined to recurved, compact, ovoid to ellipsoid; rachis usually continuous; rachis branches short to mid-long, stiff; glumes pubescent but pubescence partly deciduous at maturity, black to reddish brown or sometimes straw-colored, somewhat chartaceous near apex, but indurate below middle, transversely wrinkled, obovate to sometimes ovate, apices acute to obtuse, but frequently broken off at maturity; lemmas with long awns; stigmas yellow; kernels much exposed, large, salmon yellow (Ridgway's pale yellow orange to ferruginous[12]), obovoid to almost globose, somewhat flattened on embryo side, endosperm starchy, corneous layer thin, nucellar layer absent; pedicellate spikelets straw-colored to reddish brown; coleoptile red. A panicle, spikelets, and kernels are shown in plate 21.

History.—Origin undetermined. No imported sorghum has been observed which is identical with milo, but some forms of yellow-seeded durra received from Africa are very similar to it in seed and panicle characters. The name "millo maize" (*86*) seems to have been first applied by H. B. Pratt, of South Carolina, to the sorghum known as Guinea kafir, Guinea corn, or Rural Branching durra, which was formerly grown in this country. Mr. Pratt attempted to copyright the name "millo maize" and sell seed at $2 a pound in 1882 (*18*). After Standard Yellow milo became known the Guinea kafir was designated as White milo and the true milo as Yellow milo.

The date of the introduction or first propagation of Standard Yellow milo is unknown, but it was reported by King (*95, p. 60*) among the crops grown in 1886, as follows: "On the Gulf border of Florida, the Yellow Millo Maize and Johnson grass have been reported by good farmers as excelling all other forage plants." Yellow milo also had been grown in South Carolina as early as 1886 (*59*). Seed was offered for sale by seedsmen in Augusta, Ga., in 1887 (*19*), and in Richmond, Va., in 1888 (*134, p. 64*). Standard Yellow milo was grown at the Kansas (*134, p. 64*) and Louisiana (*145, p. 316*) Agricultural Experiment Stations in 1888 and at the Nebraska station in 1889 (*141, p. 17*). After 1890 the growing of milo expanded rapidly, particularly in Texas.

No definite evidence exists that the present type of milo was derived from a so-called "Giant" milo formerly reported occasionally. The occurrence of Giant milo in the United States is not definitely proved. However, some grain sorghum plants very similar to milo introduced from Africa have displayed the extreme height, thickness, and vigor of first-generation hybrid milo plants, which are in some instances referred to as "Giant milo."

Distribution.—Grown in Texas, Oklahoma, and Arizona and to a very small extent in some other States.

Synonyms.—Standard maize, Standard Red maize, Red Egyptian corn.

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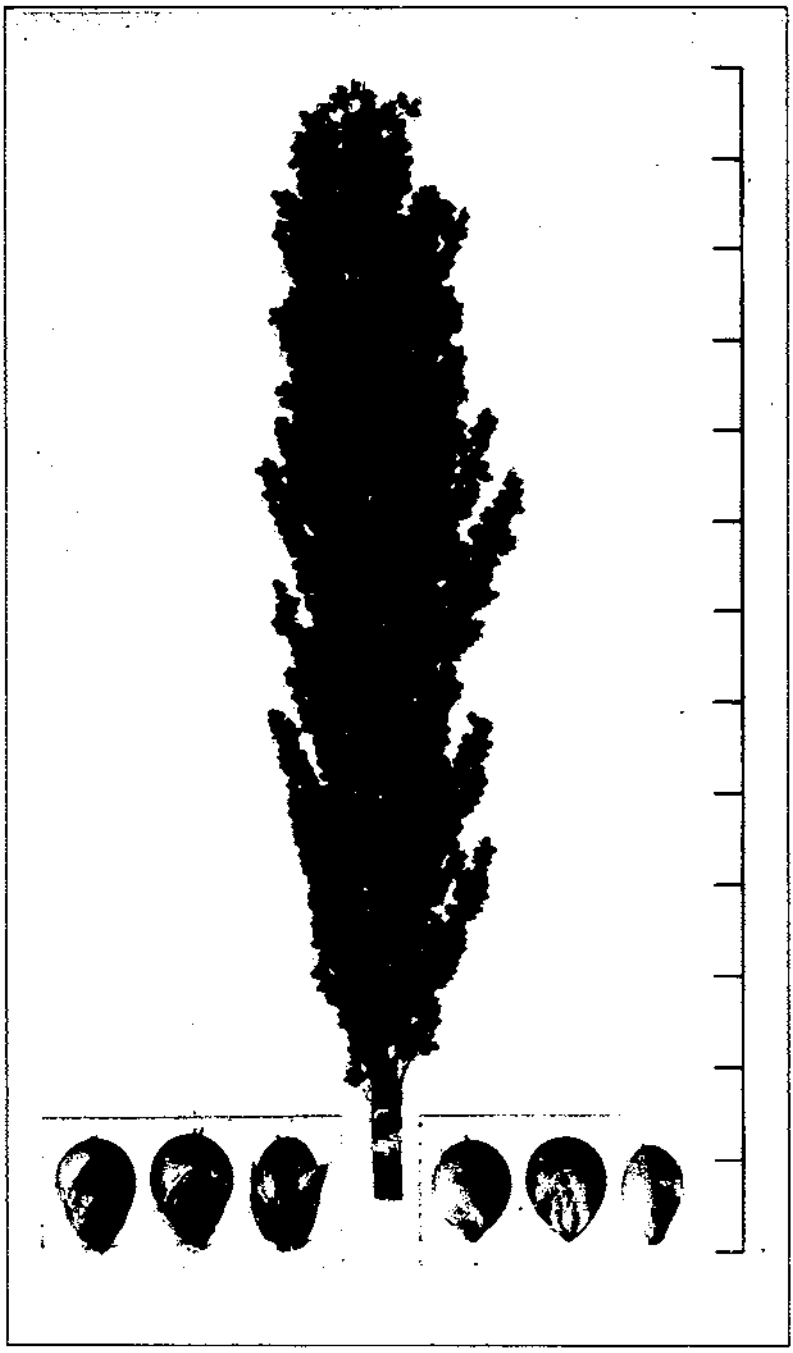
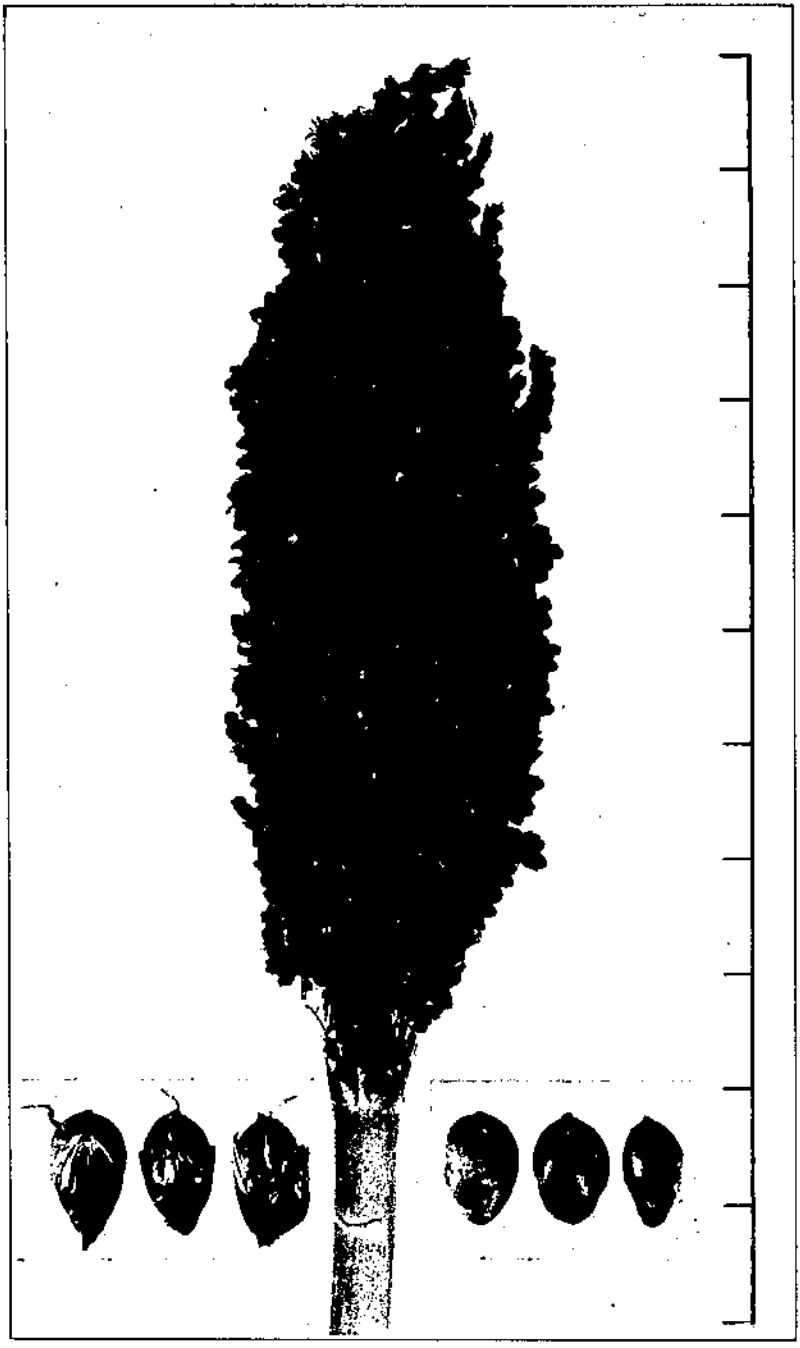
[12] RIDGWAY, R. COLOR STANDARDS AND COLOR NOMENCLATURE. 43 pp., illus. Washington, D. C., 1912.



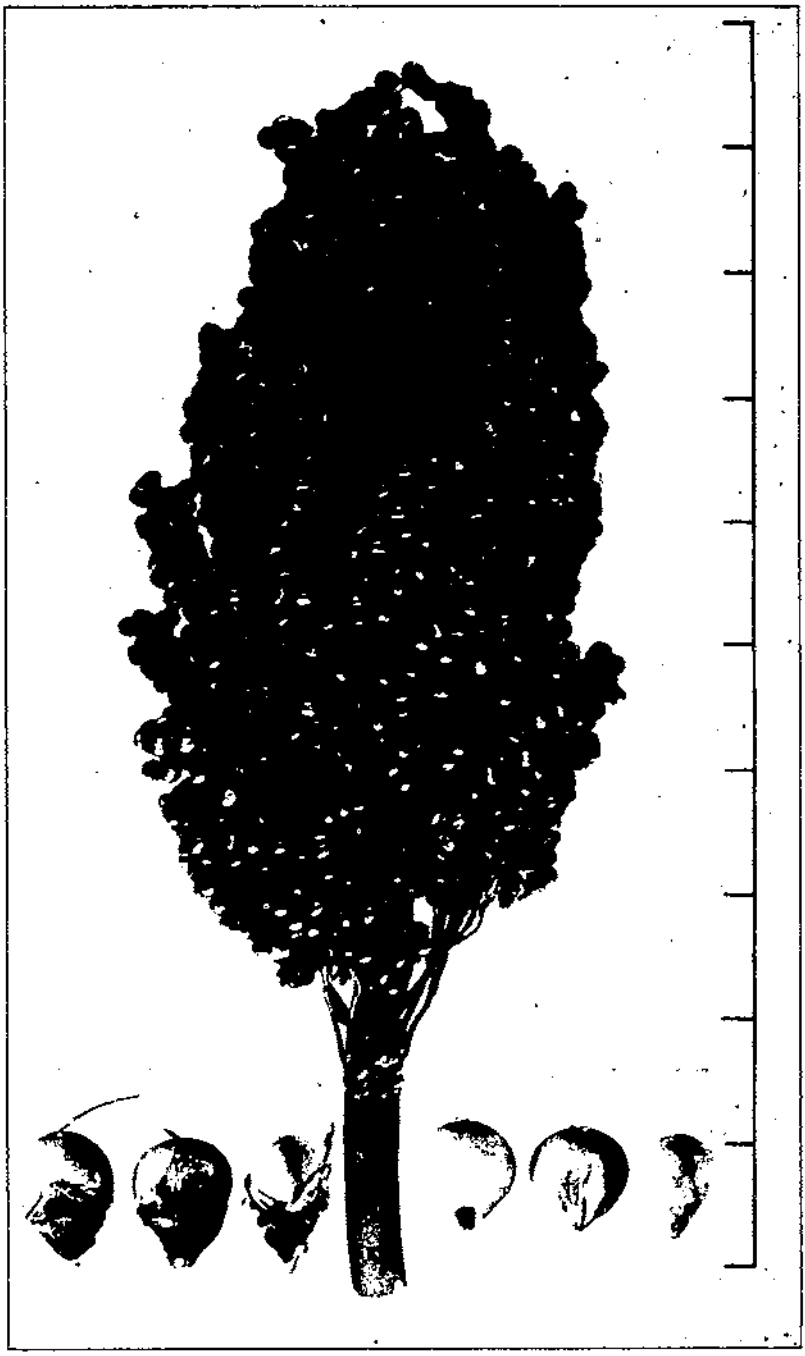
RED KAFIR

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



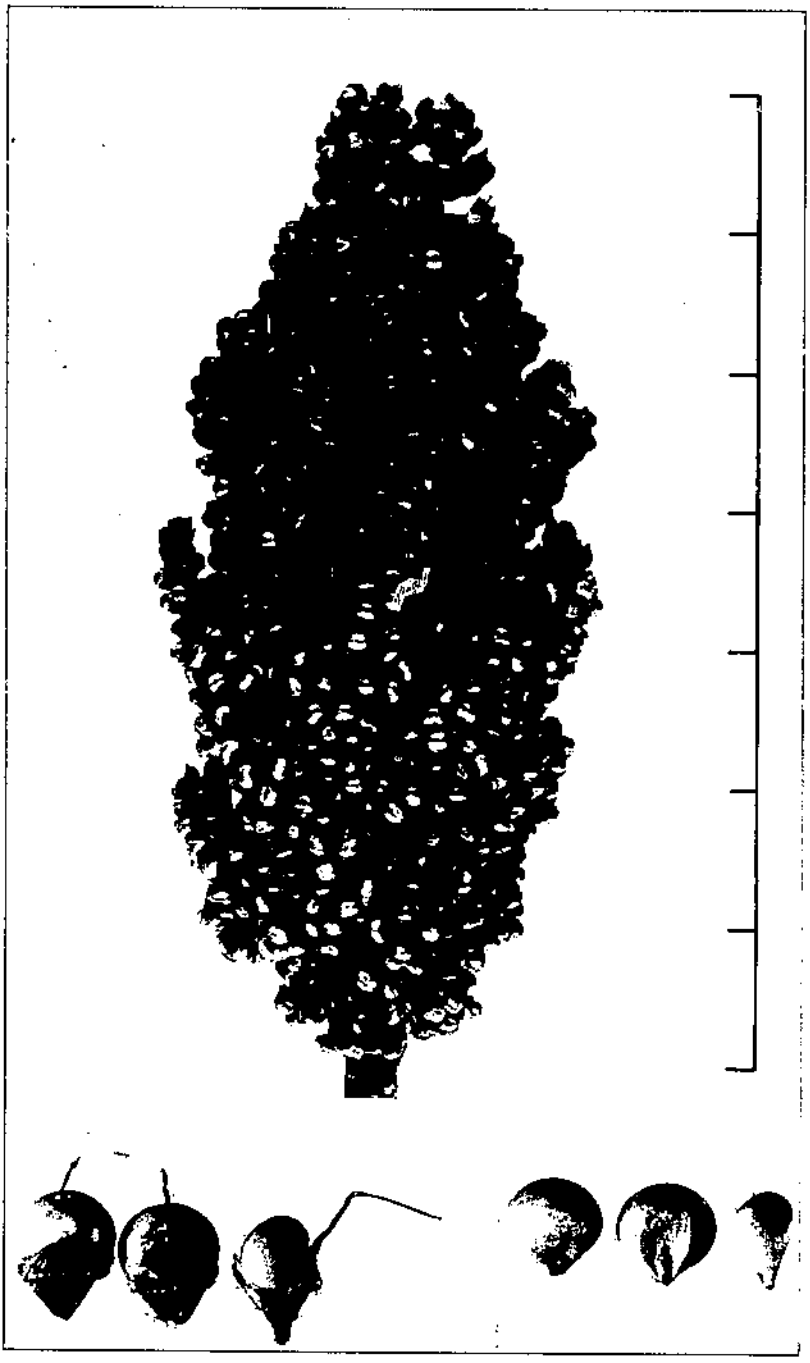
MANCHU BROWN KAOLIANG

Panicle, scale indicates size in inches, spikelets and kernels in three positions, × 3



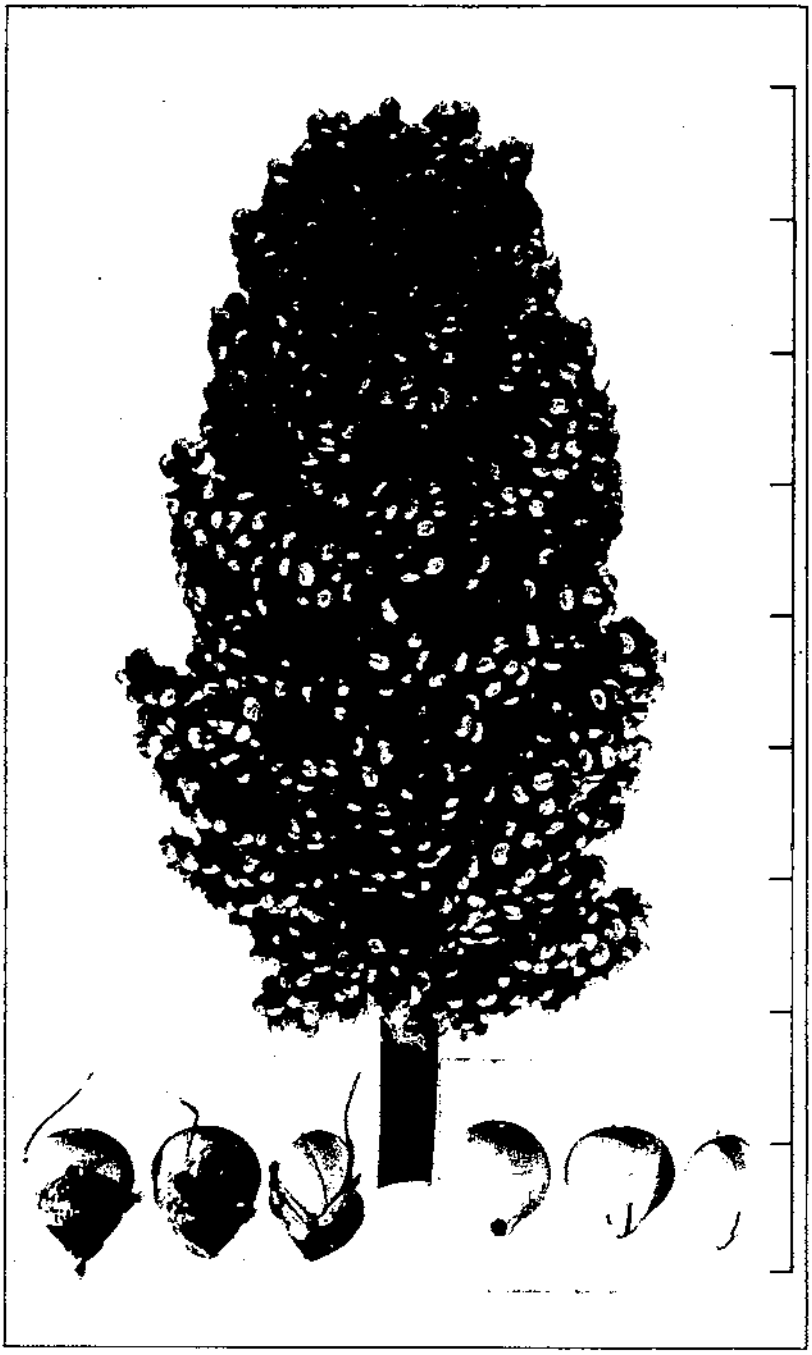
STANDARD YELLOW MILO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



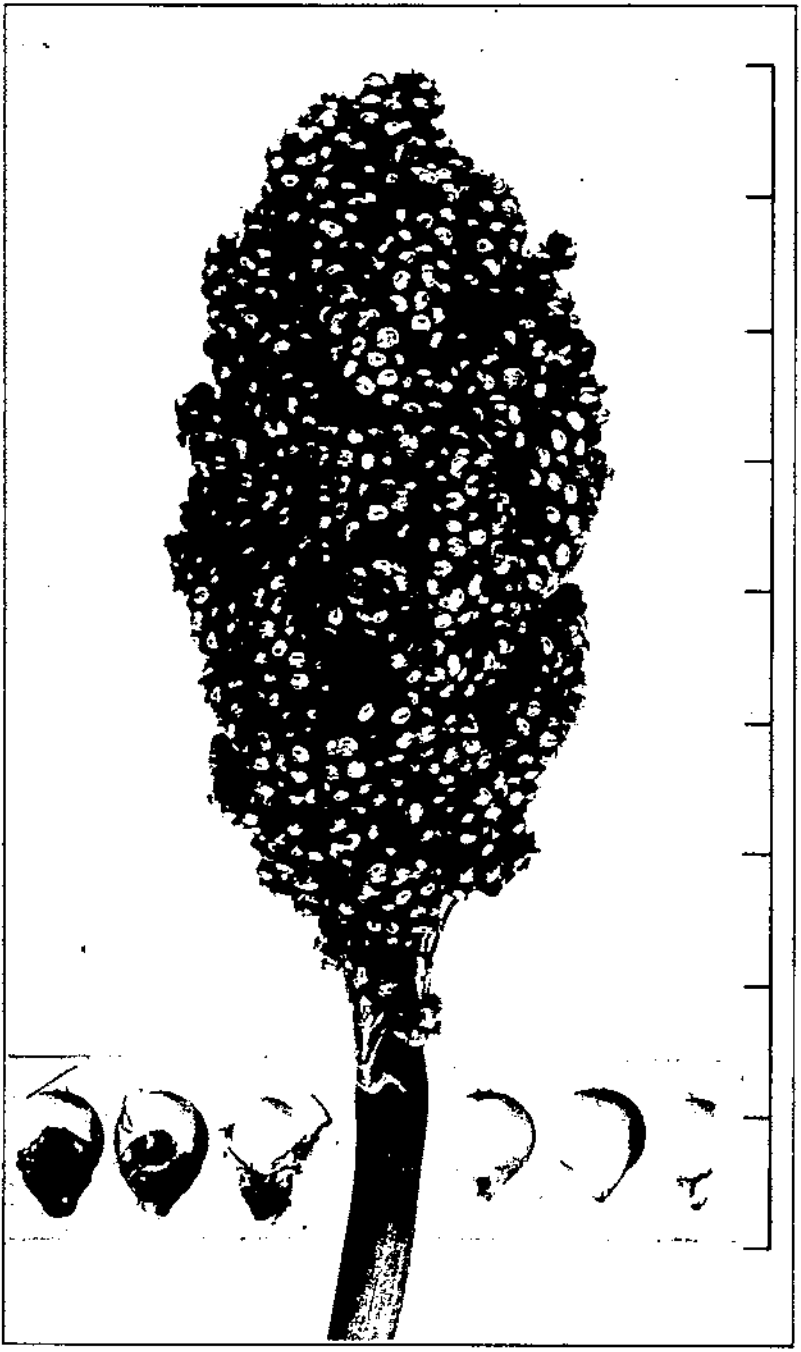
DOUBLE DWARF YELLOW MILO

Panicle, seeds, and the size they reached when spikelet and kernel pedicels were clipped



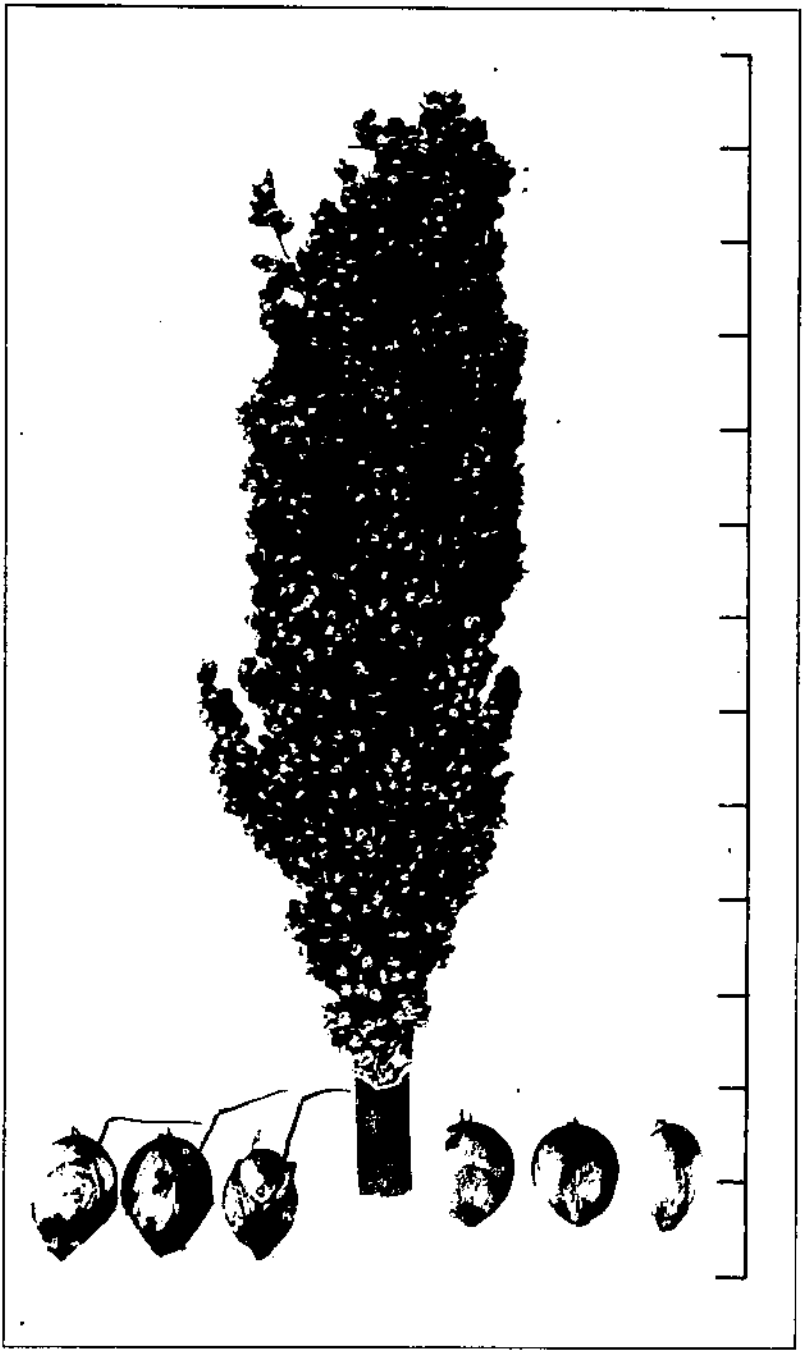
DWARF WHITE MILO.

Panicle, cultivated; grain in pedicelled spikelet and kernel in three positions; × 3



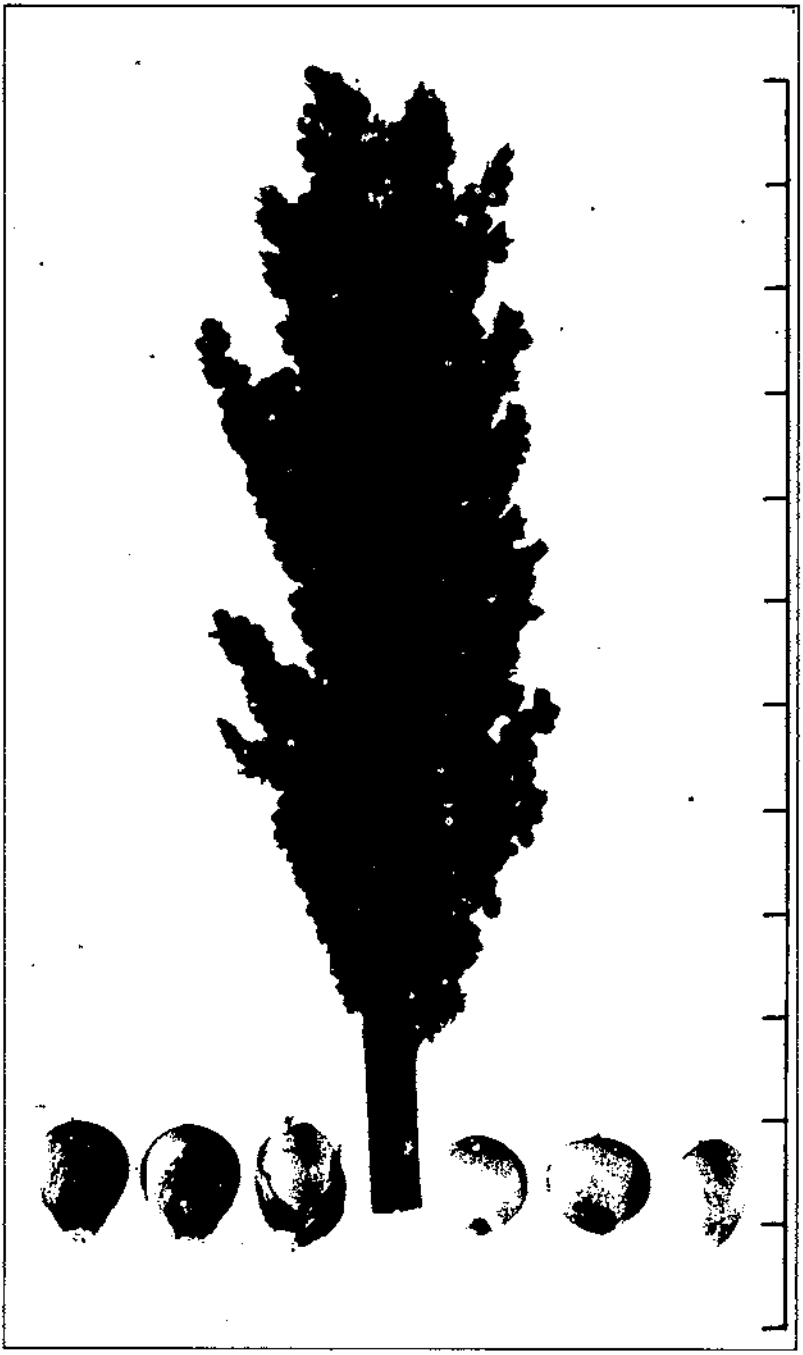
EARLY WHITE MILO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3



BEAVER

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



WHEATLAND.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.

26. DWARF YELLOW MILO

Description.—Similar to Standard Yellow milo except that the plants are short (average about 48 inches), the heads are not as well exserted, the rachis is more often discontinuous, and the leaves overlap more.

History.—Origin undetermined. It probably arose as a mutation from Standard Yellow milo by the change of a single genetic factor for internode length. Its first appearance is not recorded, and it may not have been isolated from Standard Yellow milo until some years after it developed. Standard Yellow milo usually was rather short when grown under semiarid conditions and was frequently mistakenly called Dwarf milo. In the spring of 1906, however, seed of the true Dwarf Yellow was secured from J. F. Bradley, Memphis, Tex. He wrote: "I did not originate the variety, nor do I know the origin of it. It was brought to this county from Oklahoma, and I observe that it now grows much taller than 3 years ago." An erroneous origin of the variety was suggested by Mr. Bradley: "[6] Now I have been told, but have never seen it verified, that the dwarf variety is originated by using seed from short suckers that come out far upon the stalk."

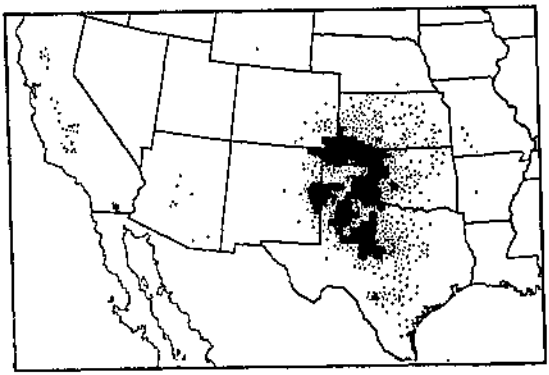


FIGURE 9.—Distribution of Dwarf Yellow milo in the United States in 1924. Each dot represents 500 acres. Estimated area, 1,025,000 acres.

Several hundred pounds of Mr. Bradley's seed was purchased and distributed by the United States Department of Agriculture in 1906. It was later distributed from several field stations, and doubtless most of the Dwarf Yellow milo now being grown is the progeny of the crop grown by Mr. Bradley.

A quantity of seed of Dwarf Yellow milo (C. I. 149; S. P. I. 18345) also was secured from the Barteldes Seed Co., Lawrence, Kans., April 17, 1906. This strain was grown at the Amarillo (Tex.) Cereal Field Station for several years. Dwarf Yellow milo may thus have been grown in Oklahoma and probably in Kansas for several years previous to its discovery by agronomists. Owing to the variation in height under different environments, it is not always possible to distinguish between Standard Yellow and Dwarf Yellow milo unless the two varieties are grown in adjacent plots. References to Dwarf Yellow milo previous to 1906 may have referred either to the true dwarf type or to the taller Standard Yellow variety dwarfed by environmental conditions.

Distribution.—Dwarf Yellow milo is the principal grain sorghum variety in Texas, New Mexico, Colorado, and California and is second only to Blackhull kafir in Oklahoma and in the Sorghum Belt as a whole. Grown extensively in southwestern Kansas and on smaller acreages in North Carolina, Kentucky, Tennessee, Georgia, Alabama, Arkansas, Missouri, Nebraska, and Arizona. The center of its production is somewhat south and west of the center of Blackhull kafir production (fig. 9).

Synonyms.—Dwarf maize, red maize, red milo, crook-neck maize. Helleman milo is the name given to a purified lot of Dwarf Yellow milo formerly distributed in California.

27. DOUBLE DWARF YELLOW MILO

Description.—Plants midseason, mature with Dwarf Yellow milo or 2 to 6 days earlier; extra dwarf (24 to 30 inches); leaf sheaths overlapping very much, heads often not well exserted, panicles usually ellipsoid; fewer heads recurved than in Dwarf Yellow. Otherwise like Standard Yellow and Dwarf Yellow milo. A panicle, spikelets, and kernels are shown in plate 22.

[6] Letter, Feb. 13, 1908.

History.—Like the other true milos, the origin of the Double Dwarf variety has not been determined. Probably it originated as a mutation from Dwarf Yellow milo by the change of a single height factor. Double Dwarf Yellow milo was first brought to the attention of agronomists in the Imperial Valley of California in 1918. It was grown there that year by C. C. Deane, who purchased a 40-pound lot of Arizona-grown seed from the Nicholl-Loomis Grain Co., Brawley, Calif.[15] Mr. Deane rogued his crop for 3 years and sold his 1920 crop to the Germain Seed Co., Los Angeles, Calif., which distributed it widely. O. B. Crary also was growing Double Dwarf milo near Calipatria, Calif., in the Imperial Valley in 1918 from seed obtained in El Centro, Calif. Seed from this farm was later purified and distributed by the California Agricultural Experiment Station. Apparently the Double Dwarf Yellow variety was first isolated in the Salt River Valley of Arizona. D. E. Creighton,[16] former assistant farm adviser of Imperial County, Calif., recalls seeing the double dwarf type of milo in the Salt River Valley as early as 1910.

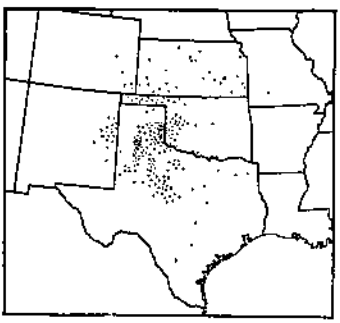


FIGURE 10.—Distribution of White milo (Standard and Dwarf) in the United States in 1924. Each dot represents 500 acres. Estimated area, 122,100 acres.

Double Dwarf Yellow milo, under the name of Extra Dwarf milo, was secured from the Texas Seed & Floral Co., Dallas, Tex., by R. E. Dickson, superintendent of Texas substation no. 7, Spur, Tex., in April 1920.

Distribution.—Grown in California, Arizona, and Texas.

Synonyms.—Extra Dwarf milo, rabbit maize.

28. STANDARD WHITE MILO

Description.—Very similar to Standard Yellow milo except that the seed coat is white, usually with reddish-brown to black spots.

History.—Origin undetermined. It probably originated as a mutation from Standard Yellow milo by the change of a single genetic factor for color. Its first appearance on farms apparently has not been recorded. The name White milo was first used for Guinea kafir about 1887, and early references to the true Standard White milo are thus badly obscured. According to Ball and Rothgeb (*33*), Standard White milo probably was introduced about 1888 to 1893. "It was found under cultivation in scattered localities in western Texas in 1909, during an extensive reconnaissance made by the senior writer. It has since been found sparingly in Oklahoma." This late discovery would indicate that the variety may have originated much later than the writers suggest.

Standard White milo has never become widely grown, as it is in no way superior to the Standard Yellow variety, and the yellow grain is preferred in the market.

Distribution.—Grown to a limited extent in Texas and occasionally in adjoining States (fig. 10).

Synonym.—White maize.

29. DWARF WHITE MILO

Description.—Like Dwarf Yellow milo except that the seed coat is white. A panicle, spikelets, and kernels are shown in plate 23.

History.—Origin undetermined. It probably originated as a mutation from either Dwarf Yellow or Standard White milo, or as a recombination from a cross between the two, as it apparently differs from each of these varieties by a single genetic factor. The variety was brought to public attention by Camp, who wrote (*42*): "There are two kinds of white milo, the standard and the dwarf. The standard has been grown in southwestern Texas for many years. It grows from 6 to 8 feet high. * * * The improved white dwarf has been grown in some of the western counties of Oklahoma for several years. It grows from 4

[15] Letter from C. C. Deane, Los Angeles, Calif.
[16] Personal correspondence with A. T. Bartel, U. S. Department of Agriculture.

to 6 feet high * * *. Last year we got one peck of improved white dwarf milo seed from a neighbor, who had been visiting in Texas County, Okla."

Distribution.—Grown sparingly in several Southwestern States.

30. EARLY WHITE MILO

Description.—Early White milo is similar to Standard White milo but is much earlier and has fewer leaves, smaller panicles, and more slender stalks. In height it is intermediate between the Standard White and Dwarf White varieties. It is the earliest commercial variety of White milo. The stalks are regarded as sweet by some farmers. A panicle, spikelets, and kernels are shown in plate 24.

History.—Early White milo was being grown in western Texas as early as 1911, since it was obtained in February 1912 by the Division of Cereal Crops and Diseases from C. F. Harris, Hale Center, Tex., and during the same year by the Division of Forage Crops and Diseases from a farmer's field near Chillicothe, Tex.

Distribution.—Grown in western Texas.

Synonyms.—Sugar milo, Little Sweet milo, 40 day milo, 70-day milo.

31. BEAVER

Description.—Plants early to midseason, very short (average about 30 inches); stem mid-stout, mid-juicy to dry, not sweet; tillers mid-freely; branches mid-freely; mid-leafy (10 to 15); midribs yellow; leaf sheaths overlapping much; panicles erect to inclined but sometimes recurved; compact, ovoid to ellipsoid; rachis 80 to 90 percent of head length; rachis branches short to mid-long, somewhat appressed; glumes pubescent, dark reddish brown, indurate, ovate to obovate, not transversely wrinkled, apices obtuse; lemmas awned; stigmas pale yellow; kernels much exposed but less than Standard Yellow or White milos, mid-size to large, yellow, obovoid to nearly globose, endosperm starchy, corneous layer mid-thick, nucellar layer absent; pedicellate spikelets dark brown; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 25.

Beaver differs from Double Dwarf Yellow milo in tillering less, in having nearly erect, less compact but better exserted panicles, and glumes without the transverse wrinkles.

History.—A selection from a backcross on Dwarf Yellow milo of a kafir-milo hybrid produced by J. B. Sieglinger at the Southern Great Plains Field Station, Woodward, Okla. The F_2 generation of the original cross was grown in 1920, and one of the hybrid selections was crossed back with Dwarf Yellow milo in 1922. It was first distributed to farmers in 1928 (*139*).

Distribution.—Western Kansas and Oklahoma and the Texas Panhandle.

Synonyms.—Combine milo, hog maize.

32. WHEATLAND

Description.—Plants early to midseason, very short (average about 30 inches); stems mid-stout, mid-juicy to dry, not sweet; tillers mid-freely to freely; branches mid-freely; mid-leafy (8 to 13); midribs yellow; leaf sheaths overlapping much; panicles erect, mid-compact, cylindroid; rachis 50 to 70 percent of head length and usually discontinuous; rachis branches mid-long and appressed except at tip; glumes pubescent, dark reddish brown, thin, and sometimes indurate, ovate to elliptic, apices acute; lemmas awnless; stigmas pale yellow; kernels much exposed, mid-size to large, yellow, obovoid to globose, endosperm starchy, corneous layer mid-thick, nucellar layer absent; pedicellate spikelets reddish brown, large and conspicuous; coleoptiles red. The leaves have a tendency to roll and are somewhat narrow. The heads "blast" severely when heading during hot, dry weather. A panicle, spikelets, and kernels are shown in plate 26.

Wheatland differs from Double Dwarf Yellow milo in having erect, less compact panicles with truncate tips, longer glumes with no transverse wrinkle, awnless lemmas, and slightly smaller and less intensely colored seeds.

History.—A selection from a kafir-milo hybrid made by J. B. Sieglinger, Woodward, Okla. It was named and first distributed to farmers in Kansas and Oklahoma in 1931 (*139*).

Distribution.—Grown in the western part of Kansas and in Oklahoma and Texas.

33. FARGO

Description.—Plants late (average about 124 days), mid-tall (average about 60 inches); stems mid-stout to stout, mid-juicy to dry, not sweet; tillers mid-freely to freely; branches mid-freely; leafy (13 to 16); midribs yellow; leaf sheaths overlapping much; panicles erect, but tips of branches often drooping, mid-compact to effuse, various shapes but usually ellipsoid or ovoid; rachis 75 to 90 percent of head length; rachis branches mid-long to long; glumes pubescent but pubescence partly deciduous, straw-colored to brown, somewhat chartaceous, not transversely wrinkled, ovate to elliptic, apices acute; lemmas with geniculate awns; stigmas yellow; kernels much exposed but less than in Dwarf milo, mid-size to large, salmon yellow with red and black spots, obovoid to globose but flattened on embryo side, endosperm starchy, corneous layer thin to mid-thick, nucellar layer absent; pedicellate spikelets straw-colored to brown, large and conspicuous; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 27.

History.—A variety originated by H. Willis Smith, a farmer and sorghum breeder, of Haskell County, Kans., and later of Seward County, Kans., as a selection from a kafir-milo hybrid. It was breeding true in 1916 and was distributed in 1919[11] and again in 1921. The variety was called "Buff kafir" by the originator. Farmers who later grew the crop called it "straight-neck maize" or "straight-neck milo" and apparently were unaware of its origin or of the name given by the originator. In 1928 the Division of Cereal Crops and Diseases secured seed of Buff kafir from Mr. Smith. When grown that season Fargo straight-neck and Buff kafir proved to be the same variety. Until then the origin of Fargo was undetermined.

The variety was first obtained by the United States Department of Agriculture in 1922 from a farmer residing near Fargo, Ellis County, Okla., and was grown in experiments at Woodward, Okla., in 1923. The variety gradually increased in popularity in southwestern Kansas and the Oklahoma Panhandle until 1927, when it occupied a larger area than Dwarf Yellow milo in some localities. Since 1927 the acreage has declined considerably because of its late maturity and tendency to lodge.

Distribution.—Grown in Oklahoma, Texas, and southwestern Kansas.

Synonyms.—Buff kafir, Fargo milo, Fargo Straight-Neck, Straight-Neck maize, Straight maize.

34. MANKO

Description.—Manko is similar to Fargo but is later and leafier, and the panicles are more compact and are ellipsoid. The stalks are rather juicy, and the leaf midribs are a yellowish gray. The glumes are not transversely wrinkled and have acute tips. The coleoptiles are green.

History.—Doubtless a kafir-milo hybrid of unknown origin. It was exploited by seedsmen at Lubbock, Tex., in 1928.

Distribution.—Grown scatteringly in Texas, New Mexico, and Oklahoma.

Synonyms.—Manko maize, sweet maize.

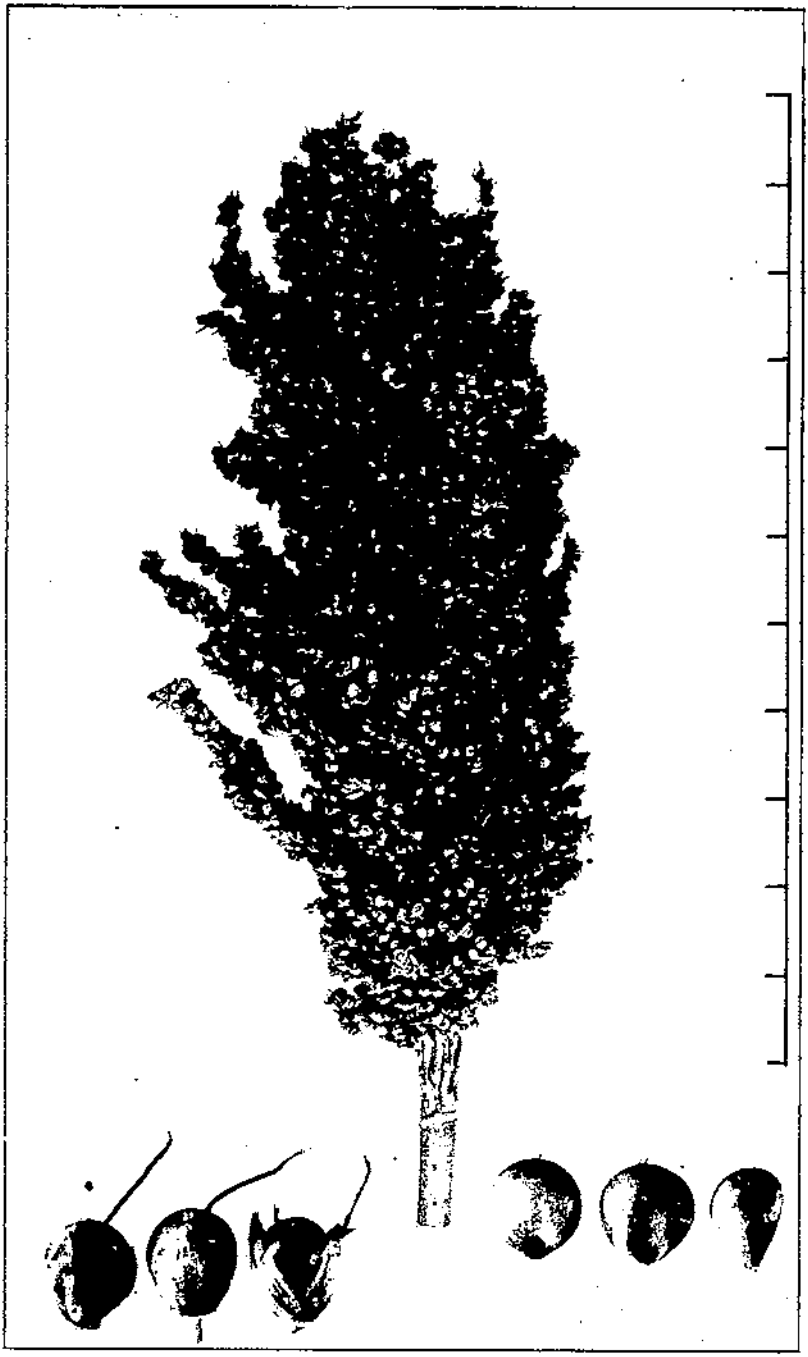
35. DESERT BISHOP

Description.—Plants midseason, mid-tall; stems mid-stout to stout, mid-juicy, not sweet; tillers mid-freely; branches mid-freely; mid-leafy (8 to 12); midribs yellow; leaf sheath overlapping moderately; panicles inclined to recurved, compact, ellipsoid; rachis 70 to 100 percent of head length but usually continuous; rachis branches mid-long at base and short at apex, appressed; glumes pubescent, usually dark brown but vary from black to straw color, indurate but often chartaceous at apex, obovate, transversely wrinkled, apices obtuse; lemmas with long geniculate awns; stigmas creamy white; kernels much exposed, large, white with dark-brown spots, obovoid to globose, endosperm starchy, corneous layer thin, nucellar layer absent; pedicellate spikelets straw-colored to dark brown; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 28.

Desert Bishop differs from Standard White milo in being later and in having longer, more slender, and pointed panicles. It resembles Bishop except in having more compact panicles and in having glumes and kernels like milo.

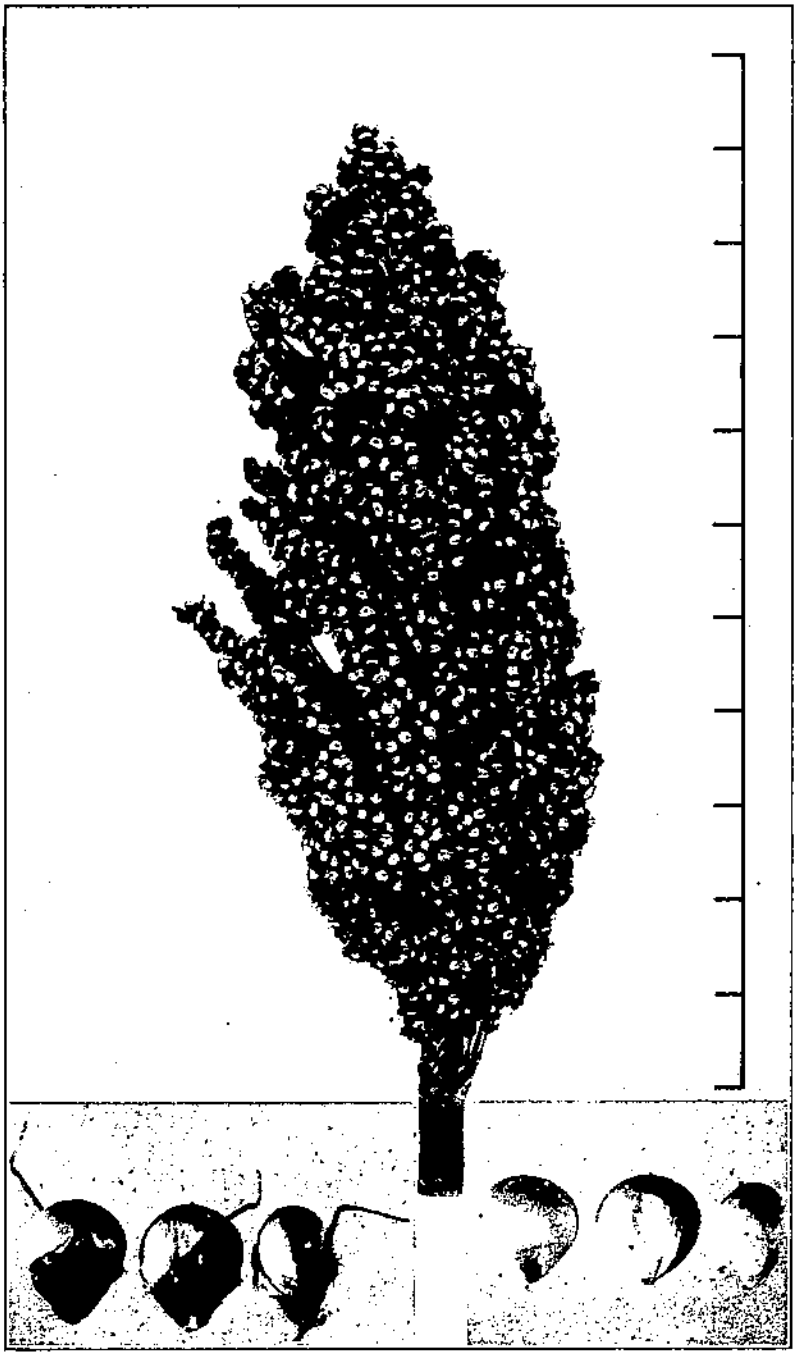
History.—Probably a kafir-milo hybrid. It was selected from a mixed lot obtained in the Oklahoma Panhandle by H. H. Finnell, Panhandle Agricultural and Mechanical College, Goodwell, Okla., and was distributed in 1927.

[11] Letter from H. Willis Smith, Feb. 3, 1930.



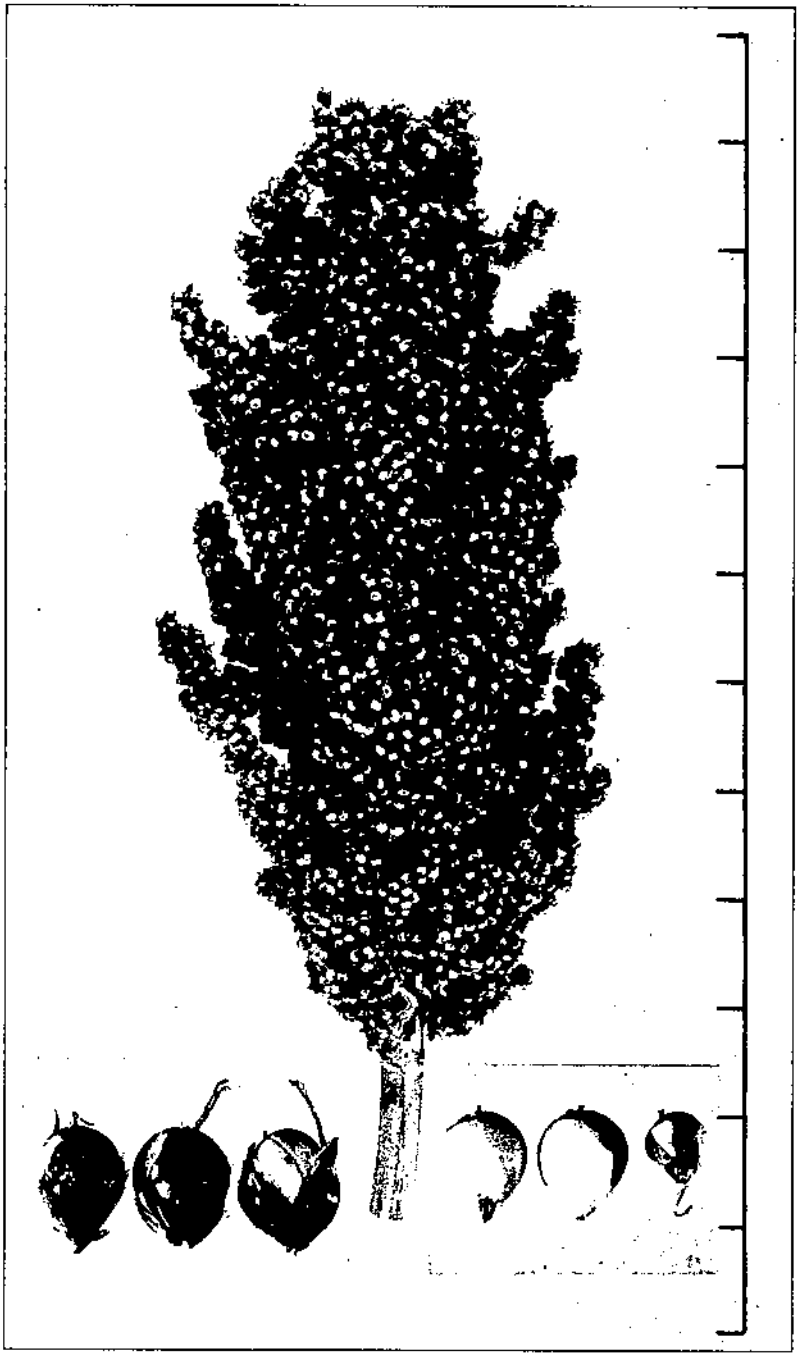
FARGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



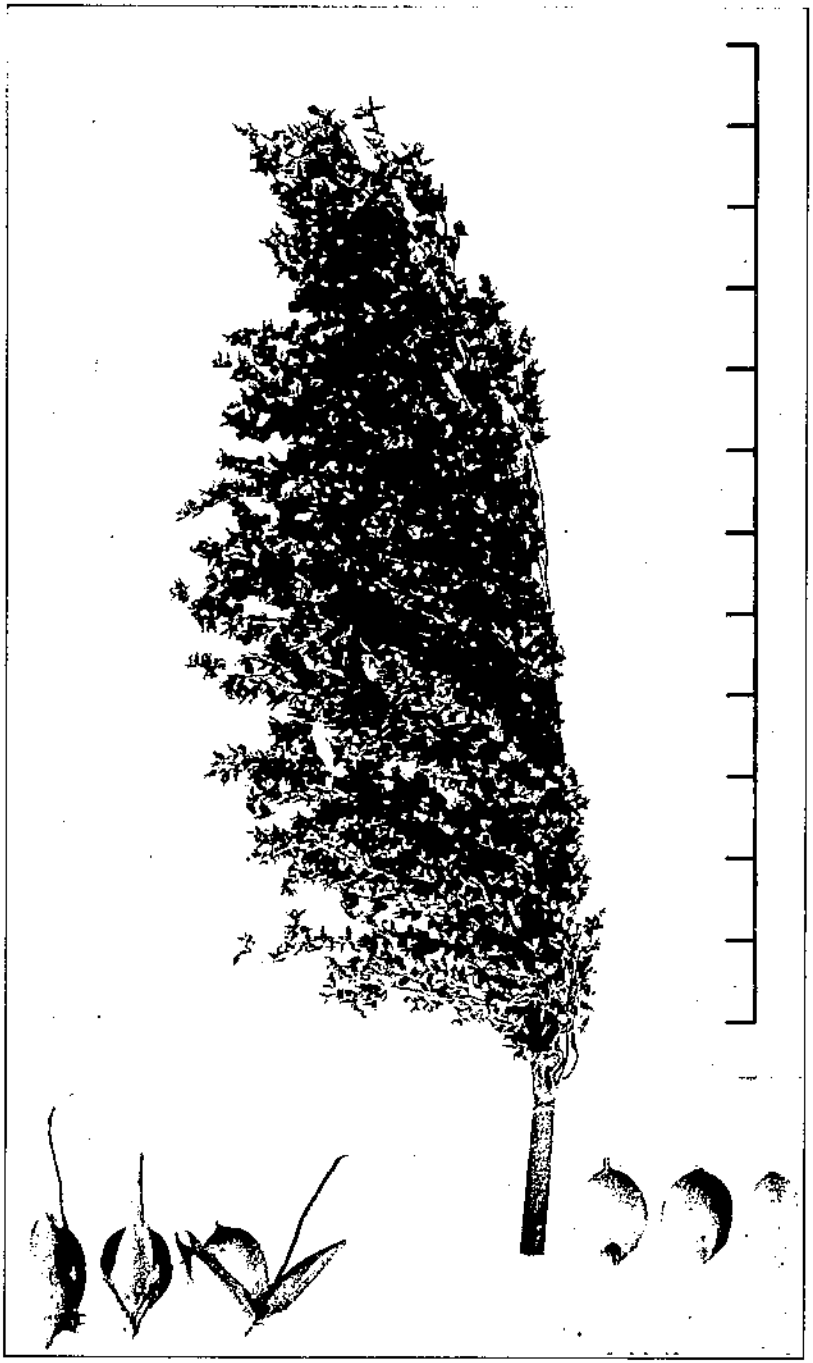
DESERT BISHOP.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



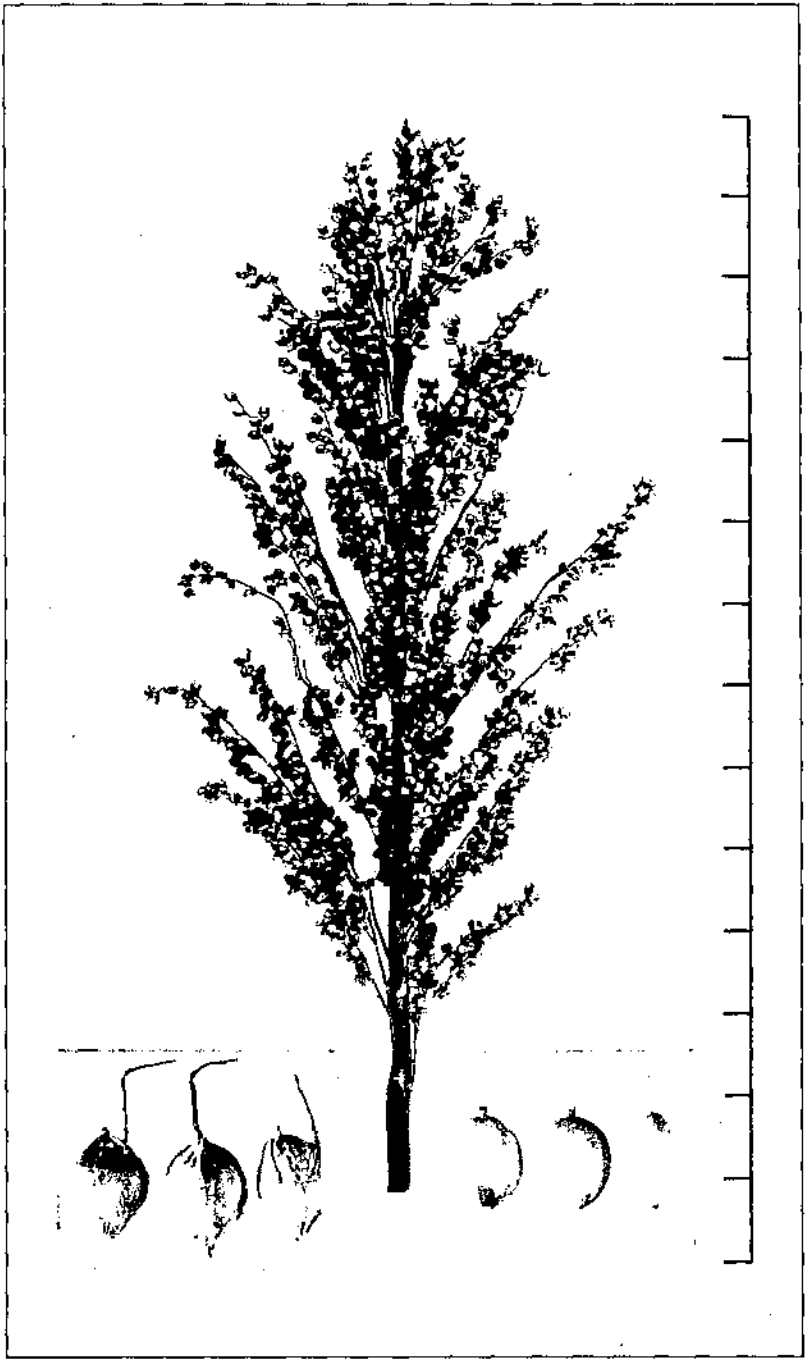
BISHOP.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



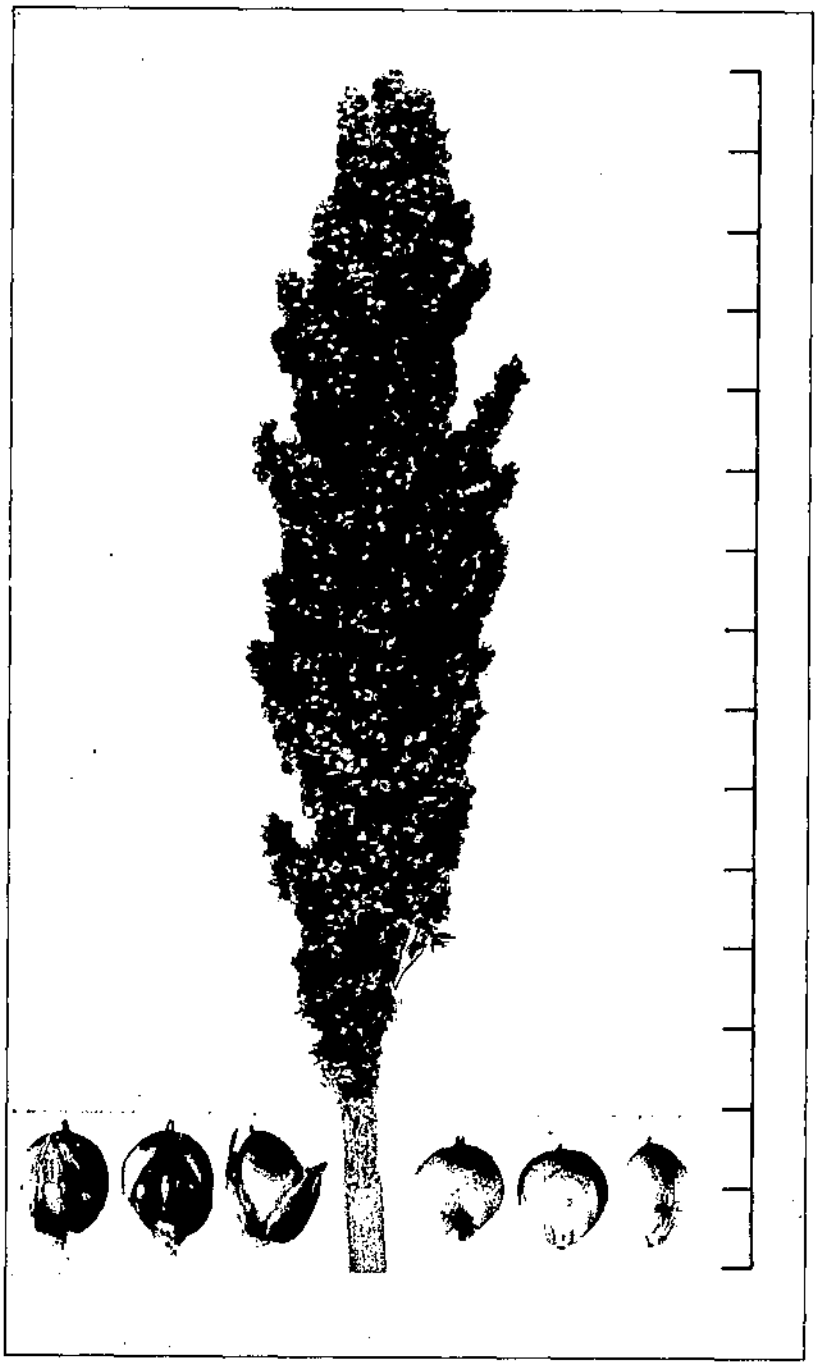
SHALLU.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



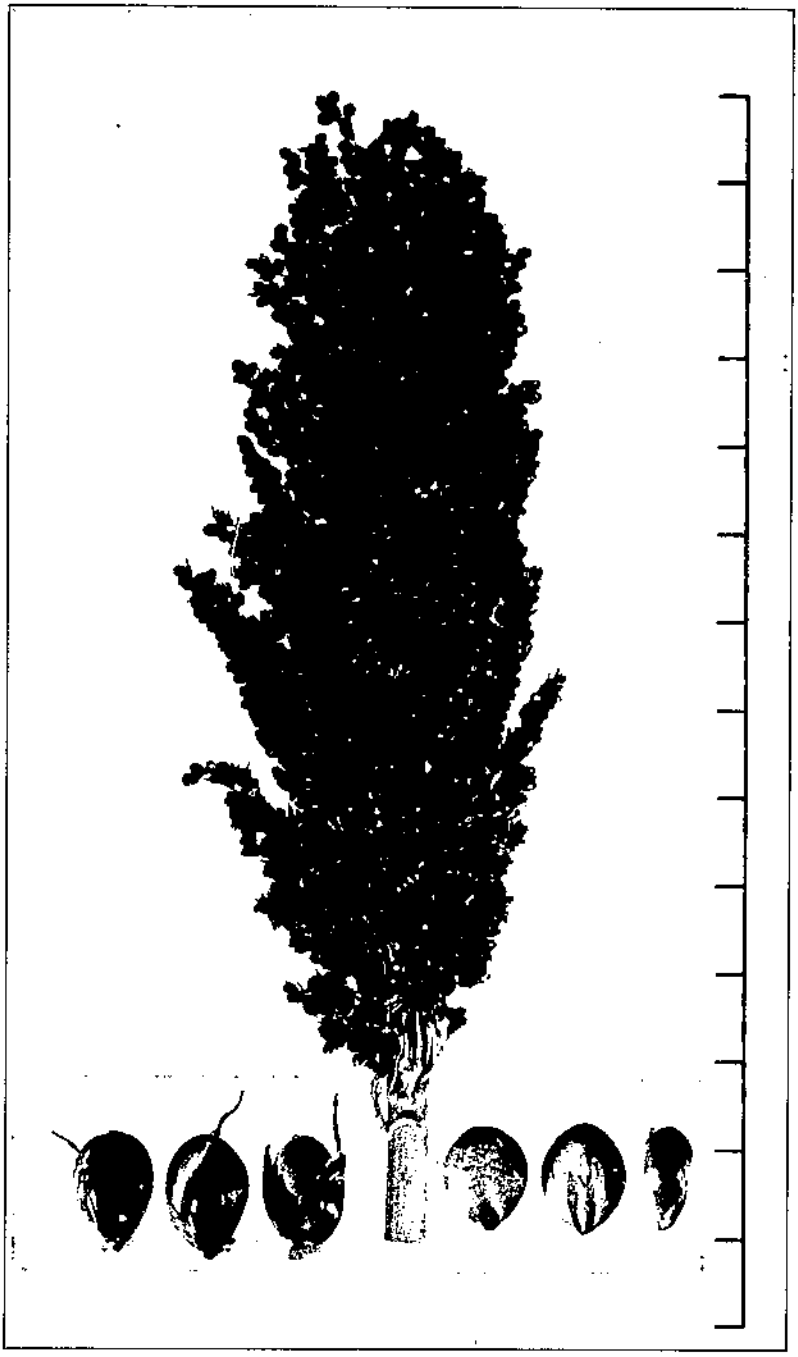
FREED

Panicle, scale indicates size in inches; spikelets and kernels in three positions. × 3.



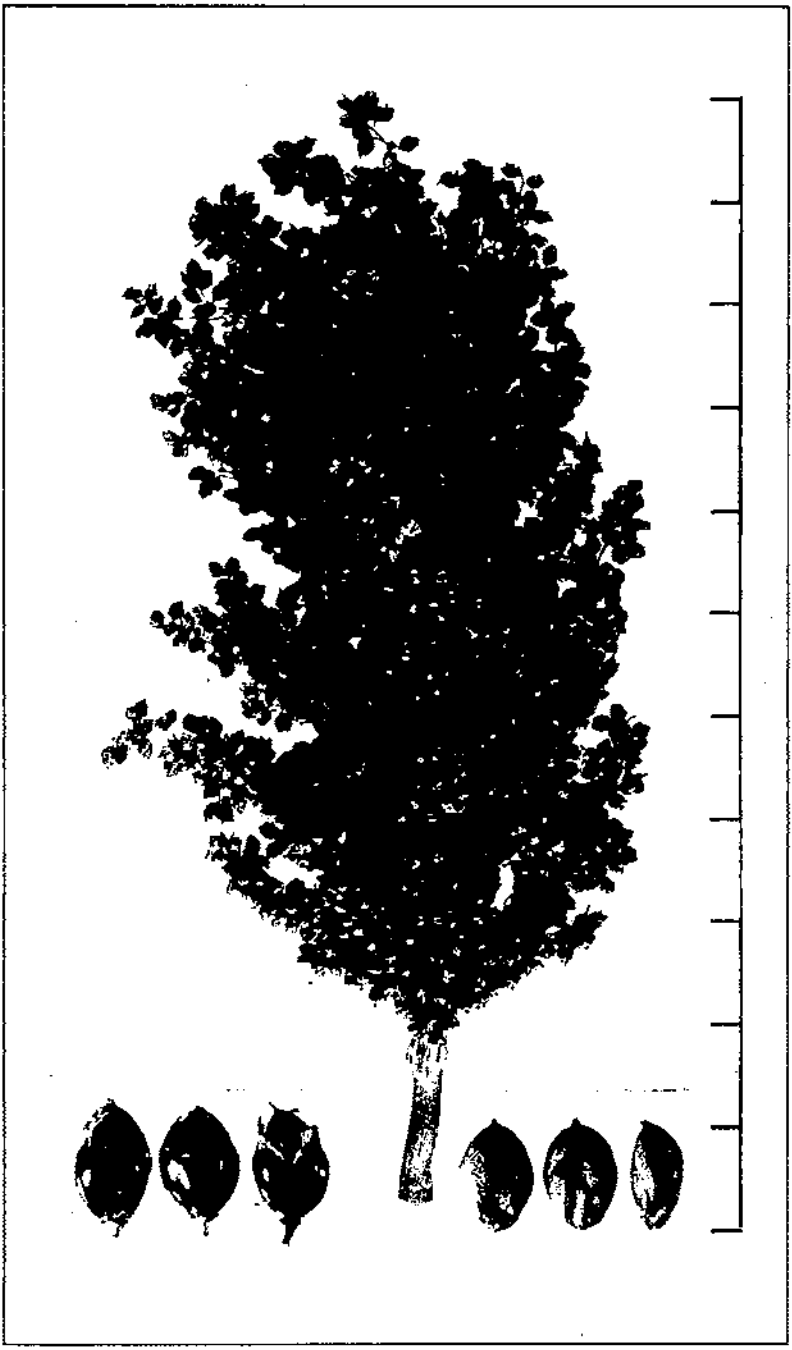
GROHOMA.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



DARSO

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



SCHROCK.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, X 3

Distribution.—Grown to a limited extent in western Oklahoma.

Synonym.—Desert maize. The desert maize strain has slightly more open panicles which are not quite so pointed at the tip; it was found growing in the Texas Panhandle about 1923.

36. BISHOP

Description.—Plants midseason to late, mid-tall; stems stout, mid-juicy, not sweet; tillers mid-freely; branches sparsely; leafy (13 to 16); midribs cloudy; leaf sheaths overlapping much; panicles erect, mid-compact but tending toward effuse, ellipsoid to ovoid; rachis 85 to 100 percent of head length; rachis branches mid-long, somewhat spreading or drooping; glumes pubescent, black, indurate, elliptic, apices acute to obtuse; lemmas with long geniculate awns; stigmas white; kernels partly exposed in angle of glumes and somewhat beyond apices of glumes, mid-size to large, white with reddish-brown to black spots, obovoid, endosperm starchy, corneous layer mid-thick, nucellar layer absent; pedicellate spikelets straw-colored to reddish-brown, inconspicuous at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 29.

Bishop differs from kafirs in having awns and from White milo in having no transverse wrinkle on the glumes.

History.—History not established. Judging from its characteristics, it doubtless is a kafir-milo hybrid. George Bishop, Cordell, Okla., former editor of the Oklahoma Farmer-Stockman, was instrumental in the distribution of the variety about 1915.

Distribution.—Grown on limited acreages in Oklahoma, Texas, and Kansas.

Synonym.—Algeria. Bishop was exploited under this name in 1928 by seedsmen at Lubbock, Tex. (*121*). The Algeria strain occasionally differs slightly from Bishop in height and maturity.

37. SHALLU

Description.—Plant: very late (average about 130 days), mid-tall to tall; stems mid-slender to mid-stout, dry, not sweet; tillers freely; branches very freely; leafy (12 to 15); mid-ribs white; leaf sheaths overlapping moderately; panicles erect, effuse with long, usually drooping branches, conoid but usually flattened on leaning tillers because the panicle branches hang to the lower side; rachis usually continuous; rachis branches long; glumes partly pubescent, straw-colored, somewhat coriaceous, widely spreading at maturity and inrolled or involute, apices acute; lemmas with long awns; stigmas yellow; kernels almost wholly exposed and usually rotated slightly or even as much as 90 degrees at maturity, mid-size, white, ellipsoid, flattened on embryo side, endosperm starchy, corneous layer thick, nucellar layer absent; pedicellate spikelets straw-colored; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 30.

Strains with colored kernels and glumes occur but are not common.

History.—The previous known history of shallu in this country was given by Ball (*27, p. 4*) in 1910 as follows:

"It was imported directly from India by officers of the Louisiana State Experiment Station about 1890. By them it was known as 'Egyptian wheat', and was found to be an inferior variety of sorghum * * *.

"Though discarded by the Louisiana station, small lots of seed had been taken from time to time by visitors. In this way the variety was carried to other localities, principally westward into Texas and Oklahoma. Early in 1905 it came to the writer's attention in Texas, under the name 'California wheat.' Through field investigation and the aid of agricultural papers it was found growing at scattered points in Oklahoma and Texas. Many names, mostly somewhat misleading, have been applied to it in the past five years. Among them are 'California Rice corn', 'California wheat', 'Chicken corn', 'Chinese Golden sorghum', 'Egyptian rice', 'Egyptian wheat', 'Mexican wheat', and 'Rice corn'."

Varieties of shallu are commonly grown in India. The name in the Bombay Deccan is applied to any fall-sown sorghum of which varieties similar to the above are commonly grown.

Distribution.—Reported from Georgia, Mississippi, Arkansas, Missouri, Colorado, and New Mexico, and grown occasionally in Texas and Louisiana.

Synonyms.—See History.

38. FREED

Description.—Plants very early (80 days, average of 23 crop years), mid-tall to tall (64 inches, average of 23 crop years); stem slender, juicy, slightly sweet; tillers mid-freely; branches freely; leaves few; midribs cloudy; leaf sheaths overlapping none to slightly; panicles erect, effuse, ellipsoid or with branches often hanging to one side; rachis 90 to 100 percent of head length but usually continuous; rachis branches mid-long to long and spreading; glumes thinly pubescent to glabrous on back at maturity but thickly pubescent at callus, edges, and apex, straw-colored to purplish, indurate, usually elliptic but from ovate to obovate, apices acute to obtuse; lemmas with long awns; stigmas yellow; kernels somewhat exposed but less than Blackhull kafir, mid-size and flatter than kafir, pearly white and usually without spots except at the hilum, globose to ellipsoid, endosperm starchy, corneous layer thick, nucellar layer absent; pedicellate spikelets straw-colored to purplish, large; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 31.

History.—A variety distributed by J. K. Freed, of Scott City, Kans. The United States Department of Agriculture purchased some seed in 1910, and it was assigned S. P. I. No. 27764. At that time Mr. Freed stated that he had grown this variety for 3 or 4 years, but its origin was unknown to him. In an interview with one of the writers in 1925 he recalled that he had obtained locally some "cane" seed that had been brought in by homesteaders, which proved to be a mixture containing some White durra and a white-seeded sorgo, along with the seed of Black Amber and other sorgos. The Freed sorghum was selected from this mixture. The characters of the variety indicate that it may be a hybrid between White durra and Black Amber sorgo.

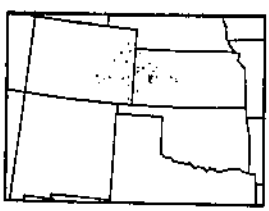


FIGURE 11.—Distribution of Freed sorghum in the United States in 1924. Each dot represents 500 acres. Estimated area, 18,800 acres.

Distribution.—No acreage of consequence except in western Kansas and eastern Colorado, but reported from Nebraska and Texas and grown occasionally in Oklahoma (fig. 11).

Synonym.—White cane.

39. DWARF FREED

Description.—Differs from Freed in being shorter (about two-thirds as tall).

History.—Originated as a dwarf plant found by A. F. Swanson in a head row of Freed sorghum growing at the Fort Hays Branch Experiment Station, Hays, Kans., in 1921. Selection to eliminate natural hybrids was continued until 1924. In 1925 a small quantity of seed was sent to J. K. Freed, Scott City, Kans., for trial. He produced about 100 bushels of seed in 1926, and the following year about 1,000 acres were planted in the vicinity.

Distribution.—Limited distribution in western Kansas.

40. GROHOMA

Description.—Plants midseason to late, mid-tall (48 to 66 inches); stems mid-stout to stout, mid-juicy, slightly sweet; tillers mid-freely; branches freely; mid-leafy to leafy; midribs white to cloudy; leaf sheaths overlapping much; panicles erect, poorly exserted, mid-compact, cylindroid to fusiform, long; rachis about 95 percent of head length; rachis branches mid-long to long at base to short at tip, somewhat appressed; glumes black to dark reddish black, indurate, ovate to elliptic, apices acute to sometimes obtuse; lemmas not awned; stigmas creamy white; kernels considerably exposed, mid-size, buff or light brown, globose to ellipsoid or obovoid, somewhat flattened on hilum side, endosperm starchy, corneous layer mid-thick, nucellar layer present; pedicellate spikelets straw-colored or brown and inconspicuous; coleoptiles green. Grohoma contains mixtures of plants with long black glumes, chalky white kernels, and short, compact panicles. A panicle, spikelets, and kernels are shown in plate 32.

History.—The characteristics of Grohoma indicate that it is the result of a hybrid between feterita and some variety of sorgo. It was first distributed in 1929 by Fred Groff, a farmer living near Britton, Okla., who claimed to have produced the variety by budding or grafting kafir on "ribbon cane" (Honey sorgo). The name Grohoma was derived from the words Groff and Oklahoma. Attempts by Mr. Groff to demonstrate such an origin were not successful. The

claim of promoters that Grohoma was produced by grafting kafir on sugarcane is obviously false. The characters of Grohoma are such that it could not have been produced even by a combination of kafir and Honey, although its origin by hybridization is almost certain. Grohoma was widely exploited from 1929 to 1932.

Distribution.—Grown to a limited extent in many States.

41. DARSO

Description.—Plants midseason (112 days, average of 23 crop years), dwarf to mid-tall (49 inches, average of 24 crop years); stems mid-stout to stout, mid-juicy, somewhat sweet; tillers sparsely; branches sparsely to mid-freely; mid-leafy (8 to 12); midribs cloudy and sometimes yellow; leaf sheaths overlapping moderately; panicles erect, mid-compact, ellipsoid; rachis usually continuous; rachis branches mid-long to long at the base and usually hanging to one side; glumes thinly pubescent, reddish black to reddish brown, indurate, elliptic, apices acute; lemmas awned; stigmas pale yellow; kernels much exposed but somewhat less than kafir, mid-size, reddish brown (varies about the Hays russet of Ridgway[38]), ellipsoid to obovoid, endosperm starchy, corneous layer thin to mid-thick, nucellar layer present, seed coat checked; pedicellate spikelets large, reddish-brown, coleoptiles green. A panicle, spikelets, and kernels are shown in plate 33.

Distinguished from Schrock by longer heads, which usually lean more, presence of awns, narrower glumes, and somewhat lighter color and the checking of the seed coat.

History.—The following report on darso was made by Beeson and Daane (*36, p. 2*) in 1919:

"Darso is a new sorghum developed and named at the Oklahoma Experiment Station. The exact origin and history is not known. In 1912 the station received the first supply of seed from a farmer in southwest Logan County who sent a head for identification. Later it was learned that it had been grown in a small way in Kingfisher and adjoining counties. * * * Selection work has been carried on at the Oklahoma Experiment Station for high grain-yielding quality and improvement of other characteristics."

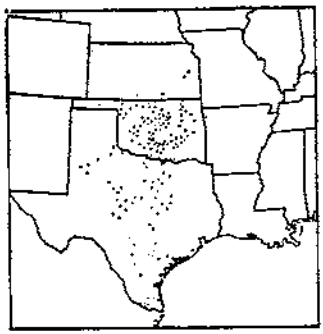


FIGURE 12.—Distribution of darso in the United States in 1924. Each dot represents 500 acres. Estimated area, 70,100 acres.

It probably is the result of a natural hybrid between some sorgo and a grain sorghum. The name is a contraction of letters from the descriptive name "dwarf red sorghum."

Distribution.—Grown in Kansas, Oklahoma, Arkansas, and Texas (fig. 12).

Synonym.—Maizo.

42. SCHROCK

Description.—Plants late (120 days, average of 17 crop years), dwarf to mid-tall (50 inches, average of 22 crop years); stems stout, mid-juicy, not sweet; tillers sparsely; branches sparsely; leafy (12 to 15), leaves large; midribs cloudy; leaf sheaths overlapping much; panicles erect, mid-compact or tending toward effuse, cylindroid to obconoid and various shapes; rachis 50 to 100 percent of head length; rachis branches mid-long to long; glumes pubescent but pubescence largely deciduous, giving a shiny appearance at maturity, black or reddish black, indurate, elliptic, apices acute to obtuse; lemmas not awned; stigmas pale yellow; kernels much exposed but a little less than kafir, mid-size, reddish brown with dark spots, ellipsoid, endosperm waxy, nucellar layer present; pedicellate spikelets straw-colored or tan; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 34.

History.—Vinall and Edwards (*151, p. 7*) reported the first recognition of Schrock as follows:

"The Schrock variety * * * was discovered by Roy Schrock, a mail carrier at Enid, Okla., in 1912.[39] Seeing a vigorous and very heavily seeded

[38] RIDGWAY, R. See footnote 13.

[39] Correspondence with Mr. Schrock places these years as 1911 and 1912, respectively.

plant growing in a field along his route, he gathered the seed and took it home to plant the following year. In 1913[20] Mr. Schrock grew a row of it in his garden and sent a sample to the United States Department of Agriculture for identification. It appears to be a hybrid between some kafir and a sweet sorghum * * *."

The waxy endosperm indicates that the sorgo parent was Chinese Amber or a derivative of that variety.

Distribution.—Grown in Kansas, Oklahoma, Arkansas, Mississippi, Louisiana, and Texas.

Synonym.—Sagrain. This is the name applied to a selected strain of Schrock which, according to the Mississippi Agricultural Experiment Station Press Circular 109, was found in 1917 growing on the farm of W. T. Allen near Lyon, Miss. It was highly recommended as a grain crop in the Delta section of Mississippi in 1926 and 1927.

43. SUMAC SORGO

Description.—Plants midseason to late (119 days, average of 25 crop years), tall (72 inches, average of 22 crop years); stems mid-stout, juicy, sweet; tillers freely; branches sparsely to mid-freely; leafy (12 to 15); midribs cloudy; leaf sheaths overlapping much; panicles small, erect, compact, cylindroid, relatively short and blocky; rachis 60 to 100 percent of head length but usually discontinuous; rachis branches short, appressed and heavily fruited; glumes thinly pubescent, black to reddish brown in well-matured heads, thin but indurate, small, elliptic to ovate or rarely obovate, apices sometimes acute but generally rounded or obtuse, the second glume usually larger than the first; lemmas not awned; stigmas yellow; kernels much exposed and extending well beyond apices of glumes, small, uniformly dark reddish brown but sometimes lighter where unexposed, very plump and generally obovoid to globose, endosperm starchy, corneous layer mid-thick to thick, nucellar layer present; pedicellate spikelets small, light reddish brown, almost straw color at the base, inconspicuous, fairly persistent; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 35.

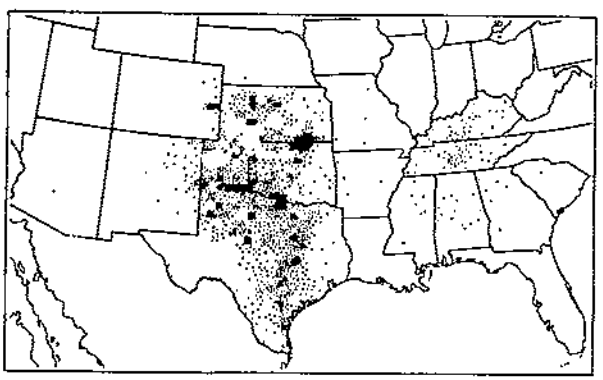
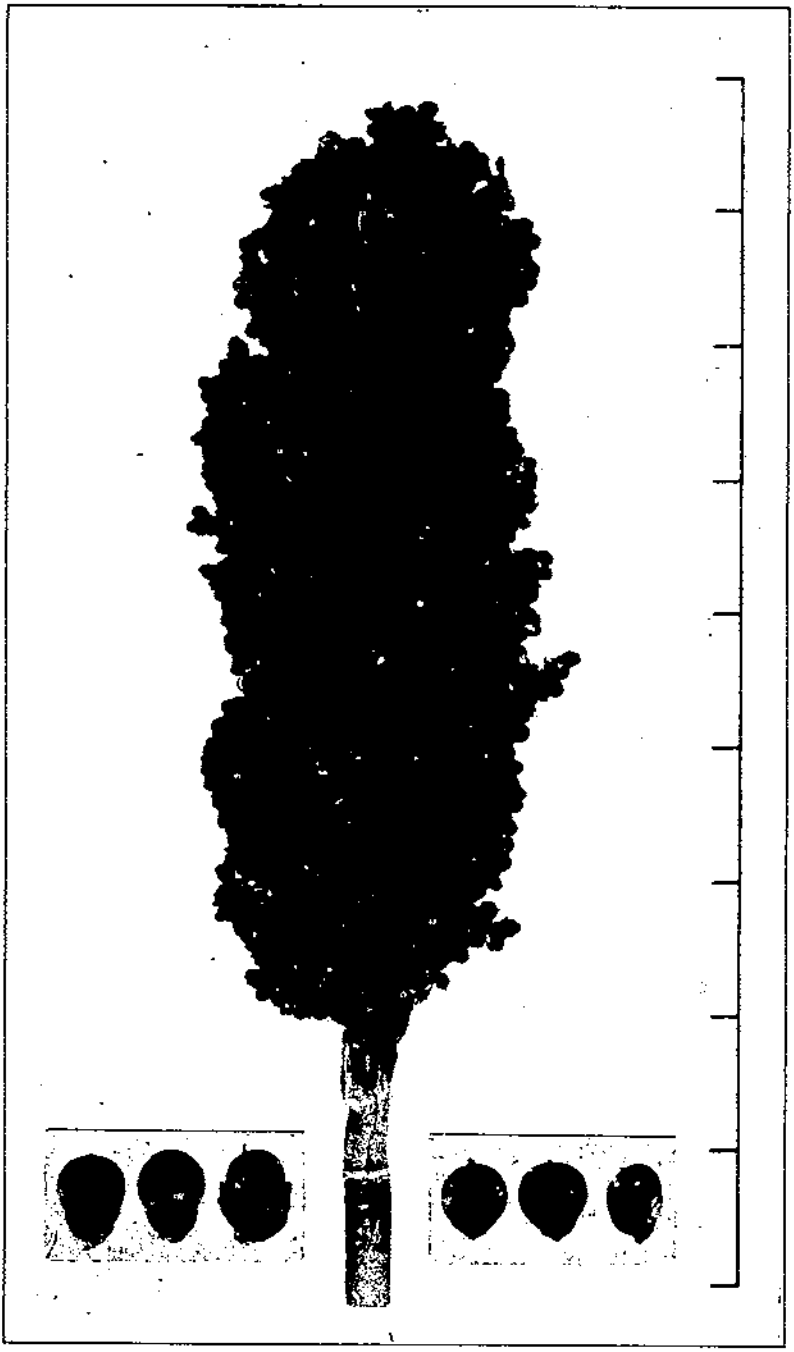


FIGURE 13.—Distribution of Sumac (including Early Sumac) sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 1,060,000 acres.

The relatively small, compact, cylindroid panicle with deep brownish-red kernels very prominently exposed almost to the exclusion of glumes makes this variety easily identified because the heads resemble so closely the fruit of ordinary sumac (*Rhus glabra* L.).

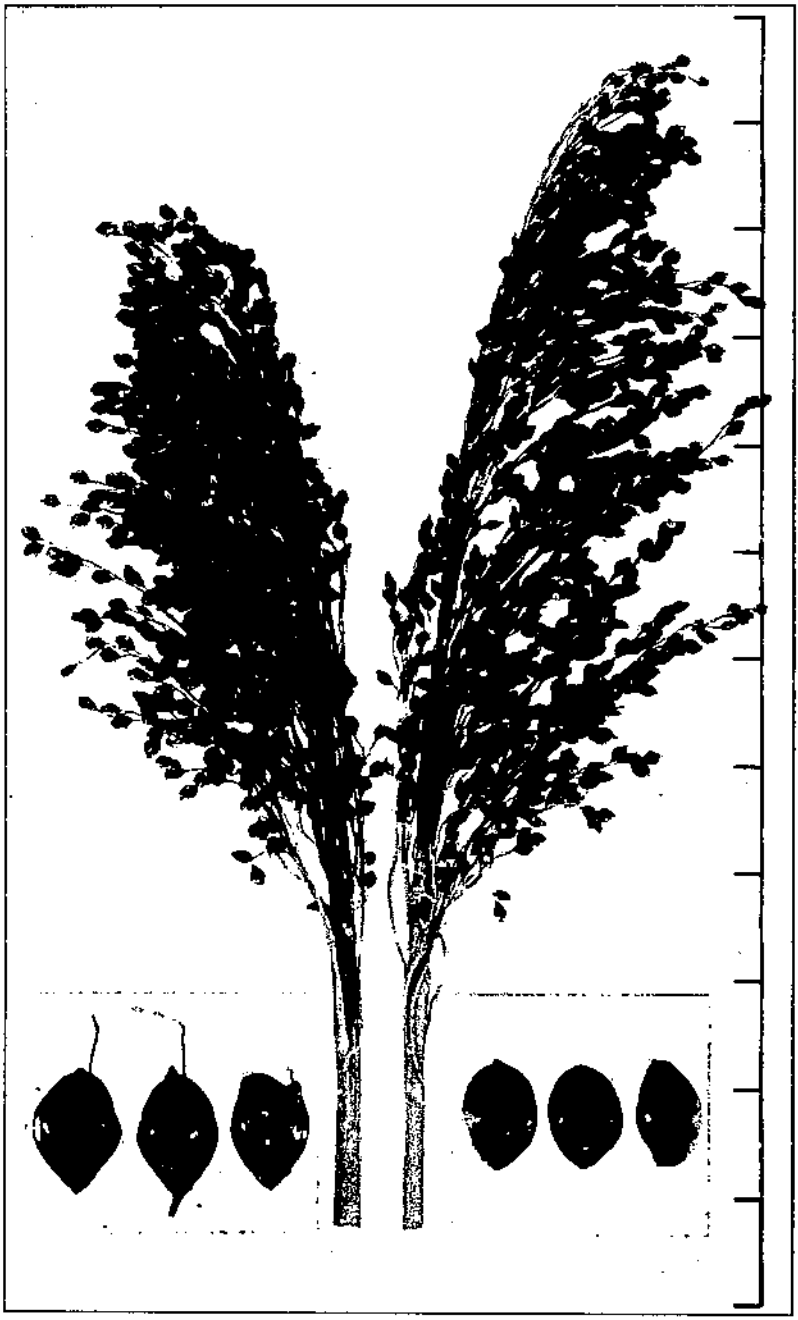
History.—Sumac is without doubt one of Leonard Wray's introductions from Natal. In March 1851 Leonard Wray, an Englishman, arrived in Natal, South Africa, and observed the sorghums being grown by the natives. He secured seeds of some of these and in 1854 had them grown in Europe, particularly in France, England, Spain, and Italy (*171*). Seed produced near Toulouse, France, was brought to this country by Mr. Wray in May 1857 at the request of Horace Greeley. Fifteen varieties of African sorgos, which he called "African Imphees", were introduced by Wray (*171*), who sent the seed to Georgia and South Carolina to be grown on farms. Richard Peters, of Atlanta, Ga., grew about 36 acres and ex-Governor Hammond of South Carolina grew a somewhat larger acreage. The varieties were badly mixed in 1857 (*2, 3*), but the seed from the crop was sold widely.

[20] See footnote 19.



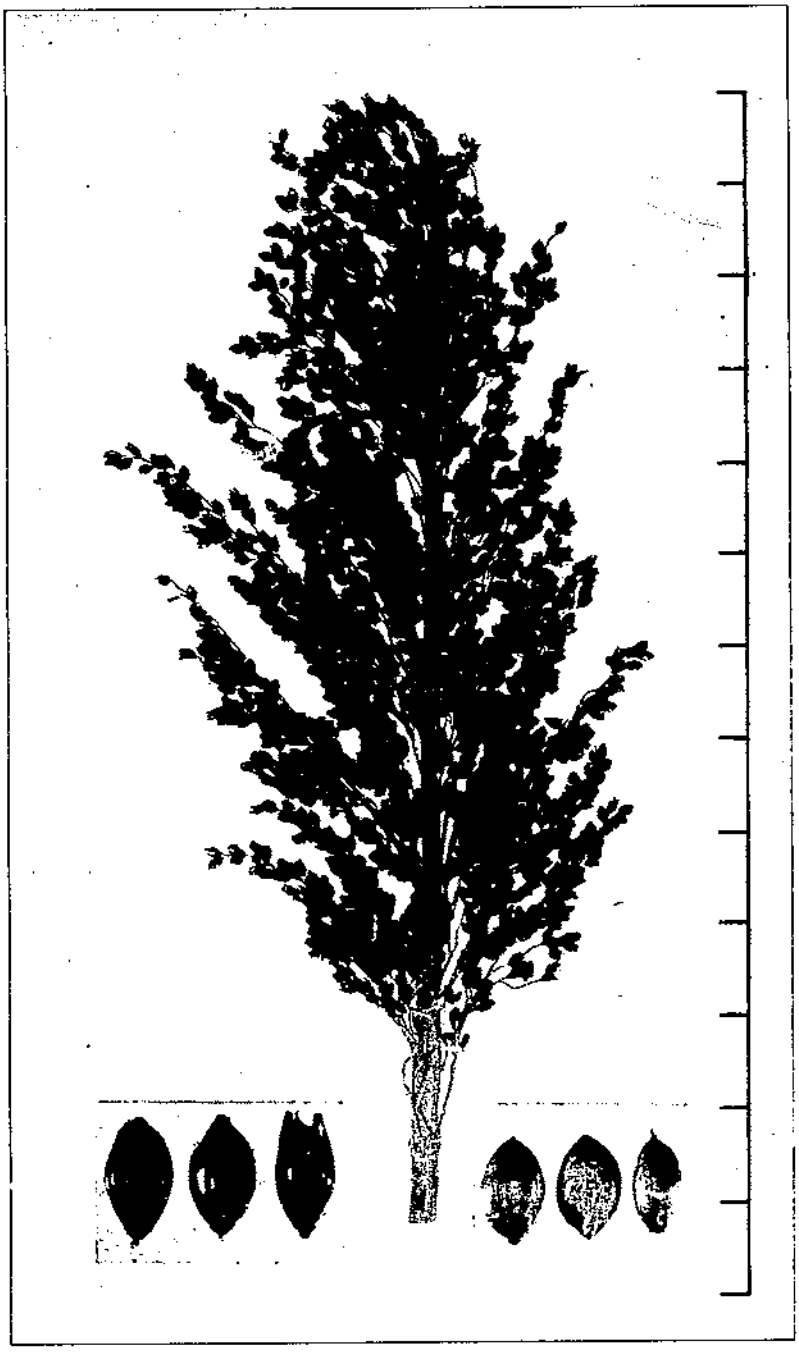
SUMAC SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, X 3.



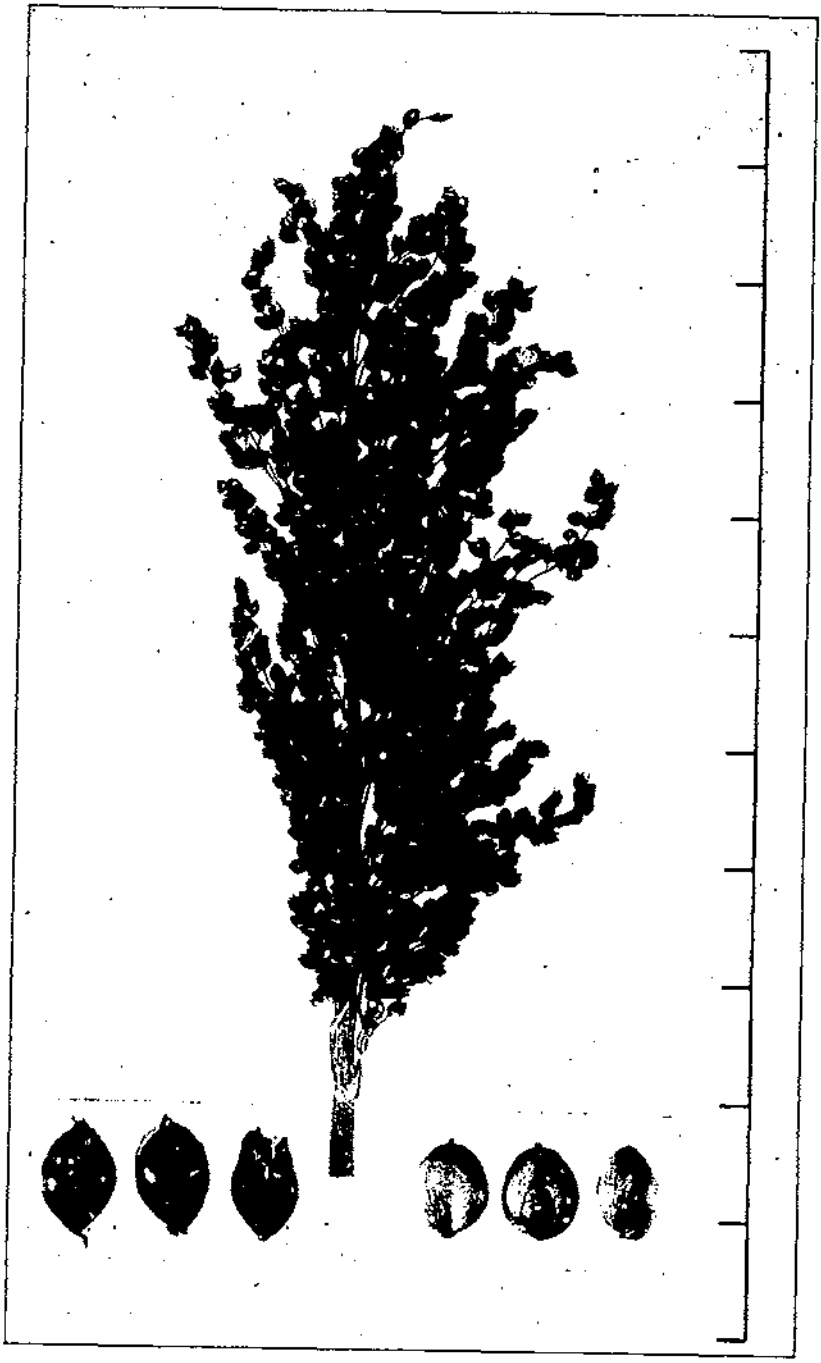
CHINESE AMBER SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



MINNESOTA AMBER SORGO.

Panicle, scale indicates size in inches; spikelet and kernels in three positions, × 3.



DAKOTA AMBER SORGO.

Panicle, scale indicates size in inches; spikelets and kernel in three positions, × 3

The description of the Koombana variety by Gould (*71*) closely corresponds to the Sumac variety of today. Pech (*111*) illustrated and described the Sumac variety under the name Liberian. Collier (*48, pp. 68–69*) reports that Wray identified the Liberian from photographs (*48, pl. 12, p. 94*) as his Koombana. Old seed of the Koombana obtained from Mr. Wray many years after the introduction of his sorgos proved identical with seed of the variety then being grown as Liberian.

Hedges (*75*), who witnessed the unpacking of Wray's introductions, believed that Wray's Boomvwana variety was the one later called Liberian, but this can hardly be true, in view of the description of Boomvwana and of the facts noted above. By 1888 samples of the variety generally known as "Red Liberian" were received under the names of Sumac, Club Head, Red Top, and others (*162, pp. 112, 117*).

Distribution.—Has largest total acreage of any sorgo and is the most important sorgo variety in Texas, Oklahoma, New Mexico, Kentucky, and Tennessee; also grown in North Carolina, South Carolina, Georgia, Alabama, Mississippi, Missouri, Nebraska, Colorado, Kansas, Arkansas, Arizona, and California (fig. 13).

Synonym.—The name Red Top is still in common use for the Sumac variety Club Head.

44. EARLY SUMAC SORGO

Description.—An early selection from Sumac which differs from the parent variety in the following characters: Plants 10 to 15 days earlier (107 days, average of 12 crop years), 2 to 12 inches shorter (64 inches, average of 13 crop years); stems more slender; branches more freely; often not so leafy; panicles usually smaller. Otherwise plant, panicle, and kernel characters are like those of Sumac.

History.—Developed by selection at the Fort Hays Branch Experiment Station, Hays, Kans., by R. E. Getty, who obtained the original seed in 1916 from H. W. Joy, a farmer. The first general distribution of this variety was made by the station to farmers in 1922.

Distribution.—Grown commercially in central and western Kansas.

45. CHINESE AMBER SORGO

Description.—Plants early (mode 100 days), tall (mode 74 inches); stems mid-slender, juicy, sweet; tillers freely; branches mid-freely; leaves few (mode 9); midribs cloudy; leaf sheaths overlapping none to slightly; panicles erect, effuse, conoid to various shapes; rachis 80 to 100 percent of head length: rachis branches mid-long to long, lightly fruited, spreading and usually drooping; glumes thinly pubescent or glabrous at maturity, black, indurate, elliptic, apices usually acute but sometimes obtuse; lemmas awned; stigmas pale yellow; kernels little exposed in angles but usually extending to or slightly beyond apices of glumes, mid-size, brown, ellipsoid or approaching ellipsoid, endosperm waxy, nucellar layer present; pediceliate spikelets straw-colored or sometimes brown or black near base, mid-size, largely deciduous and not conspicuous at maturity; coleoptiles red. Panicles, spikelets, and kernels are shown in plate 36.

One of the Black Amber group differing little from Minnesota Amber except in size of panicle and shape of glumes. The panicle is small, often but little more than one-half as large as that of the Minnesota Amber, and the panicle branches are somewhat shorter. The glumes are shiny black, but usually have straw-colored apices; they are broader and more gibbous than those of Minnesota Amber, and the kernels are plumper and usually darker brown where exposed. The presence of short geniculate awns is apparent on the immature panicle, but these awns are so deciduous that the spikelets often appear unawned when a mature panicle is casually examined.

History.—The Black Amber sorgos now being grown in the United States were obtained from introductions from China. This group appears to be the only true sorgo grown in China, and its cultivation in that country, according to Collins (*49*), was confined to small areas, aggregating about 20 acres annually, on the island of Tsungming at the mouth of the Yangtze River. The stalks were sold on the Shanghai market for chewing and sucking the sweet juice. Collins (*49, pp. 86–87*) indicates that the most generally accepted name for

the sweet-stemmed sorghum in China is loo-tsoh, distinguishing it from kau leang, the nonsaccharine grain sorghum, and kain-so, the true sugarcane (*Saccharum officinarum* L.). The name loo-tsoh is said to have been derived from Se-tsoh, the ancient name for Szechwan, the Province where this sorgo was first produced.

Seed first reached the United States by way of France. Quoting from Collins (*49, p. 89*): "In the year 1851, Count de Montigny, at that time French Consul at Shanghai, forwarded at the request of his Government, to the Geographical Society of Paris, a collection of such plants, seeds, and cuttings, found in this part of China as he thought might grow in Europe. Among this collection was a package of Sorgo seeds."

The seeds were sent to M. Robert, director of the Marine Gardens at Toulon, and within a few years considerable quantities of seed were available for distribution, chiefly through the efforts of M. Vilmorin of the firm Vilmorin, Andrieux & Co. The first importation of the seeds of this sorgo into the United States appears to have been in 1853 by William R. Prince, a nurseryman of Flushing, Long Island, N. Y. (*101, p. 233*). In 1854 a few pounds were sold to the public, and a much larger quantity was distributed the following year. This account agrees with that of Collier (*48, p. 64*) and others except that in some cases the date of its introduction into France is given as 1850 instead of 1851.

Other importations of this sorgo seed were made subsequent to 1853. Browne (*39*) brought back some seeds from France in 1854, and in the spring of 1857 the Patent Office distributed about 275 bushels of the seed, 175 bushels of which was obtained in the United States and the remainder imported from France.

The American Agriculturist (New York) had a great deal to do with the successful introduction of this sorgo into the United States. From the first the publishers of this farm paper had shown a deep interest in this crop. In 1856 they obtained some seed of the "new Chinese sugarcane" from Vilmorin, Andrieux & Co., Paris, France, and grew a small plot of it. In 1857 this journal distributed small parcels of seeds to 31,000 subscribers and in addition saved enough seed to grow 34,500 pounds in Georgia that year. About 1,600 pounds of seed was imported from France in 1857 and was distributed along with seed grown by the American Agriculturist and others in the United States (*1, 6, 8, 14, 15*).

According to Le Duc (*101, p. 233*) the name Early Amber was applied to a selection from the Chinese sorgo made by E. Y. Teas, of Dunreith, Ind. He quotes Mr. Teas as follows:

"In a visit to Europe 18 years ago [1859], in search of seed and plants, I bought of Vilmorin, Andrieux & Co., seedsmen in Paris, a few pounds of Chinese cane-seed, asking them for the best variety. This seed was given to a friend to plant who was an experienced grower and manufacturer of sorghum.

"In this lot of cane one stalk was found of a different habit from the rest, that ripened its seed before the rest of the plot was fully in bloom. Seed of this stalk was saved, and the next year planted separate to prevent admixture. This crop ripened much sooner than any other cane known to me, and the sirup was superior in color and taste to any other produced in the neighborhood. From its earliness and fair color I named it 'Early Amber', and under this name sent packages to customers in nearly every State and Territory in the Union, especially to Minnesota and the Western and Southern States."

Distribution.—Rarely found growing on any considerable acreage in pure cultures. This type found intermixed with other varieties wherever the Black Ambers are grown.

Synonym.—Early Amber.

46. MINNESOTA AMBER SORGO

Description.—Plants early (96 days, average of 20 crop years), tall (72 inches, average of 20 crop years); stems mid-slender to mid-stout, juicy, sweet; tillers freely; branches mid-freely; leaves few (mode 9); midribs cloudy; leaf sheaths overlapping none to little; panicles midsize to large, erect, effuse, conoid to ellipsoid or with branches often hanging to one side; rachis deeply furrowed, 70 to 100 percent of head length, but usually continuous; rachis branches mid-long to long and spreading; glumes usually glabrous or pubescent on upper third only, black or brownish black, giving the head a shiny black appearance, indurate, elliptic or approaching elliptic, apices acute or sometimes obtuse; lemmas both

awned and awnless, strains of variety not pure for this character; stigmas pale yellow; kernels only slightly exposed in angle of glumes and usually not extending to apices of glumes, mid-size, reddish brown where exposed and otherwise buff, usually ellipsoid, endosperm starchy, corneous layer mid-thick to thick, nucellar layer present; pedicellate spikelets small and usually inconspicuous, often dark brown and almost entirely deciduous at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 37.

Minnesota Amber is one of a large group of black-glumed sorgos which differ from it only in minor characters, such as the presence of awns, size and density of the panicle, and earliness.

History.—Seed purchased in Minnesota and distributed as Minnesota Early Amber or Minnesota Amber by Seth H. Kenney, Waterville, Waseca County, Minn., who selected it from Early Amber about 1869 (*168*).

Distribution.—The most common variety in Minnesota, South Dakota, Nebraska, Kansas, and Colorado; grown to a less extent in Iowa, Missouri, Illinois, Indiana, Ohio, and other States (fig. 14).

Synonyms.—Black Amber, Early Amber, Early Black Amber, Minnesota Early Amber.

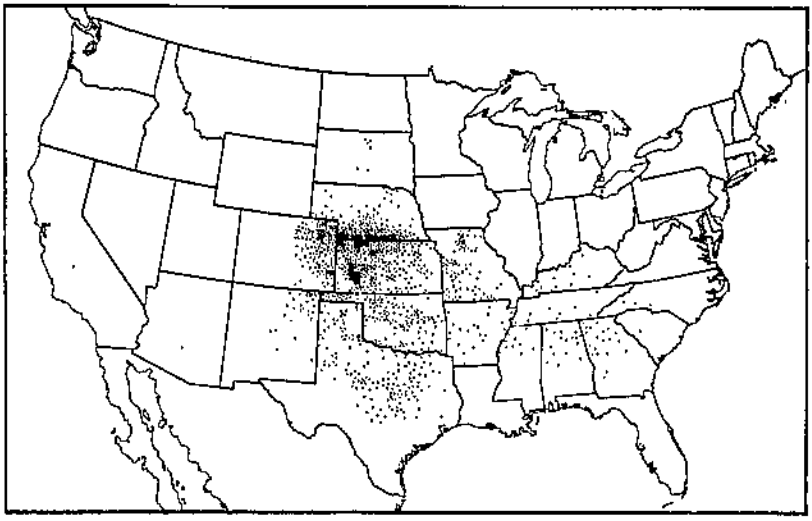


FIGURE 14.—Distribution of Black Amber sorgo (Chinese Amber, Minnesota Amber, Dakota Amber) in the United States in 1924. Each dot represents 500 acres. Estimated area, 644,400 acres.

47. WACONIA AMBER SORGO

Description.—Waconia Amber is practically identical with Minnesota Amber in gross vegetative characters.

History.—Developed by the Waconia Sorghum Mills, Inc., Waconia, Minn. This firm describes the origin of this variety as follows (*167*):

About 5 years ago (1919) it was decided that some improvement was possible in the Minnesota Amber sorghum that had been grown at Waconia for a great many years. Therefore, some selection work was started with the object of improving the strain along four principal lines—sugar content of the juice, tonnage, earliness, and resistance to head smut. After 5 years of work there has now been selected a strain called the "Waconia Amber" that is considerably superior in all of these respects to the original Minnesota Amber.

Distribution.—Locally in Minnesota and Iowa.

48. DAKOTA AMBER SORGO

Description.—Plants very early (87 days, average of 6 crop years), mid-tall (62 inches, average of 6 crop years); stems mid-slender, juicy, sweet; tillers freely; branches mid-freely; leaves few (mode 8); midribs cloudy; leaf sheaths

overlapping none to slightly; panicles small, erect, mid-compact to effuse, ellipsoid to fusiform; rachis deeply furrowed, 85 to 100 percent of head length but usually continuous; rachis branches mid-long and very slightly spreading, giving the heads a somewhat denser appearance than the Minnesota Amber heads; glumes shiny black except light-brown margins particularly at the apices, glabrous except for thin pubescence near apices, indurate, elliptic, apices acute or rarely obtuse; lemmas not awned; kernels but little exposed in angle of glumes and rarely extending to or beyond the apices, mid-sized, plump, reddish brown where exposed and otherwise buff, broadly ovoid or approaching globose, endosperm starchy, corneous layer mid-thick to thick, nucellar layer present; pedicellate spikelets small, light brown, deciduous at maturity. A panicle, spikelets, and kernels are shown in plate 38.

Distinguished from Minnesota and other Black Ambers by its shorter, stiffly upright stalks, early maturity, and plumper, more nearly spheroid seeds.

History.—A short early strain of Minnesota Amber S. D. no. 341. The latter originated as a selection made by W. A. Wheeler at the Highmore (S. Dak.) substation in 1903. Selection was continued at the Highmore substation and later at the Belle Fourche Field Station, Newell, S. Dak. An early dwarf strain (designated A. D. I. no. 341–10–4) was isolated and purified by A. C. Dillman at Newell, who named it Dakota Amber. It was first distributed to farmers about 1915 (*60*).

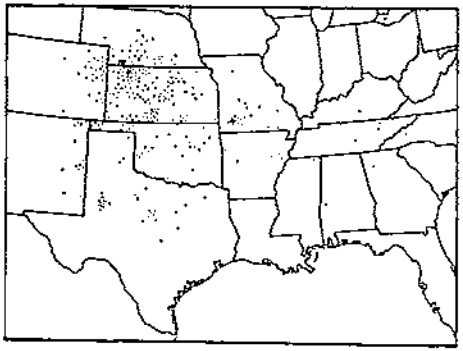


FIGURE 15.—Distribution of Red Amber sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 160,300 acres.

Distribution.—Grown commercially in South Dakota and to a less extent in North Dakota, eastern Montana, Wyoming, Colorado, and northern Nebraska.

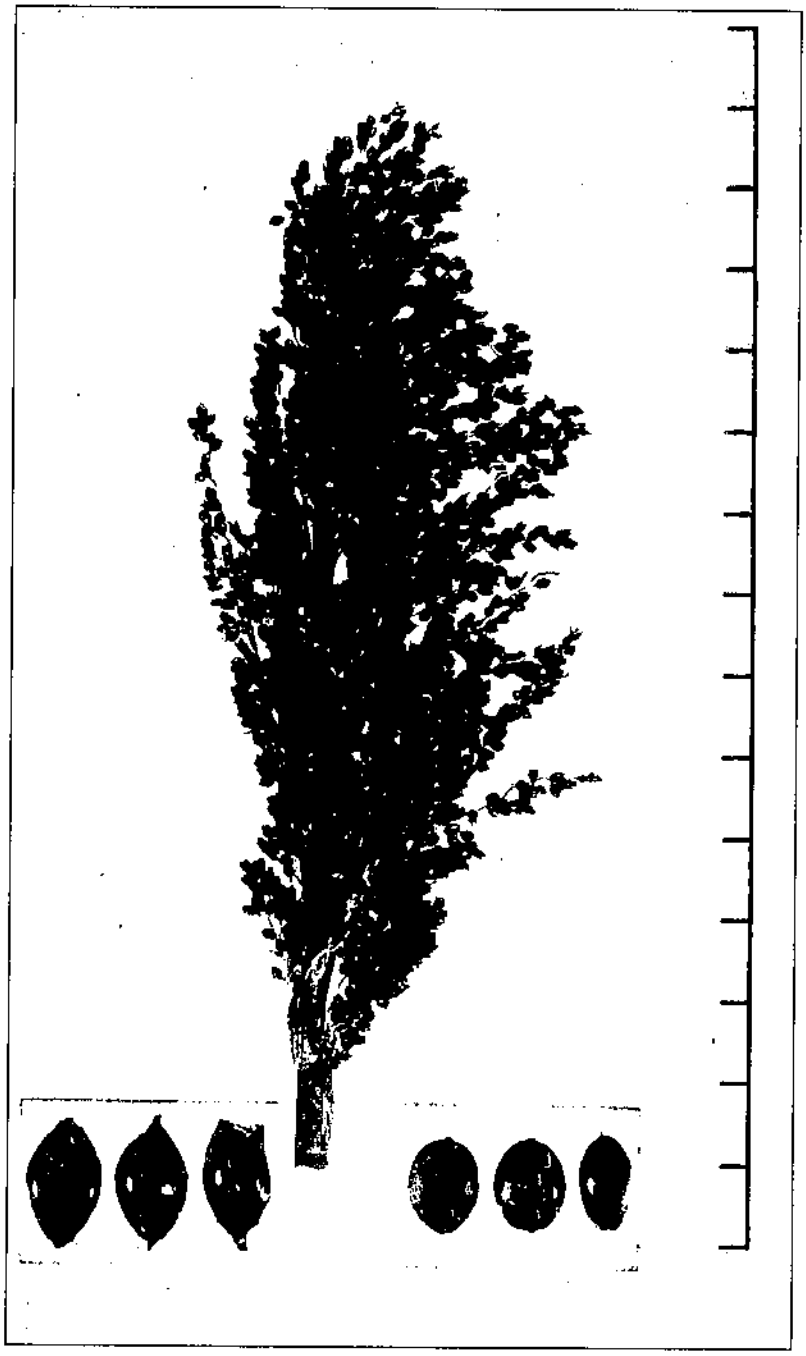
Synonyms.—Early Amber, Black Amber.

49. RED AMBER SORGO

Description.—Plants early (96 days, average of 37 crop years), mid-fall to tall (71 inches, average of 37 crop years); stems mid-slender to mid-stout, juicy, sweet; tillers freely; branches mid-freely; mid-leafy (mode 12); midribs cloudy; leaf sheaths overlapping none to slightly; panicle mid-size to large, erect, effuse, ellipsoid or variable in shape; rachis 60 to 100 and averaging about 90 percent of head length; rachis branches long; glumes usually glabrous and shiny but sometimes thinly pubescent, deep or dark red, sometimes reddish brown near apices, tightly appressed, about as long as the kernel, somewhat gibbous, coriaceous or indurate, elliptic, apices acute, seldom obtuse; lemmas, both awned and awnless strains included; stigmas pale yellow; kernels slightly exposed in the angles of the glumes, mid-size, uniformly light reddish brown, usually ellipsoid, endosperm starchy, corneous layer mid-thick, nucellar layer present; pedicellate spikelets often reddish brown but usually so deciduous that they are almost entirely absent at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 39.

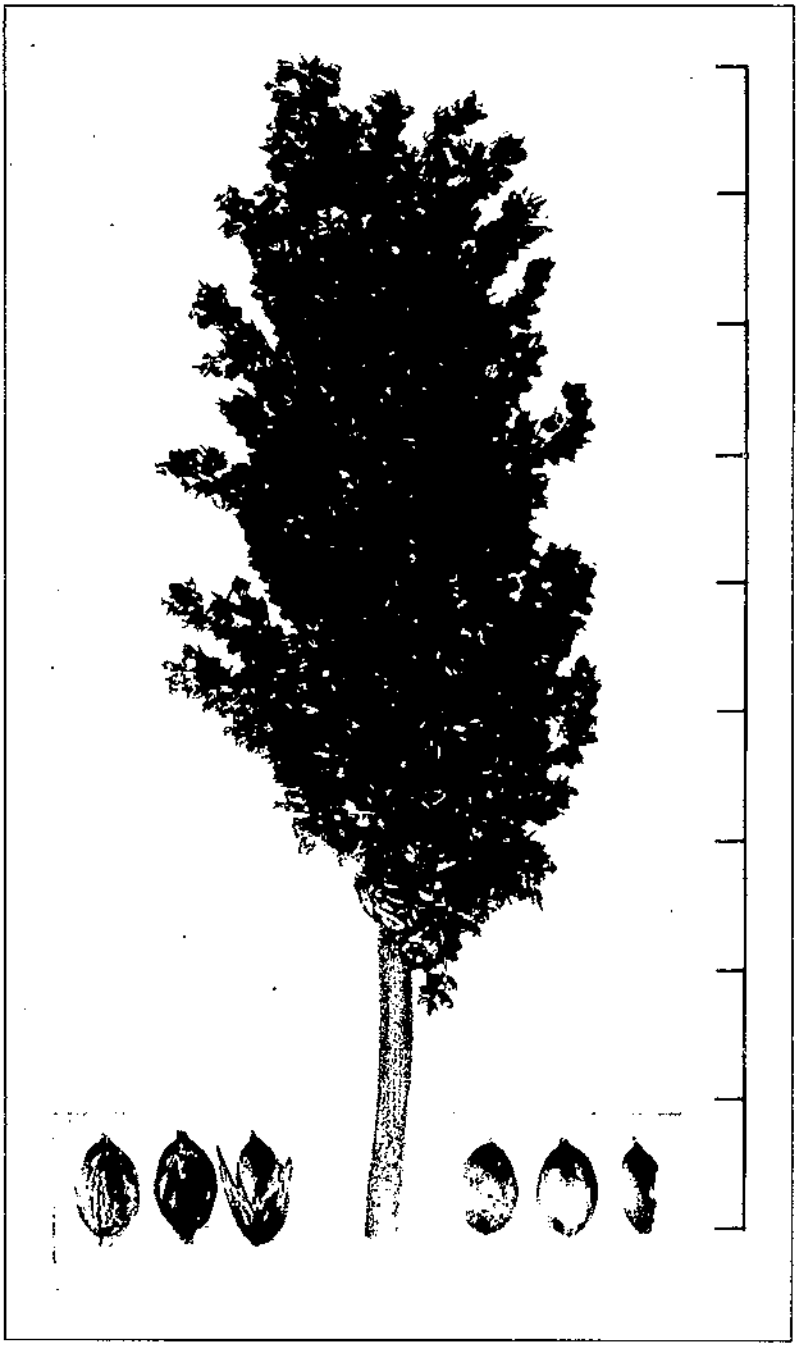
The deep-red color of the large or mid-size panicle gives to a field of Red Amber at maturity a distinctly red appearance.

History.—Records indicate that Red Amber sorgo was selected by the United States Department of Agriculture from sorghum grown from seed obtained in 1903 under the name of "Early Orange sugar cane" from the manager of the Wagga Experiment Farm, Bomen, New South Wales, Australia. The origin of the variety cannot be definitely determined, but most of the sorghums grown in Australia have been introduced from the United States or South Africa. The progenitor of Red Amber may have been a variety introduced by Wray from South Africa known as Shalgoova. Pech (*111, p. 306*) calls this variety "Red Imphee" and describes the glumes as "long as the seed, reddish yellow or cherry color." His illustration of the panicle with rather long, drooping seed branches also agrees with Red Amber. Wray's own description (*171, pp. 208–209*), indicating a growing season of about 105 days and emphasizing the beauty of the heads, might well be applied to Red Amber. If it did originate from



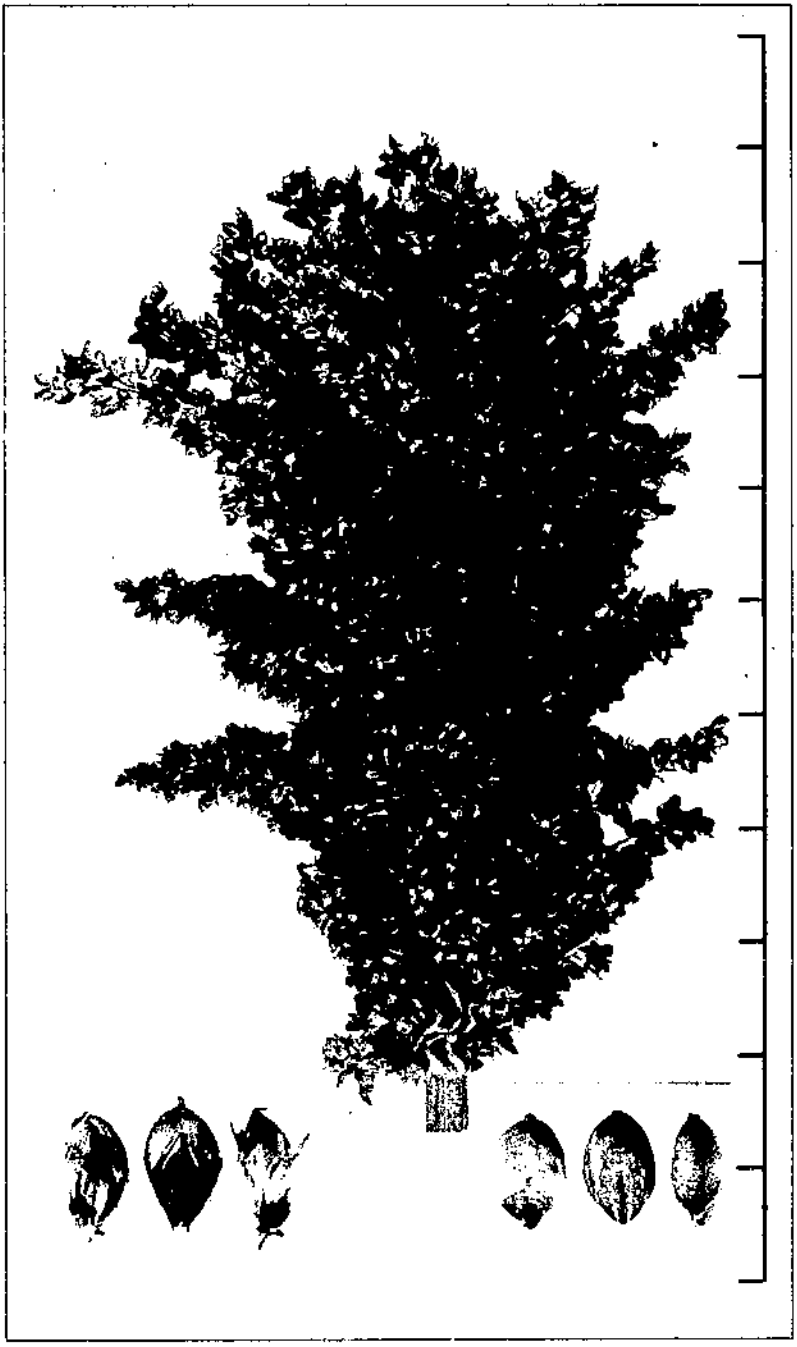
RED AMBER SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



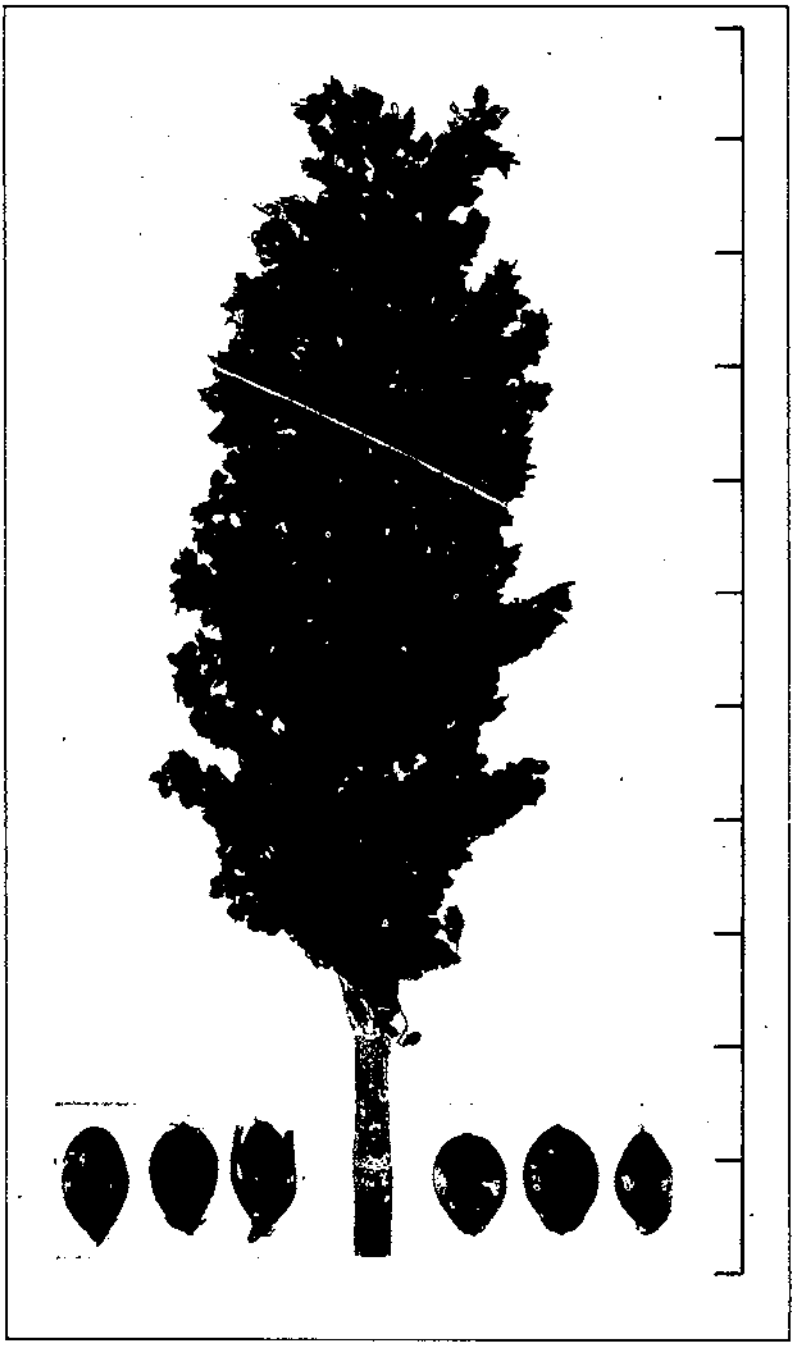
ORANGE SORGO

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3



KANSAS ORANGE SORGO

Panicle, scale indicates size in inches; spikelets and kernels in three positions, ×4.



COLMAN SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.

Shalgoova, then the seed of this South African variety must have been sent directly to Australia or introduced from the United States, to be returned later.

An unidentified variety of sorghum of unknown origin called "Red Amber" was grown in experiments at Abilene, Tex., in 1899 (*38*).

Distribution.—Red Amber sorgo has been distributed in Kansas and other States but is not widely grown except in Kansas (fig. 15). It is grown also in Georgia, Alabama, Tennessee, Missouri, Arkansas, Oklahoma, Texas, New Mexico, and to some extent in North Carolina, South Carolina, Mississippi, Kentucky, Arizona, and California.

50. ORANGE SORGO

Description.—Plants midseason (113 days, average of 16 crop years), mid-tall to tall (68 inches, average of 19 crop years); stems mid-slender to mid-stout, but stouter than those of Amber, juicy, sweet; tillers freely; branches mid-freely; mid-leafy (mode 12); midribs cloudy; leaf sheaths overlapping moderately; panicles mid-size to small, erect, mid-compact, approaching cylindroid but sometimes ellipsoid; rachis 50 to 100 percent of head length; rachis branches mid-long, loosely appressed; glumes usually pubescent but sometimes glabrous and shiny, color varying often in the same head from straw color through reddish brown (Ridgway's claret brown[21]) to black on the second glume, first glume usually lighter, second glume sometimes indurate but first usually chartaceous, ovate to elliptic, veins prominent, apices generally acute, rarely obtuse; lemmas not awned; stigmas yellow; kernels much exposed in most strains but less than in Blackhull kafir or Sumac sorgo, usually extending to apices of glumes and in some strains considerably beyond, mid-size, deep reddish brown where exposed between the apices of the glumes, lighter where not exposed, ellipsoid to ovoid, endosperm starchy, corneous layer mid-thick, nucellar layer present; pedicellate spikelets small to mid-size, dilute reddish brown, rather persistent; coleoptiles green or in some strains light red. The combination of colors in the glumes, sterile spikelets, and kernels is reddish brown, thus giving rise to the variety name. A panicle, spikelets, and kernels are shown in plate 40.

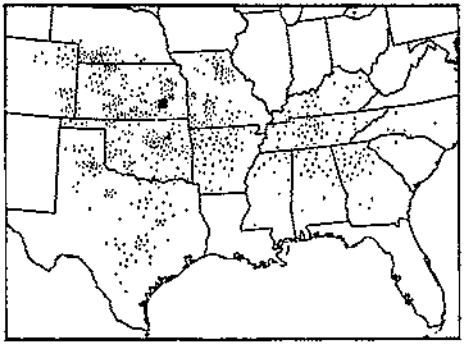


FIGURE 15.—Distribution of Orange sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 392,500 acres.

The gross color effect of dull orange, rather infrequent in the panicles of sorgo, together with the distinct but vacant node in the peduncle 1½ or 2 inches below the first whorl of rachis branches, are the chief distinguishing features of the true Orange.

History.—The history of this variety is obscure. Apparently it is one or is derived from some of Leonard Wray's introductions from Natal. "Early Orange" was mentioned by the Commissioner of Agriculture (*47, p. 38*). Hedges (*75*) says "it is not at all like any variety mentioned in Wray's descriptive catalogue" and suggested that it was a hybrid between the Oomseeana and Neeazana varieties. Collier (*48, p. 73*) claimed that Neeazana bore a close resemblance to Orange, and Ball (*26, p. 34*) stated that Orange was derived from the Neeazana variety. During the sixties the Neeazana variety was described by Peck (*111, p. 305*) and others (*46, 71, 75*) as having white seeds and was frequently called White Imphee.

The white or nearly white color of seeds of Neeazana suggests to the writers that it may have been more nearly like the Sourless or "African millet" than the Orange. These varieties are quite similar to Orange in most characters except seed and glume colors, therefore it is quite possible that the

[21] RIDGWAY, R. See footnote 13.

Orange appeared as a variant or rogue with brown seed and darker-colored glumes in the "white-seeded" Nceazana.

Distribution.—One of the important sorgos in North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Kentucky, Missouri, Nebraska, Colorado, Kansas, Oklahoma, Arkansas, and Texas. While the acreage of Orange is less than that of Sumac, this variety is probably more widely distributed than any other group of sorgos except the Black Amber (fig. 16).

Synonym.—Early Orange.

51. KANSAS ORANGE SORGO

Description.—Plants midseason to late, tall (78 inches, average of 15 crop years); stems mid-stout, juicy, sweet; tillers freely; branches mid-freely; leafy (mode 14); midribs cloudy; leaf sheaths overlapping slightly to moderately; panicles erect, mid-compact, cylindroid to ellipsoid, tending to be clavate; rachis 60 to 100 and usually about 90 percent of head length; rachis branches mid-long, loosely appressed; glumes thinly pubescent, reddish brown in one strain and black in another, indurate, elliptic, apices acute to acuminate; lemmas not awned; stigmas yellow; kernels somewhat exposed in angles and extending to or beyond apices of glumes, mid-size, reddish brown with dark spots and lighter where unexposed, ellipsoid, endosperm starchy, corneous layer mid-thick, nucellar layer present; pedicellate spikelets rather persistent and conspicuous at maturity; coleoptiles slightly red. A panicle, spikelets, and kernels are shown in plate 41.

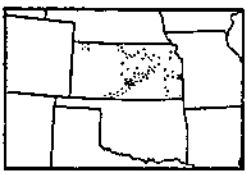


FIGURE 17.—Distribution of Kansas Orange sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 45,500 acres.

In growth habits Kansas Orange is similar to Planter and Sourless, but it differs from them in panicle characters. The differences between it and the parent variety (Orange) have been indicated in the description above. In general it is a larger, coarser, later-maturing strain of Orange.

History.—The history of this variety is undetermined. It was not among the varieties grown in the experiments of the United States Department of Agriculture in 1880 (*47, p. 38*), but was grown the following year (*48, p. 248*). According to G. H. Failyer, former chemist of the Kansas Agricultural Experiment Station, the Kansas Orange variety was first grown at the Kansas station in 1883. Mr. Failyer writes:[22] "In 1883 I procured some sorghum seed from I. A. Hedges, of St. Louis, Mo. * * * Among the four sorts of sorghum seed * * * was one called Kansas Orange."

Selection and purification of this and other varieties was carried on at the Kansas station. Kansas Orange as now distributed by the Kansas station is regarded as an improved variety. Laude and Sumner (*100*) say: "This variety is an improved selection from Orange made by the Kansas State Agricultural College at Manhattan."

Distribution.—Grown commercially in Kansas, chiefly in the eastern half of the State, and now found on small acreages in the adjacent States, Missouri, Oklahoma, and Arkansas (fig. 17).

52. COLMAN SORGO

Description.—Plants midseason (109 days, average of 12 crop years), tall (73 inches, average of 18 crop years), stems mid-stout, juicy, sweet; tillers freely; branches sparsely; leafy (12 to 15); midribs cloudy; leaf sheaths overlapping slightly to moderately; panicles mid-size, erect, mid-compact, cylindroid, or sometimes ellipsoid; rachis 60 to 100 percent of head length, but usually discontinuous; rachis branches mid-long to short and heavily fruited; glumes appressed, thinly pubescent to glabrous, intense dark red, indurate, veins hardly perceptible, elliptic, apices acute; lemmas not awned; stigmas pale yellow; kernels much exposed, especially in angles of glumes and usually extending slightly beyond apices of glumes, mid-size, plump, mostly light buff but reddish brown where exposed, ellipsoid to obovoid, endosperm starchy, corneous layer mid-thick, nucellar layer present; pedicellate spikelets mid-size, mostly straw-colored, fairly persistent at maturity; coleoptiles green or in some strains slightly red. A panicle, spikelets, and kernels are shown in plate 42.

[22] Personal letter Feb. 18, 1932.

Often confused with Orange, but quite unlike the latter in color of the glumes. The glume color of Colman gives rise to the name "Red Orange" and is similar to that of Red Amber, but Colman has a stouter, more erect stem, a more compact upright panicle, relatively shorter glumes, lighter-colored kernels (the lighter color of the kernel is especially noticeable just before maturity), and more persistent pedicellate spikelets than Red Amber.

History.—Developed by A. A. Denton, United States Department of Agriculture, at the sugar sorghum experiment station at Sterling, Kans., as the result of a selection from a natural hybrid found in 1887, and believed to be a cross between the Kansas Orange and Early Amber varieties (*164, pp. 62, 63*). Subsequent selection and purification resulted in the new variety, which was named Colman in honor of Norman J. Colman, Commissioner of Agriculture. It was especially promising as a sirup variety, one cane showing by analysis 20.72 percent of sugar, "the highest sorghum analysis ever recorded."

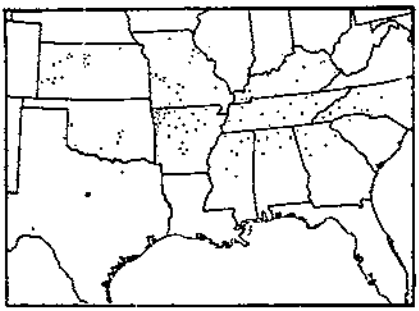


FIGURE 18.—Distribution of Colman sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 67,900 acres.

Distribution.—Considerable acreage in Arkansas, and grown in North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Kentucky, Missouri, Kansas, Oklahoma, and Texas (fig. 18).

Synonyms.—Honey Drip, Sugar Drip, Red Orange.

53. HONEY SORGO

Description.—Plants late (124 days, average of 18 crop years), very tall (87 inches, average of 15 crop years); stems stout, tapering toward the top, juicy, sweet; tillers freely; branches mid-freely; leafy (mode 16); midribs cloudy; leaf sheaths overlapping slightly; panicle large, erect, very effuse, conoid and variable in shape; rachis 85 to 100 percent of head length, but usually continuous; rachis branches long, spreading, lower branches drooping, glumes mostly glabrous, veins apparent only near apex, brownish red (Ridgway's garnet brown to morocco red[23]), coriaceous to indurate, elliptic, rather tightly appressed, apices acute to obtuse; lemmas awned but awns largely deciduous; stigmas yellow; kernels often not exposed in angles and usually shorter than the glumes, mid-size, rather uniformly reddish brown but darker where exposed, ellipsoid or sometimes ovoid or obovoid, endosperm starchy, corneous layer mid-thick to thick, nucellar layer present; pedicellate spikelets light reddish brown, small to mid-size and largely deciduous at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 43.

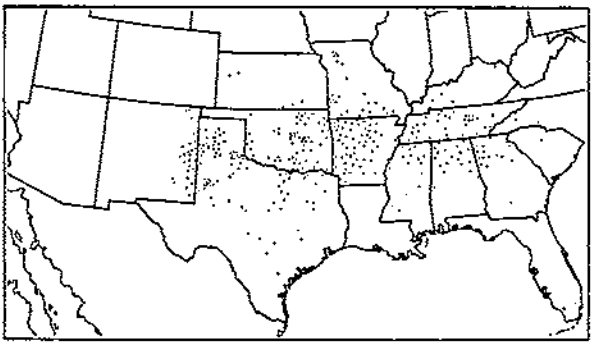


FIGURE 19.—Distribution of Honey sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 172,800 acres.

Compared with Red Amber, Honey is later in maturity, has stouter and more erect stalks, more effuse and spreading panicles with longer rachis

[23] RIDGWAY, R. See footnote 13.

branches and a more conical shape, lighter colored glumes (more of the yellow quality in the red), and it is more sparsely seeded. The spikelets of Honey are somewhat deciduous shortly after maturity.

History.—The origin cannot be definitely determined. It probably traces back to one of the original importations from Natal, South Africa. According to Hedges (*75*), of St. Louis, Mo., who witnessed the unpacking of the sorghum heads by Mr. Wray, the variety Vimbisehunpa was identical with the sorghum later known as Honduras. Early descriptions and illustrations of Honduras sorgo indicate its identity with Honey.

This variety was being grown under the name "Honey Cane" by the United States Department of Agriculture for a determination of its value as a possible source of sugar as early as 1880, according to Collier (*47, p. 38*). Seed for this test was obtained from J. H. Clark, Pleasant Hill, La. Plate 10 in Collier's report plainly identifies the variety Honduras as Honey, also known then as Sprangle Top and Mastodon.

A report on seed sources indicates that this variety was being grown in Alabama, South Carolina, and Texas. It is reasonable to suppose that it spread through these States from the original plantings of Wray's varieties by ex-Governor Hammond of South Carolina and Richard Peters of Atlanta, Ga.

Distribution.—Grown to a considerable extent for sirup and silage production in Georgia, Alabama, Tennessee, Missouri, Arkansas, Oklahoma, Texas, New Mexico, and to some extent in North Carolina, South Carolina, Mississippi, Kentucky, Arizona, and California (fig. 19).

Synonyms.—Japanese Cane, Japanese Seeded Ribbon Cane, Japanese Honey Drip, Sprangle Top.

54. SOURLESS SORGO

Description.—Plants midseason (113 days, average of 13 crop years), mid-tall to tall (71 inches, average of 14 crop years); stems mid-stout, juicy, sweet; tillers freely; branches freely; leafy (mode 14); midribs cloudy; leaf sheaths overlapping moderately; panicles erect, mid-compact, ellipsoid to cylindroid or variable in shape; rachis 60 to 100 percent of head length with average about 90 percent; rachis branches mid-long, heavily fruited; glumes thinly pubescent; straw-colored but often tinged with reddish brown, spreading slightly, chartaceous, ovate, apices acute to acuminate; lemmas not awned; stigmas creamy white; kernels much exposed in the angles and extending beyond the apices of the glumes, light buff to light brown, many with conspicuous spots of dense brown, small to mid-size, usually ellipsoid, hilum very flat, endosperm starchy, corneous layer thin to mid-thick, nucellar layer present; pedicellate spikelets mid-size, straw-colored, fairly persistent; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 44.

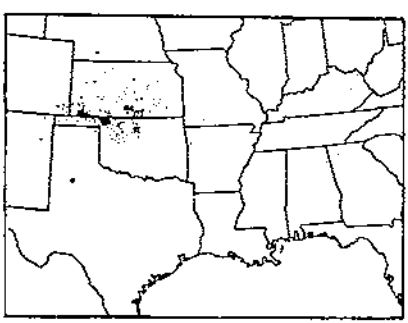
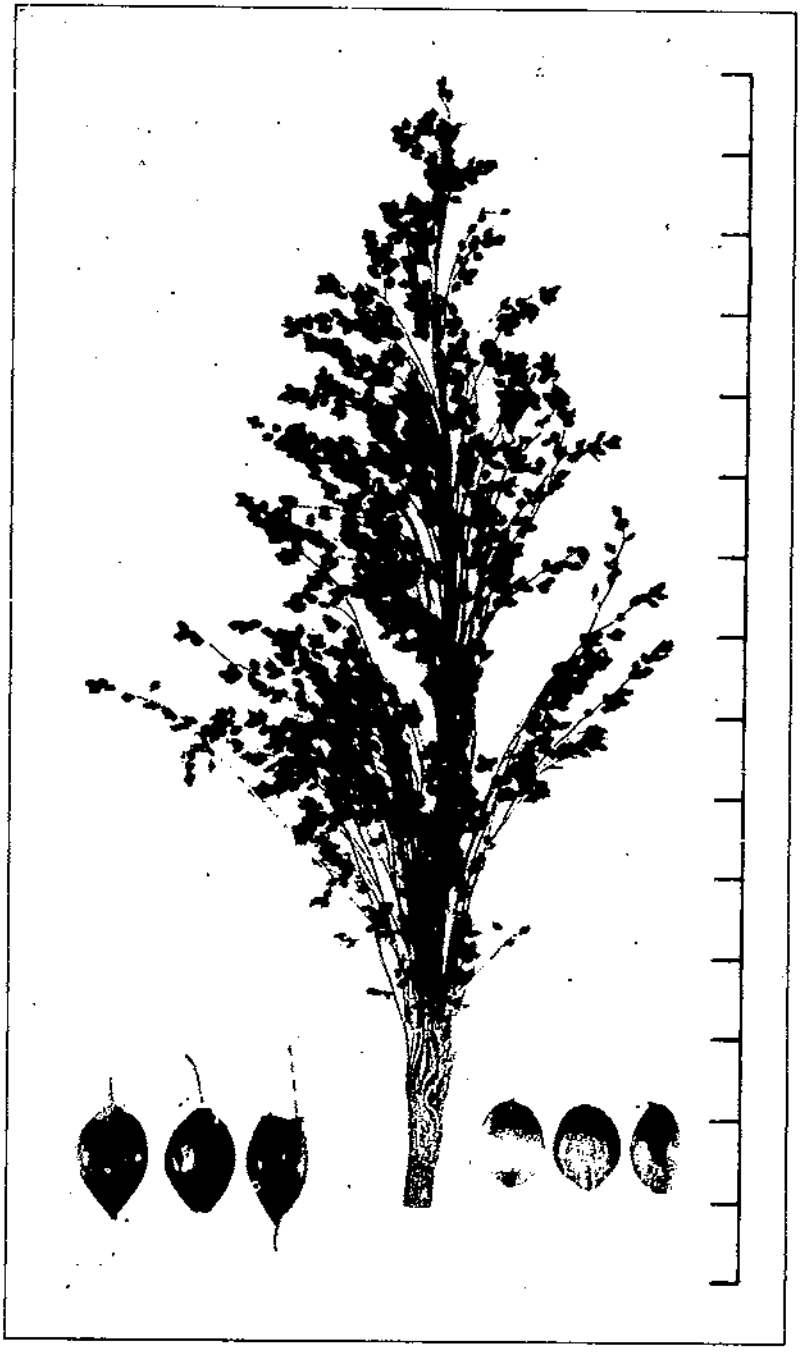


FIGURE 20.—Distribution of Sourless sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 118,900 acres.

In plant characters Sourless most resembles Orange, but the cream- or buff-colored kernels and straw-colored glumes have given rise to the name "White Orange" and readily distinguished it from the other varieties. The seeds are not as pure white as those of White African or Atlas sorgos.

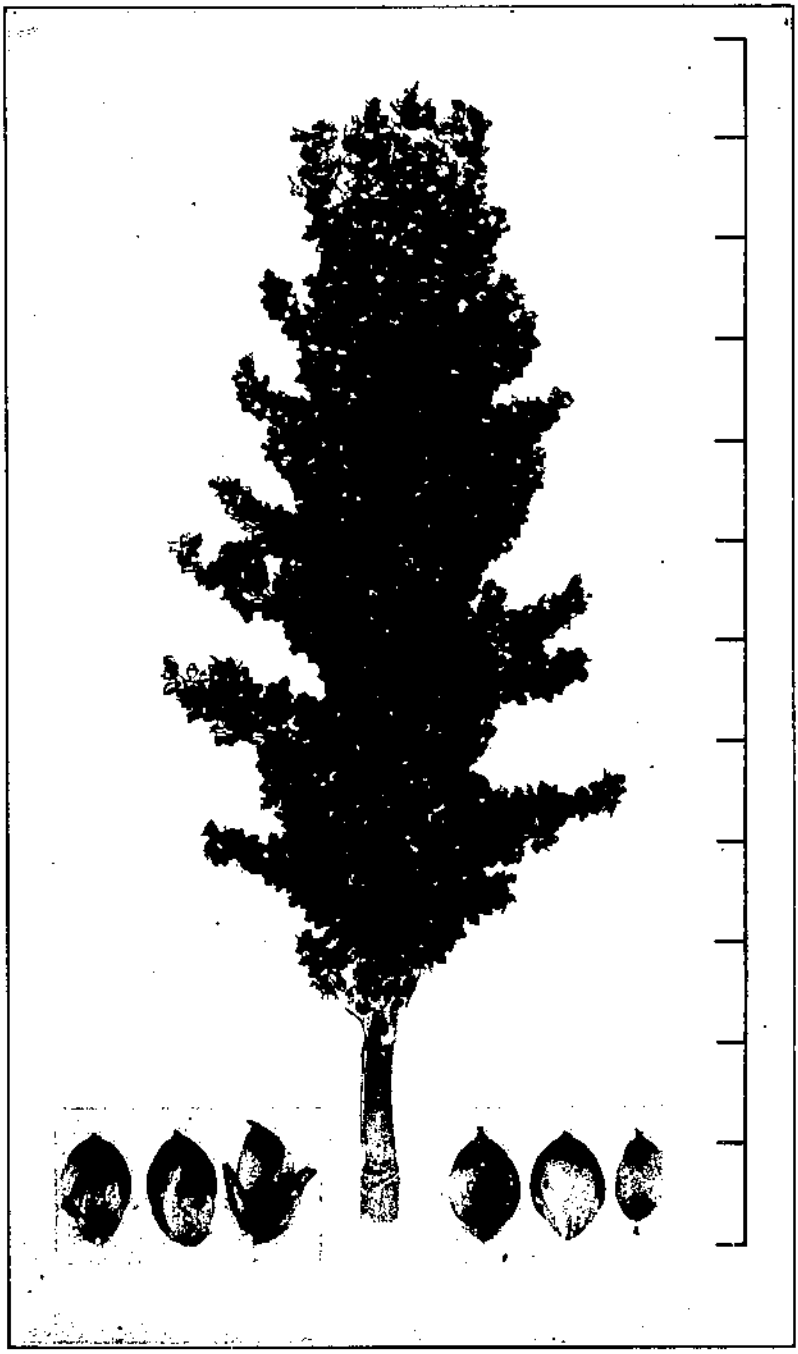
History.—Probably a descendant from the Neeazana variety introduced by Leonard Wray from Natal. Although the Neeazana variety has been frequently regarded as the progenitor of Orange, it was described as having white seeds by Hedges (*75*) and Peck (*111, p. 305*), and a common synonym of Neeazana was "White Imphee."

During the early part of the twentieth century the Sourless variety was being grown in the vicinity of Fort Scott, Kans., where it probably had been introduced when the sorghum-sugar experiments of the Division of Chemistry, United States Department of Agriculture, were being conducted there. Later C. S. Hall, a cattleman, obtained seed and grew considerable quantities of



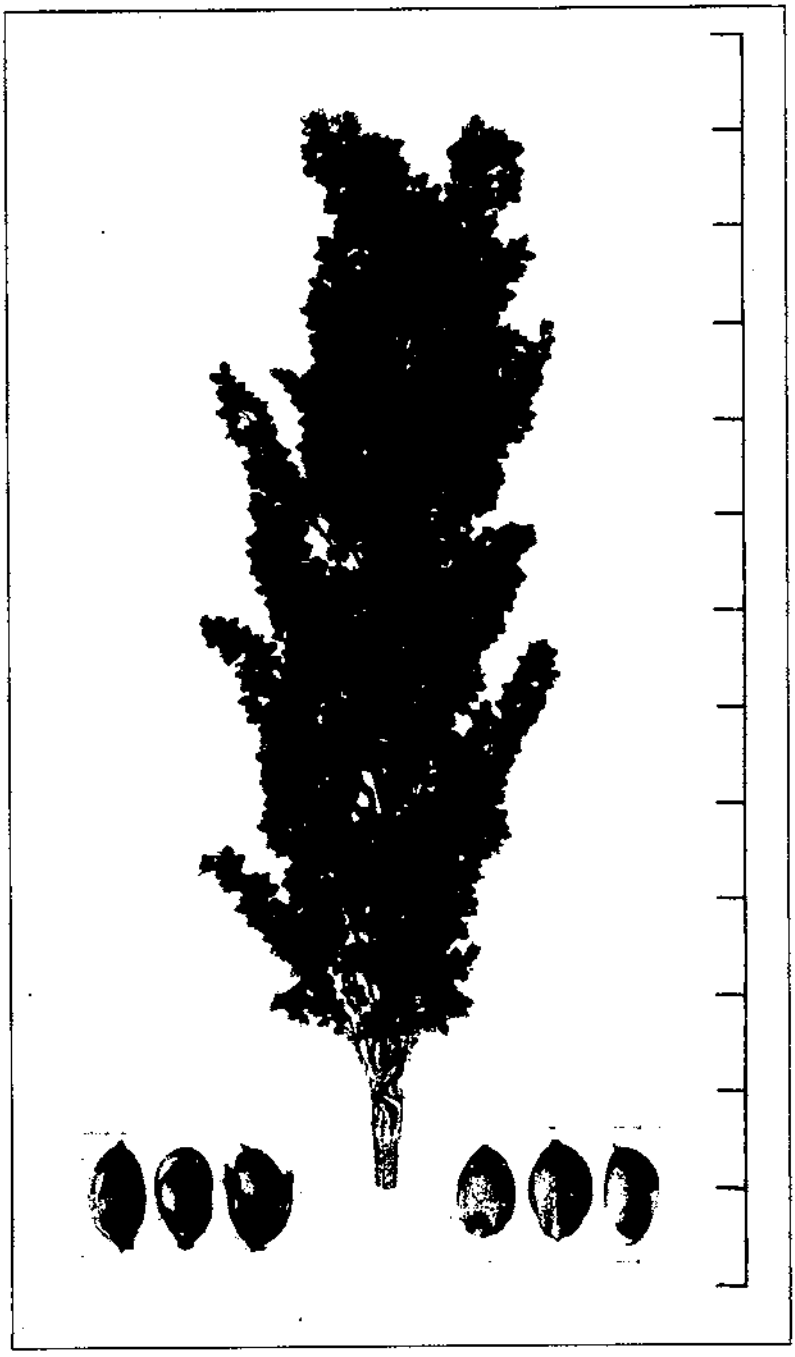
HONEY SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



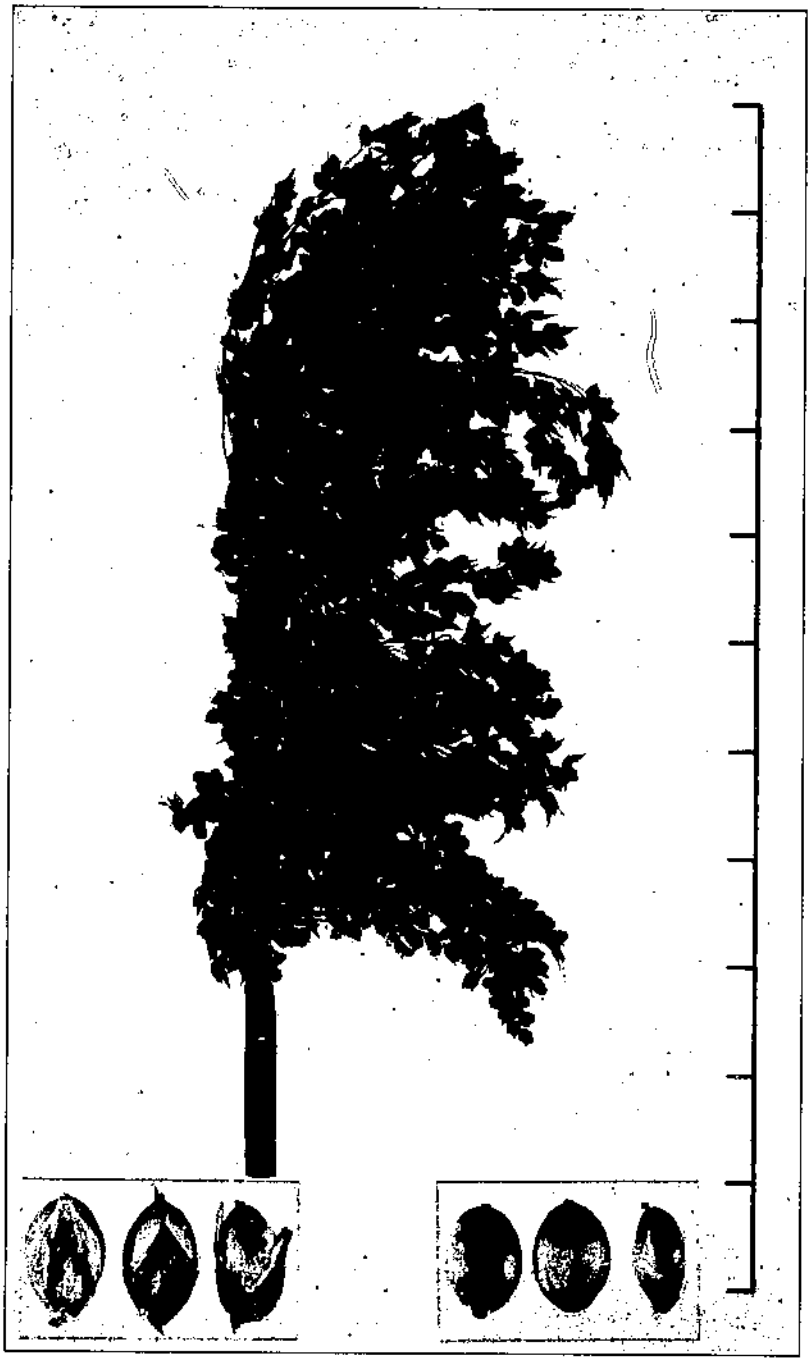
SOURLESS SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



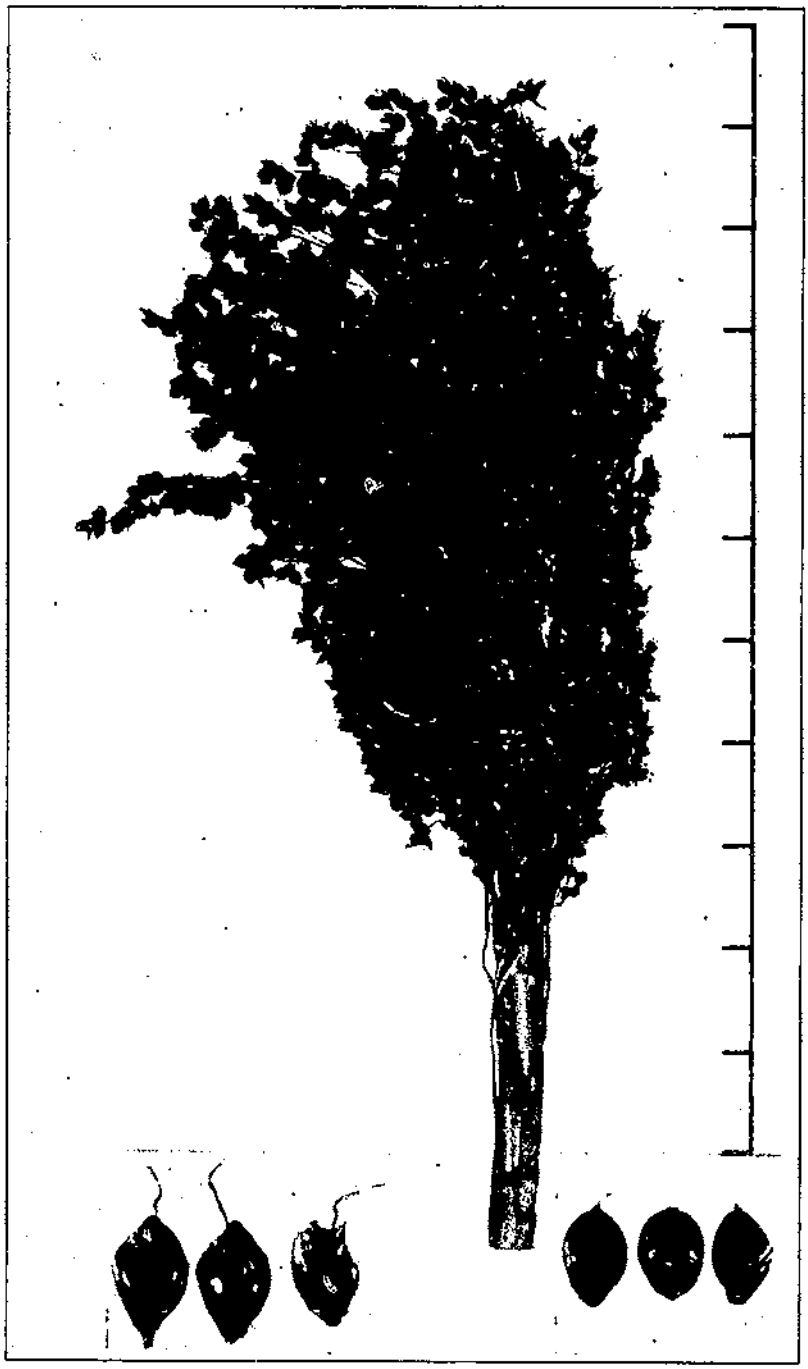
SAPLING SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



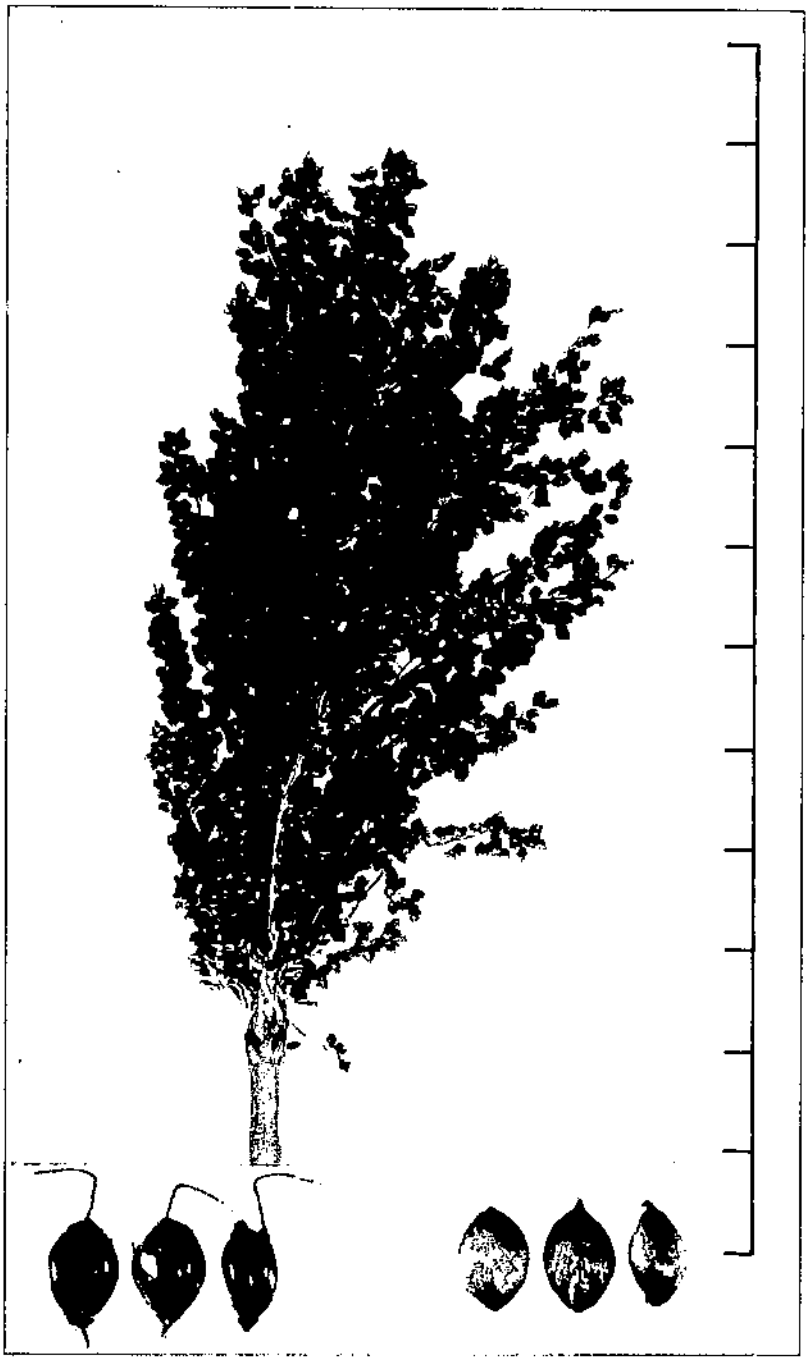
PLANTER SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



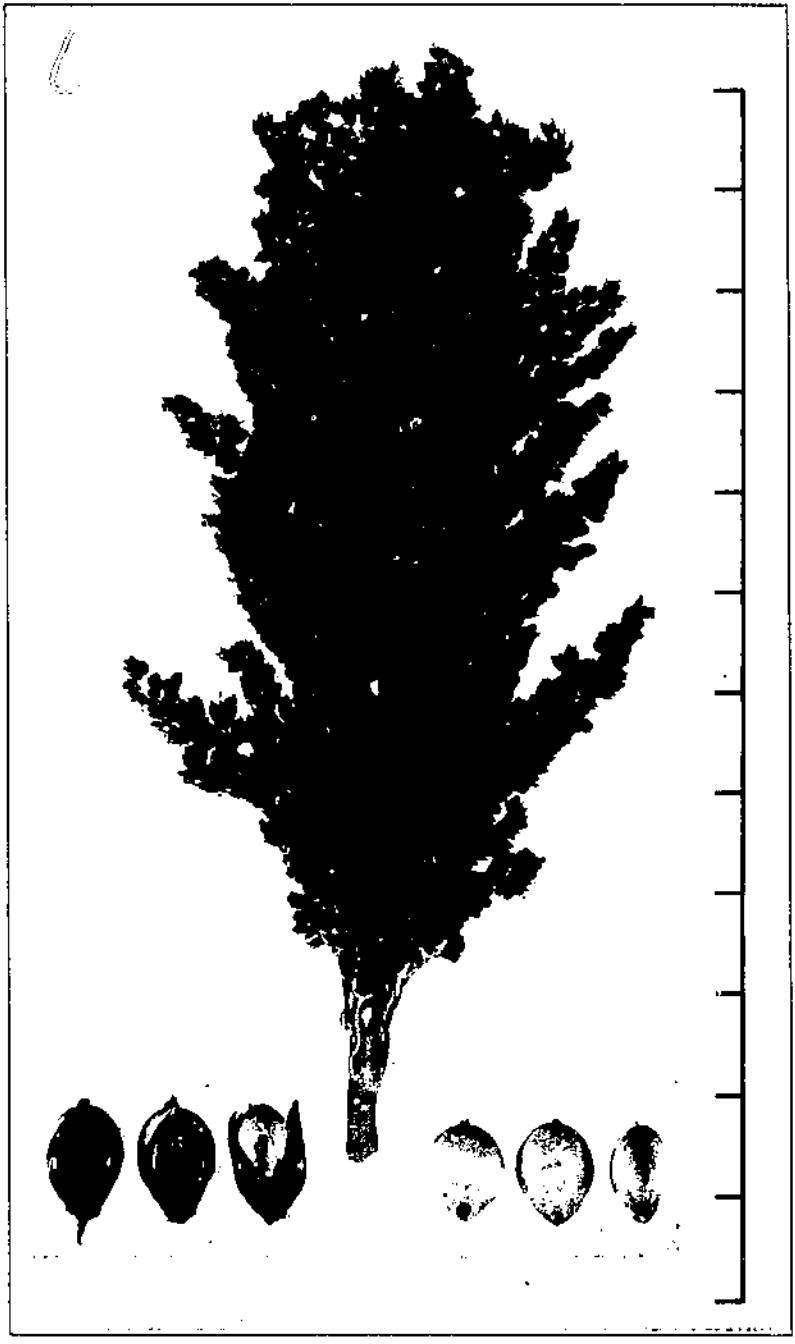
GOOSENECK SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



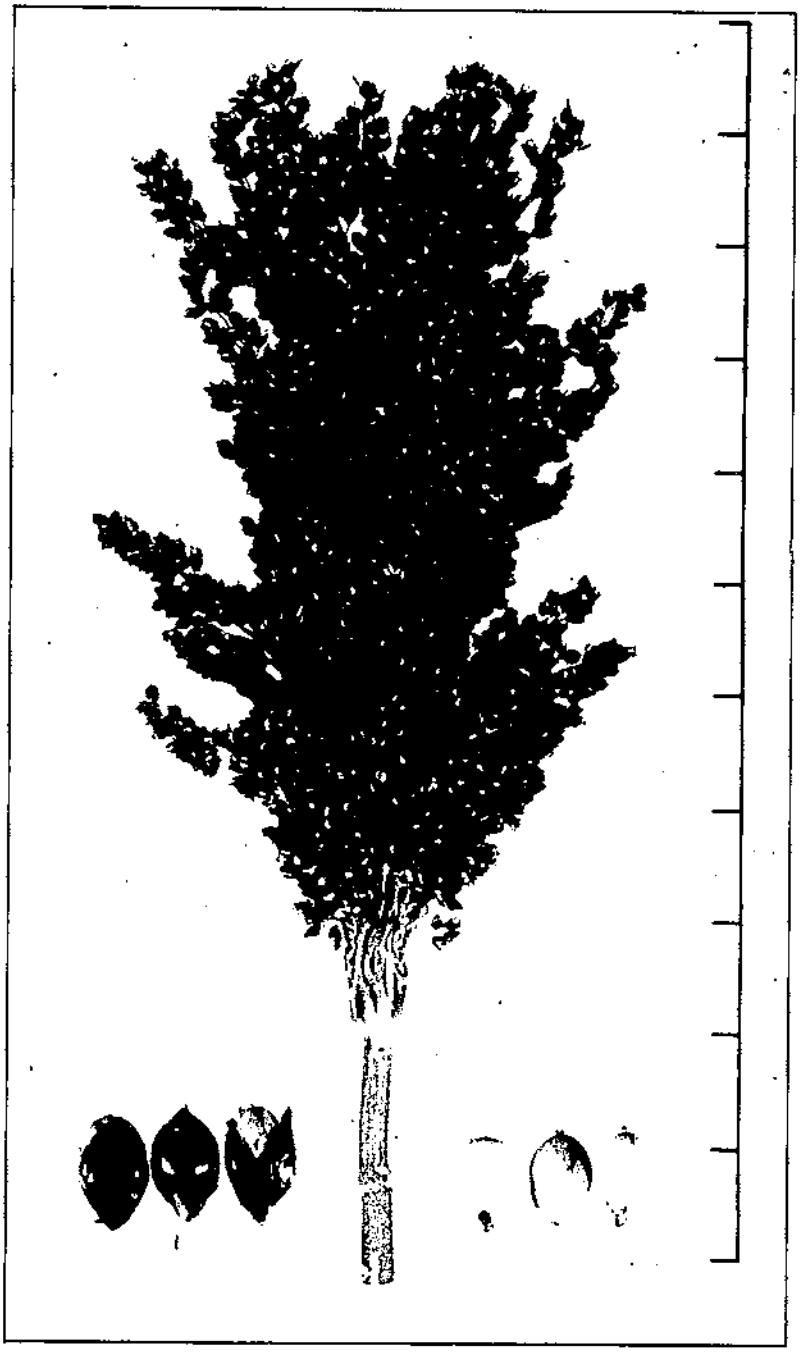
LEOTI SORGO.

Panicle, scale indicates size in inches, spikelets and kernels in three positions, × 3.



FOLGER SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



WHITE AFRICAN SORGO.

Panicle, scale indicates size in inches, spikelets and kernels in three positions, × 3.

Sourless sorgo at Eureka, Kans., where the variety was sometimes known as Hall's sorghum. Mr. Hall shipped some of his seed to Canadian, Tex., and the Sourless variety so named first came to the attention of the Department of Agriculture in 1905, when Robert Moody & Son were growing 1,500 acres of it near Canadian. They claimed that the fodder cut at any stage would not sour during the winter and would retain its juice and be fresh and sweet until spring, whereas the ordinary sorghum would usually be too sour for feeding after February 1.

Distribution.—There is a large acreage in Kansas and Oklahoma, and it is grown to some extent in South Carolina, Georgia, Alabama, Mississippi, Tennessee, Kentucky, Missouri, Nebraska, Colorado, New Mexico, Texas, and Arkansas (fig. 20).

Synonyms.—African Millet, White Orange.

55. SAPLING SORGO

Description.—Plants midseason to late, very tall (88 inches, average of 9 crop years); stems mid-stout, juicy, sweet; tillers freely; branches mid-freely; leafy (12 to 16); midribs cloudy; leaf sheaths overlapping moderately; panicles erect, mid-compact, cylindroid; rachis 75 to 100 and averaging about 85 percent of head length; rachis branches mid-long to short and usually appressed; glumes small, thinly pubescent, black, indurate but somewhat chartaceous at the tip, ovate or ovate-elliptic, apices acute; lemmas not awned; stigmas creamy white; kernels much exposed and extending considerably beyond apices of glumes, small to mid-size, reddish brown, ellipsoid, endosperm starchy, corneous layer mid-thick, nucellar layer present; pediceliate spikelets small and inconspicuous, usually straw colored but sometimes yellowish gray with purple edges, partly deciduous at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 45.

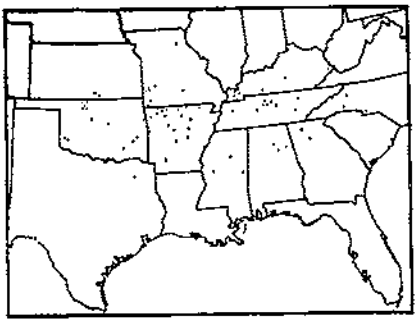


FIGURE 21.—Distribution of Sapling (Saccaline) sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 35,200 acres.

The tall, rather slender stems with the long, narrow, cylindrical panicle, heavily fruited with plump but small kernels strikingly exposed in the angles and beyond the apices of the black glumes, readily distinguish this from most other varieties.

History.—The origin is undetermined. It probably arose from one of Leonard Wray's introductions from Natal. As now recognized, it apparently was first grown under the name Link's Hybrid. The Link Hybrid variety is the progeny of a head selected from a field of Honey (Honduras) sorgo by Ephraim Link, Greeneville, Tenn., in 1878. Collier (*48, pp. 71–72*) quotes a letter from Link, as follows:

"Also 4 years ago I found a head—a clear sprout in the Honduras—entirely different in appearance from it, propagated it, and found its yield and richness in juice second to no other, and its sirup freer from the sorghum flavor than any I ever made. I sent General Le Duc [United States Commissioner of Agriculture] a specimen of the sirup and seed, and he ordered all the seed I had, about 14 bushels. In his report of the analysis of varieties he calls it 'Link's Hybrid.' It grows to good size, stands well, ripens before the Honduras, and I predict for it a high place among varieties."

This seed obtained by the United States Department of Agriculture was sown in 1880. In 1904 a variety under the name Sapling or Foxtail was secured by the Department of Agriculture from J. E. Randel, of Chillicothe, Tex., who in turn had obtained it from North Carolina. Specimens of Link Hybrid sorgo which proved to be identical with Sapling were obtained from Robert Link, Greeneville, Tenn., a son of Ephraim Link, in 1907.

In 1919 a variety was obtained from Australia under the name Saccaline, which apparently originated as a selection of Sapling, being quite similar to it in all important characteristics.

Distribution.—Grown in North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Kentucky, Missouri, Arkansas, and Oklahoma under various local names, but rarely is it called Sapling (fig. 21).

Synonyms.—Saccaline (Australia), Link Hybrid, and Straightneck. The last name is applied to a Sapling having red glumes but otherwise characteristic.

56. PLANTER SORGO

Description.—Plants midseason, tall; stems mid-stout, juicy, sweet; tillers freely; branches mid-freely; mid-leafy (mode 13); midribs cloudy; leaf sheaths overlapping moderately; panicles erect, mid-compact or tending toward effuse, variable in shape, ellipsoid to obconoid; rachis 50 to 60 percent of the head length; rachis branches mid-long to long, frequently drooping to one side; glumes spreading widely, usually pubescent, straw-colored to light brown or sometimes black, rather chartaceous, ovate, apices acute to acuminate; lemmas not awned; stigmas very pale yellow; kernels much exposed in the angles and extending beyond the apices of the glumes, mid-size, buff to light brown, often nearly white where unexposed, darkest where exposed, the oval surrounding the hilum and area above it usually outlined clearly, ellipsoid to globose, endosperm starchy, corneous layer mid-thick, nucellar layer present; pedicellate spikelets large, conspicuous, mostly straw-colored, fairly persistent at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 46.

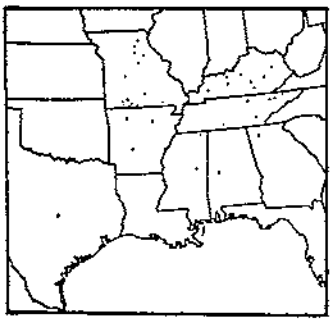


FIGURE 22.—Distribution of Planter sorgo in the United States in 1924. Each dot represents 500 acres. Estimated area, 17,800 acres.

Planter sorgo is much like Sourless and Orange, but is readily distinguishable from both by the panicle characters. The gross color impression of the Planter panicle is a rather uniform combination of light brown and dark, while in Sourless the color impression is light buff and in Orange it is reddish-brown or orange color.

History.—The history of Planter (formerly known as Planter's Friend) cannot be fully determined. Apparently, it is not one of Leonard Wray's introductions from Natal. The Madras Government of India obtained seed of Black Amber (Chinese) sorgo from the United States and "Imphee" from the Cape of Good Hope in Africa in 1858. The Planter's Friend variety was grown at the Government Experiment Farm at Sydapet, Madras, India, in 1875 (*157, p. 288*). Planter's Friend has been grown in Australia for many years and was obtained from there by the United States Department of Agriculture in 1888 (*165, p. 90*) and again in 1904. It very likely came to India and Australia from South Africa, as along with the Sourless and Orange it bears a close resemblance to Wray's Neenzana.

Distribution.—Grown to a limited extent only in North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Kentucky, Missouri, Arkansas, and Texas (fig. 22).

Synonym.—Planter's Friend.

57. GOOSENECK SORGO

Description.—Plants very late, very tall; stems stout, juicy, sweet; tillers freely; branches mid-freely; leafy (mode 15); midribs cloudy; leaf sheaths overlapping moderately; panicles mid-size, erect, inclined or recurved, mid-compact, obovoid; rachis 50 to 100 percent of head length but usually discontinuous; rachis branches mid-long, longest in upper half and somewhat drooping near apex; glumes gibbous, usually pubescent on margins, at base and near apex, but glabrous and shiny on the hump, black but usually with reddish brown chartaceous tips, indurate to corinaceous, elliptic to obovate, apices sometimes acute but generally obtuse or rounded; lemmas with short readily deciduous awns; stigmas pale yellow; kernels slightly exposed and extending to or not quite to apices of glumes, small to mid-size, uniformly dark reddish brown, plump, ellipsoid or approaching globose, endosperm usually waxy, but in some strains starchy, nucellar layer present, seed coat usually checked; pedicellate spikelets mid-size, pink or light reddish brown, rather conspicuous while at-

tached but mostly deciduous at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 47.

The principal distinguishing features of Gooseneck sorgo are the tall, stout stem, the long season of growth, and the often recurved peduncle.

History.—Claimed by Leonard Wray as one of his introductions from Natal (*48, p. 68*). This is probably true, since some of his varieties were said to have pendent heads. Gooseneck early became a popular sorghum in the South and had been grown near Brookhaven, Miss., several years previous to 1878.[24] It was believed to have been grown near Eagletown, N. C., previous to 1875. Gooseneck was listed among the varieties grown in the experiments of the United States Department of Agriculture in 1880 (*47, p. 38, pl. 12*).

In 1903 the Gooseneck variety began to be widely exploited under the name "Texas Seeded Ribbon Cane" by A. W. Short, Dodd City, Tex., who reported having obtained the seed under the latter name from W. J. Maltry, Admiral, Tex., in 1895.

Distribution.—Grown in North Carolina, South Carolina, Georgia, Alabama, Mississippi, Oklahoma, Arkansas, and Texas.

Synonym.—Texas Seeded Ribbon Cane.

58. LEOTI SORGO

Description.—Plants early to midseason (104 days, average of 10 crop years), mid-tall to tall (average 68 inches); stems mid-slender to mid-stout, juicy, sweet; tillers freely; branches sparsely to mid-freely; mid-leafy (mode 12); midribs cloudy; leaf sheaths overlapping slightly; panicles erect, mid-compact, but tending toward effuse, cylindroid or obconoid and various shapes; rachis 50 to 80 percent of head length; rachis branches mid-long to long, sometimes drooping; glumes gibbous, usually glabrous except near apex and at the base, dull yellowish red (somewhat like the burnt sienna of Ridgway[25]), with straw tips, coriaceous to indurate, obovate, the first glume usually constricted near the base, apices usually obtuse or rounded, many approaching truncate; lemmas with short, geniculate, mostly deciduous awns; stigmas pale yellow; kernels slightly exposed, extending to or not quite to apices of the glumes, mid-size, buff color, darker where exposed, broadly ellipsoid, endosperm waxy, nucellar layer present, pedicellate spikelets reddish brown and almost wholly deciduous, so that at maturity they may appear lacking entirely; coleoptiles red.

The principal distinguishing feature in Leoti sorgo is the peculiar quality of red in the glumes, which is lighter than in Red Amber and duller than that of Honey. The head shapes are very muniform, much more so than in most varieties, the leaves less subject to red discolorations, and it is one of the few varieties having seed with waxy endosperms. A panicle, spikelets, and kernels are shown in plate 48.

History.—Origin undetermined. It was obtained by the Department of Agriculture in 1920 from V. E. F. Kleyman, Leoti, Wichita County, Kans. R. E. Getty, who secured the seed, observed the variety being grown on occasional farms in southwestern Kansas.

Distribution.—Grown commercially in Kansas.

Synonym.—Leoti Red.

59. FOLGER SORGO

Description.—Plants midseason, tall; stems mid-stout, juicy, sweet; tillers freely; branches mid-freely; leafy (mode 14); midribs cloudy; leaf sheaths overlapping slightly; panicles erect, mid-size, mid-compact, cylindroid or approaching cylindroid to sometimes ellipsoid; rachis 60 to 100 percent of head length but usually discontinuous; rachis branches mid-long, of nearly equal length; glumes usually keeled and thinly pubescent, black or very dark reddish brown, sometimes with indistinct straw-colored apices, coriaceous to indurate, ovate to elliptic, apices acute or approaching accuminate; lemmas not awned; stigmas pale yellow; kernels considerably exposed in the angles and at apices of well-opened glumes, extending to or not quite to the apices of the glumes, mid-size, light buff where unexposed but reddish brown where exposed, broadly ellipsoid to obovoid, endosperm starchy, corneous layer mid-thick, nucellar layer present; pedicellate spikelets small, inconspicuous, light straw color and largely deciduous at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 49.

Folger heads are somewhat shorter than McLean but longer than Orange. Compared with McLean and Minnesota Amber, the kernels are more exposed,

[24] Letter of J. T. Elliott, Eagletown, N. C., Oct. 20, 1905.
[25] Ridgway, R. See footnote 13.

broader, and rounder at the tip. The glumes are wider as compared to length than those of McLean, and the straw-colored margins are much less conspicuous.

History.—A variety originating in selections of Early Amber made by A. S. Folger, Shenandoah, Iowa (*164, p. 65*). Seeds from these selections were planted at Sterling, Kans., in 1888, and the resulting crop was quite variable in sugar content and in other respects. Selections were made, and one of these gave a uniform progeny with a 3-percent greater sugar content than the original selections from Folger. This selection was increased and given the name "Folger's Early."

Distribution.—Grown to a small extent in South Carolina, Georgia, Alabama, and Kansas.

Synonym.—Folger's Early.

60. WHITE AFRICAN SORGO

Description.—Plants midseason to late (118 days, average of 12 crop years), very tall (82 inches, average of 12 crop years); stems mid-stout to stout, mid-juicy to juicy, sweet; tillers freely; branches sparsely; leafy (mode 15); midribs cloudy; leaf sheaths overlapping slightly to moderately; panicles erect, mid-compact, obconoid to cylindroid, relatively short; rachis 40 to 70 percent of head length, but usually about 50 percent; rachis branches mid-long, spreading at apex; glumes thinly pubescent or partly pubescent at maturity, brownish black, coriaceous to indurate, elliptic, apices acute to obtuse; lemmas not awned; stigmas very pale greenish yellow; kernels considerably exposed in angles of glumes and extending to or slightly beyond apices of glumes, small to mid-size, white with small reddish-brown spots near apices, ellipsoid, endosperm starchy, corneous layer thick, nucellar layer absent; pedicellate spikelets small, straw-colored with brown spots, largely deciduous at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 50.

One of the very few sorgos having pure-white kernels with no nucellar layer; also has tall, rather stout stems, with comparatively small panicle.

History.—Apparently an introduction in 1857 by Leonard Wray from Natal, South Africa, under the name Enyama. Later the variety sometimes was called White Mammoth, and Collier (*48, pp. 68, 69*) obtained some old seed of Enyama from Mr. Wray and found it identical with White Mammoth. Early illustrations (*37, pl. 15; 47, pl. 5*) and descriptions of this White Mammoth indicate its identity with the variety now being grown as White African. Both White African and White Mammoth were listed among the varieties of sorghums grown in the United States in 1880 (*47, p. 38*).

The illustrations by Collier (*48, pls. 14 and 15*), as well as his descriptions (*47, p. 40*), indicate that the present White African sorgo is more like the original White Mammoth than the White African of that date. In some way the varietal name must have been shifted from the original White African to the White Mammoth.

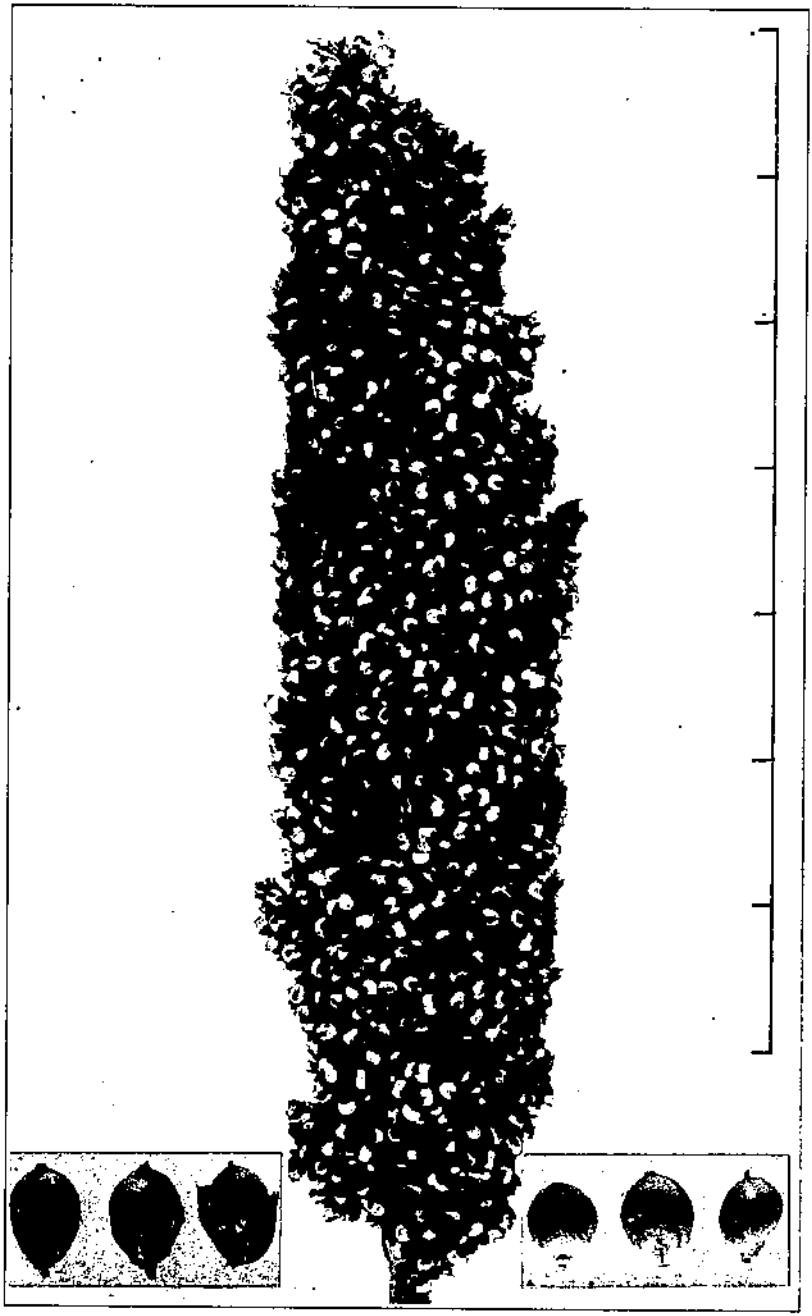
Distribution.—Grown commercially in Georgia, Arkansas, and Oklahoma.

Synonym.—Known at first as White Mammoth.

61. ATLAS SORGO

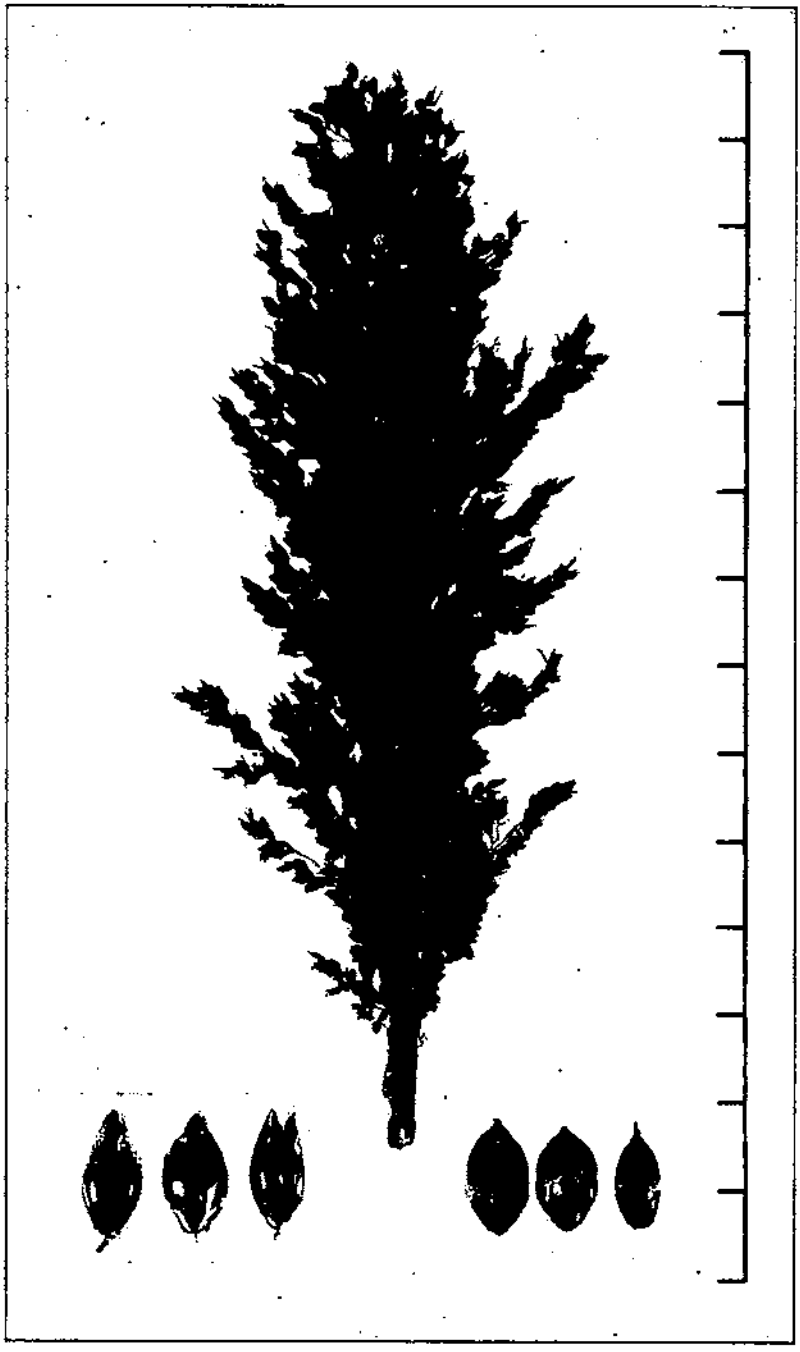
Description.—Plants midseason to late, mid-tall to tall (average 70 inches); stems mid-stout, juicy, sweet; tillers freely; branches mid-freely; leafy (13 to 15); midribs cloudy; leaf sheaths overlapping moderately; panicles erect, mid-compact, ellipsoid to cylindrical; rachis about 90 percent of head length and usually discontinuous in main heads; rachis branches mid-long, appressed; glumes pubescent, black, indurate, ovate to elliptic, apices acute; lemmas not awned; stigmas creamy white; kernels much exposed in angles and extending well beyond apices of glumes, mid-size, white with reddish brown to black spots, obovoid to globose or ellipsoid, embryo prominent, endosperm starchy, corneous layer thick, nucellar layer absent; pedicellate spikelets mostly straw-colored, some dark with purple tinge, largely persistent but inconspicuous at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 51.

History.—Originated as a selection from the progeny of a cross between Blackhull kafir and Sourless sorgo. This cross was made by I. N. Farr, a farmer and sorghum breeder at Stockton, Kans., but the selection work was done at the Kansas Agricultural Experiment Station at Manhattan under the direction of Parker (*109*). Hybrid heads were sent to the experiment station by Mr. Farr, and after several years of head-row tests the most promising



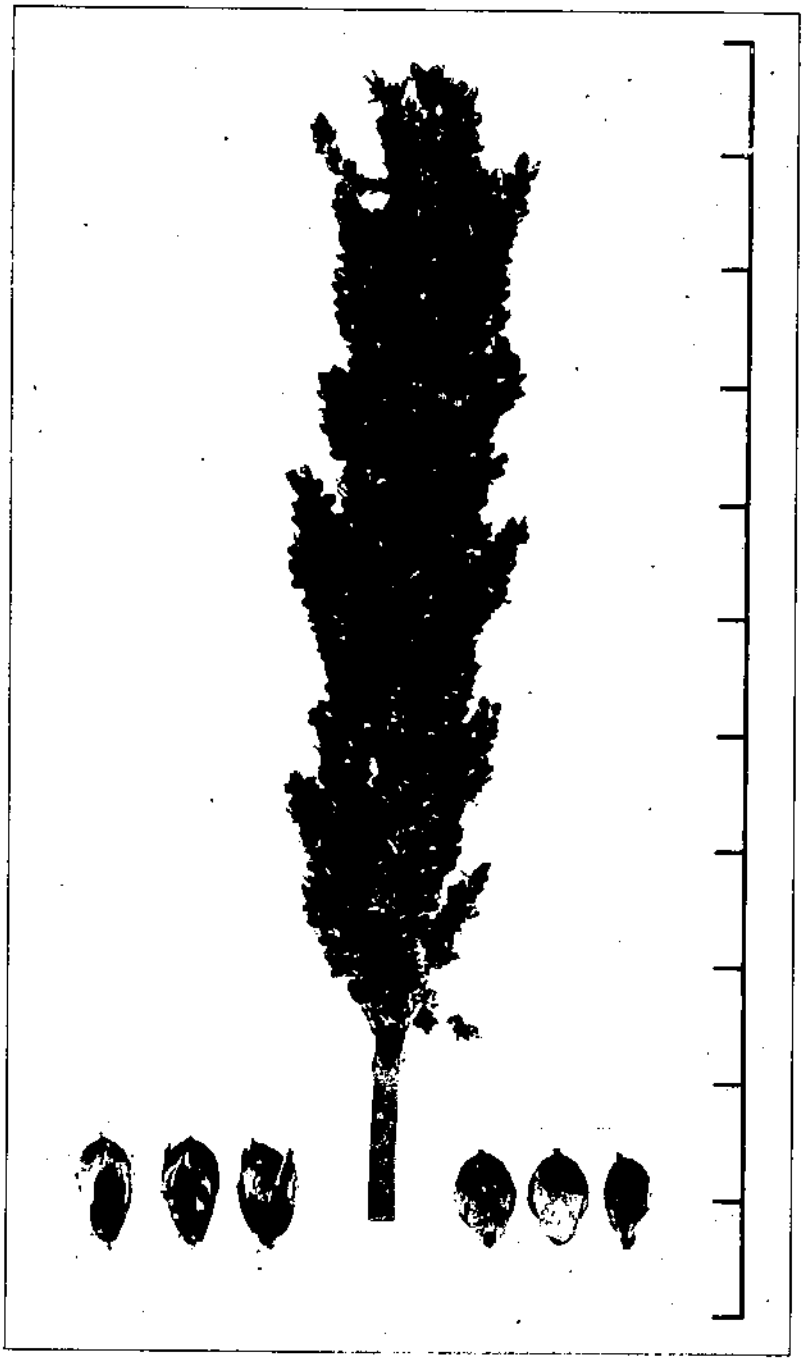
ATLAS SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



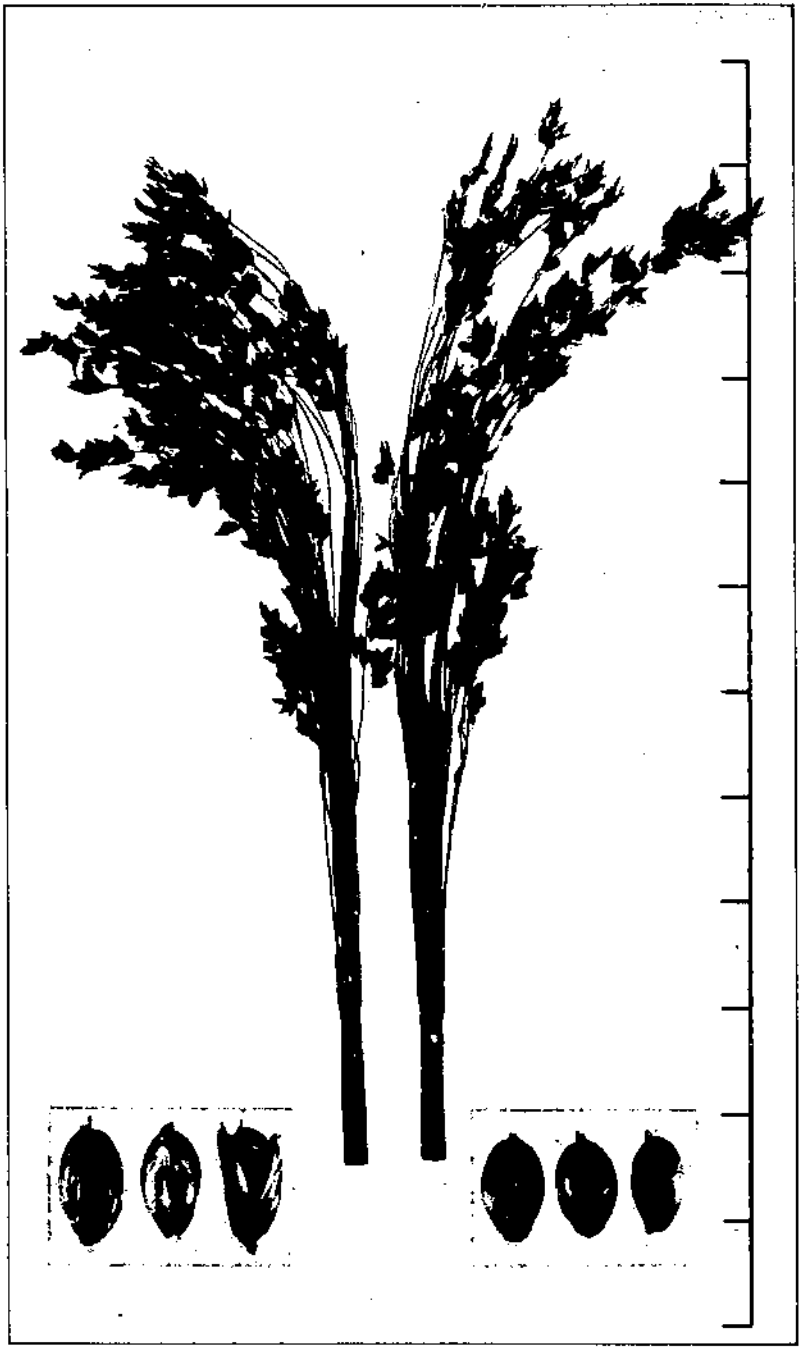
MCLEAN SORGO.

Panicle, scale indicates size in inches, spikelets and kernels in three positions, × 3.



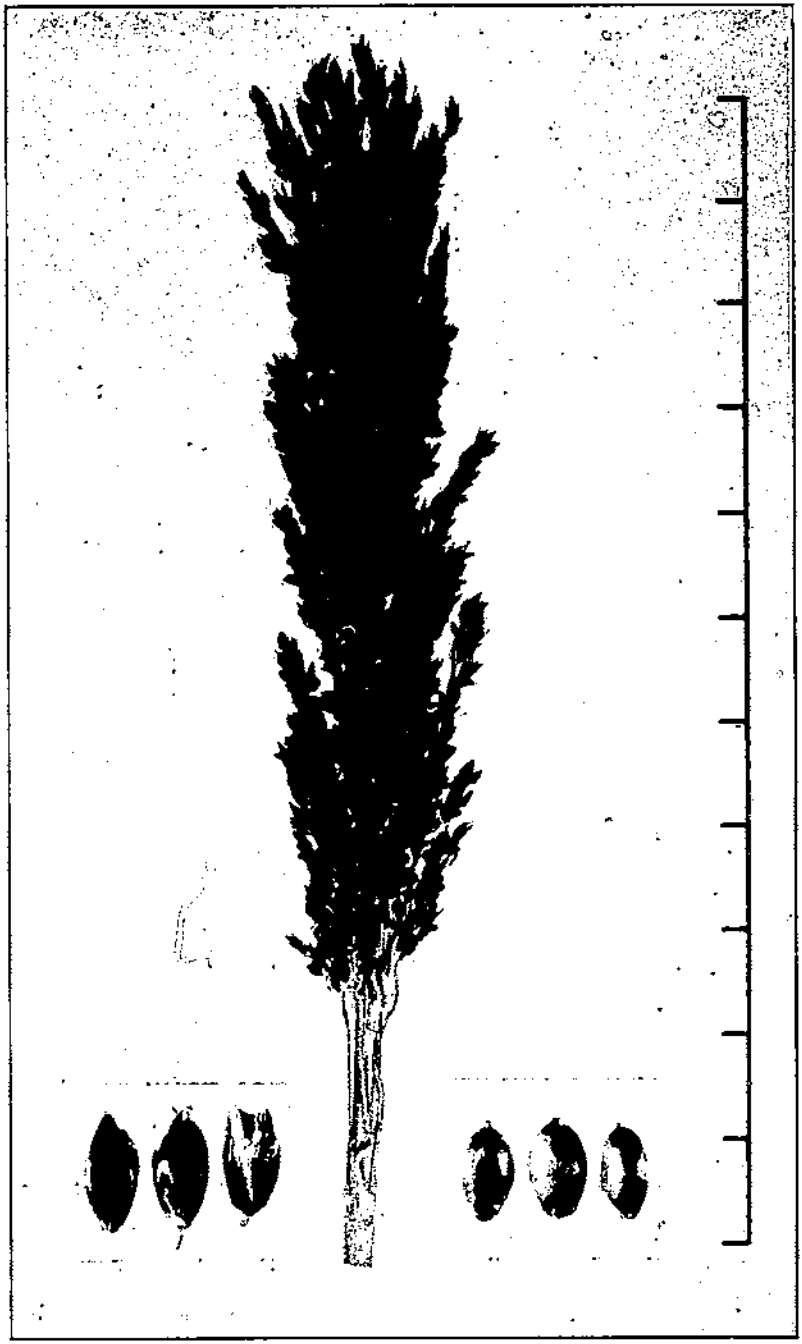
REX SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



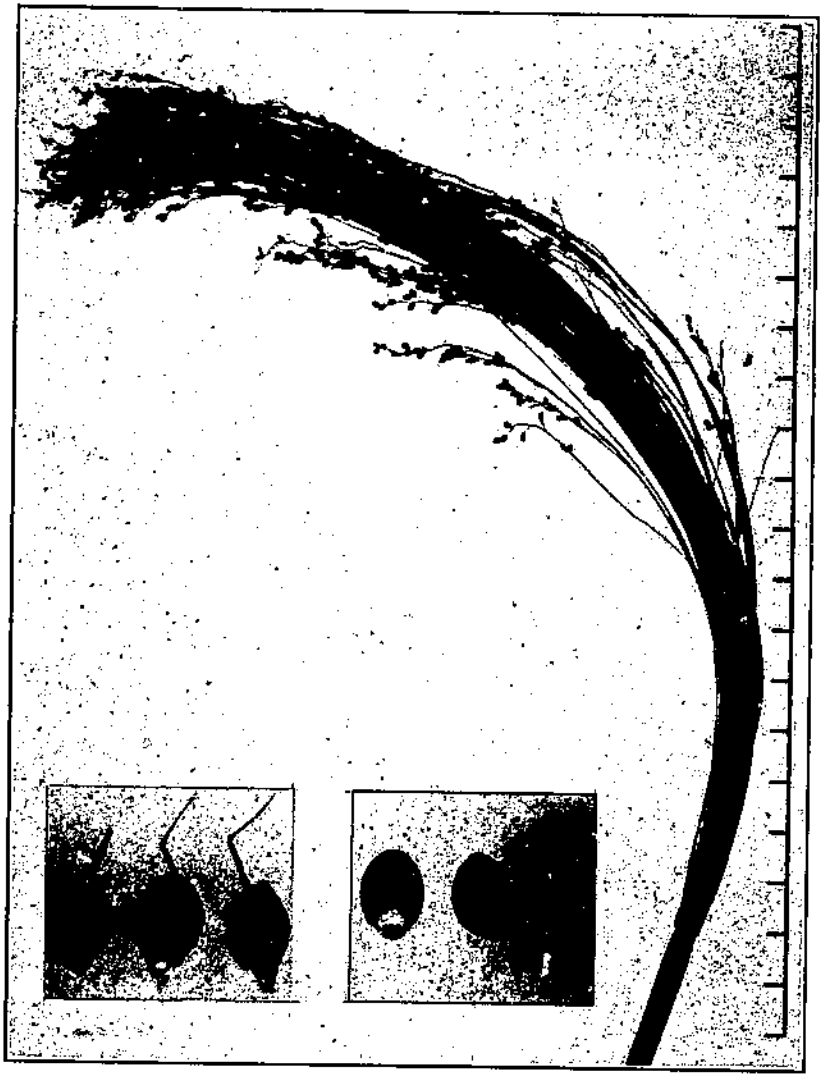
COLLIER SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



DENTON SORGO.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.



EVERGREEN BROOMCORN.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, × 3.

segregate was selected in 1923, and this strain was later given the name Atlas. The first general distribution of Atlas to farmers was made about 1928.

Distribution.—Grown principally in Kansas but spreading to adjoining States.

62. McLEAN SORGO

Description.—Plants midseason to late (115 days, average of 11 crop years), tall (72 inches, average of 14 crop years); stems mid-stout, juicy, sweet; tillers freely; branches mid-freely; mid-leafy (mode 12); midribs cloudy; leaf sheaths overlapping slightly; panicles long, erect, mid-compact tending toward effuse, cylindroid or approaching cylindroid; rachis 60 to 100 percent of head length but usually discontinuous; rachis branches mid-long, appressed to spreading; glumes pubescent near apices but pubescence partly deciduous at maturity, indurate except around edges, black with apices of outer glumes uniformly straw-colored to reddish brown, ovate or ovate-elliptic, appressed, apices acute; lemmas not awned; stigmas yellow; kernels slightly exposed in angles of glumes, mid-size, reddish brown, ellipsoid to ovoid or obovoid, somewhat narrow and pointed toward apex, endosperm waxy, nucellar layer present; pedicellate spikelets mid-size to large, straw-colored to light reddish brown, usually as long as or longer than sessile spikelets, generally somewhat conspicuous in mature head because a relatively large proportion are retained after maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 52.

Closely related to the Black Ambers, but distinguishable from them by the less effuse, rather stiff panicle, and the somewhat variegated appearance of the panicle due to the straw-colored apices of the black glumes and the unusually numerous persistent pedicellate spikelets. It is also somewhat later in maturing than most of the Ambers.

History.—This variety was received by the United States Department of Agriculture from Peter McLean, Undersecretary for Agriculture, Queensland, Australia, in 1890 (*165*). It was unnamed, and the name McLean was applied to it in recognition of the service of Secretary McLean in supplying seed. In the experiments at Sterling, McLean sorgo made an excellent record as a sirup sorgo in 1890 and 1891.

Distribution.—Grown in Arkansas to a greater extent than elsewhere, but nowhere very extensively.

63. REX SORGO

Description.—Plants midseason, mid-tall; stems mid-slender to mid-stout, juicy, sweet; tillers freely; branches mid-freely; mid-leafy (mode 13); midribs cloudy; leaf sheaths overlapping moderately; panicles erect, slender, mid-compact, cylindroid or sometimes fusiform; rachis 60 to 100 percent of head length with average about 80 percent and usually discontinuous; rachis branches short to mid-long, appressed; glumes thinly pubescent, reddish brown and usually with straw-colored margins, chartaceous at the tip but somewhat thickened near the base, ovate to elliptic, apices acute; lemmas not awned; stigmas pale yellow; kernels well exposed and extending to or beyond apices of glumes, small, color quite variable ranging from cream buff to liver brown (Ridgway [26]) on the same seed, obovoid to sometimes ellipsoid, embryo unusually prominent, endosperm starchy, corneous layer mid-thick, nucellar layer present; pedicellate spikelets mid-size, straw-colored, persistent in mature heads; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 53.

Rex most resembles Denton, from which it differs in having very few infertile sessile spikelets and in the greater exposure of the kernels in the angles and at the apices of the glumes.

History.—Among the sorghums grown at the sorghum sugar station of the United States Department of Agriculture at Sterling, Kans., in 1891, were two designated as 8X and 14X. These are listed (*165, pp. 97, 125*) as selections from natural crosses found in Link Hybrid (Sapling) and Amber sorgos. According to R. Best, of the Fort Scott Sugar & Sorghum Sirup Co., Fort Scott, Kans.,[27] the name Red X was applied to both of the above strains, which differed only in the length of the heads. The variety name has been changed to Rex.

Distribution.—Grown commercially to a small extent in Arkansas for sirup production and experimentally in Kansas and Texas.

Synonym.—Red X.

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[26] RIDGWAY, R. See footnote 13.
[27] Letter dated Apr. 20, 1906.

64. COLLIER SORGO

Description.—Plants early (97 days, average of 7 crop years), mid-tall to tall (71 inches, average of 12 crop years); stems mid-slender to mid-stout; juicy, sweet; tillers freely; branches freely; mid-leafy (mode 12); midribs cloudy; leaf sheaths overlapping moderately; panicles small, erect, sometimes effuse and umbelliform but more often not spreading, tending to lie close together and droop to one side like broomcorn; rachis usually less than 20 percent of head length with poorly defined nodes; rachis branches long and fruited only near the outer ends; glumes thinly pubescent to glabrous, spreading considerably, straw-colored to reddish brown or black but usually with straw-colored margins, the center colored but with the color often in spots and streaks, usually somewhat chartaceous but often thickened at the base, ovate to sometimes elliptic, apices acute or acuminate and not adhering close to kernel; lemmas not awned; stigmas yellow; kernels considerably exposed in angles of glumes and extending nearly to but rarely beyond the apices of glumes, small, narrow, reddish brown, ellipsoid, endosperm starchy, corneous layer mid-thick to thick, mucellar layer present; pedicellate spikelets midsize to large, chartaceous, straw-colored to reddish brown and largely persistent in the mature head; coleoptiles green. Panicles, spikelets, and kernels are shown in plate 54.

This variety is easily distinguished from other sorgos by its characteristic short rachis with usually one or but few nodes and very long rachis branches, giving the panicle an appearance somewhat like broomcorn.

History.—In 1881 the United States Department of Agriculture received 13 varieties of sorghum from the Botanical Gardens at Natal, South Africa (*48, pp. 76, 77*), through W. T. Thiselton Dyer, assistant director of the Royal Gardens, Kew, England. Among these was one called "Undendebule", which was grown in the sorghum-sugar experiments of the Department being conducted by Collier. In 1888, after Dr. Collier had become director of the New York Agricultural Experiment Station, he sent seed of Undendebule sorghum to Denton (*165, p. 89*) at the United States Department of Agriculture experiment station at Sterling, Kans. The variety contained two types, which were separated. In 1891 one of the types (Undendebule No. 1) was named Collier at the suggestion of H. W. Wiley, then chief chemist, United States Department of Agriculture. The illustration of Undendebule in Collier's book (*48, p. 90*) leaves little doubt about its relation to the present Collier sorgo.

Distribution.—Grown to a small extent in Georgia and South Carolina.

65. DENTON SORGO

Description.—Plants midseason, mid-tall; stems mid-stout, juicy, sweet; tillers freely; branches freely; mid-leafy (mode 11); midribs cloudy; leaf sheaths overlapping moderately; panicles erect but sometimes tending toward effuse, cylindroid to fusiform; rachis 80 to 100 percent of head length, rachis branches mid-long to short, generally appressed; glumes thinly pubescent, brownish red, often with the margins straw-colored, especially near the apices, indurate, elliptic or narrowly ovate, apices acuminate or often acute; lemmas not awned; stigmas very pale greenish yellow; kernels slightly exposed in the angles of the glumes but not so long as the glumes, small, light brown or tan with reddish brown spots, ellipsoid, endosperm starchy, corneous layer mid-thick, mucellar layer present or in one strain absent; pedicellate spikelets straw-colored, mid-size to large, persistent, and conspicuous at maturity; coleoptiles green. A panicle, spikelets, and kernels are shown in plate 55.

In this variety, seed characteristically fails to develop in many sessile spikelets, giving the heads an appearance of partial sterility. This feature and the narrow, rather small panicle and narrow but long brownish-red glumes are the chief distinguishing features of Denton sorgo.

History.—Selected from a field of Honduras (Honey) sorgo at Sterling, Kans., in 1888 by A. A. Denton, of the United States Department of Agriculture. The selection, which did not resemble Honey, was first designated as No. 101, but was later named Denton in honor of the originator by Wiley.[73] Denton sorgo was distributed by the Department of Agriculture in 1890.

Distribution.—Not grown except to a limited extent.

[73] Letter from Mary Best, Medicine Lodge, Kans., July 1, 1907.

66. SUGAR DRIP SORGO

Description.—Plants midseason, mid-tall to tall; stems mid-stout, juicy, sweet; tillers freely; branches mid-freely; mid-leafy; midribs cloudy; leaf sheaths overlapping moderately; panicles erect, mid-size, dense or mid-compact, cylindroid or approaching cylindroid; rachis 75 to 90 percent of head length; rachis branches mid-long, appressed, heavily fruited; glumes small, usually appressed, thinly pubescent on the margins, black to reddish brown, indurate, veins hardly perceptible except near the apex, broadly ovate, apices acute or approaching truncate in some instances; lemmas not awned; kernels plump, very much exposed and extending nearly half their length beyond the apices of the glumes, mid-size, reddish brown where exposed but lighter in color underneath the glumes, decidedly obovoid with the apex rounded so that the seed on the head appears globose, somewhat flattened on the ventral side, endosperm starchy, corneous layer thick, nucellar layer present; pedicellate spikelets small, inconspicuous, mostly deciduous at maturity; coleoptiles red, or green in some strains.

In general characters Sugar Drip is most like Colman. It differs from Colman chiefly in the more slender definitely cylindric panicle, and the dark-colored, smaller, and less acute glumes, resulting in much greater exposure of the more globose and browner seeds. Sugar Drip is more heavily fruited than Red X, and the glumes rarely if ever have light-colored margins.

Another variety or strain that resembles Sugar Drip in all of its characters, except that the glumes are dark red or reddish brown, is encountered frequently in the Southeastern States. It is apparently not so common, however, as the type here described.

History.—Little is known as to the origin of this variety. It seems to have been a common practice to apply the name Sugar Drip or Honey Drip to almost any good sirup variety, which led to endless confusion, and the name is therefore objectionable from a classification standpoint. The variety here described is fairly distinct from other varieties, and since no suitable name has been applied to it the best course seems to be to fix a definite type for the name Sugar Drip.

Distribution.—A considerable acreage is found in Arkansas, and it is grown sparingly as a sirup variety in other Southeastern States.

Synonyms.—Honey Drip, Golden Drip, Silver Drip, Japanese Honeydrip, Japanese Ribbon Cane, and Texas Seeded Ribbon Cane.

67. EVERGREEN BROOMCORN

Description.—Plants midseason[29] (80 days, average of 10 years), tall (95 inches, average of 10 years); stems mid-stout, dry, not sweet; tillers mid-freely; branches freely; mid-leafy (10–12); midribs white; leaf sheaths overlapping slightly; panicles erect, sometimes effuse and umbelliform but usually appressed forming a brush; rachis very short; rachis branches very long (16–24 inches), usually arising in nearly the same portion of the rachis, usually drooping to one side; glumes partly pubescent but pubescence largely deciduous, tan, coriaceous, elliptic, apices acute to obtuse; lemmas awned; stigmas yellow; kernels slightly exposed in angles and extending usually to apices of glumes, small, brown, ellipsoid; endosperm starchy, nucellar layer present; pedicellate spikelets straw-colored and largely deciduous at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 56.

Panicle almost entirely exserted from the sheath. Peduncle thick and firmly attached at the base.

History.—Evergreen broomcorn is of the type commonly grown in Europe, particularly in Italy and Hungary. It has been introduced into the United States under different names from time to time, but the date of the first introduction is not known. It was the leading variety in Illinois (*149*) and was commonly grown in New York (*64*) in 1873.

The first-known mention of the varietal name Evergreen was in 1867 (*9*). From comparative descriptions, however, it is believed that the Evergreen variety is identical with one known previously under such names as New Jersey and Large English, which was being grown in Massachusetts as early as 1842 (*20*).

The names Tennessee Evergreen and Missouri Evergreen are regional strains coming from those States and were known as early as 1873.

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[29] See footnote 6, p. 21.

Austrian broomcorn was introduced from Hungary by J. P. Gross & Co., Chicago, Ill., in 1899. A few seeds saved from the imported brush were sent to central Illinois for growing. White Italian has been the leading variety of broomcorn in Illinois for more than 10 years. Its origin has not been determined.

Illinois Favorite is reported to have been produced by hybridization of two varieties (Black Spanish and White Italian) by Pfeifer (*113*). It was first distributed in 1922.

Some local strains are later and taller and have longer brushes than the more common strains of Evergreen, but are otherwise identical. One strain has been called "Long Brush Evergreen."

Distribution.—Grown in Illinois, Texas, Tennessee, Missouri, and Oklahoma and to a small extent in many other States.

Synonyms.—Austrian, White Italian, Illinois Favorite, Standard.

68. BLACK SPANISH BROOMCORN

Description.—Black Spanish differs from Evergreen in having chocolate or dark-brown to black glumes and shorter brush and in being shorter and earlier. A panicle is shown in plate 57.

History.—Black Spanish broomcorn has been grown in this country under that name for 30 years or more, and under the name "Japanese" at least since 1887. It may be the same variety as the Shirley or Black Brush, grown in Massachusetts in 1842 (*20*).

Standard broomcorn varieties with black glumes, probably identical with Black Spanish, were received by the United States Department of Agriculture more than 30 years ago from countries in western Europe and South America.

Distribution.—Grown in Oklahoma, Colorado, Kansas, New Mexico, Illinois, and Texas.

Synonyms.—Black Jap, Japanese, Extra Early Japanese.

69. CALIFORNIA GOLDEN BROOMCORN

Description.—Identical with Evergreen broomcorn except in being earlier, shorter, and with shorter brush. Similar to Black Spanish except in having tan instead of dark-brown glumes.

History.—Reported from Ford County, Kans., in 1882, and in 1880 a "Golden" variety was mentioned in a report of the Kansas State Board of Agriculture (*88, p. 23*). The characteristics of the variety correspond closely with those of the variety called "Mohawk", "York", or "Shaker" (*10, 149*), which was grown in the Mohawk Valley of New York early in the nineteenth century and later in Illinois.

Distribution.—Grown sparingly in several States.

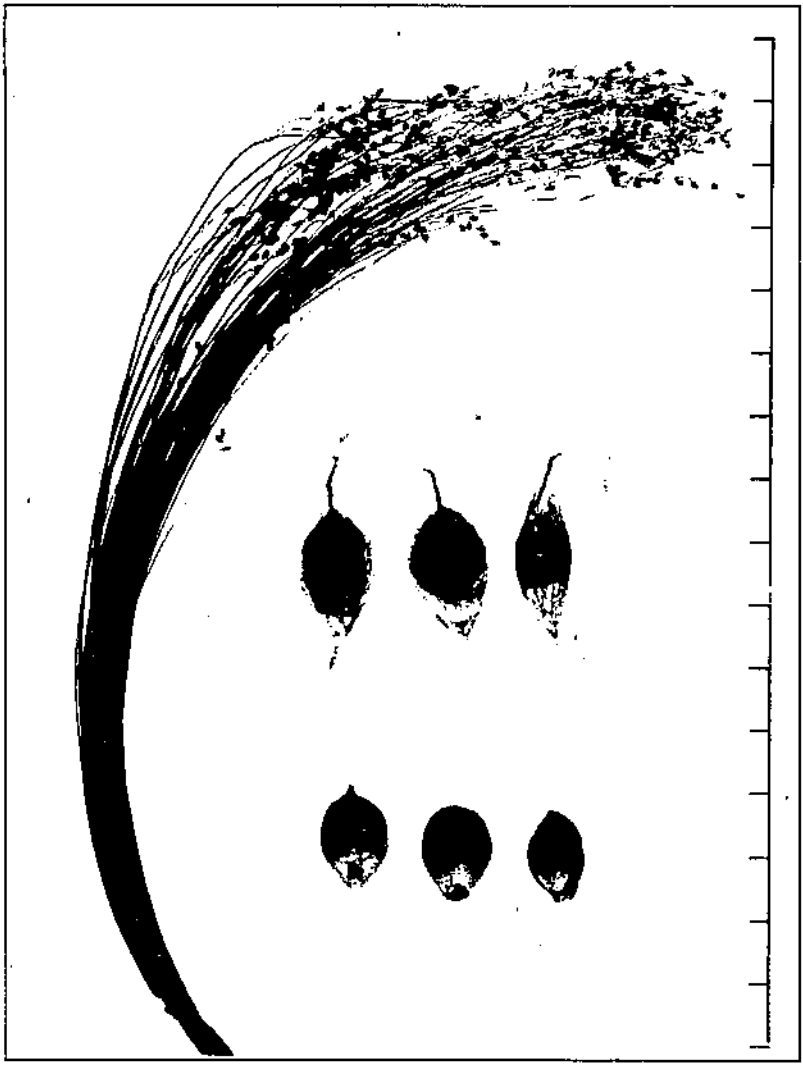
Synonym.—Was distributed as Aksarben Special in Nebraska about 1923.

70. EVERGREEN DWARF BROOMCORN

Description.—Plants midseason (90 days, average of 10 years), mid-tall (55 inches, average of 10 years); stems mid-stout, not juicy, not sweet; tillers freely; branches freely; mid-leafy (10–12); midribs white; leaf sheaths overlapping; panicles erect, sometimes effuse and umbelliform but usually appressed, forming a brush; rachis very short, rachis branches very long (16–24 inches) and usually arising in nearly the same portion of the rachis, often drooping and hanging to one side; glumes partly pubescent but pubescence largely deciduous at maturity, reddish tan, coriaceous, elliptic, apices acute; lemmas awned; stigmas yellow; kernels almost entirely covered by glumes, small, brown, ellipsoid, to obovoid, endosperm starchy, nucellar layer present; pedicellate spikelets tan or straw-colored and deciduous at maturity; coleoptiles red. A panicle, spikelets, and kernels are shown in plate 58.

This variety differs from Evergreen in being shorter, in tillering more freely, and in having a shorter and more slender peduncle and more red in the color of glumes. The more slender peduncle permits readily its detachment from the stalk by pulling; the shorter peduncle causes the brush to be enclosed in the upper leaf sheath for half to two-thirds of its length.

History.—Origin undetermined. It may have arisen as a mutation in Evergreen, as it has not been found in Europe. Dwarf broomcorn from Europe



BLACK SPANISH BROOMCORN.

Panicle, scale indicates size in inches; spikelets and kernels in three positions. × ½.

EVERGREEN DWARF BROOMCORN.

Panicle, scale indicates size to inches; spikelets and kernels in three positions, × 3.

has differed considerably from any American variety. A variety somewhat similar to Evergreen Dwarf was obtained recently from Russian Turkistan in Asia, where it has been grown for many years. Evergreen Dwarf was listed in the seed catalog of R. K. Bliss & Sons, New York, in 1873. It apparently was grown in Kansas as early as 1879 (*89*), and has been a common variety in the Southwestern States since that time, but particularly from 1900 to 1925.

Distribution.—Oklahoma, Kansas, Texas, New Mexico, and Colorado.

Synonyms.—Acme, Dwarf Evergreen, Oklahoma Dwarf, Long Brush Dwarf, Western Dwarf. Acme is a selected strain of Evergreen Dwarf distributed by the United States Department of Agriculture.

71. SCARBOROUGH BROOMCORN

Description.—Scarborough differs from Evergreen Dwarf in being later and slightly taller. The seed is less reddened, and the rachis branches (brush) are somewhat longer. The distinguishing feature of Scarborough is the production of most of its seed near the tips of the panicle branches (fig. 23).

History.—Reported to have been developed on the farm of William Scarborough in Texas County, Okla., from seed of an unknown variety received from Mangum, Okla.[30] It is the progeny of a single superior-looking panicle selected by Tilden Scarborough in 1910.[31] During the next 2 years all off-type plants were removed from the field. Seed was distributed in 1914, but the variety did not become well known until about 1922. By that time it had become badly mixed with Evergreen Dwarf and hybridized with it. Later it was isolated and purified by workers at the United States Field Station at Woodward, Okla., and by others.

Distribution.—Oklahoma, Kansas, New Mexico, Colorado, Texas, and Illinois.

Synonyms.—Scarbough, Scurbro, Scarboro, Scarbaugh.

72. JAPANESE DWARF BROOMCORN

Description.—Japanese Dwarf differs from Evergreen Dwarf in being shorter and earlier and in having shorter (12–18 inches) and finer brush. About three-fourths of the length of the brush is enclosed in the upper leaf sheath. The brush usually is considerably reddened. The peduncle is short and slender and produces several constrictions near the base, where it breaks from the stalk in pulling. A panicle, spikelets, and kernels are shown in plate 59.

History.—Japanese Dwarf broomcorn probably originated as a mutation from some tall (standard) variety of broomcorn. It appears to have been first grown at least as early as 1855 (*7*) in Ohio, and in York County, Pa., in 1860 (*4*). It has been cultivated rather extensively at times but now is rarely grown.

Distribution.—Grown sparingly in Oklahoma and probably other States.

Synonyms.—Jap Dwarf, Sterling Dwarf, Whisk Dwarf.

73. BLACK SPANISH DWARF BROOMCORN

Description.—This variety is similar to the Black Spanish, an early standard variety, in time of maturity, color of glumes, and type of brush, but has the height of stalk, weak stem attachment, and the brush much enclosed in the sheath like the dwarf parent, Scarborough.

History.—Originated by H. Z. O'Hair & Sons, Bushton, Ill., who state: "This is a new variety of Dwarf that we have produced by crossing the Black Spanish onto the Scarborough Dwarf. We have been working on this for 7 years past, and have succeeded to a point that we feel justified in offering a limited amount to the planters for their trial."

Distribution.—Grown sparingly in Illinois, Colorado, and other States.

ACREAGE OF IMPORTANT VARIETIES BY STATES

To provide more definite information as to the acreage and distribution of the principal varieties of sorghum grown in the United

[30] UNITED STATES DEPARTMENT OF AGRICULTURE. SCARBOROUGH DWARF BROOMCORN. U. S. Dept. Agr. Press Release, Mar. 7, 1927. [Mimeographed.]

[31] Personal correspondence dated Mar. 17, 1929.

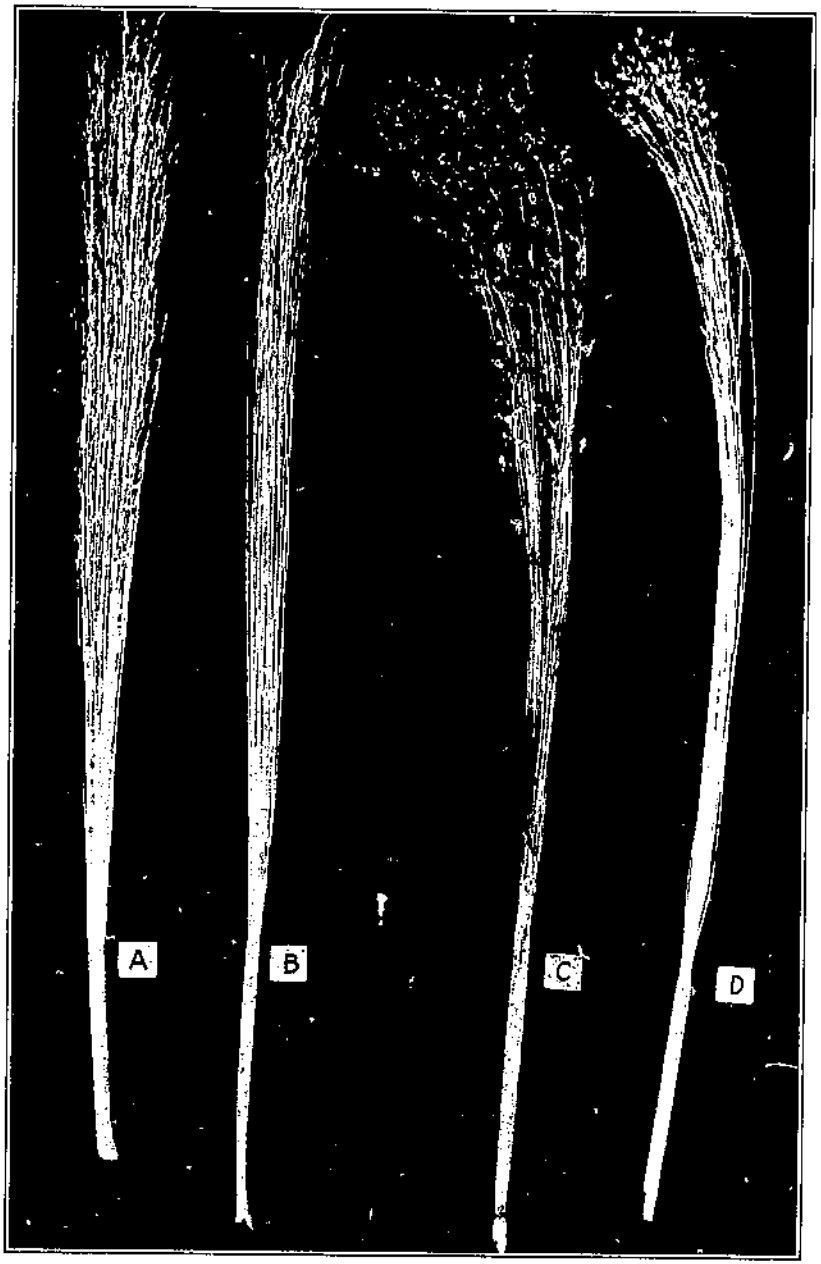
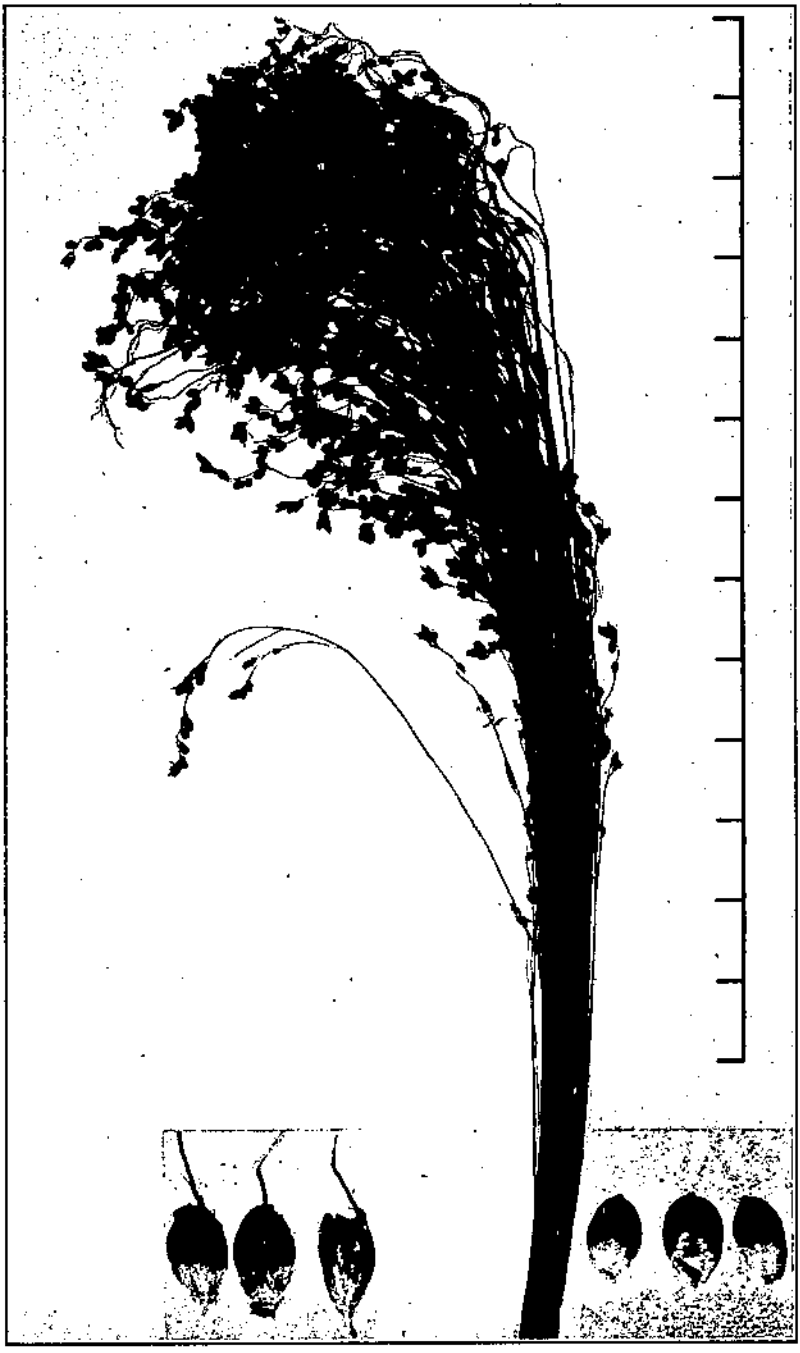


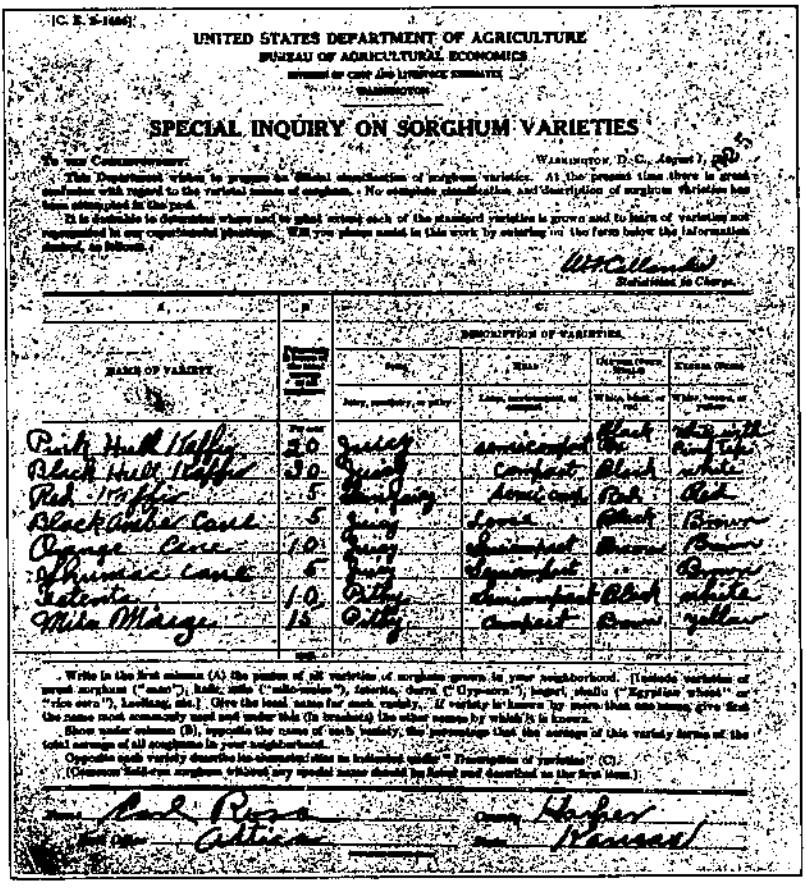
FIGURE 23.—Threshed and unthreshed panicles of Acme and Scarborough broomcorn, showing that the seed branches occur nearer the tip of the panicles in Scarborough than in Acme: *A* and *C*, Acme; *B* and *D*, Scarborough.



JAPANESE DWARF BROOMCORN.

Panicle, scale indicates size in inches; spikelets and kernels in three positions, X 3.

States, a survey was conducted in 1925 in cooperation with the Division of Crop and Livestock Estimates of the Bureau of Agricultural Economics. This survey was limited to those sections of the United States known to produce an appreciable acreage of sorghum. The voluntary crop reporters were asked to name and describe briefly all the varieties grown in their respective localities and indicate the percentage of the total sorghum acreage contributed by each variety.



UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL ECONOMICS

SPECIAL INQUIRY ON SORGHUM VARIETIES

Washington, D. C., August 1, 1925.

To our Correspondents:

This Department wishes to prepare an official classification of sorghum varieties. At the present time there is great confusion with regard to the varietal names of sorghum. No complete classification and description of sorghum varieties has been attempted in the past.

It is desirable to determine where and to what extent each of the standard varieties is grown and to learn of varieties not represented in any experimental plantings. Will you please assist in this work by entering on the form below the information desired, as follows:

W. A. Ellenbeck
Statistician in Charge.

NAME OF VARIETY	Percentage of total sorghum acreage	DESCRIPTION OF VARIETIES			
		Sorgo, saccharine, or grain	Head: Loose, intermediate, or compact	Glumes (Chaff): White, black, or red	Kernels: White, brown, or yellow
Pink Head Kaffir	20	Grain	semi-compact	Black	Pink
Black Hull Kaffir	30	Grain	Compact	Black	white
Red Kaffir	5	Grain	semi-comp.	Red	Red
Black Amber Cane	5	Juicy	Loose	Black	Brown
Orange Cane	10	Juicy	Semi-compact	Brown	Brown
Sumac Cane	5	Juicy	Semi-compact		Brown
Feterita	10	Grain	Semi-compact	Black	white
Milo Maize	15	Grain	Compact	Brown	yellow

Write in the first column (A) the names of all varieties of sorghum grown in your neighborhood. [Include varieties of sweet sorghum ("cane"), kafir, milo ("milo-maize"), feterita, durra ("Egyptian"), broom corn ("Egyptian wheat" or "rice corn"), kowliang, etc.] Give the local name for each variety. If variety is known by more than one name, give first the name most commonly used and under this (in brackets) the other names by which it is known.

Show under column (B), opposite the name of each variety, the percentage that the acreage of this variety forms of the total acreage of all sorghums in your neighborhood.

Opposite each variety describe its characteristics as indicated under "Description of varieties" (C).

(Common field-run sorghum, without any special name, should be listed and described on the first item.)

Name Carl Ross
Post Office Attica
County Harper
State Kansas

FIGURE 24.—A returned questionnaire of the sorghum varietal survey.

A specimen schedule as returned to the Department is shown in figure 24.

The questionnaire was modeled after that used in the survey of wheat varieties (*45*). It was not explicit enough, and some confusion as to the exact information desired was evident in the replies. The chief difficulty arose from the failure of the reporters to understand that the term sorghum included both the sorgos and the grain sorghums. Some listed only the sorgos, even though the different groups of grain sorghums were all named in an explanatory note. Through an error in mailing the questionnaires, a few crop-reporting districts

were omitted in the 1925 survey, and these were included in a second distribution of questionnaires in January 1927. The results were combined and applied to the census returns for 1924. Since, however, the acreage and distribution of varieties are now fairly stable, it is believed that the data from crop reporters for the 1926 crop as well as that for the 1924 crop may justifiably be applied to the returns obtained in the 1925 census. In any case the number of districts reporting from the second questionnaire was so small that the effect of any slight error in applying these to the 1925 census results would be entirely negligible.

The 3,500 returned questionnaires were carefully reviewed and many of the reports were discarded because of obvious deficiencies. There were many others in which local varietal names had been applied. (The extent of this substitution of local names in certain varieties is indicated in the lists that follow.) These local names were interpreted with the aid of the descriptive notes included in the schedule. There remained, however, a considerable number in which the varietal name and accompanying description were not sufficient to identify the variety. Requests for head specimens representing these unidentifiable varieties were mailed to the authors of such reports. Marked success was achieved in obtaining head specimens, and most of the doubtful varieties were easily identified as some one of the common varieties. In order to verify the identifications of the 326 doubtful varieties a short row of each was grown at Chillicothe, Tex., in 1926, and the earlier varieties were grown also at Hays, Kans., and Monetta, S. C. After studying these sorghums in the field there remained only 37 lots that could not be definitely assigned to some known variety, and over half of these were obviously hybrids. The remainder were grown for several succeeding years to determine the stability of their characters and their value in comparison with standard varieties. None proved likely to become important commercially. By these additional tests several more were associated with known varieties. The few remaining had, no doubt, originated as natural crosses or mutations and become stabilized through years of selection in the community where they first appeared.

Some sorgo varieties and the vernacular names under which they were received in the varietal survey

Colman:
- Alabama cane
- Amber
- Amber Gray
- Blue Ribbon
- Coleman's Golden
- Early Orange
- Georgia White cane
- Golden Orange
- Golden Rope
- Gray Top cane
- Honey Dew
- Honey Drip
- Improved Orange
- Japanese cane
- Kansas Orange
- Long Bunch cane

Colman—Continued.
- Long Red cane
- Orange
- Orange Top
- Osage Orange
- Red Orange
- Red Ribbon cane
- Short Bunch
- Silver cane
- Silver Drip
- Silver Top
- Sourless
- Sugar Drip
- Sweet cane
- Texas Honey Dew
- Yellow Orange

Honey:
- Blue Ribbon cane
- Broomcorn cane
- Foxtail
- Georgia cane
- Georgia Wonder
- Hastings Seedling
- Honey Drip
- Japanese cane
- Japanese Honey cane
- Japanese Honey Drip
- Japanese Honeysuckle
- Japanese Seeded Ribbon cane

Some sorgo varieties and the vernacular names under which they were received in the varietal survey—Continued

Honey—Continued.
- Large Red cane
- Red seed cane
- Redtop sugar cane
- Ribbon cane
- Seeded Ribbon
- Silver Drip
- Sugar Drip
- Texas Honey Drip
- Texas Ribbon
- Texas Seeded Ribbon cane
- Texas Sugar cane
- Zachary cane

Orange:
- African millet
- Buttermilk cane
- California cane
- Clear Stalk cane
- Cuban Grayhead
- Georgia White
- Honey
- Honeycomb
- Honey Drip
- Klondike cane
- Missouri cane
- Redtop
- Ribbon cane
- Silver Drip cane
- Silver Top cane
- Sugar cane

Orange—Continued.
- Sugar Drip
- Texas Honey cane
- Texas Ribbon cane
- White Amber

Planter:
- Arkansas cane
- Beck Dale cane
- Blue Ribbon
- Clear Stalk cane
- Corbin cane
- Grey Orange
- Honey Dew
- Honey Drip
- Japanese cane
- Ribbon cane
- River cane
- Seeded Ribbon
- Sea Island cane
- Silver Drip
- Sugar Drip
- Tom Hill cane
- Yellow Amber
- White Stem cane

Sapling:
- Blue Ribbon
- Buckbee's Golden
- Early Orange
- Georgia White
- Golden Drip
- Graytop
- Grey Orange

Sapling—Continued.
- Grey's Best
- Hasting's Syrup cane
- Honey Drip
- Improved Orange
- Japanese cane
- Nix cane
- None Sucker cane
- Orange
- Red Ribbon cane
- Ribbon cane
- Redtop
- Seeded Ribbon
- Silver Drip
- Silver Tip
- Sugar cane
- Sugar Drip
- Sure Head Honey Drip
- Texas Honey Dew
- Texas Ribbon cane
- White Ribbon
- Yellow Amber

Sourless:
- African millet
- Big Gray cane
- Gray Top cane
- Large Brownhead cane
- Sugar Drip

A few of many vernacular names applied to more than one sorghum variety, and the varieties to which they were applied, in reports received in the varietal survey

African millet:
- Orange
- Sourless

Blue Ribbon:
- Colman
- Honey
- Planter
- Sapling

Graytop cane:
- Colman
- Sapling
- Sourless

Honey Dew:
- Colman
- Planter
- Sapling

Honey Drip:
- Colman
- Honey
- Orange
- Planter
- Sapling

Japanese cane:
- Colman
- Honey
- Planter
- Sapling

Redhead cane:
- Sumac
- Gooseneck

Redtop:
- Honey
- Orange
- Sapling
- Sumac

Ribbon cane:
- Gooseneck
- Honey
- Orange
- Planter
- Sapling

Seeded Ribbon cane:
- Gooseneck
- Honey
- Planter

Seeded Ribbon cane—Con.
- Sapling

Silver Drip:
- Colman
- Honey
- Orange
- Planter
- Sapling

Silver Top:
- Colman
- Orange
- White African

Sugar cane:
- Honey
- Orange
- Sapling

Texas Ribbon cane:
- Honey
- Orange
- Sapling

Yellow Amber:
- Planter
- Sapling

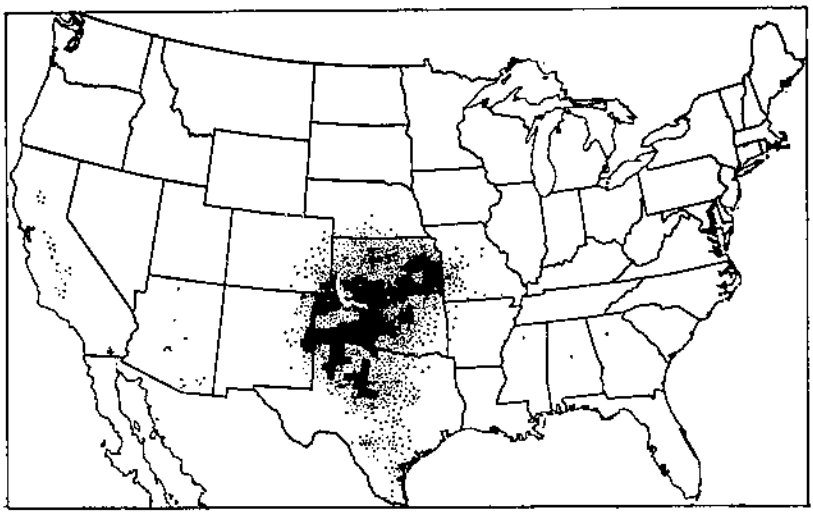


FIGURE 25.—Outline map of the United States showing distribution of grain sorghums in 1924. Each dot represents 1,000 acres. Estimated area, 4,500,000 acres.

The distribution of varieties as determined by this survey is shown in tables 1 and 2 and on the small dot-maps in connection with the descriptions of varieties. The larger dot-maps show total acreage of grain sorghums (fig. 25) and sorgos (fig. 26).

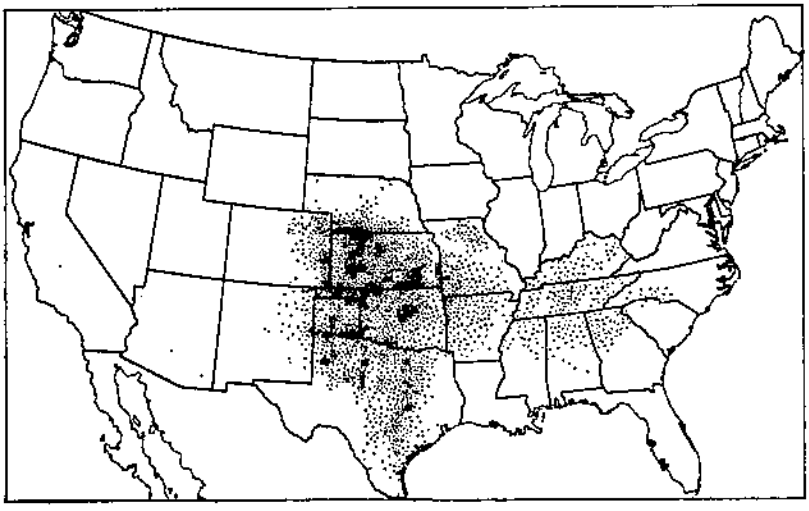


FIGURE 26.—Outline map of the United States showing distribution of sorgos in 1924. Each dot represents 1,000 acres. Estimated area, 3,121,000 acres.

In order to test the reliability of the survey, the data for Kansas were compared with those collected by the Kansas State Board of Agriculture in 1924 (*90, pp. 569–631*). The acreages in these reports are taken from the tax assessors' reports and have been considered reasonably accurate. No separation of the acreage among the several

varieties is made in the Kansas board's reports, hence the comparison was limited to the larger groups, sorgo and kafir.

The total sorghum acreage of Kansas according to the 1925 census was 2,016,791 acres, and according to the State board it was 2,023,987 acres, and the correlation coefficient for the acreages in the 101 individual counties is 0.965 ± 0.005. This high degree of correlation indicates a very close agreement between the census and board acreages for the counties and makes a comparison of the groups reliable. The correlation coefficient for kafir was 0.876 ± 0.016 and for sorgo 0.740 ± 0.032 when the survey acreages were compared with those of the State board by counties. There is, therefore, at least for the broad groups, statistical evidence that the distribution shown by the survey is reliable to a high degree. It would, of course, be less reliable for individual varieties.

TABLE 1.—*Estimate of actual and percentage acreages of grain sorghum varieties in the principal sorghum-producing States in 1924*

[Percentages shown for each variety are based on the total sorghum acreage of the State]

Class and variety	Alabama	Arizona	Arkansas	California	Colorado	Georgia	Kansas	Kentucky	Mississippi	Missouri	Nebraska	New Mexico	North Carolina	Oklahoma	South Carolina	Tennessee	Texas	Total acreage	Percentage of all grain sorghums	Percentage of all sorghums
Kafirs:																				
Blackhull:																				
Acreage	429	471	2,154	381	26,918	237	776,506	20	28	37,077	10,615	72,958	------	522,426	------	261	350,903	1,801,384	------	------
Percent	0.9	3.2	1.7	1.1	10.1	0.5	38.5	------	0.1	17.7	6.2	25.2	------	32.2	------	0.3	13.6	----------	40.0	23.6
Red:																				
Acreage	51	------	146	------	1,261	33	58,213	------	------	6,212	219	438	------	10,101	------	10	16,043	92,727	------	------
Percent	0.1	------	0.1	------	0.5	0.1	2.9	------	------	3.0	0.1	0.2	------	0.6	------	------	0.6	----------	2.1	1.2
Pink:																				
Acreage	------	------	------	------	4,003	------	75,380	------	------	------	412	112	------	1,407	------	------	----------	81,314	------	------
Percent	------	------	------	------	1.5	------	3.7	------	------	------	0.2	------	------	0.1	------	------	----------	----------	1.8	1.1
White:																				
Acreage	------	------	433	------	7,145	------	18,309	272	------	3,525	4,741	------	------	4,658	------	------	2,600	41,683	------	------
Percent	------	------	0.3	------	2.7	------	0.9	0.4	------	1.7	2.8	------	------	0.3	------	------	0.1	----------	.9	.5
Sunrise:																				
Acreage	------	------	------	------	------	------	4,043	------	------	92	------	57	------	3,383	------	------	----------	7,575	------	------
Percent	------	------	------	------	------	------	0.2	------	------	------	------	------	------	0.2	------	------	----------	----------	.2	.1
Milos:																				
Dwarf Yellow:																				
Acreage	208	3,934	550	26,024	37,320	68	155,153	25	------	2,326	568	116,912	13	385,944	------	17	895,930	1,624,992	------	------
Percent	0.4	26.9	0.4	72.6	14.0	0.1	7.7	------	------	1.1	0.3	40.4	0.1	23.8	------	------	34.8	----------	36.1	21.3
Standard Yellow:																				
Acreage	------	324	------	------	------	------	----------	------	------	------	------	----------	------	3,899	------	------	18,152	22,375	------	------
Percent	------	2.2	------	------	------	------	----------	------	------	------	------	----------	------	0.2	------	------	0.7	----------	.5	.3
Double Dwarf Yellow:																				
Acreage	------	97	------	1,163	------	------	----------	------	------	------	------	----------	------	----------	------	------	5,287	6,547	------	------
Percent	------	0.7	------	3.2	------	------	----------	------	------	------	------	----------	------	----------	------	------	0.2	----------	.1	.1
White:																				
Acreage	------	42	------	------	2,627	------	12,747	28	------	658	71	9,640	23	23,525	------	30	72,734	122,125	------	------
Percent	------	0.3	------	------	1.0	------	0.6	------	------	0.3	------	3.3	0.2	1.5	------	------	2.8	----------	2.7	1.6
Feteritas:																				
Standard and Spur:																				
Acreage	2	362	500	487	5,408	86	98,050	------	77	3,844	2,011	5,397	------	91,262	------	40	117,564	325,090	------	------
Percent	------	2.5	0.4	1.4	2.0	0.2	4.9	------	0.2	1.8	1.2	1.9	------	5.6	------	------	4.6	----------	7.2	4.3
Dwarf:																				
Acreage	------	------	------	------	------	------	----------	------	------	------	------	----------	------	----------	------	------	10,692	10,692	------	------
Percent	------	------	------	------	------	------	----------	------	------	------	------	----------	------	----------	------	------	0.4	----------	.2	.1

Durras:																				
White:																				
Acreage		20		5,888	19		2,784					945		50			1,249	10,964		
Percent		0.2		16.4			0.1					0.3							.2	.1
Brown:																				
Acreage				587										244			512	1,343		
Percent				1.6																
Miscellaneous:																				
Hegari:																				
Acreage		6,675	123	581	3,298		22,992			65		15,933		26,410			134,715	210,792		
Percent		45.6	0.1	1.6	1.2		1.1					5.5		1.6			5.2		4.7	2.8
Fargo:																				
Acreage														2,924			7,150	10,074		
Percent														0.2			0.3		.2	.1
Bishop:																				
Acreage														3,678				3,678		
Percent														0.2					.1	
Darso:																				
Acreage		4	499				2,107					113		46,010			30,345	79,078		
Percent			0.4				0.1							2.8			1.2		1.8	1.0
Freed:																				
Acreage					7,981		10,516				111						181	18,789		
Percent					3.0		0.5				0.1								.4	.2
Schrock:																				
Acreage			318				6,206		1,049	21				1,819			423	9,926		
Percent			0.3				0.3		3.1					0.1					.2	.1
Shallu:																				
Acreage	90	248	274		612	498	196	9	230	641	21	383		1,067		22	1,730	6,021		
Percent	0.2	1.7	0.2		0.2	1.0			0.7	0.3		0.1		0.1			0.1		.1	.1
Other varieties:																				
Acreage		12		46			3,129			52				8,908		90	629	12,866		
Percent		0.1		0.1			0.2							0.5		0.1			.3	.2
Total acreage	780	12,198	4,997	35,157	96,592	922	1,246,421	354	1,384	54,513	18,769	222,888	36	1,137,715		470	1,666,839	4,500,035		

TABLE 2.—*Estimates of actual and percentage acreages of sorgo varieties in the principal sorghum-producing States in 1924*

[Percentages shown for each variety are based on total sorghum acreage of the State]

Variety	Alabama	Arizona	Arkansas	California	Colorado	Georgia	Kansas	Kentucky	Mississippi	Missouri	Nebraska	New Mexico	North Carolina	Oklahoma	South Carolina	Tennessee	Texas	Total acreage	Percentage of all sorgos	Percentage of all sorghums
Sumac:[1]																				
Acreage	7,948	306	2,192	58	20,373	2,967	164,058	16,488	3,686	1,937	621	24,414	333	186,024	229	25,931	603,331	1,060,896	------	------
Percent	16.7	2.1	1.8	0.2	7.7	6.2	8.1	26.8	10.9	0.9	0.4	8.4	2.2	11.5	6.9	28.5	23.5	------	34.0	13.9
Black Amber:																				
Acreage	7,802	763	10,175	269	92,579	10,114	201,019	4,757	5,718	45,178	98,602	14,707	1,668	65,281	674	4,533	80,668	644,447	------	------
Percent	16.4	4.8	8.2	0.8	34.8	21.2	10.0	7.7	17.0	21.5	57.3	5.1	11.2	4.0	20.3	5.0	3.1	------	20.6	8.5
Orange:																				
Acreage	11,223	------	30,367	------	19,654	14,423	88,470	13,697	6,959	46,629	23,493	66	3,154	62,406	1,213	20,953	49,829	392,536	------	------
Percent	23.5	------	24.5	------	7.4	30.2	4.4	22.3	20.6	22.2	13.6	------	21.1	3.9	36.4	23.0	1.9	------	12.6	5.2
Honey:																				
Acreage	9,649	628	29,194	161	10	8,351	2,565	2,025	6,395	12,052	------	13,368	1,746	29,590	378	15,586	41,076	172,774	------	------
Percent	20.2	4.3	23.5	0.4	------	17.5	0.1	3.3	19.0	5.7	------	4.6	11.7	1.8	11.4	17.1	1.6	------	5.5	2.3
Red Amber:																				
Acreage	546	247	2,901	------	15,458	662	67,007	576	662	10,565	20,385	6,645	427	15,849	9	2,111	16,235	160,285	------	------
Percent	1.1	1.7	2.3	------	5.8	1.4	3.3	0.9	2.0	5.0	11.8	2.3	7.9	1.0	0.3	2.3	0.6	------	5.1	2.1
Sourless:																				
Acreage	766	------	935	------	2,464	587	63,006	821	282	1,274	313	762	------	45,897	14	726	1,026	118,873	------	------
Percent	1.6	------	0.8	------	0.9	1.2	3.1	1.3	0.8	0.6	0.2	0.3	------	2.8	0.4	0.8	------	------	3.8	1.6
Colman:																				
Acreage	3,146	------	18,486	------	------	3,170	9,685	5,311	3,588	8,868	------	------	4,279	3,443	318	6,236	1,349	67,879	------	------
Percent	6.6	------	14.9	------	------	6.6	0.5	8.6	10.6	4.2	------	------	28.7	0.2	9.6	6.9	0.1	------	2.2	.9
Kansas Orange:																				
Acreage	------	------	------	------	------	------	45,544	------	------	------	------	------	------	------	------	------	------	45,544	------	------
Percent	------	------	------	------	------	------	2.3	------	------	------	------	------	------	------	------	------	------	------	1.5	.6
Sapling:																				
Acreage	1,694	------	8,940	------	------	899	973	3,695	1,164	4,736	------	------	1,446	6,642	109	4,445	464	35,207	------	------
Percent	3.6	------	7.2	------	------	1.9	------	6.0	3.5	2.3	------	------	9.7	0.4	3.3	4.9	------	------	1.1	.5
Planter:																				
Acreage	456	------	1,515	------	------	377	------	3,891	910	7,124	------	------	70	------	32	3,124	278	17,777	------	------
Percent	1.0	------	1.2	------	------	0.8	------	6.3	2.7	3.4	------	------	0.5	------	1.0	3.4	------	------	.6	.2
Gooseneck:																				
Acreage	554	------	791	------	------	252	------	64	759	375	------	------	137	496	50	753	403	4,634	------	------
Percent	1.2	------	0.6	------	------	0.5	------	0.1	2.3	0.2	------	------	0.9	------	1.5	0.8	------	------	.1	.1
Leoti:																				
Acreage	------	------	------	------	------	------	4,136	------	------	------	------	------	------	------	------	------	------	4,136	------	------
Percent	------	------	------	------	------	------	0.2	------	------	------	------	------	------	------	------	------	------	------	.1	.1
Folger:																				
Acreage	262	------	------	------	------	1,331	2,194	113	------	------	------	------	------	------	90	------	------	3,990	------	------
Percent	0.5	------	------	------	------	2.8	0.1	0.2	------	------	------	------	------	------	2.7	------	------	------	.1	.1

White African:																				
Acreage			1,340			143								397				1,880		
Percent			1.1			0.3													.1	
McLean:																				
Acreage			693					19										712		
Percent			0.6																	
Rex:																				
Acreage			500															500		
Percent			0.4																	
Other varieties:																				
Acreage	2,845	547	8,964	184	4,239	3,606	9,257	3,900	2,103	7,081	2,676	623	1,585	6,792	212	4,423	20,118	79,755		
Percent	6.0	3.7	7.2	0.5	1.6	7.5	0.5	6.3	6.2	3.7	1.6	0.2	10.6	0.4	6.4	4.9	0.8		2.6	1.0
Field run:																				
Acreage			2,210		14,918		112,456	5,787	106	9,073	7,285	6,105	36	60,086		1,637	90,421	310,120		
Percent			1.8		5.6		5.6	9.4	0.3	4.3	4.2	2.1	0.2	3.7		1.8	3.5		9.9	4.1
Total sorgo acreage	46,891	2,431	119,203	672	109,695	46,882	770,370	61,144	32,332	155,492	153,375	66,690	14,881	482,903	3,328	90,458	905,198	3,121,945		
Total acreage of all sorghums	47,671	14,629	124,200	35,829	266,287	47,804	2,016,791	61,498	33,716	210,005	172,144	289,578	14,917	1,620,618	3,328	90,928	2,572,037	7,621,980		

[1] Standard and Early.

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INDEX TO VARIETIES AND SYNONYMS

(Recognized varieties are in capitals, and synonyms are in lower case)

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