FARMERS' BULLETIN 1126
UNITED STATES DEPARTMENT OF AGRICULTURE

SUDAN GRASS

SUDAN GRASS is grown for hay. It was obtained in 1909 from the Sudan Government at Khartum as the result of a systematic search for a form of Johnson grass without rootstocks. No other plant importation ever gained such immediate and widespread popularity in the United States.

Sudan grass is strictly an annual without underground rootstocks. It grows to a height of 3 to 5 feet in drilled seedings and 5 to 8 feet in cultivated rows. Drilled seedings are generally preferred for hay and the cultivated rows for seed production.

Sudan grass requires a warm climate for its best development and is of most value as an emergency hay crop, being superior to millet for this purpose in all except the northern third of the United States.

In irrigated sections of the Southwest, Sudan grass yields practically as much hay as alfalfa and is very useful in providing a variety of roughage for dairy cows.

The best time to cut Sudan grass for hay is when it is in full head, but the grass can be harvested somewhat earlier or later than this with no material loss in feeding value.

Sudan grass is a good soiling crop, but is of minor value for silage. The hay is equal in feeding value to that of timothy, millet, or Johnson grass.

It is being utilized more and more as a summer pasture in the Central and Southern States and is valuable as a pasture in the irrigated districts of the Southwest.

There is less danger of prussic-acid poisoning in pasturing or feeding Sudan grass than larger sorghums, but care must be observed in pasturing the grass, especially in the Northern States.

Feeding experiments have shown Sudan grass to be an excellent roughage for work animals and stock cattle and only slightly less valuable than alfalfa for milk cows.

Seed production is profitable only in certain favored localities. Johnson grass seed is dangerous as an adulterant in Sudan grass seed south of the thirty-eighth degree of latitude only. There Johnson grass behaves as a perennial and is difficult to eradicate.

Sudan grass hybridizes freely with the sorghums, and care is necessary to keep it from becoming a mongrel crop as have many of the sweet sorghums.

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief
Washington, D. C. May, 1920

SUDAN GRASS.

H. N. VINALL,
Agronomist, Office of Forage-Crop Investigations.

CONTENTS.

	Page.		Page.
Origin of Sudan grass	3	Culture	11
Description of Sudan grass	3	Utilization	16
Climatic requirements	6	Feeding value	20
Drought relations	7	Seed production	21
Soil requirements	8	Diseases of Sudan grass	24
Place in the cropping system	9	Insect enemies of Sudan grass	26
Value in irrigated regions	9	Improvement of Sudan grass	27
Sudan grass and legume mixtures	10		

ORIGIN OF SUDAN GRASS.

DOUBTLESS Johnson grass would be a much more valuable hay plant for the Southern States if it were not equipped with vigorous underground stems. Recognizing this fact, systematic search for forms of andropogons lacking these aggressive rootstocks was begun under the direction of C. V. Piper, Agrostologist in Charge of the Office of Forage-Crop Investigations. With the assistance of the Office of Foreign Seed and Plant Introduction, 8 ounces of seed of a grass known as Garawi was obtained on March 15, 1909, from Mr. R. Hewison, Director of Agriculture and Lands of the Sudan Government at Khartum.[1] A portion of this seed was planted at the Forage-Crop Field Station, Chillicothe, Tex., that spring. The grass proved very promising there, and it has since been grown at many other points. In order that it might have a distinctive name it was called Sudan grass.

DESCRIPTION OF SUDAN GRASS.

Under cultivation in the United States, Sudan grass has shown itself to be distinctly an annual. Only under practically frost-free conditions, such as obtain along the Gulf coast and in southern California, have plants lived over winter. This grass is very closely related to the cultivated sorghums and hybridizes with them readily. The fact that it has no rootstocks places it nearer the cultivated sorghums than Johnson grass, though for many years Johnson grass

[1] Piper, C. V. Sudan grass, a new drought-resistant hay plant. U. S. Dept. of Agr., Bur. Plant Indus. Cir. 125, 20 p. 1913.

Oakley, R. A. Some new grasses for the South. *In* Yearbook, Department of Agriculture, for 1912, p. 495–504.

has been credited by some botanists with being the primitive form of the sorghums.

Sudan grass when seeded broadcast or in drills grows about 3 to 5 feet high and has stems about three-sixteenths of an inch in diameter

FIG. 1.—Single plant of Sudan grass, illustrating its habits of growth when planted in rows.

(a little smaller than a lead pencil). If grown in rows and cultivated, it reaches a height of 6 to 8 feet, and the stems are about one-fourth of an inch in diameter. (Fig. 1.) The panicle is loose and open, very much like that of Johnson grass, but a little larger and a trifle less open. The hulls, or glumes, are awned and when in flower are often

purplish in color. This color usually fades to a pale yellow when ripe. The awns are broken off in thrashing, so that the commercial seeds

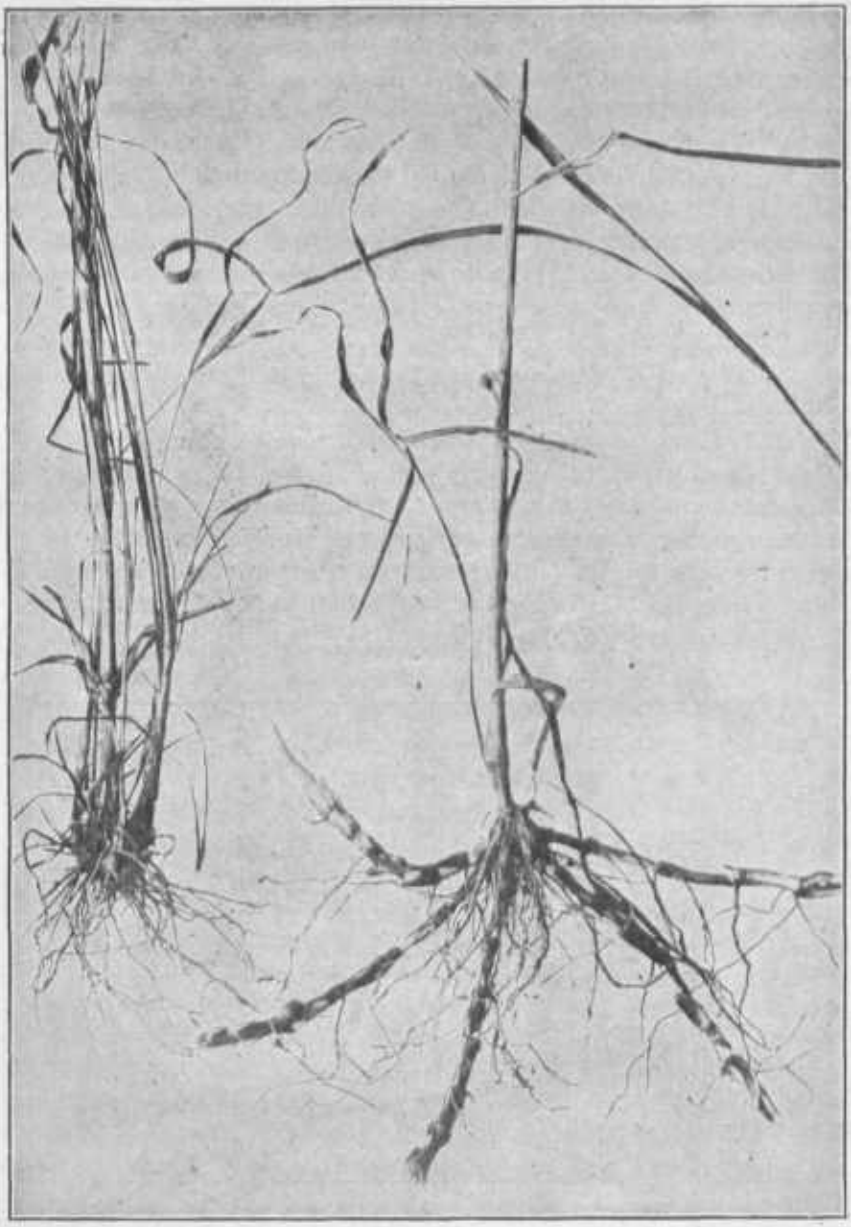

FIG. 2.—Young plants of Sudan grass (left) and Johnson grass (right), showing the vigorous rootstocks of Johnson grass and their entire absence on Sudan grass.

rarely have awns. The leaves are broader and more numerous than those of Johnson grass, giving the grass a much more favorable appearance as a hay plant. The most important difference, however,

is that the aggressive underground stems, or rootstocks, with which Johnson grass is equipped are entirely absent in Sudan grass. This striking difference is shown clearly in the accompanying figure illustrating young seedling plants of the two grasses. (Fig. 2.) Sudan grass, like the cultivated sorghums, never develops anything but fibrous roots, therefore it can not become an obnoxious weed as the perennial Johnson grass does. Furthermore, it has shown no tendency to persist in fields as an annual weed through volunteer seedlings. When it has plenty of room, the grass tillers very freely. It is not uncommon to find over 100 stems arising from one crown. This decided tendency to tiller is most apparent after the first cutting, and usually makes the hay from the second cutting of finer texture than that from the first.

CLIMATIC REQUIREMENTS.

Sudan grass, like sorghums, does best in a warm climate. In favorable seasons, where the growing period is long, as many as four cuttings can be obtained in one year. As in the case of all other crops, in determining the regions of greatest importance, climatic and soil conditions are linked with the acuteness of the need for such a crop. The principal regions of production in the United States are shown on the map (fig. 3) as follows:

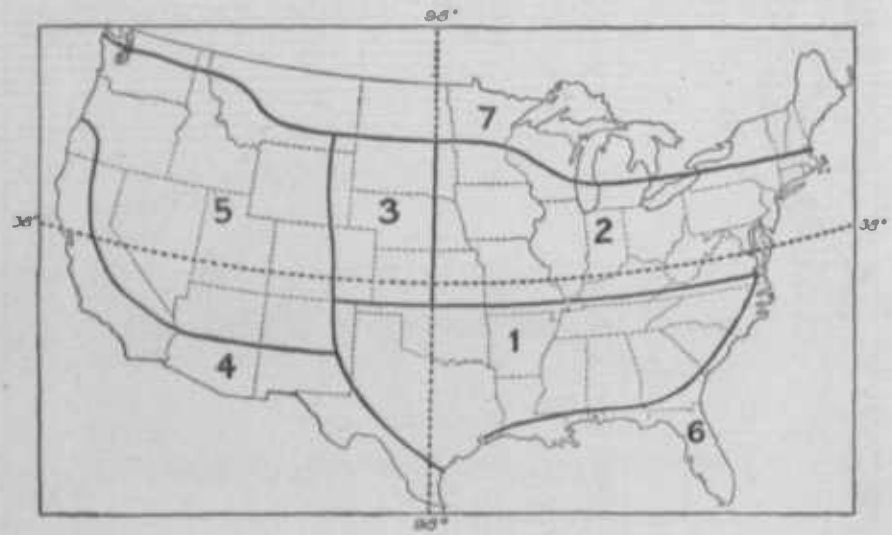

FIG. 3.—Outline map showing the forage value of Sudan grass in different parts of the United States.

Region 1.—Two or three good cuttings of hay are secured without irrigation in this region, the yields varying from 2 to 4 tons to the acre. This is the region of its greatest importance because of the need for a better hay grass in these States. Profitable seed yields are secured west of the 98th meridian only, the sorghum midge usually preventing seed formation in the more humid district east of this meridian.

Region 2.—Sudan grass thrives here almost as well as in region 1, making good yields both of hay and of seed. Timothy, clover, and alfalfa, however, meet the hay requirements of this region so fully that Sudan grass is valued chiefly as a catch crop or for limited culture on soils not suited to these forage crops.

Region 3.—This comprises the region west of region 2, where the rainfall is too low for the successful cultivation of timothy and clover. Sudan grass commonly makes one cutting under such conditions, and in favorable seasons two, yielding 1 to 3 tons of hay to the acre. Its chief competitors in this region are alfalfa, sorghum, and millet. Alfalfa is preferred to Sudan grass only in the more favored locations, such as river and creek valleys or where irrigation is possible. The better varieties of sorghum, such as Red Amber and Orange, will outyield Sudan grass, but the latter is better suited for pasture purposes, produces a better quality of hay, and is easier to handle with haying machinery. Seed production, though possible in most of this region, is profitable only in the southern part.

Region 4.—Sudan grass yields abundantly both in hay and in seed in all irrigated localities in this region; yields of 4 tons of hay to the acre are not uncommon on good soils. It is used chiefly to supplement alfalfa in the rations of horses and dairy cattle, as a pure alfalfa hay ration seems to result in digestive disturbances, especially in dairy cows.

Region 5.—In this part of the United States Sudan grass is successful only in limited areas. Its failure except in these localities is due either to low temperatures caused by high altitudes or to insufficient rainfall.

Region 6.—In this region, including Florida and the Coastal Plain along both the Atlantic and Gulf coasts, Sudan grass is usually a failure, largely on account of the injury to the foliage caused by red-spot or sorghum blight.

Region 7.—This is a region 100 to 200 miles wide along the northern border of the United States. Sudan grass is not profitable here, because of the cool summers and short growing season.

Since its introduction in 1909 Sudan grass has become known in nearly every part of the United States and is now being grown where it was at first thought to be wholly unadapted. Its short growing period permits it to thrive and make good crops of hay as far north as southern Michigan and New York. Throughout the timothy and clover region, though it may never become the leading hay grass, it will be used more and more as a catch crop in place of the millets. In the Rocky Mountain region (fig. 3, region 5) the results are for the most part unfavorable except in the irrigated valleys. At the higher altitudes untimely frosts and continued low temperatures during the summer months preclude a successful growth. The upper limits of profitable hay production seem to be 6,000 to 8,000 feet in New Mexico, Arizona, and southern California; 5,000 to 6,000 feet in Colorado, Utah, Nevada, and northern California; and 4,000 to 5,000 feet north of those States. The altitudinal limits for seed production are at least 1,000 feet lower, respectively, than those named for hay, because under cool conditions it takes a month or more to mature seed after the crop is ready to be cut for hay.

DROUGHT RELATIONS.

That Sudan grass will grow and produce fair crops in regions of low rainfall has been demonstrated by numerous tests in the Great

Plains. Its ability to endure periods of drought is equal, though not superior, to that of the best varieties of sorghum. In the South, where drought is usually combined with extreme heat, Sudan grass yields much better than millet, but in Montana and the Dakotas millet makes a slightly larger yield.

Experiments have shown that Sudan grass requires a greater amount of water to produce a pound of dry matter than does corn, sorghum, or millet. Notwithstanding this indicated high water requirement, Sudan grass has been successfully grown as a dry-land

FIG. 4.—A plat of Sudan grass (at left) grown beside a plat of Kursk millet at Redfield, S. Dak., 1916. Both crops are in approximately the right stage to be cut for hay.

crop since 1912, when the first wide distribution of seed took place. As an emergency hay crop and summer pasture no other crop is better suited to conditions in the southern half of the Great Plains.

On the University Farm at Davis, California, it has been grown with good results as a dry-land crop and is recommended for use in other parts of that State where irrigation water is not available.[1]

SOIL REQUIREMENTS.

Sudan grass is not at all exacting in its soil requirements. It does best on a rich loam, but it has been grown successfully on almost every class of soil from a heavy clay to a light sand. Where the soil is quite sandy, however, the yield may be expected to be light. Cold, wet, muggy soils are particularly unsuited to Sudan grass. Before

[1] Madson, B. A., and Kennedy, P. B. Calif. Agr. Exp. Sta. Bul. 277, p. 200. 1917.

such soils will grow it, thorough drainage must be provided. Small amounts of alkali in the soil reduce the yields markedly and stronger concentrations prevent profitable culture.

PLACE IN THE CROPPING SYSTEM.

Although Sudan grass is an annual and can be introduced easily into any rotation, it probably never will be widely used as a staple crop in permanent rotations. To fill such a position acceptably a crop must serve either as a "money crop" or as a soil improver. Under certain conditions in the Southern States Sudan grass utilized as a hay crop or for seed production may be considered as a cash crop, but in most cases it will be grown as an emergency hay crop or for summer pasture.

The other two crops most widely grown as catch crops or emergency hay crops are millet and sorgo, or "cane." (Fig. 4.) The yields of Sudan grass, as compared with these two, its chief competitors, over a series of years from 1912 to 1916 and at a considerable number of stations are given in Table I.

TABLE I.—*Comparison of Sudan grass with millet and sorgo in yields per acre of cured hay.*

Regions.	Yield per acre (tons).		
	Sudan grass.	Millet.	Sorgo.
Northern Great Plains	2.28	2.14	3.89
Central Great Plains	2.51	2.01	3.49
Southern Great Plains	4.03	1.25	5.34
Timothy and clover belt	2.64	2.65	5.95

It will be seen that in the northern Great Plains and in the timothy and clover belt millet yields practically as much hay as Sudan grass, but in the central Great Plains there is a difference of one-half ton per acre in favor of Sudan grass, and in the southern Great Plains the yield of Sudan grass is over three times that of millet. The yield of sorgo in drilled or broadcasted seedings averages in each region about 1 ton more hay per acre than Sudan grass, but this is because of the larger amount of moisture in the sorgo hay due in a measure to the greater difficulty of curing its coarse stems. The difference in the actual yield of dry matter is partly offset by the better quality of the Sudan grass hay.

VALUE IN IRRIGATED REGIONS.

In many of the irrigated parts of the West, where alfalfa is the principal crop and dairying the chief industry of the people, alfalfa has been made the constant and the almost complete diet of the cows. The continuous use of this high-protein hay has caused digestive

troubles, but this derangement of the digestive functions seems to disappear promptly when the feed is changed. Under irrigation south of Oregon and Wyoming, Sudan grass makes an excellent crop to grow for mixing with alfalfa. Yields of cured hay obtained under irrigation in California and Arizona have been equal and in some cases larger than those from alfalfa. At Chico, Calif., Sudan grass when irrigated gave a yield of 9.8 tons of cured hay per acre, as compared with a yield of 8.3 tons of alfalfa hay; and at Bard, Calif., in the extreme southern end of the State, Sudan grass on favorable soil gave a yield of 8 tons of hay per acre, as compared with 7.9 tons of alfalfa. The yield of 8 tons at this place was obtained from grass planted almost a month later than it should have been. At Phoenix, Ariz., the yield of Sudan grass was 7.8 tons per acre, as compared with a yield of 9.8 tons of alfalfa, and at Owens, Ariz., Sudan grass made a yield of 4.5 tons per acre with only one irrigation during the season.

These unusual yields of hay from an annual crop, which by its nature can be made to fit into any rotation, will no doubt mean much to the dairying industry of the Southwest.

The percentage of moisture is apt to be somewhat greater in Sudan grass than in alfalfa when the weights are taken directly from the field, but less labor is necessary to handle the Sudan grass because the maximum yield from it is secured in three cuttings, while with the alfalfa five or more cuttings are required to produce the yields mentioned.

Sudan is the only grass which yields under irrigation in the Southwest even approximately as much as alfalfa. It can be used, therefore, in providing a change of feed without reducing the tonnage obtained from the land. Sudan grass was found just in time to fill this need, and although it is not as rich in protein as alfalfa, experience indicates that when mixed with alfalfa or fed with some concentrate rich in protein the flow of milk will be nearly or quite normal.

SUDAN GRASS AND LEGUME MIXTURES.

The suitability of Sudan grass for growing in mixtures with cowpeas, soy beans, and other legumes in regions to which Sudan grass and these legumes are well adapted is at once apparent. (1) Sudan grass grows strictly erect, with a stem stiff enough to support the vines characteristic of most legumes, and it thus makes the harvesting easier by keeping the legumes off the ground. It also allows them to cure more quickly by preventing the leaves from matting. (2) It is low in protein, which is abundant in the legumes, and thus a well-balanced mixture is produced. (3) The yields, although they are not often as great as when Sudan grass is seeded alone, are more valuable, as the feeding value of the hay is considerably enhanced.

The yields obtained from such a mixture in 1913 varied from 1 to 3½ tons per acre. The best showing was made at the Maryland Agricultural Experiment Station, where the yields averaged about 3¼ tons of cured hay per acre. In 1912 at Arlington Farm, Virginia, the mixture of Sudan grass and cowpeas gave a yield of 4.6 tons of cured hay per acre, and Johnson grass in mixture with the same variety of cowpeas made a yield of only 2.8 tons per acre. (Fig. 5.)

FIG. 5.—Plats at Arlington Farm, Va., in 1912, showing mixtures of Sudan grass and cowpeas (right) and Johnson grass and cowpeas (left).

Sudan grass in mixture with soy beans the same year yielded 4.4 tons per acre. Such mixtures are profitable only in humid regions or where irrigation is possible.

CULTURE.

PREPARATION OF THE SEED BED.

In seeding Sudan grass a rather firm seed bed is best. Usually, when it is desired to drill the seed, the ground is plowed in the spring and harrowed well, as for corn. A cool soil delays the germination of the seed; therefore spring plowing is preferable for the seed bed, because it assists in warming the soil. No fertilizers are necessary in the West, where the soil is reasonably good, but in the East it is probably advisable to use some complete fertilizer, such as is applied for corn, or some combination of phosphorus and nitrogen, if the price of potash is high. Few experiments have been conducted to determine the best practice to follow, but in Kentucky applications of acid phosphate at the rate of 200 pounds per acre resulted in increases of

yield in 8 out of 10 cases. The average increase attributed to the fertilizer was 68 per cent.

DATE OF SEEDING.

It has been found best to seed Sudan grass after the soil has become warm, or about two weeks after corn-planting time. When sown in cold soil the result usually is a poor stand or a slow growth for several months, so that in the end no advantage has accrued from the early seeding.

Widely scattered experiments have shown that in very few cases are the earliest seedings highest in hay yield. The experience so far gained by the United States Department of Agriculture in its tests indicates that for the extreme South the best time for seeding lies

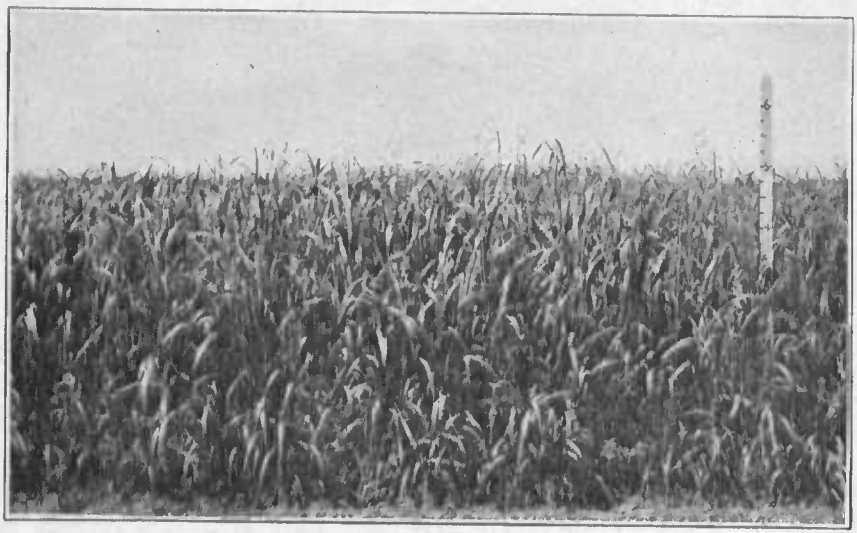

FIG. 6.—A close-up view of a field of Sudan grass seeded with a grain drill on June 1. Photographed August 12, 1915, at Hays, Kans.

between April 1 and May 1; in the latitude of Oklahoma and Kansas, any time between May 1 and June 15 (fig. 6); and in the latitude of Nebraska and South Dakota between May 15 and June 15. From Kansas south good crops of hay can be secured from seedings made July 1 or even later.

METHOD OF SEEDING.

For hay production in regions of abundant rainfall the best machine for seeding is no doubt the common grain drill. Well-cleaned seed feeds freely from this drill, and it can be distributed evenly and a good stand thus secured. If a press drill is used the ground is left level and in good condition for the mower. The depth of seeding has but little effect on the root system of Sudan grass. It seems to be a characteristic of the grass that the root system begins near the surface

of the soil, regardless of the depth at which the seed is placed. The best depth, everything considered, is about 1 inch, but where the soil does not become packed the plant will force itself to the surface even from a depth of 3½ to 4 inches.

In the semiarid regions for hay, and in any locality for seed production, better results are obtained by seeding in rows far enough apart to allow cultivation. This can be accomplished with a grain drill by stopping up a sufficient number of the holes so that the rows will be the desired distance apart. If only the ordinary corn cultivators are available for the work it is best to place the rows 36 to 42

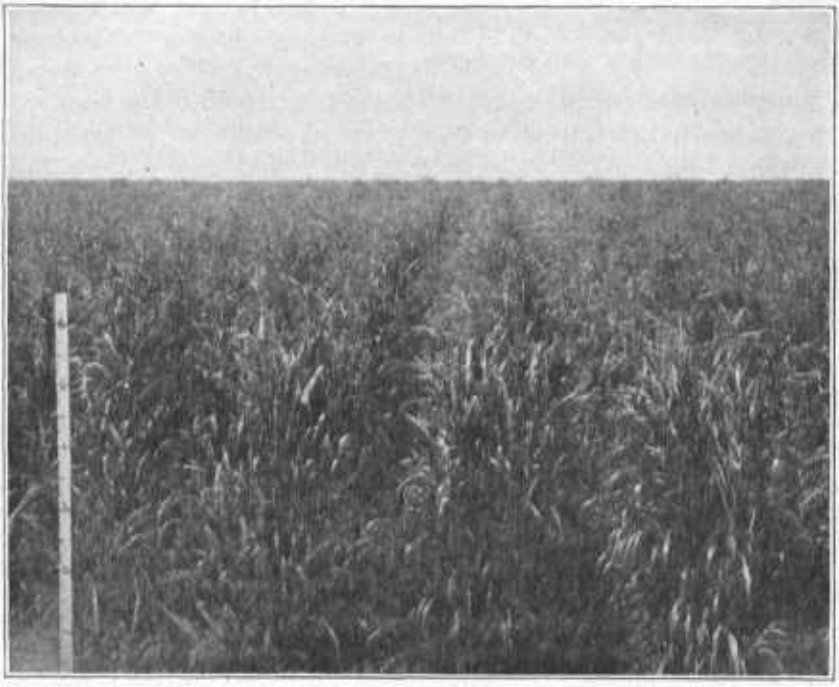

FIG. 7.—Sudan grass planted in rows 42 inches apart for seed production. Photographed at Hays, Kans., September 9, 1915.

inches apart. (Fig. 7.) If a beet cultivator or some similar tool is available, larger yields can be obtained from rows 18 to 24 inches apart. Twenty-four inches is perhaps as close as practicable, unless horses especially trained to walk between the rows are to be had. Otherwise much of the stand will be destroyed by trampling in rows less than 24 inches apart. Against any difference in favor of the cultivated-row planting over the broadcasted field will have to be charged the cost of cultivation. A better quality of hay is produced from the broadcast stand, owing to the finer stems. The grass grown in cultivated rows is likely to be coarse and therefore not so desirable for market hay. For home feeding the coarseness will be of little dis-

advantage, as the stems do not become so woody that they are refused by stock.

RATE OF SEEDING.

Rates of 10 to 40 pounds of seed to the acre have been tested at the different agricultural experiment stations. There was, however, no definite superiority indicated for any one of these rates in drilled seedings. Sudan grass tillers so profusely in thin stands that the final number of stems per square foot of ground is usually very nearly the same, whether the rate is 15 or 40 pounds. Taking all the factors into consideration, 20 to 25 pounds per acre are recommended for drilled or broadcasted seedings in the humid regions and 12 to 15 pounds in the dry sections. Under irrigation, 15 to 20 pounds of seed are sufficient, owing to the more favorable conditions for germination. These quantities should be proportionately increased if the seed is of low germination or the soil in poor physical condition. A grain drill set to sow 2 pecks of wheat to the acre will ordinarily sow about 20 to 25 pounds of Sudan grass seed. If it is desired to sow a less quantity, this can be accomplished by stopping alternate holes in the drill or by mixing the Sudan grass seed with bran or some other mill feed in any proportion necessary.

For seeding in cultivated rows 36 to 44 inches apart, 2 to 4 pounds of seed per acre will be found sufficient, while in rows 18 to 24 inches apart, 4 to 6 pounds per acre will be required, the smaller quantity being used, as in the broadcast seedings, for regions of light rainfall. If the crop is intended for hay, enough seed should be used in any case to insure a thick stand of plants in the row. When a seed crop is desired, the rate of seeding should ordinarily be somewhat less than for a hay crop.

HARVESTING.

The most common way of harvesting the grass for hay is with a mower. It cures readily and can be cut in the morning and if the sun is bright raked up that afternoon or the next day. After bunching, it is placed in cocks, just as with millet, and removed from these cocks to the barn or stacks after it has thoroughly cured. Because of the large amount of juice in the stems of Sudan grass, the leaves cure first and the hay often appears ready to stack when it is not; therefore, the only sure way to avoid injury by heating is to allow Sudan grass to remain in cocks long enough for the stems to become dry. The leaves are retained well, and if cut at the right stage of maturity and handled properly it will make a bright, leafy, sweet hay of the very best quality.

Where the crop is desired for seed, it is harvested like the small grains with an ordinary grain binder and allowed to cure in shocks. This method can also be used in making hay in the semiarid regions where such good drying weather prevails that the grass will cure in

the shock. Where the planting is made in cultivated rows, a corn or row binder can be used, but in most cases a grain binder is preferable. Sometimes, where the growth is rank, trouble is experienced in getting the reel over the tops of the plants and at the same time cutting a short stubble.

The time for cutting is governed to some extent by the fact that several cuttings are expected in most cases, and this often makes it seem more profitable to cut the first time as early as possible, so that the grass will have more time for the second growth. Experiments have shown, however, that early cutting is not justifiable either from the standpoint of total yield or from that of food value. At the Fort Hays experiment station, Hays, Kans., the average seasonal yield of air-dry hay for the years 1915 to 1918, inclusive, was as follows:

	Tons per acre.
1. Cut just before heading	1.83
2. Cut as the first heads appeared	2.24
3. Cut when in full head	2.14
4. Cut when the seed was in milk	2.31

In the first stage two cuttings were obtained each year; in the second stage in three out of four years; and in the third stage in only two of the years. In the fourth stage only one cutting a year was obtained, but the average yield was the largest of the four methods.

The above experiment clearly shows that it is not profitable to cut Sudan grass before it has begun to head. The preferable stage of maturity for cutting is from the time it begins heading until it is fully headed. There is little loss, however, when the grass is allowed to grow until the seed has reached the soft dough stage and only one cutting is then required to harvest the crop and obtain a maximum yield of forage.

There are very few hay grasses which are injured so little by standing beyond the proper stage of maturity as Sudan grass. This is due largely to the numerous tillers which, arising from the base, mature successively later than the primary stem and provide immature stalks throughout the entire growing season. There is, in addition, the fact that like the sorghums it holds its leaves well and makes the best quality of fodder when the seed has reached the dough stage. This characteristic makes it possible, where necessary, to extend the haying process over a long period without any material loss either in the quantity or quality of the hay. Such a feature is of great importance to the farmer, since haying is often interfered with by other work or by rains which prevent cutting at the most favorable time.

The scarcity of roughage, the presence of a drought, or the danger of loss from insects may also enter into the decision as to when Sudan grass should be harvested. If feed is scarce, or the weather turns dry,

or grasshoppers become destructive, a good crop of hay can be harvested in 50 to 55 days from the date of seeding; and even though the grass has not then reached the proper stage of maturity for cutting, it should under such conditions be harvested.

UTILIZATION.

HAY.

The hay from Sudan grass is of excellent quality and the yields are quite satisfactory; therefore, the grass will continue to be most largely

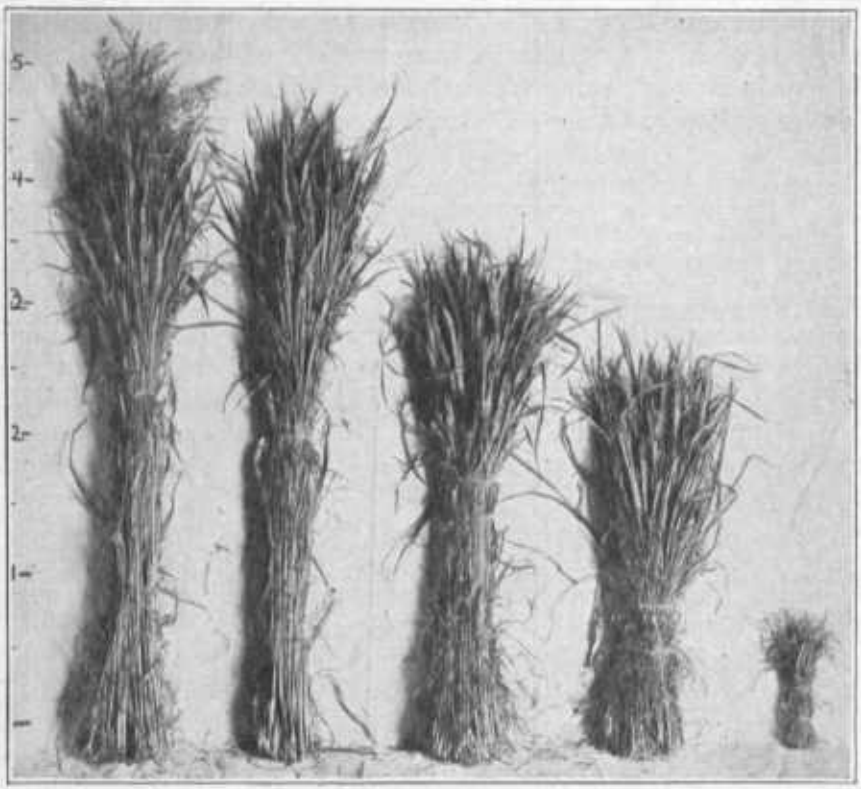

FIG. 8.—Bundles of Sudan grass, illustrating its rapidity of growth. From left to right: No. 1, 71 days; No. 2, 56 days; No. 3, 42 days; No. 4, 28 days; and No. 5, 13 days from date of seeding. Sudan grass should not be cut for hay until it has reached the stage of maturity shown by bundles 1 and 2.

utilized as a hay crop. From the central United States southward it is possible to get two cuttings, and in favorable instances as many as four cuttings have been secured. From seeding to the first cutting 60 to 80 days are necessary. When conditions favor continuous growth the second cutting is ready in about 45 days after the first one, but the third one is likely to take a little longer—50 to 55 days. (Fig. 8.) This means that the growing season must extend over a period of six months to produce three cuttings. By cutting the grass

a little earlier each time, four cuttings can be obtained during the same period. This was done at Chillicothe, Tex., in 1912. A plat was seeded April 26 and the following cuttings obtained:

Date of cutting.	Yield per acre.	Growing period.
	Pounds.	*Days.*
June 22	2,140	57
July 17	1,810	25
August 20	3,050	34
October 14	1,800	55
Total	8,800	171

It is quite probable that an equally large yield of hay of better quality would have been obtained from three cuttings, as this would have given time for each cutting to reach the proper stage of maturity.

It will be noted in Table I that Sudan grass can be expected to make an average yield of 2½ tons in the Northern and Central States and about 4 tons of hay per acre in the Southern States. These yields were obtained without irrigation. When irrigated, the yields compare favorably with those of alfalfa. In a few localities millet has given a slightly larger crop than Sudan grass, but comparisons between the two crops in such cases have been based on one cutting only. When the very much better quality of the Sudan grass hay and the possibility of two or more cuttings in the Southern States are taken into account there is little doubt that this grass will replace millet as the most widely used catch crop.

SOILING AND SILAGE.

Sudan grass is admirably suited for use as a soiling crop, since it makes a large yield and is very palatable in the green state. By this method of feeding, a small area in the South, where the rainfall is adequate or where irrigation is possible, can be made to support a goodly number of animals. Large yields are secured under irrigation, because the growth is so rapid and the recovery from cutting so prompt.

The use of Sudan grass for silage will no doubt be limited, owing to the ease with which it can be made into hay, to the fact that there is but little waste in feeding it as hay, and to the larger silage yields of the sorghums and corn. The Oklahoma experiment station[1] has conducted some experiments with Sudan grass silage. A considerable number of analyses were made which showed that Sudan grass silage was about the same in chemical composition as corn silage. Sheep did not relish the silage as well as they did corn silage, but they liked it equally as well as they did the silage made from grain sorghums.

[1] Francis, C. K., and Friedemann, W. G. Okla. Agr. Exp. Sta. Bul. 115, 8 p. 1917.

Mixtures of Sudan grass with cowpeas or soy beans can be grown for silage in humid regions. Such mixture makes a bright-colored, palatable silage of high feeding value.

PASTURE.

Sudan grass is rapidly gaining popularity as a summer pasture crop. In regions of low rainfall and high temperatures, its carrying capacity during the hot summer months is superior to that of any other grass or legume. On the experimental farm at Dodge City, Kans., in the summer of 1914 a herd of milk cows was pastured alternately on Sudan grass and on native grasses. The Sudan grass furnished abundant pasturage at the rate of one cow per acre for 125 days and the cows made a daily average of 3.8 pounds more milk per cow on the Sudan grass than on the native grasses.

In 1915, at Chillicothe, Tex., mules, horses, and cows allowed the run of a field containing equal areas of Amber sorgo, Golden millet, and Sudan grass all showed a decided preference for the Sudan grass. At the Arizona experiment farm near Prescott, Ariz., Sudan grass without irrigation maintained 20 sheep per acre continuously for 100 days. The sheep pastured on Sudan grass fattened, while those grazing Amber sorgo made only ordinary growth. The California experiment station pastured a nonirrigated field of Sudan grass with sheep at the rate of 22 head per acre. The sheep made gains of one-third of a pound a day while on the pasture, and no injurious effects were noted.

Sudan grass is also one of the best pasture grasses for irrigated lands in the Southwest. On the Yuma experiment farm at Bard, Calif., a small area of about 8 acres was pastured for six months in 1915 with milk cows and work horses (fig. 9). The field was divided in halves and each half pastured alternately in periods of 2 to 3 weeks. The grass was irrigated in each case as soon as the animals were removed. The field maintained an average of three head per acre in good condition throughout the entire period.

Besides these more or less definite tests by experiment stations, numerous farmers have reported excellent results with Sudan grass pasture. Hogs relish the grass and when they have access to Sudan grass pasture, good gains can be produced with one-half the customary grain ration.

Sudan grass, like Johnson grass, is less likely to contain dangerous amounts of prussic acid than the larger sorghums. Only three authentic cases of poisoning by Sudan grass have been called to the attention of the United States Department of Agriculture. The most serious of these occurred on a farm in Kansas where for two years Sudan grass had been pastured without trouble. The third year, after a crop badly injured by drought had been cut for hay, 40 cows were turned into the field to pasture the aftermath. In three hours

17 of the cows became sick and some of them died. Such experiences show plainly that, notwithstanding the comparative safety of Sudan grass as pasture, care must be used in pasturing it with cattle, especially in the Northern States.

Several facts in regard to prussic-acid poisoning should be kept in mind by the grower of Sudan grass.

FIG. 9.—Cows pasturing on irrigated Sudan grass at Bard, Calif.

(1) The formation of prussic acid is most frequent in Sudan grass that has been injured by drought or other unfavorable climatic conditions.

(2) Hogs can be pastured on Sudan grass in safety, and horses and sheep are less susceptible to the poison than cattle.

(3) No case of Sudan grass poisoning has been reported from the Southern States. North of Oklahoma care must be exercised in pasturing Sudan grass with cattle.

(4) The poison acts quickly and no sure remedy for it has been found. Doses of glucose or other sweet sirups relieve the animal in some cases. Soda and dilute vinegar used as a drench while the mixture is foaming has also been recommended.

FEEDING VALUE.

Sudan grass is relished by all classes of live stock either as a hay or when fed green. Chemical analyses of Sudan grass show it to have about the same composition as the common foxtail millet and timothy.

TABLE II.—*Total nutrients and amount of each digestible in 100 pounds of the dry matter of Sudan grass, millet, and timothy.*[1]

Nutrients.	Total.			Digestible.		
	Sudan grass.	Millet.	Timothy.	Sudan grass.	Millet.	Timothy.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Dry matter	100	100	100	63.50	65.00	59.00
Ash	7.94	7.35	5.28			
Ether extract	1.80	3.27	2.98	.95	2.09	1.42
Protein	8.96	9.68	7.34	3.89	5.81	4.33
Crude fiber	29.68	28.00	33.83	20.56	19.04	19.28
Nitrogen-free extract	51.62	51.69	50.69	34.22	34.63	31.93

[1] The averages of 35 analyses of Sudan grass made by the Bureau of Chemistry, United States Department of Agriculture, are given in Table II, together with the averages of 56 analyses of common or Hungarian millet, and 50 analyses of timothy. The analyses of millet and timothy are taken from Henry and Morrison's Feeds and Feeding, 16th edition, as were also the coefficients of digestibility used in calculating the pounds of digestible nutrients in each 100 pounds of dry matter. The amounts of digestible nutrients in Sudan grass were calculated from coefficients given in Table XIII of Iowa Experiment Station Research Bulletin No. 46, p. 73. These coefficients are the averages of those obtained by the Maryland experiment station and the Iowa experiment station.

It appears from the results in Table II that Sudan grass is slightly less digestible than millet, although more digestible than timothy. Sudan grass grown in the dry atmosphere of the Western States has a higher protein and ash content than that grown in the more humid climate of the Central and Eastern States. Plants grown in the East and cut when in bloom showed 5.85 per cent of crude protein and 5.48 per cent of ash, and those grown in the West and cut at the same stage of maturity had 9.62 per cent of protein and 8.9 per cent of ash. This difference in composition appears to be sufficient to affect the feeding value of the hay.

Feeding experiments conducted by the agricultural experiment stations at Manhattan and Hays, Kans., show that Sudan grass has a somewhat higher feeding value than a consideration of the chemical analyses indicated. In the winter of 1914–15 a test was conducted at the Fort Hays experiment station in wintering horses and mules on Sudan grass. The horses and mules were taken from a normal grain ration when work ceased and placed on a ration consisting wholly of roughage. One lot, consisting of four horses and two mules, was fed 20 pounds of Sudan grass hay per head daily, a second lot of the same kind and number of animals was fed a daily ration of 20 pounds per head of alfalfa hay, and a third lot was fed 20 pounds of kafir stover per head daily. At the end of a 50-day feeding period the lot fed on Sudan grass had lost an average of only 8 pounds per

animal, the lot fed on alfalfa showed an average gain of 5 pounds per animal, and the lot fed on kafir stover showed an average loss of 50 pounds per head.

The Fort Hays experiment station also found Sudan grass hay an efficient feed for carrying stock cattle through the winter. When fed with a small supplementary ration of silage and linseed or cottonseed meal, steady gains in weight were obtained during the winter at a reasonable cost.

For milk cows Sudan grass hay was slightly less efficient than alfalfa in a test carried out at the Kansas experiment station. Cows fed on Sudan grass hay with a supplementary ration of silage and grain produced 97 per cent as much milk as when fed alfalfa hay in place of the Sudan grass hay.

SEED PRODUCTION.

Sudan grass produces seed freely in a loose, open panicle which is held nearly erect by the stem, and can be harvested easily. The seed is retained fairly well, and thus the loss from shattering is much less than in other wild forms of sorghum. However, on the Great Plains, high winds sometimes shatter out a large percentage of the seed.

At the present time most of the commercial Sudan grass seed is produced in Texas, Oklahoma, and Kansas, but western Missouri and eastern Colorado and New Mexico also produce more seed than is needed for local consumption. Seed yields per acre are largest in the irrigated regions of California and Arizona, but only limited acreages are devoted to Sudan grass in these localities because of the profitable returns from other crops. The yields of seed per acre obtained in different sections of the United States are shown in Table III.

TABLE III.—*Yields of Sudan grass seed under different climatic conditions in cultivated rows and close drills.*

Climatic conditions.	Yield of seed per acre (pounds).			Number of localities.[1]
	Broadcast or close drills.	Cultivated rows 18 to 24 inches apart.	Cultivated rows 36 to 44 inches apart.	
Humid	328	417	354	10
Dry (not irrigated)	224	296	270	13
Dry (irrigated)	1,426	1,216	1,110	6

[1] The yields for the humid regions are averages for tests at Manhattan, Kans.; Stillwater, Okla.; Beeville and Temple, Tex.; Jackson, Tenn.; St. Paul, Minn.; Madison, Wis.; College Park, Md.; and Arlington Farm and Blacksburg, Va.; for dry regions not irrigated, averages of tests at Colby, Hays, Tribune, Garden City, and Dodge City, Kans.; Chillicothe, Spur, Lubbock, Amarillo, and Dalhart, Tex.; Ritzville and Wenatchee, Wash.; and Davis, Calif.; for dry regions irrigated, averages of tests at San Antonio, Tex., Phoenix, Ariz.; Bard, Davis, and Chico, Calif.; and Umatilla, Oreg.

These yields represent rather accurately the possibilities of seed production in different parts of the United States. Of course, certain localities are better suited to seed production than others. In Lubbock, Crosby, Floyd, Hale, and Swisher Counties in Texas the seed yields average about 600 pounds per acre for Sudan grass planted in rows, as compared with an average for the entire nonirrigated lands in the dry regions of only 270 pounds per acre. After the market demands for Sudan grass seed become better established, the seed production will no doubt be centered in favored localities, as it now is for such crops as Kentucky bluegrass, timothy, orchard grass, vetch, and alfalfa.

The planting of Sudan grass for seed production has already been described. Harvesting the seed is accomplished most economically with an ordinary grain binder or a row binder. Harvesting with a row binder is illustrated on the title-page. When the seed is practically mature, Sudan grass can be cut and bound like grain and left to cure in shocks. It may then be hauled directly to the thrashing machine or stacked in the same manner as bundle grain. There is danger in stacking Sudan grass, however, because the sap in the stems dries out slowly, and if stacked before it has cured thoroughly the grass will heat in the stack and injure the viability of the seed. Growers usually find it best, therefore, to allow the Sudan grass to remain in the shock until they are ready to thrash. The use of shock covers results in a much brighter, better quality of seed.

The ordinary grain separator thrashes and cleans Sudan grass seed very satisfactorily. Care must be observed to so regulate the air blast as to prevent seed from being blown over into the straw pile. A clover huller also has been used with success in thrashing Sudan grass, but seed thrashed in a clover huller is likely to be rather completely freed from the hulls and therefore weigh much heavier than ordinary seed.

The weight of the seed varies from 25 to 40 pounds per bushel. Good clean seed should weigh 36 to 40 pounds to the bushel, and such seed will pass through the feed of an ordinary grain drill without clogging.

Owing to the unusual success with Sudan grass in 1912 and 1913, the price of seed was high during the winter of 1913–14. Retail seed merchants asked $1.50 to $2 a pound for the seed, and farmers were paid 50 cents to $1.50 a pound for seed in bulk. The retail price of Sudan grass seed for the last two or three years has varied from 12 to 20 cents a pound, and farmers have sold their supply at 10 to 15 cents a pound. It can be grown profitably at these prices, especially if the grower utilizes the thrashed Sudan grass as forage for his live stock

The seed of Sudan grass resembles Johnson grass seed very closely, except that it is larger and more plump. (Fig. 10.) No machinery for separating the two kinds of seed has been devised; hence the only way of obtaining pure Sudan grass seed is to guard against its mixture with Johnson grass during the growing period and in the thrashing process. South of 38° north latitude, indicated on the map shown as figure 3, Johnson grass behaves as a perennial and is troublesome because it is difficult to eradicate. North of the thirty-eighth parallel of latitude, roughly speaking, Johnson grass is not troublesome, because it usually is killed by the winter freezes. A slight admixture of Johnson grass in the Sudan grass seed sown for hay production north of the thirty-eighth parallel is no great disadvantage.

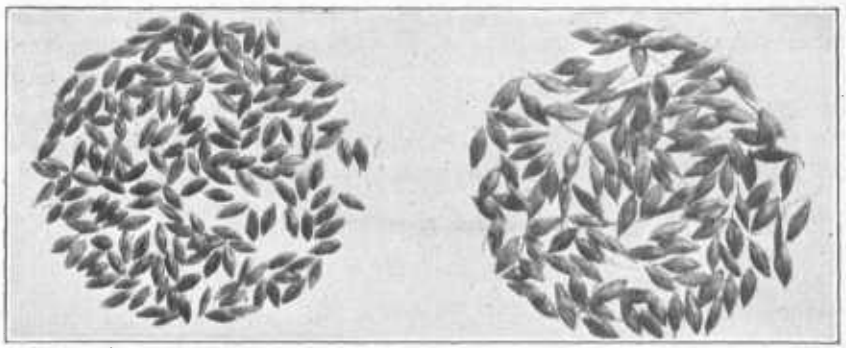

FIG. 10.—Seeds of Johnson grass (left) and Sudan grass (right) showing their comparative size and their similarity in shape.

South of this line, where Johnson grass is likely to become a pest, care must be used to see that the Sudan grass seed is free from Johnson grass seed.

The following suggestions may be remembered with advantage by the farmer in the Southern States: A farmer may grow sufficient seed for his own plantings and thus be assured of its purity; when he finds it necessary to buy Sudan grass seed and his land is free from Johnson grass, he should purchase only that grown outside the Johnson grass region or from responsible growers in the South who can guarantee the purity of the seed. If the Sudan grass is to be seeded on land already containing Johnson grass, the presence of seed of the latter is a matter of small importance.

The presence of even a small number of Johnson grass seeds can be detected by a properly trained seed analyst. A method for their identification has been formulated by F. H. Hillman, of the United States Department of Agriculture, and is described fully in Department Bulletin 406.

A point to be remembered in the production of Sudan grass seed is that the plant hybridizes very freely with sorghum, especially with

the sweet sorghums. In dry regions where the pollen is carried for considerable distances by the wind, a Sudan grass field intended for a seed crop should be 60 to 80 rods from any sorghum. Another source of cross-pollination exists in the volunteer plants of sorghum sometimes found in fields that were planted to sorghum the previous year. To avoid such sources of trouble, fields that have been growing other crops than sorghum should be chosen for the Sudan grass seed crop.

To make sure of pure seed, roguing the field at least once a year must be resorted to, and the rogues should be removed before a chance has been afforded for cross-pollination. The great need of special efforts to keep Sudan grass pure is illustrated by the present condition of the sweet sorghums, very few fields of which are to be found anywhere that are pure as to variety. They are very commonly mixed not only with other varieties of sorgo, but also with the grain sorghums. Unless seedsmen and growers unite in an effort to keep their seed fields free from sorghum hybrids, Sudan grass will lose much of its distinctiveness within the next 20 years.

DISEASES OF SUDAN GRASS.

RED-SPOT.

The worst disease of Sudan grass is the so-called sorghum blight,[1] more appropriately designated as red-spot. This is a bacterial disease, characterized by the appearance of distinct reddish spots on the leaves, which gradually spread until the leaves turn brown and die. (Fig. 11.) Its effect on the plant is much the same as rust, and, like rust, it is most destructive in warm, humid regions. It is prevalent in the Great Plains, but does little damage there except in wet seasons. Along the South Atlantic and Gulf coasts it almost entirely prevents the profitable production of Sudan grass. (See map, fig. 3.)

No remedy or preventive of red-spot has been found other than the use of resistant varieties. Rotation with other crops not subject to the disease probably holds it in check. In localities where sorghums are regularly grown, however, they furnish a continuous source of infection.

KERNEL SMUT.

Sudan grass is subject to the kernel smut of sorghum. This disease changes the individual kernels into a mass of dark spores covered by a grayish membrane. These spore masses look like an elongated seed, fully twice as large as the healthy kernels.

---

[1] Kellerman, W. A., and Swingle, W. T. Sorghum blight. *In* 1st Ann. Rpt., Kans. Agr. Exp. Sta., 1888, p. 281–302. 1889.

Burrill, T. J. A disease of broom-corn and sorghum. *In* Proc. 8th Ann. Soc. Prom. Agr. Sci., 1887, p. 30–36. 1887.

Radais, Maxime. On the blight of sorghum. *In* Bot. Gaz., vol. 28, no. 1, p. 65–68. 1899.

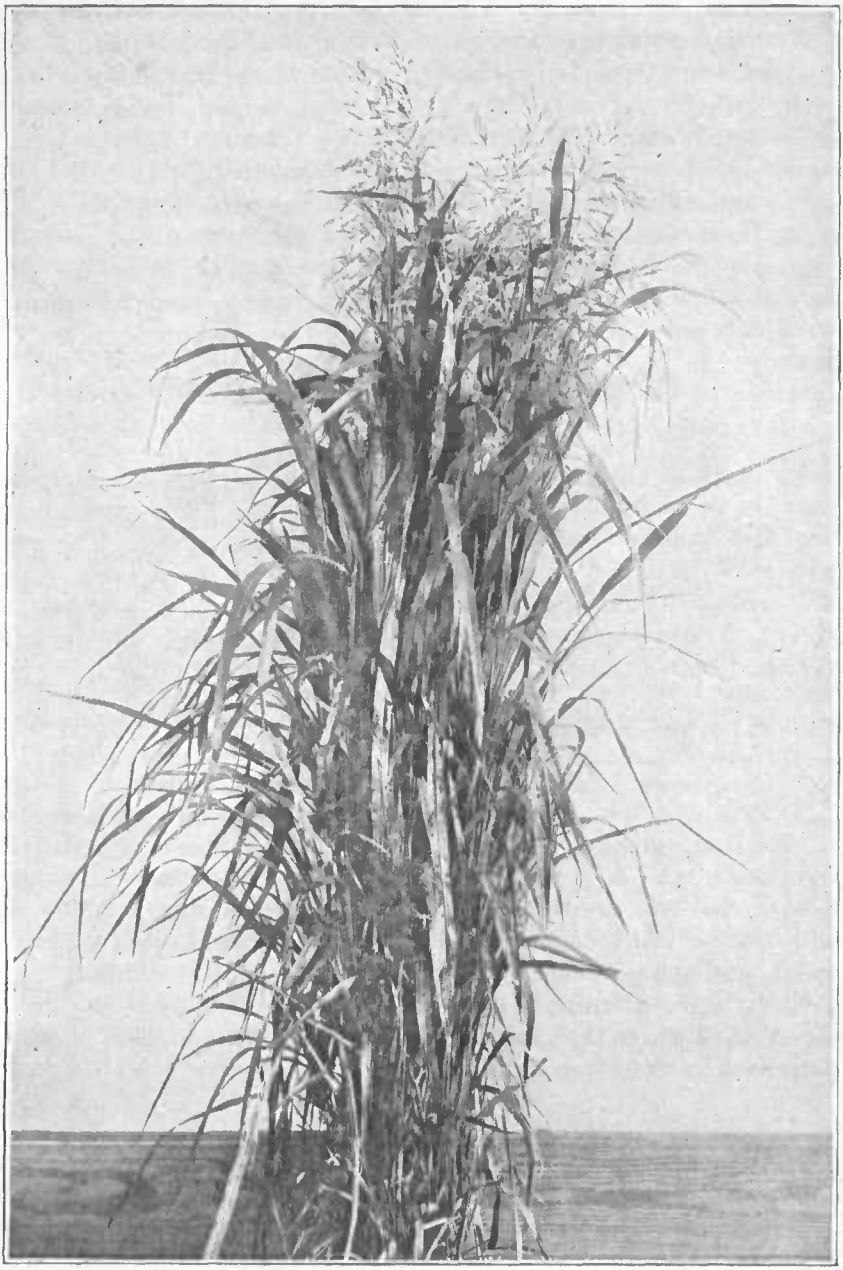

FIG. 11.—A Sudan grass plant affected with red-spot. Note the spots on the leaves. This illustration shows one of the earlier stages of the disease in which the vitality of the grass has not yet been overcome.

As in the case of red-spot, the sorghums furnish a source of infection for the kernel smut. This disease of the seed is not of any great importance in the production of Sudan grass for hay and pasture.

Kernel smut can be controlled very effectively by treating the seed with formalin.[1] One pound of full-strength formalin is mixed with 30 gallons of water. The sacks of seed are immersed for one hour in this solution, which should be stirred occasionally. Then the sacks are taken out and drained, after which the seed is spread upon a clean floor or canvas to dry. When dry the seed can be sown, but care must be used to see that, after the treatment, it does not come in contact with any smut-infected sacks. Such seed treatment is profitable only for planting fields intended for seed production.

INSECT ENEMIES OF SUDAN GRASS.[2]

GRASSHOPPERS.

In parts of the United States where grasshoppers are abundant they do considerable damage to Sudan grass. These grasshoppers are chiefly native species which hatch out in the vicinity. The cultivation of fields and fence rows late in the fall or in early winter destroys large quantities of the eggs and helps to keep these pests in check. The most effective method of controlling the grasshopper is by poisoned bran mash. This poisoned mash is made up as follows:

Bran	pounds..	25
Paris green or white arsenic	do....	1
Molasses	quarts..	2
Oranges or lemons	number..	3
Water	gallons..	3½

The Paris green and bran are thoroughly mixed dry in some receptacle, such as a washtub. The juice of the oranges or lemons is squeezed into the water, the pulp and peeling chopped fine and added, after which some strong-smelling molasses is dissolved in the water, and the poisoned bran is moistened with this solution.

Early in the morning is the best time to scatter this damp mash about fields where the grasshoppers are troublesome. The quantity described in the foregoing formula is sufficient for 4 or 5 acres.

CHINCH BUG.

The chinch bug, though not as frequently troublesome as the grasshopper, does considerable damage when it is abundant. A field of Sudan grass can be protected from a threatened invasion of chinch bugs by means of a deep furrow plowed around the edges of the field,

[1] Freeman, E. M., and Umberger, H. J. C. The smuts of sorghum. U. S. Dept. Agr., Bur. Plant Indus. Cir. 8, 9. p. 1910.

[2] This discussion of insects was prepared with the advice and cooperation of W. R. Walton, entomologist in charge, cereal and forage insect investigations, Bureau of Entomology, United States Department of Agriculture.

the land side of the plow being toward the field. Holes with perpendicular sides are then dug across the bottom of the ditch at intervals of 30 to 40 feet. The chinch bugs in attempting to cross this furrow collect in the holes and can be destroyed by an application of kerosene oil.

Chinch bugs commonly pass the winter at the base of bunches of grass and in the piles of trash usually found along fences and hedge rows. Burning this grass and trash in November or December destroys a large percentage of the chinch bugs and does much to prevent trouble from them the following summer.[1]

SORGHUM MIDGE.

This insect is destructive only in the South. It very largely prevents the profitable production of Sudan grass seed from central Texas east to the Atlantic coast. The damage to the plant is slight, other than the prevention of seed formation; therefore there is little loss from a forage standpoint.

There is no effective way of combating the sorghum midge other than planting very early or very late in the season, so that the Sudan grass will come into bloom at a time when the midge is not abundant.

IMPROVEMENT OF SUDAN GRASS.

Considerable work has been done at agricultural experiment stations in an effort to improve the original Sudan grass. No strains of exceptional value, however, have been developed, and in fact the grass as it came from Africa is a satisfactory hay and pasture plant. The chief need for improvement seems to be the production of strains of Sudan grass or hybrids between it and other grass sorghums which will be more resistant to red-spot.

[1] Webster, F. M. The chinch bug. U. S. Dept. Agr., Farmers' Bul. 657, 28 p., 8 fig. 1915.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO GRASSES AND FORAGE CROPS.

AVAILABLE FOR FREE DISTRIBUTION.

Alfalfa. (Farmers' Bulletin 339.)
Red Clover. (Farmers' Bulletin 455.)
Market Hay. (Farmers' Bulletin 508.)
Forago Crops for the Cotton Region. (Farmers' Bulletin 509.)
Vetch Growing in the South Atlantic States. (Farmers' Bulletin 529.)
Crimson Clover: Growing the Crop. (Farmers' Bulletin 550.)
Tho Making and Feeding of Silage. (Farmers' Bulletin 578.)
Crimson Clover: Utilization. (Farmers' Bulletin 579.)
Sudan Grass as a Forage Crop. (Farmers' Bulletin 605.)
Crimson Clover: Seed Production. (Farmers' Bulletin 646.)
Growing Hay in the South for Market. (Farmers' Bulletin 677.)
Tho Field Pea as a Forago Crop. (Farmers' Bulletin 690.)
Bur Clover. (Farmers' Bulletin 693.)
Wireworms Destructive to Cereal and Forago Crops. (Farmers' Bulletin 725.)
Natal Grass: A Southern Perennial Hay Crop. (Farmers' Bulletin 726.)
Button Clover. (Farmers' Bulletin 730.)
The Clover Leafhopper and Its Control in tho Central States. (Farmers' Bulletin 737.)
Commercial Varieties of Alfalfa. (Farmers' Bulletin 757.)
Sweet Clover: Growing the Crop. (Farmers' Bulletin 797.)
Bermuda Grass. (Farmers' Bulletin 814.)
Sweet Clover: Utilization. (Farmers' Bulletin 820.)
Sweet Clover: Harvesting and Thrashing the Seed Crop. (Farmers' Bulletin 836.)
Harvesting Hay with tho Sweep Rako. (Farmers' Bulletin 838.)
Irrigation of Alfalfa. (Farmers' Bulletin 865.)
Harvesting Soy-Bean Seed. (Farmers' Bulletin 886.)
Haymaking. (Farmers' Bulletin 943.)
Hog Pastures for the Southern States. (Farmers' Bulletin 951.)
Curing Hay on Trucks. (Farmers' Bulletin 956.)
Velvet Beans. (Farmers' Bulletin 962.)
Purple Vetch. (Farmers' Bulletin 967.)
The Soy Bean: Its Culture and Uses. (Farmers' Bulletin 973.)
Hay Caps. (Farmers' Bulletin 977.)
Labor-Saving Practices in Haymaking. (Farmers' Bulletin 987.)
Timothy. (Farmers' Bulletin 990.)
Sweet Clover on Corn-Belt Farms. (Farmers' Bulletin 1005.)
Hay Stackers. (Farmers' Bulletin 1009.)
Rhodes Grass. (Farmers' Bulletin 1048.)
Forago for the Cotton Belt. (Farmers' Bulletin 1125.)
Carpet Grass. (Farmers' Bulletin 1130.)
The Agricultural Species of Bent Grasses. (Department Bulletin 692.)
Certain Desert Plants as Emergency Stock Feed. (Department Bulletin 728.)
Sweet-Clover Seed. (Department Bulletin 844.)
Kudzu. (Department Circular 89.)
The Jack Bean. (Department Circular 92.)
The Development of the Peruvian Alfalfa Industry in tho United States. (Department Circular 93.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

Variegated Alfalfa. By J. M. Westgate. Pp. 63, pls. 9, figs. 5. 1910. (Bureau of Plant Industry Bulletin 169.) Price, 10 cents.

Breeding Drought-Resistant Forage Plants for the Great Plains Area. By Arthur C. Dillman. Pp. 40, pls. 4. 1910. (Bureau of Plant Industry Bulletin 196.) Price, 10 cents.

Grimm Alfalfa and Its Utilization in the Northwest. By Charles J. Brand. Pp. 66, pls. 2. 1911. (Bureau of Plant Industry Bulletin 209.) Price, 10 cents.

Forage-Crop Experiments at the San Antonio Field Station. By S. H. Hastings. Pp. 27, pls. 4, fig. 1, tables 19. 1913. (Bureau of Plant Industry Circular 106.) Price, 5 cents.

Some Important Grasses and Forage Plants for the Gulf Coast Region. By S. M. Tracy. Pp. 15, figs. 5. 1907. (Farmers' Bulletin 300.) Price, 5 cents.

The Genera of Grasses of the United States. By A. S. Hitchcock. Pp. 307, pls. 20; figs. 174. 1920. (Department Bulletin 772.) Price, 40 cents.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1920