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†As of November 1, 1919.
*In cooperation with School of Veterinary Medicine, A. & M. College of Texas.
**In cooperation with United States Department of Agriculture.
††In cooperation with School of Agriculture, A. & M. College of Texas.
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REPORT OF EXPERIMENTS AT SUBSTATION NO. 12, CHILlicothe, Texas†

BY R. W. Edwards, B. S., SUPERINTENDENT.*

In cooperation with:
The Office of Forage Crop Investigations, U. S. Department of Agriculture, Washington, D. C.

Beginning in 1905, experiments mainly with forage crops have been conducted continuously at Chillicothe. Until 1915 this work was carried on at the Chillicothe Field Station on land leased for this purpose by the United States Department of Agriculture. This Station is now located on land owned by the State of Texas, and is a part of the Texas Agricultural Experiment Station. The Substation is located on a tract of 100 acres of land five miles southwest of Chillicothe, in Hardeman County. The conduct of this Station always has been carried on cooperatively by the United States Department of Agriculture and the Texas Agricultural Experiment Station, and much of the expense of the work of this Station during the period covered by this bulletin has been borne by the United States Department of Agriculture.

Previous publications of the Texas Agricultural Experiment Station relating to the work done at Substation No. 12 are Bulletins No. 137 on Alfalfa, and 202, Progress Report.

Texas Substation No. 12 came into existence as such in January, 1916. At this time a tract of one hundred acres of land located five miles southwest of Chillicothe, Hardeman county, was purchased by the State of Texas. Previous to this (1905-1915) experiments mainly with forage crops had been conducted at the Chillicothe Field Station on land leased for this purpose by the United States Department of Agriculture. During the entire period the work has been carried on cooperatively between the United States Department of Agriculture and the Texas Agricultural Experiment Station.

On September 1, 1916, funds appropriated by the Texas Legislature for the purpose of permanent improvements on the new Station became available. Since that date the farmstead has been rearranged, graded, filled and leveled where necessary, five new buildings have been constructed, fences built, and a water system installed. A comparison of Figure No. 1 with Figure No. 2 shows what progress has been made along these lines. At the same time the scope of the Substation investigational work has been broadened to include work with cotton, corn, small grain, garden and other crops of interest to this locality. This

†1915-1917.
*Resigned March 31, 1918.
Fig 1.—Substation Buildings and Farmstead in 1916.
newer work just getting under way at the time this report is submitted will be reported upon in succeeding publications.

The incentive for experiment work with forage crops at Chillicothe was, primarily, the finding of varieties which possessed unusual drought resistance, and the selection and improvement of these varieties. Crops belonging to the sorghum family are considered best adapted to the successful production of forage in this region and have been given first attention. A secondary consideration was the finding of some leguminous crop which could be utilized both as a forage and for its fertilizing effects upon the soil.

During the thirteen years' work at this point, no less than fifteen hundred varieties and selections of plants belonging to the sorghum family have been grown in trial plots. Naturally out of this large number only a few have been found of sufficient value to take the place of common varieties so generally grown by farmers in this section of the country. It has been the policy of the Station to test each variety or selection through several seasons before either discarding it or advocating its adoption by farmers. Some new plants, of course, may be discarded after one trial, while it is difficult to determine the value of others even after they have been grown for several years.

In addition to the sorghums, a large number of varieties of millet, annual legumes, perennial grasses, and alfalfa have been tested. Attempts have also been made to find by detailed experiments the best rate, date, and method of planting the crops. This is especially important for new varieties. Approved methods of cultivation have been employed.

In a previous report (Texas Agricultural Experiment Station Bulletin No. 202) the work of this Station is summarized for the period from 1905 to 1914, inclusive. The present publication is intended chiefly as a report on experiment data secured since 1914. Many of the experiments, however, have been conducted through a much longer period of years and summaries here given will cover available data in an endeavor to present long-time average results.

SOIL.

The soil on the Substation is a mixed sandy loam quite uniform in character throughout the field used for plat tests. It is very representative of a considerable portion of the land in this and the surrounding counties. It is what might be termed a "happy medium" between the very sandy soil on the one hand and the so-called "tight land" on the other. Both of these extreme types of soil are found within a very few miles of the Station. The sandy soil is well adapted to the production of corn, cotton, sorghums, and cowpeas, while the "tight land" is found more suited to the raising of wheat, although the sorghums and cotton are both extensively grown upon it. Soil like that on the Substation is suitable for the production of any of the crops which are adapted to this region.

METEOROLOGICAL DATA.

The climatic conditions in this region have a direct bearing on crop production. The rainfall and its distribution is probably the most im-
portant of all climatic factors. The temperature and the dryness of the air are likewise influencing factors.

In table I is given the monthly and annual precipitation as recorded at the Substation for the years 1906 to 1917, inclusive.

Table 1.—Monthly and annual precipitation from 1906 to 1917, inclusive, with monthly and yearly averages.

<table>
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<td>.00</td>
<td>.00</td>
<td>.50</td>
<td>3.92</td>
<td>1.78</td>
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<td>8.71</td>
<td>2.67</td>
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<td>.99</td>
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<td>.00</td>
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<td>1.52</td>
<td>1.71</td>
<td>6.60</td>
<td>.90</td>
<td>26.88</td>
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<tr>
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<td>T</td>
<td>T</td>
<td>2.28</td>
<td>3.51</td>
<td>6.40</td>
<td>8.41</td>
<td>5.68</td>
<td>T</td>
<td>2.22</td>
<td>1.84</td>
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<td>.00</td>
<td>.22</td>
<td>1.80</td>
<td>1.41</td>
<td>.56</td>
<td>8.06</td>
<td>1.49</td>
<td>1.07</td>
<td>1.26</td>
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<td>.64</td>
<td>.08</td>
<td>1.08</td>
<td>1.39</td>
<td>2.74</td>
<td>1.91</td>
<td>1.42</td>
<td>1.72</td>
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<td>.14</td>
<td>.53</td>
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<td>3.05</td>
<td>2.92</td>
<td>2.73</td>
<td>.08</td>
<td>.34</td>
<td>22.63</td>
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<td></td>
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<tr>
<td>1913</td>
<td>.35</td>
<td>1.90</td>
<td>1.32</td>
<td>1.77</td>
<td>1.01</td>
<td>2.33</td>
<td>2.90</td>
<td>4.21</td>
<td>4.71</td>
<td>2.79</td>
<td>5.51</td>
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<td>1914</td>
<td>.30</td>
<td>1.88</td>
<td>2.40</td>
<td>6.16</td>
<td>1.67</td>
<td>1.76</td>
<td>8.47</td>
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<td>6.71</td>
<td>4.07</td>
<td>3.73</td>
<td>3.83</td>
<td>5.07</td>
<td>.15</td>
<td>.53</td>
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<td>1916</td>
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<td>.48</td>
<td>1.48</td>
<td>3.62</td>
<td>1.02</td>
<td>1.17</td>
<td>1.19</td>
<td>1.77</td>
<td>3.06</td>
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<td>.02</td>
<td>16.34</td>
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<td>1917</td>
<td>.20</td>
<td>.30</td>
<td>.30</td>
<td>.73</td>
<td>2.33</td>
<td>.54</td>
<td>4.08</td>
<td>1.11</td>
<td>2.06</td>
<td>.35</td>
<td>.82</td>
<td>T</td>
<td>12.59</td>
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</table>

The average annual rainfall is 24.09 inches, but the yearly totals are seen to vary between the extreme of 12.59 inches in 1917 and 34.81 in 1915. The two extremes of rainfall occurred during the three years under consideration in this report, while the remaining year of the three had a precipitation below the normal, but as it followed a wet year it approached an average crop season. The results presented here should be considered very conservative for this region.

The distribution of the rainfall is frequently of as much importance as the total amount. For example, heavy downpours are usually accompanied by excessive run-off before there is time for the moisture to soak in. On the other hand, numerous very light showers may occur, the moisture of which evaporates without reaching the plant roots. Often an abundance of rain may occur during one portion of a year while another portion will be very dry. Thus while rainfall may be considered the limiting factor of production in this region the monthly and annual totals are not necessarily a complete index to the crop production possibilities of the season.

The maximum, minimum, and mean temperatures for each month of the past five years are shown in the following table:

Table 2.—Monthly Maximum, Minimum, and Mean Temperatures; 1913 to 1917.

<table>
<thead>
<tr>
<th>Mo.</th>
<th>1913</th>
<th>1914</th>
<th>1915</th>
<th>1916</th>
<th>1917</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>Min.</td>
<td>Mean</td>
<td>Max</td>
<td>Min.</td>
<td>Mean</td>
</tr>
<tr>
<td>Jan.</td>
<td>76</td>
<td>0.39</td>
<td>54</td>
<td>17</td>
<td>44</td>
</tr>
<tr>
<td>Feb.</td>
<td>77</td>
<td>12</td>
<td>35</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Mar.</td>
<td>86</td>
<td>17</td>
<td>47</td>
<td>38</td>
<td>21</td>
</tr>
<tr>
<td>April</td>
<td>90</td>
<td>30</td>
<td>62</td>
<td>99</td>
<td>61</td>
</tr>
<tr>
<td>May.</td>
<td>101</td>
<td>44</td>
<td>74</td>
<td>93</td>
<td>45</td>
</tr>
<tr>
<td>June.</td>
<td>100</td>
<td>56</td>
<td>77</td>
<td>177</td>
<td>61</td>
</tr>
<tr>
<td>July</td>
<td>107</td>
<td>84</td>
<td>105</td>
<td>65</td>
<td>85</td>
</tr>
<tr>
<td>Aug.</td>
<td>106</td>
<td>59</td>
<td>87</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>Sept.</td>
<td>101</td>
<td>45</td>
<td>72</td>
<td>95</td>
<td>45</td>
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<tr>
<td>Oct.</td>
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<td>Nov.</td>
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<tr>
<td>Dec.</td>
<td>67</td>
<td>15</td>
<td>57</td>
<td>32</td>
<td>33</td>
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</tbody>
</table>
As will be seen in the table the winter temperatures do not usually fall below zero. Summer temperatures are relatively high, and thus plants requiring much heat, as, for instance, cotton and certain sorghums, which are more or less subtropical in their nature, reach maturity with certainty. These high temperatures are moderated somewhat by the dryness of the air. Rather dry atmosphere is not detrimental to such crops as sorghum and cotton, but it does have an adverse effect on corn, soy beans, and other crops which require a more humid atmosphere for their maximum production.

Sorghums.

A very large number of sorghum varieties and types have been tested. It seems desirable to give here a brief description of the habit of growth and characteristics of several of the more important varieties tested. It should be borne in mind that the descriptive matter is presented so as to familiarize the reader with the varieties and not as a recommendation of any particular variety. Following the description, tabular matter is presented showing the performance of the better yielding types.

Description of Varieties of Grain Sorghums.

The varieties described range in height from three to six feet. In length of growing season they vary from 70 to 120 days.

White Kafir.

A dwarf uniform strain varying in height from 3½ to 5 feet. It is the earliest kafir variety tested, maturing in from 85 to 100 days, and does not tiller as freely as other varieties. The heads are slender and as a rule do not fill very well.

Dwarf Kafir.

A good leafy strain growing to a height of from 3½ to 4½ feet, and maturing in from 100 to 110 days. The heads are from small to medium in size, and produce a yield of grain which is about the average for kafirs. The forage yield is less than that produced by the taller-growing and late-maturing varieties.

Early Blackhul Kafir.

A rather small-stemmed variety growing from 4½ to 6 feet in height and maturing in from 100 to 110 days. The stems are rather sweet, producing a good yield and high quality of forage. The heads are of medium size and well out of the boot, being from 3 to 10 inches above the last leaf sheath. The yield of grain compares very well with that of other varieties of kafir.

Blackhul Kafir.

A standard variety in common use, which is of medium height and produces good yields of both forage and grain. It requires 110 to 120 days to mature, a slightly longer period than that of the white, dwarf,
and early blackhul varieties. Under very favorable conditions it will usually out-yield these varieties.

**Whitehul Kafir.**

Grows somewhat taller than blackhul, 4½ to 6 feet, and is less desirable on this account. The heads are large and rather open, having a tendency to fill poorly at the tip. It produces good yields of both forage and grain under favorable conditions but is a medium late-maturing sort, and is surpassed in yield by the earlier-maturing varieties in dry seasons.

**Pink Kafir.**

Makes a growth similar to blackhul, 4 to 5½ feet in height, and is a very high yielder under favorable conditions. The seed are of a light pink color and the heads are rather large and open.

**Red Kafir.**

Quite uniform and rather fine-stemmed. Requires a long season for maturity and suffers greatly during periods of extreme drouth. It produces a good quality of forage and a heavy seed yield under favorable conditions, but heads poorly during dry seasons. The heads are long and slender and the seed are red.

**Schrock Kafir.**

Quite leafy and a good forage variety. Height, 3½ to 5 feet. Heads large and rather open, often with a drooping tip and well above the last leaf sheath. It requires about the same length of season as blackhul kafir. The seed is brown and contains some tannin, which makes it slightly objectionable for feed.

**Dwarf Hegari.**

The stalk resembles kafir but bears more and larger leaves, producing an excellent forage. It makes a good growth of from 3½ to 5 feet, bearing large, rather compact heads. Matures in about 100 days. The grains are larger and whiter than kafir, somewhat resembling feterita. Hegari ranks among the first of grain sorghum varieties in the yield of both forage and grain.

**Darso Sorghum.**

This is a very dwarf variety, varying in height from 3 to 4½ feet. It gives fair results under drouthy conditions, heading better and producing more grain than the early kafirs. It matures in from 90 to 100 days. The heads are large and rather compact and the seed have a brownish color. They contain some tannin and, consequently, are of less value for feed.

**Whooper Sorghum.**

A good combination grain and forage sorghum growing to a height of from 4½ to 6 feet, and maturing in about 100 days. The stalks are
Fig 3.—Pink Kafir and Red Kafir.

Fig. 4.—Dwarf Red Kaoliang and Dwarf White Milo.
medium juicy and sweet, and the grain lacks the tannin which makes the seed of sorgos undesirable for feed. The heads are rather open and the seed are white.

**Dwarf Red Kaoliang.**

This kaoliang produces a uniform growth of from 5 to 6 feet and matures in from 85 to 95 days. It has a very attractive head with light red seed. It withstands drouth well but usually does not produce as large a yield of grain as kafir, milo or feterita. The grain when ground makes an excellent meal for human food. The stalks are dry and pithy, producing a poor quality of forage.

**White Kaoliang.**

This is very similar to Dwarf Red kaoliang except that the seed are white. It grows to a height of 5 or 6 feet and matures in about 90 days. The stalks are of low feeding value, but the grain is good feed and makes an excellent meal for human food when ground.

**Feterita.**

Feterita as introduced varied considerably in height, time of maturity, and other characteristics. This original introduction, however, was characterized by earliness and high grain production under extreme conditions. Numerous selections of feterita have been made and a number of distinct strains developed. All of these have the same general characteristics, but may vary with respect to height, leafiness, length of season, shape of head or other characters. As a whole the variety is characterized by early maturity, the length of its growing season being 80 to 90 days. Its height is from 4 to 6 feet. It has rather compact heads and large white seeds. It is distinctly a hot weather crop and is noticeably superior to other grain sorghum varieties in seasons of severe drouth. The seed shatter easily when over-ripe, a drawback which is largely overcome by harvesting during the early stages of maturity. The grain has a bluish white color and is softer than that of kafir. It does not produce quite as good forage as kafir.

**Dwarf Yellow Milo.**

This is probably the most common grain sorghum grown throughout the western part of the State. It varies in height from 3½ to 4½ feet and matures in from 90 to 100 days. The seed are large, reddish yellow, and the heads are large, compact and frequently goose-necked. The lower leaves usually fire badly, as the crop reaches maturity. The fodder is not as valuable as that of kafir. In seasons of severe drouth dwarf milo produces grain with more certainty than kafir but is not superior to feterita.

**White Milo.**

This variety has become quite common in some localities. Certain strains of it are similar to Dwarf Yellow milo in habit of growth, while others vary with respect to height and erectness of head. In general,
Fig. 5.—Freed Sorgo.

Fig. 6.—Dwarf Milo and Feterita.
they have about the same value as the various yellow-seeded strains. One strain developed at this Substation has proved to be an especially good grain yielder under conditions of severe drought.

_Freed Sorgo._

This is one of the earliest varieties, and as it matures in from 70 to 85 days, it is an especially desirable crop for early feed. It grows to a height of from 5 to 6 feet; has a slender stalk and comparatively few leaves. The stems are sweet and rather juicy until about the time the grain begins to ripen, after which time these qualities disappear. The heads are long-branched and open, similar to those of Amber sorghum. The seed are white and make a good feed. This variety is not an exceptionally heavy yielder of either forage or grain, but its value lies chiefly in its quick maturity and the certainty with which it produces a crop even under the most adverse conditions.

_Seed Yields of Varieties of Grain Sorghums._

That the reader may compare the grain sorghum varieties described in the foregoing pages, a table is presented which gives their average production of grain for the past five years.

Table 3.—Seed yields of grain sorghum in bushels to the acre.—Chillicothe, Texas, 1913–1917

<table>
<thead>
<tr>
<th>Variety</th>
<th>1913</th>
<th>1914</th>
<th>1915</th>
<th>1916</th>
<th>1917</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwarf Kafir</td>
<td>0.0</td>
<td>13.1</td>
<td>28.6</td>
<td>9.1</td>
<td>4.2</td>
<td>11.0</td>
</tr>
<tr>
<td>Red Kafir</td>
<td>0.0</td>
<td>13.1</td>
<td>38.7</td>
<td>0.0</td>
<td>5.9</td>
<td>11.9</td>
</tr>
<tr>
<td>Pink Kafir</td>
<td>0.0</td>
<td>13.4</td>
<td>46.1</td>
<td>0.0</td>
<td>9.4</td>
<td>13.8</td>
</tr>
<tr>
<td>Early Blackhu Kafir</td>
<td>0.0</td>
<td>17.7</td>
<td>32.1</td>
<td>10.8</td>
<td>4.4</td>
<td>12.9</td>
</tr>
<tr>
<td>Blackhu Kafir</td>
<td>0.0</td>
<td>12.6</td>
<td>41.2</td>
<td>10.8</td>
<td>4.7</td>
<td>13.8</td>
</tr>
<tr>
<td>Dwarf Hegari</td>
<td>0.0</td>
<td>56.6</td>
<td>58.4</td>
<td>0.0</td>
<td>11.1</td>
<td>21.2</td>
</tr>
<tr>
<td>Paterita</td>
<td>10.7</td>
<td>53.5</td>
<td>28.0</td>
<td>18.6</td>
<td>5.5</td>
<td>23.3</td>
</tr>
<tr>
<td>Dwarf Milo</td>
<td>9.2</td>
<td>42.8</td>
<td>36.8</td>
<td>15.6</td>
<td>4.6</td>
<td>21.8</td>
</tr>
<tr>
<td>Dwarf White Milo</td>
<td>17.5</td>
<td>21.3</td>
<td>32.5</td>
<td>17.0</td>
<td>6.1</td>
<td>18.9</td>
</tr>
<tr>
<td>Freed Sorgo</td>
<td>4.6</td>
<td>21.6</td>
<td>27.7</td>
<td>11.7</td>
<td>5.7</td>
<td>14.3</td>
</tr>
</tbody>
</table>

_Description of Varieties of Forage Sorghums—Sorgos._

Sorghums of this group are characterized by their sweet stems and shy seed production. Typical varieties of this group are Sumac or Red Top, Amber and Orange.

The varieties described in height from 3½ to 8 feet. In length of growing season they vary from 80 to 125 days.

**Red Amber.**

This is an excellent forage variety growing to a height of 5 to 6 feet and maturing in from 80 to 95 days. The stems are quite leafy, sweet, and juicy. It produces good forage but does not yield as well as some of the later-maturing varieties.

**Black Amber.**

This variety is similar to Red Amber in habit of growth. There are several types, two of which are known as Dakota Amber and Minnesota
Fig. 7.—Varieties of Milo in Field.

Fig. 8.—Grain Sorghum Varieties in Bundles.
Amber. The former is a very early-maturing, slender-stemmed type. In it the seed branches are held erect and thus give the heads the appearance of being fairly compact. Minnesota Amber is a slightly coarser, taller type which is later in maturing and the heads are more open than those of the Dakota Amber strain. The stems of all types in the Black Amber are sweet and juicy, producing a good quality of forage, but usually the Black Amber type does not equal Red Amber in yield under the conditions prevailing at Chillicothe.

Collier.

This variety produces tall, slender stems, which grow to be 5½ to 7 feet in height. It matures in from 90 to 100 days. The stems are sweet and juicy, producing a good quality of forage. Under favorable conditions the stalks grow tall and have a tendency to lodge, so that harvesting becomes difficult. The seed are brown and the glumes or hulls are black. The head is short and usually drooping at the tip.

McLean.

This variety produces tall, slender stems 5½ to 7½ feet in height. It reaches maturity in from 100 to 115 days. The stems are sweet and juicy, the seed is light brown in color, and the heads are rather open, being similar to those of Amber sorgo. Like Collier sorgo, it is subject to lodging before harvest time.

Honey.

This is a tall, rather coarse-stemmed variety, growing from 5½ to 8 feet in height, and requiring 125 days or more to mature. Usually it heads rather poorly. The heads are open and sprangled. The seed are light-colored and the glumes or hulls are orange-colored. The stems are very sweet and juicy; it is an excellent variety for syrup production, but is rather coarse for forage.

Honey sorgo is sometimes erroneously called Japanese cane, Japanese seeded ribbon cane, or Japanese sorghum. These names are trade names incorrectly applied to the sorghums. Japanese sugar cane is a true sugar cane and does not belong to the sorghum family. It does not produce seed in this country but is extensively grown in South Texas for forage purposes.

White African.

The White African produces very coarse stems, which are 5½ to 7½ feet tall. It requires 120 days or longer to mature. The stems are sweet and juicy. It makes a heavy yield, which, though rather coarse, is suitable for silage. The seed are white and the heads are rather compact and except for being broader they appear similar to those of kafir.

Gooseneck.

This variety is commonly known in many localities as “Texas Seeded Ribbon Cane.” The stems are tall, coarse, and late in maturing. It is used extensively for syrup making, being one of the best varieties
Fig. 9.—Amber Sorgo in Bundle.

Fig. 10.—Threshing Sorghum.
for this purpose. It produces a large tonnage but is not so satisfactory for forage as many other varieties.

**Sumac.**

This variety is also known as Red Top and is a standard forage sorghum of Texas. It grows to a height from 5½ to 7½ feet. The stems are of medium size, very leafy, and are quite sweet and juicy. It is used successfully for both silage and dry forage. To mature it requires at least 115 days. The heads are short and compact. The seed are small, almost round, and are of a dark reddish color. This variety is used to some extent for syrup making, but is not considered as desirable for this purpose as the Honey, Gooseneck, and Orange sorghums.

**Orange.**

This variety produces a good leafy growth of from 5 to 7½ feet in height and requires 115 days or longer to mature. The stems are quite leafy, sweet and juicy. It produces a good quality of forage. It is earlier and not quite as tall as Sumac; hence it is more desirable in these two respects. Some strains are considered especially good for syrup making. A dwarf type which has been grown at this Substation for a number of years is especially promising as forage sorghum.

**Dwarf Ashburne.**

This is a dwarf, leafy variety, resembling Sumac. It grows from 3½ to 4½ feet in height and matures in from 100 to 120 days. It is quite leafy. The stems are sweet and juicy, producing a good quality of forage. The heads are rather compact and the seed are a dark reddish brown in color. From the standpoint of both yield and quality, it is one of the best forage varieties that have been tested at this Substation.

**Forage Yields of Varieties of Sorghums.**

Sumac, Orange, and Red Amber are the most common varieties grown. That the yields of these may be compared, they are presented in the following table, in which are included also the forage yields of the chief grain sorghums.

Table 4.—Forage yields in pounds per acre of sorghum varieties—Chillicothe.

<table>
<thead>
<tr>
<th>Variety</th>
<th>1913</th>
<th>1914</th>
<th>1915</th>
<th>1916</th>
<th>1917</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>4540</td>
<td>16360</td>
<td>13640</td>
<td>4520</td>
<td>3900</td>
<td>8580</td>
</tr>
<tr>
<td>Sumac</td>
<td>2560</td>
<td>14460</td>
<td>13640</td>
<td>4580</td>
<td>5000</td>
<td>8040</td>
</tr>
<tr>
<td>Red Amber</td>
<td>2660</td>
<td>9000</td>
<td>5660</td>
<td>3100</td>
<td>2520</td>
<td>4580</td>
</tr>
<tr>
<td>Teed</td>
<td>1340</td>
<td>5560</td>
<td>4100</td>
<td>2120</td>
<td>1900</td>
<td>3000</td>
</tr>
<tr>
<td>Bakhtul Khair</td>
<td>1900</td>
<td>7700</td>
<td>9680</td>
<td>2860</td>
<td>3240</td>
<td>5040</td>
</tr>
<tr>
<td>Dwarf Mile</td>
<td>1960</td>
<td>9400</td>
<td>4740</td>
<td>2700</td>
<td>2500</td>
<td>4260</td>
</tr>
<tr>
<td>Dwarf Feterita</td>
<td>1920</td>
<td>9900</td>
<td>5040</td>
<td>2620</td>
<td>2320</td>
<td>4360</td>
</tr>
</tbody>
</table>
Rate of Planting Sorghums in Rows.

There are a number of factors to be considered in deciding the best rate of planting sorghums. Among these factors are variations in climate, soil, seasonal conditions, variety of seed used, method of harvesting and purpose for which the crop is intended. Occasionally also a condition exists in which it seems advisable to plant thinly because of the scarcity or high price of seed, but such instances are rare. Variations in climate and seasonal conditions have not been observed to have much influence on the yield of varieties when averages are available. Wet or dry seasons seem to affect the thick and thin plantings to about the same extent.

A variety used chiefly for forage purposes, as is usually the case with the sorgos, should be planted thicker than varieties intended essentially for grain or seed production. Otherwise, the five varieties,—feterita, dwarf milo, blackhul kafir, Sumac sorge, and Freed sorgo, which have been tested out at different rates at this Substation, have all given similar results from the variations in rates of planting.

It is quite a common practice in many parts of the sorghum growing country to harvest the heads of grain sorghums by hand from the standing stalks in the field. If this is practiced, comparatively large heads, which are the natural results of thin planting, are more desirable than a greater number of small heads. Where the harvesting and heading or threshing are all done by machinery, the comparatively large number of small heads, occasioned by thick planting, are not objectionable.

Most varieties of sorghums have the ability to tiller developed to a high degree. Thus nature tends to equalize the stands and there is less difference in yield due to different rates of planting than will be found in crops which do not possess this characteristic. The influence of stooling or tillering is plainly shown by counting the number of stalks in a row when the plants first come up and again when the crop is near maturity, and by then comparing these counts with those obtained from other various rates of planting. Very thick plantings produce few tillers, while in thin stands there may be from two to eight, or even more, tillers to the plant. Since under favorable conditions many of the tillers will produce good heads the yield of seed as well as that of forage is often about the same for both thick and thin plantings.

In the following tables are given summaries of the forage and seed yields of the five above-mentioned varieties planted at four different rates. The column headed "Rate Inches" shows the average of the actual rates secured since these did not always conform exactly to the intended rate. For convenience, the rows were planted forty inches apart. Yields are given and averaged for a period of four years and each yield is computed on the acre basis from plats planted in duplicate.
In the preceding tables it is noticeable that the yields of neither forage nor grain vary directly with the differences in stand. This fact indicates, as stated previously, that because of the tillering habit the sorghums tend to equalize deficiencies in stand. In respect to both yield and quality of forage the thickest rate has proved the best from a forage standpoint.

In the table of seed yields it is noticeable that, except for Dwarf milo, the thinnest rate produced the lowest yield.

In the table of forage yields this is the case with three of the five varieties, while thicker plantings made the largest yields with all varieties except the Sumac.

Rate of Seeding Sorgo in Close Drills or Broadcast.

Seeding sorghums broadcast as a hay crop is a very common and a profitable practice in all but the dry parts of Texas.

This method of seeding has not given good results here except in
seasons of abundant rainfall. When the rainfall is very light as in the seasons 1913 and 1917 all rates of seeding, both thick and thin, were so badly damaged by drouth that little growth was produced. In 1914 when there was plenty of moisture all rates produced a heavy growth, but the thin seedings grew so tall and coarse that the crop was very difficult to handle and the thickest seedings produced the best quality of hay.

In the experiments at this Substation both Red Amber and Sumac sorgos have been seeded with a grain drill at the rate of 15, 30, 45, 60, and 75 pounds of seed to the acre. In broadcast plantings one-third to one-half more seed would be required to secure the same stands. In

the following table is given a summary of the yields of both varieties covering a period of four years, 1914 to 1917, inclusive.

Table 7.—Rate of seeding Sorgo in close drills for hay—Summary of yields for period of four years from 1914 to 1917, inclusive.

<table>
<thead>
<tr>
<th>Rate of Seeding Lbs. per Acre</th>
<th>Red Amber, Tons per Acre</th>
<th>Sumac, Tons per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>6.13</td>
<td>5.25</td>
</tr>
<tr>
<td>30</td>
<td>6.83</td>
<td>5.93</td>
</tr>
<tr>
<td>45</td>
<td>7.23</td>
<td>6.25</td>
</tr>
<tr>
<td>60</td>
<td>7.28</td>
<td>6.05</td>
</tr>
<tr>
<td>75</td>
<td>6.98</td>
<td>5.50</td>
</tr>
</tbody>
</table>

In the above table it will be noticed that seeding at the rate of 45 pounds to the acre gave the highest yield of forage for both Red Amber and Sumac in the average of four years' results.
Date of Planting Sorghums.

Where the seasons are long there is a period of at least three months during which many of the sorghums may be planted with reasonable assurance of success, but the optimum date of planting may vary somewhat with different years. The proper date of planting, therefore, will always remain largely a question for the judgment of the farmer.

Experiments which have been conducted over a period of years, however, show quite conclusively the average best time of planting. Seldom is there any advantage from planting very early in the spring. The sorghums require much heat and only reach their best development in a hot climate. Cold weather, while they are small, stunts early plants to such an extent that they are usually inferior in growth to plantings made after the weather has become continuously warm. The usual result of very early plantings of sorghums is that they germinate poorly, make a slow early growth, and, furthermore, the weeds get an equal start with the crop. Very late plantings on the other hand usually germinate well and make a rapid early growth. There is danger, however, that the maturity of the crop will be interfered with by frosts or continued cool weather in the fall.

The table following gives a summary of the yields of five varieties: feterita, dwarf milo, blackhul kafir, Sumac sorgo, and Freed sorgo planted on seven different dates for a period of five years:

<table>
<thead>
<tr>
<th>Average date planted</th>
<th>Feterita</th>
<th>Dwarf Milo</th>
<th>Blackhul Kafir</th>
<th>Sumac Sorgo</th>
<th>Freed Sorgo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forage yields, pounds per acre.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 2</td>
<td>3280</td>
<td>3120</td>
<td>4920</td>
<td>7780</td>
<td>2140</td>
</tr>
<tr>
<td>April 15</td>
<td>3860</td>
<td>3100</td>
<td>4720</td>
<td>7180</td>
<td>2700</td>
</tr>
<tr>
<td>May 3</td>
<td>4320</td>
<td>4220</td>
<td>5160</td>
<td>8300</td>
<td>3600</td>
</tr>
<tr>
<td>May 15</td>
<td>4640</td>
<td>4980</td>
<td>5880</td>
<td>8180</td>
<td>3540</td>
</tr>
<tr>
<td>June 2</td>
<td>(B) 5020</td>
<td>(B) 5480</td>
<td>(B) 6460</td>
<td>(A) 11040</td>
<td>(A) 4640</td>
</tr>
<tr>
<td>June 15</td>
<td>(A) 5040</td>
<td>(A) 5900</td>
<td>(A) 6500</td>
<td>(B) 9620</td>
<td>(B) 3620</td>
</tr>
<tr>
<td>July 1</td>
<td>4000</td>
<td>4740</td>
<td>5940</td>
<td>8120</td>
<td>2860</td>
</tr>
</tbody>
</table>

| Seed yields, bushels per acre. |          |           |               |             |             |
| April 2                 | 17.2     | 14.9      | 12.6          | 5.8         | 8.2         |
| April 15               | 18.5     | 12.9      | 12.5          | 11.2        | 12.0        |
| May 3                  | 17.8 (B) | 15.3      | 15.5          | 11.9        | 15.1        |
| May 15                 | 18.8 (A) | 16.4      | 15.5          | 11.8 (B)    | 16.6 (B)    |
| June 2                 | 18.9     | 13.1      | 12.1          | 4.8         | 6.8         |
| June 15                | (A) 19.1 | 10.1      | 11.0          | 7.8         | 5.2         |
| July 1                 | 11.9     | 12.5      | 11.0          | 7.8         | 5.2         |

(A)—Highest yield. (B)—Second highest yield.

From the above table it will be noted that the average highest and second highest yields of forage for all varieties are from the two plantings made in June. It has also been observed that the quality of the fodder from these plantings is better than that planted earlier. Being harvested later in the season the fodder from the June planting does not dry out as badly before winter as that from the earlier plantings. This is an additional advantage if the fodder is intended for winter feeding. While the data on seed yields are less complete or consistent than those for forage, the indications are that the highest grain yields will be produced from plantings made from two to four weeks earlier than the date for the highest yields of forage.
From the standpoint of expense of operation, it is very important that these crops be planted late rather than early in the season. An unplanted field may be cared for and kept free of weeds much more cheaply than one which has been planted, or which is growing an early seeded crop. The fields which are planted at the dates indicated above will produce a more rapid growth of crop, less cultivation will be required, and because of cheap early tillage fewer weeds will be present. As the cheap and complete control of weeds is undoubtedly one of the greatest problems of the farmer in this district, it is evident that these planting dates here given are of very great importance.

Sudan Grass.

Sudan grass was brought into use in America as a result of plant introduction tests at this Substation. The early belief that it would end the search for a better crop than Johnson grass and that it was free from all the objectionable characteristics of Johnson grass has been abundantly proved. It is now a standard crop in Texas. With the recognition of the excellence of Sudan grass as a hay and pasture crop there is a large and increasing market for the seed.

The experiments with Sudan grass reported upon in Experiment Station Bulletins No. 172 (Sudan Grass), and No. 202 (Progress Report Substation No. 12) have been continued.

The experiments with methods of planting Sudan grass have been continued. This experiment for the past five years has given the figures in the following table:

Table 9.—Method of planting Sudan grass for seed.

<table>
<thead>
<tr>
<th>Method of planting</th>
<th>Yield of seed in pounds per acre.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1913</td>
</tr>
<tr>
<td>40-inch rows</td>
<td>00</td>
</tr>
<tr>
<td>24-inch rows</td>
<td>00</td>
</tr>
<tr>
<td>Close drill</td>
<td>00</td>
</tr>
</tbody>
</table>

*36-inch rows. **18-inch rows.

For seed production there has been a decided advantage from planting Sudan grass in 40-inch rows over that planted in 24-inch rows, or in close drills. Not only has the yield of seed been higher from the 40-inch rows, but the crops have been much more easily harvested. The 40-inch rows were harvested with a row binder and shocked in the field until cured sufficiently for threshing. The 24-inch rows and close-drilled plats were cut with a mowing machine but might have been harvested with a grain binder had one been available.

An experiment similar to that reported upon above has been conducted with Sudan grass as a hay crop. The dates are presented in the following table:
Table 10.—Method of seeding Sudan grass for Hay. Summary of the yields 1913 to 1917, inclusive.

<table>
<thead>
<tr>
<th>Method of seeding</th>
<th>Yield in pounds per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1913</td>
</tr>
<tr>
<td>40-inch rows</td>
<td>A 2720</td>
</tr>
<tr>
<td>24-inch rows</td>
<td>B 2980</td>
</tr>
<tr>
<td>Close drill</td>
<td>1520</td>
</tr>
</tbody>
</table>


There has been a higher yield of hay from Sudan grass planted in 40-inch rows than from plantings in 24-inch rows, or in close drills. The growth in the row plantings was the coarser, however, making a poorer quality of hay. Another objection is that in mowing and raking the cultivated rows more dirt was gathered with the hay than in the close-drilled seedings where no cultivation was given. There must be considered also the labor of cultivation in the case of the row-planted crop. Taking all points into account, one must consider the close-drilled seedings better for hay production than cultivated rows.

As it seems very desirable from the standpoint of quality of hay and cheapness of operation to produce Sudan grass hay in close-drilled seedings, the experiment to determine the proper amount of seed to plant is of value and is presented here.

Table 11.—Rate of seeding Sudan grass in close drills. Summary of yields, in pounds, for four seasons.

<table>
<thead>
<tr>
<th>Rate of seeding, pounds per acre</th>
<th>1914</th>
<th>1915</th>
<th>1916</th>
<th>1917</th>
<th>4 Year Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8620</td>
<td>5800</td>
<td>2420</td>
<td>3120</td>
<td>4890</td>
</tr>
<tr>
<td>15</td>
<td>11140</td>
<td>5800</td>
<td>2500</td>
<td>3480</td>
<td>5730</td>
</tr>
<tr>
<td>20</td>
<td>10020</td>
<td>5940</td>
<td>2760</td>
<td>3520</td>
<td>5560</td>
</tr>
<tr>
<td>25</td>
<td>10340</td>
<td>5760</td>
<td>2540</td>
<td>4320</td>
<td>5740</td>
</tr>
<tr>
<td>30</td>
<td>9680</td>
<td>5960</td>
<td>2360</td>
<td>3960</td>
<td>5490</td>
</tr>
</tbody>
</table>

Considering the average of four years’ results as in the above table there is seen to be no very striking difference in yield of hay when Sudan grass is seeded at different rates varying from 10 pounds to 35 pounds of seed per acre. The thinner seedings made a somewhat coarser growth early in the season, but owing to the abundant stooling habit of Sudan grass these would thicken up by the time of the second cutting so that there would be little difference. From 15 to 20 pounds of seed per acre sown with a grain drill can be counted on to give satisfactory results, and by this practice from 15 to 20 pounds of seed may be saved as compared to the heavier rates.

SOY BEANS.

Soy beans as a whole have not proved satisfactory at Chillicothe. Their forage yields have always been light and the seed yields are not equal to those of the best cowpeas. Added to this is the difficulty of harvesting and curing without loss. With dry weather at harvest time as a rule the pods burst and shatter the seed. Rabbits are very fond
of the young, tender plants, and many times have either partly or entirely destroyed the crop early in the season. The soy bean is not recommended as a crop for this region. Variety tests and test of introduced foreign varieties are being continued.

COWPEAS.

While the experiments conducted at this Substation have shown alfalfa to be adapted as a dry farming crop here, there is nevertheless a very large need of annual legumes. Of these the cowpea is much the most successful.

A description of the varieties of cowpeas which are most valuable here follows:

Description of Varieties of Cowpeas.

Brabham.

This variety makes a rank leafy growth and is one of the heaviest yielders of hay. The plants are quite erect; hence it is one of the easiest varieties to harvest. It is rather late maturing and produces a comparatively light yield of seed.

Groit.

The Groit makes a more spreading growth than the Brabham, matures earlier, and usually produces a comparatively good yield of both hay and seed.

Coffee.

In growth the Coffee is very spreading; and for that reason is difficult to harvest for hay. In yield it compares very well with Groit and New Era. It has consistently been a good seed yielder. The pods and seed are large.

New Era.

This is a good, thrifty variety, similar in habit of growth to the Groit and seems to withstand dry seasons better than the Groit, Brabham, or Iron. In the 1917 experiment the New Era came second to Coffee in seed production.

Early Buff.

One of the earliest maturing varieties tested. The growth is rather bushy and the forage yield light. The seed yields have been especially good when compared with those of other varieties in dry seasons. This is perhaps due to the early maturity of this variety. The seed are light buff in color and especially good for table use either as snaps or dry.

Iron.

The Iron variety grown in the east as a wilt-resistant cowpea is here similar in habit of growth to the Brabham but not quite so erect. It is about the same as Brabham in forage yield, but somewhat better as a seed producer.
Blackeye.

This is the common garden variety. It produces a rather spreading growth and only average yields of forage. Usually the seed yield has not been equal to that of Coffee, Early Buff, New Era, or Groit.

Monetta.

This variety produces rank growth, which is mostly erect, and very similar to Brabham and Iron. Likewise it is a good hay yielder but low in seed production.

Taylor.

The Taylor produces a rank, rather spreading growth, and is difficult to harvest for hay. The seeds and pods are very large but the seed yield is only fair.

Red Ripper.

The habit of growth is like that of Taylor and Coffee. It is rather spreading and difficult to mow for hay. In seed or forage yield it is not equal to that of the best varieties mentioned above.

PEANUTS.

Spanish peanuts have been grown, but with no definite results, although the 1917 crop was better than the average. The forage was very good but the pods were not filled out. In the rather dry seasons the peanuts have not been successful.

MISCELLANEOUS ANNUAL LEGUMES.

Chick peas, Jack beans, Guar, and Yokohoma beans have never given any promise as forage plants. *Dolichos biflorus* and *Dolichos lablab* both produce fair crops of hay under favorable conditions, but have never produced seed in amounts of any importance. These are less valuable than cowpeas. Adzuki beans have given fair seed yields but they are of little forage value.

Kulthi Beans.

The Kulthi bean produces a fine-stemmed, leafy growth, from 15 to 20 inches high. It is an erect plant during its early growth, but its weight causes it to fall over more or less before the end of the season. It yields about three-fourths of a ton of hay to the acre, but this is not eaten readily by live stock. In the several years that this bean has been tested it has failed to bloom. Its use cannot be advised in this region.

Moth Beans.

Moth beans produce a mat of fine leaves and stems which cover the entire surface of the ground between the rows. This legume produces an excellent hay under favorable conditions. The hay, is of less value
than that of cowpeas. With the exception of one year it has never produced seed here.

**Mung Beans.**

The Mung beans are very early in maturing, but have a poor quality of forage. The pods and seed are too small to be of value as a hand-picked crop. The crop is of value for chicken pasture.