11-1-1914

Kaoliang, A New Dry Land Crop

A.N. Hume

Manley Champlin

BULLETIN No. 156 NOVEMBER, 1914

AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA
STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS

AGRONOMY DEPARTMENT

KAOLIANG, A NEW DRY LAND CROP.

BROOKINGS, SOUTH DAKOTA

The Mitchell Publishing Company, Mitchell, S. D.

GOVERNING BOARD

Hon. A. E. Hitchcock, President.....Mitchell, S. D.
Hon. T. W. Dwight, Vice President....Sioux Falls, S. D.
Hon. A. M. Anderson.....Sturgis, S. D.
Hon. August Frieberg.....Beresford, S. D.
Hon. Frank Anderson.....Webster, S. D.

STATION STAFF

T. W. Dwight.....Regent Member
A. M. Anderson .....Regent Member
E. C. Perisho.....President of College
James W. Wilson.....Director and Animal Husbandman
N. E. Hansen.....Vice Director and Horticulturist
James H. Shepard.....Chemist
C. Larsen .....Dairy Husbandman
A. N. Hume.....Agronomist and Supt. of Sub-Stations
J. G. Hutton .....Assistant Agronomist
M. Champlin.....Assistant Agronomist and Collaborator
Howard Loomis.....Agronomy Analyst
Matthew Fowlds .....Assistant in Crops
J. D. Morrison...Crops, Detailed by U. S. Department
..... of Agriculture
J. M. Fuller.....Assistant and Dairy Bacteriologist
E. H. Hungerford.....Dairy Analyst
Howard W. Gregory.....Assistant Dairyman
Perry Clifford.....Assistant Dairyman
Guy E. Youngberg.....First Assistant in Chemistry
R. A. Larson.....Secretary and Accountant
E. I. Fjeld.....Bulletin Clerk and Stenographer

SUMMARY

Contribution from Agronomy Department.

By A. N. Hume and Manley Champlin

1. Kaoliang was introduced by the United States Department of Agriculture to fill the demand for an early ripening grain sorghum in the Northern Great Plains.

2. It has been tested for five years and subjected to a careful process of selective breeding for uniformity and yield at the Highmore Substation of the South Dakota Experiment Station.

3. It is drouth resistant and has produced a satisfactory yield in the driest seasons experienced at Highmore and has out yielded corn in a two year test at Cottonwood.

4. Its moisture requirement is comparatively low.

5. It should be planted from May 15th to June 1st on well prepared land, thoroughly cultivated and kept as free from weeds as possible.

6. This cultivation benefits the following crops.

7. Harvest can be handled either with or without expensive machinery.

8. The stock will thresh it for themselves.

9. Seed heads should be selected.

10. Both seed and stalks should be utilized for feed.

A NEW DRY LAND CROP

In the western part of Kansas, Oklahoma and Texas crops known in a general way as grain sorghums have been the main stay of the settlers. It is indeed doubtful whether the western part of these states could have been permanently settled except by cattlemen, had it not been for such crops as kafir and milo.

This being the case, it was but natural that investigators who were on the lookout for crops for the dry regions should desire some sort of a grain sorghum that would do the same thing for the northern part of the Great Plains that kafir and milo had done for the southern part. Some progress was made by selecting the earliest dwarf plants from the kafir and milo, and the resulting varieties, dwarf kafir and dwarf milo, are matured successfully as far north as the southern part of South Dakota. For the principal part of western South Dakota something still earlier was needed. The United States Department of Agriculture learned through its explorers and agents in the Orient of a very early ripening grain sorghum grown by the people of Manchuria. This crop was known as kaoliang, a word made up of the Chinese kao and liang, meaning tall or great millet. The Manchurians use the leaves for fodder, the stalks for building and basket material and the seed for food for themselves and their live stock, besides distilling a portion of it and making an alcoholic liquor. It also attracted attention during the Russo-Japanese war when whole regiments of soldiers were able to maneuver under cover of the kaoliang fields. Since Manchuria lies in approximately the same latitude as South Dakota, and is somewhat similar in climatic conditions, it was thought likely that the kaoliang from there would do well here and trial lots of seed were furnished to the South Dakota Experiment Station in the spring of 1909 and placed on trial in cooperation with the Office of Cereal Investigations of the Bureau of Plant Industry, at the Highmore Sub-station.

The crop grown in this trial was found to be extreme-

ly variable. There were tall stalks, short stalks, compact heads and loose heads. Apparently the native Manchurians had not given much attention to selecting seed for a uniform type. Thus it became necessary to do considerable selective breeding work before the seed was adapted to general distribution and to machine handling.

Selection of the heaviest, most compact heads on stalks of a uniform height was practiced and the best of the resulting progeny saved for two seasons and in the spring of 1911 seed was distributed to a few farmers from two of these selections. One of these descended from Manchu Brown Kaoliang, Cereal Investigations No. 171-8, and was put out as Kaoliang S. D. 289 and the other one descended from Manchu Brown Kaoliang, Cereal Investigations No. 261-4, and was put out under the designation Kaoliang S. D. 290. The former has proved the better yielder but the latter is the earlier. Seed distribution and selective breeding have been continued through 1912, 1913 and 1914 until in 1914, it is estimated that kaoliang from these two original selections is growing on one thousand farms in central and western South Dakota.

Fig. 1—Kaoliang on Left and Corn on Right under Severe Drouth Conditions. Highmore, 1911.

PROBABLE RETURNS

Kaoliang, though primarily valuable as a grain crop may also be properly called a dual purpose crop. In a five year trial at Highmore Substation and a three year trial at Cottonwood Substation, it has never failed to mature its seed. The seed is usually ready to be harvested by September 15th. At Highmore, the average yield for the five years from 1909 to 1913 inclusive, has been 16.5 bushels of S. D. 289 and 13.8 bushels of S. D. 290. The highest yield of S. D. 289 was 19.2 bushels in 1910, and the lowest was 10.3 bushels in 1911. The average yield of Minn. No. 13 yellow dent corn for this same period is 12.6 bushels, showing that the climatic conditions were decidedly severe. At Cottonwood in 1912, kaoliang yielded an average of 23.7 bushels per acre in farm system No. 4 as compared with 22.5 bushels per acre for Minn. No. 13 corn in farm system No. 5, which is similar to No. 4, except that kaoliang is exchanged with corn. In 1913, the season was so severe at Cottonwood that both kaoliang and corn failed to produce grain in farm systems 4 and 5, but the kaoliang produced 440 pounds of dry fodder per acre to 260 pounds per acre for the corn. In another farm system No. 6, kaoliang yielded 2 bushels of grain and 766 pounds of dry fodder as compared with corn which yielded 0 grain and 687 pounds of dry fodder, thus proving its value in an extremely severe season. The soil at Highmore is a rich glacial clay loam. At Cottonwood, the soil is a very sticky residual clay highly impregnated with white alkali. In some places this alkali is serious enough to interfere with the germination and growth of plants, as can be seen in the accompanying picture, Fig. 3. Under such conditions, a crop must be extremely hardy to be able to make even a small yield. At this writing the 1914 crop is not harvested but promises a good yield at all five of the experiment station farms.

Fig. 2—Kaoliang after a rain, Highmore, 1911.
Note the rapid recovery of the crop after the drouth con ditions in the preceding figure.

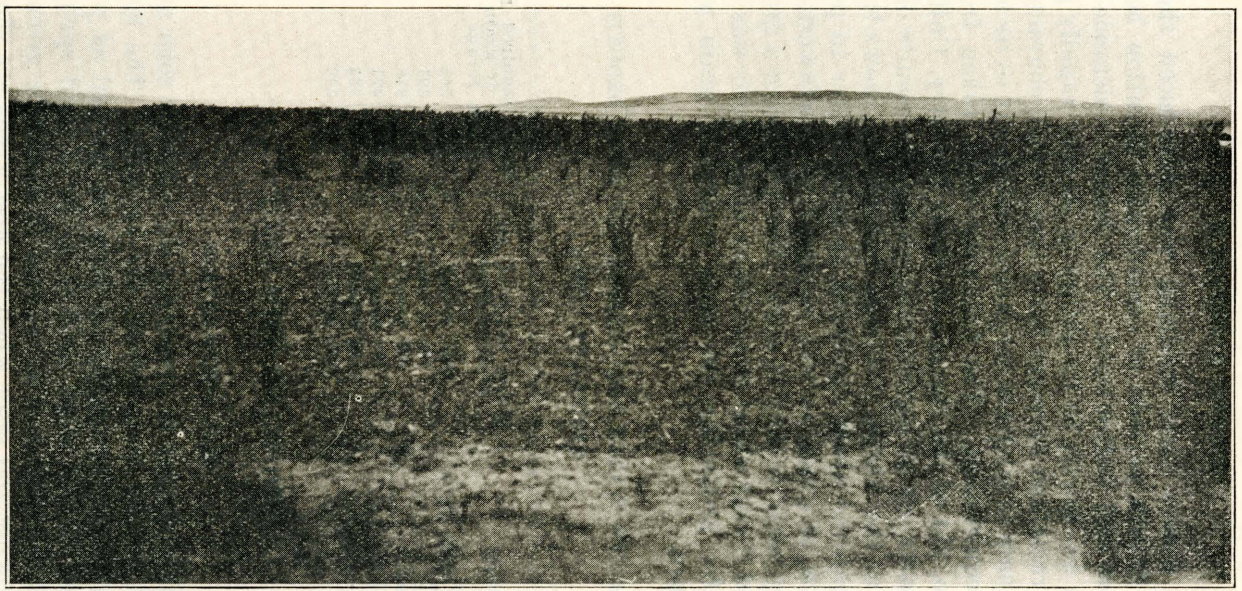

Fig. 3.—Kaoliang on Alkali Land at Cottonwood Substation. The soil in the foreground contains so muchalkali that very few plants are able to germinate and grow. The picture was taken July 23, 1914.

DROUTH RESISTANCE

Every season since kaoliang was introduced there have been drouth periods of considerable duration both at Highmore and Cottonwood. The drouth resistance of kaoliang is due partly to its ability to recover rapidly after having remained dormant for a time, which characteristic is common to all grain sorghums, and partly to its low moisture requirement. The following table, taken from Bulletin No. 284 of the Bureau of Plant Industry, United States Department of Agriculture, giving the results of a trial made at the Akron, Colorado Substation, shows that kaoliang required about one-third as much water to produce a gram of grain as was required by Northwestern Dent, a very early variety of corn. For producing a gram of grain and forage about five-sixth as much water was required as for producing the same weight of grain and forage in corn.

COMPARATIVE WATER REQUIREMENT OF SOME DROUTH RESISTANT CROPS

Crops	Water required per gram of grain	Water required per gram of grain and forage
Northwestern Dent Corn..	2040 grams	368
Kaoliang	726 grams	301
Black Hull Kafir	803 grams	278
White Durra	806 grams	321
Dwarf Milo	1123 grams	333
Red Amber	1494 grams	2 98

GROWING THE CROP

SOIL PREPARATION

The rules applied to preparing the land for corn also apply well to its preparation for kaoliang. The land should be plowed thoroughly as early in the fall as possible and no further work need be given it until spring. As early as the land may be worked it should be given a single harrowing and later when the first weeds are showing up, it should receive a thorough double discing prefer-

ably by lapping half so as to avoid ridging. Another harrowing just before seeding completes the soil preparation.

TIME TO SOW

Like corn, the kaoliang seed requires a warm seed bed in order to germinate, so that it should not be planted earlier than the middle of May in the central part of South Dakota. In the southern part it may be possible to plant it slightly earlier in some seasons. Since a mature crop of seed is desired, the planting should not be delayed much after June 1st. For purely forage purposes, it may be used as a catch crop or following the removal of an early grain crop and planted as late as the middle of July. With a reasonable amount of moisture, there would still be time to grow a fair yield of forage.

METHOD OF PLANTING

Kaoliang can be planted either with a grain drill or a corn planter. It may be either in drills or hills. If drilled, the rows should be far enough apart to permit of cultivation and the stalks should average four or five to the yard. This requires about four pounds of seed per acre if the drill rows are three and one-half feet apart. If planted in hills three or four stalks per hill is a perfect stand. All modern corn planters are, or may be equipped with special sorghum plates for either drilling or checking. The holes for kaoliang should be about the diameter of a ten penny nail. If a wheat drill is to be used, the tubes may be plugged or the holes blocked so as to put the drill rows the desired distance apart. None of the drills are calibrated for kaoliang so that it will be necessary to test the drill and adjust it before starting to seed. Care must be taken not to plant too deep as the seed is small and will not come through the soil if so planted. One to two inches is a satisfactory depth depending upon the thickness of the soil mulch. The object is to place the seed at the top of the firm moist earth just beneath the mulch so that it will germinate uniformly.

Fig. 4—Kaoliang on Gumbo Soil, Cottonwood Sub station, 1912. Average Yield, 23.7 Bushels of Grain and 1,607 Pounds of Dry Fodder per **Acre.**

CULTIVATION

For best results, the crop must be kept clean and free from weeds. This is somewhat more difficult than with corn because the kaoliang is very tender for the first two weeks of its life and will not stand cross harrowing. However, we have found a spring tooth weeder very satisfactory to run lengthwise with the drill rows for the first cultivation. A common harrow can be used but in that case the first cultivation must be delayed until the crop is at least one and one-half inches in height and quite firmly rooted. The remaining cultivation is the same as a thorough farmer would give corn, alternating cultivations with a surface and a shovel cultivator. If the koaliang is planted in hills, no hand labor is necessary unless the field is exceptionally foul with weeds. If sown in drills, one hand hoeing to remove the weeds in the rows, is imperative, if the best results are to be had. Though the drill rows may yield slightly more per acre than the hills, the hill system would seem the most practical under present labor cost conditions. The clean cultivation demanded by the kaoliang, puts the land in good shape for the following crop.

HARVESTING

When the seed heads ripen in September, they can be harvested by hand at about the same rate per day that corn can be picked by hand. This method of harvest makes threshing very easy or the heads need not be threshed at all as horses, cows, hogs, sheep and poultry will eat it readily without threshing. The stalks remain green up to the time the heads are ripe and can be utilized either as silage or fodder, though they are not as valuable as corn for this purpose, not being as leafy and the stems being more pithy. Just what the silage or forage value is as compared with corn, has not yet been determined.

A number of familiar machines may be used for harvesting the crop, such as the corn binder, the row header, or the grain header, the former, being preferable.

SEED SELECTION

To keep the crop producing well, heads should be selected each year for seed. This will prevent the natural tendency to run out or become inferior.

In selecting the seed heads, attention should be given to securing compact heavy heads growing on stalks of uniform, medium height. These heads may be hung up to dry and threshed out at leisure during the winter. This will tend to increase the yield, insure seed of high viability and make the crop easier to handle with modern machinery.

FURTHER INFORMATION

Further information on the subject of kaoliang and other grain sorghums may be found in Farmers Bulletin No. 288 and the 1913 Year Book of the United States Department of Agriculture or in South Dakota Bulletin No. 135.

If personal advice is desired, a request addressed to the South Dakota Experiment Station at Brookings will bring it. In many cases it will be possible to refer to farmers who are testing it in the reader's own immediate neighborhood, so that those contemplating trying it for the first time will have opportunity to consult with their neighbors about it before incurring any expense for seed.

Fig. 5—Individual Mother Heads in the Grain Sorghum Breeding Work at Highmore. Heavy compact heads should be selected for seed.

AVAILABLE BULLETINS

96. Forage Plants and Cereals at Highmore Sub-Station.
97. Speltz and Millet for the Production of Baby Beef.
99. Macaroni and Durum Wheats. A continuation of Bulletin 92.
105. Stock Foods for Pigs.
106. Sugar Beets in South Dakota.
107. Sheep Scabs.
108. New Hybrid Fruits.
109. Rusts of Cereals and Other Plants.
110. Progress in Variety Tests of Oats.
111. A Study of South Dakota Butter with Suggestions for Improvement.
112. The Killing of Mustard and other Noxious Weeds in Grain Fields by the Use of Iron Sulphate.
113. Progress in Variety Tests of Barley.
114. Digestion Coefficients of Grain and Fodders for South Dakota.
115. Report of Work for 1907 and 1908 at Highmore Sub-Station.
116. Acidity of Creamery Butter and its Relation to Quality.
117. Sugar Beets in South Dakota.
123. Milk Powder Starters in Creameries.
125. Fattening Steers of Different Ages.
126. Alkali Soils.
127. Breeding and Feeding Sheep.
128. Progress in Wheat Investigations.
129. Growing Pedigreed Sugar Beet Seed in South Dakota.
130. Some New Fruits.
131. Scabies (Mange) in Cattle.
132. Effects of Alkali Water on Dairy Products.
134. More Winter Dairying in South Dakota.
135. Trials with Millets and Sorghums for Grain and Hay in South Dakota.
136. Fattening Pigs.
137. Wintering Steers.
138. Hog Cholera.
139. Soil and Crop and Their Relation to State Building.
141. Co-operative Tests of Alfalfa from Siberia and European Russia.
142. Sugar Beets In South Dakota—Results to Date.
143. Roughage for Fattening Lambs.
144. Preliminary Report on the Milking Machine.
145. A Report of Progress in Soil Fertility Investigations.
146. Some Varieties and Strains of Wheat and their Yields in South Dakota.
147. The Effect of Alkali Water on Dairy Cows.
148. Corn Silage and Mill Products for Steers.
149. Some Varieties and Strains of Oats and their Yields in South Dakota.
150. Weeds.
151. Trials with Sweet Clover as a Field Crop in South Dakota.
152. Testing and Handling Dairy Products.
153. Selecting and Breeding Corn for Protein and Oil in South Dakota.
154. The Pit Silo.