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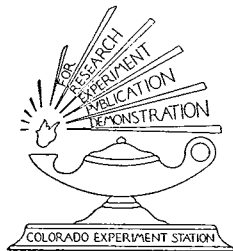
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## FORAGE CROPS FOR THE COLORADO PLAINS

—BY—

ALVIN KEZER



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# The Agricultural Experiment Station

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# FORAGE CROPS FOR THE COLORADO PLAINS

By Alvin Kezer

## INTRODUCTION

It is the purpose of this publication to treat of some of the fundamental considerations necessary for the growing of forage crops on the Colorado Plains outside of the irrigated districts. The farming conditions are those commonly called "dry farming." Considerable experimental work has been done from time to time at Cheyenne Wells, Monument, by the Government at Eads and Akron, at Julesburg, and cooperatively at a number of other points. The experimental work has been supplemented by the work of different field agents from time to time, and several years acquaintance and observation thru this territory.

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## CLIMATE AND TOPOGRAPHY

The Colorado Plains constitute a part of what is known as the Great Plains area. They lie east of the Rocky Mountains and extend from the base of the foothills to the state line. These plains are, for the most part, smooth to rolling prairies. Thru the northern part, the Platte River has cut its valley, which gives rise to an extended depression extending north-easterly from the city of Denver to the state line. Thru the southern part, running almost due east and west, the Arkansas River has cut its valley, creating a depression and many soil modifications due to stream flow and the deposition of soil material from flowing water. The Divide region between the Platte and Arkansas drainage reaches a considerable altitude, above 9,000 feet. This divide decreases in altitude and sharpness of slope towards the east, being much flatter as it approaches the eastern border. The streams cause more or less breaks and some rugged features in the otherwise general smooth to rolling appearance.

The climate is mild-temperate, but subject to very sharp extremes of both heat and cold, moisture and dryness.

The normal rainfall as shown by the Government and State rainfall records, varies from a minimum of approximately 8 inches to a maximum of about 18 inches. In years of drouth the rainfall is very much less than normal, while in years of heavy precipitation—so-called wet years—rainfall greatly exceeds the normal.

The region is one vast, unprotected, treeless plain, and as a consequence it is subject, especially during the spring and fall months,

to violent winds. A considerable knowledge of the climatic features to be met is essential because it has a strong bearing upon the cropping possibilities of the region.

The altitude of this region is high, varying from a minimum of about 3,500 feet to over 10,000 feet. These altitudes are associated with short seasons and cool nights.

### SOILS

For the most part, the soils are exceedingly rich and deep. There are, however, localities in which the surface soils are underlaid close to the surface with the country rock. This country rock is quite variable in its exposure—different geological formations are exposed in different localities. For the most part the soils are rather light in nature, running from sandy loams to as coarse as gravelly loams, sandy and silt loams predominating. There are an extremely small number of places where heavy clay and adobes prevail. The acreage, compared to the 22,000,000 acres of plains lying in Colorado is relatively small.

In the eastern and northeastern portion there are some areas of almost pure sands. These have been blown about by the winds to form sand dunes or sand hills. Sand dunes appear at other points in the Colorado Plains, but in less extensive areas.

In some sections the soils are almost pure silt, making loams of great depth, more available water relations, and amount of rainfall considered, unusual certainty of productivity.

The U. S. Bureau of Soils has made surveys of soil types in Larimer and Weld counties, and in the Arkansas Valley. These surveys and a careful checking of the same territory by later workers, show that the prevailing types in those different sections are largely sandy loams and silt loams. Those soils which have the proper physical texture and great depth are the ones which are capable of supporting a dry farming population. No matter how favorable the texture may be, if the surface soil is underlaid at a short depth with impervious clay layers, or with one or another of various beds of country rock, or with gravel, it is unfit for dry farming purposes except in the very wettest years, because such shallow soil is not capable of supporting vegetative growth thru prolonged periods of drouth.

In the sand hill regions the tendency to blow in the prevailing high spring and fall winds is so great that except in wet valleys, the soil should not be broken up. An effort should be made to make use of the native pastures and to increase their carrying capacity by intelligent grazing methods, by seeding in such crops as Sweet Clover which seems to thrive under such conditions. Even the sandy loams and silt loams if plowed up so as to dry out, and if finely pulverized at the surface, will blow in a very short time after being broken up—that is, as soon as the organic matter contained in the fresh sod is reduced in amount. It is essential, therefore, on all lands to carry on some system of farming which will assist in keeping up the organic matter content; to resort to such a system of plowing and cultivation as will leave the immediate surface more or less rough and quite coarsely granulated.

If the surface is granulated from the size of small gravel up to the size of a walnut, there is almost no danger of its blowing. A finely pulverized surface will almost certainly blow, no matter what the texture of the soil.

On all but the very sandiest lands, soil blowing may be controlled. Control methods consist of keeping the immediate soil surface rough on all plowed land and cultivated land not in crop. Anything which will break the force of the wind at the soil surface is effective. On many soils where the tendency is to blow badly, fall plowing can not be done. Usually, however, such lands may be fall listed crosswise of the direction of the prevailing winds. The furrows furnish sufficient protection to largely prevent blowing.

When a crop is to be planted, other protection is sometimes necessary. One successful method is to plant grain in strips alternate with listed land. Corn or some of the sorghums are planted in the listed furrows. Having these strips at least a rod wide and placed from ten to forty rods apart furnishes protection against soil blowing on any soils except the purest sands.

## DRY FARMING

The commonly accepted definition of dry farming is taken to be the production of crops without irrigation in a region where the rainfall is between 10 to 20 inches per annum. Much work has been done in an attempt to find adapted crops for dry farming; to find out the principles of water movement; the principles of moisture conservation; and what practical methods of plowing and cultivation must be followed to get the best results. At first, both practically and scientifically, the effort seemed to run itself to the production of grain crops or a knowledge of the principles underlying their production. Long experience, however, has shown, and a study of the climatic and moisture conditions of the soil bears the opinion out, that any system of farming which depends upon the production of cash grain crops on dry lands of the Colorado Plains, is destined to failure in all but a very few localities.

The crops which grow and thrive best, which are most certain of reaching harvestable maturity, are forage crops. Owing to their bulk and to the varied character of these crops they can not generally be marketed directly for cash. They must therefore, be fed to some kind of livestock and the livestock marketed if a permanent system of agriculture is to be established and maintained in this region. With the proper use of forage crops and livestock, with perhaps the growth of small acreages of the best adapted cash crops, and the use of livestock, a permanent system can be established. The cash grain crops will not bring in money each year, but occasionally they will make an agreeable addition to the money supply of the family. The main dependence, however, must be placed upon forage crops marketed thru livestock.

## GENERAL FARM PRACTICE AND MANAGEMENT

Dry farming at its best is serious business. As a consequence, there are certain fundamental considerations which the settler should bear in mind. A well for domestic water supply is absolutely essential. If such domestic water supply can not be obtained upon the land or immediately adjacent to it, other features would have to be extremely desirable to make it advisable to locate a home. The production of crops is more or less uncertain and the prospective settler should by all means bring sufficient capital in money, or in money and materials, to carry him thru at least one year until production can be started.

For the most part the plains are treeless. In the building of a home, one of the first things, after the house and sheds for livestock are provided, should be the making of some provisions for trees. Where land is properly prepared and properly cultivated, trees can be grown almost anywhere on the plains, providing they are given sufficient space. The moisture supply on dry land soils is always less abundant than it is in the humid regions; consequently the trees should be set much farther apart. The sod should be broken up at once in preparation for planting trees. A strip should be plowed at least twenty feet wider than the expected space which the trees will occupy. This should be kept free of weeds by plowing or other form of cultivation to permit the accumulation of water. Sometimes the soil can be sufficiently moistened, when such clean cultivation is followed, in one season to permit perfect safety in tree planting. Sometimes two seasons must elapse, and in extreme seasons as many as three. The ground should be ready and have sufficient moisture before trees are put out.

The planting of trees will make it possible to have some shade about the home. In addition to this, trees will break the dreary monotony of the plains—a monotony which is very real to all those not born and bred plainsmen. The women folks of the family are especially susceptible to this loneliness because of the isolation and difficulty of social relations with the neighbors.

The dry farmer should make provision for a garden somewhere near his well. If a good well is present for domestic water supply it can be used, especially if a little storage is possible, to insure a good small garden if the water is properly applied at the right time.

The dry farmer should by all means plan his cropping system so as to grow feed for at least a few chickens and pigs, so that the family living will be insured. The type of other livestock which he chooses to grow will depend a good deal upon his location, as either dairy or meat animals can be made profitable. There will be seasons when an abundance of feed will be produced. There will be other seasons when the amount of feed produced must be very carefully husbanded in order to permit existence; consequently, sooner or later the dry farmer should come to the proposition of saving all of his feed, and in extra

good crop years to store up excess feed to tide him over the lean years which are bound to follow one season or another.

The wide use of the silo is bound to come as a part of this development, because it permits all, or practically all, the feed grown to be stored in available succulent condition for future feeding. In 1912 the Experimental Sub-Station at Cheyenne Wells produced feed enough to have carried the herd on the land at that time for a period of two years. The silo capacity was limited to two pit silos at that time. They were filled to capacity, but they were only capable of carrying the herd thru the winter and the following early summer. In 1913 by saving every bit of feed that it was possible to save and putting it into the silo, it was not possible to quite fill even these two silos. In 1914 two more silos were put down so that now we have capacity enough to carry the normal regular herd thru a period of two years if extreme conditions should appear.

No method of dry curing of the crop is so efficient that it does not waste at least as much as thirty per cent. In the dry windy conditions which prevail as much as eighty per cent of the feed value may be lost. If put in the silo at least ninety per cent should be saved under normal conditions. In other words the loss need not be over ten per cent and often will be less than five per cent. The silo making possible this great saving in feed is bound to have a much greater use upon the dry farms.

In many places dry farmers are making use of open range available to carry their stock in the summer. During some seasons this open range will be cut short by extreme drouth so that the animals lose flesh or fall off in milk production according to the kind of animals kept. If the dry farmer had a silo at this time he could open the silo and feed some silage during the period of short pasture and keep up his gains on beef animals and his milk production on dairy animals.

The entire system can be summarized then, briefly as follows: Forage crops are best adapted to the soil and climatic conditions. In the best management they should be grown and placed in the silo to be fed later to livestock. Grain farming should be entirely supplementary to the general system. Of the grain cash crops which may be grown, we have winter wheat, flax and Mexican beans. With winter wheat and flax especially, the farmer should look upon the proposition as a chance for getting something extra, his living and his main returns to be obtained from livestock which are fed upon forage crops.

## ALFALFA

Farmers, experimenters and others have long recognized the need of a reliable legume crop that would supply forage for the dry farming sections of the plains. Alfalfa was tried and pronounced a failure by most of the persons who tried it. The fault was not entirely that of the alfalfa. In attempting to produce alfalfa, planting was done in

exactly the same way, using the same amount of seed as was used in irrigated and more humid regions. Frequently also, improper and unadapted varieties were used.

In the dry farming sections of the plains the water supply is always limited, except in an occasionally unusually wet year, and thick planting of alfalfa, such as thrives under irrigation or in humid conditions did not survive because there were more plants upon the land than there was soil water upon which they could draw. Failure, of course, followed.

In a practical way the Brott Brothers of Sextrop, Nebraska, just across the northeastern Colorado line, were the first to successfully solve the difficulties. Their method of meeting the difficulty was to plant alfalfa in rows and cultivate. Different distances to plant the rows were experimented with until finally it was decided that under dry land conditions it was necessary to put the rows from 3 to 3½ feet apart.

J. E. Payne, working as Agronomy Field Agent of the Experiment Station, worked out six or eight years ago the fact that alfalfa must be planted thinly on the land if it is to survive in the dry land sections. Under his direction a number of farmers made broadcast plantings using 3 and 5 pounds of seed to the acre. The three pound seedings were the most successful. Definite experimental work since that time has shown for Colorado conditions that it was necessary to plant alfalfa in rows in order that the number of plants might be easily limited on the land to prevent other plants coming in and competing for a part of the moisture supply, and the rows cultivated to keep down weeds.

In the past four years, successful row plantings on dry lands have been made in Weld, Larimer, Sedgwick, Elbert, El Paso, Lincoln, Cheyenne, Kit Carson, Otero, Crowley Counties and a few other localities. Experience with these plantings has been that row planting is a success for seed production. When it is considered that on an average the grower can count on a yield of about three-fourths of a ton of cured hay per annum for dry land conditions, it must be acknowledged that row planted alfalfa gives promise of having a very important place among the forage crops of the dry lands.

*Varieties.*—Experimental work has shown that the less hardy common alfalfas are absolutely no good for the dry lands. Work of the Experiment Station has shown that Baltic, Grimm and Hardy Turkestan alfalfa are the best varieties, in the order named. The Baltic and the Grimm are very much alike—in fact, the Baltic is a selection from the Grimm. These two sorts are very superior, both for hay and seed production wherever we have experimented with them on the Colorado Plains. Next to these varieties just mentioned, it has been found that if common alfalfa is used, the seed of which is taken from fields which have stood eight or ten years, that fairly good results are always obtained. Where the field of alfalfa has stood for ten years, most of the weak and non-hardy plants have been killed out so that seed is obtained only from plants capable of enduring the con-



ditions. When selected in this way seed may be taken from irrigated regions.

*Preparation of the Seed Bed.*—Alfalfa is a crop that is going to occupy the land for some years, so every possible precaution must be taken to get it started with the desired stand. In order to do this the seed bed must be prepared. It is necessary to get moisture into the seed bed before it is safe to put in the seed. There should be moisture enough to carry the crop for some months without additional rainfall. To accomplish this purpose the soil should be moist to a depth of at least two feet before plantings are made. Of course it is understood that rains are always liable to come and wet up the soil. It is also well known that rains may fail to come for periods of three months. In order to be on the safe side, alfalfa should be planted only in soil that is properly prepared, with the right amount of moisture to start the seed off and keep the crop growing for a period of at least two or three months without help of rainfall. In preparing such a seed bed it is frequently necessary to adopt the summer fallow. The land should be plowed thoroly and deeply. It is well to disk the soil immediately after the plowing in order to flatten the furrow slice.

Alfalfa does best on land which has been plowed and then afterwards well packed. The surface should be left granular rather than fine and dusty. The granular or "small cloddy" surface not only takes up the moisture which falls better than a dust surface but it protects the moisture supply present much better and is in very much less danger of blowing. When the seed bed has been properly prepared and has a sufficient supply of moisture present, the soil is ready for planting.

In most of our plains districts the rainfall is such that the best moisture conditions prevail between March and the first of July. On a properly prepared seed bed seeding may be done with safety any time from early in April until the first of July—preferably April and May seeding if the seed bed is in condition, because the alfalfa will grow better if it has a root system started before hot weather of July and August, and planting should be done in rows 3 to 3½ feet apart.

Where the prevailing winds are north and south the rows should be planted east and west. In other words, wherever the lay of the land will permit, the rows should be crosswise of the direction of the prevailing winds.

Seed should be put in with some sort of a drill. It is possible to rig a corn planter by using extra seed cups from some of the grass seeder attachments with which many of the modern drills are equipped.

With Baltic and Grimm seed, if the soil is properly prepared, one-half pound per acre, with rows 3½ feet apart is sufficient. With most methods available probably about two pounds will be planted, because of the difficulty of regulating the drop so as to drop less. Careful, patient, mechanical farmers can devise ways of reducing the rate of

planting. For many of our experimental plantings, Mr. P. K. Blinn devised an attachment which could be put on the corn planter and beet drill, or even attached to a grain drill. We obtained some of the drop cups manufactured for the grass seeder attachments of one of the standard makes of drills. These were provided with individual seed boxes which were mounted upon a drive shaft in such a way that their width was readily adjustable. Then by means of a couple of sprockets, it was possible to drive the drill from the shaft of a corn planter, grain drill, or a beet drill. With this device several hundred acres were successfully planted.\* A number of farmers have devised ingenious corn planter attachments for row planting. If the soil has been properly prepared very little cultivation will be needed after seeding until the crop has gained some little size. If it is necessary to cultivate the plants while small, shields should be used on the cultivators. After the plants get above five inches in height, cultivation is easy. The cultivation given should aim to keep down weeds and to prevent the formation of a crust.

*Harvesting.*—When the row alfalfa is harvested for hay it is cut with a mower and put up in the same manner as any alfalfa. If there is dew present, the mowing should not be done until the dew is off. The hay should be raked before it has had time to do anything more than slightly wilt. Further curing is done in the windrow or cock. It can be done more rapidly than is possible in the swath. If left in the swath the leaves dry up almost at once leaving the stems full of water. If it can be raked into a loose windrow so that the leaves are partially shaded, the evaporation or drying will go on very much more rapidly, because the moisture will pass out thru the leaves more rapidly than it will pass thru the stems.

When harvested for seed it is necessary to determine at what time to cut. The aim should be to cut it at such a time as to get the greatest number of ripe seed pods. Unfortunately the seed pods do not all mature at once. Usually if the cutting can be done when about three-fourths of the seed pods are ripe the greatest amount of seed possible will be obtained. When cut for seed the mower is again the most desirable tool to use. If a buncher attachment is at hand the problem is easy, as a man can walk along behind the mower and move the bunches over so the horses in making the next swath will not walk upon the cut alfalfa. This precaution is rather necessary, especially in dry times, because if the horses walk upon the cut swath they will thrash out and break off a large amount of seed. If a buncher attachment is not at hand it will probably be necessary to either rake or lay over swaths with forks. The ripe swath can be placed in a loose windrow and allowed to cure there, or into small cocks. As soon as the stems are dry enough, it can be thrashed, or if thrashing facilities are not immediately available, it can be stacked in order to keep it in condition until thrashing can be done.

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\* The drill manufactured by the Columbia Drill and Planter Co., Springfield, Ohio, has a drop which can be successfully attached for seeding alfalfa in rows.

## CORN

Corn is commonly considered a grain crop, yet upon the Colorado Plains it is one of the leading forage crops, and in many sections will be the leading grain forage crop. In the higher and moister sections, on the Arkansas-Platte Divide region, corn will produce a greater tonnage than any other similar forage. There are many other localities where it will out-yield the grain or forage sorghums. Where corn will out-yield such other crops it should be used for forage. It makes an excellent fodder where properly cured and when stored in the silo makes the very best silage possible. Corn can be grown in cooler localities than can any of the sorghums. It is probable, therefore, that corn will take the first place in the cooler and moister sections, while the sorghums will take first place in the dryer and hotter sections of our territory.

*Preparation of the Soil.*—The best method of soil preparation for corn depends upon the character of the soil, the rotation, and the crop which precedes corn on the land. If the land is rather light and sandy, fall plowing is not wise on account of danger of soil blowing. However, such lands may usually be managed so as to keep down weeds and put the surface in shape for catching winter and spring moisture. Where small grain or an early harvested cultivated crop preceded corn, the land may be double disked at once to kill weeds and put the surface in good condition for catching rainfall. Then, instead of plowing, the land is listed. Experiment shows that this practice stops danger of blowing. In the spring, just as early as possible, the middles are broken out.

Listing tends to lengthen the time required to develop corn to full maturity, consequently, planting corn on listed land is not always advisable. Where, on account of the difficulty of maturing listed corn, it is advisable to surface plant, the listed ground is worked down by disking and harrowing.

Often on the lighter lands, experiment has shown a system may be followed which keeps down weeds and conserves moisture at a great reduction of labor without reducing yields. Thus the cost of production is kept down. The suggested system is carried out as follows, starting the system and rotation with summer tilled land. The first crop put on is winter wheat. Immediately after the binder, the land is double disked for the double purpose of killing all weeds which spring up and to put the surface in good condition to catch rainfall. The following spring the land is double disked early, then corn or other cultivated crop is planted. Following corn, small grain is planted. The yields of grain after corn or other clean cultivated crop are nearly as large as after the fallow. As this last small grain crop is cut, the land is double disked. It is then allowed to lie. The following spring, as soon as weeds start, the soil is again disked to kill weeds, preserve tilth and the better to catch rainfall. In June and July the land is plowed thoroly and deeply, disked and harrowed immediately behind the plow. Winter wheat is planted in September and the rotation is under way again. Such

management has been found more successful on many soils than more frequent plowing and the cost of following the system is very low.

Upon the soils which give better results from plowing each season, the soil should preferably be plowed early in the fall, the earlier the better.

Over most of the Plains area, corn can be planted by the 10th of May. In the extreme southeastern part of the Colorado Plains, planting can be done the last of April or the first of May. In the extreme eastern part, some planting may be done by the first of May, but usually it is not wise to put in corn very much before May 10. Nearly always the Plains are subjected to a frost about the middle of May and there is little use of getting corn in prior to this danger period for frosts. By this time, the ground has become somewhat warmed so that the crop will start off readily.

Corn should be planted in rows  $3\frac{1}{2}$  feet apart. If drilled on the dry land there should be one seed about every 18 to 22 inches. If check-rowed, only two kernels to the hill should be planted.

In very dry localities where experience shows difficulty of getting sufficient moisture to produce a crop, the rows may be planted 7 feet apart or double the usual distance. When thoroly cultivated, such wide planting insures a crop in years when ordinary planting fails. With such wide planting, the seed may be put in a little thicker, 15 to 18 inches, in the row when drilled. This method of planting has been tried with success in several Colorado Plains localities.

*Varieties.*—There are an infinite number of corn varieties, but owing to the altitude and the shortness of the season, only the short season or so-called northern corns should be planted. Of the native varieties which have been tried out, the Swadley Dent, the White Australian Flint, and Parson's High Altitude corn have given very excellent results. For the more northern portions of the Colorado Plains area, Pride of the North, Minnesota Number 13, Minnesota Number 23, and Wisconsin Number 7 have been tried and have given good results. Of the imported corns, Minnesota Number 13 and Wisconsin Number 7 have been among the best. Minnesota Number 23 has not been tested a very long period of time, but gives promise.

For dry land forage purposes, it is unwise to plant the large-eared, late maturing types of corn. They are more subject to injury, will not produce as heavy yields and will not mature seed with any certainty.

*Cultivation.*—The major portion of corn cultivation should be done in the preparation of the seed bed. Cultivation after planting should be relatively shallow and frequent enough to prevent weeds gaining a foothold, and prevent the formation of a crust. For this purpose, the use of a type of cultivator having numerous shovels to the gang should be used. Numerous small shovels work up the entire surface thoroly and do a better job than the larger shovels as ordinarily used. Cultivation should be approximately four inches deep. It is seldom wise to go deeper, as root pruning becomes severe and very injurious, especially in dry times.

*Harvesting.*—For forage purposes it should be the plan of the dry farmer to put his corn crop largely in the silo. Corn should be allowed

to mature pretty well, at least to mature until the ears are well dented and glazed before the crop is harvested, as it will make better silage and a greater yield of feed if harvested at this time. It will not be harmful if some of the lower leaves are dry, because water can be run into the silage as the silo is being filled.

If cut for fodder it should be cut at about the same time as for silage and put at once into shocks. As soon as cured it should be taken in from the field and stacked in order to reduce the waste from the dry, high winds of winter to as low a minimum as possible. With the silo, it is possible to save ninety to ninety-five per cent of all of the feed produced in the field. With the best methods of dry fodder making, not over seventy per cent will be saved, and there will be a great deal more waste in feeding as the animals will not eat nearly so much. Often where the crop is harvested by cutting and shocking, weather conditions will be such that as much as eighty per cent may be lost, altogether too high a loss to be permitted where forage is as scarce as it is upon the ordinary Plains farm.

### SORGHUMS

Two kinds of sorghums are commonly grown. Both have about an equal resistance to dry weather and drouthy conditions. These are forage, or saccharine sorghums, and grain, or non-saccharine, sorghums. The latter are distinguished from the saccharine sorghums in that the juices are not sweet. They are ordinarily called grain sorghums because they produce heavy yields of seed or grain which is well adapted for feeding purposes. The sorghums have one very valuable characteristic—in drouthy periods they will cease growth and unless the drouthy period is exceedingly prolonged, will recover and continue growth if moisture comes later. The sorghums have a very large place in the forage crops of our dry land regions because of their ability to withstand drouth. They can not be successfully grown in some localities because of the cold climate resulting from the high altitudes. Where the sorghums will out-yield corn, they should be grown for forage purposes in preference to corn.

*Forage Sorghums or Sorgos.*—The forage sorghums can be grown practically all over the Colorado Plains. In some localities near the foothills and in some localities on the Platte-Arkansas Divide, the altitudes are too high and the climate too cool for the best development of even the shortest-season sorghums.

There are a large number of varieties and types of sorghum. Practically only two types are adapted to any of our regions. These are the Ambers and Sudan Grass. Of the Ambers we have Black Amber, Red Amber, and White Amber. The White Amber was produced by selection by Mr. Freed of western Kansas. It is called in many sections and in some Government literature, "Freed's Sorgo."

Sudan Grass is not commonly called a sorghum, but for the purpose of this bulletin, it can be classed with the sorghums. It crosses



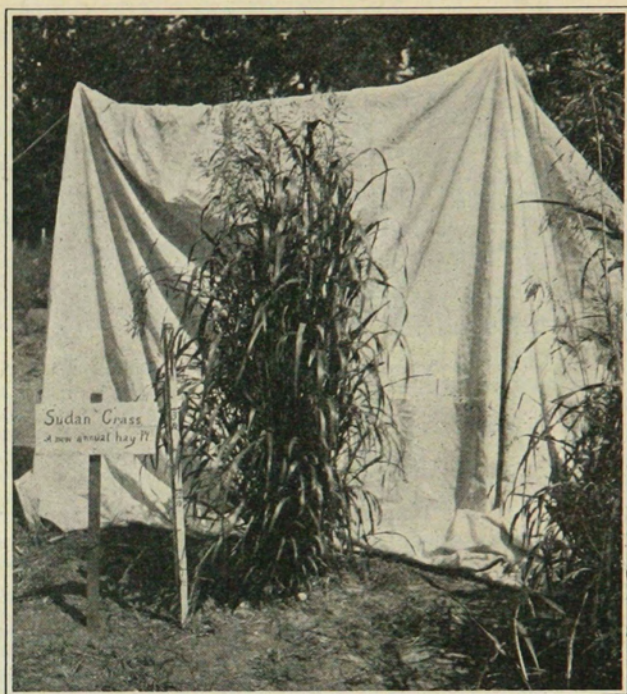
"Freed's Sorgho" grown at Akron, Colorado

readily with the Ambers or other sorghums, showing its close relationship.

Of the Ambers, the Black is the best variety. Altho in our experimental work at Cheyenne Wells, the White did well, it was not equal to our local strains of Black Amber. The Amber sorghums are best adapted to the southeastern portion of the State although they do well in the extreme eastern portion. They are less well-adapted as the altitudes rise close to the mountains, but even here they may be grown to some extent.

Sudan Grass has been tried in the State for 3 years. It was imported from Khartum in 1909. Sudan is a province in Central Africa, of which Khartum is the leading city. On this account the Department of Agriculture officials called the grass Sudan Grass. This grass has been tested for 3 years in Colorado and has given promise of being the best adapted hay crop of the forage sorghum types. It matures in a shorter season than Amber, stands drouth well, and grows vigorously. Its yield will, of course, be largely according to the moisture supply available and it will vary from 1 to 8 or 9 tons. The latter yield is only possible under irrigated conditions. Sudan





A single Sudan Grass plant, 7 feet high, showing heavy stooling habit.

Grass is not adapted to the higher altitudes next to the foothills nor in the Platte-Arkansas Divide, but is adapted to the rest of the Colorado Plains.

*Preparation of the Soil.*—The soil for sorghum should be prepared the same as for corn. Owing to the fact that all of the sorghums are what might be termed hot weather crops they require a warm soil before it is safe to plant. This planting should follow corn planting, usually from the 15th to the 20th of May is a safe time. Planting may even be delayed until early in June.

If seeded broadcast 20 to 30 pounds of Amber will make a thick enough stand. In most of the dry land regions, it will pay however, to plant the sorghums in rows so as to permit of cultivation. Six to 15 pounds per acre in rows, according to width of rows, will be amply sufficient upon most soils. Sudan Grass is smaller seeded and consequently a fewer number of pounds will do. If planted in rows 3 to 6 pounds will make a sufficiently heavy stand. If planted broadcast 10 to 15 pounds is abundantly sufficient.

*Not Safe to Pasture.*—Owing to the fact that the sorghums develop a poisonous principle which causes the liberation of hydrocyanic acid, commonly called prussic acid, it is unsafe in dry land regions to pasture with livestock. This poisonous principle seemingly





Sudan grass,  $7\frac{1}{2}$  feet high, grown near Rocky Ford, Colorado, on irrigated land, but without irrigation. Seasonal rain fall of 11 inches. Seeded May 15, photographed July 30

does not hold its effectiveness when the crop is cut and made into hay or made into silage. In other words changes occur so that the poison is no longer injurious.

*Harvesting.*—If not planted too thinly Amber Cane or Sudan Grass can be mowed and cured as hay. Either of these crops can be allowed to mature to be put into the silo if conditions warrant. When made into hay the crop should be raked, after allowing partial drying in the swath, immediately cocked and allowed to cure in the cock. Often Cane and Sudan Grass may be harvested with the grain or corn binder. The bundles are much more easily handled than the loose hay.

### GRAIN SORGHUMS

The grain sorghums for the most part require a longer season to properly mature than Amber Cane or Sudan Grass. The following varieties of grain sorghums have been tried in an experimental and



Kafir grown at Akron, Colorado



practical way: Kafir, Milo, Kaoliang, Shallu, and Feterita (Sudan Dura). Each of these crops is represented by a large number of varieties.

Of the Kafirs, the Black Hulled White Kafir has been the best. Black Hulled White Kafir can only be matured in Colorado in the extreme southeastern part of the State and in a narrow belt extending along the eastern border practically as far north as Wray. It can be used for a forage considerably further west.

There is only one type of Milo that should be grown in Colorado, and that is the Dwarf Yellow. The tall Milos require too long a season. Dwarf Yellow Milo, in Colorado, is the earliest maturing of the grain sorghums and can be grown farther north and west and at higher altitudes than any other grain sorghum, now grown. In Kansas, Oklahoma, and Texas, Feterita is as early or earlier than Dwarf Milo, but in Colorado the situation is reversed—Dwarf Milo, will mature in a shorter season than Feterita.

Brown Kaoliang is very promising for many sections. It has been possible to mature Kaoliang at higher altitudes and in cooler situations



Brown Kaoliang grown at Akron, Colorado

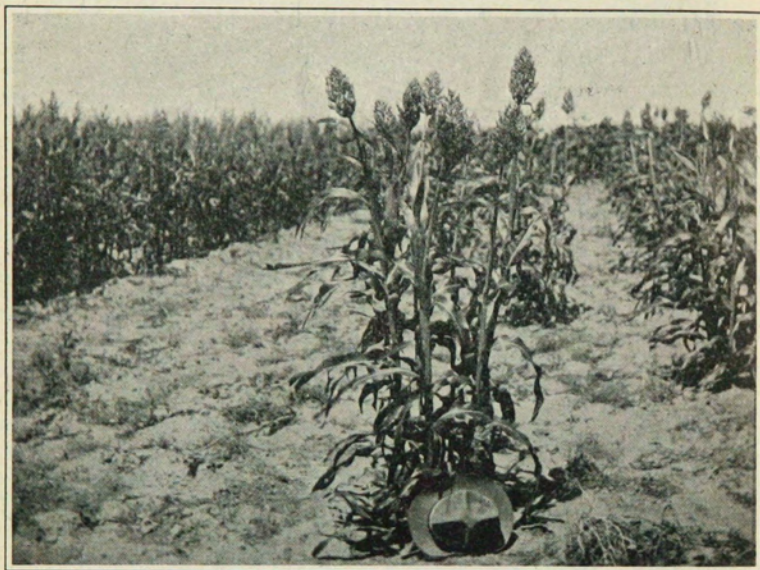
than other grain sorghums. It has about the same feeding quality and value as the Kafirs. Milo and Feterita are better adapted where the season is long enough to mature them. In very dry situations with excessively short seasons, Kaoliang may have a place. In such locations corn does not thrive and other sorghums are not adapted.

Shallu has been tried and gives some promise. At the present time, however, the Kaoliangs and Shallu can not be recommended for



the Colorado Plains as strongly as Kafir and Milo. It is advisable to confine the grain sorghum production largely to those two crops.

Feterita is a white seeded crop, resembling Milo very much, except that the heads are always erect. Milo and Feterita belong to the group of sorghums known as Duras. Feterita was first tried in Colorado under the name of Sudan Dura. It is adapted to practically



Feterita grown at Akron, Colorado

the same territory that Milo is adapted. It is more drouth resistant than Milo, but is somewhat more adversely affected by the cool climate. As a consequence, Milo is to be preferred for planting.

*Methods of Planting.*—All of the grain sorghums should preferably be planted in rows whether it is expected they are to be used for grain or forage. The rows should be at least  $3\frac{1}{2}$  feet apart. The rate of planting should be such that Kafir should have a space of 8 to 10 inches between plants—in very dry situations 12 to 15 inches; Feterita should be planted about as Milo. This rate of seeding will require 5 or 6 pounds of seed per acre ordinarily. For planting, an ordinary corn planter can be used provided with Milo plates. If Milo plates are not at hand, blank plates can be made into Milo plates by having a blacksmith drill holes of the proper size and spacing.

In the hotter, dryer sections of the Plains the grain sorghums will produce heavier yields of forage than corn. In such sections they should be grown for the silo or for fodder in preference to corn.

*Harvesting.*—When harvested for forage, these crops should be made into fodder, or preferably siloed. They should be allowed to

stand in the field under ordinary conditions until the seed is practically ripe. If put into the silo earlier, they will not make as much feed and there is a tendency to the formation of a sour silage.

In addition to being valuable for forage, the seed of the grain sorghums is valuable for feeding to all kinds of animals. It is possible to feed the seed of Amber Sorghum, but it is usually not advisable. The seed coat of Amber Sorghum is very hard and impervious to moisture. As a consequence Amber Sorghum seed is very much more difficult for the animals to eat than the seed of grain sorghums. Besides, the grain sorghums, where adapted, will produce a heavier amount of seed.

Milo and Fetera, when mature, have rather woody stalks and do not make a good fodder. They make a good silage, however. For fodder purposes, Kafir is a much superior grain sorghum. If hay alone is desired, it is better to grow Sudan Grass or Amber Sorghum than any of the grain sorghum varieties.

*Harvesting for Seed.*—When it is desired to harvest the grain or seed of the grain sorghums, it is best to allow the crop to get ripe, then, if possible, to cut with a binder and shock.

For feeding purposes the fodder having the ripe seed can be run thru a thrashing machine as soon as the stalks are well cured. Where the seed is to be used for seed, the heads should be picked out and stored under cover. Any of the grain sorghums, if stored in bulk, are very liable to heat, and only a very slight heating is necessary to render the germ infertile. Where a corn binder is not possible, the crop can be harvested by cutting by hand or by the use of a cutting sled. These methods are more economical of time and labor than to attempt to harvest the heads separately in the field. For seed purposes only it is possible to economically harvest heads from desirable plants in the field.

## MILLETS

Owing to the fact that they will develop with relatively small moisture supplies and that they will mature in a short season, Millets must be considered among the important dry land forage crops. Millets, as are the sorghums, are "hot weather" crops and will not do well at higher and cooler altitudes. For the most part their place among the dry land forage crops is to furnish hay for horses, cattle and other similar livestock.

*Varieties.*—The varieties commonly met with on the Plains are the German, Common, Hungarian, Siberian, and Hog Millet. Hog Millet is grown more frequently for the grain than for the forage. In some sections it will produce quite heavy yields of seed. It is not widely adapted for Colorado Plains conditions. Where it is adapted it is worthy of a place in the rotation. Elsewhere, it should not be grown at all. Most of the sections where it does well lie in the north-eastern part of the state.

In general, German Millet is recommended in preference to others. It grows more rank than the Common and consequently, where moisture supplies are fairly good, should be seeded a little thicker. If this pre-

caution is taken it will make as fine hay and usually a little more tonnage than Common. The other varieties are adapted, but do not possess any superiority. As a consequence, planting for hay purposes should be limited to the German and Common.

*Preparation of the Soil.*—The soil for millets must be prepared as thoroly, or more thoroly, than for sorghums and corn, as it is small seeded and must have a comparatively congenial seed bed if it is to produce a good crop. In order to accomplish the production of such a seed bed, plowing should be very early in order to allow the accumulation and protection of the moisture supply.

*Seeding.*—Millet should not be seeded until approximately the first of June for most of the Plains territory. It will not develop in a cold soil, and since it matures in a short season, planting can be delayed until the soil is thoroly warm, which is about the first of June. Preferably the seed should be put in with a press drill, using about 25 to 30 pounds of seed per acre. It can, however, be seeded by broadcasting and harrowing the seed in, or better still, rolling it in and following the roller with a harrow.

*Harvesting.*—Millet makes a valuable hay if it is cut at the right time. The right time is about the time the seed is in the milk. It allowed to mature farther than this the seed is liable to injure livestock to which it is fed. This is especially true of horses. When cut at the proper time, just as the seed is reaching the milk it makes a palatable, nutritious hay. The hay can be cut and allowed to partly cure in the swath, raked and cocked for complete curing. As soon as thoroly cured, it should be stacked to prevent loss.

## SWEET CLOVER

In Colorado, Sweet Clover has been considered a weed and a serious pest until very recently. Many, however, are coming to recognize that this crop has value. As a soil renovator there is no legume which will give as desirable and quick results as will Sweet Clover. It finds an excellent place in pastures, and when cut at the proper time makes a nutritious, palatable hay. Feeding experiments at a number of experiment stations have shown that Sweet Clover hay, cut at the right time and properly cured, will give equal results with alfalfa hay. There is a little more waste usually with Sweet Clover than alfalfa, but for the pounds consumed, just as good returns in meat or milk production are received.

Sweet clover is usually well adapted for the sandier sections and should be planted rather freely in native pastures. In many places where it is difficult to start alfalfa, or to get a crop of alfalfa, Sweet Clover will make a profitable legume crop in place of it. It can be planted in rows similar to row alfalfa, or planted broadcast. It is sufficiently valuable to be given a thoro trial wherever there is difficulty in growing alfalfa in rows. Probably in those localities where alfalfa does well in rows, it will not be worth while to grow Sweet Clover for hay, but even in such localities it will be well to attempt getting the crop started in pastures. If rightly managed, it will be possible

to materially increase the carrying capacities of many native pastures.

*Varieties.*—There are three varieties of Sweet Clover that may be encountered. The White Sweet Clover (*Melilotus alba*); the Yellow Sweet Clover (*Melilotus officinalis*); and Small or Annual Sweet Clover (*Melilotus indica*). The two first named varieties are biennial, that is the plants live two years. The third variety is an annual. The Annual Yellow Sweet Clover has no value for pasture or hay as it is very small growing and is less palatable than the other two varieties. For the most of the territory, White Sweet Clover is greatly to be preferred. It is a better hay crop as it grows taller, and stands more erectly. Yellow Sweet Clover does not grow so large and has a more spreading habit of growth. While it is less well adapted for hay, there are some localities where it will do better than the White, notably in extremely high altitudes. In the Platte-Arkansas Divide country at altitudes above 7,500 feet, Yellow Sweet Clover is preferable to the White as it will mature in a shorter season. Yellow Sweet Clover is better for pasture purposes than for hay purposes.

*Soil Preparation.*—When seeded for a hay crop or when seeded upon old lands, the soil should be prepared exactly as for alfalfa. When seeded in native pastures or in sandy regions among native grasses it can frequently be seeded on the snows in the winter time, or seeded early in the spring and harrowed. Usually this will give sufficient covering to permit the crop to start. Sometimes on land having a rather heavy sod, running over the land with a disk set rather straight, followed with a harrow, is found to be good practice.

*Seeding.*—Sweet Clover may be seeded in the spring or fall. There is little danger of its being injured by frosts. It can therefore be seeded as early in the spring as the land can be prepared and conveniently worked. Eight to 10 pounds of hulled seed are a great plenty for dry land conditions. Fifteen to 20 pounds of the unhulled seed should be used to make approximately the same stands. Sweet Clover has many so-called hard seeds, which germinate slowly. In this case the "hard seeds" are viable, but the seed coat is impervious to water. Owing to this "hard seed" condition, it is often possible to plant in the fall and get better stands than from spring seeding.

The crop should be given much the same care as alfalfa. The first cutting should not be made until the sprouts which are to produce the following crop commence to appear. Usually one crop can be received the first year if there was sufficient moisture in the seed-bed to properly start the development and maintain the growth thru possible dry spells. The second year two cuttings should be received, except in very drouthy years. The cutter bars should be set high in cutting the second year crop in order not to kill the plants. The plants start out from sprouts which come out on stalks close to the

ground. If cut below these sprouts the crop will be killed. If cut high there will be no danger of this.

Sweet Clover becomes very woody and a bitter principle (*cumerin*) which it contains is very strongly developed as the plant approaches full bloom. Consequently care should be taken to cut the crop as soon as the shoots for the next crop commence to appear. If this is done a more palatable hay of a very much less bitter quality with less waste will be produced.

### THE GRAINS FOR HAY

A large use is already being made of many of the grains for both hay and pasture. Winter wheat and rye each make fairly good late fall and summer pasture. These two grains are the only ones at all well adapted for pasture purposes, but they are very well adapted for dry land annual pastures. In the cooler regions, and in the northern and northwestern parts of the Colorado Plains, rye is probably preferable. In the warmer portions, winter wheat will be preferable. Wheat, oats, beardless barleys, rye and emmer will each make a good quality of hay if harvested when the seed is in the milk or soft dough stage. Often these crops will make profitable hay yields, the season taken into consideration, when the grain which is produced upon them would not be worth harvesting.

When grown for hay, these crops are planted and cared for as they would be for grain. For pasture purposes, winter wheat, and rye should be seeded in July; for hay purposes the latter part of September is preferable where the crop is to be harvested the following year. Barley and emmer can be seeded in March if conditions are such that the land can be worked. Oats should not usually be seeded until the middle of April at least, on account of possible injury from late spring frosts. Wheat and rye should be seeded at the rate of about 30 to 35 pounds of seed per acre. Oats should be seeded at the rate of from 40 to 50 pounds; hulless barley should be seeded at the rate of 50 to 60 pounds, and hulled barley at about 60 pounds for hay purposes. Emmer should be seeded at the rate of 60 to 70 pounds. Each of these crops should be seeded with a press drill to obtain best results.

### STOCK MELONS

Another source of possible late fall and early winter succulent feed, is Stock Melons. Stock Melons look very much like water-melons, but have a very much thicker rind. Experiments at Eads and Cheyenne Wells show that stock will eat these melons with relish. They make an excellent sod crop and if weeds are kept down will do well on old lands. They are best adapted to the hotter portions of the eastern and southeastern parts of the State. The land should be well prepared, and if sod land, the sod should be rolled flat immediately behind the plow. The melons should be planted in hills at least 10 feet apart each way. On sod land they need very

little cultivation. On old lands they will need sufficient cultivation to keep the weed crop down.

The keeping quality of the melons is good, if kept from freezing. Thus they may be fed out in the fall as desired, if properly protected from being frozen by straw or other covering.

### PEAS

Field Peas or Canada Field Peas are exceedingly well adapted to the high lands of the Platte-Arkansas Divide. They are not well adapted to the relatively lower altitudes of the eastern and south-eastern parts of the State. It is possible to grow them, but they are not sufficiently profitable to pay for cultivating them under normal conditions except in the Divide territory.

They should be seeded usually on well prepared land at the rate of 30 to 45 pounds per acre, using preferably a disk drill having a revolving cup type of feed in order not to crush the seed. Planting should be done just as early in the spring as weather and soil conditions will permit, as peas develop best in the cool of the year. Peas will do better at an altitude of 6500 to 8500 feet than they will at lower altitudes, because they develop better in the cool weather of the season. It is this feature which makes them adapted to the Divide, and poorly adapted to the other portions of the Colorado Plains.

### VETCH

Vetch has been recommended, but in the experimental work carried on thus far it has not given sufficient returns to pay at all. At the present we cannot recommend Vetch for Colorado Plains planting.

### PEANUTS

Peanuts is another crop which has been discussed a good deal and recommended by some for our territory. Peanuts is another hot weather crop. In Texas and Oklahoma and other southern States they do exceedingly well, but so far as experiments show, they do not give sufficient promise in our cool climate, with our short growing seasons, to warrant recommending them for much of our territory. They can be grown and occasionally matured as far in the State as Hugo. They do a good deal better in the extreme south-eastern part of the State, but even here are not yet well enough adapted to be unqualifiedly recommended.

### BROOM CORN

Broom Corn is very well adapted to the southeastern portions of the State and as far west as two tiers of counties from the eastern border. This crop should not be grown in preference to other sorghums for a forage crop, but in some localities Broom Corn is grown for a cash crop. In such localities if the fodder is harvested it will make a very useful and valuable feed. Except to be used in this way it can not be recommended because it is not so valuable as other adapted sorghums as an exclusive forage crop. Where it is grown

for the brush, however, it is worth while to take particular pains to save the fodder which can be dry cured or siloed as circumstances permit.

### SOY BEANS

Soy Beans can be grown in the Arkansas Valley from Pueblo eastward. Only the very earliest types, however, are adapted. We have succeeded in maturing some varieties at Cheyenne Wells, but the development of the crop was not such as to warrant recommending it for general planting even in that section. This crop may find a place in the extreme southeastern section, as the season is long enough in that region to permit maturing one or two of the earliest varieties. The Soy Bean is capable of withstanding considerable drouth, so it may find some use in that section.

### COW PEAS

Cow Peas is a southern crop. While called Cow Peas, they are in reality not peas at all, but a species of beans. They are killed by the very lightest frosts, consequently they are not adapted to any except the extreme southeastern portions of the Colorado Plains, and even there only one or two of the very earliest varieties can be grown. They do not possess sufficient merit to warrant very general recommendations even for this territory. Both Soy Beans and Cow Peas should be planted in rows and cultivated if their growth is attempted. Such a method takes less seed which is very expensive, and under dry land conditions will give as good or better returns. About 20 pounds of seed will probably be sufficient per acre if planted in rows for cultivation. The seeds are rather large and should be planted with a corn planter or with a grain-drill, stopping part of the holes. The revolving cup type of feed will not break or crack many of the seeds.

### PASTURES AND NATIVE HAYS

*Russian Thistles.*—Russian Thistles are one of the worst weeds of the dry lands. They are much worse pests in dry than in wet years. While they cannot be recommended for purposeful planting, there are occasional seasons when they may be utilized to help a deficient supply of forage. The years of 1911 and 1913 had such seasons.

Russian Thistles when utilized return the most feed when properly siloed. They may also be cut, cured, and stacked for hay. The thistles must be cut before the spines get developed and hard, otherwise there is serious danger to the stock to which the thistle hay is fed.

*Native Hays.*—Many of the native grasses of the Plains make very nutritious hays. But, except in low places or swales, the growth



is normally insufficient for hay. The Wheat Grasses, Bluestem, and Gramas are the most common native hay species.

*Native Pastures.*—There are still many places on the Plains where there are large areas of native pasture. Where these native pastures are open range, little may be done to improve their carrying capacity. Where under fence and private control it is possible to very materially improve carrying capacity by letting part of the pasture rest while the other portion is grazed.

Some improvement may often be made by seeding in Sweet Clover. This is especially true of the sandier localities.

In the high Divide country Brome Grass (*Bromus inermis*) does well. Here it may be seeded in the native pastures with a disk drill.



Brome grass grown by Mr. Chas. Green, Leroy, Colorado

The wet valleys in the sand hills often produce Brome quite well. Except under the conditions just mentioned, Brome Grass is very indifferently successful or a total failure.

*Tame Pastures.*—Tame pastures are among the most serious and difficult problems of dry farming.

No tame grass is ever successful. Brome and Orchard Grass may be grown in the few limited sections above mentioned. But they are not generally adapted. Yet they are the best tame grasses with which experiments have thus far been conducted.

For hog and horse pasture, alfalfa, in rows, may be used. Probably for those animals which may safely be pastured upon it, alfalfa will furnish more feed than any other permanent crop.

Sweet Clover will make some pasture practically anywhere on the Plains, even under conditions too severe for alfalfa.

It may be grazed with greater safety than alfalfa. But it is unsafe to graze Sweet Clover with either cattle or sheep when wet from dew or rain.