

Dry Farming in Colorado

*Pertinent Facts About Conditions to be Found
and Methods to be Used which Should
be Known by Every Person Who
Contemplates Locating on Dry
Land in Colorado*

By PROF. ALVIN KEZER
Head of the Department of Agronomy, Colorado Agricultural College



AMBER CANE ON A COLORADO DRY FARM

Published and Circulated by

**THE COLORADO STATE BOARD OF
IMMIGRATION**

Capitol Building, Denver, Colorado

MEMBERS OF THE BOARD

THE GOVERNOR (Ex-Officio)

L. WIRT MARKHAM, Lamar

T. B. STEARNS, Denver

H. U. WALLACE, Boulder

J. H. JENKINS, Commissioner

COLORADO STATE UNIVERSITY



U18400 5271274

LIBRARY

DO A. & M. COLLEGE
COLLINS, COLORADO

B110
K 44

Dry Farming in Colorado

By ALVIN KEZER
Head of the Department of Agronomy
Colorado Agricultural College

INTRODUCTION

Colorado still has a very large acreage of unoccupied and undeveloped lands. Much of these lands lie in regions where irrigation is not feasible. Consequently they must be farmed without irrigation, by so-called "dry farming" methods. In order to answer many of the questions raised by settlers and prospective settlers on these lands, this publication has been prepared. It is well known that complete information cannot be given in so short a space, but it is hoped that the essentials of the problem can be handled in such a way that prospective settlers will understand the possibilities and difficulties to be met, and some of the means necessary for the successful development of this great unoccupied domain.

DRY FARMING

Dry farming, as commonly understood, means the production of crops without irrigation, in a region where the rainfall lies between the approximate limits of ten to twenty inches per annum. If the rainfall is much less than ten inches, the type of farming becomes arid, and when the rainfall lies much above twenty inches, the type of farming followed falls in the class of humid farming.

Successful dry farming depends upon the success of adapted crops, the finding of the principles of water movement in the soil and understanding of the principles of moisture conservation and what practical methods of plowing and other cultivation must be followed to get paying results. Most new settlers in Colorado dry farming sections have attempted to gain success by grain farming. Long experience has shown that a permanent agriculture may be built up in dry farming sections only where a diversified system of farming is followed. This means a variety of crops, combining cash crops, feed and forage crops, with a properly balanced amount of live stock.

Types of Precipitation. Any discussion of dry farming must consider the time when rain falls, as well as the amount which

falls. In different dry farming regions we have at least three types of precipitation—the spring and early summer, the evenly distributed, and the winter season precipitation. In most of the Colorado dry farming sections, the spring and early summer type of precipitation prevails; that is, the precipitation commences to increase in March and increases month by month until July, when it decreases rapidly for the rest of the year. Such a type of precipitation throws most of the rainfall during the growing season. This type of precipitation prevails thruout the Colorado plains—the region lying east of the Rocky Mountains, and extending to the eastern border of the state. The same type of precipitation prevails in most of the foot hills and intermountain dry farming sections, altho there are localities in the mountains and on the western slope where the precipitation largely occurs during the winter season. A different type of dry farming and a different set of farm crops may be grown in regions having the spring and early summer type of rainfall. Here cultivated crops, grains, and diversified farming are easily possible.

Where the winter type of precipitation prevails, as it does in small areas, the types of crops which may be grown are limited to those which are capable of growing and maturing on the stored water supply of the soil.

Colorado Dry Farming Regions. The dry farming regions of Colorado may be easily divided into the “plains” which comprise the area lying east of the mountains, the “foot-hills” which comprise the valleys and swales in the foot-hill regions of the mountains, and, “intermountain districts.”

The plains region is characterized by great extremes of temperature and moisture. The climatic conditions of the foot-hills and intermountain regions are more equitable, but the season is short, due to high altitude. Precipitation is usually, tho not always, greater, but evaporation is nearly always much less than on the plains. Consequently, the plains furnish the most difficult dry farming problems.

The foot-hills and intermountain regions present problems largely of precipitation and length of season, while the plains present problems of evaporation, precipitation, violent changes of temperature and violent extremes of wind velocity.

Climate and Topography. Since the plains constitute an area of about 22 million acres, possibly three-fourths of the entire possible dry farming area of Colorado, and since they present most of the problems, the climate and topography of this region will be given more attention than that of the foot-hills and intermountain regions.

The Colorado plains constitute a part of what is known as "The Great Plains Area." They comprise all of that region lying east of the Rocky Mountains from the base of the foot-hills to the state line. These plains are largely smooth to rolling prairies. The Platte River has cut its valley northeasterly from the city of Denver to the state line. The Arkansas River has made a valley almost directly east and west, just about thru the center of the south half of the plains section. The valley of each of these streams constitutes a depression. Between them lies a more or less flattened ridge of land separating the drainage of the two rivers, known as the Divide, or sometimes better known as the Platte-Arkansas Divide. Many points on the Divide near the foot-hills reach an altitude of 9,000 feet and even above. Towards the east the sharpness of slope of the divide area, and its altitude, decrease until it is relatively flat at the eastern border of the state. These streams and their tributaries cause more or less breaks and rugged features to appear in the otherwise smooth or rolling plains' surface. These modifications also produce marked changes in soils.

The climate is mild tempered, but subject to very sharp extremes of heat and cold, moisture and dryness. The normal rainfall, according to government and state records, varies from a minimum of close to 8 inches to a maximum of above 18. In years of drouth, the rainfall is decidedly less than the normal. In so-called wet years, rainfall is greatly above. In 1911 the rainfall of the growing season thru the central portion of this region was 7.69 inches. In 1916, it was 7.38 inches. In the years of 1914 and 1915, however, the rainfall was nearly three times this amount, during the growing seasons. These just about mark the extremes of rainfall to be expected, as these four seasons exhibit two of the driest and two of the wettest years since rainfall has been recorded in the state.

The region is a vast plain, unprotected by timber or hills. As a consequence, it is subject, especially during the spring and fall months, to violent winds. A knowledge of these climatic features is necessary in order to arrange proper methods of cropping and soil treatment. The minimum altitude of the section is about 3,500 feet, and the maximum is a little over 10,000 feet; consequently the seasons are relatively short and the nights cool.

Dry Farming Soils. The first essential of success in dry farming is a soil adapted for the production of crops in regions of deficient rainfall. The first essential is that the soil shall be of proper and uniform texture to a considerable depth. The soils best adapted to Colorado dry farming conditions run from sandy

loams to silt loams in texture. No matter what the texture of the soil, however, it must be uniform to a considerable depth. A shallow soil will not hold water enough to carry crops thru periods of prolonged drouth. A layered or stratified soil gives rise to a different series of water relations, which prevent the crops from getting and taking out the water supply in the soil, except during wet years. Gravels, heavy clays and adobes are very poorly adapted for dry farming. A shallow soil overlying gravel, rock, shale, or clay, will only produce crops in wet years.

For the most part, the soils of Colorado dry farming regions are deep and rich. They are rich because they have been formed in an arid or semi-arid climate, consequently the mineral elements of fertility have not been leached out. Most of these soils are deficient in organic matter (vegetable matter). For the most part these soils are rather light in nature, sandy loams and silt loams being much more numerous than adobes and clays. In some localities there are areas of gravel. In a few localities there are areas of almost pure sand. Such areas are often wind blown into sand dunes or sand hills. A few regions have soils of almost pure silt. These regions are characterized by soils of great depth, very desirable water relations and great certainty of productivity, rainfall considered. On a few soil surveys have been made. These have been made by the United States Bureau of soils in Larimer and Weld Counties, in the Arkansas Valley, in the San Luis Valley and in the Grand Valley.

Owing to the prevalence and tendency of high winds, methods to prevent soils blowing must often be devised and practiced. Control methods consist largely in keeping the immediate soil surface rough on all cultivated land which is in crop. - Anything which will break the force of the wind at the soil's surface is effective. Over much of the plains area fall plowing is inadvisable because of the tendency and danger of soil blowing. In such sections fall listing may be successfully practiced, making furrows crosswise of the direction of prevailing winds. Soil listing not only conserves moisture, but it prevents blowing, keeps down weed growth and leaves the soil in good shape for catching any winter precipitation.

In the spring, a seed bed may be prepared by breaking out the middles and leveling down the land with disk and harrow, or, in many instances, simply by leveling down the land with disk and harrow. Where soils have a tendency to blow during the summer season, the tendency can be largely overcome by planting crops in strips so that strips of corn or sorghums are interspersed with strips of grain. These methods will almost entirely prevent soil blowing except in sand hill sections where the soils are almost pure sand.

SOME PRINCIPLES OF SOIL MOISTURE FOR DRY FARMING

Dry farming never means farming without moisture. But it always means farming where the supply of natural moisture is deficient or low. Consequently, any discussion of dry farming that does not take into consideration the principles and conditions under which moisture is obtained, conserved and used, fails to meet all of the problem.

In saving soil moisture, the first and most important process is to get it into the soil. If a rain of 3 inches falls and only one inch penetrates the soil, the land is worse off than if it had a one-inch rain, all of it entering the soil. The two inches which did not soak in, ran off the top, carrying with it some soil, beating and puddling the surface, thus favoring the formation of a soil crust. Consequently all cultivated land should be kept in the best possible condition to catch rainfall. What is that condition? Moist soil takes water rapidly, while dry soil takes water slowly. The first effort then should be to keep the soil always moist. This may be illustrated by experiments made during the summer of 1907. The summer was wet early but dry from July on until September 23th. In the experiment the stubble of grain fields was given this treatment: One field was disked behind the binder. As soon as the grain could be taken off, the field was plowed. Each half day of plowing was disked and harrowed. The plowing was done in July. A second field was not touched after harvest until the first of September. No treatment was given after plowing. The soil of the first field was in fair tilth. The soil of the second field was in poor tilth, being very dry, lumpy and cloddy. Rains came September 28th and 29th, and October 3rd and 4th. In all a fraction over 4 inches of water fell in the period. Field one was in fairly good condition before the rains. The four inches of rain wet the soil in this field so the surface moisture went down slightly over 2 feet. In field two the same rain only went down about 8 inches. Thus, field one was in very excellent condition for fall seeding, while field two was too dry to justify fall seeding in spite of four inches of rain. In other words, in field two, four inches of rain had only been sufficient to put the soil in shape to catch future rains.

The time of breaking is very important. Plowing should be done in the spring or early summer for fall crops, and in the summer and fall for spring crops. Where there is danger of soil blowing, listing or middle breaking may be used in place of plowing.

Water moves very much faster in a moist soil than in a dry one. Very dry soils actually repel water at first. It might be asked, how is it possible to keep a soil moist? Never let it get dry. Keeping soil from becoming dry requires careful methods of cultivation and cropping.

Surface Treatment to Catch Rainfall. What kind of treatment the surface soils shall be given to assist in catching rainfall or snow fall depends upon the kind of soil—whether sandy, silt or clay; upon the kind and time of plowing, whether the plowing is on breaking or old land, and upon the kind of crop grown.

Sandy lands are open and porous. They take rainfall readily. Such lands may be plowed relatively shallow, because they will take rain practically as fast as it falls. Silty and clayey soils are less open. Under natural conditions such soils will not take rain as fast as it falls unless the rain is a drizzle. To make such heavy, close-textured soils take water as fast as it falls in normal rains, it is necessary to plow very deeply. Deep plowing makes a rough layer which takes in rainfall rapidly. This loose layer forms a temporary reservoir holding the water for a time and then passing it on slowly to the more tight subsoil.

Kind of Plowing for New or Old Land. Plowing on old lands should be as deep as possible. If the plowing is done long enough before seeding to permit nature to do the settling and compacting, it can scarcely be too deep on silt and clay lands. If, however, breaking cannot be done a considerable period before seeding, it should be relatively shallow, because usually it cannot be properly settled and compacted immediately prior to seeding. The disk following the plow will be of service. But it does not equal time and rainfall. Besides plowing breaks the existing moisture relations and time is essential for readjustment. Unless followed by rain, deep plowing immediately before seeding will give poorer yields than shallow plowing.

Movement of Water in the Soil. After the water is caught by the soil, it undergoes certain movements. When it moves downward thru the spaces between the soil particles by its own weight, we say it percolates. When it crawls upward or downward or sidewise like water in a lump of sugar or oil in a lamp wick, we say it is capillary or film movement, because it moves along as a thin film over the surface of the soil particles. Sometimes changes in temperature cause soil water to move. In that case we say there is temperature movement or thermal movement.

Water is held in two ways in the soil—as a film which surrounds the soil particles and in the tiny spaces between soil particles. When it rains, water enters the soil. When the surface

gets more water than it can hold, it loses some by percolation to the soil below. That is, some of the free water flows from the soil spaces above to the soil spaces below. This process continues as long as it rains and often for a time afterwards, depending on the amount of rain.

When percolation ceases another movement begins. The films begin to crawl from particle to particle as water in the lump of sugar, only much slower. Very dry soils wet very slowly. But when the particles are very slightly moistened, they tend to draw water from the moister towards the dryer soil particles. This movement continues until the pull away is balanced by the pull to hold.

Most deep soils in regions of moderate or slight rainfall never have their subsoils thoroly wet. In fact, they are rarely ever moistened beyond a depth of a few feet. The rains wet the surface. A portion of the water percolates a little further in. After percolation ceases, the water penetrates a little further by film movement. In such deep soils free water moving in the soil spaces does not exist for any length of time. The water is all held as thin films around soil particles. These are stretched as thin as they can be by soil attraction, because there is always dry soil below trying to pull it away from the moister soil above. The condition is a balanced one, one portion of the soil trying to pull the water away and the other resisting with equal strength. This condition, we call the minimum capillary or film capacity. In a sandy soil this minimum film capacity varies somewhat, but is from 7 per cent to 11 per cent. This percentage of water ranges from 0.84 inches to 1.32 inches per foot of soil. In a silty soil the percentage is higher, ranging around 12 per cent to 18 per cent, depending on the proportion of silt in the soil. This equals from 1.44 inches to 2.16 inches of water per foot of soil. In a clay or adobe soil the percentage of minimum film water amounts to 18 to 25 per cent and even more where the percentage of clay or adobe is very high in the soil. The percentages equal from 2.16 inches to 3 inches of water per foot of soil. Thus it is seen that heavy soils, as silt and clay, retain more water per foot than light sandy soils.

Available Water. But all the water a soil contains is not available for the growth of plants. Plants can only take out a portion. Some plants can take out more than others. For instance, sorghum will dry out a soil more than wheat. Wheat will take away more water than corn. Russian thistles and sunflowers will dry out a soil worse than any of those crops which we try to grow for profit. Most crops will dry out a sandy soil so that only 2 to 4 per cent of the moisture remains.

From the minimum capillary capacity we see that a sandy soil would have from 5 to 7 per cent of available water, amounting to 0.6 inches to 0.84 inches per foot. A silty soil would be dried under similar conditions to 7 to 12 per cent, depending upon the physical composition of the soil, giving from 5 to 9 per cent of available water amounting to from 0.6 to 1.08 inches of water per foot of soil. A clay soil, under similar conditions, would retain from 12 to 18 per cent, depending upon composition, leaving available from 6 to 7 per cent or slightly more, equivalent to from 0.72 inches to about one inch of water per foot of soil. While there are great variations in individual soils, it is seen that, under dry land conditions, the available water is nearly the same in widely different soil types.

Amount of Water It Takes to Grow Crops. Investigators in dry land crops agree pretty well that it takes from 300 to 400 up to as high as 1,000 pounds of water to produce a pound of dry matter in the crop. That is, the crop uses up that much water in growing a pound of dry matter.

Thus a sandy soil which contained from 0.6 to 0.8 inches of available water per foot would have to contain this amount of available water 5 to 7 feet in depth to grow a 15 bushel crop of wheat from the soil water unless helped out by rain. The same principle holds with other soils and other crops altho the limits are somewhat different for each soil and crop. This principle is: A dry land soil must be deep in order to hold enough water to insure crops. Crops will dry out a shallow soil quickly. Then, if no rains come, the crop dies.

The dry farming soil must be of uniform texture also, a layer of gravel or gypsum below the surface will cut off the effective depth of soil. This was very well shown the season of 1911 at Rocky Ford. In a field of alfalfa two spots were noticed where the crop was not growing. Borings revealed a gravel layer under one spot and a gypsum layer under the other spot. These layers of different texture broke the continuity of the soil mass and prevented the roots getting water at lower depths.

Under normal dry farming conditions, there is very little movement of the soil moisture except after rains. The soil water does not move to the plant roots. The roots move to the moisture. If one will take a dish of wet soil and sprinkle dry soil on top, water will move up into the dry soil. If this is then scraped off and dry soil again sprinkled on top and scraped off when moistened, a point will soon be reached when the dry soil will no longer be moistened. We will then have a condition comparable to dry farming soils (except immediately after rains). This

is the minimum capillary or film condition already mentioned. In such condition the soil water does not move unless more water is added or the temperature changes so as to alter the soil water relation.

Loss of Water by Evaporation. Experiments were made in California to determine the water loss by evaporation. The experiments were run from June to September. The average evaporation from a free water surface was about 2.88 inches per week. The evaporation from a saturated soil surface was 4.88 inches per week. When the moisture in the surface soil was about 11 per cent, the evaporation was less than 1 inch per week; when the percentage of water in the surface soil was slightly above 4 per cent, the loss by evaporation was less than 0.25 inches per week. In other words, a dry surface soil prevents surface evaporation.

Most dry land soils do not lose their moisture by evaporation. The moisture is lost by plants which use up the soil water in growing. In order to conserve soil water, plants must be kept from growing while it is being conserved.

Advantage has been taken of the soil properties which have just been mentioned to store up the water falling one season to be used the next by summer tillage or summer fallowing. If the land is cultivated one season to keep down weeds, to keep a dry surface and to put the soil in better shape to catch rainfall, a large part of the precipitation of the season can be caught and saved to be used the next season. Just how much can be caught and saved depends on how the precipitation comes. When the precipitation falls in quarter-inch or half-inch rains, very little can be saved, because most of it will be lost when the dry surface is produced. Very heavy, dashing rains run off faster than they can soak in even when the soil is in the best of shape to take in moisture. More water can be saved from a heavy slow rain or drizzle than from any other kind of precipitation. On the average, on good normal soils, it will be possible to store from 50 to 70 per cent of a season's rain to be used the next. Thus, if the normal rainfall is 15 inches, the clean summer fallow will make from 20 inches to 22 or 23 inches of water available for the use of the growing crop. The clean summer fallow greatly increases the certainty of getting crops.

It has been found by experiment and proved by experience on many farms, that it is possible to get practically all the benefits of a clean summer fallow and at the same time raise some crop on the land. The crop, of course, must be a cultivated crop. Pinto beans, corn, grain or forage sorghums may be used as a crop. When they are used to accomplish the objects of a clean

summer fallow, about half the usual number of rows of corn are put on the land. The method may be illustrated by using corn. Corn is ordinarily planted in rows $3\frac{1}{2}$ feet apart. Where it is desirable to grow corn, and still get part of the benefits of a clean summer fallow, the corn is planted in rows 7 feet apart. The space between the rows is kept cultivated so as to keep down all weeds. About three-fourths as much crop may be grown by this method of tillage as by the thicker planting. Crops such as wheat and other small grains after corn grown in this way do just as well as after clean summer fallow. This method has a very decided advantage over the clean fallow in that a paying crop may be grown. Thus the work of keeping the land clear by this method is paid for by the crops grown, while the clean summer fallow method produces no return the year of the fallow.

The farming methods which will enable the most crops to be produced, and make the best out of the available water with the least amount of work are to be preferred. Many successful dry land farmers, especially on the lighter lands, follow a system which reduces the amount of plowing and still conserves moisture and prevents weed growth. For these lighter lands the suggested system is about as follows: The system makes use of a partial summer fallow. If we start a description of the system at the point where the land has been partially summer tilled, we may carry the process thru its logical steps. After the partial summer tillage, winter wheat is the first crop. When the winter wheat is harvested the land is double disked immediately after the binder for the purpose of killing all weeds which spring up and to put the surface in good condition to catch rainfall. The next spring the land is double disked early to kill all weeds starting. If weeds start later, it is disked again and harrowed; after which, corn or some other cultivated crop is planted. After corn, small grain of some kind is planted, the soil being prepared by disking and harrowing. The yields of grains, after corn, are nearly as much as after a fallow. When this latter small grain crop is harvested, the land is at once double disked. No other treatment is given until the next spring. Then, as soon as weeds start, the soil is disked to kill weeds, and the better to catch rainfall. In June and July the land is plowed thoroly and deeply. It is disked and harrowed immediately behind the plow. Upon this plowed land, so prepared, winter wheat is planted in September, and the system starts in again where we began.

Under this system the land is only plowed once in every three years. The system produces excellent results on the lighter lands, reduces the danger of soil blowing and can be carried out very much more cheaply. Some of the heavier lands such as the clays

and adobes require more frequent plowing. On such lands the loss ordinarily caused by the summer fallow can largely be overcome by planting a cultivated crop and spacing rows double the usual distance.

It must be remembered that the supply of water in all dry farming sections is limited or likely to be limited. Consequently, if more crop is planted on the land than the soil is capable of supplying water, yields will be reduced. Thus the stands of crops, to produce best yields under dry farming, must be much thinner than is required in humid or irrigated regions. If too many plants are on the land, none will get enough water and all will fail. The best success is obtained with relatively thin stands. It is impossible to give the exact amount of seed which should be planted for dry farming conditions, because the amount varies widely according to the severity of the climatic conditions, the type of soil and the total precipitation.

The following list, however, can be taken as a general guide and is suggestive of the practice which should be followed, namely, to make the stand of grain proper for the conditions of soil moisture.

AMOUNT OF SEED TO USE FOR THICKNESS OF STAND FOR DIFFERENT CROPS UNDER DRY FARMING.

Wheat, 20 to 35 pounds.

Oats, 40 to 60 pounds.

Barley, 40 to 60 pounds.

Rye, 30 to 40 pounds.

Corn, stand, for ordinary cropping, rows $3\frac{1}{2}$ feet apart, stand in the row, 20 to 24 inches, drilled.

Corn, to be used on land in place of summer fallow, rows 7 feet apart, stand in row 20 to 24 inches, drilled.

Cane, for seed, broadcasted, 15 to 20 pounds.

Cane, for seed, drilled, 6 to 15 pounds.

Cane, for hay, broadcasted, 30 to 40 pounds.

Kafir, for hay, in rows $3\frac{1}{2}$ feet apart, 2 to 4 inches in the row.

Milo, for seed, in rows $3\frac{1}{2}$ feet apart, 4 to 8 inches in the row.

Kafir, for seed, in rows $3\frac{1}{2}$ feet apart, 6 to 12 inches in the row.

Kafir and milo require from 3 to 10 pounds of seed per acre, depending on the thickness of planting.

Feterita, for seed, in rows $3\frac{1}{2}$ feet apart, 8 to 12 inches in the row.

Flax, 20 to 30 pounds per acre.

Millet, 15 to 30 pounds per acre, depending on conditions.

Alfalfa, broadcast, 3 to 5 pounds per acre. In rows 3 to $3\frac{1}{2}$ feet apart, 2 pounds per acre. If the seed is good, and proper tools for drilling are available, half a pound of seed per acre will make the stand thick enough.

Potatoes, in rows $3\frac{1}{2}$ feet apart, 1 to 2 feet in the row, 300 to 400 pounds seed per acre.

Pinto beans, in rows 3 to $3\frac{1}{2}$ feet apart, 6 to 10 inches in the row, approximately 15 pounds of seed per acre.

Field peas, preferably, in rows, and cultivated, 20 to 30 pounds per acre.



A THRIFTY FIELD OF ALFALFA IN ROWS ON A COLORADO DRY FARM

GENERAL FARMING 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 cannot 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 provision 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—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 sure 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 Substation 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 question of dry farming and its success then can be summarized in the following brief statement of conditions. Forage crops are best adapted to the soil and climatic conditions. Under the best management they should be grown and placed in the silo to be fed later to live stock. The live stock will constitute a constant market for successful crops which have no other available market. Cash crops should be grown, but they should be put on as an extra, or extra enterprises, rather than the chief dependence of the dry farmer. In most seasons some saleable crop will be available from these so-called cash crops. Such income will be a welcome addition to that brought in by live stock. Of the cash crops which may be grown, winter wheat, pinto beans, flax in some of the northeastern sections of Colorado, broom corn in many sections, and some of the grain sorghums in the southeastern part of the state, will constitute the larger portion possible. In a few localities corn may be successfully used as a cash crop, tho. in most sections it will make the greatest returns harvested entire and siloed.

SOME SPECIAL FEATURES OF MANAGEMENT INFLUENCING THE SUCCESS OF DRY FARMING

During the past few seasons, the Experiment Station has been making studies of a number of dry farms in five counties in the dry farming district of Colorado. These studies have had several objects in view; primarily, however, they hope to discover the fundamental principles of success in the organization of the farming businesses under dry land conditions. Already these studies have resulted in much valuable information. We have long known that one of the causes of failure on dry lands was the lack of sufficient means or capital to survive the first year or two of development. These studies have further shown that the farming business under dry land conditions increases with the amount of capital invested. We have a way of measur-

ing the profitableness of the business, that is, by a study of the labor incomes. The labor income is considered as the net farm income, less interest on the capital invested in real estate and working equipment. In other words, labor income is that income which the labor earns whether that labor is physical or managerial.

On dry farms in eastern Colorado the labor income has increased uniformly with the increases in capital up until the capital reached about \$20,000. In other words, the greatest returns from the labor used on dry land farms in Colorado, has been obtained where the capital in the shape of real estate and equipment amounted to about \$20,000.

But the amount of capital used is not the only thing which influenced the size of the labor income. Uniformly, in the five counties studied, the labor incomes increased as the number of acres in crops increased, and the labor income increased uniformly as the number of acres in crops tended by one man increased. In other words, the man who could so conduct his business as to handle more acres, either by a better system of working, or by diversifying his crops so as to distribute the work thru longer periods, was rewarded by a higher labor income.

In those counties where dairy stock was kept, the labor income was almost in exact proportion to the receipts from dairy products. Dairy stock has uniformly been more profitable than beef stock, as the following comparison, taken from El Paso County, will show. The illustration is typical of other counties:

On 14 farms the average receipts per cattle unit (a cattle unit is a full grown animal, or its equivalent in young stock) was \$44.00, and the average feed cost per animal unit was \$28.00, or an average net return of \$16 per animal unit. On 14 farms in the same locality beef cattle returned an average of \$28 per cattle unit, while the feed cost per animal unit in the case of the beef animals was \$21, leaving a margin of \$7. On the dairy cattle farms, 94 per cent of all live stock was dairy cattle. On the beef cattle farms 96 per cent of all live stock was beef cattle. Dairy cattle adapt themselves much better to a small business than beef cattle. In a large business both may be successfully used. If properly managed both are capable of profit.

A thoro study of these investigations brings out the further fact that the proper proportion of live stock to crop acres must be maintained to get the largest profits. On the average this has been found to be about 8 crop acres per animal unit. The average crop value per acre in the five counties studied was about \$12.30. It is not yet possible to give average costs for producing this average crop value. But it is possible to give the amount of

work normally required. The item of work covers everything except interest or rentals, depreciation and similar items of cost. Labor costs differently in different neighborhoods, so that it is at present almost impossible to place a fair average value for the labor expended. Accordingly there are listed below figures which show the number of hours of man labor and the average number of hours of horse labor required to produce a few standard crops.

The following table gives several crops, the number of acres of each kind of crop used, and the amount of labor required per acre per year for the production.

Kind of Crop.	No. of acres studied for each crop.	No. of man hours per acre per year.	No. of horse hours per acre per year.
Corn	13,000	15	42
Spring wheat	470	12	26
Winter wheat	370	10	23
Oats	1,200	15	28
Barley	140	10	28
Rye	180	12	23

Oftentimes by taking advantage of good management principles the same amount of labor can be made to accomplish a greater amount of work. For instance, the farmer who arranges his cropping in a rotation system so as to require plowing only once in three years, and still keeps up his production and soil fertility, will produce his crops with much less labor than the man whose system requires him to plow all of his tilled land each season. It has been shown above that the labor income was increased when the crop acres tended by one man was increased. To increase the crop acres per man requires some extra equipment usually, but more often a better arrangement of work and farming system. The largest labor incomes have not been produced on farms getting the highest yields. They have been produced, however, on those farms getting just about or a little above the average yield. Extra high yields are usually produced too expensively to return a profit. The law which economists call the law of diminishing returns comes into play. Briefly stated, this law is: Extra work or capital applied to an enterprise sooner or later reaches a point beyond which the addition of capital or labor produces increases in product at greatly increased expense.

The most profitable businesses on the dry lands have been those which had considerable diversity—at least from three to five sources of income. These different sources of income can be kept up by the growth of live stock, forage crops and cash crops.

Newcomers Should Get in Touch with the Colorado Agricultural College

Persons coming to Colorado with the intention of engaging in any of the various agricultural pursuits should immediately get in touch with the Colorado Agricultural College. Through co-operation with the United States government, the Colorado Experiment Station, located at the college, is constantly engaged in experiments and investigations the aim of which is to make more successful and profitable the agricultural industries of the Centennial State. Bulletins containing the results of these experiments and other information on agricultural subjects are mailed free to all residents of the State who request them. Through the Extension Service, also maintained in co-operation with the United States government, twelve county agricultural agents are now aiding the farmers in eighteen counties of the State, specialists in animal husbandry, farm management, demonstrations, markets and marketing and home economies are helping the farmers and farm women, and many valuable publications are being issued. To obtain Experiment Station bulletins, simply write stating your request, to the Director, Colorado Experiment Station, Colorado Agricultural College. For information from the Extension Service, address the Director, Extension Service, Colorado Agricultural College. The College is located at Fort Collins, Colorado.

THIS BULLETIN PREPARED FOR THE
COLORADO STATE BOARD OF IMMIGRATION
BY THE COLORADO AGRICULTURAL COLLEGE

LIBRARY
COLORADO A. & M. COLLEGE
FORT COLLINS COLORADO

