Dry Land Farming

By Prof. Thomas Shaw.

SOILS IN DRY AREAS.

The discussion of soils in dry areas will be essentially popular in kind. The attempt will not be made to classify these soils on what may be termed a strictly scientific basis. They will be discussed on the basis of the popular conception of their leading characteristics. Hilgard suggests the following classifications: (1) soils very sandy; (2) ordinary sandy soils; (3) sandy loams; (4) clay soils and (5) heavy clay soils. The first of these has from 0.5 to 3 per cent of clay; the second 3.0 to 10.0; the third 10 to 15 and the fourth 15 to 35. The present discussion will regard them as: (1) clay; (2) sandy; (3) silt; (4) volcanic ash; (5) gumbo, and (6) alkali. It will be preceded by the consideration of some of the characteristics peculiar to western soils and subsoils and followed by the discussion of natural production as an index of soils.

Some Characteristics of Western Soils

The soils in dry areas frequently differ from those in humid areas: (1) in color; (2) in their mineral constituents; (3) in the supply of organic matter, and (4) in their moisture-holding power. In other respects they may be similar to the latter, as in their physical constituents.

The avgrage soil of the Mississippi valley is dark in its color. This is essentially the outcome of the large amount of organic matter which it contains in one or the other of its forms. One who is familiar only with such soils, looks suspiciously on those of the semi-arid west. He is much prone to conclude that they are also difficult to till. These conclusions are far from correct. These soils, which are usually brown in color, with variations, of course, that are lighter and darker, are much richer in the essential elements of plant food, especially those that are mineral in character, than the soils of humid areas, and in many instances it is easier to maintain them in proper condition as to tilth after they have been broken. The sparse character of the vegetation that frequently grows on them in a state of nature still further enhances the contempt which many persons from humid regions cherish for the soils of the semi-arid country when they first see them.

Soils in dry areas are much richer in soluble salts, alkalies and mineral plant food than the soil of humid areas. They have all the minerals contained in the rocks from which they come, and of soluble salts there may be even an accumulation. They have not been washed out as in humid areas. The soluble silica and alumina which indicate the availability of these soils are about 2½ times greater in the former and about 4 times greater in the latter than in the soils of humid climates. Soda and magnesia, which up to a certain limit stimulate plant growth, are also plentiful. Where the accumulation of these is excessive, vegetation partly or wholly disappears. Phosphate, potash and lime are also more abundant in dry than in humid soils. It has been claimed that the phosphate is from 1 to 2 times greater on the average, that potash is more than 3 times greater, and that lime is frequently from 10 to 12 times greater. It is fortunate that so much lime is present in semi-arid soils. Among the benefits resulting from its presence are the following: (1) It aids in the quick conversion of organic matter into humus, and this in many instances represents the main portion of the nitrogen content of the soil. (2) In so doing it encourages the presence and action of bacterial life, which is an important factor in maintaining and developing soil fertility. (3) It aids in liberating and rendering more available the phosphoric acid and potash in the soil through the chemical changes which it brings about. (4) It tends to prevent acidity in soils where much organic matter is buried in the same, a condition that is often seriously detrimental to plant growth in humid climates. In the semi-arid belt the amount of lime present is relatively very large before it proves injurious. In many humid climates the application of lime may in many instances be necessary in order to insure good returns. It is seldom necessary to add lime thus to semi-arid soils. Western soils are comparatively low in humus.

Because of this it is a matter of prime importance that the humus supply in these shall be increased if maximum production is to be obtained from them. The moisture-holding power of much of the soil in the semi-arid country is very marked. This follows from the fact: (1) that while it is sufficiently porous it is not unduly loose, a condition arising from the character of the soil grains which compose it; (2) that it is possessed of sufficient firmness, without that undue consolidation which is a barrier to the penetration of moisture; (3) that it is close grained, but not run together and so adhesive that it cannot be readily penetrated by the roots of plants. This moisture-holding power is increased by proper cultivation and increasing the supply of humus in the soil.

The following are among the essential characteristics of a good dry land soil: (1) It must be easy of tillage. Such will be its condition when the sand and clay constituents are properly blended. Western soils have usually enough sand in them to make them easy of tillage when they are sufficiently moist. They also excel in flocculation, that is the looseness or fineness of the particles. (2) It must be easily penetrated by moisture when subjected to the process of tillage. Many soils that are so firm as to resist the easy penetration of water when not yet broken are easily penetrated by the same when tilled, a result of the structure of the soil grains as neither too coarse nor to fine. Some soils are so fine that through impaction they resist the easy penetration of water. Such are clays of fine texture. Other soils may be so open that they lose moisture by leaching almost as fast as it comes to them. Such are coarse sands, but they are not very prevalent. (3) It must be able to retain moisture. This will follow when the soil grains are neither too large nor too small, too adhesive nor too much filled with air spaces. This condition is best found in sandy loam soils well supplied with humus. The deeper that the soil possessed of these properties is, the more moisture will it contain. Such a soil and subsoil will readily store a good supply of moisture for further use, and it will also furnish ample feeding ground for the roots of plants. (4) It should not have in excess those elements that lead to a gumbo or an alkali condition. Such soils are very hard to till owing to the difficulty of keeping them in a proper mechanical condition. (5) They should not be so light and fine as to lift with the wind. Such a condition would add greatly to the difficulty of cultivating and cropping such soils in dry areas. (6) They should not wash readily when rainfall is abundant. This is one of the weak characteristics of many western soils. The particles are so light and so little adhesive that they are easily held in solution and hence are easily carried away. This is often true of soils that are productive. This tendency may be lessened in various ways, but more especially by adding humus to the soil. (7) It should be rich in plant food not only in the tillable portion but in the subsoil. This characteristic is usually present in a marked degree, not only in western soils but also in the subsoils that underlie them.

Characteristics of Subsoil.

In dry areas the physical constituents of soil and subsoil are frequently much alike. The same is true of their chemical constituents. The surface soils have more humus in them and more of the mineral plant food is in an available form, but the difference in these respects is oftentimes not very marked. That it so is very fortunate, as deep storage is thus made for moisture and much opportunity is given for that soil moisture movement which carries plant food in solution up to the surface soil. It also furnishes deep feeding ground for the roots of plants.

Should the subsoil be dense clay, the downward movement of water would be hindered. Should it be hard-pan it would be more effectively hindered. Should it be coarse sand or gravel, the upward movement would be entirely cut off, or virtually so. But when the subsoil is much like the surface soil, none of these evils follow. The most objectionable subsoils in dry areas include the following: (1) soils that are underlaid with hard-pan that is not distant from the surface; (2) those that have gravel seams not far below the surface or that are underlaid with sand coarse in character, and with but little clay interspersed between the soil grains; (3) subsoils that are so compact that they are not easy of penetration by air or by the roots of plants, and (4) subsoils that are saturated frequently with seepage water that rises to the surface.

A hard-pan condition is usually brought about by the action of lime, which is so abundant in the soil of semi-arid areas, and water. Water carries down the lime in solution as far as it goes, but, owing to the light precipitation and the dry and hard character of the subsoil, it does not go very far, and it goes down to about the same distance from year to year. When the lowest limit of water penetration is reached, it combines with other soil ingredients and forms a layer of calcareous material so dense and hard that it cannot be penetrated easily by the roots of plants. Even where but little lime is present, clayey particles are worked down, so as to aid in forming so firm an under-soil that the roots of plants may not easily penetrate it. Such a condition of the subsoil may frequently be removed by tillage that is deep and judiciously given. Such tillage facilitates the downward movement of water to an extent that tends to break up the hard-pan even at distances far below the surface soil.

When a gravel seam has been deposited not far distant from the surface, it facilitates the downward movement of water in the soil and cuts off the upward movement of the same, on the principle known as capillarity. In dry areas such a condition is greatly harmful to vegetation. If the gravel seam is of great depth, the harmful influence referred to is intensified, and if the subsoil consists almost entirely of coarse sand grains, similarly adverse influences will follow. It may be impossible in some instances to obtain satisfactory production from soils thus underlaid, but should the sand or gravel be interspersed with clay particles, these harmful results will be reduced proportionately to the extent to which the clay particles are present.

In some instances fine clay particles are carried down from the surface and left to mingle with the substances composing the subsoils so as to form a mass that is not easily penetrated by the roots of plants. Opening up the surface soil so as to admit more readily the descent of water will usually help this condition, and it may be still further aided by the decay of deep rooted plants, as those of alfalfa, which to a greater or lesser extent may have penetrated these soils.

In some instances, especially in the soils adjacent to higher lands, seepage waters come down from the former and to such an extent as to rise to the surface at certain seasons of the year. These may exclude the air from both soil and subsoil to such an extent as to prevent growth in the higher forms of vegetation and in some instances any form of the same. In soils thus saturated, oxygen, so essential to germination and vigorous growth, is in a great measure excluded. In the absence of this element of the air, microscopic organisms cannot carry on their beneficent work, the decay of plant food is proportionally retarded and the formation of nitrates is proportionately hindered. Moreover, when the seepage waters contain alkali substances, these conditions are intensified, and oftentimes to the extent of excluding all kinds of vegetation. Such a condition cannot be remedied until drainage has been effected that will promptly carry away the ingredients that are harmful.

Clay Loam Soils.

These may be defined as soils that contain approximately from 15 to 20 per cent of clay. They differ from clay soils in the less percentage of the clay which they possess, and from sandy loams having a lower percentage of sand. They have also less clay than soils that are classed simply as loams. They are relatively high in their percentage of humus.

It would seem correct to say that clay loam soils prevail to a greater extent on the grass-covered bench lands than any other class of soils. This means that they are the principal soils found on the benches of the Plains country. The soils that grow sagebrush are also frequently of this type. They are also found interspersed to a considerable extent in the Inter-mountain region, and to some extent in the Great Basin.

The superiority of clay loam soils lies first in the ease with which they may be tilled, second in their moisture-holding power, and third in their richness in the elements of plant food. It would not be correct to say that they are the easiest tilled soils in semi-arid areas, but they are relatively easy of tillage, because of the happy blending of the clay and sand particles, more especially when they are properly supplied with humus. The moisture-holding power of course increases with the humus supply, other things being equal. The richness which these soils usually possess gives them great wearing power. It is also retentive of gases and soluble plant foods.

Heavy compact clays are undesirable. They are slow to absorb water, and quick to lose it by evaporation, because of the readiness with which they impact and form openings in the surface which allow moisture to escape. Stiff clays are composed of the finest particles of the soil, in some instances five hundred times finer than sand grains. They are so fine that they do not settle readily when held in solution. If these soils are tilled when wet they become so adhesive as to be almost unworkable on drying. Such a condition will preclude successful production in dry weather. But the mission of clay particles when mixed with coarser soil particles is most beneficent, since it increases their richness and also their moisture-holding power.

Sandy Loam Soils.

In dry areas sandy loam soils are such as are composed of sand particles intermingled with clay to the extent of 10 to 15 per cent of clay. The clay content in them is from two to three times as much as the clay content in sandy soils. In some areas sandy soils have come from sand-bearing rocks which, when decomposed, are not capable of furnishing clay, hence the low fertility of these. But this is not usually true of sandy soils in dry areas, as in arid regions experience has shown that these soils are as productive as other good soils when sufficiently supplied with water. This holds good even with arid soils that are desert in the absence of irrigating waters. The sand and silt particles in these are capable on further reduction of yielding clay. The clay particles are greatly helpful in lessening the spaces between the soil grains. Many of these particles may adhere to one grain, and in so far as they do they lessen the tendency to leaching.

Sandy loam soils and also sandy soils cover much of the surface of the

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NOTICE FOR PUBLICATION

Department of the Interior, U. S. Land Office at The Dalles, Oregon, October 16th, 1912.

Notice is hereby given that Elmer A. Antes, of Bend, Oregon, who, on September 13th, 1911, made homestead entry No. 09482, for NE¼, Section 25, Township 20 South, Range 16 East, Willamette Meridian, has filed notice of intention to make final commutation proof, to establish claim to the land above described, before H. C. Ellis, U. S. Commissioner, at his office at Bend, Oregon, on the 30th day of November, 1912.

Claimant names as witnesses: Orlea O. King, Peter Jordan, O. C. Henkle and W. C. McCuiston all of Bend, Oregon.

C. W. MOORE, Register.

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NOTICE FOR PUBLICATION

Department of the Interior, U. S. Land Office at The Dalles, Oregon, October 16th, 1912.

Notice is hereby given that C. S. Benson, guardian of Jesse L. Foush, of Bend, Oregon, who, on June 19th, 1907, made homestead entry No. 15542, Serial No. 04113, for NW¼, Section 8, Township 18 South, Range 16 East Willamette Meridian, has filed notice of intention to make final five year proof, to establish claim to the land above described, before H. C. Ellis, U. S. Commissioner, at his office at Bend, Oregon, on the 26th day of November, 1912.

Claimant names as witnesses: C. H. Erickson, Oliver Erickson of Bend, Oregon. George T. Kitching and Ralph E. Gates, of Roberts, Oregon.

C. W. MOORE, Register.

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