Chapter II

Soil theory
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2.1 Introduction

Many words that we use every day have several meanings and may be used in various ways. The word soil is no exception. As a transitive verb it means, “to make dirty” as in the case of solid dishes or clothing. The noun soil is derived through Old French from the Latin solum, which means floor or ground.

In general, soil refers to the loose surface of the earth as distinguished from solid rock. Many people, when they think of the word soil, have in mind that material which nourishes and supports growing plants. This meaning is even more general, since it includes not only soil in the common sense, but also rocks, water, snow, and even air—all of which are capable of supporting plant life. The farmer, of course, has a more practical conception of soil; to him it is the medium in which crops grow. The civil engineer, on the other hand, looks upon soil as that material which supports foundations, roads, or airport runways.

Soil may also be defined as a mixture of mineral matter, organic matter, water, and air. The volume occupied by each of these in a loam-textured surface soil that is in ideal condition for plant growth will be approximately as follows:

Mineral matter 45 percent; organic matter 5 percent, water 25 percent; and air 25 percent. It is interesting to note that about half the volume is pore space.
Proportions of the components vary from time to time and from place to place. The volume of water and air bear a direct reciprocal relationship with each other. Entrance of water into the soil excludes air. As water is removed, by drainage, evaporation, or plant growth, pore space that was occupied by water becomes filled with air once more. Considerably less organic matter than surface soils generally characterizes sub soils. An organic soil, like a muck or peat, has a greater volume occupied by organic matter than by mineral matter.

Soils used in greenhouses are manufactured in the sense that topsoil, sand, and organic matter are mixed together to provide a desirable proportion of the four components.

Soil as ordinarily found in the field is not suited for golf greens. When the soil surface is wet, traffic causes soil compaction, and the maintenance of favorable air and water relationships is difficult. In the construction of a golf course, the sites where the greens will be located are excavated and refilled with a base layer high in sand and gravel to provide good drainage. This is overlain by a layer, which is commonly 12 inches thick and composed of a mixture of sand, topsoil, and organic matter (peat).

### 2.2 Soil fertility versus soil productivity

Soil fertility is defined as the quality that enables a soil to provide the proper compounds, in the proper amounts, and in the proper balance, for the growth of specified plants when other factors are favorable. Soil productivity, on the other hand, is defined as “the capability of a soil for producing a specified plant or sequence of plants under a specified system of management”. For a
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Soil to be productive it must of necessity be fertile. It does not follow, however, that a fertile soil is productive. For instance, many fertile soils exist in arid regions, but under systems of management, which do not include irrigation they cannot be productive for corn or rice.

A most important fact to keep in mind is that the productivity of a soil is measured in terms of a given kind of crop or sequence of crops. A soil may be productive for blueberries, which require very acid conditions, but be unproductive for alfalfa, which requires a nearly neutral soil with an abundance of available calcium. A soil may currently be unproductive for corn because of its low fertility but owing to the much lower fertility demands of some tree species, may have been very productive for the original stand of pines that occupied the virgin soil.

2.3 Soils and their utilization in society

Man domesticated plants and animals and ushered in the agricultural revolution in the hills surrounding the Fertile Crescent in southwestern Asia about 10,000 years ago. The change from food gathering to food production at first gave more certainty to the source of food than to the abundance of supply. It was not until about 4000 B.C. when irrigation had developed sufficiently on the floodplains of southern Mesopotamia that productivity of the soil was great enough to give rise to cities.

In the absence of the knowledge required to maintain soil fertility with cropping systems, animal manures, or chemical fertilizers, “productive” agriculture was necessarily restricted to the fertile soils of the arid regions that could irrigated or to the alluvial soils subject to renewal of nutrients by
periodic flooding. Later the ingenuity of the oriental farmers enabled them to maintain soil fertility over extensive areas in the humid region for a long period of time as shown in the book entitled, Farmers of Forty Centuries. The Chinese farmer’s carefully utilized plant and animal wastes, including human, grew legumes to fix atmospheric nitrogen; and returned canal mud to the land. There is good reason to believe that many of their soils were not of extraordinary fertility and that they were kept fertile by judicious management. It seems reasonable to suggest that the discoveries, which allow man to permanently maintain soil fertility, rank in importance with the discoveries of irrigation, the plow, and the wheel.

Certainly the earliest of farmers recognized that soils had different capacities or abilities to produce a particular crop. With limited knowledge and limited ability to alter the soil, however, they had to use the soil in large part as it was. Today, in an industrial society, many alternatives exist. Crops may be grown in a given location because the climate is ideal, markets are close, or water is available for irrigation, rather than because “good soil” exists. For example in Florida, naturally infertile sand soils are used for citrus and organic soils for vegetable production. The year round growing season and the location near centers of population make it feasible to greatly alter the existing soil so these crops can be grown successfully. The same kind of soil in northern Minnesota or Wisconsin might very likely be tax delinquent because of the extremely short growing season that sets severe limits on crops choices and the number of crops that can be produced in one year. Transportation is also a big problem. Thus some of the most productive soils
in society owe their usefulness to man’s ability to alter their characteristics rather than to their original fertility or nature.

2.4 Physical properties of soils

2.4.1 Soil Texture

The relative size of the soil particles is expressed by the term texture, which refers to the fineness or coarseness of the soil. More specifically, texture is the relative proportions of the different size groups or separates. The rate and extent of many important physical and chemical reactions in soils are governed by texture because it determines the amount of surface on which the reactions can occur. The determination of the amount of the various separates present in the soil is called a mechanical analysis.

SOIL SEPARATES -- THE PARTICLE SIZE CATEGORIES:

Table 2.4.1 some characteristics of soil separate

<table>
<thead>
<tr>
<th>Separate</th>
<th>Diameter in mm. *</th>
<th>Diameter in mm. **</th>
<th>No. of particles per gram</th>
<th>Surface area in 1g per sq.cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very coarse sand</td>
<td>2.00 – 1.00</td>
<td>….</td>
<td>90</td>
<td>11</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>1.00 – 0.50</td>
<td>2.00 – 0.20</td>
<td>720</td>
<td>23</td>
</tr>
<tr>
<td>Medium sand</td>
<td>0.50 – 0.25</td>
<td>….</td>
<td>5700</td>
<td>45</td>
</tr>
<tr>
<td>Fine sand</td>
<td>0.25 – 0.10</td>
<td>0.20 – 0.02</td>
<td>46000</td>
<td>91</td>
</tr>
<tr>
<td>Very fine and</td>
<td>0.10 – 0.05</td>
<td>….</td>
<td>722000</td>
<td>227</td>
</tr>
<tr>
<td>Silt</td>
<td>0.05 – 0.002</td>
<td>0.02 – 0.002</td>
<td>5776000</td>
<td>454</td>
</tr>
<tr>
<td>Clay</td>
<td>Below 0.002</td>
<td>Below 0.002</td>
<td>90260853000</td>
<td>8000000</td>
</tr>
</tbody>
</table>

An outstanding fact in the examination of soils is their composition by particles of different sizes. These particles have been divided into groups entirely on the basis of size, that is, without regard to their chemical composition, color, weight, or other properties. The groups of particles are termed soil separates.

In the Table 2.4.1 the names of the separates are given, together with their diameters, the number of particles in 1 gram, and the surface area in square centimeters exposed by the particles in 1 gm of the separate.

Mechanical Analysis by the Hydrometer Method: Bouyoucos devised the hydrometer method for determining the sand, silt, and clay content of the soil without separating them. The soil sample is first soaked overnight in a 5% Calgon solution in order to facilitate dispersion. Then it is placed in a metal cup with baffles on the inside and is dispersed for 2 minutes by the soil mixer running at a speed of 16,000 rpm. The soil mixture poured into the cylinder and water is added to bring the contents to the liter mark. With the help of a rubber stopper, the cylinder is turned upside down several times to produce a thorough mixing of the soil suspension. The cylinder is placed on the table of the soil suspension using a special soil hydrometer. A reading taken at 40 seconds determines the total percentage of sand and the 2-hour reading determines the total percentage of clay in the sample. The silt is calculated by difference—add the percent sand and the percent clay and subtract from 100.

The hydrometer method fits exceptionally well into the International Society of Soil Science particle size classifications.
2.4.2 Mechanical analysis by the separation of sand, silt & clay

Before a soil can be divided into groups of particles on the basic of size, it is essential to overcome the tendency of the very small particles to cling to the larger ones and to each other. Every particle should exist as an individual. Organic matter is one of the chief agents, which binds particles together, and hence the first problem is to destroy this cementing material. The commonly accepted procedure is to oxidize the organic matter by boiling the sample in hydrogen peroxide solution.

Other cementing agents include the oxides of iron and aluminum. Iron and aluminum oxides also may be dissolved with suitable chemical reagents, but it is doubtful if such a procedure is advisable as the oxides are a part of the very fine or colloidal clay and should be determined as such.

2.4.3 Functions of sand

Sand particles are of comparatively large size and hence expose little surface compared to that exposed by and equal weight of silt or clay particles. Because of the small surface of the sand separates, the part they play in the chemical and physical activities of a soil is almost negligible. The smaller sand particles may contain a sufficient coating of the very small clay separate to attain some activity, but the action is due to the day and not to the sand. Because the sands are inactive, their chief function in soil is to serve as a framework around which the active part of the soil is associated. Unless present in too small proportion, the sands increase the size of spaces between particles, thus facilitating movement of air and drainage water.
2.4.4 Silt in relation to soil properties

The coarser silt particles are very similar to the finer sands in surface exposed and hence takes very little part in the chemical activities of soils. The finer silt has sufficient surface to give it some slight chemical activity, and, if present in considerable quantity must be considered in the determination of the total activity of the soil.

2.4.5 Function of the clay

The clay separate is composed of the smallest particles. This means that the amount of surface in a gram of clay is much more than that in a gram of silt or sand. Since a large part of the water in the soil is held as a film on the surface of the clay particles, the amount of clay in the soil has a great influence on its total water-holding capacity. In addition, certain available nutrients are held on the surface of clay particles. Therefore, clay acts as a storage reservoir for both water and nutrients. Clay may have thousands of times more surface area per gram than silt and nearly a million times more surface area than very coarse sand (Table 2.4.1).

2.5 A textural grouping of soils

Suppose the results of a mechanical analysis showed that a soil contained 15 per cent clay, 65 per cent sand, and 20 per cent silt.

2.5.1 Soil classes used to designate texture

A soil is never composed of only one separate. Usually at least small quantities of the majority of the separates are present. The first step in a
textural classification, therefore, is to group them on the basis of the proportion of the different separates present. These groups are designed as soil classes, which are named according to the separate or separate which contribute most to their characteristics. This does not mean that a class is necessarily named after the separate present in largest quantity. It usually takes a very large quantity of coarse particles to exert as much influence on soil properties as a comparatively small quantity of the finest particles clay. Clay is the most potent separate in imparting its properties to a mixture of separates, and hence the adjective clay is found in the class name of many soils, which contain a higher percentage of the other separates than they do of clay.

The proportions of the separates in classes commonly used in describing soils are given in the textural triangle shown in Fig. 3-3. The sum of the percentages of sand, silt, and clay at any point in the triangle is 100. Point A represents 15 per cent clay, 65 per cent sand, and 20 per cent silt; the textural class name for this sample is sandy loam. A soil containing equal amounts of the three separates is a clay loam.

2.5.2 A generalized grouping of soils

Definite lines of division separate the various soil classes from one another. Their properties do not change abruptly at these boundary lines, however, but one-class grades into the adjoining classes of coarser or finer texture. For example, a loam gradually merges into a silt loam or clay loam as the percentages of silt and clay increase, and, or the other hand a sandy loam is produced as the percentage of sand separates replaces silt and clay in the loam.
It is difficult, therefore, for those not well acquainted with the specific properties, which characterize the different soil classes to distinguish accurately between them, and hence a more generalized textural classification of soils is sometimes used. For instance, it is customary, when speaking in general terms to refer to loams and silt loams as medium textured to clay loams, silty clay loams, and clays as fine textured and to sand loams, loamy sands, and sands as coarse-textured soils. The fine-textured soils are sometimes referred to as clay land or as heavy soils, and the coarse-textured soils as light soils. The basis for differentiation is the amount of energy required on the draw bar for plowing.

2.6 Class names and soil properties

Strictly speaking, the class name describes only the particle-size distribution, rigidity, permeability, ease of tillage, doughtiness, fertility, and productivity may be closely related to the textural classes in a given geographical region, but, due to the great variation that may exist in the mineralogical nature of the separates, no broad generalizations of the world’s soils can be made. Thus, a soil with 25 per cent clay, which is montmorillonitic, will be much more plastic than a soil with over 70 per cent clay which is composed mainly of hydrous oxides of iron and aluminum. The sand and silt in some soils are composed mainly of minerals rich in essential nutrients, whereas in others they are dominated by quartz (Si02).
2.6.1 Influence of coarse fragments on the class name

Some soils contain significant amounts of gravel, stones, or other coarse fragments that are larger than the size of sand grains. An appropriate adjective is added to the class name in these cases. For example a sandy loam with 20 to 50 per cent of the volume made up of gravel is a gravelly sand loam. If 50 to 90 per cent of the volume were gravel, it would be a very gravelly sandy loam. Rockiness is used to express the amount of the land surface composed of exposed bedrock.

2.7 The texture profile

The textures of the various horizons in a soil profile are usually different. When this occurs, the soil has a texture profile. Since the texture has a great influence on the properties of soil horizons, the development of the texture profile must be considered.

2.7.1 Texture-profile development

Consider soil development in an unconsolidated parent material. When the soil first develops, it will inherit the texture of this parent material. If the texture of the parent material was uniform with depth, the same will be true of the young soil. Where conditions are favorable for the weathering of minerals, the texture will slowly change as clay is formed throughout the soil. When water percolates through the soil, the finely divided clay may be gradually translocated downward, decreasing the amount of clay in the surface horizon. The deposition of translocated clay in the surface horizon. The deposition of translocated clay in the subsoil thus becomes finer than that of the surface soil.
and the soil acquires a texture profile. The zone of clay accumulation in the subsoil is called the B-horizon and is a common characteristic of many mature soils.

**2.7.2 Influence of the texture profile on plant growth**

The presence of the texture profile can be beneficial or detrimental, depending on the degree to which it has developed. Up to a certain point, an increase the amount of clay in the subsoil is desirable. It can increase the amount of water and nutrients stored in that zone. By slightly reducing the rate of water movement through the soil, it will reduce the rate of nutrient loss through leaching. If, however, the accumulation of clay is great, as in the case of a clay-pan soil, it will severely restrict the movement of air and water and the penetration of roots in the B-horizon. It will also tend the increase the amount of the rainfall that will occur as on sloping land.

**2.7.3 The texture profile & deep plowing for wind erosion control**

Deep plowing has been used to control wind erosion where sandy surface soils are underlain by B-horizons containing 20 to 40 per cent clay. Scientists of the United States Department of Agriculture and the Agricultural Experiment Stations of Kansas and Texas observed that at least one inch of subsoil should be plowed up for every two inches of surface soil thickness in order to control wind erosion. In many cases, the soil must be plowed to a depth of 20 to 24 inches. This kind of plowing increased the clay content of the surface soil 5 to 12 per cent in some cases. Since it was found that about 27 per cent clay in the surface soil was required to halt soil blowing deep plowing by it resulted in only partial and temporary control of wind erosion. When deep plowing was
not accompanied by other erosion control practices, wind erosion removed the clay from the surface soil and the effects of deep plowing were short-lived.

2.8 Soil structure

The term texture is used in reference to the size of soil particles, but, when the arrangement of the particles is being considered, the term structure is used. Structure refers to the aggregation of primary soil particles (sand, silt, clay) into compound particles, or clusters of primary particles, which are separated from the adjoining aggregates by surfaces of weakness. The structure of the different horizons of a soil profile is an essential characteristic of the soil just as are color, texture, or chemical composition.

Structure modifies the influence of texture in regard to moisture and air relationships, availability of plant nutrients, action of micro-organizations, and root growth. A good example of this occurs in the “black-lands” of Alabama and Texas, where the content of highly plastic clay is as high as 60 per cent. These soils would be of limited value for crop production if they did not have a well-developed granular structure, which facilitates aeration and water movement.

When particles adhere in clusters and the clusters then function as particles, a structure is developed. These clusters or compound grains may be called secondary particles, peds, or aggregates. Some of the very small particles combine in to clusters too small to be seen by the naked eyed and so may be said to develop a microstructure. The small units together with
primary particles unite into larger and visible units of various shapes and sizes to develop a macrostructure.

2.9 Soil density and weight

Plowing of mineral soils requires a great expenditure of energy owing largely to the density of the soil. Further, the heaviness of the soil makes it unprofitable to change soil texture on a large scale by hauling and spreading sand on clay-textured soils or vice versa. Three useful density and weight properties will be discussed. They are particle density, bulk density, and weight per acre furrow slice.

In determining the particle density of soil, consideration is given to the solid particles only. Thus, the particle density of any soil is a constant and does not vary with the amount of space between the particles. It is defined as the mass (weight) per unit volume of soil particles (soil solids) and frequently expressed as grams per cubic centimeter. For many mineral soils the particle density will average about 2.65 grams per cubic centimeter. It does not vary a great deal for different soils unless there is considerable variation in content of organic matter or mineralogical composition.

In determining bulk density of soil consideration is given to the pore space as well as to the solid particles. Bulk density of a given soil is, accordingly, a variable because the volume of pore space varies.


2.10 Pore space of soil

The portion of a given volume of soil, which is unfilled with solid matter, is termed pore space. The proportion of a soil occupied by pore space depends on both the texture and structure of the soil because space exists between soil grains as well as between aggregates. The amount of pore space in a soil is expressed as a percentage of the total soil volume. The amount of pore space and the size of pore spaces vary from horizon to horizon, as do the other soil properties.

Pores spaces are important because they contain air and moisture and allow movement. Roots require pore spaces for their habitat.

2.10.1 Determining porosity of soil

The percentage of pore space in a soil may be calculated from the bulk density and particle density if both are expressed in the same units of measurement. The following formula will give the percentage of the soil, which are solid particles.

\[
\frac{\text{Bulk density}}{\text{Particle density}} \times 100 = \% \text{ Solids}
\]

This percentage, taken from the total volume (100%), will give the percentage of pore space, hence the formula

\[
100\% - \frac{\text{Bulk density}}{\text{Particle density}} \times 100 = \% \text{ Pore space}
\]

Substitution in the formula of 1.3 for bulk density and 2.65 for particle density gives 50.3 % total spore space, which is considered rather typical for medium-textured plow layers.
2.10.2 Pore size and its importance

In the discussion of bulk density, it was pointed out that sandy surface soils usually have a greater bulk density than do clayey soils. This means that in a dry condition sandy soil has less volume occupied by pore space. Yet our everyday experiences tell us that water usually moves much faster through a sandy than through a clayey soil. The explanation for this seeming paradox lies in the size of the pores that are found in each soil.

2.11 Soil color

The color of soil serves both farmer and soil scientist, provided that they understand the causes of the various colors and are able to interpret them in terms of soil properties. Organic-matter content, drainage condition, and aeration are soil properties related to color, which are of interest to farmers. The investigator uses color as an aid in soil classification and draws from the color of the different horizons information about conditions pertaining to and forces active during soil formation.

2.11.1 Color produced by reflected light

Color is the sensation produced when light from an object enters the human eye. Thus the color of a soil is the result of light reflected from the soil. In order to describe it concisely it is necessary to define carefully

(1) The qualities of the light falling on the soil;

(2) The soil conditions affecting the reflection of this light; and

(3) Some standard method for measuring the qualities of this reflected light.
Finally we need some system of nomenclature to translate these measurements into words that will convey our observations to other persons.

### 2.11.2 Standard conditions for observing soil color

The usual standard light source for the observation of soil colors is the light from a clear sky. This closely approaches white light; that is, all visible wavelengths of light are present in nearly constant proportions.

The color should be recorded at two standard moisture contents:

1) At field moisture capacity, and

2) When the sample is air dry.

It is usually more practical in fieldwork to use moist samples, because a sample can be moistened and the color observed as soon as the visible moisture films have disappeared from the surface. It is frequently impractical, however, to wait for a moist soil to dry. Soil colors generally become whiter on drying, but they vary greatly in the magnitude of the color differences at different moisture contents. Consequently, color descriptions are most helpful when made under both of the suggested moisture conditions.

### 2.11.3 Measurement of the quality of light

The color of light can be accurately described by measuring its three principal properties, hue, value, and can be shown by use of a solid, for example a cube, in which hue, value, and chroma. Hue refers to the dominant wavelength or color of the light. Value, sometimes called brilliance, refers to the total quantity of light. It increases from dark to light color. Chroma is the relative purity of the dominant wavelength of light.
2.11.4 Color designations

The Munsell notation of color is a systematic numerical and letter designation of each of the three variable properties of color. The relationships of the colors to one another can be shown by use of solid, for example a cube, in which hue, value, and chroma are plotted along the three edges. Each possible color represents a point in this cube and is completely defined by the three coordinates of that point, which is its Munsell notation. The three properties are always given in the order hue, value, and chroma. For example, in the Munsell notation 10YR 6/4, 10YR is the hue, 6 is the value, and 4 is the chroma.

2.11.5 Colors of soil minerals

The minerals occurring in the appreciable quantities in most soils are light in color. As a result, soils would be of a light gray color if composed of crushed minerals, which had undergone little chemical change. Accordingly, for an explanation of the dark gray, brown, red, and yellow colors in soils we must look to chemical changes in the constituents (especially iron) of the minerals and to the addition of organic matter. There are a few instances, however, in which the proportion of colored minerals is sufficient to give the soil a decided color.
2.11.6 Gray and brown soil colors

The dark color of soils is generally due to the highly decayed organic matter they contain; in fact, with some practice the percentage of organic matter in many soils may be judged with reasonable accuracy from their colors. Although we speak of black soils, there are none, which are truly black. Organic matter imparts a gray, dark gray, or dark brown color to soils unless some other constituent such as iron oxide or an accumulation of salts modifies the color.

If soil is poorly drained there is usually a greater accumulation of organic matter in the surface layers thus giving a very dark color. The lower soil layers, which contain very little organic matter, on the other hand, are of a light gray color, indicating the poorly drained condition. If drainage is intermediate, the gray of the sub-soil is likely to be broken by flecks of yellow.

2.11.7 Yellow soil colors

When drainage permits aeration and moisture and temperature conditions are favorable for chemical activity, the iron in soil minerals is oxidized and hydrated into red and yellow compounds. Highly hydrated iron oxides are yellow, but as hydration diminishes reds replace the yellows. Accordingly, we find shades of red in soils extending from the southern deserts across the semi-arid and sub humid belts to the humid stages of the Southeast. The red and yellow colors of the sub soils in the southeastern states immediately catch the eye of the traveler. The low organic matter content of many soils in this area leaves undulled the brilliant colors of the iron oxides. With appreciable humus content the red colors are converted into mahogany colors.
2.12 Soil temperature

As temperature decreases, the life process of both plants and animals are slowed down until finally they cease altogether. Growth process of most agriculturally important plants are very sluggish at temperatures about 40o 1 and increase until temperatures ranging from 70o to 90o F are reached. The chemical processes and activities of microorganisms, which convert plant nutrients into available forms, are also materially influenced by temperature. The farmer is much interested therefore in soil as well as in air temperatures.

2.12.1 Sources of soil heat

The movement of heat from the warm interior of the earth is counteracted by the loss of heat from the surface by radiation. Thus at a given depth, about 3 or 4 feet at the equator and 50 feet in the latitude of New York, the earth remains at an approximately uniform temperature, which is the same as the average annual air temperature, and the growth of plants is unaffected through the warming of the soil around their roots by the interior heat of the earth. Likewise the soil is not warmed by the decay of organic matter within it, for the heat so generated is liberated so slowly that the effect on soil temperature is not measurable.

2.12.2 Heat capacity of soil

Mineral particles require a comparatively small amount of heat to raise their temperature. The quantity of heat required to raise the temperature of a gram of soil particles 1 degree C is only about one-fifth as much as is required to warm a gram of water the same amount. In other words, the specific heat of dry soil particles is 0.2, and it is evident from this fact that moisture content is
Soil theory

an important factor in determining soil temperature. Soil high in water content will warm up slowly in the spring and will cool down slowly in the fall. Drainage therefore exerts a major influence on soil temperature.

2.12.3 Control of soil temperature

As has just been pointed out, the removal of excess water from a soil will facilitate changes in soil temperature. By providing drainage, man may exert some influence on the temperature relations of soils, which are so situated that they hold excessive quantities of water. By use of mulches and various shading devices, the soil may be protected from the sun’s rays and evaporation of moisture may be reduced, thus modifying changes in soil temperature. Aside from these practices there is little that man can do to affect the temperature of the soil he tills except to keep it in good tilth and increase the humus content. Soils high in organic content absorb more heat because of their dark color and hence tend to be warmer. But this effect is offset to some extent by the increased water-holding capacity. When in good structural condition, soils also warm up more readily than when they are in poor tilth.

2.12.4 Location and temperature

In the northern hemisphere soils located on southern and southeastern slopes warm up more rapidly in the morning than those located on the level or on the northern slopes. The reason is that they are more nearly perpendicular to the sun’s rays, and hence a maximum amount of radiant energy strikes a given area. Soils with a southern or southeastern exposure often are selected for the growing of early vegetables and fruits.
References


