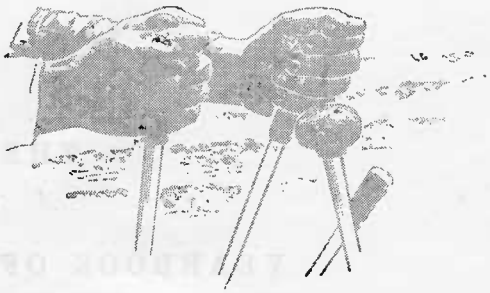
THE YEARBOOK OF AGRICULTURE 1957



the yearbook of agriculture 1957

THE UNITED STATES

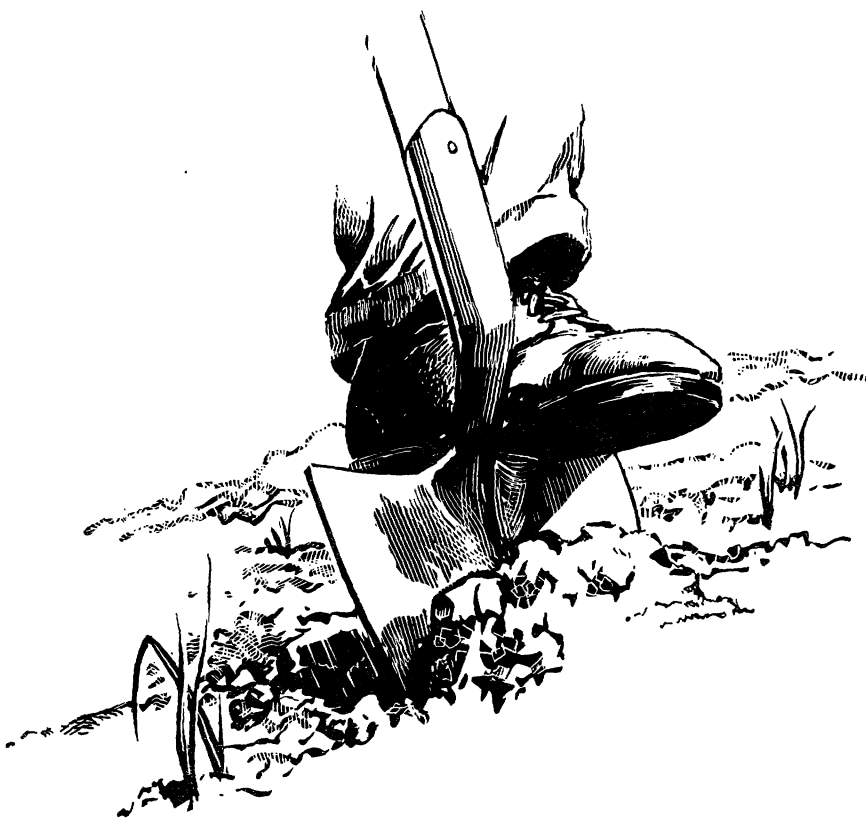
DEPARTMENT OF

AGRICULTURE

WASHINGTON, D. C.

THE UNITED STATES GOVERNMENT PRINTING OFFICE

SOIL



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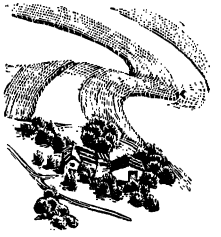
Foreword



EZRA TAFT BENSON

Secretary of Agriculture

ALL MY LIFE I have had direct experience of the importance of soil. As a boy and young man I tilled it, worked with it, and got from it its bounty or, in bad years, wrested from it its reluctant yield. Then and later I learned to love it, respect it, and appreciate its values and limitations.

I LEARNED what every farmer knows—that each of the thousands of different kinds of soils requires its own care and skillful use, which also change from season to season as conditions of moisture, temperature, and crops change.

THESE TRUTHS, so simple to say here but so acutely complex when one's living depends on observing them, were brought home to me again, but more forcefully than ever, when I accompanied President Eisenhower early this year on a trip to survey the disastrous effects of drought in the Southwest, the Great Plains, and other sections. Farmers and ranchers in some of the States had suffered their sixth consecutive year of drought and needed help urgently.

THE PROBLEM demanded action of several kinds—emergency measures to provide for feed, refinancing of farm indebtedness, and urgent conservation needs; cooperation of State and Federal Governments, farmers and ranchers, and other citizens whose livelihood depends on agricultural well-being; and a long-range program looking to the best use of land and other natural resources.

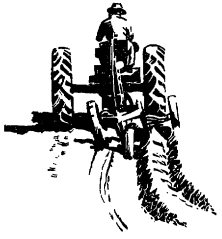
MORE RESEARCH—continuing, thorough research—in the management of soil and water is a vital part of the long-range program. Not only must we learn more about the management of our soil and water; we must encourage the wider dissemination and application of the results of this research.

THAT IS WHY I am so keenly interested in this Yearbook of Agriculture and commend it to you and your neighbors. The facts in it are the

product of years of patient, useful, practical research, and publishing it in this form is the best way I know of making it available to all Americans, wherever they live.

FOR TO ALL AMERICANS, wherever they live, soil is a basic treasure. Soils produce good yields and keep on doing so if they are well managed. The management of soil is among the oldest of the arts, but none is changing more rapidly than it. We know more about taking care of soil than our fathers and grandfathers did. There is much more that we should know.

Preface



ALFRED STEFFERUD

Editor

THIS BOOK IS, as a plant scientist might say, a new and adapted variety of *Soils and Men,* the 1938 Yearbook of Agriculture. The parent, a giant of 1,232 pages and 258,042 copies, is now out of print. That may be a manifest of its popularity and value. Surely it did help make Americans aware of the acute need to take care of their heritage. It warned: "The social lesson of soil waste is that no man has the right to destroy soil even if he does own it in fee simple. The soil requires a duty of man which we have been slow to recognize."

A PURPOSE of the present book is to indicate the extent to which that warning has been heeded—and at times to repeat it—and to describe the knowledge about soils that scientists and farmers have since gained.

THE 1938 YEARBOOK OF AGRICULTURE devoted considerable space to the classifications of soils, technical aspects of soil science, and the use of land (which we take to be different from the use of soil).

BECAUSE OUR KNOWLEDGE of soil has expanded greatly since 1938 and emphasis and needs have changed, this Yearbook of Agriculture is limited to the management of soil, itself a big and burgeoning subject. We plan to devote a subsequent Yearbook to the use and ownership of land. The material here about soil classification, the soils of the United States, and basic soil science is sufficient, we think, for the nontechnician to understand the principles of soil management that are set forth in this volume.

WE HAVE TRIED to help a farmer appraise his own requirements and help him decide which of the many available practices, machines, and materials are best for his situation. We have explained the continually increasing opportunities for more efficient soil management on a permanent basis—how the same soils can be farmed more efficiently than our fathers and grandfathers could farm them and how also more kinds of soil can be farmed efficiently.

WE EMPHASIZE that for best results all parts of the soil-management system for a field must fit together—that systems of crop and timber management must be geared to the characteristics and requirements of both soil and plants.

A GLANCE at the table of contents will tell you more about the scope and organization: The place of soil management within the broad field of agriculture; how new scientific principles are developed; what we have learned about soils and the basic principles of their behavior; methods for achieving specific objectives, such as liming, cultivating, controlling moisture, increasing organic matter and storage of water, and preventing erosion; how systems of soil management support one another, and the requirements and methods of developing farm plans and systems of soil management for high production with conservation; soil-management systems for forest trees, gardens, and a few special crops that have requirements somewhat unlike those of the general run of field crops; and the opportunities for improved systems of soil management in the different regions of the United States.

THE MATERIAL AND SCOPE were planned by a Yearbook Committee, whose members are:

Charles E. Kellogg, Soil Conservation Service, Chairman
W. H. Allaway, Agricultural Research Service
Carleton P. Barnes, Agricultural Research Service
N. C. Brady, Cornell University
V. L. Harper, Forest Service
Carl P. Heisig, Agricultural Research Service
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F. G. Ritchie, Agricultural Conservation Program
Alfred Stefferud, Office of Information
Wynne Thorne, Utah State University
C. H. Wadleigh, Agricultural Research Service
Eric Winters, University of Tennessee

TWO OF THEM, Dr. Kellogg and Dr. Barnes, were members of the 1938 Yearbook Committee. Their devotion and wisdom in agricultural research and their distinguished work in the Department of Agriculture are reflected in their continuing concern that the results of the research and achievements of scientists be made public for the benefit of all.

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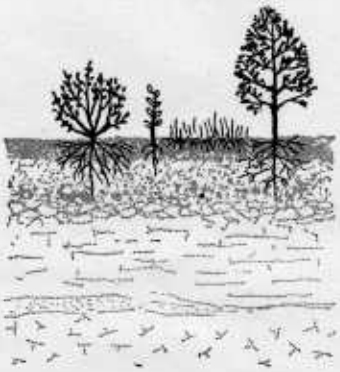

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Glossary

A HORIZON The surface horizon of a mineral soil having maximum biological activity, or eluviation (removal of materials dissolved or suspended in water), or both.

ABC SOIL A soil with a complete profile, including an A, a B, and a C horizon.

ABSORBING COMPLEX The materials in the soil that hold water and chemical compounds, mainly on their surfaces. They are chiefly the fine mineral matter and organic matter.

AC SOIL A soil with an incomplete profile, including an A and a C horizon, but no B horizon. Commonly such soils are young, like those developing from alluvium or on steep, rocky slopes.

ACID SOIL Generally, a soil that is acid throughout most or all of the parts of it that plant roots occupy. Commonly applied to only the surface-plowed layer or to some other specific layer or horizon of a soil. Practically, this means a soil more acid than pH 6.6; precisely, a soil with a pH value less than 7.0. A soil having a preponderance of hydrogen over hydroxyl ions in the soil solution.

ACTINOMYCETES A group of soil microorganisms which produce an extensive thread-like network. They resemble the soil molds in some respects but are more like the bacteria in size.

ADDITIVE A material added to fertilizer to improve its chemical or physical condition. An additive to liquid fertilizer might prevent crystals from forming in the liquid at temperatures where crystallization would normally take place.

ADSORB Removal of a substance in solution to a solid surface or a separate phase; to accumulate on a surface.

ADSORPTION The attachment of compounds or ionic parts of salts to a surface or another phase. Nutrients in solution (ions) carrying a positive charge become attached to (adsorbed by) negatively charged soil particles.

AERATION, SOIL The exchange of air in soil with air from the atmosphere. The composition of the air in a well-aerated soil is similar to that in the atmosphere; in a poorly aerated soil, the air in the soil is considerably higher in carbon dioxide and lower in oxygen than the atmosphere above the soil.

AEROBIC (1) Conditions with oxygen gas as a part of the environment. (2) Living or acting only in the presence of air or free oxygen. (3) Pertaining to the activity of organisms that grow under aerobic conditions, such as aerobic decomposition.

AGGREGATE (OF SOIL) Many fine soil particles held in a single mass or cluster, such as a clod, crumb, block, or prism. Many properties of the aggregate differ from those of an equal mass of unaggregated soil.

ALKALI SOIL Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity—pH 8.5 or higher—or so high a percentage of exchangeable sodium—15 percent or higher—or both, that the growth of most crop plants is reduced. (In former years this term was also applied loosely to both alkali and saline soils. The term is also applied by some to those uncommon soils that contain highly alkaline salts, such as sodium carbonate.)

ALKALINE SOIL Generally, a soil that is alkaline throughout most or all of the parts of it occupied by plant roots; although the term is commonly applied to only a specific layer or horizon of a soil. Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH above 7.3.

ALLUVIAL SOILS Soils developing from transported and relatively recently deposited material (alluvium) with little or no modification of the original materials by soil-forming processes. (Soils with well-developed profiles that have formed from alluvium are grouped with other soils having the same kinds of profiles, not with the alluvial soils.)

ALLUVIUM Sand, mud, and other sediments deposited on land by streams.

ALUMINO-SILICATES Compounds containing aluminum, silicon, and oxygen atoms as main constituents.

AMENDMENT Any material, such as lime, gypsum, sawdust, or synthetic conditioners, that is worked into the soil to make it more productive. Strictly, a fertilizer is also an amendment, but the term "amendment" is used most commonly for added materials other than fertilizer.

AMINO ACIDS Amino acids are nitrogen-containing organic compounds, large numbers of which link together in the formation of a protein molecule. Each amino acid molecule contains one or more amino ($-NH_2$) groups and at least one carboxyl ($-COOH$) group. In addition, some amino acids (cystine and methionine) contain sulfur.

AMMONIA A colorless gas composed of one atom of nitrogen and three atoms of hydrogen. Ammonia liquefied under pressure is used as a fertilizer.

AMMONIFICATION The formation by organisms of ammonium compounds from nitrogen-containing organic materials.

AMMONIUM ION The positively charged NH_4^+ ion. The form in which nitrogen occurs in many commercial fertilizers.

ANAEROBIC Living or functioning in the absence of air or free oxygen.

ANHYDROUS Dry, or without water. Anhydrous ammonia is water free; in contrast to the water solution of ammonia commonly known as household ammonia.

ANION An ion carrying a negative charge of electricity.

ANTHROPIC SOIL A soil produced from a natural soil or other earthy deposit by the work of man that has new characteristics that make it different from the natural soil. Examples include deep, black surface soils resulting from centuries of manuring, and naturally acid soils that have lost their distinguishing features because of many centuries of liming and use for grass.

ANTIBIOSIS Opposed to living. Antibiotics suppress some micro-organisms.

APATITE A native phosphate of lime. The name is given to the chief mineral of phosphate rock and the inorganic compound of bone.

AQUA AMMONIA A water solution of ammonia.

AQUIFER A water-bearing formation through which water moves more readily than in adjacent formations of lower permeability.

ARID CLIMATE A very dry climate like that of desert or semidesert regions where there is only enough water for widely spaced desert plants. The limits of precipitation vary widely according to temperature, with an upper limit for cool regions of less than 10 inches and for tropical regions of as much as 20 inches. (The precipitation-effectiveness index ranges from 0 to about 16.)

ARID REGION Areas where the potential water losses by evaporation and transpiration are greater than the amount of water supplied by precipitation. In the United States this area is broadly considered to be the dry parts of the 17 Western States.

ASH The nonvolatile residue resulting from the complete burning of organic matter. It is commonly composed of oxides of such elements as silicon, aluminum, iron, calcium, magnesium, and potassium.

ASSIMILATION Conversion of substances taken in from the outside into living tissue of plants or animals.

AUTOTROPHIC Capable of using (oxidizing) simple chemical elements or compounds, such as iron, sulfur, or nitrates, to obtain energy for growth.

AUXINS Organic substances which cause lengthening of the stem when applied in low concentrations to shoots of growing plants.

AVAILABLE NUTRIENT IN SOILS The part of the supply of a plant nutrient in the soil that can be taken up by plants at rates and in amounts significant to plant growth.

AVAILABLE WATER IN SOILS The part of the water in the soil that can be taken up by plants at rates significant to their growth; usable; obtainable.

AZONAL SOILS A general group of soils having little or no soil profile development. Most of them are young. In the United States, Alluvial soils, Lithosols, and Regosols are included in the azonal group.

B HORIZON A soil horizon, usually beneath an A horizon, or surface soil, in which (1) clay, iron, or aluminum, with accessory organic matter, have accumulated by receiving suspended material from the A horizon above it or by clay development in place; (2) the soil has a blocky or prismatic structure; or (3) the soil has some combination of these features. In soils with distinct profiles, the B horizon is roughly equivalent to the general term "subsoil."

BANDING (OF FERTILIZERS) The placement of fertilizers in the soil in continuous narrow ribbons, usually at specific distances from the seeds or plants. The fertilizer bands are covered by the soil but are not mixed with it.

BASE SATURATION The relative degree to which soils have metallic cations absorbed. The proportion of the cation-exchange capacity that is saturated with metallic cations.

BASIN IRRIGATION (OR LEVEL BORDERS) The application of irrigation water to level areas that are surrounded by border ridges or levees. Usually irrigation water is applied at

rates greater than the water intake rate of the soil. The water may stand on uncropped soils for several days until the soil is well soaked; then any excess may be used on other fields. The water may stand a few hours on fields having a growing crop.

BASIN LISTING A method of tillage that creates small basins by damming lister furrows at regular intervals of about 4 to 20 feet. This method is a modification of ordinary listing and is carried out approximately on the contour on nearly level or gently sloping soils as a means of encouraging water to enter the soil rather than to run off the surface.

BC SOIL A soil with a B and a C horizon but with little or no A horizon. Most BC soils have lost their A horizons by erosion.

BEDDING SOIL Arranging the surface of fields by plowing and grading into a series of elevated beds separated by shallow ditches for drainage.

BEDROCK The solid rock underlying soils and other earthy surface formations.

BENCH TERRACES An embankment constructed across sloping soils with a steep drop on the downslope side.

BLOWOUT An area from which soil material has been removed by wind. Such an area appears as a nearly barren, shallow depression with a flat or irregular floor consisting of a resistant layer, an accumulation of pebbles, or wet soil lying just above a water table.

BOG SOIL An intrazonal group of soils with mucky or peaty surface soils underlain by peat. Bog soils usually have swamp or marsh vegetation and are commonest in humid regions.

BONDS Chemical forces holding atoms together to form molecules.

BORDER IRRIGATION Irrigation in which the water flows over narrow strips that are nearly level and are separated by parallel, low-bordering banks or ridges.

BROAD-BASE TERRACE A low embankment, with such gentle slopes that it can be farmed, constructed across sloping soils approximately on the contour. Broad-base terraces are used on pervious soils to reduce runoff and soil erosion.

BROWN FOREST SOILS An intrazonal group of soils that have dark-brown surface horizons, relatively rich in humus, grading through lighter colored soil into the parent material. They are characterized by a slightly acid or neutral reaction and a moderately high amount of exchangeable calcium. They are commonly developed under deciduous forests from parent materials relatively rich in bases, especially calcium.

BROWN PODZOLIC SOILS A zonal group of soils with thin mats of partly decayed leaves over thin, grayish-brown mixed humus and mineral soil. They lie over yellow or yellowish-brown, acid B horizons, slightly richer in clay than the surface soils. These soils develop under deciduous or mixed deciduous and coniferous forests in cool-temperate humid regions, such as parts of New England, New York, and western Washington.

BROWN SOILS A zonal group of soils having a brown surface horizon that grades below into lighter colored soil. These soils have an accumulation of calcium carbonate at 1 to 3 feet. They develop under short grasses, bunchgrasses, and shrubs in a temperate to cool semiarid climate.

BUFFER, BUFFERING Substances in the soil that act chemically to resist changes in reaction or pH. The buffering action is due mainly to clay and very fine organic matter. Highly weathered tropical clays are less active buffers than most less weathered silicate clays. Thus with the same degree of acidity, or pH, more lime is required to neutralize (1) a clayey soil than a sandy soil, (2) a soil rich in organic matter than one low in organic matter, or (3) a sandy loam in Michigan, say, than a sandy loam in central Alabama.

BUFFER STRIPS Established strips of perennial grass or other erosion-resisting vegetation, usually on the contour in cultivated fields, to reduce runoff and erosion.

BULK DENSITY The mass or weight of ovendry soil per unit bulk volume, including air space. This mass in relation to the weight of a unit volume of water, was formerly called "apparent density" or "volume weight."

C HORIZON The unconsolidated rock material in the lower part of the soil profile like that from which the upper horizons (or at least a part of the B horizon) have developed.

CALCAREOUS SOIL A soil containing calcium carbonate, or a soil alkaline in reaction because of the presence of calcium carbonate. A soil containing enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid.

CALICHE A broad term for the more or less cemented deposits of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. When it is very near the surface or exposed by erosion, the material hardens. (Caliche is also used for deposits of sodium nitrate in Chile and Peru.)

CAPILLARY POROSITY The volume of small pores within the soil that hold water against the force of gravity.

CAPILLARY WATER The water retained in the fine pores in soil by surface tension that moves as a result of capillary forces.

CARBOHYDRATES Compounds containing carbon, hydrogen, and oxygen. Usually the hydrogen and oxygen occur in the proportion of 2 to 1, such as in glucose ($C_6H_{12}O_6$).

CARBON One of the commonest chemical elements, occurring in lampblack, coal, and coke in varying degrees of purity. Compounds of carbon are the chief constituents of living tissue.

CARBON DIOXIDE A colorless gas (CO_2) composed of carbon and oxygen and normally found in small amounts in the air. It is one of the end products of the burning (oxidation) of organic matter, or carbon-containing compounds.

CARBON-NITROGEN RATIO The ratio of the weight of organic carbon to the weight of total nitrogen in a soil or in an organic material.

CATALASE An enzyme capable of decomposing hydrogen peroxide into water and oxygen: $2H_2O_2 \rightarrow 2H_2O + O_2$.

CATALYST A material that increases the rate of a chemical reaction.

CATENA A group of soils, within a specific soil zone, formed from similar parent materials but with unlike soil characteristics because of differences in relief or drainage.

CATION An ion carrying a positive charge of electricity. The common soil cations are calcium, magnesium, sodium, potassium, and hydrogen.

CATION EXCHANGE The exchange of cations held by the soil-adsorbing complex with other cations. Thus if a soil-absorbing complex is rich in sodium, treatment with calcium sulfate (gypsum) causes some calcium cations to exchange with some sodium cations.

CATION-EXCHANGE CAPACITY A measure of the total amount of exchangeable cations that can be held by the soil. It is expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7) or at some other stated pH value. (Formerly called base-exchange capacity.)

CELLULOSE The principal constituent of the cell walls of higher plants. It is made up of glucose molecules arranged in long chains and has the chemical formula $(C_6H_{10}O_5)_x$. The long molecules give it a fibrous nature. Cotton fibers are almost pure cellulose. Paper is mainly cellulose separated by chemical processes from wood or other plant remains.

CHELATES A type of chemical compound in which a metallic atom is firmly combined with a molecule by means of multiple chemical bonds. The term refers to the claw of a crab illustrative of the way in which the atom is held.

CHERNOZEM SOILS A zonal group of soils having deep, dark to nearly black surface horizons and rich in organic matter, which grades into lighter colored soil below. At 1.5 to 4 feet, these soils have layers of accumulated calcium carbonate. They develop under tall and mixed grasses in a temperate to cool subhumid climate.

CHERT A structureless form of silica, closely related to flint, which breaks into angular fragments. Soils developed from impure limestones containing fragments of chert and having abundant quantities of these fragments in the soil mass are called cherty soils.

CHESTNUT SOILS A zonal group of soils with dark-brown surface horizons, which grade into lighter colored horizons beneath. They have layers of accumulated calcium carbonate at 1 to 4 feet. They are developed under mixed tall and short grasses in a temperate to cool and subhumid to semiarid climate. Chestnut soils occur in regions a little more moist than those having Brown soils and a little drier than those having Chernozem soils.

CHISEL A tillage machine with one or more soil-penetrating points that can be drawn through the soil to loosen the subsoil, usually to a depth of 12 to 18 inches.

CHITIN A nitrogen containing polysaccharide found in the outer part of insects.

CHLOROPHYLL The constituent responsible for the green color of plants. Chlorophyll is important in photosynthesis in plants, the process by which sugar is manufactured.

CHLOROPLASTS Small bodies in cells of plants in which the green pigment chlorophyll is concentrated.

CHLOROSIS A condition in plants resulting from the failure of chlorophyll (the green coloring matter) to develop, usually because of deficiency of an essential nutrient. Leaves of chlorotic plants range from light green through yellow to almost white.

CLAY As a soil separate, the mineral soil particles less than 0.002 mm. in diameter. As a soil textural class, soil material that contains 40 percent or more of clay, less than 45 percent of sand, and less than 40 percent of silt.

CLAY LOAM Soil material that contains 27 to 40 percent of clay and 20 to 45 percent of sand.

CLAY MINERAL Naturally occurring inorganic crystalline material in soils or other earthy deposits of clay size—particles less than 0.002 mm. in diameter.

CLAYPAN A compact, slowly permeable soil horizon rich in clay and separated more or less abruptly from the overlying soil. Claypans are commonly hard when dry and plastic or stiff when wet.

CLOD A mass of soil produced by plowing or digging, which usually slakes easily with repeated wetting and drying, in contrast to a *ped*, which is a natural soil aggregate.

COLLOID, SOIL Colloid refers to organic or inorganic matter having very small particle size and a correspondingly large surface area per unit of mass. Most colloidal particles are too small to be seen with the ordinary compound microscope. Soil colloids do not go into true solution as sugar or salt do, but they may be dispersed into a relatively stable suspension and thus be carried in moving water. By treatment with salts and other chemicals, colloids may be flocculated, or aggregated, into small crumbs or granules that settle out of water. (Such small crumbs of aggregated colloids can be moved by rapidly moving water or air just as other particles can be.) Many mineral soil colloids are really tiny crystals and the minerals can be identified with X-rays and in other ways.

COLLUVIUM Mixed deposits of soil material and rock fragments near the base of rather steep slopes. The deposits have accumulated through soil creep, slides, and local wash.

COMPANION CROP A crop grown with another crop, usually a small grain with which alfalfa, clover, or other forage crops are sown. (Formerly such small grain crops were known as nurse crops, but because the small grain does not "nurse" the other crop this older term is being abandoned.)

COMPLEX, SOIL An intimate mixture of tiny areas of different kinds of soil that are too small to be shown separately on a publishable soil map. The whole group of soils must be shown together as a mapping unit and described as a pattern of soils.

COMPOST A mass of rotted organic matter made from waste plant residues. Inorganic fertilizers, especially nitrogen, and a little soil usually are added to it. The organic residues usually are piled in layers, to which the fertilizers are added. The layers are separated by thin layers of soil. The whole pile is kept moist and allowed to decompose. The pile is usually turned once or twice. The principal purpose in making compost is to permit the organic materials to become crumbly and to reduce the carbon-nitrogen ratio of the material. Compost is sometimes called artificial or synthetic manure.

CONCRETIONS Hard grains, pellets, or nodules from concentrations of compounds in the soil that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Concretions can be of various sizes, shapes, and colors.

CONDITIONER (OF FERTILIZER) A material added to a fertilizer to prevent caking and to keep it free flowing.

CONDUCTANCE Conducting power, the reciprocal of resistance.

CONDUCTIVITY, ELECTRICAL A physical quantity that measures the readiness with which a medium transmits electricity. Commonly used for expressing the salinity of irrigation waters and soil extracts because it can be directly related to salt concentration. It is expressed in mhos per centimeter (or millimhos per centimeter or micromhos per centimeter at 25° C.).

CONSISTENCE The combination of properties of soil material that determine its resistance to crushing and its ability to be molded or changed in shape. Consistence depends mainly on the forces of attraction between soil particles. Consistence is described by such words as loose, friable, firm, soft, plastic, and sticky.

CONSOLIDATE (SOIL) To place into a compact mass and thus increase density and reduce pore space.

CONSUMPTIVE USE The water used by plants in transpiration and growth, plus water vapor loss from adjacent soil or snow, or from intercepted precipitation in any specified time. Usually expressed as equivalent depth of free water per unit of time.

CONTINENTAL CLIMATE A general term for the climate typical of great land masses where wide ranges in temperature and other weather conditions occur because the area is not greatly influenced by nearness to the sea. Much of the United States has a continental climate.

CONTOUR An imaginary line connecting points of equal elevation on the surface of the soil. A contour terrace is laid out on a sloping soil at right angles to the direction of the slope and level throughout its course. In contour plowing, the plowman keeps to a level line at right angles to the direction of the slope, which usually results in a curving furrow.

CONTOUR BASINS Basins made by levees or borders built on contours with occasional cross levees.

CONVEYANCE LOSS Loss of water from a conduit due to leakage, seepage, and evaporation.

CREEP, SOIL The downward mass movement of sloping soil. The movement is usually slow and irregular and occurs most commonly when the lower soil is nearly saturated with water.

CRUMB STRUCTURE Very porous granular structure in soils.

CRUST A thin, brittle layer of hard soil that forms on the surface of many soils when they are dry. An exposed hard layer of materials cemented by calcium carbonate, gypsum, or other binding agents. Most desert crusts are formed by the exposure of such layers through removal of the upper soil by wind or running water and their subsequent hardening.

CYTOCHROME An iron-containing pigment that plays a major role in respiration.

CYTOPLASM The portion of the protoplasm of a cell outside the nucleus.

D LAYER Any stratum underlying the soil profile that is unlike the material from which the soil has been formed.

DAMPING-OFF Sudden wilting and death of seedling plants resulting from attack by micro-organisms.

DEALKALIZATION Removal of exchangeable sodium (or alkali) from the soil, usually by chemical treatment and leaching.

DEEP PERCOLATION A general term for the downward movement of water beyond the reach of plant roots.

DEEP SOIL Generally, a soil deeper than 40 inches to rock or other strongly contrasting material. Also, a soil with a deep black surface layer; a soil deeper than about 40 inches to the parent material or to other unconsolidated rock material not modified by soil-forming processes; or a soil in which the total depth of unconsolidated material, whether true soil or not, is 40 inches or more.

DEFLOCCULATE To separate or to break up soil aggregates into the individual particles; to disperse the particles of a granulated clay to form a clay that runs together or puddles.

DEGRADATION (OF SOILS) The change of one kind of soil to a more highly leached kind, such as the change of a Chernozem to a Podzol.

DEHYDRATION Removal or loss of water.

DENITRIFICATION The process by which nitrates or nitrites in the soil or organic deposits are reduced to ammonia or free nitrogen by bacterial action. The process results in the escape of nitrogen into the air and is therefore wasteful.

DESALINIZATION Removal of salts from saline soil, usually by leaching.

DESERT SOIL A zonal group of soils that have light-colored surface soils and usually are underlain by calcareous material and frequently by hard layers. They are developed under extremely scanty scrub vegetation in warm to cool, arid climates.

DESILTING AREA An area used for removing the sediment from flowing water, especially by vegetation.

DESORPTION The removal of sorbed materials from surfaces.

DETAILED SOIL MAP A soil map showing the kinds of soil. The soil boundaries have been plotted on a base map or aerial photograph from observations made throughout their course and the kinds of soil are classified and the boundaries shown in all the detail significant to soil use and management. Most of the soils shown on such maps are phases of soil types.

DIFFUSION The transport of matter as a consequence of the movement of the constituent particles. The intermingling of two gases or liquids in contact with each other takes place by diffusion.

DIPOLAR Having two poles as a result of separation of electric charge. A dipolar molecule orients in an electric field.

DISPERSION OF SOIL Deflocculation of the soil and its suspension in water.

DIVALENT MANGANOUS ION The chemical element manganese (Mn^{+2}) in its lowest valence state.

DRAINAGE (A PRACTICE) The removal of excess surface water or excess water from within the soil by means of surface or subsurface drains.

DRAINAGE, SOIL (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation. For example, in well-drained soils, the water is removed readily, but not rapidly; in poorly drained soils, the root zone is waterlogged for long periods and the roots of ordinary crop plants cannot get enough oxygen; and in excessively drained soils, the water is removed so completely that most crop plants suffer from lack of water.

DRIFT Material of any sort deposited by geological processes in one place after having been removed from another. Glacial drift includes the materials deposited by glaciers and by the streams and lakes associated with them.

DROP-INLET DAM A dam through which overflow water is carried through a shallow, sloping pipe in order to drop water from one level to another for gradient control and for stabilization of a waterway.

DROUGHT A period of dryness, especially a long one. Usually considered to be any period of soil moisture deficiency within the plant root zone. A period of dryness of sufficient length to deplete soil moisture to the extent that plant growth is seriously retarded.

DRY FARMING Generally, producing crops that require some tillage in subhumid or semiarid regions without irrigation. The system usually involves periods of fallow between crops during which water from precipitation is absorbed and retained.

DRY SANDS Sandy deposits, with low water-holding capacity, in which there has been no clear development of soil characteristics since deposition.

DRY WEIGHT PERCENTAGE (OF WATER IN SOIL) The weight of water expressed as a percentage of the ovendry weight of soil.

DUFF The matted, partly decomposed organic surface layer of forested soils.

DUNE A mount or ridge of loose sand piled up by the wind. Occasionally during periods of extreme drought, granulated soil material of fine texture may be piled into low dunes, sometimes called clay dunes.

DUST MULCH A loose, dry surface layer of a cultivated soil, formerly thought to be effective in reducing the loss of moisture from the underlying soil.

ECOLOGY The branch of biology that deals with the mutual relations among organisms and between organisms and their environment.

EFFLUENT The outflowing of water from a subterranean storage space. (Also used generally for gases and other liquids.)

ELECTROLYTE Any conductor of electric current in which chemical change accompanies the passage of the current and the amount of the change is proportional to the amount of current passed. Usually electrolytes are solutions of substances in a liquid, such as salt in water. A substance that forms a conductor of electricity when added to a solvent. Thus, common table salt becomes an electrolyte when added to water.

ELUVIATION The movement of material from one place to another within the soil in either true solution or colloidal suspension. Soil horizons that have lost material through eluviation are said to be eluvial; those that have received material are illuvial. With an excess of rainfall over evaporation, eluviation may take place either downward or laterally according to the direction of water movement. The term refers especially to the movement of soil colloids in suspension; leaching refers to the removal of soluble materials such as salt in true solution.

ENVIRONMENT All external conditions that may act upon an organism or soil to influence its development, including sunlight, temperature, moisture, and other organisms.

ENZYMES Substances produced by living cells which can bring about or speed up chemical reaction. They are organic catalysts.

EQUILIBRIUM A state of balance between opposing soil forces or actions.

ERODIBLE (SOIL) Soil susceptible to erosion.

EROSION The wearing away of the land surface by detachment and transport of soil and rock materials through the action of moving water, wind, or other geological agents.

EROSIVE (WIND OR WATER) Used in reference to wind or water having sufficient velocity to cause erosion. Not to be confused with erodible as a quality of soil.

EVAPOTRANSPIRATION The loss of water from a soil by evaporation and plant transpiration.

EXCHANGE CAPACITY (See cation-exchange capacity.)

EXCHANGEABLE This word describes the ions in the absorbing complex of the soil that can be exchanged with other ions. For example, when acid soils are limed, calcium ions exchange for hydrogen ions in the complex; when alkali soils are treated with gypsum, calcium ions exchange for sodium ions that can be leached away.

EXCHANGEABLE SODIUM Sodium that is attached to the surface of soil particles which can be exchanged with other positively charged ions in the soil solution, such as calcium and magnesium.

FALLOW Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop. Bush or forest fallow is a rest period under woody vegetation between crops.

FELDSPARS Primary alumino-silicate minerals having a three-dimensional framework structure.

FERRIC IRON An oxidized or high-valence form of iron (Fe^{+3}) responsible for red, yellow, and brown colors in soils. Fe^{+++}.

FERROUS IRON A reduced or low-valence form of iron (Fe^{+2}), imparting a blue-gray appearance to some wet subsoils on long standing.

FERTILITY, SOIL The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

FERTILIZER Any natural or manufactured material added to the soil in order to supply one or more plant nutrients. The term is generally applied to largely inorganic materials other than lime or gypsum (mineral fertilizers) sold in the trade.

FERTILIZER GRADE An expression that indicates the percentage of plant nutrients in a fertilizer. Thus a 10–20–10 grade contains 10 percent nitrogen (N), 20 percent phosphoric oxide (P_2O_5), and 10 percent potash (K_2O). This convention is in common use even though the nitrogen, phosphorus, and potassium are present in other forms.

FIELD CAPACITY The amount of moisture remaining in a soil after the free water has been allowed to drain away into drier soil material beneath; usually expressed as a percentage of the ovendry weight of soil or other convenient unit. It is the highest amount of moisture that the soil will hold under conditions of free drainage after excess water has drained away following a rain or irrigation that has wet the whole soil. For permeable soils of medium texture, this is about 2 or 3 days after a rain or thorough irrigation. Although generally similar for one kind of soil, values vary with previous treatments of the soil.

FIELD MOISTURE The water that soil contains under field conditions.

FILM WATER The water held on the surfaces of soil particles that does not drain away, although it moves rapidly under suction gradients. Most of it is available to plant roots.

FINE-TEXTURED SOIL Roughly, clayey soil containing 35 percent or more of clay.

FIRST BOTTOM The normal flood plain of a stream, subject to frequent or occasional flooding.

FIXATION (IN SOIL) The conversion of a soluble material, such as a plant nutrient like phosphorus, from a soluble or exchangeable form to a relatively insoluble form.

FLOCCULATE To aggregate or clump together individual tiny soil particles, especially fine clay, into small groups or granules. The opposite of deflocculate, or disperse.

FLOOD IRRIGATION Irrigation by running water over nearly level soil in a shallow flood.

FLOOD PLAIN The nearly flat lands along streams that overflow during floods.

FLUORAPATITE A member of the apatite group of minerals, rich in fluorine. Most common mineral in raw rock phosphate.

FOLIAR DIAGNOSIS Estimation of the plant-nutrient status of plant or the plant-nutrient requirements of a soil for producing a crop through chemical analyses or color manifestations of plant leaves or by both methods together.

FOLIAR FERTILIZATION Fertilization of plants by applying chemical fertilizers to their foliage.

FOOD, PLANT The organic compounds elaborated by a plant within its cells. (Sometimes used loosely for plant nutrients.)

FORAGE Unharvested plant material which can be used as feed by domestic animals. Forage may be grazed or cut for hay.

FOREST LAND Land bearing a stand of trees at any age or stature, including seedlings, and of species attaining a minimum of 6 feet average height at maturity; or land from which such a stand has been removed but on which no other use has been substituted. The term is commonly limited to land not in farms; forests on farms are commonly called woodland or farm forests.

FRAGIPANS Dense and brittle pans or layers in soils that owe their hardness mainly to extreme density or compactness rather than to high clay content or cementation. Removed fragments are friable, but the material in place is so dense that roots cannot penetrate and water moves through it very slowly because of small pore size.

FREE Often said of silica, ferric oxide, or calcium carbonate. The condition of the substance within a mixture when it is not chemically combined with the other components of the mixture. For example, iron oxide in soils may be by itself as free iron oxide, or it may be combined with other elements in a mineral.

FUNGI Forms of plantlife, lacking chlorophyll and unable to make their own food.

GENESIS, SOIL The mode of origin of the soil, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

GLEY SOIL A soil horizon in which water-logging and lack of oxygen have caused the material to be a neutral gray in color. The term "gleyed" is applied, as in "moderately gleyed soil," to soil horizons with yellow and gray mottling caused by intermittent water-logging.

GRANULAR, FERTILIZER A fertilizer composed of particles of roughly the same composition, about one-tenth inch in diameter. This kind of fertilizer contrasts with the normally fine or powdery fertilizer.

GRANULAR STRUCTURE Soil structure in which the individual grains are grouped into spherical aggregates with indistinct sides. Highly porous granules are commonly called crumbs. A well-granulated soil has the best structure for most ordinary crop plants.

GRAVITATIONAL WATER IN SOILS The water in the large pores of the soil that drains away under the force of gravity with free underdrainage. Well-drained soils have such water only during and immediately after rains or applications of irrigation water. In poorly drained soils, this water accumulates in the pores at the expense of air. Under such conditions, the soil lacks oxygen for the roots of most crop plants and is said to be water-logged.

GRAY-BROWN PODZOLIC SOILS A zonal group of soils having thin organic coverings and thin organic-mineral layers over grayish-brown leached layers that rest upon brown B horizons richer in clay than the soil horizon above. These soils have formed under deciduous forests in a moist temperate climate.

GREAT SOIL GROUP Any one of several broad groups of soil with fundamental characteristics in common. Examples are Chernozem, Gray-Brown Podzolic, and Podzol.

GROUND WATER Water that fills all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

GROUND-WATER PODZOL An intrazonal group of soils, developed from imperfectly drained sandy deposits in humid regions, with thin organic and organic-mineral layers over light-gray or white leached layers that rest on dark-brown B horizons irregularly cemented with iron, organic matter, or both.

HARDPAN A hardened or cemented soil horizon or layer. The soil material may be sandy or clayey and may be cemented by iron oxide, silica, calcium carbonate, or other substances.

HEAD Difference in elevation of water-producing discharge. (Sometimes used incorrectly for the size of irrigation streams.)

HEAVY SOIL An old term formerly used for clayey or fine-textured soils. (The term originated from the heavy draught on the horses when plowing.)

HORIZON SOIL A layer of soil, approximately parallel to the soil surface, with distinct characteristics produced by soil-forming processes.

HUMIC ACIDS Alkali soluble end products of the decomposition of organic matter in soil and in composts. The term sometimes is used interchangeably for humus.

HUMID CLIMATE A climate with enough precipitation to support a forest vegetation, although there are exceptions where the plant cover includes no trees, as in the Arctic or high mountains. The lower limit of precipitation may be as little as 15 inches in cool regions and as much as 60 inches in hot regions. The precipitation-effectiveness index ranges between 64 and 128. A climate having a high average relative humidity.

HUMIFICATION A process or condition of decay in which plant or animal remains are so thoroughly decomposed that their initial structures or shapes can no longer be recognized.

HUMUS The well-decomposed, more or less stable part of the organic matter in mineral soils.

HYDRAULIC EQUILIBRIUM (OF WATER IN SOIL) The condition for zero flow rate of liquid or film water in soil. This condition is satisfied when the pressure gradient force is just equal and opposite to the gravity force.

HYDRONIUM IONS The predominant form of occurrence of hydrogen ions in solution, each hydrogen ion being associated with a single water molecule; H_3O^+.

HYDROUS Containing water.

HYDROXYAPATITE A member of the apatite group of minerals rich in hydroxyl groups. A nearly insoluble calcium phosphate.

HYGROSCOPIC Capable of taking up moisture from the air.

HYGROSCOPIC COEFFICIENT The amount of moisture in a dry soil when it is in equilibrium with some standard relative humidity near a saturated atmosphere (about 98 percent), expressed in terms of percentage on the basis of ovendry soil.

IGNEOUS ROCK Rock produced through the cooling of melted mineral matter. When the cooling process is slow, the rock contains fair-sized crystals of the individual minerals, as in granite.

ILLITE A series of micalike, nonexpandable, or slightly expandable alumino-silicate clay minerals in which two silica layers alternate with one alumina layer; also called hydrous micas.

ILLUVIATION An accumulation of material in a soil horizon through the deposition of suspended mineral and organic matter originating from horizons above. Since at least part of the fine clay in the B horizons (or subsoils) of many soils has moved into them from the A horizons above, these are called illuvial horizons.

IMMATURE SOIL A soil lacking clear individual horizons because of the relatively short time for soil-building forces to act upon the parent material since its deposition or exposure.

IMMOBILIZATION (OF PLANT NUTRIENTS) The conversion of an available plant nutrient in the soil from an inorganic to an organic form in living tissue. Thus the addition of fresh straw or sawdust to the soil may greatly increase the number of bacteria. These remove available nitrogen and phosphorus from the soil and immobilize them within their cells.

IMPERVIOUS SOIL A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to water and air all the time.

INHERITED SOIL CHARACTERISTICS Any characteristic of a soil that is due directly to the nature of the material from which it formed, as contrasted to the characteristics that are wholly or partly the result of soil-forming processes acting on parent material. For example, some soils are red because the parent material was red; although the color of most red soils is due to soil-forming processes.

INORGANIC Refers to substances occurring as minerals in nature or obtainable from them by chemical means. Refers to all matter except the compounds of carbon, but includes carbonates.

INORGANIC NITROGEN Nitrogen in combination with mineral elements, not in animal or vegetable form. Ammonium sulfate and sodium nitrate are examples of inorganic nitrogen combinations, while proteins contain nitrogen in organic combination.

IN PLACE (*in situ*) (1) Formed or accumulated on the spot. A rock may decay and break down into small particles where it is first exposed in the land surface. It is then said to have weathered in place or in situ. (2) As a mass appears in the soil before any disturbance. For example, the deeper part of a profile may be massive and show no signs of structure in place but break down into lumps of regular size and shape when removed.

INTAKE RATE The rate, usually expressed in inches per hour, at which rain or irrigation water enters the soil. This rate is controlled partly by surface conditions (infiltration rate) and partly by subsurface conditions (permeability). It also varies with the method of applying water. The same kind of soil has different intake rates under sprinkler irrigation, border irrigation, and furrow irrigation.

INTERTILLED CROP A crop having or requiring cultivation during growth.

INTRAZONAL SOIL Any one of the great groups of soils having more or less well-developed soil characteristics that reflect a dominating influence of some local factor of relief or of parent material over the normal influences of the climate and the vegetation on the soil-forming processes. Such groups of soils may be geographically associated with two or more of the zonal groups of soils having characteristics dominated by the influence of climate and vegetation.

ION An electrically charged particle. As used in soils, an ion refers to an electrically charged element or combination of elements resulting from the breaking up of an electrolyte in solution. Since most soil solutions are highly dilute, many of the salts exist as ions. For example, all or part of the potassium chloride (muriate of potash) in most soils exists as potassium ions and chloride ions. The positively charged potassium ion is called a cation and the negatively charged chloride ion is called an anion.

ISOTOPE One of two or more forms of a chemical element having the same atomic number and position in the periodic table of elements, but distinguishable by differences of weight.

KAOLIN MINERALS A group of nonswelling clay minerals in which one layer or sheet of silicon and oxygen alternates with a sheet made up of aluminum, oxygen, and hydrogen.

LACUSTRINE DEPOSITS Materials deposited from lake water. Many nearly level soils have developed from such deposits from old lakes that have long since disappeared.

LAND The total natural and cultural environment within which production takes place. Land is a broader term than soil. In addition to soil, its attributes include other physical conditions such as mineral deposits and water supply; location in relation to centers of commerce, populations, and other land; the size of the individual tracts or holdings; and existing plant cover, works of improvement, and the like. Some use the term loosely in other senses: As defined above, but without the economic or cultural criteria, especially in the expression "natural land"; as a synonym for "soil"; for the solid surface of the earth; and also for earthy surface for-

mations, especially in the geomorphological expression "land form."

LAND-CAPABILITY CLASSIFICATION A grouping of kinds of soil into special units, subclasses, and classes according to their capability for intensive use and the treatments required for sustained use.

LANDSCAPE The sum total of the characteristics that distinguish a certain kind of area on the earth's surface and give it a distinguishing pattern in contrast to other kinds of areas. Any one kind of soil is said to have a characteristic natural landscape, and under different uses it has one or more characteristic cultural landscapes.

LAND-USE PLANNING The development of plans for the uses of land that, over long periods, will best serve the general welfare, together with the formulation of ways and means for achieving such uses.

LATTICE The structural framework of a clay mineral which is made up by the orderly arrangement of the various ionic components of the mineral. The mineral is held together by the chemical bonds exerted toward each other by the various ions in the mineral. The structural pattern repeats itself indefinitely and regularly; the atoms are linked according to definite angles and distances. For example, micas and alumino-silicate clay minerals have layer lattices consisting of alternate silica and alumina layers.

LEACHING The removal of materials in solution by the passage of water through soil.

LEVEL TERRACE A broad surface channel or embankment constructed across sloping soil on the contour, as contrasted to a graded terrace, which is built at a slight angle to the contour. A level terrace can be used only on soils that are permeable enough for all of the storm water to soak into the soil so that none breaks over the terrace to cause gullies.

LEVELING (OF LAND) The reshaping or modification of the land surface to a planned grade to provide a more suitable surface for the efficient application of irrigation water and to provide good surface drainage.

LEY A term used in English writing for pastures or meadows. A short ley is roughly equivalent to our "rotation" pasture or meadow, and a long ley to our "longtime" pastures and meadows, often incorrectly called permanent.

LIGHT SOIL An old term formerly used for sandy or coarse-textured soils.

LIGNIN An organic substance that incrusts the cellulose framework of plant cell walls. It is made up of modified phenyl propane units. It is dissolved only with difficulty and is more inert chemically and biologically than other plant constituents. Lignin increases with age in plants.

LIME Generally the term lime, or agricultural lime, is applied to ground limestone (calcium carbonate), hydrated lime (calcium hydroxide), or burned lime (calcium oxide), with or without mixtures of magnesium carbonate, magnesium hydroxide, or magnesium oxide, and materials such as basic slag, used as amendments to reduce the acidity of acid soils. In strict chemical terminology, lime refers to calcium oxide (CaO), but by an extension of meaning it is now used for all limestone-derived materials applied to neutralize acid soils.

LIME REQUIREMENT The amount of standard ground limestone required to bring a 6.6-inch layer of an acre (about 2 million pounds in mineral soils) of acid soil to some specific lesser degree of acidity, usually to slightly or very slightly acid. In common practice, lime requirements are given in tons per acre of nearly pure limestone, ground finely enough so that all of it passes a 10-mesh screen and at least half of it passes a 100-mesh screen.

LITHOSOL A soil having little or no evidence of soil development and consisting mainly of a partly weathered mass of rock fragments or of nearly barren rock.

LOAM The textural class name for soil having a moderate amount of sand, silt, and clay. Loam soils contain 7 to 27 percent of clay, 28 to 50 percent of silt, and less than 52 percent of sand. (In the old literature, especially English literature, the term "loam" applied to mellow soils rich in organic matter, regardless of the texture. As used in the United States, the term refers only to the relative amounts of sand, silt, and clay; loam soils may or may not be mellow.)

LOAMY SOIL A general expression for soils of intermediate texture between the coarse-textured or sandy soils, on the one hand, and the fine-textured or clayey soils on the other. Sandy loams, loams, silt loams, and clay loams are regarded as loamy soils.

LOESS Geological deposit of relatively uniform, fine material, mostly silt, presumably transported by wind. Many unlike kinds of soil in the United States have developed from loess blown out of alluvial valleys and from other deposits during periods of aridity.

LUXURY CONSUMPTION The intake by a plant of an essential nutrient in amounts exceeding what it needs. Thus if potassium is abundant in the soil, alfalfa may take in more than is required.

MACROPORE Large or noncapillary pores. The pores, or voids, in a soil from which

water usually drains by gravity. Is differentiated from micropore, or capillary pore, space, which consists of voids small enough that water is held against gravity by capillarity. Sandy soils have a large macropore, or noncapillary, pore space and a small micropore, or capillary, pore space. Nongranular clayey soils are just the reverse.

MANURE Generally, the refuse from stables and barnyards, including both animal excreta and straw or other litter. In some other countries the term "manure" is used more broadly and includes both farmyard or animal manure and "chemical manures," for which the term "fertilizer" is nearly always used in the United States.

MARL An earthy deposit, consisting mainly of calcium carbonate commonly mixed with clay or other impurities. It is formed chiefly at the margins of fresh-water lakes. It is commonly used for liming acid soils.

MATURE SOIL Any soil with well-developed soil horizons having characteristics produced by the natural processes of soil formation and in near equilibrium with its present environment.

MECHANICAL ANALYSIS The physical analysis of soil materials to determine the amounts of the various soil separates, or grain-size fractions.

MECHANICAL STABILITY Resistance of soil to breakdown by mechanical forces such as tillage or abrasion from windborne soil particles; strength of coherence; mechanical strength.

MEDITERRANEAN CLIMATE A general term for warm-temperature climates that are dry in the warm season and moist in the cool season.

MELLOW SOIL A porous, softly granular soil easily worked without becoming compacted.

METABOLISM Life functions that are a result of building up foods within the living body and using the foods for energy sources for various life processes. The synthesis of foods and their use as sources of energy.

METAMORPHIC ROCK A rock that has been greatly altered from its previous condition through the combined action of heat and pressure. For example, marble is a metamorphic rock produced from limestone, gneiss is one produced from granite, and slate is produced from shale.

METHOXYL A chemical grouping composed of a carbon atom linked to an oxygen atom and 3 hydrogen atoms. The conventional symbol is $-OCH_3$.

MICAS Primary alumino-silicate minerals in which two silica layers alternate with one alumina layer. They separate readily into thin sheets or flakes.

MICRO- A prefix meaning very small, as in micro-organism; one-millionth of something; that which makes use of a microscope, as in microbiology. Macro- implies large.

MICROCLIMATE The local climatic condition near the ground resulting from the modification of the general climatic condition by local differences in relief, exposure, and cover.

MICRONUTRIENTS Nutrients that plants need in only small, trace, or minute amounts.

MICRO-ORGANISMS Forms of life too small to be seen with the unaided eye, or barely discernible.

MICRORELIEF Small-scaled differences in relief, such as small mounts, swales, or pits that are a few feet across and have differences in elevation of a few inches to around 3 feet that are significant to soil-forming processes, to growth of plants, or to preparing the soil for cultivation.

MILLIMHOS Units of conductance.

MINERAL SOIL A general term for a soil composed chiefly of mineral matter, in contrast to an organic soil, which is composed chiefly of organic matter.

MINERALIZATION The release of mineral matter from organic matter, especially through microbial decomposition.

MOISTURE STRESS The tension at which water is held by the soil.

MOISTURE TENSION The force at which water is held by soil; usually expressed as the equivalent of a unit column of water in centimeters; 1,000 cm. equal 1 atmosphere equivalent tension. Moisture tension increases with dryness and indicates the degree of work required to remove soil moisture for use by plants.

MOLECULE A group of atoms bonded together in a characteristic pattern.

MONOVALENT CATIONS Ions having a single positive charge; having a deficiency of one electron from the neutral state.

MONTMORILLONITE A finely platy, alumino-silicate clay mineral that expands and contracts with the absorption and loss of water. It has a high cation-exchange capacity and is plastic and sticky when moist.

MOR Raw humus; a type of forest humus layer of unincorporated organic material,

usually matted or compacted or both; distinct from the mineral soil, unless the latter has been blackened by washing in organic matter.

MORPHOLOGY, SOIL The constitution of the soil including the texture, structure, consistence, color, and other physical, chemical, and biological properties of the various soil horizons that make up the soil profile.

MOTTLED Soil horizons irregularly marked with spots of color. A common cause of mottling is imperfect or impeded drainage although there are other causes, such as soil development from an unevenly weathered rock. Different kinds of minerals may cause mottling.

MUCK Highly decomposed organic soil material developed from peat. Generally, muck has a higher mineral or ash content than peat and is decomposed to the point that the original plant parts cannot be identified.

MULCH A natural or artificially applied layer of plant residues or other materials on the surface of the soil. Mulches are generally used to help conserve moisture, control temperature, prevent surface compaction or crusting, reduce runoff and erosion, improve soil structure, or control weeds. Common mulching materials include compost, sawdust, wood chips, and straw. Sometimes paper, fine brush, or small stones are used.

MULCH TILLAGE Tillage of the soil and treatment of crop residues in ways to leave plant materials within or on the soil surface to form a mulch.

MULL A humus-rich layer of forested soils consisting of mixed organic and mineral matter. A mull blends into the upper mineral-layers without an abrupt change in soil characteristics.

MYCELIA The threadlike bodies of simple organisms, such as the common bread mold.

MYCORHIZA (MYCORRHIZA) The morphological association, usually symbiotic, of fungi and roots of seed plants. The feeding roots are enshrouded and partially penetrated by fine filaments of fungi; such roots commonly are more branched and lose their root hairs.

NECROSIS Death associated with discoloration and dehydration of all or parts of plant organs, such as leaves.

NEMATOCIDE Any substance that can be used to kill nematodes.

NEMATODES Very small worms abundant in many soils and important because many of them attack and destroy plant roots.

NEUTRAL SOIL A soil that is neither significantly acid nor alkaline. Strictly, a neutral soil has pH of 7.0; in practice, a neutral soil has a pH between 6.6 and 7.3.

NITRIFICATION The formation of nitrates and nitrites from ammonia (or ammonium compounds), as in soils by micro-organisms.

NITROGEN FIXATION Generally, the conversion of free nitrogen to nitrogen combined with other elements. Specifically in soils, the assimilation of free nitrogen from the soil air by soil organisms and the formation of nitrogen compounds that eventually become available to plants. The nitrogen-fixing organisms associated with legumes are called symbiotic; those not definitely associated with the higher plants are nonsymbiotic.

NORMAL SOIL A soil having a profile in near equilibrium with its environment; developed under good but not excessive drainage from parent material of mixed mineral, physical, and chemical composition. In its characteristics it expresses the full effects of the forces of climate and living matter.

NUCLEIC ACIDS Complex compounds found in the nuclei of plant and animal cells and usually combined with proteins as nucleoproteins.

NUTRIENT, PLANT Any element taken in by a plant, essential to its growth, and used by it in elaboration of its food and tissue.

ORDER The highest category in soil classification. The three orders are zonal soils, intrazonal soils, and azonal soils.

ORGANIC SOIL A general term applied to a soil or to a soil horizon that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers. Organic in chemistry refers to the compounds of carbon.

OSMOTIC A type of pressure exerted in living bodies as a result of unequal concentration of salts on both sides of a cell wall or membrane. Water will move from the area having the least salt concentration through the membrane into the area having the highest salt concentration and, therefore, exerts additional pressure on this side of the membrane.

OXIDATION A chemical change of an element or compound involving the addition of oxygen or its chemical equivalent. A chemical change that involves an increase of positive valence or a decrease of negative valence. For example, if iron is changed from the ferrous state (in which it has 2 positive valences) to the ferric state (in which it has 3 positive valences), the iron is said to be oxidized. The reverse process is reduction. During the burning of fuel, oxygen is added to carbon to form carbon dioxide; in the rusting of iron, the addition of oxygen forms a red iron oxide.

OXIDE A compound of any element with oxygen alone.

PAN A layer or soil horizon within a soil that is firmly compacted or is very rich in clay. Examples include hardpans, fragipans, claypans, and traffic pans.

PARENT MATERIAL The unconsolidated mass of rock material (or peat) from which the soil profile develops.

PARTS PER MILLION (p.p.m.) A notation for indicating small amounts of materials. The expression gives the number of units by weight of the substance per million weight units of ovendry soil. The term may be used to express the number of weight units of a substance per million weight units of solution.

PEAT Unconsolidated soil material consisting largely of undecomposed or only slightly decomposed organic matter accumulated under conditions of excessive moisture.

PED An individual natural soil aggregate such as a crumb, prism, or block, in contrast to a clod, which is a mass of soil brought about by digging or other disturbance.

PEDOLOGY The science that treats of soil.

PERCOLATION The downward movement of water through soil.

PERMANENT PASTURE Pasture that occupies the soil for a long time in contrast to rotation pasture, which occupies the soil for only a year or two in a rotation cycle with other crops. As used in the humid parts of the United States, the term "permanent pasture" is equivalent to the European "long ley."

PERMEABILITY, SOIL The quality of a soil horizon that enables water or air to move through it. It can be measured quantitatively in terms of rate of flow of water through a unit cross section in unit time under specified temperature and hydraulic conditions. Values for saturated soils usually are called hydraulic conductivity. The permeability of a soil may be limited by the presence of one nearly impermeable horizon even though the others are permeable.

pH A numerical designation of relatively weak acidity and alkalinity as in soils and other biological systems. Technically, pH is the common logarithm of the reciprocal of the hydrogen-ion concentration of a solution. A pH of 7.0 indicates precise neutrality, higher values indicate increasing alkalinity, and lower values indicate increasing acidity.

PHASE, SOIL The subdivision of a soil type or other classificational soil unit having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. Examples of the variations recognized by phases of soil types include differences in slope, stoniness, and thickness because of accelerated erosion.

PHOTOSYNTHESIS The process of conversion by plants of water and carbon dioxide into carbohydrates under the action of light. Chlorophyll is required for the conversion of the light energy into chemical forms.

PITTING The making of shallow pits in the soil to retain rainwater of snowmelt. In shortgrass rangelands pitting is done mainly with an offset disk or pitting machine.

PLANOSOL An intrazonal group of soils with eluviated surface horizons underlain by claypans or fragipans, developed on nearly flat or gently sloping uplands in humid or subhumid climates.

PLATY SOIL STRUCTURE Soil aggregates with thin vertical axes and long horizontal axes. Flat, tabular; a three-dimensional object that has one dimension much smaller than the other two.

PLOW LAYER Equals surface soil.

PODZOL A zonal group of soils having surface organic mats and thin, organic-mineral horizons above gray leached horizons that rest upon illuvial dark-brown horizons developed under coniferous or mixed forests or under heath vegetation in a cool-temperate, moist climate.

PODZOLIC SOIL Soils that have part or all of the characteristics of the Podzol soils, especially leached surface soils that are poorer in clay than the B horizons beneath.

PODZOLIZATION The process by which soils are depleted of bases, become more acid, and have developed leached surface layers from which clay has been removed.

POLYNUTRIENT FERTILIZER A fertilizer containing more than one major plant nutrient.

POLYSACCHARIDES Compounds formed by chemical union of two or more simple sugars.

PORE SPACE The fraction of the bulk volume or total space within soils that is not occupied by solid particles.

POROSITY, SOIL The degree to which the soil mass is permeated with pores or cavities. Porosity can be generally expressed as a percentage of the whole volume of a soil horizon that is unoccupied by solid particles. In addition, the number, sizes, shapes, and distribution of the voids is important. Generally, the pore space of surface soil is less than one-half of the soil mass by volume, but in some soils it is more than half. The part of the pore space that consists of small pores that hold water by capillary is called capillary porosity.

The part that consists of larger pores that do not hold water by capillary and free drainage is called noncapillary porosity.

PRAIRIE SOILS A zonal group of soils having dark-colored surface horizons grading through brown soil material to lighter colored parent material at 2 to 5 feet, formed under tall grasses in a temperate, humid climate. The term has a restricted meaning in soil science and does not apply to all soils developed in treeless landscapes.

PRECIPITATION-EFFECTIVENESS (P–E) INDEX The sum of the 12 monthly quotients of precipitation divided by evaporation.

PRIMARY MINERAL A mineral which occurs, or originally occurred, in igneous rocks; examples are micas and feldspars.

PRISMATIC SOIL STRUCTURE Prismlike structural aggregates with the vertical axes of the aggregates longer than the horizontal axes.

PRODUCTIVITY (OF SOIL) The present capability of a kind of soil for producing a specified plant or sequence of plants under a defined set of management practices. It is measured in terms of the outputs or harvests in relation to the inputs of production factors for a specific kind of soil under a physically defined system of management.

PROFILE (SOIL) A vertical section of the soil through all its horizons and extending into the parent material.

PROTEIN Any of a group of nitrogen-containing compounds that yield amino acids on hydrolysis and have high molecular weights. They are essential parts of living matter and are one of the essential food substances of animals.

PROTOPLASM The basic, jellylike substance in plant and animal cells; it carries out all their life processes.

PUDDLED SOIL Dense, massive soil artificially compacted when wet and having no regular structure. The condition commonly results from the tillage of a clayey soil when it is wet.

PULVERANT A term applied to ungranulated fertilizers, those which are largely powdered. Pulverant fertilizers are dusty and blow readily.

PURINES A group of closely related compounds containing carbon, hydrogen, and nitrogen. Uric acid, an example, is formed from proteins as an end product of animal metabolism. Uric acid is the chief nitrogenous compound in the excrement of birds.

QUICK TESTS Simple and rapid chemical tests of soils designed to give an approximation of the nutrients available to plants. Interpretations of results depend upon previous standardization with field trials of fertilizers and vary among different kinds of soil.

RADIATION The propagation of energy in the form of waves.

RANGE (or rangeland) Land that produces primarily native forage plants suitable for grazing by livestock, including land that has some forest trees.

REACTION, SOIL The degree of acidity or alkalinity of a soil mass, expressed in either pH value or in words, as follows:

	pH
Extremely acid	Below 4.5.
Very strongly acid	4.5–5.0.
Strongly acid	5.1–5.5.
Medium acid	5.6–6.0.
Slightly acid	6.1–6.5.
Neutral	6.6–7.3.
Mildly alkaline	7.4–7.8.
Moderately alkaline	7.9–8.4.
Strongly alkaline	8.5–9.0.
Very strongly alkaline	9.1 and higher.

RED PODZOLIC SOILS Formerly used for a zonal group of soils having thin organic and organic-mineral horizons over a yellowish-brown leached horizon that rests upon an illuvial red horizon developed under deciduous or mixed deciduous and coniferous forests in a warm to warm-temperate humid climate. These are now placed in the Red-Yellow Podzolic group.

REDUCTION Any chemical change involving the removal of oxygen or its chemical equivalent. A chemical change involving a decrease of positive valence or an increase of negative valence. The reverse of oxidation.

REGOLITH The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth materials above solid rock. Only the upper part of this, modified by organisms and other soil-building forces, is regarded by soil scientists as soil. In soil mechanics, however, most American engineers speak of the whole regolith, even to great depths, as "soil."

REGOSOL An azonal group of soils that includes those without definite genetic horizons developing from deep unconsolidated or soft rocky deposits.

RELIEF Elevations or inequalities of the land surface, considered collectively.

RENDZINA An intrazonal group of soils, usually with brown or black friable surface horizons, underlain by light-gray or pale-yellow soft calcareous material, developed under grass vegetation or mixed grass and forest vegetation, in humid and semiarid regions.

RESIDUAL FERTILIZER The amount of fertilizer that remains in the soil after one or more cropping seasons.

RESIDUAL MATERIAL Unconsolidated and partly weathered parent material for soils presumed to have developed from the same kind of rock as that on which it lies. The term "residual" is sometimes incorrectly applied to soils, but it can be applied correctly only to the material from which soils are formed.

RHIZOBIA The bacteria that can live in symbiotic relations with leguminous plants within nodules on their roots. The normal result of the association is the fixation of nitrogen from the air into forms that can be used by living plants.

RHIZOSPHERE The bounding surface of plant roots. The soil space in the immediate vicinity of the plant roots in which the abundance and composition of the microbial population are influenced by the presence of roots.

ROOT ZONE The part of the soil that is invaded by plant roots.

RUNOFF The surface flow of water from an area; or the total volume of surface flow during a specified time.

SALINE SOIL A soil containing enough soluble salts to impair its productivity for plants but not containing an excess of exchangeable sodium.

SALINE-ALKALI SOIL A soil having a combination of a harmful quantity of salts and either a high degree of alkalinity or a high amount of exchangeable sodium, or both, so distributed in the soil profile that the growth of most crop plants is less than normal.

SALTATION The movement of soil and mineral particles by intermittent leaps from the ground when the particles are being moved by wind or water.

SALTS The products, other than water, of the reaction of an acid with a base. Salts commonly found in soils break up into cations (sodium, calcium, etc.) and anions (chloride, sulfate, etc.) when dissolved in water.

SAND Individual rock or mineral fragments in soils having diameters ranging from 0.5 mm to 2.0 mm. Usually sand grains consist chiefly of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more of sand and not more than 10 percent of clay.

SANDY CLAY Soil of this textural class contains 35 percent or more of clay and 45 percent or more of sand.

SANDY CLAY LOAM Generally, soil of this textural class contains 20 to 35 percent clay, less than 28 percent silt, and 45 percent or more of sand.

SANDY LOAM Generally, soil of the sandy loam class of texture has 50 percent sand and less than 20 percent clay.

SANDY SOILS A broad term for soils of the sand and loamy sand classes; soil material with more than 70 percent sand and less than 15 percent clay.

SEDIMENTARY ROCK A rock composed of particles deposited from suspension in water. Chief groups of sedimentary rocks are conglomerates, from gravels; sandstones, from sand; shales, from clay; and limestones, from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sands have been consolidated into sandstones.

SEEPAGE The escape of water through the soil, or water emerging from an area of soil along an extensive line of surface, in contrast to springs where the water emerges from a local spot.

SEMIARID CLIMATE A climate characteristic of the regions intermediate between the true deserts and subhumid areas. In the semiarid climate the precipitation-effectiveness (P–E) index ranges between 16 and 32. The upper limit of the average annual precipitation in cool semiarid regions is as low as 15 inches and in warm regions as much as 45 inches. The vegetation is close-growing or scattered short grass, bunchgrass, or shrubs. Soils in such regions that can take in nearly all of the rain that falls and that can hold it for crop plants can be used for crops under dry-farming methods but irrigation is common where water is available.

SEPARATE, SOIL One of the individual-size groups of mineral soil particles—sand, silt, or clay.

SERIES, SOIL A group of soils that have soil horizons similar in their differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and are formed from a particular type of parent material. Soil series is an important category in detailed soil classification. Individual series are given proper names from place names near the first recorded occurrence. Thus names like Houston, Cecil, Barnes, and Miami are names of soil series that appear on soil maps and each connotes a unique combination of many soil characteristics.

SERPENTINE ROCKS Rocks consisting of acid magnesium silicate.

SESQUIOXIDES Oxides of trivalent cations, such as iron and aluminum.

SIEROZEM SOILS A zonal group of soils having brownish-gray surface horizons that grade

through lighter colored material into accumulated calcium carbonate, developed under mixed shrub vegetation in a temperate to cool-arid climate.

SILICA An important soil constituent composed of silicon and oxygen. The essential material of the mineral quartz.

SILICA-SESQUIOXIDE RATIO The ratio of the number of molecules of silica to the number of molecules of alumina plus iron oxide in a soil or in the clay fraction of a soil. The more highly weathered materials of warm-temperate humid regions and especially of the Tropics generally have low ratios. The clay in soils with low ratios usually are less active, physically and chemically, than those with high ratios.

SILT (1) Individual mineral particles of soil that range in diameter between the upper size of clay, 0.002 mm., and the lower size of very fine sand, 0.05 mm. (2) Soil of the textural class silt contains 80 percent or more of silt and less than 12 percent of clay. (3) Sediments deposited from water in which the individual grains are approximately of the size of silt, although the term is sometimes applied loosely to sediments containing considerable sand and clay.

SILT LOAM Soil material having (1) 50 percent or more of silt and 12 to 27 percent of clay or (2) 50 to 80 percent of silt and less than 12 percent of clay.

SILTY CLAY Soil of this textural class has 40 percent or more of clay and 40 percent or more of silt.

SILTY CLAY LOAM Soil of this textural class has 27 to 40 percent of clay and less than 20 percent of sand.

SINGLE GRAIN SOIL A structureless soil in which each particle exists separately, as in dune sand.

SLICK SPOT A small area of "alkali" or Solonetz soil.

SLIP The downslope movement of a mass of soil under wet or saturated conditions; a microlandslide that produces microrelief in soils.

SLOPE The incline of the surface of a soil. It is usually expressed in percentage of slope, which equals the number of feet of fall per 100 feet of horizontal distance.

SOIL (1) The natural medium for the growth of land plants. (2) A dynamic natural body on the surface of the earth in which plants grow, composed of mineral and organic materials and living forms. (3) The collection of natural bodies occupying parts of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time.

A soil is an individual three-dimensional body on the surface of the earth unlike the adjoining bodies. (The area of individual soils ranges from less than one-half acre to more than 300 acres.)

A kind of soil is the collection of soils that are alike in specified combinations of characteristics. Kinds of soil are given names in the system of soil classification. The terms "the soil" and "soil" are collective terms used for all soils, equivalent to the word "vegetation" for all plants.

SOIL ASSOCIATION A group of defined and named kinds of soil associated together in a characteristic geographic pattern. Except on detailed soil maps, it is not possible to delineate the various kinds of soil so that on all small-scale soil maps the areas shown consist of soil associations or two or more kinds of soil that are geographically associated.

SOIL CHARACTERISTIC A feature of a soil that can be seen and/or measured in the field or in the laboratory on soil samples. Examples include soil slope and stoniness as well as the texture, structure, color, and chemical composition of soil horizons.

SOIL CLIMATE The moisture and temperature conditions existing within the soil.

SOIL CONSERVATION The efficient use and stability of each area of soil that is needed for use at its optimum level of developed productivity according to the specific patterns of soil and water resources of individual farms, ranches, forests, and other land-management units. The term includes the positive concept of improvement of soils for use as well as their protection and preservation.

SOIL MANAGEMENT The preparation, manipulation, and treatment of soils for the production of plants, including crops, grasses, and trees.

SOIL POPULATION The group of organisms that normally live in the soil.

SOIL QUALITY An attribute of a soil that cannot be seen or measured directly from the soil alone but which is inferred from soil characteristics and soil behavior under defined conditions. Fertility, productivity, and erodibility are examples of soil qualities (in contrast to soil characteristics).

SOIL SURVEY A general term for the systematic examination of soils in the field and in the laboratories, their description and classification, the mapping of kinds of soil, and the interpretation of soils according to their adaptability for various crops, grasses, and trees, their behavior under use or treat-

ment for plant production or for other purposes, and their productivity under different management systems.

SOLONCHAK SOILS An intrazonal group of soils with high concentrations of soluble salts in relation to those in other soils, usually light colored, without characteristic structural form, developed under salt-loving plants, and occurring mostly in a subhumid or semiarid climate. In soil classification, the term applies to a broad group of soils and is only approximately equivalent to the common term "saline soil."

SOLONETZ SOILS An intrazonal group of soils having surface horizons of varying degrees of friability underlain by dark-colored hard soil, ordinarily with columnar structure (prismatic structure with rounded tops). This hard layer is usually highly alkaline. Such soils are developed under grass or shrub vegetation, mostly in subhumid or semiarid climates. This term is used for a broad group of soils that include many so-called alkali soils in the western part of the United States. (Where the hard, claycy layer is overlain with a light-colored leached layer, the soils are called solodized Solonetz.)

SOLUM The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soils includes the A and B horizons. Usually the characteristics of the material in these horizons are quite unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

SPECIFIC HEAT The amount of heat required to change the temperature of unit mass 1 degree.

SPECIFICITY Limited to a particular organism, compound, or set of conditions.

SPHAGNUM A group of mosses which grow in moist places. By annual increments of growth, deep layers of fibrous and highly absorbent peat may be built up. Sphagnum grows best in cool, humid regions.

STORAGE CAPACITY The amount of water that can be stored in the soil for future use by plants and evaporation.

STRATIFIED Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological materials. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

STRESS (SOIL MOISTURE) A term used for the total energy with which water is held in the soil, including tension of soil moisture and additional effects of salts in the soil water. It can be expressed in any convenient pressure unit.

STRIPCROPPING The practice of growing crops in a systematic arrangement of strips, or bands. Commonly cultivated crops and sod crops are alternated in strips to protect the soil and vegetation against running water or wind. The alternate strips are laid out approximately on the contour on erosive soils or at approximate right angles to the prevailing direction of the wind where soil blowing is a hazard.

STRUCTURE, SOIL The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are platy, prismatic, columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain—each grain by itself, as in dune sand, or (2) massive—the particles adhering together without any regular cleavage as in many claypans and hardpans. ("Good" or "bad" tilth are terms for the general structural condition of cultivated soils according to particular plants or sequences of plants.)

STUBBLE MULCH A mulch consisting of the stubble and other crop residues left in and on the surface of the soil as a protective cover during the preparation of a seedbed and during at least part of the growing of the succeeding crop.

SUBHUMID CLIMATE A climate intermediate between semiarid and humid with sufficient precipitation to support a moderate to heavy growth of short and tall grasses, or shrubs, or of these and widely spaced trees or clumps of trees. The precipitation-effectiveness (P–E) index ranges from about 32 to 64. The upper limit of rainfall in subhumid climates may be as low as 20 inches in cold regions and as high as 60 inches in hot regions.

SUBIRRIGATION Irrigation through controlling the water table in order to raise it into the root zone. Water is applied in open ditches or through tile until the water table is raised enough to wet the soil. Some soils along streams are said to be naturally "subirrigated."

SUBSOIL The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."

SUBSOILING The tillage of the soil below the normal plow depth, usually to shatter a hardpan or claypan.

SUBSTRATUM Any layer lying beneath the solum or true soil. It is applied to both parent materials and to other layers unlike the parent material, below the B horizon or the subsoil.

SUBSURFACE TILLAGE Tillage with a sweep-like plow or blade that does not turn over the surface cover or incorporate it into the lower part of the surface soil.

SUCTION (OF SOIL WATER) The equivalent negative pressure in soil water. It is the pressure reduction required to extract water from soil. Suction, measured in pressure units, indicates the tenacity with which water is held by surface force action in soil. Experimentally, the suction of water in soil is the pressure difference required across a permeable membrane to produce hydraulic equilibrium between water in soil that is subject to surface force action and free water in bulk on the other side of the membrane. Also, soil suction; soil moisture suction.

SUPPLEMENTAL IRRIGATION A general term sometimes used for irrigation during dry periods in regions where normal precipitation supplies most of the moisture for crops.

SURFACE SOIL The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness.

SYMBIOSIS The living together of two different organisms with a resulting mutual benefit. A common example includes the association of rhizobia with legumes; the resulting nitrogen fixation is sometimes called symbiotic nitrogen fixation. Adjective: Symbiotic.

SYNTHESIS Combination of simple molecules to form another substance—for example, the union of carbon dioxide and water under the action of light in photosynthesis.

TENSIOMETER A device for measuring the tension with which water is held in the soil. It is a combination of a porous cup and a vacuum gage.

TENSION, SOIL-MOISTURE The equivalent negative pressure of suction of water in soil.

TERRACE An embankment or ridge constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff in order to retard it for infiltration into the soil and so that any excess may flow slowly to a prepared outlet without harm.

TERRACE (GEOLOGICAL) A nearly flat or undulating plain, commonly rather narrow and usually with a steep front, bordering a river, a lake, or the sea. Although many old terraces have become more or less hilly through dissection by streams, they are still regarded as terraces.

TEXTURAL CLASS Kinds of soil material according to the proportions of sand, silt, and clay. The principal textural classes in soil, in increasing order of the amount of silt and clay, are as follows: Sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. These class names are modified to indicate the size of the sand fraction or the presence of gravel, cobbles, and stones. For example, terms such as loamy fine sand, very fine sandy loam, gravelly loam, stony clay, and cobbly loam, are used on detailed soil maps. These terms apply only to individual soil horizons or to the surface layer of a soil type, as in the name "Miami silt loam." Commonly the various horizons of any one kind of soil belong in different soil textural classes.

TEXTURE, SOIL The relative proportions of the various size groups of individual soil grains in a mass of soil. Specifically, it refers to the proportions of sand, silt, and clay.

TILLAGE The operation of implements through the soil to prepare seedbeds and rootbeds.

TILTH, SOIL The physical condition of a soil in respect to its fitness for the growth of a specified plant or sequence of plants. Ideal soil tilth is not the same for each kind of crop nor is it uniform for the same kind of crop growing on contrasting kinds of soil.

TOPOGRAPHY The shape of the ground surface, such as hills, mountains, or plains. Steep topography indicates steep slopes or hilly land; flat topography indicates flat land with minor undulations and gentle slopes.

TOPSOIL A general term used in at least four different senses: (1) A presumed fertile soil or soil material, usually rich in organic matter, used to topdress roadbanks, lawns, and gardens; (2) the surface plow layer of a soil and thus a synonym for surface soil; (3) the original or present dark-colored upper soil, which ranges from a mere fraction of an inch to 2 or 3 feet on different kinds of soil; and (4) the original or present A horizon, varying widely among different kinds of soil. Applied to soils in the field, the term has no precise meaning unless defined as to depth or productivity in relation to a specific kind of soil.

TRACE ELEMENTS An old term used for the elements found in plants in only small amounts, including several that are essential to plant growth, others that are essential to animals even though not to plants, and others having no known biological functions. (See micronutrients.)

TRACER TECHNIQUES The use of small amounts of radioactive isotopes to follow normal elements. The tracer is readily detected and measured by its radioactivity.

TRAFFIC PANS Subsurface layers in soil that have been so compacted by the application of weight (e. g., by machines, tractors, etc.) that the penetration of water and roots is interfered with. Because the traffic of machines is not the only cause of these pans, some persons call them pressure pans.

TRANSPIRATION Loss of water vapor from the leaves and stems of living plants to the atmosphere.

TYPE, SOIL A subgroup or category under the soil series based on the texture of the surface soil. A soil type is a group of soils having horizons similar in differentiating characteristics and arrangement in the soil profile and developed from a particular type of parent material. The name of a soil type consists of the name of the soil series plus the textural class name of the upper part of the soil equivalent to the surface soil. Thus Miami silt loam is the name of a soil type within the Miami series.

UNHUMIFIED Organic matter prior to its decomposition into humus.

UPLAND SOILS High ground; ground elevated above the lowlands along rivers or between hills.

VALENCE The combining capacity of atoms or groups of atoms. Sodium (Na^+) and potassium (K^+) are monovalent, while calcium (Ca^{++}) is divalent.

VIRGIN SOIL A soil that has not been significantly disturbed from its natural environment.

VISCOSITY, OF FLUID Property of stickiness of liquid or gas due to its cohesive and adhesive characteristics.

VOLATILIZATION The evaporation or changing of a substance from liquid to vapor.

WATER RATIO (IN SOIL) The fraction of the total bulk volume of soil that is filled with water.

WATER REQUIREMENT (OF PLANTS) Generally, the amount of water required by plants for satisfactory growth during the season. More strictly, the number of units of water required by a plant during the growing season in relation to the number of units of dry matter produced. The water requirement varies with climatic conditions, soil moisture, and soil characteristics. Factors unfavorable to plant growth, such as low fertility, disease, and drought, increase the water requirement.

WATER RETENTION The physical property of soil that is based on surface force action and that makes it necessary to do work in order to remove water from soil pores and from soil surface.

WATER TABLE The upper limit of the part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

WATER-HOLDING CAPACITY The capacity (or ability) of soil to hold water; field capacity is the amount held against gravity or 1 atmosphere tension or pF 2.7. The moisture-holding capacity of sandy soils is usually considered to be low while that of clayey soils is high. Often expressed in inches of water per foot depth of soil.

WATERLOGGED A condition of soil in which both large and small pore spaces are filled with water. (The soil may be intermittently waterlogged because of a fluctuating water table or waterlogged for short periods after rain.)

WATERSHED In the United States, the term refers to the total area above a given point on a stream that contributes water to the flow at that point. Synonyms are "drainage basin" or "catchment basin." In some other countries, the term is used for the topographic boundary separating one drainage basin from another.

WEATHERING The physical and chemical disintegration and decomposition of rocks and minerals.

WILTING POINT (OR PERMANENT WILTING POINT) The moisture content of soil, on an ovendry basis, at which plants (specifically sunflower plants) wilt and fail to recover their turgidity when placed in a dark humid atmosphere. The percentage of water at the wilting point approximates the minimum moisture content in soils under plants in the field at depths below the effects of surface evaporation.

YELLOW PODZOLIC SOILS Formerly used for a zonal group of soils having thin organic and organic-mineral layers over grayish-yellow leached horizons that rest on yellow B horizons, developed under coniferous or mixed coniferous and deciduous forests in a warm-temperate to warm, moist climate. These soils are now combined into the Red-Yellow Podzolic group.

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SCIENTIFIC NAMES