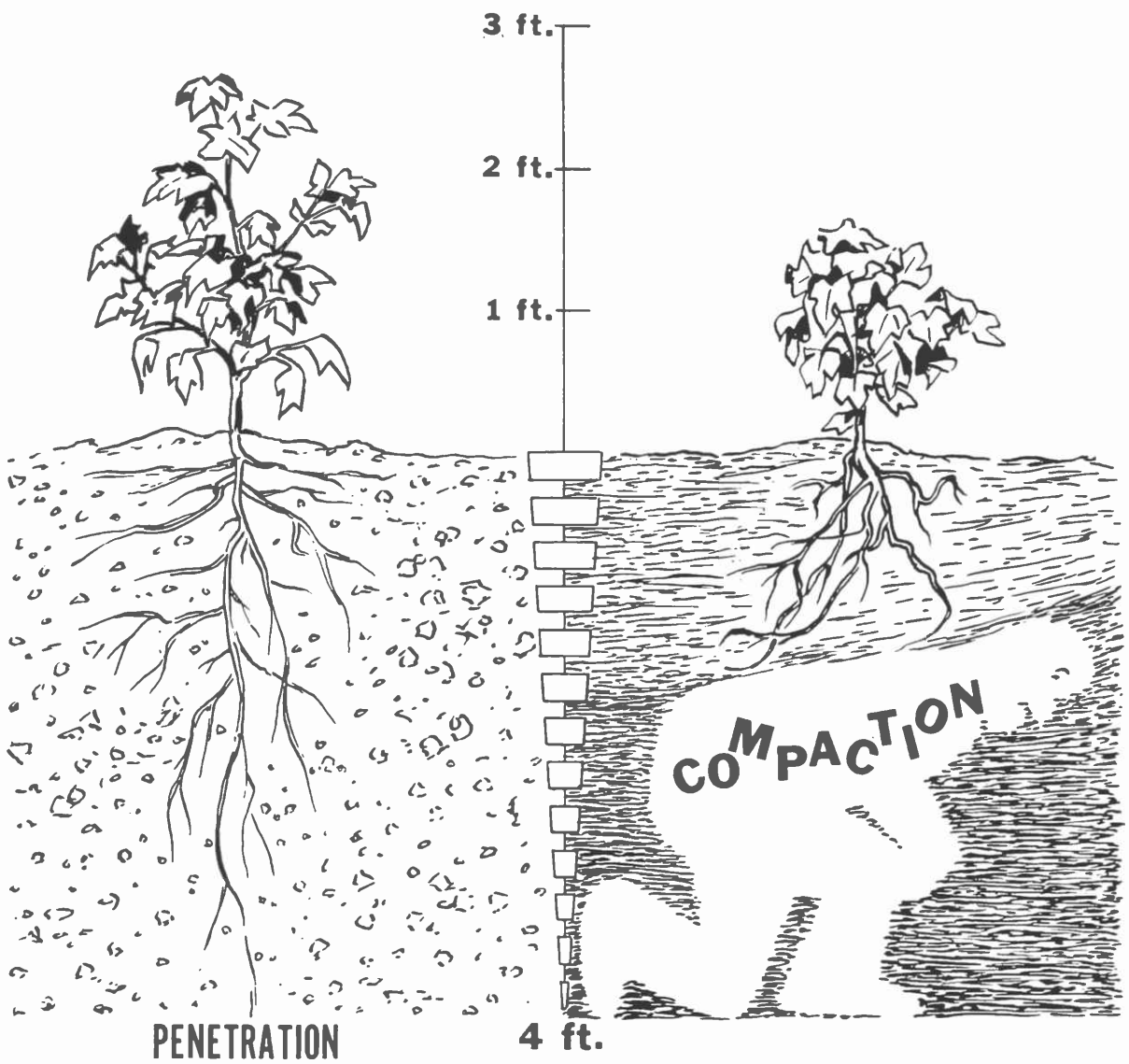
PLANTS NEED MORE THAN FOOD AND WATER



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If a man is locked in a cage where he is cramped, unable to stand, he will not be happy even though he is furnished food and water. Nor will he thrive if he is sealed in an airtight box, again permitting him both food and drink. The same is true of plants — the plants which man grows for his uses. Water and food alone are not enough. There also are other needs for a satisfactory environment, such as proper air, room to grow in, the right temperature and other factors. This is portrayed in Dr. Amburgey's article given here.

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Soil is essential to the support of higher plant and animal growth. Since animal growth is an end use of plant material, this discussion will refer only to soils in relation to plant growth or crop production. Nothing so essential to our livelihood as soils is taken for granted to so great an extent. It finds its rightful place of importance only among students of soils.

The inter-relationships between factors which influence soil conditions are such that a change in one may bring about changes in several others. This situation becomes so involved that it seems impossible to consider separate parts of the total area of soil management to any great extent. One can appreciate the complexities of management only in areas where he has a thorough working knowledge of the subject.

Importance of Manipulation

Soil management includes the manner in which plant nutrients, various physical properties of soils, water, and other things are handled. Manipulation of a soil is directly related to the desired end result. Soils are compacted to provide a good base for roads and buildings.

On the other hand, every possible means is employed to avoid compaction of soils in the production of food, feed and fiber, excepting the firming of the soil around seed as it is planted. Changing one factor, such as excess water from a high water table, brings about changes in other things, such as soil, air or temperature. This is reflected in differences in plant behavior.

Each soil requires its own combination of management practices. The successful farmer recognizes this and adjusts his practices to capitalize on the benefits from interactions among the separate management operations and the characteristics of his soils.

Includes Many Factors

Productivity, which includes fertility, refers to the overall ability of a soil to produce crops. Fertility, one factor in determining productivity, is the capacity of a soil to supply nutrients to plants in adequate amounts and suitable proportions. Other aspects of productivity are equally important in producing top yields of high quality crops.

Plant nutrients and water have been

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considered possible limiting factors in crop production for many years. Research emphasis has been placed on forms, amounts, methods of application, time of application and other considerations related to fertilizers and their use.

As a result, principles of fertilizer use and water management are more thoroughly understood than other aspects of soil management. These other aspects are less tangible and much more difficult to measure, consequently less understood.

On irrigated soils, water management enjoys a position of importance comparable to that of fertilizer use. In recent years, the importance of water management has increased materially in humid areas, with or without supplemental irrigation. Response to plant nutrients is reduced when the water necessary to plant growth is in short supply. Thus water becomes a limiting factor in productivity.

Need Both Food and Drink

An adequate supply of water has been shown to increase the response to plant nutrients. When plant nutrients are limiting or in short supply, yields are reduced even though the water supply is adequate. This is an example of the inter-relationship between plant nutrients and one of the many other factors which influence crop yield. When the supply of irrigation water is limited, crop yield per unit of water may become a more important measurement than yield per unit of land.

The physical properties of soils include a number of factors which may be limiting. These physical factors are inter-related in such a complex manner that change in any single factor will influence several others.

Soil texture, structure, water, air and temperature are physical properties which affect plant nutrition and the use of fertilizers. The modern farmer is concerned with the responsiveness of soil to his management. An understanding of soil physical properties is essential.

Soil Texture Important

Soil texture is the expression of proportion of different soil particle sizes. This is ordinarily expressed as percent each of sand, silt and clay. Clay is the finest particle size, may be colloidal, and has the greatest ability to store nutrients and deliver them to plants as needed for plant growth. The smaller particles have more total pore space between and around them than larger ones, providing for greater storage of water in soils having good aggregation. When a lump of soil is broken, one can see that quite often plant roots tend to follow certain routes through it. Roots tend to concentrate where plant nutrients, water and air are most readily available.

Particle size, arrangement, and cementation of particles determine soil structure or aggregation. As organic matter decomposes it acts as a cementing agent. Like some clay, it becomes colloidal and possesses the ability to store and deliver plant nutrients and water. The benefits derived from organic matter, and the process of decomposition, are difficult to measure. However, the thought has been expressed that these colloidal and cementing properties are of much greater value than the nutrients released by organic matter as it decomposes.

Chemical salts influence structure or aggregation. Calcium contributes to the bonding together of soil particles, while sodium disperses them. Sodium must be kept at acceptable concentrations to avoid dispersion, as well as to avoid toxic effects on plants. Water percolation downward through the soil leaches excess soluble salts down below the effective feeding depth of plant roots. Compaction, restrictive layers, a high water table, etc. can restrict percolation. Water also leaves salts in the surface layer of the soil when it evaporates or is taken up by plants.

Tillage Pro and Con

Tillage, mechanically disturbing the soil, has both beneficial and detrimental effects. On the beneficial side it loosens the soil, breaks up layers which may be impervious or restrictive to plant roots, air and moisture, and prepares a seedbed favorable to seed germination and plant growth. It is harmful in that it tends to break down structure leading to a dispersed soil condition and creates restrictive layers when improperly done. Moisture content is very important in tillage—too much or too little is detrimental.

Soil water is also important because of its influence on microbiological action in decomposing organic matter and conversion of plant nutrients. Although essential to growth processes, excessive water in a soil can be detrimental. Excess water reduces the amount of pore space available for air, and disperses soil, creates restrictive layers in soil, reduces the root feeding area and root development, and decreases the supply of soil air. The effects of salts discussed above in relation to soil structure, also are related to soil water.

Soil air has been mentioned in conjunction with practically all of the other factors listed. It differs from air of the atmosphere primarily because it contains from 10 to 100 times as much carbon - dioxide. Adequate amounts of oxygen, as well as proper balance between oxygen and carbon-dioxide, are vital to plant respiration and nutrient availability. These reactions are controlled to a large extent by such physical factors as structure, pore space, particle size, drainage, etc. Partial or total exclusion of air, resulting from saturation with water, appears to bring the growing plant to a standstill, making it become chlorotic and often more susceptible to disease. So-called iron chlorosis can often be attributed to partial drowning of plants because the supply of soil air is reduced or excluded.

Soils and Temperatures

Soil temperature is influenced by texture, color, and water content of the soil as well as atmospheric temperature. Coarser textured soils (sands) are subject to quicker, more radical changes in temperature than finer textured soils. Darker soils absorb heat more rapidly than light colored ones. Wet soils remain cooler than dry soils and warm up more slowly. Temperature is very important in seed germination as well as plant growth. It exerts a strong influence on plant diseases at certain stages of growth, such as the seedling stage, and as the plant approaches maturity.

These would include damping off, rhizoctonia, and soreshin as seedling diseases, and verticillium wilt in cotton. Then, too, nutrient availability is affected by soil temperature. Conversion of nitrogen from ammonia to the nitrate form, due to microbiological activity, occurs more rapidly at the higher soil temperatures. Temperature also controls or influences the rate of chemical reactions involving other plant nutrients.

It is the consideration of these factors in a soil management program that will lead to greater success in crop production. Any of these points can limit crop yield, thus limiting the amount of fertilizer which can be used successfully. Raising the ceiling on crop yields opens the way for more extensive use of increasing amounts of plant nutrients.