

October 2014

Citrus Talks-Soils and Subsoils

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Recommended Citation

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CITRUS TALKS

"SOILS AND SUBSOILS"

Citrus

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SOILS AND SUBSOILS.

When President Garfield was shot the first news was "probably fatal," then came the glad message "recovery probable; temperate life and abstinence from drink and tobacco greatly in his favor." Similar words rejoiced us all when Roosevelt was so cruelly wounded last October. The robust, vigorous animal will survive disease, exposure and wounds when the one with feebleness body topples over.

Our cousins, the various plants, are subject to the same law. Fungus, the bacterial germ or mutilation find ready victims in the ill-nourished trees or the enfeebled shrubs; thus blight, wither tip or fungoid and bacterial germs are quick to lay hold of the shrub or tree that from over-fruiting, cemented, impoverished, ill-drained or water-clogged soil is weakened or diseased. There can be no question but that the surest way to resist fungoid attacks is to only grow vigorous and robust plants and trees.

There are a number of plant affections that seem to be wholly due to physiological disturbance--the plant is sick; thus the common "dieback" of citrus, walnut and most deciduous fruit trees is probably the result of faulty soil conditions and ill-nourished trees. Paleor in the man might be called "dieback," for here the skin is surely in a sense dead or weakened; that mal-nutrition would first manifest itself far away from the source of supplies in wilt or death is just what we should expect. Thus such terms as "wither tip" and "dieback" are not

only significant in locating affection but they indicate peripheral disturbance in the most susceptible.

Chlorosis, yellow leaf or variegated leaf are precisely like palor in the human subject. Here through mal-nutrition chlorophyl is not sufficiently provided, and the plant yellows. If asked why the chlorosis, we can only reply: "The plant is sick." To name the cause, we cannot; we must know the entire condition of the soil as to mineral and moisture content and physical texture as well. The same can be said of "Gummosis," scaly-bark, "mal di gomma" and possibly brown spot of the orange.

We see then that to know the needs and exact condition of our soils and subsoils is of supreme importance to every tiller of the soil; the health and fruitfulness of his trees are wholly dependent on the composition, texture and general physical condition of the soil of his orchard, and no study or research from himself or experts whom he may secure to aid him can pay better than a thorough investigation of his soils.

HOW TO INVESTIGATE.

Before one purchases land for orchard purpose he should know accurately the conditions of not only the surface soil but also the subsoil. If he already possesses an orchard and is not informed of the exact character of both soil and subsoil, he cannot too quickly acquire this knowledge. There are two kinds of data that are very essential: Character of the soil as to texture and mechanical make-up and composition. There are two ways to determine the first; by digging trenches in several places in the orchard, forming a point immediately beneath the tree to the center between four trees. This ditch should be

five feet deep and of convenient width to work easily. This shows the mechanical condition of the moisture content and root distribution. Such trenches are often a great surprise to the owner of the orchard and will often entirely modify his practice. A second way is to use the King soil tester which costs about \$7.00 and should be possessed and regarded as invaluable by every orchardist. This enables one to secure a cylinder of soil an inch in diameter quickly and easily in many portions of the orchard down to a depth of six feet. Except for root distribution this gives all the data that are secured from the ditch and at very slight expense and labor. For soil analysis I believe we are now dependent on private aid which we engage and for which we pay. Doctor Hopkins in his address at Santa Barbara emphasized the value and importance of such analyses, and suggested that the State ought to provide for such service, but that each orchardist should pay for the same. This would insure a reliable report and would give the amount of humus, nitrogen, lime and available potash and phosphoric acid.

SOIL AILMENTS.

Of course every soil is likely to be destitute of the required amounts of these necessary soil elements, humus, nitrogen, lime, potash and phosphoric acid. Any deficiency of these can be supplied most cheaply by the use of cover crops, also by the use of stable fertilizer when that can be had at a price that is not prohibitive. By such practice we also secure the invaluable humus. There is no question but that our California soils are lacking in humus or decaying organic matter. The cover crop supplies the need, and if a legume like vetch,

Canadian field peas, ^{or} bur clover furnishes nitrogen as well.

Mr. Powell of New York so famous as a producer of apples contends that he owes much of his success to the use of cover crops. Moreover he has by their use made many of his trees annual bearers.

In the absence of stable manure we may use alfalfa as suggested by both Doctors Hilgard and Hopkins. Doctor Hilgard asserts that alfalfa is worth \$8.00 a ton simply to plough under as a fertilizer; Doctor Hopkins suggested that it might pay well to grow alfalfa in fields adjacent to the orchard to be used exclusively in fertilizing the soil.

We may also secure the separates directly from the dealers in commercial fertilizers, and apply them as needed, or we may purchase a complete fertilizer; the former practice is probably the better if one is willing to study into the matter thoroughly. For nitrogen, nitrate of soda or chilly saltpetre is often used. Its ready solubility and quick action make it desirable in early spring before the ground warms up and growth is active. The late Doctor King urged caution in its use, as it may add to the amount of carbonate of soda or black alkali in the soil and so do serious harm. This results from a chemical change in the soil. The use of gypsum would lessen the danger. The ready solubility of this salt makes its escape in the run-off probable, if used very cautiously. Many prefer tankage or dried blood. This organic nitrogen is without opposition; it is all utilized.

^{stone}
Lime is becoming more and more recommended as a fertilizer. It should be ground lime rock not burnt lime. It is

quite soluble and so need not be very finely ground.

For potash we may use potassium sulphate or potassium carbonate, the chemical term for ashes. Though these are quite soluble, they are retained in the soil, and like the phosphates are not usually lost by drainage. They should be applied deep in the soil where they are needed and utilized.

For the phosphates we may use finely ground bone or rock; either is excellent. If we wish to make these immediately available we may treat them with sulphuric acid, reducing them to super-phosphates which are more soluble. If, however, there is abundant humus in the soil the untreated bone or rock will be available and no whit lost. Phosphate slag is also available as a source of the needed phosphates.

CEMENTED SOILS.

Hard-pan--natural or induced--is all too common, and there is no greater bar to success in the orchard. The natural hard-pan can be broken up by blasting with dynamite. The developed hard-pan is caused by lime in the irrigating water and is often called "plow-sole," as it occurs just beneath the plane of cultivation. A more suitable name is "irrigating hard-pan," as it is usually caused by the lime cement in the water used in irrigation. The water as it comes from the rocks is saturated with bicarbonate of lime. This is very soluble, but as it enters the soil it becomes reduced to carbonate of lime as the water evaporates, and the less soluble carbonate cements the soil into the so-called plow-sole or irrigating hard-pan, which of course must form just where the greatest evaporation occurs or just at the level of the cultivation limit. In dry seasons and late in the season this cement is most in evidence. In seasons

of heavy winter rains this cement or hard-pan may entirely disappear.

This artificial hard-pan is entirely too common. It is the cause of much of the chlorosis and ill health of the trees. It may be that dieback often owes its presence in our orchards to this cementing of the soil. That it would foster gummosis and bacterial and fungoid attacks is more than probable. Early deep cultivation and cultivating at varying depths through the season will aid to break up and prevent this impervious formation. It is quite common now among many of our best orchardists to use the subsoiler during the season to break through this cemented stratum of the soil.

ALKALI.

There are two soil salts that are known as alkali--carbonate and sulphate of soda. The first is black alkali; the other, white alkali. Both are quite readily soluble and present in small quantities in most all rocks and so are conveyed in very minute quantities in most all running water which flows from the rock strata of the earth.

In low poorly drained sections--usually clay basins--these salts are often present and harmful. Black alkali is much the more serious. It takes its name from the fact that earth containing it in the presence of humus is very black in color. Sowing gypsum on such land tends to change the black to the much less injurious white alkali. Thorough drainage and plenty of water will wash out the alkaline salts and restore the fertility of the land.

This explains why arid soils are much more likely to be alkaline than are those in humid regions. It remains to be said that some crops are far more tolerant of

black alkali than are others.

In purchasing land every one should examine closely to find whether alkali and hard-pan are present. If either occur in very limited areas this would be no bar to making the purchase; if in considerable abundance one better think twice before procuring such land for ranch purpose.

WATER CONTENT OF THE SOIL.

A water-clogged soil is very prejudicial to plant growth. A great scarcity will also cause the crops to die of thirst. This latter is very serious in times of extreme heat. Drainage is the cure of over-wet soils. They prevail in clay basins and are especially serious where the subsoil is cemented as already described.

A soil may be perched from neglect when from parsimony or scarcity of water the irrigation is omitted. The irrigating hard-pan or plow-sole often keeps the water from the roots of the plants and trees and brings on wilt and death.

The King soil tester and the ditch already recommended will often reveal a condition of moisture and root distribution that will surprise the orchardist and suggest a quick modification of his orchard practice.

AERATION.

We now know that every live soil is the home of countless millions of micro-organisms. These change the ammonia to nitrites and these in turn to nitrates which can be absorbed and utilized by the plants. These minute bacterial germs transform the humus into the necessary food to form tissue. Another group of these bacilli have the power to cooperate with leguminous plants in changing the inert nitrogen of the air into nitrates so

costly and necessary to all plant nutrition. These and other valuable soil micro-organisms must have oxygen to live--thus the necessity of soil aeration.

One of the most important functions of cultivation is to provide this aeration. Every soil at all times should be loose and friable. Clay soils often suffer from neglect of this aeration because of the lack of thorough cultivation. The highest success in fruit growing demands thorough aeration, and this only comes especially in clay soils with the most thorough stirring of the soil.

DRY EARTH MULCH.

We have referred above to the necessity of soil moisture. It is the most important plant food and is all too scarce in many of our orchards. Its conservation is all important. Humus helps greatly to hold it in the soil. It does ^{in acting} this _{as} a sponge in clay soils and compacts sand to its betterment.

One of the best uses of cultivation is to form a dry earth mulch, a loose stratum of the top of the soil from four to six inches in depth. This must never be neglected would we reach the best in our tillage. This demands thorough cultivation after each rain or irrigation throughout the growing season of the year. Few of us secure this perfect dry earth mulch at all times when plant life is most active. The best ranchers are keenly alive to its value and necessity, and their great crops and profits speak eloquently in its praise.

SUMMARY

To sum up, healthy plants exist only in a rich loam soil. The ditch and soil tester give the necessary knowledge. Soil texture and composition must be right. Cover crops, stable fertilizer and commercial fertilizers are very important. Humus, ^{nitrogen} potash, and phosphoric acid must abound. Hard-pan is a serious obstacle; alkali is also inimical to success. Right water content is a sine qua non to great productivity. Aeration is a prime factor in successful ranching. To neglect the dry earth mulch is to court failure.