What are Plant Diseases?

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Mr. President, Members of the Florida Horticultural Society:

It certainly gives me pleasure to be with you this evening.

The question has always been asked "What are plant diseases, and when is a plant diseased?" A plant is diseased when it does not react favorably to its environment. You who have been here through the day and have sat and listened to the discussions on how to manage groves, have found out that plants may be diseased, with being attacked by an organism, either fungous, bacterial or animal.

If we do not fertilize properly, our grove is in trouble. The plants are diseased. If we do not cultivate properly the plants are in trouble. If the water table is too high, we soon find out that our plants are in an unhealthy condition. If we have a prolonged drought we soon find that our plants are diseased. A healthy organism, a healthy plant is one which adapts itself to its environment.

Now I am not going to go over the whole field of citrus culture tonight. I am not going to take up the cultivation of the citrus grove, nor the physiology of the tree, but I want to confine a few of my statements to a plant being in an unhealthy condition or diseased, and how the organisms work on the plant when that plant is diseased.

To every plant there are three fundamental parts—the root, the trunk and the crown. It is the business of the root first to anchor the tree in the soil. Secondly, it is the business of those roots to gather the mineral nutriments which have been dissolved in water, and take those to the tree. Those are the two great functions of the roots. If the roots are diseased, they rot off, and cannot anchor the tree to the ground, which means it has failed to accomplish its purpose. If the roots are unable to withdraw from the soil the nutriments and give them to the tree, the tree is in trouble.

It is the business of the trunk first to conduct the nutriment from the soil to the crown of the tree. Secondly, it is the business of the trunk to raise the crown of the tree from the soil, and push it up toward the sunlight. Also a third function is to take the food material, which is elaborated in the leaf, and conduct that to the various parts of the tree.

The crown has several functions. The crown functions first in elaborating the food material, or taking the carbon dioxide from the air, combining
it with the water, which has been brought up from the soil, and making starch. That is one of the first functions of the crown, or of the leaves in the crown. If you should take a cross-section of a leaf you will find that the leaf is made up of a number of cells, and in each one of those cells you will find a number of small, green circular bodies. It is those small, microscopic, green bodies which are capable of combining the carbon dioxide from the air and the water from the soil, and making starch.

We can readily see then that any environment which is unfavorable to the proper action of either one of the parts of the tree, causes that tree to become diseased.

There are, however, in the plant world, small microscopic organisms, which are parasites, which have not the ability to take the carbon dioxide from the air and water from the soil and combine them to make starch. Therefore, those organisms must depend upon something else for their food supply. Unluckily, for the citrus grower, some of those organisms have chosen to live on the citrus tree. Hence we have some of our plant diseases.

Let us take, for instance, the small organism which causes foot-rot. It is a small fungus, microscopic in character, which lives in the soil. It is incapable of making the food substance for itself, so it chooses to live on the citrus tree. The citrus tree has made the starch; it has also taken the ammonia and the various products brought in from the soil, and combined the same with the starch, and has made what we wish to call “protein.”

Now this little organism which lives in the soil attacks those roots. It hasn’t a hammer nor a chisel that it can cut the roots of the tree with, or drill a hole in them, but it has created for itself an enzyme. When it comes up against a piece of food material, it just secretes some of this substance and dissolves the food. It enters into the root, there dissolves the wood and bark, and finally we will see that the root is decayed.

You are all familiar in the citrus tree business with what we wish to term gummosis. I do not mean the psorosis type. There are several types of this gummosis. One type is caused by the organism that causes melanose. The organism begins to dissolve away the substance in the bark, and in the wood, making this gum, and at the same time destroying the living tissue.

The region in a trunk of a tree which is known as the cambium layer, a small layer of live cells, two or three cells deep, around the tree, and when this fungus has destroyed this layer of cells all around the tree, the tree dies at the top. So that is what is happening in our gummosis type of diseased citrus.

A few years ago; perhaps several of you still remember; it is perhaps too fresh in your mind—that most serious of all citrus diseases appeared in Florida, known as the citrus canker. The citrus canker is caused by a very small organism. Suppose you should take a piece of paper or wood about an inch
long; then you should cut that piece of wood up into about 25,000 parts. The citrus bacterium is only about 2/25000 of an inch long, a very small organism. This organism chooses to live on citrus. We find that it settles down on a leaf and no doubt gets in through the breathing pores on the leaf. There it begins to grow and multiply. The first evidence of disease is a dead, yellow spot. The little organism has produced its dissolving material, which I wish to call an enzyme. Inside of that leaf then, where the spot is formed, there is formed a great big mass of bacteria which escapes to the surface. These bacteria have attacked the chemical factories of the leaves, the little green plastids. The bacteria are incapable of combining the carbon dioxide from the air with the water from the soil, and making them into starch.

There are other types of organisms which work in our groves, and one type which works when perhaps we least suspect. I have reference to that fungus which causes more trouble than any one of our disease producing organisms. After we have spent eleven months of care on the fruit, we may have a wonderful crop. We go out and we pick those beautiful, golden balls, bring them into the packing house, wrap them in a piece of paper, put them into a box, and send them to the market, hoping that we will get enough in return to pay us for the labor which was expended in raising that product. But we do not realize that we have turned loose in our grove a crew who does not appreciate what citrus fruit is; they don’t pick the fruit; they gather it. They simply go and rob those trees, just pull off the fruit; they don’t care how they get it. They bruise that fruit; they put it in a box and haul it to the packing house. They are not very careful how they haul it either, just so they deliver it. It goes over the belts and it is packed, and all along the line there hasn’t been a critical eye watching that fruit. So injuries have occurred; small indeed, because it does not take a large hole in fruit to allow a little spore to penetrate into the small holes. When you receive word from the market end, you find that there is some red ink, and that you have had ten, fifteen, twenty and as high as sixty per cent decay on account of carelessness. This fungus which is causing this decay is called green mold. This fungus enters through wounds, and if you want to keep your fruit in perfect condition until it arrives on the market, it is your business to see that the fruit is uninjured.

Member: I would like to ask if the organism is the same in gummosis as in foot-rot?

Dr. Burger: There are two distinct organisms which cause the foot-rot and which cause some types of gummosis. The organism which causes foot-rot may at times cause gummosis. Member: What percentage of citrus food is taken from the soil?
Dr. Burger: That's hard for me to answer. I wonder if there are not some chemists who can give that analysis. There was for many years a discussion among ancient horticulturists whether it was water or air, or what it was that made a tree grow. In Russell's book "Plant Nutrition and Crop Production" on page 1, you will find the following:

"The view that water is the food of plants was tested experimentally about 1620 and convincingly proved by the very beautiful and satisfying experiment of van Helmont:

'I took an earthen vessel in which I put 200 pounds of soil dried in an oven, then I moistened with rain water and pressed hard into it a shoot of willow weighing 5 pounds. After exactly 5 years the tree that had grown up weighed 169 pounds and about three ounces. But the vessel had never received anything but rain water or distilled water to moisten the soil when this was necessary, and it remained full of soil, which was still tightly packed; and, lest any dust from outside should get into the soil, it was covered with a sheet of iron coated with tin but perforated with many holes. I did not take the weight of the leaves which fell in the autumn. In the end I dried the soil once more and got the same 200 pounds that I started with, less about two ounces. Therefore the 164 pounds of wood, bark and root, arose from the water alone.'"

Member: What percentage doctor, approximately is taken from the soil?

Dr. Burger: I hate to venture a guess, but maybe perhaps 99% comes from the air and the water.

Member: You say 99% from the air and the water. Then do you mean to say that from all our expenditure for fertilizer we only get 1%?

Dr. Burger: It might not be exactly 99%, but it's a very high percentage. The fertilizer which you put on the soil weighs very little; the ash content of your tree weighs very little indeed.

Mr. Richard Compton: I would like to ask—do I understand that the roots of the tree take the fertilizer and change it to the nitrate form before it can be absorbed?

Dr. Burger: No, it is taken in as nitrates. It must be changed to the nitrate form before it can be taken in.

Mr. Compton: The root does that?

Dr. Burger: No, the soil organisms do that, I believe.