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Fruit-Tree Blight in General.

J. M. STEDMAN.

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FRUIT-TREE BLIGHT IN GENERAL.

J. M. STEDMAN.

INTRODUCTION.

Blight is a disease of plants that has of recent years attracted considerable attention, especially to the fruit grower, due to the fact that certain kinds of fruit trees have become affected with this disease, which has spread each year doing increasing harm. With the rapid yearly increase in the number of fruit trees affected, together with the equally rapid increase in the geographical area of distribution of the disease, has come a wide spread interest in this subject throughout the whole country. And this subject is attracting attention more and more; and it has so increased that it is now not confined to the fruit grower, but the farmer and even the general public have come to recognize this disease as a most serious one. The fact that its exact nature is not generally known, and the remedy perhaps even less, has helped to increase the dread of it, and to allow many to neglect their trees and permit them to die in consequence. Hundreds of instances have come under my observation in this state where village people with a few fruit trees, as well as farmers and even fruit growers, allow their trees to go unattended to when the disease appears, and the disease to increase and kill the trees and spread to others unaffected. So great has been this sad neglect of trying to check this disease, due no doubt to a want of information, together with the great yearly financial loss due to it, that this bulletin has been written with the sole purpose of giving to the public, and to the fruit growers and farmers of this state in particular, a general knowledge of what is at

the present time known to biologists in regard to the nature and cause of the disease, and of the remedies to be used to combat it and to prevent its spreading to unaffected trees and areas.

The blight is at present more common in the northern part of the State. A fruit grower from that locality who depends almost exclusively upon his fruit trees for a living, states that his apple trees are so badly affected with blight that he has lost nearly his entire crop and a large percentage of the trees. One can readily see what the disease blight means to such a citizen. While attending farmers' institutes in various parts of the state this past summer, I had a good opportunity to observe the effect and extent of this blight; and it was sickening to note the great amount of damage and loss by it, not only of this years' crop, but of the trees themselves; and what is still more, to note the neglect, which must result in the great increase and spread of the disease next year. It is to be hoped that all who read this bulletin will take every precaution themselves and inform their neighbors on this subject; and let all work together to greatly lessen, if not annihilate this, the worst of all plant diseases.

The different kinds of plants that are subject to the attack of the disease—blight—is very great; and it is by no means confined to fruit trees, but even shade and forest trees are subject to it. In some localities in the northern part of this state, I have observed the oak trees affected to such an extent, that with certain species, it was almost impossible to find one perfectly healthy, and as a rule the entire tree was more or less diseased. Fortunately this seems at present to be confined to a few localities only, but one of these is at least five miles in diameter. Should this blight increase as it seems certain to do, we may in a few years have an even greater problem to contend with than that of our fruit trees.

The blight appears in many cases soon after the trees are leaved out, but more often later, and may appear at any time during the summer. Its growth ceases in the Fall at about the time the leaves begin to dry and turn preparatory to shedding, or at the approach of cool weather. The blight makes itself manifest by causing the affected parts, both leaves and stems, and it may be also the fruit, to turn a brown color, which varies from a light brown to a dark tobacco brown, or in some cases an almost black appearance. This coloration of the leaves due to the blight is readily distinguished from the coloration of the leaves due to any other cause, as the partial or total breaking of a stem, or the girdling of the trunk or stems, or an injury of the roots. In the case of coloration by blight the leaves do not appear dried or shriveled as a rule, except in the case of the water oak, but preserve their proper shape; whereas in the coloration due to other causes the leaves appear dried and shriveled and have a lighter brown color. Moreover, the coloration due to blight may not at the time being affect the entire leaf, but may appear on any portion of the leaf or in several places, and cause it to be spotted. Ultimately, however, the entire leaf will become affected unless the growth of the disease be checked by some cause. The disease appears first as a rule at the buds or growing tips of stems or young leaves where the tissues are tender; and from these places it spreads down the stem, involving ultimately all the branches and leaves of the affected limb together with its fruit. As a rule a tree is attacked in several places at once; it may be on many different limbs or on several twigs of the same limb or both; and when a tree is attacked in a great many localities involving a large number of limbs, and this early in the season, the disease will often so increase as to involve the entire tree above the roots and kill it in one summer, if unattended to. It is not an uncommon occurrence, when such a tree has been cut down close to the ground soon

after it died, to have new shoots appear from the old roots and grow to be good bearing trees. (Pear.)

Blight always kills the parts of the plant affected. Although the term *blight* is restricted in its true sense to this particular disease of the leaves and stems with their fruit which is often itself affected, due to a spreading of the disease to it from the stem, nevertheless, there are diseases of the fruit itself that do not involve other parts of the tree, which diseases are the result of a cause, the nature of which is like the cause of true blight. When the fruit alone is effected with a *blight* that does not spread to other parts of the plant, we call this disease *Rot* as a rule, although the term rot is also applied to diseases of the fruit, the cause of which is entirely different from that of true blight. There are cases, however, where true blight may begin in the fruit or even blossom before the fruit is formed, and from it spread to the stem and leaves. In this case Waite has demonstrated that insects are the active agents in carrying the disease from one place to another; and that they inoculate the flowers which may have produced minute fruit before the disease increased so as to kill it and spread to the twig, or the disease may have increased so as to prevent the least formation of fruit.

THE NATURE AND CAUSE OF BLIGHT.

The disease known as *blight* is caused by bacteria. Bacteria are plants that are so small that in some cases twenty-five thousand (25,000) of them placed side by side would extend but one inch. Most bacteria, however, are a little larger than this, while many are smaller. They are as a group the smallest of living things, but what they lack in size they make up in numbers. Their power of multiplication is so great that in many cases, when every thing is favorable as regards food and temperature, the result of the

growth and multiplication of a single individual plant would be many thousand in one day.

Each plant or bacterium consists of nothing more than a single cell, or to make it more plain to the cultivator, of a single minute sack or mass of living matter. The rapid multiplication of these organisms takes place by a simple division of this single cell into two usually equal parts, each one now constituting a new and independent plant, which repeats the same process of division after a little growth. Bacteria also have another mode of reproduction by what are called spores. These spores are as a rule much smaller than the adult bacteria, and are capable of withstanding greater hardships and live. The adult bacteria themselves can withstand in many cases prolonged drying and a very high or low temperature, but the spores can withstand much more. The spores of many species or kinds of bacteria will withstand boiling for an hour or even more, and some at an even higher temperature, while the spores of *Bacterium anthracis* are stated by Pasteur to remain alive in absolute alcohol.* The spores will also withstand the action of many fungicides and insecticides. This will give the reader some idea of the great vitality of these micro-organisms, and enable one to understand why these creatures can live in the soil, not only during the dry and hot summer weather, but also during the cold of winter. Their minute size will also enable one to readily see how it is that they can float about in the air in great numbers, and be carried from one place to another.

Many bacteria are harmless, since they feed upon only dead or not living tissues or organic substances, and some are even beneficial; but many are injurious since they feed upon and live within other living organisms, both plant and animal, and in this case may produce disease and death. This death or disease may be the result of the direct action

*Charbon et Septicemie, Compt. Rend. lxxxv. p. 99.

of the bacteria in consuming the tissues, or it may be as a result of the chemical action of the waste products (ptomaines) thrown off during the growth and metabolism of the bacteria. Hence it is observed that there are many species or kinds of bacteria; and they not only act differently and produce different results and diseases, but each species as a rule has its particular animal or plant or substance in which it will grow and multiply and will not do so in any other.

The bacteria that cause the disease in fruit trees known as blight are carried by the wind, or by insects in some cases, from the soil to the buds or leaves of the trees. Here they gain access to the interior of the leaves by means of the stomata or minute openings in the epidermis of the leaf, of which there are in some cases many thousand to a square inch. Once on the tender buds or inside the leaves the bacteria find suitable food and conditions for their growth and multiplication. They feed upon the tissues of the host plant and destroy it, and as they increase in number, they gradually come to infest the entire leaf, and finally the petiole and the twig to the stem and other healthy parts. In this way the disease once started in a single place in the tree, will spread so as to include in time the entire limb or even the entire tree. The disease works down towards the trunk of the tree as well as in all other directions, and since the tissues affected soon die, it follows that if the blight start low down on a branch, it will necessarily kill the entire branch beyond the diseased portion.

The peculiar coloration of the blighted portion does not in reality indicate the entire area affected, since the bacteria are in many cases, especially in the stem, far below or down the branch before the coloration appears there, the coloration not being produced immediately upon the appearance of a few bacteria. Hence in cutting off of a diseased limb it is not sufficient to cut off the portion showing the coloration, since

we would leave the stump affected with the bacteria for a considerable distance; and these would continue to multiply and spread, and shortly the disease would again make itself manifest. It is essential then in cutting off the blighted portion of a tree, to cut far below the portion that looks diseased, say from one to three feet according to the size of the limb. It is also safer to cut off the dieased portion just as soon as it appears, and before it has had time to spread to any considerable extent.

In the Fall the leaves that are diseased, as well as the unaffected ones, fall to the ground. Here they decompose and the bacteria are set free, for they do not decay, and are again carried to other localities. In this manner the disease is spread from one tree to another and from one field or locality to another, and thus it is that the blight has and is spreading all over our country. It is then readily understood why it is that, if one neglect to attend to his fruit trees, the blight will ultimately reach those of his neighbors.

During the past summer I made pure cultures of the bacteria causing the blight in the pear, quince, apple, and a coniferous tree. These were made in nutrient gelatine by the usual method of plate and tube culture. In this way the bacteria from each kind of diseased tree were grown in separate tubes of gelatine in which they fed and multiplied, and thus were obtained a large number of individuals of each special kind of bacteria, each tube containing but one kind or species.

Some of the bacteria from the tube containing the ones obtained from the pear tree blight were then inoculated into the healthy leaves of a pear tree by the use of a sterilized needle dipped into the culture, and then pricked through the epidermis of the leaf. Many leaves were thus inoculated in different localities and on different trees, and each inoculated part labeled. In five days every leaf thus inoculated had taken the disease blight, thus proving that these special bacteria were the cause of the disease.

The same method was also followed in regard to the blight of quince and apple trees, and also with the conifera, and in all cases the inoculated leaves took the disease.

I then tried to determine, if possible, whether or not the bacteria causing the blight in the pear tree would, if inoculated into the quince or apple tree, give the blight to those trees; and whether or not the bacterium of the quince tree blight would cause the blight in the pear or apple tree; and also the bacteria of the apple tree blight cause the disease in the pear or quince trees. To determine this I cross inoculated many leaves of the different fruit trees with the blight bacteria from the other kinds of fruit trees, and in no case was I able to produce the blight, except by the inoculation of the bacteria obtained from the blight of the particular kind of tree inoculated. It thus appears that each kind of fruit tree, at least so far as pear, quince and apple are concerned, has its special species of bacteria that produce the blight in that tree, and that this species of bacteria will not produce blight in the other kinds of fruit trees.

It should be mentioned, here, however, that I was able to produce blight in three different species of conifereus trees by the inoculation of the blight bacteria obtained from but one species of tree.

REMEDIES.

From the above it is readily seen that, since the cause of the blight is a minute plant—bacterium—that feeds upon and lives, grows and multiplies within the tissues of its host plant, that we can not reach the micro-organisms that are thus internal parasites, and kill them by the application of any substances to the tree in the form of a spray, as we can do for many fungoid diseases. We would kill the tree before the bacteria could be reached and affected. Hence the only means of combatting this disease *blight* at present known, is the cutting off of the affected portion far below the external

signs of the disease. And since we have seen how the germs of this disease remain in the affected parts, as the leaves, that fall to the ground, and how they are eliberated and carried to infest other trees, it is plainly seen that if we cut off the diseased branches and leave them upon the ground, that we are doing no good whatever, for we have killed nothing, but are simply allowing the disease to multiply and spread so much the more, and next year the disease will appear with increased damage. The diseased portion of the trees that are cut off are to be gathered and burned, and especially the leaves, and thus the cause of disease will be destroyed and its spreading prevented.

The simple remedy is then to cut off all blighted portions of the trees far below the parts that appear diseased, and to burn all these cuttings, especially the leaves. The sooner this is done after one discovers the blight in a tree the better.

It is not enough that one thus guard his trees while his neighbors neglect theirs. We must all fight this blight, which is doing more harm already than any other single disease. If every person will thus attend to his fruit trees, we can almost exterminate the disease in a very few years.

I am now experimenting on the application of chemicals to the soilto be taken up with the sap in the Spring to kill or prevent blight, but as yet no definite results have been reached. Little has as yet been done in this line of preventing or curing bacterial diseases of plants, although the field looks promising, since we can in many cases cure bacterial diseases of animals by the internal application of chemicals.