

THE COLLAR BLIGHT IN WESTERN COLORADO

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Submitted as Thesis for Master's Degree

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IMPORTANCE OF THE DISEASE

In traveling through the orchard section of western Colorado, one is impressed with the frequency of so called "sick trees", (Fig. 1) which occur either as isolated cases, or in groups. These trees are affected by the collar blight, or collar rot, which has been known in Colorado for twelve of fifteen years, but which has recently become more wide spread and is causing the loss of a number of good trees, especially in the Surface Creek Valley in Delta County. In some orchards as many as six or eight trees have been killed or rendered worthless in the last few years. The fruit growers in the affected areas are baffled as to the cause and remedy.

SYMPTOMS

The orange red color of the bark of the

affected trees render them conspicuous at quite a distance. The trouble is not characterized by any discoloration of foliage, but the foliage is stunted and in bad cases entirely lacking on the affected parts. In the early stages, one side only of the tree is affected, or possibly only one of the main limbs. Eventually, however, the whole tree takes on this sickly appearance, and in the course of about three years it is dead.

In digging around the base of the tree, one finds a blackish water soaked appearance of the roots on the affected side, (Fig. 2) the roots being completely dead, and the cambium layer disintegrated, so that in many cases the bark of the root may be freely slipped back and forth. This condition will be found to exist to the very tip of the root. In the advanced stages the collar, or base of the trunk, also takes on this appearance, sometimes completely girdling the tree. It does not appear, however, to originate in the collar, but rather to work up to the collar from the roots. No mycelium is found, except where the tissue has long been dead. From the nature of the injury the pathogen is plainly not a fungus.

## LITERATURE

The earliest available records of the disease in this state is by Paddock in 1901, who described a root rot similar to the present trouble, and attributes it to a fungus which may exist on both healthy and on diseased trees, which causes the root rot only when the trees are weakened by other agencies.

In the report of the Field Horticulturist for 1906, O. B. Whipple describes two forms of root rot; one working under ground only, and the other extending up the trunk into the large branches. It is claimed that two seasons are necessary to kill the tree. The first season the tree is completely girdled and defoliated; the second season the tree starts out in the spring as a normal tree, but dies in midsummer. Arsenical poison is suggested as a cause. The only remedy mentioned is the prompt removal of the affected trees. Ben Davis and Gano are mentioned as the most susceptible varieties.

In 1908 Dr. Wm. P. Headdon of this station, published a bulletin on Arsenical Poison of Fruit Trees, and the symptoms described are identical with the case

under discussion. He advances the theory and gives supporting data, that heavy spraying with arsenate of lead causes an accumulation of arsenical compounds in the soil at the base of the tree, and that this is responsible for the injury.

In 1909 and again in 1912, Grossenbacher, of the Geneva Experiment Station, published extensive technical bulletin on this trouble. He discusses at length the literature considering three main hypotheses: first, a pathological cause; second, arsenical poison; third, winter killing. He presents his own investigations and concludes winter killing to be the cause. He takes issue with Dr. Headdon on the ground that while there is shown a high arsenical content in the soil beneath affected trees, it is not shown that there is less beneath normal trees.

In 1915 Orton and Adams of Pennsylvania published on the collar blight, the symptoms tallying with our trouble in Colorado. They attribute the cause to Bacillus amylovorus, the causal organism of the common pear blight or fire blight. These workers succeeded in isolating pure cultures of this germ and in reinoculating so as to produce typical collar blight and other forms of

fire blight.

Still more recently Dr. M. B. Waite of the U. S. Department of Agriculture investigated the collar blight in California, and proved it to be due to *B. amylovorus*. He isolated an organism and by inoculation obtained both collar blight and blossom blight, as did the Pennsylvania workers. Dr. Waite is quoted in the Plant Disease Survey Bulletin for 1919 as saying: "This form of the disease (collar blight) was found in considerable abundance on the apples in Montrose and Delta Counties in 1904. It was later, in 1907, found in Utah in moderate abundance. It occurred occasionally along with a similar form of the pear, in the Sacramento Valley of California, in 1905-6-7. In 1906 numerous cases were found on Spitzenburg apples in Payette, Idaho. It was looked for but not found at Hood River, Oregon. In the summer of 1907, it was found abundant in the orchards of D. M. Werts at Quincy, Pennsylvania, and during this and subsequent years was found abundant on Grimes in the Shenandoah Valley of Virginia and West Virginia."

Hesler and Wetzel, in their "Manual of Fruit Diseases", describe the collar blight as one of the forms of fire blight.

Manns and Le Cato report the trouble as bad in Delaware and attribute it to fire blight having gained entrance to the collar thru lesions caused by winter injury.

A recent popular discussion of this subject, is that of Mr. Lee M. Hutchins before the Washington State Horticultural Association in 1919. Mr. Hutchins reviewed the findings of Dr. Waite and discussed control measures, which will be found further on in this paper.

#### THE PRESENT INVESTIGATION

The investigation in this state was undertaken by the writer in June, 1920, to determine if possible, the cause of the disease. Samples of soil and roots were collected in Delta and Mesa Counties and brought to the experiment station in Ft. Collins. Careful notations were made of symptoms, cultural and soil conditions. No relation was found either between clean culture and sod, and the collar blight, or between heavy or light soils and the disease.

The trouble often occurred in seeped orchards or in poorly drained places; but in many cases the trees stood in deep, well drained, sandy loam, and among the

most thriving and prosperous orchards.

#### OPINION OF GROWERS.

Altho the collar blight was studied in over forty orchards, no uniformity of opinion existed among the growers as to the cause of the trouble. In fact only seven ventured explanations which were as follows:

Arsenical poison.....	1
Pathological cause.....	2
Seepage or excess of water....	3
Borers, or lack of water.....	1

#### CHEMICAL ANALYSIS

Owing to the excessive cost of chemical analysis only four of the sixty-two soil samples collected could be analyzed for arsenic. Of these, two were taken at the base of the tree from soil in contact with the affected part. The other two were taken next to affected roots, but some little distance ( 8 ft. and 5 ft. respectively) from the base of the trees. As would be expected, a much higher arsenical content was found near the base of the tree, (See Table 1). However, Grossenbacher's criticism is that we do not show the soil around normal trees to have less arsenic, still holds good.



TABLE 1

Percentage of Arsenic in Soils, as Shown by Chemical Analysis

Tree	Source	As <sub>2</sub> O <sub>3</sub>	As <sub>2</sub> O <sub>5</sub>	Total
1	Next to trunk at surface of ground	3.50	4.06	7.56
2	Same	3.96	4.59	8.55
3	5 ft. from trunk .6 to 8 in. below surface	1.83	2.12	3.95
4	8 ft. from trunk 1 ft. below the surface	2.75	3.19	5.94

In this connection, however, it is interesting to note that this form of root rot or collar blight is more general in the Cedaredge District, where only one or two arsenical sprays are applied, than it is in the Grand Valley, where six to ten applications are made. This would seem to indicate that this trouble is not correlated with arsenic in the soil. A number of other root troubles of fruit trees however, do exist in the Grand Valley, and it is highly probable that some of these are influenced by arsenic.

## BACTERIOLOGICAL INVESTIGATIONS

Attempts have been made to isolate the causal organism from the root samples collected. Vigorous cultures of bacteria were in all cases obtained, both from roots already destroyed by the disease and from diseased tissue next to the margin of the injury. (Figs. 3 & 4) This organism was at first believed to be *B. amylovorus*, but further investigation showed that it was not. Check cultures of *B. amylovorus* were obtained from reliable sources (see Acknowledgements) and were grown on various culture media side by side with collar blight culture. On agar and gelatin the organisms appeared to be the same, but on potato were very different, and also differed as regards the fermentation of sugar, the check cultures causing no growth in the closed arm of fermentation tubes containing broth and 2% sugar, while the collar blight culture grew vigorously and produced considerable gas.

Young apple seedlings were inoculated with the collar blight, and the control cultures. Checks were used to determine the extent of the mechanical injury in inoculation. The seedlings inoculated with collar blight

cultures suffered only the mechanical injury and continued to grow normally while the check cultures produced typical fire blight, killing the seedlings.

One year old French pear seedlings were forced in the green house, and simultaneously inoculated with the collar blight cultures, and the check cultures. The check culture produced fire blight, while all attempts to produce it from the collar blight cultures failed.

These results convince the writer that notwithstanding the investigations in other states, the collar blight in Colorado is not caused by *B. amylovorus*. Whether bacterial organisms isolated from collar blight tissue is the causal pathogene, or whether it is merely a saprophyte following winter injury, is still a matter of conjecture. Inoculation both of the roots of the potted apple trees in the green house, and on standard trees in the orchard, have been made, but it is too early to report any findings. It is hoped that before many months we will know whether or not the very vigorous cultures obtained in all cases from the collar blighted tissue is the causal organism.

The description of *B. amylovorus* given by D. H. Jones of Ontario was followed in a partial cultural study of the organism obtained, and this, as well as the difference in behavior between the known cultures and the collar blight cultures, together with the inoculation results, points very strongly to other agencies than *B. amylovorus* as the cause of the collar blight.

#### CONTROL MEASURES

No work having been done in this state on the control of the collar blight, we can only restate Whipple's suggestion of 1907, that the trees be promptly removed. There is an opinion among some of the growers that dehorning, if done in the early stage of the disease, will save the trees. Other growers in the Surface Creek Valley are attempting to control the disease by applying lime sulphur around the collar. However, since the disease appears to work in the cambium layer, the efficiency of this remedy is to be questioned. It is interesting to note that the government investigators have found that, in the early stages of the trouble,

cutting away the affected tissue and painting the wounds with coal tar diluted with creosote is an effective cure for the collar blight on the Pacific Coast, said to be due to *B. amylovorus*.

#### SUMMARY

1. The collar blight of the apple has become a serious menace to fruit growing in the western part of the state, particularly in the Surface Creek Valley of Delta County.

2. The three hypotheses advanced as to the cause of the trouble are (1) winter killing; (2) a pathological cause; and (3) arsenical poisoning.

3. The particular case under discussion is now definitely shown to be caused by other agencies than arsenical poisoning, leaving winter killing and a causal organism as the two remaining possibilities.

4. Investigators in other states now commonly agree that the collar blight is a form of fire blight. However, the present investigation indicates very strongly that for the Colorado trouble, this is not the case.

5. Vigorous cultures of bacteria have been obtained from collar blighted tissue, but it has not yet

been determined whether this is the causal organism or merely a saprophyte.

6. Pending further investigation as to remedial measures, growers are advised to dehorn or remove trees in the early stages of collar blight, and to practice prompt removal in all cases where the trouble has progressed further,

#### ACKNOWLEDGMENTS

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Fig. 1.



Fig. 2.

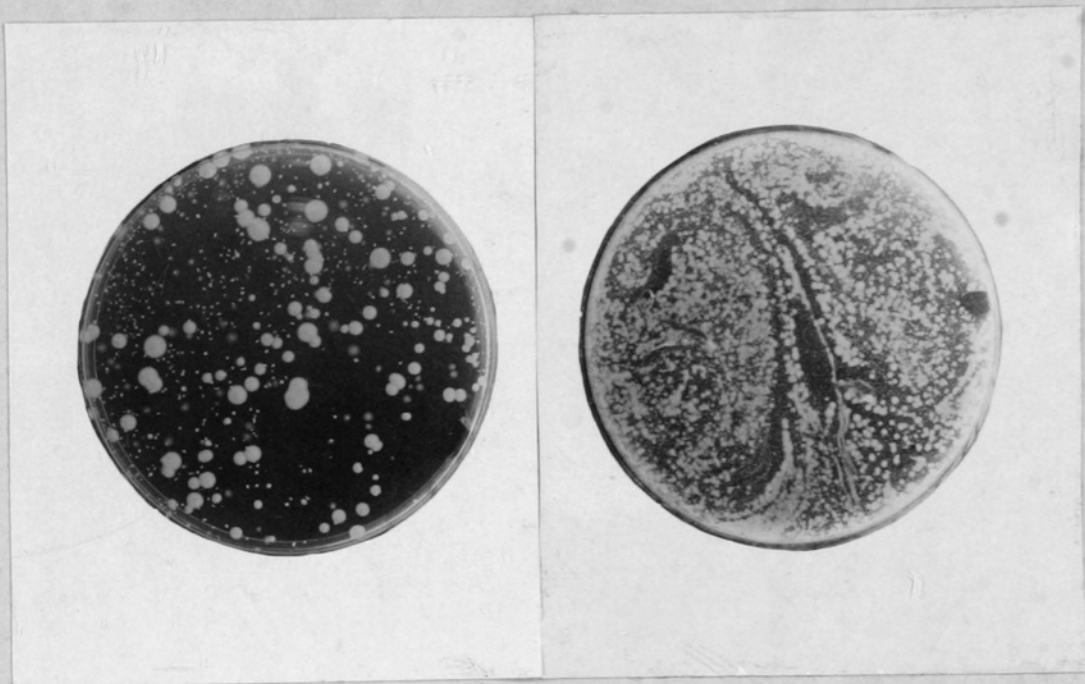


Fig. 3.

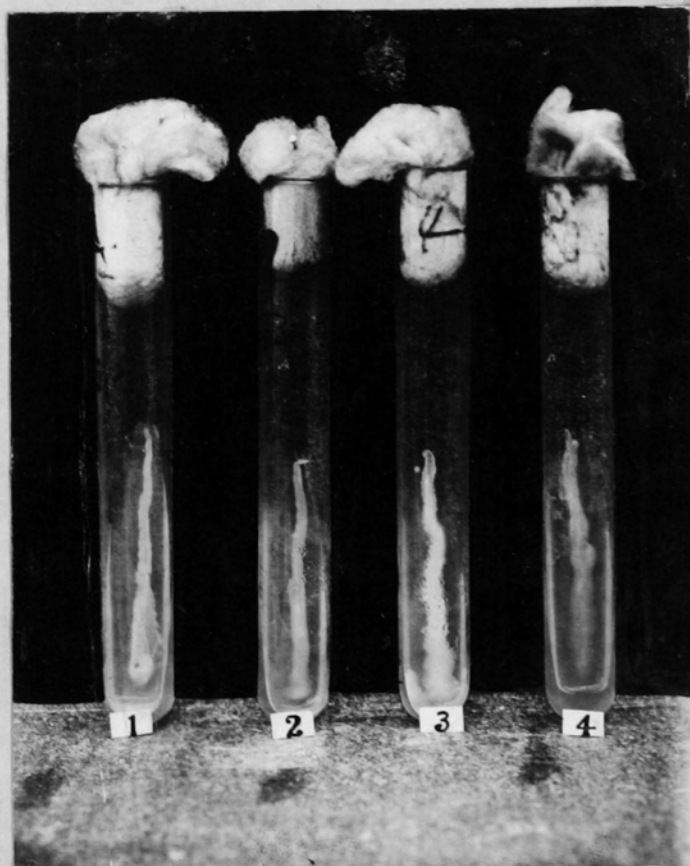


Fig. 4.