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An Apricot Blight.

—BY—

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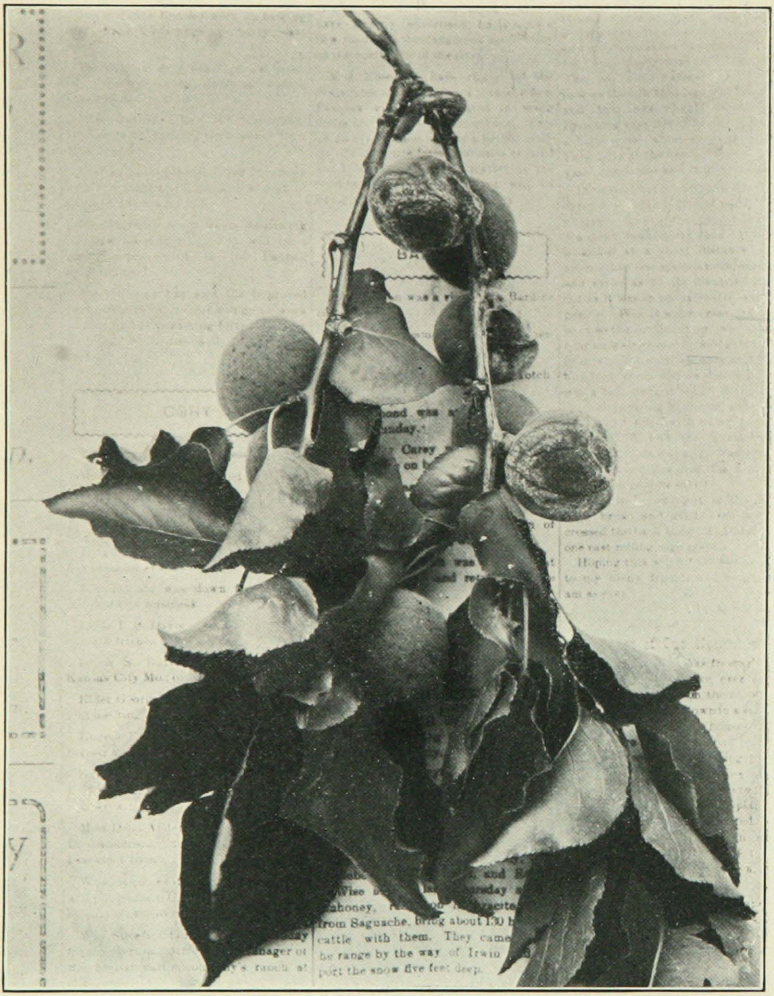

PLATE I. Apricot Fruit Attacked by Pear Blight. Photographed June 25.

An Apricot Blight.

By Wendell Paddock.

The writer's attention was called to a disease of apricots in the fall of 1902 by Mr. H. E. Mathews, horticultural inspector of Delta county, which was thought by the growers to be an attack of pear blight. Many of the twigs had blighted and all of the fruit on several of the trees had decayed. At the time of my visit it was too late in the season to see the disease in an active condition, but microscopic examination of the dead twigs and of the dried fruit failed to show any sign of fungous attack. The indications pointed to a bacterial disease but the idea that it was caused by the germs of pear blight was doubted since at that time there was no record of this disease ever having attacked the stone fruits.

The orchard was visited again on June 25, 1903, when the disease was found in an active condition. In one row, containing ten Moorpark and ten Royal apricot trees, every tree was more or less affected, as well as other trees in various parts of the orchard.

At this time many of the fruits were attacked, the diseased areas varying in size from a spot an eighth of an inch in diameter to irregular areas that involved three-fourths of the fruit. The skin over these places soon became nearly black in color and shrunken as the tissues were consumed till the outline of the pit was disclosed. These discolored areas were always definitely outlined and bordered with a zone of watery appearing tissue usually about an eighth of an inch in width. The latter was green in color and as hard as the sound flesh. Three such fruits are shown on Plate I.

The smaller spots where the disease had evidently just started, invariably surrounded a lenticle, thus indicating that the disease gained entrance to the fruit through these openings.

The injury to the twigs may be described best by saying, that they resembled closely, blighting pear or apple twigs. (Plate II.) So far as noticed only tender twigs of the current season's growth were attacked. These were shrivelled and discolored from a few to several inches of their length and small drops of sticky fluid were occasionally found on their surface and upon the

shrivelling leaf-stems. The discolored outer bark blended gradually into normal appearing tissue but the inner bark was discolored for some distance below any external evidence of disease.

Unfortunately the infected orchard is so far from the Experiment Station that the progress of the disease could not be watched, but specimens of diseased ripe fruit were secured from Mr. Mathews on August 2. These were in all stages of decay. Those that were only slightly attacked had a small shrunken area over which the skin was discolored but little. In those specimens where a half or two-thirds of the fruit was involved the tissue was much shrunken and the skin over these areas was quite brown. In some specimens a thick juice, swarming with bacteria, oozed from the diseased tissue and collected in a large drop on the surface. Much watery appearing tissue which was still firm surrounded the diseased parts.

Infection evidently took place more readily early in the season as there was much more diseased fruit at the time of my visit than there was when the later specimens were secured.

Since the appearance of Prof. Jones' paper* in which he proves that pear blight may produce twig blight in various kinds of plum trees it seems probable that this blight and rot of the apricot was due to the same organism. The trees are situated in a mixed orchard and the adjacent pear and apple trees suffered severely from an outbreak of pear blight during the season of 1902, and it was abundant, though not as severe, in 1903. Microscopical examination showed that the diseased parts of both twigs and fruit were swarming with bacteria and that these germs were abundant in the watery appearing though firm flesh of the fruits.

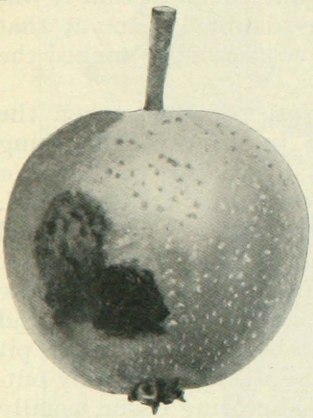

FIG. 1. Apple three days after inoculating with diseased tissue from an apricot fruit.

Working upon this supposition experiments were undertaken as follows: June 30, 12 apples were inoculated by inserting under the skin bits of the watery tissue taken from diseased apricot fruits. These wounds were covered at once with sterile grafting wax. Four of the apples were picked by children but at the end of twelve days the remaining eight were found to have developed the rot that is peculiar to apples attacked by pear blight. The disease gradually spread until the entire apple was discolored and shriveled and drops of sticky fluid appeared upon the surface of most of them. (Fig. 2.)

*Jones, L. R. Studies Upon Plum Blight. Centralb. f. Parasitenk. u. Infek. II. Abt. II. Band. pp. 835-841.

Nine apple twigs were inoculated on the same day with the fresh diseased tissue from apricot fruits. The disease spread in all of these twigs, killing them from the tips down; in one instance ten inches of the twig from the tip, back, was dead. No difference could be detected in the appearance of these twigs and in those that were known to have been killed by pear blight. Both leaves and twigs shrivelled and turned dark colored and drops of sticky fluid exuded from the bark and from the leaf stems.

On the same day, June 30, seven apple twigs were inoculated with fresh diseased tissue taken from a blighting apple limb. These inoculations were made for the purpose of comparing the disease produced with that produced with germs taken from apricot fruits. All of the twigs developed typical cases of pear blight, becoming shrivelled, dark colored and exuding drops of sticky fluid. The twigs in this lot could not be told from those that had been killed by inoculating with diseased tissue from an apricot fruit. The bacteria appeared to be the same when examined with a microscope and made the same growth when cultivated artifically in the laboratory.

FIG. 2. Apple inoculated with tissue from apricot twig; the latter having been inoculated with a culture of pear blight.

There was no blight in the trees on which these experiments were made and to make sure that the mechanical injury of inoculation could not cause the twigs to die or the fruit to decay, control or check twigs and apples were carried along with all the experiments. These were made by making incisions with a sterile knife through the skin of the apple or through the bark of the twigs; the wounds were then covered with sterilized grafting wax. No disease developed in any of the checks and the injuries soon healed.

These experiments were repeated a number of times with cultures of the bacteria taken from apple twigs, apricot twigs and apricot fruits. Inoculations were made in both apple twigs and fruit and the results were the same, namely, a typical case of pear blight from all three sources.

As there are no apricot trees growing on the College grounds, Mr. J. S. McClelland kindly offered the use of one of his trees for experimental purposes. A number of inoculations were made in the twigs of this tree July 8. Cultures of the disease obtained from apple twigs, apricot twigs and apricot fruit were used. The orchard was visited on July 20 when it was found that blight had been produced in a number of the inoculated twigs, while the check twigs remained sound.

The disease was recovered in pure cultures from these apricot twigs in which blight had been artificially produced and apples inoculated with this material developed typical cases of pear blight. (Fig. 2).

The results of these experiments prove that pear blight may attack apricot twigs and fruit and observations show that the disease may do a considerable amount of damage. While this apricot blight has not yet assumed alarming proportions, yet there is a possibility of its becoming a common disease. It has been found in several Colorado orchards and an apricot disease has been reported from Utah, which is probably due to the same cause. Blighted twigs were also found on Prunus simonii trees which were also thought to be caused by an attack of pear blight.

REMEDIES.

Since this disease has been proven to be due to attacks of pear blight, the logical method of treatment would appear to be the suppression of this disease in apple and pear trees. With pear and apple orchards free from blight there would probably be no apricot blight. There is little probability at present, however, of ever attaining this ideal condition, but much can be done to hold the disease in check if all orchardists will unite in following the best treatment that is now known. This consists in cutting out all blighted limbs after the growing season is over, as in late fall or any time during the winter.

It is now definitely known that the germs of pear blight live over winter in occasional diseased limbs. The germs in such limbs become active in the spring with the growth of the tree and cause a thick fluid to ooze from the diseased bark. This juice is swarming with blight germs and because it is slightly sweet, bees and other insects are frequently attracted to it. That bees do carry blight germs in particles of this sticky juice that may accidently stick to their bodies was proven by Mr. Waite of the Department of Agriculture. Then when visiting flowers in their search for nectar or pollen it is easy to conceive how these particles may become dislodged from the bees' bodies and fall into the nectar in the blossom. Mr. Waite also proved that this does take place as he found pear blight germs growing in nectar in pear flowers. Thus the pear blossoms become sources of infection and the disease spreads rapidly or "like a fire," from which expression the term "fire blight" is derived, as hundreds of insects visit flower after flower.

Just how many of the twigs become infected has not been satisfactorily explained, but in the light of our present knowledge

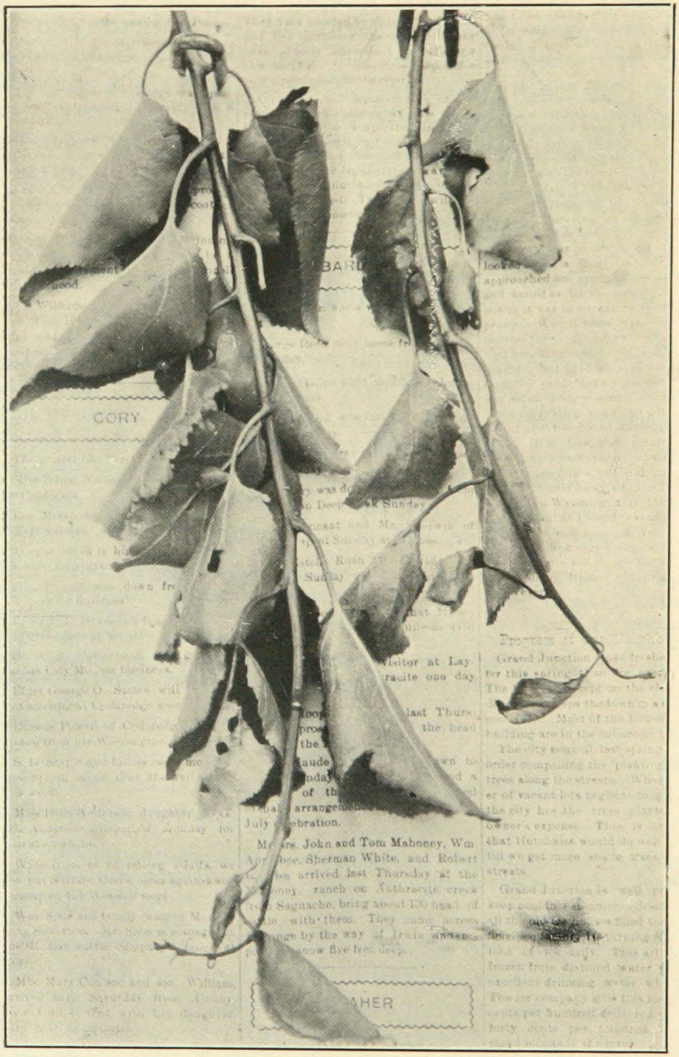

PLATE II. Apricot Twigs Attacked by Pear Blight.
Photographed June 25.

the cases of so-called "hold-over" blight in limbs and twigs must be regarded as the sole means of keeping the disease alive over winter. The appearance of this apricot blight then should emphasize the importance of keeping pear blight in check. All diseased trees whether they be apple, pear, apricot or plum, should be looked over carefully in late fall or during the winter and all blighted limbs and twigs removed. When cutting out diseased branches, especially during the growing season, care should be taken to make the cut 8 or 10 inches below any evidence of discolored bark.

DETAIL OF EXPERIMENTS.

Experiment No. 1. June 30; inoculated 12 apples with diseased tissue from apricot fruits. Apples on the tree and about one-fourth grown. Inoculations made with sterile instruments and diseased tissue taken from in under the skin from the zone of watery appearing tissue. The wounds were covered with sterile grafting wax as soon as the inoculations were made. Notes were taken on the development of the disease as follows:

July 7. Inoculations have taken in four fruits. In one, disease has spread over one-fourth of the surface and a characteristic bead-like drop has formed on the surface. Four fruits destroyed by children. The other four show no signs of disease. July 11. Inoculations have taken in all of the apples. These apples were eventually entirely consumed by the disease. Five check apples punctured but not inoculated remained sound.

Experiment No. 2. On the same date, June 30, nine apple twigs in the same tree were inoculated with diseased tissue from apricot fruits as described above. All wounds were protected with sterile grafting wax.

July 7. Blight appearing on all of the twigs. Twigs brown and whithering with bead like droplets on surface. July 31, disease has spread 10 inches on one twig and eight inches on another.

Experiment No. 3. For the purpose of comparison seven twigs were inoculated June 30 with diseased tissue from a blighting apple limb. Bits of inner bark which was only slightly discolored by the disease were inserted in incisions made in the tips of green twigs.

July 7. Three twigs show no results. Four are diseased and show characteristic symptoms of pear blight, though the disease has not advanced as rapidly as it did in the twigs that were inoculated with tissue from apricot fruits.

July 11. All the twigs in this experiment are now blighting and thick juice has formed in drops on the surface as in the other experiment. The gross appearance of the twigs in the two lots are the same and microscopical examination shows that all diseased parts in both experiments are swarming with bac-

teria which appear identical. Eight check twigs punctured at the tip with a sterile knife show no sign of disease.

Pure cultures of the bacteria from the three sources, apricot fruits, apricot twigs and apple twigs were secured as soon as possible with which further inoculations were made. Plain neutral potato agar was used in making poured plates from which transfers were made to tubes of potato agar, potato plugs and sugar beet plugs. Inoculations were made July 7 with the pure cultures into apple fruits and apple twigs as given in the following tables:

TABLE I.

Inoculations of Apples with Cultures of Bacteria Secured from Diseased Apricot Twigs, Apricot Fruit and Apple Twigs.

No. of Experiment.	No. of Apples.	Sources of Cultures.	Date of Inoculation.	Date of Examination.	Results.
No. 4.....	5	Apricot Twigs	July 7	July 28	All discolored and shrivelled.
No. 5.....	5	Apricot Fruit	July 7	July 14	Negative.
No. 6	6	Apple Twigs	July 7	July 28	One fruit black and shrivelled.
No. 7	6	Check		July 28	Sound.
No. 8...	6	Apricot Fruit	July 14	July 28	Five fruits shrivelled and discolored.

Evidence of the success of the inoculations became apparent in some instances on the third day. (Fig. 1.) There being no development of disease in any of the apples in Experiment No. 5, further inoculations were undertaken on July 14, as indicated in Experiment No. 8, using another tube of the same culture. Final notes were taken on July 28. The five fruits in Experiment No. 4 inoculated with culture from apricot twigs all discolored and shrivelled. Experiment No. 5 gave negative results, probably due to weak or dead culture material. No. 6, using a culture of known pear blight taken from a blighting apple limb, one fruit black and shrivelled; the other five gave negative results. No. 7, check apples, all sound. No. 8, inoculated with culture from apricot fruit, five apples shrivelled and blackened over most of their surface. One showed no evidence of disease

TABLE II

Inoculation of Apple Twigs with Cultures of Bacteria Secured from Diseased Apricot Twigs, Apricot Fruits and Apple Twigs

No. of Experiment.	No. of Twigs.	Source of Culture.	Date of Inoculation.	Date of Examination.	Results.
No. 9.....	7	Apricot twigs.	July 7	July 29	Five twigs diseased.
No. 10	7	Apricot fruit.	July 7	July 29	All twigs diseased.
No. 11.....	5	Apple twigs.	July 7	July 29	All twigs diseased.
No. 12.....	6	Check.		July 29	Sound.

In Experiment No. 9 the disease made good growth in three twigs, extending eight inches in one. The growth was slight in two twigs while the remaining two gave negative results.

The disease made good growth in all of the twigs in Experiment No. 10; one of them being blighted for 18 inches of its length. All twigs blighted in Experiment No. 11. One diseased 18 inches of its length and others for 12 inches. The twigs used in this experiment were younger and more succulent than the others, which no doubt accounts for the greater growth. Check twigs all sound.

There being no apricot trees on the College grounds, Mr. J. S. McClelland kindly offered the use of one of his trees for experimental purposes. Accordingly inoculations were made in the twigs of this tree as shown in Table III. The tree bore no fruit this season.

TABLE III.

Inoculation of Apricot Twigs with Cultures of Bacteria Secured from Diseased Apricot Twigs, Apricot Fruit and Apple Twigs.

No. of Experiment.	No. of Twigs.	Source of Culture.	Date of Inoculation.	Date of Examination.	Results.
No. 13.....	7	Apricot twig.	July 8	August 5	Three blighted; four, no results.
No. 14.....	5	Apricot fruit.	July 8	August 5	All made some growth.
No. 15.....	7	Apple twig.	July 8	August 5	Five blighted; two, no results.
No. 16.....	7	Check.		August 5	Sound.

In Experiment No. 13, three twigs of the seven were blighted; one five inches, one eight inches and the third, 10 inches. New growth was selected for the experiments and the inoculations were made as near the tip as possible. The four twigs that gave no results made a rapid growth after inoculation, of from 18 to 20 inches. And curiously enough two of them were blighted at their tips. This can be accounted for by natural infection from the inoculated twigs as four other twigs were found on the tree that were blighted. None of the check twigs showed any evidence of blight and there was none found on the other two trees that stood within 12 feet of the tree experimented on.

All of the twigs in experiment No. 14 were diseased; the blighted areas varying from one to four inches in length.

Cultures of known pear blight were used in Experiment No. 15. Five of seven twigs were blighted, two of them for eight inches from the tip where the inoculations were made.

The disease was recovered in pure form from the inoculated apricot twigs and apples on the tree were inoculated as shown in Table IV. Specimens of diseased ripe apricots were received at about the this time, together with blighting twigs. Cultures were made from both sources and inoculations were made as is also shown in table IV.

TABLE IV.

Inoculation Experiments with Cultures of Bacteria from Various Sources.

No. of Experiment.	No. of Inoculation.	Source of Culture.	Date of Inoculation.	Date of Examination.	Results.
No. 17.....	6 Apples	Apricot twig.	July 29.	August 18.	Two fruits diseased.
No. 18.....	5 Apples	Ripe apricot fruits.	July 29.	August 18.	All diseased.
No. 19.....	4 Apples	Apricot twigs that had been inoculated with cultures from apricot twigs.	July 29.	August 18.	One fruit diseased.
No. 20.....	6 Apples	Check.		August 18.	Sound.
No. 21.....	10 Apples	Apricot twigs that had been inoculated with cultures of pear blight.	Aug. 7.	August 18.	Three fruits, decaying.
				August 30.	Three more fruits diseased.
No. 22	5 Apples	Check.		August 30.	Sound.

Cultures from apricot twigs produced decay in two fruits out of six inoculated while all inoculations with cultures from ripe apricots were successful.

One out of four inoculations was successful, where a culture from an apricot twig, from McClelland's, that had been inoculated with cultures from apricot twigs were used. As a more complete test was desirable than was afforded by No. 19, a similar experiment was undertaken in No. 21. Ten apples were inoculated with diseased tissue taken from an apricot twig that had been inoculated with a known culture of pear blight. Six of these inoculations were successful. The check apples in every instance remained sound.