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# THE "X DISEASE" OF PEACH

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Characteristic Leaf Symptoms of X Disease.

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**I**N the summer of 1933 an apparently new peach disease was reported in a few orchards in Connecticut and the Station began investigations to determine the cause and possible methods of control. In the light of present knowledge it is certain that the disease must have been present in these and other orchards for some time previous to 1933 without attracting the attention of the owners.

The name "X disease" was suggested because in mathematics the character "X" stands for an unknown quantity. At the beginning of our investigations X represented the disease very aptly and even now there is sufficient mystery in some of its manifestations to warrant the name.

Subsequent studies indicate that the X disease is a new disease of peach and is caused by a virus, probably falling into the same general classification as peach yellows, little peach, peach mosaic and others.

### Distribution of the Disease

The distribution of the X disease is, as far as we know, confined chiefly to Connecticut. We have seen a light infection in one orchard in the Hudson Valley and have had unconfirmed reports of its presence in Rhode Island and Massachusetts. The latter seem credible, as the disease occurs in Connecticut at points not far from the boundaries of these states. In Connecticut it is well distributed through the central part of the State, where the peach orchards are concentrated. However, isolated cases occur in the northeast corner. If its present rate of increase is maintained, it will soon become a serious menace to the peach industry in Connecticut and possibly in any other peach growing section into which it may spread.

The following table indicates the amount of X disease injury and the the rapidity of its spread.

TABLE I. INCREASE IN X DISEASE

Orchard and Year Planted	Percent of Diseased Trees by Years <sup>1</sup>					Total Percent
	1933	1934	1935	1936	1937	
A 1932-33		5.1	11.8	20.4	30.0	67.4
B 1933	0	0	0	11.5	21.6	30.0
C <sup>2</sup> 1932		11.0	22.4	31.2	16.0	85.0
D <sup>2</sup> 1932			31.0	34.2	27.7	94.0

<sup>1</sup> This indicates the percentage of new cases each year, except during the first year when data were collected.

<sup>2</sup> The apparent decrease in 1937 is due to the small percentage of healthy trees left to show infection that year.

The above table is self-explanatory and makes further comment unnecessary.

\* This brief circular is presented at this time because of the economic importance of the X disease. A complete report of these and subsequent investigations will be published later.

### Symptoms of X Disease

As previously stated, the X disease appears to be a new virus disease known to infect peach and nectarine. At present there are no varieties of peach grown commercially in Connecticut resistant to the disease. Except where the infection has reached an advanced stage, trees look normal in the spring, making the normal growth of leaves and new shoots until about the middle of June. Then small, yellowish areas appear on the leaves, usually near the base. These increase rapidly in number and size until the entire leaf is conspicuously discolored. The leaf tissue becomes dry and brittle, and irregular patches of the blade fall out, giving the foliage a very tattered appearance. This latter characteristic is not always noticed as the diseased leaves drop easily, often before the tattered appearance is evident. The tip leaves on the diseased twigs seldom fall and this characteristic is so conspicuous that it constitutes a major feature of diagnosis.

The fruit usually shrivels and falls soon after the leaf symptoms appear on the diseased parts of the tree. In mild cases, where the fruit remains on the branches, it ripens prematurely and has a bitter flavor. When the fruit does mature, there is usually no development of the pit in the stone, which contains only the dry, shrunken remains of the seed, or a soft, immature seed incapable of germination.

The diseased twigs or branches do not necessarily die. Many of them remain alive after shedding the leaves and leaf out in apparently normal condition the following spring, only to repeat the performance of the previous season. The visible symptoms of infection do not appear over an entire tree at once, but show at first only on a few twigs, or perhaps on one twig, and from that point spread irregularly over the tree. Curiously enough the healthy parts of the tree are not visibly affected and continue growth and fruit production as long as the foliage does not develop the characteristic symptoms of the disease. How long a tree can survive an attack of X disease we do not know. None of those under observation in the field have died, although most of them are soon rendered valueless for fruit production.

### INVESTIGATIONS

At the beginning of our investigations a rather extensive survey was made of the peach orchards of Connecticut. Seventeen diseased orchards, containing about 4,000 trees, were mapped and individual records have been kept in the intervening years. It is from these records that much of the data here presented has been obtained.

Trees of all ages, from one year up, have been found infected with X disease. Therefore it is logical to assume that a tree of any age is susceptible. As in the phony peach disease, a vigorous, rapidly growing tree is more likely to be infected than a stunted, slow growing tree, and the disease spreads through a vigorous tree more quickly and with more destructive effect than it does on a slow growing tree. From our budding experiments and observations in the field it seems that the characteristic symptoms usually appear the year following infection, although in a few rare cases trees have developed recognizable symptoms the first season,

or even the second or third. The time of year when natural infection takes place is not definitely known, although the evidence at hand indicates that it is in the earlier part of the season. The natural vector of X disease has not been determined but it seems reasonable to suppose that it is some insect. Field observations and some rather limited experiments with a few insects have so far failed to give positive results.

Early in the studies of this disease it was found that the first infected trees were usually located at or near the edge of the orchard. This led to the conclusion that infection was possibly being brought in from some wild host in the immediate vicinity. A systematic search showed choke cherries, *Prunus virginiana*, exhibiting somewhat the same foliage discoloration as the peach. These trees were invariably associated with the diseased peach trees, and at no very great distance from them.

Further investigation showed that diseased cherries could be found far from any peach tree. This indicated that diseased peaches were not necessarily responsible for the diseased choke cherries, but rather, if any connection existed between the two hosts, the choke cherries were responsible for the occurrence of the disease in peaches. However, due to accidents, the budding experiments to demonstrate transfer of the disease from cherry to peach have been unsatisfactory, and only one positive case of infection of peach from budding with diseased cherry buds has developed.

### Experimental Work

A large amount of data has been collected on soil analyses, cultural methods, varieties affected, weather conditions and other particulars, none of which appear to have any bearing on the occurrence or absence of X disease. Fungi associated with a streaking of the wood in the older trees in some orchards were studied exhaustively, but infections made with the incidental fungi failed to produce the characteristic symptoms of X disease. This, coupled with the fact that streaking was not associated with the disease in all localities, caused the abandonment of this line of investigation.

Healthy trees were treated in various ways with the expressed juice of diseased leaves but in no case so far has infection resulted from this procedure. At the present time we believe that attempts to produce the disease by introduction of diseased juice into a healthy tree will uniformly fail, as they have in the case of peach yellows.

Budding of healthy peach trees with diseased buds has always produced a certain percentage of diseased trees, although the results are not as uniformly good as in working with peach yellows. All the buds that grow produce the disease, but many of them fail to grow and it is these that give negative results. However, such failure does not necessarily mean failure to produce the disease, as positive cases sometimes develop where the buds do not grow. Budding in pieces of bark from diseased trees has so far failed to produce infection, although it would seem as if positive results should be obtained by this method inasmuch as infection results from buds that fail to grow.

As previously mentioned, attempts to produce infection in peach by

budding with diseased choke cherry buds have not given satisfactory results because of unavoidable damage to the budded stock from winter injury and other causes. Only one positive case of infection has resulted. Several trees have exhibited partial symptoms but not enough to warrant making any positive statement about them. Budding choke cherry with diseased peach buds has been tried in a limited way with a small percentage of positive results, but further trials are needed to make the evidence completely satisfactory.

Healthy seedlings were top and root grafted with wood from diseased trees in the summer of 1937. Both top and root scions made a satisfactory union with the stock, but showed no results before the end of the growing season.

It is not known at what time of year infection takes place although we suspect it to be in the early part of the season. During the summer of 1937, potted trees were put out in infected orchards for two-week periods to determine this point, if possible. Other potted trees in the same locality were kept in cheesecloth cages to prevent possible infection by insects. At this writing, the development of the disease in the exposed trees has not become definite enough to warrant a positive statement as to time and amount of infection.

We have not been able to carry on much work with insects as possible carriers of X disease. In 1936 two species of flea beetles found feeding on foliage of choke cherry and to a lesser extent on peach foliage were transferred to healthy peach trees. The results were negative, as might have been expected, since chewing insects are not often reported as transmitting virus diseases. In 1937 a species of tree hopper was frequently found feeding on choke cherry. Considerable numbers of these were taken, and permitted to feed on diseased choke cherry for several days after which they were transferred to healthy peach trees in cages in the greenhouse. No symptoms of the disease developed during the remainder of the growing season. Trees thus treated were brought into the greenhouse about January 1, and after six weeks showed no indication of a diseased condition.

#### Control Experiments

The question of adequate and practical control of X disease is uppermost in the mind of the orchardist and to this end considerable work has been done. In 1934, 1935 and 1936, diseased limbs were cut from trees of various ages as a possible control after infection had already taken place. On large, older trees this method proved successful in a small percentage of cases during a period of three years. In some orchards many of these trees remained free of visible symptoms of the disease for one or two seasons, but subsequently the disease reappeared in nearly all. As there was plenty of opportunity for reinfection during this time we cannot be sure that much of the so-called reappearance might not have been due to reinfection. On young trees up to five or six years of age, any attempts at control by cutting diseased limbs have so far proved to be a definite failure.

The removal of diseased trees from an orchard has not given any meas-

ure of control up to the present time. Granting the hypothesis of infection from adjacent diseased choke cherry to be true, this result might well be expected. It might be mentioned at this point that new trees, set where diseased trees have been taken out, show no greater incidence of the disease than similar trees in the same orchard, set where healthy trees were taken out.

With the thought that a causal organism might be destroyed or inactivated, or elements lacking in the diseased trees might be supplied, various chemicals were used as injections and soil treatments without any very apparent effect except severe injury to the tree in some cases. Studies of this method of control have been temporarily discontinued, although the action of a few of the materials indicated the possible value of further study.

Basing our opinion on the assumption that X disease is transmitted from choke cherry to peach, the most promising method of control seems to be the destruction of all choke cherry in the vicinity of peach orchards. To this end we have studied the problem of a satisfactory method of destroying the choke cherry. At once it was evident that digging or grubbing out the bushes was not practical or effective because it is not economically possible to get all the roots, and any pieces left in the soil will sprout and reestablish the plant again in a short time. Cutting of the tops is entirely unsatisfactory as the plant sprouts very readily and, in the case of diseased plants, the resulting sprouts are invariably diseased. The only successful method tried so far has been killing the cherry by spraying with a proprietary compound of sodium chlorate and a deflagration agent. *If not combined with some deflagration agent sodium chlorate is a distinct fire hazard. The solution will kill all green vegetation with which it comes in contact.*

The material used was dissolved at the rate of three-quarters of a pound per gallon of water and sprayed on the cherry when in full leaf. The foliage and all parts of the plant above ground were killed quickly and if the tops were not cut during the season, a high percentage of the bushes was completely killed by absorption of the toxic material into the roots. High pressure or large quantities of material per plant did not seem necessary, since just as good a kill was obtained with a hand pump as with a power sprayer. It appeared that the only advantage of the power outfit was speed and more ease for the operator. The more foliage present at the time of spraying, the more certain the kill, as more of the material is absorbed by the plant.

#### SUMMARY

The X disease has increased in prevalence and in destruction of the usefulness of orchards in Connecticut during the past five years.

Apparently it is a virus disease in the same classification as peach yellows and little peach.

It can be transmitted by budding but so far no other artificial method of transmission has been discovered.

The natural vector has not been determined.

The disease causes a characteristic discoloration of the foliage, followed by defoliation. The fruit usually drops with the leaves, but if it stays on the tree it ripens prematurely and is very bitter. No cases of death of the tree from this disease have been observed up to the present time.

It appears to spread from choke cherry *Prunus virginiana*, to peach, probably being carried by some insect. In view of this fact the destruction of choke cherry in the vicinity of peach orchards, as well as the removal of diseased peach trees is recommended.

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The writer wishes to give credit to Dr. Florence A. McCormick for her investigations of the possible relationship of fungi to the occurrence of this disease. We also want to express our appreciation of the careful field work of Mr. Wilbur H. Odell, and our thanks to the several fruit growers who have allowed much useful experimental work to be done in their orchards.