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A ROOT-ROT OF FRUIT TREES.

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O. M. MORRIS.

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EXPERIMENT STATION, Stillwater, Oklahoma.

A Root-Rot of Fruit Trees.

E. MEAD WILCOX and O. M. MORRIS.

SUMMARY.

(1). The root-rot disease of fruit trees herein described is found in many of the orchards of the Southwest, and is very common throughout many parts of Oklahoma.

(2). This disease is caused by a toadstool that has been described by one of us as a new species. The black underground strands of this fungus penetrate the bark of the root and then produce between the bark and the wood plates and threads of white mycelium. These threads and plates soon kill the parts with which they come in contact.

(3). The disease has been found in apple, peach and cherry trees in Oklahoma and the same fungus is a common parasite and saprophyte on several species of oak in the Territory.

(4). No practical remedial measures can be suggested for diseased trees. All such should be removed promptly and burned. The same applies to the roots of such trees and to old oak stumps still standing in the orchard. Perhaps the isolation of a single diseased tree by means of a ditch will prevent the further spread of the disease through the soil to healthy trees.

The cultivation of fruit trees has become so important an industry in many parts of Oklahoma that it is very necessary that all fungus and insect enemies of these trees receive prompt attention. It is very fortunate that, as yet, peach curl and peach yellow have not become prevalent and dangerous diseases in Oklahoma. In fact, fruit growers must also congratulate themselves that the apple trees have not suffered here to any great extent from the

NOTE:—This bulletin is a popular summary of the technical edition of Bulletin No. 49 entitled "A Rhizomorphic Root-Rot of Fruit Trees," by E. Mead Wilcox. Copies of the technical edition will be sent upon application to the Experiment Station.

usual parasitic fungi associated with this tree in the Northern and Eastern States.

For some years past the attention of this Station has been frequently called to a disease of apple and peach trees that had received the common name, "root-rot." From reports received last summer, it seemed that this root-rot disease was one of great importance. Subsequent studies and extensive correspondence with fruit growers over the entire Territory have shown that this root-rot of fruit trees is a very serious disease indeed, and one towards which very stringent measures must at once be adopted.

Owing to the kindness of many correspondents it has been possible to determine with fair accuracy the distribution of this disease over the Territory. It has been found in the following counties: Canadian, Cleveland, Dewey, Greer, Kingfisher, Lincoln, Logan, Noble, Oklahoma, Pawnee, Payne, Pottawatomie and the Osage Nation. Further studies will probably reveal its presence in other parts of the Territory besides those mentioned. The same disease has also been reported from the following States: California, Georgia, Illinois, Indiana, Missouri, Ohio, Oregon and Texas.

The symptoms of this disease are so very characteristic that no one should have any difficulty in determining whether it is present or not in his orchard. Perhaps the most characteristic symptom of this disease is the great flow of gum from and about the crown of the trees. This gum-flux occurs according to our observations in peach, apple and cherry trees, and is reported from California also in apricot trees. It frequently happens that the amount of gum to exude is so great that it unites with the soil about the crown of the tree to form a mass of gum-cemented soil about the tree. This mass often becomes hardened and forms then a sort of cast about the crown and larger roots of the diseased tree.

An examination of the diseased roots will afford absolute evidence of the presence of the disease in question. Upon removing pieces of the bark great masses and threads of a velvety white substance will be found between the bark and the wood. These masses constitute the "mycelium" of the fungus. If the outside of the root be carefully examined there will in many cases be found some blackish root-like fibres adhering closely to the bark. Perhaps in a few cases it will be possible to trace these black strands to a point where they enter the bark of the root. If such a point is found then it is a simple matter to determine that the black strands when they enter the root become flattened out and are white threads

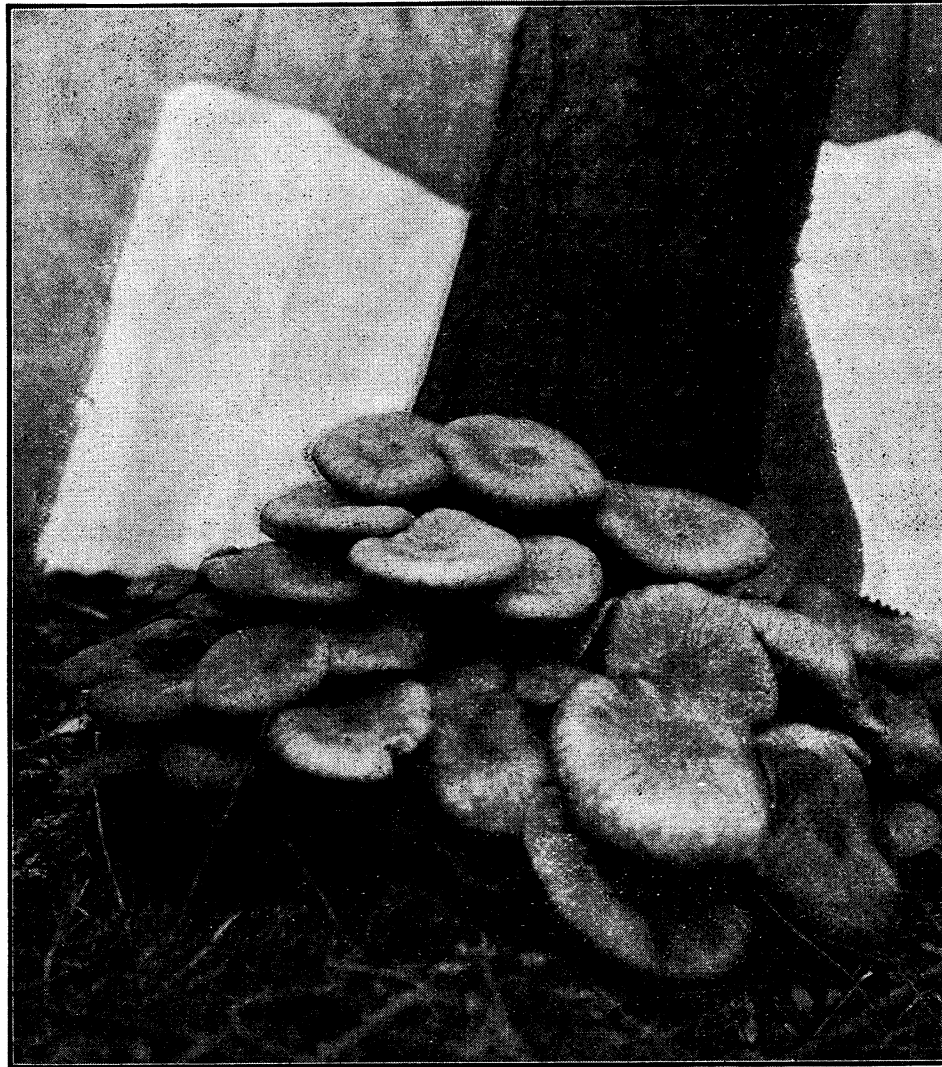


Fig. 1.

or sheets between the bark and the wood. These black strands found adhering to the root are called "rhizomorphs," and are the characteristic underground part of a certain toadstool.

The toadstool producing these strands will be found about the crown of diseased trees during September and October—as a rule the toadstools form great clusters extending in many cases entirely about the base of the tree. Figure 1 shows a group of these toadstools about the base of a peach tree. A careful study of this toadstool showed it to be a new species and it was therefore described in the technical edition of this Bulletin as a new species. Toadstools, like all fungi, reproduce by means of spores, and these spores in the case of the toadstool are found on the surface of the plates or gills that are produced on the under side of the cap of the toadstool. If the stem of this toadstool is cut off and the cap placed gills down on a piece of black paper for about ten hours it will be found that the spores, that have fallen onto the paper, are white.

Each one of these spores is able upon germination to produce some of the velvety white threads already mentioned and these white strands may be formed into the strong black strands and these are then able to grow out through the soil to great distances. And whenever they come in contact with a root of one of the fruit trees mentioned they are able to enter through the bark and then produce the disease we are considering. But an entire orchard may be killed before a single one of the fruiting bodies, commonly called toadstools, appears about the base of any of the trees. This is due to the fact that each small piece of the white threads produced by the germination of the spores is able to develop into the typical black strands and then infect new trees. And from these strands are produced the toadstools, though as a rule they do not appear until the crown of the tree at least is quite dead.

This same toadstool is very common throughout the Territory about old oak trees or about dead oak stumps. The black strands will often be found inside of these old rotten stumps. These strands are in fact the resting stage of the toadstool and they may remain apparently dead for a long time and then, when proper moisture and temperature conditions are present, may again begin their growth. It is very apparent from what has been said that old oak stumps constitute fertile sources of infection and we would expect to find the disease of fruit trees especially marked and common in orchards planted out on recent clearings. This in fact is the

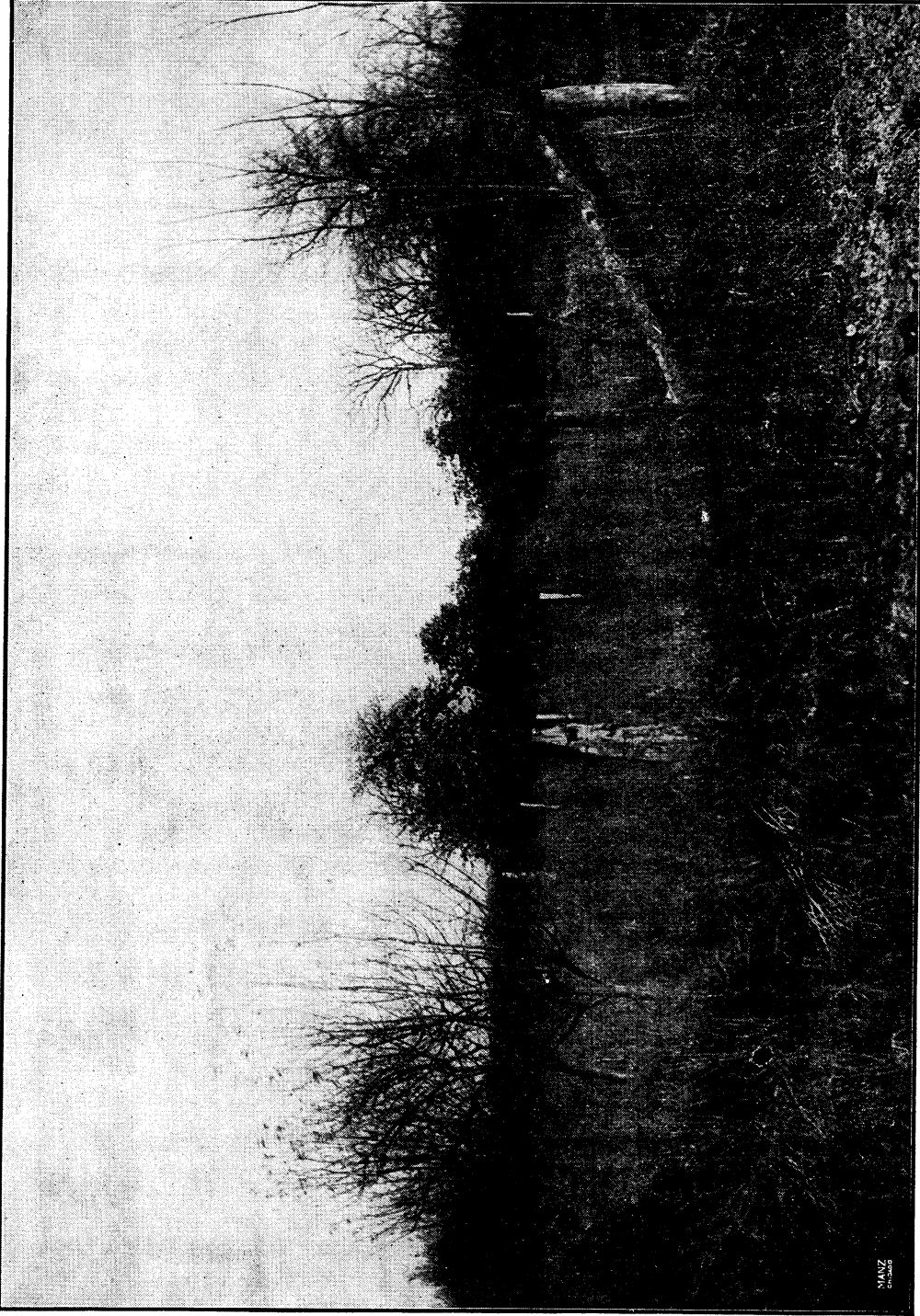


Fig. 2.

case—for the distribution of the disease agrees exactly with the distribution of the local timber belts in the counties from which the disease has been reported. Figure 2 shows an orchard planted on the opposite side of the road from an oak woods. About fifty per cent of the peach trees and about fifteen per cent of the apple trees in this orchard were found to be diseased, while on the trunks of many of them were found large clusters of the toadstool we have just described.

The rotting of the roots caused by the entrance of the threads of this fungus or toadstool leads to a great reduction of the absorbing power of the tree. This leads to one of the prominent symptoms of the disease; the leaves frequently turn yellow during the growing season or what is more usual wilt very rapidly and remain on the limbs. If the tree is in fruit then the fruit will also wilt very rapidly but usually will remain attached to the limbs. It is perfectly useless to attempt to restore any tree showing these symptoms to its normal condition.

The greater part of our knowledge concerning the proper remedial measures to be applied against this and other wood-destroying fungi is derived from the wide experience of the foresters of Europe. Among the strictly remedial measures none are of greater importance than the isolation of diseased trees by ditching. If a single tree in the midst of the orchard is found to be diseased, a ditch should at once be dug around it to prevent, if possible, the further spread of the disease by the under ground strands. This ditch should be dug at a distance of about ten feet from the tree, i. e., with a diameter of about twenty feet. The ditch should be about one foot wide and about two feet deep, with vertical walls. The same measures are to be adopted to protect a group of diseased trees that are found in the orchard. In this case the ditch may be dug so as to include all the trees in the group. It is possible that the burning of brush in this ditch will kill the strands and prevent further spreading. So far as the authors are aware this method has never been practiced to any great extent in America, though in Europe it seems to have proven effective in combating this and similar diseases.

It cannot too strongly be insisted upon that all fruit trees that are found to be diseased should at once be removed from the orchard. Care must also be taken in such cases to remove and burn not only the trunk but all the larger roots and especially all the diseased roots. Perhaps a tree will bear salable fruit after the

mycelium of this fungus has entered its root system but it is a near-sighted system and poor business judgment to allow such a tree to stand, when it is remembered that thereby all the other trees in the orchard are being endangered.

Too great care cannot be taken to avoid cutting or otherwise injuring the roots of the trees by ploughing or other cultivation. For although the black strands of this toadstool are able to enter the bark of a perfectly healthy tree, yet its entrance, as well as progress in the roots, is much facilitated by wounds of any character. In one of the orchards visited last fall it was quite apparent that in many cases the strands had found their entrance into the roots through wounds made by the plough while cultivating between the rows.

The same statements apply to the matter of ridding all trees promptly of all borers. For it is a fact that this toadstool and many other fungi of the same character find ready entrance to trees through the holes made by borers and other insects. Several cases have been seen in which the strands of this toadstool had entered the bark of roots through holes made by one of the common boring beetles. It is very evident, therefore, that very careful attention must be given to insects of this character in combating this root-rot disease.

Attention has frequently been called to a practice among some fruit growers of placing in the bottom of the hole, in which they are about to set a tree, a quantity of chips from their wood pile. In many of these chips there is sure to be found some of the mycelium of this fungus and the introduction of the disease into the orchard is the result of this practice in many cases. It is a well-known fact that each small piece of mycelium of these fungi is capable of remaining dormant for long periods and of again producing, when placed under proper conditions, the mycelium and even the normal fruiting bodies of the species.

It was early found in these investigations that the disease was largely or entirely confined to those orchards that were planted on recently cleared timber land. This matter has been referred to in the discussion of the local distribution of the fungus. In fact the disease has never been reported in this Territory from orchards planted out on real prairie soil. Subsequent investigations have afforded abundant proof that the fungus described in this Bulletin is common as a parasite and also as a saprophyte on various species of oak in this Territory. Consequently old oak stumps or even

dead oak roots remaining in the soil are apt to become fertile sources of the infection of the healthy trees planted in that same soil. From the above it follows that it is the part of wisdom to remove all old oak stumps from the orchard and to dig up all roots of such trees remaining in the soil. These should be carefully burned and in no case allowed to remain on the surface of the soil.

From the very nature of the disease the application of any fungicide as a remedial agent cannot be recommended at all. For even if it were possible to kill all of the mycelium and the strands adhering to the root the growth of the mycelium within the root would not be interfered with in the least. But, moreover, it is also very doubtful if the application of any fungicide to the soil about the tree would effectually prevent the spread of the fungus by means of the strands through the soil from a diseased tree to healthy trees in the neighborhood. This is made possible from the fact that these fungicides are apt to combine with other things present in the soil and thus lose their strength and usefulness. Woodworth in California recommends that a large amount of earth be removed, and that the hole be then lined with either iron or copper sulphate. The hole can then be filled with new earth and another tree be planted. So far as is known this method has never been tried in Oklahoma and any who are troubled with this disease in their orchards are urged to try the method and determine for themselves its value.

It is very doubtful if any great good will result from the "liming" of the soil or from mixing large amounts of wood ashes with the soil. Neither of these methods would be of the slightest value as remedial methods and further tests must be made before any value is ascribed to them as preventives of the further spreading of the mycelium.

And though thorough cultivation of the soil in orchards is always to be recommended for other reasons yet this may not tend to greatly reduce the spread of this disease. The thorough cultivation of cleared timber land in other crops before planting an orchard is of course to be recommended. Perhaps in this fashion the fungus may simply be cultivated out of existence.

In view of all that has been said it is plain that it is not advisable to replant trees in holes from which diseased ones have just been removed, unless perfect precautionary measures have been taken to rid the soil of all traces of the mycelium. And it is even

doubtful if new trees should ever be planted out between the rows of diseased ones.

Whenever groups of toadstools are found about the base of trees in the orchard they should be removed and burned. For each toadstool, if allowed to mature, will produce a very great number of spores, each of which is able upon germination to produce a new mycelium. The particular toadstool causing this disease has been found to be edible and those who have developed a taste for mushrooms may care to "kill two birds with one stone" by employing these mushrooms on their tables.

The search for disease-resisting varieties will probably prove a failure and is a method that has in similar cases not yet proven itself entirely practical. The fact that this fungus and other similar ones are found as parasites on such widely different species would of itself discourage the attempt to secure a disease-resisting variety. It is suggested, however, that fruit growers note carefully which varieties remain free from the disease and send complete notes regarding the subject to the Experiment Station.

