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Mycoplasma: New Causes for Old Diseases in Michigan
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MYCOPLASMA:

New Causes for old Diseases in Michigan

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The actual causes of some plant diseases are either unknown or imperfectly understood, even in this time of technological progress. One large group of plant diseases, commonly called "yellows" diseases, has been thought to be caused by viruses. Viruses were suspected because no fungi or bacteria could be found in association with diseased plants. Furthermore, the disease-causing agents were graft-transmissible and usually had insect vectors, characteristic of virus diseases. Yellows diseases are characterized by stunted, yellow foliage and irregularities of growth such as witches' brooms, excessive roots, reversion of flowers to a leaf-like form, and spindly or distorted leaves.

In 1967, scientists in Japan reported that new plant disease agents, mycoplasmas, caused certain yellows diseases. These mycoplasmas, also called pleuropneumonia-like organisms (PPLO), have long been known to cause diseases in animals and man.

Since 1967, a world-wide investigation of yellows diseases has shown that most of them are caused by mycoplasmas, forcing the entire agricultural community to take a new look at some of our old diseases.

WHAT ARE MYCOPLASMAS?

Mycoplasmas are very small parasitic organisms (25,000 would fit on a one-inch line), that live within plant or animal cells. They have no constant shape, since they consist of a membrane with enclosed living protoplasm. They change shape with changes in outside pressures, resembling a balloon filled with water. They change shape with changes in outside pressures, resembling a balloon filled with water.

Mycoplasmas live in the food-conducting tissues, or phloem, of plants. The phloem is a network or pipe-

line of cells for moving foodstuffs manufactured in the leaves to other parts of the plant (Figure 1). Once the mycoplasmas enter the phloem cells, they multiply rapidly and millions are soon spread throughout the plant. This rapid mycoplasma growth comes at the expense of plant growth, since plant foods are used up by the mycoplasmas.

The parasites may also block the phloem pipeline, resulting in wilting, stunting and yellowing of the infected plant. This interference in transport of foods (starches and sugars), is most damaging during the critical period of flowering and fruiting. Fruit set and quality are reduced. Root and bulb crops develop poorly. Usually, the edible portion of the crop is bitter tasting.

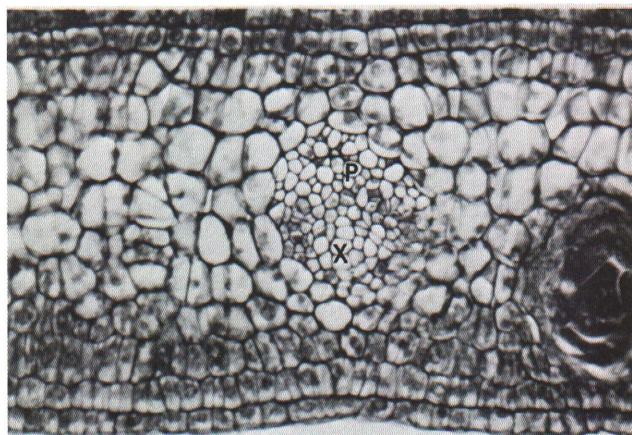


Figure 1. Cross section of leaf vein. Xylem cells (X) carry water; phloem cells (P) carry foodstuffs. Pipelines like these reach all areas of the plant (X 150 magnification).

In addition to stunting and yellowing, infected plants often exhibit excessive shoot or root production. These symptoms, known as witches' brooms or hairy root (Figure 2), are common. However, the reason for their occurrence is not fully understood.

Certain leafhoppers play a major role in spreading yellows diseases. They feed on infected plants, pick up the mycoplasmas and transmit them to other plants. Mycoplasmas sometimes overwinter in wild hosts and are later transferred to cultivated crops by leafhoppers. Mycoplasmas can also be carried in propagative materials, such as buds or grafting stock, onion sets and *Gladiolus corms*.



Figure 2. Aster yellows disease in carrot. Affected carrot (left) has bushy top and numerous rootlets; healthy carrot on right. (Photo: courtesy New York Ag. Exper. Stat.)

MICHIGAN MYCOPLASMA DISEASES

In Michigan, aster yellows disease is important on many crops and has long been believed to be caused by a virus. It now appears that this disease is caused by a mycoplasma. Aster yellows on onion, carrot, lettuce, celery and other vegetables has been studied by examining very thin slices of infected plants in an electron microscope. The mycoplasmas are then visible as small bodies in the food conducting cells (Figures 3, 4).

Similar studies of aster yellows-infected strawberries, stunt virus-diseased blueberries and X-diseased stone fruits show that these maladies are caused by mycoplasmas. Several other diseases of flower and ornamental crops with aster yellows-like symptoms are also being studied.

Aster yellows diseases of vegetables—Carrots, lettuce, onions, celery and other vegetable crops are susceptible to aster yellows. The amount of infection in these crops varies depending upon leafhopper populations and the presence or absence of mycoplasmas in the vectors.

Widespread damage, with losses of 25% or more, often occurs in carrots. Affected carrots have a very unpleasant taste, and as little as 15% infection of the harvested carrots can make processed foods unpalatable.

Healthy onions become infected in the field when infectious leafhoppers feed on them. When infection occurs early in the season, the onion becomes stunted and yellowed, and may die before harvest. Late season infections may escape notice until after harvest.

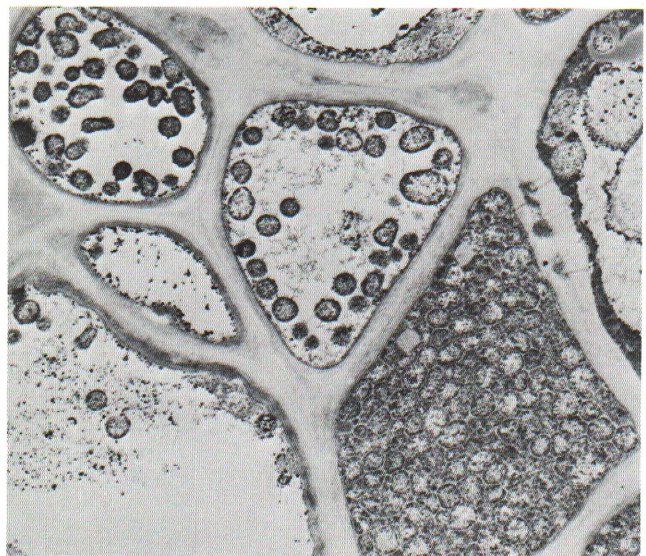


Figure 3. Mycoplasmas in cross-sectioned carrot phloem. Cell at lower right is completely plugged by the organisms (X 7,700).

Bulbs from infected plants do not become dormant, but continue to produce sprouts even when sprout-inhibitory chemicals are used (Figure 5). These sprouts may serve as starting points for other diseases of stored onions. Mycoplasma infection can cause sterility and reduce seed production in onions grown for seed.

Michigan's lettuce crop is occasionally almost completely destroyed by aster yellows. Infected lettuce plants are small and yellowed, and do not form marketable heads (Figure 6).

Celery plants affected by the same disease are stunted and have excessive, malformed stalks (Figure 7).

Fruit Diseases—Aster yellows infection of strawberry is characterized by plant yellowing and dwarfing. The infected plants produce abnormal greenish flowers, and fruit production is reduced or fruit is malformed. Runner plants are sparse on affected mother plants.

Blueberry stunt disease has long been blamed on a virus. Recently, mycoplasmas were found in affected plants in New Jersey and Michigan. The stunted, yellowed plants produced a small crop of bitter fruit and did not recover (Figure 8).

Mycoplasma carried by leafhoppers into stone-fruit orchards has caused X-disease. The characteristic mycoplasma bodies have been found in both cultivated fruit trees and wild chokecherry bushes. The wild plants apparently serve as a continuing source for infection, since no tree-to-tree spread in the orchard is known.

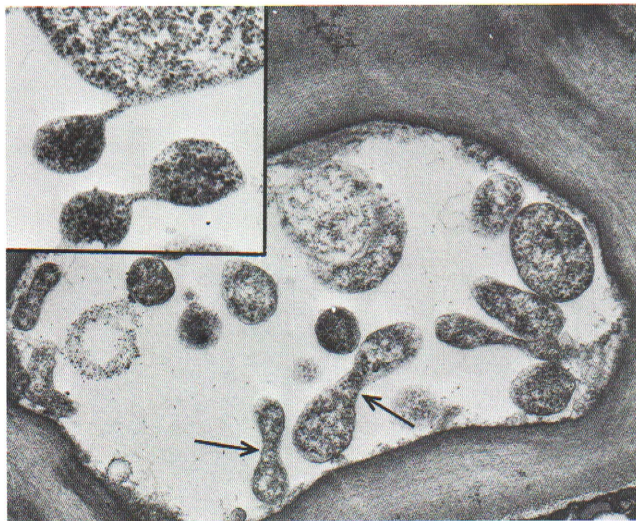


Figure 4. Mycoplasmas in leaf-vein phloem of stunt-diseased blueberry (X 15,400). Reproduction is by simple division (arrows) or by production of new bodies on stalk-like structures (insert, upper left—X 23,000).

Ornamental Diseases—As the name aster yellows indicates, the disease has been associated with certain flower crops for many years. Asters are very susceptible to infection and are not grown in some areas because of this disease. In Michigan, *Gladiolus* is severely affected and mycoplasmas are suspected in diseases of other flowers and certain ornamental shrubs. In some areas of the United States, mycoplasmas have been found in diseased shade trees with yellows symptoms.

CONTROLLING MYCOPLASMA DISEASES

The new understanding of the cause of yellows diseases does not change control recommendations, but hope now exists that chemicals may be found for suppressing or controlling these diseases. It has been found that mycoplasma multiplication can be temporarily stopped by tetracycline antibiotics. This response is now being studied.

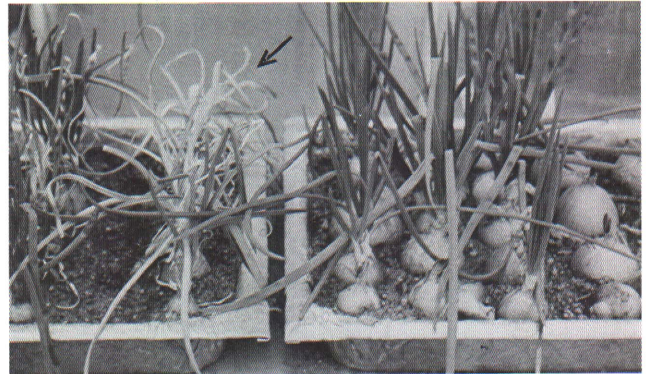


Figure 5. Aster yellows infection in stored onions. Bulbs on left (arrow) had spindly, yellow leaves in storage bins and died soon after being placed in the greenhouse. Healthy, non-sprouted bulbs (right) produced normal foliage and flowers when placed in the greenhouse.



Figure 6. Field infection of lettuce with aster yellows mycoplasma. Such plants remain dwarfed and yellow or die.

Currently, control of mycoplasma diseases is best accomplished by insecticide applications that reduce leafhopper infestations. Control of the insect vectors is especially important for vegetable and flower crops.



Figure 7. Aster yellows mycoplasma caused this disease in celery. Leaf stalks are numerous and malformed; celery is bitter and cannot be marketed.

If plants are propagated by vegetative means, it is essential to start with clean planting stock. Plants certified "virus free" or otherwise inspected for virus or mycoplasma infections should be used to establish new plantings. It is also very important to maintain good control of leafhopper populations on new and established plantings. And, the disease reservoir of chokecherry plants within a 500-foot radius of stonefruit orchards should be eradicated.

In all woody plantings, plants suspected of being infected should be promptly removed and destroyed, to prevent spread of the disease.



Figure 8. Stunt-diseased blueberry plant (foreground) has small, misshapen leaves. Examination of such leaves under the electron microscope shows them to be filled with mycoplasmas. (See Fig. 4.)