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Powdery Mildew

A Serious Apple Disease Problem in the Eastern States

ARS 22-22

March 1956

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

SUMMARY

The apple powdery mildew fungus has escaped control in orchards east of the Mississippi River. It is causing such damage that apple growers now have to fight it directly.

Plant pathologists can offer only partial measures for control of this parasite, and each of the two available controls has a drawback:

1. Lime-sulfur and other forms of sulfur are effective, but burn leaves and damage crops. (It was the shift from sulfur compounds to the more advantageous organic fungicides for control of apple scab that released the mildew fungus from check in the East.)
2. The organic compound known as Karathane or Mildex equals sulfur for mildew control and does little or no damage to tree tissue, but is expensive.

A grower is advised to follow the guidance of his State agricultural experiment station in using mildew control material best suited to his locality.

This report summarizes available information about the fungus, its partial control, and problems that it presents for research and the apple industry.

Information in this report was provided by the Horticultural Crops
Research Branch, Agricultural Research Service

POWDERY MILDEW: A SERIOUS APPLE DISEASE PROBLEM IN THE EASTERN STATES

Apple powdery mildew, spreading rapidly in the past few years, has become a troublesome disease in apple orchards east of the Mississippi River.

The need to fight this fungus disease directly is a new problem for most growers in this region. Ironically, it was their shift to the use of the new improved organic pesticides that unleashed this particular foe.

For many years, apple powdery mildew was held in check in the States east of the Mississippi because growers used lime-sulfur solution and other forms of sulfur as the standard treatment for another fungus disease--apple scab. Sulfur did double duty by keeping down the powdery mildew fungus also.

However, sulfur, while outstandingly effective in this dual role, caused such severe burns to apple leaves and fruit that crops were reduced in quantity and quality. For more than 30 years, growers used sulfur as the best known material for scab control, but hoped for something better.

The something better was provided when research developed organic fungicides able to control scab, and without damage to plant tissues.

These organic compounds, however, did nothing to check the mildew fungus. Wherever they replaced sulfur on mildew susceptible varieties, the fungus spread rapidly. Powdery mildew is now causing concern to apple growers the world over.

Thus far, plant pathologists are unable to offer completely satisfactory measures for control of the apple powdery mildew fungus. This report summarizes such information as Agricultural Research Service pathologists can give regarding the fungus, its partial control, and difficult problems that it presents to research and to the apple industry.

HOW THE FUNGUS ATTACKS

Damage from the fungus advances in three stages, in an endless round year after year.

1. When apple leaf buds open in spring, the mildew fungus, which has overwintered in the buds, sends thread-like suckers over the surface of the unfolding leaves soon covering them with a mat of fungus filaments. These infected leaves remain small, narrow, and stiff and do not function normally. This parasitic growth of the fungus thus robs the

trees of much nutrient material which the leaves would normally provide for development of fruit. Spores--the seeds of the fungus--are released in the air from the fungus filaments to spread infection to additional leaves, and occasionally to the twigs and fruit.

2. Build up with greater damage continues until mid-summer. The fungus infects more and more leaves, spreads down the leaf stems, over the twigs and sometimes over the fruit. Twig growth is stunted and the tip or terminal portion frequently is killed. A network of fine lines of russet may develop on the fruit. This damage to the developing apple, sometimes serious in western orchards, has not been observed in the East. Where it occurs, apples may be so stunted, shriveled, or cracked that they are salable only for processing.

3. Overwintering infection of the apple trees is launched by the fungus just as soon as buds for the following season begin to form. These buds at first consist of very tiny leaves loosely surrounded by two bud scales which are joined at the base but are open at the top. Fungus filaments growing either from the twig or down the leaf stem penetrate this opening and infect the tiny leaves. Once the leaves are infected the fungus remains dormant within the buds until leaf growth starts the following spring.

In this critical stage, when the fungus has entrenched itself in the leaf buds, it defies outside attack. Every known means of killing the fungus in the leaf buds will injure bud tissues also. It is this power to infiltrate the buds that makes the fungus so formidable a foe.

SUSCEPTIBILITY OF APPLE VARIETIES

No variety of apple has been found immune to apple powdery mildew. The fungus infects all cultivated varieties, and also wild crab-apples. A few cultivated varieties have shown relative resistance. In the East, these include McIntosh, Delicious, and Golden Delicious. (Under the strong attack of the fungus, it is possible that such varieties may become less resistant.) Varieties that are classed as very susceptible include Baldwin, Cortland, Gravenstein, Jonathan, Monroe, Rome Beauty, Stayman Winesap, Yellow Transparent.

RESEARCH PROBLEMS AND PROGRESS

Problems

Current efforts to control apple powdery mildew are handicapped by lack of information that would answer basic questions, such as the following:

* Can infection of the newly formed buds be prevented?

The region where these buds form is protected by the base of the leaf stem and is extremely difficult to reach with sprays at the time infection takes place. Perhaps some antibiotic material that can be sprayed on the leaves and then be carried (translocated) into young buds will solve this problem.

* Can some material be found that will destroy the fungus in the tiny leaves in the buds?

Research with organic and antibiotic compounds has yielded no encouragement for achieving this.

* Can some fully satisfactory means be found for controlling the mildew in growing season?

A fully satisfactory treatment will meet 3 requirements: It will be (1) effective, (2) not injurious to tree tissues, (3) inexpensive. Antibiotics and sulfur have thus far failed on count 2. The one organic that scores on counts 1 and 2 is expensive.

Progress

Many organic and antibiotic materials are being tested for power to destroy apple powdery mildew, and some encouragement comes from the fact that one organic compound has proved equal to sulfur in effectiveness.

Typical of such experiments are those by plant pathologists at the ARS Plant Industry Station, Beltsville, Md., for the past few years. In a recent experiment, 7 organic compounds were sprayed on selected trees in a block of 11-year-old Rome Beauty apples which showed overwintering infections. For comparison, some trees were sprayed with wettable sulfur, and some with water, as a check. In early June, leaf samples of similar age--similar position on the shoots--were examined to measure the extent of mildew infection on the underside of the leaf.

The one organic material that has equaled sulfur in keeping leaves almost free from apple powdery mildew in such tests is a compound developed about 7 years ago. Commercially it is known as Karathane or Mildex, and at times has gone by such other names as Arathane and CR 1639. Chemically, it is 2-capryl-4,6 dinitrophenylcrotonate. It is applied at the rate of 1 pound in 100 gallons of water. The addition of a wetting agent greatly increases its efficiency.

The compound has some advantages besides its effectiveness in mildew control. It destroys mites to some extent. It does little or no damage on most apple varieties even when leaf growth is young and tender. It can be applied in combination with the commonly used insecticides and fungicides, except the organic phosphates and oil-based spray materials. Thus, its use does not materially increase labor costs.

However, Karathane or Mildex has limitations. It has no effect on the fungus entrenched inside apple leaf buds. It does not control apple scab. Since the current cost is relatively high, extensive use would add considerably to a spraying budget.

PARTIAL CONTROL WORTHWHILE

Although apple growers seek simpler, rather than more complex, spray programs, many growers in the East are becoming aware of the urgent need to get apple powdery mildew back under control. Even where a systematic mildew spraying program is resumed, it may take 3 to 4 years to halt the spread of the fungus and reduce it to its former state as a minor pest.

In choosing weapons to combat mildew, eastern growers face this dilemma:

- (1) Should they return to sulfur sprays, despite their injury to leaves and fruit?
- (2) Should they continue to use organic fungicides for apple scab, and apply Karathane or Mildex to control the mildew fungus despite its high cost?

In view of local differences in climate, in the amount of mildew damage, and other factors affecting a spray program, ARS scientists advise growers to follow recommendations of their State agricultural experiment station regarding spray materials best suited to control the disease in their areas.

RESEARCH CONTINUES

Apple powdery mildew has become such a critical problem that the Agricultural Research Service and the State agricultural experiment stations are intensifying their efforts to find an economical and effective means of bringing this spreading disease under control.

