

The Influence of the Retention of Immature Apple Mummies by Certain Cultivars on the Overwintering of *Physalospora obtusa*

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ABSTRACT

Frogeye leaf spot development was associated with immature apple mummies on the Cortland variety in New Hampshire. About 83% of immature apple mummies were infected with the causal fungus *Physalospora obtusa*. Large numbers of immature apple mummies (retained June drops), but relatively few mature apple mummies, remained over winter on Cortland trees. Mummies were not retained on McIntosh or Red Delicious varieties.

Increased inoculum in the form of immature mummies from Cortlands was shown to increase the incidence of frogeye leaf spot in McIntosh and Red Delicious. Retention of June drops by some apple varieties appears to be of primary importance in the overwintering of the organism, and is largely responsible for the varietal differences in the amount of frogeye leaf spot and apple rot observed. Phytopathology 60:452-453.

Black rot and frogeye leaf spot of apple (caused by *Physalospora obtusa* [Schw.] Cooke), once considered under control, has been observed in several commercial orchards in New Hampshire in recent years. Earlier writers who noted the association of apple mummies with the black rot disease did not specify whether the mummies were retained immature apples or mummified mature fruit (3, 6). The impression generally conveyed, however, is that they were mature, mummified apples. Groves (2), in 1951, observed that partially developed fruits that normally would have fallen in the June drop or earlier remained attached to Rome trees sprayed with naphthalene acetic acid. Subsequently, many of these apples became infected with *P. obtusa*, while unsprayed trees that did not retain these immature apples were not infected.

Frogeye leaf spot in the summer and fruit rot in the fall were observed more frequently on Cortland than on McIntosh or Red Delicious varieties. It was also observed that a scattered pattern of frogeye leaf spot occurred on leaves located below immature apple mummies. Furthermore, there appeared to be more immature apple mummies on Cortland than on the other two varieties. A preliminary report of these observations was presented by Holmes (4).

MATERIALS AND METHODS.—In a neglected apple orchard, differences were observed in the amount of frogeye leaf spot and apple rot on Cortland, McIntosh, and Red Delicious varieties. To evaluate the observed varietal differences, the amount of leaf spot/100 leaves (tabulated six times, summer 1967), the per cent of fruit rot, and the overwintering of mature apple mummies and immature apple mummies (retained June drops) were determined on six trees/variety. Dodine fungicide was used to control apple scab.

The incidence of infection of immature apples by *P. obtusa* prior to dropping from the tree was determined in the following manner. Six trees each of Cortland, McIntosh, and Red Delicious varieties were used in this experiment. Ten immature apples/tree, known as June drops, and identified by a slight yellowing of

their stems, were selected. Prior to dropping from the tree, these 60 samples/variety were collected and surface-sterilized, and *P. obtusa* cultured and identified.

Twenty-five immature apple mummies (obtained from Cortland trees) were attached with paper-coated wire (Twistems) to the branches of six McIntosh and six Red Delicious trees. This was done to determine if varietal differences in the amount of frogeye leaf spot were caused by the amount of inoculum in the tree or by resistance of the variety to the pathogen. Six branches/variety served as a control. The number of leaf spots/100 leaves was determined six times during the summer of 1968. Dodine fungicide was used to control apple scab.

RESULTS.—The Cortland variety had approximately ten times as many leaf spots as the other two varieties in comparable samples of 100 leaves each. This is also substantiated by the per cent leaves infected, which showed Cortland as having about five times more leaves infected than the other two varieties (Table 1). Cortland also had the most mummified mature apples in the fall, but few were retained on the tree over winter. Cortland retained an average of 282 immature apple mummies/tree over winter. The McIntosh and Red Delicious varieties had few mummified mature apples in the fall, and none remained over winter. These two varieties also had no immature apple mummies in the fall, and so none were retained on the tree over winter (Table 2).

TABLE 1. Incidence of fruit rot and frogeye leaf spot (*Physalospora obtusa*), and per cent of apple leaves infected with *Physalospora obtusa* as influenced by variety in New Hampshire

Variety ^a	No. rotted fruits/total apples examined	Mean no. leaf spots/100 leaves	% Leaves infected
Cortland	4/97	185	86
McIntosh	0/80	18	18
Red Delicious	0/174	16	13

^a Six trees/variety. Data of September 1967.

TABLE 2. Overwinter retention of mature and immature apple mummies on three varieties of apple in New Hampshire

Variety	No. trees	Mature apple mummies/tree		Immature apple mummies/tree	
		Fall 1967	Spring 1968	Fall 1967	Spring 1968
Cortland	19	11.1	0.4	319	282
McIntosh	40	0.5	0	0	0
Red Delicious	7	3.4	0	0	0

The per cent infection of immature apples by *P. obtusa* prior to dropping from the tree is shown in Table 3. In the Cortland variety, 83% of the immature apples that would normally be June drops (except for their retention on the tree) were infected with *P. obtusa* in early June. The McIntosh variety showed 27% infection of fruit; Red Delicious showed 15% infection. Thus, even before the normal June drop took place, the immature apples in the Cortland variety were already heavily infected with *P. obtusa*, again indicating the probability of a greater source of primary inoculum in the Cortland variety than in McIntosh and Red Delicious.

The effect of attached immature Cortland mummies on incidence of frog-eye leaf spot in McIntosh and Red Delicious trees is shown in Table 4. The inoculum increased the number of leaf spots/100 leaves from 25 to 108 (four times) in McIntosh, and from 10 to 93 (nine times) in Red Delicious.

DISCUSSION.—The retention of immature apples (retained June drops) by Cortland trees appears to be of primary importance in the overwintering of the organism and the subsequent varietal differences in the amount of frog-eye leaf spot and apple rot observed. Murneek (5), in 1933, described four waves of apple

drops in Missouri. He gives the following factors as possibly responsible for the shedding of immature fruit: (i) genetic constitution of the plant; (ii) the physiological condition of the tree; (iii) type of pollination; (iv) external environmental factors; and (v) diseases and insect pests. Murneek (5) also stated that distinct varietal traits are exhibited by apples in the abscission of their immature fruit. He suggested that the behavior is determined by the genetic constitution of the clone, and hence is deep-seated and hereditary.

Childers (1) says that horticulturists usually lump the first and second drops into the "first drop", and the third and fourth drops into the "June drop". No mention has been found in the literature of the fact that in some apple varieties the "June drops" are retained in nature on the trees as observed on the Cortland variety here. The results shown in Tables 2 and 4 leave little doubt as to the importance of naturally retained immature apple mummies (June drops) on the tree, and the resultant potential for providing inoculum for primary infection in the spring. It was found that although the average number of immature apple mummies overwintering/tree was 282, the count ranged from 55 to 477 for individual trees. This variation was probably due to physiologic or genetic variation within the Cortland variety. Thus, it is suggested that the selection or breeding of apple varieties that do not retain immature apples (June drops) might reduce the incidence of frog-eye leaf spot and apple rot in apple orchards. Furthermore, cultural practices which do not favor retention of June drops should be followed.

TABLE 3. The infection of immature apples (June drops) by *Physalospora obtusa* prior to dropping from the apple tree as influenced by variety

Variety ^a	No. isolates/60 samples	Frequency of <i>P. obtusa</i> in per cent
Cortland	50	83
McIntosh	16	27
Red Delicious	9	15

^a Six trees/variety.

TABLE 4. The effect on frog-eye leaf spot (*Physalospora obtusa*) development of attaching immature apple mummies from Cortland trees to the branches of McIntosh and Red Delicious trees

Variety ^a	Mean no. leaf spots/100 leaves	
	Control	Immature apple mummies attached to the tree (25/limb)
Cortland	185	
McIntosh	25	108
Red Delicious	10	93

^a Six trees/variety.

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