Apple Fruit Disease Assessment and Identification

THOMAS E. STARKEY and FLOYD F. HENDRIX, JR., Assistant Professor and Professor, Department of Plant Pathology and Plant Genetics, University of Georgia, Athens 30602

ABSTRACT

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When assessing apple fruit rot, care must be taken to insure that improper sampling techniques do not misestimate the effectiveness of a particular treatment. A harvest sampling alone is not sufficient to evaluate control of fruit rots. At least two other samplings should be collected during the growing season to detect infected fruit that may drop before harvest. Apple fruit rots should not be diagnosed solely on the basis of symptoms. Isolations should be made and the pathogen identified.

The identification and assessment of disease are crucial in epidemiologic and control studies. Diseases frequently can be diagnosed by symptoms alone. For a correct diagnosis, there must be no other diseases present that can be confused with the one being considered. When a disease cannot be diagnosed with certainty on the basis of symptoms alone, the pathogen must be isolated and identified. In the case of apple fruit diseases, there are three rots that cannot be diagnosed without isolation. These are black rot, caused by *Botryosphaeria obtusa* (Schw.) Shoemaker; bot or white rot, caused by *B. dothidea* (Moug. ex Fr.) Ces et de Not.; and the necrotic leaf blotch strain of bitter rot, caused by *Glomerella cingulata* (Stonem.) Spauld. & Schrenk (2,5). Other apple fruit and foliage diseases usually can be diagnosed on the basis of symptoms.

The incidence of apple fruit diseases can be determined by the number of lesions, size of lesions, rate of lesion size change, or number of infected fruit, depending on the nature of the study. When assessing the amount of disease caused by the apple fruit rot pathogens, a reasonable degree of accuracy is required to evaluate fungicide efficacy. Improper sampling techniques must not misestimate the effectiveness of a particular fungicide.

Evaluations of apple fruit rots generally have been limited to one or two samplings at or near harvest (3,4,6). The objective of our study was to examine sampling techniques commonly used for disease assessment and identification of apple fruit rots.

MATERIALS AND METHODS

During the past 3 yr, numerous fungicides have been tested on Red Delicious apples at the Bateman and Company farm near Gray, GA, and on Red Delicious, Golden Delicious, Detroit Red, and Rome Beauty apples at the Georgia Mountain Experiment Station, Blairsville. Materials were applied with an air blast sprayer. A randomized complete block design was used. The plots of the Red Delicious apples at Gray consisted of 10 trees per treatment replicated four times. The plots at

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Table 1. Percentage apple fruit rot at three sampling times related to various fungicide spray treatments[a]

Treatment[b]	Disease	Percentage fruit rot		
		Early season	Mid-season	Harvest
Dikar	Black rot	60	52	7
Spray guide[c] less early prepink	Black rot	42	0	5
Spray guide[c] less early prepink and prepink	Black rot	26	52	2
Dikar	Bot rot	34	0	2
Spray guide[c] less early prepink	Bot rot	8	40	1
Folpet	Bot rot	0	24	1
Captan plus lead arsenate	Bot rot	0	71	14
Benomyl and captan through first cover, then benomyl and maneb	Bot rot	0	31	3
Benomyl, with Dikar added at second cover	Bot rot	0	31	2
DPX112	Bitter rot	4	34	1
Benomyl until mid-season, then maneb	Bitter rot	18	8	1
Spray guide[c] (control)	All rots[d]	1	4	3

[a] A sample of all treatments over a 3-yr period, except for last listed.

[b] Benomyl = methyl 1-(butylcarbamoyl)-2-benzimidazole carbamate, 1.11 kg/ha; captan = *N*-[(trichloromethyl)thio]-4-cyclohexene-1,2-dicarboximide, 2.47 kg/ha; folpet = *N*-[(trichloromethyl)thio]phthalimide, 2.47 kg/ha; Kelthane = 1,1-bis(p-chlorophenyl)-2,2,2-trichloroethanol, 2.47 kg/ha; maneb = manganous ethylene bis[dithiocarbamate], 2.47 kg/ha; DPX112 = benomyl plus captan, 2.47 kg/ha; Dikar = maneb plus Kelthane, 2.47 kg/ha.

[c] Spray schedule recommended by Georgia Cooperative Extension Service; basically, captan (2.47 kg/ha) through first cover, maneb (2.47 kg/ha) until 6 wk before harvest, then benomyl (1.11 kg/ha) plus maneb or captan until harvest.

[d] Includes an average of black, bot, and bitter rot infections over the 3-yr period for the spray guide.

Blairsville consisted of two trees of each variety replicated four times.

Plots were sampled twice during the growing season (early season and mid-season) and at harvest for the past 3 yr. During the first two samplings, at least 25 apples per treatment per replicate were collected at random. The fruit were surface-sterilized in 10% Clorox and plated on natural acidified potato-dextrose agar. The plates were placed under artificial lamps for 2 wk. All fungi reported to rot fruit were identified. At harvest, 200 apples were collected in addition to any rotted apples remaining on the tree or ground. The 200 apples were stored at room temperature for 2 wk. Rots developing during that period were identified by isolation. In addition, selected treatments were sampled every 2 wk and plated out. During the past 3 yr, an average of 13,000 apples per year have been sampled.

RESULTS AND DISCUSSION

Table 1 shows the percentage of fruit rot at the three sampling times—early season, mid-season, and harvest. The treatments show that evaluation of fungicides to control fruit rots should not be based solely on a harvest sample. For example, the incidence of black rot in apples treated with Dikar was 60 and 52% in the early season and mid-season samplings, respectively. Most of the infected fruit dropped before harvest, reflected in the 7% infection in that sampling. Dikar also failed to control bot rot; during the early season and mid-season samplings, 34 and 0% of the fruit were infected, respectively, whereas 2% infection was noted at harvest time. The incidence of bitter rot in apples treated with the experimental compound DPX112 was 4 and 34% in early season and mid-season samplings, respectively, but only 1% at harvest time.

When only the evaluation made at harvest time is considered, most of the treatments in Table 1 appear to be suitable for the control of fruit rots compared to the spray guide control recommended by the Georgia Cooperative Extension Service. When the preharvest samples are considered, however, none of the treatments is satisfactory.

Although apples in the early season and mid-season samplings had no external symptoms, the infected fruit eventually would have developed rot. All fruit sampled should be plated out, and the fungi should be induced to sporulate and identified.

The identification of the causal agents of fruit rots should not be based exclusively upon symptoms. Rot symptoms produced by *B. obtusa* and *B. dothidea* may be easily confused (5). In Georgia, assessment of frog-eye leaf spot (caused by *B. obtusa*) on the foliage is not a reliable indication of the amount of fruit rot. Fruit infection occurs earlier than foliar infection (F. F. Hendrix, *unpublished*). When the first foliar symptoms are visible, 20–30% of the fruit may be already infected.

Multiple fruit samplings should also be taken for other apple diseases, such as scab. Anderson (1) indicated that early fruit drop, which has been ascribed to pollination failure, also may be due to scab infection of the pedicel.

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