A BRIEF HANDBOUT TO AID IN THE IDENTIFICATION AND CONTROL OF COMMON POSTHARVEST DISEASES OF APPLES AND PEARS

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USE OF THIS DECAY CONTROL HANDOUT
This guide is intended for use by the operators of packing and storage plants to assist them in minimizing decay problems which may cause fruit loss during the long storage periods required by today's marketing programs.

The information contained should allow you to determine the decay confronting you, the areas to attack to give you an advantage in its control, and a range of materials, which can be used in that control.

Start with the Decay Description (Table 1) to begin the identification process, and then use the Decay Classification Key (Table 2) to pinpoint the decay. It is quite possible that you will find more than one cause with any given situation. A picture identification sheet has been included to help in the identification process. Once the decay has been identified, go to the individual decay information sheet. This sheet will indicate the source of the problem, the primary point of infection and methods and materials generally used to control the decay at the primary point of infection.

You will note that the primary source of infection of some of the decay problems is in the orchard and will require involvement of your field staff and growers in order to do an adequate job of control.

Also included is a short discussion of warehouse sanitation in order to assist your understanding of the importance of that area of decay control.

This guide is intended to be as useful a tool as possible. If you have a suggestion for its improvement or additions you would like to see included, that can be easily done. Contact Dr. Gene Kupferman at the WSU Tree Fruit Research and Extension Center in Wenatchee (509 663-8181 ext. 239) if you would like to see changes made.

WAREHOUSE CLEANING AND SANITATION
The term sanitation generally refers to procedures in the warehouse that reduce or eliminate spore loads and includes those procedures, which we commonly call disinfecting treatments. Sanitation can only be effective if it follows a cleaning procedure. Clean first, then sanitize.

There are three areas of concern in the warehouse, each of which requires a different approach, using generally the same materials. These areas of concern are:

• Surfaces of plant and equipment
• Water used to drench, float or transport fruit
• Fruit surfaces

Materials commonly used for treatment of these problem areas are:

• Chloride dioxide, either foam or gas
• Quaternary ammonia compounds
• Ozone
• Hypochlorite-Chlorine
These materials are generally very quick acting with little or no residual action and require close attention in order to keep the treatment chemicals at the proper level of concentration for effective control.

Use these materials as recommended by the manufacturers, depending on the area in which the material is being applied.

<table>
<thead>
<tr>
<th>TABLE 1. DECAY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria</td>
</tr>
<tr>
<td>Texture of decay</td>
</tr>
<tr>
<td>Color of decay</td>
</tr>
<tr>
<td>Shape</td>
</tr>
<tr>
<td>Odor</td>
</tr>
<tr>
<td>Growth/ enlargement pattern</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Criteria</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Color of spore-bearing fungus</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Margin between decay and healthy tissue</td>
</tr>
</tbody>
</table>
### TABLE 2. DECAY CLASSIFICATION KEY

<table>
<thead>
<tr>
<th>Texture</th>
<th>Color of decay</th>
<th>Shape</th>
<th>Odor</th>
<th>Growth pattern</th>
<th>Location</th>
<th>Color of spore-bearing fungus</th>
<th>Other</th>
<th>Decay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm</td>
<td>Pale tan to brown</td>
<td>Irregular pattern, usually starting from stem or calyx end</td>
<td>Sweetish, fermented</td>
<td>Slow, irregular pattern</td>
<td>Initial entry through stem or open calyx, during nesting may enter through unbroken skin</td>
<td>Short, white, cottony appearing, turning gray in late stages</td>
<td>Totally involved fruit still retains much of its original shape</td>
<td>Gray Mold</td>
</tr>
<tr>
<td></td>
<td>Pale yellow to cream alternating with brown; appearance of bull’s-eye</td>
<td>Round, flat to sunken</td>
<td>Indistinctive</td>
<td>Slow, V-shaped areas of decay</td>
<td>Most often stem bowl or calyx; may also enter open lenticels</td>
<td>Wet appearing short, cream-colored; young lesions show no spare growth</td>
<td>Seldom involves the total fruit</td>
<td>Bull's-eye</td>
</tr>
<tr>
<td>Soft, watery</td>
<td>Tan 10 dark brown</td>
<td>Round, sharp margins</td>
<td>Musty</td>
<td>Rapid, well-formed, cone-shaped area of decay</td>
<td>Primary entry through wounds; may also enter through stems, calyx or open lenticels</td>
<td>Short, white tufts, turning blue-green 10 blue</td>
<td>In final stages causes complete collapse of the fruit; very wet and sloppy</td>
<td>Blue Mold</td>
</tr>
<tr>
<td></td>
<td>Start as round lesions, often become irregular in shape, with irregular margins</td>
<td>Alcoholic</td>
<td>Rapid, irregular growth pattern</td>
<td>Generally enters through stem, secondarily through calyx and wounds</td>
<td>Long, dirty, cottony appearing; black nodes on lips</td>
<td>In final stages takes on appearance of elephant skin; will exude large amounts of juice while still retaining some original shape</td>
<td>Mucor</td>
<td></td>
</tr>
</tbody>
</table>
BLUE MOLD DECAY

Scientific name: *Penicillium expansum*

Problem location: Warehouse

Primary source of infection: Equipment and area contamination

Primary control: Cleaning, then sanitation

**Areas of sanitation**
- Drench tank
- Dump tank
- Elevator rolls
- Brush bed, cleaning
- Sponge bed
- Brush bed, waxing
- Drying tunnel, including rolls
- Sorting tables
- Singulator
- Sizing cups
- Transfer belts
- Run-off aprons
- Tub liners/tubs
- Floors/walls
- Air filtration

Secondary control: Fungicide application

Discussion: Blue Mold organisms are present everywhere in the environment. However, because of their very nature, they are numerous in the storage and packing areas of the typical warehouse. They can enter the fruit through any break in the skin, even minute openings. The fruit is susceptible to infection at any time during its life cycle, particularly as it ages during storage.

Primary control: Cleaning and sanitation are the first line of defense against Blue Mold and can be quite successful if properly done. The following areas in the packing cycle are listed with a suggested frequency of cleaning and sanitation. In the final analysis, the severity of the infection problem will determine the areas treated and any changes in frequency.

- Drench tank: Weekly Somewhat dependent on the materials being used in the drench.
- Dump tank: Each time the dump tank contents are changed or several times a week.
<table>
<thead>
<tr>
<th>Task</th>
<th>Frequency</th>
<th>Activity Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevator rolls</td>
<td>Daily</td>
<td>Twice a day if excessive decay is coming out of the dump tank.</td>
</tr>
<tr>
<td>Brush beds cleaning</td>
<td>Daily</td>
<td>Twice a day if decayed fruit is crossing the brush bed.</td>
</tr>
<tr>
<td>Sponge bed</td>
<td>As often as practical</td>
<td>A huge potential reservoir for decay spores.</td>
</tr>
<tr>
<td>Brush beds waxing</td>
<td>Daily</td>
<td>To maximize the wax job, brushes should be kept clean.</td>
</tr>
<tr>
<td>Drying tunnel (incl. rolls)</td>
<td>Weekly</td>
<td>Remove fruit and fruit pieces from the floor of the dryer.</td>
</tr>
<tr>
<td>Sorting tables</td>
<td>Daily</td>
<td></td>
</tr>
<tr>
<td>Singulator</td>
<td>Weekly</td>
<td></td>
</tr>
<tr>
<td>Sizing cups</td>
<td>Weekly</td>
<td></td>
</tr>
<tr>
<td>Transfer belts</td>
<td>Weekly</td>
<td></td>
</tr>
<tr>
<td>Run-off aprons</td>
<td>Weekly</td>
<td></td>
</tr>
<tr>
<td>Tubs/tub liners</td>
<td>Weekly</td>
<td></td>
</tr>
<tr>
<td>Floors/walls</td>
<td>Every 6 months</td>
<td></td>
</tr>
<tr>
<td>Air filtration</td>
<td>Daily</td>
<td></td>
</tr>
</tbody>
</table>

The following materials are available for sanitation:
- Chlorine Dioxide Foam
- Quaternary Ammonia Compounds
- Chlorine

Use in accordance with manufacturer's label.

**Secondary control:**
The following fungicides will give protection when used in accordance with the manufacturer's label recommendations.

**TBZ (Mertect)**—Some resistance to TBZ (Mertect) has been found so it is recommended that multiple applications be avoided and that they be used in conjunction with the other fungicides in order to obtain the best possible results.

**SOPP**—on pears only

**Captan**

Biocontrol agents are currently under evaluation
GRAY MOLD DECAY

Scientific name: Botrytis cineria

Problem location: Warehouse/orchard
Primary source of infection: Decaying organic matter
Primary control: Harvest practices
Secondary source of infection: Warehouse contamination
Secondary control: Fungicide intervention

Discussion: The most severe infestations of Gray Mold occur during or shortly after harvest. The most common entrance point on pears is down through the stem, entering when the fruit is separated from the tree or when in the bin. It can also enter through wounds, openings or by contact with other infected fruits. On apples, the entrance is most commonly in the stem bowl or calyx. The infecting spores are to be found in decaying organic matter, weeds and dropped fruit and, to some degree, on the surface of the soil.

Control in orchard: The best defense against Gray Mold is to reduce the presence of infecting spores in the orchard. The following is suggested to accomplish this:

Do not mow your orchard within 30 days of harvest. This will reduce the amount of freshly decaying organic matter.

Remove any decayed or decaying fruit from the orchard floor.

Clean and disinfect your picking bags prior to harvest. Do not throw picking bags on the ground. Store them temporarily by hanging them in the tree.

Control in warehouse: Make sure your bins do not contain any residual decayed fruit. Any warehouse treatment must occur shortly after harvest to be effective. The more deeply the infection has penetrated into the fruit the more difficult it becomes to control. The use of the following fungicidal materials during the packing cycle may give protection against secondary infections occurring during packing and storage.

- TBZ (Mertect)
- SOPP-on pears only
- Biocontrol agents are currently under evaluation
- Captan

Use in accordance with label recommendations.

It is recommended to use more than one of these materials in sequence in order to reduce the potential of developing resistant strains.
GREY MOLD

[Image of an apple and two pears, one with grey mold on it]
MUCOR DECAY
Scientific name: Mucor spp.

Problem location: Warehouse/orchard

Primary source of infection: Soil

Primary control: Harvest practices

Secondary source of infection: Warehouse contamination

Secondary control: Fungicide intervention

Discussion: Mucor is a soil-borne organism. Its primary point of infection is in the orchard during the movement of bins into the orchard and after they are filled and being transported from the picking area to the collection point and on to the warehouse. Care must be exercised to keep the forks of the forklift clear of dirt and grass clumps. The bin side runners must be kept clean.

Control in orchard: Keep the bins and fruit clean of dirt and grass clumps. Remove decayed and decaying fruit from the orchard prior to harvest.

Control in warehouse: While the primary protection from Mucor needs to occur during harvest in the orchard, some secondary infections can be prevented in the warehouse by the application of the following materials:

- TBZ (Mertect)
- SOPP-on pears only
- Biocontrol agents are currently under evaluation
- Captan

Use in accordance with label recommendations.

It is recommended to use more than one of these materials in sequence in order to reduce the potential of developing resistant strains.
BULL'S-EYE DECAY

Scientific name: *Pezicula malicorticis*

Problem location: Orchard

Primary source of infection: Perennial canker lesions

Primary control: Orchard sprays

Discussion: Bull's-eye results from spores of perennial canker infecting fruit during the growing season. It can happen at any time while the fruit is on the tree, from shortly after bloom until harvest. Once the fruit has been infected, there is very little that can be done during the packing cycle to control this disease.

Control: Spray as many times as is required, using the manufacturer's label recommendations for perennial canker control.

Clean, treat and paint perennial canker lesions on the trees.

Spray for woolly apple aphid control. This particular insect keeps tree wounds open and susceptible to perennial canker infestations.

Control the use of overhead sprinklers in blocks with perennial canker infestations. Water falling through the tree can wash spores from the lesions onto the fruit.