Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001

Title:
Feasibility of Sanitizing Apple Field Bins to Eliminate Postharvest Pathogens

Project Leader(s):
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Cooperator(s):
(none)

Type of grant:
Cultural methods; sanitation; physical controls

Project location(s):
Work was performed at the Hudson Valley Laboratory in Highland, NY, but results have applications nationally for apple producers and storage operators.

Abstract:
New York State produces approximately 26 million bushels of apples each year. Apples harvested in autumn are held in low-oxygen storage for up to 10 months to allow orderly marketing of the crop and to provide consumers with a year-round supply of high-quality fruit. However, several fungal pathogens can cause apples to decay during storage and shipping. In a survey during winter/spring of 2000 and 2001, decayed Empire apples were evident in bagged apple displays in nearly 40% of retail stores surveyed. Fungal spores can be carried from season to season on the large bins that are used to hold fruit during storage. Sanitizing bins after they are emptied might break the disease cycle, thereby reducing both losses in apple storages and the incidence of decays in bagged apples at the retail level. Commercial sanitizers (sodium hypochlorite and quaternary ammonia compounds) were compared for effectiveness using small, uniformly-contaminated pieces of wood and plastic bin materials. None of the sanitizers were effective for killing spores of *Penicillium expansum* that were grown on wooden blocks soaked in apple juice. Results of this work suggest that steam cleaning may be necessary to remove inoculum from apple bins.

Background and justification:
New York State produces approximately 26 million bushels of apples each year. Apples harvested in autumn are held in low-oxygen storage for up to 10 months to allow orderly marketing of the crop and to provide consumers with a year-round supply of high-quality fruit. Research on non-chemical means for controlling postharvest decays of apples is justified by the importance of the crop in New York State, the increasing losses caused by the diseases, and the fact that eliminating postharvest treatments account for much of the detectable pesticide residues on fresh-market apples. Postharvest decays caused by *Penicillium expansum* cause significant losses of Empire fruit held in long-term storage and sporadic losses of other apple

varieties (Rosenberger, 2000). When packinghouses become contaminated with high levels of inoculum from decay-causing fungi, some of that inoculum settles on fruit being packed and contributes to decays that appear at the retail level.

The problem posed by decayed apples in consumer packages was documented during winter and spring of 2000 and 2001. A survey was conducted to determine if and how often rotten apples occurred in consumer packages presented for sale in chain stores. Data collectors for this survey visited 17 to 20 chain stores in the mid-Hudson Valley (Newburgh, New Paltz, Kingston, Poughkeepsie) on each of four dates. The data collectors perused the displays of bagged apples as if they intended to make a purchase. They recorded the varieties of bagged apples on display and noted whether or not the bags contained any visibly decayed fruit. If decayed fruit were evident in one or more bags, the data collectors counted the number of bags on display and recorded how many of those bags contained decayed fruit.

For the stores surveyed in 2000, the proportion of Empire displays that contained decayed fruit varied from a low of 20% on February 3 to a high of 47% on April 11 (Rosenberger, 2001a). Among those displays that contained decayed Empire fruit, the proportion of individual bags that contained decays ranged from 18% to 27%. For McIntosh, the proportion of stores with decayed fruit on display ranged from 10-28%, and 12-27% of the individual bags in those displays contained decays. Similar results were obtained during surveys in 2001 (Rosenberger, 2001a).

Fruit held in controlled atmosphere (CA) storages have routinely been treated with a postharvest fungicide. However, fungicide treatments are no longer effective or feasible because *P. expansum* has developed resistance to thiabendazole and the only alternative, captan, is not acceptable in some export markets and is under review by EPA. Packinghouses are heavily contaminated with air-borne spores of *P. expansum*, and this inoculum recycles from one season to the next on contaminated field bins (Rosenberger, 2001b). Effective sanitizing of field bins should make it feasible to store Empire fruit without any postharvest treatment and will reduce inoculum levels that contribute to decays of other apple cultivars during storage and shipping.

Objectives:

1. Evaluate effectiveness of sodium hypochlorite and quaternary ammonia compounds for eliminating P. expansum from both wood and plastic field bins.
2. Determine if temperature of the treatment solution affects efficacy of sanitizing solutions.

Procedures:

Commercially available and registered sanitizers (sodium hypochlorite and quaternary ammonia compounds) were evaluated for effectiveness against dormant spores of *P. expansum*. Small squares cut from oak and plastic bins were dusted with dry spores of *P. expansum*. The squares were then treated by dipping into sanitizer solutions with appropriate controls being left untreated. After the treated squares of bin material were dried, they were tested for presence of viable spores of *P. expansum*. Levels of inoculum surviving treatment were quantified by washing the squares of bin material in sterile water then making dilution plates and counting the number of colonies of P. expansum that developed.

The work described above was repeated with bin squares that had been "stained" with P. expansum by allowing the fungus to grow over the surface of the bin squares that had been

soaked in apple juice. The effectiveness of sanitizers was compared at several different temperatures.

Results and discussion:

Work on this project is still underway. Because this is a postharvest project funded on a grant cycle that runs from July 1 to June 30, much of the work is scheduled for winter after field work for other projects has been completed. Furthermore, data from experiments already completed could not be summarized in time for this report because of the university-wide hiring freeze that was imposed in late fall of 2001. The technician working on this project was transitioning from a temporary service position to a permanent position when the freeze was imposed. Time that should have been spent compiling data for this project was instead consumed by the disruptions, paper work, and delays involved in getting an exemption from the hiring freeze.

Although the data has not yet been fully summarized, the experiments completed to date allow the following conclusion: The sanitizers tested were reasonably effective for killing dry spores that had been dusted onto squares of bin material, but they were not effective for controlling spores that had grown directly in place on the juice-soaked bin squares. Results of this work suggest that steam cleaning may be necessary to remove inoculum from apple bins where the inoculum attachment to bins will be similar to that of inoculum that was grown in place on the bin squares.

More definitely conclusions and recommendations should be available after data is fully anlyzed and additional planned experiments are completed.

References: (if applicable)

Rosenberger, D. A. 2000. Postharvest pathogens create new problems for apple storages. Pages 3-10 in: 2000 Cornell Fruit Handling and Storage Newsletter (C.B. Watkins and D.A. Rosenberger, eds). 13 p.

Rosenberger, D. A. 2001a. Decay and quality problems at the retail level. Pages 21-23 in: Apple Handling and Storage: Proc. Storage Workshop 2001, Cornell University, Ithaca. Natural Resource, Agriculture, and Engineering Service (NRAES) Publication 153, Cornell University, Ithaca, NY. 130 p.

Rosenberger, D. A. 2001b. Postharvest decay control without fungicides. Pages 21-23 in: Apple Handling and Storage: Proc. Storage Workshop 2001, Cornell University, Ithaca. Natural Resource, Agriculture, and Engineering Service (NRAES) Publication 153, Cornell University, Ithaca, NY. 130 p.