2003 CORNELL FRUIT HANDLING AND STORAGE NEWSLETTER

Items of Interest for Storage Operators
in
New York and Beyond

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Mention of specific trade names or omission of other trade names does not imply endorsement of products mentioned or discrimination against products not mentioned.

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SmartFresh^{TM} (1-Methylcyclopropene; 1-MCP) – Summary and recommendations

1-MCP presents storage operators with revolutionary capabilities for improving apple quality at the consumer level. Not only does 1-MCP slow softening during storage, it also extends shelf-life after fruit have been removed from storage. Rapid loss of quality after apples leave the packing shed has been a major problem for the apple industry, especially for varieties such as McIntosh, Cortland and Empire. Thus the New York industry has expressed tremendous interest in the potential for 1-MCP to improve the marketability of our apples. However, 1-MCP represents a powerful technology that has both positive and negative effects. We are attempting to define these as quickly as possible in order to minimize risk to the industry, especially because of rapid adoption of 1-MCP technology over the past two years.

Detailed information about our research is available from the recent Cornell Storage Workshop (see details in the 'Publications' section of this newsletter). The following is a brief summary of conclusions and recommendations to date.

<u>Summary</u>

1. The vast majority of apple varieties that we have tested respond well to 1-MCP, but some e.g. McCoun, have poor responses probably because of high ethylene production at harvest. However, even for responsive varieties 'degrees of response' occur. Response to 1-MCP depends on harvest maturity, storage type, length of storage, handling protocols prior to 1-MCP application, and interactions among all of these factors. These interactions are most likely associated with ethylene production of the fruit at harvest and the effectiveness of postharvest handling treatments on slowing down ethylene production by the fruit.
2. Maturity. Judging maturity is an art and a science, and the value of any single maturity index is limited. A danger for our industry is that we may harvest fruit too early in order to maximize fruit responses to 1-MCP, thereby sacrificing other quality attributes. Early harvested fruit can have low flavor development, and this may be further compromised by 1-MCP, especially for sensitive varieties such as Delicious and Empire. Attention to harvest maturity and quality will be an essential component of 1-MCP use.
3. Do not use 1-MCP on ethrel-treated fruit as these fruit respond poorly to treatment.
4. 1-MCP can maintain quality of fruit of many varieties in air for 2-3 months. Best responses of fruit to 1-MCP occur in combination with CA, however, and we believe that it is unlikely that 1-MCP will be a substitute for CA storage. However, for some varieties 1-MCP has the potential to greatly improve quality of air-stored fruit marketed during December and January, especially where it is not feasible to hold that fruit in short-term CA storage.
5. Responses of McIntosh, Cortland, Empire and Delicious to 1-MCP have been evaluated more thoroughly than responses of other varieties. Although other varieties are being tested in other states, it is likely that regional variations in

varietal responses will necessitate development of regionally-specific recommendations for 1-MCP. Thus, what works in Washington State may not work the same way in New York State. "Don't put all your eggs in one basket" for varieties that you are unfamiliar with – test small quantities of different varieties before applying treatments to large volumes of fruit from untested varieties.

6. Application of 1-MCP sometimes increases the risk of carbon dioxide injury of susceptible varieties such as McIntosh, Cortland and Empire. This injury can be prevented by DPA, but where DPA is not used, special care is needed to reduce fruit loss. We are testing different strategies, but our tentative recommendation is to maintain carbon dioxide levels for Empire at less than 1% for the first 4 to 6 weeks of storage. If fruit are treated with DPA, standard storage recommendations should be used.
7. Effectiveness of 1-MCP for controlling superficial scald without diphenylamine (DPA) is variable, depending on variety. Results to date indicate that scald on Delicious is generally controlled very well by 1-MCP.
8. Treatment with 1-MCP is unlikely either increase or decrease the incidence of postharvest decays that develop during storage. However, DPA-treated fruit may develop more decay than fruit that are moved into storage without any drench treatment because the DPA solution carries fungicide-resistant spores. If fruit treated with 1-MCP must also be treated with DPA to control carbon dioxide injury, then 1-MCP may indirectly contribute to greater losses from postharvest decays. This situation could be resolved either by introduction of a new fungicide or by introduction of DPA thermofogging technology.
9. Maintain temperature recommendations for CA-stored fruit that are appropriate to your region.

<u>Variety recommendations</u>

(These recommendations are additional or complementary to those provided by AgroFresh)

<u>McIntosh:</u>

<u>Benefit</u>

- High for Champlain-grown fruit, and low to moderate benefit elsewhere depending on fruit maturity at the time when fruit develop acceptable color, and also on preharvest factors such as ethrel usage.

<u>Risk factors</u>

- Increased variability of fruit after storage if maturity is mixed at harvest, i.e. if some fruit have high ethylene production they may not respond to 1-MCP and treatment will result in both firm and soft fruit in the same consignment.
- Fruit treated with 1-MCP may not develop the texture and flavor characteristics that the traditional market for this variety expects.
- CO_2 injury in regions where DPA is not used.

<u>Cortland:</u>

<u>Benefit</u>

- High, depending on fruit maturity. For fruit treated at optimum maturity, 10 months of CA storage may be possible.

Risk factors

- CO_2 injury if DPA is not used.
- Fruit treated with 1-MCP may not develop the texture and flavor characteristics that the traditional market for this variety expects.
- Scald appears to be less consistently controlled by 1-MCP.

Empire:

Benefit

- High, and less dependent on fruit maturity than many other varieties.

Risk factors

- CO_2 injury: If DPA is not used, special care must be taken to reduce CO_2 in storages. In years where weather conditions during the growing season create increased risk of CO_2 injury, DPA treatment may prove essential for fruit receiving 1-MCP treatment.
- Lack of varietal flavor if fruit are harvested when too immature.

Delicious:

Benefit

- Moderate, and although less dependent on fruit maturity than many other varieties, we do not obtain as marked responses as elsewhere, perhaps because we harvest our fruit relatively late.
- Can avoid DPA application for CA stored fruit.

Risk factors

- Watercore disappearance is slowed or prevented by 1-MCP application.

Gala:

Benefit

- High

Risk factors

- Isolated reports of CO_2 injury, but DPA treatment is not recommended.

IdaRed:

Benefit

- High in air and CA

Risk factors

- None identified. Low scald susceptibility

Law Rome:

Benefit

- Moderate

Risk factors

- Scald control variable.

Diphenylamine (DPA)

Diphenylamine (DPA) is registered as an inhibiter of the physiological storage disorder superficial scald development. Its use is essential for safe long term storage of varieties that are susceptible to the disorder.

DPA formulations

Two formulations of DPA are available to the industry; Pace Shield Liquid DPA (15%) and Ceraxagri/Decco No Scald DPA (31%). Both formulations are applied by dipping or drenching bins of fruit according to the manufacturer's instructions. It is expected that fogging technology may become available for DPA application within several years.

DPA recommendations

Recommended concentrations for New York varieties are shown in Table 1. These recommendations are based on amounts required to control scald, label maximums, and susceptibility of each variety to DPA-induced injury. However, even under ideal conditions injury can occur. Examples of injuries are shown in Fig. 1.

Recommendations for varieties that have not been tested in New York are shown in italics, and are based on those for other growing regions. No large scale treatment of a new variety should be carried out without treating small lots of fruit within your facility. Recommendations exist for varieties with low scald risk such as Empire and Gala, and storage operators may consider using lower DPA concentrations or none at all as they gain experience under their specific storage conditions. It is important to realize however that DPA may have additional advantages such as maintaining firmness and preventing CO_2 injury, and therefore DPA treatment should be omitted only after carefully considering the risks. These include seasonal variation.

Use of DPA varies by region in New York. McIntosh is generally not treated with DPA in the Champlain region, whereas it is essential for scald control in McIntosh fruit in the Hudson Valley and Western New York regions. The Marshall strain of McIntosh should be drenched however, even in the Champlain, because scald tends to be more severe at the higher O_2 levels recommended for CA storage of this variety.

In New York it is common to have over-lapping varieties requiring treatment at the same time. When this happens, the DPA concentration that is used should be based on the highest concentration that can be safely used without injury on the most injury-prone variety. If the variety with the lowest recommended concentration, e.g. 1000 ppm, will be burned by a higher concentration, e.g. 2000 ppm, then the lower concentration should be used. Golden Delicious may be burned by 2000 ppm and therefore if a tank load is used for both Red and Golden Delicious, then the concentration should not exceed 1000 ppm. However, if Empire, which requires only 1000 ppm, is mixed with Red Delicious, then 2000 ppm can be used because this DPA concentration will not burn Empire.

Critical factors for safe DPA application

Application of DPA is currently by drenching or dipping.

1. Ensure that the concentration is appropriate for the variety. Actual concentrations of DPA in the tank decline over time and should be checked regularly using the test kit appropriate to the formulation that you are using.
2. Use only permitted and non-injurious chemicals with DPA. These include certain calcium and fungicide formulations (see below). NEVER use chlorine with DPA.
3. The DPA solution must be clean, as dirt and debris will decrease its effectiveness. The DPA labels indicate that a maximum of 30 bins (750 bushels) can be treated with each 100 gallons of drench solution. Thus, 300 bins can be treated between changes if the treatment tank holds 1000 gallons of solution. Sediment should be removed from the bottom of the treatment tank each time the solution is changed.
4. The solution must be mixed thoroughly and solutions should be constantly agitated to avoid stratification of the compound in the holding tank.
5. Apply DPA as soon as possible after harvest, preferably within a day of harvest and no later than 7 days.
6. Drenching temperature should be above 45^{o}F because of ineffective retention of DPA at low temperatures.
7. Bins of fruit must be allowed to drain thoroughly after treatment. Severe damage to fruit can occur when DPA solution is trapped between apples, next to bin walls, or in corners. Evaporation of solution within closed storages can result in high concentrations of DPA vapors
8. Cartons containing apples that have been treated with DPA must be labeled.

Compatibility of DPA with other chemicals

Both calcium and fungicides are used routinely with DPA.

1. ***Calcium.*** Materials containing $CaCl_2$ are the only calcium sources that may be used. Dry $CaCl_2$ at 94% purity or higher may be used, and it should be used at no more than 12 lbs./100 gallons of water, since damage to the fruit may occur at higher concentrations. Vinegar (5%) at 8 to 10 ozs. per 100 gallons can be used to counteract the alkalinity of the calcium chloride solution. Two commercial liquid formulations of calcium chloride are also labeled for use. "STOPIT" liquid calcium concentrate (Shield-Brite Corp.; 12% calcium) is labeled for use at 1 gallon per 74 gallons of drench water. "Decco Calcium Chloride-EC 405" (12% calcium) is labeled for use at 1 gallon per 79 gallons of drench water. Both of these labeled rates result in markedly lower calcium concentrations in the solution than does 12 lbs. of dry calcium chloride (94%) per 100 gallons. However, the liquid formulations are easier to use than 94% calcium chloride pellets.
2. ***Fungicides.*** DPA is compatible with both of the fungicides (Captan and Mertect 340F) that are currently registered for postharvest use on apples. DPA is also compatible with Scholar and PenBoTec, the two new postharvest fungicides that are in the middle of the EPA registration process.

DPA is NOT compatible with oxidizing agents such as sodium hypochlorite, calcium hypochlorite, or hydrogen dioxide (StorOx). Chlorinated water or hypochlorite solutions can be used to disinfect fruit after harvest, but treated fruit must either be rinsed or allowed to dry before they are subsequently treated with DPA. Similarly, fruit that are still wet from DPA treatment should not be treated with chlorinated water.

Disposal of DPA

The label states that "Wastes resulting from the use of this product may be disposed of on site or at an approved disposal facility." It is our understanding that storage operators generally spray the used solution out in the orchard. DPA readily adsorbs onto soil, exhibiting low motility. It undergoes rapid degradation in the presence of ultraviolet light and air, having a half-life of approximately 30 days in unamended soil. However, humic substances enhance the degradation process, showing a half-life of approximately 10 days (Fresh fruit packing general permit fact sheet; http://www.ecy.wa.gov/programs/wq/permits/index.html). Earlier formulations were much more toxic to aquatic life than the newer high purity products, but DPA must not be discharged to sewer systems without previously notifying the local sewage treatment plant authority. Spent DPA solutions must never be discharged into ditches, streams, or wetlands.

Table 1. Recommended concentrations of diphenylamine (DPA) for scald control of New York apple varieties

Variety	DPA (ppm)
Baldwin	1000-1500
Braeburn	*1000*
Cortland	2000
Delicious	1000-2000
Empire	1000
Fortune	*1000*
Fuji	*2000**
Gala	*1000*
Golden Delicious	1000**
Granny Smith	*2000*
Idared	1000
McIntosh	1000
Mutsu	2000
Pink Lady	*2000*
Rome	1500
Stayman	1500

* DPA-injury risk is high in WA and should be avoided in low scald-risk seasons

**Golden Delicious can be sensitive to DPA-injury and DPA retards chlorophyll loss.

Figure 1. DPA Injury on various apple varieties

Review of Postharvest Fungicides for Apples and Biocides Useful in the Packinghouse

Both fungicides and biocides can be used to manage postharvest decay problems in apple packinghouses. Fungicides control only fungal pathogens whereas biocides are toxic to all microorganisms (i.e., both fungi and microorganisms that can cause human diseases). Most fungicides provide residual protection following treatment so that treated fruit are protected from infection even when spores reach the fruit surface days or weeks after the treatment was applied. Biocides provide little or no residual activity, and they are generally less effective than fungicides for killing spores that become embedded in wounds on fruit. Biocides are used primarily for killing spores in water flumes, on fruit bins, or on packinghouse and storage floors and walls.

Registered fungicides: Only two fungicides are currently registered for use on apples: captan and thiabendazole (Mertect 340F). Both have weaknesses that limit their usefulness.

Captan has never been very effective for controlling postharvest decays in apples. Effectiveness if controlled experiments has been very variable for unknown reasons. When this fungicide is used, it should be used at the full postharvest label rate to maximize effectiveness. Note, however, that apples receiving a postharvest captan treatment might not be acceptable in Canada, where the residue tolerance for captan in lower than in the U.S.

Thiabendazole is a benzimidazole fungicide with mode of action similar to that of benomyl (Benlate) and thiophanate-methyl (Topsin M). Thiabendazole was very effective for controlling *Penicillium* and *Botrytis* in stored apples until these fungi developed resistance to the benzimidazole group. The combination of thiabendazole plus diphenylamine (DPA) provided control of both pathogens for many years after thiabendazole resistance first appeared because DPA controlled fungicide-resistant isolates while thiabendazole continued to control non-resistant isolates. The combination of thiabendazole plus DPA is still effective for controlling *Botrytis*, but *P. expansum* populations in many packinghouses are now completely resistant to this combination. In storages where *P. expansum* is fungicide-resistant, postharvest treatment may increase the incidence of decays because the postharvest solution collects and disperses inoculum, thereby ensuring that all stem-punctures and wounds will become infected.

Potential new postharvest fungicides: Three new fungicides are currently being evaluated as controls for postharvest decays in apples and pears, and two of them may soon receive federal registrations.

PenBoTec (pyrimethanil) is being marketed by Janssen Corporation and is expected to receive a federal label in May of 2004, although availability in NY may be delayed until 2005. This product has been very effective for controlling *P. expansum* in the three tests that we conducted in the past year. PenBoTec can be mixed with DPA and/or calcium chloride.

Scholar (fludioxonil) is being produced by Syngenta. We have evaluated this product in more than a dozen trials over the past five years. It controls both *P. expansum* and *B. cinerea.* Like PenBoTec, Scholar can be mixed with DPA and/or calcium chloride. This fungicide should be registered in time for use during the 2005 season.

Pristine (boscalid + pyraclostrobin) is a package-mixed fungicide being developed by BASF for use in both postharvest and field applications. In initial tests with this product, it was just as effective as PenBoTec and Scholar.

New biocontrols: Biocontrols for postharvest decays have been studied extensively over the past two decades, but to date, the products that have developed commercially are relatively ineffective. *Candida oleophila*, a yeast, was sold under the trade names of Aspire and Decco I-182, but it proved ineffective for controlling *P. expansum* in apples under commercial conditions. *Pseudomonas syringae*, a bacterium, was developed and marketed as Biosave, but it was only marginally effective. The commercial formulation had to be kept frozen until it was used, and the distributors never attempted to market the product outside of the Pacific Northwest.

Several new products may be commercialized over the next few years. *Cryptococcus infirmo-mineatus*, a yeast, has performed well in university trials in Oregon and is currently undergoing commercial development. Other researchers are investigating the use of *Muscodor albus*, a fungus that is being called a biofumigant because it produces volatiles that are toxic to most postharvest pathogens. However, none of these biocontrols are likely to be available in the near future. Cost-effectiveness of postharvest biocontrols in general is still questionable.

Biocides: The most common biocide used in apple packinghouses is sodium hypochlorite, the active ingredient in products commonly used to chlorinate water. Unlike fungicides, biocides provide no residual protection for fruit that pass through the treated water.

Most biocides are oxidizers that kill spores via oxidative reactions. Bacteria are generally easier to kill with biocides than are spores of *P. expansum*. Effectiveness of biocides is dependent on the following factors and their interactions:

- Biocide concentration affects activity. However, usable concentrations are limited because high concentrations can injure fruit that are handled in the water flumes.
- Solution pH affects the activity of hypochlorite solutions. The pH should be maintained between pH 6 and pH 7.5. With pH > 7.5, the effectiveness of the biocide is decreased and with pH< 6 chlorine off-gassing can create a disagreeable and potentially hazardous work environment. Hypochlorite solutions with pH < 6 are also more corrosive to equipment and nails in wooden bins.
- Duration of exposure affects activity. Many fungal spores can survive brief exposure to biocides, especially at lower temperatures. Spores in water flumes generally receive long exposures (days) in the recirculating water whereas exposure for bins passing through a water dump is often a matter of minutes.
- Solution temperature affects activity of biocides, with greater activity at higher temperatures. The constant introduction of cold apples into water dumps keeps temperatures relatively low and reduces activity of the biocides in apple handling flumes.
- Organic matter introduced into the biocide solutions can quickly deplete the oxidizing potential of the solution. If water flumes contain organic matter, the solution will need regular recharging with a biocide.

- Surfactants can affect biocide activity when biocides are intended to control pathogens like *P. expansum* that have very hydrophobic spore masses. However, using surfactants in flume water may also enhance penetration of *P. expansum* spores into fruit wounds, stems, and calices and therefore could conceivably enhance decay, especially if the concentration of biocide dropped below critical levels. Additional research is needed to evaluation the risks and benefits of adding surfactants to water flumes that are used to handle fruit.

The most common biocides available for use in apple packinghouses include the following:

- Sodium hypochlorite (e.g., Agchlor 310) is most commonly used for chlorinating water flumes.
- Calcium hypochlorite is available in a system where water flowing through a dispenser unit releases a constant supply of hypochlorite (e.g., Klorman Chlorine Dispensers). Calcium hypochlorite is less corrosive than sodium hypochlorite.
- Hydrogen dioxide (Stor-Ox) was recently registered as an alternative for hypochlorite in water flumes, but we have no data to suggest that it is more cost-effective than hypochlorite solutions. According to company literature, hydrogen dioxide is very effective for disinfesting storage rooms when the product is introduce via cold-fogging. The advantage of cold fogging is that exposure time can be extended by running the fogging equipment continuously for several hours.
- Ozone introduced into water with an ozone generator can substitute for hypochlorite solutions, but ozonation is used primarily in states where packinghouse operators have difficulty disposing of chlorinated water.
- Chlorine dioxide is extremely effective, when mixed into a foam, for sanitizing bins, storage walls, and floors. However, as with ozone generation, equipment for generating chlorine dioxide can be relatively expensive and worker safety issues must be carefully addressed.
- Quaternary ammonia compounds, or "quats" (e.g., Deccosan) are not labeled for use in water flumes but are very effective for killing spores and microorganisms on bin surfaces and storage walls and floors.

Recommendations for using biocides: Sodium hypochlorite is probably the most cost-effective biocide for sanitation of water flumes in apple packinghouses in New York. Dump tanks and water flumes in apple packinghouses should contain 70 ppm of free chlorine if chlorine is continuously metered into the system or 100 ppm of free chlorine if chlorine levels are adjusted only periodically. Chlorine levels should be tested at least every four hours. Each time that chlorine levels are tested, water pH should also be tested and, if necessary, adjusted to keep the solution with the range of pH 6-7.5.

Maintaining biocide levels in dump tanks and water flumes is especially critical during the period from late March through the end of the packing season. By the end of March, the incidence of decays in stored fruit increases and spore levels in packinghouses skyrocket. Maintaining biocide levels in the water flumes is essential for killing spores on decayed apples that enter the water dump and for preventing those spores from reaching healthy fruit. Healthy fruit that become infected during packing appear as decayed fruit in retail stores.

More work is needed to determine the best biocide for sanitizing field bins. Based on available information, we believe that quaternary ammonia products will be more effective than chlorine products for killing spores on bins. Where recycling solutions are used to sanitize bins, the solution temperature should be maintained above 65 °F to enhance activity of the biocide.

Quaternary ammonias can also be used to sanitize empty storage rooms and packinghouse floors. Other products may be equally effective, but we have not seen enough research data to make alternative recommendations.

Why worry about sanitation if we have new fungicides? I suspect that introduction of a new postharvest fungicide will make the apple decay problems disappear ….. temporarily! In the absence of good sanitation, resistance to the new fungicides will develop very quickly and the decay problems will re-appear. Also, concerns about contamination of fruit with human pathogens can be addressed only through effective sanitation of water flumes and packinghouses. Thus, the industry can ill-afford to ignore sanitation even if and when a new fungicide relieves some of the immediate problems with postharvest decays of apples.

Web-sites for additional information on biocides and their uses:

Zagory, D. Wash Water Sanitation: How Do I Compare Different Systems? Food Safety & Quality Programs, Davis Fresh Technologies, LLC. http://www.davisfreshtech.com/articles_washwater.html

Crisosto, C.H. Hydrocooler water sanitation. http://www.uckac.edu/postharv/

Publications and web sites

Publications

The Apple handling and storage workshop proceedings, 2003, are available from Max Welcome, Department of Horticulture, Cornell University, Ithaca, NY 14853, for $15 (postage included). Topics include: Diphenylamine (Watkins and Rosenberger); DPA fogging technology and new fungicides (Sanderson); (1-Methyl-cyclopropene (1-MCP) –NY review and recommendations (Watkins and Nock); CA room testing (Bartsch); Status of SmartFresh™: The first commercial year (Reed and Wargo); Effect of 1-MCP treatment on development of blue mold decay in Empire apples (Rosenberger, Wargo and Watkins); and Honeycrisp maturity and storage recommendations (Watkins and Nock).

A special issue on Honeycrisp, which includes research on maturity and storage, is available in the New York Fruit Quarterly 11(3), Autumn 2003. <http://www.nysaes.cornell.edu/hort/fq/03fall/NYFQFall2003.pdf>

Copies of the following papers are available on request:

Capdeville, G. de, Beer, S.V., Watkins, C.B., Wilson, C.L., Tedeski, L.O., Aist, J.R. 2003. Pre- and post-harvest harpin treatments of apples induce resistance to blue mold. Plant Disease 87:39-44.

Fernández-Trujillo, J. P., Nock, J.F., Kupferman, E.M., Brown, S.K., Watkins, C.B. 2003. Peroxidase activity and superficial scald development in apple fruit. J. Agric. Food Chem. 51: 7182-7186.

Kochhar, S., Conklin, P.L., Brown, S.K., Watkins, C.B. 2003. A quantitative and qualitative analysis of antioxidant enzymes in relation to susceptibility of apple fruit to superficial scald. J. Amer. Soc. Hort. Sci. 129: 910-916.

Meyers, K.J., Watkins, C.B., Pritts, M.P., Liu R.H. 2003. Antioxidant and anti-proliferative activities of straw-berries. J. Agric. Food Chem. 51: 6887-6892.

Stover, E.W., Fargione, M.J., Watkins, C.B., Iungerman, K.A. 2003. Harvest management of Marshall 'McIntosh' apples: Effects of AVG, NAA, ethephon, and summer pruning on preharvest drop and fruit quality. HortScience 38:1093-1099.

Tong, C.B.S., Bedford, D.S., Luby, J.J., Beaudry, R.M., Mattheis, J.P., Propsom, F.M., Watkins, C.B., Weis, S.A. 2003. Location and temperature effects on soft scald in 'Honeycrisp' apples. Hort-Science 38: 1153-1155.

Wargo, J.M., Merwin, I.M., Watkins, C.B. 2003. Fruit size, yield and market value of 'GoldRush' apple are affected by amount, timing and method of nitrogen fertilization. HortTechnology 13: 5-13.

Web sites

Postharvest Information Network, Washington State University < http://post-harvest.tfrec.wsu.edu/>

Postharvest Technology Research and Information Center <http://rics.ucdavis.edu/postharvest2/Pubs/index.shtml>

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