

PROJECT NO.: New¹

TITLE: Reducing Storage Disorders with Natural Plant Oils

YEAR INITIATED: 2000-2001 **CURRENT YEAR:** 2000-2001 **TERMINATING YEAR:** 2001-2002

PERSONNEL: Dr. Eric Curry, Plant Physiologist, USDA, ARS, TFRL, Wenatchee, WA

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COOPERATOR: Dr. Peter Sanderson, Plant Pathologist, WSTFRC, Wenatchee, WA

JUSTIFICATION:

Storage disorders and fruit decay are two major issues that affect profitability of the fruit industry. Scald (including superficial scald and senescent scald) and internal browning (including senescent breakdown, core browning, and flesh browning) are the major physiological disorders that develop after prolonged regular storage. Although postharvest fruit decay often occurs after months in storage, the innoculum is often present when fruit are placed in storage. Gray mold (*Botrytis cinerea*) and blue mold (*Penicillium expansum*) are the main decay causing pathogens in the Pacific Northwest.

Currently, no effective measures are available to control senescent scald or internal browning except fruit maturity and temperature management. Ethoxyquin or oiled papers without ethoxyquin are used to assist in the prevention of superficial scald, whereas fungicides are the primary tools in controlling fruit decay during storage. With dependency on these chemicals, however, there is no immunity from the constant challenges of 1) induced or natural pathogen resistance; 2) tightened regulations from foreign markets; or 3) increasing regulatory pressure stemming from consumer advocacy groups regarding chemical use in food or food products. The development of chemical alternatives that are effective and environmentally friendly would be highly beneficial to the fruit industry.

Early in 1919, Brooks et al. reported that fruit wrapped with tissue paper containing 15% mineral oil developed less scald after cold storage. Although this method is quite effective, and still in use in Washington, Oregon, and California, it was abandoned by many countries after the commercialization of DPA and ethoxyquin. Since the early 90's, the effects of surface oil treatments on fruit quality and storage disorders have been studied. Scott et al. (1995) in Australia showed that wiping fruit with both vegetable oil (canola, castor, palm, peanut, and sunflower) and petroleum oil effectively reduced scald development in 'Granny Smith'. Curry (1999) found that scald was reduced in 'd'Anjou' pears, 'Red Delicious' and 'Granny Smith' apples when fruit were wiped with wheat germ oil. The practical application of wiping fruit with plant oils, however, is limited because: 1) it is hard to get uniform coverage; 2) additional machinery may be required in the packing houses thereby adding cost; 3) its inhibition on scald is time dependent and does not meet requirements for practical usage; and 4) the application method may increase greasiness on the fruit surface which is undesirable.

Instead of wiping fruit with oil, Ju et al. in 1990 (personal communications) and Curry in 1992 used oil emulsions to treat fruit and effectively controlled scald in apples. Oils from corn, soybean, peanut, cottonseed, and linseed are equally effective, and the formulation developed by Ju et al., is stable, and leaves no greasiness on fruit surface either at application or after storage. The fungicidal property of edible plant oils, on the other hand, has not been well studied and the few reports available are contradictory. In one report, both canola and soybean oil at 1% were effective in controlling apple powdery mildew (*Podosphaera leucotrica*), but had no effect on brown rot of peaches (Northover and Schneider, 1991, 1993) or black knot (*piosporina morbososa*) on leaves of plum and cherry. Duan et al., (personal communication) on the other hand, showed that edible plant oils at 5 to 10% were effective in reducing decay severity (lesion size), but not incidence, caused by gray mold (*B. cinerea*), blue mold (*P. expansum*) and bitter rot (*Glomerella cingulata*) in apples and pears.

Data from initial trials in our laboratory (Ju and Curry, 2000), suggest that treatment of 'd'Anjou' and 'Bartlett' pears with natural oil emulsion formulations: 1) inhibited ethylene production and respiration, and delayed fruit ripening and senescence; 2) prevented superficial scald in 'd'Anjou' and senescent scald in 'Bartlett'; 3) controlled core breakdown in 'Bartlett'; and 4) reduced decay severity of gray mold and blue mold. Fruit treated with oil emulsions were firmer, greener, had higher levels of titratable acidity and showed no scald or internal browning after 3 months for 'Bartlett' or 6 months for 'd'Anjou'. Initial observations also suggest oil treatment reduces fruit shrivel during prolonged storage.

OBJECTIVE:

As an alternative or adjunct to present chemical treatments, to study the mechanisms of control of physiological disorders, and to optimize treatment with natural oil emulsions of 'd'Anjou' and 'Bartlett' pears.

PROPOSED RESEARCH:

1. Evaluate the efficacy and effects of emulsion treatments using commercial treatments on fruit quality attributes, storage disorders, shrivel, and decay of 'd'Anjou' and 'Bartlett' pears in RA and CA storage.
2. Investigate mechanisms by which oil treatment delays ripening, and reduces physiological disorders and/or decay.
3. Determine if combinations of oil plus fungicides can improve decay control.
4. Initiate large scale applications of oil treatment with packing houses.

ANTICIPATED BENEFITS AND INFORMATION TRANSFER:

This work will provide 2 benefits: 1) because 'd'Anjou' pears may be treated up to 2 months after harvest and still benefit from treatment, the fruit packer has a tool for management of large fruit volumes; and 2) it will enable packers to extend storage life while maintaining superior quality of 'Bartlett' pears for canning and 'd'Anjou' pears for the fresh market. Results of this work will be published in peer reviewed journals and technical publications and presented at industry meetings and conferences.

BUDGET:

1. Amount allocated by WPCC for FY 1999-2000: \$0
2. Request for FY 1999-2000: \$34,500¹

Salary (½ Research Associate)	\$19,000
Benefits	6,200
Travel (work)	800
Publications & Presentations	500
Equipment ²	3,500
<u>Supplies³</u>	<u>4,500</u>
TOTAL	\$34,500

¹ The amount requested is half that for the entire project (\$69,000) to fund Dr. Ju for an additional 2 years on his present appointment concerning scald reduction and farnesene metabolism. Because the experiments will also be conducted on several apple varieties, that half of the proposal will be presented to the Postharvest Committee of the TFRC in July.

² Purchase of CO₂/O₂ microanalyzer equipment for small sample volume analysis.

³ Chemical supplies, equipment consumables (vials, columns, gases; gases for CA storage and calibration); electron microscope supplies.

REFERENCES

- Brooks, C., Coolly, J.S. and Fisher, D.F., 1919. Nature and control of apple scald. *J. Agree. Res.* 18, 211-240.
- Curry, E. A. 1999. Farnesene and squalene reduce scald in apples and pears. *Acta Hort.* (In press).
- Ju, A, and Curry, E. 2000. Stripped corn oil emulsion alters ripening, reduces superficial scald, and reduces coreflush in 'Granny Smith' apples and decay in 'd'Anjou' pears. *Postharvest Biology and Technology* (In press).
- Northover, J. and Schneider, K.E. 1991. Efficacy of canola and soybean oils against peach brown rot, 1990. *Fungic. Nematicide Tests.* 46, 69.
- Northover, J. and Schneider, K.E. 1993. Activity of plant oils on diseases caused by *Podosphaera leucotricha*, *Veneria inaequalis*, and *Albugo occidentalis*. *Plant Dis.* 77, 152-157.
- Scott, K.J., Yen, C.M.C. and Kim, G.H., 1995. Reduction of superficial scald of apples with vegetable oils. *Postharvest Biol. TechNet.* 6, 219-223.