J. Amer. Soc. Hort. Sci. 106(4):478–480. 1981.

Some Effects of Emulsifiable Coatings on Weight Loss, Stem Discoloration, and Surface Damage Disorders in 'Van' Sweet Cherries[1]

P. D. Lidster
Agriculture Canada, Research Station, Kentville, N.S., Canada B4N 1J5

Additional index words. Prunus avium, antitranspirant, waxing, impact damage

Abstract. **Preharvest antitranspirant sprays were most effective in decreasing the incidence of surface pitting in 'Van' sweet cherries (*Prunus avium* L.) when applied immediately prior to harvest. Antitranspirant or wax coatings applied to 'Van' cherries as a postharvest dip decreased weight loss in storage, the incidence of discolored stems and surface pitting in storage. Antitranspirant concentration in the postharvest dipping solution was negatively correlated to the incidence of surface pitting.**

Mechanical damage in sweet cherries has been shown to be expressed as surface pitting (5), flattened surface bruises (2) or internal discolored bruising (1). Surface pitting or bruises may result from either impact or severe compression injury (4) received during picking, sorting, and transport of the fruit.

Porritt et al. (5) determined that the large sub-epidermal cells (8-10 cell layers beneath the cuticle) collapsed in response to impact damage. This caused the non-damaged cells between the damaged zone and the epidermis to recede to form a sunken pit. For the sunken pit to form there must be a net volume loss in the ruptured cell region to allow the undamaged epidermal cells to sink inwards. The major volume change after cell collapse is likely due to cell content relocation within the fruit or vapour loss (presumably mostly water) from the fruit. Lidster et al. (3) suggested that a surface layer of xanthan gum applied to 'Van' cherries as a postharvest dip prevented water loss from damaged fruit to reduce the incidence of surface pitting.

The present study investigates the effects of antitranspirants and wax coatings on water loss, the incidence of discolored stems and surface disorders due to impact damage in 'Van' sweet cherries. The effects of antitranspirant concentration and application as a preharvest spray or a postharvest dip on the incidence of surface disorders were also examined.

Materials and Methods

1978. 'Van' cherries were harvested at red-mahogany color maturity from a commercial orchard in Summerland, British Columbia and randomly divided to form a completely randomized design of 2 dipping solutions, 3 washing schedules, and 5 replications each with 250 fruits. Dipping solutions consisted of either tap water or 200 ml/liter Mobileaf[2] antitranspirant (Table 1), each with 1.0 ml/liter non-ionic surfactant and 0.5 g/liter Benlate (E. I. Du Pont de Nemours & Co., Wilmington, Delaware). The washing schedules consisted of no wash, washing prior to bruising or washing after bruising of the fruit.

All fruits were dipped for 15 sec in the appropriate 21°C solution and cooled to 0° within 16 hr of harvest. Fruit which required washing prior to bruising was rinsed in cold running water and then returned to storage until fruit temperature reached 0°. All fruits were then impact damaged by dropping them 46 cm onto a moving fiber belt. Fruits which required washing after bruising were rinsed under cold running water. All fruits were placed in paperboard boxes in perforated polyethylene liners and replaced in 0° storage. Fruits were removed after 14 days of storage and examined for sunken surface pits and flattened surface bruises. The percentage data were transformed to angles and mean separation determined by Duncan's multiple range tests.

Preharvest vs. postharvest antitranspirant application, 1979. A single antitranspirant spray (50 ml/liter Vapor Gard, Table 1) was applied at 10 or 1 days prior to harvest to a branch selected at random in each of 6 'Van' cherry trees (replicates) in a commercial orchard in Kentville, Nova Scotia. Fruits were harvested at red color maturity. Non-treated fruits from each of the 6 trees were divided into 2 subsamples; one series was dipped in tap water (control) and the remaining series was dipped in 50 ml/liter Vapor Gard antitranspirant. All fruits were cooled to 0°C within 24 hr of harvest, impact damaged as previously described and stored at 20° and 85% relative humidity for 7 days. Weight loss, the incidence of discolored stems, bruised and pitted fruits were determined on 250 fruits/replication. The percentage data were transformed to angles and mean separation done by Duncan's multiple range test.

Postharvest antitranspirant application, 1979. 'Van' cherries were harvested at red color maturity from each of 5 mature trees (replicates) from a commercial orchard in Kentville. About 2500 fruits from each replicate were randomly divided to give 15 treatments which consisted of 3 antitranspirants (Folicote, Wilt Pruf, or Vapor Gard, Table 1) and 5 concentrations (0, 5, 10, 20, and 40 ml/liter). Fruits were dipped in the appropriate solution at 21°C immediately after harvest, cooled to 0°, impact damaged as previously described and then replaced in 0° storage. After 14 days of storage, the incidence of bruised and pitted fruit were determined on about 125 fruits/replication. The percentage data were transformed to angles and analyzed by analysis of variance.

1980. A single antitranspirant spray (40 ml/liter Vapor Gard) was applied to a large branch selected at random in each of 7 'Van' cherry trees (replicates) in a commercial orchard in Kentville. Each of 3 branches/tree was sprayed to run-off with a backpack sprayer at 28, 10, or 1 days prior to harvest. All fruits were harvested at red color maturity. Non-treated fruits from each of the 7 trees were divided into 6 subsamples and received posthar-

[1]Received for publication January 3, 1981. Contribution No. 1714 from Research Station, Agriculture Canada, Kentville, Nova Scotia, B4N 1J5.

The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

[2]Mention of a trademark name or proprietary product does not imply its approval to the exclusion of other products that may also be suitable.

Table 1. Sources and formulations of antitranspirants and wax coatings applied.

Commercial name	Supplier	Product	Formulation
Mobileaf	Mobil Chemical Co. Richmond, Virginia	Antitranspirant	Paraffin and petroleum wax emulsion
Vapor Gard	Miller Chemical and Fertilizer Corp. Hanover, Pennsylvania	Antitranspirant	Di–1–p–menthene
Folicote	Crystal Soap and Chemical Co. Lansdale, Pennsylvania	Antitranspirant	Paraffin wax emulsion
Wilt-Pruf	Nursery Specialty Products, Greenwich, Connecticut	Antitranspirant	di–1–p–menthene
Sta-Fresh 711	FMC Corp., Riverside, California	Wax coating	Vegetable oil emulsion
Sta-Fresh 215	FMC Corp., Riverside, California	Wax coating	Shellac base emulsion
Fresh Cote	Mitsubishi Corp., Tokyo, Japan	Wax coating	Polysaccharide-protein-oil emulsion

vest dips of: 1) no dip, 2) tap water dip, 3) 40 ml/liter Vapor Gard, 4) SF 711, 5) SF 215, or 6) Fresh Cote (Table 1). Fruits which required dipping were dipped immediately after harvest in the appropriate 21°C solution and all fruit cooled to 0° with 16 hr of harvest. Fruits were then impact damaged as previously described and stored at 20° and 40% relative humidity for 6 days at which time weight loss, the incidence of discolored stems, bruised and pitted fruit were determined on 100 cherries. The disorder incidence data were transformed to angles and mean separations among the 9 treatments determined by the Duncan's multiple range test.

Table 2. Effects of water and antitranspirant dips on surface disorder incidence in 'Van' cherries, 1978 crop.

Dipping solution	Wash sequence	Bruised fruit (%)	Pitted fruit (%)
Water	None	5 b[z]	63 a
	Before impact damage	4 b	62 a
	After impact damage	3 b	63 a
Mobileaf 200 ml/liter	None	2 b	28 c
	Before impact damage	4 b	48 b
	After impact damage	10 a	43 b

[z]Analysis of variance performed on the arcsin of the square root of the percentage; the tabulated percentage data are the reconverted means of the transformed data (n = 5). Mean separation within columns by Duncan's multiple range test, 5% level.

Results

Fruit dipped in 200 ml/liter Mobileaf (Table 2), 50 or 40 ml/liter Vapor Gard (Tables 3, 4, 5) consistently developed fewer surface pits as compared with non-treated control fruit. Partial removal of the antitranspirant coating by rinsing the fruit under running tap water, prior or subsequent to impact bruising, increased the incidence of surface pitting (Table 2). Postharvest applications of Folicote, Wilt Pruf, and Vapor Gard antitranspirants were not significantly different ($P > 5\%$) in reducing the incidence of fruit with surface pitting (Table 4). As the antitranspirant x concentration interaction was not significant ($P > 5\%$) for fruit bruises or pitting the analysis of variance data were omitted. The incidence of fruit with surface pitting was negatively correlated ($P < 0.1\%$) with antitranspirant concentration in the postharvest dip for the 3 antitranspirants applied. Single antitranspirant sprays applied at 10 or 1 days prior to harvest also decreased the incidence of fruit with surface pitting (Tables 3, 5). The antitranspirant spray applied 1 day prior to harvest was most effective in preventing surface pitting in 1979 and 1980. However, an antitranspirant spray applied 28 days prior to harvest in 1980 did not significantly reduce the incidence of pitted fruit. Fresh Cote and SF 215 were the most effective treatments, reducing the incidence of surface pitting from 63 or 66% in the controls to 11 and 15%, respectively.

Antitranspirant or wax coatings applied as preharvest sprays or postharvest dips tended to reduce the incidence of bruised fruit but

Table 3. Effects of mode of antitranspirant application on weight loss, the incidence of discolored stems, and surface damage disorders in 'Van' sweet cherries, 1979.

Treatment	Mode of application	Time of application	Weight loss (%/day)	Discolored stems (%)	Bruised fruit (%)	Pitted fruit (%)
Water (control)	Dip	Postharvest	3.1 a[z]	94 a[y]	24 a	39 a
Vapor Gard (50 ml/liter)	Spray	10 day prior to harvest	2.5 b	94 a	23 a	20 b
	Spray	1 day prior to harvest	2.3 b	85 ab	16 b	6 c
	Dip	Postharvest	2.4 b	72 b	14 b	6c

[z]Mean separation within columns by Duncan's multiple range test, 5% level.
[y]Analysis of variance performed on arcsin of the square root of the percentage; the tabulated percentage data are the reconverted means of the transformed data (n=6).

Table 4. Effects of antitranspirant type and concentration of postharvest dip on the incidence of surface damage disorders in 'Van' sweet cherries, 1979.

Antitranspirant	Concn (ml/liter)	Bruised fruit (angles)	Bruised fruit (%)	Pitted fruit (angles)	Pitted fruit (%)
Folicote	0	25[z]	18	38	38
	5	38	38	28	22
	10	35	34	27	20
	20	36	35	28	22
	40	28	22	17	9
Vapor Gard	0	20	11	38	38
	5	35	32	28	22
	10	37	36	27	20
	20	37	36	30	26
	40	19	11	14	6
Wilt Pruf	0	22	14	42	45
	5	38	39	24	16
	10	36	34	26	19
	20	33	29	24	18
	40	29	24	17	9
SE		2.6		1.6	

[z]Analysis of variance performed on arcsin of the square root of the percentage; the tabulated percentage data are the reconverted means of the transformed data (n = 5).

were inconsistent (Tables 2, 3, 4, 5) in the 3 years studied. A preharvest spray applied 1 day prior to harvest or a postharvest application of 40 or 50 ml/liter Vapor Gard or Fresh Cote or SF 215 significantly reduced fruit weight loss and the incidence of discolored stems. However, 50 ml/liter Vapor Gard spray applied 1 day prior to harvest in 1979 did not significantly reduce the incidence of discolored stems and SF 711 applied as a postharvest dip increased the incidence of discolored stems.

Discussion

The application of emulsifiable coatings to 'Van' cherries to decrease weight loss was generally associated with a reduction in the incidence of discolored stems and surface pitting. Antitranspirant or wax coatings may reduce surface pitting by the inhibition of net volume loss (presumably water loss) from the fruit in a manner similar to that proposed for a xanthan gum layer applied to cherries (3). However, high storage humidity has been shown to decrease the rate of water loss from cherries and decrease the rate of surface pit development, but did not modify the final incidence of the disorder (2). In addition, Vapor Gard applied 10 days prior to harvest and SF 711 applied as a postharvest dip (Table 4) in the present study decreased surface pitting without a corresponding decrease in observed weight loss. This evidence suggests that factors other than weight loss may be involved with the inhibition of surface pit formation in 'Van' cherries.

Antitranspirant application to cherries would be generally unacceptable for commercial use as they leave an objectionable sticky residue. However, several of the wax formulations appear to be acceptable for commercial development. An appropriate means of applying a smooth wax coating which is capable of drying prior to packing for a large volume of fruit must be determined before a recommendation for commercial use can be made.

Literature Cited

1. Couey, H. M. and T. R. Wright. 1974. Impact bruising of sweet cherries related to temperature and fruit ripeness. HortScience 9:586.
2. Lidster, P. D. 1978. Modification of the incidence of surface damage symptoms in sweet cherries by pre- and postharvest treatments. PhD Thesis, Univ. of British Columbia, Vancouver.
3. Lidster, P. D., M. A. Tung, and R. G. Yada. 1979. Effects of preharvest and postharvest calcium treatments on fruit calcium content and the susceptibility of 'Van' cherry to impact damage. J. Amer. Soc. Hort. Sci. 104:790–793.
4. Lidster, P. D. and M. A. Tung. 1979. Identification of deformation parameters and fruit response to mechanical damage in sweet cherry. J. Amer. Soc. Hort. Sci. 104:808–811.
5. Porritt, S. W., L. E. Lopatecki, and M. Meheriuk. 1971. Surface pitting, a storage disorder of sweet cherries. Can. J. Plant Sci. 51:409–414.

Table 5. Effects of emulsifiable coatings and mode of application on weight loss, the incidence of discolored stems, and surface damage disorders in 'Van' sweet cherries, 1980.

Treatment	Mode of application	Time of application	Weight loss (%/day)	Discolored stems (%)	Bruised fruit (%)	Pitted fruit (%)
No dip	–	–	2.9 a[z]	33 b[y]	20 ab	63 a
Water	dip	postharvest	2.9 a	30 b	22 a	66 a
Vapor Gard (40 ml/liter)	spray	28 days prior to harvest	3.0 a	31 b	15 ab	60 a
	spray	10 days prior to harvest	3.0 a	20 c	15 b	48 b
	spray	1 day prior to harvest	2.4 b	17 cd	16 ab	22 d
	dip	postharvest	2.2 bc	11 de	16 ab	22 d
SF 711	dip	postharvest	3.0 a	62 a	9 c	34 c
SF 215	dip	postharvest	2.0 c	11 de	13 bc	15 c
Fresh Cote	dip	postharvest	1.6 d	8 e	15 b	11 e

[z]Mean separation within columns by Duncan's multiple range test, 5% level.
[y]Analysis of variance performed on arcsin of the square root of the percentage; tabulated percentage data are the reconverted means of the transformed data (n = 7).