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Effect of Detergent Sanitizers on Post-harvest Diseases of Avocado

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Abstract

Commercially available sanitizing agents from the food processing and dairy industries were evaluated for control of avocado post-harvest diseases. When applied as postharvest dip treatments a higher than commercially recommended concentration for SU319 and a commercially recommended concentration of Stericlen and Iodet could effectively control anthracnose and stem-end rot. Agrisan evaluated at both the commercially used and at a higher concentration could control anthracnose. Similarly, a higher than commercially used concentration of Stericlen and 76 % Ethanol could also only control anthracnose. The possibility of using these disinfectants in combination with other control measures should be investigated further.

INTRODUCTION

Limited control of avocado post-harvest diseases can be obtained through pre- or post-harvest fungicide applications such as copper oxychloride (Kotzé *et al.,* 1982), benomyl (Darvas & Kotzé, 1987) and prochloraz (Darvas, 1985). However, copper oxychloride leaves unsightly residues (Denner & Kotzé, 1986), while prolonged use of benomyl can lead to build up of pathogen resistance (Darvas & Kotzé, 1987). On the other hand product clearance for prochloraz on fruit exported to France has still not been given. Most importantly of all are the limited number of fungicides available and the prospect of not getting new fungicides registered for the relatively small subtropical industry. This combined with general global chemophobia over the extensive use of agricultural chemicals make it desirable to seek alternative control strategies.

Biological controls of pre- and post- harvest fruit diseases have therefore received much attention over the past 10 years as alternative control strategy (Wilson & Wisniewski, 1989). Subsequently, *Bacillus subtilis* was evaluated for control of avocado post-harvest diseases, with resultant control equal to or better than that achieved with fungicides (Korsten *et al.,* 1989). To further improve efficacy, *B. subtilis* was integrated with fungicides at concentrations equal to, or lower than the registered rate. Although some improvement was noticeable, it was not consistent (Korsten *et al,* 1989; 1991; 1992; 1993).

In foodprocessing and dairy industries, detergents and or sanitising agents are routinely used to reduce inoculum of food spoilage microorganisms. These products have as yet not been evaluated on avocado fruit. The purpose of this study was therefore to

evaluate five disinfectants commonly used in the food industry for their compatibility with avocado fruit and to determine their effect on post-harvest disease severity.

MATERIALS AND METHODS

Fuerte avocado fruit were commercially harvested (1994/06/10) early in the morning from block F4 Everdon Estate. Harvested fruit was immediately transported to the commercial packhouse where the untreated fruit was sorted according to size. Ten carton boxes with count 14 fruit were randomly selected for each treatment. The following treatments were included in the first experiment: An untreated as well as water dip control. For comparative purposes a chemical treatment was included which consisted of a prochlaraz (Omega, 45 % a.i. E.G., FBC Holdings (Pty) Ltd.) ultra low volume spray application at 4ppm, followed by drying and commercial Tagwaxing (Polyethylene, Sanachem, with benomyl Benlate, 50 % WP, Du Pont De Nemours International SA.) at 1.7 ppm and thiabendazole (Tecto, 45 % a.i., Logos Agvet) at 3 ppm, included. Five different disinfectants were included in this study and were used at the commercial concentrations (Table 1). In addition ethanol (Ethyl alcohol) treatments (99.99 %) were also included in this experiment. Fruit was dipped into the specific disinfectant solutions for three minutes before air drying and commercial Tag-waxing. Fruit from all the treatments were packed, each treatment coded for evaluation and stored at 5.5°C for 28 days to simulate export conditions. After removal from commercial cold storage, fruit was allowed to ripen at 21°C, 90 % RH. Fruit was evaluated at the ready to eat stage for external disorders viz. black cold (BC), lenticel damage (LD) and anthracnose and internally for SE and physiological disorders pulp spot (PS), grey pulp (GP) and vascular browning (VB). Evaluations were done on a 010 scale according to Bezuidenhout and Kuschke (1982), where zero represents healthy fruit and 10 totally affected fruit. The experiment was repeated twenty days later (1995/06/30) using Fuerte fruit from the same orchard. Due to early morning rain only a water dip control was included in the experiment and not an untreated control as was used in the first experiment. The ethanol dip treatment was also used at 76 % and not at 99.99 %. The disinfectants previously described (Table 1), were used at either the commercial or a higher concentration. Data was analyzed statistically using Duncan's multiple range test and results are expressed as disease severity.

Table 1
Disinfectants, chemical groups and concentrations used in Fuerte fruit dip treatments aimed at controlling post-harvest diseases.

Disinfectants	*Chemical group*	*Concentration*	
		Commercial	*High*
1. Agrisan	Quartenary ammonium compound	0.20 %	0.80 %
2. SU319	Quartenary ammonium compound	0.80 %	1.60 %
3. SU330	Chlorinated	300 ppm	900 ppm
4. Stericlen	Quartenary ammonium compound	8.20 %	16.40 %
5. Iodet	Iodine	30 ppm	60 ppm

RESULTS

In the first experiment none of the treatments effectively controlled anthracnose or SE (Table 2). However, compared to the water dip control, SU330 and Stericlen significantly increased disease severity. None of the treatments had any effect on internal physiological disorders PS, GP and VB (Table 2). However, BC was significantly increased by the 99.99 % ethanol and by the fungicide treatment, when compared to the water dip control. Lenticel damage was increased by the SU330 treatment.

Table 2
Effect of detergents on physiological and pathological disorders of Fuerte avocado fruit harvested on 10–06–1994

Treatments	*External evaluation*				*Internal evaluation*		
	BC	*LD*	*ANT*	*SE*	*PS*	*GP*	*VB*
1. Agrisan	0.03a	1.98ab	0.00a	0.45a	0.03a	0.26ab	0.27a
2. SU319	0.16a	1.57ab	0.01a	0.40a	0.04a	0.10a	0.49ab
3. SU330	0.00a	2.29b	0.23c	0.42a	0.09a	0.17ab	0.39ab
4. Stericlen	0.02a	1.24a	0.13b	0.50a	0.05a	0.06a	0.69b
5. Iodet C	0.15a	2.01ab	0.03a	0.64a	0.06a	0.43b	0.36ab
6. Ethanol 99.99 %	0.66c	1.71ab	0.02a	0.57a	0.04a	0.13ab	0.62ab
7. PTB	0.48bc	1.04a	0.02a	0.54a	0.02a	0.14ab	0.37ab
8. Control + Water	0.08a	1.30a	0.01a	0.32a	0.10a	0.27ab	0.40ab
9. Untreated	0.29ab	1.24a	0.05ab	0.42a	0.10a	0.26ab	0.33ab

BC = Black cold; LD = Lentidamage; Ant = Anthracnose; SE = Stem-end rot; PS = Pulpspot; GP = Greypulp; VB = Vasular browning.
PTB = Prochloraz, Benlate and Tecto (Fungicidal treatment)
Values followed by the same letter do not differ significantly according to Duncan's multiple range test (P = 0.05). Values indicate mean disease severity
Fruit were evaluated at a 0 –10 scale, 0 being healthy and 10 indicating completely affected (Bezuidenhout & Kuschke, 1982)

In the second experiment a much higher disease incidence was recorded and more treatment effects could be observed. Both anthracnose and SE were effectively controlled by the high SU319 and commercially used concentrations of Stericlen and lodet (Table 3). Both concentrations of Agrisan and the high concentration of lodet and Stericlen as well as the 76 % ethanol treatment, could effectively control anthracnose but not SE (Table 3). Interestingly, the high concentration of SU330 reduced anthracnose but increased SE severity above that of the control. The fungicide treatment significantly increased SE and was the only treatment that reduced PS (Table 3). The high lodet and commercial Stericlen concentrations increased PS severity above that of the control. Similarly GP was increased by both Stericlen and by the commercial lodet concentrations. None of the treatments affected VB or BC while the 76 % ethanol increased LD (Table 3).

Table 3
Effect of detergents used at commercial and higher concentrations on physiological and pathological disorders of Fuerte avocado fruit harvested on 30/06/1994

Treatments	*External evaluation*			*Internal evaluation*			
	BC	*LD*	*Ant*	*SE*	*PS*	*GP*	*VB*
1. Agrisan C	0.00a	1.82b	0.08a	0.82abc	0.45ab	0.57ab	0.23a
2. Agrisan H	0.00a	1.67ab	0.10a	0.82abc	0.47ab	0.60ab	0.30a
3. SU319 C	0.00a	1.61ab	0.19ab	0.99abc	0.36ab	0.28a	0.28a
4. SU319 H	0.00a	1.71ab	0.03a	0.62ab	0.32ab	0.41ab	0.14a
5. SU330 C	0.00a	1.89b	0.35b	0.32bcd	0.27ab	0.34a	0.20a
6. SU330 H	0.00a	1.88b	0.08a	3.01e	0.51ab	0.85ab	0.38a
7. Stericlen C	0.00a	1.80b	0.07a	0.34a	1.05c	2.20b	0.33a
8. Stericlen H	0.00a	1.71ab	0.12a	0.75abc	0.67bc	1.57c	0.32a
9. Iodet C	0.00a	1.58ab	0.07a	0.44a	0.49ab	1.06bc	0.35a
10. Iodet H	0.00a	1.64ab	0.03a	1.04abc	0.68c	0.66ab	0.33a
11. Ethanol 76 %	0.00a	3.34c	0.13a	1.82d	0.34ab	0.35a	0.18a
12. PTB	0.00a	1.35a	0.21ab	2.89e	0.09a	0.13a	0.24a
13. Control+ Water	0.00a	1.62ab	0.31b	1.46cd	0.55b	0.25a	0.15a

C = Commercial concentration; H = High concentration; BC = Black cold; LD = Lentidamage; Ant = Anthracnose; SE = Stem-end rot; PS = Pulpspot; GP = Greypulp; VB = Vasular browning. PTB = Prochloraz, Benlate and Tecto (Fungicidal treatment)
Values followed by the same letter do not differ significantly according to Duncan's multiple range test (P = 0.05). Values indicate mean disease severity
Fruit were evaluated at a 0–10 scale, 0 being healthy and 10 indicating completely affected (Bezuidenhout & Kuschke, 1982)

DISCUSSION

Evaluation of products other than fungicides for the reduction of post-harvest fruit diseases has been reported for chlorine (Bartz, 1988), antioxidants (Prusky, 1988) and calcium (Conwey *et al,* 1992). Bartz (1988) demonstrated that the incidence of disease associated with the infiltration of tomato fruit with water was reduced but not eliminated by adding 50-1000 ppm chlorine per litre water and that disease incidence increased as chlorine concentration decreased. However, according to Bartz (1988) chlorination increased the potential for water infiltration, and water infiltrated fruit were likely to become diseased. In both our experiments the chlorine compound increased certain diseases or had no effect. However, in one instance the high chlorine concentration significantly reduced anthracnose.

Besides being used to sanitise empty storage bins in lemon packinghouses (Bancroft *et al.,* 1984) quartenary ammonium compounds (QAC's) have previously not been used as post-harvest fruit treatments. In the present study, anthracnose was readily controlled by QAC's more so than SE and generally had no effect on the other parameters monitored. Stem-end rot was less severe on fruit treated with QAC SU319 and Iodet (Iodine compound). The latter compounds as well as ethanol (76 %) were effective against anthracnose. However, ethanol (76 %) was the only product which drastically increased lenticell damage in the second experiment. The significant increase in blackcold in the first experiment and SE in the second experiment in PTB treated fruit is no new phenomenon and has previously been reported (Gibbs, 1972).

An observation of the present study was the improved appearance of fruit washed in detergent solutions. It is proposed that products such as SU319 and Stericlen be evaluated further in combination with research into rapid drying techniques and

integration with biological control measures.

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