green mold among untreated, inoculated fruit was 98.3%. When SC treatment was applied alone and the fruit were not rinsed after treatment, the green mold incidence was 18.2%. When SC treatment was preceded by washing the inoculated fruit with water at high pressure, a further and significant reduction in green mold incidence to 9.5% occurred on cvs. Frost and Lane Late oranges, while on cv. Eureka lemons a slight but not significant improvement in carbonate effectiveness was observed. When SC treatment was followed by washing the inoculated fruit with water at high pressure, the incidence of green mold was 38.1%. Pressure washing alone did not significantly reduce the incidence of green mold on oranges, but it slightly but significantly reduced green mold on lemons (Fig. 4). The green mold incidence of 97.0% among inoculated control lemons was reduced to 88.9% among those that were washed with water applied at high pressure.

Influence of SC solution temperature on rind injury of oranges. Phytotoxicity increased after SC treatment at 56 and 61°C among navel oranges cvs. Atwood, Bonanza, Fisher, New Hall, and Thomson Improved, but not after treatment at 28, 33, 44, or 50°C (Fig. 5). The cv. Thomson Improved had less injury than the other cultivars. Rind injuries were sunken areas 1 to 2 mm in depth that were light to dark brown in color.

Influence of SC on the effectiveness of subsequent biological control antagonist applications. *P. syringae* strain ESC10 significantly ($P \leq 0.001$) improved the control of green mold when its application followed fruit treatments in heated solutions of water, SC, or SBC treatments (Fig. 6).

Influence of SC on the effectiveness of subsequent imazalil application. The incidence of green mold after the combination of SC treatment followed by treatment by imazalil was significantly lower than after either treatment alone. The incidence of green mold after inoculation alone, SC treatment alone, imazalil (1,000 µg/ml) treatment alone, or SC treatment followed by imazalil treatment was 61, 36, 22, and 6%, respectively. The incidence of green mold after the combined treatment was significantly less ($P \leq 0.001$) than the imazalil or SC treatments alone.

DISCUSSION

The toxicity of SBC (pH 8.4; ED_{50} = 14.1 mM) to spores of *P. digitatum* was much less than that of SC (pH 11.0; ED_{50} = 5.0 mM); however, they were similar in effectiveness for the control of green mold. Therefore, the pH and in vitro toxicity of the solutions did not predict the efficacy of the solutions to control green mold. Although pH values above 8.5 inhibit the germination and growth of *P. digitatum* (10,26) and the higher pH of the carbonates enhanced their inhibitory activity in vivo, the equal performance of SBC and SC to control green mold demonstrates the pH of these solutions did not influence control of green mold significantly. Palmer and coworkers (30) and Homma and coworkers (10) showed that pH alone cannot explain the inhibitory action of these compounds. The pH of the solution deposited within the inoculation site was probably influenced by the albedo tissue of the rind, which is usually approximately pH 5.5, and the pH of the residual of both bicarbonate and carbonate solutions within the infection sites may have been similar. Furthermore, sodium apparently had some role in the control of the disease because the sodium salts were superior to the ammonium and potassium carbonate and bicarbonate solutions. The superior performance of the sodium salts was not anticipated. We and

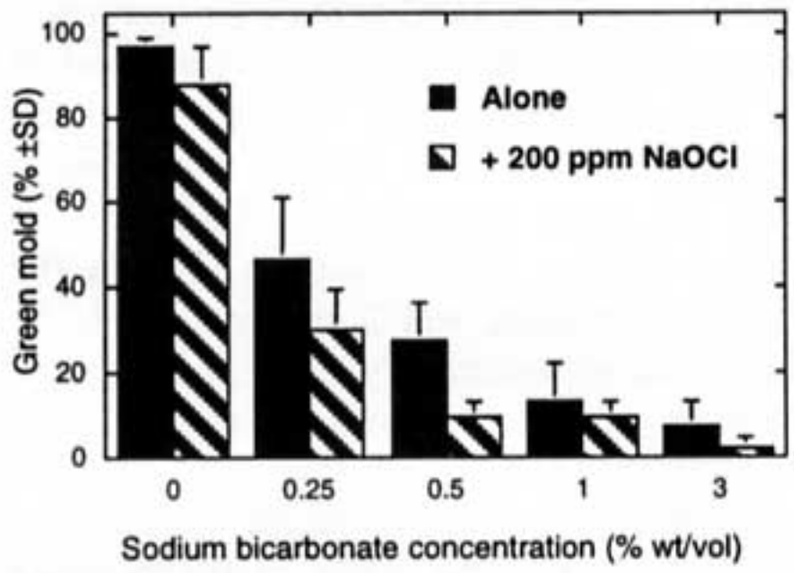

Fig. 3. The incidence of green mold on lemons after 2 min of treatment at 25°C in pH 7.5 solutions of water alone or sodium bicarbonate with or without 200 µg/ml of sodium hypochlorite. Inoculated fruit were immersed in each solution for 2 min and stored for 2 weeks at 18°C before the incidence of green mold was determined.

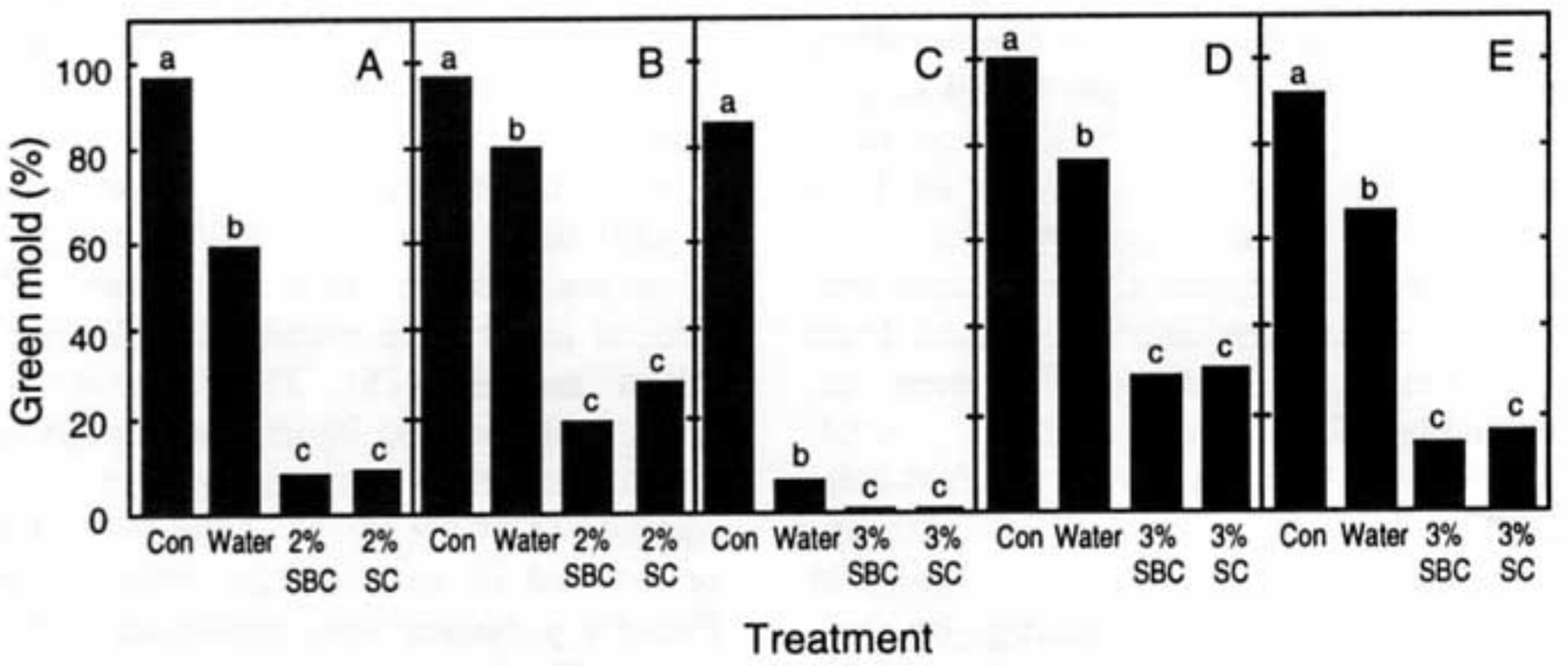

Fig. 2. The incidence of green mold on lemons or oranges after treatment in solutions of water alone or sodium carbonate (SC) or sodium bicarbonate (SBC) at 2 or 3% (wt/vol). Inoculated fruit were immersed in each solution for 2 min, rinsed with 10 ml of water per fruit, and stored 3 weeks at 13°C before the incidence of green mold was determined. **(A)** Treatment temperature 45°C; in all other tests, temperature was 40°C. **(A)** **(B)** and **(C)** Results with lemons; **(D)** and **(E),** results with cv. Valencia orange. Columns with unlike letters are significantly different by Fisher's least significant difference ($P \leq 0.05$).

Table 2. The incidence of green mold on lemons after treatment in solutions of carbonate or bicarbonate salts

Treatment	pH	Test no. 1[x]			Test no. 2			Test no. 3		
		M[y]	%	Green mold (%)[z]	M	%	Green mold (%)	M	%	Green mold (%)
Inoculated, not treated	NA	NA	NA	87.5 a	NA	NA	99.0 a	NA	NA	99.7 a
Water	7.2	NA	NA	67.5 b	NA	NA	91.1 b	NA	NA	97.6 a
Na_2CO_3	11.0	0.50	5.3	9.9 d	0.28	3.0	20.0 d	0.47	5.0	13.6 d
$NaHCO_3$	8.5	0.50	4.2	14.5 d	...	...	...	...	...	...
K_2CO_3	11.0	...	...	...	0.30	3.0	33.0 c	0.50	5.0	27.2 c
$KHCO_3$	8.4	0.50	5.0	23.4 c	...	...	...	0.50	5.0	41.6 b
NH_4HCO_3	7.6	0.50	4.0	24.4 c	0.38	3.0	39.0 c	...	...	...

[x] Values in test 1 are the means of 10 replicates of 25 lemons each, immersed for 2 min at 26°C and stored for 3 weeks at 13°C; values in test 2 are the means of 4 replicates of 25 each, immersed for 2 min at 40°C and stored for 2 weeks at 20°C; values in test 3 are the means of 5 replicates of 25 each, immersed for 1.5 min at 40°C and stored for 2 weeks at 20°C.

[y] M = concentration in molarity; % = concentration in wt/vol; NA = not applicable; ... = treatment not applied.

[z] Values within columns followed by unlike letters are significantly different ($P \leq 0.05$) by Fisher's least significant difference applied after an analysis of variance of arcsin transformed values. Actual data are shown.