GRAPE, (*Vitis vinifera* 'Princess Seedless')
Postharvest gray mold; *Botrytis cinerea*

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Evaluation of alternatives to fungicide to control postharvest gray mold alone or with ozone storage in grapes, 2011.

Gray mold, caused by *B. cinerea*, causes severe losses since it spreads easily among berries during cold storage. Currently, it is controlled by fumigation with SO_2 or SO_2-emitting sheets within boxes. Alternative methods, such as storage in ozone atmospheres, are needed because SO_2 is banned in organic agriculture and consumers prefer to avoid SO_2 residues. The effectiveness of three alternative treatments to control postharvest gray mold alone or in combination with ozone atmosphere storage were evaluated. The trial was arranged using a completely random experimental design, with five or six clamshell boxes (replicates) prepared for each treatment. Approximately 1.5 kg of freshly harvested, organic 'Princess Seedless' grapes were dipped for 60 seconds in 1% vol/vol hydrogen peroxide (30% a.i. hydrogen peroxide, Brenntag Pacific, Inc., Fresno, CA) containing 6mM copper sulfate (Sigma-Aldrich Chemical Co., St, Louis, MO), 1% wt/vol chitosan (99% a.i. chitosan, Chito Plant, ChiPro GmbH, Bremen, Germany), or 0.5 % wt/vol potassium sorbate (99% a.i. potassium sorbate, Fruit Growers Supply, Exeter, CA) and placed into clamshell boxes. All were stored at 2°C, either in air or ozone at 150 parts per billion (ppb). Ozone concentration in the storage room was maintained automatically with a system that employed an air drier, oxygen concentrator and corona-discharge ozone generator (Purfresh, Inc. Fremont, CA). For comparison purposes, grapes were either not treated or an SO_2 sheet (3 g anhydrous sodium bisulfate, Uvas Quality Grape Guard, Imal Ltda, Santiago, Chile) was placed in boxes. Two single berries were infected by injection of 20 µl of a suspension containing 10^6 conidia of *B. cinerea* (isolate 1440) per ml and placed in each side of each clamshell after treatment at the beginning of storage. After 3 weeks at 2°C, natural incidences of gray mold and other rots were recorded. Spread of gray mold from the inoculated berries was recorded as the number of infected berries near it. Aerial mycelial growth on inoculated berries, shatter (naturally detached berries) and rachis appearance were evaluated.

Chitosan, potassium sorbate, or hydrogen peroxide + copper sulfate, followed by storage in air or ozone, reduced the incidence of natural gray mold and other rots compared to the control. Ozone consistently reduced the spread of gray mold from the inoculated berries, but was not very effective alone. The combination of ozone storage with treatments of chitosan, potassium sorbate or hydrogen peroxide + copper sulfate generally had both a lower incidence of gray mold and other rots and a reduced rate of gray mold spread from inoculated berries. The number of shattered berries was significantly reduced by all the treatments. The rachis appearance was variable and possibly harmed by potassium sorbate. Although none matched the effectiveness of the SO_2 emitting sheets, these alternative treatments combined with constant low-level ozone storage were promising, although the use of processes that wet the grapes after harvest are not used by most grape growers.

		Natural decay (%)		Inoculated gray mold			
Treatment	Ozone	Gray mold	Other rots	Mycelium growth[z]	Infected berries	Shatter (%)	Rachis rating[y]
Control[x]	No……..	34.2 a[w]	5.9 a	1.6 cd	3.2 a	28.9 a	2.3 ab
Control	Yes……..	34.5 a	1.5 c	1.1 cde	2.0 ab	10.9 bc	0.9 b
Chito Plant	No……	8.3 b	1.4 c	2.7 a	1.8 bc	4.9 c	1.5 b
Chito Plant	Yes…….....	5.0 b	1.6 c	0.7 e	0.2 d	4.1 c	1.2 b
K sorbate	No……...	13.0 b	2.1 bc	2.4 ab	2.0 ab	6.9 bc	3.6 a
K sorbate	Yes……..	11.4 b	0.9 c	1.1 cde	0.5 cd	7.3 bc	1.8 b
H_2O_2 + $CuSO_4$	No……...	11.3 b	3.6 b	1.7 bc	2.2 ab	10.2 bc	2.3 ab
H_2O_2 + $CuSO_4$	Yes……..	10.6 b	1.9 bc	0.9 de	0.2 d	7.9 bc	2.2 ab
SO_2 sheets	No……	0.2 c	0.7 c	0.0 f	0.0 e	12.6 b	0.9 b

[z]The mycelium development rating employed a scale of 0 to 5, where 0 = no mycelium; 1 = just visible to 5% of berry surface; 2 = >5 to 15% of berry surface; 3 = >15 to 30%; 4 = >30% to 60%; 5 = >60%.
[y]The rachis appearance rating employed a scale of 0 to 5, where 0 = fresh and green; 1 = pedicels only are brown; 2 = all pedicels and <50% of the laterals are brown; 3 = pedicels and >50% of the laterals are brown; and 4 = pedicels and laterals brown, main rachis stem green; 5 = rachis entirely brown.
[w]Values within columns followed by unlike letters are significantly different according to Fisher's protected LSD ($P = 0.05$).
[x]The control grapes were not treated.