

## **Efficacy of Ozone Combination Treatment to Control Bean Thrips in Navel Oranges**

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This research investigates the efficacy of ozone combined with carbon dioxide and vacuum to control bean thrips in navel oranges. A focus of this work in 2004-2005 was effects of wax type and cultivar to mitigate phytotoxic damage.

Our main objective was to determine if any phytotoxic response develops in navel oranges following exposure to 5000 ppm ozone (O<sub>3</sub>) at 41°F in combination with carbon dioxide (7-10%) and vacuum (-10" Hg). Oranges were obtained weekly from various packinghouses and delivered to the USDA-ARS San Joaquin Valley Agricultural Services Center in Parlier for testing.

Four cultivars were included: OLW, Atwood, Fisher, and TIs. Waxes from four manufacturers were included, coded Wax A, B, C, or D. Shellac from all four wax manufacturers was tested, but carnauba from only A and B. Presence of fungicides (TBZ and/or Imazalil) was variable and often unknown.

This year's tests were not as controlled in design as would normally be the case. Fruit was supplied from several packing facilities and several factors were highly variable or not known at all. Unknown or highly variable parameters included fruit quality, presence or absence of fungicides (TBZ and/or Imazalil), and the rate and quality of application of the waxes. Unfortunately, the quality of the wax application was highly variable and the rate of application was always unknown. Any quantitative data derived from the experiments is meaningless. Hence, this year's experiments tended to generate more questions than answers and allowed for only descriptive comments to be made.

We observed five different and distinctive types of rind injury to navel oranges due to exposure to gaseous ozone (5,000 ppm, 2 h, 41°F, 7-10% CO<sub>2</sub>, -10" Hg): 1) navel discoloration (Figure 1) was characterized by areas of cell desiccation and collapse at the edges of the navel in cultivars prone to "navel crack-out"; 2) rind stippling showed wide spread injury or collapse to non-oil cells with little or no discoloration or darkening; 3) rind damage (Figure 2) affected oil cells with associated darkening and collapse of damaged cells; 4) red wound (Figure 3) appeared as dark red discoloration surrounding pre-existing mechanical wounds, scrapes, or other scarring; and 5) wound cauterization (Figure 4) was observed as depressed areas of cauterization encircling pre-existing puncture wounds and with no discoloration.

Data from tests in recent years showed that application of wax to the fruit surface afforded protection to the navel orange from damage resulting from exposure to gaseous ozone. This has been the case, without exception, up until this year. Several growers, packers, and scientists working in the citrus industry have complained that this was a "weak rind" year with damage to the rind occurring at every step of processing. With the combination of variables and the "weak rind" this year, damage to rind only told us that we needed to repeat the testing under more controlled conditions.

Next year we hope to conduct more tightly controlled, scientific experiments to establish minimum application rates of shellac or carnauba waxes that will protect the navel orange from damage caused by exposure to gaseous ozone.

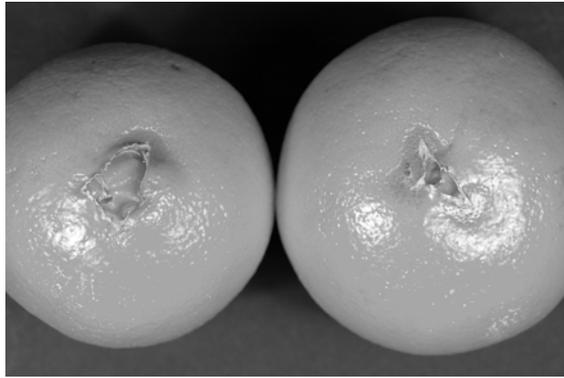


Figure 1. Navel discoloration and desiccation.

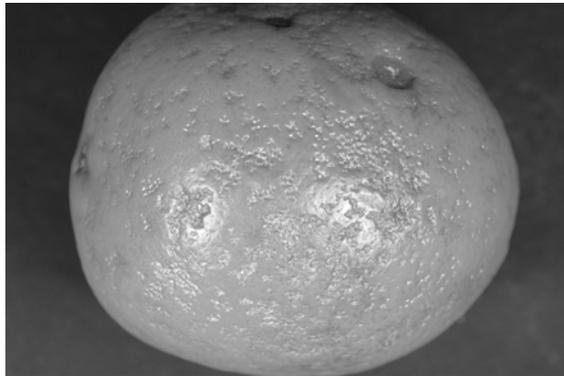


Figure 2. Rind damage and darkening.

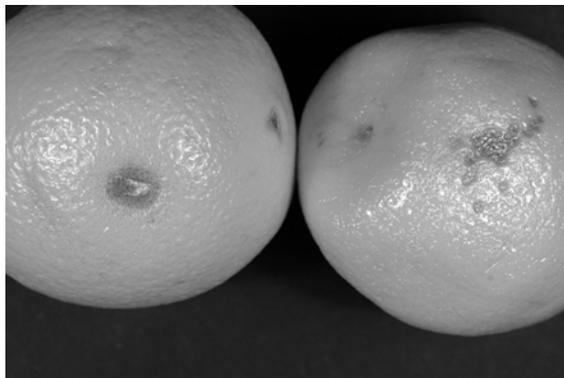


Figure 3. Red wound.

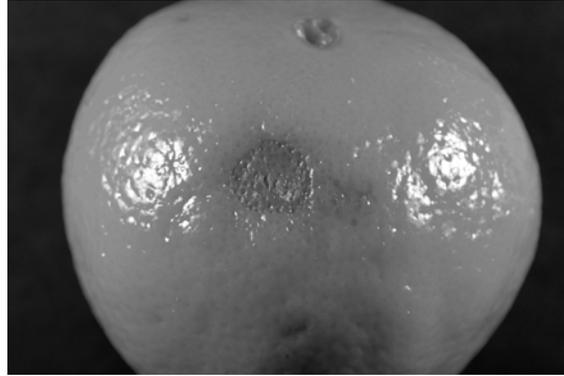


Figure 4. Cauterization.

Wax	Type	Cultivar			
		OLW	Atwood	Fisher	TIs
A	Shellac	X	X	X	X
	Carnauba	X	X	X	—
B	Shellac	X	X	X	X
	Carnauba	X	X	—	X
C	Shellac	X	X	X	—
	Carnauba	—	—	—	—
D	Shellac	X	X	—	—
	Carnauba	—	—	—	—

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