EFFECTS OF FUMIGANTS AND AERATION ON LEMON AND NECTARINE QUALITY/PHYTOTOXICITY

Louis H. Aung, J. F. Jenner*, J. G. Leesch and F. J. Ryan
USDA, ARS, Horticultural Crops Research Laboratory
2021 S. Peach Ave., Fresno, CA 93727

Methyl bromide (MB) has been used in world agriculture over the past 60 years for controlling both pre- and postharvest pests. The loss of MB in 2005, therefore, will significantly affect world food production, trade and the prevention and control of postharvest diseases and pests. New fumigants are needed, and they may be more practical and less expensive as alternatives to MB than certain nonchemical (e.g. temperature) treatment for pest disinfestation of horticultural fresh commodities. The biocidal property of carbonyl sulfide (COS), methyl iodide (MI) and sulfuryl fluoride (SF) are recognized, but tests on specific fresh commodities are lacking. Thus, the present investigations were initiated to assess the effects of COS, MI and SF fumigation and postfumigation aeration on the quality and phytotoxicity of lemon and nectarine.

Lemons were treated with MI at 0, 10, 20, 40, 60 mg/liter, SF at 0, 10, 20, 40, 80 mg/liter and COS at 0, 20, 40, 60 and 80 mg/liter. MI at ≥ 40 mg/liter caused significant fruit injury. Conditioning lemons at 15°C for 3 days before MI fumigation reduced lemon phytotoxicity. Forced aeration at 3.5 standard liters per minute of lemons for 24 hour after MI fumigation at 20 mg/liter significantly reduced phytotoxicity compared to 2 hour postfumigation aeration after MI treatment. SF at ≥ 40 mg/liter caused severe commodity phytotoxicity of both conditioned or unconditioned fruit. Both MI and COS intensified nectarine peel color and significantly inhibited fruit softening. MI at 25 mg/liter did not significantly alter fruit quality as shown by Brix value and firmness. COS treated lemons acquired an off-odor after fumigation, but it dissipated subsequently.

Total glutathione in lemon flavedo tissue, a measure of antioxidant status, decreased 87% in comparison to that of control tissue after fumigation with MI at 20 mg/liter followed by a 2 hr aeration, but was only 45% lower than the control value after a 24 hr forced aeration. Glutathione levels in lemon flavedo were not significantly affected by fumigation with 40 mg/liter SF. From these results, it was shown that glutathione in lemon flavedo responded dramatically to MI fumigation, as would be expected from the chemical reactivity of the fumigant. In the case of SF, however, even though levels of phytotoxicity were appreciable with both 2 and 24 hr aeration, no perturbation of the levels of glutathione were evident immediately or after 5 weeks storage. This may indicate that the mechanisms of phytotoxicity are different between the two fumigants, or that changes in glutathione are correlative at best and not related to the mechanism of phytotoxicity in any case.

The present work indicates conditioning and forced aeration after fumigation lessened phytotoxicity, but the amount of benefits obtained depended on the kinds of fumigant and types of commodity fumigated.