

Integrated control of blue and gray molds of apples with antagonistic yeasts combined with carbon dioxide or ozone

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Abstract

Botrytis cinerea and *Penicillium expansum* are the most important pathogens of apples during the postharvest phase. In the present study, the effect of ozone (O₃) and carbon dioxide (CO₂) gases combined with application of the yeast isolates *Candida membranifaciens* A2, *Saccharomyces cerevisiae* 69, *Pichia guilliermondii* M47 and A6, was investigated to control blue and gray molds of apples in vitro and in vivo conditions. In vitro, O₃ and CO₂ treatments exerted respectively fungistatic and fungicidal activity on fungal spores. In dual culture tests, the combination of antagonistic yeasts with CO₂ was the most efficient way to control the growth of both pathogens. In vitro, O₃ completely inhibited the growth of yeast isolates, whereas CO₂ did not influence the yeast growth. Inoculation of apples with *C. membranifaciens* A2, *P. guilliermondii* A6 or *S. cerevisiae* PTCC 69 in combination with CO₂ completely suppressed blue or gray mold symptoms for up to 62 days of storage, both at 20 °C and 4 °C. Yeasts combined with O₃ (10 ppm) were poorly effective in controlling disease development on fruit. However, CO₂ or O₃ treatments used alone resulted in a decrease of apple quality after 62 days of storage at 4 °C; necrotic spots were observed for fruits treated with O₃.