Effects of surface treatments and application shanks on nematode, pathogen and weed control with 1,3-dichloropropene

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Abstract

BACKGROUND: Preplant fumigation with methyl bromide (MeBr) has been used for control of soilborne pests in high-value annual, perennial and nursery crops, but is being phased out. In 2007 and 2008, research trials were conducted to evaluate the effects of surface treatments and two application shanks on pest control with 1,3-dichloropropene (1,3-D) in perennial crop nurseries.

RESULTS: All 1,3-D treatments controlled nematodes similarly to MeBr. Application of 1,3-D with virtually impermeable film (VIF) reduced Fusarium oxysporum compared with unfumigated plots, but was not as effective as MeBr. Applications of 1,3-D with VIF or 1,3-D followed by metam sodium reduced Phytophthora spp., but 1,3-D followed by intermittent water seals was comparable with the untreated plots. When sealed with high-density polyethylene (HDPE) film or VIF, 1,3-D generally was as effective as MeBr for reducing weed density and total weed biomass, but weed control was reduced by intermittent water seals and in unsealed plots subsequently re-treated with additional 1,3-D or metam sodium.

CONCLUSION: Applications of 1,3-D sealed with HDPE or VIF film or with intermittent water seals can control nematodes similarly to MeBr. However, additional management practices may be needed for effective pathogen and weed control if plastic film is not used.

Keywords: 1,3-dichloropropene; methyl bromide; nursery stock; soil fumigation; surface sealing

1 INTRODUCTION

The fumigant methyl bromide (MeBr; CH₃Br) has been widely used for several decades for preplant control of nematodes, pathogens and weeds in horticultural crops, and also for commodity and post-harvest quarantine treatments. However, MeBr was listed as an ozone-depleting substance and officially phased out as of January 2005 under the US Clean Air Act and the Montreal Protocol.1 Owing to the commercial importance of this pesticide, there have been a considerable number of studies conducted to find technically feasible, economically viable and environmentally sound alternatives to MeBr for broad-spectrum pest control in high-value annual, perennial and nursery cropping systems.

California produces more than 50% of all fruits, vegetables and nuts and accounts for about 22% of the total agricultural pesticides used in the United States.2 Open-field nursery production of tree, vine and ornamental plants in California is subjected to strict certification procedures for production of nematode-free nursery stock.3 MeBr is currently used in nursery nurseries under the Critical Use Exemption (CUE) and Quarantine/Preshipment (QPS) criteria allowed under the provisions of the Montreal Protocol.1 Because these uses are under increasing international scrutiny, effective alternatives are needed in order to avoid severe economic impacts on the California nursery industry.3,5 Without effective treatments, the impacts of soilborne diseases and nematodes could increase nursery stock losses to unpredictable levels and reduce the productivity of thousands of hectares of fruit orchards and vineyards planted with infested nursery stock.5,6 Economic losses as a result of MeBr withdrawal could be in excess of $US 1.5 billion annually in the United States if suitable alternatives are not found.7

Several fumigants, including 1,3-dichloropropene (1,3-D), chloropicrin, metam sodium and other methyl isothiocyanate (MITC) generators, carbon disulfide, propylene oxide, methyl iodide and propargyl bromide have been tested in various cropping systems.8-12 However, 1,3-D is the only one of these alternatives that is currently widely used as a nemacide in California because of registration or efficacy limitations.13 In 1990, concerns about the health effects of 1,3-D air emissions resulted in suspension of registration in California; however, with modified equipment and soil condition requirements, use of 1,3-D was re-established since 2002.

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