The Latest on Soil Fumigation in Bareroot Forest Nurseries

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Background

Soil fumigation has been used in bareroot forest nurseries to control pathogens, nematodes, insects, and weed seed for many decades (Cordell 1989; Landis and Campbell 1996). Many fungal pathogens are difficult or impossible to control with post-emergent pesticide applications so a majority of nurseries rely on fumigation to keep disease incidence at a minimum. Depending on the fumigant used, some of the target pests include soil fungi (*Fusarium, Pythium, Cylindrocarpon,* charcoal root rot, *Cylindrocladium, Phytophthora)*, parasitic nematodes, and most weed seeds. At a cost of more than $1000 per acre, soil fumigation can be the most costly cultural practice in a bareroot nursery. This cost is usually justified by the healthy, uniform seedling crop that results from a relatively pest-free field.

Fumigation materials and application procedures

The primary chemicals currently used for fumigation in bareroot forest nurseries are methyl bromide (in combination with chloropicrin), chloropicrin, Basamid (Dazomet), Telone, metam-sodium, and methyl iodide (listed in order of overall usage preference and frequency among forest nurseries). Each of these are either injected or incorporated into the soil and covered with a tarp to seal the surface for a period of time following application (2 to 40 days depending on the fumigant). After application, a toxic gas develops and penetrates the soil profile by moving through the soil pores and coming into contact with the target pest. Fumigant type, application rate, soil characteristics (temperature, moisture, texture, bulk density, and organic matter content), tarp material, duration of tarping, and target organisms all influence the degree of pest control (Cordell 1989; Landis and Campbell 1996; Wang and others 2006). Some nurseries used to do their own fumigant applications, but most bareroot forest nurseries in the US are currently using professional applicators to fumigate their soil. This is to ensure maximum safety, efficiency, and effectiveness.

Methyl bromide phase out

In 1991, methyl bromide was detected in significant concentrations within the earth's stratosphere. Subsequent testing determined it to be a contributor to ozone depletion. As a result, methyl bromide was categorized as a Class 1 ozone depleting substance and was put under a phase out schedule pursuant to the Montreal Protocol and the Clean Air Act (Table 1). Since that time, many trials have been conducted to examine alternatives to methyl bromide. Chemical, biological, and cultural treatments have been examined to evaluate their efficacy for pest control as well as their effect on seedling growth, yield, and quality. Specific treatments have included cover crops, compost, solarization, steam, fungicides, and others (Cooley 1985; Stevens 1996; Hildebrand and others 2004). The forest nursery industry is only one small sector that is

Table 1 — Production and import phase-out schedule followed for Methyl Bromide (Source: US EPA, The Phaseout of Methyl Bromide, http://www.epa.gov/Ozone/mbr [accessed 8 Sep 2009])

1993 to 1998	Freeze at 1991 baseline levels (US Consumption ~25,500 metric tons) (consumption = production + imports - export)
1999 to 2000	25% reduction from baseline levels
2001 to 2002	50% reduction from baseline levels
2003 to 2004	70% reduction from baseline levels
2005	100% phase out - except for allowable exemptions[1]

[1]Allowable exemptions to the phaseout (agreed to by the Montreal Protocol Parties) include 1) the Quarantine and Preshipment (QPS) exemption, to eliminate quarantine pests, and 2) the Critical Use Exemption (CUE), designed for agricultural users with no technically or economically feasible alternatives.

significantly impacted by the loss of methyl bromide; many agricultural crops such as strawberries, melons, tomatoes, and peppers also rely on this fumigant for optimum production. As a result, the Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions has been held since 1994 with the goal to develop and implement economically viable and environmentally sound alternatives (http://mbao.org).

Soil Fumigants and the EPA Re-registration Eligibility Decisions

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the EPA reviewed several soil fumigants over the past few years to ensure that they meet current scientific and regulatory standards. In 2008, the EPA announced new rules for soil fumigants as a result of their Re-registration Eligibility Decisions (REDs). Prior to announcing those rules, there was a great deal of input from the forest nursery industry and other agricultural entities regarding the importance of soil fumigation, the safe practices already in place, the long-standing safety record, and the economic impact of reduction or elimination of soil fumigant use. Nevertheless, the rules (as published in 2008) were expected to have severe impacts on bareroot forest nurseries and other agricultural crops. The rules for chloropicrin were especially worrisome given the fact that many years of research identified it as the most promising alternative to methyl bromide (Carey 2000; South 2007).

There was widespread outcry and numerous submissions to the public docket in opposition to the REDs published in 2008. Many were asking how this could come about when there had had not been any noteworthy instances of injury. It was noted that a person has a higher probability of dying from a fall in this country than of experiencing eye irritation from soil fumigation. Some of the new requirements were expected to result in nursery closures, doubled or tripled bareroot seedling prices, and reduced seedling quality and uniformity. Depending on the product and application rate, required buffer zones around fumigated beds and nearby buildings would effectively take many acres out of production and necessitate multiple entries for fumigation thereby increasing costs and raising safety concerns. Intensive monitoring for emissions was also expected to be very costly. Additionally, there was concern that the mandated community outreach would unnecessarily frighten neighbors who had lived in harmony with nearby nurseries for decades without incident. From a scientific standpoint, the statistical validity of the data used to generate the risk models and develop the REDs was in question since it was based on data collected from arid sites in Arizona and did not

As methyl bromide is injected into the soil, it is immediately covered with a plastic tarp

Table 2 — Modifications from 2008 to 2009 Amended Soil Fumigant REDs (Source: US EPA, Implementation of risk mitigation measures for soil fumigant pesticides, http://www.epa.gov/oppsrrd1/reregistration/soil_fumigants/#soilreds [accessed 8 Sep 2009])

Mitigation	2008 REDs	2009 Amended REDs
Buffers	Buffer zones based on available data	• New chloropicrin data support smaller buffers and increased confidence in safety • New dazomet data support larger buffers
Buffer Credits	Credits allowed based on available data	• New data support more credits
Rights-of-Way	Permission from local authorities must be granted if buffers extend onto rights of way	• Permission from local authorities is only required when sidewalk is present
Buffer Overlap	Buffers may not overlap	• Buffers may overlap; separate applications by 12 hours
Restrictions for Difficult-to-Evacuate Sites	¼ mile restriction around hard-to-evacuate areas including day care centers, nursing homes, schools	• Maintain 1/4 mile restriction but allow a reduced restricted area of 1/8 mile for applications with smaller buffers (less than 300 feet)
Respiratory Protection	Required monitoring devices to trigger additional measures	• Allow sensory irritation properties to trigger additional measures for MITC and chloropicrin • Device required for methyl bromide formulations with <20% chloropicrin
Emergency Response and Preparedness	If neighbors are near buffers, they must be provided with information or buffer zones must be monitored every 1 to 2 hours over 48 hours with monitoring devices	• Same basic measures • Monitoring is required only during peak emission times of the day; irritation acceptable trigger for MITC and chloropicrin in lieu of devices; methyl bromide requires devices

account for critical soil characteristics (for example, moisture), which have a profound influence on fumigant behavior following application. The EPA staff acknowledged several “gaps” and “uncertainties” in their risk models but were hampered by a limited amount of available data. Another concern was that decreased production of forest seedlings and other agricultural commodities in the United States would result in more importing of these goods, possibly from sources without adequate safety and quality standards.

Although the 2008 REDs were labeled “final”, the considerable objection and the availability of new emissions data for development of more accurate risk models led to revision of the REDs (Table 2). While these new rules will not be nearly as devastating to forest nurseries, they will still have a significant impact on bareroot seedling production.

Clearly, no one in the nursery industry wants to compromise safety for their employees, their surrounding community, and the environment. That is evidenced by the excellent chemical safety record among nurseries. All operations should routinely take protective and preventative measures as dictated by all applicable laws and regulations for their pest management activities. Nonetheless, as the EPA and the general public focus more and more on being “green”, there is likely to be continued scrutiny for chemical usage in plant production. Therefore, it is critical for the industry to be proactive by continuing to explore alternative treatments as well as to collect rigorous scientific data on current treatments should it be needed during future reviews.

Sources

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