Stratospheric Ozone Protection Case Study
Methyl Bromide Alternative

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Weyerhaeuser: Integrated Approaches to Developing Alternatives to Methyl Bromide

Summary
The Weyerhaeuser Corporation is a large forest products company operating private bare-root nurseries in the United States and British Columbia, Canada (Littke 1994a). Due to concerns over the continued availability of methyl bromide for tree seedling production, Weyerhaeuser formulated a strategy to identify and investigate potential alternatives to methyl bromide including alternatives that reduce reliance on chemicals. Both alternative chemical fumigants and a variety of cultural and stock selection techniques have been identified for the control of soil-borne pests. Based on trial results Weyerhaeuser has determined that Basamid or metham sodium can partially replace methyl bromide in the short term while soil solarization or steaming, cultural technologies and biocontrol may offer non-chemical alternatives in the long term after further research and refinement of the techniques.

Weyerhaeuser has used methyl bromide fumigation in its nurseries, since the mid-1970's as the principal treatment to eradicate soil-borne pests including insects, plant pathogens, nematodes, and weeds (McCullough 1994). At Weyerhaeuser nursery sites, commercial contract fumigation companies inject methyl bromide into the soil prior to planting and covers the treated areas with a tarp to limit volatilization and maximize soil concentrations. The company uses both the 98/2 and the 67/33 methyl bromide/chloropicrin formulations depending on soil conditions, and generally applies the mixture at a rate of about 350 pounds per acre (Terry 1994, Littke 1994b). Currently, Weyerhaeuser uses approximately 39 metric tons (85,000 pounds) of methyl bromide annually to treat 250 acres of forest tree nurseries in the United States (Littke 1994b). Overall, total forest tree nursery production in the United States is concentrated in the southeastern and northwestern United States and accounts for approximately one percent of total U.S. methyl bromide consumption (EPA 1994).

Benefits of Integrated Pest Management

- *reduces the need for fumigation and decreases production costs*
- *relies on a preventative proactive response*
- *reduces disease outbreaks and increases biological diversity*
- *helps reduce U.S. consumption of methyl bromide*

Integrated Pest Management

Weyerhaeuser's pest management goals were developed in 1985 and consist of reducing reliance on chemicals, developing approaches that incorporate integrated pest management techniques,

investigating methods to increase biological soil diversity, improving the understanding of disease cycles, developing a preventative proactive response, and developing new pest management paradigms. To find alternatives to methyl bromide, Weyerhaeuser has investigated and operationally tested both chemical and non-chemical pest management techniques. These approaches are discussed below.

Chemical Alternatives

Weyerhaeuser has performed field trials in sandy soils in the southeastern U.S. using two fumigants, Basamid and metham-sodium to measure their effectiveness at controlling the principle soil pests (e.g., *Fusarium, Phytophthora, Pythium, Rhizoctonia*). Both fumigants provided similar levels of seedling emergence and resulted in equal knockdown of *Fusarium* as compared to methyl bromide (Littke 1994a). Based on the successful completion of these trials, Weyerhaeuser believes that Basamid or metham sodium can effectively replace methyl bromide in the short term at a cost that is comparable to methyl bromide fumigation. Both chemicals are registered for this use. Further examinations of the efficacy offered by these fumigants in controlling a broad range of soil pests under varying soil conditions are underway. Additionally, Weyerhaeuser has also begun trials using the chemical fumigants Telone and chloropicrin, but results are not yet available. (Littke 1994b).

Non-Chemical Alternatives

Non-chemical techniques under investigation by Weyerhaeuser include soil pasteurization by steam treatment or solar irradiation, biological controls which result in pest suppression, and cultural practices that reduce cumulative plant stresses thus decreasing the risk of disease outbreaks in crops and soil management methods which increase biodiversity and competition in the soil under crops (Littke 1994a, Littke 1994b).

Soil Solarization and Pasteurization

Soil solarization, a technique using clear-plastic tarps to trap solar radiation, can heat the soil profile to temperatures that effectively suppress soil-borne pests in areas with sufficient levels of solar radiation. For example, Weyerhaeuser has achieved soil temperatures sufficient to control pests in the upper 8-cm of soil in the southeastern United States. During solarization trials held in Arkansas in July and August, temperatures of 50-60øC (122-140øF) were achieved at a depth of 3 inches successfully suppressing *Fusarium* levels through two successive loblolly pine crops (Littke 1994a). However, in other growing areas (i.e., the Pacific Northwest), either the quantity or the duration of effective solar radiation is insufficient to control soil pests.

When pasteurization accomplished by soil solarization is applicable, soil pasteurization accomplished with the use of steam heat can be an additional, effective method of soil disinfestation. Either technique can be employed independently or in combination to raise soil temperatures sufficiently to destroy nematodes, soil pathogens, and weeds. In fact, Weyerhaeuser laboratory trials combining steam pasteurization with solarization suggest that this may be an effective and economical soil treatment (Littke 1994b).

Cultural Controls
Weyerhaeuser is investigating methods of disease avoidance through proper cultural management, phytosanitation requirement of propagation fields, and the potential role tree genetics might play. Current areas of research interest include: (1) producing high quality vigorous seed, (2) seed and seedling testing to reduce the likelihood of unwanted pest introduction, (3) achieving uniform irrigation, (4) reducing the need for nitrogen fertilization during the summer months, and (5) modification of root morphology through root pruning culture, undercutting, and bed wrenching (Littke 1994a). Weyerhaeuser's aim is to decrease the likelihood of cumulative plant stresses which predispose seedlings to disease. Attaining this goal could potentially reduce the need for fumigation in the future (1994a).

Biological Control
A variety of composts and biological organisms are being evaluated for use as preplant soil treatments. Trials using chicken-litter, yard waste, crab processing residues, and cricket litter have been conducted to evaluate their ability to control disease and suppress pests. The composts contributed positively to soil fertility and disease suppression, but further development of the technique is necessary to increase consistency of results within and between different types of compost (Littke 1994a).

Weyerhaeuser has begun to examine biological organisms, such as parasitic nematodes, fungi, and bacteria for controlling weeds, disease organisms, and nematodes. Specifically, Weyerhaeuser is investigating biological control agents along with other investigators using techniques such as boosting levels of antagonistic biocontrol agents in compost media, direct application of biocontrol agents to seed beds, and the potential for development of mycoherbicides as weed control agents. Weyerhaeuser is investigating the potential for utilizing biological control agents coupled with other cultural practices (soil pasteurization, crop rotations, and bare-fallow treatments) in the hope of intensifying their ability to combat disease.

Future Efforts
As a result of research efforts to identify alternatives to methyl bromide, Weyerhaeuser intends to continue an integrated approach to managing soil pests. Research results show promise in the development of effective alternatives to methyl bromide, by the deadline of 2001 and the phase out of methyl bromide. However, to date, no single treatment has demonstrated the potential broad spectrum biocidal efficacy of methyl bromide in control of weeds, pathogens, insects, and nematodes. Weyerhaeuser will continue to take a proactive stance in the investigation of alternatives to methyl bromide and will continue to attempt to approach the problem of finding alternatives by developing new pest management paradigms. Rather than search for a single, stand-alone solution, Weyerhaeuser believes that the combination of techniques described above can be used as substitutes to methyl bromide.

References

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