Enclosure 1 - Alternatives to Fumigations-II

FHP Technology Development Project Proposal
FY 1998 Full Proposal
November 3, 1997

PROJECT STATUS: New, not previously funded.

PROJECT NUMBER: R2-98-01

PROJECT TITLE: Alternatives to Fumigation-II

SUBJECT: Nursery Diseases

PROJECT OBJECTIVE: Enhance integrated pest management by developing new or fine-tuning alternative cultural and chemical regimes for production of high quality bare-root conifer seedlings at USDA-Forest Service and State nurseries, with minimal fumigation, especially without methyl bromide.

BRIEF DESCRIPTION OF PROJECT: Building on the information learned from the previous nursery TDP (Alternatives to Fumigation, R6-93-01) and other work, nurseries in every Region (except 3 and 10) will participate in field comparisons of a variety of cultural treatments customized for each nursery. Treatments include use of bare fallowing, beneficial microorganisms, seed treatments, organic amendments, mulches, cover crops, tilling, solar heating, fumigants, herbicides, and changes in irrigation, fertilization, and sowing.

FHP PERSON WHO WILL SPONSOR THE PROJECT: Jeri Lyn Harris, R2

JUSTIFICATION: Forest tree nurseries throughout the United States rely on methyl bromide fumigation to control soilborne pests in bareroot operations (Smith and Fraedrich 1993). Currently no one alternative is as effective as methyl bromide + chloropicrin (MBC) as a broad spectrum biocide. The widespread reliance on chemical fumigation with MBC for control of diseases, insects, nematodes, and weeds for the past 30 some years, has left many nurseries unprepared for the loss of methyl bromide in the year 2001.

Chemical fumigation is expensive, and detrimental to human and environmental health. Nurseries need help in developing integrated cultural regimes tailored to their specific site conditions, crops, and pests, that will enable production of economical quantities of high quality seedlings without use of methyl bromide and with reduced use of other fumigants. Previous work identified some promising treatments and techniques that need refinement for use at each nursery. In addition, new products are available, including beneficial microorganisms, that need to be tested.

URGENCY: The Environmental Protection Agency plans to withdraw the registration of methyl bromide in the year 2001. To date, alternative methods of controlling Macrophomina sp. (cause of charcoal root rot) and Cyperus sp. (nutsedge) and other persistent problems have not been effective, and some nurseries are still relying on MBC fumigation. Nurseries require alternative technologies for controlling pests to be in place by 2001.

LINK TO NATIONAL FHP TECHNOLOGY DEVELOPMENT PRIORITIES: Over the past several
years, developing alternatives to methyl bromide fumigation for nurseries has been rated a top priority for technology development by both Eastern and Western Disease Committees.

SCOPE OF APPLICATION: Results from this project will be generally applicable to other nurseries across the country. Benefits will be highest for cooperating nurseries, and hundreds of nurseries nationwide will also benefit as they adapt the results to their own situations.

COOPERATORS: R1 Robert James, Coeur d'Alene Nursery
R2 Jeri Lyn Harris, Bessey Nursery
R4 Lucky Peak Nursery (Robert James)
R5 Susan Frankel, Placerville Nursery
R6 Diane Hildebrand, J. Herbert Stone Nursery
R8 Michelle Cram
R9 Ron Overton, Toumey Nursery
NE Area Joe O'Brien, Jill Pokorny
NC Station Jenny Juzwik
Southern Station Stephan Fraedrich, David Dwinell
ARS St. Paul Raymond Allmaras
Auburn University Scott Enebak
University of Minnesota Neil Anderson, Cynthia Buschena
Oregon State University Jeff Stone, Cynthia Ocamb
Alabama Forestry Commission Edward A. Hauss Nursery
Georgia Forestry Commission Flint River Nursery
Minnesota Badoura State Nursery
Wisconsin Griffith State Nursery
Hendrix and Dale, Inc. Clarence Lemons

RESEARCH BASIS: Results from recent work are encouraging; bare-fallow without fumigation, organic amendments, and dazomet are showing satisfactory results for some nurseries (Barnard et al., 1996; Hildebrand et al., 1995). At some nurseries, pathogens are more problematic and additional soil management and chemical applications may be needed (Frankel et al., 1996; Juzwik et al., 1996). Enebak and others (1990) found chloropicrin compared well with MBC for control of soil-borne pathogens.

The most important pest problems concerning nursery managers in the South are nutsedge followed by post-emergence damping-off (Cram and Fraedrich 1996). EPTC (Eptam) is an herbicide now registered for control of nutsedge in southern pine nurseries.

Plant growth-promoting rhizobacteria (PGPR) are used in agricultural crops to promote plant growth, and their use in tree nurseries is an emerging technology (Chanway 1997). In several studies, testing of PGPR on pine and spruce seed resulted in increases in seedling emergence and growth (Holl et al., 1992; O'Neill et al., 1992). Recent tests of 12 PGPR strains on loblolly pine resulted in increased rate of seedling emergence, with three strains decreasing damping-off (Vonderwell and Enebak 1997). Application of rhizosphere bacteria to eastern white pine seed, coupled with application of ectomycorrhizal fungus at sowing, resulted in protection from Fusarium root rot and increased seedling density (Ocamb et al., 1996).

METHODS: Soil treatments will begin by summer 1998, with sowing in Fall 1998 or Spring 1999. Lifting of 2+0 stock will occur in Fall 2000 or Winter 2001. Region 8 will sow and lift three crops of 1+0 southern pine, beginning in spring 1998. Parameters for comparison will be soil population levels of pathogens, and seedling survival and quality.

Treatments will vary by nursery, as follows.

Coeur d'Alene Nursery, ID

Barefallow with tilling, dazomet, sawdust with nitrogen amendment, and supplementary beneficial microorganisms will be compared in large plots for one seedlot of Douglas-fir.

Bessey Nursery, NE

Barefallow with tilling, solar heating, cover crop, dazomet, and MBC will be compared for fall sown eastern redcedar or Rocky Mountain juniper. Plant parasitic nematodes are an additional problem at Bessey.

Lucky Peak Nursery, ID

Barefallow with tilling, dazomet, sawdust with nitrogen soil amendment, and supplementary beneficial microorganisms will be compared in large plots for one seedlot of ponderosa or lodgepole pine.

Placerville Nursery, CA

Barefallow, cover crop, dazomet, chloropicrin, MBC, and cooling with irrigation will be compared for sugar pine. Charcoal root rot, caused by Macrophomina phaseolina, is a major problem at Placerville.

J. Herbert Stone Nursery, OR

Three cover crops or barefallow with tilling followed by dazomet or no fumigation, and two levels of irrigation on the bare fallow will be compared over several conifer seedlots in a large field.

Edward A. Hauss and Flint River Nurseries (South)

Pre-plant herbicide (EPTC), seed treatment with plant growth-promoting rhizobacteria, chloropicrin, and MBC will be compared for loblolly pine at each nursery. Treatments will be applied in a split-plot factorial design, with the seed treatment split over the five treatments: no fumigation, MBC, chloropicrin alone, EPTC alone, and chloropicrin with EPTC. Nutsedge and damping-off are the most important nursery pest problems in the south.

Toumey Nursery, Badoura Nursery/Griffith Nursery (Northeast Area)

Operational cover crop followed by MBC or Dazomet will be compared with a combination of changes in cover crop culture, root raking and subsoiling, and application of beneficial microorganisms, for eastern white pine, jack pine and red pine. Treatment plots will be assessed for damping-off and early and late root disease.

MEASURE OF SUCCESS/PRODUCTS: In 2001, nurseries will have guidelines for cultural
or chemical treatments that will eliminate the need for methyl bromide fumigation. Cooperating nurseries will be implementing integrated pest management with reduced need for chemical fumigation.

PUBLICATION/TECHNOLOGY TRANSFER: In addition to Regional and nursery reports,
results will be presented at Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions, at Forest and Conservation Nursery Association Meetings, and published in journals.

PROJECT DURATION: Including 1998, three years of funding are required to complete the project.

LONG TERM BUDGET:

Year	R1,2,4,5,6	South	NE Area	Total Request	Contributed
FY 1998	$ 45,000	34,000	21,000	100,000	153,000
FY 1999	45,000	34,900	43,000	122,900	148,500
FY 2000	41,000	34,400	28,000	103,400	147,900
Project Total	131,000	103,300	92,500	326,300	449,400

TY 1998 BUDGET REQUEST: STDP funds requested for FY 1998 = $100,000.

Budget Details for each Region:

West FY 98

	R1	R2	R4	R5	R6	OSU	Total
Salary/Wages		2300				26,600	28,900
Lab supplies/ publications					2500		2500
Travel	1000	2000	1000	1000	2000	1000	8000
Materials/ shipping		300	2000			2300	
Overhead					3300		3300
Total Requested	1000	4600	1000	3000	2000	33,400	45,000
Contributed by Other Sources	10,000	10,000	10,000	10,000	10,000	8700	58,700

South

	FHP	Auburn	FIDR	Total
Travel	5,800	6,100	5,100	17,000
Lab supplies	1,200	2,000	1,200	4,400
Technical support		5,000	4,300	9,300
Chemical	1,500		1,500	
Soil testing	300		300	
Foliage testing	400		400	
Overhead			1,542	1,542
total:	9,200	13,100	12,142	34,442
Contributed by Other Sources	11,500	13,044	45,000	69,544

NE Area

	Requested	Contributed by Other Sources
Salary		
Graduate Student	11,500	10,800
Technician		14,000
Supplies/ Equipment	4,500	
Travel	5,000	
Total	21,000	24,800

PRODUCTION FUNCTION

Project Number: R2-98-01, Alternatives to Fumigation II

Project Cost:

Year	1998	1999	2000	Total
STDP Request	100,000	122,900	103,400	326,300
Contributed by Other Sources	153,000	148,500	147,900	449,400
Total	253,000	271,400	251,300	775,700

Project Objective:

This project will enhance integrated pest management by developing new or fine-tuning alternative cultural and chemical regimes for production of high quality bare-root conifer seedlings at USDA-Forest Service and State nurseries, with minimal fumigation, especially without methyl bromide.

The benefits will be reduced losses in nursery seedling production and reduced cost of pesticide treatments. Benefits will be highest for cooperating nurseries, and hundreds of nurseries nationwide will also benefit as they adapt the results to their own situations. Unquantified benefits of the project include increased soil quality, decreased human health risk, and decreased environmental risk to air, soil, and water quality.

Many nurseries are relying on methyl bromide fumigation for control of soilborne pests, including pathogens, insects, and weeds. Methyl bromide will be unavailable January 1, 2001. Without this project, increased losses to soilborne fungi and weeds are expected. This project will also develop regimes that require less fumigation by alternative fumigants.

Assumptions, Background Data and Quantitative Analysis

Different levels of benefits will accrue to nurseries based on their current reliance on methyl bromide fumigation. Of the 9 nurseries cooperating in this project, one third have benefit expectations at the Bessey level, one third at the Placerville level, and one third at the Flint River level. Each nursery incurs one ninth of the costs of the project ($775,700 / 9 = $86,189). At each of the three levels, benefits and a B/C ratio will be computed. The total project B/C ratio will be an arithmetic average of the three computed B/C ratios. PNV will be computed for the total project based on the average benefits.

Benefits from the project will accrue for 15 years (after which a whole new world of pesticides, regulation, and soil management will have evolved).

1. Bessey Level

Background information:

Annual dazomet fumigation = 15 ac for $18,000 (350 lb/ac plus labor).
Approximately one third of the production acreage (45 ac) is fumigated each year.
Usual rotation is one year of cover crop and two years of conifer, so a piece of ground gets fumigated every 3 years (before the conifer crop is sown). At any given year, one third of the acreage is under cover crop, one third is fumigated and sown, and one third is under 2-0 conifer.

Assumptions:

The alternative treatments of bare fallow with tilling and/or solar heating cost the same as the current procedure of growing a cover crop
Project will result in fumigation needed only every other conifer crop or once every 6 years with no loss in seedling production.

Quantitative Analysis:
Expenditures without project
15 fumigations @$18,000 (discounted depending on year)
18,000 (yr0) + ...+ 18,000 (yr 10) + ...+ 18,000 (yr 14) = $208,136

Expenditures with project
18,000 (yr0) + 18,000 (yr 4) + 18,000 (yr 5) + 18,000 (yr 6) + 18,000 (yr 10) + 18,000 (yr 11) + 18,000 (yr 12) = $112,358

Benefit = Difference in cost = $95,778

Benefit/Cost ratio = $95,778 / ($775,700/9) = $95,778 / $86,189 = 1.11
This B/C ratio does not reflect the unmeasured benefits to environmental quality and human safety by greatly reducing the amount of biocide applied.

2. Placerville level

Background Information:

The difference between production (estimated shippable seedlings) in unfumigated blocks and blocks fumigated with MBC was 33% (1997 inventories of ponderosa pine in fumigated and non-fumigated blocks).
Annual seedling production is 6 million;
Average value of seedlings produced is $270 per 1000 seedlings.

Assumptions:

Alternative fumigants and cultural practices will cost approximately the same as MBC fumigation.
Alternative treatments will result in 15% losses.

The value of seedlings is $270 per 1000 whether the seedlings are produced, destroyed, or not grown (because of excessive losses).

Quantitative Analysis
The difference in losses with and without the Alternatives to Fumigation Project is 33% - 15% = 18%
18% * 6 million seedlings * $270/1000 seedlings each year for 15 years.
= 18% * $1.62 million = $291,600 each year for 15 years = $3.37 million.

Benefit = Difference in losses = $3,370,000

Benefit/Cost ratio = $3,370,000 / $86,189 = 39.12

3. Flint River level

Background Information:
Seedling losses with MBC are 1.5%, and without MBC are 20% (Fraedrich and Dwinell, 1996).
Seedling value is $35 per 1000.
Flint River Nursery produces 18 million seedlings per year.

Assumptions:
Seedling losses with alternative treatments will be 2%.
Alternative treatments have costs equivalent to MBC fumigation.

Quantitative Analysis
The difference in losses with and without the Alternatives to Fumigation Project is 20% - 2% = 18%
18% * 18 million seedlings * $35/1000 seedlings each year for 15 years = 18% * $630,000 each year for 15 years = $1.31 million.

Benefit = Difference in losses = $1,310,000

Benefit/Cost ratio = $1,310,000 / $86,189 = 15.2

Summary Analysis for Entire Project

Benefit/Cost ratio:

B/C for entire project is the arithmetic mean of the three B/C levels computed above = (1.11 + 39.12 + 15.2) / 3 = 18.48

Cost of entire project = $775,700

Benefit attributable to entire project:

Benefit = cost * B/C = $775,700 * 18.48 = $14,336,528

Benefit attributable to STDP:

STDP Benefit = B/C * STDP cost = 18.48 * $326,300 = $6,030,694

PNV of Project:

PNV = Total project benefit minus total project cost =

$14,336,528 - $775,700 = $13,560,828

PNV of STDP:

PNV of STDP = STDP Benefit minus STDP costs =

$6,030,694 - $326,300 = $5,704,394

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