Oregon Department of Agriculture and Oregon Association of Nurseries
Nursery Research Pre-proposal

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Project Title: Developing Pulse electricity as a Fumigant Alternative in Nursery Seedling Beds

Principal Investigator(s):

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Collaborators: Dr. Inga Zasada & Dr. Jerry Weiland, USDA, ARS Horticultural Crop Research Unit, Corvallis, OR; Jason Crisp, Lisi Global, Richland, WA, Sam Doane; J. Frank Schmidt Nursery, Boring, OR and Tyler Roskins, Robinson Nursery, McMinville, OR.

Project background:

This project will evaluate the performance of pulse electricity, safety, and costs as an alternative to methyl bromide in nursery seedling beds. The Pacific Northwest leads the US in tree seedling production. Tree seedling nurseries often rely on fumigation and hand weeding to control soil pathogens, nematodes, and weeds. This practice is unsustainable due to increased regulation, costs, and environmental safety. Although pulse electricity is currently used commercially in golf courses for weed control, we aim to develop it for soil disinfestation. We will explore alternative approaches to soil fumigation using soil-applied energy pulses to control the target organisms using a continuous electrical current to heat the soil - Ohmic heating. Both methods have documented efficacy in a broad-spectrum array of pests. However, it is unclear whether direct energy or Ohmic heating will be more cost-effective for soil fumigation. The volume of soil treated, and depth of treatment application also affects efficacy and costs. The optimum volume of treated soil will depend on the target species to improve the effectiveness of these tools. An economic analysis will be performed to determine whether either of these practices are a cost-effective pest management tool. This project leverages funds from the USDA Methyl Bromide Alternative Program, in which evaluations include control of weeds, nematodes, soilborne pathogens, and economic analysis. We initiated field research in the collaborators' field in the fall of 2022 and quickly noted that much more work is needed to adjust the existing technology to new uses. The current proposal would secure the funds necessary the additional required field work to develop the equipment and expand field studies beyond fall-planted species.

Project objectives:

1) **To develop pulse electricity to control weed seeds and soilborne pathogens in nursery seedlings beds**. The long-term goal is to discover new ways to manage weeds and soilborne pathogens that will reduce costs and reliance on pesticides and soil fumigants, such as methyl bromide, and enhance environmental sustainability of the nursery sector.

Methods & Timeline:

This work expands the collaborative work by USDA Horticulture and a private company (Lisi Global) that has documented the efficacy of pulse electricity in controlling nematodes and soil pathogens (Riga et al. 2020) . A commercially available Direct Energy System unit (DES, Lisi

Global, Inc.) will generate electric energy. This unit delivers energy via pins, or electrodes inserted into the soil in a 6 ft swath from the soil surface to a maximum depth of about 10 in. The energy levels can be adjusted by manipulating the number of electrical pulses and duration of pulses in a pulse-electric field (PEF) on a near-constant manner, rapidly increasing the soil temperature in an Ohmic process heating (OH). Field experiments will be conducted in a commercial tree seedling nursery in Boring, OR (JF Schmidt) and McMinnville (Robinson Nursery). The cooperating growers will prepare the site following the nursery's standard practices. This study will compare the efficacy of a single-level PEF based on work reported by Riga et al. (2020) and OH treatment to achieve a soil temperature of 70° C or greater for 20 min. As the amount of energy required is related to the volume of soil treated, we will compare the efficacy of PEF and OH applied at 5 and 10 cm of depth. A nontreated check will be included as a reference. The collaborating grower will plant tree seedlings. A 5 m long section of the 20 m plots will be inoculated at 5 and 10 cm below the soil surface with packets containing the same fungi, nematodes, and weed species. Weeds that emerge in the plot will be identified at the species level, and the percentage of soil coverage by weeds will be recorded monthly. Hand-weeding will be performed following the collaborating nursery practices. Total hand-weeding time per plot will be recorded to document labor and production costs. Five commercially important species will be planted on each experimental plot, including *Prunus sp, Quercus sp., Acer sp, Fraxinus sp, and Malus sp* (50 seedlings/tree species/treatment). Tree seedling emergence and height will be recorded monthly after soil treatment. Trunk caliper will be recorded before harvest in the fall of the following year. Bare root operations will harvest seedlings and grade their quality according to plant height, trunk caliper, and root and shoot form

The benefit to Nursery Industry:

The objective of this study is to address the need for non-fumigant alternatives for shade tree nurseries, a significant industry in Oregon valued at $118 million yearly. Our proposal will develop a non-fumigant strategy to manage soilborne pests and pathogens. If successful, our project will reduce industry reliance on fumigants and pesticides, decrease labor demands, promote the longer-term economic viability of the industry, and enhance environmental sustainability of the sector. The public-private partnership allows us to adapt an existing and locally available technology for the industry. The research team has a proposal under review with the Horticulture Research Institute.

Budget summary:

	Description	Requested
Personnel		
Technician salary	0.15 FTE ($55,000/ year)	$ 8,250
Employee benefits (OPE)	72%	$ 5,940
Supplies and Expenses		
Equipment	Small equipment, DES replacement parts	$ 3,500
Travel	$1,200/A	$ 2,310
TOTAL REQUEST		$ 20,000

References

Riga E, Crisp JD, McComb GJ, Weiland JE, Zasada IA (2020) Directed energy system technology for the control of soilborne fungal pathogens and plant-parasitic nematodes. Pest Manag Sci 76:2072-2078