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MTSU Clean Energy Initiative Project Funding Request

There are five (5) sections of the request to complete before submitting. See <http://www.mtsu.edu/~sga/cleanenergy.shtml> for funding guidelines. Save completed form and email to cee@mtsu.edu or mail to MTSU Box 5/.

| 1. General Information | |
|--|----------------------------------|
| Name of Person Submitting Request Anthony Farone, PhD | |
| Department/Office Biology | Phone # (Office) 615-898-5343 |
| MTSU Box # 60 | Phone # (Cell) 615-653-6537 |
| E-mail anthony.farone@mtsu.edu | Submittal Date 10/5/2017 |

| 2. Project Categories (Select One) | |
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| Select the category that best describes the project. | |
| <input checked="" type="checkbox"/> Energy Conservation/Efficiency | <input checked="" type="checkbox"/> Sustainable Design |
| <input checked="" type="checkbox"/> Alternative Fuels | <input type="checkbox"/> Other |
| <input checked="" type="checkbox"/> Renewable Energy | |

| 3. Project Information |
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| a. Please provide a brief descriptive title for the project. |
| b. The project cost estimate is the expected cost of the project to be considered by the committee for approval, which may differ from the total project cost in the case of matching funding opportunities. Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission. |
| c. List the source of project cost estimates. |
| d. Provide a brief explanation in response to question regarding previous funding. |
| 3a. Project Title Conservation of Economically-Threatened Wild Ginseng |
| 3b. Project Cost Estimate \$9,000 |
| 3c. Source of Estimate Fisher Scientific (FisherSci.com) |
| 3d. If previous funding from this source was awarded, explain how this request differs? The current ginseng project is unrelated to the previous CEE-funded barbital project (see additional comments section). |

4. Project Description

(Completed in as much detail as possible.)

- a. The scope of the work to be accomplished is a detailed description of project activities.
- b. The benefit statement describes the advantages of the project as relates to the selected project category.
- c. The location of the project includes the name of the building, department, and/or specific location of where the project will be conducted on campus.
- d. List any departments you anticipate to be involved. Were any departments consulted in preparation of this request? Who? A listing may be attached to this form when submitted.
- e. Provide specific information on anticipated student involvement or benefit.
- f. Provide information for anticipated future operating and/or maintenance requirements occurring as a result of the proposed project.
- g. Provide any additional comments or information that may be pertinent to approval of the project funding request.

4a. Scope: Work to be accomplished

Cold-stratified ginseng seeds will be obtained from our contacts with Wisconsin farmers. The seeds will be sterilized, scarified, and germinated in the laboratory with gibberellic acid to stimulate the germination metabolic pathways. Upon germination, tissues will be allowed to grow until samples achieve proper size for extraction. Tissue will be collected and incubated on callus induction medium that has been experimentally optimized for growth. Variation in growth rate, bioactive compound production and production ginseng plant callus tissue will be monitored and inoculated into liquid media cell suspension. Ginseng cultures will be then monitored over time until the tissues achieve 500 ml volumes. Initiation of liquid cell suspension will be replicated three separate times, using the stable cell culture lines. Samples will be filter separated, dried, extracted, and extracts will be analyzed in human tissue culture cells with an Enzyme-Linked ImmunoAssay (ELISA) to determine immunomodulatory activity. Plant byproduct solid waste will be fed into a biofuel study that will analyze the ability of protozoa to grow on the waste and produce biodiesel-like compounds.

4b. Scope: Benefit Statement

Panax quinquefolius, commonly known as North American ginseng, is a species native to the forests of Eastern North America particularly in the Appalachian Ozark Mountains. Plants in this genus, including the closely-related Asian or Korean ginseng are perennial herbs prized for their fleshy taproots which contain compounds of pharmaceutical interest. Ginseng has a long history of medicinal use in the Far East and has become a multi-million dollar industry being shown to have beneficial effects on the human immune system. Ginseng produces unique metabolites called ginsenosides which have been extracted, analyzed and categorized for their potential health effects. Plants in the genus *Panax* also produce unique polysaccharides, but these compounds have been less-thoroughly investigated. Because the tissue culture-grown ginseng can be stimulated experimentally, our hypothesis is there will be more bioactive compounds produced than in the wild ginseng. If more bioactivity is demonstrated in the cultured ginseng callus, which can be scaled-up to produce large quantities of plant tissue more energy efficiently, the harvest of economically-threatened wild ginseng will decrease.

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| <p>4. Project Description (continued)</p> |
| <p>4c. Location of Project (Building, etc.) Research Laboratories 2080 and 2040 SCI have adequate facilities to conduct this project.</p> |
| <p>4d. Participants and Roles Three undergraduates (currently Marissa Perez, Chelsey Molina, and one new student) and 1 MS current graduate student, Marshall Baughman, will conduct this project under the supervision of doctoral students Raj Ghosh and Shannon Smith who are in their third year as part of the Molecular Biosciences Program and have experience in all the plant tissue culture and extraction techniques necessary. Drs. Mary and Anthony Farone and Elliot Altman are members of the MTSU graduate faculty, Molecular Biosciences Doctoral Program, and Tennessee Center for Botanical Medicinal Research and will supervise all students and assist with production of plant tissue, extraction (Altman), and bioactivity analysis (A. Farone) of ginseng compounds. Solid waste byproducts from the ginseng production then will be analyzed as a biofuel (M. Farone).</p> |
| <p>4e. Student participation and/or student benefit Students will gain knowledge, skills, and experience in scientific research and data analysis. Included in the techniques the students will master in this work are: plant and animal tissue culture, the operation and data analysis of instrument software, extract purification, enzyme-linked immunosorbent assay (ELISA), and protozoan culture techniques. Drs. Farone will include this research as part of their Microbiology/Immunology courses impacting approximately 200 MTSU undergraduate and graduate students/year.</p> |
| <p>4f. Future Operating and/or Maintenance Requirements None. We are seeking external funding to continue this project.</p> |
| <p>4g. Additional Comments or Information Pertinent to the Proposed Project Current Total Budget Request \$9000.00 Sterile flasks, centrifuge tubes, pipets and pipet tips \$ 1500.00, Tissue culture medium and growth factors \$ 2000.00, Purification columns \$ 2500.00, Extraction solvents \$800.00, ELISA kits \$1500.00, Biofuel analysis solvents \$700. We would like to thank the CEE for previous funding to Dr. Farone that has benefited many MTSU students. Chasity Bagsby, Anita Saha, Granville Goodin, Sheeba Siddiqi, Mary Farone, Tony Farone, and Paul C. Kline have recently submitted the research manuscript "Stability of Pentobarbital in Soil" for publication that was funded by the CEE.</p> |

5. Project Performance Information

Provide information if applicable.

- a. Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
- b. Provide information on estimated annual energy cost savings in monetary terms.
- c. Provide information on any annual operating or other cost savings in monetary terms. Be specific.
- d. Provide information about any matching or supplementary funding opportunities that are available. Identify all sources and explain.

5a. Estimated Annual Energy Savings (Estimated in kW, kWh, Btu, etc.)

Based on the conversion from the government website below,
https://www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf

1 gallon of gasoline = 33.7 kWh of electricity, the estimated fossil fuel energy expended to harvest wild ginseng from rural areas is much greater than the electrical energy required to produce laboratory ginseng while possibly producing a sustainable biofuel energy source.

5b. Annual Energy COST Savings (\$)

Due to overharvesting and 7 years to reach maturity, Ginseng is difficult to find in the wild, hence the "economically-threatened designation", and therefore it is difficult to determine the energy expended by wild ginseng collectors. Depending on the quality, wild ginseng root ranges from \$200-\$400/pound Preliminary results from our laboratory suggest cultured callus can be produced much more rapidly and therefore producing more bioactive compounds/time.

5c. Annual Operating or Other Cost Savings. Specify. (\$)

Because the goal of this project is research-based, the annual operating cost savings is dependent upon how efficiently the ginseng callus waste byproducts are found to be converted to usable biofuels by the protozoans.

5d. Matching or Supplementary Funding (Identify and Explain)

The Biology Department supports MS student stipends and the MOBI doctoral program provides stipends to PhD students.