DOE NEPA Tracking Number

**U. S. DEPARTMENT OF ENERGY, OFFICE OF SCIENCE**
**INTEGRATED SUPPORT CENTER—CHICAGO OFFICE**

**NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)**
**ENVIRONMENTAL EVALUATION NOTIFICATION FORM**

***To be completed by "Applicant," i.e., organization receiving funds and/or implementing Federal Actions as defined by 40 CFR § 1508.18. For assistance, refer to "Instructions for Preparing ISC-CH F-560, Environmental Evaluation Notification Form."***

Solicitation/Award No. (if applicable): 0000217779

Organization Name: University of Nebraska Lincoln

Title of Proposed Action: Systems Analysis of the Physiological and Molecular Mechanisms of Sorghum Nitrogen Use Efficiency, Water Use Efficiency and Interactions with the Soil Microbiome

Total DOE Funding/Total Funding: $13,460,684

I. Project Description: ***(Use explanation pages if additional space is required)***

A. Proposed Project/Action (if applicable, delineate Federally funded/Non-Federally funded portions)
See additional narrative for Objectives and Overview of Project Description.

All of the proposed work is federally funded.

| | Yes | No |
|---|---|---|
| B. Would the project proceed without Federal funding? | ☐ | ☒ |

***If "yes," use explanation page.***

II. Description of Affected Environment: ***(Use explanation pages if additional space is required)***
See additional narrative for description of the field work that will be done as part of this project.

III. Preliminary Questions:

| | | Yes | No |
|---|---|---|---|
| A. | Is the DOE-funded work routinely administrative or *entirely* advisory or a "paper study?" | ☐ | ☒ |

***If "Yes", ensure that the description in Section I reflects this and go directly to Section V.***

B. Is there any potential whatsoever for: (***Provide an explanation for each "Yes" response)***

| | | | |
|---|---|---|---|
| 1. | Work to be performed outdoors? | ☒ | ☐ |
| 2. | Major modification of a building interior? | ☐ | ☒ |
| 3. | Threat of violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health? | ☐ | ☒ |
| 4. | Siting, construction or major expansion of waste treatment, storage, or disposal facilities? | ☐ | ☒ |
| 5. | Disturbance to hazardous substances, pollutants, or contaminants preexisting in the environment? | ☐ | ☒ |
| 6. | The presence of any environmentally-sensitive resources? | ☐ | ☒ |
| 7. | Potential for high consequence impacts to human health or the environment? | ☐ | ☒ |
| 8. | The work being connected to another existing/proposed activity that could potentially create a significant impact? | ☐ | ☒ |
| 9. | Nearby past, present, and/or reasonably foreseeable future actions such that collectively significant impacts could result? | ☐ | ☒ |
| 10. | Scientific or public controversy, uncertainty over potential impacts, or conflicts regarding resource usage? | ☐ | ☒ |

***If "No" to ALL Section III.B. questions, go directly to Section V.***

IV. Potential Environmental Effects: (***Provide an explanation for each "Yes" response)***

A. Sensitive Resources: Could the proposed action potentially result in changes and/or disturbances to any of the following resources?

| | | Yes | No |
|---|---|---|---|
| 1. | Threatened/Endangered Species and/or Critical Habitats | ☐ | ☒ |
| 2. | Other Protected Species (e.g., Burros, Migratory Birds) | ☐ | ☒ |
| 3. | Sensitive Environments (e.g., Tundra/Coral Reefs/Rain Forests) | ☐ | ☒ |
| 4. | Cultural or Historic Resources | ☐ | ☒ |
| 5. | Important Farmland | ☐ | ☒ |
| 6. | Non-Attainment Areas for Ambient Air Quality Standards | ☐ | ☒ |
| 7. | Class I Air Quality Control Region | ☐ | ☒ |
| 8. | Special Sources of Groundwater (e.g. Sole Source Aquifer) | ☐ | ☒ |
| 9. | Navigable Air Space | ☐ | ☒ |
| 10. | Coastal Zones | ☐ | ☒ |
| 11. | Areas with Special National Designation (e.g. National Forests, Parks, Trails) | ☐ | ☒ |
| 12. | Floodplains and/or Wetlands | | |

B. Regulated Substances/Activities: Would the proposed action involve any of the following regulated Items or activities?

| | | | |
|---|---|---|---|
| 13. | Natural Resource Damage Assessments | ☐ | ☒ |
| 14. | Invasive Species or Exotic Organisms | ☐ | ☒ |
| 15. | Noxious Weeds | ☐ | ☒ |
| 16. | Clearing or Excavation (indicate if greater than one acre) | ☐ | ☒ |
| 17. | Dredge or Fill (under Clean Water Act, Section 404, greater than one acre) | ☐ | ☒ |

B. Regulated Substances/Activities: Would the proposed action involve any of the following regulated Items or activities? (*continued*)

| | | Yes | No |
|---|---|---|---|
| 18. | Noise (in excess of regulations) | ☐ | ☒ |
| 19. | Asbestos Removal | ☐ | ☒ |
| 20. | Polychlorinated biphenyls (PCBs) | ☐ | ☒ |
| 21. | Import, Manufacture, or Processing of Toxic Substances | ☐ | ☒ |
| 22. | Chemical Storage/Use | ☐ | ☒ |
| 23. | Pesticide Use | ☐ | ☒ |
| 24. | Hazardous, Toxic, or Criteria Pollutant Air Emissions | ☐ | ☒ |
| 25. | Liquid Effluents | ☐ | ☒ |
| 26. | Spill Prevention/Surface Water Protection | ☐ | ☒ |
| 27. | Underground Injection | ☐ | ☒ |
| 28. | Hazardous Waste | ☐ | ☒ |
| 29. | Underground Storage Tanks | ☐ | ☒ |
| 30. | Radioactive or Radioactive Mixed Waste | ☐ | ☒ |
| 31. | Radiation Exposure | ☐ | ☒ |
| 32. | Nanoscale Materials | ☐ | ☒ |
| 33. | Genetically Engineered Microorganisms/Plants or Synthetic Biology? | ☐ | ☒ |
| 34. | Ozone Depleting Substances | ☐ | ☒ |
| 35. | Greenhouse Gas Generation/Sustainability | ☐ | ☒ |
| 36. | Off-Road Vehicles | ☐ | ☒ |
| 37. | Biosafety Level 3-4 Laboratory | ☐ | ☒ |
| 38. | Research on Human Subjects or other Vertebrate Animals | ☐ | ☒ |
| 39 | Facility footprint exceeds 5,000 Square Feet | ☐ | ☒ |

C. Other Relevant Information: Would the proposed action involve the following?

| | | Yes | No |
|---|---|---|---|
| 40. | Disproportionate Nearby Presence of Minority and/or Low Income Populations | ☐ | ☒ |
| 41. | Existing, Modified, or New Federal/State Permits | ☐ | ☒ |
| 42. | Involvement of Another Federal Agency (e.g. license/permit, funding, approval) | ☐ | ☒ |
| 43. | Action in a State with NEPA-type law | ☐ | ☒ |
| 44. | Expansion of Public Utilities/Services | ☐ | ☒ |
| 45. | Depletion of a Non-Renewable Resources | ☐ | ☒ |
| 46. | Subject to an Existing Institutional Work Planning and Control Process | ☐ | ☒ |
| 47. | Other Pertinent Information Which Could Impact Human Health or the Environment | ☐ | ☒ |

V. Applicant Certification that to the best of their knowledge all information provided on this form is accurate:

| | Yes | No |
|---|---|---|
| Does this disclosure contain classified, confidential, or other exempt information that DOE would not be obligated to disclose pursuant to the Freedom of Information Act? | ☐ | ☒ |

A. Organization Official (Name and Title): Jeanne Wicks, Director of Sponsored Programs

Signature: Jeanne Wicks Digitally signed by Jeanne Wicks DN: cn=Jeanne Wicks, o=University of Nebraska-Lincoln, ou=OSP Director, email=jwicks2@unl.edu, c=US Date: 2015.08.12 19:41:45 -05'00' Date: 8/13/2015

e-mail: unlosp@unl.edu Phone: 402-472-3173

B. Optional Secondary Approval (Name and Title): _____

Signature: _____ Date: _____

e-mail: _____ Phone: _____

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***Remainder to be completed by DOE***

VI. DOE Concurrence/Recommendation/Determination:

A. DOE Project Director/Program Manager or Contract/Grant Management Specialist:

| | Yes | No |
|---|---|---|
| Has the Applicant completed the Form correctly? | ☒ | ☐ |
| Does an existing Generic Categorical Exclusion apply? | ☒ | ☐ |

If yes, indicate: _____

Name and Title: Brenda E. Farries, Grants Management Specialist

Signature: Brenda E. Farries Date: 08/25/2015

B. DOE NEPA Team Review:

| | Yes | No |
|---|---|---|
| Is the class of action identified in the DOE NEPA Regulations (Appendices A-D to Subpart D (10 CFR § 1021))? | ☒ | ☐ |

If yes, specify the class(es) of action: Generic CX (10 CFR 1021, Subpart D, Appendices A & B B3.6

Name and Title: _____

Signature: _____ Date: 9/10/2015

C. DOE Counsel (if requested):

Name and Title: _____

Signature: _____ Date: _____

D. DOE NEPA Compliance Officer:

The preceding pages are a record of documentation required under DOE Final NEPA Regulation, 10 CFR § 1021.400.

☒ Action may be categorically excluded from further NEPA review. I have determined that the proposed action meets the requirements for Categorical Exclusion referenced above.

☐ Action requires approval by Head of the Field Organization. Recommend preparation of an Environmental Assessment.

☐ Action requires approval by Head of the Field Organization or a Secretarial Officer. Recommend preparation of an Environmental Impact Statement.

Comments/limitations if any:

NEPA Compliance Officer:

Name: Peter B. Siebach

Signature: _____ Date: 9/10/2015

Optional Additional Narrative: (add additional detail to description to Sections I and II or explanations to responses in Sections III and IV.

Project Objectives:
The overall project objective is to establish a foundational, systems-level understanding of plant, microbial, and environmental interactions that will lead to strategies for enhancing growth and sustainability of sorghum through genetic and microbial adaptations to water and nitrogen limited environments.

Project Description, Methods, and Outcomes:
To compete in the biofuel energy market, cellulosic feedstocks will need to be high yielding and carbon neutral or negative while requiring low inputs. To avoid competition with existing food production systems, these crops will also need to be grown on marginal lands. This will require the introduction of novel traits to increase abiotic stresses tolerance associated with marginal soils. This project will utilize multiple interdisciplinary approaches in varied settings – including the laboratory, controlled environments, and the field – to identify plant genes and sorghum associated microbes that will enhance the sustainable production of sorghum as a biofuel feedstock. Basic knowledge about physiological and genetic mechanisms involved in nitrogen use efficiency (NUE) and water use efficiency (WUE) and potential mechanisms involved in microbe interaction will be generated. A range of methods will be used, including: classical whole plant physiology, stable isotope detection, phenomics, transcript profiling, metabolic profiling, 16S amplicon sequencing, metagenomics, microbial genome sequencing, comparative genomics, microbiology, genetics, and a range of computational methods for data analysis, integration and storage. To conduct these comprehensive studies, we have assembled a multi-institutional, interdisciplinary team with a wide range of expertise in these areas.
This research will increase our knowledge about the genetic and physiological mechanisms involved in WUE and NUE, which will be used to create sustainable biofuel feedstock systems on marginal land. Identification of microbial community membership and testing of culturable microbes, as well as genetic dissection of sorghum genotype X microbe interactions, will result in new strategies for the development of microbial solutions to increase abiotic stress tolerance and sustainable sorghum systems. Two major resources will be created: a sorghum microbe collection and a multi-dimensional relational database to house and access the biological materials and data generated in this project.

Description of Affected Environment:
Field experimental design. The experimental field plan will done outdoors on land owned by the University of Nebraska or on the farm of a famer cooperator. The land will be maintained in excellent condtion and will not be used for any purposes that would degrade the land quality. Thirty sorghum genotypes will be planted (approximately 90 plants per genotype per plot) in 10 randomized complete blocks. The sorghum genotypes will encompass the parents of nested association mapping (NAM) panels and several other diverse lines of sorghum. Ten replicated blocks will be planted for each of the two treatments (high vs. low water and high vs. low nitrogen). Each treatment will be planted at two independent locations in Nebraska to exploit the rainfall zones that lie along an East-West cline and in locations where soil nitrogen has been depleted. The field experiment will be replicated in year 2. In year 3, five of the most divergent lines will be studied with increased replication to characterize the lines in more detail. Fig. 3 shows the field plan. Each plot will be three square meters and will be buffered by a half meter border. Five of the ten blocks will be used for in season phenotyping and for collection of leaves for stable isotopes. The additional plots will be used for in season destructive measurements and as backup to replace any plots that are damaged by inclement weather or pests.
Two environmental stresses will be tested in this project: drought and low nitrogen. For each stress, adjacent blocks of control plots that lack the stress condition will be included. Metadata such as rainfall, temperature, day length, and irradiance will be collected throughout the season. Soil texture and soil biogeochemistry data such as total C and N, available nutrients, pH, and soil water content will be collected from each block prior to planting and then again when samples are taken.

Replicated field experiments will be undertaken in years 4 and 5 to validate Gsorghum X Gmicrobes X E interactions in the field and to extend the genetic understanding of abiotic stress and as appropriate microbe interactions. In SC, sandy soils that are depleted in nitrogen will be utilized for NUE testing. In Nebraska, populations will be evaluated for drought tolerance and NUE. South Carolina and Nebraska will provide excellent contrasts for testing the persistence and efficacy of microbial consortia. Data on the best parental lines identified in years 1, 2, and 3 will used to determine the mapping populations that will be grown with optimized, microbe inoculated, and untreated seed and planted in sandy, low fertility, lower water holding capacity soils in SC and on low N and drought prone sites in NE. All tests will be replicated across germplasm, and microbial treatments will most likely be applied as seed treatments. Prior to the field trials, we will test gum arabic and other polymers mixed with freshly grown bacterial cultures to adhere the microbes to the seed to optimize this seed treatment process. Optimization will be done in a greenhouse. All coatings will be done immediately before planting. Depending on the success of seed treatments, we may also apply bacterial mixtures using a sprayer to the base of each plant just following germination.