CleanSEED
Project Timeline

The long-term goal of this CleanSEED project is to address the critical needs of the sweetpotato industry by identifying opportunities to leverage progress made by NCPC-SP Clean Plant Centers to increase foundation clean plant material across the nation. Increased use of CFS will result in improved sweetpotato quality and yield, improved profitability for the sweetpotato industry, and long-term sustainability of CFS production systems in the United States. Both process and outcome evaluation will be conducted in this project.

To document implementation of the CleanSEED project, **process evaluation** will incorporate four major components: progress, engagement, products, and participants.
Progress: Implementation of proposal activities will be tracked using an Excel spreadsheet that contains the project milestones chart (Table 1) and the milestones activity track chart in the Project Management Plan (Appendix C). This will allow for comparison of actual vs. planned effort to ensure that the project stays on course in achieving both research and Extension activities/objectives. Progress will be reviewed at each CleanSEED Project Partner Committee (CPPC) meeting and CleanSEED Advisory Group (CAG) meeting, so plans can be discussed regarding any needed modifications. **Progress metric:** Project milestones will be completed within three months of the date indicated in the project timeline.
Engagement: Engagement across participating states and organizations (CPPC), and with the CAG and other stakeholders is critical to success. The CPPC will meet virtually each month to share updates, new developments, and future timeline actions. The CAG will meet twice a year to provide executive oversight and direct input on the project's objectives, results, and plans. Meeting minutes and attendance logs will document the extent of engagement and the stakeholder groups represented. **Engagement metrics: a)** 80% of CPPC members will participate in monthly meetings. **b)** 90% of CAG members will participate in the summer and winter meetings. **c)** Participation from all sectors of the sweetpotato industry in all states.
Products: An educational outreach log will be used to track number and type of products developed and delivered by each "Objective team." Products include virtual and traditional educational meetings (e.g., field days, advisory group meetings, grower meetings) and online and print Extension pubs (e.g., fact sheets, BPs guide) distributed through the USSC convention and website, email, social media, state Extension services. An Excel spreadsheet that documents product, developer(s), date completed, dissemination methods, etc., will be in a shared drive (accessible by invitation). Each Objective team leader will enter outreach efforts on a quarterly basis and upload completed products to the shared drive. **Product metrics: a)** Existence of educational products repository developed through this project. **b)** Completion of products identified in proposal (e.g., BPs guide on CFS, video).
Participants: Although sweetpotato growers/producers are the primary target audience for outreach efforts, multiple audiences will be reached. Stakeholder reach will be documented to ensure targeted audiences receive information that meets their needs. The number and characteristics (e.g., industry sector, size of operation, university personnel) of individuals who participate in educational meetings will be collected through sign-in sheets. The number of sweetpotato producers in each participating state is known; therefore, reach will be assessed by the percent of individuals who participate in an educational meeting, based on a valid denominator of total sweetpotato producers. **Participant metrics: a)** 80% of stakeholders in

each state reached by at least one outreach effort. **b)** All sweetpotato sectors reached by at least one outreach effort.

General desired benefits include increased knowledge of CFS, reduced barriers to adoption of CFS use/practices, improved quality, and increased profit, thus, industry sustainability. To document benefits of the CleanSEED project, an **outcome evaluation** will be conducted. Short- medium- and long-term outcomes are identified in the project's logic model. Given the length of this project, not all long-term outcomes can be assessed. However, if the desired short- and medium-term outcomes are achieved, theory of change models suggest that the desired long-term outcomes should subsequently occur.
Short-term outcomes: Focus on engagement; common terminology and standards; improved BPs; and changes in awareness, attitudes, and knowledge related to CFS. Enhanced collaboration and engagement will be assessed through a document review of CPPC and CAG meeting notes. A document review of CFS policy standards on state and national organization websites will indicate acceptance of new standardized terminology across states. The existence of documents outlining BPs will demonstrate improved BPs. When educational meetings or events are conducted for stakeholders, post-only or retrospective pre-post questionnaires will be administered to assess changes in awareness, attitudes, knowledge, and intended use of CFS. A survey will also be distributed annually at the USSC Convention to assess general understanding, knowledge, and adoption related to project goals. As part of Objective 4, a survey will be distributed to growers/producers in years 1 and 4 to evaluate the impacts of this project. **Metrics: a)** Representation/engagement from 50% of sectors of the sweetpotato industry in all participating states. **b)** Integration into and acceptance of standardized CFS terminology across the sweetpotato industry. **c)** 70% of participants report an increase in awareness, attitudes, and knowledge of CFS and other BPs after attending educational events.
Medium-term outcomes: Focus on adoption and production of CFS and use of other BPs developed through this project. The annual "Opinion poll" surveys at the USSC Convention will track adoption incrementally over time and specific practices adopted. Barriers to adoption will also be assessed in the surveys and through formal/informal conversations with stakeholders. **Metric:** 50% of stakeholders report an increase in adoption and use of CFS and at least one other related BP.
Long-term outcomes: Relate to sustained collaboration/engagement, improved sweetpotato quality and yield, improved profitability, and long-term sustainability of CFS production systems. The Year 4 survey and annual USSC Convention surveys will assess adoption of CFS and use of other BPs, quality and yield, profitability, and perceptions of sustainability. Interviews will be conducted with individuals recommended by CAG or CPPC members to collect in-depth information to enhance understanding of the project's impact on their adoption of CFS and other BPs and how their operation has been affected. Focus groups with CAG and CPPC members will be conducted to assess perceptions of the long-term sustainability of CFS as well as sustained collaboration/engagement across the sweetpotato industry. **Metrics: a)** Engagement from all sectors of the sweetpotato industry in all participating states. **b)** 50% of producers surveyed report an increase in adoption and use of CFS and at least one other related BMP. **c)** 70% of stakeholders perceive long-term sustainability of CFS due to activities of this project.

The key personnel of each "Objective team" involved with specific objectives during each year of the project are listed in Table 1. Also, "Objective team" leaders are identified by bold initials.

Table 1. CleanSEED Project Milestones Chart

Objectives	*Y 1*	*Y 2*	*Y 3*	*Y 4*	**Objective Teams** *State/Personnel Initials*[1]
Obj 1. Unify terminology and develop quality control standards for the CFS production systems					
1.1 Review of certification standards, define terminology, and incorporate new technological tools for testing	X	X	X	X	AR/SF CA/SS LA/TS MS/**LH**, GF NC/DA
1.2 Develop Extension and outreach material- and prepare CleanSEED Production Manual from research results	X	X	X	X	AR/SF CA/SS LA/TS MS/**LH**, GF NC/DA
Obj 2. Develop best practices (BPs) for efficient CFS production in both the lab and greenhouse					
2.1.1 Lab: Epigenetic effects of micropropagation techniques	X	X			LA/**DL** SC/PW
2.1.2 Lab: Identify somatic mutations within 'Beauregard' maintained by the clean plant centers and USDA-ARS	X	X	X	X	LA/DL SC/**PW**
2.2.1 GH: Maximize the number of clean plants	X	X			AR/SP MS/LH NC/**CA**
2.2.2 GH: Conditions to harden plants for in-field survival	X	X			MS/LH NC/**CA**
2.2.3 GH: Strategies to monitor virus levels for quality control of clean plant materials	X	X			AR/SP HI/MK, RGC, AA MS/**LH** NC/**CA** SC/KL
2.2.4 GH: Strategies to monitor insects and control measures	X	X	X		AR/SP HI/MK, RGC, AA LA/JD NC/**AH**
Obj 3. Develop new technological innovations to determine the presence of viruses/pest/diseases on-site and determine BPs that minimize their source and reinfection rate					
3.1.1 Develop spectral signatures to use in identifying symptomless infected plants in the field	X	X	X	X	MS/LH, **NKW** SC/PW
3.2.1 Determine unrecognized pathogens that should be included in sweetpotato clean seed testing	X	X	X	X	AR/SP HI/MK, JS LA/TS MS/**SS, NAG** NC/CA SC/KL, **WR**
3.2.2 Develop more sensitive real-time RT-PCR methods for viruses and nematodes		X	X	X	AR/SP HI/MK, JS LA/DL MS/LH NC/CA SC/**KL**, WR
3.2.3 Develop a sensitive, specific test for rapid field-based detection of sweetpotato viruses		X	X	X	HI/MK, JS LA/DL MS/LH, SS NC/CA SC/**KL, WR**
3.3.1 Weed survey and management to reduce sweetpotato virus inoculum	X	X	X		AR/**NB**, SF, SP CA/SS HI/RG, AA LA/JD MS/**TPS**, MS
3.4.1 Reducing reinfection with virus vector management	X	X	X	X	CA/SS LA/**JD** MS/**FM** NC/AH
Obj 4. Conduct economic analysis and launch CleanSEED marketing campaign to increase awareness and adoption of CFS					
4.1.1 On-farm demonstrations and small-plot research studies of CFS performance and economics	X	X	X	X	AR/SF CA/SS HI/AA, MK, RG LA/**JD**, TS MS/**LH**, MS, **WM**
4.1.2 Economic cost benefit analysis for using CFS		X	X	X	MS/**WM** NY/MG
4.2.1 Field days, producer workshops, and stakeholder engagement	X	X	X	X	AR/**SF** CA/**SS** HI/**MK** LA/**TS** MS/**LH**, RC, WM NC/**AH**
4.2.2 Project integration with USSC website	X	X	X	X	LA/TS MS/**LH**, RC
4.2.3 Present progress, economic findings, and recommendations to stakeholders through diverse platforms	X	X	X	X	AR/SF CA/ss LA/TS MS/**LH**
4.2.4 Conduct surveys to gauge changes in perception and use of CFS	X	X	X	X	AR/SF CA/ss LA/TS MS/**DP**, LH, RC
4.2.5 Publish "Journey of CleanSEED" video		X	X	X	CA/ss LA/TS MS/**LH, RC**
4.2.6 Distribution of CleanSEED production manual				X	AR/SF CA/SS HI/MK LA/TS MS/**LH**, RC NC/CA

[1]Objective team leader(s) identified by **bold letter initials**. Reference full names of "Objective team" members in the Project Staff table as part of the Executive Summary in the "Project Narrative pdf".

Mississippi State University: **Dr. Mark W. Shankle** (PD) is ultimately responsible for administration and budgetary actions. He is a Research Professor and has been engaged with efforts to minimize mutations and cultivar decline of sweetpotato since the Mississippi CFS program transitioned from traditional "hill selection of roots" to "virus-testing of plants" in the year 2000. **Dr. Lorin M. Harvey** (Co-PD) is the Sweetpotato Extension Specialist and serves as co-director of the NCPN-SP Clean Plant Center for Mississippi. He works with sweetpotato industry stakeholder groups. Dr. Harvey is leading the terminology standardization and Extension efforts for this project. **Drs Sead Sabanadzovic and Nina Aboughanem** (CoPIs), both experienced plant virologists, will be responsible for coordinating/executing activities for HTS-based discovery of unknown pathogens. They will share raw HTS data with other scientists for further identification of nematodes/other pathogens in those samples and mentor a graduate student. Dr. Sabanadzovic is an internationally recognized expert in Virus Taxonomy. **Dr. William E. Maples** (CoPI) is the state crop marketing and policy specialist for Extension, and he will be responsible for all economic portions of project activities and stakeholder education. He will work with on-farm and small-plot research, providing data and economics analysis skills along with supervising a graduate student. **Dr. Donna J. Peterson** (CoPI) will manage evaluation data for the project. She was involved with the initial workshop grant planning process. Dr. Peterson is an Extension Professor and has served as evaluator on various USDA, CDC, NIH, and NSF funded grants through her 20-year career. **Dr. Rachael Carter** (CoPI) is an Extension Instructor with over 15 years of experience using community development and policy strategies to address issues in agriculture/natural resources. She specializes in helping organizations, communities, and industry sectors create/implement action plans to make positive change. She will work on Extension and outreach activities of this project. **Dr. Fred Musser** (CoPI) is a Professor of Entomology focused on integrated pest management for numerous crops, including sweetpotatoes. He will mentor a graduate student on entomological aspects of the project focused on managing aphids to minimize reinfection of CFS production fields. **Dr. Nuwan K. Wijewardane** (CoPI) is an expert in soil and plant spectroscopic sensing. He has experience in VisNIR and MIR spectroscopy, machine learning, and sensor development. He will find the sensitive spectral bands using spectroscopic sensing to identify potyvirus infected sweetpotato plants. **Paul Tseng** (CoPI) is a weed scientist in the Department of Plant and Soil Sciences. He will participate in all aspects of weed species management in this project.

University of Arkansas: **Dr. Sathish K. Ponniah** (PI) is an Extension Specialist in the Dept. of Agriculture at Pine Bluff, with 9 years of experience in virus testing and multiplying plants through tissue culture in support of the AR-CFS program. He will be involved with lab and greenhouse activities in this project. **Mr. Shaun Francis** (CoPI) is an Extension Specialist with 26 years of experience. He has coordinated AR-CFS program for the past 8 years and is responsible for propagation and distribution of clean plants and first generation (G-1) seedstock. He will participate with Extension activities. **Nilda Burgos** (CoPI) is a Weed Physiologist with over two decades of research experience in weed management. She has been the AR liaison to the IR-4 program since 2005. She will participate in weed-related aspects of the project.

University of California: **Mr. Scott Stoddard** (PI) is an Extension Farm Advisor in Merced, CA, with 21 years of experience in sweetpotato production systems. He is the Executive Secretary of the Sweetpotato Council of California, a member of the NCPN Tier II governing

body, and NCPN Extension/Outreach Committee. He will participate in the weed survey and Extension activities. He will be a link to NCPN, and Foundation Plant Services located in CA.

University of Hawaii: **Dr. Michael Kantar** (PI) is an associate professor in plant breeding and genetics whose work focuses on operationalizing the use of exotic germplasm. Collaborators include **Dr. Amjad Ahmad,** an Extension agent focused on sustainable agronomy, with extensive experience in complex cropping systems; **Rosemary Gutierrez-Coarite,** an Extension agent who has extensive experience doing on-farm research, and **Dr. Jon Suzuki,** a molecular plant pathologist with the USDA, ARS, Pacific West area, with extensive experience in virology.

Louisiana State University: **Dr. Jeffrey A. Davis** (PI) is a Professor of Field Crop Entomology and Plant Disease Vector Epidemiology in the Dept. of Entomology. Dr. Davis has 15+ years of experience and is internationally renowned for work on vectors of potato and sweetpotato viruses. He will be responsible for overall coordination of the subaward to LSU and mentoring the Postdoc researcher. **Dr. Don LaBonte** (Co-PI) has an applied and basic plant breeding and genetics program on sweetpotato. His breeding program has extended over 30 years and is focused on pathogen resistance, improved shape, and higher yield. He will examine genetic variability within clonal sweetpotato on this project. **Dr. Tara Smith** (Co-PI) presently serves as the Regional Director of the AgCenter Central Region as well as Research Coordinator of the Sweetpotato Research Station. Dr. Smith has been actively engaged with state/national sweetpotato industries since 2006. Dr. Smith will be involved with Extension activities on this project.

North Carolina State University: **Dr. Christie Almeyda** (PI) is Director of the Micropropagation and Repository Unit (MPRU) with 10 years of experience in conducting virus testing on sweetpotatoes to produce CFS. She has been leading the NC Sweetpotato CFS Program since 2017 and worked at the MPRU since 2012, which produces 90,000 clean plants yearly for NC certified seed growers. **Dr. Anders Huseth** (CoPI) is a research/Extension entomologist with 5 years of sweetpotato insect control experience and 13 years of applied pest control. His program also coordinates the annual NCSU Extension Sweetpotato Field Day. He will be responsible for training a graduate student focused on developing innovative BPs targeting disease vectors of greenhouse-grown clean plant material.

USDA-ARS, SE area: **Dr. Kai-Shu Ling** (PI) is a Plant Pathologist specializing in virology with extensive experience in virus id, epidemiology, and detection. He will develop species and genus-specific real-time PCR detection and coordinate ring tests of new real-time PCR primers and probes. He will also lead efforts in developing isothermal amplification using RPA. **Dr. William Rutter** (CoPI) is a Plant Pathologist with experience working with *Me* on sweetpotato. In this study, he will use bioinformatics to mine sequences in RNA-seq datasets from the virus surveys to identify any potential nematodes/other pathogens and develop primers and probe for real-time PCR to identify sequences related to *Me* and other pathogens. **Dr. Phillip Wadl** (CoPI), Research Geneticist, will utilize Phenospex phenotype scanning for early virus diagnosis. He will also lead efforts in genome resequencing of Beauregard maintained by each NCPN-SP clean plant center to identify genetic factors affecting the somatic mutation (genetic degradation) of sweetpotato in tissue culture propagation.