

Nominating Region: South

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Project or Committee Number and Title: S1084: Industrial Hemp Production, Processing, and Marketing in the U.S.

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Project Summary

Issue, problem or situation addressed: After the 2014 Farm Bill permitted states to develop pilot research programs on industrial hemp, many land-grants were approached by state agencies and other stakeholders about investigating the potential for the crop. The 2018 Farm Bill, which broadly allowed for the legal cultivation of hemp for the first time in decades, further spurred tremendous interest among both existing farmers and people completely new to farming enticed by the seemingly limitless potential touted by its advocates. Very little research had been conducted in the U.S. for more than 80 years resulting in limited information about appropriate variety selection, optimal management practices, pressures from pests and diseases, and production economics and markets. Regulatory requirements added to the uncertainty for growers and processors. Because adoption of hemp research programs varied greatly from state to state, especially in the beginning, a multistate approach was critical to sharing knowledge and resources among the land-grant institutions that were trying to respond to producer, industry, and regulator needs.

Objectives:

1. Determine the effects of agronomic practices and environmental conditions on grain, fiber, dual-purpose and essential oil productivity.
2. Assess the impact of field trial conditions and practices on crop quality. Considerations include stem and stem fiber, grain quality, and suitability for other industrial uses.
3. Identify genetics for advanced traits of interest including photoperiodicity, yield/quality of fiber and grain, cannabinoid profile, pest and pathogen resistance, abiotic stress resistance, etc.
4. Assess crop value for different markets and cropping systems. This includes developing production budgets and considering the potential for market scale and new market development.

Accomplishments:

S1084 has developed into a nation-wide network of interdisciplinary scientists who regularly conduct joint projects, engage stakeholders, and share best practices. When the project began, only a small number of states had active hemp pilot programs. Participants from states that had not yet begun hemp research were able to get critical insight from their peers and avoid common challenges by participating in S1084. Despite the difficulties of simply sourcing seed, accessing germplasm for use in breeding, and serving stakeholders dealing with a highly unstable market and regulatory landscape, S1084 continues to have strong collaborative participation that will stay the course toward developing sustainable and viable opportunities for this versatile crop. Some of the **outputs** that demonstrate the broad reach and activity of this group include:

- Reported 42 peer-reviewed research publications and 35 fact sheets/extension publications facilitated as a result of their participation in the project.

- Reported 36 grant proposals submitted and awards of \$10.2 million resulting from their participation in this group.
- Organized a National Hemp Research and Education Conference in 2020. Produced a special issue of GCB Bioenergy with 5 articles, including one summarizing results from a national survey of hemp stakeholders conducted by S1084 members.
- Established a protocol for conducting multi-state variety trials in hemp for both dual-purpose and essential oil production. A publication summarizing the results for 4 years of the dual-purpose variety trials is in preparation.
- Conducted national surveys of production costs and consumer preferences through leveraged grant funding. Results are being prepared for publication.
- Completed a national survey to assess the presence and distribution of common diseases and pests in hemp. A manuscript entitled “Occurrence and Distribution of Common Diseases and Pests of US Cannabis: A Survey” was submitted to *Plant Health Progress*.
- Leveraged the geographic diversity of S1084 members to develop a collection of feral hemp. Members have secured NIFA grant support through the Supplemental and Alternative Crops program to build on this effort. Collections will be deposited into the USDA ARS Hemp Germplasm Bank and characterized.

Selected outcomes that demonstrate how S1084 created awareness among the research community and stakeholders, influenced federal and state agency activities, and created new resources that will support long-term development of a sustainable hemp industry include:

- Variety trial data provided one of the earliest resources on variety suitability across agroecosystems. Results provided critical guidance for researchers and growers in selecting compliant hemp varieties for local growing conditions. Data provided to state regulators helped inform sampling protocols and variety recommendations enabling many to host successful pilot programs before the USDA final rule. (*Short-term*)
- Efficacy trials in conjunction with IR-4 and state regulators helped provide disease and pest control options for producers as early as December of 2019. (*Short-term*)
- S1084 provided national leadership in setting research and extension priorities at the federal level through several engagement activities including multiple surveys and the National Hemp Research and Education Conference. Members also contributed to AMS’s rulemaking process to ensure that the Hemp Production Program’s Final Rule was compatible with university research programs. (*Short/Medium-term*)
- The pest and disease survey results provide a baseline for field and greenhouse scouting guidance, enabling producers and extension agents to identify and address potential issues before they become an economically significant problem. The survey also provides a foundation for prioritizing regulatory activities at the regional and national scales. (*Medium-term*)
- Contributions to the feral hemp collection and ARS germplasm repository are expanding resources accessible to university-based breeders. Breeding tools developed include high throughput molecular markers for low THC. This work is advancing the development of new varieties adapted for different regions, resistant to disease, optimized for the intended end use and compliant with federal and state regulations for THC levels. (*Long-term*)

Impacts: Hemp has been touted as a crop with tremendous benefits by its advocates, but S1084's research-based solutions for cultivation, variety selection and improvement, pest/disease management and marketability are needed for it to be a viable production option across much of the US. Research will also facilitate its role in climate-smart production systems that help meet climate change mitigation goals. A strong hemp industry would provide diversified production options to many producers, including new, limited resource and disadvantaged farmers.

Added-value and synergistic activities across mission areas:

S1084's activities are inherently **multi-disciplinary** and include agronomists, plant breeders, entomologists, bioprocess engineers, plant pathologists and economists. Results from each objective inform work across the others. For example, disease resistance screenings performed as part of the variety trials identified at least one source of resistance to powdery mildew in the crop, which has been incorporated into ongoing breeding work. Fourteen official participants hold Extension appointments. Evidence of **multi-function integration** includes the numerous extension publications, field days, integrated NIFA grant applications, and public presentations given by members. An example of a multi-function integration is how the field trial data are being used by Extension to develop grower education while also providing information for the breeding group on variety traits under different environmental conditions.

Additional partnerships, associations and collaborations include linkages to IR-4 and S1075 Science and Engineering for a Biobased Industry and Economy. S1084 has collaborated with multiple USDA agencies, including AMS, ERS and ARS. Ties to ARS's hemp germplasm repository in particular have been mutually beneficial. It should be noted that members from five different 1890 Land-Grants are active participants in this project as well.

Because of the dearth of modern information on hemp production and marketing options when pilot programs began, a multi-state approach was necessary to respond to the incredible interest from producers quickly. S1084 has developed a set of resources that have helped address key issues associated with incorporating hemp into cropping systems across the US. The coordinated variety trails, pest control efficacy trials, pest and disease surveys and feral germplasm collection efforts would not have been accomplished through individual work.

Evidence of multi-institutional and leveraged funding with examples of sources:

- Multi-state variety trials were supported through seed donations from industry and by the participating institutions covering the cost of trials at their locations. Coordination of seed distributions provided by University of Kentucky (grain and fiber) and Oregon State University (floral). University of Florida provided support for data organization and analysis as well as publication preparation.
- NIFA Supplemental & Alternative Crops grant: *National Hemp Research & Education Conference* 9/1/19-8/31/21. \$50,450 (CO,WI; many S1084 members participated in planning and execution of the conference agenda)
- NIFA AFRI Grant: *Economic Impacts of the Hemp Industry: Opportunities for Rural Development* 5/1/20-4/30/24. \$496,215 (VT, CO, NC, KY)
- Hemp Research Consortium: Up to \$2,000,000 in Foundation for Food and Agriculture Research (FFAR) funds to be matched 1:1 by industry. (NC, KY, NY)

Participating Institutions and Units:

Alabama A&M University

Central State

Cornell University

Kentucky State University

Michigan State University

Montana State University

Oregon State University

Purdue University

Southern Illinois University

University of Connecticut

University of Illinois

University of Maryland

University of Minnesota

University of Tennessee

University of Wisconsin

Utah State University

Washington State University

Auburn University

Colorado State University

Kansas State University

Louisiana State University

Mississippi State University

North Carolina State University

Pennsylvania State University

Rutgers University

University of California

University of Florida

University of Kentucky

University of Maryland- Eastern Shore

University of Nebraska

University of Vermont

USDA-ARS Plant Genetic Resources Unit

Virginia State University

West Virginia University