

## Progress Report

<b>Title:</b>	<b>Stop the rot: Combating onion bacterial diseases with pathogenomic tools and enhanced management strategies</b>		
<b>Sponsoring Agency</b>	NIFA	<b>Project Status</b>	ACTIVE
<b>Funding Source</b>	Non Formula	<b>Reporting Frequency</b>	Annual
<b>Accession No.</b>	1020312	<b>Grants.gov No.</b>	
		<b>Award No.</b>	2019-51181-30013
<b>Project No.</b>	WNP03104	<b>Proposal No.</b>	2019-03171
<b>Project Start Date</b>	09/01/2019	<b>Project End Date</b>	08/31/2024
<b>Reporting Period Start Date</b>	09/01/2022	<b>Reporting Period End Date</b>	08/31/2023
<b>Submitted By</b>	Ellen Yeates	<b>Date Submitted to NIFA</b>	11/22/2023

**Program Code:** SCRI**Program Name:** Specialty Crop Research Initiative**Project Director**

Lindsey Du Toit  
360-848-6140  
dutoit@wsu.edu

**Recipient Organization**

WASHINGTON STATE UNIVERSITY  
240 FRENCH ADMINISTRATION BLDG  
Pullman, WA 991640001  
DUNS No. 041485301

**Performing Department**

Plant Pathology

**Co-Project Directors**

Uchanski, Mark  
Hoepfing, Christine  
Kvitko, Brian  
Dutta, Bhabesh  
Aegerter, Brenna

**Departments**

Horticulture & Landscape Arch.  
Cooperative Extension Vegetable Program  
Department of PLANT PATHOLOGY  
{NO DATA ENTERED}

**Non-Technical Summary**

Onion bulb crops are grown on ~140,000 acres/year in the U.S. at a farm-gate value of \$925M. Bacterial pathogens cause >\$60M in losses annually to this industry. Losses can be particularly severe for stored bulbs as bacterial bulb rots typically only develop in storage, after all production costs have been incurred. Poor scientific understanding of the diversity and epidemiology of bacterial pathogens, and the lack of systemic bactericides limit industry capacity to mitigate these losses; this is in sharp contrast to the significant work that has been accomplished with fungal pathogens of onion. This 'Stop the Rot' project organizes 24 scientists in diverse disciplines across the U.S. to research the complete system (host, pathogen, and environment) of bacterial diseases of onion. The long-term goal is to support profitability and sustainability of onion production in the U.S. using a coordinated, national survey of bacterial pathogens affecting onion crops combined with a stakeholder-focused, systems approach to investigate how production practices, inoculum sources, and environmental conditions can be managed to develop effective, practical, economically-viable, and environmentally-sound strategies to limit losses to bacterial diseases.

The project has two primary objectives linked iteratively in a systems approach. The first objective utilizes comparative genomics to identify genetic factors that enable some bacteria to cause diseases on onion, and to develop practical diagnostic tools as well as phenotypic resistance screening methods for bacterial pathogens of onion. A survey of onion bacterial diseases over three seasons in each of 12 states representing the seven primary regions of onion production in the U.S. will be used to understand the diversity of onion bacterial pathogens in the U.S., and to develop a National Onion Bacterial Strain Collection. Genomic assessment of this bacterial collection will enable us to understand the genetic basis of bacteria that can cause diseases of onion across the U.S. This, in turn, will be used to design rapid, accurate, and robust methods of detecting and identifying onion bacterial pathogens. The collection also will be used to develop methods of screening onion germplasm for resistance to bacterial pathogens. The screening methods can then be used in breeding programs to develop cultivars with greater resistance than currently available. The second objective focuses on onion bacterial disease management by examining

Accession No. 1020312

Project No. WNP03104

how irrigation practices, fertility practices, pesticide programs, cultural practices, post-harvest practices, and bacterial disease modeling can be managed to develop effective, practical management programs. A 12-person, nation-wide onion Stakeholder Advisory Panel worked with our team from 12 states to prioritize the objectives and develop approaches for this project. Broad, stakeholder-based evaluations of the research results over the duration of the project will ensure results are delivered to constituents and that solutions developed are viable economically and environmentally.

## Accomplishments

### Major goals of the project

The ability of growers to manage bacterial diseases of onion is limited compared to many fungal diseases because of unique epidemiological and management aspects of the bacterial pathogens, which cause >\$60 million/year in damages to the U.S. onion industry. Losses can be particularly severe for stored onions as bacterial bulb rots typically develop after harvest, with losses ranging from 5-100% in individual fields. The cost of sorting symptomatic bulbs can result in rejection of entire fields if the incidence of rot exceeds 30%. There are effective tools to manage other factors that can cause storage losses (e.g., sprouting and fungal bulb rots), in contrast to bacterial rots. This project takes a systems approach encompassing the pathogen, host, environment, economics, and stakeholder priorities to address the need to manage onion bacterial diseases far more effectively. The goal of this project is to support long-term profitability and sustainability of onion production in the U.S. using a stakeholder-informed, systems approach by:

1. Undertaking a national survey of onion bacterial diseases;
2. Developing a National Onion Bacterial Strain Collection (NOBSC);
3. Using this resource for genotypic characterization of the pathogens to design rapid, accurate, and robust methods for detecting and identifying onion bacterial pathogens across the U.S.;
4. Developing methods of screening onion germplasm for resistance to these bacteria;
5. Integrating the diagnostic and detection tools into comprehensive integrated disease management research trials;
6. Generating predictive bacterial disease models across diverse regions of onion production in the U.S.; and
7. Implementing a broad, Stakeholder Advisory Panel (SAP)-informed dissemination plan to deliver results to constituents.

The goal utilizes a coordinated, national survey of bacterial pathogens affecting onion crops combined with a stakeholder-focused, systems approach to investigating how production practices, inoculum sources, and environmental conditions can be managed to develop effective, practical, economically-viable, and environmentally-sound strategies to limit losses to bacterial diseases. The project has two primary objectives linked iteratively in a systems approach:

A: Utilize comparative genomics to identify virulence factors and develop practical diagnostic tools, as well as phenotypic resistance screening methods for bacterial pathogens of onion (60% of the effort for this project). The four activities for this objective entail: **A1**) national onion bacterial disease surveys and development of a National Onion Bacterial Strain Collection (NOBSC), **A2**) onion bacterial pathogenomics, **A3**) development of onion bacterial pathogen detection tools, and **A4**) development of onion phenotyping (screening) protocols for reactions to bacterial pathogens.

B: Examine how key production practices, environmental factors, and inoculum sources that impact bacterial disease outbreaks can be managed to develop practical solutions that are viable environmentally and economically (40% of the project effort). This will entail six areas of investigation: **B1**) irrigation management, **B2**) fertility management, **B3**) pesticide programs, **B4**) cultural management, **B5**) post-harvest management, and **B6**) bacterial disease modeling.

Objective A addresses the SCRI focus area of "efforts to identify and address threats from pests and diseases" by clarifying for stakeholders nationwide, using standardized protocols, the diversity of onion bacterial pathogens causing losses in each of three growing seasons. The National Onion Bacterial Strain Collection resulting from this project will provide an invaluable resource for this and future projects on genetic studies of pathogens and associated bacteria in/on onions, e.g., whole genome sequencing to find virulence factors in order to develop robust molecular tools to detect and differentiate pathogenic vs. non-pathogenic bacteria. This will facilitate development of effective phenotypic methods of screening onion germplasm for reactions to diverse bacterial pathogens, alone and in combinations, which will facilitate future efforts to breed for resistance.

Objective B addresses the SCRI focus area efforts to identify and address threats from pests and diseases" as well as "efforts to improve production efficiency, handling and processing, productivity, and profitability". This coordinated, multi-state objective will determine how regional onion production practices, environmental conditions, and inoculum sources can be managed using practical, economically-viable, and environmentally-sound strategies to limit losses to bacterial rots in fields, storage, and shipping.

### What was accomplished under these goals?

#### Objectives:

Accession No. 1020312

Project No. WNP03104

**A1. Bacterial disease surveys, NOBSC:**

In year 4, onions were surveyed in 8 states, and 1,080 bacterial strains obtained. 607 isolates were added to the National Onion Bacterial Strain Collection (NOBSC) for a total 1,872 strains from 110 genera. Metadata for strains will be available on Alliumnet.com.

**A2. Onion bacterial pathogenomics:**

Whole genome sequencing and annotation were completed for 81 *P. agglomerans* (Pagg) strains, and comparative genomics and phylogenetic analysis completed. 100 public genomes were added. Most Pagg strains (all onion strains) fell into 2 phylogroups. Pagg strains encoding the HiVir gene cluster for pantaphos phytotoxin virulence factor are in phylogroup 2. The HiVir cluster is encoded on 2 extra-chromosomal plasmids. The HiVir and alt encoding plasmid from NY strain CB1 is self-transmissible, and plasmid transfer conferred virulence to Pagg strains. Phylogroup 2 strains encoding HiVir on the Pagg universal plasmid include US and SA isolates. Most Pagg onion strains carry an alt-encoding plasmid that often encode genes for Cu tolerance. A novel phosphonate cluster "HaloPhos", responsible for pathogenicity to onion in *Pantoea stewartii* subsp. *indologenes* and *P. allii*, was characterized, and a diagnostic assay for halE developed.

Bacterial community analyses in symptomatic and asymptomatic onion bulbs were completed. A project is planned to determine changes in bacterial communities over time following inoculation of bulbs with *Enterobacter ludwigii*.

Bacteriophages were purified from symptomatic bulbs, and 3 characterized that infect *Pantoea ananatis* and *P. agglomerans*. We will determine their efficacy for controlling these pathogens. A comparative genomics study is in progress with *Rahnella* strains.

**A3. Diagnostic tools:**

TaqMan PCR assays for the HiVir gene cluster, and species-specific TaqMan assays for *P. agglomerans* and *P. ananatis* were designed and evaluated. The assays were tested on bulbs inoculated with individual species and both species. A LAMP assay for *P. agglomerans* was designed and demonstrated at a Field Day.

**A4. Phenotypic onion cultivar screening methods:**

In GA, 51 *Vidalia* cultivars were screened in a field trial, and bulbs tested for scale lesions with *P. ananatis*. In NY, 16 cultivars in a 2022 field trial were screened with bulb scale and bulb injection assays. Data are being analyzed. In CA, a 2022 phenotypic screening cultivar trial in Kern Co. was harvested, and susceptibility compared with: 1) bulb rot at harvest from plots inoculated with *Burkholderia* and *Pantoea*, 2) severity of rot in bulbs injected with *Burkholderia*, and 3) a scale assay using *Burkholderia*. There were differences among cultivars with each assay, but results of the tests were not correlated. In Feb. 2023, a field trial was established in CA with 12 cultivars, and harvested in Aug. Onions in storage will be tested. In WA, bulbs were harvested from a 2022 trial with 12 cultivars. Timing inoculations based on cultivar maturity facilitated screening for susceptibility to bacterial infection. A phenotypic screening trial in WA used bulbs from 53 cultivars to test a bulb injection assay vs. a scale assay. There was no correlation of bulb or scale assay results with bacterial rot in storage from natural infection, and a weak correlation in results of bulb vs. scale assays.

**B1-B5. Onion bacterial disease management:**

Results from Year 3 trials were finalized after rating bulbs in storage. In Year 4, field trials of management practices were planted to optimize management practices. Trials are in progress for irrigation (WA and CA), fertility (WA), cultural (UT, GA, NY, WA), and pesticide (CO, WA, GA, NY) practices, and postharvest application of disinfectants to bulbs (WA). Results for 2022-23 trials include:

- In CA, sprinkler irrigation increased leaf blight and bulb rot, and reduced yield compared to drip irrigation.
- In GA, Lifegard WP and copper reduced bulb rot but no treatment tested in CO had efficacy. A CA pesticide trial will be evaluated in 2023. In WA, Badge SC and ManKocide had limited control of bacterial leaf blight but increased yield, but had no effect on bulb rot. Chemigation increased bulb rot (large amount of water on senescing necks facilitated infection).
- No differences in bacterial bulb rot were detected in a UT variety trial, to be harvested in Sep. and bulbs stored for evaluation.
- In GA, more bulb rot was observed when neck length after topping was  $\leq 1$  inch vs. 2 to 3 inches. Harvesting bulbs with a chain digger vs. a straight blade undercutter resulted in less bacterial rot.
- In WA, rolling onion tops at onset of 'tops down' did not affect bulb rot; undercutting early increased yield and reduced bulb rot compared to undercutting at 100% tops down or no undercutting; early topping of bulbs (green/moist) reduced yield by 54% and increased bulb rot by 32-35%.
- In NY, rolling onions significantly reduced bulb rot compared to onions with straight necks during windrowing.
- Postharvest application of H<sub>2</sub>O<sub>2</sub> + peroxyacetic acid or ozone to bulbs in a CO trial did not reduce bacterial bulb rot.
- In NY, onions with 70% foliar bacterial infection developed only 20% bulb rot when cured with heated air for 7 days.

**B6. Onion bacterial disease risk modeling:**

A PNW bacterial disease risk model was developed using 4 risk categories: current/cumulative risk, field variables, environmental variables, and production variables. Weekly scores are plotted over the season. The model was demonstrated at farms in WA and tested on several crops in 2023. We are waiting on storage results for validation. Data from trials in

## Progress Report

Accession No. 1020312

Project No. WNP03104

Seasons 1-3 are being used to test the model. This was led by Project Manager, MacKay, who resigned in 2023 for medical reasons. PD will seek expertise to develop the model and a model app for stakeholders. Environmental factors that drive bacterial disease risk were mapped regionally to provide context for how these contribute to the risk of bacterial diseases.

**B7. Outreach and Extension:**

Year 4 outreach included 7 articles in Onion World and Vegetable and Specialty Crop News. Presentations were given at grower meetings in 7 states, attended by >780 stakeholders.

**B8. Economics:**

Economic analysis of 2 years of onion trials in NY showed that, despite record N prices, the economics of a grower's decision on how much N to apply did not change. Growers should apply amounts of N to maximize yield for the variety, soil type, location, and other aspects affecting N use. A preliminary assessment using 1 year of GA data showed larger-scale growers can increase profits by adopting a chain digger due to a decrease in bacterial bulb rot compared to a straight blade undercutter. For small-scale growers, the payback period may be too long. An analysis of economic returns to input intensity in GA (low vs. grower standard vs. high input intensity) showed the high input strategy yielded greatest per-acre economic return from reduced bacterial rot, even with high chemical prices.

A survey of team members and Stakeholder Advisory Panel members assessed: (a) progress on delivering new insights and solutions for growers to reduce economic losses from onion bacterial diseases, (b) level of confidence in the solutions, and (c) need for further research and evidence. The project has made excellent or very good progress on increased awareness of bacterial pathogens of onion, and developing standardized assays for bacterial isolations and virulence screening. Field practices such as avoiding cutting necks too short (<2 inches), avoiding early topping of bulbs, and drip irrigation instead of overhead irrigation, were considered effective.

**PROJECT MANAGEMENT**

Coordination, communication, and integration across the team and with SAP members have been supported by monthly videoconferences, annual team meetings, and SAP meetings.

**What opportunities for training and professional development has the project provided?****Graduate students:**

**M. J. Hart.** 2022. Is there an Economic Return to Reducing the Quantity of Fertilizer Applied to Onions when Growers Face Record Nitrogen Prices? University of Georgia. (M.Sc.)

**T. L. Waldrop.** 2022. An Economic Analysis of Onion Harvesting Equipment in Georgia. University of Georgia. (M.Sc.)

**B. P. Bhatta.** August 2023. Genetic and Genomic Studies on Diseases of Watermelon and Onion In Texas. Texas A&M. (Ph.D.)

**V. Ibanez,** 4th year student. Dissertation title: Bacterial community associated with symptomatic and asymptomatic onion bulbs from Georgia, USA. (M.Sc.) University of Pretoria

**A. Grobler,** 2nd year. Dissertation: Characterisation of bacteriophages of *Pantoea ananatis* and *P. agglomerans* and their potential use in managing diseases caused by these two pathogens. (M.Sc.) University of Pretoria

**F. Mnguni,** 4th year. Thesis: Characterisation of the bacterial pathogens associated with bulb rot in the USA and South Africa. (Ph.D.) University of Pretoria

**BSc honours student:**

**I. Pooa,** project: Identification and pathogenicity of *Enterobacter* species isolated from the first and second survey of the Stop the Rot project. University of Pretoria

**Post-Doc:**

**Gi Yoon Shin:** Comparative genomics and genetics of *Pantoea* onion pathogens. University of Georgia

**Undergraduate students:**

At least five undergraduate students were trained in lab techniques (preparing media, culturing bacteria, conducting PCR and gel electrophoresis) and field protocols (setting up and maintaining field plots, collecting data, evaluating onions for rot).

**How have the results been disseminated to communities of interest?**

In this reporting period, we have been actively reaching out to growers and stakeholders to: share new information and learning from the project as well as current scientific understanding of onion bacterial diseases and their management; understand growers' current state of knowledge about causes and management of bacterial diseases of onion, and identify priority concerns for growers and the onion industry regarding management of bacterial diseases. Information has been shared with growers and stakeholders through a range of communication channels, including the Alliumnet website, research summaries, extension bulletins, articles in trade publications and presentations at growers' meetings and field days. Results were also shared at professional scientific meetings (primary venues being the International Congress of Plant Pathology in August 2023, the Stop the Rot Annual Team Meeting in Jan. 2023, and many regional grower meetings).

**REACHING GROWERS AND ONION INDUSTRY STAKEHOLDERS:**

- Outreach to growers and onion industry stakeholders, field representatives and extension staff has occurred through

## Progress Report

Accession No. 1020312

Project No. WNP03104

informal visits with growers during field surveys, grower meetings, field days and technical workshops.

- Our Stop the Rot video playlist

[https://www.youtube.com/playlist?list=PLajA3BBVyv1zf2obB16bNEdQPQeLW\\_XB](https://www.youtube.com/playlist?list=PLajA3BBVyv1zf2obB16bNEdQPQeLW_XB) contains several videos aimed at growers and the onion industry - introduction to rot identification, in both English and Spanish; a longer video providing an overview of bacterial diseases in onion and current management options; a short video of the experimental equipment for our field trials of post-harvest disinfection treatments; a short time-lapse video of the Red Scale Necrosis (RSN) assay; and two training videos on inoculating trials and designing field experiments.

- Outreach and dissemination of preliminary results to onion stakeholders and the industry has been conducted through informational articles in trade publications and extension newsletters (see list of publications) and websites.

Outreach to growers and industry stakeholders through the Stop the Rot Stakeholder Advisory Panel:

- Our 14-member Stakeholder Advisory Panel (SAP) brings a diverse range of expertise and experience to the project. The Panel includes growers, pathologists and onion breeders from onion growing regions across the US. Panel members are active in sharing information about the project to growers and onion industry stakeholders through their own regional and national networks in 12 states, and in bringing insights and information into the project from their networks. Our second annual meeting with the SAP was held on Feb. 3, 2023, by videoconference. Panel members have actively participated in our monthly project team meetings by videoconference, and they continue to receive project updates, notes from the monthly meetings and our internal project team newsletters.

#### REACHING ACADEMIC RESEARCHERS, EXTENSION PROFESSIONALS AND GRADUATE STUDENTS

- The project team now includes 24 research collaborators from 12 states, representing all 7 major U.S. onion growing regions, as well as onion bacteriologist Prof. Teresa Coutinho from South Africa. We hold monthly team videoconferences to share preliminary results and experiences and discuss recent findings. These monthly meetings of 1.5 to 2 hours have facilitated research and Extension collaborations. Almost all the project collaborators are also involved in extension services and education in their regions, which makes for efficient transfer of new information and research results from the team to extension professionals and thence to growers. Technicians and graduate students from each of the regional teams also join our monthly meetings and contribute actively to the discussions, providing feedback on methods and protocols and sharing their latest results with the full team in a collegial setting.

- Our annual project team meeting was held in Savannah, GA, in Jan. 2023, in conjunction with the Southeast Fruit & Vegetable Conference, and the annual meeting of the W-4008 Multistate Onion Research Project. This allowed us to share and discuss research results with academic colleagues and onion stakeholders. 12 oral presentations were made.

- Results of Year 3 field trials in participating states have been published in peer-reviewed Plant Disease Management Reports (see list of publications).

- Articles have been published in scientific journals (see list of publications).

- Poster presentations were shared at the International Congress of Plant Pathology in Aug. 2023.

#### What do you plan to do during the next reporting period to accomplish the goals?

We received a one year no-cost extension for the grant to complete objectives that were delayed due to COVID restrictions in Year 1.

#### Objective A:

##### A1. Bacterial survey

The regional labs will send representative strains from Season 3 to UGA to be included in the NOBSC, and will finish characterizing the strains from Seasons 1-3 that were not completed by the end of Year 4 of this project (pathogenicity testing on scales, foliage, and bulbs; and DNA sequencing for genus and potentially species identification). UGA will continue to characterize the strains received, and add results and metadata to the NOBSC database. The NOBSC dataset will be made available publicly on Alliumnet by the end of the grant. Regional labs will plan for long-term storage and back-up of their regional collections, since the NOBSC will only include a subset of strains from each regional lab. Publications on regional survey results are being developed by individual states or regions, as well as a final survey publication for the entire project, summarizing the combined survey results from all participating states over all three seasons.

##### A2. Pathogenomic analyses, virulence factors and bacterial community analyses

UGA will finish the analyses for a comparative genomics study of *P. agglomerans* and *P. allii*, and publish the results.

Manuscripts for the description of novel species, including *Ewingella allii*, *Kosakonia beeriae*, and *Phytobacter cepae*, isolated during these surveys are in preparation.

##### A3. Molecular diagnostic tools

Woodhall will continue testing soil, seed, water, and plant samples received from various states in the surveys, using the real-time PCR assays developed for more rapid testing than traditional isolations followed by DNA sequencing.

##### A4. Phenotypic resistance screening methods

## Progress Report

Accession No. 1020312

Project No. WNP03104

Results from the phenotypic screening trials in GA and NY will be analyzed and published. Onion bulbs from the variety trial in CA are currently in storage and will be rated and tested this fall. Results of 3 seasons of cultivar field trials in WA will be combined into a journal publication, along with a paper on the phenotypic assays vs. field trials carried out in NY, CA, WA, and GA.

**Objective B:****B1 to B6:**

Bulbs in storage from 2023-24 field trials in multiple states in Year 4 will be evaluated for bacterial rot, the data analyzed, and results published in Plant Disease Management Reports. A limited number of field trials will be completed in 2024-25, including irrigation and fertility trials in WA, a variety trial in UT, a pesticide trial in CA, and several cultural practice trials in GA. Results will be shared with growers and other stakeholders on Alliumnet, at grower and other professional meetings, and in various outreach materials. The field-scale risk-assessment model will be tested with more growers' fields in 2024, and using field trial data from 3-4 seasons of results, in collaboration with the WSU Decision Aid System program. Risk model results will be compared with regional-scale mapping.

**B7. Outreach and extension**

In Year 5, we will continue to direct more attention to synthesizing work from the four seasons to highlight regional and national trends in bacterial diseases and options for management. Results from field trials in Year 4 will be shared with growers, industry representatives and other interested parties at grower meetings, field days, on Alliumnet, and in trade and outreach publications. A video summarizing results of the Stop the Rot onion bacterial project has been initiated in collaboration with the WSU CAHNRS Office of Communication, to complement the highly successful 14-minute video we made at the start of the project, summarizing the situation and the gaps in knowledge. The wrap-up video will highlight key results that are readily adoptable by growers to limit losses to onion bacterial pathogens.

The redesigned Alliumnet.com website will be maintained to provide a home for national onion research collaborations, including other USDA projects, the National Allium Research Conference, links to National Onion Association meetings and events, and the W-1008, W-2008, W-3008 and W-4008 onion multi-state project reports, activities, and meeting details.

**B8: Economic analysis**

Two components will be completed during the final project year. To capture the project's impact on growers' knowledge of bacterial diseases and perception of management tools to reduce economic losses, an end-line survey will be administered and analyzed. Survey results will be contrasted with the baseline survey administered in year one of the project. Economic analysis of field trials aimed at assessing the relative efficacy of alternative products (bactericides), input intensities (nitrogen), and cultural practices (undercutting, timing of topping, and length of the necks at topping) will be updated with the final year of field trial results to provide multi-year averages.

**Project Management and Coordination**

The fourth annual project team meeting is scheduled for March 5-7, 2023, in Mount Vernon, WA, and the Stakeholder Advisory Panel videoconference is scheduled for later than month. Regular monthly videoconferences for the full team, regular meetings for the co-PIs every ~3 months will continue in Year 5. The team will focus on wrapping up research projects, publishing regional research results, and compiling results into larger papers that summarize results across the entire project, e.g., 3 years of surveys across 12 states, 3-4 years of field trials on various aspects of onion bacterial disease management, risk model development and evaluation, etc.

**Participants****Actual FTE's for this Reporting Period**

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	3.7	0.7	4.4	1.8	10.600000000000001
Professional	0	0	0	0	0
Technical	4.7	0	0	0	4.7
Administrative	0.7	0	0	0	0.7
Other	0.1	0	0	0	0.1
Computed Total	9.2	0.7	4.4	1.8	16.100000000000001

## Progress Report

Accession No. 1020312

Project No. WNP03104

## Student Count by Classification of Instructional Programs (CIP) Code

Undergraduate	Graduate	Post-Doctorate	CIP Code
0	4	0	01.01 Agricultural Business and Management.
5	3	0	01.11 Plant Sciences.
0	1	0	01.12 Soil Sciences.
7	3	5	26.03 Botany/Plant Biology.
0	0	1	01.99 Agriculture, Agriculture Operations, and Related Sciences,

## Target Audience

Stakeholders involved in the US onion industry are the primary audience for this project. This includes onion producers (farmers), packers, shippers, and associated stakeholders engaged in various capacities in onion production, distribution, and marketing, e.g., agronomists, crop consultants, farm managers, field workers; personnel associated with agricultural supply companies (fertilizer and pesticide dealers, irrigation supply companies, etc.), seed companies, and dealers; onion breeders (public and private); and onion storage and shipping/transport personnel and companies. Public and private research and extension specialists, undergraduate students, graduate students, and postdoctorates working with diverse aspects of onion production are also a target audience for this project.

The target audiences reached during this reporting period included:

- Onion growers, packers, processors, and associated stakeholders in the 7 main onion-growing regions of the US;
- Extension professionals in the 12 onion-growing states represented in this project;
- Onion researchers from the US and other countries attended a session dedicated to Stop the Rot project results at the Stop the Rot Annual Team Meeting in Savannah, GA on Jan. 5-7, 2023 (25 participants);
- Onion stakeholders at the Southeast Fruit & Vegetable Conference in Savannah, GA on 5-7, 2023 (35 people);
- Growers at the Tri-County Produce Auction Meeting in New Wilmington, PA on Oct. 22, 2022 (12 people);
- Stakeholders at the Ephrata Agway Grower Meeting in Ephrata, PA on Dec. 13, 2022 (52 people);
- Onion stakeholders at the New England Vegetable and Fruit Conference, Manchester, NH on Dec. 15, 2022 (70 attendees);
- Onion stakeholders in Colquitt Co., GA on Jan. 24, 2023 (55 attendees);
- Onion stakeholders in Tattnall Co., GA on Jan. 26, 2023 (60 attendees);
- Onion stakeholders at the UT Onion Association Annual Meeting in Brigham City, UT on Feb. 7, 2023 (13 attendees);
- Onion stakeholders at the CA Garlic and Onion Research Symposium in Tulare, CA on Feb. 13, 2023 (80 attendees);
- Onion stakeholders at the CO Fruit & Vegetable Growers' Association Annual Meeting in Denver, CO on Feb. 21-22, 2022 (30 attendees);
- Onion stakeholders at a Treasure Valley, ID survey on Feb. 7, 2023 (25 attendees);
- Allium stakeholders at the Allium Produce Grower Update webinar on Mar. 2, 2023 (24 attendees);
- Onion stakeholders at the Vidalia Onion Field Day Demonstration and Training in Lyons, GA on Apr. 7, 2023 (30 attendees);
- Onion stakeholders at the BASF/Nunhems Onion Growers' Meeting in Kennewick, WA on Nov. 15, 2022 (50 people);
- Onion stakeholders at the Onion Session of the 2023 Annual Convention & Trade Show of the Pacific Northwest Vegetable Association in Kennewick, WA on Nov. 16, 2022 (250 people);
- Onion stakeholders at the Vegetable Spring Field Day in Uvalde, TX on May 11, 2023 (85 attendees);
- Onion growers at the NMSU Onion Field Day in Las Cruces, NM on June 7, 2023 (36 attendees);
- Onion stakeholders at the UI Parma REC Field Day in June 2023 (~50 attendees);
- Onion growers/stakeholders at the Muck Donut Hour weekly in August 2022 (~10 people each time);
- Onion stakeholders at the ID Treasure Valley Onion Field Day in August 2023 in Parma, ID (~50 people);
- Onion stakeholders at the WSU Onion Field Day on Aug. 31, 2023 (~80 people);
- The project's 14-member Stakeholder Advisory Panel represents onion farms, regional onion associations, and major vegetable seed companies (including onion breeders and plant pathologists) from across the US, with one international member. Panel members conducted further outreach to their own networks on behalf of the project. Panel members who are grower representatives include Greg Bird (President of the Michigan Onion Committee), Bob Ehn (California Garlic and Onion Research Advisory Board), Charles Hall (Executive Director of the Georgia Fruit and Vegetable Growers Association), and Michael Locati (President of the Columbia Basin Onion Research Committee. The onion seed industry is represented by Peter Rogers and Juan Carlos Brevis (Nunhems), Scott Hendricks (Bayer), and Margreet Asma (Bejo Zaden).

## Progress Report

Accession No. 1020312

Project No. WNP03104

• 12 undergraduate students, 11 graduate students, and six postdoctorates have worked on research directly related to the Stop the Rot project in this reporting period. They are conducting research in Washington State, Georgia, Texas, Pennsylvania, Colorado, New Mexico, and South Africa.

• We used multiple channels to reach our target audience during this reporting period, including grower meetings and field days, conferences and workshops, the Alliumnet.com website, industry newsletters, and trade publications. Project team members also reached out directly to growers in each of the onion-growing regions to recruit growers for participation in the bacterial field surveys.

During this reporting period, the Stop the Rot project page on the Alliumnet.com website received 7,888 page views from 4,290 visits by 3,065 users. This is a significant increase from page views in the previous reporting period.

Approximately 1,110 growers, agronomists, and industry professionals were reached directly through presentations at conferences, workshops, field days, and grower meetings in this reporting period, with many others accessing recorded webinars/presentations, meeting individually with specialists on the team, etc. Most of these events were shifted back to in-person events following the COVID-19 pandemic.

Communication and outreach materials and specific activities are reported in detail in the list of products.

**Products**

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2022	YES

**Citation**

Manzeal Khanal, Sujan Timilsina, Bed Prakash Bhatta, Khumbuzile Bophela, Teresa Coutinho, Kimberly Cochran, and Subas Malla. 2022. *Pseudomonas uvaldensis* sp. nov., a bacterial pathogen causing onion bulb rot. *Int. J. Syst. Evol. Microbiol.* 2022;72:005311. DOI 10.1099/ijsem.0.005311

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2022	YES

**Citation**

Mei Zhao, Chris Tyson, Hsiao-Chun Chen, Sujan Paudel, Ron Gitaitis, Brian Kvitko, and Bhabesh Dutta. 2022. *Pseudomonas allivorangis* sp. nov., a plant-pathogenic bacterium isolated from onion foliage in Georgia, USA, *Systematic and Applied Microbiology* 45 (1):126278. <https://doi.org/10.1016/j.syapm.2021.126278>.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Belo T., du Toit L., and G.T. LaHue. 2023. Reducing the risk of onion bacterial diseases through irrigation, fertility, and other cultural management strategies. *Agron. J.* 115:459–473. <http://dx.doi.org/10.1002/agj2.21301>

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Belo T., du Toit L., Waters T., Derie M., Schacht B., and LaHue, G.T. 2023. Reducing the risk of onion bacterial diseases through managing irrigation frequency and final irrigation timing. *Agric. Water Manag.* 288:108476. <https://doi.org/10.1016/j.agwat.2023.108476>

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Bhatta B.P., M. Khanal, and Malla, S. 2023. Whole genome and 16S rRNA dataset of *Pectobacterium carotovorum* strain 21TX0081 isolated from a symptomatic onion foliage in Texas. *Data Brief* 46:108823.



## Progress Report

Accession No. 1020312

Project No. WNP03104

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Khanal M., B.P. Bhatta, and Malla, S. 2023. Isolation and characterization of bacteria associated with onion and first report of onion diseases caused by five bacterial pathogens in Texas, U.S.A. *Plant Dis.* 107:1721-1729.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Khanal M., and Malla, S. 2023. Draft genome sequence and annotation of *Pseudomonas carnis* strain 20TX0167 isolated from onion (*Allium cepa*). *Microbiol. Resour. Announc.* 12(2):e01051-22. <https://doi.org/10.1128/mra.01051-22>.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2022	YES

**Citation**

Khanal, M., B.P. Bhatta, S. Timilsina, S. Ghimire, K. Cochran, and Malla, S. 2022. *Curtobacterium allii* sp. nov., the actinobacteria species causing onion bulb disease. *Antonie van Leeuwenhoek* 116:83-96.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2022	YES

**Citation**

Khanal, M., S. Timilsina, B.P. Bhatta, K. Bophela, T. Coutinho, K. Cochran, and Khanal, M., S. Timilsina, B.P. Bhatta, K. Bophela, T. Coutinho, K. Cochran, and Malla, S. 2022. *Pseudomonas uvaldensis* sp. nov., a bacterial pathogen causing onion bulb rot, isolated from Texas, USA. *Int. J. Syst. Evol. Microbiol.* 72:005311. <https://doi.org/10.1099/ijsem.0.005311>.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Myers, B. Shin, G.Y., Stice, S., Agarwal, G., Gitaitis, R., Kvitko, B., and Dutta, B. 2023. Genome-wide association and dissociation studies in *Pantoea ananatis* reveal potential virulence factors affecting *Allium porrum* and *A. fistulosum* × *A. cepa* hybrid. *Front. Microbiol.* 13:1094155. doi: 10.3389/fmicb.2022.1094155.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Shin, G.Y., Dutta, B., Kvitko, B. 2023. The genetic requirements for HiVir-mediated onion necrosis by *Pantoea ananatis*, a necrotrophic plant pathogen. *Molecular Plant-Microbe Interactions* 28:381-391.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Zhao, M., Shin, G.Y., Stice, S., Coutinho, T., Gitaitis, R., Kvitko, B., and Dutta, B. 2023. A novel biosynthetic gene cluster across the *Pantoea* species complex is important for pathogenicity in onion. *Mol. Plant Microbe Interact.* <https://doi.org/10.1094/MPMI-08-22-0165-R>.

## Progress Report

Accession No. 1020312

Project No. WNP03104

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2022	YES

**Citation**

Zhao, M., Tyson, C., Gitaitis, R., Kvitko, B., and Dutta, B. 2022. Rouxiella badensis, a new bacterial pathogen of onion causing bulb rot. *Front. Microbiol.* 13:1054813.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Davey, J., and Uchanski, M.E. 2023. Evaluation of bactericides to manage slippery skin bacterial bulb rot in onion in Colorado, 2022-2023. *Plant Disease Management Reports* 17:V120.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Davey, J., and Uchanski, M.E. 2023. Efficacy of disinfectants applied to onion bulbs in storage for control of slippery skin bacterial bulb rot, Fort Collins, CO, 2022-2023. *Plant Disease Management Reports* 17:V121.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Dutta, B., and Tyson, C. 2023. Evaluation of digging methods on post-harvest incidence of external and internal bacterial bulb in onion, Georgia, 2022. *Plant Disease Management Reports* 17:V006.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Dutta, B., and Tyson, C. 2023. Evaluation of harvesting methods on post-harvest incidence of external and internal bacterial bulb rot in onion, Georgia, 2022. *Plant Disease Management Reports* 17:V007.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Dutta, B., and Tyson, C. 2023. Evaluation of neck-clipping length on post-harvest incidence of external and internal bacterial bulb rot in onion, Georgia, 2022. *Plant Disease Management Reports* 17:V008.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Dutta, B., Donahoo, W.M., and Foster, M.J. 2023. Evaluation of bactericides and LifeGuard programs to manage internal bacterial rot of onion in Georgia, 2022. *Plant Disease Management Reports* 17:V009.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

du Toit, L.J., Derie, M.L., Gundersen, B., Waters, T.D., and Darner, J. 2023. Effects of application method and bactericides on bacterial leaf blight and bulb rot of onion, Pasco, WA, 2022-23. *Plant Disease Management Reports* 17:V123.

## Progress Report

Accession No. 1020312

Project No. WNP03104

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

du Toit, L.J., Derie, M.L., Gundersen, B., Waters, T.D., and Darner, J. 2023. Effects of bulb undercutting on bacterial leaf blight and bulb rot in an onion crop, Pasco, WA, 2022-23. Plant Disease Management Reports 17:V129.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

du Toit, L.J., Derie, M.L., Gundersen, B., Waters, T.D., and Darner, J. 2023. Effects of rolling tops on bacterial leaf blight and bulb rot in an onion crop, Pasco, WA, 2022-23. Plant Disease Management Reports 17:V128.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

du Toit, L.J., Derie, M.L., Gundersen, B., Waters, T.D., and Darner, J. 2023. Effects of time of topping on bacterial leaf blight and bulb rot in an onion crop, Pasco, WA, 2022-23. Plant Disease Management Reports 17:V125.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

du Toit, L.J., Derie, M.L., Gundersen, B., Waters, T.D., and Darner, J. 2023. Susceptibility of 12 onion cultivars to bacterial leaf blight and bulb rot in Pasco, WA, 2022-23. Plant Disease Management Reports 17:V124.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Hoepting, C.A., Caldwell, S.K., and van der Heide, E.R. 2023. Effect of slow curing with artificially heated forced air via a drying wall in a box storage on bacterial bulb rot in onion, 2021. Plant Disease Management Reports 17:V141.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Hoepting, C.A., Caldwell, S.K., and Gropp, N.K. 2023. Evaluation of rolling onions that are failing to lodge to reduce bacterial bulb rot of onion, 2022. Plant Disease Management Reports 17: V140.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2023	YES

**Citation**

Nischwitz, C., and Drost, D. 2023. Evaluation of efficacy of bactericides to control slippery skin of onion in Utah, 2021. Plant Disease Management Reports 17:V152.

## Progress Report

Accession No. 1020312

Project No. WNP03104

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

du Toit, L., Aegerter, B., Colson, G., Coutinho, T., Cramer, C., Dutta, B., Gugino, B., Hoepting, C., Kvitko, B., LaHue, G., MacKay, H., Malla, S., Nischwitz, C., Reitz, S., Shin, G., Uchanski, M., Waters, T., and Woodhall, J. 2023. Combating onion bacterial diseases with pathogenomic tools and enhanced management strategies. 12th International Congress of Plant Pathology, 21-25 Aug. 2023, Lyon, France.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Dutta, B., Zhao, M., Shin, G., du Toit, L., and Kvitko, B. 2023. A micro- and macro-perspective of bacterial pathogens affecting onion in Georgia, USA. 12th International Congress of Plant Pathology, 20-25 Aug. 2023, Lyon, France.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Mnguni, F., Shin, G.-Y., du Toit, L., Derie, M., Aegerter, B., Woodall, J., Dutta, B., Zhao, M., Hoepting, C., Gugino, B., Mazzone, J., and Coutinho, T. 2023. The diversity and pathogenicity of *Rahnella* species isolated from diseased onion bulbs in the United States and South Africa. International Congress of Plant Pathology, 21-25 Aug. 2023, Lyon, France.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Ibanez, V., Liakos, C., Derie, M., du Toit, L., Dutta, B., Kvitko, B., van der Waals, J., Coutinho, T.A., and Lebre, P. 2023. Metagenome analysis of bacteria present in storage onion bulbs in the USA. International Congress of Plant Pathology, 21-24 Aug. 2023, Lyon, France.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2022	YES

**Citation**

Ibanez, V., Liakos, C., Derie, M., van der Waals, J., Coutinho, T.A., and Lebre, P. 2022. Bacterial and viral inhabitants of onion bulbs in the USA. Proceedings of the 52nd Congress of the Southern African Society for Plant Pathology, Future Africa, University of Pretoria, 1 to 3 August 2022.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2022	YES

**Citation**

Grobler, A., Theron, J., and Coutinho, T.A. 2022. Isolation and characterization of phages for potential biocontrol of *Pantoea ananatis* and *P. agglomerans*. Proceedings of the 52nd Congress of the Southern African Society for Plant Pathology, Future Africa, University of Pretoria, 1 to 3 August 2022.

United States Department of Agriculture  
Progress Report

<b>Accession No. 1020312</b>	<b>Project No. WNP03104</b>
------------------------------	-----------------------------

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2022	YES

**Citation**

Mnguni, F., Shin, G.-Y., and Coutinho, T.A. 2022. Identification and pathogenicity of Rahnella species isolated from diseased onion bulbs from the USA and South Africa. Proceedings of the 52nd Congress of the Southern African Society for Plant Pathology, Future Africa, University of Pretoria, 1 to 3 August 2022.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2022	YES

**Citation**

Gugino, B.K. 2022. Managing key diseases of onions: Stop the Rot! 2022 New England Vegetable and Fruit Conference Proceedings (pp. 3).

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Thompson, C. 2023. Major Scientific Breakthrough in Onion Research. Vegetable and Specialty Crop News, April 2023. (edits provided by B. Dutta)

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Thompson, C. 2023. Downy Mildew Discovered in Vidalia Onion. Vegetable and Specialty Crop News, March 2023. (edits provided by B. Dutta)

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Thompson, C. 2023. Scala Fungicide No Longer Viable Option on Botrytis for Vidalia Onion Producers. Vegetable and Specialty Crop News, February 2023. (edits provided by B. Dutta)

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Thompson, C. 2023. Producers Beware: Downy Mildew Disease a Threat for Vidalia Onions. Vegetable and Specialty Crop News, February 2023. (edits provided by B. Dutta)

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2022	YES

**Citation**

Thompson, C. 2021. UGA Extension Encourages Copper Applications for Vidalia Onion Producers. Vegetable and Specialty Crop News, December 2022. (edits provided by B. Dutta)

United States Department of Agriculture  
Progress Report

<b>Accession No. 1020312</b>	<b>Project No. WNP03104</b>
------------------------------	-----------------------------

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Mackay, H., du Toit, L.J. and Hoepting, C. 2023. Stop the Rot – Rollout of research results. Onion World. July/August 2023. [https://issuu.com/columbiamediagroup/docs/ow\\_july-august\\_2023?fr=sYmUxNzQ5MDQ1MjQ](https://issuu.com/columbiamediagroup/docs/ow_july-august_2023?fr=sYmUxNzQ5MDQ1MjQ)

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Kvitko, B., Hoepting, C. and du Toit, L.J. 2023. Stop the Rot - Mistaken identity Onion World September/October 2023

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Hoepting, C.A. 2023. The onion rot race. August 30, 2023 Veg Edge, 19(21):7-8.

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Hoepting, C.A. 2023. Rolling onions that are “dying standing up” to stop the rot. August 23, 2023 Veg Edge, 19(20):6-7.

Type	Status	Year Published	NIFA Support Acknowledged
Other	Published	2023	YES

**Citation**

Hoepting, C.A. 2023. Mid-July/early bulbing signals onset of disease in onion. July 13, 2023 Veg Edge, 19(14):4-5.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2022	YES

**Citation**

Onion Storage Treatment Demonstration. Fort Collins, CO. October 24, 2022, Shad Wenta, from Wenta Nip and Sanitizing and CSU research associate, Jane Davey gave an on-farm demonstration of how to treat onion or potato crops in storage by thermo-fogging with disinfectant products to manage fungal and bacterial disease development. The presentation was given to CSU’s farm manager, Sky Handyside, two undergraduate students, and two CSU research entomologists.

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

du Toit, L., MacKay, H., and Kvitko, B. 2023. Objective A1. Bacterial survey and the National Onion Bacterial Survey Collection. Annual team meeting, USDA NIFA SCRI ‘Stop the Rot’ onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

## Progress Report

Accession No. 1020312

Project No. WNP03104

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Kvitko, B., Shin, G.-Y., and Dutta, B. Objective A2a. Pathogenomics. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Coutinho, T., Kvitko, B., and Shin, G.-Y. 2023. Objective A2b. Microbiome analysis, Rahnella and Enterobacter identifications, and bacteriophage identifications. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Woodhall, J. 2023. Objective A3. Development of onion bacterial pathogen detection tools. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

du Toit, L., Derie, M., Waters, T., Dutta, B., Hoepting, C., Aegerter, B., Sidhu, J., and Nischwitz, C. 2023. Objective A4. Development of onion phenotyping protocols for screening for resistance to bacterial pathogens. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

LaHue, G., Aegerter, B., Belo, T., Caldwell, S., Coolong, T., Derie, M., Dutta, B., Feibert, E., Gugino, B., van der Heide, E., Hoepting, C., de Jesus, H., Mazzone, J., Murdock, M., Nault, B., Nicholson, K., Regan, K., Reitz, S., Rivera, A., Schacht, B., da Silva, A., Trenkel, I., Waters, T., Wieland, K., Wilson, R., Woodhall, J., and du Toit, L. 2023. Objectives B1 and B2. Irrigation practices and soil fertility management. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Davey, J., du Toit, L., Dutta, B., Uchanski, M., and Waters, T. 2023. Objective B3. Field evaluations of bactericides to manage onion bacterial diseases. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

du Toit, L., Derie, M., Waters, T., Dutta, B., and Hoepting, C. 2023. Objective B4. Cultural practices. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

## Progress Report

Accession No. 1020312

Project No. WNP03104

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Waters, T., du Toit, L., Uchanski, M., and Davey, J. 2023. Objective B5. Postharvest disinfectant practices. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

du Toit, L., MacKay, H., and Rajagopalan, K. 2023. Objective B6. Bacterial disease risk modeling. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Hoepting, C. 2023. Objective B7. Outreach and Extension update. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2023	YES

**Citation**

Colson, G. 2023. Objective B8. Economics component. Annual team meeting, USDA NIFA SCRI 'Stop the Rot' onion bacterial project, 5 Jan. 2023, Savannah, GA (35 people).

**Other Products****Product Type**

Other

**Description**

PA: Oct. 22, 2022. Tri-County Produce Auction Meeting, New Wilmington, PA  
Identification and management of common foliar and bulb diseases of onion (Beth Gugino), 12 attendees

**Product Type**

Other

**Description**

PA: Dec. 13, 2022. Ephrata Agway Grower Meeting, Ephrata, PA  
Onion disease identification and management (Beth Gugino), 52 attendees

**Product Type**

Other

**Description**

PA: Dec. 15, 2022. New England Vegetable and Fruit Conference, Manchester, NH  
Disease management: Allium (Beth Gugino), 70 attendees



United States Department of Agriculture  
Progress Report

Accession No. 1020312

Project No. WNP03104

**Product Type**

Other

**Description**

GA: Jan. 24, 2023. Management of diseases in multiple vegetable crops (Colquitt County), (Bhabesh Dutta), 55 attendees

**Product Type**

Other

**Description**

GA: Jan. 26, 2023. Mid-season update on fungal and bacterial disease in onion (Tattnall County, (Bhabesh Dutta), 60 attendees

**Product Type**

Other

**Description**

UT: Feb. 7, 2023. Utah Onion Association meeting, Brigham City, UT, Stop the Rot – National Program Successes by Lindsey du Toit, 10 attendees

**Product Type**

Other

**Description**

CA: Feb. 13, 2023. California Garlic and Onion Research Symposium, Tulare, CA  
Combating Onion Bacterial Disease, 80 attendees

**Product Type**

Other

**Description**

CO: Feb. 21-22, 2023. Annual Meeting of the Colorado Fruit and Vegetable Growers Association (CFVGA), Denver, CO; poster: CSU Specialty Crops Program 2021-2022 Research Highlights, 25-30 attendees

**Product Type**

Other

**Description**

ID: Feb. 7, 2023. Stop the Rot update for Idaho (James Woodhall)  
Treasure valley survey (Ben Wood, Ph.D. student)

**Product Type**

Other

**Description**

PA: Mar. 2, 2023. Produce Grower Update: Allium (Webinar) Common diseases on onion (Beth Gugino), 24 attendees

**Product Type**

Other

**Description**

GA: Apr. 7, 2023. Vidalia Onion Field Demonstration and Training (Lyons, GA) (Bhabesh Dutta), 30 attendees

## Progress Report

Accession No. 1020312

Project No. WNP03104

**Product Type**

Other

**Description**

WA: Nov. 15, 2022. Onion foliar diseases: Fungicide use and recommendations. Invited presentation, BASF/Nunhems Onion Growers' Meeting, Kennewick, WA (Lindsey du Toit), ~50 people

**Product Type**

Other

**Description**

WA: Nov. 16, 2022. Stop the Rot: Research update. Invited presentation, Onion Session, Pacific Northwest Vegetable Association Annual Convention & Trade Show, 1, Kennewick, WA (Lindsey du Toit), ~250 people

**Product Type**

Other

**Description**

GA: Jan. 5-7, 2023. A national perspective on onion bacterial diseases. Invited presentation. Vidalia Onion Session, Southeast Fruit & Vegetable Conference, Savannah, GA (Lindsey du Toit), ~35 people

**Product Type**

Other

**Description**

UT: Feb. 7, 2023. Stop the Rot Update – National program successes. Utah Onion Meeting, virtual (Lindsey du Toit), 13 people

**Product Type**

Other

**Description**

TX: May 11, 2023. Vegetable Spring Field Day, Uvalde, TX, 85 attendees

**Product Type**

Other

**Description**

NM: June 7, 2023. NMSU Onion Field Day, Las Cruces, NM, 36 attendees

**Product Type**

Other

**Description**

ID: June 2023. Parma R&E Center field day, Demonstration of bacterial disease symptoms in the field

**Product Type**

Other

**Description**

NY: August 22, 2023. Presentation at Muck Donut Hour (weekly outreach activity in Elba muck): Rolling onions that are dying standing up to Stop the Rot, 10 attendees

United States Department of Agriculture  
Progress Report

Accession No. 1020312

Project No. WNP03104

**Product Type**

Other

**Description**

ID: August 2023. Booth with display of bacterial onion disease plus a demonstration of LAMP use for *P. agglomerans*

**Product Type**

Other

**Description**

WA: Aug. 31, 2023. WSU Onion Field Day, Skone & Conners Farms, Quincy, WA. Presented updates on onion bacterial research (Lindsey du Toit) ~80 people

**Changes/Problems**

**Problems affecting the work plan and budget:**

CO/Uchanski: Problems affecting the work plan and budget: In late 2022 the University of California sub-contract transferred \$5,000 plus associated F&A (~\$1,300) to the Colorado State University sub-contract due to cost savings from California and a need to additional Research Associate salary for Colorado to complete reporting in early 2023. This allowed us to complete two PDMRs from our 2022 (year 3) field work in year 4.

WA/LaHue: Poor stand establishment in WA trials for irrigation and nitrogen management, so trials were abandoned for the 2022 growing season and postponed to 2023 (a year in which no trials were originally planned). Stand establishment in 2023 was acceptable and the risk of poor stand establishment was spread out by planting in two separate locations.

WA/du Toit: The Project Manager, MacKay, had a severe medical emergency in Mar. 2023 that lasted a month, and then had to go on extended medical leave from early June. Sadly, MacKay had to resign as Project Manager on Oct. 1<sup>st</sup>, 2023 due to continuing medical issues. This has added significant work for the PD, du Toit, since June 1<sup>st</sup>, 2023 and has delayed aspects of the project organization and management. du Toit is seeking additional assistance to help with some aspects of the project in the no-cost extension year.

Budget support: High rates of turnover in grant support staff at various institutions involved in the project has complicated the ability to get timely documentation for tracking invoices and cost-share reporting for those subcontracts.