

Report from the:

**SAES-422 Multistate Research Project W-3008:
Integrated Onion Pest and Disease Management**

ANNUAL MEETING

Virtual
(Feb 3, 2021) at 11 AM -3PM EST

hosted by: Penn State University Zoom:

<https://psu.zoom.us/j/96980170966?pwd=Y3pDTUYlZUJaMVNyL3gxMGpFaVYyQT09>

February 3, 2021

W3008 Committee Officers – 2020:

Chair: Bhabesh Dutta, University of Georgia

Vice-Chair: Peter Rogers, BASF Vegetable Seeds

Secretary: David Burrell, National Onion Labs

Past Chair: Beth Gugino, The Pennsylvania State University

2021 W-3008 Onion Multistate Project Annual Meeting Agenda

Feb 3, 2021 (via zoom) (11 AM – 3 PM EST)

Meeting was held via Zoom.

DRAFT AGENDA

11:00 am Welcome and Introductions Bhabesh Dutta (Chair)

W3008 status, 2020 annual report, etc. – Tracy Dougher (advisor to W-3008),

State Reports

11:20 am New York- Christy Hoepting; Sarah Pethybridbride and Frank Hay (SLB research update)

11:40 am Colorado – Mark Uchanski

11:50 am Pennsylvania – Beth Gugino

12:00 pm Georgia - Bhabesh Dutta

12:10- 12:20 pm Short break

12:20 pm Utah - Dan Drost/Claudia Nischwitz

12:30 pm New Mexico - Chris Cramer

12:40 pm Texas – Subas Malla

12:50 pm Oregon (Treasure Valley) – Jeremiah Dung

1:00-2:00 pm Lunch break

2:00 pm Washington - Tim Waters

2:10 pm California – Bob Ehn/Tom Turini/Rob Wilson

2:20 pm Idaho – Brenda Schroeder

2:30 pm Update on Alliumnet (Joe Laforest/Sarah Jean)

2:40 pm to 3:00 PM Election of new officers, 2022 annual

Participants

Name	Affiliation	Email
Apurba Barman	IPM Advisor – Imperial County-CA	
Beth Gugino	The Pennsylvania State University	bkgugino@psu.edu
Bhabesh Dutta	University of Georgia	bhabesh@uga.edu
Brenda Schroeder	University of Idaho	bschroeder@uidaho.edu
Brian Kvitko	University of Georgia	bkvitko@uga.edu
Brian Nault	Cornell University	ban6@cornell.edu
Chris Cramer	New Mexico State University	cscramer@nmsu.edu
Christy Hoepting	Cornell Cooperative Extension	cah59@cornell.edu
Claudia Nischwitz	Utah State University	claudia.nischwitz@usu.edu
Dan Drost	Utah State University	dan.drost@usu.edu
Daniel Heck	Cornell University	dwh237@cornell.edu
David Burrell	National Onion Labs	davidb@onionlabs.com
Doug Higgins		
Frank Hay	Cornell University	fsh32@cornell.edu
Heather Mackay Brown	Washington State University	heather.mackaybrown@wsu.edu
Joe LaForest	University of Georgia	laforest@uga.edu
Jeremiah Dung	Oregon State University	jeremiah.dung@oregonstate.edu
Karly Regan		
Kevin Vander Kooi	University of Guelph	kvander@uoguelph.ca
Khuong Hua	Oregon State University	gia.hua@oregonstate.edu
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Lindsey du Toit	Washington State University	dutoit@wsu.edu
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Mark Uchanski	Colorado State University	Mark.uchanski@colostate.edu
Mary Ruth McDonald	University of Guelph, Canada	mrmcdona@uoguelph.ca
Mike Bartolo	Colorado State University	michael.bartolo@colostate.edu
Omar Cruz	Bland Farms	omar@blandfarms.com
Peter Rogers	BASF	peter.rogers@vegetableseeds.basf.com
Robert Ehn	SBC Global	robertehn@sbcglobal.net
Rebecca Turner		
Riley Harding	Cornell University	rsh263@cornell.edu
Ray Kniss / Sakata		
Robert Sakata		
Romana Iftikhar	Washington State University	Rmniftikhar229@gmail.com
Stormy Sparks	University of Georgia	
Sarah Swain	University of Georgia	sjswain@uga.edu
Stuart Reitz	Oregon State University	stuart.reitz@oregonstate.edu
Sarah Stricker	University of Guelph	strickes@uoguelph.ca
Sarah Pethybridge	Cornell University	sjp277@cornell.edu
Tim Waters	Washington State University	twaters@wsu.edu
Thomas Turini	University of California	taturini@ucanr.edu
Tracy Dougher	Montana State University	tracyaod@montana.edu
Travis Cranmer		
Tyler Blauel		

The meeting began promptly at 11:00 AM Eastern.

Welcome and Introductions: Bhabesh Dutta (Chair) led each participant to introduce themselves, describe their professional association and areas of interest.

Tracy Dougher - During the introductions, Tracy gave some feedback on the mid-term report that more highlight needs to be given to “your linkages and how you work as a multi-state group,” but that the reports are excellent. Tracy also mentioned the expiration of W-3008 and the submission deadline for the next project is no later than January 15th of 2022, along with the comment that the annual report is due 60 days after this meeting (secretary note - April 3, 2021).

Bhabesh Dutta – Bhabesh reiterated that Peter Rogers will be responsible to collect state reports, David Burrell will be responsible for submitting the minutes of the meeting. After review by the officers Peter will then send both to Tracy. Bhabesh commented that each state has 20 minutes allocated for their presentation.

State Report Section

New York Presenters: Christine Hoepting, Frank Hay, Brian Nault

11:20 AM Additional Personnel: Sarah Pethybridge, Karly Regan, Daniel Heck, Lidia Komondy, Lindsay Iglesias, and Denis Willett

- Christine led with a summary of the NY 2020 season. The weather was cold and generally dry with some high wind events resulting in blowouts along with a high incidences of herbicide injury. There was no spring with temperatures going from 50 to 60 to 80 F, going from winter to summer.
- Christine reviewed the fungicide trials for *Stemphylium* leaf blight noting that many fungicides that were effective in 2015 were no longer effective in 2020. Especially concerning was the loss of effectiveness of many Frac 7 fungicides..
- Frank Hay noted changes in sensitivity of *Stemphylium* spp. isolates to FRAC 7 fungicides between 2016 and 2018; with 2020 data still in analysis.
- Frank Hay noted that large percentages of isolates are drifting towards insensitivity to several FRAC 7 active ingredients, and this trend is appearing across multiple New York growing regions.
- Next Frank Hay detailed an analysis of which *sdh* gene mutations might explain the FRAC 7 resistance; concluding that *Stemphylium* spp. rapidly develop resistance to the FRAC 7 group.
- Christine presented 2020 field trial performance, noting exceptionally fast “fungicide crashes.” Many FRAC 3 compounds performed significantly better than FRAC 7.
- A highlight of two additional projects led by Brain Nault, Karly Regan and Lindsay Iglesias were shared on the impact of reduced fertilizer and insecticide utilization and organic Thrips control, along with another project involving sequential sampling and a digital application platform to improve Thrips control measures.
- Christine noted Thrips pressure was high, which led to challenges winding up this year’s crop. Christine briefly reported the effectiveness of a “Hammer” insecticide trial for Thrips control.

Colorado Presenter: Mark Uchanski

11:40 AM Additional Personnel: Mike Bartolo, Thad Gourd, Jane Davey, Antoinette Machado, Seth Urbanowitz, Jillian Lang, Brandon Sandoval

- Mark Uchanski noted the transitional retirement of Mike Bartolo and the retirement of Thad Gourd. Both will be seriously missed.
- Mark noted the addition of Seth Urbanowitz in 2018 as the Tri River Area Extension Agronomist (Western Slope) where he is coordinating the regional onion cultivar trials. Mark shared a quick snapshot detailing the results of the 2020 Western Slope onion Variety trial.
- Mark detailed the initial involvement at the Fort Collins research center in the SCRI “Stop the Rot” project. A new staff addition, Antoinette Machado has joined in the master’s program who will be involved in this project.
- This season plants were inoculated with some of Howard Schwartz’s *Pantoea* isolates. Control measures were selected after survey consultation with Colorado growers. Six bactericide control measures were selected to test. The results of these tests will be completed along with the storage trial evaluations currently in process.

Pennsylvania Presenter: Beth Gugino

11:50 AM Additional Personnel: Jenny Mazzoni, Shelby Fleischer

- Beth Gugino summarized the cultural practices of the onions grown in Pennsylvania reporting mostly small acreages involving a great deal of hand labor. Most of the fields use raised beds, with two rows on plastic and drip tape. The cultivars are Spanish sweet types, using transplants grown in Arizona. Harvest typically occurs in mid-July with onions being processed at two packing houses and sales being direct, in roadside markets, and/or through a grower co-op.
- Beth reported that it had been drier than normal, and cool in April and May, but hot during harvest in July. Bacterial rot is a major issue for growers. Six hundred fifty nine bacterial Isolations were made and collected early in the season.
- Beth reported that Shelby Fletcher, entomologist at Penn State, has been working on the Allium leaf miner (ALM), which was first detected in the Western Hemisphere in Lancaster County. His group has been developing degree day models to forecast adult emergence as well as evaluating Parasitoids that could be associated with ALM control. Lastly, Beth commented the ALM tends to die in the dry papery outer leaf scales and is not currently regarded as a significant threat to the sweet onion crop.

Georgia Presenters: Bhabesh Dutta, Stormy Sparks

12:00 PM

- *Stemphylium* spp. is a problem but it is usually seen as secondary to either Botrytis leaf blight (BLB) or a bacterial infection.
- Bhabesh noted that BLB is endemic to Georgia and is an issue every year. BLB was widespread but not severe in the 2020 season. Bhabesh reported on trials studying the efficacy of several fungicides to BLB. Merivon, Omega 500, Miravis Prime, and Luna Tranquility were most effective with final disease severity in the low to mid 50% range. Rovral and Scala were in the low to mid 70% range, with the non-treated check being reported as 98%
- For BLB, six programs in total were tested. Four programs contained Inspire Super and Scala as common components. The variable components were in combination with (1) Luna Tranquility, (2) Omega 500, (3) Miravis Prime or (4) Merivon. Though there were some numerical differences between the 5 fungicide programs all showed significant improvement over the non-treated check. The addition of K-Phite did not result in improved efficacy.
- An additional trial screened some new entries in the market. Four programs were tested. The constant was Inspire Super with Scala (4). The variables were (1) Howler, (2) Esendo, (3) Lektivar. Howler and Lektivar are labeled for onions, Esendo is not yet labeled for onions. The

addition of Howler (1) did not improve the efficacy of fungicide program against BLB; whereas Esendo and Lektivar demonstrated some improved effectiveness. The heavy lifting is being accomplished by the Inspire Super and Scala.

- Bhabesh reported that Onion Downy Mildew was widespread and moderate in 2019 but light and highly localized in 2020. He shared the results of the 2019 trials: Program A included Orondis Ultra + Bravo and Zampro + Bravo whereas; Program B included Orondis Ultra + Bravo and Omega 500 + Bravo. Program B was significantly better than Program A and both were significantly better than the grower's control.
- Bhabesh concluded from three years of trials, against Downy Mildew, that Omega 500 and Orondis Ultra had moderate efficacy, Bravo and Zampro had moderate to low efficacy, Phosphite had low efficacy, while Previcur Flex, Ranman, Reason, Revus and Presidio had no efficacy.
- Stormy Sparks shared that Thrips pressure in Georgia is less significant than in other onion growing regions. However, they continue to look at Thrips control measures and the role that Thrips may play as an insect vector for other significant onion pathogens.
- Stormy noted that no formal surveys are occurring for Allium Leaf Miner (ALM).

12:10 – 12:20 PM Short Break

Utah Presenters: Dan Drost, Claudia Nischwitz

12:20PM

- Dan Drost reported a challenge with the conversion of agricultural land to residential housing. Additionally, water availability is driving 50 to 60% of the growers to convert from gravity or furrow irrigation to drip. This results in about 25 to 30% water savings but comes at the cost of significant infrastructure investment (ponds).
- Claudia reported that the ability to collect samples was impacted by Covid-19 restrictions. Nevertheless, as they collected samples for the bacterial SCRI project they were observant for other factors that could be observed. Instances of Stemphylium, Purple Blotch, Pink Root, and IYSV were observed.
- One item of interest was the presence of bulb mites on the base of the onion with one field having about 2 to 3% of the onions affected.
- To date they have not identified any ALM but have identified other leaf miners in onions from the Liriomyza family.
- Claudia reported that one of the issues that some growers are experiencing with the conversion to drip is the accumulation of Na in the soils.

New Mexico Presenter: Chris Cramer

12:30 PM

- Chris Cramer noted the extremely hot conditions during 2020 growing season. From mid-May through the end of July, 59 of the 108 days had temperatures exceeding 100 °F.
- Chris reported progress and methods on the two separate onion breeding projects with the objective of developing resistance to Fusarium Basal Rot (FBR) and Iris Yellow Spot Virus (IYSV).
- A bulb inoculation using a virulent FBR isolate along with the evaluation methods to determine resistance / susceptibility were presented. Applying this method through multiple selection cycles produced germplasm with less FBR disease incidence and severity.

- Regarding the IYSV initiative the creative test plot design method was shared, which ensured that both Thrips and IYSV inoculum was abundant. Utilizing this method through multiple selection cycles they were able to improve germplasm for both IYSV incidence and severity.

Texas No Report given Allocated time was used for general Q&A

12:40 PM

- Alexander Putman questioned Bhabesh Dutta regarding resistance to Ridomil Gold Bravo? Bhabesh response was that it was tried in 2017 and 2018 trials, and by multiple growers and no efficacy was seen against Onion Downy Mildew. Ridomil Gold Bravo and Aliette have both been removed from the (Georgia) onion spray guide.
- Lindsey du Toit asked if there was any known resistance to Aliette? Bhabesh shared that he had not seen any efficacy with Aliette and that his predecessor, David Langston had reported the same when using Aliette, Ridomil and Reason for Downy Mildew control, in that they showed efficacy prior to 2015 but showed no efficacy afterwards.
- Mary Ruth McDonald commented that Aliette in alternation with Ridomil Gold Bravo seemed to help improve Downy Mildew control and reduce the risk of resistance. It is supposed to stimulate plant resistance but on its own they do not see effectiveness, but in rotation it seems effective in prevention. Alternation with Aliette and Ridomil Gold Bravo is a standard practice for Canadian Onion growers.
- Christine Hoepting asked Bhabesh to comment regarding Georgia growers spray schedule – is it a crop stage or weather stage? Answer was both – early bulb swelling and bulb expansion, which increases foliar stress, which corresponds with periods of hot and humid weather with rainfall and heavy dews.

Oregon Presenter: Stuart Reitz

12:50 PM Additional Personnel: Michael Qian, Jeremiah Dung,

- Stuart gave an update on the work being conducted at each of the three Oregon research centers involved in the W-3008 project.
- At the Central Oregon Station in Madras, Jeremiah Dung is leading the investigation into white rot looking at various allium extracts and trap crops. Several traditional chemical controls are also being investigated for in season white rot management.
- At the Malheur Station in Eastern Oregon there is a focus on Thrips and IYSV along with conducting the annual onion variety trials in which 50 to 60 cultivars are screened for Thrips, IYSV, grade and quality, neck rot, bacterial and other bulb rots.
- Several investigations are ongoing regarding insecticide rotations for Thrips control, Thrips and virus management and yield and Thrips relationships.
- Stuart reported the interesting finding that each additional Thrips per plant per week decreases marketable yield by 1% and within this a 2.7% decrease in the large size yields.
- Additional projects are looking at various insecticide thresholds, insecticide resistance development, and the impact of reduced nitrogen fertility as it relates to Thrips pressure.
- In terms of grower outreach – OSU staff were participating in weekly monitoring of 62 commercial fields.
- Lastly efforts are underway to develop a quarantine rule for Allium Leaf Miner.

1:00 PM Lunch Break

Washington Presenter: Tim Waters

2:00 PM Additional Personnel: Carrie Wohleb, Lindsey de Toit, Hanu Pappu, Doug Walsh

- During the season there were several untimely wind events with many onion crops getting sand-blasted, and some grower fields needed re-planting. The wind events led to less-than-ideal conditions for herbicide applications. At harvest, in August and early September, they encountered extremely smoky conditions with some crops going into storage not well cured.
- Tim noted that they are beginning to see yellow nutsedge as a weed management challenge.
- It was shared to date they have been unsuccessful in working with the WA Dept of Ag to get an Allium Leaf Miner quarantine rule established.
- The objectives of the project were detailed:
- Objective 1: Evaluate onion germplasm for resistance to pathogens and insects. The WA state cultivar trial was planted near Pasco, three replicates of 51 cultivars were regularly evaluated with harvest analysis conducted in September. The storage analysis for these will occur in February of 2021.
- Objective 2: Investigate the biology and management of onion Thrips and other pests. Several insecticide trials were conducted along with efforts to test for resistance in Thrips samples collected from grower fields. The resistance investigation has been inconclusive to date.
- Objective 3: Investigate the biology, epidemiology, and management of onion plant pathogens. In this area of investigation, soil fumigation trials were established using an identical product (metam sodium) but varying rates, methods of application, and differing soil moisture levels.
- In comparison to untreated checks, none of the treatments reduced the incidence or severity of pink root nor did any of the methods reduce the incidence or severity of Fusarium basal rot. Similar evidence was lacking regarding any preferable method for both weed control and nematode suppression.
- Objective 4: Facilitate discussions between W3008 participants and onion industry stakeholders that will advance onion pest and disease management. Given Covid restrictions they were limited in direct grower interaction however Newsletter articles were written and distributed to more than 600 subscribers along with numerous presentations and publications.

California Presenter: Alexander Putman

2:10 PM Additional Personnel: Brenna Aegerter, Rob Wilson, Bob Ehn, Tom Turini, Jaspreet Sidhu, Jeff Mitchell, Richard Smith, Andre Biscaro, Apurba Barman

- Alex gave an overview of the CA onion industry, stating in 2018 there were approximately 42,000 acres of onions, approximately 1/3 of the US acreage. A large portion of that acreage is designated for the dehydrator market. Alex then highlighted the characteristics of the onion production for each location (fresh, commercial, dehydrator) and the UC support staff in each of the production areas.
- Regarding the stop the rot project, several fields were sampled in various production areas from both fresh market and dehydrator onion fields. Samples were sent to WSU where both *Pantoea* and *Burkholderia* isolates were identified. For 2021 they will be examining bactericide efficacy, irrigation management, and the interaction of disease with herbicide management.
- At the intermountain Research and Extension Center in Tulelake research is ongoing using seed treatments for the management of seed corn maggot. Seed treatment has been very successful. Staff at this center are also involved in the white rot aspects of the SCRI grant.
- Additional work is being done to test various downy mildew forecasting models and application trials comparing the efficacy of the forecasting model with a typical calendar-based application schedule. Preliminary results are promising.

Idaho Presenter: – Brenda Schroeder
2:20 PM Additional Personnel: Mike Thornton, James Woodhall, Clint Shock, Erik Feibert, Stuart Reitz

- Brenda reported the results of some prior work conducted in 2014 when a number of growers reported 5 – 10% storage loss (manifest in October) due to what appeared to be a novel bacterial leaf and neck rot.
- Further examination revealed the pathogen to be fungal, *Fusarium proliferatum*. Field leaf and bulb storage assays were conducted the following season confirming the pathogen.
- Both 2014 and 2015 growing seasons both had periods of warmer than normal temperatures.
- Temperature / growth assays demonstrated that warm temperatures foster rapid growth (77°F and 86°F) but that higher temperatures retard growth (95°F and 104°F). The higher temperatures were not fungicidal but were fungistatic. Post-harvest curing studies were conducted. Cultivar studies were conducted with some cultivars being more and others being less susceptible.
- James Woodhall has been working on a rapid LAMP assay for White Rot (*Sclerotium cepivorum*) reporting positive result in 6 minutes.
- Additionally, he is also working on a real time PCR for pink root and reports that positives can be identified before symptoms are identified and as early as 3 weeks after planting.
- These tests have been utilized to demonstrate pink root variability at the field level.
- James has also been utilizing a spore trap to collect *Stemphylium* Leaf blight spores and has identified pesticide resistant strains. It was noted that the spore trap results supported “two phases of infection” and this warrants additional research.
- Mike has been conducting various fungicide treatment protocols to establish effectiveness for pink root control. These treatments demonstrated various degrees of efficacy in reducing the impact of pink root that was further demonstrated by differences in yield and size profile.

Michigan Presenter: Doug Higgins
2:38 PM

- Doug shared that they were conducting some fungicide trials utilizing climatic forecasting models vs. traditional calendar approaches and various fungicide treatments. No results were shared at this time.

Comment from Ontario Canada
2:49PM

- Bhabesh read a text from Canada where Kevin reports the onion season as fairly normal, *Stemphylium* was still their major foliar issue, that fungal control measures were being tested but that they still have a high incidence. No downy mildew in 2020, crop yields were average, normal harvest and have not seen many storage issues.

Other Reports and Discussion

Alliumnet Presenter: Sarah Swain
2:30 PM Additional Personnel: Joe Laforest

- Sarah reviewed the status of the Alliumnet web page, pointing out that much of the content is outdated and difficult for the users to find what they need. A document was presented which demonstrates which components are staying, what is leaving, and what will be added, along with a presentation of the new look which will be streamlined and “cleaner.”

- There will be three main areas of focus on the home page. These will be Meetings, Projects, and Diagnostic Resources. On the home page will be a search engine link. Meetings and Projects will be updated to include those from 2015 forward.
- Detail was shared as to the web presence for the Stop the Rot project.
- Methods were shared as to how project participants could update information on the site. Sarah suggested that anyone who wants to update or contribute to the stop the rot site for them to contact her directly.

Stop the Presenter: Lindsey du Toit

Rot Update

2:40 PM

- Lindsey shared an overview of the “Stop the Rot” project”
- Combating onion bacterial diseases with pathogenomic tools and enhanced management strategies which is an SCRI project that began in late 2019.
- Lindsey detailed the participants spread across 12 states and one participant at the University of Pretoria, South Africa.
- As a part of the project, regional labs have been established in 7 locations so that uniform diagnostic testing protocols can be utilized.
- Lindsey detailed the input of the Stakeholder Advisory panel whose input it is hoped to keep the efforts grounded in both scientific truth and stakeholder applicability.
- Objective A, 50% of the Stop the Rot project, was detailed. “Onion bacterial disease characterization.” This aspect is divided into 4 sub-objectives, A1-A4 respectively; A1 National 12 state survey, A2 Comparative genomics of onion bacterial pathogens to identify virulence factors, A3 Develop practical, molecular diagnostic tools and A4 Develop phenotypic resistance screening methods.
- Objective B, also approximately 50% of the project, which is “Onion bacterial disease management.” This aspect is divided into 6 sub-areas of management strategies, B1-B6 respectively: B1 Irrigation management, B2 Fertility management, B3 Pesticide programs, B4 Cultural practices, B5 Postharvest treatment of bulbs, and B6 Bacterial disease risk modeling.
- Year 1 activities were summarized as Bacterial surveys (1,720 samples) have been conducted in 12 states with various degrees of analysis conducted on the collected samples.
- In terms of the B objectives, various trials are being conducted in multiple states with Outreach Efforts being added as a B7 strategy and Economic Survey being added as a B8 strategy.

Election New Officers

2:50 PM

Bhabesh reported that Peter Rogers is in line to be the Chair, David Burrell is in line to be the Vice-Chair, and a Secretary was required, preferably from Academia. Much discussion occurred. Bhabesh reported that Sarah Pethybridge nominated Frank Hay from Cornell University New York, Mark seconded the nomination. Frank Hay was accepted as Secretary. Passed without opposition.

The officers for 2021-2022 are as follows:

Peter Rogers, chair - peter.rogers@vegetableseeds.basf.com

David Burrell, vice-chair – davidb@onionlabs.com

Frank Hay, secretary – fsh32@cornell.edu

Bhabesh Dutta, past-chair – bhabesh@uga.edu

Annual Meeting Discussion

Discussion occurred regarding coordination of the W3008 meeting with the NOA Annual meeting, the NARC meeting and or the NW Regional Veg Grower meeting in Pasco WA. Many alternatives were discussed. Kerrick Bauman proposed an easy to fly into hub for the meeting. Denver and Salt Lake locations were suggested. Plan on Denver first then accept Salt Lake as a second location with exact dates to be determined.

W-4008 Discussion Proposal

W-3008 will end September 2022, so a W-4008 will be needed to be submitted no later than January 15, 2022. Brian Nault will lead the writing with contributions from various collaborators. Comments were shared that breeding support in both the public and private sector and cultivar evaluation might have been an underserved aspect of the W-3008 project.

The floor was opened by Bhabesh for comments.

Stuart Reitz commented that some new participants were involved, and that it might be beneficial to share the 2018 project documents with the new participants.

Kerrick Bauman commented that the group is very valuable and needs help with outreach to connect with the stakeholders. The outreach needs to be user friendly and the stakeholders have a huge resource that is under- utilized.

Discussion occurred regarding re-allocating any unused travel funds to help support the allium net development.

Discussion occurred that there is a huge need with packers / shippers to understand how the packing equipment is safe and sterilized. This is a huge area of interest regarding food safety. Discussion occurred if this should be a part of the W4008 project. Comments were shared for the group to be aware of this aspect of the food safety issue.

Comments were shared regarding interest in use of precision agriculture in Ag in Georgia. Food safety, precision ag, and disease management and breeding can become more focused. Comments were shared regarding interest in the relationship between plant nutrition and disease expression.

Bhabesh concluded the meeting with the comments that Peter Rogers will be responsible for compiling the state reports. David Burrell will be responsible for the writing the minutes of the meeting. Both of these will be submitted to the committee officers for review before they are submitted to Tracy.

Meeting closed
3:10 PM

3. Accomplishments (29702 characters with spaces; allowed 30,000 characters with spaces)

Objective 1. Evaluate onion germplasm for resistance to pathogens and insects.

New Mexico (Cramer): Twenty-eight entries of original, intermediate, and advanced FBR-selected onion populations (4 reps) were sown in fields at the Fabian Garcia Science Center (FGSC) in October 2019. From late May to late June of 2020, bulbs were harvested once plants had reached maturity. After harvest, the basal plate of all bulbs was cut transversely and a 1 cm diameter plug of FOC isolate CSC 515 (spore concentration of 3×10^4 spores/ml⁻¹) was applied to the cut surface. Following 21 d of incubation, the basal plate was rated (1-9). Of the FBR-selected populations, recent selections of 'NuMex Chaco', 'NuMex Crispy', and 'NuMex Mesa' exhibited less disease than their original cultivar generation, the susceptible check and the resistant check. Results indicate that breeding for FBR resistance has been successful in producing more resistant germplasm.

New York (Nault, Hoepting, Pethybridge, Hay): Fourteen onion varieties (95 to 120 days maturity) were evaluated for differences in susceptibility to bacterial bulb rot. An identical trial was set up that was artificially inoculated leaves at 10% lodging with a mixture of *Pantoea agglomerans* and *P. ananatis* 10^9 colony forming units (cfu)/ml. Both trials were set up as split-plot designs with copper bactericide (Badge 2 pt/A) as the main factor, which was applied to one-third of each plot length weekly beginning at first leaf senescence until 50% lodging. The varieties were divided into three maturity cohorts to ensure that copper application and artificial inoculation were consistent within crop stage. Varieties that tended to have lower incidence of bulb rot included Stanley, Red Mountain, SVNY1141 and Saddleback. Similarly, varieties that tended to have more rot included Red Wing, Ridgeline, SVNY1298 and Montclair. Catskill, Pocona and Braddock had mid-range bulb rot. Hamilton demonstrated good tolerance to bulb rot. There was no relationship between maturity and bulb rot

Onion thrips management programs consisting of several different tactics were evaluated over two years. Treatments included a) two onion plant cultivars with semi-glossy leaves ('Rossa di Milano' and B5336A x B5351C) and one with waxy leaves ('Bradley'), b) silver reflective and white plastic mulches, and c) with or without an application of a bioinsecticides (spinosad + neem oil). Thrips densities were counted weekly and bulbs weighed at harvest. The cultivar 'Rossa di Milano' had fewer thrips compared with 'Bradley' and B5336A x B5351C, but also had the lowest yield. Reflective mulch had lower thrips densities than white mulch, but had no effect on yield. Bioinsecticides were most effective at reducing thrips densities and increasing yield. No other tactics provided significant additional benefits to thrips management.

Idaho (Schroeder, Thornton and Woodhall): Twenty cultivars of Spanish yellow storage onions were inoculated with 1×10^5 spores of *Fusarium proliferatum* per bulb in September, right after harvest and stored under commercial conditions at the Malheur Experiment Station. Bulbs were evaluated for percent surface area exhibiting rot 6 months after inoculation. Second year of trial determined that Oloroso, Vaquero, Tucannon, Sedona, Pandero were the most susceptible exhibiting rot between 20-25% of the surface area. The most resistant cultivars included Scout, 16000, Avalon and Grand Perfection with less than 15% of the surface area exhibiting rot.

Oregon (Reitz, Dung and Qian): Thrips and IYSV are the most important pests of onions grown in the Treasure Valley of eastern Oregon and in the southwest Idaho. As part of ongoing Onion Variety trials conducted at the Malheur Experiment Station, cultivars were rated during the season for thrips damage and severity of iris yellow spot as well as yield and quality. Bulbs from the 2020 trial are in storage awaiting grading in January.

Utah (Drost, Nischiwitz): Facilitated acquisition of and distribution of onion varieties for evaluation by grower cooperator Bret Fowers (Bear River City, Utah). Growers planted seed in early April 2020 and collected production data. Crop evaluated periodically during year and no differences in pest or disease pressure were noted. Assessed establishment and early growth of density trials planted (planted March 19-21, 2020) on Bennett and Norman Farms in Weber/Box Eder Counties. Evaluated impacts on growth,

pest pressure and disease incidence. Grower management in trials was excellent and few pest or disease problems were noted.

Washington (du Toit, Waters, Pappu): The Washington State University Onion Cultivar Trial was planted in April 2020 near Pasco, WA, with three replicate plots of each of 51 cultivars submitted by various onion seed companies. The plots were evaluated regularly for diseases and pests. Bulbs were harvested from the plots in September to assess yield, and 50 bulbs/plot were placed in storage to evaluate for storage quality and storage rots in February 2021.

Objective 2. Investigate the biology, ecology and management of onion Thrips and other pests.

New York (Nault, Hoepting, Pethybridge, Hay): Combinations of fertilizer and insecticide use were evaluated for onion thrips management in commercial onion fields in 2019-20. Main plot treatments included no fertilizer, the grower's full rate of fertilizer and the grower's half rate of fertilizer. Sub-plots included either an action-threshold based insecticide program or a weekly insecticide application program. Thrips populations and marketable bulb yield were not affected by fertilizer treatment. The action-threshold based insecticide program was highly successful and controlled thrips with an average of two fewer applications than spraying weekly.

Mechanisms of spinosad seed treatment for protecting onion seedlings from onion maggot were investigated. Results showed that spinosad was more than twice as lethal to one-week old larvae than two-week old larvae when it was ingested. In contrast, spinosad was equally toxic to both larval ages via contact exposure. In choice assays, larvae preferred feeding on untreated plants seventy-five percent of the time compared with spinosad-treated ones; however, without a choice, larvae fed and survived equally well on untreated and treated plants. These results provide valuable insight into the mechanisms for how spinosad protects onion seedlings against onion maggot.

An insecticide trial was conducted to find a highly effective insecticide treatment that could be used in rotation with Radiant under high thrips pressure. A trial was initiated when thrips were 20 per leaf. After the first spray all treatments reduced thrips to the same extent as Radiant 10 fl oz/A (~69% control), except Exirel 20 fl oz + Lannate LV 3 pt/A + Warrior 1.9 fl oz/A, which had significantly fewer thrips than Radiant. After the second spray, Exirel + Lannate + Warrior, Exirel 20 fl oz/A + Lannate LV 3 pt, Minecto Pro 10 fl oz + Warrior and Exirel 20 fl oz resulted in 94 – 96% control of thrips with no difference among them and significantly fewer onion thrips than the Radiant 10 fl oz/A and Minecto Pro 10 fl oz/A.

Idaho (Schroeder, Thornton and Woodhall): Analysis was completed for *Fusarium proliferatum* storage assays. Storage assays evaluated the impact of *Fusarium proliferatum* on Vaquero under different curing temperatures and durations. The bulbs were inoculated with 1×10^5 spores per bulb in September right after harvest cured at 25, 30, 35, 40°C for 2 days or 2 weeks and then stored at 5°C. Bulbs were evaluated for percent surface area exhibiting rot 6 at 4 months and 6 months after storage. With the 2 day curing assays it is apparent that the amount of bulb rot is reduced from ~40% for bulbs cured at 25°C to ~25% for bulbs cured at 40°C. Interestingly, when bulbs are cured for 2 weeks bulbs temperature did not appear to be a factor and all the bulbs across curing temperatures exhibited ~40% of the surface area with rot.

Oregon (Reitz, Dung and Qian): Ongoing insecticide efficacy trials demonstrated effectiveness of new insecticide use programs to better manage thrips and IYSV in the Treasure Valley.

As part of a USDA-SCRI grant we completed a second year of field trials to assess how nitrogen fertilization combined with insecticide management programs based on sampling thresholds or scheduled applications affect thrips and iris yellow spot. In addition to these IPM field trials, we are conducting laboratory trials to assess susceptibility of local thrips populations to commonly used insecticides. In August, we established colonies of five thrips populations from commercial onion fields in the Treasure Valley for use in these trials. A regional pest-monitoring program provided information to growers on seasonal pest trends, including changing patterns in thrips and IYSV incidence.

Texas (Malla): Thrips monitoring using yellow sticky traps showed that the insect population slowly increased from the second week of February 2020 (average 82 thrips/trap; Trece Inc., OK) in the organic nursery. The insect population reached peak on the third week of March 2020 (avg 1,059 thrips/trap).

Washington (du Toit, Waters, Pappu): Several insecticide efficacy trials were conducted to evaluate control options for onion thrips (*Thrips tabaci*) management. One trial featured new unregistered insecticides, one of which was nearly as efficacious as Radiant (spinetoram), which is currently the most effective insecticide available for use by producers. Another trial looked at products that are currently registered for use on onions, but that are not used to manage onion thrips. None of those insecticides provided consistent efficacy that compares to products that are currently already in use. In collaboration with Dr. Doug Walsh, we also evaluated insecticide resistance in onion thrips found in commercial fields. We tested for resistance to Radiant (spinetoram), Movento (spirotetremat), and Torac (tolfenpyrad). Results are still being evaluated. Alternative insecticides were also tested for control of seed corn maggot (*Delia platura*). Pest pressure was lower than anticipated and as such, we did not detect any differences among the insecticides screened.

The genetic diversity of onion thrips (*Thrips tabaci*) in various onion-growing regions of the US is being determined. The 658 bp fragment of the COI-5' was used to carry out barcoding. Haplotypes were generated using sequence polymorphism software (DnaSP 5.10). A total of 15 *T. tabaci* samples from eight locations (four states) were analyzed. Two *T. tabaci* haplotypes with haplotype diversity of 0.740 ± 0.030 and 14 polymorphic sites (SNPs) were found. Haplotype 1 was the most common haplotype.

Objective 3. Investigate the biology, epidemiology and management of onion plant pathogens.

California (Putnam): Field trials were initiated in October 2019 in Holtville, Brawley, and Sacramento Valley CA, to evaluate the utility of weather-based models to schedule fungicide applications to manage downy mildew of onions for processing (Holtville and Brawley) or seed (Sacramento Valley). A weather station was established within study area to measure standard parameters at a height of 2 m, including temperature, relative humidity, and leaf wetness within the plant canopy. The standard calendar treatment was initiated in late February at Holtville and Brawley and the second application was made at Brawley on March 13, 2020. Active downy mildew was observed at both Holtville and Brawley in mid-April, but disease was not observed at the Sacramento Valley location. To summarize the two trials in 2019-2020, at Brawley, the same control was achieved by either two applications (standard calendar) or one application (weather-based model) in a low disease incidence situation. At Holtville, the model-based treatments could not be evaluated. However, a single application of Ridomil Gold Bravo on February 25, approximately 14 days prior to a major weather event, provided complete numeric control of moderate to severe downy mildew.

Georgia (Dutta, Kvitko): In a study, foliar treatments of acibenzolar-S-methyl (Actigard 50WG), cupric hydroxide (Kocide 3000), and Actigard + Kocide were evaluated for their effectiveness in the presence and absence of thrips infestation at two critical onion-growth stages; bulb initiation and bulb swelling. Onion growth stage had no impact on effectiveness of either Kocide or Actigard. In the absence of thrips, Kocide application resulted in reduced center rot incidence compared with Actigard, regardless of the growth stage. However, when thrips were present, the efficacy of both Kocide and Actigard was reduced with bulb rot incidence not significantly different from the non-treated control. In independent greenhouse studies in the presence or absence of thrips, it was observed that use of protective chemicals (Kocide or Actigard or combinations) at different rates also affected the incidence of bulb rot. These results suggest that thrips infestation can reduce the efficacy of protective chemical treatments against *P. ananatis*. Therefore, an effective center rot management strategy should likely include thrips management in addition to bactericides at susceptible growth stages of onion.

In order to assess the distribution of HiVir and *alt* gene clusters, two PCR primer sets were designed. Two hundred fifty-two strains of *Pantoea* spp. were phenotyped using the red onion scale necrosis (RSN) assay

and were assayed using PCR for the presence of these virulence genes. A diverse panel of strains from three distinct culture collections comprised of 24 *Pantoea* species, 41 isolation sources, and 23 countries, collected from 1946-2019, were tested. There is a significant association between the *alt* PCR assay and *Pantoea* strains recovered from symptomatic onion ($P < 0.001$). There is also a significant association of a positive HiVir PCR and RSN assay among *P. ananatis* strains but not among *Pantoea* spp., congeners. This may indicate a divergent HiVir cluster or different pathogenicity and virulence mechanisms. Lastly, a combination of assays that include PCR of virulence genes [HiVir and *alt*] and an RSN assay can potentially aid in identification of onion-bulb-rotting pathogenic *P. ananatis* strains.

New York (Nault, Hoepting, Pethybridge, Hay): Forty treatments including an untreated control were evaluated for Stemphylium leaf blight efficacy across two on-farm small-plot field trials in Elba, NY. Poor or no control of SLB was observed with 1) FRAC 7 fungicides a.i.s belonging to four sub-classes including fluopyram (Luna Tranquility/Experience), fluxapyroxad (Merivon), pydiflumetofen (Miravis Prime) and isofetamid (Kenja, note: not labeled on onion); 2) FRAC 3 fungicides with two active ingredients including difenoconazole (Inspire Super, Quadris Top) and propiconazole (Tilt); 3) FRAC 2 a.i. iprodione (Rovral); 4) FRAC 9 a.i. pyrimethanil (Scala); 5) FRAC M5 a.i. chlorothalonil (Bravo); 6) FRAC 22 a.i. zoxamide (Gavel); FRAC M1 a.i. copper hydroxide (Badge); 7) FRAC 29 a.i. fluazinam (Omega); and 8) FRAC 21 a.i. fenpicoxamid. Viathon 3 pt + Tilt 9 fl oz (FRAC 3 + 3) had significantly healthier plants than all other treatments in the trial. In general, acceptable control of SLB only occurred with FRAC 3 + 3 combinations, Viathon alone (a.i. tebuconazole), Luna Tranquility 16 fl oz + Rovral 1 pt and high rates of Scala 18 fl oz + Rovral 1.5 pt.

The genetic basis of reduced effectiveness of FRAC 7 fungicides against Stemphylium leaf blight in NY was examined. Resistance of *Stemphylium vesicarium* to FRAC 7 fungicides was associated with at least eight single nucleotide polymorphisms in the succinate dehydrogenase genes, *SdhB*, *SdhC* and *SdhD*. Some 95-100% of *S. vesicarium* isolates considered insensitive ($EC_{50} > 10 \mu\text{g/ml}$) to fluxapyroxad, fluopyram and penthiopyrad contained at least one of these mutations, with the most common mutations being C135R, H134R and G79R in the *SdhC*. For boscalid, 57% of isolates with $EC_{50} > 10 \mu\text{g/ml}$ had at least one of these mutations, with a predominance of C135R and H134R mutations in the *SdhC*. Many of these mutations appear to confer cross resistance amongst fluxapyroxad, fluopyram, penthiopyrad and boscalid, limiting the effectiveness of the FRAC 7 group for the control of Stemphylium leaf blight.

Idaho (Thornton and Woodhall): A LAMP assay was designed for *S. cepivora* which can detect the pathogen within 6 minutes in highly infested material. TaqMan assays for *Stemphylium vesicarium* and *Pantoea agglomerans* have been designed and have been used to detect both pathogens in rain splash traps. *Stemphylium vesicarium* was detected in Burkard spore traps.

Field trials were completed to compare the efficacy of Fontelis applied via drip irrigation to commercial products (Fontelis + Proline, Elatus, Luna Experience, Velum Prime +Serenade) that contain mixtures of two different fungicides. The incidence of bulbs showing any symptoms of pink root ranged from 95 to 100% on July 7 and from 97 to 100% on July 29, indicating relatively high disease pressure. Velum Prime and Elatus were the only treatments that had significantly lower incidence of disease on July 7 compared to the non-treated check.

Oregon (Reitz, Dung and Shock): We completed two field trials to assess cultural management techniques and bactericide efficacy on bacterial rot of onions. In the cultural management trial, we examined the effects of irrigation amount and timing, and nitrogen fertilization on bacterial rot. An additional factor was bacterial inoculation. One-half of the trial was inoculated twice and one-half was not inoculated. Efforts in another USDA-SCRI grant focused on integrated management of white rot. Diallyl disulfide (DADS), isopropyl disulfide, dipropyl disulfide (DPDS), and dimethylsulfoxide were evaluated alone at 0.1, 1, and 2 gal/A rates and in all two-, three-, and four-way combinations (1 gal/A each) in growth chamber trials. All individual compounds significantly reduced sclerotia counts in soil, with the lowest

sclerotia counts recorded in DADS (1 and 2 Gal/A) or DPDS (2 Gal/A) treated soils. Additive or synergistic effects were not observed when sulfur compounds were combined.

Novel fungicides were screened for white rot control in a garlic field trial. Pyraziflumid, pydiflumetofen, benzovindiflupyr were evaluated as in-furrow applications and compared to tebuconazole, penthiopyrad, and a non-treated control. All of the fungicides increased stand counts and plant heights and reduced disease severity in April. By June, plots treated with tebuconazole, pyraziflumid, and pydiflumetofen exhibited reduced disease severity. Tebuconazole and pyraziflumid significantly increased marketable yields compared to the non-treated control.

Pennsylvania (B.K. Gugino): During the 2020 production season, 10 whole onion plants samples with characteristic center rot bacterial disease symptoms were collected from each of five fields in Centre, Clinton, and Lancaster Co., PA at two time points during the season (8 to 9 leaf stage and at harvest). From each plant, isolations were made on OEM and NA media and up to six unique bacterial colonies were selected from each media. A total of approximately 600 bacterial isolates were collected from PA fields and stored at -80C. Samples were also collected from NY onion fields and processed in a similar manner under an APHIS 526 permit for a total of 1238 isolates. An additional 136 bacterial isolates were obtained from NY post-harvest samples in Dec 2020/Jan 2021. DNA from approximately 500 isolates have been sequenced thus far and 160 isolates have undergone red scale pathogenicity testing with 93% being characterized as pathogenic.

Colorado (Uchanski, Machado, Bartolo, Davey): Mark Uchanski and graduate student (Antoinette Machado) and new research associate (Jane Davey) conducted Stop the Rot field surveys in 2020 as well as conducted bactericide trials at ARDEC South with two cultivars of onions.

Utah (Drost, Nischiwitz): Onion bacteria disease management trial planted in March at the USU Kaysville Research Station in Kaysville, Utah. Trial inoculated with *Pantoea allii*. After bulbs initiated bulbs were treated weekly with a range of possible bactericides. Infection incidence was recorded for the inoculated, non-inoculated, and percent incidence calculated. In inoculated treatments, incidence ranged from 14-28% while in the non-inoculated plots, incidence of bacterial infection was 12-31%. Bulbs were harvested, cured, and stored to early December. Evaluations of bulbs for bacterial diseases is ongoing.

Washington (du Toit, Waters, Pappu): In October 2019, metam sodium soil fumigation trials were set up in the Columbia Basin to assess the efficacy of 4 methods of application of Sectagon (chemigated at 40 gpa, shanked at 10" depth at 40 gpa, shanked at 4 and 10" depths at a total 40 gpa, and chemigated at 20 gpa + shanked at 10" depth at 20 gpa) compared to non-fumigated control plots. One trial was in a grower's field near Othello that had a high population of stubby root nematode, and the other trial was near Pasco that had high populations of the pink root pathogen. In the Pasco trial, most metam sodium was at the 4" depth in chemigated plots, whereas shank applications distributed metam sodium more evenly from 6 to 10" deep. More metam sodium was detected in plots with shank applications compared to plots with chemigation. At the Othello trial, soil moisture was ~80% saturation during fumigation, (recommended soil moisture) for effective fumigation than the 50% at the Pasco trial during fumigation. Metam sodium levels in plots with chemigated + shanked applications were at least 4x greater in the Othello trial than the Pasco trial. This showed the importance of adequate soil moisture during fumigation with metam sodium. The results suggested very limited or no efficacy of the chemigated and shanked applications of Sectagon 42 for control of weeds, pink root, Fusarium basal rot, and nematodes.

Research was initiated in fall 2019 on the project 'Stop the rot: Combating onion bacterial diseases with pathogenomic tools and enhanced management strategies'. In 2020, 5 onion bulb crops were surveyed twice for symptoms of bacterial diseases. Isolations yielded >300 bacterial strains being identified using DNA sequencing, and tested for pathogenicity on onions. Strains will be part of the National Onion Bacterial Strain Collection. Nine onion field trials were set up in WA in 2020: 1) bactericide trial, 2) cultivar screening trial, 3) postharvest bulb treatments, 4) timing of topping onion bulbs, 5) undercutting

onion bulbs, 6) rolling onion tops before harvest, 7) nitrogen fertilizer program, 8) frequency of irrigation, and 9) timing of terminating irrigation. Bulbs from the trials are in storage to be evaluated for bacterial rots.

Objective 4. Facilitate discussions between W3008 participants and onion industry stakeholders that will advance onion pest and disease management.

New York (Nault, Hoepting, Pethybridge, Hay): Despite safety restrictions for COVID-19 for a majority of the past year, some of our results were presented at meetings throughout New York and beyond.

The Stop the Rot project is a multi-state, multi-disciplinary, multi-year and multi-million dollar USDA-NIFA project whose six co-PIs are members of W3008. 2020 marked the first year of research trials across the nation for the Stop the Rot project. Interaction with onion industry stakeholders include: 1) Stop the Rot project has a 15-member stakeholder advisory panel that includes onion growers and allied industry members from all major onion growing regions; 2) An article featuring an introduction to this ambitious project was published in Onion World (see publication section; and 3) Alliumnet website is going to be revamped to become the home for national onion collaboration content including i) National USDA-NIFA collaborative onion projects; ii) National Allium Research Conference (NARC), and iii) W4008.

Georgia (Dutta, Kvitko): Four trainings for county extension agents and professionals in Georgia, 15 Georgia producer trainings, and 4 national or regional invited extension presentations were conducted to disseminate updated information on onion disease management. These meetings have covered onion disease management through transfer of information and technology in Georgia.

Pennsylvania (Gugino) Aided in the diagnosis of onion and other allium samples submitted to the Penn State Plant Disease Clinic, as needed. Research results were disseminated through one-on-one interactions with growers as well as winter meetings with vegetable growers and training update for PDA inspectors.

Washington (du Toit, Waters, Pappu): Newsletter articles were written and distributed to >600 subscribers, mostly in the Pacific Northwest USA, via the WSU Onion Alerts. The 'Stop the Rot' onion SCRI team met for 2 days at the Univ. of GA in February 2020 for orientation to the whole project and to plan the 1st of the 3 field seasons of the project. The meeting included a hands-on lab session to review basic methods to be used for the 12-state survey of onion bulb crops for bacterial diseases. Workshop was attended by 25 team members, including faculty, technical staff, post-doctorates, graduate students, and some of the Stakeholder Advisory Panel members.

California (Putnam): The partnership with a seed company will continue in the upcoming season to evaluate the model-based approach for downy mildew in seed production in CA.

Oregon (Reitz, Dung and Shock): Regional pest monitoring results were sent weekly to growers and allied industry members, as were periodic newsletters. Research results and updates were communicated to the White Rot Advisory Committee via bi-monthly video conferences and at the California Garlic and Onion Research Symposium in February 2020. A webinar was presented in August 2020 as part of a brown bag seminar series hosted by the Washington State University Mt. Vernon NW Washington Research and Extension Center

4. Impacts

New York (Nault, Hoepting, Pethybridge, Hay): In 2020, Onion growers adopted new fungicide recommendations for SLB resistance management as, 73%, 78% and 100% of the 18 different spray programs did not exceed more than three applications per FRAC for FRAC 3, 9 and 7, respectively. In 66 out of 89 fungicide applications (= 74%), two FRAC groups for SLB were co-applied when using FRAC 3 or 7. To relieve selection pressure on high-risk FRAC groups 3, 9 and 7, growers used low-risk fungicides, FRAC M5 (e.g. Bravo) and M3 (e.g. mancozeb) in 49 out of the total 102 fungicide applications (= 48%). This was accomplished in part by the new recommendation to use mancozeb early for Botrytis leaf blight instead

of SLB FRAC 3/7 fungicides in 50% of the scouting fields. These impressive adoption rates of complicated spray programs demonstrate onion growers' commitment to manage fungicide resistance and the important role Extension has to ensure they make informed decisions.

Oregon (Reitz, Dung, Qian): The onion pest monitoring program and new insecticide recommendations for the Treasure Valley allowed growers to better time insecticide applications for improved thrips and IYSV management. Data collected from the fungicide efficacy trial can be used to develop new fungicide labels for white rot in Allium crops.

New Mexico (Cramer): Onion stakeholders have identified onion thrips, Iris yellow spot virus (IYSV) and Fusarium basal rot (FBR) as the greatest pest and disease threats to onion yield and economic sustainability. Onion germplasm developed by our breeding program shows great promise for reducing disease impacts. When onion bulbs from developed FBR-resistant breeding lines were inoculated with FOCE, a lower incidence and severity of disease was observed through our breeding efforts.

Utah (Drost, Nischwitz): We worked with local onion growers to solve problems critical to their respective farms including weed management, nutrient needs, and irrigation management, ensuring successful maturity of crop for 500 acres of onions. Dr. Claudia Nischwitz conducted field surveys in onion fields and used results to track diseases and insect pests. 3) As growers transition from furrow to drip irrigation, growers find plant populations do not match the improvements associated with improved water conditions. Trials identifying appropriate plant populations to ensure growers maximize jumbo (3-4" bulb diameters) production were assessed. New guidelines will be issued as information becomes available. 4) In cooperation with Dr. Niel Allen, better irrigation guidelines for onions are being developed as water resources are in short supply due to severe drought in Utah.

Washington (du Toit, Waters, Pappu): Collaborative efforts and networking of W-3008 members led to successful submission and funding of a \$4.0 million + \$4.2 million matching funding, 4-year USDA NIFA SCRI grant to help onion stakeholders address the negative impacts of bacterial diseases on onion production in the USA. The project was initiated in fall 2019. A survey for onion bacterial diseases was carried out in each of 12 states and field trials in each of 6 states for the first year of this project. Results were shared virtually at grower meetings in each state and at the National Onion Association summer meeting, because of COVID-19 constraints. This productive collaboration resulted, in part, from many years of synergistic interactions through the W-1008, W-2008, and now the W-3008.

5. Publications (October 1, 2019 to December 30, 2020) (25906 characters w/spaces)

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- Woodhall, J. W., Harrington, M., Keith, S. Oropeza, A., Thornton, M. and B. K. Schroeder. 2020. First report of root rot caused by *Pythium myriotylum* of onion in Idaho. Plant Disease 104:9, 2529, <https://doi.org/10.1094/PDIS-05-19-0991-PDN>

Other Activities

1. Abstracts and Papers at International Professional Meetings

2. Abstracts and Papers at National Professional Meetings

- Hua, G.K.H., and Dung, J.K.S. 2020. Use of Alliums as trap crops to reduce white rot inoculum in infested field soil. American Phytopathological Society Plant Health 2020 Meeting. ePoster presentation. August 10-14, 2020. Online meeting.
- Iglesias, L., and B. A. Nault. 2019. Host-plant resistance and plastic mulches: Potential for managing onion thrips (*Thrips tabaci*) in organic onion production. Entomological Society of America Annual Meeting, St. Louis, MO, November 20, 2019.
- Mandal, S. and C.S. Cramer. 2020. Advancement in breeding for Fusarium basal rot resistance of onion. HortScience 55: S22 (Abstr).
- Nault, B. A., R. Harding, L. Iglesias, E. Grundberg, T. Rusinek, T. Elkner, B. Lingbeek and S. Fleischer. 2019. Management of Allium leafminer (*Phytomyza gymnostoma*): A new invasive pest of Allium crops in North America. Entomological Society of America Annual Meeting, St. Louis, MO, November 17, 2019.
- Leach, A. B., S. Reinert and B. A. Nault. 2019. Integrating pest management for onion thrips and bacterial bulb rot in onion production. Entomological Society of America Annual Meeting, St. Louis, MO, November 20, 2019.
- Moretti, E., and B. A. Nault. 2019. Influence of abiotic factors on onion maggot adult population dynamics and larval damage in commercial onion fields. Entomological Society of America Annual Meeting, St. Louis, MO, November 18, 2019.
- Leach, A. B., F. Hay, R. Harding and B. A. Nault. 2019. Role of onion thrips in the development of Stemphylium leaf blight in onion. Entomological Society of America Annual Meeting, St. Louis, MO, November 20, 2019.
- Regan, K., and B. A. Nault. 2019. Evaluating fertilizer rates and insecticide application frequency for management of onion thrips (*Thrips tabaci*) on onion. Entomological Society of America Annual Meeting, St. Louis, MO, November 17, 2019.

3. Reports at Grower Meetings and Field Days

- Drost, D. and Nischwitz, C. Onion water Use; Onion Weed Control; National “Stop the Rot” project; Onion Stand Variability; Onion Leaf Miners and other Disease Issues; and Utah Legislative Update about Agriculture. Winter Educational Meetings: February 11, 2020. Brigham City, UT. 50 attendee’s.
- Dung, J.K.S. 2020. Epidemiology and IPM of white rot in Allium crops. Invited speaker. Brown Bag Seminar. Webinar presentation. August 21, 2020. Online.
- du Toit, L.J. 2020. Onion bacterial diseases: Knowledge gaps and a federal grant to ‘Stop the Rot’. Invited presentation, 2020 Grower Education Conference & Industry Show, Wisconsin Potato &

- Vegetable Growers' Association & University of Wisconsin Division of Extension, 4-6 Feb. 2020, Stevens Point, WI. Zoom videoconference (~20 people)
- du Toit, L.J. 2020. Onion fungal and bacterial bulb rots, and efficacious use of fungicides for disease control in onion production. Invited presentation, AgriNorthWest farm managers, 5 Feb. 2020, Kennewick, WA (50 people)
- du Toit, L.J. 2020. Effective identification and management of diseases impacting vegetable crops. Invited presentation, Columbia Basin Crop Consultants' Association Short Course, 29-30 Jan. 2020, Moses Lake, WA. (~100 people)
- du Toit, L.J. 2019. Bacterial rots of onion: USDA SCRI project update and knowledge gaps. Pacific Northwest Vegetable Assoc. Annual Convention & Trade Show, 20-21 Nov. 2019, Kennewick, WA. (200 people)
- du Toit, L.J. 2019. Effective identification and treatment of diseases impacting onion. Pacific Northwest Vegetable Assoc. Annual Convention & Trade Show, 20-21 Nov. 2019, Kennewick, WA. (200 people)
- du Toit, L.J. 2019. Keeping our seed pathogen-free. Webinar presented at BC Seed Gathering 2019, Kwantlen Polytechnic University, 9 Nov. 2019, Richmond, BC. YouTube recording <https://www.youtube.com/watch?v=DNub-iJXbHo&t=1s> (20 people in person + online attendance)
- Dutta, B., and Gitaitis, R. 2020. Bacterial Diseases of onion in Georgia. University of Georgia Cooperative Extension Bulletin B1534.
- Dutta, B., and Tyson, C. 2021. Evaluation of harvesting methods on post-harvest incidence of center rot and sour skin in onion, Georgia 2020. PDMR 15:V025.
- Dutta, B., and Tyson, C. 2021. Evaluation of digging methods on post-harvest incidence of center rot and sour skin in onion, Georgia 2020. PDMR 15:V026.
- Dutta, B., Tyson, C., Edenfield, J., Williams, Z., Tanner, S., Shirley, A., Reeves, B., and Powell, S. 2021. Evaluation of onion growth stage directed chemical applications and thrips management program on center rot incidence in onion bulbs in Georgia, 2020. PDMR 15:V023.
- Dutta, B., Foster, M. J. and Donahoo, W.M. 2021. Evaluation of fungicides to manage Botrytis leaf blight in Georgia, 2020. PDMR 14:V024.
- Dutta, B., Foster, M. J. and Donahoo, W.M. 2020. Evaluation of fungicides to manage Botrytis leaf blight in onion in Georgia, 2019. PDMR 14:V129.
- Dutta, B., Tyson, C., Edenfield, J., Williams, Z., Tanner, S., Shirley, A., Reeves, B., and Powell, S. 2020. Evaluation of onion growth stage directed chemical applications and thrips management program on center rot incidence in onion bulbs in Georgia, 2019. PDMR 14:V091.
- Gugino, B.K. Integrated disease management with emphasis on cucurbits, tomatoes, and onions. Beginning Vegetable Growers Meeting Series, Lewisburg, PA. 29 February 2020.
- Gugino, B.K. Vegetable (bacterial) disease update. Pennsylvania Department of Agriculture Inspector Training. Webinar. 27 April 2020.
- Hay, F.S. 2020. Current status of Stemphylium leaf blight fungicide resistance in onion in New York. Empire State Producers EXPO. Cornell Coop. Extension. Syracuse, NY. January 15, 2020. Attendees: 43.
- Hoepting, C.A. 2020. Botrytis leaf blight in onion featuring 2020 on-farm trial results and onion scouting summaries. Potato and Onion Twilight Meeting, Cornell Vegetable Program, Marion, NY: September 3, 2020. Attendees: 25.

Hoepting, C.A. 2020. Sneak peak at results from 2020 on-farm onion thrips research trials. Potato and Onion Twilight Meeting, Cornell Vegetable Program, Marion, NY: Sep 3, 2020. Attendees: 25.

Hoepting, C.A. and E.R. van der Heide. 2020. Big fat onion variety nitrogen rot project. Muck Donut Hour, Elba, NY: August 18, 2020. Attendees: 9.

Hoepting, C.A. 2020. First look at 2020 results from onion thrips “hammer” trial. Muck Donut Hour, Elba, NY: August 11, 2020. Attendees: 8

Hoepting, C.A. and S.K. Vande Brake. 2020. Onion fungicide use summaries across major muck-onion growing regions in New York. Muck Donut Hour, Elba, NY: July 28, 2020. Attendees: 10.

Hoepting, C.A. 2020. New onion fungicide recommendations for onion. Muck Donut Hour, Elba, NY: June 23, 2020. Attendees: 10.

Hoepting, C.A. 2020. New onion fungicide recommendations for onion. Wayne County Onion Grower Meeting, Newark, NY: June 25, 2020. Attendees: 6.

Hoepting, C.A. 2020. New onion fungicide recommendations for onion. Orange County Onion Grower Meeting, Fulton, NY: June 25, 2020. Attendees: 8.

Hoepting, C.A. 2020. Mancozeb for early BLB control in onion. Muck Donut Hour, Elba, NY: June 2, 2020. Attendees: 6.

Hoepting, C.A. 2020. Results from 2019 onion fungicide trials for *Stemphylium* leaf blight. Orange County Onion School, Pine Island, NY: March 6, 2020. Attendees: 50.

Hoepting, C.A. 2020. 2020 Vision: New fungicide recommendations for *Stemphylium* leaf blight in onion. Empire State Producers Expo, SLB Onion Fungicide Resistance Workshop. Cornell Cooperative Extension. Syracuse, NY. January 15, 2020. Attendees: 43.

Hoepting, C.A. 2020. The Ever-changing field performance of fungicides for control of *Stemphylium* leaf blight in onion. Empire State Producers Expo, SLB Onion Fungicide Resistance Workshop. Cornell Cooperative Extension. Syracuse, NY. January 15, 2020. Attendees: 43.

Hoepting, C.A. 2020. Onion disease management: *Stemphylium*, downy mildew and *Botrytis*. 2020 Ontario County Produce Auction Meeting, Stanley, NY: January 8, 2020. Attendees: 103.

Hua, G.K.H., and Dung, J.K.S. 2020. White Rot Research: USDA National Institute of Food and Agriculture Grant. Invited speakers. California Garlic and Onion Research Advisory Board Allium Research Symposium. Oral presentation February 10, 2020. Tulare, CA. (~100 attendees)

Moretti, E., and B.A. Nault. 2020. Influence of environmental factors on onion maggot larval damage in commercial onion fields. Cornell Cooperative Extension. Syracuse, NY. January 15, 2020. Attendees: 50.

Nault, B.A., L. Iglesias, and F. Hay. 2020. Vegetable: Update on organic onion pest and disease management. Northeast Farming Organization of New York Winter Conference Workshop. January 27, 2020. Attendees: 30.

Nault, B.A. and K. Regan. 2020. Onion thrips research round-up for 2019. Empire State Producers EXPO. Cornell Cooperative Extension. Syracuse, NY. January 15, 2020. Attendees: 43.

Nault, B.A. 2020. Flies in the ointment: Update on onion maggot and allium leafminer management. Cornell Cooperative Extension. Syracuse, NY. January 15, 2020. Attendees: 50.

Putman, A.I. Evaluation of weather-based models for management of onion downy mildew. California Garlic and Onion Symposium, UC Cooperative Extension, February 10 2020, Tulare, CA.

Reitz, S. 2019. Thrips and IYSV Management in the Treasure Valley. Pacific Northwest Vegetable Association Annual Meeting.

Reitz, S. 2020. Thrips/IYSV Management. Idaho-Malheur County Onion Growers Associations Annual Meeting

Reitz, S. 2020. Onion Variety Day – Self Guided Tour. Malheur Experiment Station, August 2020

Thornton, M. and K. Beck. Pink root – drip applied fungicides and remote sensing. Idaho – Malheur County Onion Growers Association Annual Meeting. Ontario, OR, February 4, 2020.

Thornton, M. Herbicide and growth regulator effects on single centers. Idaho – Malheur County Onion Growers Association Annual Meeting. Ontario, OR, February 4, 2020.

Thornton, M. Management of pink root in onions. Idaho Association of Plant Protection, (Virtual), November 4, 2020.

Thornton, M. Opportunities for insect and disease management in drip irrigated onion production. Far West Agribusiness Association Conference, Virtual, December 17, 2020.

Waters, T.D., and Reitz, S. 2019. Avoiding further resistance development and insecticide efficacy for onion thrips. Pacific Northwest Vegetable Association, Kennewick, WA. Invited. (200 people)

Waters, T.D. 2019. Seedcorn maggot biology and control in organic production systems. Pacific Northwest Vegetable Association, Kennewick, WA. Invited. (200 people)

Woodhall, J. Stemphylium Leaf Blight Identification and Control Strategies. Pacific Northwest Vegetable Association Meeting.

4. Newsletter Articles

Drost, D and Nischwitz, C. Details of February 2020 Utah Onion Association meetings published in Onion World. Available online at https://issuu.com/columbiamediagroup/docs/onion_world_may-june_2020

Gugino, B.K. Pennsylvania Vegetable and Berry Production: Current issues for July 14, 2020. Pennsylvania Vegetable Disease Update. <https://extension.psu.edu/pennsylvania-vegetable-and-berry-current-issues-for-july-14-2020>

Gugino, B.K. Pennsylvania vegetable disease update for June 17, 2020. Pennsylvania Vegetable Disease Update. <https://extension.psu.edu/pennsylvania-vegetable-disease-update-for-june-17-2020>

Gugino, B.K. Pennsylvania Vegetable and Berry Production: Current issues for June 16, 2020. <https://extension.psu.edu/pennsylvania-vegetable-and-berry-production-current-issues-for-june-16-2020>

Putman, A.I. 2020. Vegetable disease update: disease activity continues. Imperial County Agricultural Briefs 23(3): 33-35.

Putman, A.I. 2020. Vegetable disease update: winter starts wet then turns dry. Imperial County Agricultural Briefs 23(2): 21-22.

Reitz, S.R. 2020. Onion Variety Day – Self Guided Tour. Malheur Experiment Station, August 2020

Walsh, O.S., Thornton, M., Marshall, J.M., Morishita, D., Felix, J. and Hatzenbuehler, P.L. 2020. Adjusting cropping systems affected by COVID-19. IPC Potato Pulse. April 24 issue.

WSU Onion Alerts. <https://mailchi.mp/wsu/wsu-onion-alert-aug-14-1303793?e=72ba613792>: Time-sensitive onion disease, pest, and production topics covered in regular articles between May and August of 2020.

5. Annual Reports

Beck, K., M. Thornton, R. Portenier, O. Morgan, J. Ryu and J. Neufeld. 2020. Evaluating the use of hyperspectral remote sensing and spectral vegetation indices to diagnose onion pink root. *Proc. of the Idaho/Malheur County Onion Growers Meeting*. 11pp

Feibert, E. B. G., Reitz, S., Rivera, A., Wieland, K. D. (2020). 2019 Onion Variety Trials (pp. 21-49). Oregon State University Malheur Experiment Station Annual Report 2019, Department of Crop and Soil Science Ext/CrS 163. <https://Agsci.oregonstate.edu/mes/station-complete-annual-reports/2019-annual-report>

Reitz, S., Trenkel, I., Feibert, E. B. G., Wieland, K. D., Rivera, A. (2020). Evaluation of Mastercop® for Disease Management—2019 (pp. 89-91). Oregon State University Malheur Experiment Station Annual

- Report 2019, Department of Crop and Soil Science Ext/CrS 163. <https://Agsci.oregonstate.edu/mes/station-complete-annual-reports/2019-annual-report>
- Reitz, S. (2020). Monitoring Onion Pests across the Treasure Valley—2019 (pp. 92-96). Oregon State University Malheur Experiment Station Annual Report 2019, Department of Crop and Soil Science Ext/CrS 163. <https://Agsci.oregonstate.edu/mes/station-complete-annual-reports/2019-annual-report>
- Reitz, S., Trenkel, I., Feibert, E. B. G., Wieland, K. D., Rivera, A. (2020). Thrips and Iris Yellow Spot Virus Management in the Treasure Valley—2019 (pp. 97-120). Oregon State University Malheur Experiment Station Annual Report 2019, Department of Crop and Soil Science Ext/CrS 163. <https://Agsci.oregonstate.edu/mes/station-complete-annual-reports/2019-annual-report>
- Thornton, M., R. Portenier, O. Adams, and B. Simerly. 2020. Long term storage of onion cultivars. *Proc. of the Idaho/Malheur County Onion Growers Meeting*. 4pp.
- Thornton, M., J. Woodhall and R. Portenier. 2020. Pink root control in onions with drip-applied fungicides. *Proc. of the Idaho/Malheur County Onion Growers Meeting*. 9pp.
- Thornton, M., R. Portenier, and O. Morgan. 2020. Evaluation of herbicides for impact on the incidence of single centers in onions. *Proc. of the Idaho/Malheur County Onion Growers Meeting*. 6pp.

6. Internet Resources

- du Toit, L.J. <https://www.youtube.com/watch?v=FpmGHBUEzVc&feature=youtu.be> (English) and <https://www.youtube.com/watch?v=13k5H6oTzds&feature=youtu.be> (Spanish) videos on basic identification of onion bacterial bulb rots compared to other causes of onion bulb rots or abiotic problems. Video available in English and Spanish.
- Hoepting, C.A. 2020. Cornell Cheat Sheet: Seed treatments and in-furrow drenches for muck-grown direct seeded onion. Cornell Cooperative Extension Cornell Vegetable Program website. online: https://rvpadmin.cce.cornell.edu/uploads/doc_937.pdf
- Hoepting, C.A. 2020. 2020 fungicide status for control of Stemphylium leaf blight in onion. Cornell Cooperative Extension Cornell Vegetable Program website. online: https://rvpadmin.cce.cornell.edu/uploads/doc_888.pdf
- Hoepting, C.A. and S.K. Vande Brake. 2020. Cómo diagnosticar la podrición bacteriana de bulbos de cebolla. VIDEO. Cornell Cooperative Extension Cornell Vegetable Program website. online: <https://www.youtube.com/watch?v=FpmGHBUEzVc&list=PLMxaHBxUI9qbChbojOUBlozWK2ypCo50p&index=2&t=17s>
- Hoepting, C.A. and S.K. Vande Brake. 2020. How to diagnose onion bacterial bulb rot. VIDEO. Cornell Cooperative Extension Cornell Vegetable Program website. online: <https://www.youtube.com/watch?v=13k5H6oTzds&list=PLMxaHBxUI9qbChbojOUBlozWK2ypCo50p&index=3>
- Nault, B.A., and C.A. Hoepting. 2020. Guidelines for 2020 Management of Onion Thrips in Onion. Cornell Cooperative Extension Cornell Vegetable Program website. online: https://cvp.cce.cornell.edu/submission.php?id=587&crumb=crops|crops|onions|crop*20
- Pacific Northwest Vegetable Extension Group (PNW VEG) website (http://mtvernon.wsu.edu/path_team/vegpath_team.htm), a tri-state Extension team with resources on diverse vegetables grown in the PNW USA. Sections on onions include the Photo Gallery (http://mtvernon.wsu.edu/path_team/onion.htm) and IPM Resources (http://mtvernon.wsu.edu/path_team/ipmResources.htm#onion).
- <https://Alliumnet.com/projects/stop-the-rot/> website added and updated regularly to include outline and progress on the USDA NIFA SCRI 'Stop the Rot' onion bacterial disease project.

Reitz, S.2020. <https://Agsci.oregonstate.edu/mes/malheur-experiment-station>