Report from the:

SAES-422 Multistate Research Project W-4008: Integrated Onion Pest and Disease Management

ANNUAL MEETING

Live-In Person

Jan 5 at 8:30AM – 12:00PM EST
In association with
Southeast Regional Fruit and Vegetable Conference (SERFVC)
&
Stop the Rot
Savannah, GA

January 5,2023

W4008 Committee Officers – 2022:
Chair: David Burrell, National Onion Labs
Vice-Chair: Frank Hay, Cornell University
Secretary: Gabriel LaHue, Washington State University
Past Chair: Peter Rogers, BASF Vegetable Seeds

2023 W-4008 Onion Multistate Project Annual Meeting Agenda
Thursday, Jan 5, 2023 (8:30 AM – 12:00 PM EST)
Southeast Regional Fruit and Vegetable Conference (SERFVC)
Savanah Convention Center- Room 202

AGENDA

Start time	**Thursday January 5 (Meeting Room 203)**
7:30 AM	SERFVC registration, set up slides for today's speakers
8:30 AM	W-4008 annual meeting
10:30 AM	*Coffee/tea break, poster viewing*
11:00 AM	W-4008 annual meeting, ending at 12:00 PM
12:00 PM	*Lunch break*

7:30 AM	SERVC Registration Opens
8:30 AM	W-4008 Meeting begins – Welcome and introductions - David Burrell (Chair)
8:40 AM	W4008 status, 2023 annual report comments. – Tracy Dougher (Advisor to W-4008)
8:50 AM	Individual State Reports – attendees and presenters
8:50 AM	California – Attending – Rob Wilson, Brenna Aegerter, Jaspreet Sidhu, Presenting – Rob Wilson
9:05 AM	Colorado – Attending – Mark Uchanski, Presenting - Mark Uchanski
9:20 AM	Georgia - Attending – Bhabesh Dutta, Brian Kvitko, Gina Shin, Presenting – Bhabesh Dutta
9:35 AM	Idaho – Attending – James Woodhall, Presenting - James Woodhall
9:50 AM	New Mexico - Attending – Chris Cramer, Presenting - Chris Cramer
10:05 AM	New York - Attending – Brian Nault, Christine Hoepting, Frank Hay, Presenting – Brian Nault, Christine Hoepting, Frank Hay
10:20 AM	Texas – Attending – Subas Malla, Presenting - Subas Malla
10:30 AM	Coffee Tea Break
11:00 AM	Utah – Attending – Claudia Nischwitz, Presenting - Claudia Nischwitz
11:10 AM	Washington – Attending- Lindsey du Toit, Tim Waters, Presenting – Tim Waters & Lindsey du Toit
	States not Presenting – Michigan, Oregon, Pennsylvania, Wisconsin
11:30 AM	Nominees for next Secretary of W3008/W4008
11:40 AM	Discussion of next meeting venue -2024
12:00 PM	W-4008 meeting adjourns

Participants

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State participants not able to attend but potentially submitting reports:	Michigan, Oregon, Pennsylvania, Wisconsin.	
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W-4008 Annual Meeting Minutes

8:30 am – 12 pm, Thursday, January 5th, 2023

- Introduction by David Burrell and update by Tracy Dougher, Montana State project administrator
- W-4008 has begun (until Sept. 2028?), Dr. Brian Nault led the renewal proposal.
    - Evaluate onion germplasm for performance against insect pests, weeds, and diseases.
    - Biology, epidemiology, and management of insect pests of onions
    - Biology, epidemiology, and management of onion diseases
    - Biology, epidemiology, and management of weedy plant species in onion production
- Currently about 25 participants in the NIMS system – need everyone registered.
- Brief introductions of all meeting attendees
- California update:
    - Drought and acreage limitations due to water restrictions is the biggest issue.
    - Very good crop in 2022, acreage was stable (but moved regionally)
    - Fusarium and seed corn maggot were the biggest issues in 2022.
    - Stop the Rot: 16 survey locations, 3 years – isolated four different pathogens.
        - Bactericides have not worked very well in California generally.
        - Drip has reduced bacterial disease incidence compared to sprinkler irrigation.
        - Continuing phenotypic screening work
    - Fusarium basal rot has become a big issue in garlic but also in onions.
        - Often a misdiagnosed disease in California
    - Continued to do seed corn maggot work, had really good results with some products.
    - Weed management is a big issue due to the labor shortage and labor costs.
    - Just hired a new agricultural engineer that will work on onions.
- Colorado update:
    - Cooler and much winder spring got the season off to a late start (3 weeks late)
        - Crop quality and yield was negatively impacted by the late start, two mid-season hail events, and hot temperatures at harvest.
    - Stop the Rot project: did trials on post-harvest fogging treatments.
- Georgia update:
    - 80% of Vidalia onions grown in only 2 counties, $800 million within 100 miles of Tifton
    - No updates on bacterial diseases since they will be saved for the Stop the Rot meeting.
    - Botrytis leaf blight was widespread and moderately severe in 2022 – if not controlled it leads to issues with Stemphylium (issues better than 2019 and 2022)
        - Most fungicides are still working but Scala has lost some efficacy.
        - Novel FRAC 3 fungicide (Cevya) showed promise in 2020 and 2021.
        - Omega 500 has good efficacy on Botrytis but no efficacy on Stemphylium.
    - No foliar disease symptoms seen in 2022 bactericide field trials (but saw internal bulb rots in storage) – most bactericides effective at reducing internal rot after storage.
        - Cu bactericide rotated with LifeGard reduced bacterial bulb rot.
        - No issues in tank mixing LifeGard with Cu bactericides
    - New Assistant Professor of Mycotoxicology and Postharvest Pathology – Jake Fountain
        - New survey for black mold (*Aspergillus niger*) – occurrence and genetic diversity in the field and in storage
    - Insect pests: thrips are the primary concern though light in 2022.

        - Loss of chlorpyrifos is a major concern, diazinon is the primary replacement though has shorter residual control and most organophosphates may be lost.
        - Extremely cold weather in December likely to result in excessive dead / decaying plant material which could lead to seed corn maggot contamination.
        - No difference in pest or beneficial insect diversity between organic and conventional Vidalia onion production
    - Population of wild radish escaping control by Goal herbicide (major herbicide used)
- Idaho update:
    - James Woodhall (plant pathology and diagnostic clinic), Mike Thorton (potato and onion agronomy), Brenda Schroeder (plant bacteriology)
    - Very cool and wet spring compared to normal but warmer August.
    - Slightly better onion crop than in 2021, bacterial rot issues came later than 2021.
    - Many more *Pantoea* samples than in previous years
    - Brenda Schroeder has a project working on *Rahnella* species (Idaho State Dept. of Ag.)
    - Other projects include pink root, *Rahnella* curing and temperatures, impact of heat on growth and bacteria, *Stemphylium* spore monitoring, screening for white rot in imports, allelopathy from wheat residue (saw that it reduced growth when incorporated)
- New Mexico update:
    - Pretty good year – no major weather events, good moisture, no extreme heat
    - Evaluating germplasm for performance against thrips and Iris Yellow Spot (IYS) virus
        - Measure leaf number, sheath diameter, total thrips, IYS, maturity date, and bulb, height, diameter, and weight at harvest
        - Most breeding lines have lower thrips density than the susceptible check, though populations saturate mid-season and then crash (differences disappear)
        - Some breeding lines also have lower IYS severity than the susceptible check.
    - Work on germplasm resistance to Fusarium basal rot
        - Inoculate cut basal plates with conidia, rate after 21 days.
        - Some populations seeing progress on resistance to Fusarium basal rot, many populations have better resistance than the resistant check.
    - Residual herbicides (bensulide and DCPA) are relatively expensive and have high potential environmental impacts compared to pendimethalin (Prowl)
        - Some states have special local needs registration for application after germination but before cotyledon emergence.
        - Work funded by a NM Specialty Crop Block Grant for a special local need.
        - Main weeds: London rocket, yellow nutsedge, Palmer amaranth
        - Some efficacies for weed control in fall-planted onions, not in spring-planted
        - No effect on onion yield, stand, or residue levels.
- New York update:
    - Frank Hay (Plant Pathology and Microbiology), Sarah Pethybridge (Plant Pathology and Microbiology), Christy Hoepting (Extension Educator), Brian Nault (Entomology)
    - Normal spring, crop planted on time, onion thrips low until late July with excellent control, IYSV observed later than usual, Stemphylium incidence and severity was low (dry July), low bacterial rot incidence, bad nematode issues
    - *Stemphylium vesicarium*
        - Residue from previous crops likely primary source of inoculum

        - Investigating barley nurse crop (not a major source), volunteer onions (high incidence), seed (no inoculum present), and onion transplants (52% mean incidence)
        - Forecasting model used for predicting risk but with little success.
        - Also been doing spore trapping, investigating fungicide resistance (found 11 mutations for resistance to FRAC 7 fungicides),
        - National project proposal on Stemphylium submitted to SCRI-SREP "Fight the Blight"
        - Stemphylium leaf blight developed resistance to FRAC groups 2, 7, 9, and 11 with some evidence that FRAC 3 is slipping – on-farm fungicide trials.
            - Data not yet analyzed but single FRAC 3 product ineffective while stacking 2 – 3 FRAC 3 fungicides is still effective (and better than doubling the rate of a single FRAC 3 active ingredient)
    - Weed management: Stinger labeled as a special local need for perennial sowthistle
        - Can reduce a hand weeding pass, reducing control costs by about 50%
    - Entomology: onion maggots account for 82% of all maggots, 18% seed corn maggot, no obvious difference in the temporal distribution of the two pests
        - Maggots pulled from plants in CA, IN, and WA were mostly seed corn maggot with no onion maggots (some damaged samples or other maggots)
        - PLINAZOLIN (IRAC Class 30) hasn't looked that great in 2020 and 2021, so evaluated at a higher rate in 2022 – reduced damage but not at a commercially acceptable level unless Cruiser was added to it
        - CORTEVA got Spinosad labeled as a commercial seed treatment for 2023.
        - Most products tested other than Spear T worked well for onion thrips control in scallions (including PLINAZOLIN, Sivanto Prime, and Radiant SC)
        - Tested early-season insecticide sprays to reduce adults for thrips and IYSV control, which may have worked at 2 sites out of 4 sites (too low pressure)
        - Allium leaf miner numbers higher in chive than in leeks or scallions
- **Discussion:** Concerns raised by several plant pathologists about stacking multiple FRAC 3 fungicides when resistance is already developing as this may speed resistance development
    - Question raised about why tank-mixing two different FRAC 3 fungicides is different from applying a higher rate of a single FRAC 3 fungicide.
    - Have very few FRAC groups in NY so doing it out of necessity currently.
    - Important that these recommendations don't get translated to other states that have more fungicide and FRAC group options to avoid accelerating resistance unnecessarily.
- Texas update:
    - Good season with no major production issues
    - Isolated 123 samples from foliage and 86 from bulbs (*Pantoea* dominate species)
    - Published on 2 novel species (*Pseudomonas uvaldensis* and *Curtobacterium allii*)
        - Publications on four new species in progress
    - Found a sample with *Fusarium proliferatium* (hadn't seen in Texas previously)
    - Germplasm screening and chemical control trials for thrips management in 2023
        - Wax screening was not successful, now looking at metabolites
- Utah update:
    - Planted 1700-1800 acres of onions despite the severe drought, yield was decent

    - No disease issues, no maggots, and no issues with onion thrips
    - One field with issues of salt crusts due to flood irrigation
- Washington update:
    - Very mild and warm conditions in March, windy and snowed after planting in April.
    - Onion yield was down, quality was variable due to the cool start of the growing season.
    - Yellow nutsedge is becoming more of a problem despite 3 – 4 year onion rotations because it needs to be controlled in the rotational crops
    - Cultivar trial had low disease incidence; in-person field day was well-attended.
    - Insecticide efficacy trials for onion thrips including one effective unregistered product.
    - Seed corn maggot work showed diazinon and Capture LFR were effective, but diazinon is likely to no longer be available.
    - Stop the Rot work included a cultivar trial, bactericide trial with chemigation vs. spray boom application, rolling trial, topping trial, undercutting, postharvest disinfectants, and survey work.
    - Newsletter articles were written and sent to > 600 subscribers in WSU Onion Alerts
    - Onion Field Day has 100 attendees and 54 cultivars.
- David Burrell nominated that the W-4008 be held with the Stop the Rot meeting in Mount Vernon, Bhabesh Dutta seconded, vote was unanimous.
    - Travel allowed annually for W-4008 based on the federal fiscal year (October)
    - Question reopened to hold W-4008 in December with the National Onion Association
        - San Antonio, Nov. 29th – Dec. 2nd
        - 6 votes for holding it with NOA, 12 votes for holding it with Stop the Rot
- Rob Wilson volunteered to be the secretary, Bhabesh Dutta seconded, vote was unanimous.
- Meeting closed.

3. Accomplishments

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

Georgia: Screened 52 Vidalia cultivars under field conditions for bacterial foliar symptoms and bulbs were screened for the ability of *P. ananatis* 97-1 strain to induce necrotic lesion on scales. Six varieties (Georgia Boy, Rio Dulce, Emy 55843, Alba Blanca, White Gaspare and Maragogi) displayed significantly lower necrotic lesions compared to others.

California: Analysis of data from Kern variety trial and lab-based assays (bulb assay and scale assay on bulbs from variety trials) is underway. Preliminary results are that the lab-based assays are not well correlated with the field trial results.

Idaho: In fall of 2021, bulbs of 12 yellow cultivars and pre- commercial lines were collected and stored (36°F). On 24 June 2022, samples were evaluated for defects. Only two entries (Crockett and NUN 7212) reached >80% marketable bulbs after 9 months of storage. With few exceptions, translucent scale was the primary defect in bulbs not considered marketable, while internal decay was the second most common defect. Oloroso and Seminis 1526 showed very high levels of translucent scale, while OLX 13-331 and Trident had the highest incidence of internal decay. Vaquero, the industry standard, had ~70% marketable bulbs, below the long-term average for this cultivar.

Trials at Malheur Agricultural Experiment Station, Oregon State University during 2022, assessed the susceptibility of 16 varieties (12 yellow, four red) to *Setophoma terrestris*, the causal agent of pink root. Ten plants were pulled from the discard rows from four replicated plots on two separate dates, roots were washed and percentage infection was visually assessed. Among the yellow varieties, Legend, Trident and Caldwell appeared among the most susceptible to pink root whilst Sedona and Calliber were the least susceptible. Purple haze was least susceptible of the red onion varieties.

New York: A variety trial conducted in Elba, NY investigated the relative susceptibility of 16 onion varieties to onion thrips, bacterial bulb rot, pink root and Stemphylium leaf blight. The trial was arranged as a split-plot design with variety as the main factor and insecticide treatment as the sub-plot factor. Treatments were replicated 4 times. Data were also collected on leaf color, upright plant architecture, vigor, neck diameter, maturity and yield. Grading was completed in early January 2023 and data analysis is pending. The trial will be repeated in 2023.

New Mexico: NMSU breeding lines exhibited a lower Fusarium basal rot (FBR) incidence and severity than a FBR-susceptible and a FBR-resistant cultivar, indicating breeding efforts to be successful. When exposed to high onion thrips pressure conditions conducive for Iris yellow spot (IYS) disease development, other NMSU breeding lines exhibited fewer thrips per plant and a lower disease severity early in the growing season, and greater bulb size at harvest than a commercial cultivar grown under the same conditions.

Washington: Bulbs from the 2021 Washington State University Onion Cultivar Trial were evaluated in Feb. 2022 after 5 months in storage, for quality and bulb rots. Results were summarized and shared with onion stakeholders on the WSU Onion Alerts (>600 subscribers), demonstrating how >50 cultivars fared under Columbia Basin conditions. The 2022 Washington State University Onion Cultivar Trial was planted in April 2022 near Quincy, WA, with three replicate plots of each of 54 cultivars submitted by seed companies. Plots were evaluated for diseases and pests. Bulbs were harvested in September to assess yield, and 50 bulbs/plot placed in storage to evaluate storage quality and bulb rots in Feb. 2023. The WSU Onion Field Day was held on Aug. 25, the first in-person field day since 2019 (>100 attendees).

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

California: Several treatments provided effective control of seedcorn maggot in field trials evaluating insecticide seed treatment efficacy for spring seed onions.

Oregon: Threshold-based sampling plans reduced insecticide applications for thrips and IYSV and input costs without reducing yields. Further trials demonstrated that tank-mixing of most insecticides does not improve thrips management and is not cost effective.

Idaho: Thrips and IYSV control with a standard foliar insecticide program (Aza/M-pede, Movento, Minecto Pro, Radiant – 2 applications of each) was compared to programs where the Movento foliar applications were substituted with 2 applications of experimental insecticides from Gowan (GWN-12030 and GXP-60513) applied via the drip irrigation system. All insecticide programs reduced thrips populations and IYSV incidence compared to the untreated, and some drip programs were equal in efficacy to the standard foliar program. The total yield and the proportion of ≥3-inch diameter onions were also increased by insecticide programs.

New York: Syngenta's new insecticide, isocycloseram (PLINAZOLIN® technology), was evaluated for managing onion thrips as a foliar spray. Several foliar applications of a high rate of isocycloseram provided a commercially acceptable and equivalent level of control as high rate of cyantraniliprole (Exirel), and both provided better control than a high rate of spinetoram (Radiant SC). Isocycloseram alone and in combination with thiamethoxam (Cruiser 5FS) were evaluated as an onion seed treatment for onion maggot control. Results in 2022 showed that a high rate of isocycloseram provided a similar and excellent level of maggot control as the two standards, FarMore FI500 with Regard SC and FarMore FI500 with Trigard. Field studies in 2022 identified cyclaniliprole (Harvanta 50SL) and flupydifurone (Sivanto Prime) as effective in reducing onion thrips infestations in green onion. Future registrations for these products are being explored on onion for thrips control. Field research in 2022 documented a new formulation of spinosad (Lumiverd) that can be used as an onion seed treatment for maggot control. Results were used to assist Corteva, in getting Lumiverd registered as a seed treatment on onion for the 2023 field season.

Washington: Insecticide efficacy trials in 2022 evaluated control options for onion thrips (*Thrips tabaci*). One trial featured new unregistered insecticides, one of which was nearly as efficacious as Radiant (spinetoram), currently the most effective insecticide available to onion producers in WA. Another trial evaluated insecticides currently registered for use on onions but that are not used to manage onion thrips, but none proved effective compared to currently used products.

In trials assessing control of Seedcorn maggot, all insecticide treatments improved stands numerically compared to non-treated, but not all treatments improved stands statistically. Diazinon applied pre-planting, Diazinon applied post-planting, and Capture LFR were the most effective. They did not differ significantly from one another but caused significantly better stands than the non-treated check plots. Seedcorn maggot pressure was high in the trial, with only 58% stand in the non-treated. The best treatment resulted in 80% stands. Plots treated with Regard only had 68% plant stands, which is not acceptable commercially. FarMore FI500 and Capture LFR treatments resulted in acceptable stands of 72 and 74% respectively. Under the significant pest pressure, there was evidence that Diazinon, Farmore FI500, and Capture LFR can be used to reduce seedcorn maggot pressure and achieve adequate plant stands.

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

Pennsylvania: As part of the Stop the Rot SCRI project, during 2022 a third year of field sampling was conducted to identify bacteria associated with symptomatic onion foliage and bulbs. Ten whole onion plant samples were collected from each of five fields in PA and in NY at two times during the season. From each plant, isolations were made onto nutrient agar and up to three unique bacterial colonies were selected. Approximately 153 bacterial isolates were collected from PA and 77 from NY under an APHIS 526 permit and stored (-80C). The post-harvest samples are currently being processed. The majority of isolates were non-pathogenic based on the red scale necrosis assay and all are in the process of being identified to genus.

A bactericide efficacy trial was repeated in 2022 but disease pressure was variable despite multiple inoculations. There were no significant differences in total marketable bulb weight although numerically, the non-inoculated, untreated control was the highest and the inoculated untreated control was near the lowest (P=0.136). The percent of bulbs with bacterial rot symptoms at harvest (interior and exterior) was numerically highest in the copper treated plots and lowest in the plots treated with LifeGard or the non-inoculated, untreated control plots (P=0.670).

A nitrogen rate and timing trial with four nitrogen rates (0, 50, 105, and 160 lb/A) at two timings (half and full season) was repeated to evaluate the effect on center rot disease incidence and marketable yield. Although there was a significant rep effect, the percent of plants with foliar symptoms of center rot was significantly higher in the treatments with higher rates of nitrogen (P=0.003) and also numerically higher for symptomatic bulbs at harvest. Total marketable bulb weight was significantly higher in plots that received nitrogen (P=0.001) compared to the no nitrogen control. Nitrogen application timing and inoculation status (inoculated vs non-inoculated) did not significantly affect disease incidence or marketable weight.

Georgia: The efficacy of fungicides to manage Botrytis leaf blight (BLB) on onion was evaluated in Georgia. Four rows of 'Vidora' onion were transplanted into 6-ft beds (panels) on 10 Dec (2020) at the Vidalia Onion and Vegetable Research Center, Lyons, GA. Natural inoculum was relied upon. Disease severity was assessed on 22 Mar, 4 Apr, and 20 Apr as percent leaf area with symptoms per plot. Area under disease progress curve (AUDPC) was calculated using disease severity ratings from the four assessment periods.

BLB symptoms first appeared on 22 Mar with significantly higher disease severity for the non-treated check (63.8%) and Scala (55.0%) than for the other fungicide-treated plots, with no significant differences among other treatments. Disease progressed over a four-week period and reached 88.8% (disease severity) on 20 Apr, in non-treated plots and Scala-fungicide treated (81.3%) plots, which were significantly higher than the other fungicide-treated plots. Non-treated check and Scala-fungicide treated plots had significantly higher AUDPC compared with the fungicide treatments. Phytotoxicity was not observed with any treatment.

An evaluation of the effect of N-fertility on bacterial internal rot in onion was conduted. There was no observable difference in percent bulb incidence in field or in storage for any of the N-fertility and timing of the final N application. Different copper products and biological control products were evaluated under field conditions. Multiple bactericide programs were evaluated with LifeGard. Foliar symptoms were not observed; however, bulb incidence of internal rot after 30-days of storage differed significantly. Bactericides (Nu Cop, Mankocide, Nordox, Champ) along with LifeGard significantly reduced internal bulb rot compared to non-treated check. Cultural practices to reduce bacterial internal rot in onion were evaluated. Based on the multiple assessments, onion clipping length (2 cm or longer) resulted in significantly reduced internal bulb rot compared to the shorter neck length.

Utah: Laboratory studies were conducted to determine if temperature could influence outbreaks of Fusarium bulb rot. *Fusarium proliferatum* grew best between 25-30C. A field trial was conducted to determine the effect of cultural and chemical practices used in Utah onion production. Fungicides showed very little to no effect on the disease. There was a 10% reduction in bulb rot when onions were topped with a 3-in neck vs 1.5-in neck.

California: Pathogen screening for bacterial diseases affecting CA fresh market and dehydration onions was undertaken in seven counties. Pathogens isolated included: *Pantoea agglomerans, Burkholderia cepacia, Burkholderia gladioli*, and *Pectobacterium carotovorum*. Bactericides for management of bacterial diseases was studied in Kern and San Joaquin counties. Preliminary conclusion based on just a single successful trial is that the bactericides are not effective for bacterial disease control in CA. An irrigation study at the Intermountain REC in Tulelake evaluated the influence of sprinkler irrigation and drip irrigation on bacterial diseases. A significant decrease in bacterial disease incidence and severity was observed when onions were grown under drip compared to sprinkler irrigation in 2021 and 2022. Two studies in Southern California evaluated weather-based models for management of onion downy mildew. Fewer treatments were made in the model treatments compared to the standard calendar and no

disease was observed in the study areas, indicating the potential to forgo applications when disease pressure is low.

Oregon: Over irrigation and excess N-fertilization increase the incidence of fungal neck rot. Optimizing irrigation and fertility through soil moisture monitoring, and plant and soil nutrient testing can reduce risks for bulb rots.

The application of dry formulations of encapsulated DADS and garlic oil resulted in a 74% and 75% reduction in white rot sclerotia populations, respectively, compared to the non-treated control in naturally infested soils. Encapsulated DADS and garlic oil is easier to handle and apply than traditional liquid formulations, which could promote the adoption of sclerotial germination stimulants in a white rot IPM program.

Idaho: Pink root control from drip applications of Fontelis at the first irrigation followed by a second application 4 weeks later were compared to Velum Prime or Velum Prime followed by Minuet at the same application timings. None of the fungicide programs significantly reduced disease incidence and severity in July and August compared to the untreated. Additional trials with biological based programs (Symborg) and fall solarization treatments also failed to show any reduction in pink root compared to the untreated. The second half of the 2022 growing season was exceptionally hot and 100% of the roots showed disease symptoms by early August.

Studies were completed in which onion bulbs were inoculated with *Rahnella* spp. and incubated at 25°C (77°F), 30°C (86°F) or 35°C (95°F) and evaluated for bulb rot at 3, 5, or 8 weeks. Bulb rot increased over time, resulting in up to 60% of the bulb being impacted by 8 weeks post inoculation. Incubation at 30°C (86°F) after inoculation with *Rahnella* spp. resulted in only 36% bulb rot. A second assay incubated the onion bulbs for 2 days or 2 weeks after inoculation with *Rahnella* spp. followed by storage at 5C (41F) and evaluated bulbs for rot at 4 and 6 months. Bulbs incubated at 30C for 2 days or 2 weeks resulted in 35% bulb rot compared to 60-70% when incubated at 25°C (77°F) or 35°C (95°F). This demonstrates that temperature can significantly impact disease development.

The level *Stemphylium vesicarium* spores were monitored over the spring/summer from 2019 to 2022 in an effort to inform fungicide timing and understand the relationship of the pathogen with environmental conditions. A Burkard Multivial Cyclone spore trap was situated on Field block D at Parma and operated continuously over 24-hour periods. DNA was extracted from the spore trap samples and DNA of *S. vesicarium* was quantified using real-time PCR. DNA was recovered in all four years. In 2019 there was relatively low-level detection before mid-July which coincided with the observation of symptoms in late summer. In 2020, which was arguably when the most severe outbreaks of *Stemphylium* were observed in the Treasure Valley, relatively high levels of *Stemphylium* spores were detected throughout June and again from mid-August. Fewer spores were detected from mid-August in 2021 which coincided with arguably less disease observed that year.

Colorado: Bactericidal products were evaluated for the management of onion bacterial rots in inoculated field trials. In addition, we evaluated three post-harvest fogging treatments to assess their effectiveness in managing internal rot of stored onion bulbs. Bulbs will be cut and bulb rots quantified in February of 2023.

New York: In New York, three field trials were conducted in commercial onion fields to evaluate efficacy of fungicides for control of Botrytis leaf blight and Stemphylium leaf blight (SLB), in Elba (2 trials) and Oswego, NY (Hoepting). Each trial was arranged as a randomized complete block design with 24 treatments and 4 replications. Fungicide sprays began in mid-June and continued weekly for 8-9 weeks until mid- to late-August. Trials investigated the efficacy and development of fungicide resistance to FRAC 3 active ingredients when applied alone, in tank mixes with other FRAC group fungicides and in rotation with other FRAC group fungicides. A few novel products were trialed to identify another FRAC group with activity on SLB including Oso (FRAC 19), as well as several tank mixes and premixes. Data analysis is pending.

Control of Stemphylium leaf blight (SLB) in NY is difficult because *S. vesicarium* has developed resistance to fungicides within the FRAC 2, 7, 9 and 11 groups. Currently the most effective fungicides are in FRAC 3. However, there is also concern of resistance development in this group. Isolates of *S. vesicarium* collected from diseased onion fields in four regions of NY in 2020 (n=114) and 2021 (n=81) were tested for fungicide sensitivity to three FRAC 3 active ingredients (a.i.). Results suggest insensitivity is developing to all three a.i's but is developing more slowly to difenoconazole than to tebuconazole, with propiconazole intermediate between these. Some regional differences were also apparent. Results will be used to inform changes in fungicide programs to maintain disease control and slow the development of resistance. Other studies determined that transplants from interstate were a source of SLB, but that seed was not. The disease forecaster BSPcast was tested in a field trial but was found to be a poor predictor of disease.

Field studies showed that supplemental foliar applications of insecticides sprayed early in the season targeting adult onion thrips in an attempt to reduce transmission of IYSV were not effective. Levels of IYSV at the end of the season were similar between onion fields that received the supplemental sprays (5% incidence) and those that did not (9% incidence). However, final levels of IYSV were low. This study will be repeated in 2023.

Another field study showed that IYSV levels were similar between transplanted and direct-seeded fields early in the season, indicating that transplanted fields should not be considered the only major source of early-season IYSV epidemics. Rather, adult onion thrips that are viruliferous may be overwintering in New York and colonize onion fields early in the season. There is some evidence that thrips may prefer to initially colonize onion fields that have the largest plants in the vicinity, often those with an early planting date.

Texas:. A total of 218 bacterial strain samples from Texas (n=208) and New Mexico (n=10) were isolated from onion and identified using 16S rRNA in 2022, encompassing 34 bacterial genera. On the red scale assay, 97.2% of bacteria were non-pathogenic. Out of the 218 samples, the

predominant genus was Pantoea (56), Pseudomonas (27), Enterobacter (22), and Bacillus (20). The survey identified a novel bacterial species - *Curtobacterium allii*.

Washington: As part of the 'Stop the Rot' USDA NIFA SCRI Project No. 2019-51181-30013, we continued the 3-season, 11-state survey across the USA to determine the diversity and prevalence of bacteria associated with onion diseases. Five onion bulb crops were surveyed across the Columbia Basin in Jul – Sep. 2022. Isolations from 75 plant samples with symptoms of bacterial infection resulted in 84 bacterial isolates. Isolates are being identified to genus and species with 16S rDNA sequencing, and all isolates are being tested for pathogenicity . This will complete 3 seasons of survey in WA. We are also completing sequencing and foliar and bulb pathogenicity tests for 33 isolates obtained from symptomatic onion bulb crops in CA that were surveyed by Brenna Aegerter at UC-ANR. Strains of bacteria from Seasons 1 and 2 were submitted to the National Onion Bacterial Strain Collection at the Univ. of Georgia. In addition, soil, plant, and water samples were collected in some fields surveyed in WA in 2022, and sent to James Woodhall, Univ. of Idaho, for testing with real-time PCR assays being developed to detect pathogenic strains of *Pantoea*.

Six field trials were carried out in 2022 on management of onion bacterial diseases evaluating: 1) cultivar susceptibility, 2) chemigation vs. spray boom application of 3 bactericides, 3) timing of rolling tops, 4) timing of topping bulbs, 5) timing of undercutting bulbs, and 6) postharvest application of disinfectants. These trials were repeats of the 2021-22 trials. Bulbs were harvested in Aug.-Sep., placed in storage, and will be cut and rated in Feb. 2023. Results of the Season 2 (2021-22) trials for these same objectives demonstrated: 1) there was more bacterial leaf blight in inoculated plots of earlier maturing cultivars, with ~50% bulb rot for cultivars in maturity groups 1 and 2, 34.5% for those in maturity group 4, and 18.5% for those in maturity group 3; 2) Five weekly, preventative applications of Badge SC, ManKocide, or Lifegard WG did not control bacterial leaf blight or bulb rot, and there was no effect of the herbicide Outlook on leaf blight or bulb rot; 3) rolling tops increased leaf blight but not bulb yield or bulb rot; 4) early topping increased bacterial bulb rot compared to normal or late topping; 5) timing of undercutting did not affect bacterial leaf blight, yield, or bulb rot; and 6) none of four disinfectant treatments reduced bacterial bulb rot, as observed the year prior. We are continuing to develop a risk assessment model for onion bacterial diseases in the Pacific Northwest, using results from the 3 seasons of field trials, and we will invite growers to test the risk model in 2023.

Objective 4. Investigate the biology, epidemiology and management of weedy plant species that impact onion production.

Utah: Claudia Nischwitz presented information on Fusarium bulb rot and Dan Drost gave a presentation on Seed priming and plant population responses at the Utah Onion Association meeting February 8, 2022 attended by 28 people.. On August 9, 2022, Dan Drost held a field day demonstrating his onion variety trial and introduced the new irrigation specialist, attended by 36 people.

New York: In New York, a pre-emergent herbicide trial was conducted in a commercial onion field in Elba, arranged as a randomized complete block design with 18 treatments and 4 replications. The objective of this trial was to optimize weed control and crop safety. It compared a one-step to a two-step barley-kill herbicide program, heavy vs. light rates of pre-emergent herbicides up until barley-kill, different timings of multiple applications of Outlook and Prowl, and incorporation of bicyclopyrone into the onion herbicide program. Data were collected on onion stand, visual crop injury, stunting and vigor, as well as on weed control by species. Data analysis is pending.

New Mexico: A post planting, delayed preemergence application of pendimethalin resulted in similar or better control of annual weeds than current weed control methods using Bensulide and DCPA herbicides or pendimethalin applied at the 2-leaf stage for autumn-sown and winter-sown onions in New Mexico. This same application of pendimethalin did not impact onion stand and bulb yield and did not leave detectable residues on onion bulbs after harvest.

4. Impacts

Georgia: Dutta noted that growers are now offering training to workers to ensure neck lengths are cut longer at harvest, since the GA trials have shown that longer neck lengths lead to reduced incidence of internal bulb rot. Dutta also advised that growers were switching to chain diggers in response to results of GA trials on harvesting methods and their impact on incidence of bulb rot.

California: W4008 participants, California onion industry, and Corteva were able collaborate to fast track a new registration of a spinosad seed treatment option for CA onion production in 2023 using past CA research and grower experiences as supporting documentation. Continued use of an alpha version of an onion downy mildew disease risk advisory system, a cloud-based service that uses in-field weather conditions to assess risk of disease development. The results are provided to end-users in daily emails. An onion seed grower and the seed company used this system in a field in Arizona.

Idaho: Two large companies (JC Watson and McCain Foods) used accelerated aging to identify potential problem onion lots so that they are shipped before decay levels become problematic.

New York: 1) Muck Onion Growers Reduce Nitrogen Fertilizer Application Rates and Greenhouse Gas Emissions. In 2022, in response to cost of nitrogen (N) fertilizer more than doubling, and numerous Cornell on-farm trials from 2017 to 2021 that demonstrated that muck-grown onions could be produced using only 60-90 lb/A, instead of 120-140 lb/A without any reduction in yield, five New York muck onion farms reduced their rate of N fertilizer by 27% on 4125 acres, which is equivalent to 144,795 lb in reduced N fertilizer. This reduction saved $36,200 in N fertilizer expenses and lessened on and off-farm greenhouse gas (GHG) emissions by 723 tons CO_2eq., which is approximately equivalent to the amount of carbon sequestered in 776 acres of forests in one year, or the amount emitted by consuming 64,443 gal of diesel.

2) Muck Onion Growers Implement Fungicide Resistance Practices for Managing Stemphylium Leaf Blight in New York. In 2022, 19 commercial onion fields were scouted weekly in Elba muck,

Wayne and Oswego counties from the first week of June until the end of August for 14 weeks. Incidence and severity of SLB was reported and research-based fungicide recommendations provided in individual weekly scouting reports. Growers were provided Fungicide "Cheat Sheets" to help design responsible fungicide programs adhering to strict rotation restrictions and seasonal maximum use rates.

3) Adoption of key research-based fungicide recommendations for fungicide resistance management of SLB: A) No more than 2 apps per FRAC group before rotating to another FRAC group. B) No more than 2 apps per FRAC groups 2, 3, 7 and 9 (moderate- to high-risk for fungicide resistance) per season. C) FRAC 3 + 3. In 2020 and 2021 trials, it became apparent that FRAC 3 fungicides were beginning to lose efficacy, and that the most effective treatments were FRAC 3 + 3. D) Use of top-performing treatments. In 2020-2021 on-farm onion fungicide trials, Viathon + Tilt and Luna Tranquility/Miravis Prime + Rovral/FRAC P07 were identified as the most effective treatments for SLB control. E) Use of FRAC P07 to prevent leaf dieback.

New Mexico: Our germplasm evaluation method was successful in reliably producing disease symptoms which is essential for disease resistance evaluation. Germplasm has been developed that expresses lower disease severity. Our target audience can use this information and germplasm to develop disease resistant onion cultivars. Economic analysis showed, onion germplasm resistant to onion thrips and/or IYSV could increase profits by $1,000 per ha per year when compared with current marketable yields and management practices. Based up the annual area of onions grown in the US, the promising resistant breeding lines from our program could increase grower profits for the US industry by $54 million.

A post planting, delayed preemergence application of pendimethalin could provide comparable or better control of annual weeds as currently used herbicides in autumn-sown and winter-sown onions in New Mexico while reducing herbicide costs by 92-95% ($99-$156/acre) and reducing the legacy costs on the environment by 74-88%. This simple switch could save the NM onion industry $1 million per year.

Washington: Outreach to growers and onion industry stakeholders, field representatives and extension staff occurred through informal visits with growers during field surveys, grower meetings, field days and technical workshops. 'Stop the Rot' videos are aimed at growers and the industry: (https://www.youtube.com/playlist?list=PLajA3BBVyv1zf2obB16bNEdQPQeLW_XB). Dissemination of results to onion stakeholders and industry has been through informational articles in trade publications and extension newsletters (see list of publications) and websites/online alerts. Growers have indicated they are incorporating recommendations from the trial results into their production practices, particularly late-season irrigation and cultural practices that minimize the risk of bacterial rots. Visits to the Alliumnet website with results from the project have increased significantly. Our 13-member Stop the Rot Stakeholder Advisory Panel (SAP) members actively share information about the project with growers and onion stakeholders in their regional and national networks in 12 states and bring insights and

information to the project. Some SAP members participated in team work sessions as subject matter experts.

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6 Other Activities

1. Research Reports, Abstracts and Papers at International Professional Meetings

du Toit, L.J., MacKay Brown, H., Shin, G. Y., Kvitko, B.H. Aegerter, B.J., Cramer, C., Gugino, B.K., Hoepting, C.A., Malla, S., Nischwitz, C., Reitz, S., Uchanski, M., Woodhall, J., and Dutta, B. 2022. Distribution and pathogenicity of bacteria collected in surveys of onion crops across production regions in the U.S. in 2020 and 2021. Abstract for Plant Health 2022, Annual Meeting of the American Phytopathological Society, 6-10 Aug. 2022, Pittsburgh, PA. Phytopathology 112:S3.97.

MacKay, H., du Toit, L., Aegerter, B., Colson, G., Coutinho, T., Dutta, B., Gugino, B., Hoepting, C., Kvitko, B., LaHue, G., Malla, S., Nischwitz, C., Reitz, S., Uchanski, M., Waters, T., Woodhall, J., and Asma, M. 2022. Combating onion bacterial diseases with pathogenomic tools and enhanced management strategies: Research objectives and progress towards reducing crop losses. Abstract for a poster, 14th International Congress of Plant Pathogenic Bacteria, 3-8 Jul. 2022, Assisi, Italy.

Nault, B.A. 2021. Onion maggot management in the Great Lakes region. Agriculture and Agri-Food Canada's Pesticide Reduced Risk Webinar for Root Pests of Carrot and Onion. (Ontario, Canada). Virtual. November 30, 2021. Speaker, 25 min. Attendees: 20.

2. Research Reports: Abstracts and Papers at National Professional Meetings (2021/2022)

Aegerter, B., Donahoo, W., Davey, J., Derie, M., du Toit, L., Dutta, B., Feibert, E., Foster, M., Hoepting, C., Machado, A., Nischwitz, C., Reitz, S., Sidhu, J., Uchanski, M., Waters, T., and Woodhall, J. Evaluation of bactericides and plant defense inducers to manage bacterial rots of onion in seven states in the U.S. Oral presentation, Stop-the-Rot session, National Allium Research Conference, 28 Feb.-1 Mar. 2022, Denver, CO. https://alliumnet.com/wp-content/uploads/2022/02/ScheduleAbstracts-NARC_W3008_StR_02.21.22.pdf

Beck, D., Beck, K., Thornton, M., Portenier, R., and Morgan, O. 2022. Stunting and stand loss in drip-irrigated onions. *National Allium Research Conference* (https://alliumnet.com/2022-narc-w3008-stop-the-rot/).

Colson, G., du Toit, L., Dutta, B., and Hoepting, C. Economic assessment of management strategies for onion bacterial rots. Oral presentation in the Stop-the-Rot session, National Allium Research Conference, 28 Feb.-1 Mar. 2022, Denver, CO. https://alliumnet.com/wp-content/uploads/2022/02/ScheduleAbstracts-NARC_W3008_StR_02.21.22.pdf

Cramer, C.S., S. Shahabeddin Nourbakhsh, and S. Sharma. Breeding for reduced Iris yellow spot symptom expression in onion. 2022 National Allium Research Conference and 2022 National Onion Association Annual Meeting.

Du Toit, L.J. et al. 2022. Distribution and pathogenicity of bacteria collected in surveys of onion crops across production regions in the U.S. in 2020 and 2021. Phytopathology 112: S3.97.

Dutta, B., Walcott, R., and Gitaitis, G. 2022. Current understanding on seedborne bacterial pathogens, diagnostics, and seed treatments. *Phytopathology* 112-11-S3.210.

Heck, D.W., A. Klein, N. Pineros-Guerrero, F.S. Hay, C.A. Hoepting, S.J. Pethybridge. 2022. Lack of sensitivity in *Stemphylium vesicarium* isolates to succinate dehydrogenase inhibitors from onion in New York (Poster). In: Proceedings of the American Phytopathological Society Annual Meeting, Pittsburg, PA, USA: August 6-10, 2022.

Hoepting, C.A. 2022. Stunning weed control in muck-grown onion with bicyclopyrone. National Allium Research Conference. Denver, CO, USA: February 28, 2022 (85 attendees).

Hoepting, C.A. 2022. Extension and Outreach Update. Stop the Rot USDA NIFA Onion Bacterial Disease Project (2019-51181-300130 Annual Meeting. Denver, CO, USA: March 1, 2022 (75 attendees).

Hoepting, C.A. 2022. Stunning weed control in muck-grown onion with bicyclopyrone. In: Proceedings of the National Allium Research Conference, Denver, CO, USA: January 28, 2022. Online:chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://alliumnet.com/wp-content/uploads/2022/03 /NARC2022_Hoepting_Weed-control-in-muck-grown-onions-with-bicyclopyrone.pdf

Hoepting, C.A., E.R. van der Heide and S.K. Caldwell. 2022. Evaluation of the influence of applied nitrogen on bacterial bulb rot in muck-grown onion in New York (Poster). In: Proceedings of the National Allium Research Conference, Denver, CO, USA: January 28, 2022. Online: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://alliumnet.com/wp-content/uploads/2022/03/15.-Nitrogen_x_rot_poster_HoeptingFINAL.pdf

Hoepting, C.A., E.R. van der Heide and S.K. Caldwell. 2022. Evaluation of the influence of variety on bacterial bulb rot of onion in New York (Poster). In: Proceedings of the National Allium Research Conference, Denver, CO, USA: January 28, 2022. Online: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://alliumnet.com/wp-content/uploads/2022/03/14.-Variety_x_rot_poster_HoeptingFINAL.pdf

du Toit, L., Derie, M., Hoepting, C., and Dutta, B. 2022. Evaluation of late-season cultural practices for managing onion bacterial bulb rots. Oral presentation, Stop-the-Rot session, National Allium Research Conference, 28 Feb.-1 Mar. 2022, Denver, CO. https://alliumnet.com/wp-content/uploads/2022/02/ScheduleAbstracts-NARC_W3008_StR_02.21.22.pdf

du Toit, L., Kvitko, B., and MacKay, H. 2022. Surveys of bacterial pathogens in onion production regions of the U.S.: Preliminary results from 2020 and 2021. Oral presentation and poster, Stop-the-Rot session, National Allium Research Conference, 28 Feb.-1 Mar. 2022, Denver, CO. https://alliumnet.com/wp-content/uploads/2022/02/ScheduleAbstracts-NARC_W3008_StR_02.21.22.pdf and https://alliumnet.com/wp-content/uploads/2022/03/11.-duToit_MacKay_Kvitko_bacterial_surveys_poster_final.pdf

du Toit, L., and MacKay, H. 2022. Stop the Rot: Overview of research to combat onion bacterial diseases with pathogenomic tools and enhanced management strategies. Oral presentation, Stop-the-Rot session, National Allium Research Conference, 28 Feb.-1 Mar. 2022, Denver, CO. https://alliumnet.com/wp-content/uploads/2022/02/ScheduleAbstracts-NARC_W3008_StR_02.21.22.pdf

Hua, K., Lupien, S., and Dung, J.K.S. 2022. Identification and pathogenicity of *Fusarium proliferatum* causing clove rot on garlic. Poster presentation. 2022 National Allium Research Conference. February 28-March 1, 2022. Denver, CO.

Hua, K., Qian, Y.P., Qian, M., Wilson, R., and Dung, J.K.S. 2022. Use of sulfur compounds and *Allium* lure crops to reduce white rot inoculum in infested soils. Poster presentation. American Phytopathological Society Annual Meeting. August 6-10, 2022. Denver, CO.

Khanal, M., B.P. Bhatta, and S. Malla. 2022. Onion Microflora and Associated Pathogens. Southern Region American Society for Horticultural Science Meeting, New Orleans, LA, 11-13 Feb. 2022.

Koirala, S., Myers B., Shin GY., Kvitko, B., & **Dutta, B**. 2022. Evaluating options to increase the efficacy of bio-control agents for the management of *Pantoea* spp. under field conditions. *Phytopatholog*y 112: S3.41.

Komondy, L., and B. A. Nault. 2022. Developing spatially-optimized sequential sampling plans for onion thrips, *Thrips tabaci* (Thysanoptera: Thripidae) in onion. Entomological Society of America Eastern Branch Meeting, April 25, 2022. Philadelphia, PA.

LaHue, G., Belo, T., Derie, M., Dutta, B., Feibert, E., Gugino, B., Hoepting, C., Mazzone, J., Reitz, S., Waters, T., Wilson, R., and du Toit, L. 2022. Reducing the risk of onion bacterial diseases through irrigation and nitrogen management. Oral presentation, Stop-the-Rot session, National Allium Research Conference, 28 Feb.-1 Mar. 2022, Denver, CO. https://alliumnet.com/wp-content/uploads/2022/02/ScheduleAbstracts-NARC_W3008_StR_02.21.22.pdf

Lai, P.-C., Iglesias, L., and B. Nault. 2021. Optimizing onion thrips management programs in organic onion production. Entomological Society of America 2021 Annual Meeting, November 2, 2021. Denver, CO.

Nault, B.A. 2021. Past, current and future management of onion maggot using seed treatments. New York State Report for the W-4168 Multistate Annual Meeting, October 15, 2021. Geneva, NY.

Nault, B. A. 2021. Thrips ecology and management. *In* PIE Member Symposium: Four decades of adapting, advancing and transforming IPM: Honoring the career of Dr. Anthony Shelton. Entomological Society of America Annual Meeting, November 3, 2021, Denver, CO.

Nault, B.A. 2022. Managing insect pest of dry bulb onion in the eastern US. National Allium Research Conference, February 28, 2022, Denver, CO (85 attendees).

Nault, B.A, C.A. Hoepting and F.S. Hay. 2022. New York report. Annual Meeting for NIMSS Multistate Working Group W3008: Integrated Pest and Disease Management. Denver, CO, USA: February 28, 2022 (85 attendees).

Neupane, R, J. Mazzone, C.A. Hoepting and B.K. Gugino. Identification and pathogenicity of bacteria isolated from symptomatic onion leaves and bulbs in Pennsylvania and New York in 2020 and 2021 (Poster). In: Proceedings of the American Phytopathological Society Annual Meeting, Pittsburg, PA, USA: August 6-10, 2022.

Neupane, R., J.D. Mazzone, C.A. Hoepting, and B.K. Gugino. 2022. Identification and pathogenicity of bacteria isolated from symptomatic onion leaves and bulbs in Pennsylvania and New York in 2020 and 2021. Phytopathology 112: S3.155.

Pineros-Guerrero, N., F.S. Hay, D.W. Heck, A. Klein, C.A. Hoepting and S.J. Pethybridge. 2022. Sensitivity of *Stemphylium vesicarium* isolates to demethylation inhibitors (Poster). In: Proceedings of the American Phytopathological Society Annual Meeting, Pittsburg, PA, USA: August 6-10, 2022.

Regan, K.H., and B.A. Nault. 2021. Less is more: Evaluating reduced applications of fertilizer and insecticide use for management of onion thrips (*Thrips tabaci*) on onion. Entomological Society of America Annual Meeting, November 3, 2021. Denver, CO.

Rossi, F, Dung, J., Hua, K., and Duringer, J. 2022. Validation of an LC-MS/MS method for quantification of fumonisins in garlic. Oral presentation. Summer Undergraduate Research Symposium, Oregon State University. September 13, 2022. Virtual.

Rossi, F, Dung, J., Hua, K., and Duringer, J. 2022. Validation of an LC-MS/MS method for quantification of fumonisins in garlic. Oral presentation. Pacific Northwest Association of Toxicologists Meeting. October 2-3, 2022. Spokane, WA.

Schutte, B. L. Beck, S. Walker, R. Acharya, and C.S. Cramer. Evaluation of herbicide combinations for weed control in onion in New Mexico. 2022 National Allium Research Conference and 2022 National Onion Association Annual Meeting.

Sharma, S., S. Shahabeddin Nourbakhsh, and C.S. Cramer. Breeding for reduced Iris yellow spot symptom expression in onion. 2022 Annual Conference of the American Society for Horticultural Science.

Sharma, S. and C.S. Cramer. Improving Fusarium basal rot resistance of short-day onion cultivars through an artificial inoculation mature bulb screening. 2022 Annual Conference of the American Society for Horticultural Science
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Sharma, S. and C.S. Cramer. Improving Fusarium basal rot resistance of short-day onion cultivars through an artificial inoculation mature bulb screening. 2022 National Allium Research Conference and 2022 National Onion Association Annual Meeting.

Thornton, M., Beck, D., Beck, K., Portenier, R., and Morgan, O.. 2022. Evaluation of herbicides for impact on the incidence of single centers in onions. *National Allium Research Conference* (https://alliumnet.com/2022-narc-w3008-stop-the-rot/).

Thornton, M., Beck, D., Beck, K., Portenier, R., and Morgan, O 2022. Response of yellow sweet Spanish onion varieties to ethofumesate herbicide. *National Allium Research Conference* (https://alliumnet.com/2022-narc-w3008-stop-the-rot/).

Torres, S. and C.S. Cramer. Selection progress for reduced Iris yellow spot disease symptoms and associated traits in onion. 2022 National Allium Research Conference and 2022 National Onion Association Annual Meeting.

Waters, T., Uchanski, M., du Toit, L., Derie, M., and Davey, J. 2022. Evaluation of post-harvest treatments for control of bacterial bulb rots in onions. Oral presentation, Stop-the-Rot session,

National Allium Research Conference, 28 Feb.-1 Mar. 2022, Denver, CO. https://alliumnet.com/wp-content/uploads/2022/02/ScheduleAbstracts-NARC_W3008_StR_02.21.22.pdf

Wood, B., Murdock, M., and Woodhall, J. 2022. A survey of bacterial species associated with onion bulb rots in the Treasure Valley of southwest Idaho and eastern Oregon. APS Annual Meeting. Poster.

Wood, J.B., C S. Cramer, R. Steiner, R. Heerema, B.J. Schutte, and I. Guzman. Onions selected for resistance to Iris yellow spot virus have higher carbon assimilation rates. 2022 National Allium Research Conference and 2022 National Onion Association Annual Meeting

Woodhall, J.W., Harrington, M., Wood, B., Shin G.Y., and Kvitko, B. 2022. Developing nucleic acid amplification tests for onion pathogenic bacteria. National Allium Research Conference. Denver, USA. Oral presenter

Zhao, M., Shin, G.Y., Stice, S., Coutinho, T., Gitaitis, R., Kvitko, B., and Dutta, B. 2022. A novel biosynthetic gene cluster across the *Pantoea* species complex is important for pathogenicity in onion. *Phytopathology* 112:S3.111.

Zhao, M., Derie, M., Waters, T., Dutta, B., and du Toit, L. 2022. Evaluation of resistance screening methods for bacterial diseases of onion. Oral presentation, Stop-the-Rot session, National Allium Research Conference, 28 Feb.-1 Mar. 2022, Denver, CO. https://alliumnet.com/wp-content/uploads/2022/02/ScheduleAbstracts-NARC_W3008_StR_02.21.22.pdf

3. Activities and Reports at Grower Meetings and Field Days

California: W4008 participants met with the CA Garlic and Onion Research Advisory Board to learn of grower and industry needs related to pest management at the annual California Garlic and Onion Research Advisory Board conference held virtually on February 7, 2022. Participants also met with regional grower groups to learn about pest management issues and needs.

Oregon: Oregon (Reitz and Dung): Research was presented at the Idaho-Malheur County Onion Growers Meeting, the Pacific Northwest Vegetable Association, and the California Garlic and Onion

Research Symposium. Research was published on the Malheur Experiment Station website and Central Oregon Agricultural Research and Extension Center website. The Malheur Experiment Station hosted a research tour for the National Onion Association.

Colorado: In 2022 we formed an Onion Committee under the umbrella organization of the Colorado Fruit and Vegetable Growers Association (CFVGA). Mark Uchanski serves on this committee, which is tasked with identifying research priorities and can provide some modest funding to support research activities relevant to the onion industry in Colorado. The Onion Committee will serve as the primary conduit to facilitate communication between W3008 participants at the national level and onion industry stakeholders at the state level.

Idaho: Presentations at the annual grower meetings, PNW Vegetable Association and field days are ways we are engaging industry to increase awareness of new diseases and management options.

Idaho-Malheur County Onion Growers Meeting, February 2, 2022

Reitz: Thrips management and Lorsban alternatives for maggot management

National Onion Association tour of the Malheur Experiment Station, July 8, 2022

Malheur Experiment Station Onion Field Day, August 25, 2022

Pacific Northwest Vegetable Association, November 16, 2022

Reitz: Update on USDA-SCRI: Development and Delivery of Integrated Management Packages for the Most Serious Pest and Diseases Threatening US Allium Industries

An Update from SCRI-Funded White Rot Research. Invited speaker. Co-presented with K. Hua. Virtual California Garlic and Onion Symposium, 2021. February 7, 2022. Virtual (~50 attendees)

Other:

Aegerter, B. 2022. Update on bacterial bulb rot research in California onions. California Garlic and Onion Symposium 2/7/2022

du Toit, L.J. 2022. Stop the Rot: Research update. Invited presentation, Onion Session, Pacific Northwest Vegetable Association Annual Convention & Trade Show, 16-17 Nov. 2022, Kennewick, WA.

du Toit, L.J. 2022. Onion foliar diseases: Fungicide use and recommendations. Invited presentation, BASF/Nunhems Onion Growers' Meeting, 15 Nov. 2022, Kennewick, WA.

du Toit, L.J., Waters, T.D., C. Wohleb, and H. Pappu. (2022). Washington State W-3008 Report. W-3008 National Meeting. Denver, CO. March 1, 2022. Waters, T.D. (2022).

Gugino, B.K. Managing common diseases of onion. Sugar Valley Small Fruit and Vegetable Meeting. Greene Township Municipal Building, Loganton, PA. 4 March 2022.

Gugino, B.K. Identification and management of common foliar and bulb diseases of onion. New Wilmington Produce Auction Vegetable Meeting. Tri-County Produce Auction, New Wilmington, PA. 22 October 2022.

Gugino, B.K. Onion disease identification and management. Ephrata Agway Grower Meeting. Shady Maple Smorgasbord, East Earl, PA. 13 December 2022.

Gugino, B.K. Managing key diseases of onions: Stop the Rot! 2022 New England Vegetable and Fruit Conference. Manchester Convention Center, Manchester, NH. 15 December 2022.

Hay, F.S. 2022. Update on fungicide sensitivity testing. Cornell Co-operative Orange County Onion School (by Zoom) March 10, 2022. Otisville, NY.

Hay, F.S. 2022. Putting the heat on garlic diseases. Cornell Co-operative Extension Garlic School (by Zoom) March 23, 2022.

Hoepting, C.A. 2022. Organic and conventional strategies to limit losses from Allium insect pests. New England Vegetable and Fruit Conference – Allium and Root Crops Session. Manchester, NH, USA: December 15, 2022 (63 attendees).

Hoepting, C.A. 2022. Harvest and post-harvest cultural practices that may reduce bacterial bulb rot. CCE Cornell Vegetable Program Muck Donut Hour. Elba, NY: August 16, 2022 (8 participants).

Hoepting, C.A. 2022. Research highlights from 2021 onion fungicide trials and new fungicide recommendations for 2022 growing season. CCE Cornell Vegetable Program Muck Donut Hour. Elba, NY: June 21, 2022 (10 participants).

Hoepting, C.A. and E.R. van der Heide. 2022. Demonstration of post-emergent herbicides to control volunteer potatoes in direct-seeded onion. Annual Muck Onion Twilight Meeting. Butler, NY: June 16, 2022 (74 attendees).

Hoepting, C.A. E.R. van der Heide and S.R. Caldwell. 2022. Stop the Rot highlights: Progress towards managing bacterial bulb rot of onion. Annual Muck Onion Twilight Meeting. Butler, NY: June 16, 2022 (74 attendees).

Hoepting, C.A. 2022. Research highlights from 2021 and new onion fungicide recommendations for 2022. Annual Muck Onion Twilight Meeting. Butler, NY: June 16, 2022 (74 attendees).

Hoepting, C.A. 2022. Fungicide programs in the face of fungicide resistance: Updates from the field. Annual Orange County Onion School. Ottisville, NY: March 10, 2022 (51 attendees).

Hoepting, C.A. 2022. Stop the rot project update. Annual Orange County Onion School. Ottisville, NY: March 10, 2022 (51 attendees).

Hoepting, C.A. 2022. Seed treatments and in-furrow treatments for controlling onion smut and damping off in direct seeded onion. Annual Orange County Onion School. Ottisville, NY: March 10, 2022 (51 attendees).

Nault, B.A. 2021. Onion thrips update and maggot control in a world without Lorsban. Great Lakes Fruit, Vegetable and Farm Market EXPO (by Zoom). December 8, 2021. Grand Rapids, MI.

Nault, B.A. 2022. Current and future management options for maggots and thrips in onion. Wisconsin Potato and Vegetable Growers Association Grower Education Conference & Industry Show (by Zoom). February 9, 2022. Stevens Point, WI.

Nault, B.A. 2022. Managing onion maggot and seedcorn maggot without Lorsban. Orange County Onion School. Cornell Cooperative Extension Eastern New York Commercial Horticulture Program. March 10, 2022. Otisville, NY.

Nault, B.A. 2022. Onion insect pest management update. Muck Onion Growers Twilight Meeting, Cornell Cooperative Extension, Cornell Vegetable Program. June 16, 2022. Wolcott, NY.

Nault, B.A. and C. Hoepting. 2022. Fungicide and insecticide seed treatment options for 2023 and beyond. Orange County Onion School. Cornell Cooperative Extension Eastern New York Commercial Horticulture Program. March 10, 2022. Otisville, NY.

Rossi, F, Dung, J., Hua, K., and Duringer, J. 2022. Validation of an LC-MS/MS method for quantification of fumonisins in garlic. Oral presentation. Summer Undergraduate Research Symposium, Oregon State University. September 13, 2022. Virtual.

Schroeder, B.K., *Rahnella* spp., a bacterial pathogen causing onion bulb rot in the Treasure Valley. Idaho-Malheur County Onion Growers Annual Meeting, Nampa, ID, February 1, 2022.

Sharma, S. and C S. Cramer. Selection progress for reduced Fusarium basal rot in onion. 2022 NMSU Onion Field Day, Las Cruces, NM, 29 June 2022.

Thornton, M., Portenier, R., Morgan, O., Beck, K. and Simerly, B.. 2022. Long term storage of onion cultivars, 2020/2021 report. *Proc. of the Idaho/Malheur County Onion Growers Meeting.* 4pp.

Thornton, M., Portenier, R., Beck, D., Beck, K. and Morgan, O.. 2022. Stunting and stand loss in drip-irrigated onions. *Proc. of the Idaho/Malheur County Onion Growers Meeting.* 10pp.

Thornton, M., Portenier, R., Beck, K. and Morgan, O.. 2022. Evaluation of herbicides for impact on the incidence of single centers in onions. *Proc. of the Idaho/Malheur County Onion Growers Meeting.* 6pp.

Thornton, M.. A new look at pink root management. Idaho-Malheur County Onion Growers Annual Meeting, Nampa, ID, February 1, 2022.

Thornton, M.. Onion pink root management and emerging diseases. University of Idaho PREC Field Day, Parma, ID, August 18, 2022.

Thornton, M.. Soil borne diseases of onions. Bayer Crop Science Asset Managers Tour, Parma, ID, October 14, 2022.

Torres, S. and C S. Cramer. Selection progress for reduced Iris yellow spot disease symptoms and associated traits in onion. 2022 NMSU Onion Field Day, Las Cruces, NM, 29 June 2022

Waters, T. D. and du Toit, L.J. (2022). Evaluation of Post-Harvest Disinfectants for Onion Storages. Stop the Rot Project Meeting. Denver, CO. March 1, 2022.

Waters, T. D. (2022) Controlling Thrips: Product Updates and Strategies for 2022. Wilbur Ellis Grower Update, Wenatchee, WA. (January 11, 2022). Invited.

Waters, T.D. (2022). Controlling Thrips: Product Updates and Strategies for 2022. Wilbur Ellis Grower Update, Pasco, WA. (February 2, 2022). Invited.

Waters, T.D. (2022). Controlling Thrips: Product Updates and Strategies for 2022. Wilbur Ellis Grower Update, Yakima, WA. (January 4, 2022). Invited.

Waters, T.D. (2022). Control on Insects in Vegetable Crops Grown for Seed. Columbia Basin Vegetable Seed Growers Annual Meeting, Moses Lake, WA. (January 13, 2022). Invited

Waters, T. D. (2022). Using Pesticides in Onion Production. BASF Product Update Meeting, BASF, Kennewick, WA, United States of America. (November 15, 2022). Invited

Waters, T.D. (2022). Seedcorn Maggot Update. Pacific Northwest Vegetable Association, Kennewick, WA. November 17, 2022. Invited.

Waters, T. D. (2022). IPM Principles for Vegetable Production. Hermiston Farm Fair. Virtual via Zoom Platform. Invited.

Wilson, R. 2022. Comparison of irrigation method on the incidence and severity of bacterial diseases in onions. IREC Field Day 7/28/2022.

Woodhall, J.W. Onion Disease Update. Idaho-Malheur County Onion Growers Annual Meeting, Nampa, ID, February 1, 2022.

Woodhall, J.W. The impact of a cool wet spring on onion diseases. Pacific Northwest Vegetable Association Annual Meeting. 2022.

4. Newsletter Articles

Dutta, B., Grey, T., and Schmidt, J. 2022. Neglecting weeds can lead to late-season disease in organic onions. Specialty Crop News. March 2022.

Hua, K., Wilson, R., and Dung, J.K.S. 2022. Setting a Trap: Can Early Terminated *Allium* Trap Crops Reduce White Rot Infestations? Onion World (January 2022):16-18

MacKay, H., and du Toit, L. 2022. Stop the Rot – Year 3 highlights. Amazing Onion XL (3, April 2022):1, 6, and 7 (newsletter of the National Onion Association).

Wohleb, C.H., Waters, T.W., and du Toit, L.J. 2022. Washington State University Extension Onion Alerts. Contributed articles and photos on onion diseases, pests, and other problems, and edited WSU Onion Alerts released online on 10 & 27 Jun. and 15 Dec. 2022. https://mailchi.mp/wsu.edu/wsu-onion-alert-june-10-2022?e=72ba613792

5. Annual Reports

Chitturi, A., Feibert, E. B. G., Wieland, K. D., Rivera-Ramires, A., Trenkel, I., Rose, H. Reitz, S. 2022. Effects Of Tank-Mixing Insecticides On Thrips Management. (pp.113-118). Oregon State University. https://agsci.oregonstate.edu/system/files/m_-_reitz_2021_-_tank_mixing_insecticides_lb430.pdf

Reitz, S., Trenkel, I., Wieland, K.D., Feibert, E.B.G., and Rivera-Ramires, A. Management of Bacterial Bulb Rots in Onion–2021. (pp. 119-129) Oregon State University. https://agsci.oregonstate.edu/system/files/n_stop_rot_bactericide_efficacy_2021_lb513.pdf

Reitz, S. 2022. Monitoring Onion Pests across the Treasure Valley–2021 (pp. 97-103). Oregon State University https://agsci.oregonstate.edu/system/files/k_-_reitz_2021_-_onion_pest_monitoring_report_lb422_002.pdf

6. Internet Resources

Hoepting, C.A. 2022. Cornell onion (dry bulb) fungicide “Cheat Sheet” for control of leaf diseases in New York, 2022. Cheat Sheet: Cornell Cooperative Extension – Cornell Vegetable Program Website. Posted: July 5, 2022 (2 pages). Online: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/ https://rvpadmin.cce.cornell.edu/uploads/doc_1076.pdf. Updated annually: 2019, 2020, 2021, 2022.

Hoepting, C.A. 2022. 2022 Relative performance of fungicides including tank mixes for control of Botrytis leaf blight (Table 1) and Stemphylium leaf blight (Table 2) in onion. Cheat Sheet: Cornell Cooperative Extension – Cornell Vegetable Program Website. Posted: July 5, 2022 (2 pages). Online: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://rvpadmin.cce.cornell.edu/uploads/doc_1077.pdf

Nault, B.A. and C.A. Hoepting. 2022. Seed treatment and in-furrow treatments for managing maggots and soilborne diseases in direct seeded onion in New York, 2022. Cheat Sheet: Cornell Cooperative Extension – Cornell Vegetable Program Website. Posted: September 22, 2022 (1 page). Online: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://rvpadmin.cce.cornell.edu/uploads/doc_1090.pdf. Updated annually: 2019, 2020, 2021, 2022.

Information pertaining to the objectives of this project can be accessed via https://nault.entomology.cornell.edu/.

du Toit, L.J. Experimental design workshop. Organized and presented 1-h workshop on principles of experimental design, 8 Jun. 2022, https://youtu.be/Las-WkZZa2Y (virtual). (30 people)

du Toit, L.J., and Derie. M.L. Onion bacterial inoculation workshop. Organized and presented 1-h workshop on effective methods for bacterial inoculations in research trials, 1 Jun. 2022, https://youtu.be/7KaRS4MnxY4 (virtual). (35 people)

Websites revised/maintained:

Alliumnet: https://alliumnet.com/

Stop the Rot project and resources on Alliumnet: https://alliumnet.com/stop-the-rot-publications-and-resources/

Stop the Rot videos on YouTube: https://www.youtube.com/playlist?list=PLajA3BBVyv1zf2obB16bNEdQPQeLW_XB_