CONTINUING PROJECT REPORT **YEAR**: Final
WTFRC Project Number: 9-20-p

Project Title: Epidemiology and management of pear gray mold in the PNW

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Cooperators: Dr. Peever, WSU-WA; Dr. Ashley Thompson, OSU-OR; Christensen and Spanjer Orchards in Cashmere, WA, Duckwall and Stewart Orchards in Hood River, OR, Naumes and Bear Creek Orchards in Medford, OR.

Total Project Request: **Year 1:** $99,768 **Year 2:** $108,781 **Year 3:** $110,834

Other funding sources
KC lab:
Agency Name: Chemical company contracts. **Amt. awarded:** $100,000
Amiri lab:
Agency Name: Specialty Crop Block Grant program-USDA-WSDA. **Amt. awarded:** $170,195.
Notes: "Strategies to enhance pre- and postharvest management of gray mold in pome fruit" PI: Amiri, co-PI: Tobin Peever. This grant is split 70% and 30% for apple and pear, respectively.

WTFRC Collaborative expenses: None

Budget 1: Achala KC
Organization Name: OSU Ag. Res. Foundation **Contract Administrator:** Josh Kvidt
Telephone: 541-737-4066 **Email address:** josh.kvidt@oregonstate.edu

Item	(2019-20)	(2020-21)	(2021-22)
Salaries[1]			
Post-Doctoral research associate 6 mo	25,000	25,750	26,523
Undergraduate labor (1040 hrs @ $13.00)	6,240	10,400	13,520
Benefits[1]			
Post-Doctoral research associate	15,775	16,248	16,735
Undergraduate labor	749	1,248	1,623
Equipment	0	0	
Supplies[2]	1,500	1,545	1,591
Travel[3]	500	1,000	500
Hood River Plot Fees[4]		3,000	
Total	**49,764**	**59,191**	**60,492**

Footnotes:

[1] Salaries for a Post-Doctoral research associate @ $50,000/month for 6 months, and 63.1% benefit rate. Salaries for an undergraduate research assistant at $13.00/hr for 1040 hrs and 12% benefit rate. The hours request for undergraduate labor is increased for year 3 based on the requirement from 2018 and 2019 samples collection and processing time.
[2] Materials to collect and process samples, plates and media to isolate pathogens, reagents for DNA extraction and qPCR analysis, chemicals and reagents for in vitro analysis for year 1 and 2; labels and field supplies for year 3.
[3] Travel to experimental and commercial orchards.
[4] Plot fees for trials in Hood River @ $3,000 per acre. Trials in Hood River was not possible in 2020 due to COVID-19 related restrictions. The budget request was re-distributed to cover the extra undergraduate labor expense incurred during 2020 sample collections and processing.

Budget 2: Amiri
Organization Name: WSU **Contract Administrator:** Katy Roberts/Shelli Tompkins
Telephone: 509-335-2885/509-293-8803 **Email address:** arcgrant@wsu.edu / shelli.tompkins@wsu.edu

Item	2019-20	2020-21	2021-22
Salaries[1]	30,240	31,450	32,708
Benefits[1]	11,884	12,360	12,854
Wages	0	0	0
Benefits	0	0	0
Equipment	0	0	0
Supplies[2]	6,700	4,600	3,200
Travel[3]	1,180	1,180	1,580
Miscellaneous	0	0	0
Plot Fees	0	0	0
Total	**50,004**	**49,590**	**50,342**

Footnotes:
[1] Salaries for a Research Associate at $3,600/ month for 12 months, 0.7 FTE and 39.3% benefit rate.
[2] Supplies include chemical and reagents needed to culture fungi and material for pathogenicity tests and Molecular detection and sequencing of Botrytis from pear samples.
3 To travel to experimental and commercial orchards and to packinghouses in WA and Hood River, OR to conduct trials and collect data at about 1,200 miles/season @$0.58/mile. At the end of Year 2, travel is budgeted for the PI to travel to Medford to meet with co-PI for Extension and result discussion

OBJECTIVES

1. Understand the epidemiology of *Botrytis* infections and *Botrytis* causal species in orchards and their impact on gray mold development in storage

2. Identify new approaches to manage gray mold in pear

- **2.1.** Continued testing of registered and new fungicides for the control of gray mold disease
- **2.2.** Evaluate epidemiology-based spray programs for gray mold management

3. Conduct an outreach program to update pear growers/packers in the PNW

SIGNIFICANT FINDINGS:

- *Botrytis* was detected in orchard samples throughout the season from bloom to harvest at low and variable frequencies between locations in WA, Hood River, and Medford. Variabilities in inoculum size and dynamics throughout the season were observed among orchards located in different districts.
- In all locations, the size of *Botrytis* inoculum was greater in organic orchards compared to conventional orchards.
- *Botrytis* was detected in pear tissues from OR and WA fruit samples, including calyx, stem-bowl, cuticle, and flesh indicating latent (dormant) infections from previous infections in the orchard
- About 700 *Botrytis* spp. isolates were collected from WA and OR, respectively in 2019 and 2020.
- *B. cinerea* was the only species detected among 220 isolates screened from the 700 collected.
- In south OR trials, fungicides showed a range of effectiveness against 20 *Botrytis* isolates indicating variability in sensitivity when exposed to preharvest fungicides with different modes of action. When tested on wound inoculated fruit assays, the efficacy of Ziram, and PhD were higher than 50% for all isolates tested in this study. Whereas 25% of the isolates showed reduced sensitivity to Manzate, and Botran. Similarly, when three postharvest fungicides (ADA 72902, BioSpectra, and Scholar) were tested for their efficacy on wound inoculated fruits, their efficacy were higher than 60% for all isolates tested in this study.
- In WA, four seasonal field spray programs to improve gray mold management were tested in 2020 and 2021 field seasons. Results indicate that sprays conducted at petal fall, fruit set, and 7 to 0 days preharvest are critical to reduce gray mold in storage. A summer spray on green fruit, would optimize gray mold management in storage especially for fruit stored long-term (>6 months).

RESULTS AND DISCUSSION

Objective 1. Understand the epidemiology of *Botrytis* infections and *Botrytis* causal species in orchards and their impact on gray mold development in storage

Activity 1.1. ***Infection timing*** (Year 1)
Trials at WA and Hood River

As shown in Figure 1 below, *Botrytis* was detected in Anjou orchards at almost all sampling times. There seem to be a carry-over from bloom to fruit and increases as the fruit mature. Fungicide spray programs for each orchard were obtained and are being analyzed to correlate with potential fungicide

effect on reduction of *Botrytis* load on fruit as this can be explained by the slight reduction observed before harvest (Figure 1) following the preharvest spray. However, the incidence of fruit infected (not decayed) with *Botrytis* increased significantly in organic Anjou fruit to 78% in Hood River and 66% after 6 months of CA storage. The frequency of conventional Anjou fruit carrying Botrytis remained steady in CA storage compared to harvest time. It is important to note that the fruits used in this study were not treated postharvest.

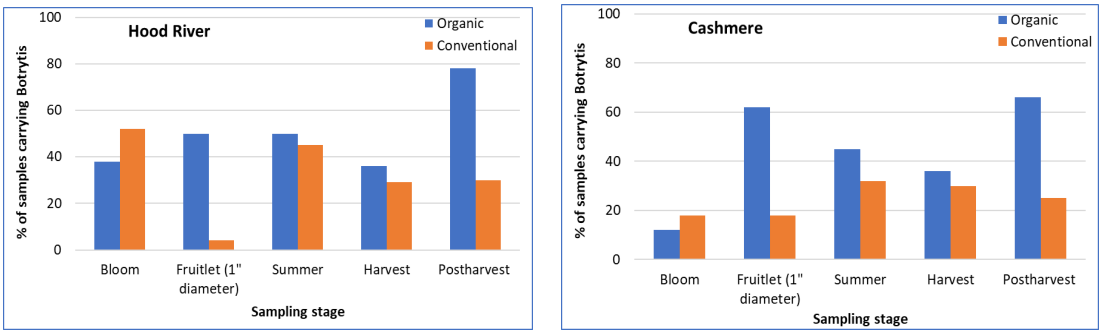

Figure 1. Evaluation of *Botrytis* incidence on organic and conventional Anjou pear in Hood River and Cashmere throughout the 2019-20 preharvest growing season and after 6 months of CA storage as detected by qPCR.

Infections by *Botrytis* were observed in all organs of the fruit (cuticle, stem-bowl, calyx and inner flesh) at harvest at variable frequencies between orchards (Figure 2). This observation indicates that not only the external parts (calyx, cuticle and stem-end) of the fruit contains *Botrytis* inoculum at harvest, but also the flesh which indicates latent (dormant) infections from previous infections in the orchard. The frequency of samples carrying Botrytis remained steady or increased slightly in storage.

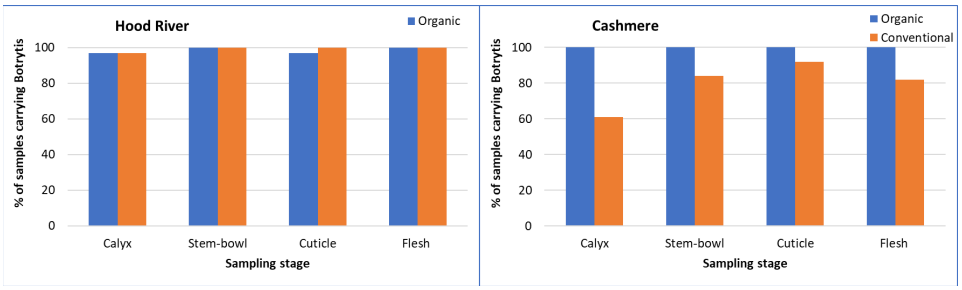

Figure 2. Incidence of *Botrytis cinerea* on different organs of the fruit at commercial maturity (harvest time) Anjou pear in organic and conventional orchards in 2019.

Trials at SO (Year 2)

Comice pears were collected in a commercial orchard in Southern Oregon starting in early April to late August of 2019 and 2020 from conventional and organic blocks in 5 stages. Based on qPCR detection of Botrytis on these samples, it was detected in all samples throughout the season with variable frequencies (Figure 3). Out of the collected pears that were grown conventionally, *Botrytis* was detected on average of 28, 9, 3, 13, and 31% from full bloom, petal fall/fruit set, fruitlet, mid-summer, and commercial maturity respectively. Out of the collected pears that were grown organically, *Botrytis* was detected in 13, 36, 18, 20, and 14% respectively from full bloom, petal fall/fruit set, fruitlet, mid-summer, and commercial maturity. When the individual pear tissues were analyzed for Botrytis presence, we detected in all types of tissue types at commercial maturity (Figure 4). From conventional fruit samples, it was detected in 11, 13, 13, and 19% of the samples from calyx, stem-bowl, cuticle, and flesh tissues respectively. Whereas from organic fruit samples, it was detected in 5, 1, 2, and 4% of the samples from calyx, stem-bowl, cuticle, and flesh tissues respectively. The overall detection

percentages in southern Oregon samples were relatively low compared to Hood River and Cashmere samples.

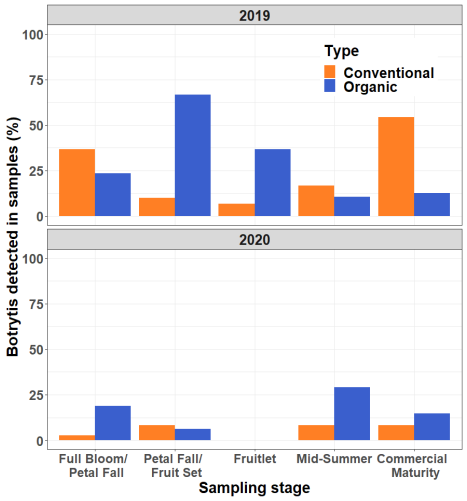

Figure 3: Percentage of *Botrytis cinerea* detected from pear samples collected in Medford organic and conventional orchards at different stages during their development in 2019 and 2020.

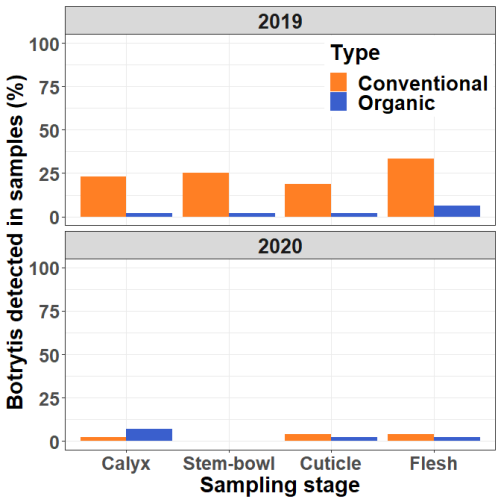

Figure 4: Percentage of *Botrytis cinerea* detected from pear tissues collected in Medford organic and conventional orchards at commercial maturity in 2019 and 2020.

Activity 1.2. **Investigate the causal species of gray mold in the PNW.**

220 isolates collected from multiple orchards WA (n = 140 isolates) and OR (n = 80 isolates) were subjected to species characterization to determine what *Botrytis* species is causing gray mold in the PNW. Molecular primers developed previously for *B. cinerea*, *B. pseudocinerea B. mali*, and *Botrytis group S*, were used to screen the 220 isolates. These species were reported to cause gray mold on several other hosts. Our investigation revealed that the 220 isolates were all *B. cinerea* (Table 1) confirming that this species is predominant in the region. The Postdoctoral Scientist leading this effort has left which has delayed the screening of the remaining isolates from nearly 700 isolates collected. Results will be shared with pear fruit stakeholders as soon as they available through extension meetings and publication.

Table 1. Characterization of species causing gray mold in the PNW to the species level

	WA	OR
Target species	**n = 140**	**n = 80**
B. cinerea	140	80
B. pseudocinerea	0	0
B. mali	0	0
B. group S	0	0

Objective 2. Identify new approaches to manage gray mold in pear

Activity 2.1. ***Continued testing of registered and new fungicides***

Preharvest fungicides, Manzate Pro-Stick (mancozeb), Ziram 76DF (ziram), Ph-D (polyoxin-D), and Botran 5F (dicloran) respectively were tested for their effectiveness against 21 Botrytis isolates in plate assays. The effective concentration to reduce radial growth by 50% (EC_{50}) values for mancozeb, ziram, polyoxin D, and dicloran ranged from 21.65 µg/ml to 136.02 µg/ml, 25.33 µg/ml to 156.77 µg/ml, 4.05 µg/ml to 619.02 µg/ml, and from 4.08 µg/ml to 26.75 µg/ml respectively (Figure 5). Overall, Botran performed the best against Botrytis isolates at concentrations of 10 ug/ml and above in plate assays followed by Ph-D. However, Botran is not registered for pear in PNW. It is interesting to note that when the isolates were grouped by the orchards they were collected from, some trends in sensitivity emerged. For instance, polyoxin D was effective against isolates collected from orchard 1, but not against isolates collected from orchard 3. This suggests that where Botrytis isolates originate from may also have an effect on their resistance towards different fungicides.

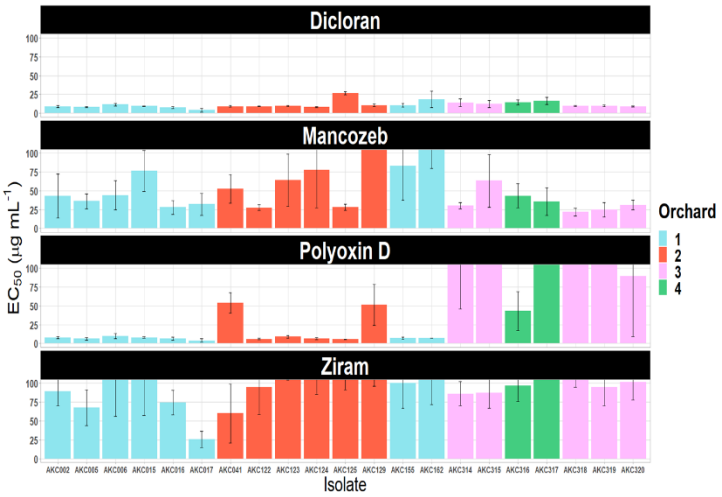

Figure 5: *In vitro* sensitivity of four fungicides against 21 Botrytis isolates in plate

In fruit assays, same fungicides were tested for their effectiveness against 20 *Botrytis* isolates. When tested on wound inoculated fruit assays, the fungicides showed a range of effectiveness against 20 *Botrytis* isolates indicating variability in sensitivity when exposed to preharvest fungicides with different modes of action (Figure 5). The ranges in fungicide efficacies were 32.31% to 99.22%, 21.15% to 89.53%, 61.39% to 96.15%, and 76.35% to 100% for Manzate, Botran, Ziram, and Ph-D respectively (Figure 6). The efficacy of Ziram, and PhD were higher than 50% for all isolates tested in this study. Whereas 25% of the isolates showed reduced sensitivity to Manzate, and Botran. Similarly, when three postharvest fungicides (ADA 72902, BioSpectra, and Scholar) were tested for their efficacy on wound inoculated fruits, their efficacy were higher than 60% for all isolates tested in this study.

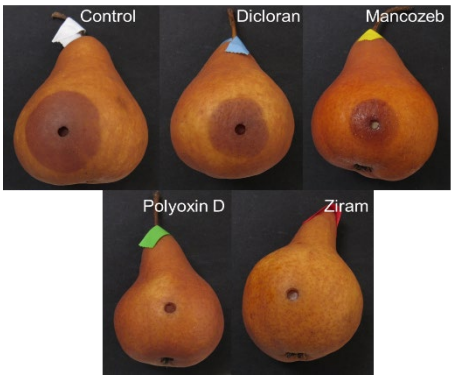

Figure 5: Wound inoculated fruit assays by four fungicides tested in this study.

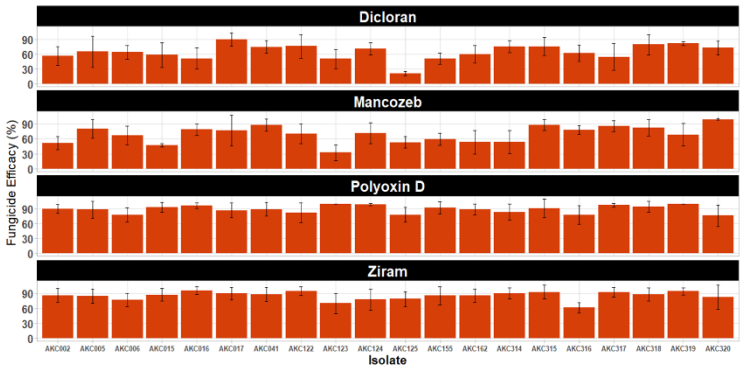

Figure 6: Efficacy of four fungicides on wound inoculated fruit trials.

Activity 2.2. **Evaluate epidemiology-based spray programs for gray mold management**

Spray programs tested in WA: 2020 and 2021

Three types of sprays, i.e., a conservative spray (1 preharvest spray), a moderate program (2 preharvest sprays), and an intensive spray (3 preharvest sprays) were tested in WA state during 2 consecutive seasons (Table 2). Sprays were conducted at different phenological stages, using fungicides from different chemical FRAC groups, in relation with epidemiological knowledge gathered from Obj. 1. Overall, gray mold incidence was lower in treatment that included a spray at fruit set with the lowest gray mold incidence being recorded in the intensive spray consisting of 3 sprays at fruit set, green fruit (mid-summer) and 7 days preharvest. The efficacy of sprays somewhere between petal fall and fruit set relate to the epidemiology of *Botrytis* which cause latent infections that may be important at this phenological stage as some remaining parts of the blossoms that serve for fruit setting may be carrying botrytis infections that occur at bloom and during petal fall. The program consisting of one preharvest spray at 7 days preharvest, which may be a standard in the WA pear industry reduced gray mold significantly compared to the control but was 5% less effective than intensive spray. In WA, we did not test a posthavest spray as our aim was to assess preharvest sprays, but it will be important to assess the efficacy of these sprays in combination with postharvest sprays in the future.

Table 2. Overall decay and gray mold incidences in d 'Anjou pears treated with different spray programs in WA in 2020 and 2021 seasons.

						Decay incidence			
		Fungicide sprayed at				2020		2021	
Treatment type	Number of sprays	Petall fall	Fruit Set	Mid-summer	7 DPH	Overall	Gray mold	Overall	Gray mold
	Untreated control	-	-	-	-	40.0	17.0	47.0	23
Conservative	1 spray-early	-	Pri	-	-	16.0	10.0	18.0	11.0
	1 spray-early	-		Pri	-	13.0	7.0	27.0	13.0
	1 spray-late	-	-	-	Pri	22.0	12.0	27.0	13.0
Moderate-Low	2 sprays-early	TopM	Pri	-	-	23.0	16.0	26.0	12.0
	2 sprays-mid	-	TopM	Pri	-	12.0	8.0	14.0	8.0
	2 sprays-mid/late			TopM	Pri	13.0	8.0	15.0	7.0
Intensive	3 sprays-early/mid-late	-	LunaS	TopM	Pri	8.0	6.0	13.0	7.5

LunaS= Luna Sensation, Pri = Pristine, TopM = Topsin-M

Spray programs tested in South OR: 2020 and 2021

Similar to WA field trials, all three types of sprays, i.e., a conservative spray (1 preharvest spray), a moderate program (2 preharvest sprays), and an intensive spray (3 preharvest sprays) were tested in southern Oregon during two consecutive seasons (Table 3 and 4). We tested two programs with two different sets of fungicides in SO. Unlike WA trials, we also included postharvest application in all but one treatment (intensive spray program). In SO, gray mold incidence was lower in both years compared to WA trials. Due to low disease incidence, no significance differences among the treatments were observed in SO gray mold result. In addition to gray mold, we also collected data on overall rot incidence. In 2020, lower disease incidence was observed in treatments that involved extensive spray program during the growing season but without postharvest sprays. This was observed for both programs that involved Topsin M, Pristine, and Luna Sensation; Ziram, Ph-D, and Inspire Super (Table 3 and Table 4). In 2021, the overall rot incidence was significantly low compared to 2020 and no significant differences between the treatments were observed for both fungicide programs. We believe that the low precipitation during fruit growing stages (March through May) in 2021 (1.4 inches in 2021 vs. 3.7 inches in 2020) could have contributed to lower rot incidence in 2021.

Table 3. Overall decay and gray mold incidences in 'Bosc' pears treated with spray program (1) in southern Oregon in 2020 and 2021 seasons.

						Decay incidence			
		Fungicide sprayed at				2020		2021	
Treatment type	Number of sprays	Bloom	petal fall / fruit set	summer	7DPH	Overall	Gray mold	Overall	Gray mold
Control	0					18.1	0.6	6.5	0
	1-Early		Pristine			33.1	0	12.3	0
Conservative	1-Mid			Pristine		26.7	0	0.8	0.6
	1-Late				Pristine	36.3	0	0.8	0
	2-Early	TopsinM	Pristine			33.1	0	0	0
Moderate	2-Mid		TopsinM	Pristine		38.1	0	5.8	0
	2-Mid/Late			TopsinM	Pristine	38.8	0.6	2.5	1.3
	3-Early/Mid/Late-No postharvest		Luna Sensation	TopsinM	Pristine	22.5	0	3.8	0
Extensive	3-Early/Mid/Late		Luna Sensation	TopsinM	Pristine	56.9	0.7	0.8	0

Table 4. Overall decay and gray mold incidences in 'Bosc' pears treated with spray program (2) in southern Oregon in 2020 and 2021 seasons.

						Decay incidence			
		Fungicide sprayed at				2020		2021	
Treatment type	Number of sprays	Bloom	petal fall / fruit set	summer	7DPH	Overall	Gray mold	Overall	Gray mold
Control	0					28.1	0.6	9	0
	1-Early		Ph-D			46.9	0	5.8	0
Conservative	1-Mid			Ph-D		50.6	1.3	1.3	0
	1-Late				Ph-D	50.6	0.6	1.3	0
	2-Early	Ziram	Ph-D			21.3	0	2.5	0
Moderate	2-Mid		Ziram	Ph-D		22.5	0	4.5	0
	2-Mid/Late			Ziram	Ph-D	60.6	0.6	13.3	0.6
	3-Early/Mid/Late-No postharvest		Inspire Super	Ziram	Ph-D	12.5	0.6	5.8	0.6
Extensive	3-Early/Mid/Late		Inspire Super	Ziram	Ph-D	30.6	0.6	0.8	0

Objective 3. Conduct an outreach program to update pear growers/packers in the PNW

Outreach activities in WA State:

Dr. Amiri and his team have provided four talks in WA since 2020 on Botrytis epidemiology and gray mold management in pear and publish a factsheet on gray mold disease and management.

***Talks*:**

Amiri A. Management of Postharvest decays. Workshop on postharvest diseases in conventional systems. Wenatchee, CTC, March 2020

Amiri A. Management of Postharvest decays. Workshop on postharvest diseases in conventional systems. Wenatchee, CTC, March 2020

Acosta W., Amiri A. 2020. *Botrytis cinerea* in pome fruit systems of the Pacific Northwest. *Phytopathology* 111-11-S2:37.

Acosta W., Amiri A. Management of gray mold pre and postharvest. *Northwest Apple Day*. Jan 21st, 2020.

***Publications*:**

Amiri A. & Acosta W., 2021. Understanding the epidemiology of gray mold caused by Amiri A., Acosta W. 2020. Gray mold factsheet. http://treefruit.wsu.edu/crop-protection/disease-management/gray-mold/

Outreach activities in OR:

Dr. KC and her team presented six talks in WA and OR since 2020 on Botrytis epidemiology and gray mold management in pear and published three abstracts in American Phytopathological Society conferences. Dr. KC was invited to interview with Pacific Northwest AG Network through which two series on Focus on Fruit have been published. On these series, she concentrated her talk on pear storage decay management. In addition, a talk by Dr. KC has been approved to be included in Post-Harvest diseases concurrent session at International Congress of Plant Pathology, Lyon, France, August 20-25.

Talks

KC, A. N. 2023. Preharvest factors associated with gray mold development in European pears. International Congress of Plant Pathology, Lyon, France, August 2023.

KC, A. N. 2023. Preharvest management of postharvest pathogens - Insights from Oregon. NCW Pear Day. Virtual presentation, January, 2023.

KC, A. N. 2022. Postharvest rot on pears. Southern Oregon Pest Management Forum. August, 2022.

KC, A. N. 2021. Pear: managing gray mold and other major pear decays in the Pacific Northwest. Washington State Tree Fruit Association 117th Annual Meeting and NW Hort. Expo. Virtual meeting, December, 2021.

KC, A. N. 2021. Postharvest rot on pears. Southern Oregon Pest Management Forum. July, 2021.

Hernandez, M., and KC, A. N. 2021. *Botrytis cinerea* infection at different stages of pear fruit development. Southern Oregon Pest Management Forum. March, 2021.

Hernandez M., and KC, A. N. 2020. *Botrytis cinerea* infection at different stages of pear fruit development. Orchard Pest and Disease Management Conference, 2020.

Radio series published in Pacific Northwest AG Network

KC, A. N. 2022. Focus on Fruit: Pacific Northwest AG Network, December 2022. https://pnwag.net/focus-on-fruit-120822/

KC, A. N. 2022. Focus on Fruit: Pacific Northwest AG Network, October 2022. https://pnwag.net/focus-on-fruit-102022/

Abstracts published in scientific conferences and presentation

Hernandez, M., and KC, A. N. 2022. *Botrytis cinerea* colonization occurs early in pear fruit development. American Phytopathological Society, 2022.

Hernandez, M., and KC, A. N. 2022. *Botrytis cinerea* varies in its sensitivity towards common fungicides used in pear orchards. APS Pacific Division virtual meeting, 2022.

Hernandez, M., and KC, A. N. 2021. Evaluation of *Botrytis cinerea* sensitivity towards fungicides commonly used in pear orchards. APS Pacific Division virtual meeting, 2021.

Executive Summary
Project title: Epidemiology and management of pear gray mold in the PNW

Key words: Gray mold, Botrytis, Pear, preharvest, management

Abstract:

Based on ongoing studies on postharvest rots of pome fruits in WA and OR, gray mold caused by *Botrytis cinerea* was identified as one of the most prevalent diseases causing postharvest rot in pears. Gray mold was found in 85% to 90% of the grower lots surveyed in 2016 and 2017 across the region with incidences ranging from 5% to 75% of total decay per lot. In order to understand the gray mold disease development during fruit developmental stages and utilize that information in developing fungicide management programs, we conducted three years of study at three districts in the PNW, Cashmere- WA, Hood River-OR, and Medford-OR. In the first two years, samples collected from both organic and conventional pear orchards were analyzed for the presence of *B. cinerea* at bloom, fruit set, mid-summer, and commercial maturity. At all sites, *B. cinerea* was detected in samples collected throughout the season from bloom to harvest at low and variable frequencies between locations in WA, Hood River, and Medford. Variabilities in inoculum size and dynamics throughout the season were observed among orchards located in different districts. In all locations, the size of *Botrytis* inoculum was greater in organic orchards compared to conventional orchards. *Botrytis* was detected in pear tissues including calyx, stem-bowl, cuticle, and flesh indicating latent (dormant) infections from previous infections in the orchard. In a concurrent study, four preharvest fungicides, Manzate Pro-Stick (mancozeb), Ziram 76DF (ziram), Ph-D (polyoxin-D), and Botran 5F (dicloran) respectively were tested for their effectiveness against 21 Botrytis isolates in both plate and fruit assays for their efficacy against *B. cinerea*. Except for Botran 5F, other fungicides are registered for pear to control other preharvest diseases such as scab, powdery mildew and other postharvest rots. Among the registered fungicides, Ziram 76DF and Ph-D provided improved efficacy in either plate or fruit or both assays. Based on the information collected from this and the previous studies, two spray programs with different fungicide groups (1: Topsin M, Pristine, and Luna Sensation; 2: Ziram, Ph-D, and Inspire Super) were developed and tested in field trials. The first program was tested at Cashmere- WA, and both programs were tested at Medford-OR in 2020 and 2021. Within each program, three spray regimes, a conservative spray (1 preharvest spray), a moderate spray (2 preharvest sprays), and an intensive spray (3 preharvest sprays) were tested in both locations. In Medford, due to low disease pressure no significant differences in gray mold at storage were observed. Whereas, in WA results indicated that sprays conducted at petal fall, fruit set, and 7 to 0 days preharvest are critical to reduce gray mold in storage. A summer spray on green fruit, would optimize gray mold management in storage especially for fruit stored long-term (>6 months).

Additional Items:

Grants
Dr. KC has assembled a multidisciplinary team to collaborate on postharvest decay management project. The team with ten scientists from nationally renowned institutions representing both east and west coast pome fruit industries submitted a preproposal to USDA-NIFA-SCRI for 2023 funding cycle requesting $4.2 Million for the research project. If funded, the project is expected to cover various areas of postharvest decay research and data from this study will be instrumental in proving baseline information for some of the project activities.

Co-PI Amiri has leveraged funds from this grant to secure two extra-mural grants, one from the Specialty Crop Block, WA State Department of Agriculture (WSDA) and another from the USDA-

Crop Protection and Pest Management (CPPM) programs to continue research and extension efforts to better manage gray mold in the PNW.

1. Epidemiology-based tactics to abate gray mold of pome fruit in the Pacific Northwest. USDA-NIFA CPPM. $199,805. P.I.: A. Amiri, Co-PI.: Karina Gallardo.

2. Strategies to enhance pre- and postharvest management of gray mold in pome fruit. Specialty Crop Block Grant program (SCBG), WSDA-USDA. $230,155. P.I.: A. Amiri, Co-P.I.: T. Peever.

This is equivalent to $3 brought for each $1 invested by the FPPC in this project (Amiri Program).

Talks and Publications:

Talks:

Amiri A. Management of Postharvest decays. Workshop on postharvest diseases in conventional systems. Wenatchee, CTC, March 2020

Amiri A. Management of Postharvest decays. Workshop on postharvest diseases in conventional systems. Wenatchee, CTC, March 2020

Acosta W., Amiri A. 2020. *Botrytis cinerea* in pome fruit systems of the Pacific Northwest. *Phytopathology* 111-11-S2:37.

Acosta W., Amiri A. Management of gray mold pre and postharvest. *Northwest Apple Day*. Jan 21st, 2020.

KC, A. N. 2023. Preharvest factors associated with gray mold development in European pears. International Congress of Plant Pathology, Lyon, France, August 2023.

KC, A. N. 2023. Preharvest management of postharvest pathogens - Insights from Oregon. NCW Pear Day. Virtual presentation, January, 2023.

KC, A. N. 2022. Postharvest rot on pears. Southern Oregon Pest Management Forum. August, 2022.

KC, A. N. 2021. Pear: managing gray mold and other major pear decays in the Pacific Northwest. Washington State Tree Fruit Association 117th Annual Meeting and NW Hort. Expo. Virtual meeting, December, 2021.

KC, A. N. 2021. Postharvest rot on pears. Southern Oregon Pest Management Forum. July, 2021.

Hernandez, M., and KC, A. N. 2021. *Botrytis cinerea* infection at different stages of pear fruit development. Southern Oregon Pest Management Forum. March, 2021.

Hernandez M., and KC, A. N. 2020. *Botrytis cinerea* infection at different stages of pear fruit development. Orchard Pest and Disease Management Conference, 2020.

Publications:

Amiri A. & Acosta W., 2021. Understanding the epidemiology of gray mold caused by Amiri A., Acosta W. 2020. Gray mold factsheet. http://treefruit.wsu.edu/crop-protection/disease-management/gray-mold/

Hernandez, M., and KC, A. N. 2022. *Botrytis cinerea* colonization occurs early in pear fruit development. *Abstract*: American Phytopathological Society, 2022.

Hernandez, M., and KC, A. N. 2022. *Botrytis cinerea* varies in its sensitivity towards common fungicides used in pear orchards. *Abstract*: APS Pacific Division virtual meeting, 2022.

Hernandez, M., and KC, A. N. 2021. Evaluation of *Botrytis cinerea* sensitivity towards fungicides commonly used in pear orchards. *Abstract*: APS Pacific Division virtual meeting, 2021.

Amiri A., Janis F., Hernandez, M., and KC, A. N. 2023. Epidemiology of *Botrytis* spp. in the pome fruit in the US Pacific Northwest. Plant Disease. In preparation.

Hernandez, M., and KC, A. N.3 2021. *In vitro* sensitivity of *Botrytis cinerea* isolates collected from European pears to fungicides with different modes of action. Plant Disease. In preparation.

Hernandez, M., Acosta, W., Amiri, A., and KC, A. N. 2022. Evaluating the seasonal fungicide programs for gray mold management in European pears. Plant Disease. In preparation.