

Identification and Management of Wheat Diseases

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Fungal Diseases of Wheat in the PNW

Common name	Pathogen
✓ Stripe rust	<i>Puccinia striiformis</i>
Eyespot	<i>Oculimacula yallundae</i> , <i>O. acuformis</i>
Cephalosporium stripe	<i>Cephalosporium gramineum</i>
Rhizoctonia root rot	<i>Rhizoctonia solani</i> , <i>R. oryzae</i>
Fusarium foot rot	<i>Fusarium culmorum</i> , <i>F. pseudograminearum</i>
<i>Pythium</i> seed/root rot	<i>Pythium</i> spp.
Snow molds	<i>Typhula ishikariensis</i> , <i>Microdochium nivale</i>
✓ Fusarium head blight	<i>Fusarium graminearum</i> and others
Stem rust	<i>Puccinia graminis</i>

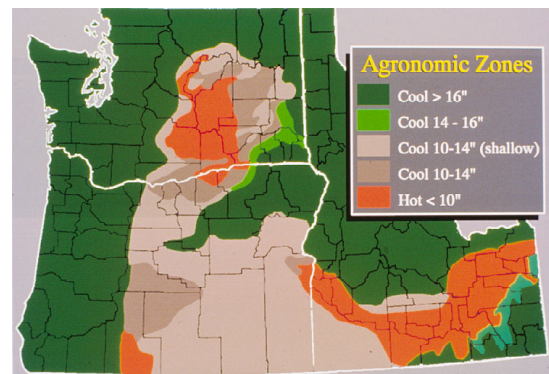
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Virus & Bacterial Diseases of Wheat in the PNW

Common name	Pathogen
Barley yellow dwarf	<i>Barley yellow dwarf virus</i> , <i>Cereal yellow dwarf virus</i>
Black chaff	<i>Xanthomonas translucens</i>
✓ Soilborne wheat mosaic	<i>Soilborne wheat mosaic virus</i>
✓ Wheat streak mosaic	<i>Wheat streak mosaic virus</i>

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PNW Agronomic Production Zones



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Distribution of Diseases by Rainfall

Disease	Rainfall zone			
	8-12"	12-18"	>18"	Irrig.
Stripe rust				
Eyespot				
Cephalosporium stripe				
Rhizoctonia root rot				
Fusarium crown rot				
Fusarium head blight				
Snow molds				
Soilborne wheat mosaic				
Wheat streak mosaic				

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Management Considerations

Disease	Cultural practices	Variety selection	Chemical control
Stripe rust	+	+	+
Eyespot	+	+	+
Ceph. stripe	+	+	-
Rhizoctonia root rot	+	-	-
Fusarium crown rot	+	-	-
Fusarium head blight (FHB)	+	-	+
Pythium root rot	+	-	+
Snow molds	+	+	-
Soilborne wheat mosaic	-	+	-
Wheat streak mosaic	+	-	-

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Cultural Management Practices

Disease	Seeding date	Residue mgt	Green bridge	Fertility	Crop rotation	Soil pH
Stripe rust	+	-	+	+	-	-
Eyespot	+	+/-	-	-	-	-
Ceph. stripe	+	+/-	-	-	+	+
Rhizoctonia	+/-	+	+	-	-	-
Fusarium	+	-	-	+	-	-
FHB	-	+	-	-	+	-
Pythium	+	+	+	-	-	-
Snow molds	+	-	-	-	-	-
SBWM	+	-	-	-	-	-
WSMV	+	-	-	-	-	-

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Stripe Rust



USDA-Cereal Disease Lab

T. Lumpkin, CIMMYT

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Stripe Rust



Courtesy X. Chen

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Factors Affecting Stripe Rust

Favorable temps/moisture for infection

- temps of 50-64°F w/6 hrs of dew
- cool temps best for disease development, but less important than infection

Fall infection

- susceptible plants in fall

Winter survival

- temperatures during Dec-Feb

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Stripe Rust Outlook – November 2023

What we know now:

- Rust developed later in the 2023 season due to low intensity and late development in 2022, followed by dry fall
- typical planting & emergence + Fall weather = average risk for rust establishment → Still very early
- November & December temperatures will determine rust survival going into 2024
- Expect Dr. Chen's 1st forecast in January

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Stripe Rust Control Options

Cultural

- Green bridge (volunteer) management
- Avoid very early planting
- Avoid excessive irrigation (furrow better than sprinkler)

Plant disease resistant varieties

- preferably those with HTAP resistance (1-4)

Monitor rust forecast, scout fields, spray fungicides when necessary

- Scout fields for rust, spray susceptible varieties (5-9) or when 1-5% of plants have active rust

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Stripe Rust Resistance - Winter Varieties 2023

Rating	Varieties
R (1,2)	aMaze, AP Dynamic, AP Exceed, AP Iliad, AP Octane, Appleby CL+, ARS Castella, ARS Crescent, ARS-Selbu 2.0, Bobtail, Bruehl, Cameo, Cara, Inspire, Jameson, Jasper, Kairos, LCS Artdeco, LCS Blancor, LCS Blackjack, LCS Drive, LCS Evina, LCS Hulk, LCS Jefe LCS Rocket, LCS Shark, LCS Shine, LCS Sonic, LCS Yeti, LCS Zoom, M-Press, Nimbus, Nixon, Norwest 553, Norwest Duet, Norwest Tandem, OR2x2 CL+, Resilience CL+, Rosalyn, Sockeye CL+, SY Assure, SY Banks, SY Clearstone CL2, SY Dayton, SY Ovation, SY Raptor, VI Bulldog, VI Frost, VI Presto CL+, WB1529, WB1604, WB1720, WB4311, WB4510CLP, WB4623CLP
MR (3,4)	AP Redeye, AP Venom, ARS Selbu, Coda, LCS Ghost, LCS Helix AX, Mela CL+, Millie, Pritchett, Stingray CL+, TMC M-Pire, UI Bronze Jade, UI-WSU Huffman, WB1376CLP, WB1621
M (5)	AP503 CL2, Guardian, GS Bounty, LCS Aymeric, Mary, Otto, Piranha CL+, Puma, SY107, SY Command, SY Touchstone, UI Castle CL+, UI Sparrow, WB1783, WB4394
MS (6,7)	AP700 CL, AP Legacy, Canvas, Curiosity CL+, Devote, Irv, Keldin, LCS Fusion AX, Milestone, Purl, Scorpio, Sequoia, UI Palouse CL+, WB1532, Whistler
S (8,9)	Battle AX, Brawl CL Plus, CP7010, CP7909, LCS Jet, Snowmass 2.0, UI Magic CL+, VI Voodoo CL+, WB4303, WB Rimrock Soft white, Hard red, Club, Hard White

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Stripe Rust Resistance - Spring Varieties 2023

Rating	Varieties
R (1,2)	Alum, AP Octane, AP Renegade, Chet, CP3055, CP3066, CP3099A, CP3119A, CPX39120, Dayn, Espresso, Glee, Hale, JD, Melba, Seahawk, SY Basalt, SY Gunsight, SY Teton, Tekoa, TMC2021, TMC Lochaven, WB6121, WB7202CLP, WB9636, WB9662, WQL008, WQL195, YSC-605
MR (3,4)	Cabernet, CP3322, Diva, Hedge CL+, LCS Iron, Net CL+, Roger, Ryan, SY Coho, SY Selway, SY Steelhead, UI Platinum, UI Stone, SY Saltese, WB9668, UI Cookie, YSC-603
M (5)	AP Coachman, AP Venom, Buck Pronto, Bullseye, Louise, WB6341, Whit
MS (6,7)	AP Mondovi CL2, Hollis, Jefferson, Jefferson HF, LCS Luna, Kelse, WB9303, WB9623
S (8,9)	Babe, CP3530, SY605 CL2, WB1035 CL+, WB6211CLP Soft white, Hard red, Club, Hard White, Durum

Variety ratings courtesy of Dr. Xianming Chen, USDA-ARS

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Fungicides

Monitor forecasts and development of rust

Spray when necessary:

Spray when susceptible varieties (5-9) have 1 to 5% rust

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What Does 5% Rust Look Like?



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Rust Fungicides - 2023

Class	Active ingredient	Product	Rate/A, fl. oz	Stripe rust*	Head scab	Harvest Restriction
Strobilurin	Picoxystrobin 22.5%	Aproach SC	6.0 - 12.0	E	NL	Feekes 10.5
	Pyraclostrobin 23.6%	Headline SC	6.0 - 9.0	E	NL	Feekes 10.5
	Azoxystrobin 22.9%	Quadris 2.08 SC**	4.0 - 12.0	E	NL	Feekes 10.5.4
Triazole	Metconazole 8.6%	Caramba 0.75 SL	10.0 - 17.0	E	G	30 days
	Tebuconazole 36.7%	Follicur 5.6 F**	4.0	E	F	30 days
	Prothioconazole 41%	Proline 480 SC	5.0 - 5.7	VG	G	30 days
	Prothioconazole 19%	Prosaro 421 SC	6.5 - 8.2	E	G	30 days
	Tebuconazole 19%	Tilt 3.6 EC**	4.0	VG	P	Feekes 10.5.4
	Propiconazole 41.8%	Sphaerex	4.0 - 7.3	E	G	30 days
	Metconazole 10.91%					
Mixed modes of action	Prothioconazole 18.19%					
	Tebuconazole 22.6%	Absolute Maxx SC	5.0	VG	NL	35 days
	Cyproconazole 7.17%	Aproach Prima SC	3.4 - 6.8	E	NR	45 days
	Picoxystrobin 17.94%	Delaro 325 SC	8.0	VG	NL	Feekes 10.5
	Prothioconazole 16.0%	Miravis Ace SE	13.7	VG	G	Feekes 10.5.4
	Trifloxystrobin 13.7%					
	Pydiflumetofen 13.7%					
	Propiconazole 11.4%					
	Fluxapyroxad 2.8%	Nexicor EC	7.0 - 13.0	E	NL	Feekes 10.5
	Pyraclostrobin 18.7%					
	Propiconazole 11.7%	Priaxor	4.0 - 8.0	VG	NL	Feekes 10.5
	Fluxapyroxad 24.3%					
	Pyraclostrobin 28.6%					
	Prothioconazole 17.39%	Prosaro Pro SC	10.3-13.6	E	G	30 days
	Tebuconazole 8.7%					
	Fluopyram 8.7%					
	Propiconazole 11.7%	Quilt Xcel 2.2 SE**	10.5 - 14.07	E	NL	Feekes 10.5.4
	Azoxystrobin 13.5%					
	Prothioconazole 10.8%	Stratego YLD	4.0	VG	NL	Feekes 10.5
	Trifloxystrobin 32.3%					
	Benzenodifluor 2.8%	Trivapro SE	9.4 - 13.7	E	NL	Feekes 10.5.4
	Propiconazole 11.9%					
	Azoxystrobin 10.5%	Topguard EQ	4.0-7.0	E	NL	Feekes 10.5.4
	Fenpropi 18.83%					
	Azoxystrobin 25.30%					

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Fusarium Head Blight



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Fusarium Head Blight or Scab = FHB



Courtesy J. Marshall

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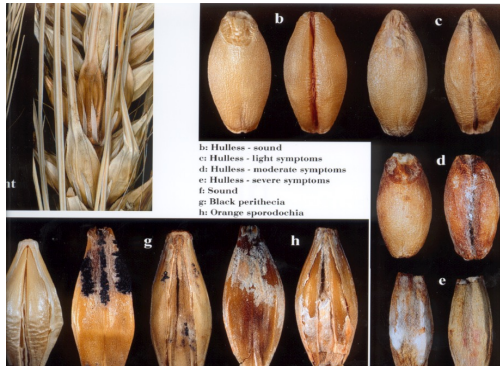
Signs & Symptoms FHB



Courtesy J. Marshall

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FHB of Barley



Courtesy Jianli Chen

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Fusarium Head Blight

Not a new disease – 1st described in the U.S. in 1884

Epidemics have occurred in Canada, the Midwest and mid-Atlantic states since 1917

Disease occurs wherever wheat and barley are grown – up to 50% yield loss

Toxin produced during grain infection

→ feed refusal, human health concerns, gushing in production of beer

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Fusarium Head Blight

Why worry now?

Not a new problem

Common and severe in some irrigated wheat fields in 2013

- widespread but low intensity in southeastern WA dryland spring wheat

Increased reports and samples of FHB in the past few years

Concerns over vomitoxin-contaminated grain

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Causes of FHB

Several *Fusarium* species are capable of causing FHB:

*F. graminearum**

F. culmorum

F. avenaceum

Microdochium nivale (pink snow mold)

→ Produce tricothecene mycotoxins
= Deoxynivalenol (DON), aka vomitoxins

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Factors Affecting FHB

Temperature/moisture

- 59 to 86°F w/ >90% RH before, during & after flowering
- frequent rain showers

Reduced tillage that retains residue on soil surface

Short rotations following previously infected crops, e.g. corn

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Controlling FHB

Crop rotation to allow infested residue to decompose – avoid following corn

Tillage to bury residue/enhance decomposition

Healthy, treated seed

Variety selection*

Irrigation management

Fungicides – foliar & seed treatment

Harvest – higher fan speed

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FHB Control – Foliar Fungicides

Fungicide sprays may reduce infection at heading but may not reduce DON production

Use triazole fungicides: Caramba, Proline, Prosaro

- all are rated good to very good

→ **Timing of application is critical!**

Wheat: Feekes 10.51 – early flowering

Barley: Feekes 10.5 – full head emergence

Do not use strobilurin fungicides – DON will not be reduced

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Seed Treatment of *Fusarium*-infected seed

Untreated Treated



Courtesy of G. Bergstrom

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Soilborne Wheat Mosaic - SBWM



Originally detected in the Walla Walla region in 2007, but found in other locations in 2022 & 2023

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SBWM

Yellow patches in fields

Mild green- to yellow-colored mosaic

- streaks of different colored tissue running in the same direction as leaf veins

Stunting of infected plants

Rosetting

- stunted with short tillers

Affected plants tend to occur in areas where water runs

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SBWM

Disease of fall-sown wheat only

Transmitted by soilborne fungus-like organism

→ acts like other soilborne diseases in terms of distribution within fields and spread

Infection occurs in the fall and symptoms appear in early spring

- symptoms fade and plants appear to recover as temperature increases in spring

Damage remains and yield is reduced

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SBWM Variety Trial, Umatilla, OR 2011

Irrigated circle on sandy soil with severe SBWM symptoms in 2010



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SBWM – Management

Disease resistance – only practical option



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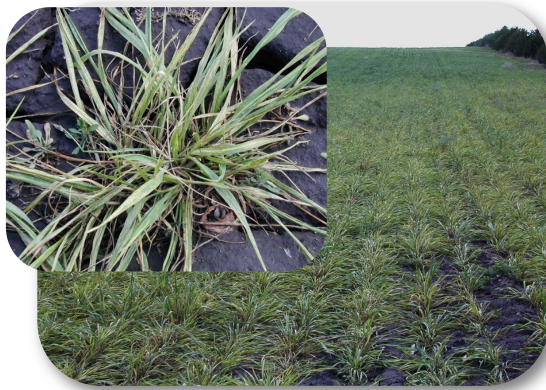
SBWMV Resistant Varieties

- ARS Pritchett
- Genesis
- Ladd
- LCS Shark
- ORCF-103
- ORCF-101
- Puma
- SY Dayton
- SY Ovation
- WB4303
- WB Junction
- Whetstone

Soft white, Hard red, Club

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Wheat Streak Mosaic



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Wheat Streak Mosaic

Disease of winter and spring wheat

Wheat streak mosaic (WSM) discovered in 1922 in Nebraska

- 1st report in WA 1954 from Spillman Farm
- widespread reports since

→ A major problem elsewhere in the US

Yield loss ranges up to 100% depending on variety

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WSM

Transmitted by *Wheat curl mite*

→ also causes damage when present in high numbers

Infection occurs in the fall or spring and symptoms appear in late spring to summer

- relatively warm temps for vector and virus

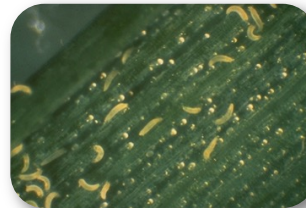
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Wheat curl mite

Aceria tosichella

Acquires virus as nymph

- Acquisition: 15 min
- Retention: 9 days
- No transovarial transmission



Thomas et al., Plant Health Progress, 2004

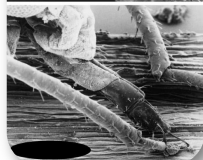
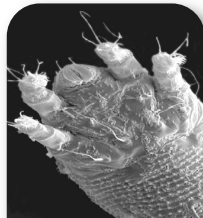


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Wheat curl mite



Thomas et al., Plant Health Progress, 2004



Stenger et al., J. Virol., 2005

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WSM Symptoms

Symptoms often appear near the edges of fields

- Individual plants up to entire fields affected

Yellow to pale-green mosaic

- Stunting – mild to severe
- Rolling and trapping of leaves

Fewer and smaller heads

- Shriveled seed

Plant death

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WSM Symptoms



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WSM Symptoms



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WSM Management

Green bridge management

Delayed seeding of winter wheat

Resistant varieties

- virus, mite or both
- *Wsm 1*, *Wsm 2* provide temperature-sensitive resistance
- nearly all PNW-adapted varieties are susceptible

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Management Considerations

Disease	Cultural practices	Variety selection	Chemical control
Stripe rust	+	+	+
Eyespot	+	+	+
Ceph. stripe	+	+	-
Rhizoctonia root rot	+	-	-
Fusarium crown rot	+	-	-
FHB	+	+/-	+
Pythium root rot	+	-	+
Snow molds	+	+	-
Soilborne wheat mosaic	-	+	-
Wheat streak mosaic	+	-	-

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Cultural Management Practices

Disease	Seeding date	Residue mgt	Green bridge	Fertility	Crop rotation	Soil pH
Stripe rust	+	-	+	+	-	-
Eyespot	+	+/-	-	-	-	-
Ceph. stripe	+	+/-	-	-	+	+
Rhizoctonia	+/-	+	+	-	-	-
Fusarium	+	-	-	+	-	-
FHB	-	+	-	-	+	-
Pythium	+	+	+	-	-	-
Snow molds	+	-	-	-	-	-
SBWM	+	-	-	-	-	-
WSM	+	-	+	-	-	-

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Disease Information Resources

Wheat and Small Grains website

<http://smallgrains.wsu.edu/>

Twitter @WSUWheatDoc

Stripe rust alerts: begin in January

• <http://striperustalert.wsu.edu/>

Variety Ratings:

• WSCIA seed guides

• Variety Selection Tool

US Wheat & Barley Scab Initiative -<http://www.scabusa.org/>

Fusarium ear blight, Wikipedia -

http://en.wikipedia.org/wiki/Fusarium_ear_blight

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Diagnosis of Problems

Plant Pest Diagnostic Clinic

The Washington State University Plant Pest Diagnostic Clinic is dedicated to serving the state of Washington and its citizens through high quality service by providing plant disease and disorder diagnosis, pest identification, and management strategies. The Plant Pest Diagnostic Clinic provides plant health problem diagnosis to homeowners, greenhouse and nursery operators, public and private landowners, and commercial growers including those involved with agriculture, horticulture, and floriculture.

Diagnosis

To submit a sample for **Diagnosis**, please fill out a [Submission Form \(pdf\)](#) and follow the sample guidelines.

Please Note: Sample MUST be accompanied by a Washington State Home Producer's License

Virus

To submit a sample for **virus** testing, please fill out a [Virus Test Submission Form \(pdf\)](#).

To submit samples for **Little Cherry Virus** and **Western X**, please fill out a [Little Cherry Disease Prevalence Questionnaire Form \(pdf\)](#).

Please Note: We are currently accepting samples for Little Cherry and Western X testing. Cost for testing is \$100/sample.

Clinic Locations

Washington State University operates two Plant Pest Diagnostic Clinics, in [Pullman](#) and in [Puyallup](#). Services of either clinic are available to clients statewide; samples from eastern Washington are usually submitted to Pullman.

To send a sample from a state other than Washington, please contact the clinic prior to submission. Out of state samples will be charge double the service fee.

Please Note: We cannot accept certain samples due to WSU compliance with Federal policy.

Contact Us

We are located at 3000 East Main
<http://www.pdclinic.wsu.edu>
 3000 East Main

Shipping Information

Clinic LPHM mailing address:
 Plant Pest Diagnostic Clinic
 Department of Plant Pathology
 P.O. Box 342000
 Pullman, WA 99164-2000

Clinic LPHM and Pullman address:
 Plant Pest Diagnostic Clinic
 Department of Plant Pathology
 4000 East Main
 Pullman, WA 99164



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Questions?

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