



# **Fungal Diseases of Brassicas: Implications for Seed Producers & Customers**



**ASTA's Farm & Lawn Seed Conference  
5-6 November 2016  
Kansas City, MO**

**Lindsey du Toit  
Washington State University Mount Vernon NWREC**



# Small-Seeded Vegetable Seed Crops in PNW

## Northwestern WA & Willamette Valley, OR (since 1880s)

Table beet, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, Chinese mustard, collard, cress, kale, kohlrabi, radish, rutabaga, spinach, Swiss chard, turnip, ...

## Columbia Basin of central WA (since 1950s) & central OR

Carrot, coriander, dill, kale, mustard, onion, parsley, parsnip, radish, turnip, ...

**~35 species**, many annual & biennial crucifers

15,000-25,000 total acres/year, \$1,000-\$11,000/acre  
>\$100 million annually

50-100% of U.S. seed supply; 10-80% of world seed supply

**Other PNW crucifers:** Canola, cover crops (>50,000 acres in WA in 2014), forages, fresh market/processing vegetables, ...

*Biodiesel "will be the biggest issue that the Legislature will be focusing on."*

**Clifford Traisman, a lobbyist for Washington Conservation Voters and the Washington Environmental Council**

# Environmentalists make strides in legislative session

By **RACHEL LA CORTE**  
Associated Press Writer

OLYMPIA — Washington state's environmental community

## **Biodiesel demand grows**

Demand for biodiesel ethanol has grown with the price of gasoline and other fuels. Biodiesel is

**Skagit Valley Herald, 2 January 2006**

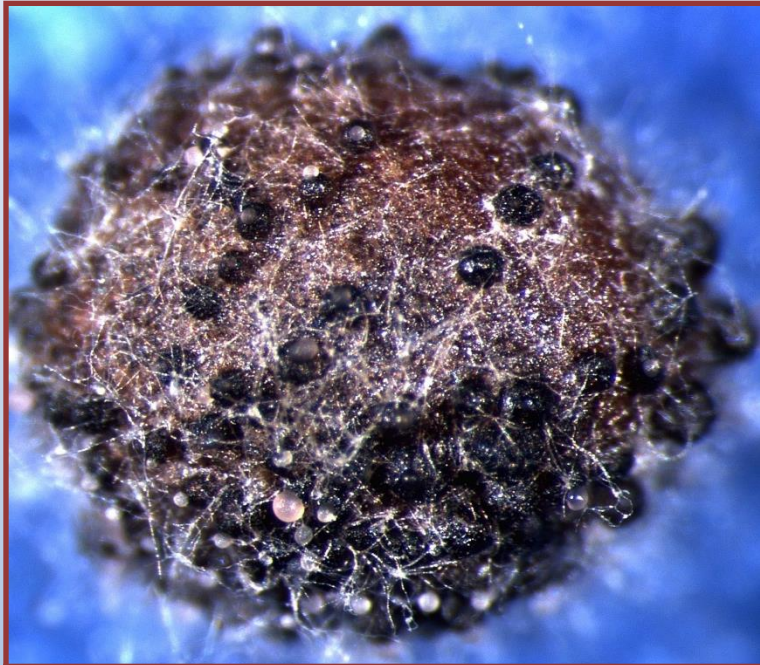




# Seedborne Crucifer Pathogens of Economic Concern = Zero Tolerance on Vegetable Seed

**Black leg (fungal disease)**

*Phoma lingam*



**Black rot (bacterial disease)**

*Xanthomonas campestris* pv.  
*campestris*



# Dormant Crucifer Seed



Tim Miller, WSU





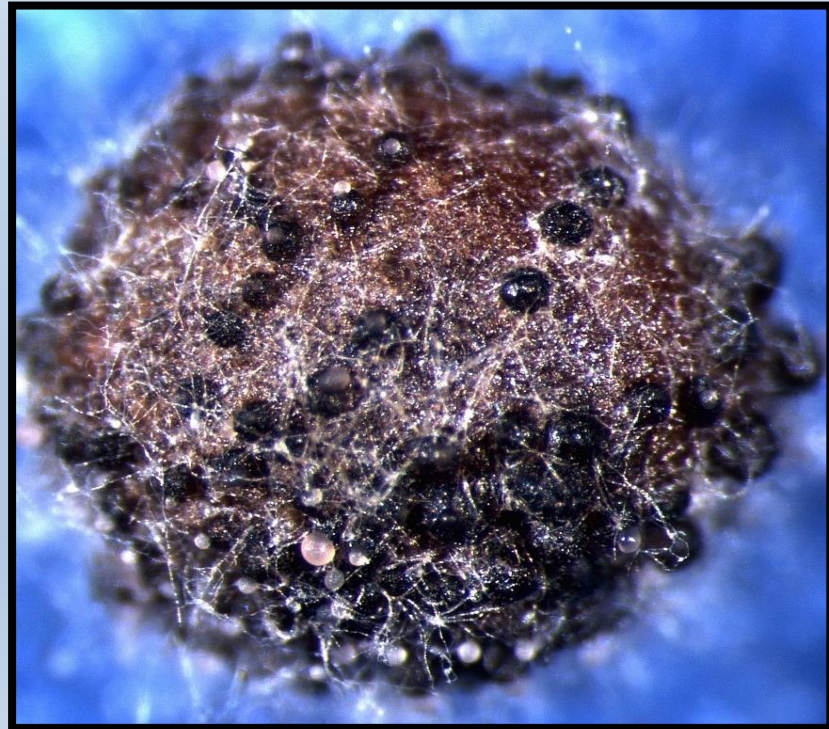
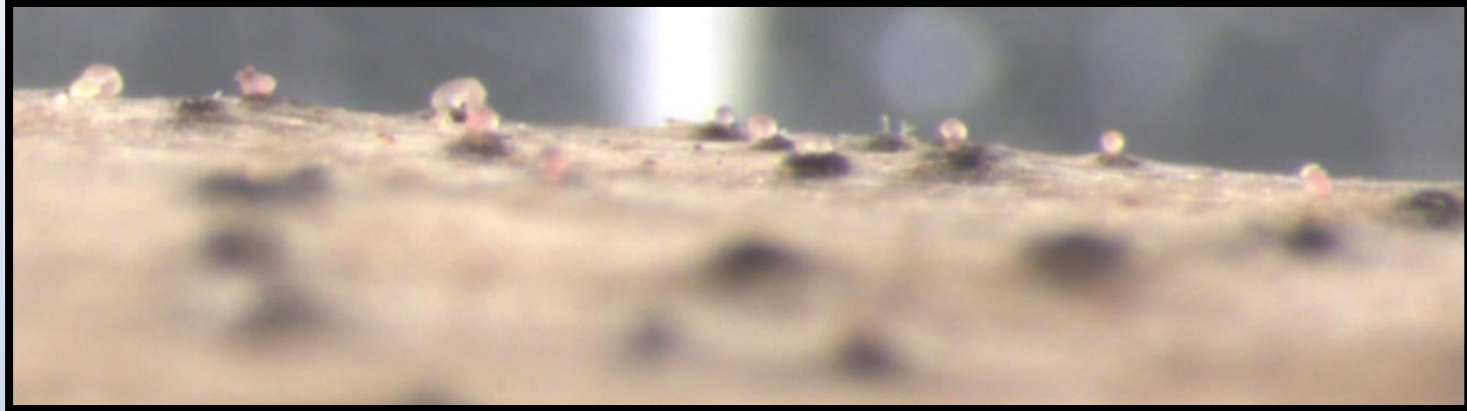
# WASHINGTON STATE LEGISLATURE

## Chapter 16.301-490 to 580 WAC

**Crucifer seed  
quarantine: 20 Jan. 2006**

- Regulated counties in northwestern WA:
  - Clallam, Island, Lewis, Skagit, Snohomish, & Whatcom
- Crucifer materials regulated: seed, seedlings, roots, or transplants for seed, oil, or commercial vegetable production; & crucifer crop residues
- Notice of Intent/Quarantine Compliance Form:
  - **Filed with WSDA Seed Program** before shipping, moving, or transporting crucifer seed into regulated area
    - Lab analysis or **phytosanitary certificate** for the 2 regulated diseases
    - Seed analysis **certificate for dormant seed** (WAC 16-301-510)
- Seed lots that test positive: Must be treated; treated seed can be planted if free of the two regulated pathogens when re-tested
- Exemptions:
  - USDA & University research trial grounds
  - Pre-packaged crucifer seed <0.5 oz, if free of the 2 regulated pathogens
  - Seedlings for home garden use, if free of the 2 regulated pathogens
  - Crucifers produced in greenhouses or indoors (solely)

# 2014 Epidemic of Black Leg in Crucifer Crops Across the Willamette Valley of OR





# 2014 Survey of Crucifer Crops in Willamette Valley, after Finding Black Leg in an Overwintered Seed Crop

Cindy Ocamb, OSU Plant Pathologist, [ocambc@science.oregonstate.edu](mailto:ocambc@science.oregonstate.edu)

43/61 sites examined by Sep. 2014 = Black leg

24/61 sites = Light leaf spot

17/61 sites = White leaf spot

**Black leg**  
*Phoma lingam*



Cynthia Ocamb, OSU

- Occurs across the US

**Light leaf spot**  
*Cylindrosporium concentricum*



Cynthia Ocamb, OSU

- Never reported in US before

**White leaf spot**  
*Pseudocercospora capsellae*



Cynthia Ocamb, OSU

- Rare in PNW, primarily in southeastern US



# Crucifer plants found infected with *Phoma lingam* in western Oregon by September 2014 (Cindy Ocamb, OSU)

County	Crop/plant	County	Crop/plant
Benton	Fall-planted canola	Marion	Kale
Benton	W. Russian kale	Marion	Cabbage or collards
Benton	Mizuna (organic)	Marion	Russian kale
Benton	Kale	Marion	Fall-planted canola
Benton	Collards	Marion	Fall-planted canola
Benton	Kale	Marion	Fall-planted canola
Benton	Volunteer mustard in wheat	Marion	Forage <i>Brassica</i>
Benton	Fresh market cabbage (spring sown)	Marion	Forage <i>Brassica</i>
Lane	Processing broccoli (spring sown)	Marion	Western yellow cress (weed)
Linn	Volunteer mustard in turnip	Polk	Cabbage
Linn	Chinese cabbage (spring sown)	Polk	Fall-planted canola
Linn	Chinese mustard (spring sown)	Polk	Fall-planted canola
Linn	Pak choi (spring sown)	Polk	Fall-planted canola
Linn	Turnip	Polk	Turnip
Linn	Western yellow cress (weed)	Polk	Turnip
Linn	Chinese cabbage (spring sown)	Polk	Forage <i>Brassica</i>
Linn	Chinese cabbage (spring sown)	Yamhill	Volunteer turnip in wheat
Marion	Forage turnip	Yamhill	Volunteer turnip
Marion	Black mustard (weed)	Yamhill	Fall-planted canola
Marion	Bird's rape (weed)	Yamhill	Turnip
Marion	Bird's rape (weed)	Yamhill	Turnip
Marion	Kale		



Overwintering kale crop, Willamette Valley, OR  
January 2015



Photos courtesy of Cynthia Ocamb, OSU





Canola crop 2/5/2015



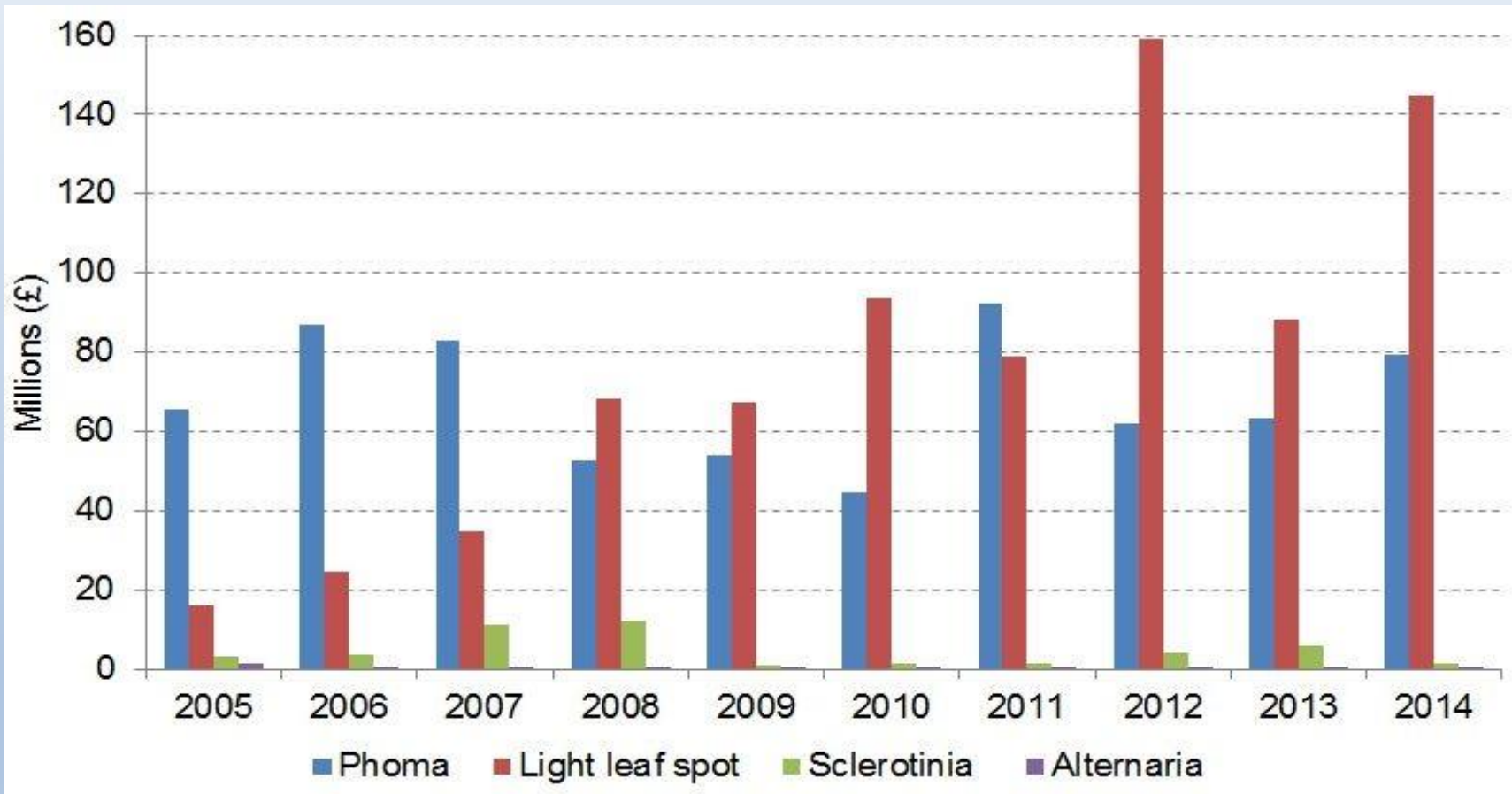
Turnip seed crop 2/5/2015





# Light Leaf Spot (*Cylindrosporium concentricum*) in Europe, Australia, & Asia

## Winter oilseed rape losses due to diseases (£ million)



Based on funded winter oilseed rape pest and disease survey data delivered through CropMonitor ([www.cropmonitor.co.uk](http://www.cropmonitor.co.uk)), for oilseed rape price of £380/t.

<http://www.rothamsted.ac.uk/light-leaf-spot-forecast/historical-trends-light-leaf-spot>

# Possible factors behind the brassica disease epidemic in the Willamette Valley in 2014-15

- **Prior to Oregon HB2427:** rapeseed production districts set in 1990 to minimize risks of black leg, cross-pollination, & volunteers
- Crucifer seed lots: Must be tested and treated for *P. lingam* before planting
- Field locations must be pinned
- Crucifers may not be grown in same field more than 2 of 5 years
  - Producers must control volunteers within 1/4 mile of fields
  - Seed transported in a manner that prevents escape
  - Equipment must be cleaned before leaving field and unloading
- *Raphanus*: same rules except for equipment cleaning
- **HB2427 implemented in ~2009:** interest in canola production in Willamette Valley - focused on cross-pollination, removed the requirement for seed testing or seed treatment for black leg (?!)
- Widespread planting of brassica cover crops during economic recession, & canola planted in approved areas of Willamette Valley



# Temporary ODA Rule in Response to Crucifer Diseases Found in Willamette Valley in 2014

Nancy Osterbauer, ODA, [nosterbauer@oda.state.or.us](mailto:nosterbauer@oda.state.or.us), (503) 986-4666

- Commodities covered:
  - *Brassica*, *Raphanus*, and *Sinapis* seed and plants
  - Exemption: prepackaged seed lots or transplants for home use
- Seed lots must be:
  - Accompanied by a certificate showing seed is black leg-free OR
  - Be treated in an approved manner for black leg
- All transplants must originate from tested &/or treated seed



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- Management practices to **minimize disease increase**
  - Covered commodities not grown on same land more than 2 consecutive years, and not more than 2 in every 5 years
  - Volunteer or uncontrolled Brassicaceae in and near production fields must be rogued/eliminated
  - Planting, harvest, and transportation equipment shall be cleaned to prevent inadvertent spread from fields
  - Unbagged loads transported within the Valley must be enclosed in bins or covered containers to prevent seed loss
- **Seed dealers** must keep copies of all pertinent records for testing and seed treatment, and make these **records** available to the ODA upon request



# ODA Response to Crucifer Diseases in the Willamette Valley in 2014

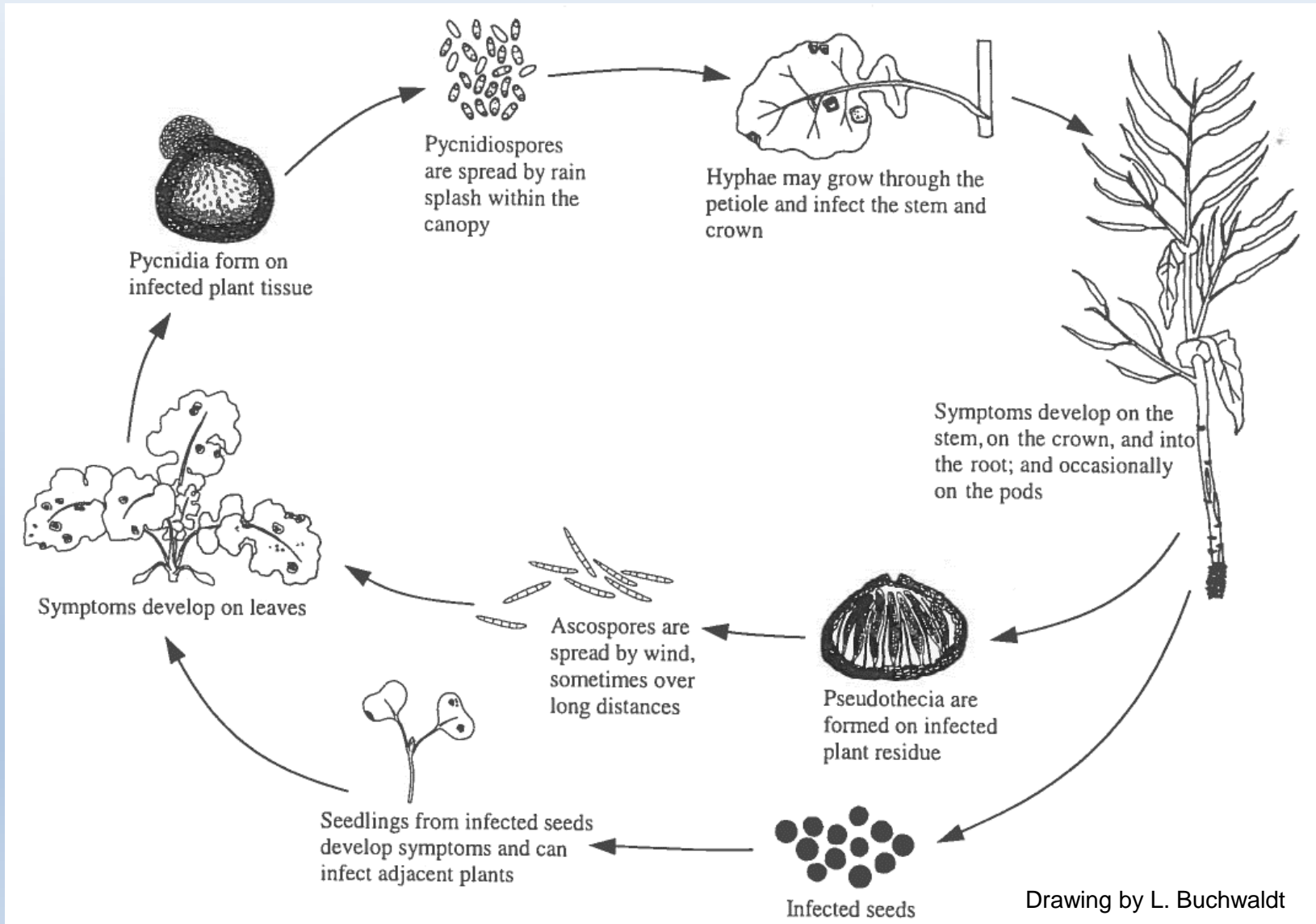
Nancy Osterbauer, ODA: [nosterbauer@oda.state.or.us](mailto:nosterbauer@oda.state.or.us), (503) 986-4666

- Emergency/temporary ODA rule proposed on 18 June 2014
- Advisory group met on 25 June
- Temporary law effective on 7 July
- **Permanent ODA rule effective as of 13 January 2015:**
  - **OAR 603-052-0870**
  - *Leptosphaeria maculans* and *L. biglobosa*
  - Mandatory biennial review of rules
  - Any crucifer seed to be planted must be tested **AND** treated for black leg



# Black Leg of Crucifers

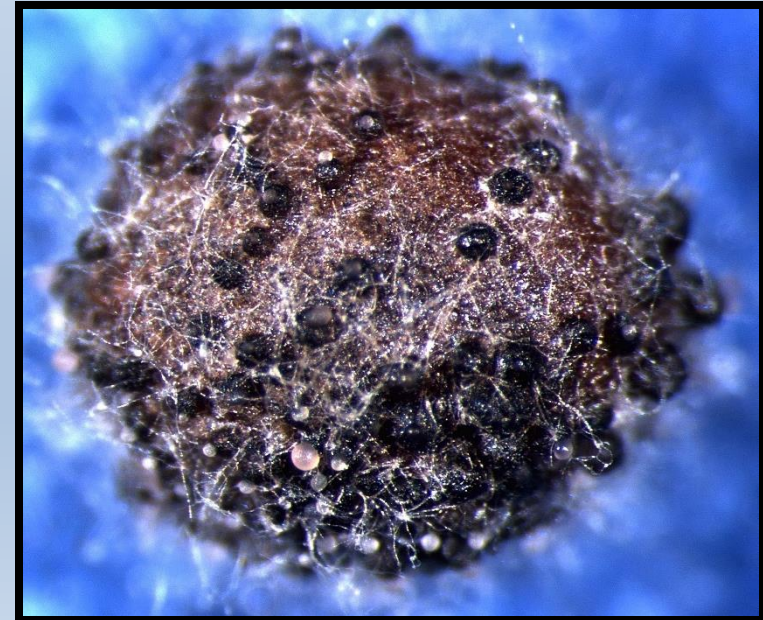
- *Phoma lingam*: asexual, pycnidia (conidia), splash dispersed
- *Leptosphaeria maculans*, *L. biglobosa*: sexual, pseudothecia (ascospores), airborne





# Black Leg of Crucifers

- Most crucifer crops & weeds
- Survival:
  - 4+ years on seed
  - 3+ years on crop residues
- Spread:
  - splashing water (conidia)
  - running surface water
  - airborne ascospores
  - seed, transplants
  - machinery, tools, workers
- Optimum conditions: wet & cool



# Management of Black Leg

- 4+ year crop rotation
- Avoid wetting transplants
- Separation of crucifer crops
- Site selection
- Some resistant cultivars
- Control crucifer weeds
- Avoid working in wet fields
- Inspection & rogueing
- Sanitation
- Foliar fungicide applications, e.g., strobilurins, iprodione, ...
- Incorporate residues soon after harvest:
  - **Do not leave crop residues on soil surface after harvest**
- **Purchase & plant only tested &/or treated seed**
  - hot water (122°F for 25-30 mins)
  - fungicides – benomyl was industry standard, newly registered fungicides
- **Region-wide adoption of management practices!**





# Treatments for Black Leg

## • Seed treatments

- Hot water: 122°F (50°C) for 25-30 minutes, cold rinse, dry
- Fungicides:
  - Boscalid + pyraclostrobin (Coronet = FRAC Groups 7 + 11)
  - Iprodione (Rovral 4F = Section 18 WA-070001 = FRAC Grp 2)
  - Difenoconazole (e.g., Helix Xtra, FRAC Groups 3 + 4 + 12; etc.)
  - Thiabendazole (Mertect 340F = FRAC Group 1)
  - Azoxystrobin (Dynasty = FRAC Group 11)
  - Fludioxonil (Maxim 4FS = FRAC Group 12)?
  - Thiram (e.g., Thiram 42-S, Signet = FRAC Group M3) – resistance management

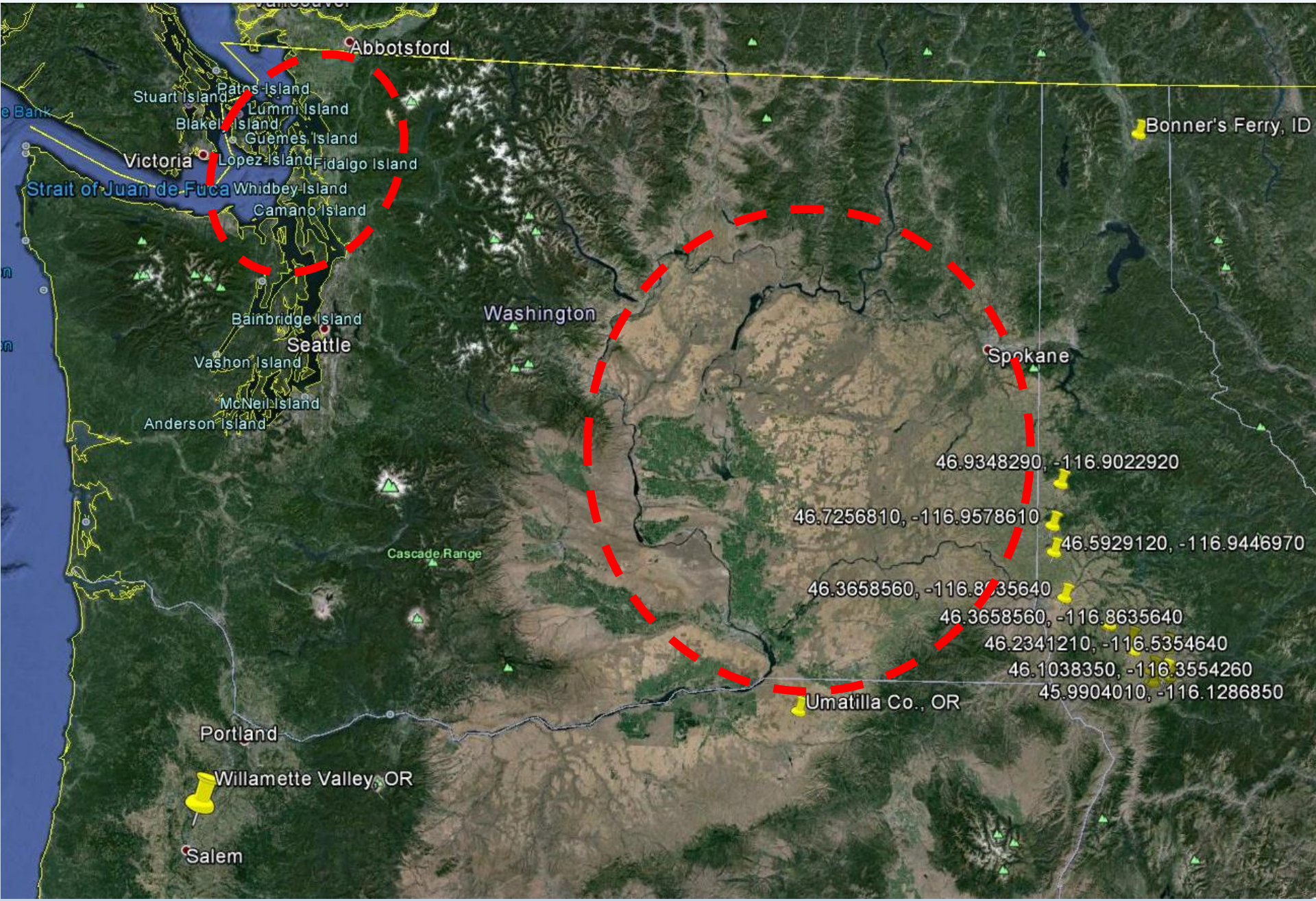
# Treatments for Black Leg

## • Foliar applications registered in WA

- Boscalid (Endura = FRAC Group 7)
- Iprodione (e.g., Rovral 4F, Meteor, Nevado = FRAC Group 2)
- Pyraclostrobin (Cabrio = FRAC Grp 11, Priaxor Xemium = pyraclostrobin + fluxapyroxad = FRAC Groups 11 + 7)
- Azoxystrobin (e.g., Aframe, Azure, Equation, Satori = FRAC Grp 11; Quadris Top = azoxystrobin + difenoconazole = FRAC Groups 11 + 3)
- Penthiopyrad (Fontelis = FRAC Group 7)
- Prothioconazole (Proline = FRAC Group 3)
  - **WSDA SLN 24(c) for non-food/non-feed brassica seed crops, to be approved in 2016? Approved by ODA in Jan. 2016)**
- Chlorothalonil, mancozeb – resistance management



# WSDA Crucifer Quarantine: Expansion of the Rule





Play With Your Food





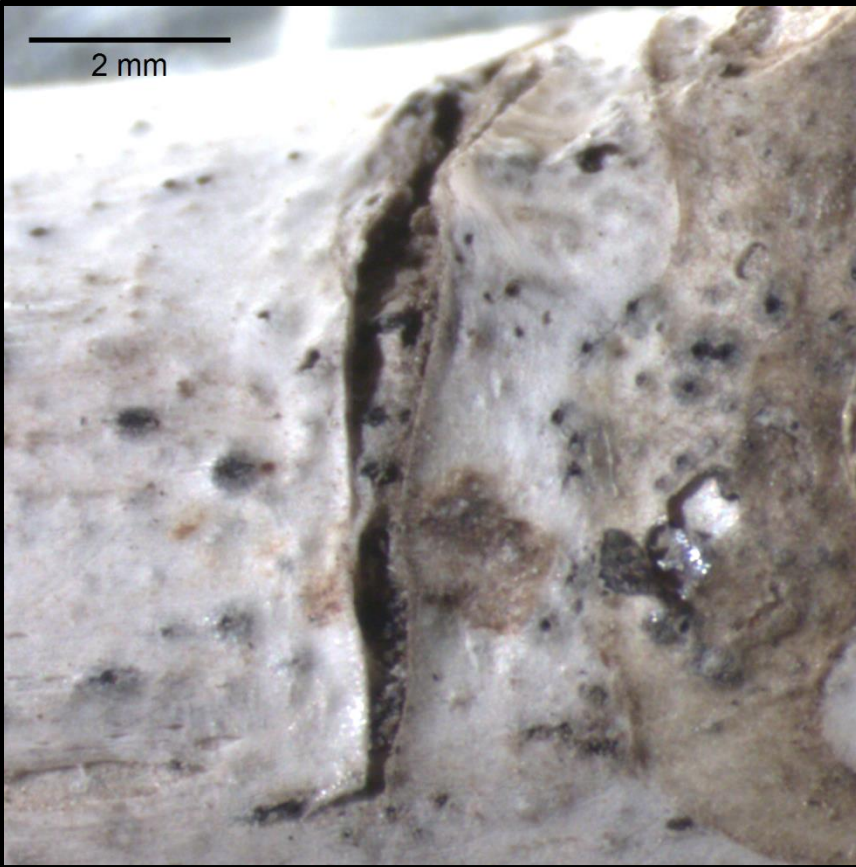
# WSDA Crucifer Quarantine: Does the Rule Suffice?

Lewiston, ID rapeseed seed crop residues (Nov. 2014)





# WSDA Crucifer Quarantine: Does the Rule Suffice?



**Mar.-Apr. 2015:**  
Canola crop residues  
Winter canola crops  
Tumble mustard (*Sisymbrium altissimum*)  
**Grangeville to Moscow**  
>15 fields in Idaho, Latah, Lewis,  
Nezperce Counties, ID  
2 winter canola crops, Umatilla Co., OR



# Presence of *Leptosphaeria* in eastern WA

Fall 2015 on winter canola residues of 2014-15 crops (Tim Paulitz, Mike Derie, Shannon Carmody)

**Okanogan Co.:** *Leptosphaeria maculans* and *L. biglobosa*

**Whitman Co.:** *L. biglobosa*



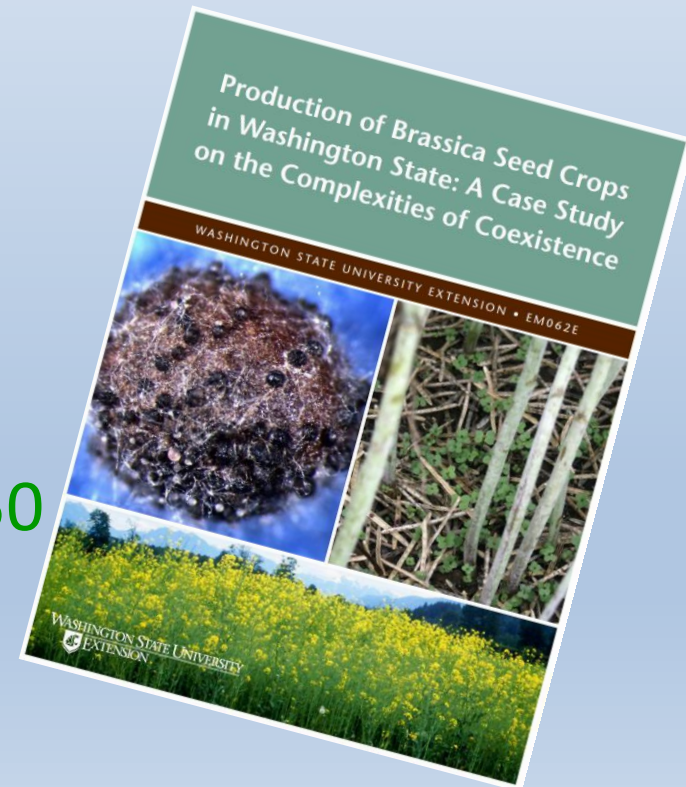
# WSDA Crucifer Quarantine: Does the Rule Suffice?

- Columbia Basin? Vegetable & canola seed crops, cover crops
- Dryland areas of WA? Canola, camelina, ...
- Spring-summer 2015 survey of canola crops & residues in dryland WA: Karen Sowers & Tim Paulitz
- 2015 WSDA survey of co.'s selling brassica seed east of Cascade Mountains:
  - Most, not all, seed lots are tested/treated for black leg/black rot
- **Amendment to WAC 16-301 for east of Cascade Mtns:**
  - Seed testing for black leg only
  - Approved black leg seed health assay
  - WSDA Crucifer Quarantine Tag required
    - WSDA tag for mother lot vs. labels for daughter lots
  - Exempt if seed is produced (grown) **in** regulated area
  - No seed treatment required if negative black leg seed test



# WSDA Crucifer Quarantine

- *Production of Brassica Seed Crops in Washington State: A Case Study on the Complexities of Coexistence.* Inglis, Miller, & du Toit, 2013. WSU EM062E.
- PNW Black Leg Interest Group:  
Lindsey du Toit  
[dutoit@wsu.edu](mailto:dutoit@wsu.edu), 360-848-6140
- WSDA Seed Program:  
Victor Shaul, Manager  
[Vshaul@agr.wa.gov](mailto:Vshaul@agr.wa.gov), 509-249-6950



Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties.

In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action.

It is your responsibility to check the label before using the product to ensure lawful use and obtain all necessary permits in advance.