Phoma (black leg) and light leaf spot in Brassica crops

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2014 OSU Crucifer survey found (in addition to the "normal diseases")

- Black leg (*Phoma lingam*)

  occurs across USA
- Light leaf spot (*Cylindrosporium concentricum*)

  problem in Europe, Australia, Asia
- White leaf spot (*Pseudocercosporella capsellae*)

  reported as problem in SE USA

Black leg (*Phoma*)

Light leaf spot (*Cylindrosporium*)

White leaf spot (*Pseudocercosporella*)

61 different fields or locations were inspected

- 43 had Black leg (35 different farms/sites)
- 24 had Light leaf spot (21 different farms/sites)
- 17 had White leaf spot (13 different farms/sites)

The trio of diseases were found in Benton, Lane, Linn, Marion, Polk, Washington, and Yamhill counties.

Black leg (*Phoma*)

Light leaf spot (*Cylindrosporium*)

White leaf spot (*Pseudocercosporella*)

Plants found infected with *Phoma lingam* in western Oregon; 2013 fall-planted seed fields unless otherwise noted. Detected in 43 locations out of 61 sites.

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

9 findings were as volunteer or weedy plants

- Black leg occurs across world
- Usually maintained at low levels in Oregon

Black leg detections during ODA certification inspections of *Brassica* seed fields in Oregon

Year	# Brassica seed fields infected with black leg	Total number of Brassica seed fields inspected
2009	7	109
2010	10	106
2011	9	134
2012	2	159
2013	0	144

2014 Brassica seed field survey

Black leg (problem where crucifers grown)

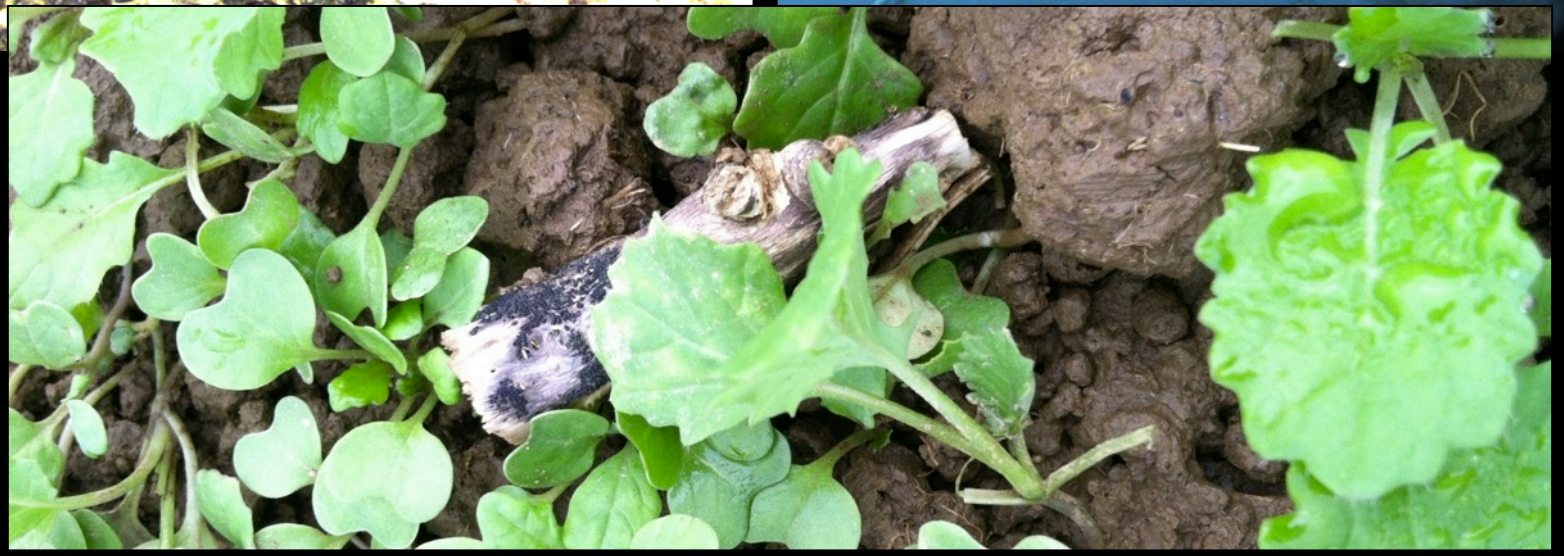
asexual fungal stage: *Phoma lingam*
sexual fungal stage: *Leptosphaeria maculans*

Reported hosts include *Brassica* (broccoli, Brussels sprouts, cabbage, canola, cauliflower, Chinese *Brassica* vegetables, collards, kales, mizuna, mustards, oilseed rape, oilseed turnip rape, rutabaga, turnip, etc.), ***Sinapis*** (white and yellow mustard), ***Raphanus*** (daikon or red radish), ***Descurainia*** (tansymustard), ***Sisymbrium*** (hedge mustard), and ***Thlaspi*** (penny-cress).

Different *Phoma* species affect pea, beet, onion, etc.

Ascospores released from crop residues on soil surface

Black leg (*Leptosphaeria maculans*; *Phoma lingam*)



Black leg (*Phoma lingam*; *Leptosphaeria maculans*)

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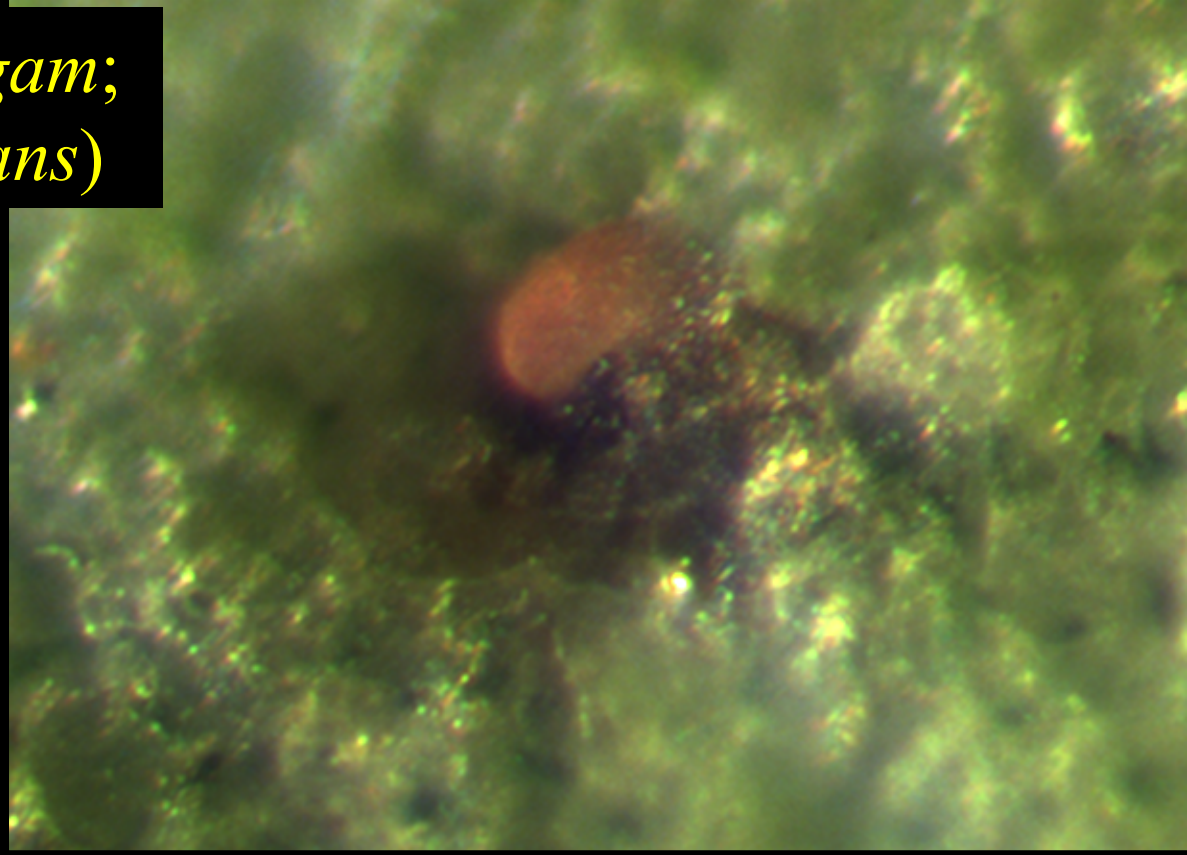
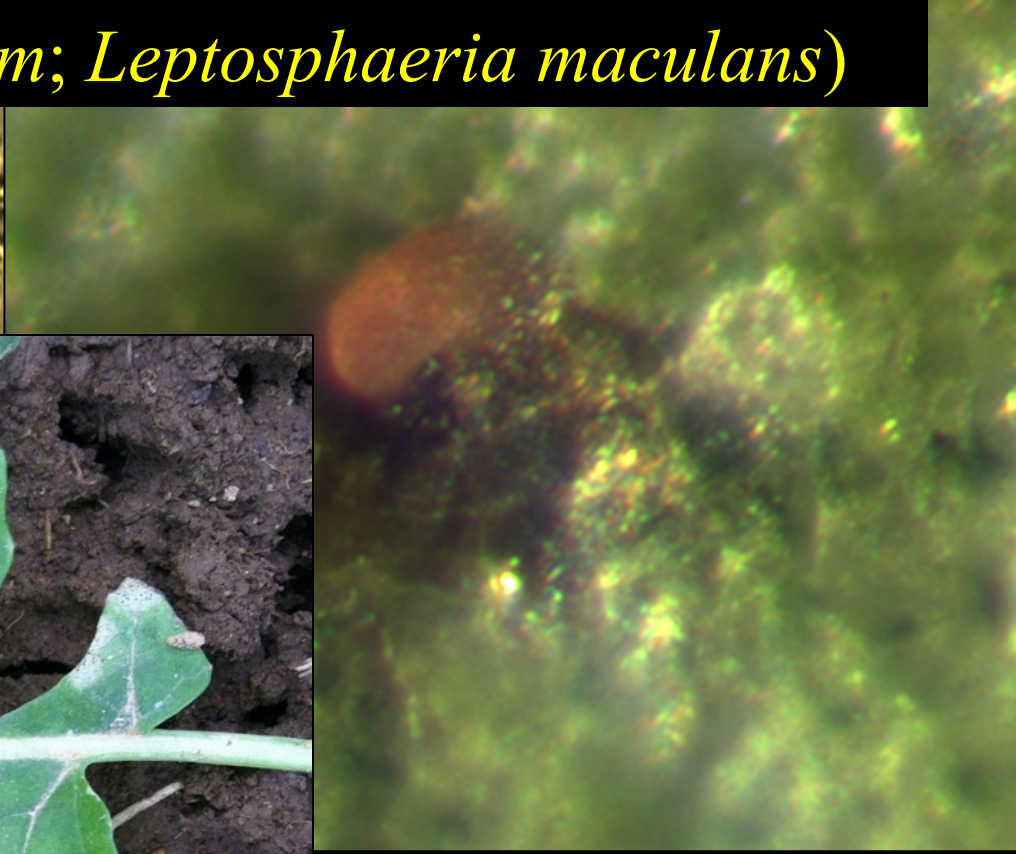


Black leg (*Phoma lingam*; *Leptosphaeria maculans*)



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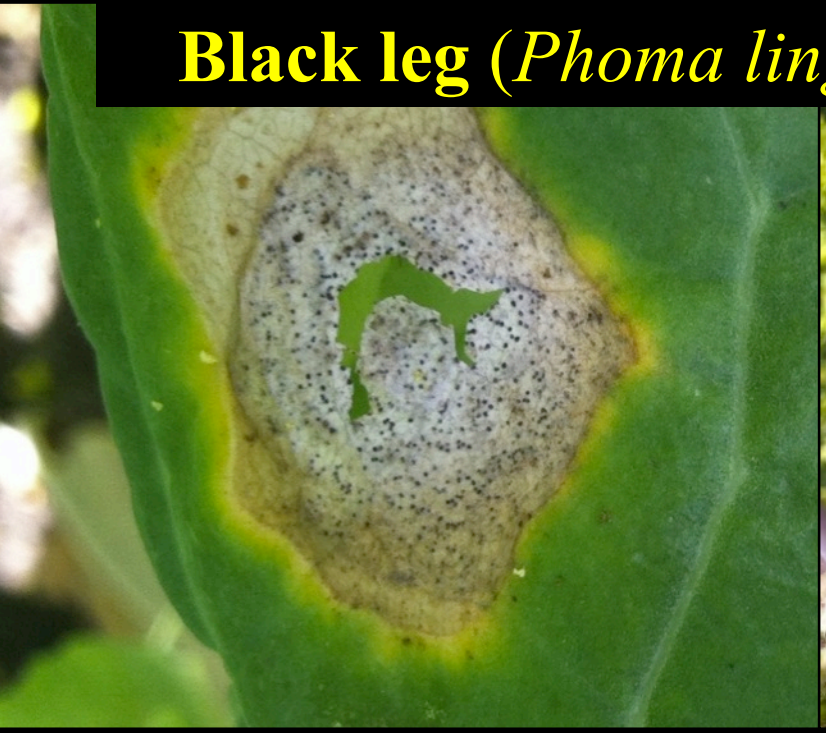
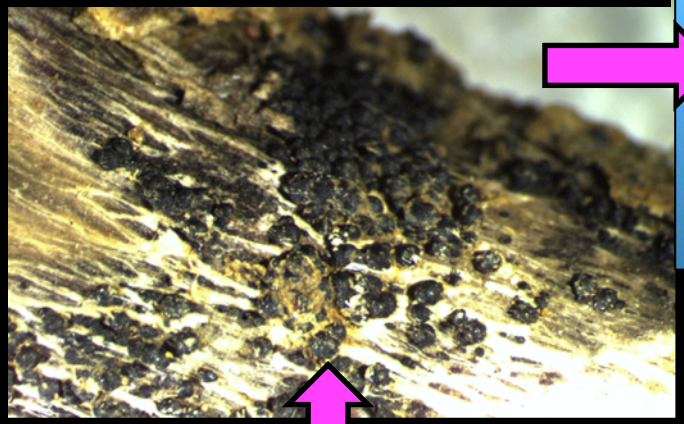
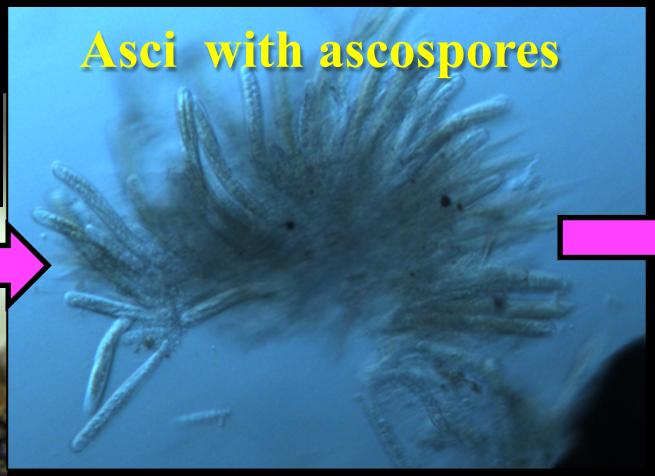


Black leg (*Phoma lingam*; *Leptosphaeria maculans*)

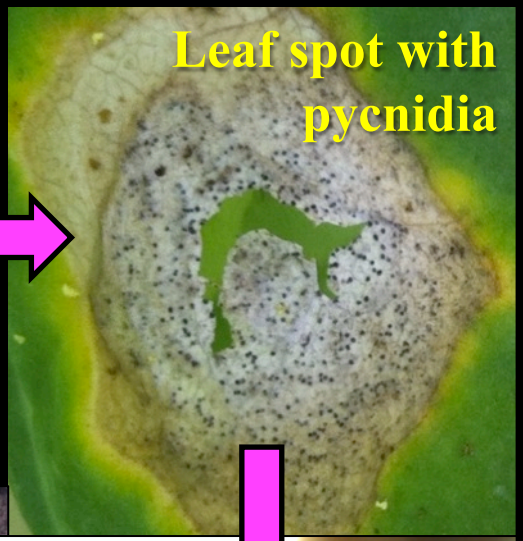
Pseudothecia (ascospores) and pycnidia (conidia) on infected stem residue



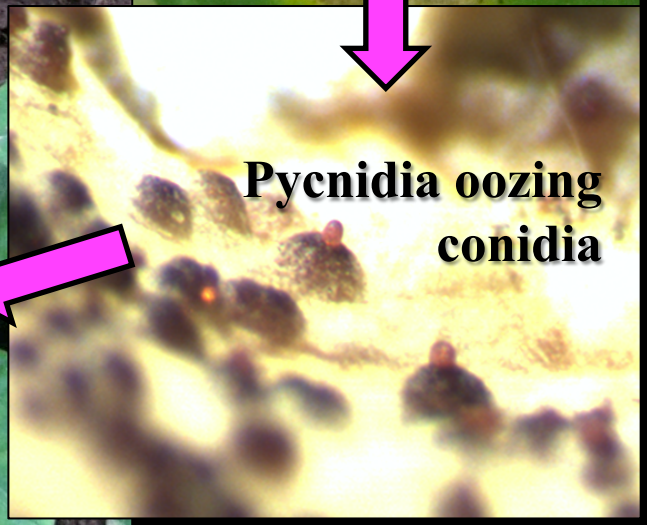
Asci with ascospores



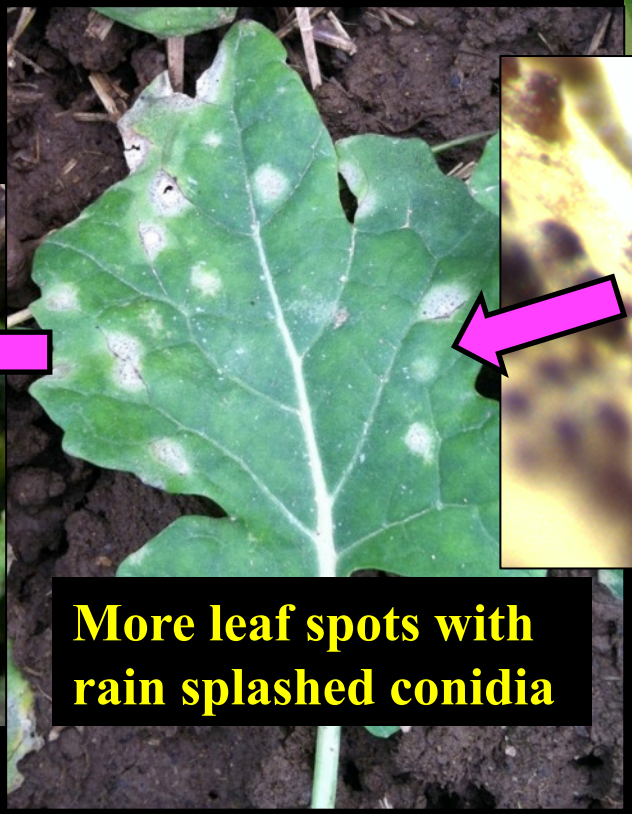
Leaf spot with pycnidia



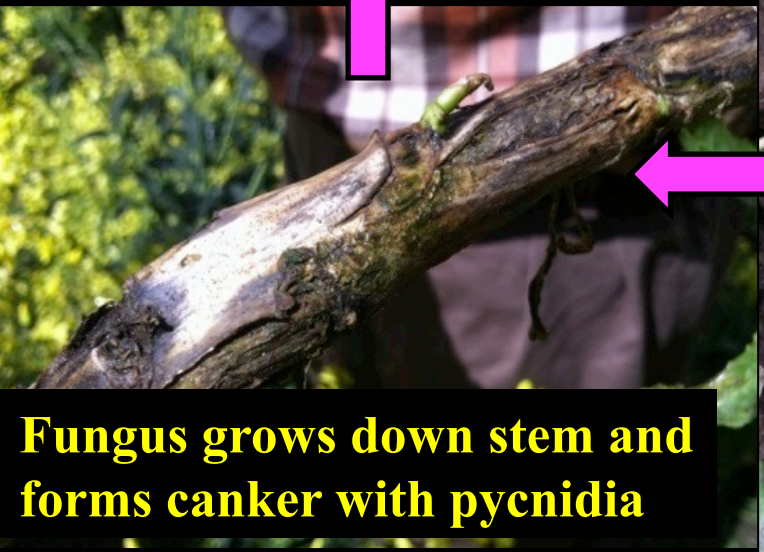
Pycnidia oozing conidia



More leaf spots with rain splashed conidia



Fungus grows down stem and forms canker with pycnidia



2014 Brassica seed field survey found:

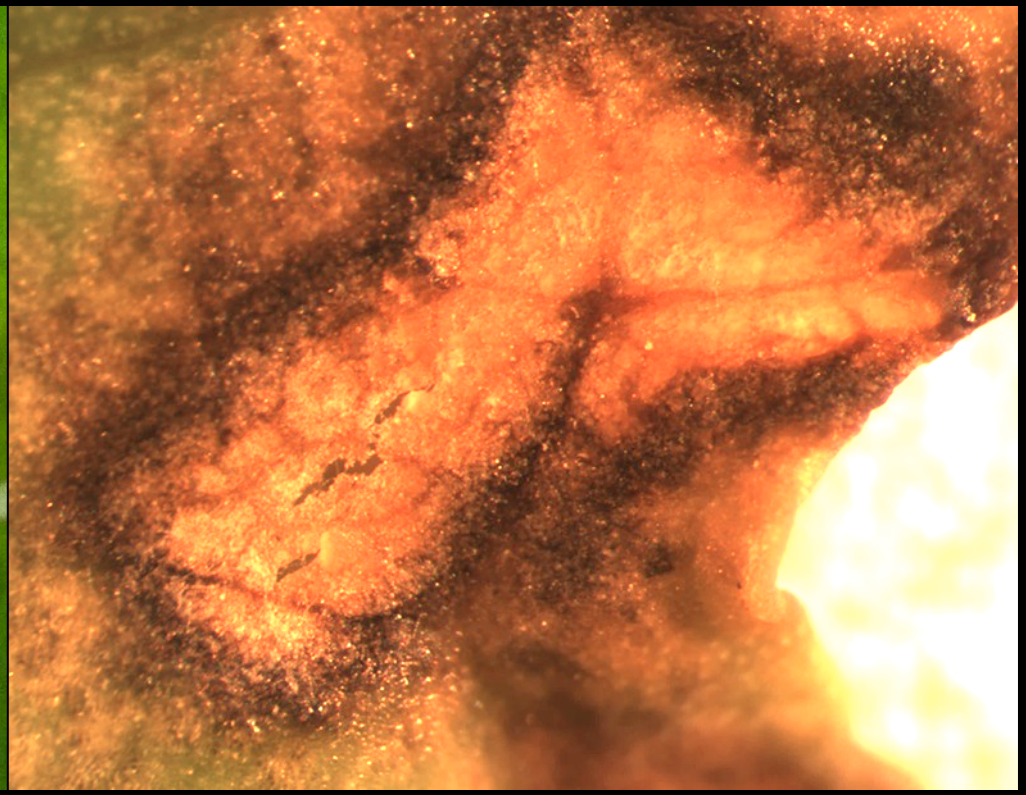
- Light leaf spot (reported in Europe, Australia, Asia)
  asexual stage: *Cylindrosporium concentricum*
  sexual stage: *Pyrenopeziza brassicae*

Plants found infected with *Cylindrosporium concentricum* in western Oregon; 2013 fall-planted seed fields unless otherwise noted. Detected in 24 locations out of 61 sites examined.

County	Crop/plant	County	Crop/plant
Benton	Mizuna (organic)	Marion	Bird's rape mustard (weed)
Linn	Turnip	Marion	Turnip
Linn	Turnip	Polk	Canola
Linn	Wild mustard (weed)	Polk	Canola
Linn	Turnip	Polk	Canola
Linn	Volunteer radish	Polk	Forage *Brassica*
Linn	Volunteer *Brassica*	Polk	Turnip
Marion	Volunteer black mustard	Washington	Turnip
Marion	Kale, red	Yamhill	Canola
Marion	*Brassica* cover crop	Yamhill	Turnip
Marion	Volunteer *Brassica*	Yamhill	Volunteer turnip
Marion	Bird's rape mustard (weed)	Yamhill	Volunteer turnip

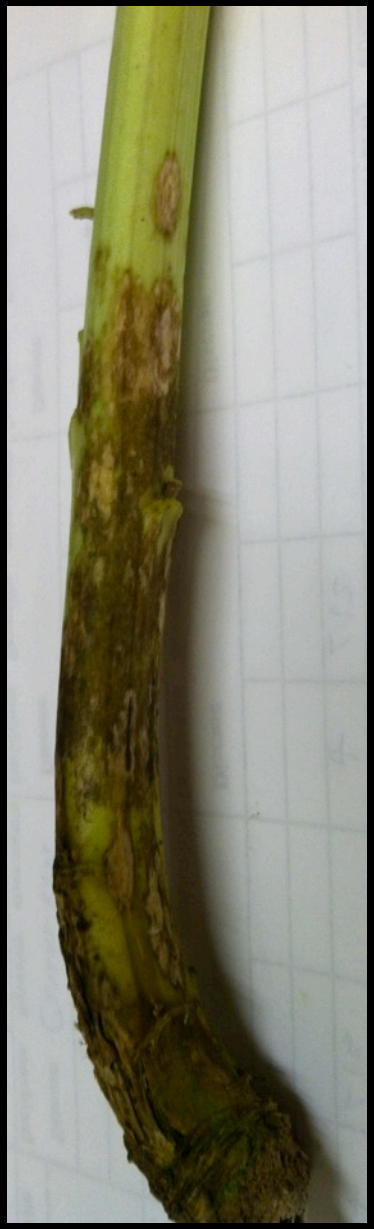
9 findings were as volunteer or weedy plants. Concern with pathogen becoming established in the valleys on weeds and uncontrolled volunteers

- Light leaf spot may remain asymptomatic till late winter/ early spring (after infection during the fall); is tricky to diagnosis (call Ocamb or bring to OSU plant clinic)
- Infected plants may be more sensitive to freeze injury



Light leaf spot on *Brassica*

April 8th, 2014

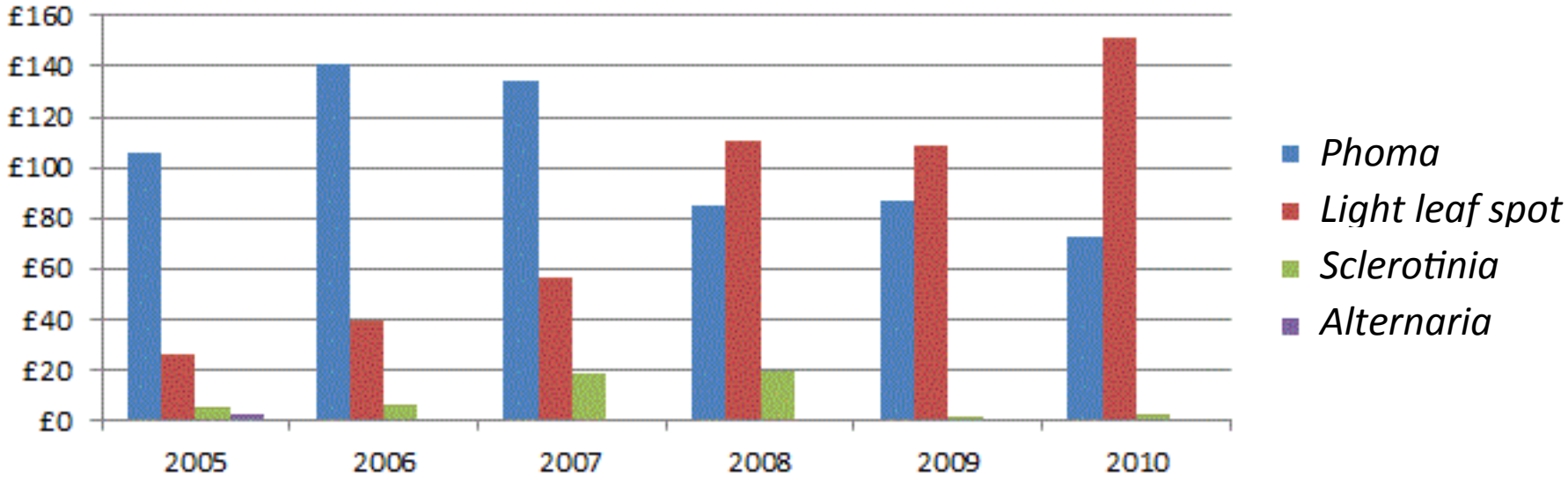


June 13th, 2014

Light leaf spot is an economic problem in Europe, Australia, Asia where winter oilseed rape is grown

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

Winter oilseed rape losses due to disease (£Million)



Based on Defra-funded Winter Oilseed Rape Pest and Disease Survey Data delivered through CropMonitor (www.cropmonitor.co.uk). Data calculated with oilseed rape at a price of £380/t.

2014 Brassica seed field survey found:

- White leaf spot (reported in USA)

  asexual stage: *Pseudocercosporella capsellae*

  sexual stage: *Mycosphaerella capsellae*

Fungi that cause black leg, light & white leaf spots:

- Produce ascospores on infected plant residues on soil surface; these spores are wind-blown for miles.
- Produce asexual spores (conidia) that develop on leaf spots, stem cankers and crop residues; spread relatively short distances by rain.
- Are promoted by cool, moist conditions (46-60°F).
- Can be seedborne.

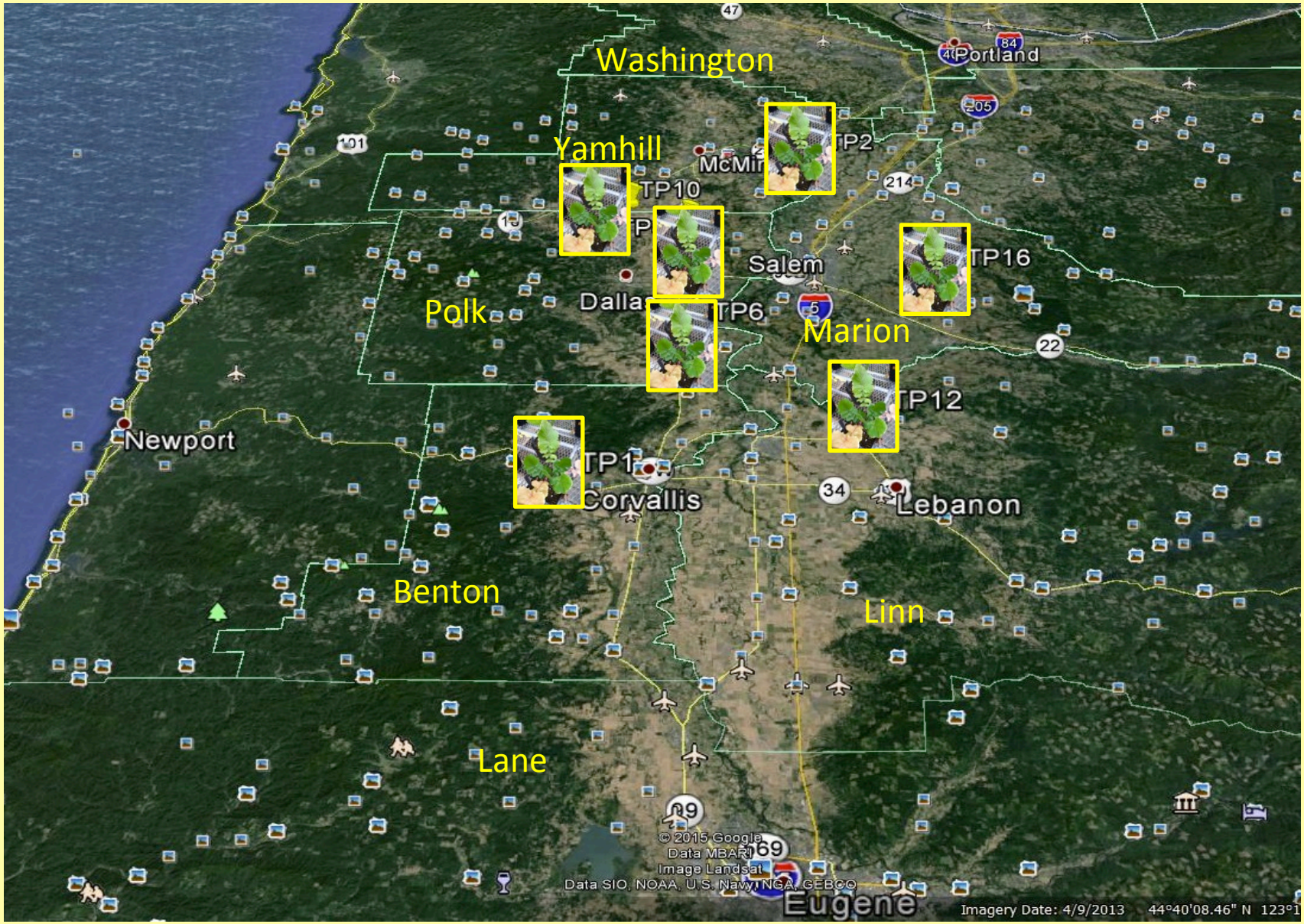
Black leg (*Phoma*)

Light leaf spot (*Cylindrosporium*)

White leaf spot (*Pseudocercosporella*)

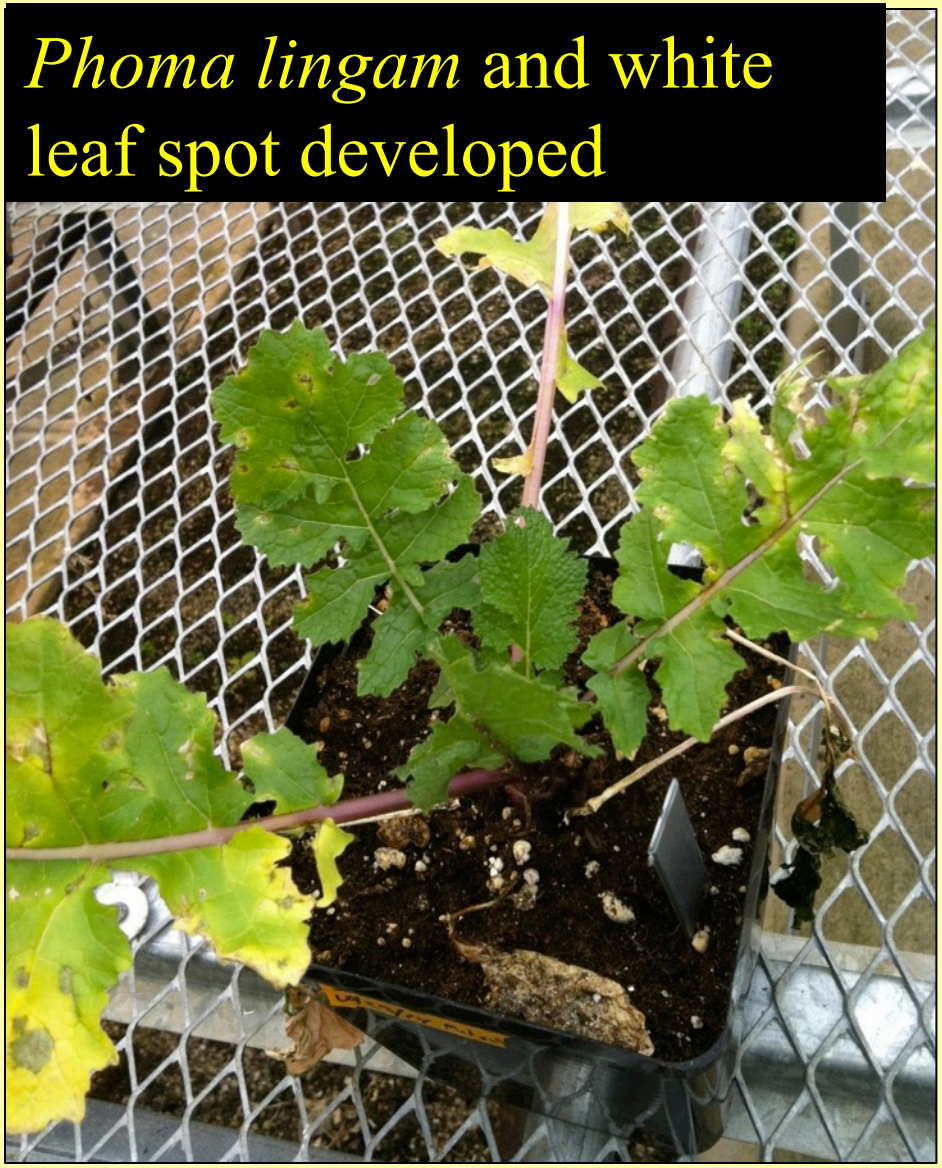

Fall
Black leg & LLS & WLS ascospore release from debris
LLS & WLS conidia develop and disperse by rain
Winter
Black leg ascospore release
LLS & WLS conidia
Spring
LLS & WLS & Black leg conidia
Black leg & LLS ascospore release, WLS?
Summer
LLS & WLS conidia develop
Black leg & LLS &WLS sexual stage develops
Water & temperature driven

Turnip trap plants deployed weekly starting Oct 1, 2014



Turnip trap plants deployed Oct 23-30, 2014

Phoma lingam and white leaf spot developed



No leaf spots

Trap plant (turnip) developed leaf spots caused by *Phoma lingam*

Date in	Date out	TP #16	TP #2	TP #10	TP #4	TP #6	TP #1	TP #12
1-Oct	9-Oct							
9-Oct	15-Oct							
15-Oct	23-Oct	X		X	X			
23-Oct	30-Oct							
30-Oct	6-Nov							
6-Nov	13-Nov							
13-Nov	22-Nov							
22-Nov	26-Nov							
26-Nov	3-Dec		X	X	X	X		
3-Dec	11-Dec							
11-Dec	17-Dec							
17-Dec	23-Dec							
23-Dec	31-Dec							
31-Dec	10-Jan							

It is imperative that each grower, regardless of whether growing a seed, oilseed, vegetable, forage or cover crop:

- Incorporate or remove infected residues after harvest (flailing + shallow or deeper plowing)

  residues on soil surface are infectious until decomposed

It is imperative that each grower, regardless of whether growing a seed, oilseed, vegetable, forage or cover crop:

- Incorporate or remove infected residues after harvest (flailing + shallow or deeper plowing)
  residues on soil surface are infectious until decomposed
- Rotate fields out of crucifers for at least three years
- Avoid planting within ¼ mile of a previously-infected field

- Eradicate susceptible weeds and control volunteer crucifers
- **Do not turn a volunteer problem into a crop**

- Plant only seed that has been certified to be free of *Phoma lingam* by official testing and has been treated with a fungicide or hot water (15 to 30 min at 122°F)

Fungicides registered for seed treatment of Brassicaceae

- **Coronet** (FRAC Group 7+11). **Not registered for use on radish, rutabaga or turnip.** WSU showed Coronet to be very effective on seedborne *Phoma* & other fungi.
- **Dynasty** (FRAC Group 11). Not completely effective on seedborne *Phoma*.
- **Maxim 4FS** (FRAC Group 12). Not registered for use on canola. Not very effective on seedborne *Phoma*.
- **Mertect 340-F** (FRAC Group 1). **For seed production fields in Oregon only (**SLN OR-100014). WSU showed Mertect to be quite effective on seedborne *Phoma*.
- **Rovral 4F** (FRAC Group 2). **For seed production fields in OR (SLN OR-140013).** WSU showed Rovral to be a very effective on seedborne *Phoma*.
- **42-S Thiram** (FRAC Group M3). Not very effective on seedborne *Phoma*.

Foliar fungicides for Black leg in seed fields

- **Cabrio EG or Quadris Flowable** (FRAC Group 11) head & stem, leafy brassicas** and root crops (radish, rutabaga, turnip)
- **Inspire Super** (FRAC Group 3+9) for leafy brassicas **
- **Priaxor Xemium Brand** (FRAC Group 7+11) for leafy brassicas**
- **Quadris Top** (FRAC Group 11+3) for leafy brassicas **
- **Priaxor Xemium Brand** (FRAC Group 7+11) for leafy brassicas **
- **Rovral 4F** (FRAC Group 2) for *Brassica* and *Raphanus* **seed crops only** (SLN OR-130001).
- **Tebuconazole** (Onset 3.6L, Tebustar formulations, Monsoon, Orius 3.6F, Tebu-Crop 3.6F, Toledo 3.6F, etc.) for leafy brassicas **

** Leafy brassicas include broccoli, Chinese broccoli (gai lon), broccoli raab (rapini), Brussel sprouts, cabbage, Chinese cabbage (bok choy, napa), cauliflower, cavalo broccolo, collards, gai choy, kale, kohlrabi, mizuna, mustard greens, mustard spinach, rape greens, and turnip greens

Foliar fungicides for light leaf spot control

- **Inspire Super** (FRAC Group 3+9) **
- **Priaxor Xemium Brand** (FRAC Group 7+11) **
- **Procure 480SC** for leafy as well as head and stem brassicas **
- **Quadris Top** (FRAC Group 11+3) **
- **Tebuconazole** formulations (Onset 3.6L, Tebustar, Monsoon, Orius 3.6F, Tebu-Crop 3.6F, Toledo 3.6F, etc.) is labeled for other diseases of leafy brassicas **

Currently no foliar fungicides for light leaf spot in turnip or radish

** Leafy brassicas include broccoli, Chinese broccoli (gai lon), broccoli raab (rapini), Brussel sprouts, cabbage, Chinese cabbage (bok choy, napa), cauliflower, cavalo broccolo, collards, gai choy, kale, kohlrabi, mizuna, mustard greens, mustard spinach, rape greens, and turnip greens

Foliar fungicides applied as a three-spray program for oilseed rape in the UK (application in fall, winter, spring)

- Make fall application after rains commence and before windblown ascospores are released, depending on weather and levels of infected residues
- If field has low level of disease incidence, a winter application can reduce secondary spread

Infected fields can go from <1 % infected stand to 90-100% incidence in 4 to 6 weeks, depending on weather and host

Brassica seed fields may need > 3 black leg sprays

- In diseased fields, it is crucial to protect upper canopy before plants start to bolt to keep disease off of developing seed pods -- to keep seed from becoming infected

Black leg (*Phoma*)

Light leaf spot (*Cylindrosporium*)

White leaf spot (*Pseudocercosporella*)

The saga continues

- Sept. 2014 -- *Leptosphaeria maculans* immature ascospores observed on infected residues
- Mid-Oct. 2014 -- Black leg leaf spots on *Brassica* volunteers
- By end of Oct. 2014 -- Black leg leaf spots in new *Brassica* plantings
- By Dec. 2014 -- Black leg detected in canola, turnip, forage rape, and vegetable *Brassica* seed fields in Benton, Linn, Marion (east and west), Polk, Washington and Yamhill counties
- White leaf spot also found at a number of locations
- No light leaf spot detected yet

Oct. 2014 through Jan. 7, 2015 survey:

- **Black leg found in 6/6 canola fields**
  80-100% disease incidence (DI)
  10-20% spotted leaf area per affected leaf
- **Black leg found in 6/7 turnip or forage rape fields**
  1-70% DI
  1-5% spotted leaf area per affected leaf
- **Black leg found in 3/7 vegetable seed fields**
  5-40% DI
  1-5% spotted leaf area per affected leaf
- **Black leg found in 4/5 volunteer canola sites (& 1 turnip)**
  1-40% DI
  1-10% spotted leaf area per affected leaf


For more information
2014 PNW Plant Disease Handbook summer ed.
http://pnwhandbooks.org/plantdisease/