Black leg in Brassiceae Crops and Wild Crucifers

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A widespread epidemic of black leg occurred on a diversity of crucifer oilseed, cover, forage, and vegetable seed crops in the Willamette Valley of Oregon in spring 2014. An outbreak of black leg also occurred in Bonner's Ferry, ID in 2011 in dryland canola crops. *Phoma lingam* (sexual stage: *Leptosphaeria maculans*) is the fungus that causes black leg. Black leg can be a significant problem for growers of fall- or spring-sown plantings of various crucifer crops, particularly under the favorable environmental conditions for this disease in the Pacific Northwest. In fact, back leg is a quarantine disease for five counties in northwestern Washington. Plants in the tribe Brassiceae that can be infected include species of *Brassica* (e.g., broccoli, Brussels sprouts, cabbage, canola, cauliflower, various Chinese brassica vegetables, collard, kale, mizuna, mustard, oilseed rape, oilseed turnip rape, rutabaga, turnip, etc.), *Sinapis* (white and yellow mustard), and *Raphanus* (daikon and radish). Several wild types exist that may be infected by *P. lingam* including species within *Descurainia* (tansymustard), *Sisymbrium* (hedge mustard), and *Thlaspi* (penny-cress) (2).

The fungus survives and reproduces both sexually and asexually. Fruiting bodies of the sexual stage, *L. maculans*, are called pseudothecia, which form and survive on plant debris or live plants, and release the sexual spore type, called ascospores. Ascospores can be wind-blown up to several miles during cool, windy, and wet conditions. In fall-planted brassica crops or winter weeds, pseudothecia can form on infected plants the next spring or summer, prior to harvest, and can continue forming in plant residues that remain on the soil surface after harvest, releasing ascospores. Pseudothecia do not develop on residues incorporated into the soil, only on residues on the soil surface. For spring-sown crops, pseudothecia do not form until after harvest, and only on residues remaining aboveground. The asexual stage develops on infected plants or residues, producing spores (pycnidiospores or conidia) that are dispersed by splashing water (rain or irrigation). Following wet or humid and cool conditions (46-60°F), spores are released from these fruiting structures on infected plants or residues on the soil surface. The fungus can survive in infected plant residues, potentially producing both spore types, until the debris decomposes fully (1 to 4 years). *Phoma lingam* can be seedborne, surviving for years in infested seed. Workers and equipment can spread spores by moving through a diseased crop during wet conditions.

Spots can develop on infected leaves, stems, petioles, or pods, and stem cankers can develop after the fungus spreads to the stems. The pale, irregular spots become ashy gray with scattered black dots (pycnidia) (Fig. 1A). Stem lesions usually develop near the soil line, are elongated and may have a purple border, and may extend below the soil surface, causing a black rot (black leg) of the lower stem (Fig. 2A). Severely affected plants can be stunted if infected early, and may wilt. In seed crops, as plants mature they may fall over from poor root anchorage. Symptoms on seed pods are rare and inconspicuous, but can lead to infection of the developing seed. Infection can spread on crucifer vegetables in storage.

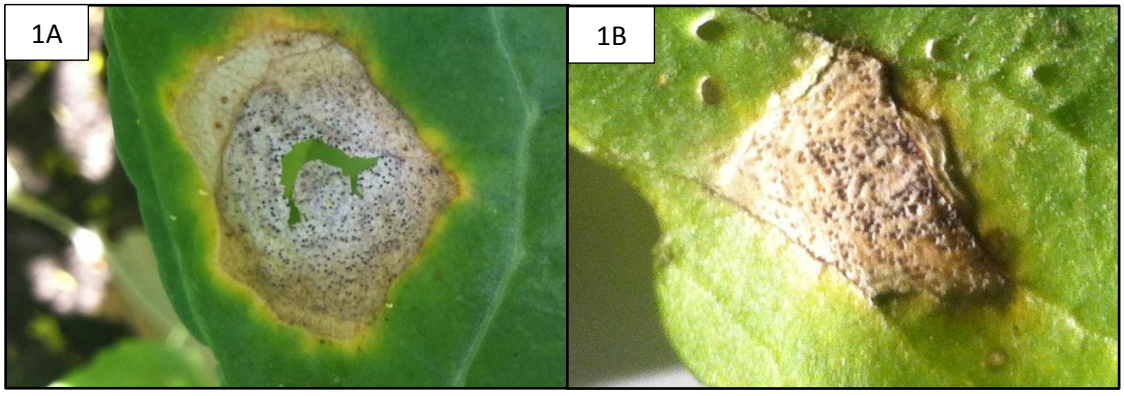

Fig. 1A and 1B. Phoma leaf spot symptoms incited by *Phoma lingam*. Phoma leaf spot lesions can resemble those caused by the ring spot pathogen, *Mycosphaerella brassicicola*.

Control of black leg is critical for all crucifer crops including seed, vegetable (fresh market or processing), forage, cover, and oilseed crops, in order to avoid epidemics. It is imperative that all Brassiceae growers, regardless of the type, practice the following to avoid introducing/spreading the pathogen:

- Only plant seed that has been tested and certified to be free of *P. lingam* (and the black rot pathogen, *Xanthomonas campestris* pv. *campestris*).

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- Avoid planting in or adjacent to a site where black leg has occurred within the last 3-4 years.
- Eradicate susceptible Brassicaceae weeds and volunteer crucifers.
- For transplant seedbeds, avoid planting near crucifer crops and use a minimum 5-year rotation.
- Do not dip transplants in water before transplanting.
- Inspect fields and seed beds for symptoms of black leg or leaf spot.
- Rid diseased fields of infested crop residues as soon as possible after harvest by propane-burning, intensive flailing with subsequent burial, deep plowing, or physical removal of plant debris.

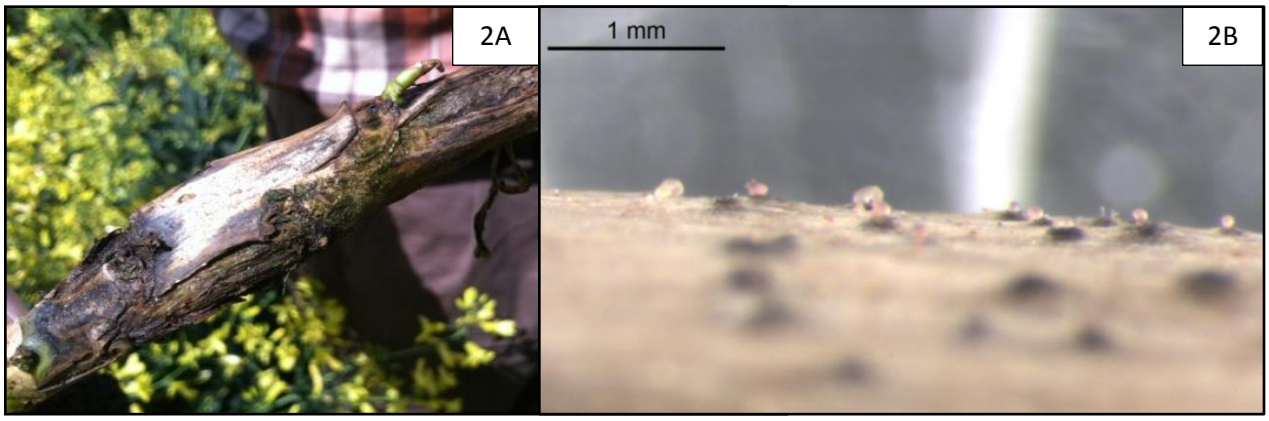

Fig. 2A and 2B. Black leg symptoms on brassica seed stalks caused by *Phoma lingam*. Small, black fruiting bodies (pycnidia and/or pseudothecia) form in the dead tissue. During wet conditions, each pycnidium imbibes moisture and produces a pink 'ooze' (cirrhus) filled with conidia (Fig. 2B) that are splash-dispersed.

- **Only plant seed treated with fungicides and/or hot water** (15 to 30 min at 122°F). The following products are registered for use on crucifer seed crops:
  - Coronet fungicide seed treatment (Fungicide Resistance Action Committee (FRAC) Groups 7+11). Not registered for use on radish. Studies at WSU showed Coronet is very effective for seedborne *P. lingam* & other fungi (1).
  - Dynasty (Group 11) at 0.1 to 0.38 fl oz/100 lb seed (0.1 to 3.75 fl oz /100 lb seed for canola).
  - Maxim 4FS (Group 12) at 0.08 to 0.16 fl oz/100 lb seed. Not registered for use on canola.
  - Rovral 4 Flowable (Group 2) at 16 fl oz in 6 gal water applied as a seed soak (24 hours at 30°C) or as a slurry. Washington (SLN WA-070001) only.
  - Thiram 50WP (Group M3) at 8 oz/100 lb seed (not labeled for Oregon) or 42-S Thiram (FRAC Group M3) at 8 fl oz/100 lb seed (6.4 fl oz for canola).
- If leaf spots develop early, **foliar sprays** help reduce disease development. Spring-planted crops may warrant protective sprays because of the potential for ascospore release and dispersal. The following foliar sprays are labeled for crucifer crops, unless otherwise noted:
  - Cabrio EG (Group 11) at 12 to 16 oz/A (8 to 16 oz in radish). Not for use on canola or rapeseed.
  - Quadris Flowable (Group 11) at 6 to 15.5 fl oz/A is labeled for other fungal diseases on crucifers and can be used in Oregon to help control *P. lingam*.
  - Priaxor Xemium Brand (Groups 7+11) at 4 to 8 fl oz/A for use on canola only.
  - Proline 480 SC (Group 3) at 4.3 to 5.7 fl oz/A is labeled only for use on canola to control *Sclerotinia*, and can be used in Oregon to control black leg in canola.
  - Rovral 4F (Group 2) at 2 to 4 pints/A. For *Brassica* and *Raphanus* seed crops, except canola/rapeseed, in Oregon (SLN OR-130001) and Washington (SLN WA-960027) only.

References

1. du Toit, L.J., and Derie, M. L. 2005. Evaluation of fungicide seed treatments for control of black leg of cauliflower, 2004. Fungicide & Nematicide Tests 60:ST011.
2. Rimmer, S.R. and van der Berg, C.G.J. 2007. Black leg (Phoma stem canker). Pp. 19-22 in: Compendium of Brassica Diseases. S.R. Rimmer, V.I. Shattuck, and L. Buchwaldt. (eds.), APS Press, St. Paul, MN. 117 pp.