

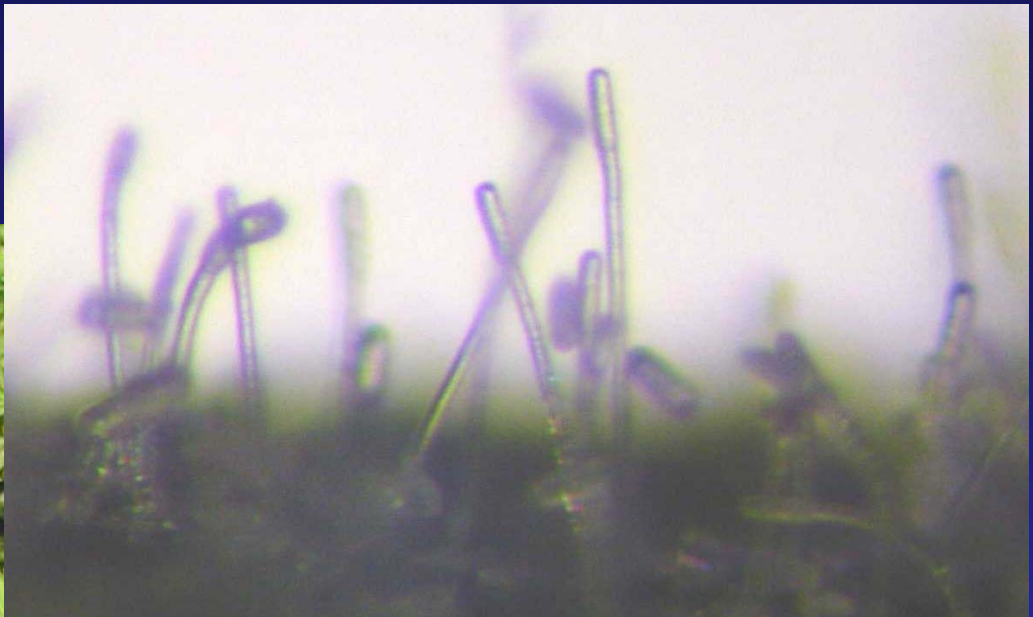
Management of Alternaria leaf blight in carrot seed crops

- disease-free seed & stecklings
- minimum 2-3 year crop rotation
- plow or disc infested residues
- fungicides
 - coppers
 - Bravo, Terranil (chlorothalonil)
 - Quadris
 - Rovral (foliar & seed treatment)
 - applications based on disease severity
 - new fungicides: Cabrio, Pristine, Folicur, ...?
- seed treatments
 - thiram, Rovral, Maxim, hot water, chlorine

Management of black rot in carrot seed crops

- disease-free seed, stecklings
- 8+ year crop rotation
- plow or disc infested residues
- avoid overhead irrigation, where possible
- resistance
- fungicides
 - coppers
 - Rovral 4F (foliar, seed treatment)
 - new (Maxim, Quadris, Pristine, ...)
- **seed treatments**
 - hot water @ 122°F for 30 min
 - hot chlorine (0.1-1.0% @ 122°F for 30 min)

Powdery mildew
Erysiphe heraclei



Powdery mildew in carrot seed crops

- no yield loss if infection occurs > mid-June, otherwise seed yield/quality reduced
- remove wild/volunteer carrots
- isolate crops
- pathogen-free stecklings
- fungicides:
 - Kaligreen (potassium bicarbonate)
 - sulfurs (e.g., Kumulus DF, Microthiol Disperss)
 - Quadris F
 - AQ10 biofungicide (incompatible with some fungicides)

Phytoplasmas

Aster yellows &
Beet leafhopper-
transmitted virescence
agent (BLTVA)



**Aster yellows,
Beet leafhopper-
transmitted
virescence agent
(BLTVA)**



Phytoplasmas in seed crops

- leafhopper transmitted
- more prevalent after mild winters
- isolate from alternative & weedy hosts (?)
 - Aster yellows/BLTVA: onion, Umbelliferous crops, Cruciferous crops, tomato, lettuce, many weeds, some ornamentals
- insecticides for leafhopper control
 - variable efficacy
 - timing relative to leafhopper migration

**Beet curly top
virus
(BCTV)
beet leafhopper**





Beet Curly Top Virus (BCTV) in seed crops

- beet leafhopper
- more prevalent after mild winters
- extensive host range
 - mustards, in perennial or winter annual weeds
- insecticides for leafhopper control
 - variable efficacy
 - timing relative to leafhopper migration
- resistance (?)

Diseases of small-seeded vegetable seed crops

Allium seed crops

- gray mold/scape blight/neck rot
- black mold
- bacterial soft rots
- Fusarium basal rot
- viruses ??

iris yellow spot virus = IYSV

Botrytis scape & flower blight

B. allii

B. squamosa,

B. cinerea,

B. byssoidea

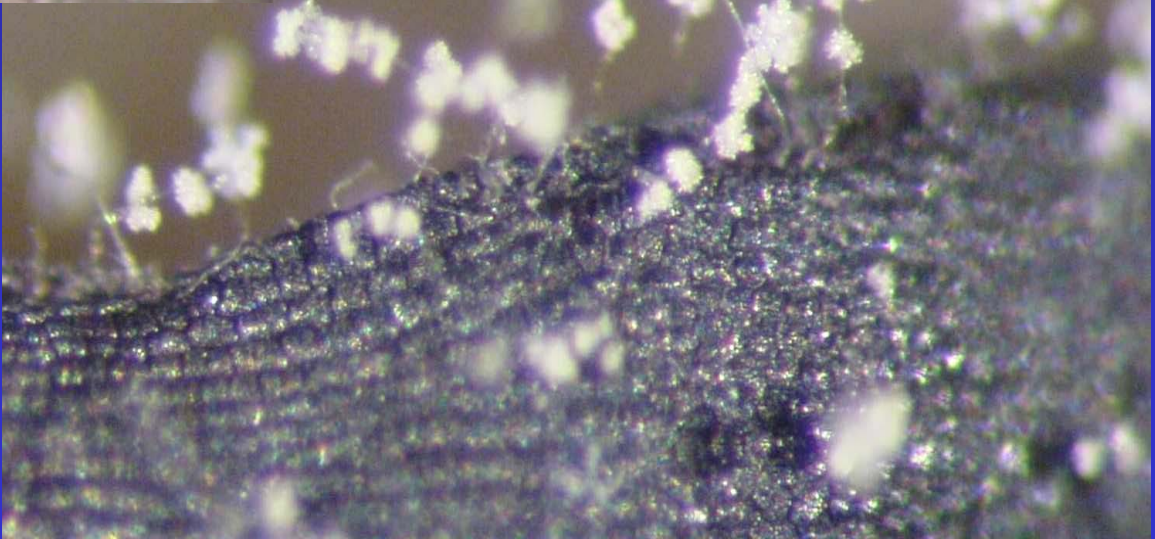


JUL 23 2001

JUL 23



Seed-borne *Botrytis*



2001/02 survey of onion seed crops in WA

Incidence (%) of plants infected with *Botrytis allii* ^a

Field & irrigation	Plants sampled					Visual symptoms in the field ^b				
	9/01	11/01	4/02	6/02	7/02	9/01	11/01	4/02	6/02	7/02
A (spr)	5	5	15	100	100	0	0	0	0	7
B (spr) ^c	3	0	-	-	-	0	0	-	-	-
C (furr)	15	3	70	100	100	0	0	0	0	16
D (furr)	8	10	95	100	100	0	0	2	5	10
E (furr)	63	0	70	100	100	0	0	0	2	10
F (furr)	8	3	25	100	100	0	0	1	6	7
G (furr)	18	3	30	95	100	0	0	0	2	4
H (spr) ^d	-	-	65	90	100	-	-	0	0	17
Mean	19.6	3.2	52.9	97.9	100	0.0	0.0	0.4	2.1	8.7

^a 20 or 40 plants sampled randomly per field

^b 100 plants rated for symptoms of neck/bulb rot, scape/umbel blight

^c Crop plowed under in 03/02

^d Bulb-to-seed crop

2001/02 survey of 7 onion seed crops in WA

Incidence (%) of seed infected/infested with *Botrytis* spp.^a

Field & irrigation ^b	Stock seed		Harvested seed		
	Internal ^c	External ^c	Internal		
	<i>B. allii</i>	<i>B. allii</i>	<i>B. allii</i>	<i>B. porri</i>	<i>Aspergillus</i>
A (sprinkler)	F,M = 0.00	F,M = 0.75	0.25	0.00	55.25
B (sprinkler)	F,M = 0.00	-	-	-	-
C (furrow)	-	-	6.00	0.00	33.75
D (furrow)	-	-	5.50	0.00	23.00
E (furrow)	1.50	0.75	28.25	0.00	9.00
F (furrow)	-	-	3.75	0.25	48.75
G (furrow)	3.00	6.75	1.50	0.00	0.75
H (sprinkler) bulb-to-seed	-	-	0.00	0.00	27.75
Mean	1.13	2.06	6.46	0.04	28.32

^a 400 seed/field; F = female parent, M = male parent; - = seed unavailable

^b sprinkler = overhead irrigation

^c Internal = 60 sec. rinse in 0.5% NaOCl + triple H₂O rinse; External = 60 min. rinse in H₂O

Management of Botrytis in onion seed crops

- pathogen-free seed, treated seed
- fungicides
 - seed treatment (hot water, Thiram, Rovral, chlorine)
 - foliar sprays (e.g., Rovral, Bravo, Switch)
 - new fungicides (Serenade, Switch, Pristine, Endura, Botran, ...)
- “healthy” crop
- sanitation (volunteers, culls, debris)
- rotation & isolation from other Allium crops
- well-dried umbels < harvest, artificial drying

Iris yellow spot virus IYSV



Iris yellow spot virus (IYSV) in *Allium* seed crops

- onion thrips, not Western flower thrips
- not known to be seedborne, nor present in bulbs
- can cause significant yield losses (bulb & seed crops)
- range from symptomless to striking
- host range
 - onion, garlic, leek, chive, iris, Nicotiana benthamiana & N. rustica, Datura stramonium*
- Brazil, Israel, Holland, US - western states

Diseases of small-seeded vegetable seed crops

Crucifer seed crops in semi-arid PNW

- viruses/BLTVA
- white rust
- powdery mildew
- Alternaria leaf/pod spot
- white mold
- damping-off/seedling blight fungi
(*Rhizoctonia*, *Aphanomyces*, *Pythium*)
- black leg??

White rust of radish

Albugo candida



White rust of radish seed crops

- light green spots; white, raised blisters
- abnormal growth on seed stalk ("staghorn");
seed may not form
- seed yield & quality may be reduced severely
- select isolated fields
- host range
 - radish, rapeseed, mustards (including wild mustard)
 - control wild mustards
- resistance (some daikon cultivars)
- incorporate debris after harvest
- fungicides:
 - seed treatment - captan, thiram
 - at planting - Ridomil Gold



Root rots/damping off of Crucifer seed crops *Aphanomyces*, *Pythium*, *Fusarium*

- blue-black lesions on roots
- constricted lesions, sometimes girdling
- discolored radial streaks
- general root rot, damping-off

- plant in well-drained soils, avoid overwatering
- > 3 year crop rotation
- fungicide treatment: e.g., Quadris in-furrow or banded





Small-seeded vegetable seed crops grown in the maritime coastal region of the PNW

Chenopodiaceous seed crops

spinach, table beet, Swiss chard

Cruciferous seed crops

cabbage, Brussels sprouts, cauliflower,
Chinese cabbage, ...

Others

Spinach leaf spot fungi:

Cladosporium leaf spot

Stemphylium leaf spot

Anthracnose



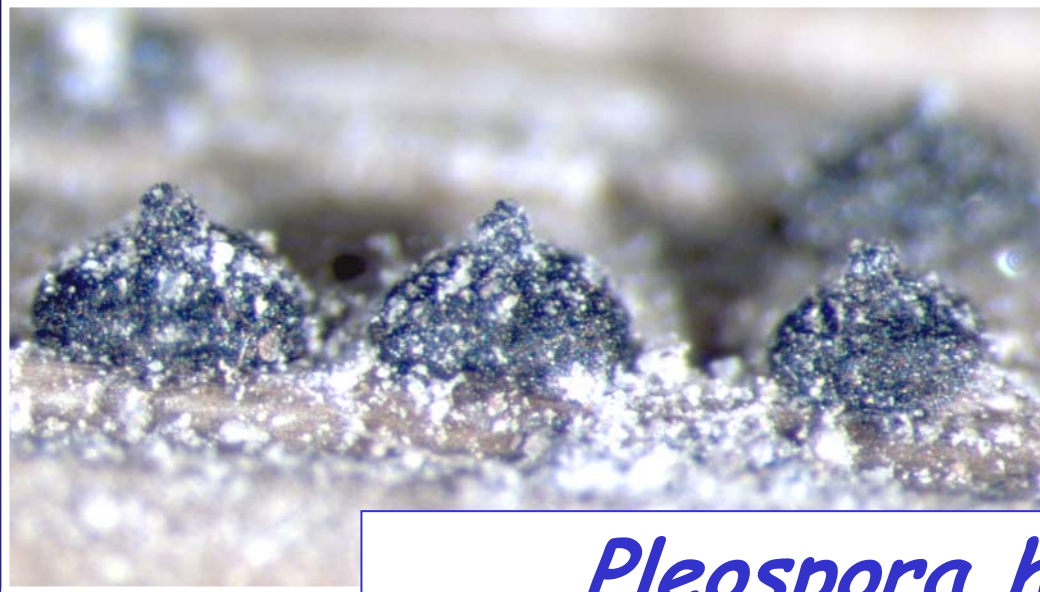
Photo by M.L. Derie



*Cladosporium
variabile*



*Stemphylium
botryosum*



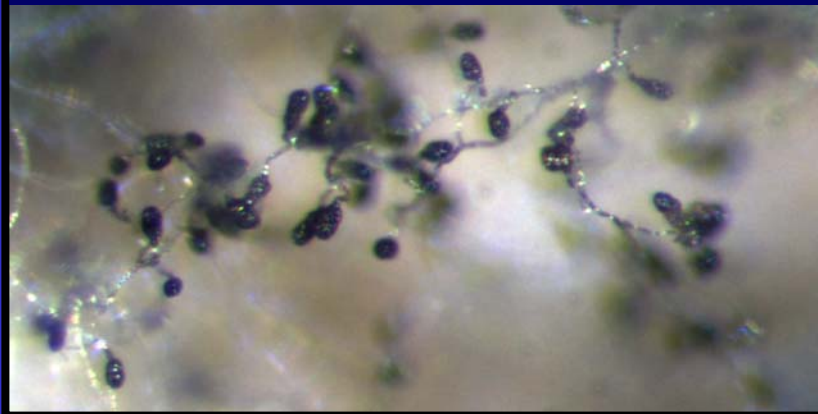
Pleospora herbarum
= sexual stage of *S. botryosum*



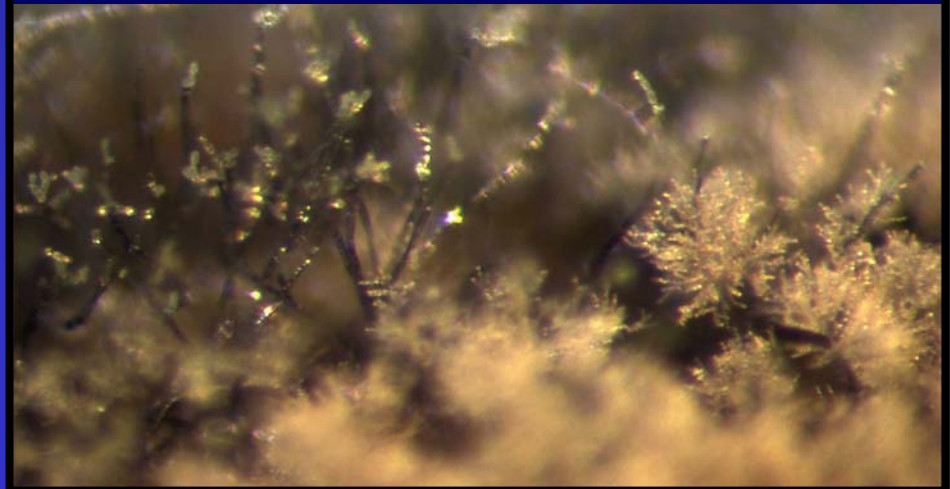
Seedborne potential of leaf spot fungi



Pseudothecia of *Pleospora herbarum* & conidia of *Stemphylium botryosum*



Conidiophores & conidia of *Cladosporium variabile* (top right & lower left) & a *Cladosporium* sp. (top left & lower right)



Spinach anthracnose: *Colletotrichum dematium* = *C. spinaciae*

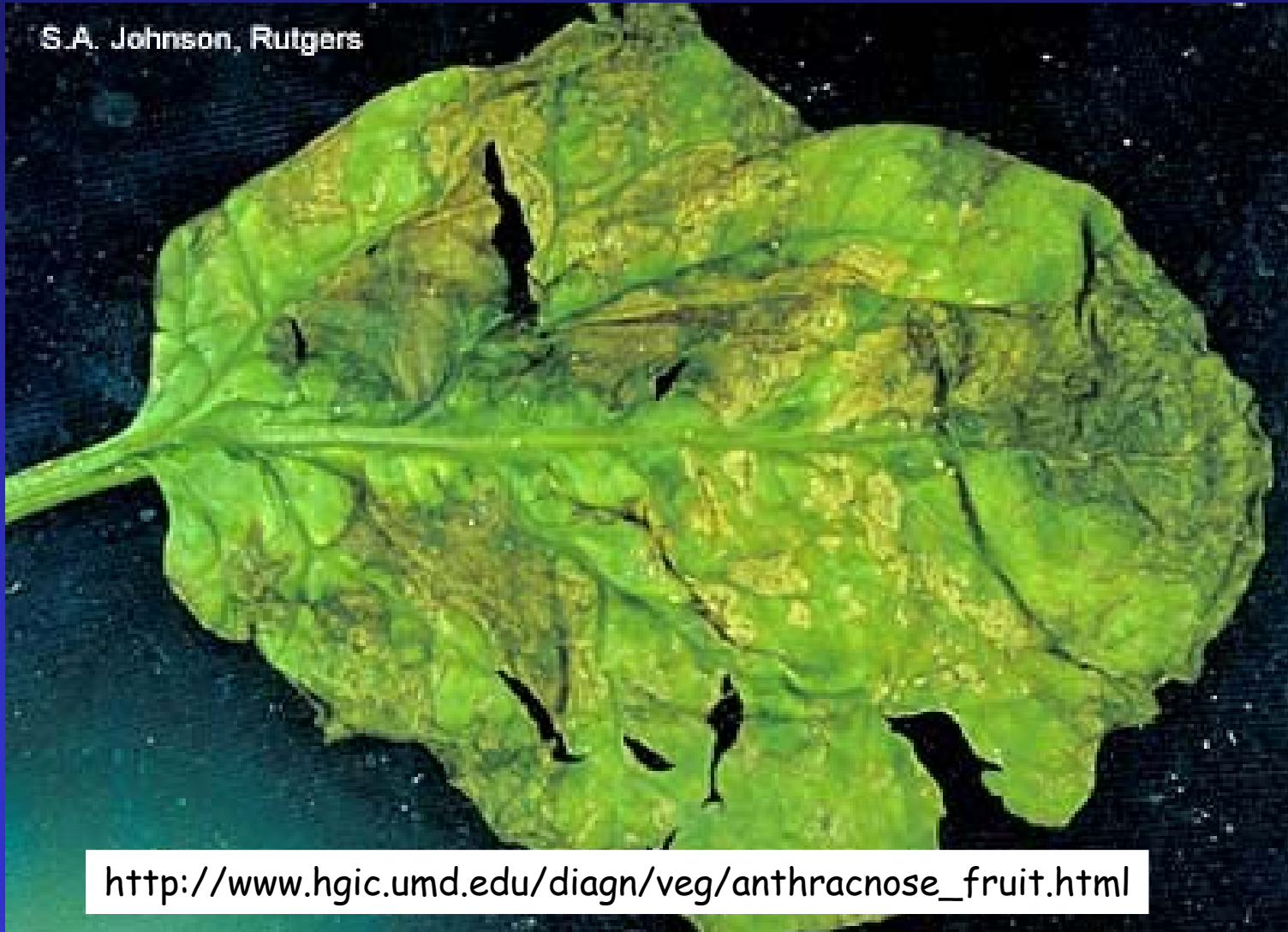


Photo by M.L. Derie

Spinach anthracnose:

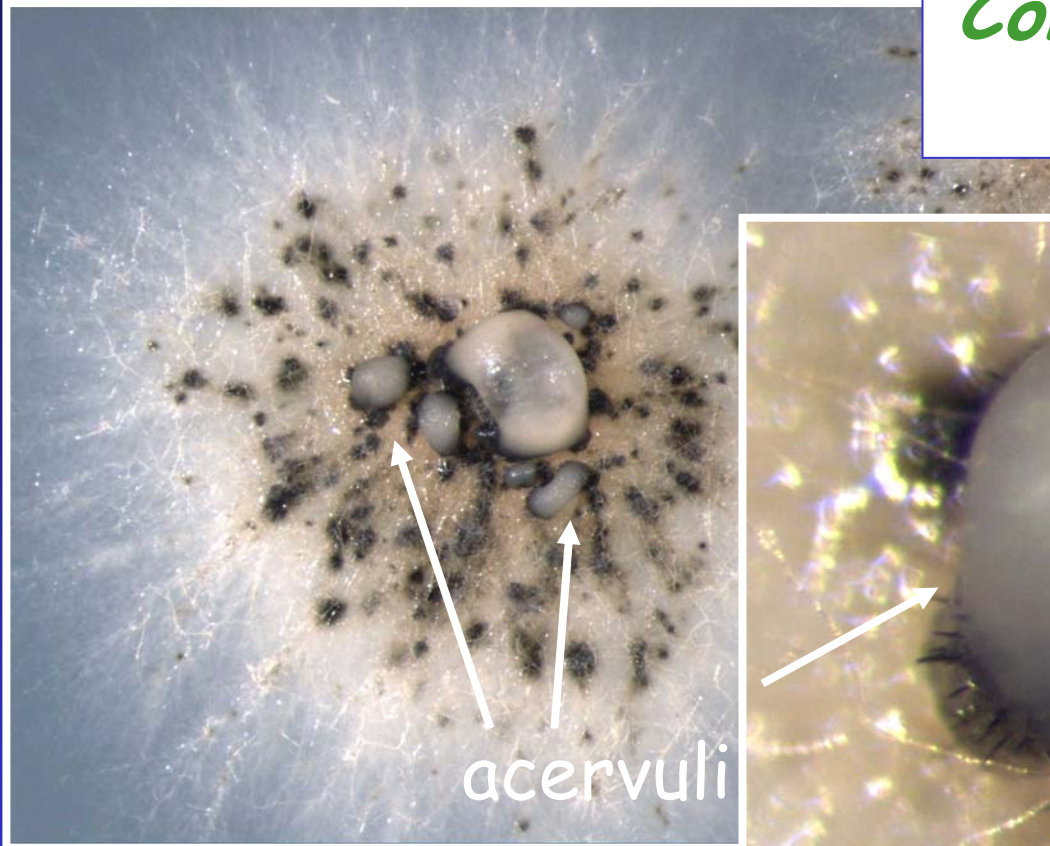
Colletotrichum dematium = *C. spinaciae*

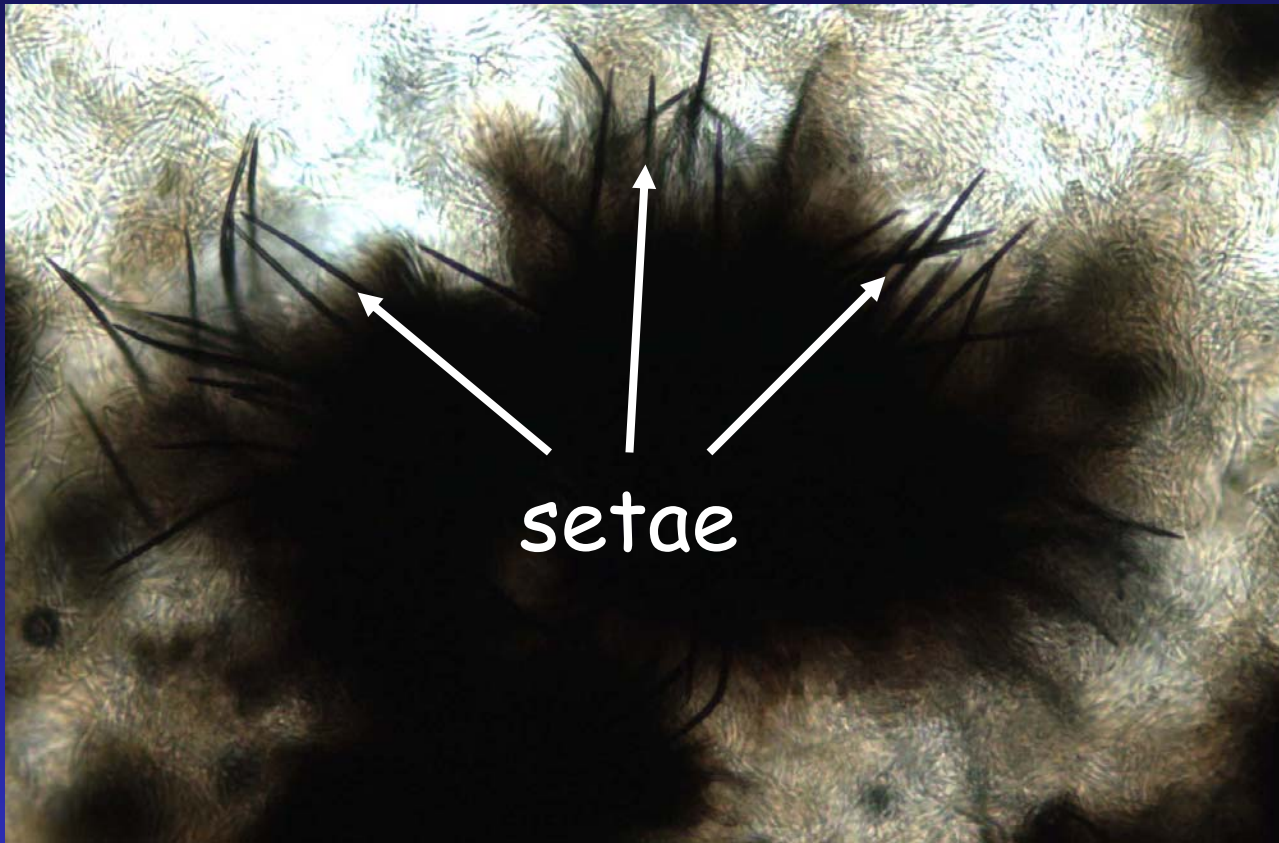
S.A. Johnson, Rutgers



http://www.hgic.umd.edu/diagn/veg/anthracnose_fruit.html

Spinach anthracnose:
Colletotrichum dematium
= *C. spinaciae*





setae

Spinach
anthracnose:
*Colletotrichum
dematium*



conidia

Cladosporium leaf spot, Stemphylium leaf spot, & anthracnose of spinach

	<i>Cladosporium variable</i>	<i>Stemphylium botryosum</i>	<i>Colletotrichum dematium</i>
Leaf spot symptoms	Distinct, develop dark margin	Diffuse, rapidly expanding	Distinct, coalesce
Spores in lesions	+ (abundant in moist conditions)	+ (in moist conditions)	+ (in acervuli)
Seedborne	+	+	+
Dispersal	Wind, seed	Wind, seed	Splashing water, seed
Overwintering	Volunteers, seed	Seed stalk debris, seed	Volunteers, seed
Favorable conditions	Moist, cool	Moist, warm, pollen	Wet, cool
Host range	> Chenopods?	Spinach	Spinach

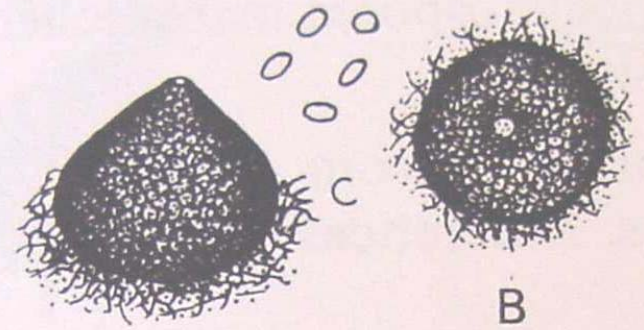
Beet & chard leaf spot fungi:

Phoma leaf spot

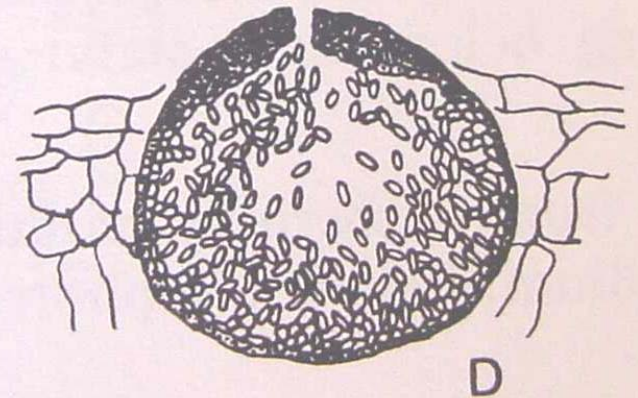
Ramularia leaf spot

Cercospora leaf spot

Phoma leaf
spot of beets
& chard:
Phoma betae



Barnett & Hunter, 1972



Phoma leaf spot of
beet/chard:
Phoma betae

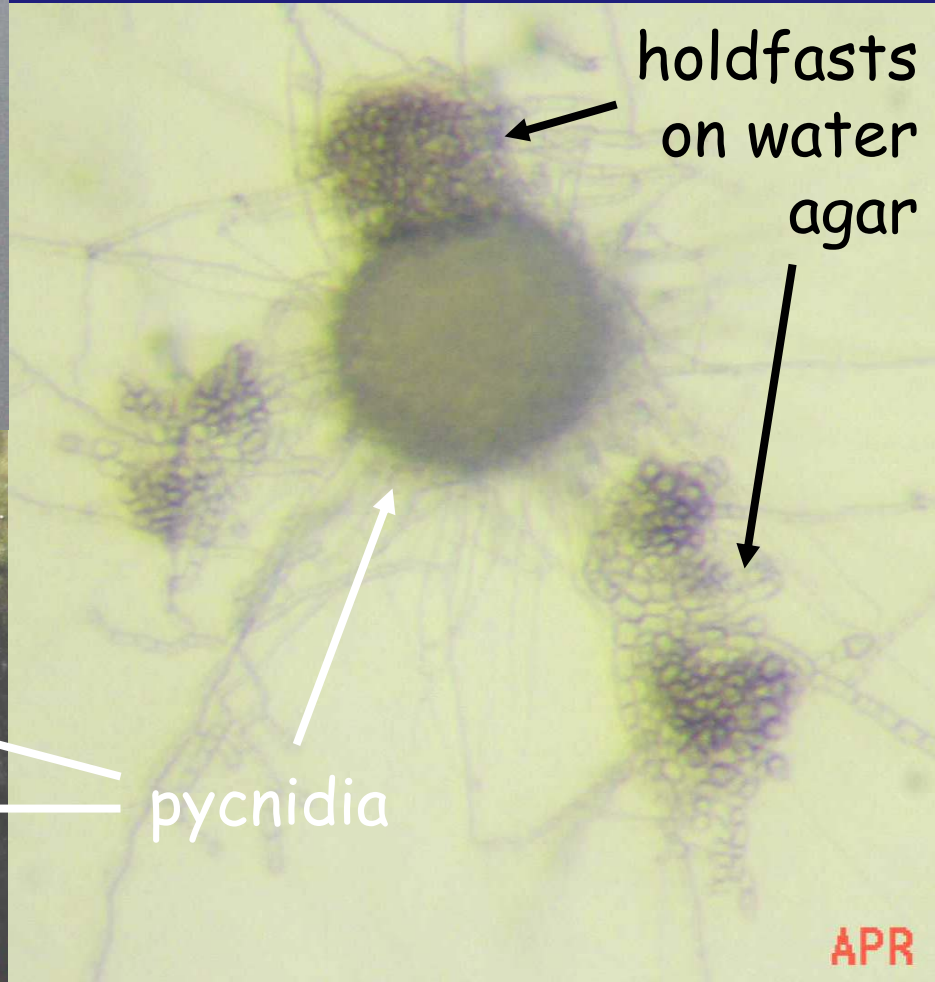
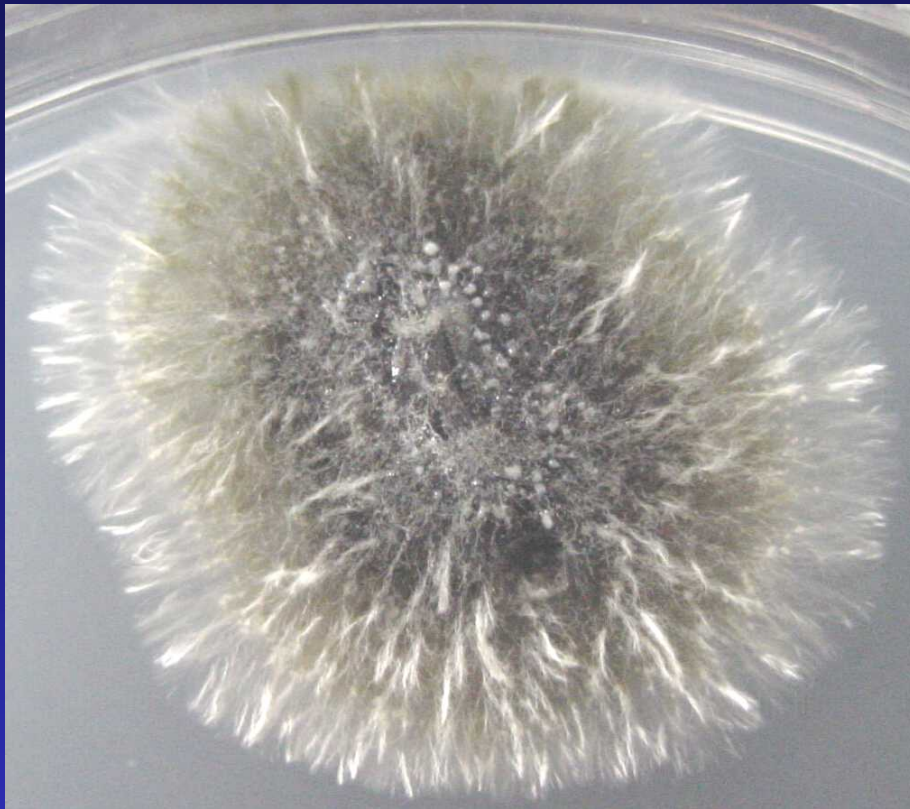
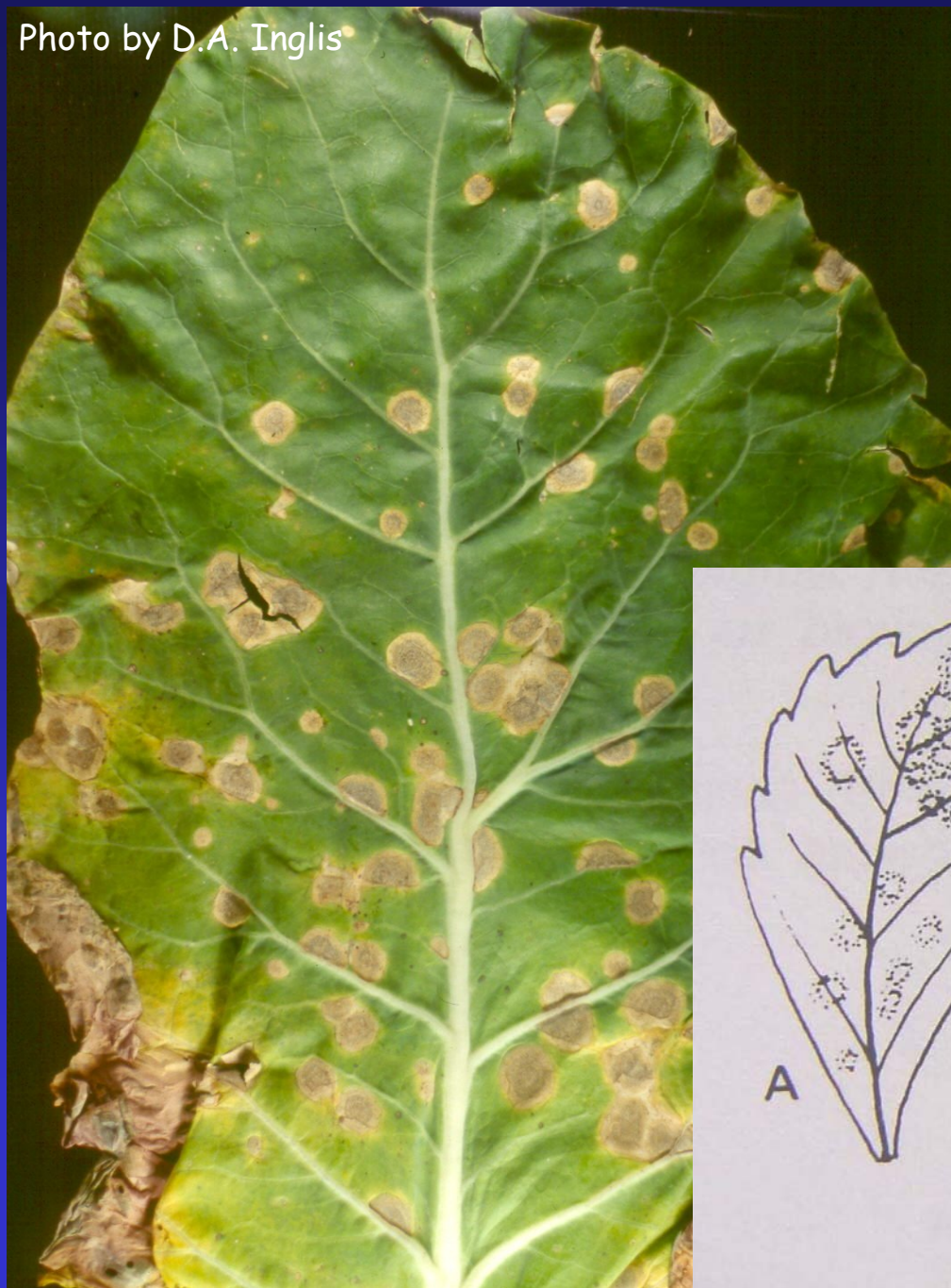
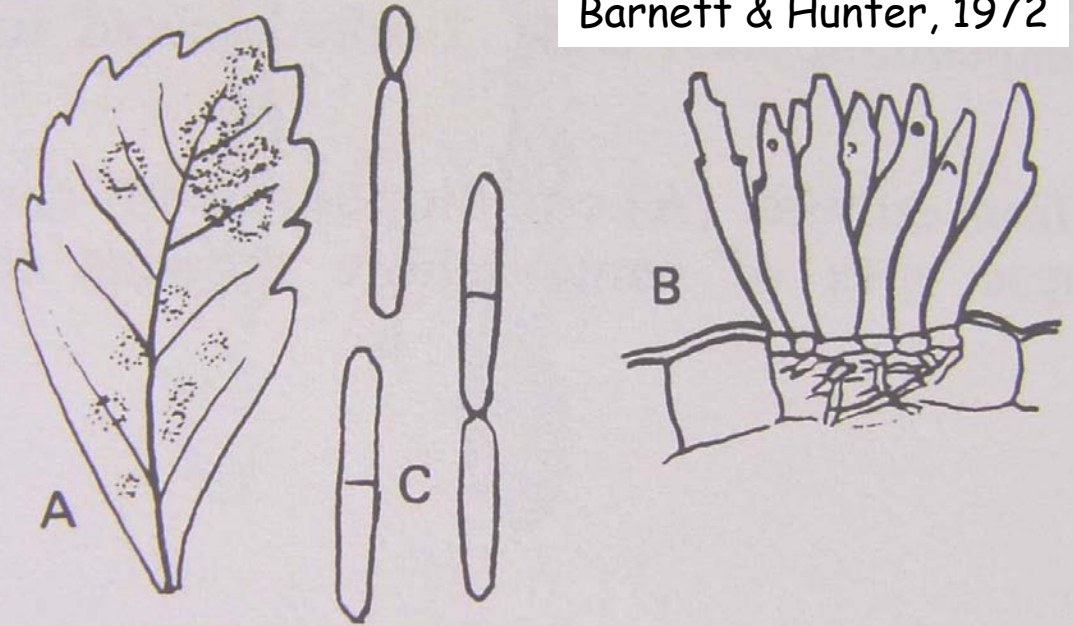


Photo by D.A. Inglis



Ramularia leaf spot
of beet & chard:
Ramularia betae

Barnett & Hunter, 1972

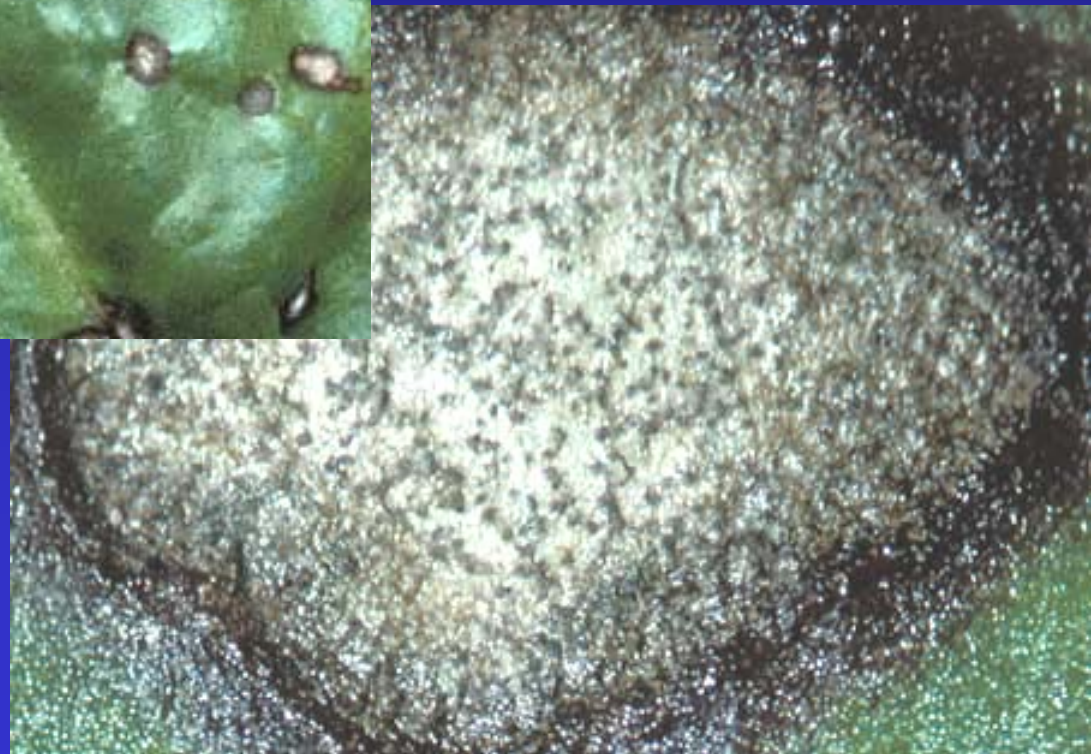


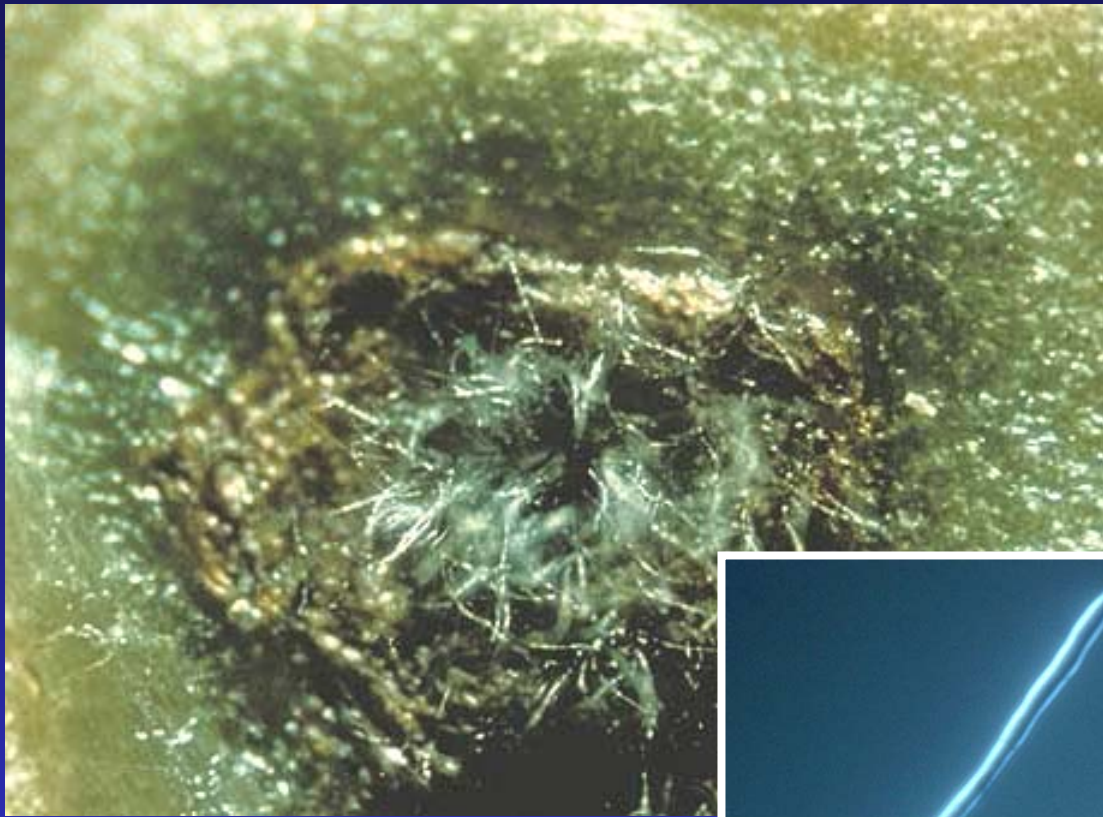
RAMULARIA



Cercospora leaf
spot of
beet/chard:
*Cercospora
beticola*

Photos at NDSU website:
[http://www.ext.nodak.edu
/extpubs/plantsci/rowcrops/pp1244w.htm](http://www.ext.nodak.edu/extpubs/plantsci/rowcrops/pp1244w.htm)





Cercospora leaf
spot of
beet/chard:
*Cercospora
beticola*

<http://www.ext.nodak.edu/extpubs/plantsci/rowcrops/pp1244w.htm>



Cercospora conidia

Cercospora leaf spot, Ramularia leaf spot, and Phoma leaf spot of beets/chard

	<i>Cercospora beticola</i>	<i>Ramularia betae</i>	<i>Phoma betae</i>
Symptoms	Circular leaf spots , red-brown margin, older leaves; Crown lesions	Light brown leaf spots , angular & larger, older leaves	Round leaf spots , concentric rings on perimeter, dark margin; Seedling black leg ; Crown rot
Spores in leaf spots	Minute black dots (stromata) in spots	Silvery gray to white in spots	Black pycnidia in leaf spots, on crowns
Seedborne	+ (external)	+ (?)	+
Dispersal	Splashing water, wind, insects	Wind	Splashing water, insects
Overwinter	Weeds, debris	Debris	Soil, roots, debris, weeds
Fav. conditions	<u>Warm</u> , moist	<u>Cool</u> , moist	<u>Cool to warm</u> , moist
Host range	Beet, chard, Chenopod. weeds	Beet, chard	Beet, lambsquarter

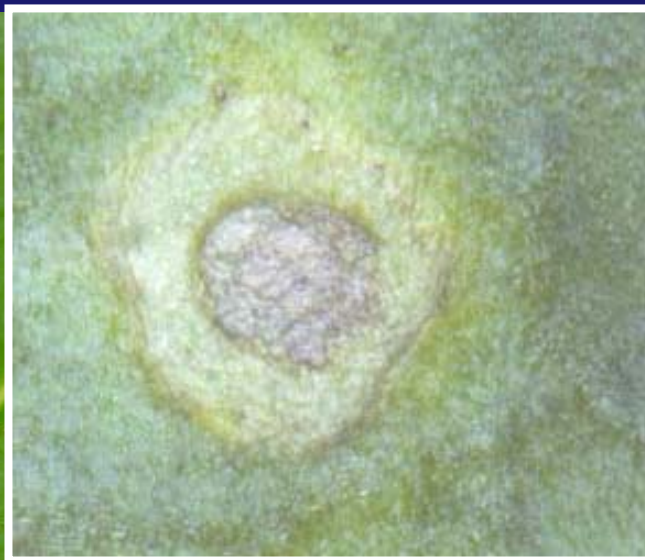
Crucifer foliar pathogens:

Alternaria leaf spot

Ring spot

Bacterial diseases

Alternaria leaf/pod spot of crucifers:
Alternaria brassicicola & *A. brassicae*



JUN 14

Alternaria leaf/pod spot of crucifers

Alternaria brassicicola

smaller spores in chains, no beak

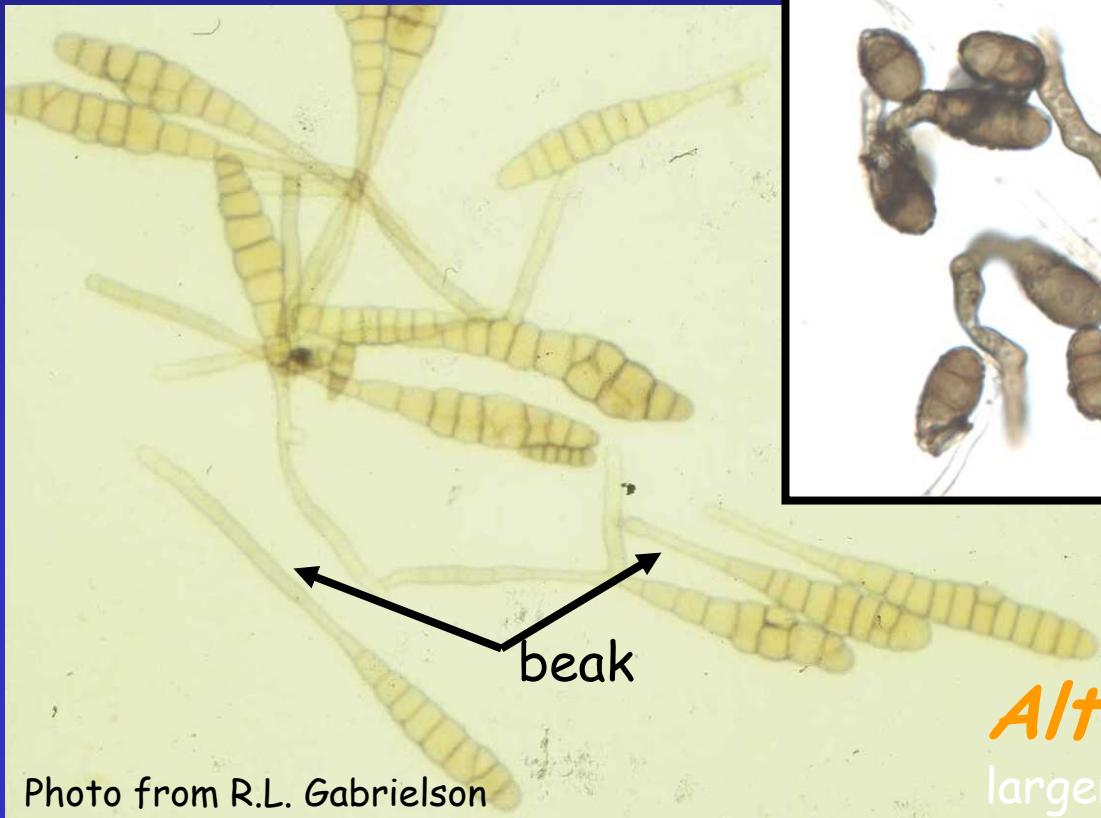
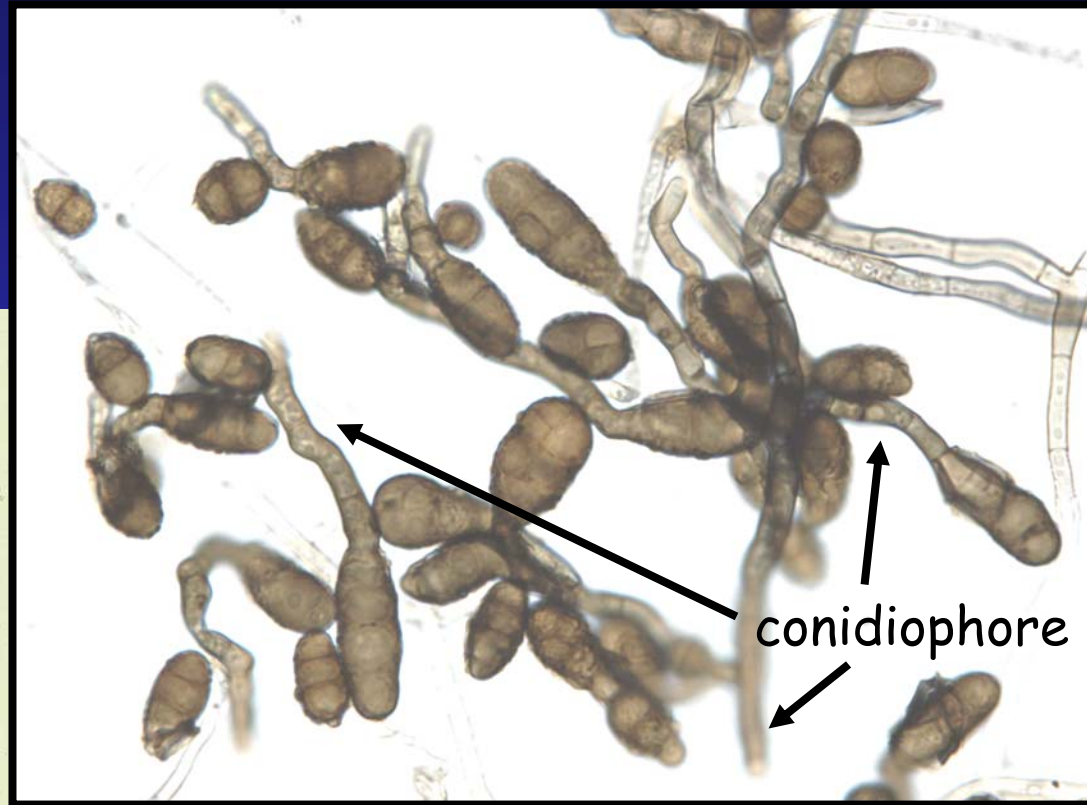


Photo from R.L. Gabrielson



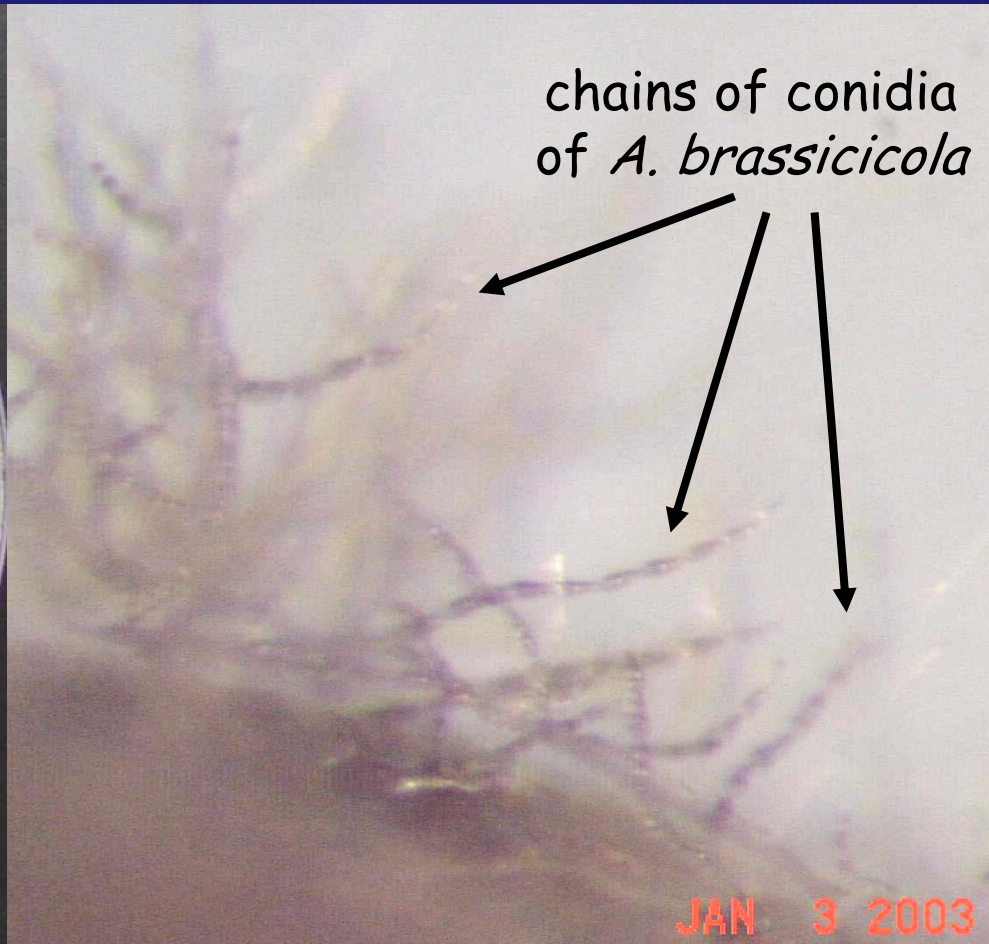
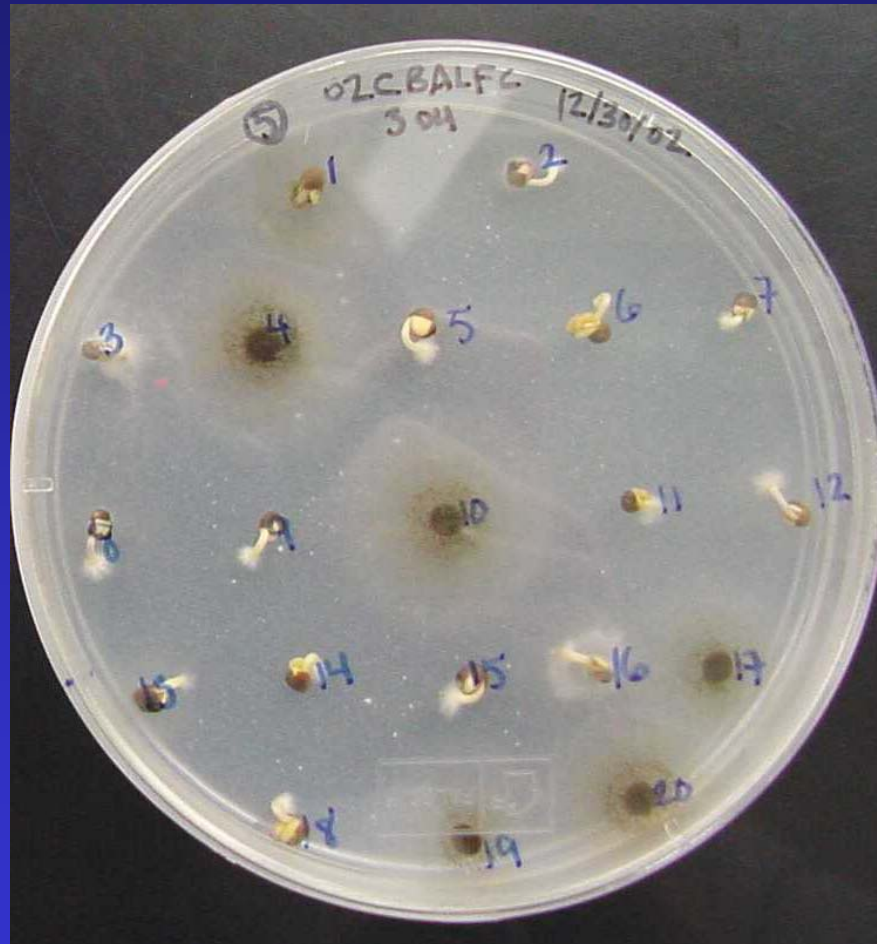
Alternaria brassicae

larger spores, not in chains, long beak

Alternaria leaf/pod spot of crucifers:
Alternaria brassicicola & *A. brassicae*



Alternaria leaf/pod spot of crucifers:
Alternaria brassicicola & *A. brassicae*



Ring spot of crucifers:
Mycosphaerella brassicicola



Photo from R.L. Gabrielson



MAY 1 2003

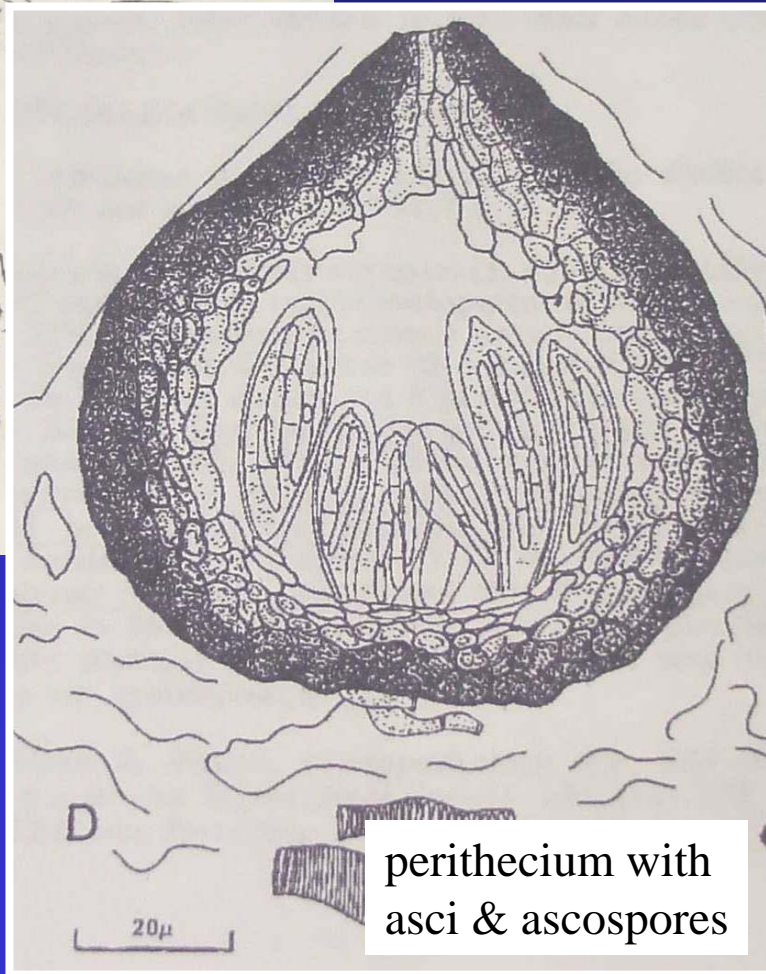
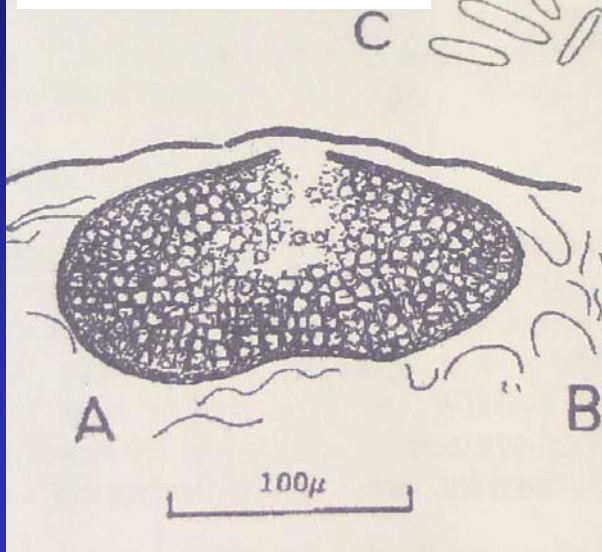
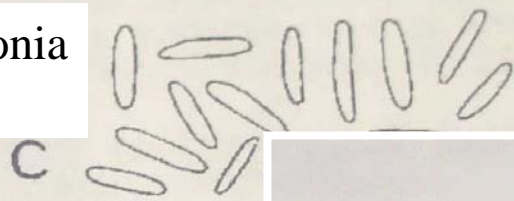
Ring spot of crucifers:
Mycosphaerella brassicicola



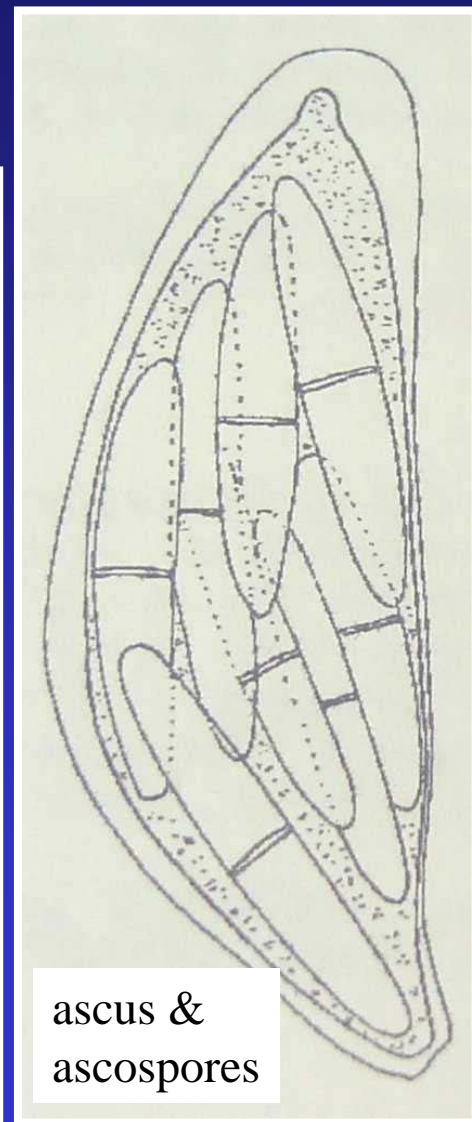
Photo from R.L. Gabrielson

Ring spot of crucifers: *Mycosphaerella brassicicola*

sterile spermagonia
& “conidia”



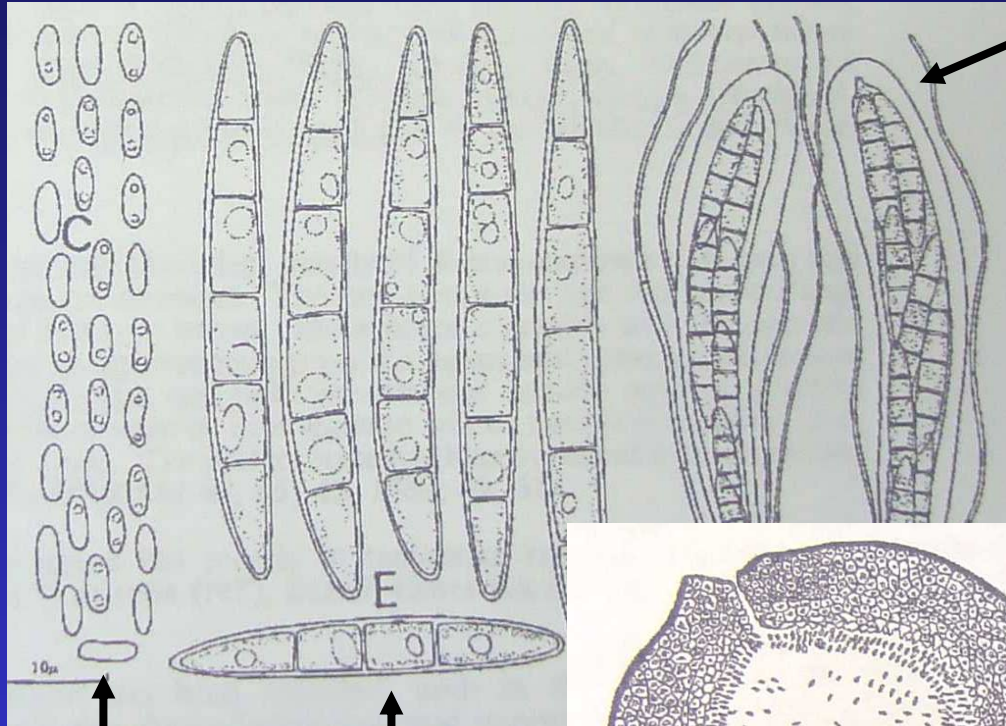
perithecium with
asci & ascospores



ascus &
ascospores

Drawings from CMI
Descriptions of
Pathogenic Fungi &
Bacteria No. 468

Black leg of crucifers: (*Phoma lingam*, sexual stage = *Leptosphaeria maculans*)



asci & ascospores

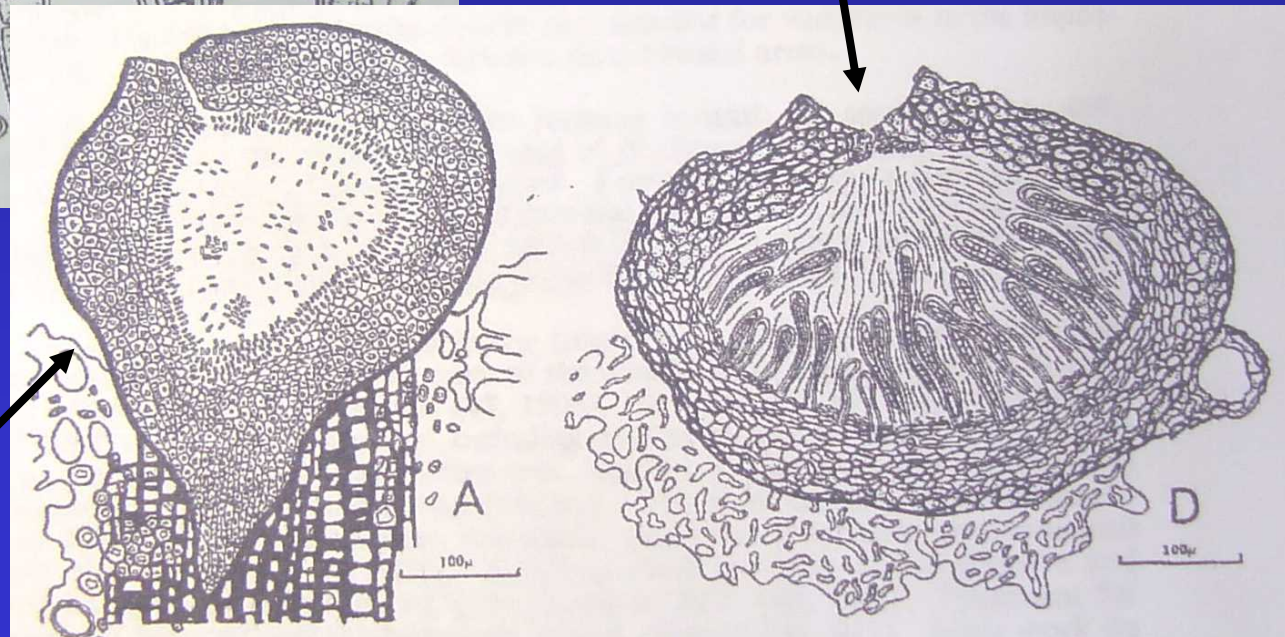
Drawings from CMI
Descriptions of
Pathogenic Fungi &
Bacteria No. 331

perithecium with asci & ascospores

conidia

ascospores

pycnidium with conidia



Alternaria leaf/pod spot & ring spot of crucifers

	Alternaria leaf/pod spot	Ring spot
Symptoms	Black circular - irregular lesions; necrotic center; black spots on pods & racemes	Circular lesions, definite margin & chlorotic halo, concentric zonation; lowest leaves
Spores in leaf spots	Naked spores	Black pycnidia &/or perithecia in concentric rings
Seedborne	+	-
Dispersal	Wind, insects	Splashing water, insects
Overwinter	Debris, biennial seed crops	Debris, biennial seed crops
Favorable conditions	Moist, <u>warm</u>	Moist, <u>cool</u>
Host range	Crucifers, beet	Crucifers