Welcome to the webinar!

- The webinar will start at the top of the hour.
- Find a handout of the slides in the "handouts" section of your gotowebinar control panel.
- To type in a question, use the question box on your control panel.
- The webinar is being recorded and you can find it in our archive within the next 2 weeks at http://www.extension.org/pages/25242 and on the eOrganic YouTube channel

ORGANIC seed ALLIANCE

Advancing the ethical development and stewardship of the genetic resources of agricultural seed

www.seedalliance.org

Organic Seed Production 2017 Webinar Series: Diseases and Pests

Jared Zystro, Organic Seed Alliance
Jodi Lew-Smith, High Mowing Seeds

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ORGANICS = PREVENTION

- Because the chemical toolbox for organics is so limited, our key strategy is to PREVENT disease and treat only as a last resort
- KNOWLEDGE is our most powerful tool

For seed-borne disease . . .

Your best friend could be the home germ test

– especially for any seed you have concerns about.

Learn to spot signs of disease in the smallest seedling

http://nwdistrict.ifas.ufl.edu/phag/2016/04/08/getting-your-cotton-started-off-right/

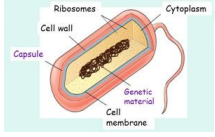
DISEASES COME FROM PATHOGENS, WHICH COME IN THREE FLAVORS:

- **BACTERIA** Systemic (=inside), <u>treatable on seed</u> but less so in fields
- **FUNGI** Topical (=on surface), <u>treatable in fields</u> but less so on seed
- **VIRUSES** Systemic, <u>not treatable</u> anywhere

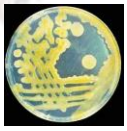
BACTERIA

simple cells with 'soft' cell walls, mostly have to stay moist at all times – so live INSIDE of plants

-Hard to stop in the field – they get into plant veins and tend to travel throughout whole plants (systemic)
-Likely to get INTO seed
-Easier to treat inside seed than fungi, as more sensitive to heat



From Microbiology



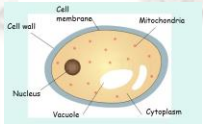
Institute of Cell and Molecular Biology, The University of Edinburgh

Xanthomonas campestris

FUNGI

complex cells with hard (chitin) cell walls, spread by spores and tend to colonize the OUTSIDE of plants

-Easier to set back in field because often on plant surfaces
-Variable entry into seed
-Variable success in treating on seed (some more sensitive to heat than others)
-Can live in soil, but usu.insignificantly seed-borne if soil-borne



From Mushbiology

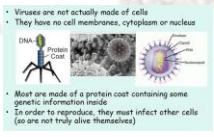

Photo: High Mowingseeds

Botrytis cinerea on lettuce seed

VIRUSES

packaged DNA or RNA – no cells –hard to 'kill' (very different from other two)

- Impossible to stop in field
- Hard to treat in seed (esp. without killing seed)
- Often less devastating as diseases go
- Easier to detect <u>before</u> planting (strip tests)



From Mushbiology


From Cornell Cooperative Extension

As a seed grower, what do I need to worry about?

- RED ALERT diseases
  = highly virulent, highly seed-borne
- ORANGE ALERT diseases
  = moderately virulent, highly seed-borne
  <u>OR</u> highly virulent, moderately seed-borne
- YELLOW ALERT diseases
  = moderate or weakly virulent, moderate or weakly seed-borne (I won't talk about these today)

Luckily…

- There are only a handful of red alert diseases.
- The worst of which are brassica diseases

SEED-BORNE BRASSICA DISEASES

- BLACK ROT
- BLACK LEG

Washington State Statute:

WAC 16-301-490 (effective 10/26/14)

Establishing a crucifer seed quarantine for black leg, black rot, and dormant seed.

. . . The director has determined that a quarantine is needed to protect the Washington crucifer vegetable seed, biofumigant and oil seed industries from the introduction of seed from areas known to be infected with black leg of crucifers and black rot and from the introduction of crucifer seed containing dormant seed. The quarantine will provide the seed growers in this state with sources of crucifer seed that have been tested and proven to be free from black leg and black rot and free from dormant seed.

Which means . . .

Any seed sold to Washington State must be accompanied by a test result of no disease found in 30,000 seeds

So most brassica seed is now being tested for black rot and blackleg!!

http://agr.wa.gov/Inspection/SeedInspection/CruciferSeedQuarantine.aspx

Brassica BLACK ROT

BACTERIA (*Xanthomonas campestris*)

- **RED ALERT**
- Highly virulent, highly seed-borne
- Distinction of being #1 among top ten seed-borne diseases
- Spreads quickly in warm, humid weather
- Sensitive to hot water and aerated steam treatment

BLACK ROT SYMPTOMS

Spreads rapidly in warm, humid weather

BLACK ROT SYMPTOMS

Leaf margins, primarily veins
– will MELT the field

Prevention Entails

1. Clean seed, ideally tested for black rot
2. Careful scouting in the field, especially during seed maturation (how it gets into seed)
3. Sanitary prevention for equipment traveling between fields

Brassica BLACKLEG

FUNGUS
(*Phoma lingam / Leptosphaeria maculans*)

- RED ALERT (#2 for Brassicas)
- Highly virulent, highly seed-borne
- Spreads quickly in warm, humid weather
- Not as common or explosive as Black Rot, but more able to survive in fields (up to 4 years) and become an ongoing problem
- Sensitive to hot water treatment and potentially to aerated steam

BLACKLEG SYMPTOMS

Stem cankers encircle stems, typically at base, black pycnidia visible within cankers

BLACKLEG SYMPTOMS

Dark grey lesions on roots, eventual spots on leaves

Prevention Entails

1. Clean seed, ideally tested for blackleg
2. Careful scouting in the field <u>throughout the season</u>
3. Spacing, sanitation, careful handling (not when wet)
4. Well-drained fields with good air flow

SEED-BORNE LETTUCE DISEASES

- LETTUCE MOSAIC VIRUS (LMV)

LMV

- RED Alert
- Highly virulent, highly seed-borne
- Very common, especially on the west coast
- Spreads by insects, mainly leaf hoppers
- Not as deadly as fungal or bacterial diseases – such that low levels can be tolerable in some regions
- Some varieties are symptomless carriers

LETTUCE MOSAIC VIRUS SYMPTOMS

Difficult to distinguish from CMV in fields, but tests are readily available

LETTUCE MOSAIC VIRUS SYMPTOMS

Prevention entails:

1. Clean seed, should ideally come with an "MTO test"
2. Roguing early and often, flagging areas showing virus
3. Understanding of end-market requirements –will it be tested? Is the crop *required* to be virus-free?

SEED-BORNE CARROT DISEASES

- BACTERIAL BLIGHT
- FUNGAL BLIGHTS
  - ALTERNARIA BLIGHT
  - CERCOSPORA BLIGHT

Carrot BACTERIAL BLIGHT

- BACTERIA (*Xanthomonas campestris* pv. *carotae*)
  - Orange Alert
  - Moderately virulent, highly seed-borne
  - Primarily causes yield losses due to poor seed germination

Bacterial Blight symptoms

Lesions turn dark brown and shiny, and progress down petiole

Prevention entails:

1. Clean seed from a reputable source (won't come with a test result, but should be vigorous in a germ test)
2. Careful scouting in the field early, especially before overwintering/storing roots
3. Sanitary prevention for equipment traveling between fields

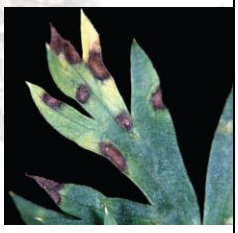
Carrot FUNGAL BLIGHTS

TWO FUNGI

- ALTERNARIA BLIGHT (*Alternaria dauci*, also *A. radicina*)
- CERCOSPORA BLIGHT (*Cercospora carotae*)

- Orange Alert
- Moderately virulent, moderately seed-borne
- Can occur in the same field, cause yield losses due to leaf loss

Cercospora Blight symptoms



Spots more round, better defined

Alternaria Blight symptoms

Lesions more irregular, typically on margins

Prevention entails:

1. Clean seed from a reputable source (won't come with test result, but should be vigorous in a germ test)
2. Careful scouting in the field early, especially before overwintering/storing roots
3. Sanitary prevention for equipment traveling between fields

Other aspects to Carrot Seed Quality

- Prevention of crossing to Queen Anne's Lace
- Issues of low-vigor seed due to environmental conditions that don't seem to favor carrot seed quality
- Increasing or decreasing spacing to favor primary v. secondary umbels

SEED-BORNE ONION DISEASES

- ONION WHITE ROT

Onion WHITE ROT

FUNGUS
(*Sclerotium cepivorum, Sclerotinia sclerotiorum*)

- Orange Alert
- Doesn't actually travel on seed itself, but black sclerotia can easily get mixed with seed because they look so similar
- Most prevalent in cool seasons and poorly-drained fields
- Sclerotia can persist in soil for up to fifteen years

White Rot Symptoms

White Rot Symptoms

Fluffy white mold, black spores and sclerotia

Prevention entails:

1. Clean seed from a reputable source (purity testing should pick up white rot sclerotia)
2. Careful scouting in the field early, especially before overwintering/storing bulbs
3. Sanitary prevention for equipment traveling between fields

SEED-BORNE TOMATO DISEASES

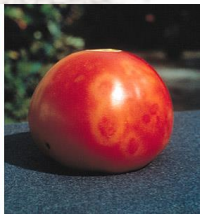
- TOMATO MOSAIC VIRUS
- BACTERIAL DISEASES
  - BACTERIAL SPECK
  - BACTERIAL SPOT
  - BACTERIAL CANKER

TOMATO MOSAIC VIRUS

Effectively same as Tobacco Mosaic Virus

- Red Alert
- Highly virulent, highly seed-borne
- Commercial damage may range from light to heavy, but disease extremely hard to eradicate from seed
- Good strip test available from Agdia

Tomato Mosaic Virus symptoms

Because it's essentially the same as Tobacco Mosaic Virus . . .

It can be transferred from tobacco in cigarettes to your plugs or field

Prevention entails:

1. Clean seed, especially be wary of the "1000-variety" all-tomato companies
2. GLOVES, especially for smokers
3. Buying TMV strip tests from Agdia, Inc.to test all stock seed
4. Rogue early and often, flagging areas showing virus
5. Understanding of end-market requirements –will it be tested? Is the crop *required* to be virus-free?

TOMATO BACTERIAL DISEASES

THREE BACTERIA

Bacterial canker (*Corynebacterium michiganense* pv. *michiganense*),

Bacterial Spot (*Xanthomonas campesiris* pv, *vesicatoria)*

Bacterial Speck (*Pseudomonas syringae* pv. *tomato*)

Orange Alert

- Highly to moderately virulent, highly seed-borne
- Cause considerable damage, esp. in GH's
- eradicated from seed by fermentation and/or hot water treatment (or aerated steam)

Bacterial Canker Symptoms

D. Cuppels, Agriculture & Agri-Food Canada, via BC Ministry of AG

Cornell Cooperative Extension

Round, pale, "birdseye" spots

Bacterial Spot Symptoms

Sherrie Smith, Univ. Ark

From Plant Health Progress article

Scabby, raised spots. Infects green fruit.

Bacterial Speck Symptoms

Univ of FL extension

Spots smaller, more shallow

Comparative Symptoms

Illinois Fruit and Vegetable News

Spots most distinctive features, leaf and stem symptoms often similar

Prevention entails:

1. Clean seed, ideally having undergone <u>heat or steam treatment</u> (controls all three!)
2. Bag and remove any plants showing symptoms.
3. If symptoms are noted or suspected, work healthy crops ahead of any with symptoms.

Print Resources

- 1. *Common Laboratory Seed Health Testing Methods for Detecting Fungi*. 2003. S.B. Mathur, O. Kongsdal. The International Seed Testing Association. Bassersdorf, CH-Switzerland.
- 2. *Crucifer Diseases: A Practical Guides for Seedsmen, Growers, and Agricultural Advisors*.1994. J. Cucuzza, T. Dodson, B. Gabor, J. Jiang, J. Kao, D. Randleas, V. Stravato, and J. Watterson. Plant Pathology Department, Petoseed Company, Inc. Saticoy, California.
- 3. *The Diagnosis of Plant Diseases: A Field and Laboratory Manual Emphasizing the Most Practical Methods for Rapid Identification*. 1972. R.B. Streets, Sr. The University of Arizona Press, Tucson, Arizona.
- 4. *Diseases and Pests of Vegetable Crops in Canada: An Illustrated Compendium*. 1994. R.J. Howard, J.A. Garland, W.L. Seaman, Eds. The Canadian Phytopathological Society and the Entomological Society of Canada. M.O.M. Printing Ltd. Ottawa, Ontario, Canada.
- 5. *Hortus Third, A Concise Dictionary of Plants Cultivated in the United States and Canada*. 1976. L. H. Bailey. Macmillan Publishing. New York, New York.
- 6. *Identifying Diseases of Vegetables*. 1994. A.A. MacNab, A.F. Sherf, J.K. Springer. Penn State College of Agricultural Sciences. University Park, Pennsylvania.
- 7. *Illustrated Genera of Imperfect Fungi*. 4th Edition. 1998. H.L. Barnett, B.B. Hunter, The American Phytopathological Society. APS Press. St. Paul, Minnesota.
- 8. *Laboratory Guide for Identification of Plant Pathogenic Bacteria*, 3rd Edition. N.W. Schaad, J.B. Jones, W. Chun. Eds. The American Phytopathological Society. APS Press. St. Paul, Minnesota.
- 9. *Plant Pathology*, 3rd Edition. 1988. G.N. Agrios. Academic Press, Inc. San Diego, California.
- 8. *Principles of Seed Pathology*, 2nd Edition. 1996. V.K. Agarwal, J.B. Sinclair. CRC Press, Inc., Lewis Publishers. Boca Raton, Florida.
- 10. *Rules for Testing Seeds*. 1999. Association of Official Seed Analysts. Lincoln, Nebraska.
- 11. *Seed to Seed; Seed Saving and Growing Techniques for Vegetable Gardeners*, 2nd Edition. 2002. S. Ashworth. Seed Savers Exchange, Inc. Decorah, Iowa.
- 12. *Tomato Diseases: A Practical Guides for Seedsmen, Growers, and Agricultural Advisors*.1997. B. Gabor and W. Wiebe, Eds. Plant Pathology Department, Seminis Vegetable Seeds, Inc. Saticoy, California.
- 13. *World Economic Plants: A Standard Reference*. 1999. J. H. Wiersema and B. Leon. Agricultural Research Service, United States Department of Agriculture. CRC Press, Inc. Boca Raton, Florida.

Online Resources

- Common Names of Plant Diseases
- http://www.apsnet.org/online/common/toc.asp
- Cornell University's Plant Disease Diagnostic Clinic Homepage http://plantclinic.cornell.edu/Default.htm
- Simplified Fungi Identification Key
- http://www.plant.uga.edu/Extension/pubs/fungikey.pdf
- SBML Fungal Databases – Selecting Fungus-Host Distributions
- http://nt.ars-grin.gov/fungaldatabases/fungushost/fungushostframe.cfm
- Vegetable Diseases Fact Sheets listed by Crop
- http://vegetablemdonline.ppath.cornell.edu/cropindex.htm
- Plant diseases directory for agricultural crops – Manitoba agriculture, food, and rural initiatives
- http://www.gov.mb.ca/agriculture/crops/diseases/index.html
- Plant Disease Information System http://www.pdis.org/
- Seedborne diseases and their control: Principles and practice. R.B. Maude. 1996. CAB International, Tucson, AZ.
- Hot water treatment of vegetable seeds to eradicate bacterial plant pathogens in organic production systems [Online]. S. Miller and M. Lewis Ivey. 2005. Ohio State Extension Bulletin HYG-3086-05. Available at: http://ohioline.osu.edu/hyg-fact/3000/pdf/3086.pdf (verified 10 March 2010).

Managing Diseases and Pests in Seed Crops

Jared Zystro, Organic Seed Alliance

Outline

1. **Considering potential pathogens**
2. **Reducing opportunities for pathogens**
3. **Choosing appropriate genetics**
3. **Managing environmental conditions**
4. **Managing diseases as they appear**

Considering potential pathogens

- What diseases are important to consider?
  - Virulent
  - Seedborne
  - Found in your area

Considering potential pathogens

- Talk to pathologist or consult references
- Disease knowledge will help you understand lifecycle, climatic preferences, alternate hosts, controls, etc.

Reducing opportunities

- Rotations
- Residue management
- Manage alternate hosts and volunteers

Reducing opportunities

- Caution around bringing seed in
- Sterilize seedling trays

Choose varieties with genetic resistance

Plant Disease Resistance Codes

A | Anthracnose | Fungus | *Colletotricum lindemuthianum*
AB | Early (Alternaria) Blight | Fungus | *Alternaria solani*
ALS | Angular Leaf Spot | Bacterium | *Pseudomonas syringae pv lachrymans*
AS | Alternaria Stem Canker | Fungus | *Alternaria alternata f sp lycopersici*
B | Bacterial Wilt | Bacterium | *Erwinia tracheiphila*
BB | Bacterial Blight | Bacterium | *Xanthomonas carotae*
BBS | Bacterial Brown Spot | Bacterium | *Pseudomonas syringae pv. syringae*
BLS | Bacterial Leaf Spot | *Xanthomonas campestris pv vesicatoria*
BLS 1-3 | Races 1-3
BLS 1, 2 | Races 1 & 2
BLS 1-10 | Races 1-10
BMV | Bean Mosaic Virus
BYMV | Bean Yellow Mosaic Virus
CMV | Cucumber Mosaic Virus
CTM | Curly Top Beet Mosaic Virus
CYYV | Cucumber Vein Yellowing Virus
DM | Downy Mildew | Water Mold
E | Enation Mosaic Virus
F | Fusarium Wilt | Fungus
FOR | Fusarium Crown and Root Rot | Fungus | *Fusarium oxysporum f. sp. radicis*
HB | Halo Blight | Bacterium | *Pseudomonas savastanoi pv phaseolicola*
L | Gray Leaf Spot | Fungus | *Stemphylium solani*

Advancing the ethical stewardship and development of agricultural seed

Manage environmental conditions

- Keep plants happy - avoid crop stress.
- Time planting to avoid conditions where pathogens thrive.

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Manage environmental conditions

- Maintain airflow with spacing and row orientation.
- Avoid overhead watering.

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Manage environmental conditions

- Time watering so that plants can dry quickly.
- Avoid working in field when plants are wet.

Manage diseases as they appear

- Remove and destroy infected plants.
- Apply OMRI approved controls.
- Know when to destroy the field.

Dry seed after harvest

- Find all upcoming and archived webinars at http://www.extension.org/pages/25242 and on the eOrganic YouTube channel
- Have an organic farming question? Use the eXtension Ask an Expert service at https://ask.extension.org/groups/1668/ask
- We need your feedback! Please respond to an email survey about this webinar.
- Thank you for coming!