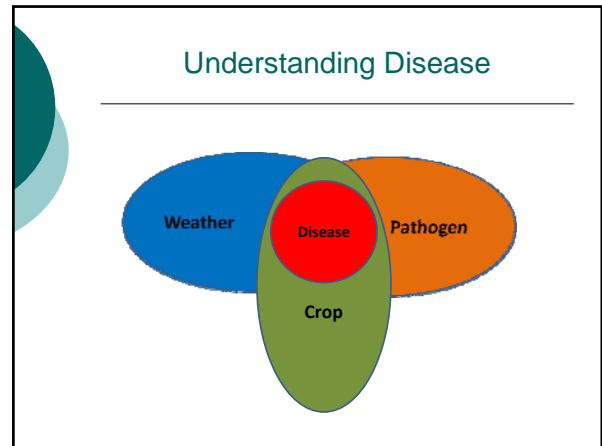


DISEASE MANAGEMENT IN ORGANIC CROPS

Jill Thomson
 University of Saskatchewan
 Organic Connections '08
 TCU Place Saskatoon
 18 November 2008



Factors influencing disease CROP

- Type
 - Annual (cereals, pulses, vegetables)
 - Biennial (caraway)
 - Perennial
 - Short term (alfalfa, strawberries)
 - Long term (fruit trees, wood lots)
- Agronomy
 - Growing requirements
 - keep crop as healthy as possible, less likely to become infected
 - Avoid over-fertilization, lush growth more prone to infection
 - Season
 - Maturity
 - weather
 - Weed competition
 - Weeds can act as source of infection
 - Seed source
- Disease
 - What pathogens are common
 - Resistance or susceptibility

Factors influencing disease PATHOGEN

- You need to know:
 - what diseases are common on your crop in your area
 - what influences the disease severity
 - life cycle of pathogen: vulnerable points
- You can minimize risk of infection by
 - Using clean seed sources
 - Practice rotation
 - Use resistant cultivar
 - Other management strategies

Factors influencing disease WEATHER

- Weather important influence on both crop and pathogen
- Crop
 - Wet: lush growth, lodging
 - Dry: plants stressed, more prone to show wilt and root rot symptoms
- Pathogen
 - Wind and rain : spore dispersal
 - Dry : mildew
 - Winter conditions: long term survival structures
 - Spring: triggers release of spores from sexual structures

Management Strategies

- **Prevention is the best strategy**
- Options are fewer once disease is present
- Disease control – low priority because:
 - Market driven
 - Weed control conflict
 - high density of crop to out-compete weeds
 - low density of crop, lower humidity, less compatible microclimate for pathogen

Ways to prevent disease

- Avoid introduction of the pathogen
- Works well for seed-borne disease
- Test seed before buying
 - Seed labs will evaluate no. of seeds infected with pathogen (cereals, pulses)
 - Inclusions (ergot bodies, sclerotia)
 - Buy certified, disease-free seed (vegetatively propagated seed such as potatoes, strawberries, fruit trees)

Seed infection

- Ascochyta on chickpea, pea and lentil
- Fusarium head blight
- Smuts
 - Loose smut INSIDE seed
 - Covered smut, bunt ON seed surface
- Viruses in potato
- Sclerotinia and ergot included in seed sample

Ascochyta blight on lentil

- Go to website for more pulse disease information

paridss.usask.ca

Fusarium spp. - infected seed

Ergot - Claviceps purpurea

- Can infect various grains
- Easy to spot at maturity because of ergot bodies

CAUTION

- Organic growers often save their own seed as know it has organic source
- Infection in or on seed can lead to rapid build up of disease problem
- For example:
 - Covered smut of grasses at
 - trace levels in first year can lead to
 - 5% in second year,
 - 50% in third year,
 - **Extremely high levels** in any subsequent year

Surface smuts

- overwinter as teliospores on surface of healthy seed
- infect roots after seed germination
- covered smuts & bunts

Internal Smuts

- overwinter as fungus inside of the seeds
- infect seed at heading stage
- loose smuts

Seed potato tubers

- Very important not to save own crop as potato seed
- Viruses present in potato crop do not show up in first year of infection but will be passed on in seed tubers
- Home gardeners often save their small tubers for seed
- Virus infection may cause production of small tubers, so increase in infection by saving and planting small tubers
- **Always use certified seed, at highest generation affordable/available**

Potato Leaf Roll Virus

- Rolling of leaves
- Stunted growth
- Net necrosis in tuber

Clean seed can **NOT** prevent disease when:

- **Pathogen already present in soil**
 - Diseased crop grown on that field in previous years
 - Root rot of cereals, very common in most soils
 - Common scab of potato often present in soil when high organic matter
- **Pathogen has stage that is readily airborne**
 - Sclerotinia produces very small airborne spores that travel several km
 - Rust spores can blow in from the US
 - Potato late blight spores travel 100 km or more when wet stormy winds blow

Sclerotinia sclerotiorum

- germinated sclerotium
- on Prairies appear at end of June
- often in cereal crops, humid conditions under canopy
- produce many tiny spores

Late blight of potato and tomato

- Dead leaves and shoots
- Spores produced at edge of lesions
- Spores can travel in winds, both within field and from field to field

Late blight – it only takes 10 days to destroy a field

Rust on saskatoon fruit

- Infection of leaves, bright orange spots initially, then develop spiky structures
- Aecia produced on leaves and fruit
- Pick off infected leaves, fruit
- Fungicide for commercial orchards

Soil-borne diseases

- Avoid introducing pathogen by soil movement
 - Keep equipment clean
 - Decontaminate machinery when moving from field with problem to clean field
 - Particularly important when machinery moving long distances
 - Oilfield equipment
 - Haulage trucks
 - Buying equipment from other provinces, etc.

Example: Club Root of Canola

- Club root is disease of canola that can cripple yields
- Present on vegetable crucifers in Canada and on rapeseed in Europe for many years
- Not recorded on prairie canola until 2003
- Found in central Alberta and has spread to more (check) counties by 2007.
- Now declared pest under Alberta Agriculture Pest Act
- Soil-borne fungus with survival spore that can remain viable for over 20 years
- Not possible to control pathogen in soil

Club Root – Plasmodiophora brassica

- Causes appreciable yield loss because destroys functional root system

on brocolli

on mustard

Survey Data from Dr. Steve Strelkov, University of Alberta

- 2007: 58 new cases out of 325 fields surveyed
- 2005 – 2007: total of 171 infested fields (out of 687 surveyed)
 - Reliable reports of an additional 79 fields
 - Grand total of 250 fields that are clubroot infested
- Total of 11 counties & City of Edmonton
 - 10 counties in central Alberta; 1 in southern Alberta

Control of spread

- Minimize movement of soil from infected areas
- Truck wash
- Restrict movement of any soil or plant debris with harvested crop in infected areas
- Recommend not using seed potatoes from infected areas as tubers often carry soil on surface

Results of these measures?

- Will not completely prevent introduction into new areas
- **BUT** should slow down disease progress
- Allows for development of control measures
- Resistance in canola is available
- New cultivars that tolerate disease are being developed and released

Tools for Management of Existing Problems

- Rotation
- Soil amendment
- Avoidance
- Host resistance
- Microclimate manipulation
- Permitted substances

Rotation

- Continuous cropping most likely to allow disease build up
- Back-to-back cereals, canola NOT recommended
- Zero-till can be problematic, deep burial of trash recommended for diseases on crop debris
 - Blackleg on canola
- Minimum of 3 years between crops to encourage total breakdown of crop residue that can harbour disease material, spores, etc
- Specific diseases can require longer periods

Rotations for Specific Diseases

- Root rot in cereals – 4 year break recommended
- Scab in potato – 5 years or more, depending on type of scab
- Club root of canola – resting spore can survive 20 years, rotation not an option for dealing with this disease
- Organic growers usually practicing rotation to deal with weeds, and to build up organic matter, nitrogen, moisture – adjust for specific disease problems

Common scab of potato *Streptomyces scabies*

- Rough, corky, surface scabs
- Do not usually penetrate into tuber

Blackleg of Canola

- Infected base of stem
- Survival when not ploughed under
- Production of air-borne spores in the spring

Soil Amendment

- Rotations can include growing “non-harvestable” crops, such as a legume crop to build up soil nitrogen
- Green manure crops are grown for short time, usually to maximum vegetative growth
- Ploughed into soil where they decay and release nutrients that are then available to subsequent crops
- Some green manure crops have biocidal properties – can reduce weed germination, speed up destruction of pathogens in soil
- Brassica species, such as mustards, release compounds into the soil that are harmful to other soil organisms, such as the fungi that cause diseases and also nematodes

Green Manures

- Current research being conducted at University of Saskatchewan, in collaboration with Alberta Agriculture, to study effect of millet, sudan grass, brassica species, and oat/pea/vetch mixture on soil-borne potato diseases
- Evaluation of mustard meal product in same trial
- Product produced in Saskatchewan, marketed for nematode control in turf grasses, may be a useful product for organic growers but still in experimental stage

Green Manure trial 2008



Experimental Strips

- Efficacy claims not always validated at present by research results
- Test for yourself
- Use product in marked strips, randomly in field
- Measure yield from strip separately and compare with field average
- Evaluate disease levels from the treated and non-treated areas
- Make a decision based on these comparisons
- If you just treat whole field other factors can influence yield, disease, etc. and you will not know if the product treatment was effective or even detrimental
- Learn from neighbours' experience but be sceptical of unverified claims

Avoidance

- Some diseases can be avoided by planting a crop earlier than usual or later than usual, to avoid the climatic conditions most conducive to disease
- Early seeding is not usually recommended because seedling blights are more likely to occur in the cooler spring soils
- Late seeding can reduce seedling blight, seed is off to a quicker start, but then problem with late harvest and frost damage at end of season

Fusarium Head Blight

- Use different cultivars and different sowing dates so not all of crop flowering at same time
- Flowering time is critical period for infection by *Fusarium* species
- Wheat has less flexibility, longer growing season
- Barley has shorter growing season so more chance to avoid wet weather with staggered heading

Harvest

- Avoid canola laying in the swathe, reduces risk of *Sclerotinia* developing on swathed plants if wet season
- Plant potatoes later and harvest earlier to avoid *Rhizoctonia* infection
- Early harvest of potatoes can lead to skinning, more Dry rot then likely
- Need to weigh up many factors, and often out of one's control
- Harvest when man-power, machinery and good conditions are all available

Host Resistance

- Always grow the cultivars most resistant to disease, if market opportunity is equal
- Check the provincial seed guide for reaction to diseases in your area
- Canola and mustard – cultivars with resistance to blackleg
- Lentil – some cultivars less susceptible to *Ascochyta* blight
- Potato – less scab on Russet types
- Cereals and flax – resistance to rust races
- Newer cultivars are often bred with resistance to disease

Stem rust of wheat

- pustules on stems & leaves
- rupture epidermis
- rusty red in colour
- "summer spores", important in spreading disease
- drains plant resources

Stem rust later in season

- overwintering stage

Leaf rust of cereals

- pustules typically on leaves
 - rounder, smaller than stem rust
 - closely spaced
- overwinters as spores in southern US & Mexico
 - appears in Canada in June

Microclimate Manipulation

- High humidity is often conducive to disease development
- Reducing humidity by increasing plant spacing not an option in annual crops because increased weed competition then an issue
- Perennial crops such as fruit trees benefit from wider spacing
- Saskatoon bushes with wider row spacing less susceptible to *Entomosporium* epidemics

Entomosporium leaf and berry spot

- Spores of pathogen spread by rain splash
- High humidity necessary for infection
- Bushes close together, easier for disease to spread
- Air flow increased when rows have wider spacing
- Leaves dry up faster and lower humidity

Irrigation

- Possible to manipulate environment with irrigation in some crops
- Stop irrigating at times when disease requires moisture
 - Fusarium Head blight worse when moisture high at heading
 - Powdery scab of potato worse when high moisture at tuber set
 - High moisture at petal fall critical for Sclerotinia infection of canola

Head blight

Fusarium species – often:

F. graminearum
F. culmorum
F. avenaceum
F. poae

Permitted Substances

- Number of products can be used
- Can be costly so mostly applied to fruit and vegetable crops
- Copper sulphate used to control bacterial diseases
 - Bacterial blight on beans
- Sulphur products help reduce mildew infections
- Vinegars, compost teas, seaweed products available
- Use test strips if uncertain of the value
- Always check if product use permitted, list is available on Canadian General Standards Board web site http://www.tpsgc-pwgsc.gc.ca/ongc/on_the_net/organic/032_0311_2006-e.pdf

Halo blight of bean

- Number of bean blights caused by different pathogens
- Difficult to distinguish, based on symptoms
- Chlorotic halo around necrotic lesions

Summary

- Integrated Pest Management
- Use the options best suited for your crop, area, market
- Know the enemy
 - The more you know about the disease (what it looks like, when it will attack, life cycle, types of spores produced, way it survives, longevity on crop residues, in storage bins, on machinery, alternative hosts)
 - The better your ability to manage the problem

Support Personnel

- With Sask Ag & Food
 - Fay Dokken, Plant Pathologist
 - Daphne Gottselig, Crop Development Specialist
 - Connie Achtymichuk, Vegetable Specialist
 - Forrest Scharfe, Fruit Specialist
- At University of Saskatchewan
 - Brenda Frick, Organic Coordinator
 - Crop Specialists in Plant Sciences, Crop Development Centre
 - Steve Shirliffe
 - Sabine Banniza, Jill Thomson, Plant Pathologists
- Agriculture Canada
 - Many crop specialists
- Your Certifiers

Any Questions?
Comments?
Helpful Suggestions?
Interesting Experiences!

Comments and questions can be sent to
Jill.Thomson@usask.ca
Ph 306 966 5862