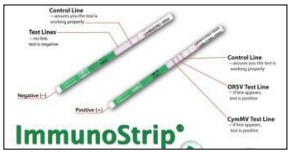
Plant Disease Diagnosis

40

- Laboratory tests
  - Microscopy
  - Culture
  - Serological methods
  - Molecular biology methods



CAES

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Plant Disease Diagnosis

41

- Final diagnosis
  - Diagnosis is a form of hypothesis testing
    - Collected information, evident
    - Published literature sources
    - Helps from collogues and experts
    - Professional judgment

Seasonal needle drop

Salt spray damage

Septorioides needle cast

CAES

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Plant Disease Diagnosis

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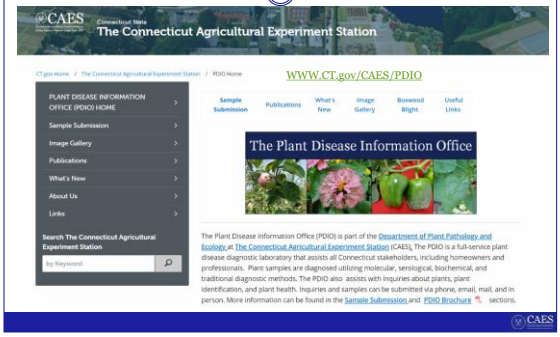

CAES

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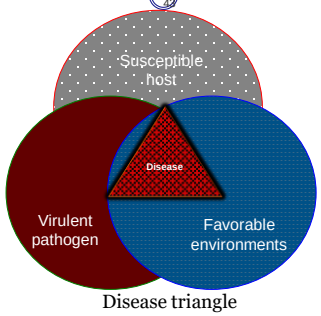
Disease Development

42



Disease triangle

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Disease Development

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- *Host range*: the range of plants on which a pathogen infects
  - *Ophiostoma ulmi:* the causal agent of Dutch elm disease
    - Host range: only elm trees (*Ulmus* spp.)
  - *Verticillium dahlia*: the casual agent of Verticillium wilt
    - Host range: over 300 woody and herbaceous including tomato, strawberry, rose, maple, and elm
- *Immune:* cannot be infected by a given pathogen

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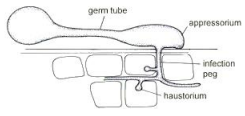
Disease Development

45

- *Penetration:* the initial invasion of a host by a pathogen
  - Directedly through cell wall
    - Leaf, stem, and root
  - Natural opening
    - stomata, lenticels
  - Wound
    - Mechanical, pruning, insect, physical injury



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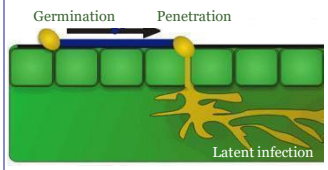
Disease Development

46

- *Infection*: penetrating and establishing a parasitic relationship with a host plant
- *Latent infection*: an infection unaccompanied by visible symptoms



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Disease Development

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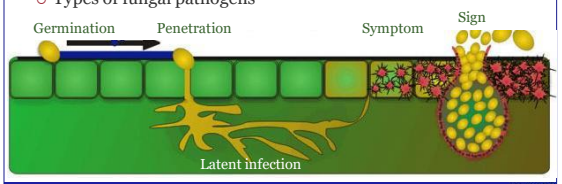
- *Latent period*: the time between infection and the production of new inoculum and/or symptoms.
  - Host resistance
  - Environments
  - Types of fungal pathogens



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Disease Development

48

- *Dispersal:* the spread of a fungal pathogen (inoculum) from diseased plants to healthy plants
  - Rain- or water-splash (short)
  - Wind or air movement (long)
  - Insects (depends on insect species and their mobility)
  - Human activity (short and long)

48

Disease Development

49

- *Overwinter:* to survive or persist through the winter period
  - Soil
    - Resting structures (more than 5 years)
  - Plant debris
    - Saprophytic (1-2 years)
  - In/on living plants
    - Annual plants in protected structures
    - Perennial roots, bulbs, or tubers
    - Woody plants – roots, stems, buds, or leaves (evergreen)

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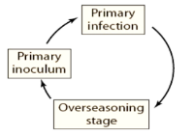
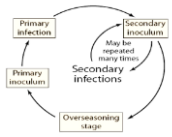
Disease Development

50

- *Disease cycle: a series of sequential* events from initial infection to over-seasoning, until another infection occurs





- *Monocyclic*: only one cycle per season
- *Polycyclic*: more than one infection cycle per season

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Disease Development

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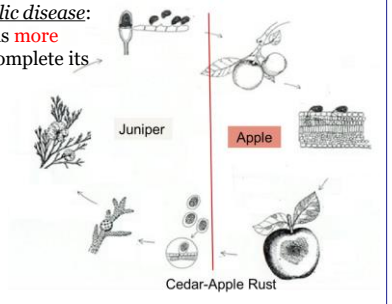
Multi-host life cyclic disease: the pathogen needs more than one host to complete its life cycle



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Disease Management

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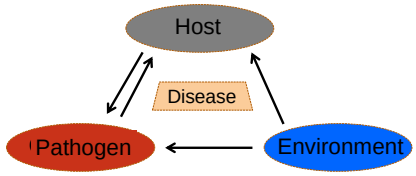
Management Triangle

- Host resistance
- Reduced inoculum
- Favorable to host/ unfavorable to pathogen



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Integrated Pest Management

53

- a sustainable, science-based, decision-making process
- combines biological, cultural, physical and chemical tools to identify,
- manage and reduce risk from pests
- minimizes overall economic, health and environmental risks

53

Disease Management - Host

54

- Right tree in the right place
  - Hardiness – USDA Zones 5-6
  - Resistant/tolerant cultivars/species
    - *Resistance:* the host's ability to limit pathogen multiplication
    - *tolerance:* the host's ability to reduce the effect of infection on its fitness (yield and quality) regardless of the level of pathogen multiplication
  - Rotation – genus or species

54

Disease Management - Pathogen

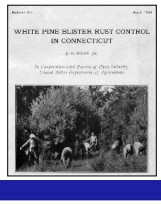
55

- *Exclusion:* prevent the introduction of a new pathogen into a region, farm, or planting
  - Quarantines: continentals, nations, states, regions
    - White pine blister rust
    - Dutch elm disease
    - Sudden oak death
  - Disease-free plant materials:
    - Seed
    - Seedlings
    - Woody trees and shrubs

55

Disease Management - Pathogen

- *Eradication:* the elimination or destruction of the pathogen after it is introduced into an area
  - Removal and destruction of host plant
  - Chemical treatment of soil or seed to kill the pathogen
  - Crop rotation for soil-borne pathogens



HOW TO PREVENT BLISTER RUST DAMAGE TO WHITE PINE

White pine, Connecticut's most valuable forest tree, is seriously threatened by the white pine blister rust. The greatest single factor at the present time in the control of the blister rust is the elimination of the European black currant. The growing, sale or possession of this plant is prohibited by law in the State of Connecticut. Help control the blister rust by destroying all European black currants wherever found.

56

Disease Management - Pathogen

57

- *Sanitation:* the destruction or removal of infected and infested plants or plant parts; decontamination of tools, equipment, containers, work-space, hands, etc.
  - Destroy fallen leaves, fruits, and other plant materials
  - Prune diseased/dead branches
  - Sanitize tools with 10% household bleach of 70% alcohol

57

Disease Management - Pathogen

58

- *Fungicide*: used to inhibit or kill the fungus causing the disease
  - *Biofungicide:* derived from plants and microorganisms

Active Ingredient	Trade Name	Control
extract of giant knotweed	Regalia	Leaf spot, rust, downy mildew, powdery mildew, Pythium, Phytophthora, Rhizoctonia
B. subtilis QST 713	Cease	Leaf spot, Botrytis, downy mildew, rust, powdery mildew, Pythium, Phytophthora, Rhizoctonia
Streptomyces lydicus	Actinovate	Leaf spot, Botrytis, rust, downy mildew, powdery mildew, Pythium, Phytophthora, Thielaviopsis, Rhizoctonia
Trichoderma harzianum T-22 + T. virens G-41	Root Shield Plus	Pythium, Phytophthora, Thielaviopsis, Rhizoctonia
Harpin protein	Immune	Stimulate plant growth and disease resistance

58

Disease Management - Pathogen

59

- *Biorational fungicide:* relatively non-toxic to people with few environmental side effects

Active Ingredient	Trade Name	Control
copper	Phyton 27	Leaf spot, Botrytis, downy mildew, powdery mildew, Pythium, Thielaviopsis, Rhizoctonia
sulfur	Drexel Sulfur	Leaf spot, Botrytis, rust, powdery mildew
potassium bicarbonate	MilStop	Leaf spot, Botrytis, rust, downy mildew, powdery mildew,
hydrogen dioxide	OxiDate	Leaf spot, Botrytis, rust, downy mildew, powdery mildew, Pythium, Thielaviopsis
neem oil	Triact 70	Leaf spot, Botrytis, rust, downy mildew, powdery mildew
horticultural oil	SuffOil-X	Rust, powdery mildew

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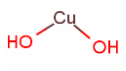
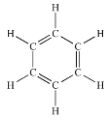
Disease Management - Pathogen

60

- *By chemical compound*
  - *Inorganic fungicide:* derived from sulfur or simple metal salts; not contain the elements carbon (C); generally stable, persistent, and insoluble in water.



  - *Organic (synthetic) fungicide*: contain carbon atoms in their structure



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Disease Management - Pathogen

61

- *By mode of Action (MOA):* the specific cellular process inhibited by a particular fungicide.
  - cell membranes
  - enzymes or proteins
  - energy production or respiration
  - Activating plant defense mechanisms

61

Disease Management - Pathogen

62

- *Fungicide Resistance Action Committee* (FRAC)
- *FRAC MOA code*: numbers and letters used to distinguish the fungicide groups according to their cross-resistance behavior.

62

Disease Management - Pathogen

63

Trade name — Formulation

Daconil® 720 Flowable Fungicide

GROUP M5 FUNGICIDE

FRAC MOA group

For control of turf and ornamental diseases

For control of diseases of apricot, cherry (sweet and tart), nectarine, peach, plum and prune trees

Common name

Active Ingredient:	
Chlorothalonil (tetrachloroisophthalonitrile)	54.0%
Other Ingredients:	46.0%
Total:	100.0%

Daconil 720 Flowable Fungicide is formulated as a suspension concentrate (SC) and contains 6.0 pounds chlorothalonil per gallon.

63

Disease Management - Pathogen

64

- *By breadth of activity*
  - *Narrow-spectrum*
    - single-site: against only one point in a metabolic pathway or a single enzyme or protein
    - high chance of fungicide resistance
    - against only a few closely related fungi
  - *Broad-spectrum*
    - multi-site
    - low risk of fungicide resistance
    - against a large variety of fungi

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Disease Management - Pathogen

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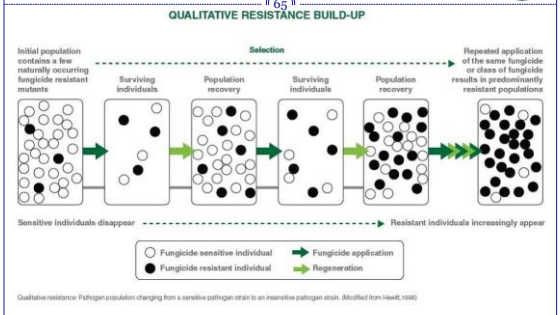

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Disease Management - Pathogen

66

- *By mobility in plant*
  - *Contact (protectant):* resides on surface of the leaf and provides protection

FRAC group	Active Ingredient	Trade Name
12	fludioxonil	Medallion, Maxim, Cannonball
M	copper	Kocide, Champ
	sulfur	Microthiol Disperss, Sulfur
	mancozeb	Mancozeb
	captan	Captan
	chlorothalonil	Bravo, Daconil 2787

  - *Systemic:* moves into leaf and provides protection
    - Locally systemic
    - Xylem-mobile systemic
    - Phloem-mobile systemic

66

Disease Management - Pathogen

67

- Locally systemic fungicides:
  - move very short distances from the site of application

FRAC group	Active Ingredient	Trade Name
2	iprodione	Chipco 26GT
7	flutolanil	Contrast
11	kresoxim-methyl	Cygnus
	trifloxystrobin	Compass
17	fenhexamid	Decree
40	dimethomorph	Stature

67

Disease Management - Pathogen

68

- Xylem mobile fungicides:
  - move in xylem tissue upward

FRAC group	Active Ingredient	Trade Name
1	thiophanate-methyl	Clear's 3336
3	triflumizole	Procure, Terraguard
	myclobutanil	Eagle, Systhane
	tebuconazole	Folicur
	propiconazole	Banner Maxx
4	metalaxyl	Subdue Max
11	azoxystrobin	Heritage, Abound, Quadris, Stadium
18	streptomycin	Agri-Mycin, Agri-Step
19	polyoxin D	Endorse, Oso, PH-D

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Disease Management - Pathogen

69

- Amphimobile/truly systemic fungicides:
  - moves in phloem out of the leaf where deposited upwards to other leaves and downwards to roots

FRAC group	Active Ingredient	Trade Name
P1	acibenzolar-S-methyl	Actigard, Messenger
33	fosetyl-aluminum	Aliette
	phosphorous acid	Alude, BioPhos

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Disease Management - Pathogen

70

- *By roles of protection*
  - Preventive
    - Contact action on the surface of the plant to which it have been applied
    - Prevent spore germination and infection
    - Repeated applications are needed
  - Curative
    - Able to penetrate plants and affect the pathogen after infection
    - Kill mycelium and fruiting bodies within the leaf

70

Disease Management - Environment

71

- Maintaining tree vigor & conditions unfavorable to pathogens
  - *Plant requirements :* pH, drainage, light
  - *Mulching:* weed control, soil moist
  - *Fertilizing:* time, soil test, balanced nutrients
  - *Watering:* one inch water/week, deep soaking
  - *Avoid sprinkler/overhead irrigation*
  - *Air circulation:* lower humidity
  - *Avoid excessive water:* newly installed trees

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Common Diseases

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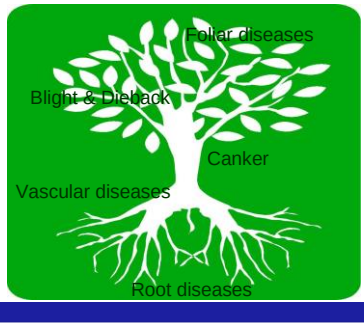

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Apple - Scab

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Apple – Gymnosporangium Rust

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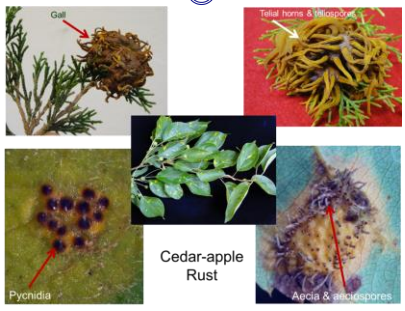

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Apple – Frogeye Leaf Spot

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Apple – Marssonina Leaf Blotch

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Birch - Anthracnose

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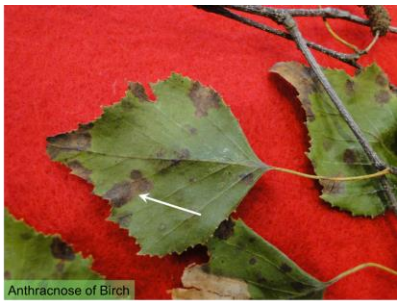

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Beech - Anthracnose

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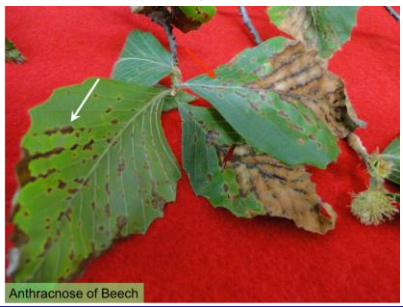

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