Principles of Disease Control

Pathogen

Exclusion: preventing the entrance of inoculum or establishment of a pathogen within an uninvaded area

Eradication: reducing, eliminating or destroying inoculum at the source.

Host

Therapy: curing diseased plants by use of chemicals (drugs), surgery or an altered environment (temperature, drainage).

Host resistance: reducing efficiency of inoculum via host genetics

Environment

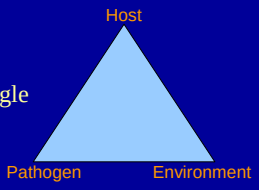
Protection: reducing the efficiency of inoculum by interposing a barrier between host and the pathogen

Avoidance: Avoiding disease by avoiding the pathogen or by altering the environment (outside and inside plant)

Disease avoidance

Avoiding disease by avoiding the pathogen or by altering the environment (outside and inside plant)

Cultural control practices targeted at one or more components of the triangle



Avoidance measures targeted at the pathogen

Principles of control targeted at the pathogen:
Exclusion, Eradication, Avoidance
(there is overlap among these terms)

Avoidance of the pathogen:

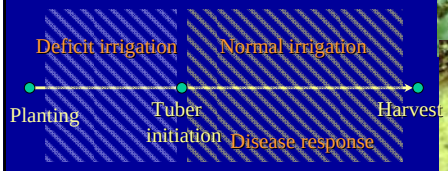
- Industry migration **(e.g., garlic, mint, malting barley)**
- Crop rotation (very common best management practice)
  - **potentially constrained by:**
    - **economics of cropping system**
    - **host range or survival capabilities of pathogen propagules**
- Planting date or harvest date
  - **(e.g., winter wheat – late planting decreases disease)**

Disease avoidance by modifying the **environment**

- Water
  - Soil water content
  - Foliar leaf wetness
- Temperature (greenhouses, storage)
- Atmosphere (storages)

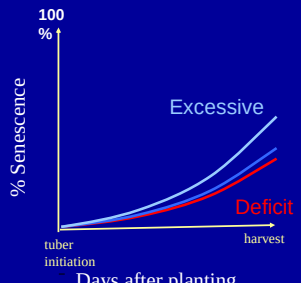
Irrigation management and soil borne disease

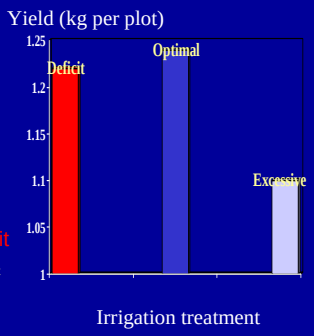
Example: Verticillium wilt of potato
Suppress disease development by deficit irrigation early in the season



Wet soils favor infection by fungal propagules

Irrigation and Verticillium wilt:





General rule: Excessive water early in season promotes fungal root rot and vascular wilt pathogens

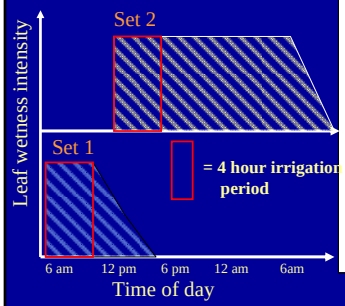
Management of Foliar Leaf Wetness

Duration of wetness required by foliar pathogens to achieve successful infection

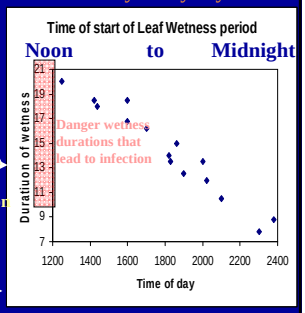
• *Botrytis*	Strawberry	8 to 32 hour (temperature dependent)
• *Puccinia*	Wheat	9 to 15 hour
• *Sclerotinia*	Bean	10 to 22 hour

Irrigation timing and leaf wetness duration

Irrigation sets started in in morning (Set 1) or in afternoon (Set 2)



Wetness periods followed by sunny day



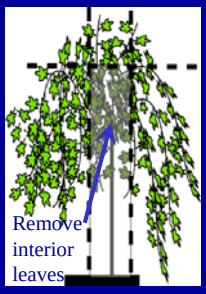
Question:

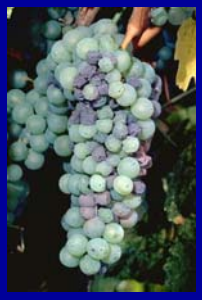
With respect to avoiding conditions for infection by a foliar pathogen, is it better to water at night or during the day?

Foliar Canopy management

Example:

Leaf removal for *Botrytis* bunch rot suppression in grapes





Leaf Removal in Grape

Before

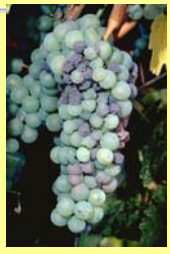
After

Reduces humidity and improves air flow

Effect of leaf removal on bunch rot suppression

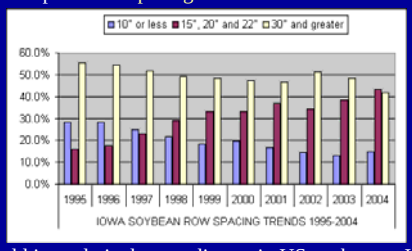
Table 3. Main effect of leaf removal on Chenin blanc grapevines during 1990-1992.

TREATMENT AND YEAR	YIELD (kg/vine)	YIELD (tons/acre)	CLUSTERS /VINE	BUNCH ROT (%)
1990				
YES	49.5	22.8	67	6.4 b
NO	51.4	23.7	68	7.4 a
	ns	ns	ns	
1991				
YES	35.6	8.5	88 a	5.9 b
NO	34.6	9.0	89 b	16.5 a
	ns	ns		
1992				
YES	39.9 b	10.3 b	89	9.4 b
NO	46.5 a	12.0 a	86	2.1 a



Foliar Canopy management

Another example: Row spacing for white mold control in soybean



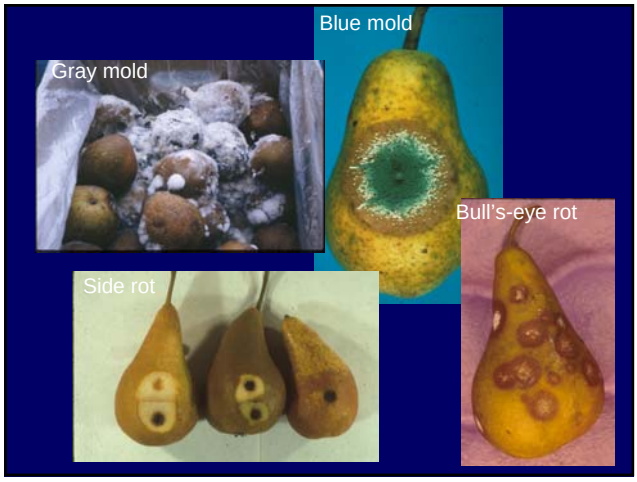
White mold is a relatively new disease in US soybeans. In the 1970s, soybean yields were greatly increased by seeding with grain drills instead of row planters. The narrower row spacings, however, allowed *Sclerotinia* to build up in the production system. The current trend is back towards wider row spacing to enhance air flow around the plants.

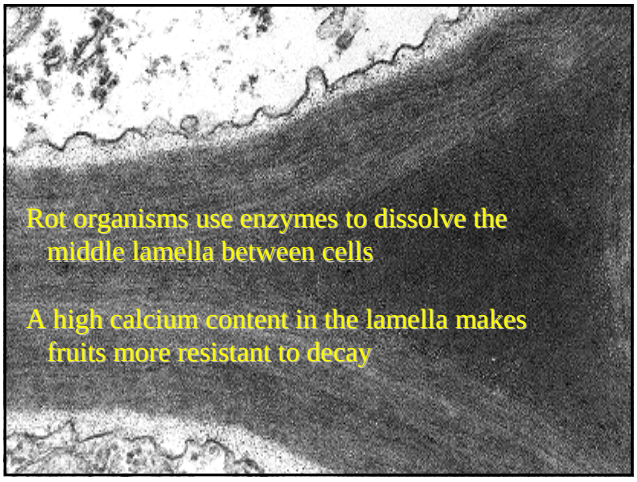
Disease avoidance by managing **host susceptibility**

Besides genetics, what can we control?

Nutrition

Nature and frequency of wounds





Nutritional status of fruit at harvest:

Scenario 1

Abundant Nitrogen

Excess Vigor

Shoot-Fruit Competition

Low Crop Density

High Fruit N

Low Fruit Calcium

Promotes **Rot!**

Nutritional status of fruit at harvest:

Scenario 2

Moderate Vigor

Orchard Calcium Sprays

"High" Calcium Fruit

Direct Inhibition of Fungal Enzymes

Less Mature Fruit

More Resistance to Decay Fungi

Slower Respiration and Senescence

Effects of Calcium Sprays and Storage Atmosphere on Pear Decay

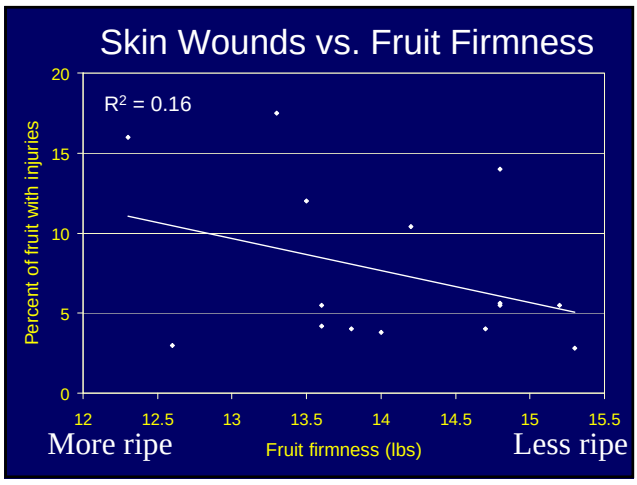
Storage atmosphere	Field treatment	Average lesion diameter (mm)		Percentage of wounds infected	
		Blue mold	Gray mold	Blue mold	Gray mold
20% CO_2	Calcium	0.5	1.9	6.8	20.8
20% CO_2	None	3.5	3.6	40.8	34.0
Air	Calcium	10.5	48.0	63.2	98.8
Air	None	20.2	54.9	92.4	99.2

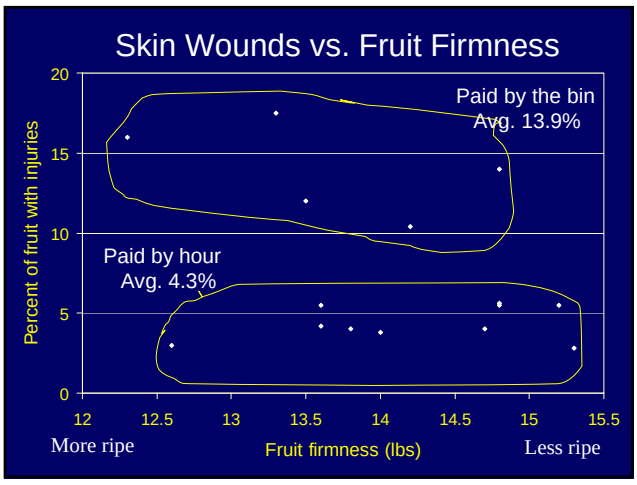
For most post harvest rots, the infections are initiated in *wounds*

Bud scratch

Stem puncture

Bucket strap staples


Skin Wounds vs. Fruit Firmness
R^2 = 0.16
Percent of fruit with injuries
20
15
10
5
0
12
12.5
13
13.5
14
14.5
15
15.5
More ripe
Fruit firmness (lbs)
Less ripe


Skin Wounds vs. Fruit Firmness
Paid by the bin
Avg. 13.9%
Paid by hour
Avg. 4.3%
Percent of fruit with injuries
20
15
10
5
0
12
12.5
13
13.5
14
14.5
15
15.5
More ripe
Fruit firmness (lbs)
Less ripe