

The Penn State Method for Pathogen Matching

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National Plant Disease Recovery System Meeting

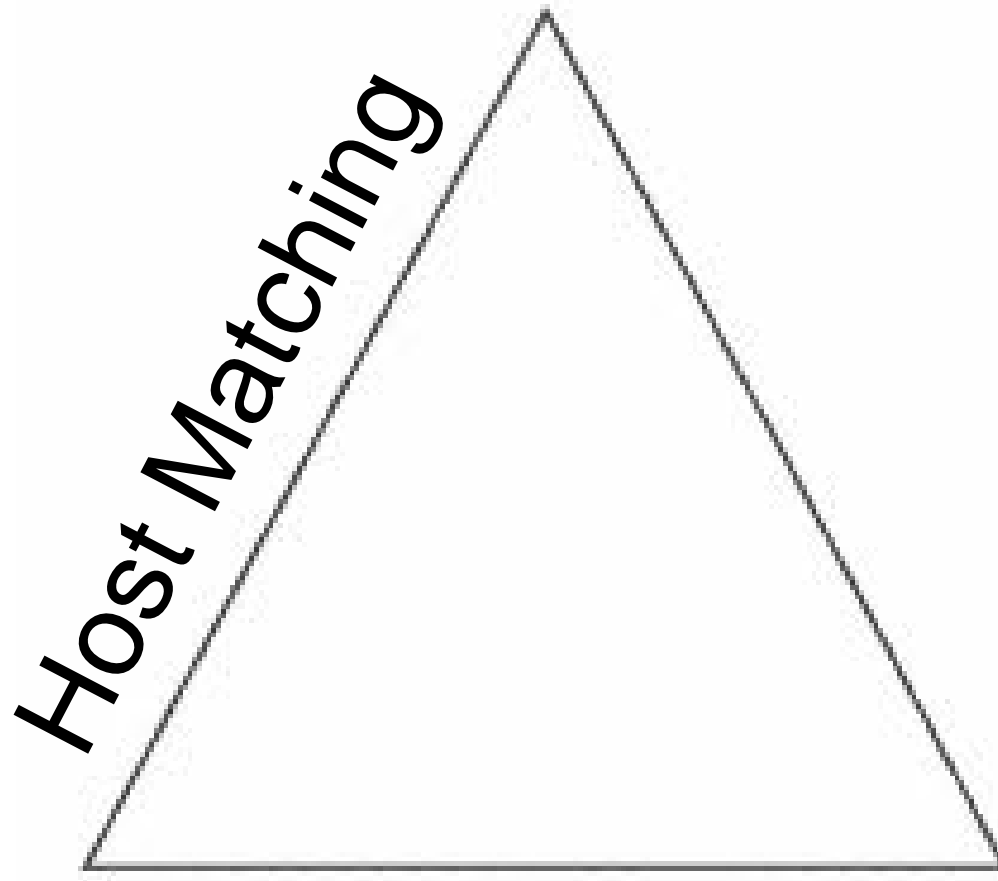
March 6-8, 2011

Assistance From:

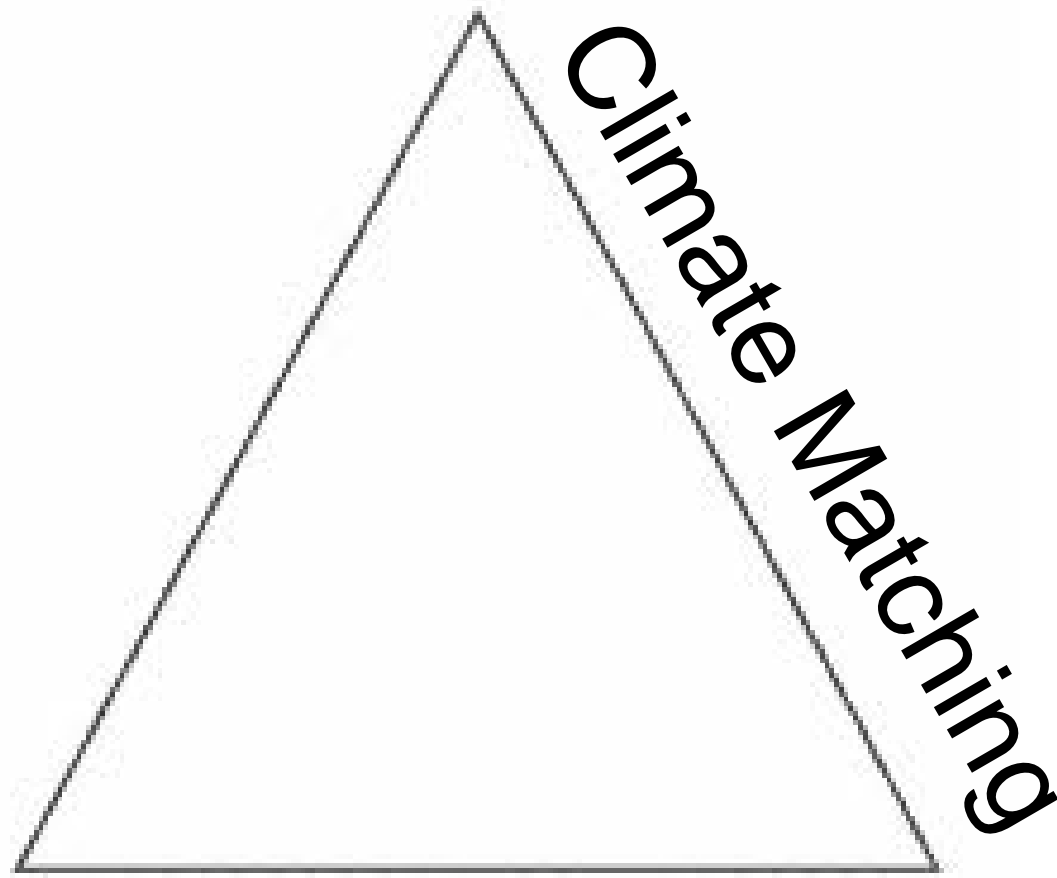
Alan Biggs

Larry Madden

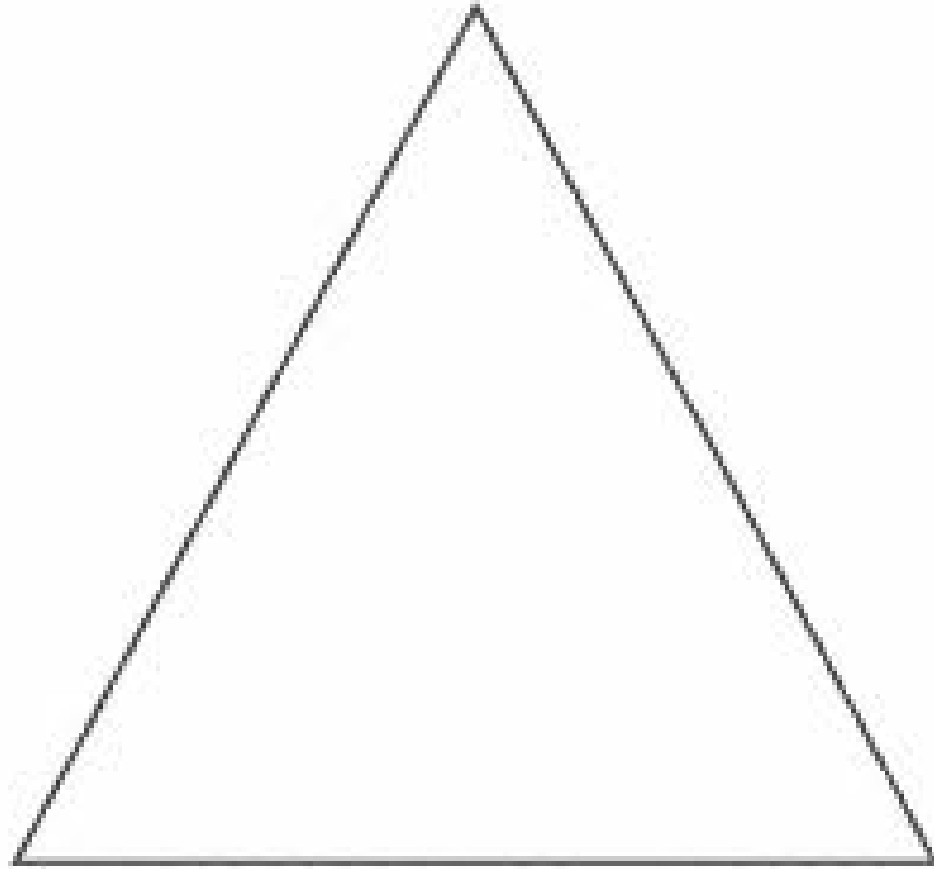
Vulnerability Assessment



Vulnerability Assessment

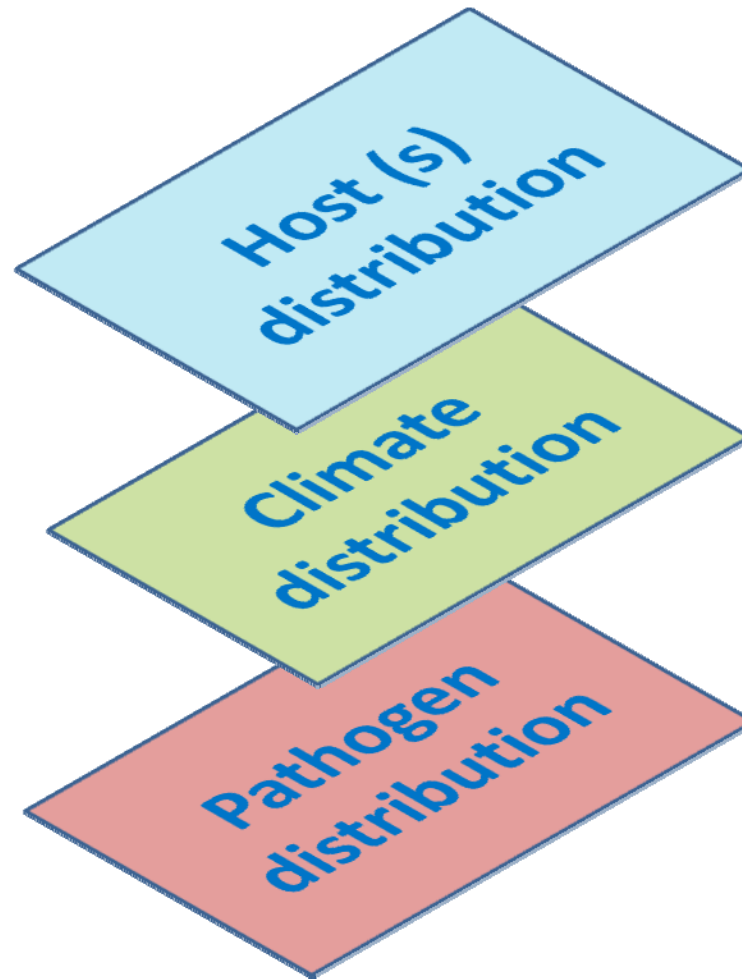


Vulnerability Assessment



Pathogen Matching

Geospatially Overlay Risk



The Penn State Concept of “Pathogen Matching”



Response
(mitigation)

Based Upon 16 Model Pathosystems that:

“Epidemiologically Match”

a Penn State reference pathosystem
with other pathosystems that have
knowledge gaps

Penn State 16 Pathosystems

MSc.

Apple Scab

Bacterial Wilt

Brown Rot of Stone Fruit

Cedar Apple Rust

Chestnut Blight

Dutch Elm Disease

Fireblight

Potato Late Blight

PhD.

Powdery Mildew

Root Knot Nematode

Southern Corn Leafblight

Soybean Cyst Nematode

Take-All of Wheat

Tobacco Mosaic Virus

Verticillium Wilt

Wheat Stem Rust

Epidemiology!

Epidemiology!

Epidemiology!



The Y_0 's and r 's
of it all!

$$Dy/dt = r * y (1 - y)$$

rate (r)



initial inoculum (y_0)

- Departmental Requirement

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- Learn the epidemiological concepts needed to design effective disease management programs
- Apply knowledge to new situations (threats)
- Facilitate Student-Faculty interaction

Pathosystem

Potato Late Blight

Wheat Stem Rust

Brown Rot of Stone Fruit

Chestnut Blight

Faculty

Dr. Dave Mackenzie

Dr. R.R. Nelson

Dr. Alan McNabb

*Dr. Bill Merrill

- History
- Life cycle
- Disease cycle
- Monocyclic processes
 - Infection efficiency
 - Incubation period
 - Lesion size/expansion
 - Latent period
 - Sporulation capacity

Scenario – Based (What if.....)

- More virulent (races)
- More or less aggressive
- Wider (or narrower) host range
- Dispersal unit(s) (sizes, spores, aphids, ?)
- Mechanisms of dispersal

Recovery Roadmap

Management strategies (Y, r)



Disease Management Principles



Integrated Management Tactics

Soybean Cyst Nematode



Potato Cyst Nematode

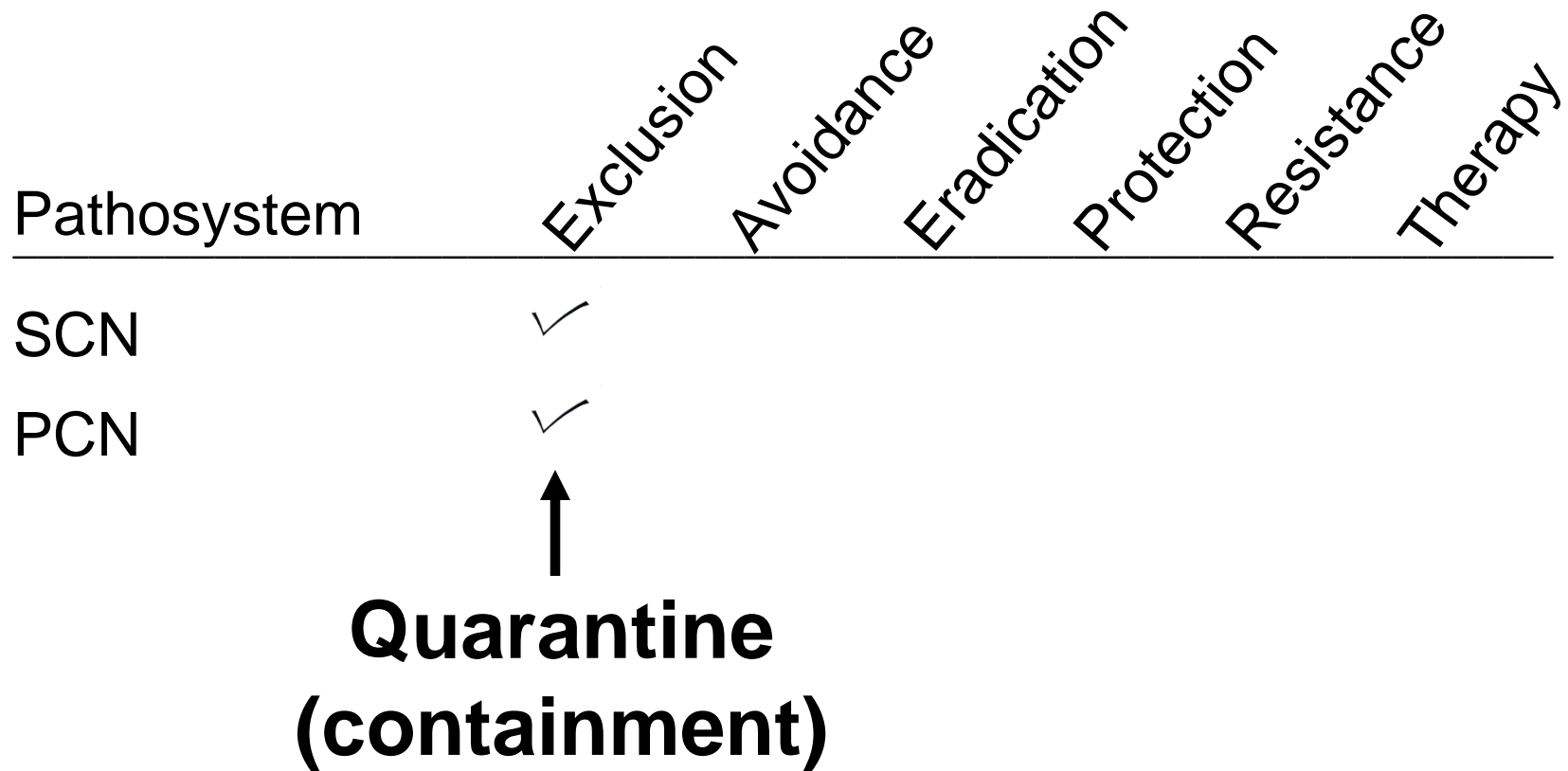
- High survival y_0
- Low rate (r)
- Host Specific



Strategy: Reduce Y_0 to zero

Disease	Strategy	
	$Y_0 \rightarrow 0$	Reduce (r)
Soybean Cyst Nematode	✓	
matched with		
Potato cyst nematode	✓	

Disease Management Principles



Disease Management Principles

Pathosystem	Exclusion	Avoidance	Eradication	Protection	Resistance	Therapy
SCN	✓	✓				
PCN	✓	✓				

↑
**Avoid
Infested
Areas**

Disease Management Principles

Pathosystem	Exclusion	Avoidance	Eradication	Protection	Resistance	Therapy
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SCN

✓ ✓ ✓

PCN

✓ ✓ ✓



Chemical

Long crop rotations

Sanitize field equipment

Green manure

Disease Management Principles

Pathosystem	Exclusion	Avoidance	Eradication	Protection	Resistance	Therapy
SCN	✓	✓	✓		$Y_{0, r}$	
PCN	✓	✓	✓		Y_0	

Race specific
↑

Stem rust of Wheat



Match with Ug99



Doubling time as high as 1.0 days



Strategy: Reduce rate (r)

Reduce $Y_0 \rightarrow$ zero

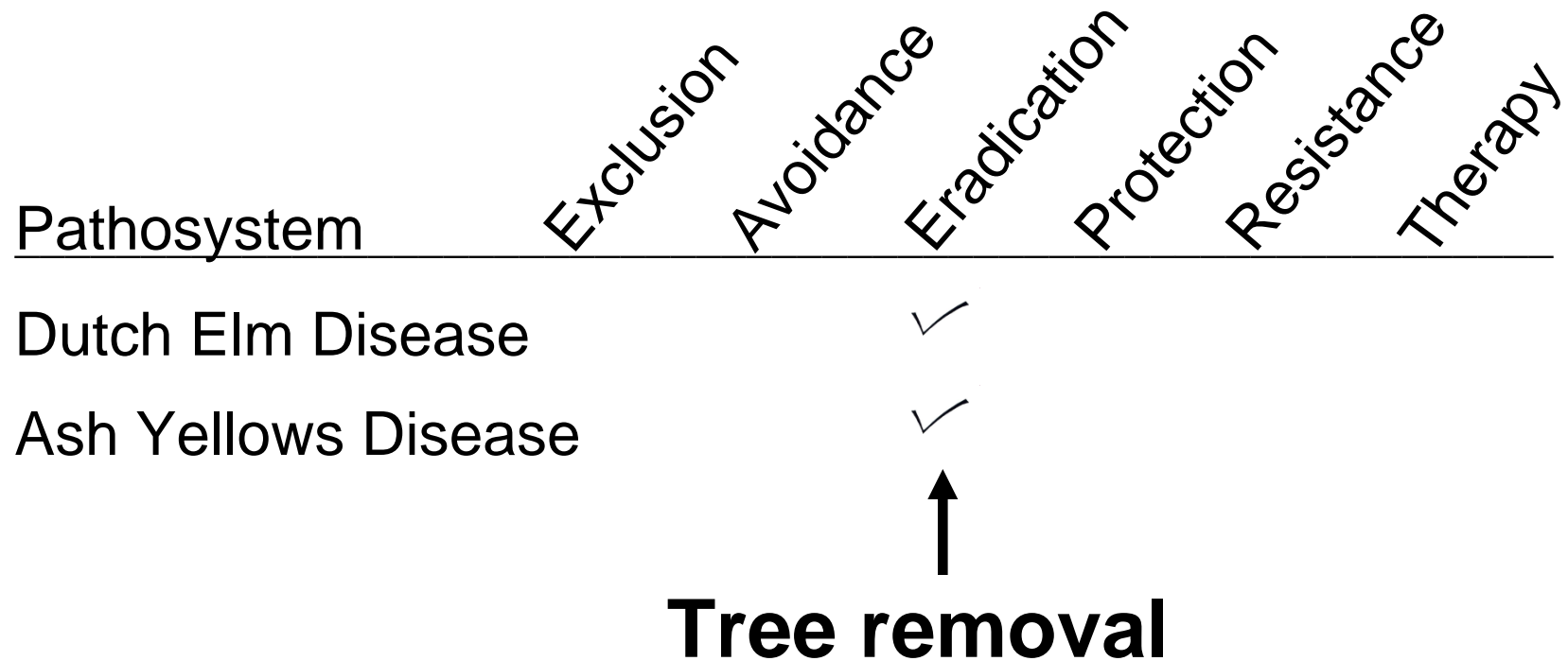
Disease	Strategy	
	$Y_0 \rightarrow 0$	Reduce (r)
Wheat Stem Rust	✓ (R)	rr
matched with		
Ug99	✓ (R)	✓ (F), rr

Disease Management Principles

<u>Pathosystem</u>	Exclusion	Avoidance	Eradication	Protection	Resistance	Therapy
Wheat stem rust				✓	✓	
Ug99				✓	✓	

Disease	Strategy	
	$Y_0 \rightarrow 0$	Reduce (r)
Dutch Elm Disease	✓	
matched with		
Ash Yellows	✓	

Disease Management Principles



Thank you!

Questions?