Managing Apple and Peach Diseases with Notes on the Strengths and Weaknesses of Sulfur

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Common Apple Diseases in Illinois

Spring Diseases

- Scab
- Fire Blight (bacterial)
- Powdery Mildew
- Rusts
- Phytophthora Root Rot

Summer Diseases

- Sooty Blotch/Flyspeck
- Fruit Rots
  - Black Rot
  - Bitter Rot
  - White Rot

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Common Peach Diseases in Illinois

- Peach Leaf Curl
- Brown Rot
- Powdery Mildew
- Scab
- Bacterial Spot

Managing Apple and Peach Diseases with Notes on the Strengths and Weaknesses of Sulfur

Brief History of Sulfur

- 1000 BC: pest-averting sulfur
- 1850: dusting sulfur for disease control
- 1852: lime-sulfur for grape mildew
- 1884: Bordeaux mixture + sulfur for grape
- 1923: wettable sulfur for plant diseases
- 1970: flowable sulfur for pests
- 1990s: micronized sulfur (less toxic)

Extraction of sulfur in Indonesia

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Sulfur for Tree Fruit Diseases

- Sulfur is a powdery mildew fungicide
- Sulfur is a protectant fungicide
- Sulfur is not prone to resistance development in fungi
- Sulfur is available for both organic and conventional crop production

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Sulfur for Plant Diseases

- **Sulfur fungicides:**
  - ✓ **Elemental sulfur: powdery mildews**
  - ✓ **Wettable sulfur: foliar diseases**
  - ✓ **Flowable sulfur: foliar diseases**
  - ✓ **Lime-sulfur: eradicant**
- **Mechanism of action: hydrogen sulfide**
- **Sulfur is phytotoxic above 88°F**

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Efficacy of Sulfur Compounds for Apple Diseases

Fire Blight	Scab	Powdery Mildew	Rusts	Bitter Rot	Black Rot	White Rot	Sooty Blotch / Flyspeck
P	F	G	P	P	P	P	P

Efficacy of Sulfur Compounds for Peach Diseases

Leaf Curl	Brown Rot Blossom Blight	Brown Rot Fruit Rot	Powdery Mildew	Scab	Bacterial Spot
_	F	P	G	G	P

- = unknown; P = poor; F = fare; G = good

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Major Apple and Peach Diseases in Illinois in the Past three Years

Apples

- Scab
- Fire Blight
- Fruit Rots
  - Bitter Rot
  - White Rot

Peaches

- Brown Rot
- Bacterial Spot

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Apple scab
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Efficacy of Compounds for Apple Scab

Fungicide	FRAC Code	Scab	Fungicide	FRAC Code	Scab
Bayleton	3	P	Rally	3	E
Captan	M	G	Rubigan	3	E
Flint	11	E	Scala	9	G
Indar	3	E	Sovran	11	E
Inspire Super	3	E	Sulfur	M	F
Mancozeb	M	G	Syllit	M	E
Polyram	M	G	Topsin-M	1	E
Pristine	11+7	E	Vangard	9	G
Procure	3	E	Ziram	M	F

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Apple fire blight in Illinois

Apple fire blight in Illinois

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Apple fire blight in Illinois

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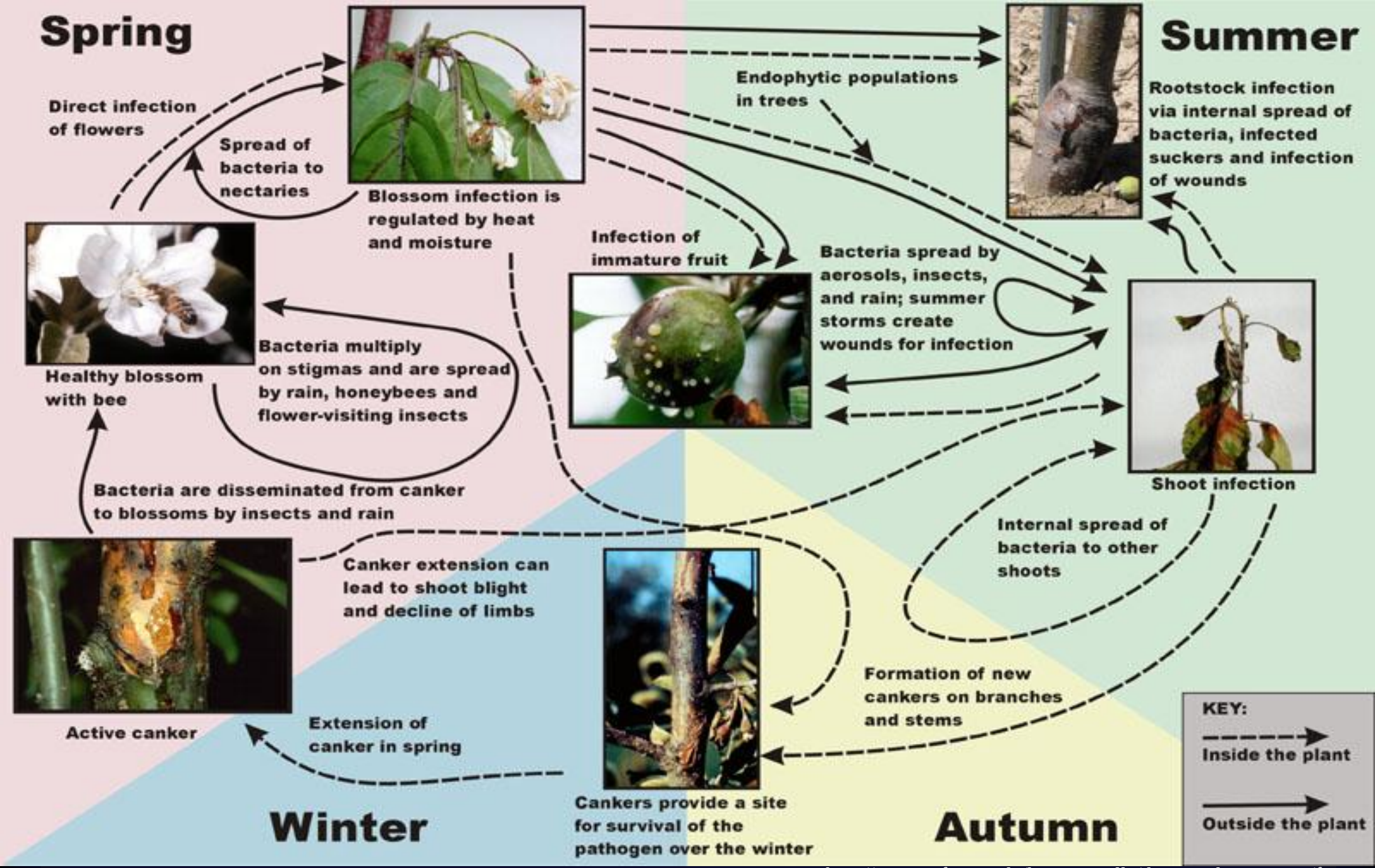

Modified by J. Norelli

http://www.caf.wvu.edu/kearneysville/disease_descriptions/fire_blight_disease_cycle.htm

Control of Fire Blight of Apple

- Copper application at silver-tip
- Streptomycin applications at bloom
  Streptomycin application as predicted by MARYBLIT or Cougar Blight
- Streptomycin application after hail damage

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Streptomycin for Fire Blight of Apple

- 1950s: Streptomycin use began
- 1971: Streptomycin-resistance in California
- By 2010: Streptomycin-resistance in western US, Michigan, New York, Canada, Israel

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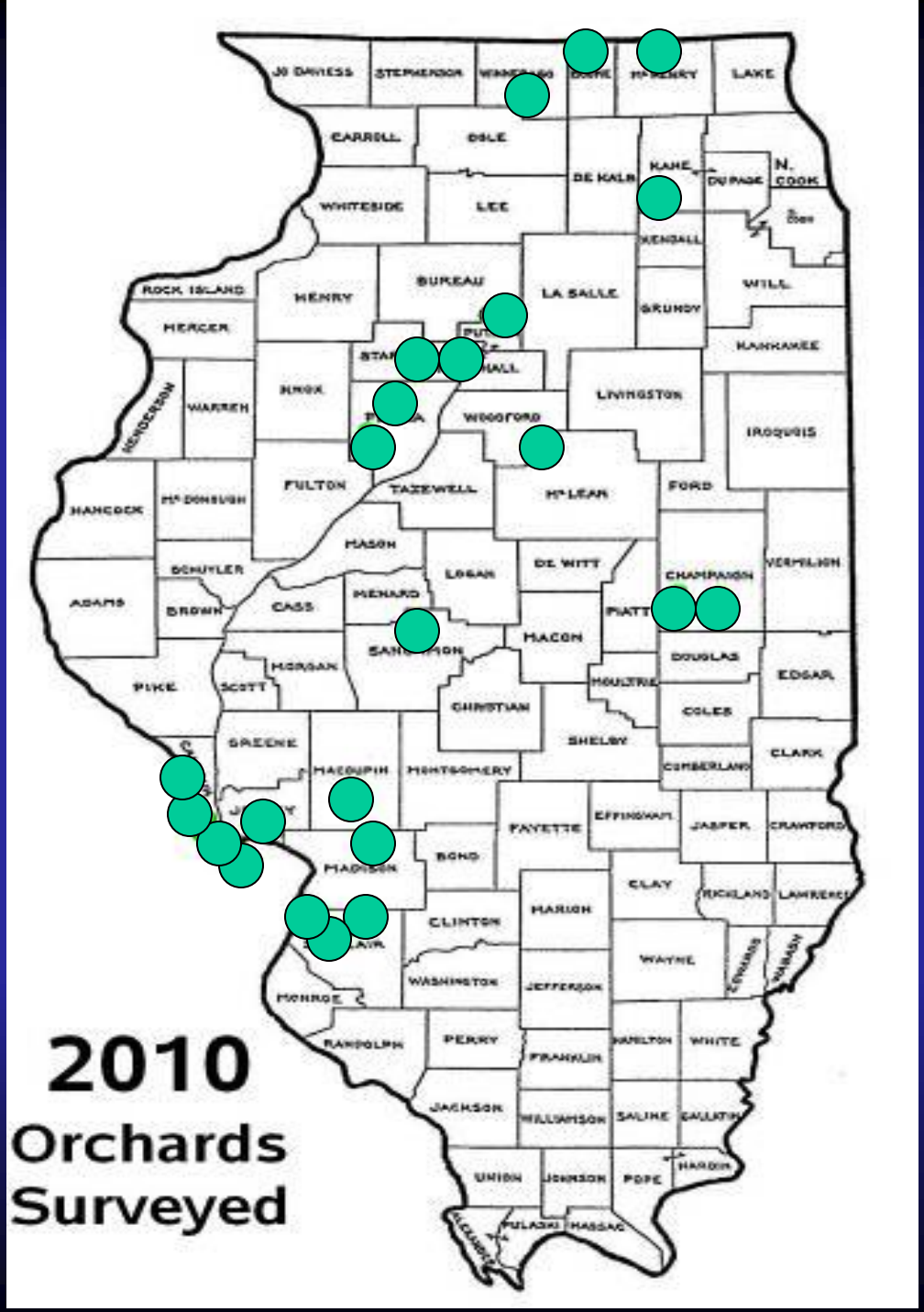
Apple Fire Blight in Illinois

- 2008: widespread and severe infection
- 2009: widespread and severe infection
- 2010: low incidence

Apple Fire Blight in Illinois

- Initiated a research to determine whether there are Streptomycin-resistant strains of the causal bacterium (*Erwinia amylovora*)


2010
Orchards
Surveyed
JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
McHENRY
LAKE
CARROLL
OGLE
DE KALB
KANE
DUPAGE
N. COOK
WHITESIDE
LEE
KENDALL
WILL
ROCK ISLAND
HENRY
BUREAU
LA SALLE
GRUNDY
MERCER
KANKAKEE
HENDERSON
WARREN
KNOX
LIVINGSTON
WOODFORD
IROQUOIS
FULTON
TAZEWELL
McLEAN
FORD
HANCOCK
McDONOUGH
MASON
SCHUYLER
LOGAN
DE WITT
CHAMPAIGN
VERMILION
ADAMS
BROWN
CASS
MENARD
PIATT
MACON
DOUGLAS
EDGAR
PIKE
SCOTT
MORGAN
CHRISTIAN
MOULTRIE
COLES
GREENE
MACOUPIN
MONTGOMERY
SHELBY
CUMBERLAND
CLARK
FAYETTE
EFFINGHAM
JASPER
CRAWFORD
MADISON
BOND
CLAY
RICHLAND
LAWRENCE
CLINTON
MARION
WAYNE
WASHINGTON
JEFFERSON
EDWARDS
WABASH
MONROE
RANDOLPH
PERRY
FRANKLIN
HAMILTON
WHITE
JACKSON
WILLIAMSON
SALINE
GALLATIN
UNION
JOHNSON
POPE
HARDIN
ALEXANDER
PULASKI
MASSAC

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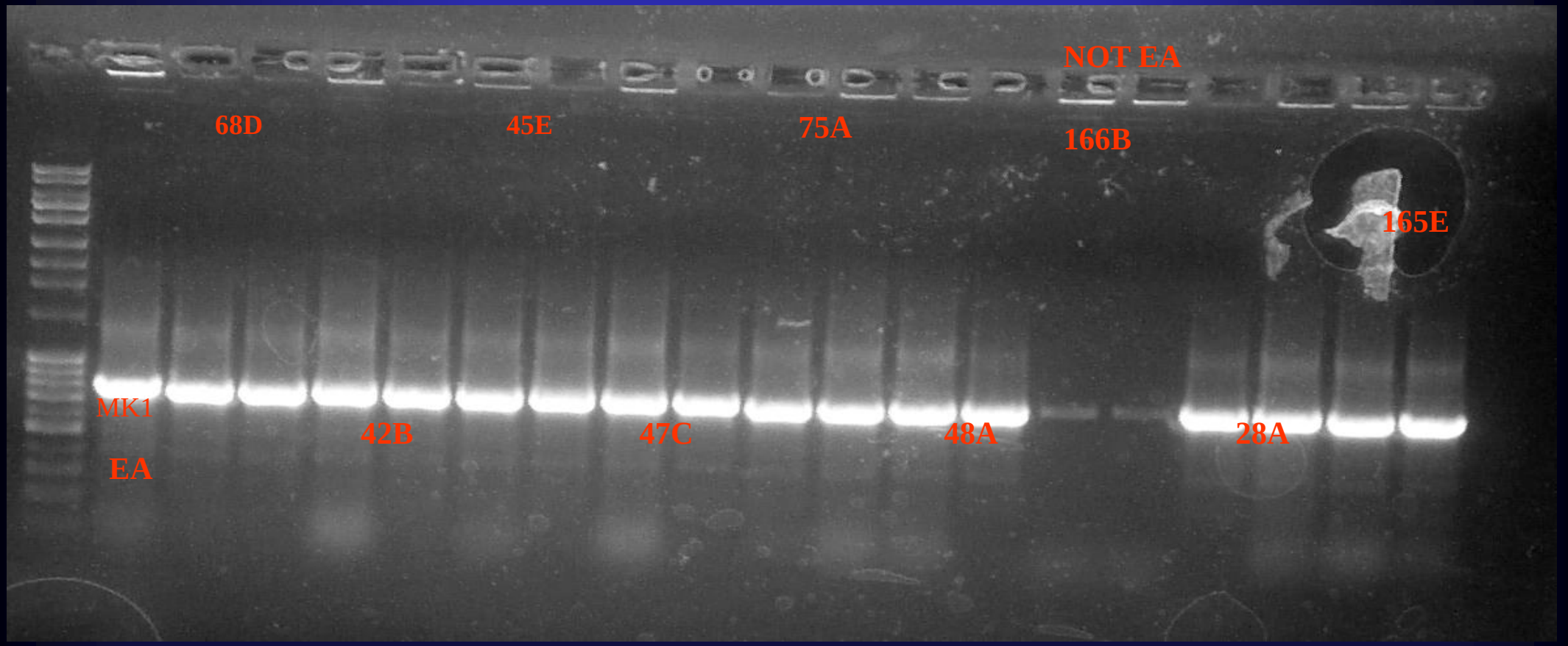
PCR Identification:

Primers AJ 75/76; targeting plasmid pEA 29

(McManus and Jones, 1995)



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2010 Streptomycin Resistance Status Report

		Growth on Streptomycin amended agar	
County	Strikes	*Erwinia amylovora* 50ppm	Other Bacteria 50ppm
Boone	15	0	1
Calhoun	36	0	4
Champaign	6	0	0
Jersey	29	0	5
Kane	11	0	6
Macoupin	9	0	0
Madison	10	0	-
Marshall	16	0	2
McHenry	6	0	0
Peoria	11	0	1
Putnam	10	0	0
Sangamon	6	0	0
St.Clair	42	0	13
Winnebago	4	0	5
Woodford	7	0	1
Totals	218	0	22

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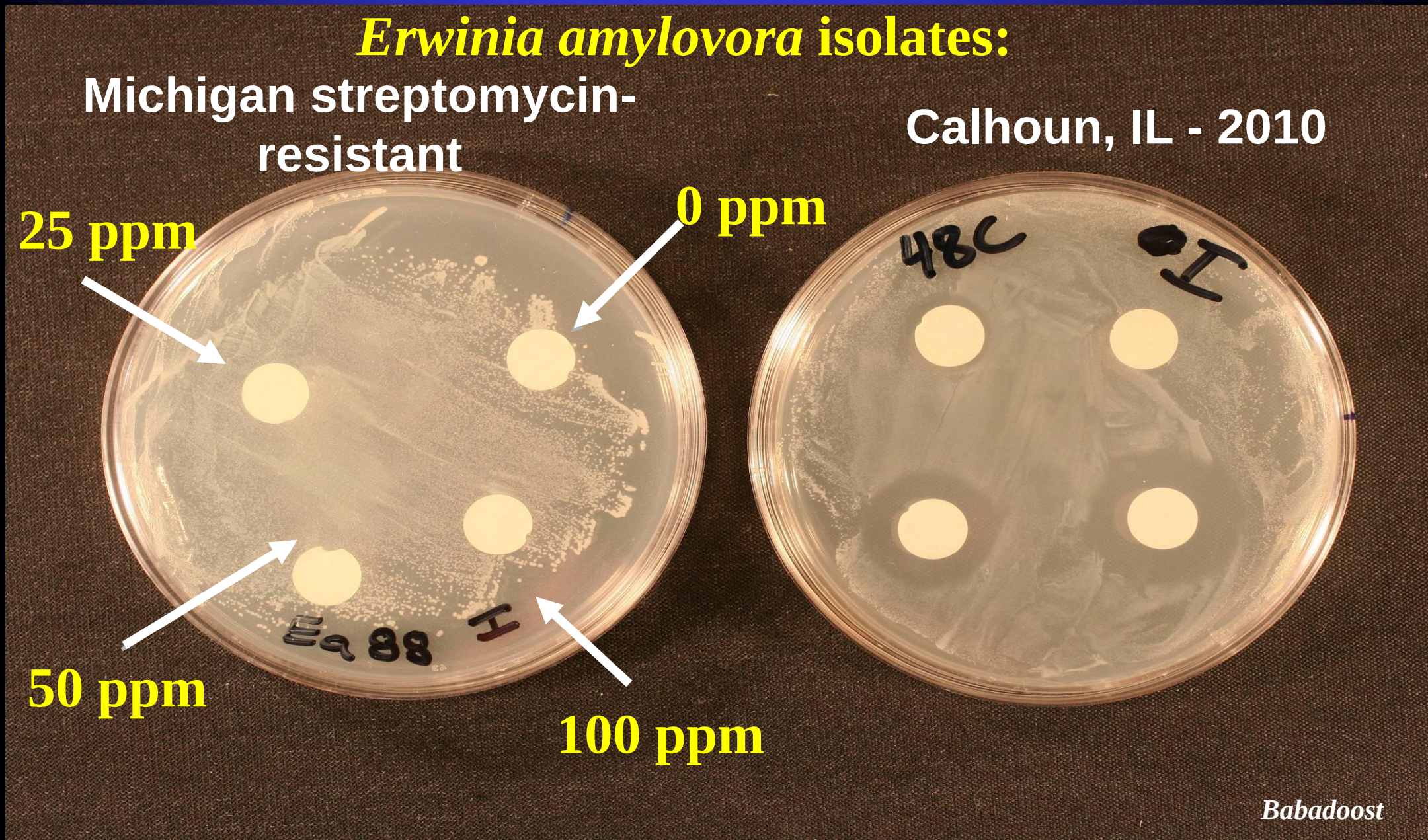
Agri-Mycin 17

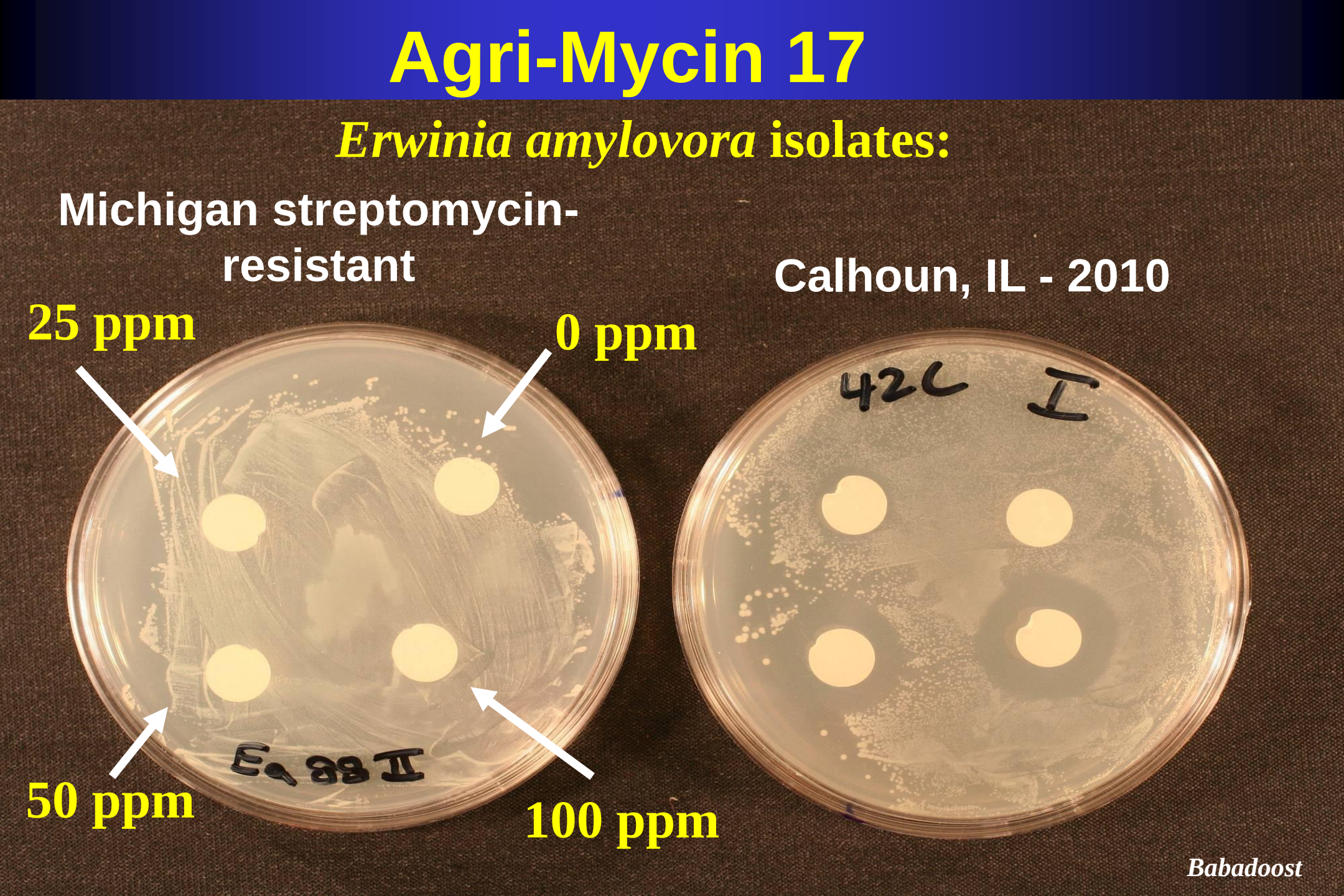


Agri-Mycin 17

Erwinia amylovora isolates:

Michigan streptomycin-resistant

Calhoun, IL - 2010



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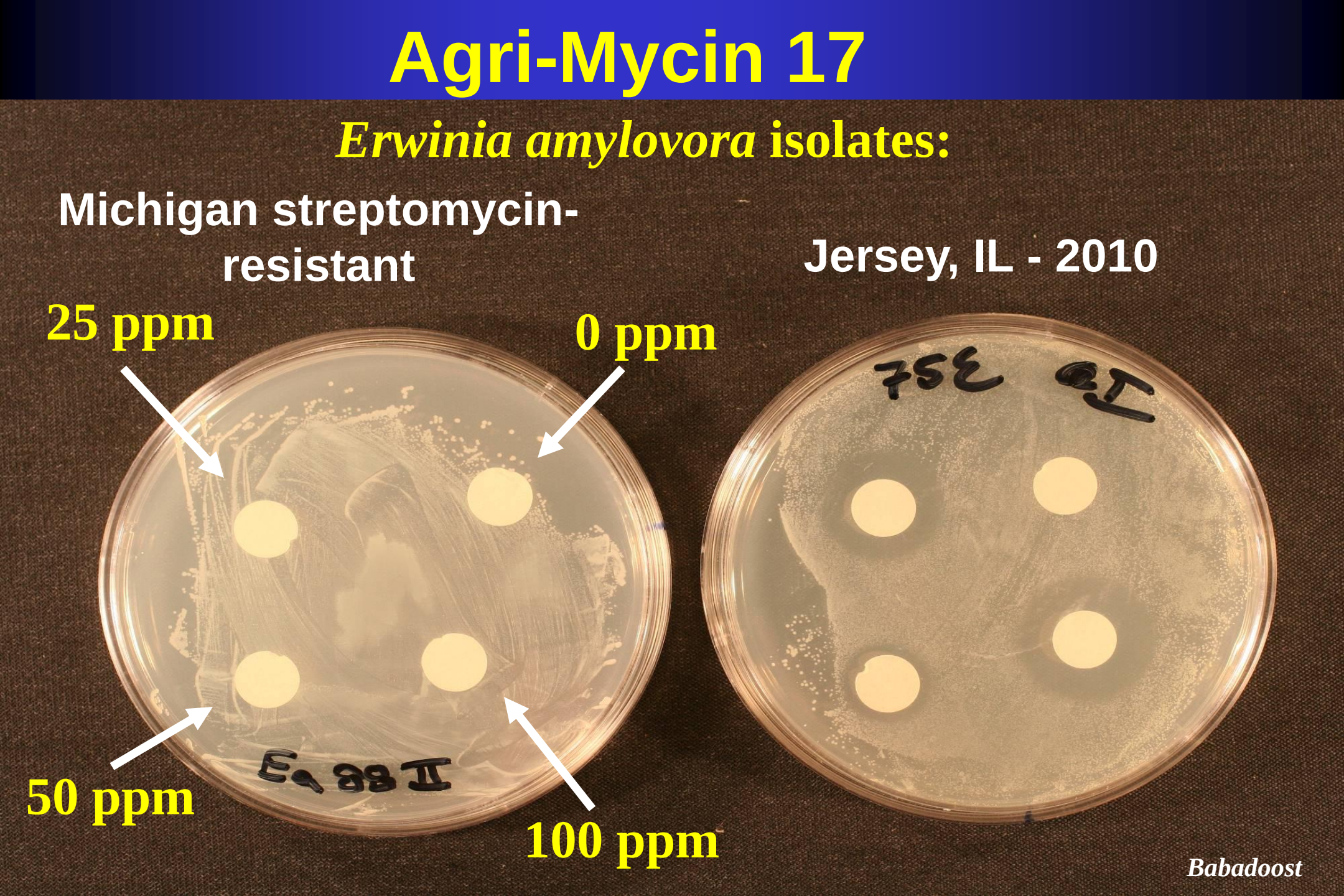
Agri-Mycin 17

Erwinia amylovora isolates:

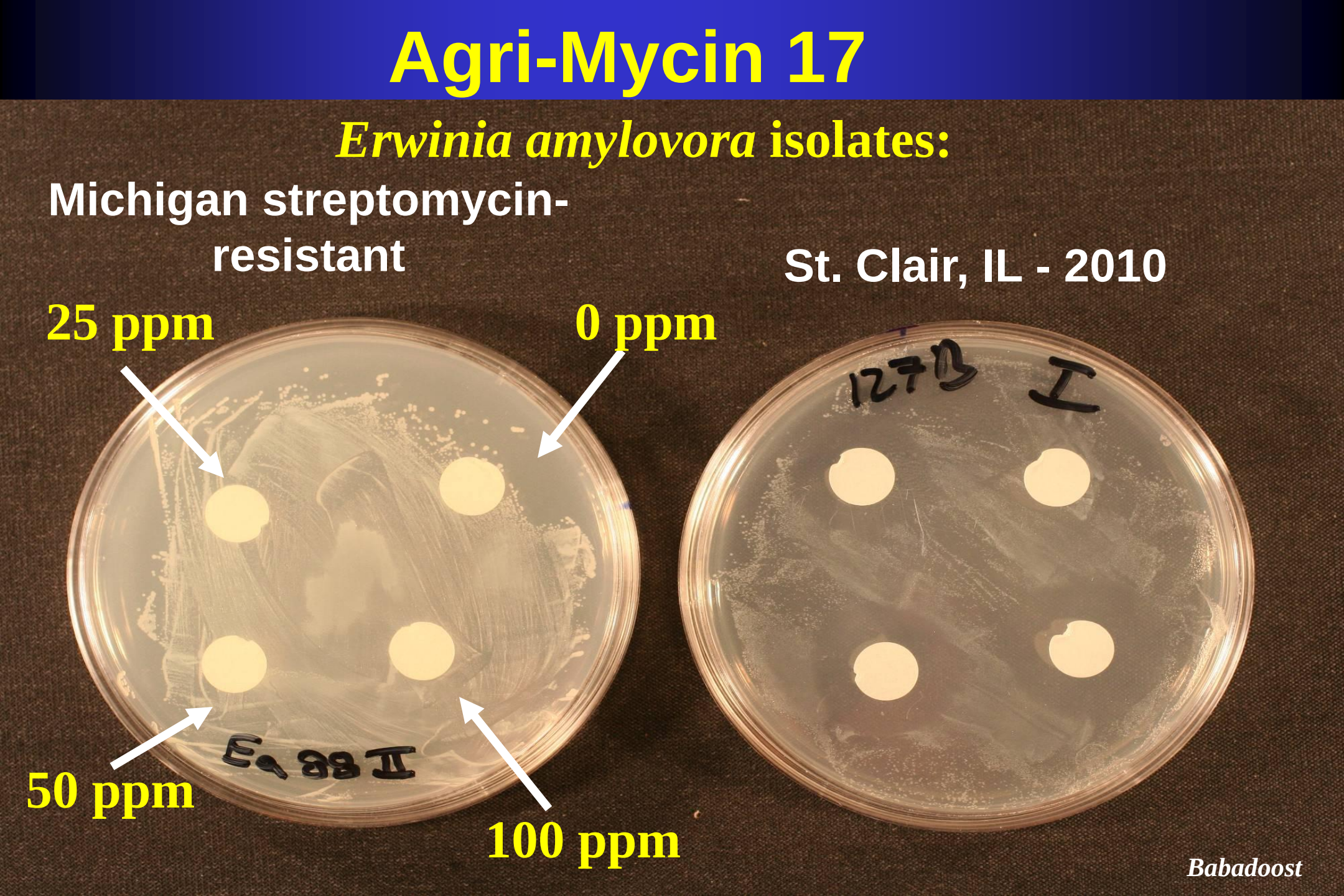


Agri-Mycin 17

Erwinia amylovora isolates:

Michigan streptomycin-resistant

St. Clair, IL - 2010

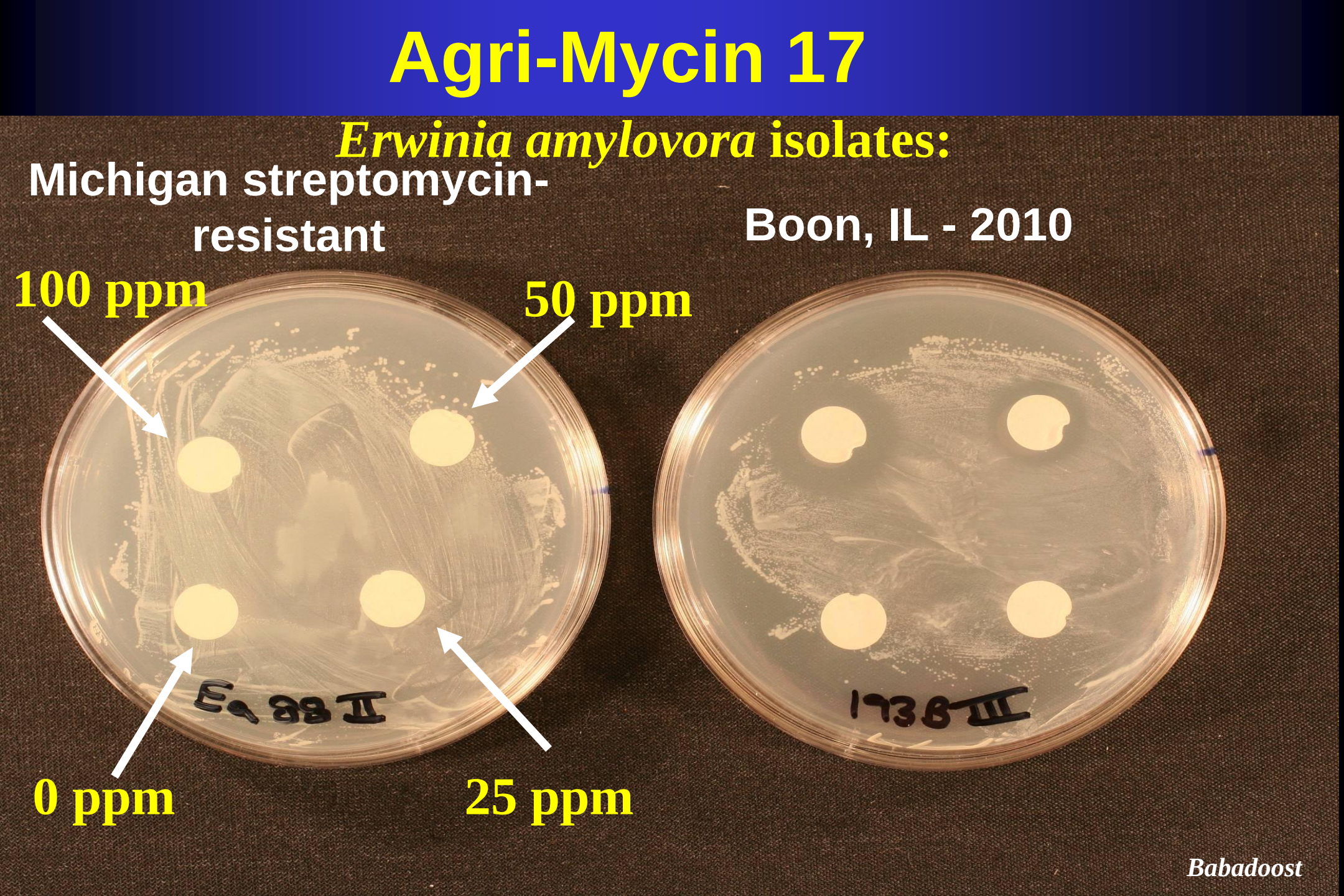


Agri-Mycin 17

Erwinia amylovora isolates:

Michigan streptomycin-resistant

Boon, IL - 2010



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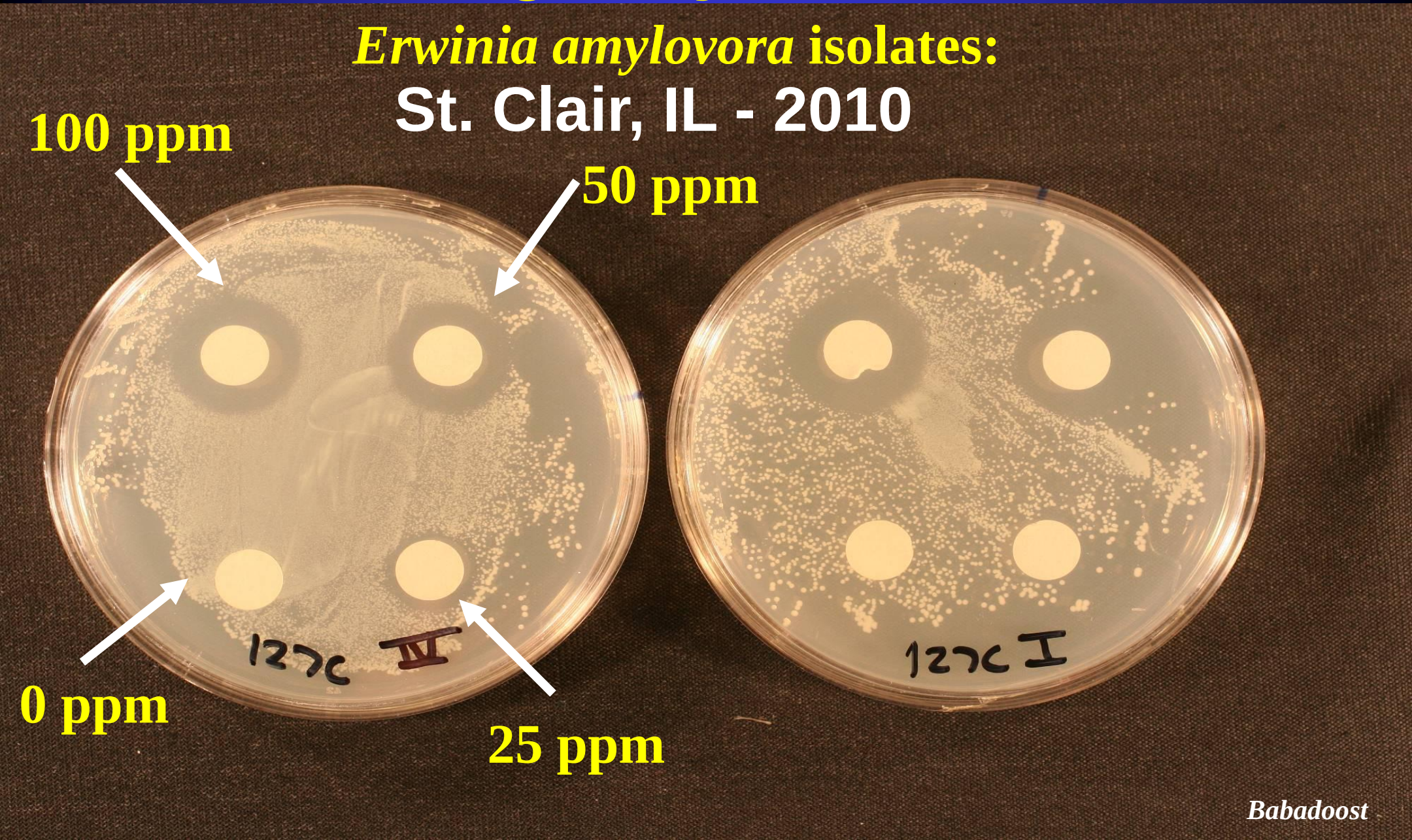
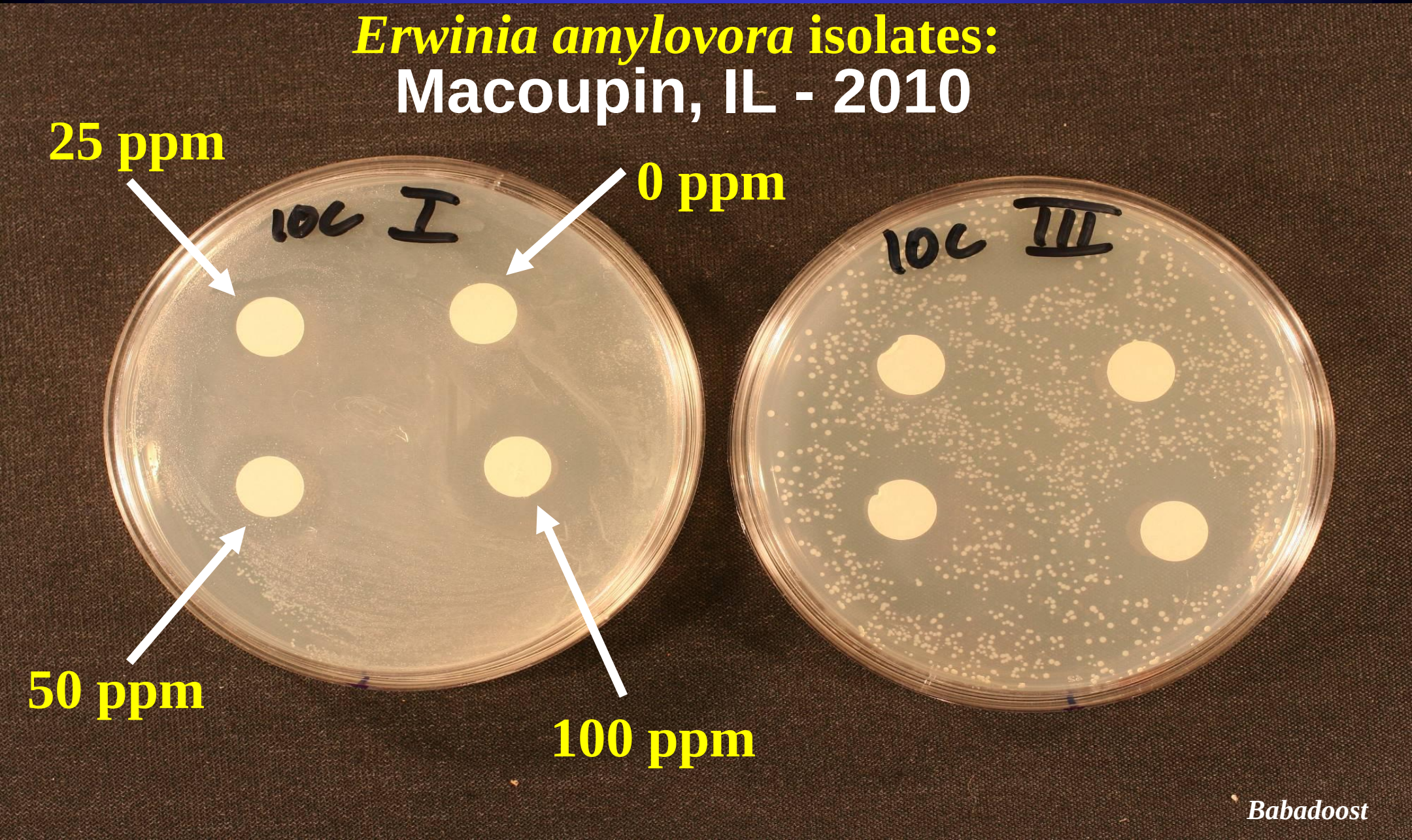
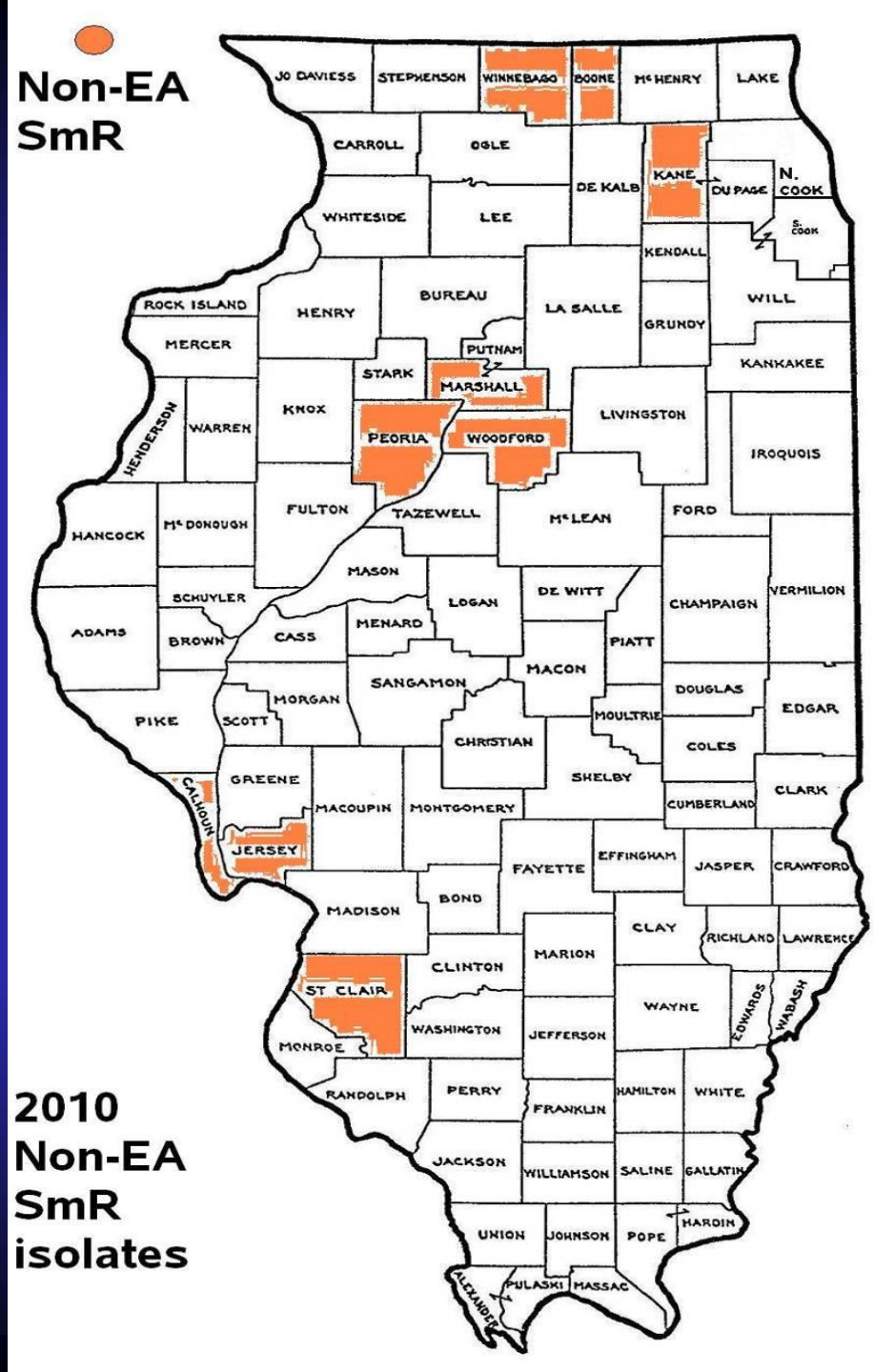
Agri-Mycin 17



Agri-Mycin 17




Non-EA
SmR
JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
McHENRY
LAKE
CARROLL
OGLE
KANE
DU PAGE
N. COOK
S. COOK
DE KALB
WHITESIDE
LEE
KENDALL
WILL
ROCK ISLAND
HENRY
BUREAU
LA SALLE
GRUNDY
MERCER
PUTNAM
KANKAKEE
STARK
MARSHALL
HENDERSON
WARREN
KNOX
PEORIA
WOODFORD
LIVINGSTON
IROQUOIS
FULTON
TAZEWELL
McLEAN
FORD
HANCOCK
McDONOUGH
MASON
SCHUYLER
DE WITT
CHAMPAIGN
VERMILION
ADAMS
BROWN
CASS
MENARD
LOGAN
PIATT
MACON
SANGAMON
DOUGLAS
EDGAR
PIKE
SCOTT
MORGAN
MOULTRIE
CHRISTIAN
COLES
GREENE
SHELBY
CLARK
CALHOUN
MACOUPIN
MONTGOMERY
CUMBERLAND
JERSEY
FAYETTE
EFFINGHAM
JASPER
CRAWFORD
MADISON
BOND
CLAY
RICHLAND
LAWRENCE
CLINTON
MARION
ST CLAIR
WAYNE
EDWARDS
WABASH
WASHINGTON
JEFFERSON
MONROE
RANDOLPH
PERRY
FRANKLIN
HAMILTON
WHITE
JACKSON
WILLIAMSON
SALINE
GALLATIN
HARDIN
UNION
JOHNSON
POPE
ALEXANDER
PULASKI
MASSAC
2010
Non-EA
SmR
isolates

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Bitter rot or apples

Fungicides for Summer Diseases of Apples

Fungicide Application	Diseases	Appl. Inter. (Days)	Suggested Fungicides
First Cover	Scab, Fruit Rot	10-14	Sovran (or Pristine)+ Ziram
Second Cover	Scab, Fruit Rot	10-14	Topsin-M + Captan
Third Cover	Sooty Blotch/Flyspeck, Fruit Rot	10-14	Sovran (or Pristine)+ Ziram
Fourth Cover	Sooty Blotch/Flyspeck, Fruit Rot	10-14	Topsin-M + Captan
Fifth Cover	Sooty Blotch/Flyspeck, Fruit Rot	10-14	Sovran (or Pristine)+ Ziram
Sixth Cover	Sooty Blotch/Flyspeck, Fruit Rot	10-14	Topsin-M + Captan
Seventh Cover	Sooty Blotch/Flyspeck, Fruit Rot	10-14	Sovran (or Pristine)+ Ziram
Eighth Cover	Sooty Blotch/Flyspeck, Fruit Rot	10-14	Topsin-M + Captan

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Disease-Warning System: Moisture

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All Summer Diseases of Apple

- 175 h leaf wetness (4 h)
- Threshold: 175 h after the first cover spray

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Watchdog Leaf Wetness/ Temperature Logger

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175 h Leaf Wetness (4 h)- Illinois

- Tested in 22 commercial orchards
- All summer diseases: 2001-2010
  - Sooty Blotch/Flyspeck
  - Fruit rots (bitter, black, white rots)
- Spring diseases (scab, powdery mildew, rusts,…) were also evaluated

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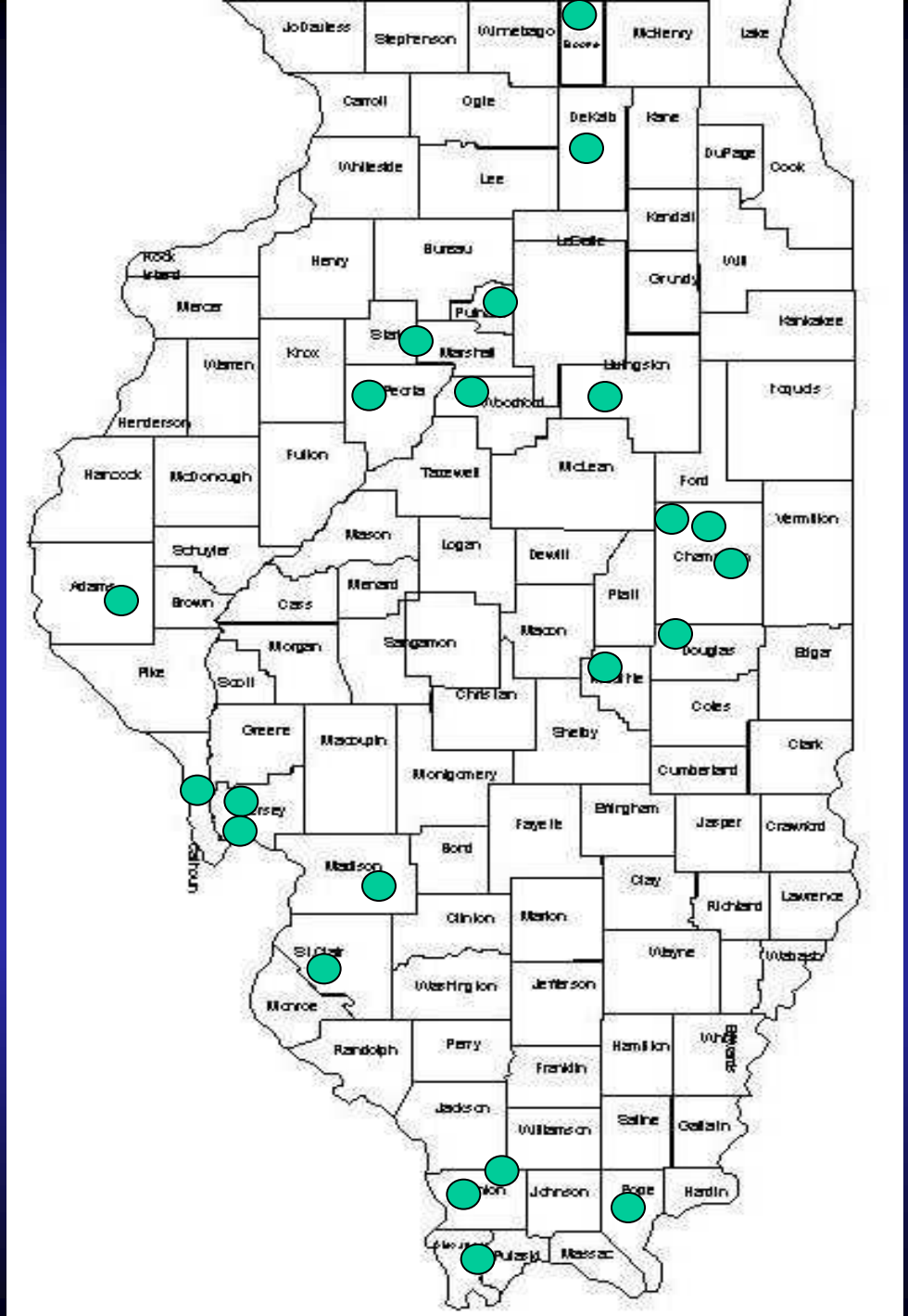
Illinois 2001-2010



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Apple Diseases in Illinois During 2001-2009

Year	No of Orchards	Sprays Saved [No. (%)]
2001	6	3.0 (43%)
2002	6	3.5 (50%)
2003	11	3.1 (44%)
2004	14	3.0 (43%)
2005	5	3.0 (43%)
2006	8	4.0 (57%)
2007	7	3.2 (46%)
2008	8	3.3 (47%)
2009	8	3.0 (43%)
No. of Orchards: 22		Average: 3.23 (46%)

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Reasons for Failure on Effective Control of Apple and Peach Diseases

- Pathogen resistance: less likely
- Timely application of fungicides
- Using effective fungicides
- Cultural practices (moisture)
  - Good pruning
  - Soil drainage
  - Weed control

Questions/ Comments