Innovations and Tracking Use of Antibiotics in Tree Crops
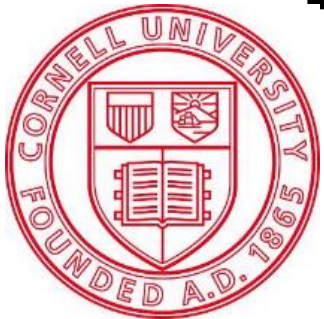
Kerik Cox, Anna Wallis, & Isabella Yannuzzi
Plant Pathology and Plant-Microbe Biology
Cornell University

Tree Fruit & Small Fruit Pathology
Research/Extension/Teaching 50/15/35

Antibiotics in tree crops

Interest in antibiotics and EPA labeling shortly after 1950s –
*Erwinia amylovora* (Fire blight)

Blister Spot

Citrus Greening – Ricke Kress

Antibiotic	Crop	Pathogen
Oxytetracycline (Stat, Pro)	Apple/Pear	*Erwinia amylovora*
Oxytetracycline	Peach/Nectarine	*Xanthomonas arboricola* pv. Pruni
Oxytetracycline	Citrus	*Candidatus* Liberibacter asiaticus
Streptomycin (Cide, LSys)	Apple/Pear	*Erwinia amylovora & Pseudomonas sryingae*
Streptomycin	Tomato & Pepper	*Xanthomonas campestris*
Streptomycin	Lettuce & celery, chrysanthemum	*Pseudomonas cichorii*
Kasugamycin (Cide, Pro)	Apple/Pear	*Erwinia amylovora*
Kasugamycin	Tomato & Pepper	*Xanthomonas campestris*
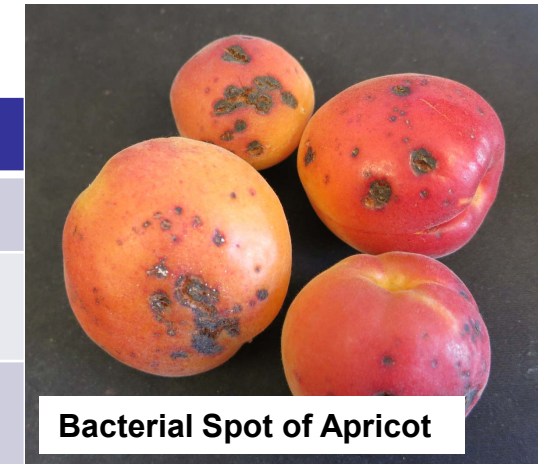
Bacterial Spot of Apricot
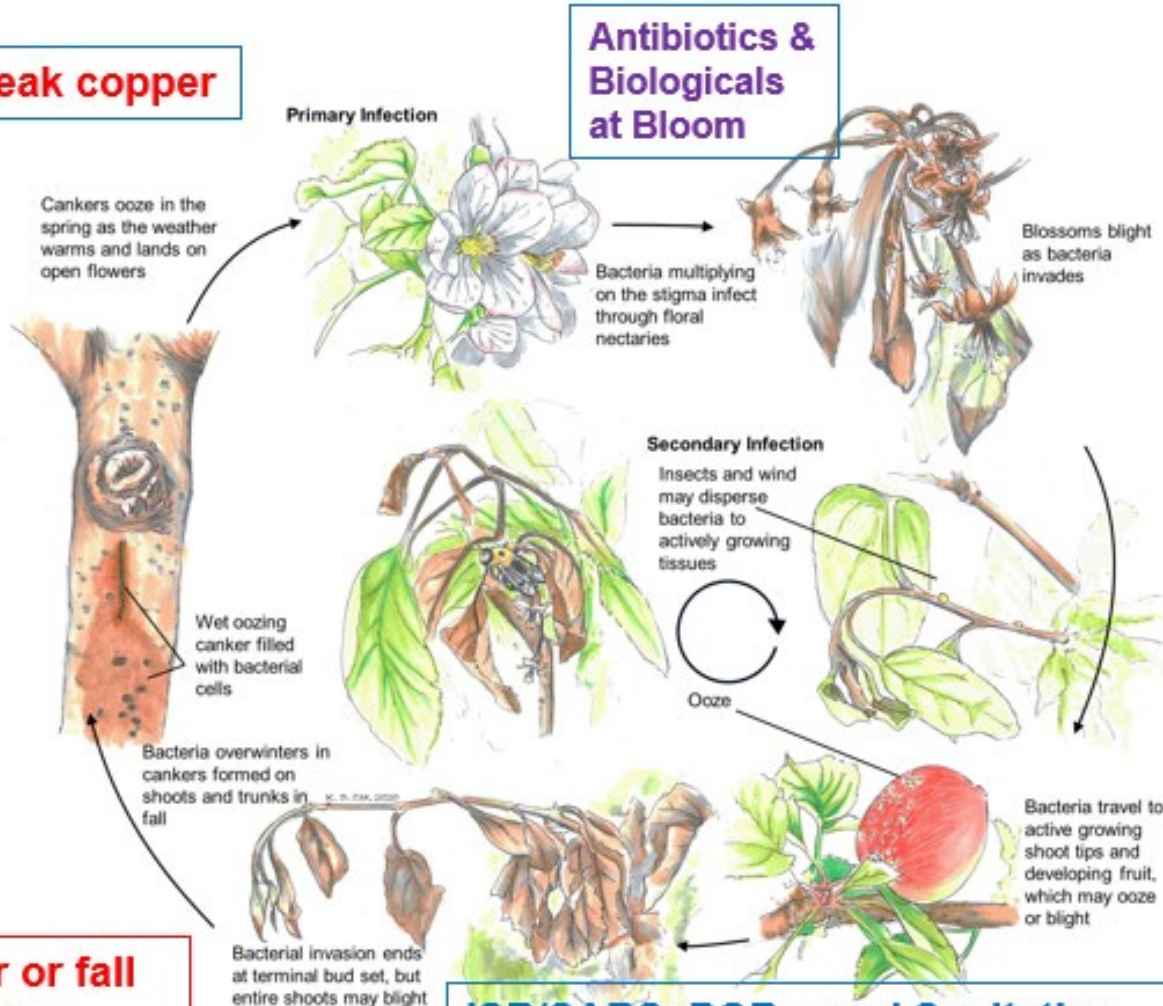

Fire Blight

Fire blight in eastern North America

- High-density super spindle plantings (1000 – 1200/A) = $high-value acreage (small trees)
- New popular scion varieties susceptible
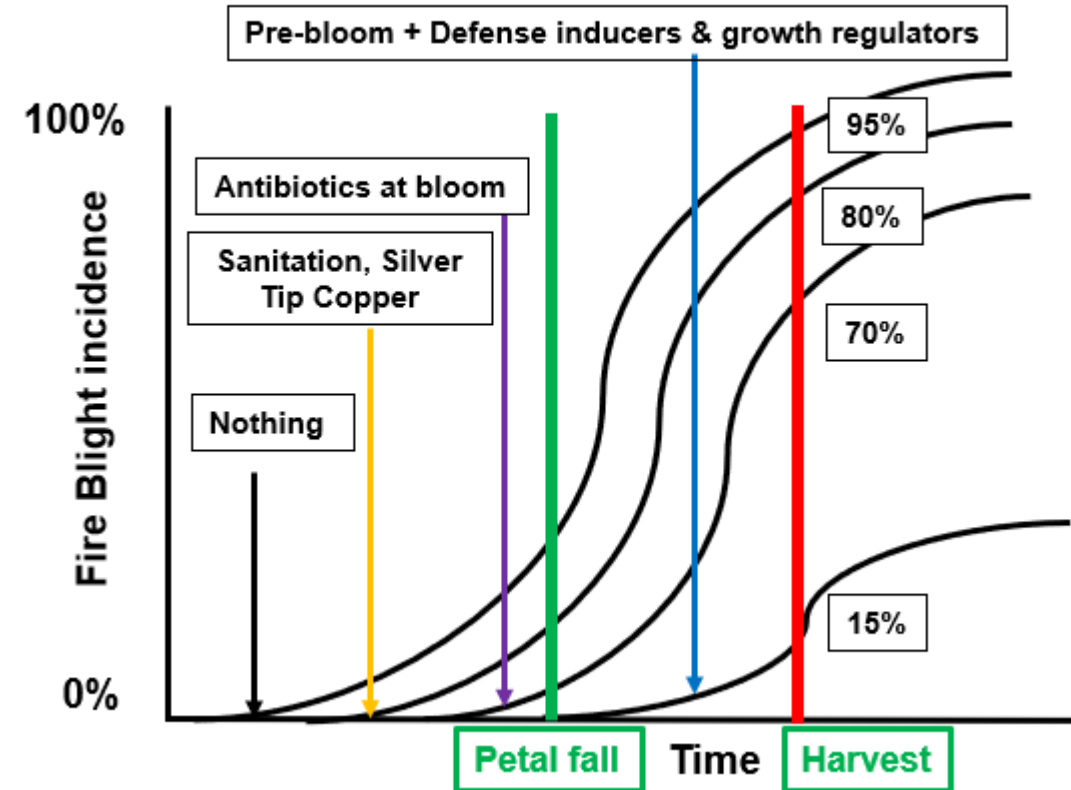- Seasons with warmer weather at bloom

Super Spindle orchard

Fire blight – USDA germplasm repository

Fire blight in eastern North America

Managing fire blight with antibiotics

- Growers only use antibiotics
  1. At bloom > use extension alerts or forecasting tools to predict fire blight infection (NEWA DSS system)
  2. After a trauma event like hail after bloom
- Selection for AMR in non-targets
  1. Selection in epiphytes after 3 apps: Plant Dis.(2017)
  2. Endophytes not affected: Phytobiomes (2021)

Fire Blight Risk Predictions for Peru

Orchard Blight History: Fire blight occurred in your neighborhood last year.
Select the fire blight history in your orchard block of interest and the tool will calculate risk. Toggle orchard blight history to recalculate risk.

First blossom open date: 5/7/2016
The first blossom open date above is estimated based on degree day accumulations. Enter the actual first blossom open date for your orchard block of interest and the tool will calculate the protection period during bloom more accurately.
Accumulated degree days (base 43°F) through 5/11/2016: 275 (0 days missing)

	Past	Past	Current	Ensuing 5 Days				
Date	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Cougarblight 4-Day DH	Low* 0*	Low* 9*	Low 37	Caution 226	Caution 252	High 318	Caution 289	Low 100
Infection Potential EIP value	Low 7	Low 0	Low 2	Moderate 52	Moderate 53	High 69	Moderate 46	Moderate 22
Wetness Events								
Rain Amount	0.00	0.00	0.00	0.00	0.08	0.01	0.03	0.02
Dew ❓	No	No	No	No	Yes	No	Yes	No
Leaf Wetness (hours)	0	0	0	0	5	3	9	0
Hours >90% RH	0	0	0	0	5	0	3	0
RH max/min	79/35	75/35	87/26	79/25	97/48	83/45	95/56	84/37
Temp avg F	43	50	52	60	59	61	45	46

NA - data not available   View Cougarblight Charts   Download Time: 5/17/2016 23:00

* Indicates incomplete accumulation of the 4-day DH total. The DH value may reach "Caution", "High" or "Extreme" levels before spanning the 4-day accumulation cut-off time of Cougarblight.

Streptomycin Spray Date: Click to enter date
If you applied streptomycin before all flowers were open, enter the date of the streptomycin application to recalculate fire blight risk predictions.

Managing fire blight with antibiotics

- Fire blight forecasting:
  - Tells: **When** and **How** favorable environmental conditions are for blossom blight infection

  - More **cost-effective & responsible** to use antibiotics for blossom blight when **environment conditions are favorable**

  - **Applying antibiotics** for blossom blight, use **forecasting models** to guide application timing

Blossom Blight
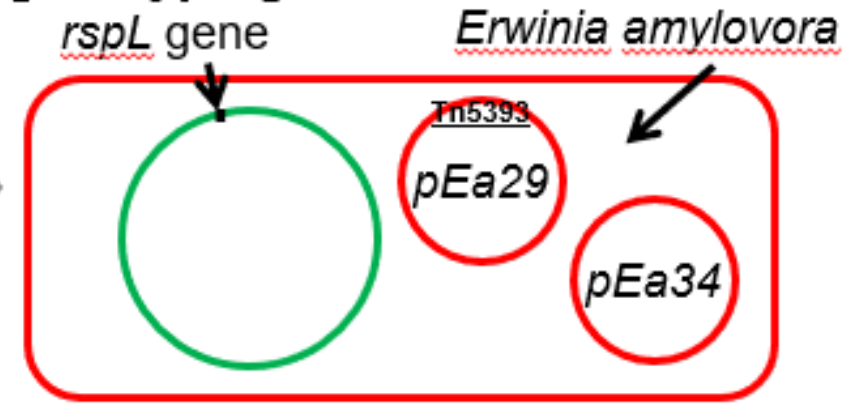
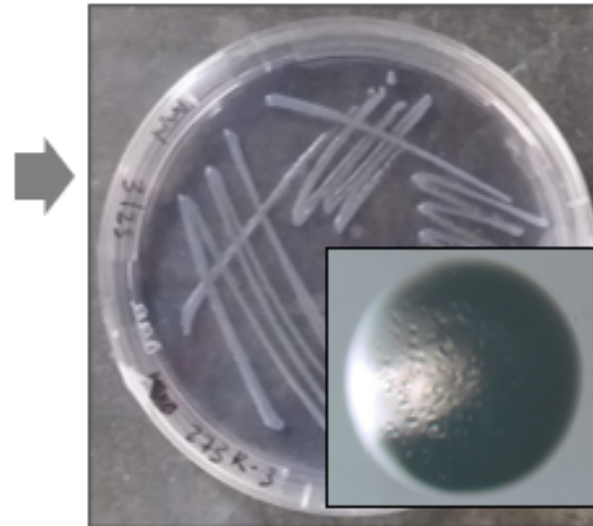# AMR and *E. amylovora* strain tracking
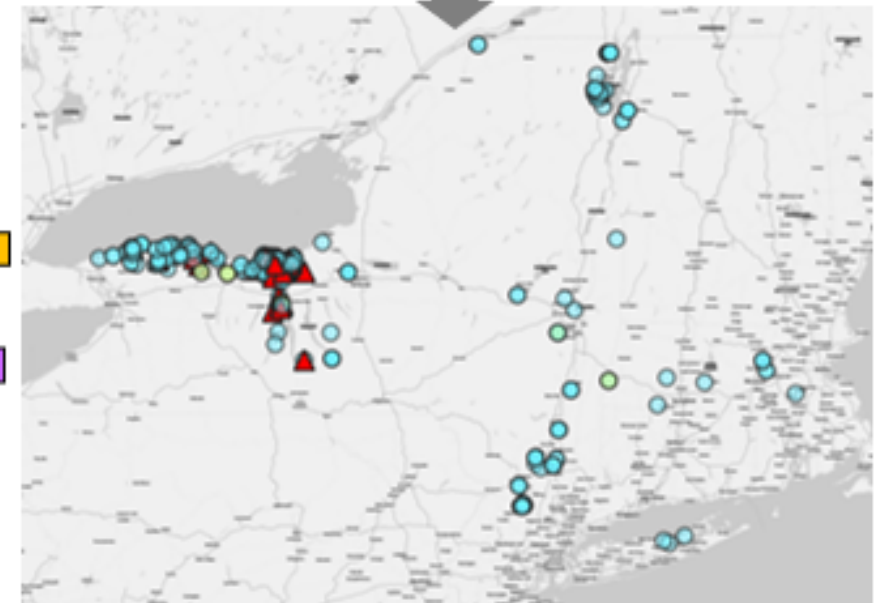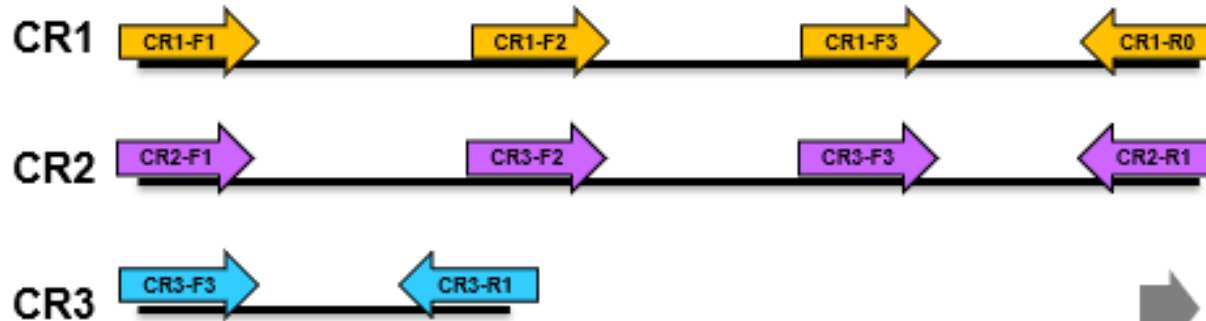
AMR and *E. amylovora* strain tracking
2011, 2012, 2013 2014

- 32 AmR isolates @ 19 farms
- 19 distinct strain profiles

Phenotype	Profiles	
AmR	41:23:38	
	15:34:38	
AmS	2:22:38	42:27:38
	4:56:38	5:55:38
	4:57:38	51:27:38
	4:58:38	43:27:38
	47:27:38	53:27:38
	50:27:38	52:27:38
AmR & AmS	4:27:38	
	4:21:38	
	5:27:38	
	40:27:38	
	44:34:38	

Original AmR Strain

Evidence of AmR development within NY?
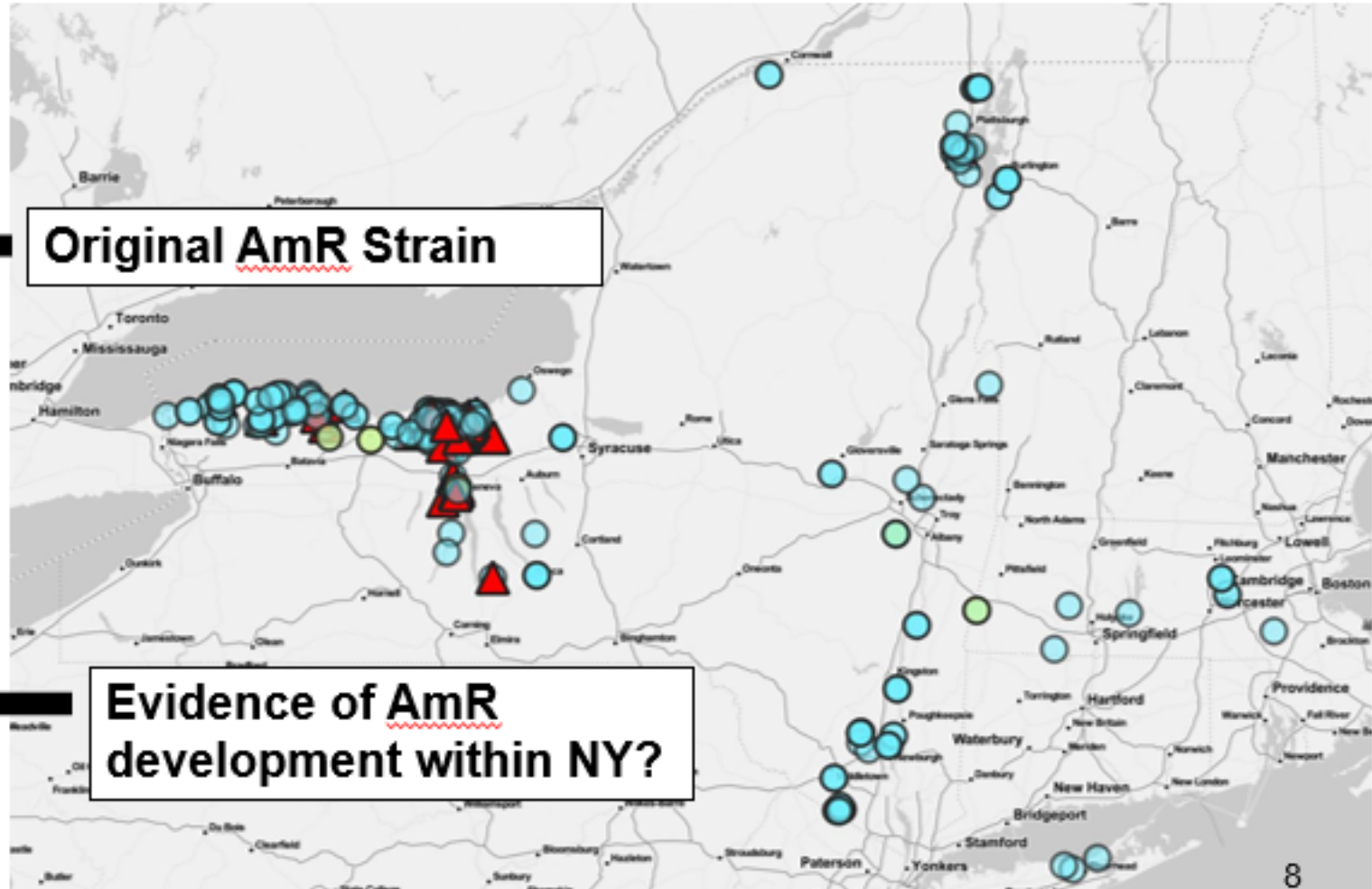
AMR and *E. amylovora* strain tracking
2015, 2016, 2017, 2018, 2019, 2020

- 70 Amr isolates @ 11 farms
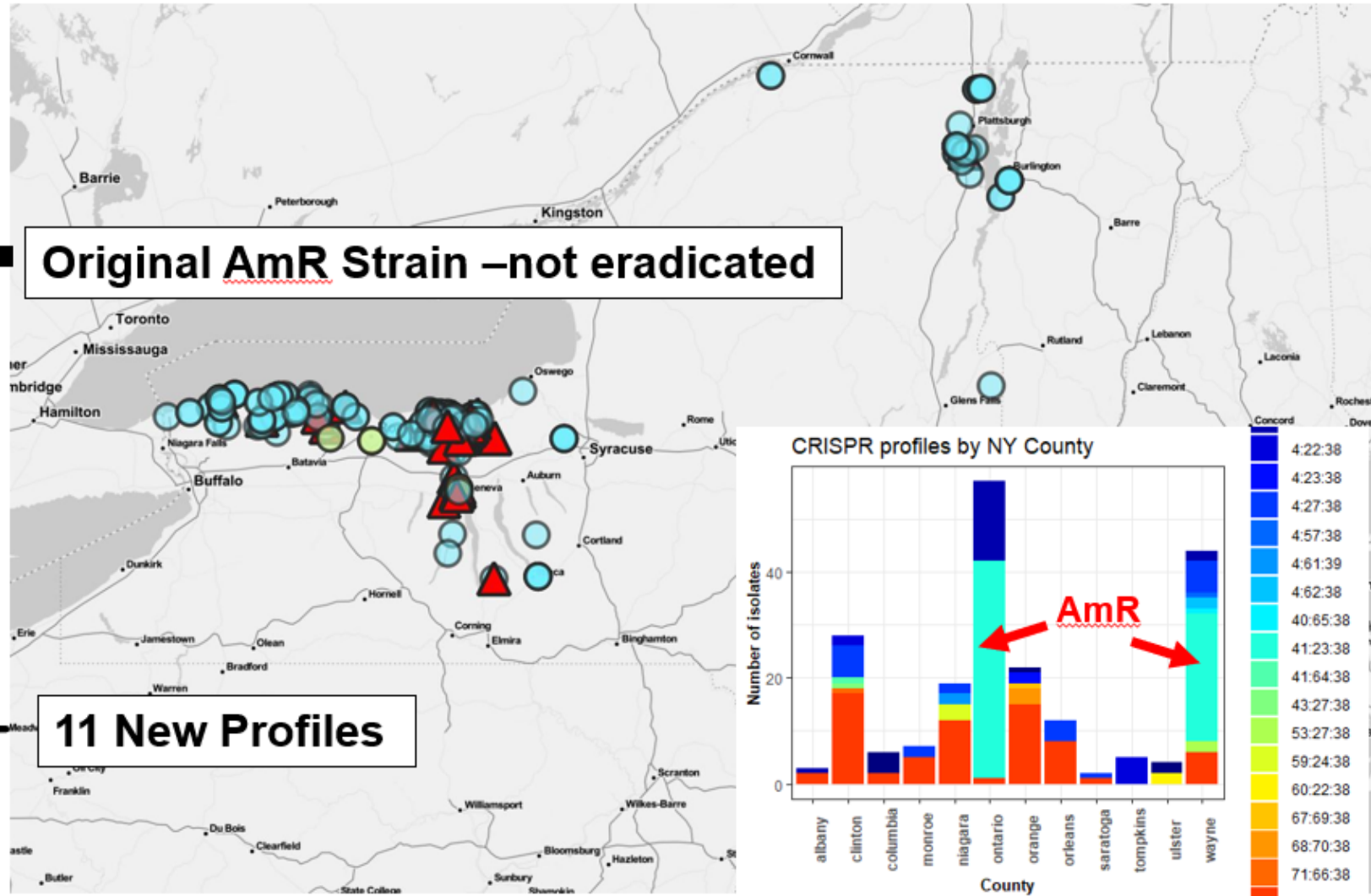- 27 distinct strain profiles

Phenotype	Profiles	
AmR	**41:23:38**	
AmS	2:22:38	**4:62:38**
	4:21:38	**4:63:38**
	4:22:38	**40:65:38**
	4:23:38	**41:64:38**
	4:24:38	**43:27:38**
	4:27:38	**59:24:38**
	4:57:38	**60:22:38**
	5:27:38	**67:69:38**
	40:27:38	**68:70:38**
	53:27:38	**71:66:38**
		4:61:39

Original AmR Strain –not eradicated

11 New Profiles

CRISPR profiles by NY County

AmR

Number of isolates

County

albany, clinton, columbia, monroe, niagara, ontario, orange, orleans, saratoga, tompkins, ulster, wayne

4:22:38
4:23:38
4:27:38
4:57:38
4:61:39
4:62:38
40:65:38
41:23:38
41:64:38
43:27:38
53:27:38
59:24:38
60:22:38
67:69:38
68:70:38
71:66:38

Summary & Takeaways

- Limited number of antibiotics labeled for tree crops & a limited number pathosystems warranting use

- Antibiotic use restricted to managing epiphytic pathogen populations

- In apples, antibiotics are integrated with other management tools & timed using disease forecasting to maximize effectiveness and reduce selection for AMR (strains are moved)

- Infrastructure is in place to monitor & track AMR & data suggest transport of AMR

Blossom Blight