Bacterial Spot Management in Stone Fruit

Sarah Bardsley Capasso

Sarah Bardsley Capasso, Kari Peter, and María del Mar Jiménez-Gasco
Department of Plant Pathology and Environmental Microbiology,
The Pennsylvania State University,
University Park, PA 16802 & Biglerville, PA 17307

PennState
College of Agricultural Sciences

Overview

- Bacterial Spot
  - Symptoms
  - Disease Cycle
  - Management
- Antibiotic Resistance

Severe bacterial spot lesions on apricot

Bacterial Spot of Peach and Nectarine

‘Snow King’ ‘Sweet Dream’ ‘Easternglo’

- Most Important Bacterial Disease of Peach and Nectarine
- *Xanthomonas arboricola* pv. *pruni* (*Xap*)

- Yield Limiting Symptoms
- 100% Fruit Loss Observed
- Few Effective Controls

Bacterial Spot Symptoms - Fruit

Early Season Lesions

- Irregularly shaped
- Extend deep into fruit

Late Season Lesions

- Shallow
- Skin Cracking

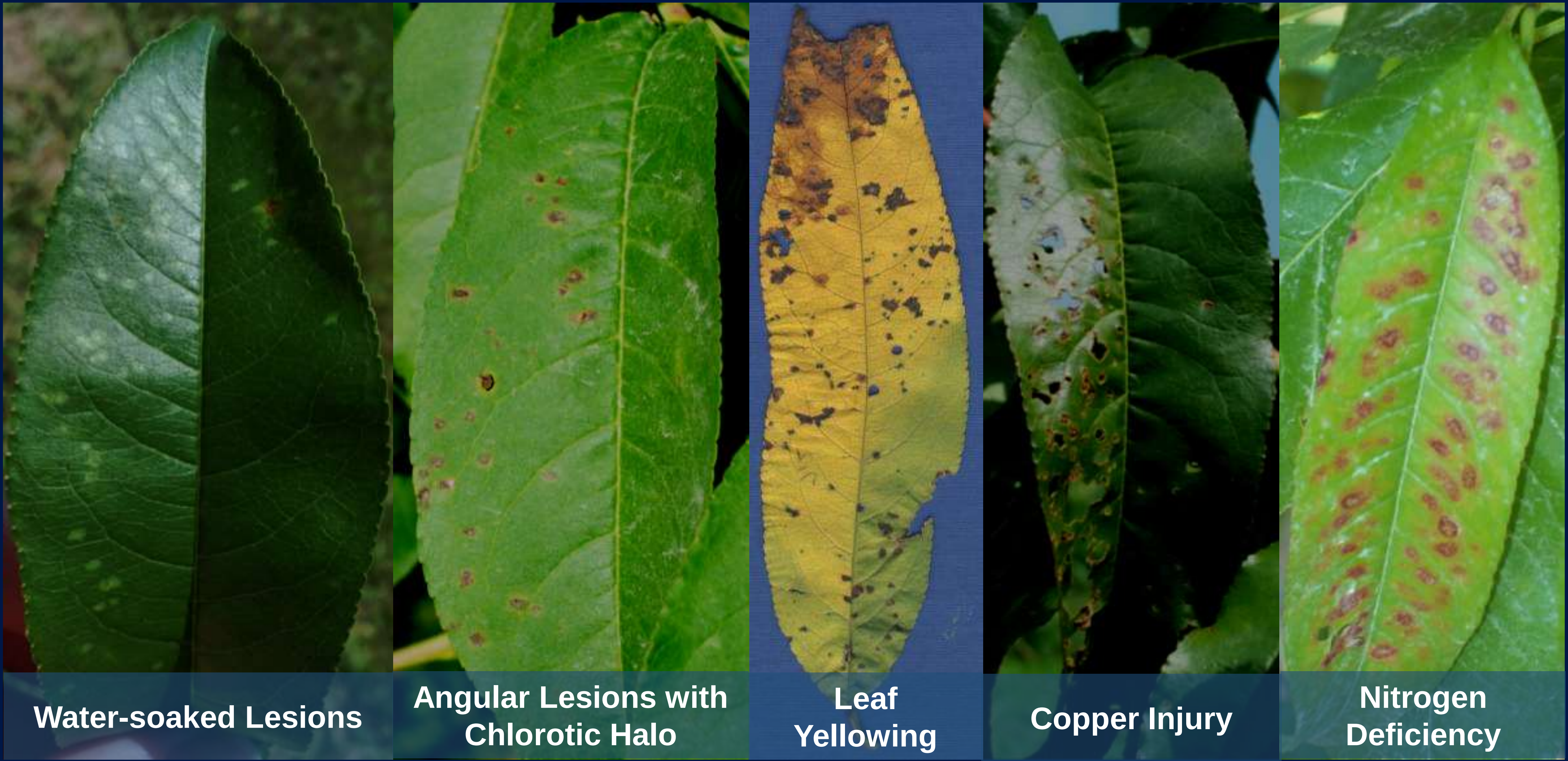
Bacterial Spot

- Bacteria
- Angular lesions
- No lesion pattern
- Surface pitting
- Foliar symptoms
- Lesions are not fuzzy

Peach Scab

- Fungus
- Circular lesions
- Lesions form pattern
- No fruit surface pitting
- No foliar symptoms
- Dark olive-brown, fuzzy lesions

Foliar Bacterial Spot Symptoms



Water-soaked Lesions

Angular Lesions with Chlorotic Halo

Leaf Yellowing

Copper Injury

Nitrogen Deficiency

Bacterial Spot Symptoms - Twigs

- Cankers
- Bark cracking
- Lack of vegetative growth
- Overwintering site for bacteria

Black Tip

Bacterial Spot Disease Cycle

Bacterial Spot Management

Three Main Strategies:

- –Less Susceptible Cultivars
- –Cultural Management
- –Chemical Bactericides

Bacterial Spot Symptoms on ‘Sweet Dream’

Cultivar Selection

- No cultivar completely resistance to bacterial spot
- Highly susceptible cultivars a source of inoculum
- Hide more susceptible cultivars inside orchard block
- Long-term strategy

Cultural Management

- Site Selection
  - Well draining soil
  - Avoid low spots
- Reduce Tree Stress
  - Nutrition
  - Weed Management
- Prune
  - Increase Airflow
  - Remove Cankers

Severe flooding in peach orchard (clemson.edu)

Bactericide Applications

- Copper
  - Dormant & cover sprays
  - Phytotoxic
- Oxytetracycline
  - Poor persistence on leaves
  - Label limitations

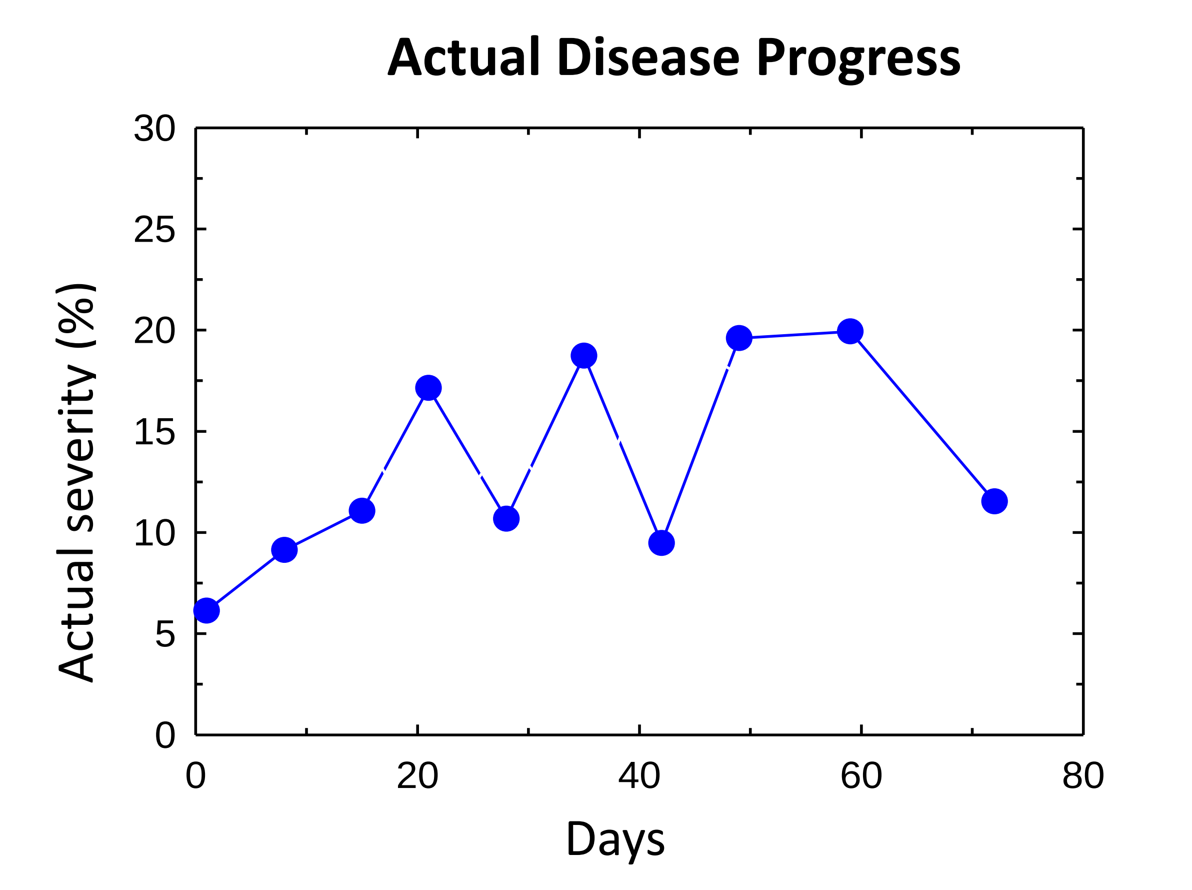

Copper Injury

Refining Management

- Disease progress
  - Target weak points
- Defoliation
  - Significant factors
- Alternative Bactericide Programs
  - Reduce the use of a single product

Bacterial Spot and Brown Rot

Disease Progress

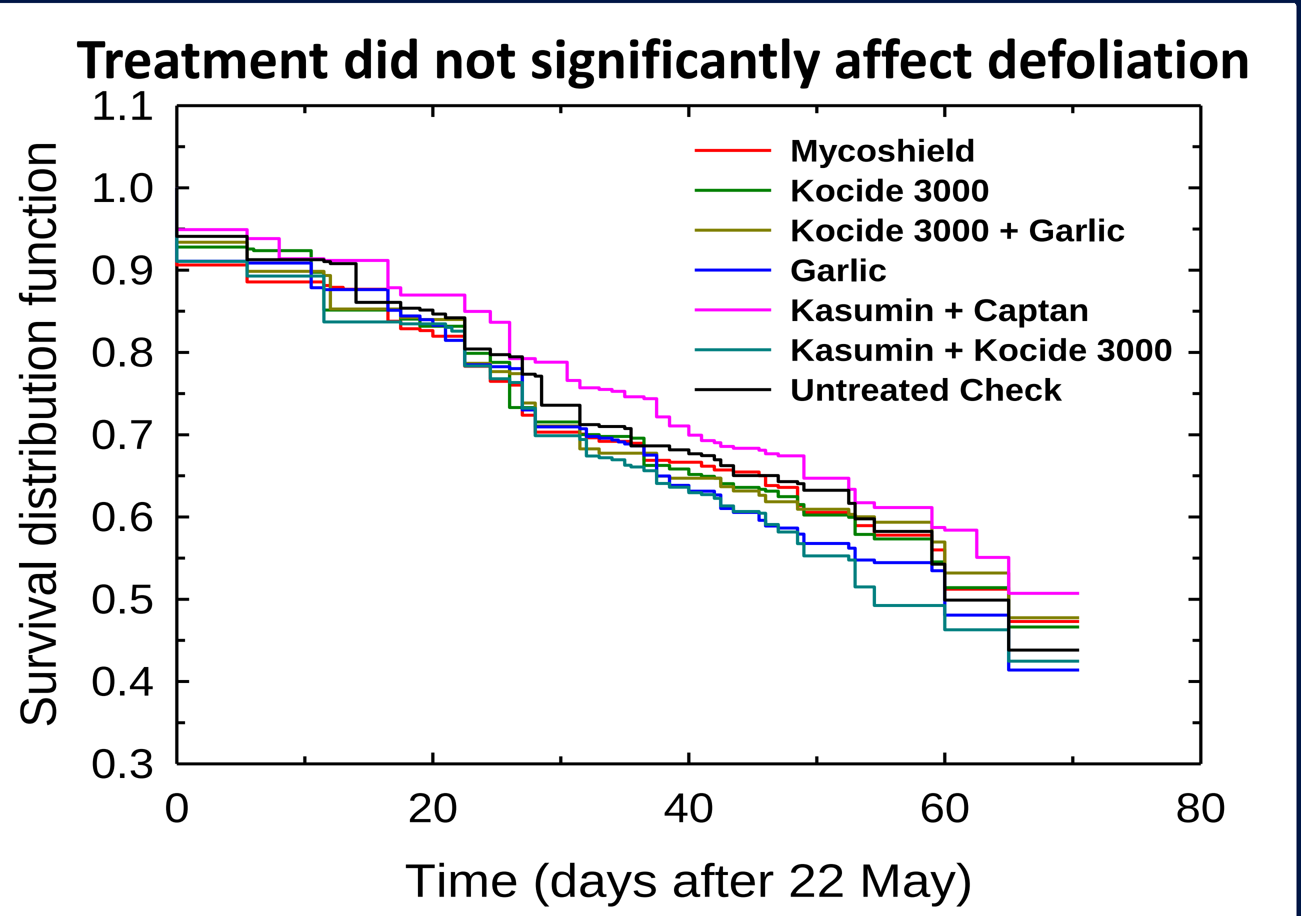


- **Highly Variable**
- **Severe Defoliation**
- **Significant Influences:**
  - **Bactericide treatment**
  - **Cultivar**

Bacterial spot progress curves do not follow standard disease progress curves due to abscission of heavily infected leaves

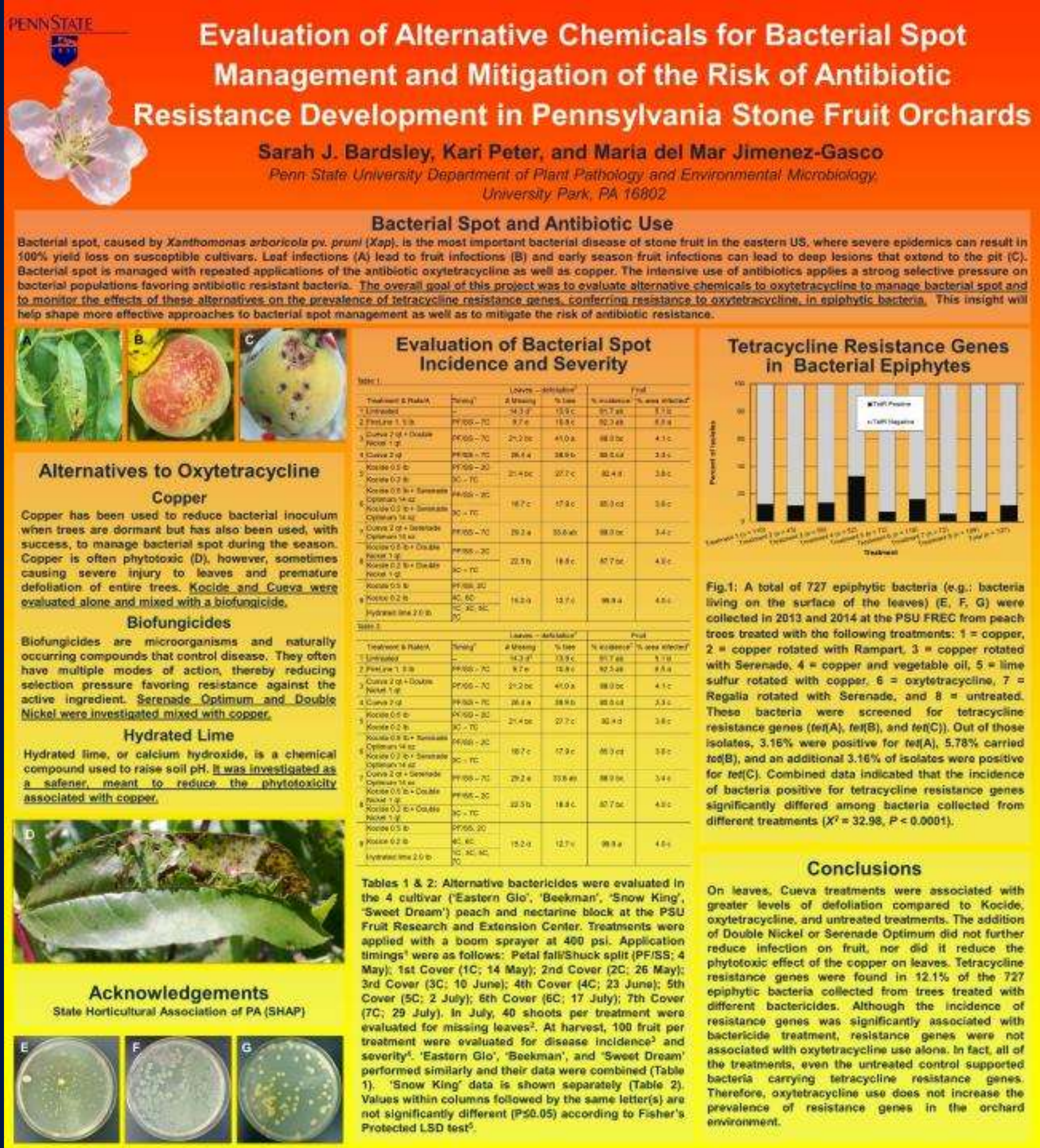
Bacterial Spot and Defoliation

- 1,460/ 3,052 leaves abscised
- Factors
  - Leaf age
  - Cultivar
  - Bactericide Treatment
  - Initial Disease Onset



For every small increase ⬆ of initial disease severity, the time the leaves remain on the tree is greatly reduced ⬇

Alternative Bactericide Programs



Antibiotic Resistance in *Xap*

Objective: To determine the sensitivity of *Xap* isolates to oxytetracycline

- Persistent yield loss
- Potential resistance development

Peach leaves with bacterial spot

Antibiotic Resistance in *Xap*

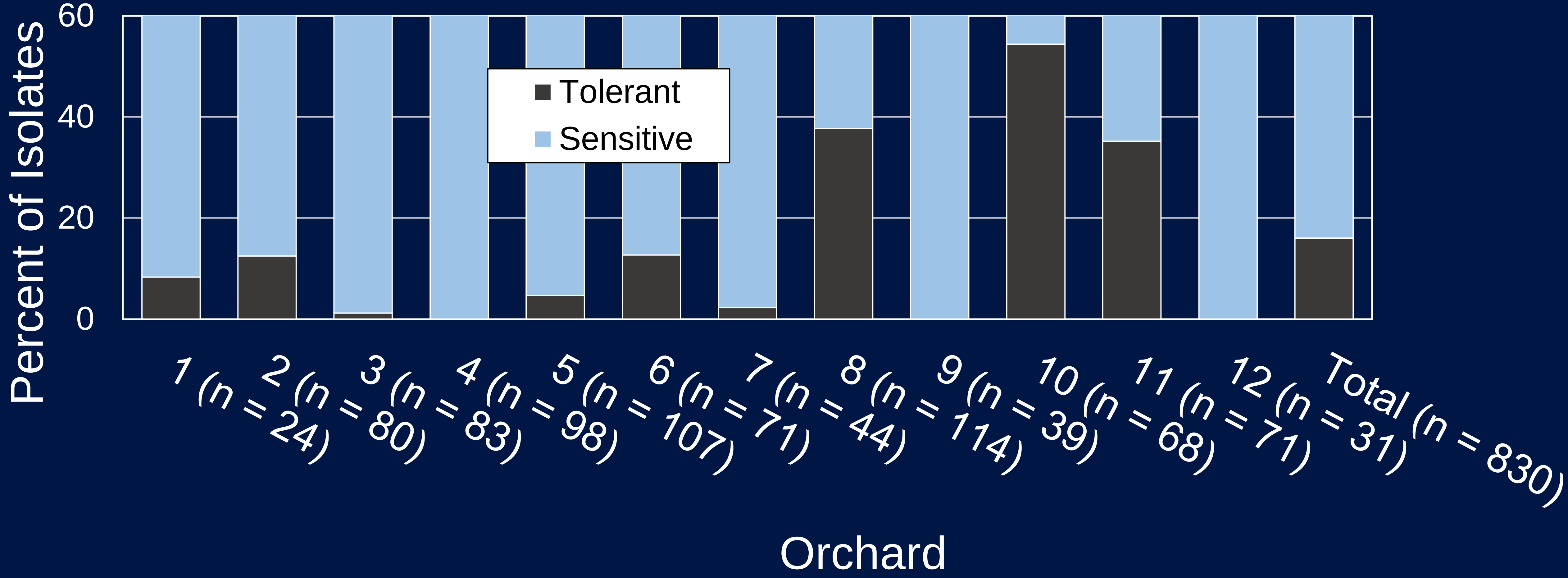
- Sampled:
  - 12 Orchards
  - 830 *Xap* Isolates
- Management Survey:
  - Oxytetracycline and Copper Use, Spray Method, Tree Age

Antibiotic Resistance in *Xap*

- No *Xap* Resistant to 150 ppm oxytetracycline
- No *Xap* Positive for Antibiotic Resistance Genes
- Variable Sensitivity

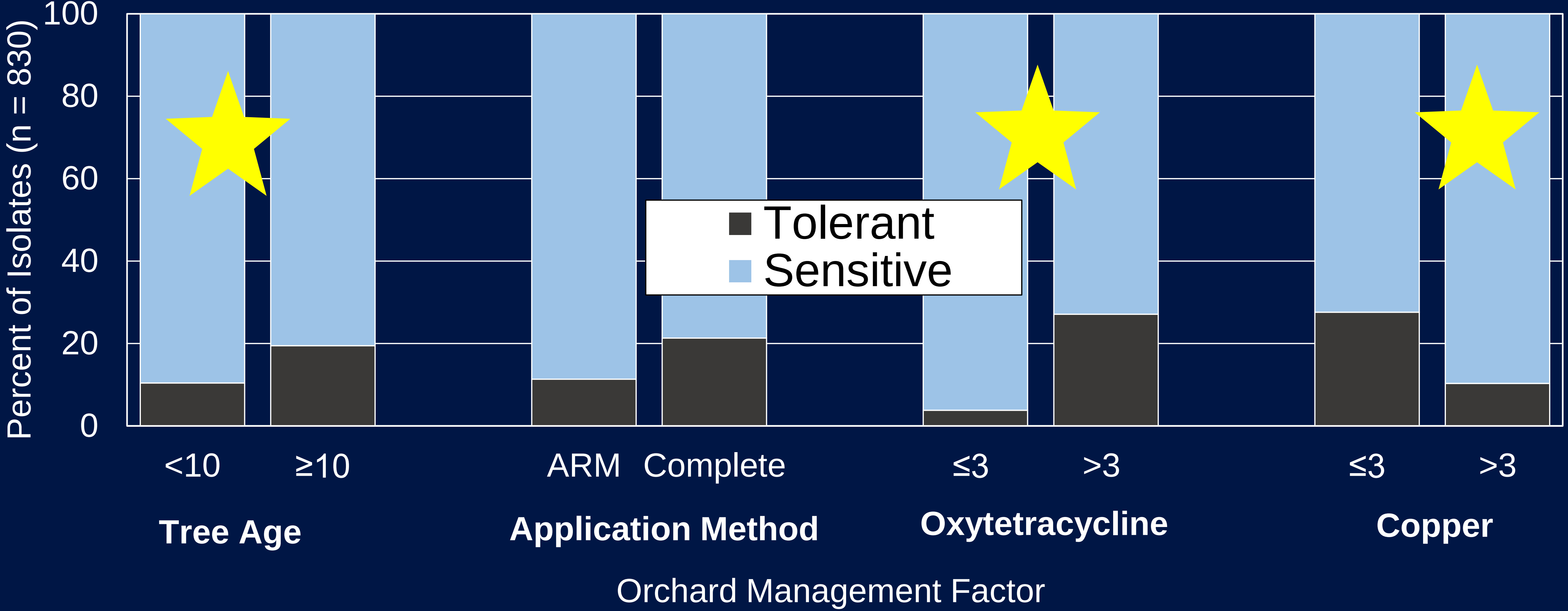
Late Season Bacterial Spot Lesions on Nectarine

Xap Sensitivity



Xap sensitivity to oxytetracycline significantly varied among isolates collected from different orchards

Xap Sensitivity



Tree age, oxytetracycline, and copper were significantly associated with the sensitivity of *Xap* isolates to oxytetracycline

Antibiotic Resistance and Oxytetracycline

- No resistance in *Xap*
- Gradual shift in antibiotic sensitivity in *Xap*
- Oxytetracycline does not persist on leaves for long – 2 days max!

Summary

- Bacterial spot disease progress is variable
- Reduce initial inoculum in order to reduce defoliation
  - Dormant copper
  - Prune out cankers
- Reduce tree stressors
- *Xap* remains sensitive to oxytetracycline in PA

Acknowledgments

- María del Mar Jiménez - Gasco
- Kari Peter
- Henry Ngugi
- Penn State University
- PSU Fruit Research & Extension Center

Funding

- State Horticultural Association of Pennsylvania (SHAP)
- PA Dept. of Ag. – Peach & Nectarine Marketing Board
- PSU College of Agricultural Sciences Graduate Student Competitive Grant Program

PennState
College of Agricultural Sciences

Questions

Alternative Bactericides

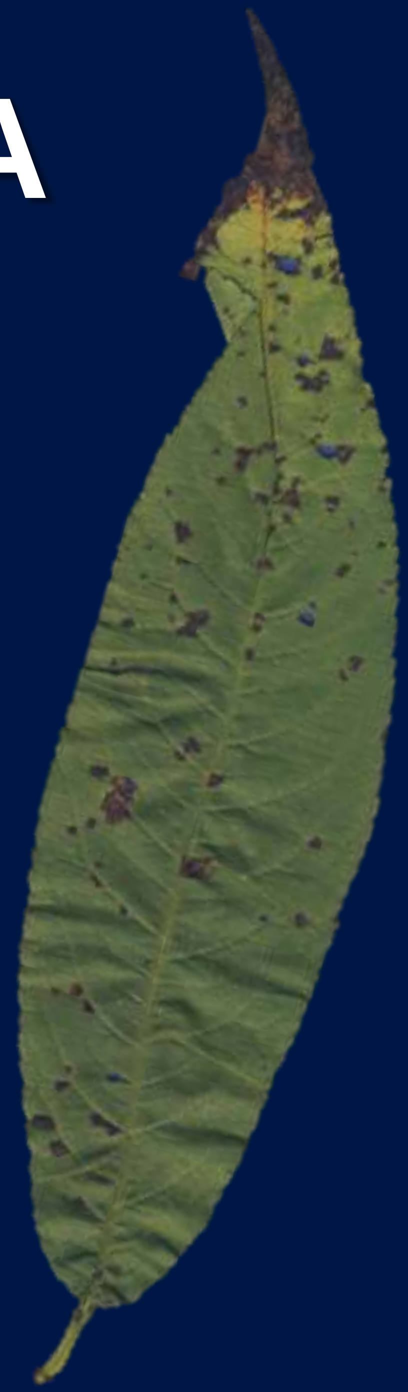
Leaves			
Treatment	Incidence	Severity	Phytotoxicity
1 Untreated	85.2a	4.1a	0.2g
2 FireLine (1.5lb)	89.3a	3.4b	0.2g
3 MasterCop (1pt)	58.4bc	1.9cd	6.3b
4 MasterCop (1.5pt)	55.6c	1.8cd	8.1a
5 Kocide3000 (0.5lb)	49.1d	1.2e	4.2d
6 MasterCop/ (1.0pt) Rampart (1.0qt)	62.7bc	2.1cd	3.7e
7 MasterCop (1.0pt)/ Serenade Optimum (14oz) ★	56.8c	1.8cd	3.1f
8 MasterCop (1.0pt) + hydrated lime (2.0lb) + vegetable oil (3.0 qt) ★	56.5c	1.5de	2.7f
9 MasterCopt (1.0pt) + vegetable oil (3qt)	58.0c	1.6d	5.6c

Alternative Bactericides

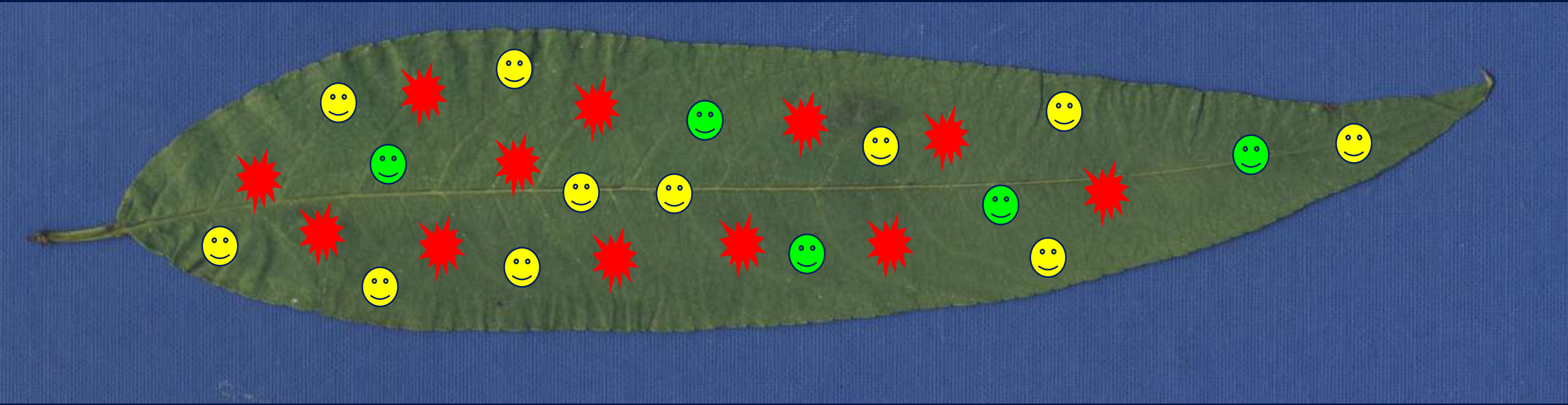
Fruit		
Treatment	**Incidence**	**Severity**
1 Untreated	89.6a	10.6a
2 FireLine (1.5lb)	84.8ab	7.8b
3 MasterCop (1.0pt)	75.5de	6cd
4 MasterCop (1.5pt)	73e	4.8de
5 Kocide3000 (0.5lb)	76.3de	3.2f
6 MasterCop (1.0pt)/ Rampart (1.0qt)	86.4ab	6.7bc
7 MasterCop (1.0pt)/ Serenade Optimum (14 oz) ★	74.7de	4.2ef
8 MasterCop (1.0pt) + hydrated lime (2.0lb) + vegetable oil (3.0qt) ★	80.0cd	5.5c-e
9 MasterCopt (1.0pt) + vegetable oil (3.0qt)	82.1bc	6.4c

Antibiotic Resistance in PA

- Persistent Yield Loss
- Potential Development of Antibiotic Resistance
- Research Goal: To determine the consequences associated with repeated oxytetracycline applications



Antibiotic Resistance Development

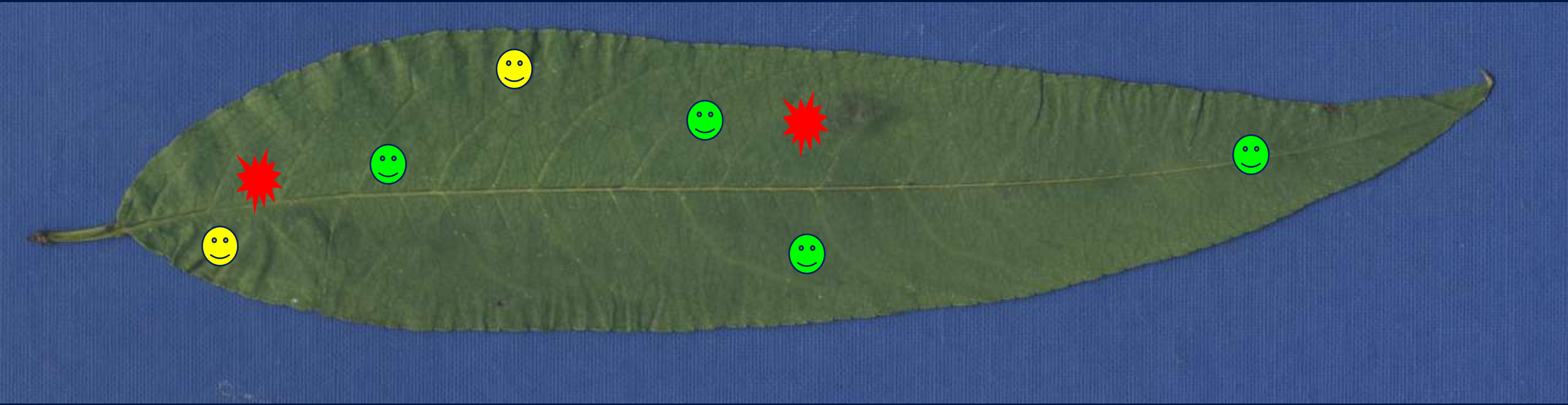


 *Xap*

 *Tet*^{R} Epiphytic Bacteria

 Sensitive Epiphytic Bacteria

Antibiotic Resistance Development

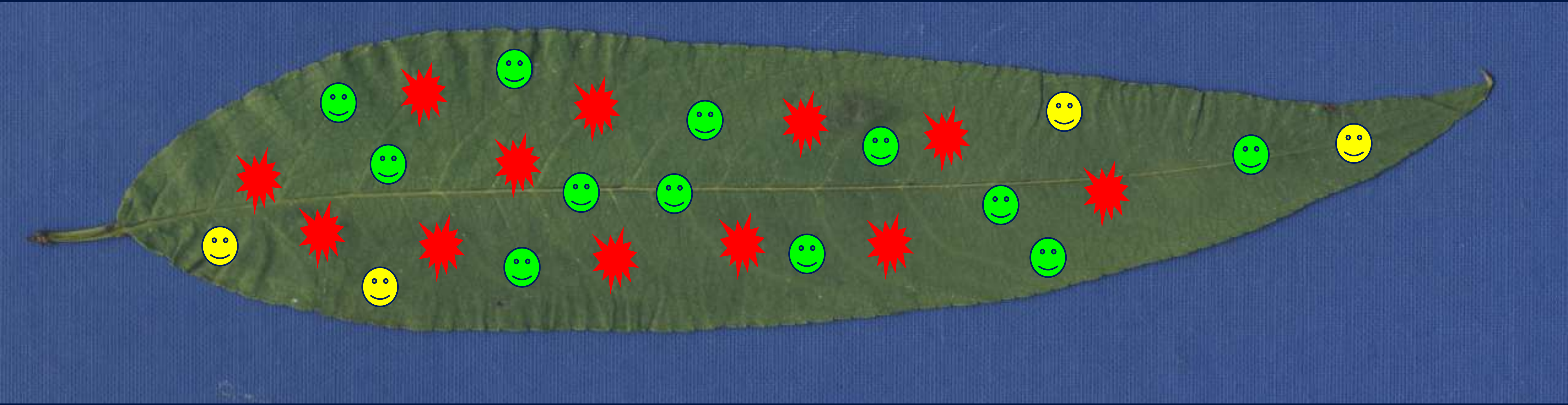


Xap

Tet^{R} Epiphytic Bacteria

Sensitive Epiphytic Bacteria

Antibiotic Resistance Development

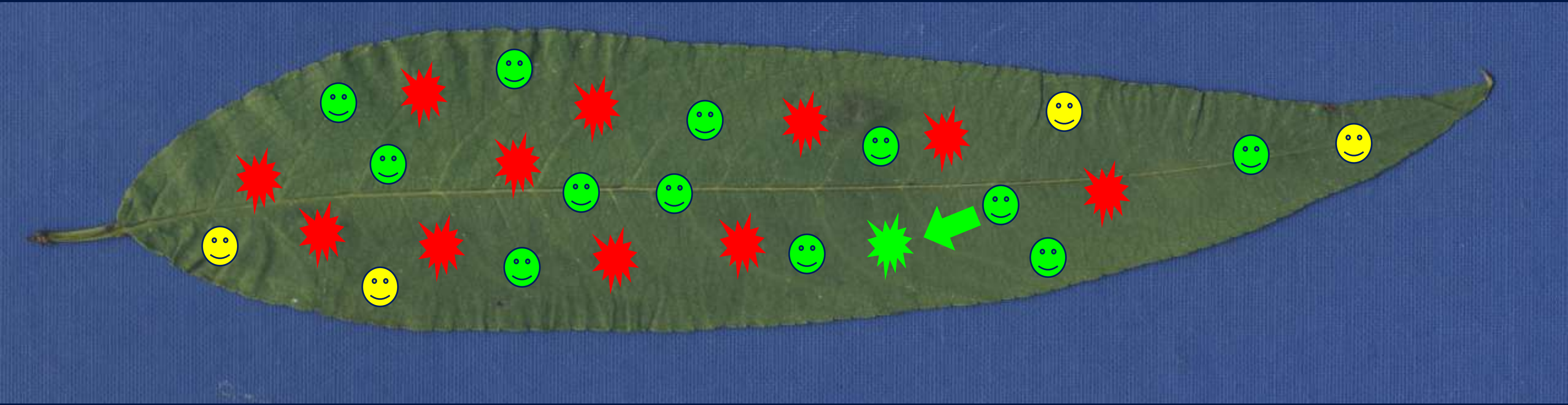


Xap

Tet[R] Epiphytic Bacteria

Sensitive Epiphytic Bacteria

Antibiotic Resistance Development

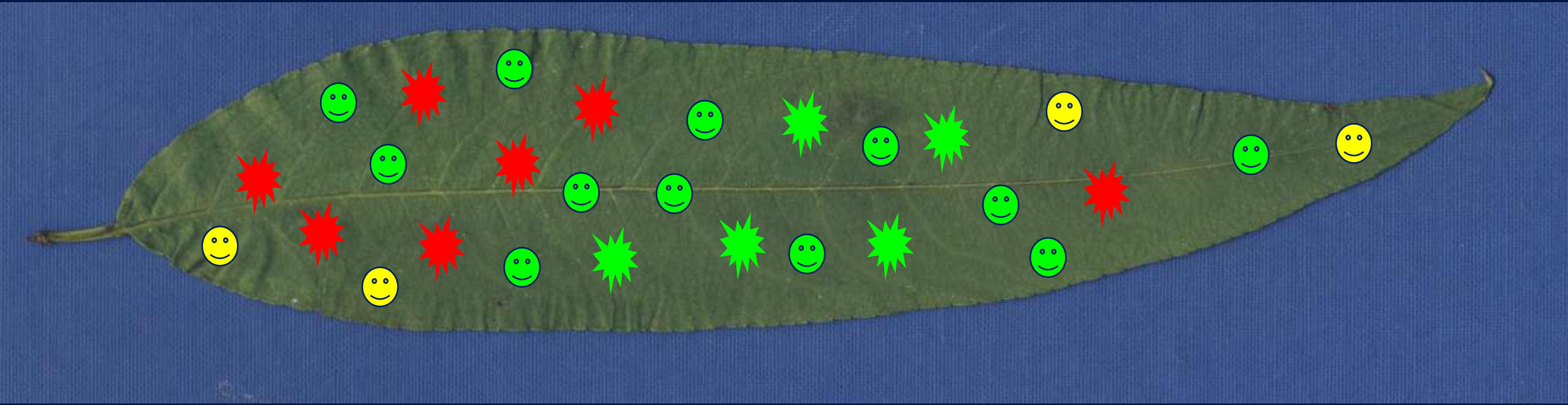


Xap *Tet*R *Xap*

*Tet*R Epiphytic Bacteria

Sensitive Epiphytic Bacteria

Antibiotic Resistance Development



Xap *Tet*^{R} *Xap*

Tet^{R} Epiphytic Bacteria

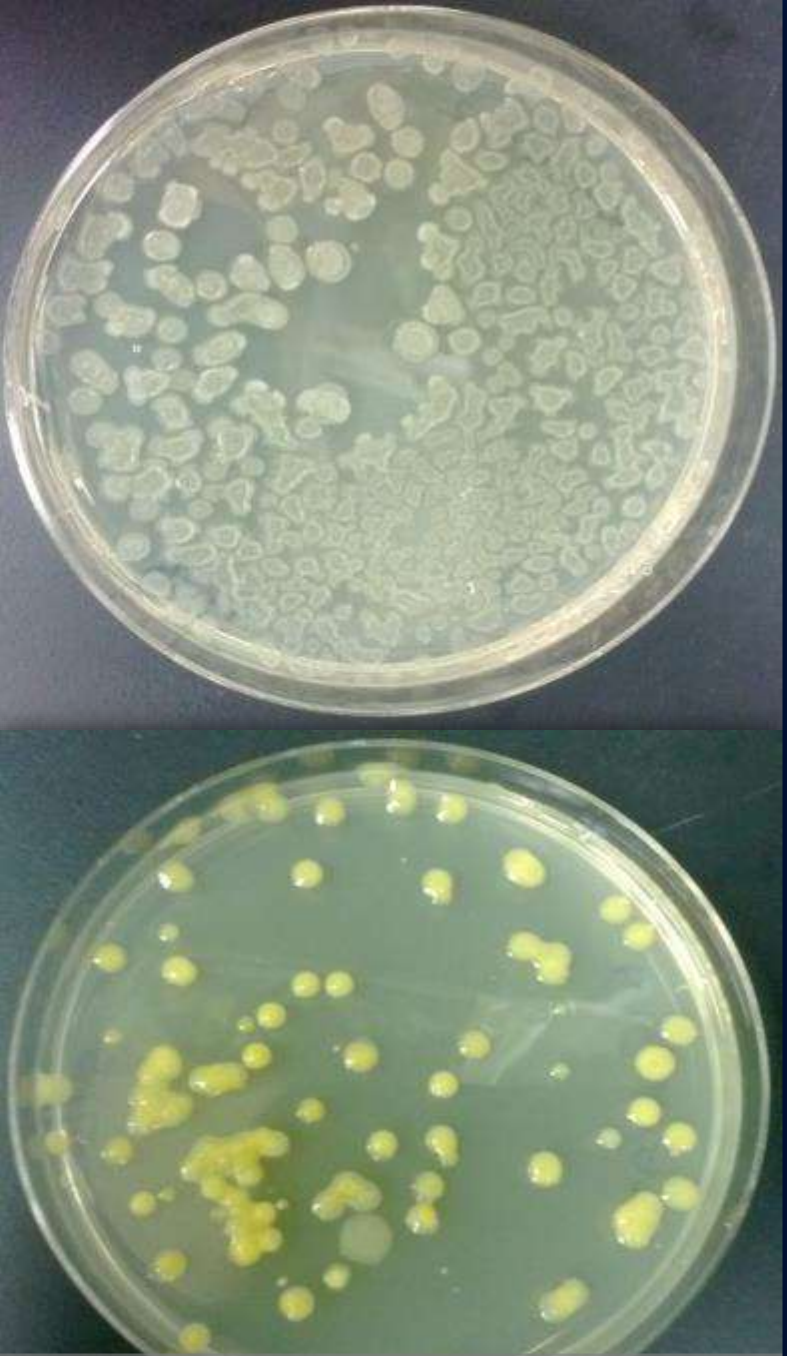
Sensitive Epiphytic Bacteria

Epiphytic Bacteria and Antibiotic Resistance

Peach Leaves

- Foliar bacteria
- Already antibiotic resistant
- Potential source of genetic material
- Objective: Monitor antibiotic resistance in epiphytic bacteria from commercial stone fruit orchards

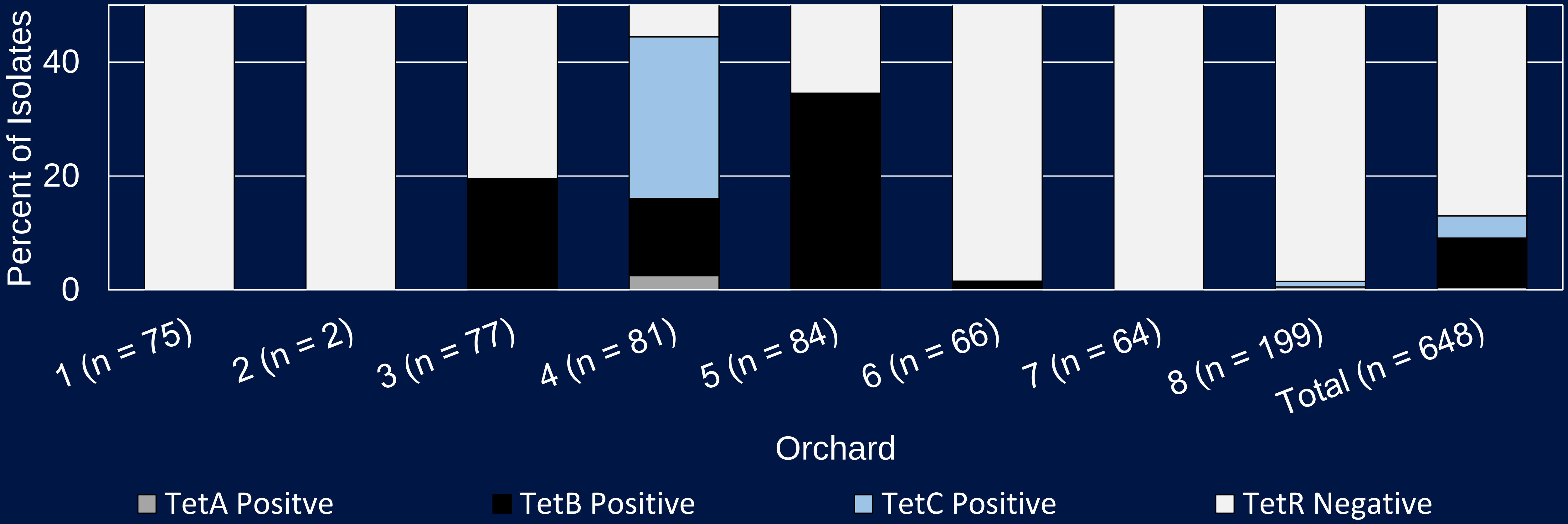
Epiphytic Bacteria and Antibiotic Resistance



Epiphytic Bacteria

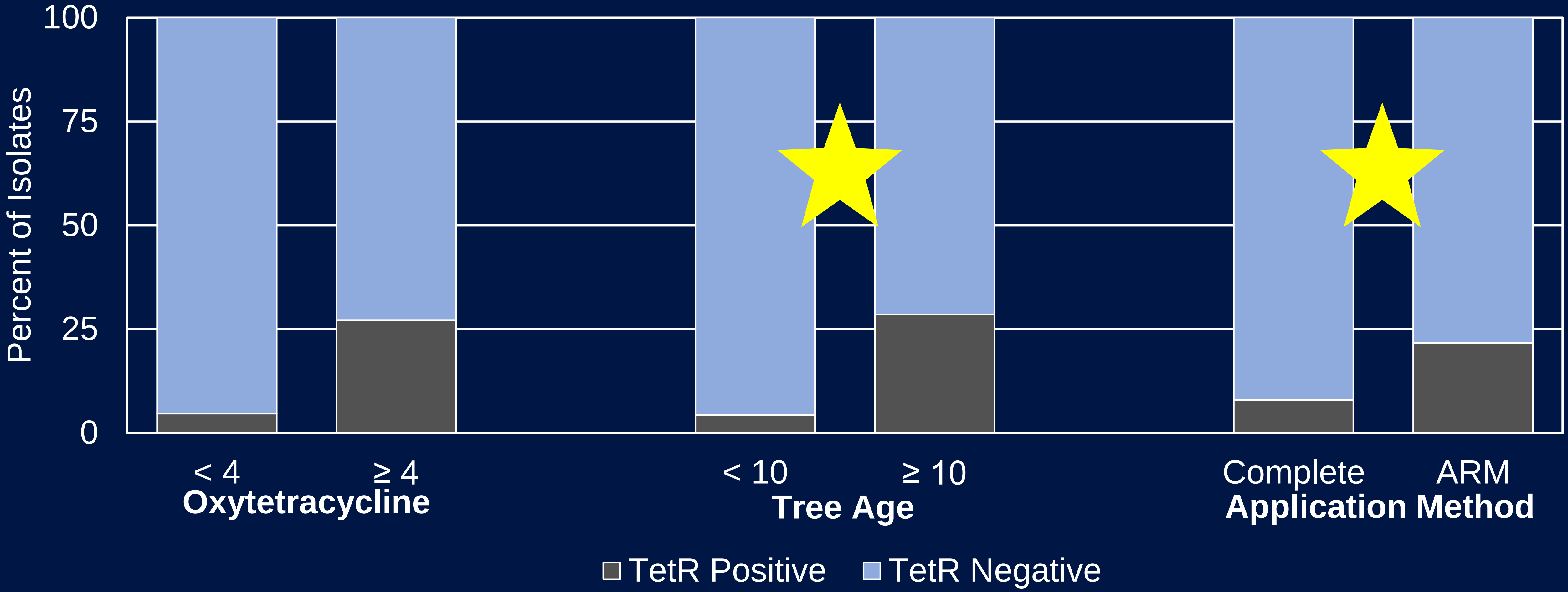
- Sampled:
  - 6 Conventional Orchards
  - 2 Organic Orchards
- Management Survey:
  - Oxytetracycline Use, Spray Method, Tree Age

Tet^R Genes in Epiphytic Bacteria



Tet^R genes were found in 12.96% of epiphytic bacteria.
Tet^R were not limited to orchards that used oxytetracycline.

Disease Management and *Tet*^{R} Genes



Tree age and application method were significantly associated with the incidence of *tet*^{R} genes but oxytetracycline use was not