Virulence and aggressiveness of diverse *Pseudomonas syringae* pv. *aptata* strains on resistant and susceptible table beet and Swiss chard cultivars

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Introduction

- *Pseudomonas syringae* pv. *aptata* is a genetically diverse bacterial pathogen with a broad host range, including chenopods (table beet and Swiss chard) and cucurbits (squash, watermelon, and cantaloupe).
- The pathogen causes bacterial leaf spot on table beet and Swiss chard globally, significantly reducing crop quality and yield.
- Previous studies demonstrated resistance in table beet and Swiss chard to single pathogen genotypes (Gaulke & Goldman, 2022; Sharma et al., 2024).

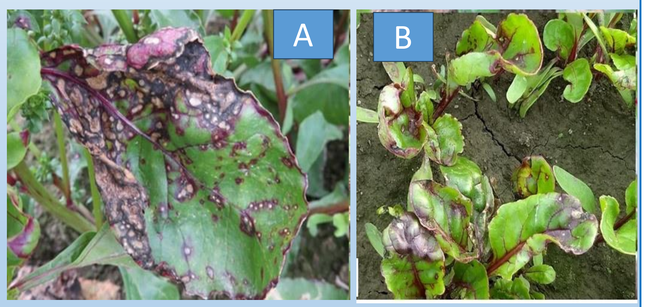

Figure 1. Bacterial leaf spot symptoms on table beet and Swiss chard. A) severe coalesced lesions beet, and B) lesions on chard (Photo credit M. Nampijja).

Objective

To assess disease severity in 12 cultivars and 2 breeding lines of table beet and Swiss chard inoculated with 10 genotypes of *P. syringae* pv. *aptata* in replicated greenhouse trials.

Methods

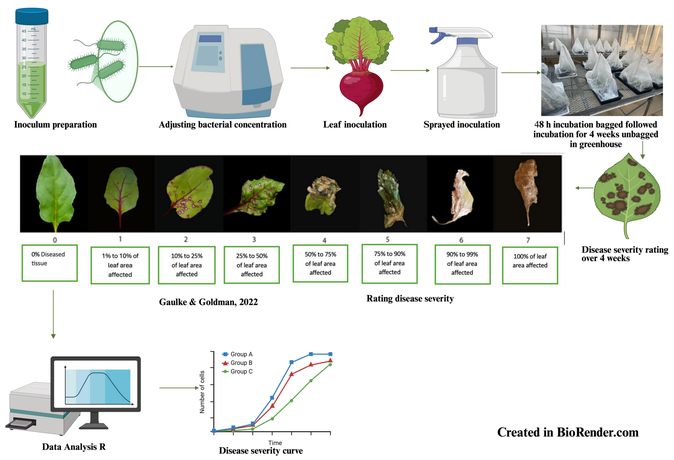

Figure 2. Greenhouse screening of beet and Swiss chard cultivars for susceptibility to *Pseudomonas syringae* genotypes. One-month-old plants were spray-inoculated with ~1 × 10^8 CFU/mL of 10 *Pseudomonas syringae* pv. *aptata* strains replicated 3 times. Disease severity was assessed weekly over 4 weeks.

Table 1: Genotypes of beet and chard, levels of resistance and susceptibility, and sources.

Accession	Resistance and susceptibility ratings		Source
W452	More resistant	Table Beet	UW Madison Carrot and Table Beet Laboratory
W451	More susceptible		UW Madison Carrot and Table Beet Laboratory
Red Ace	Susceptible		Reimer Seeds
Detroit Dark Red	Susceptible		Fedco Seeds
Evansville Orbit	More Resistant		UW Madison Carrot and Table Beet Laboratory
Touchstone Gold	Resistant		Johnny's Selected Seeds
Manolo	Least susceptible		Bejo Seeds
Bazzu	Least susceptible		Bejo Seeds
Ruby Queen	Least susceptible		Bejo Seeds
Bresko	Least susceptible		Bejo Seeds
Pablo	Susceptible		Reimer Seeds
Rainbow	Resistant	Swiss chard	Reimer Seeds
Silverado	Susceptible		West Coast Seeds
Fordhook Giant	Resistant		Territorial Seed Company

Gaulke & Goldman, 2022; Sharma et al., 2024

Table 2: Classification of *Pseudomonas syringae* pv. *aptata* strains

Names of strains	Sequence type	Host	Year of isolation	Place of isolation
BP1452	MLST 1	Beet	2015	Washington
BP4191	MLST 1	Beet	2019	Geneva, NY
BP1006	MLST3	Beet	2010	Western Europe
BP1999	MLST 3	Swiss chard	2015	Oregon
BP1001	MLST1	Swiss chard	2015	Washington
BP1454	Unique MLST	Beet	2015	Washington
BP1453	MLST65	Beet	2015	Washington
BP1547	Unique MLST	Beet	2015	Washington
BP1753	MLST33	Beet	2017	New Zealand
BP1806	MLST18	Swiss chard	2017	New Zealand
BP1611	MLST7	Beet	2015	New Zealand
BP1722	MLST40	Beet	2017	New Zealand

Bull et al., 2025

Results

Strains differed for disease severity and AUDPC on the susceptible table beet cultivar Pablo

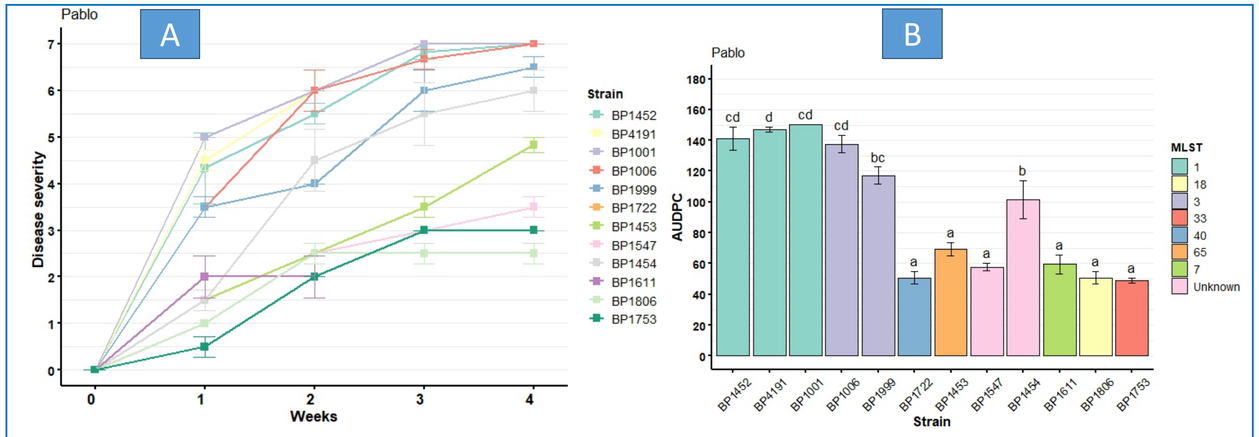

Figure 3. Effect of *Pseudomonas syringae* pv. *aptata* strains on disease severity on the susceptible table beet cultivar Pablo. (A) Disease severity, and (B) Area Under the Disease Progress Curve (AUDPC) over four weeks post-inoculation. AUDPC values with the same letter are not significantly different ($P < 0.05$).

Strains differed for disease severity and AUDPC on the resistant table beet genotype W452

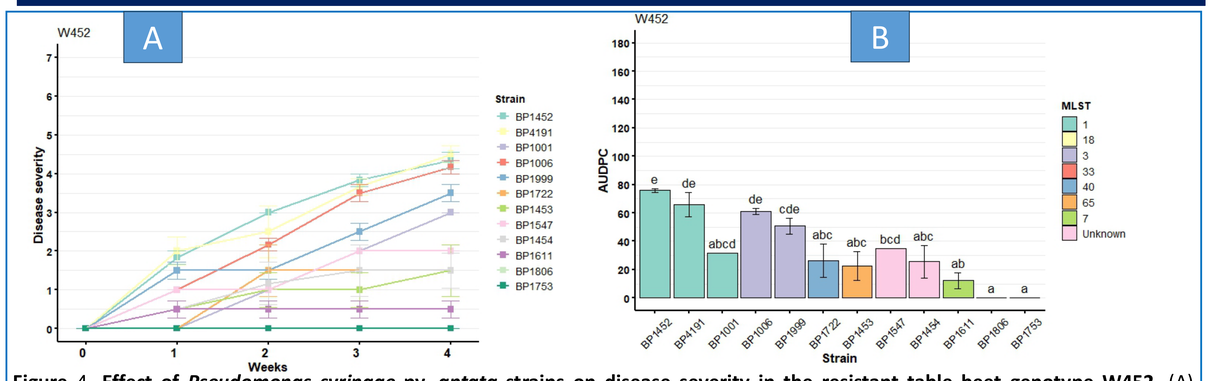

Figure 4. Effect of *Pseudomonas syringae* pv. *aptata* strains on disease severity in the resistant table beet genotype W452. (A) Disease severity, and (B) AUDPC over four weeks post-inoculation. AUDPC values with the same letter are not significantly different ($P < 0.05$).

The cluster analysis revealed distinct patterns of resistance and susceptibility among host genotypes, with isolates from MLST groups 1 & 3 consistently exhibiting higher aggressiveness in both experiments.

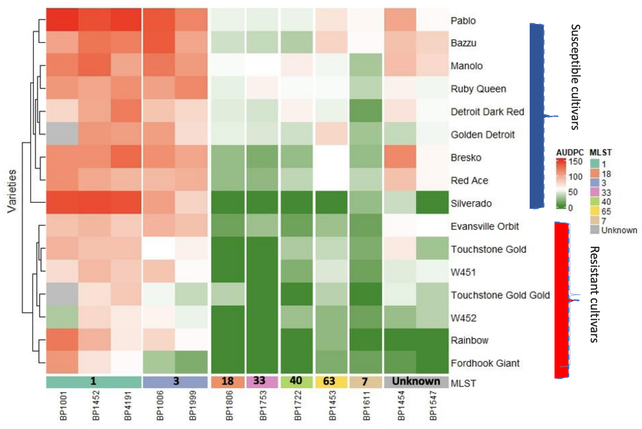

Figure 5. Heatmap summarizing disease severity at 4 weeks post inoculation in both experiments.

Discussion and Conclusions

- The study revealed substantial variation in the **aggressiveness and virulence** of *Pseudomonas syringae* pv. *aptata* strains, as reflected in differing levels of disease severity.
- **MLST 1 and 3** strains were the most aggressive across all cultivars.
- Although PAP014 was previously shown to be pathogenic on beet but avirulent on chard, our results confirmed its avirulence on **three chard genotypes (Fordhook Giant, Silverado, and Rainbow**).
- Heatmaps from both experiments consistently showed that **MLST 1 and 3** were more aggressive on both table beet and Swiss chard genotypes than other strains tested.
- These findings underscore the variability in pathogenic potential among *Pseudomonas syringae* pv. *aptata* strains and provide valuable insights into host–pathogen interactions in the table beet–Swiss chard pathosystem.

Citations

- Bull et al. (2025). *Diversity of Pseudomonas syringae pv. aptata causing bacterial leaf spot isolated from global table beet and Swiss chard seed lots* [**Poster presentation P-639**]. APS Annual Meeting 2025, American Phytopathological Society.
- Gaulke, E., & Goldman, I. L. (2022). Screening table beet and Swiss chard for resistance to *Pseudomonas syringae* pathovar *aptata*. *HortScience*, *57*(11), 1436-1446.
- Sharma et al. (2024). Susceptibility of Table Beet Cultivars to Foliar Diseases in New York. *Plant Health Progress*, *25*(4), 399-409.

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- **Please see P-011, P-020, P-164, and P-639 for more information about this project.**