

Characterization and Management of New Emerging Pathogens *Fusarium* and *Erwinia*

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Summary

Fusarium isolates from strawberry samples in five East Coast states were identified as *Fusarium oxysporum* f. sp. *fragariae* using HRM assays. Race differentiation confirmed all isolates as race 1, with varied cultivar resistance. Sensation® ‘Florida127’ and Florida Ember® ‘FL 20.80-4’ were resistant, whereas Florida Pearl® ‘FL 18.52-66’ and Florida Brilliance showed moderate resistance. Florida Encore® ‘FL 20.34-183’, Florida Medallion™ ‘FL 16.30-128’, and Florida Pearl™ ‘FL 16.78-109’ were susceptible. Separately, *Erwinia pyrifoliae* was identified from fruit rot samples received from a greenhouse grower in New York using DNA sequencing and PCR. This marks the first U.S. report of this bacterial pathogen on strawberry, previously known only in Asia and Europe, suggesting possible presence in U.S. strawberry production.

Methods

Objective 1. Characterization of *Fusarium* isolates found in Florida and the East Coast and screening of cultivars and breeding lines.

Fusarium isolates that were recovered from samples submitted to the plant diagnostic clinic were identified as *Fusarium oxysporum* f.sp. *fragariae* based on HRM assays that were developed and deployed in our clinic through a previously funded proposal. Isolates were then inoculated on a differential set of cultivars for race differentiation: Fronteras or San Andreas (possessing the *FW1* gene; resistant to race 1 and susceptible to race 2) and Monterey (lacking the *FW1* gene; susceptible to both races). In collaboration with the UF Strawberry breeding program, important Florida strawberry cultivars and selections were screened for *Fusarium* resistance using representative isolates. For both

trials (race characterization and cultivar screening), plants were established in the greenhouse, then transferred to a growth room. Plants were assessed weekly for disease incidence and the incubation period (the time between inoculation and the appearance of symptoms), and the area under the disease progress curve were calculated to compare the cultivar responses.

Objective 2. Characterization of *Erwinia* isolates causing fruit rot.

Among the samples received from other states during the 2023-24 season, one from a commercial grower in New York displayed distinctive symptoms. Strawberry plants showed intense brown to black discoloration on their immature fruit, fruit calyxes, and stems. Moreover, bacterial slime was observed on the surfaces of young fruit and their attached stems. In total, 5 isolates were recovered from different infected fruit. DNA was extracted from these isolates for molecular characterization and identification using published molecular assays.

Results

Objective 1

In this study, 16 fungal isolates were cultured from strawberry plantings across five states (CT, NY, FL, NC, and VA). All tested isolates were highly virulent on the race 1-susceptible cultivar (Monterey, lacking the resistant gene), showing clear signs of leaf yellowing and wilting, but no visible disease on the race 1-resistant cultivar (Fronteras, harboring the resistant gene *FW1*). These findings confirm that the diverse range of isolates identified in this study can be classified as race 1 strains. Cultivars and breeding lines tested exhibited a broad spectrum of

susceptibility, with disease incidence ranging from 0% to 100% (see Appendix). Some of the commercially important Florida cultivars, such as Sensation® ‘Florida127’ and Florida Ember® ‘FL 20.80-4’, were classified as resistant. Florida Pearl® ‘FL 18.52-66’ and ‘Florida Brilliance’ showed moderate resistance, whereas Florida Encore® ‘FL 20.34-183’, Florida Medallion™ ‘FL 16.30-128’, and Florida Pearl™ ‘FL 16.78-109’ were identified as susceptible.

Objective 2

We performed DNA sequencing of commonly targeted genomic regions for bacterial identification, which indicated *Erwinia pyrifoliae* as the species. Additionally, conventional PCR was performed using a species-specific primer set for *E. pyrifoliae*, as previously published, further confirming the identification. This pathogen had not been previously reported on strawberry outside Asia and Europe, making this the first detection of *Erwinia* on strawberry in the U.S. Given that the plant stock acquired by the grower was from the U.S., it is possible that this pathogen could be present at some level in the U.S. strawberry industry. Indeed, in 2024, this pathogen was reported to cause disease, flower blight, and fruit rot in Ohio.

Summary and recommendations

We strongly encourage growers to submit strawberry samples to the GREC Plant Diagnostic Clinic for accurate identification of *Fusarium oxysporum* f. sp. *fragariae*. Timely diagnosis is essential for disease management and containment. Expanding the

screening of cultivars and breeding lines will support the UF Strawberry Breeding Program in developing and refining molecular markers for genomic selection, ultimately promoting the development of resistant cultivars. This is especially critical given that *Fusarium* can persist in soil for many years, and there are limited chemical control options available. The disease has caused significant losses in regions like California and poses a potential threat to Florida production if it continues to be introduced. Additionally, continued monitoring of *Erwinia* populations is vital for pathogen surveillance. The recent detection of *Erwinia pyrifoliae*, previously unreported in U.S. strawberry, highlights the need for vigilance to prevent its establishment and spread, ensuring the long-term health and sustainability of our industry.

Disclaimer

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APPENDIX

Table 1. Responses of different UF cultivars and breeding lines to *Fusarium oxysporum* f.sp. *fragariae*.

Cultivar / Breeding line	Phenotype ^w	Race 1	
		Incidence %	AUDPC
18.46-54	S	100 A	157 A
Florida Radiance	S	100 A	156 A
20.74-80	S	100 A	136 AB
19.10-55	S	100 A	133 AB
Florida Encore® 'FL 20.34-183'	S	100 A	109 ABC
Sweet Charlie	S	100 A	89 ABC
Florida Beauty	MR	100 A	76 BC
Florida Brilliance	MR	100 A	58 BCD
Monterey (Susceptible control)	S	100 A	110 ABC
Florida Medallion™ 'FL 16.30-128'	S	90 AB	113 ABC
19.16-273	S	90 AB	106 ABC
20.43-156	MR	90 AB	76 BC
17.76-92	S	88 AB	103 ABC
WinterStar	S	88 AB	99 ABC
17.56-93	MR	83 AB	67 BC
Florida Pearl™ 'FL 16.78-109'	S	80 AB	101 ABC
Florida Elyana	S	70 ABC	90 ABC
Florida Felicity™ 'FL 17.15-86'	MR	70 ABC	53 BCD
20.59-378	MR	50 BC	50 BCD
Florida Ember® 'FL 20.80-4'	R	50 BC	47 BCD
18.20-3	R	45 BC	46 BCD
Florida Pearl® 'FL 18.52-66'	MR	40 BC	62 BC
20.27-633	R	10 CD	19 DE
20.71-50	R	10 CD	13 DE
Sweet Sensation® 'Florida127'	R	0 D	0 E
Fronteras (Resistant control)	R	0 D	0 E
Strawberry Festival	R	0 D	0 E
Pvalue		<.0001	<.0001

^x %DI = percentage of disease incidence (severely stunted, wilted, and dead plants).

^y Area under the disease progress curve.

^z Means in a column followed by the same letter are not significantly different by Fisher's Protected LSD test ($\alpha=0.05$).

^w S= Susceptible, MR= Moderate susceptible, R= Resistant.