Tolerance of lettuce varieties to Fusarium wilt – 2024

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Summary

Fusarium wilt of lettuce, caused by *Fusarium oxysporum* f. sp. *lactucae* (FOL), is an economically significant disease on the Central Coast of California. We conducted field trials to evaluate 30 iceberg and 21 romaine varieties for tolerance to Fusarium wilt. The trials were located in commercial fields in Greenfield, CA (wet date of May 27, 2024) and Salinas, CA (wet date of June 8, 2024). Foliar disease severity was visually evaluated on July 31-August 2, 2024 at Greenfield and on August 5-7, 2024 at Salinas and converted to a marketability (yes or no) rating. Disease pressure was high at both locations. Iceberg varieties that exceeded 50% marketability at both locations were Powerball and two coded entries from Vilmorin-Mikado. Nine varieties exceeded 50% marketability at Greenfield but not Salinas, and two varieties exceeded the same threshold at Salinas but not Greenfield. For romaine, 19 out of 22 varieties exceeded 90% marketability at Greenfield, but only two of those varieties (Holbrook and Momentus) also exceeded the same threshold at Salinas. In a greenhouse experiment, an isolate from Greenfield showed a susceptible reaction on variety Costa Rica #4 and a highly resistant reaction on variety San Miguel, which is consistent with the Costa Rica FOL race variant. Although FOL race 1 is suspected to be present at the Salinas location, greenhouse testing is not complete. These trials provide public data on the tolerance of iceberg and romaine varieties to Fusarium wilt.

Methods

Field trials were conducted in Greenfield, CA and Salinas, CA to evaluate both in-slot and out-of-slot varieties (30 iceberg and 21 romaine) for tolerance to Fusarium wilt in commercial fields with disease history. At Greenfield, bed center spacing was 80 inches, and plots were 1 plant line wide by 100 ft. long. Due to space constraints, 4 iceberg and 10 romaine varieties were not included in the Salinas trial. At Salinas, bed center spacing was 40 inches, and plots were 1 plant lines wide by 40 ft. long. Iceberg and romaine varieties were evaluated separately, and plots of each type were arranged in a randomized complete block with four replications. Treatments were direct seeded using the grower-cooperators' planters at Greenfield and using single-line push planters at Salinas. The wet dates were May 27, 2024 for Greenfield and June 8, 2024 for Salinas. The Greenfield trial was maintained to commercial standards for lettuce production, whereas the Salinas trial was not. After thinning by commercial crews, 50 plants at Greenfield and 30 plants at Salinas in the center of each plot were counted, and the section was marked with stakes. Data were collected from this center section. Evaluations were performed on July 31-August 2 at Greenfield and August 5-7 at Salinas, which was before maturity at the Salinas trial. Foliar disease severity was assessed on a 0 to 4 scale where: 0 = healthy; 1 = wilting or chlorosis of one to three outer leaves; 2 = up to moderate stunting and wilting or chlorosis of <25% of leaf area; 3 = head is severely stunted or absent and between 25% and 75% of leaf area is wilting or chlorotic; and 4 = head is absent and >75% of leaf area is chlorotic and nearly dead, or plant is entirely dead. For analysis, foliar disease severity was converted to marketability, where: disease severity of 0 or 1 = marketable; and disease severity of 2, 3, or 4 = not marketable.

Marketability data was analyzed by an analysis of variance ($P < 0.05$), and variety means were separated using Tukey's honestly significant difference test.

Results – Race of the FOL pathogen present

Two races of FOL are present on the Central Coast: race 1, and a novel race variant (Nayak et al., 2024). We are using the temporary name "Costa Rica FOL variant" for the novel race variant until it is officially named following completion of the upcoming ring test, which is a collaborative experiment between researchers and seed companies. In the Greenfield trial, the reaction of varieties including San Miguel and Primo suggests that the Costa Rica FOL variant is present. To confirm, isolates from each location were evaluated in a race typing experiment in the greenhouse. Variety Costa Rica #4 showed a susceptible reaction and variety San Miguel showed a highly resistant reaction to both Greenfield isolates, which supports the observation that the Costa Rica FOL race variant is present at the Greenfield location. We suspect FOL race 1 is present at the Salinas location, but the field reaction of varieties is not definitive. However, greenhouse testing of the Salinas location isolates is ongoing.

Results – Marketability

Disease pressure was high at both locations. Iceberg varieties that exceeded 50% marketability at both locations were Powerball and two coded entries from Vilmorin-Mikado (Table 1). Nine varieties exceeded 50% marketability at Greenfield only: Balboa, Fontinas, Meridian, Paraiso, San Andreas, San Miguel, two coded entries from Salinas Valley Seeds, and one coded entry from Sakata. In contrast, two varieties exceeded the same threshold at Salinas only: Fredonia and a coded entry from Takii. This pattern of some varieties showing large differences in performance between locations whereas others showed similar performance suggests that a different race is present at each location, but this has not yet been confirmed by greenhouse testing.

Of the 21 romaine varieties evaluated, two varieties exceeded 90% marketability at both locations: Holbrook and Momentus (Table 2). A total of 17 out of 21 varieties exceeded the same threshold at Greenfield but not Salinas. At the Salinas location, Holbrook and Momentus were not statistically different from four varieties (Boronda, Copious, Patton, and Solid Heart) with average percent marketability ranging from 77% to 88%.

If you have additional questions about these trials, please contact Alex Putman at 951-522-9556 or aiputman@ucr.edu.

Please Send Us Samples

We are continuing to collect samples of lettuce Fusarium wilt to determine the distribution of races and to monitor the pathogen. To support this research, please contact the person in your region. Your help would be greatly appreciated.

- Monterey, San Benito, or Santa Cruz Counties – Yu-Chen Wang (831-201-9689 or yckwang@ucanr.edu)
- San Luis Obispo, Santa Barbara, or Ventura Counties – Chris Greer (805-888-1355 or cagreer@ucanr.edu)

- Any other California county – Alex Putman (951-522-9556 or aiputman@ucr.edu)

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References

Nayak, S., K.L. Richardson, A.I. Putman, N.R. LeBlanc, F.N. Martin, N. Li, and J.D. McCreight. 2024. Detection of novel pathogenic variants of *Fusarium oxysporum* f. sp. *lactucae* in California. Plant Pathology *Early View*. doi:10.1111/ppa.14019

Table 1. Percent marketable heads of iceberg lettuce varieties in 2024.

		Greenfield			Salinas		
Company	Cultivar	% Marketable Heads[1]		Slot	% Marketable Heads[1]		Slot
Salinas Valley Seeds	SVS107	89.8	A	out	0.0	F	in
Salinas Valley Seeds	Paraiso	87.5	A	out	2.5	F	out
Salinas Valley Seeds	SVS111	83.5	AB	out	1.7	F	out
Salinas Valley Seeds	San Andreas	78.0	ABCD	out	2.5	F	in
Greengo	Balboa	77.3	ABC	out	28.0	CD	out
Rijk Zwaan	Fontinas	76.4	ABC	out	0.0	F	out
Vilmorin	24FT-003	73.0	ABC	out	78.3	A	out
Salinas Valley Seeds	San Miguel	70.0	BCD	out	0.0	F	in
Sakata	XLE12208	68.3	BCD	out	0.0	F	out
Vilmorin	24FT-002	64.6	CDE	out	66.4	AB	out
Seminis	Powerball	63.8	CDE	in	57.4	AB	in
Sakata	Meridian	53.6	DE	in	8.4	DEF	in
Sakata	XLE12301	46.0	EF	in	-	-	-
3-Star	Fredonia	31.0	F	out	69.8	AB	in
3-Star	3SICE3	9.0	G	out	-	-	-
Enza Zaden	Newcastle	7.0	G	in	25.4	CDE	in
3-Star	3SICE4	4.5	G	out	-	-	-
3-Star	3SICE2	1.5	G	in	47.9	BC	in
Takii	TLE001	1.5	G	in	77.3	A	in
3-Star	Oso Flaco	0.5	G	in	5.1	EF	in
Nipomo	NNS-2109	0.5	G	in	7.6	DEF	in
3-Star	3SICE1	0.0	G	out	0.0	F	out
3-Star	Tamarack	0.0	G	out	0.8	F	out
blank	susc check 1	0.0	G	-	-	-	-
Enza Zaden	Telluride	0.0	G	in	3.3	F	in
Nipomo	NNS-2132	0.0	G	in	14.2	DEF	out
Rijk Zwaan	Rhodenas	0.0	G	in	0.0	F	in
Salinas Valley Seeds	Primo	0.0	G	out	6.7	EF	in
Vilmorin	Tombstone	0.0	G	in	3.3	F	in
Vilmorin	Yucaipa F1	0.0	G	out	1.8	F	out

[1] Marketability is defined as a rating of 0 (no disease) or 1 (slight chlorosis on outer leaves or slight stunting) on the Fusarium wilt severity rating scale. Means within each location followed by the same letter are not significantly different at $P = 0.05$ according to Tukey's honestly significant different test.

Table 2. Percent marketable heads of romaine lettuce varieties in 2024.

		Greenfield			Salinas		
Company	**Cultivar**	**% Marketable Heads[1]**		**Slot**	**% Marketable Heads[1]**		**Slot**
Syngenta	Holbrook	99.5	A	in	94.1	AB	in
Vilmorin	Pinion	99.3	C[2]	out	-	-	-
Central Valley Seeds	Solid Heart	99.0	D[2]	in	86.4	ABCD	in
Syngenta	Cardinal	99.0	A	in	-	-	-
Syngenta	Duquesne	99.0	A	in	44.9	GH	in
Vilmorin	Bluerock	99.0	A	out	47.9	FGH	out
BASF	Themes	98.0	A	in	-	-	-
Central Valley Seeds	Valencia	98.0	C[2]	out	30.0	H	in
Syngenta	Inferno	97.5	A	in	-	-	-
Syngenta	Abilene	97.4	A	in	59.8	EFG	in
Rijk Zwaan	Rictus	97.2	C[2]	out	71.8	CDEF	out
Vilmorin	Kanaka	96.9	A	in	-	-	-
Syngenta	Boronda	95.9	C[2]	out	77.3	BCDE	out
Rijk Zwaan	Icarus	95.5	A	in	-	-	-
BASF	Copious	94.9	A	in	87.5	ABC	in
Syngenta	Rawhide	94.8	AB	in	-	-	-
Greengo	Patton	94.5	A	in	81.7	ABCD	in
BASF	Momentus	93.5	AB	in	96.6	A	in
Syngenta	Grackle	91.0	AB	in	-	-	-
Central Valley Seeds	Sunland	89.3	C[2]	in	-	-	-
Syngenta	Stampede	80.5	BC	in	67.2	DEFG	in
-	susc check 2	26.0	E	-	-	-	-
3-Star	Tamarack[3]	0.0	F	out	2.5	I	out

[1] Marketability is defined as a rating of 0 (no disease) or 1 (slight chlorosis on outer leaves or slight stunting) on the Fusarium wilt severity rating scale. Means within each location followed by the same letter are not significantly different at $P = 0.05$ according to Tukey's honestly significant different test.

[2] Significant difference of these cultivars compared to others with similar numerical values is a statistical artifact due to removal of one replicate plot from human error.

[3] Iceberg cultivar included as a susceptible control.