Effect of abiotic stresses on Macrophomina root rot development in California strawberry

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Figure 1. A) Irrigation setup located at the end of the field. B) Individual irrigation tubing leading out from setup pictured in A to a manifold leading into drip tape.

Strawberry plants subjected to environmental stressors are more prone to infection by *Macrophomina phaseolina*. This trial aims to address which stressors contribute significantly to disease progression and to use this information to improve management. This experiment consisted of 4 beds, each 153 ft long, with 10 plots per bed. Each plot was 14 ft long (44 plants per plot), with a 2.4-ft buffer between each treatment. All abiotic treatments started 78 days after planting, on 17 Jan 2025. Bare-root transplants of cultivars Fronteras and Sweet Ann were planted on 31 Oct 2024 and artificially inoculated by placing a cornmeal-sand-*Macrophomina* inoculum (1,034 CFU/g) at the base of each plant two-weeks after planting. The abiotic stress treatments (Table 1) were delivered directly through two high-flow drip tapes within each plot (Fig. 1). Data will continue to be collected until early-Aug 2025. Plant mortality was assessed weekly and recorded as "dead" once plant foliage reached 75% necrosis (Fig. 2). Plant crown tissue was then processed and plated to confirm the presence of *M. phaseolina*. Fruit was harvested at 7-day intervals during the early-season and 3-day intervals during the peak- and late-season (Figs. 3 & 4).

Table 1. Minimum soil tension for irrigation application and salts received by each treatment.

Treatment	Soil tension (kPa)	Added salts	Chloride (meq/L)	Sodium absorption ratio (SAR)	EC value* (dS/m)
Standard	10	No added salts	0.73	0.60	0.70
Drought stress	60	No added salts	0.73	0.60	0.70
Chloride stress	10	$CaCl_2$, $MgCl_2$, NaCl	6.20	0.90	1.36
Chloride × 2 stress	10	($CaCl_2$, $MgCl_2$, NaCl) × 2	13.00	1.10	2.09
High EC_W stress	10	$MgSO_4$, Na_2SO_4, $MgCl_2$, NaCl	3.70	1.80	2.52

*Salinity threshold for strawberries is 1 dS/m

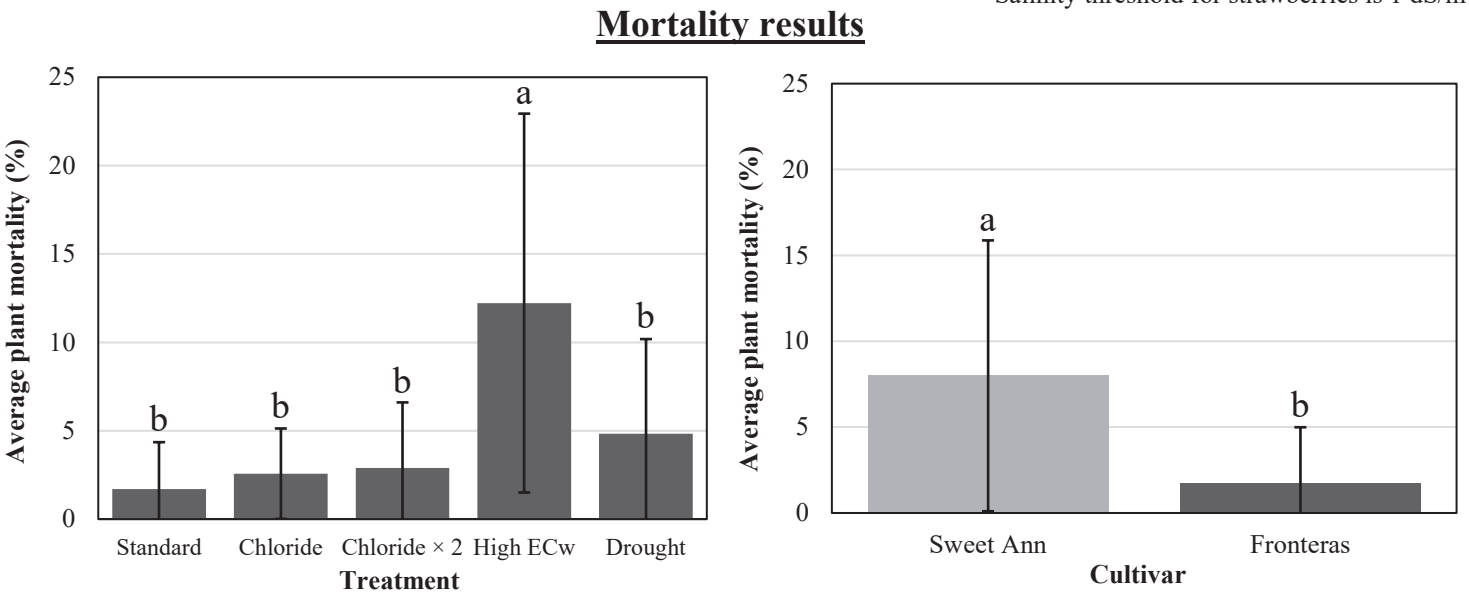

Figure 2. Average total plant mortality (%) separated by treatment (left) and by cultivar (right) as of 26 Jun 2025. Values not connected by the same letter are significantly different ($P < 0.05$). Error bars represent the standard deviation from mean.

Fruit yield results

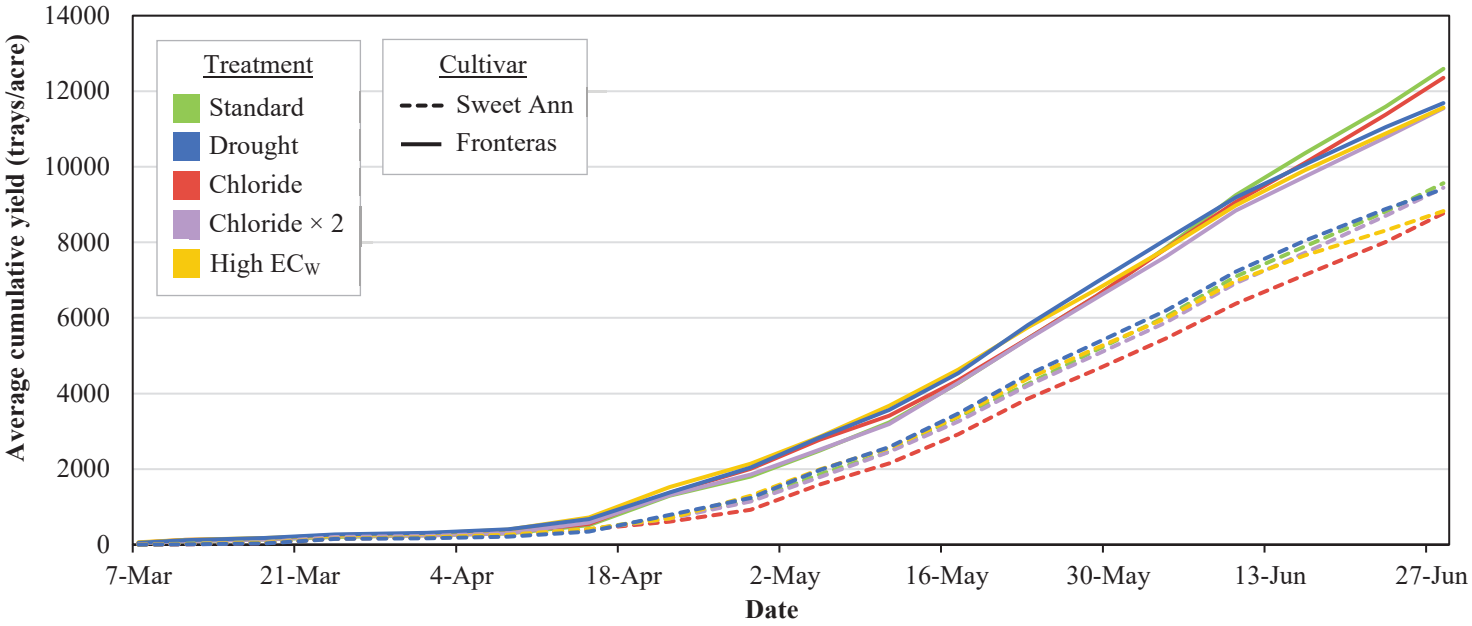

Figure 3. Timeline showing the average cumulative fruit yield of each treatment, separated by cultivar, throughout the entire season as of 28 Jun 2025. Trays per acre was calculated assuming 8 lb/tray. No significant differences between treatments were observed ($P > 0.05$).

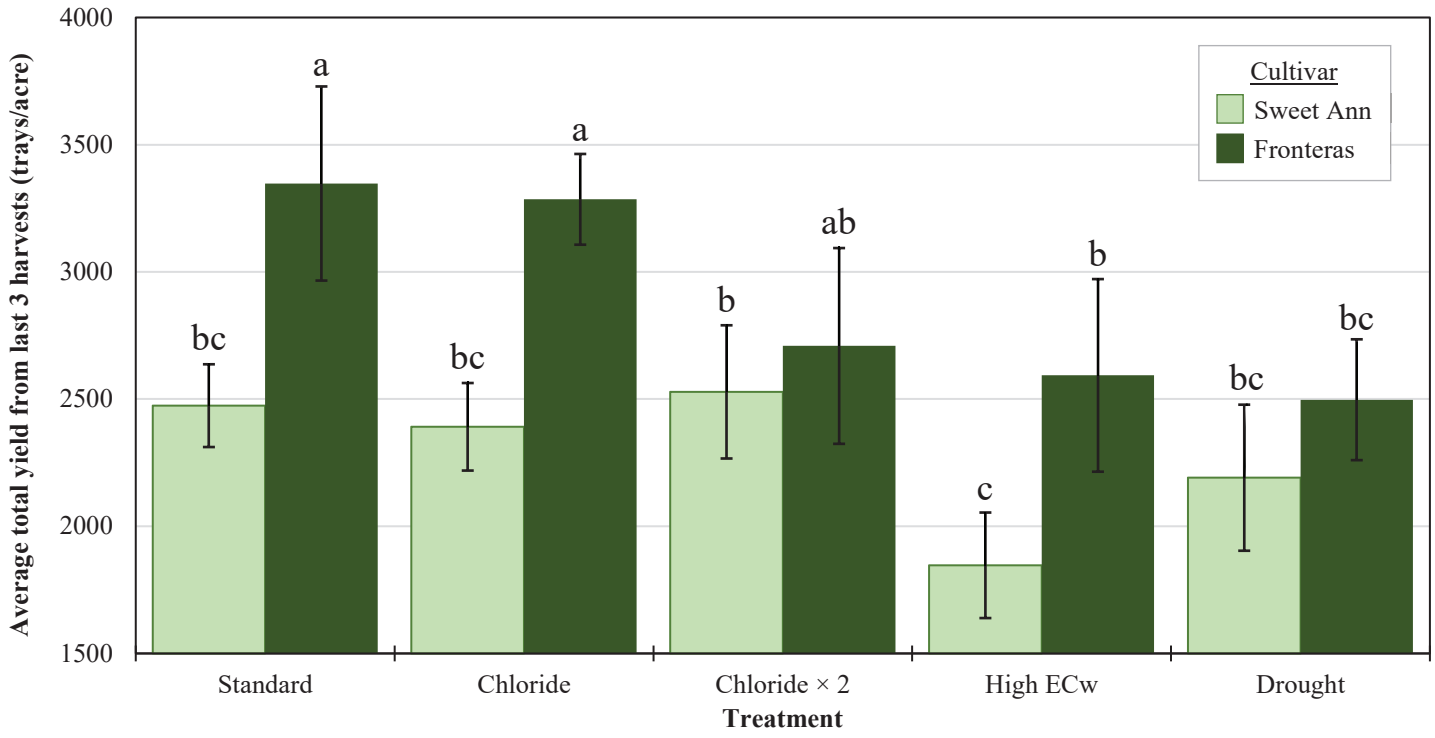

Figure 4. Average total fruit yield from the last 3 harvest events as of 28 Jun 2025. Trays per acre was calculated assuming 8 lb/tray. Values not connected by the same letter are significantly different ($P < 0.05$). Error bars represent the standard deviation from mean.

Discussion

It's important to note that this experiment does not account for salt accumulation in the soil that would typically occur in a commercial field using irrigation water with elevated salinity over multiple years. Plant mortality is expected to peak between mid-Jul and early-Aug as temperatures continue to rise. Based on last year's results, the drought and high EC_W treatments are expected to be the most severe stressors, causing the highest rates of plant mortality. For fruit yield results, a statistically significant difference in weekly yield between treatments was first observed on 23 Jun and is expected to continue separating through the late season.