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Assessing the therapeutic effects of CitruSaver on the productivity and health of HLB-affected citrus trees

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Progress Report: FL Hamlin, TX Grapefruit, TX Juvenile Valencia Summer 2025- Fall 2025

Executive Summary

Hamlin Fruit yield generally increased with biostimulant-based treatments compared with the control and BM alone. CS1 consistently trended toward higher yields, and in several cases, CS2 + BM showed the highest or among the highest yields, suggesting a positive additive effect of combining biostimulants with beneficial microbes. Canopy volume increased from spring to fall across all locations, indicating strong seasonal growth effects. CS1 consistently trended toward larger canopy volumes, particularly at Wauchula, suggesting enhanced vegetative growth. CS2 alone often trended lower in canopy volume, whereas adding BM partially improved it. Fruit quality parameters (soluble solids, titratable acidity, ripening index, and juice content) were highly stable across treatments. No consistent upward or downward trends were observed across treatments, indicating that yield and canopy responses occurred without compromising fruit quality. CS2 and CS2 + BM often trended toward lower fruit drop at later sampling dates, while CS1 occasionally showed slightly higher early-season fruit drop, though these differences diminished later in the season.

Yield

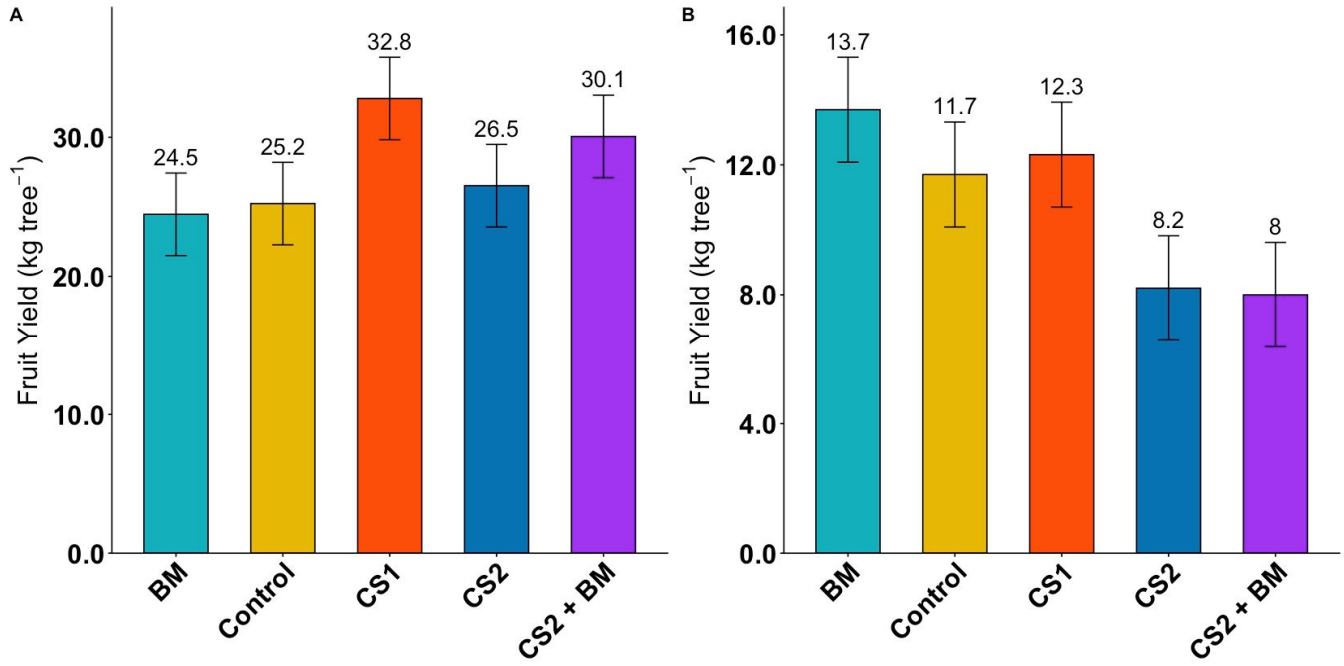

Figure 1: Fruit Yield results in kg per tree. (A) Hamlin's Wauchula site (B) Hamlin's Fort Meade site.

At the Wauchula Hamlin site, CS1 shows the highest yield (**30.2%** vs control), followed closely by CS2 + BM, while BM, Control, and CS2 have lower yields but are comparable. This suggests that CS1 alone, and CS2 combined with beneficial microbes, are more effective at enhancing fruit production.

Key takeaway (A):

Soil biostimulants, especially CS1, are associated with increased fruit yield, and adding beneficial microbes to CS2 further improves performance.

The Fort Meade site (B) shows lower overall Hamlin fruit yields than at Wauchula, indicating less favorable growing conditions. In this groove, BM yielded the highest (**17.1%** vs control) , followed by CS1 (**5.1%** vs control) and the Control. CS2 and CS2 + BM had the lowest yields, suggesting that CS2-based treatments were less effective under these conditions. Overall, the results indicate that treatment effects on fruit yield are strongly site- or management-dependent. This also means the results are

influenced by other unforeseen factors, such as farm management, tree health, and the fact that the trees are not uniform. All in CS1 performed better.

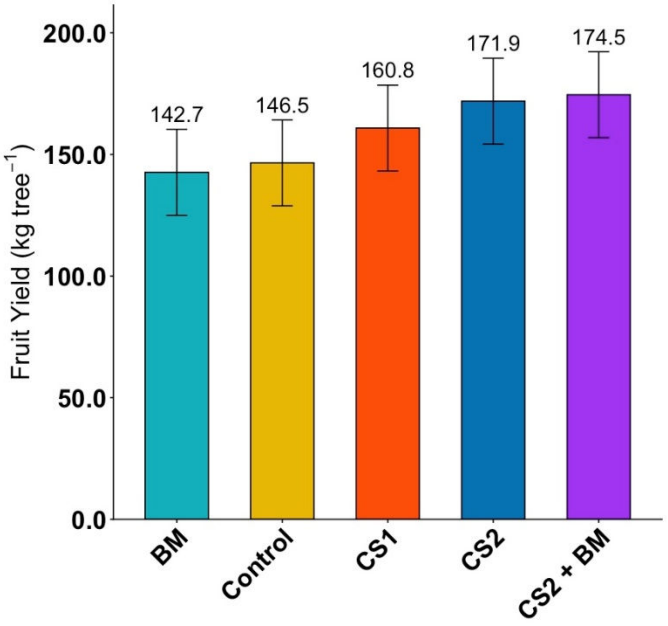

Figure 2 Fruit Yield results in kg per tree, Texas Grapefruit.

Grapefruit yield increased progressively from the BM and the Control to the biostimulant treatments. CS1 produced higher yields than both BM and the Control, while CS2 further increased fruit yield by **17.3%** vs control. The highest yield (**19.1%** vs control) was observed with the combined treatment (CS2 + BM), indicating an additive or synergistic effect when CS2 was applied together with beneficial microbes. Overall, these results suggest that biostimulant-based treatments, particularly when combined with beneficial microbes, enhanced fruit productivity compared with the control and BM alone.

There is an inverse relationship between Texas and Florida: CS2 is outperforming CS1 in Texas, while CS1 is outperforming CS2 in Florida.

Fruit Quality

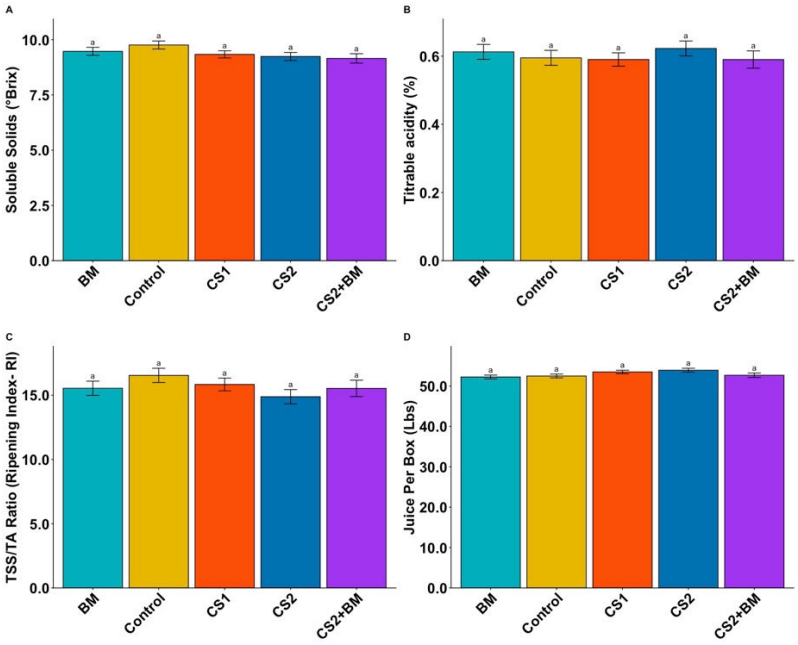

Figure 3. Wauchula Hamlins Fruit Quality Analysis

Overall, fruit quality parameters, including sugar content, acidity, ripening index, and juice yield, were not significantly affected by the treatments, indicating that yield responses observed elsewhere did not compromise fruit quality.

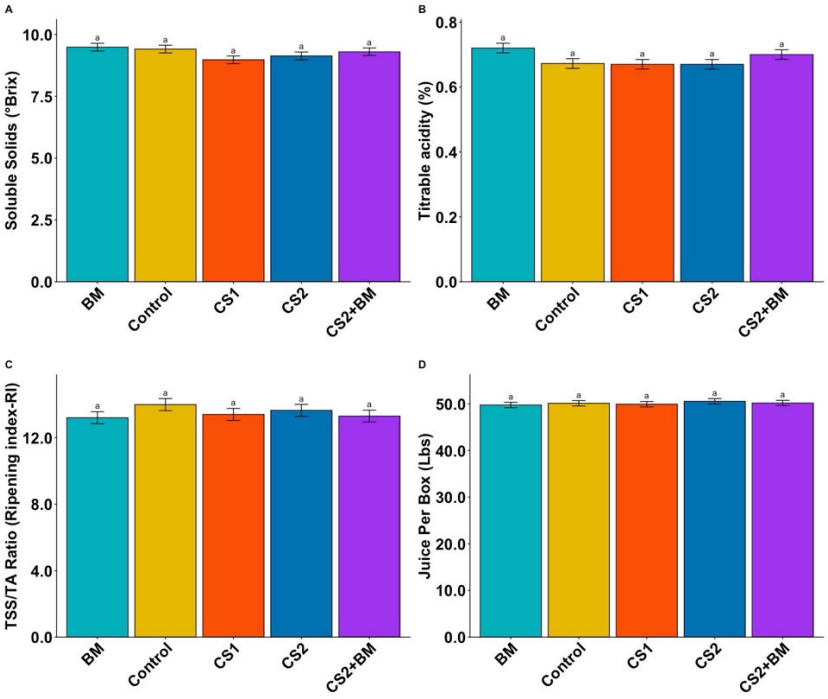

Figure 4 Fort Meade Hamlins Fruit Quality Analysis

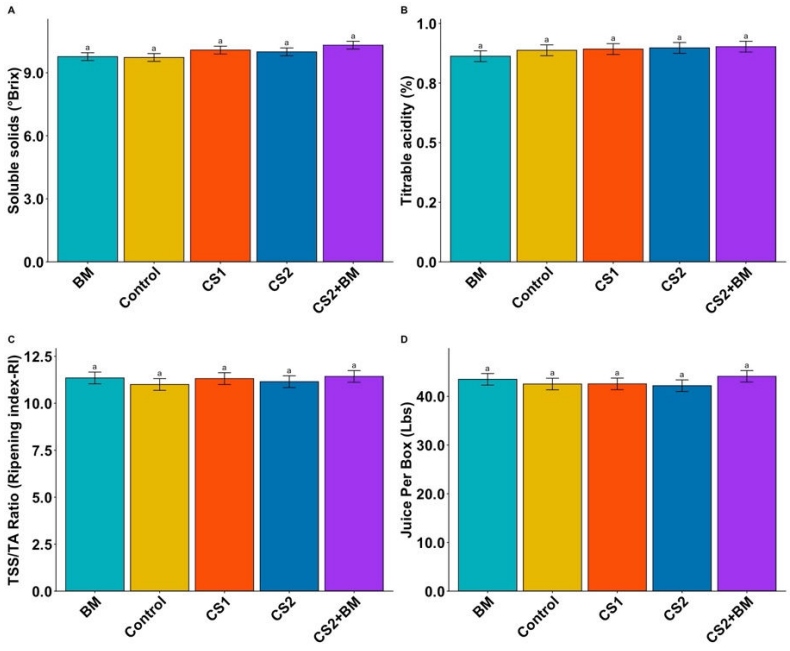

Figure 5 Grapefruit Fruit Quality Analysis

Canopy Volume

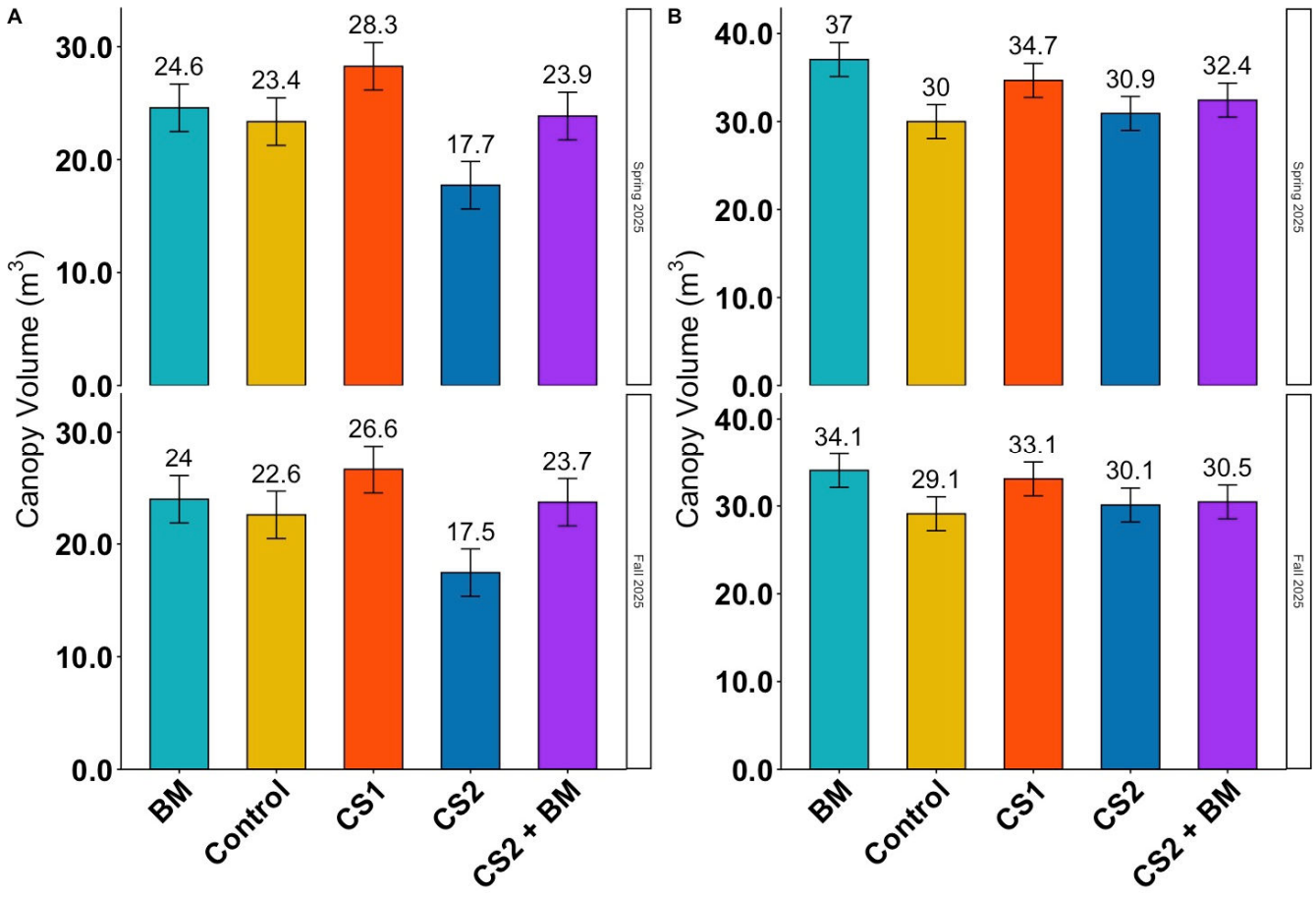

Figure 6. Canopy Volume,(A) Wauchula and (B) Fort Meade Hamlins.

At the Wauchula site (Figure 5) in Spring 2025, the Hamlin canopy volume differed among treatments. CS1 produced the largest canopy volume and was significantly higher than CS2, while BM, Control, and CS2 + BM showed intermediate values and did not differ significantly from either CS1 or CS2. CS2 consistently resulted in the smallest canopy volume, indicating reduced vegetative growth under this treatment. In Fall 2025, a similar pattern was observed. CS1 again showed the highest canopy volume, while CS2 remained significantly lower than the other treatments. BM, Control, and CS2 + BM maintained intermediate canopy volumes with no significant differences among them. Overall, these results indicate that CS1 consistently enhanced canopy development across seasons, whereas CS2 limited canopy growth, with beneficial microbes partially mitigating but not fully overcoming this reduction.

In Spring 2025, the Hamlin canopy volume at the Fort Meade (Figure 6) site did not differ significantly among treatments, as indicated by the shared significance letter across all bars, although BM and CS1 showed numerically larger canopy volumes. In Fall 2025, BM and CS1 had slightly higher mean canopy volumes than the Control, CS2, and CS2 + BM, but all treatments remained statistically similar. Overall, canopy development at this site was stable across seasons and treatments, indicating that neither biostimulants nor beneficial microbes significantly altered vegetative growth under Fort Meade conditions.

Fruit Drop

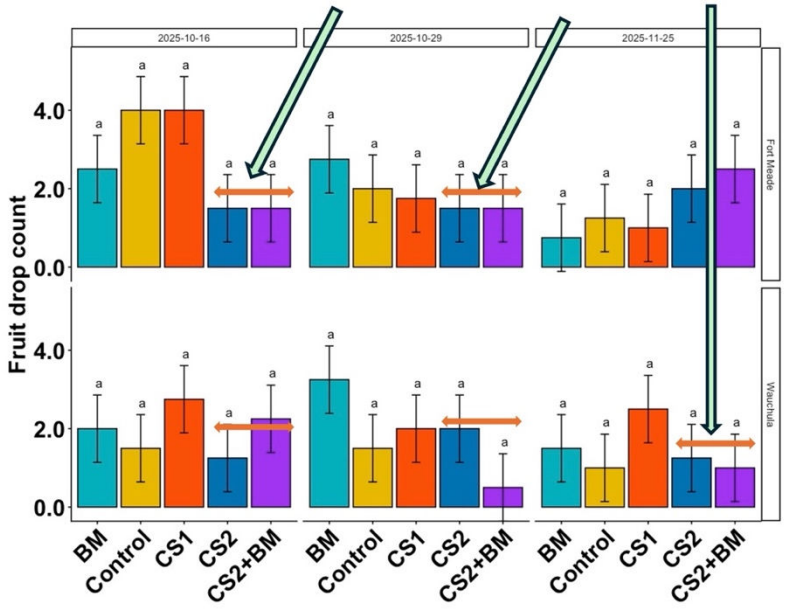

Figure 7 Fruit drop counts across treatments (BM, Control, CS1, CS2, CS2 + BM) at three sampling dates (16 Oct, 29 Oct, and 25 Nov 2025) for two sites, Fort Meade (top panels) and Wauchula (bottom panels)

At the Fort Meade site, CS2 and CS2 + BM showed lower fruit drop at some dates 2.

At Wauchula, Hamlin fruit drop followed a similar pattern, with moderate drop early in the season and generally lower values later. CS1 occasionally showed numerically higher fruit drop, while CS2 and CS2 + BM tended to be lower.

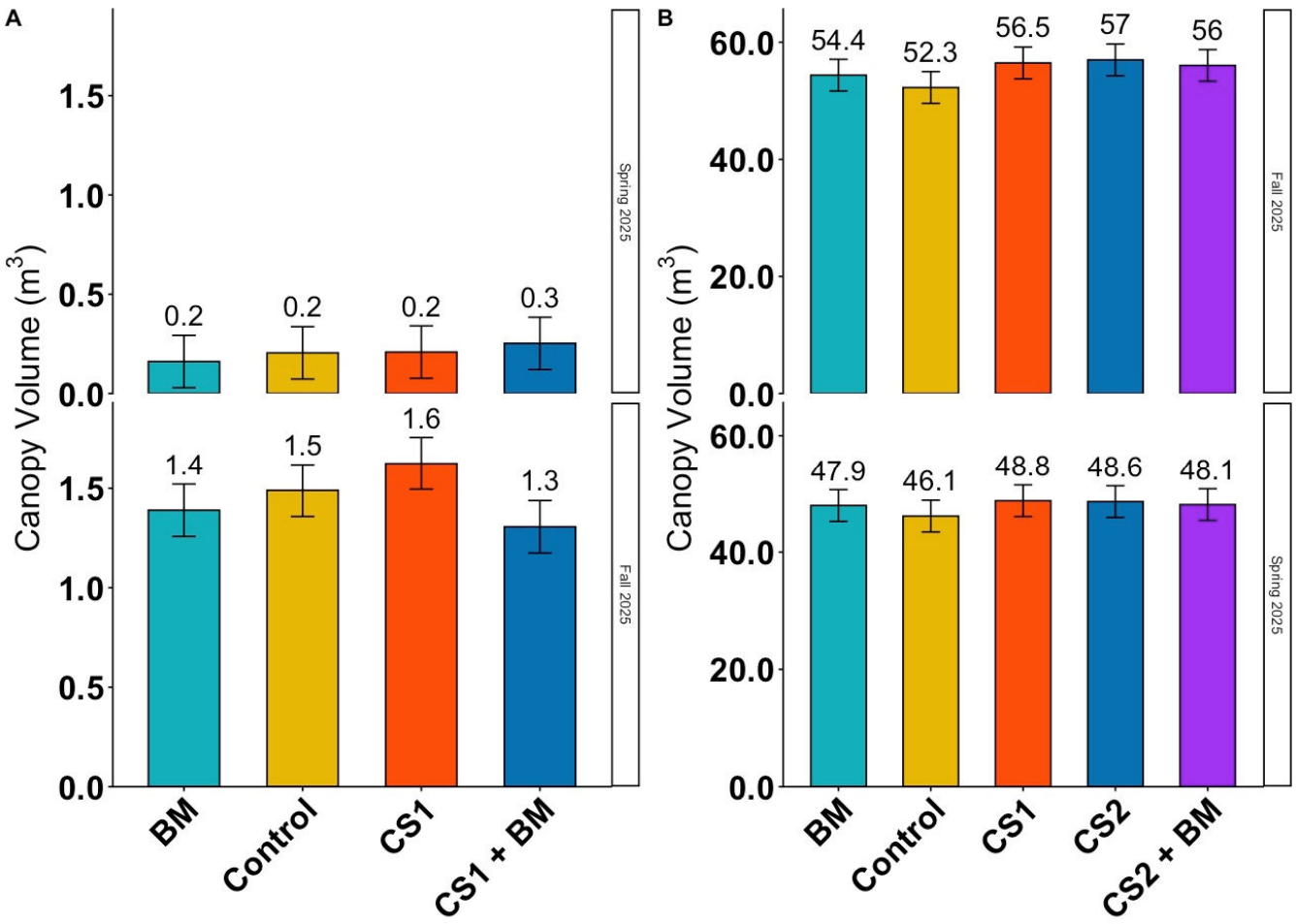

Figure 8 Canopy Volume. (A) Valencia Juvenile trees, Texas. (B) Grapefruit mature trees in Texas.

In Juvenile Valencias (Figure 8A), BM showed the lowest canopy volume, and CS1 had slightly higher values (6.7% vs control). The CS1 + BM treatment produced the largest canopy volume in spring, but overall differences among treatments were minor, suggesting minimal treatment effects on canopy growth at this early stage. In Fall 2025, canopy volume increased substantially for all treatments, reflecting seasonal canopy expansion. CS1 produced the largest canopy volume, followed by the Control and BM, while CS1 + BM showed a slightly lower canopy volume than CS1 alone. Although numerical differences are evident, the overall pattern indicates that canopy growth CS1 tends to promote greater canopy development later in the season.

In Spring 2025, the grapefruit canopy volume in Texas CS1 and CS2 (Figure 8B) was slightly higher. In Fall 2025, canopy volume increased across all treatments, with CS1 (**8% vs** control) and CS2 (**9%** vs control) having slightly higher bars.

Overall executive takeaway:

The trends suggest that biostimulant treatments, especially CS1 and CS2 combined with beneficial microbes, support improved tree performance primarily through increased yield and canopy development, with minimal effects on fruit quality. Seasonal and site-specific management strongly influenced outcomes, indicating that these treatments are most effective when integrated into location-specific management strategies rather than applied as a one-size-fits-all solution.

Future Work Plan

Looking ahead, several key milestones are scheduled for the coming months:

Completion of Valencia Treatment Applications: The remaining applications for the Valencia application

Greenhouse Experiment: The greenhouse experiment is already set up, and we are waiting for the treatments to start applications.

Soil Sample Processing for Root Density: Analysis is ongoing.

Spring 2026 Sampling: Soil & Tissue sampling to start early March at all sites.

Fruit drop count for Valencias is ongoing.

Continued support and collaboration with the growers and Savory Sun VA LLC will be essential for maximizing impact and achieving the project's long-term objectives.

Appendices: Timeline of Activities

Period	Activity	Site	Notes
Spring 2026	Treatments	FL Valencia	
Spring-summer 2026	Soil & tissue sampling	FL & TX	All sites
Spring 2026	Canopy	FL	All sites
Spring 2026	Harvest (Valencia), Yield, Juice	FL	

	Quality		
Spring – summer 2026	qPCR Analysis	ALL	Completed
Spring 2026	Treatment applications start Valencia	TX	
Current	Greenhouse Project	FL	In progress
June–November 2026	Conferences	Everywhere.	Presenting our work