Sensor-Based Assessment of LNC Effects on Root-Zone Water and Nitrate Retention in Date Palm

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Water results: Soil moisture patterns differed among the untreated control (C2C; Figure 1), split LNC treatment (C3S; Figure 2), and full LNC treatment (C4F; Figure 3). The control treatment showed relatively low soil moisture for much of the monitoring period, followed by sharp increases after irrigation, indicating rapid wetting and drying behavior typical of untreated sandy soil. In contrast, both LNC treatments maintained higher and more persistent moisture within the active root zone after irrigation events. The full LNC treatment showed the strongest retention response, with repeated moisture peaks followed by slower depletion, suggesting improved soil water-holding capacity and longer water availability for date palm roots.

Nitrate results: Nitrate dynamics also showed treatment-related differences across the control and LNC-treated plots. In the control treatment (C2C; Figure 4), nitrate concentrations were highly variable between soil depths, indicating uneven nitrate distribution and potential movement beyond the shallow root-zone layer. In the split LNC treatment (C3S; Figure 5), nitrate increased gradually over time, suggesting improved retention within the monitored soil profile. The full LNC treatment (C4F; Figure 6) maintained higher nitrate concentrations across both monitored depths, indicating stronger nutrient retention in the active root zone. Overall, these preliminary sensor trends suggest that the LNC application, especially the full treatment, improved both water and nitrate retention compared with untreated sandy soil.

KEY HIGHLIGHTS

Stronger Water Retention: The full LNC treatment maintained higher, persistent moisture and slower depletion, extending water availability for roots.

Improved Nitrate Retention: LNC maintained higher nitrate concentrations across depths, preventing uneven distribution and deep movement.

Stabilized Soil Dynamics: Treated soils completely avoided the rapid wetting and drying behavior typical of untreated sandy profiles.

Figure 1. Soil moisture dynamics under the untreated control treatment in date palm (C2C; no LNC).

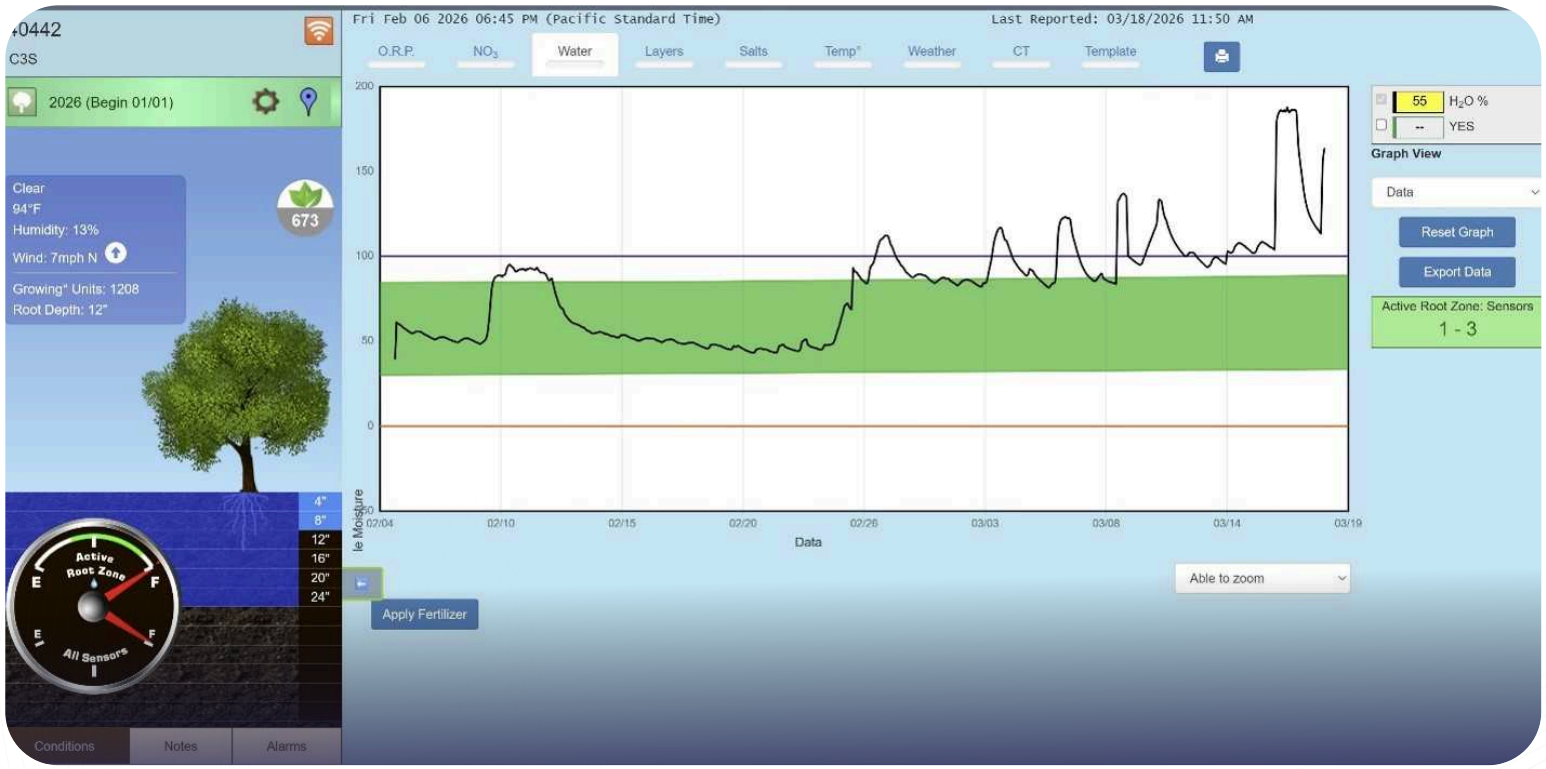

Figure 2. Soil moisture dynamics under the split LNC treatment (C3S) in date palm.

Figure 3. Soil moisture dynamics under the full LNC treatment (C4F) in date palm.

Figure 4. Nitrate dynamics under the untreated control treatment in date palm (C2C; no LNC).

Figure 5. Nitrate dynamics under the split LNC treatment (C3S) in date palm.

Figure 6. Nitrate dynamics under the full LNC treatment (C4F) in date palm.

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