Detecting moisture status in Southern New Mexico pecan orchards using remote sensing

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We are studying the physiological changes in pecan trees exposed to soil moisture deficits during cyclic flood irrigations using remotely-sensed surface reflectance derived from hand-held spectroradiometer (ASD Fieldspec Pro Full Range Spectroradiometer), Landsat-7 ETM+, and Landsat-8 LDCM.

We are conducting our research on the southern pecan orchard (9 acres) at the Leyendecker Plant Science Research Center (Figure 1a). We assigned ten trees randomly within the orchard (one tree per pixel) for canopy surface reflectance and plant physiological measurements (Figure 1b).

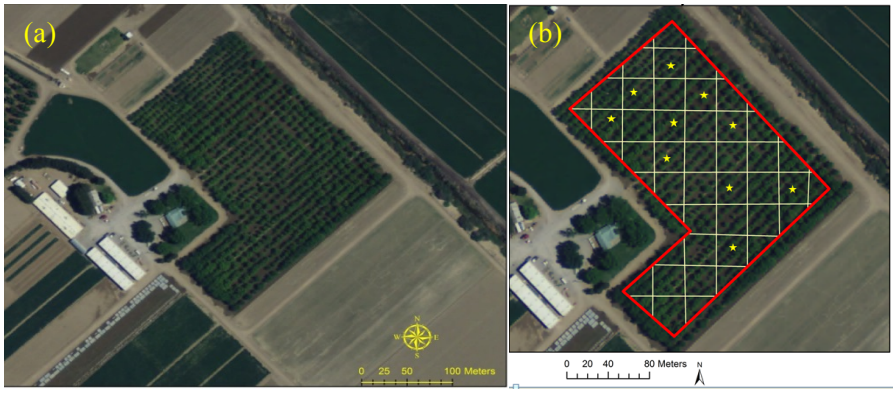
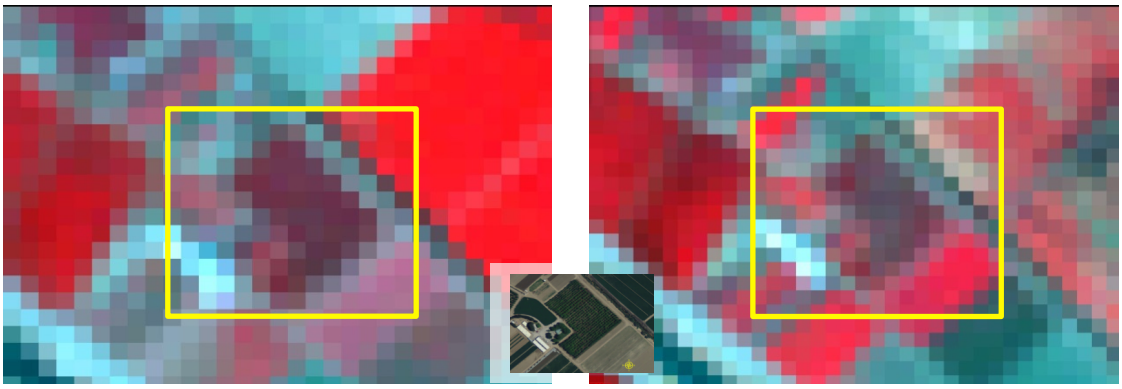


Figure1. (a) Study site location and (b) ground reference points in the Leyendecker Plant Science Research Center, NM.

We are using two irrigation treatments; well-watered and water deficit. The beginning of each irrigation cycle is considered the well-watered level, while water deficit is assumed at the end of the irrigation cycle. We are synchronizing all irrigation cycles with satellite overpasses, hand-held spectroradiometer measurements at canopy level (Figure 2), and in situ measurements of pecan stem water potential (Ψ_{smd}). Also, we are using multiple linear regression analysis to discover which remotely sensed variable exhibit the strongest relationship with Ψ_{smd}; the parameter that best represents changes in the tree water status.

Figure 2. Canopy surface reflectance measurements using hand-held spectroradiometer (ASD Fieldspec Pro Full Range Spectroradiometer) at the leyendecker orchard.

The preliminary results showed that the Landsat band ration B5/B7, positively and significantly correlated with Ψ_{smd} in five of six irrigation cycles. Multiple linear regression of remotely sensed variables revealed a significantly relationship with midday stem water potential in all cycles. Because changes in B5/B7 and multiple regression of spectral variables correlate with the moisture status of pecan orchards, we conclude that remotely sensed data holds promise for detecting the moisture status of pecan orchards (Figure 3).



Well-Watered Treatment **Dry Treatment**

Figure. 3 Landsat-7 ETM+ False color composite image (Near-infrared, Red, Green) for Leyendecker orchard. In these false color composites, (Near-infrared, Red, Green) vegetation appears more red (more reflectance in Near-infrared) depending on plant water status and type.