Dynamic irrigation in protected cultivation

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In the Northern Jordan Valley near the Sea of Galilee Lake banana irrigation under 10 and 20% white or clear shade screens is reduced below rates for open stands by about 25%, following research in the past 15 years on screenhouse climate and banana response to irrigation rates. In coastal regions reductions are about 10%. The ratio of evaporation inside to that outside decreases during the season due to changes in internal climate, caused partly by the accumulation of dust on the screen which reduces transmission of solar radiation and atmospheric evaporative demand. In addition wind speed is reduced as the banana plants grow and fill the void below the screens.

We are exploiting these dynamic changes to inform irrigation management by monitoring climate under the screens and computing reference evapotranspiration (ET_0) daily. Irrigation is adjusted according to ET_0 from the previous day. The experiment focuses on 3 plots: reference unscreened, 10% 'crystal Leno' and 20% 'pearl' screens. Treatments include regional recommendations based on tables and 'dynamic' irrigation as described above. Significant reductions in irrigation have been obtained and yield with 'dynamic' irrigation was not significantly lower. At the end of the dry season a non-significant trend of increased salinity for the reduced irrigation was observed. No other detrimental results were found.

Measurements included sap flow, leaf temperatures, soil salinity and horticultural data. Data from the weather stations under the screens were automatically collected and analyzed on site with dataloggers, transferred by cellular modems to our lab and stored in a shared Dropbox folder, which was accessed by the irrigation manager at the research station.

Similar research is being done in a Greenhouse-screenhouse complex at the hot and dry Gilgal research station 80 km south of the Banana region, where vegetables, and especially bell peppers are grown in the winter for export to colder areas. In this case, monitoring indoor climate for dynamic irrigation according to the Penman-Monteith equation has led to significant reductions of 15 to 20% in irrigation. Measurements have included yield and yield quality along with crop water use from sap flow measurements. These have showed that reduced irrigation from dynamic scheduling does not reduce yields and can lead to large savings in water application.

For early stage irrigation requirements we are investigating the use of a two source Shuttleworth-Wallace model, based on additional monitoring of canopy structure.