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RECENT RESEARCH FINDINGS IN DATE PALM WATER MANAGEMENT

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Introduction. Dates (*Phoenix dactylifera L.*), one of the world's oldest cultivated fruits, originated in the Middle East, with its distribution extending to the United States in the last century. The geographical distribution of commercial date production is limited to arid and semi-arid regions where there is not abundant water supply. The low desert of California with nearly 11,000 acres of date palms is the major date production area within the United States followed by Arizona. Since the date industry is currently economically successful and robust in California, date production is expected to increase as many new groves have been planted in recent years and more are currently being planted.

Fig. 1. A drip irrigated date palm (top picture) and an integrated drip-flood irrigated date palm (bottom picture) in the Coachella Valley.

The date palm is drought tolerant; however, more accurate irrigation scheduling and water management during its flowering and fruiting season is critical for healthy date palms and high-quality fruit production. Date palm growers have started to adopt the use of micro irrigation, but in many instances, irrigation management is based upon data developed decades ago in flood irrigated orchards (Fig. 1).

An irrigation study was conducted to acquire relevant information on crop water consumption and develop more accurate crop coefficients values for date palms in California. Extensive data collection was carried out in six mature date palm orchards in the Coachella and Imperial Valleys over a three-year period. The experimental orchards represent various soil types and conditions, irrigation management practices, canopy features, and the most common date cultivars in the region (‘Medjool’ and ‘Deglet Noor’ cultivars). The orchards have relatively heterogeneous soil; however, the dominant soil texture varies from sandy loam to silty loam and silty-clay loam. A combination of surface renewal and eddy covariance equipment (flux tower, Fig. 2) was utilized to measure actual crop evapotranspiration (ET_a) at each site. This article provides some effective irrigation and water management tips in California date palms based on the findings of this study.

Both micro/drip and flood irrigation are common practices in the low desert region, and some growers, who have installed micro irrigation systems in their orchards, irrigate their date palms through an integrated micro-flood irrigation system. The results of our recent date palm irrigation management survey demonstrated that 31% grower responders use only flood irrigation, 19% use only micro irrigation, and 50% follow an integrated micro-flood irrigation management approach. The survey also illustrated that drip irrigation systems dominate micro irrigation systems, with nearly 88% of grower responders reporting using drip irrigation and 12% using micro-sprinkler irrigation.

Fig. 2. Flux tower set up at one of the experimental sites located in Thermal, California. An aerial view of the tower from a distance (left) and a ground view of the tower (right).

Consumptive water use in date palms. The results of this study demonstrated considerable variability in date palm consumptive water use. The cumulative date palm water use over a 12-month period across the six sites ranged from 51.7 in. to 59.1 in. (Fig. 3). with a mean daily ET_a of 0.28 in d^{-1} in June-July and 0.04 in d^{-1} in December at the site with the highest crop water consumption.

The results revealed clearly that water consumption of date palms varies significantly depending upon site-specific conditions. Various factors may influence date palm crop water use including irrigation management practices, salinity and/or soil differences, groundwater table, and ground shading or canopy cover (and tree height), this last providing a good estimation of canopy size/volume and the amount of light that it can intercept.

For instance, the cumulative consumptive water use over the 12-month period was 58.8 in. in a non-salt-affected, sandy loam soil date palm under flood irrigation (site 4) with an average density of 50 trees per acre and an average canopy cover and tree height of 81% and 36.1 ft., respectively. In comparison, the cumulative annual consumptive water use was determined to be 51.7 in. in a silty clay loam saline-sodic date palm (site 5 under an integrated micro sprinkler-flood irrigation system) with an average canopy cover of 55%, density of 60 trees per acre, and tree height of 24 ft.

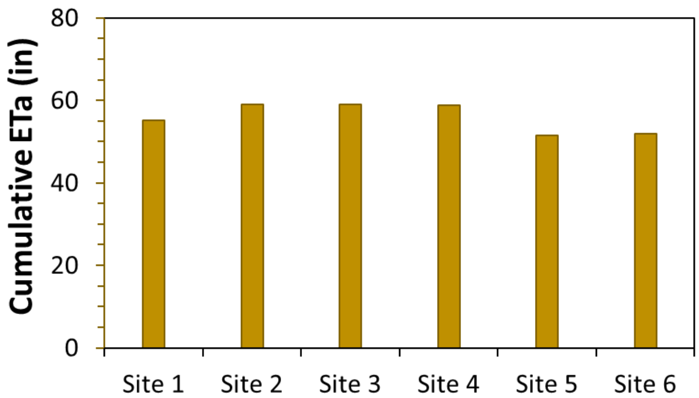

Fig. 3. Cumulative date palm actual evapotranspiration or consumptive water use (ET_a) at the experimental sites over a 12-month study period (May 2019 – April 2020).

Date palm crop coefficient values. The results indicate that there is substantial difference in crop coefficient (K_a) values of date palms, both spatially and temporally (Fig. 4). For instance, at site 4, the average monthly crop coefficient value varied between 0.64 in December and 0.88 in June. Date trees at this site experienced mild to moderate water stress during July, but soil moisture was maintained at a desired level during the remainder of the study period.

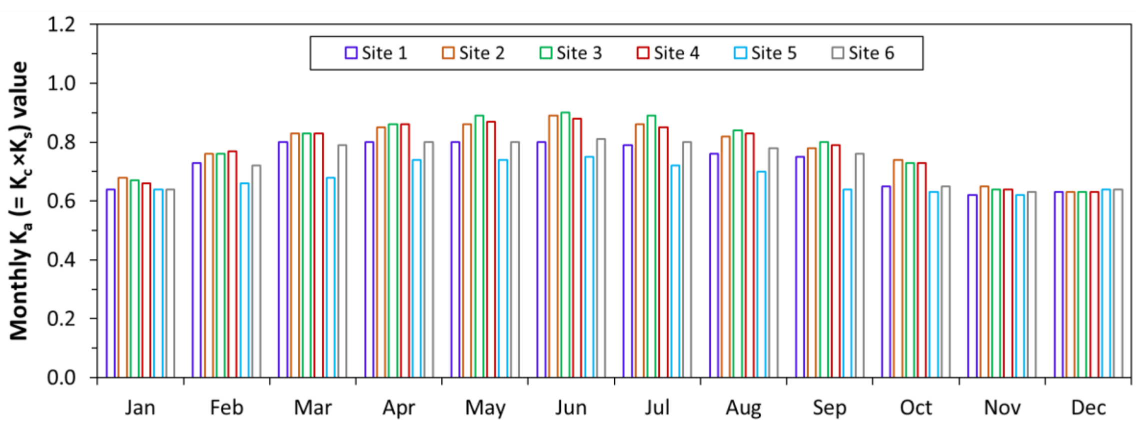

Fig. 4. Calculated monthly actual crop coefficient (K_a) values at the experimental date palms over the 12-month study period. The observed daily actual evapotranspiration (ET_a) and Spatial CIMIS reference evapotranspiration (ET_o) in each of the experimental date palms were used to compute the monthly K_a values.

The soil types and conditions at sites 2, 3, and 4 were similar, and the canopy features were relatively similar as well. Both sites 3 and 4 had a density of 50 plants ac^{-1}, whereas the density was 52 plants ac^{-1} at site 2. All three sites had the 'Deglet Noor' date cultivar. Slight differences were found among the monthly crop coefficient values of these orchards that were likely related to irrigation management differences. An integrated irrigation system consisting of drip and flood irrigation was used at sites 2 and 3. Both sites are considered fully irrigated orchards over the study period with the water applied of 7.7 ac-ft/ac at site 2 and 7.9 ac-ft/ac at site 3, with relatively high soil water availability the entire season. The average K_a values for the 12-month period were 0.81, 0.82, and 0.81 at sites 2, 3 and 4, respectively. Within the year, the monthly range of values was from 0.63 (December) to 0.90 (June) at site 3. These values likely represent the 'potential' K_c values for the date palms since the applied irrigation water in these orchards were 50% to 60% higher than the measured ET_a and both soil moisture and canopy temperature data suggested that no water deficit occurred over the 12-month period.

The monthly K_a value varied from 0.62 in November to 0.75 in June at site 5. This orchard is regularly irrigated by micro-sprinkler and occasionally flood irrigated to leach out heavy salt accumulation in the entire soil profile. Across the six sites, sites 3 and 5 had the highest and lowest K_a values averaged over the 12-month period, respectively. An average 12-month K_a value of 0.70 was obtained at site 5, which is nearly 17% lower than the average 12-month K_a value of site 3. These sites have the same date cultivar (Deglet Noor); however, site 5 had a higher planting density and smaller trees. The reduction of tree growth at site 5 is likely associated with the physiologic adjustment of trees to the long exposure to high salinity-sodicity environments.

Final recommendations. Date palms need variable amounts of irrigation water depending on time of year; canopy cover percentage and tree height; soil types and conditions; and irrigation management. To sustain date production in the desert region, growers need to integrate micro irrigation and flood irrigation together. It helps to fill the soil profile for this deep-rooted tree crop specifically at the time that drip irrigation does not have the capacity accomplish this. During mid-June to early July, one might need to apply more than 100 gallons per day per tree. Depending on the capacity of micro irrigation system, it would be beneficial to have one flood irrigation during this period. Another flood irrigation during early season (March) is also recommended. We need to keep in mind that effective irrigation management in the desert environment is different than other regions. In the desert environment, irrigation needs to maintain crop water needs and soil salinity at the same time even for an adapted and stress-tolerant crop such as date. The two or three flood irrigation events (depending on the soil types and conditions) integrated with drip irrigation can maintain crop water needs and salinity and optimize the economic benefits of date production in the low desert region.

Growers may use the crop coefficient values developed by this study along with CIMIS ET_o data to calculate crop water needs in different time of year ($ET=K_c \times ET_o$). It is highly recommended that growers monitor soil moisture at least at the depth of 1 - 2 feet. Soil moisture at the depth of 1 - 2 ft. is a good indicator of soil water availability to date palms under micro irrigation (a threshold of 25 - 30 centibar could be considered for the sandy loam soils in the Coachella Valley).

Save the Date...

UCCE Imperial County presents

34th Annual Fall Desert Crops Workshop

Hybrid (In-Person & Virtual)

Topics to be discussed; irrigation, pest management, crop productivity & hay quality

More details on location, meeting time, CEU's and registration to follow...
(442) 265-7700
https://ceimperial.ucanr.edu/

NOVEMBER 30TH
8 AM - 12 PM

IMPERIAL VALLEY CIMIS REPORT AND UC WATER MANAGEMENT RESOURCES

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The reference evapotranspiration (ET_o) is derived from a well-watered grass field and may be obtained from the nearest CIMIS (California Irrigation Management Information System) station. CIMIS is a program unit in the Water Use and Efficiency Branch, California Department of Water Resources that manages a network of over 145 automated weather stations in California. The network was designed to assist irrigators in managing their water resources more efficiently. CIMIS ET data are a good guideline for planning irrigations as bottom line, while crop ET may be estimated by multiplying ET_o by a crop coefficient (K_c) which is specific for each crop.

There are three CIMIS stations in Imperial County include Calipatria (CIMIS #41), Seeley (CIMIS #68), and Meloland (CIMIS #87). Data from the CIMIS network are available at: http://www.cim is.water.ca.gov. Estimates of the average daily ET_o for the period of October 1 to December 31 for the Imperial Valley stations are presented in Table 1. These values were calculated using the long-term data of each station.

Table 1. Estimates of average daily potential evapotranspiration (ET_o) in inches per day

Station	October		November		December	
	1-15	16-31	1-15	16-30	1-15	16-31
Calipatria	0.21	0.18	0.13	0.11	0.09	0.09
El Centro (Seeley)	0.22	0.18	0.14	0.12	0.10	0.09
Holtville (Meloland)	0.20	0.16	0.13	0.11	0.09	0.08

For more information about ET and crop coefficients, feel free to contact the UC Imperial County Cooperative Extension office (442-265-7700). You can also find the latest research-based advice and California water & drought management information/resources through link below: http://ciwr.ucanr.edu/.