Irrigation Scheduling for Small Fruit Crops
Research Proposal - 2005
Small Fruit Consortium

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Objective: Develop crop coefficients and an internet-based irrigation scheduling tool for small fruits grown in the southeast.
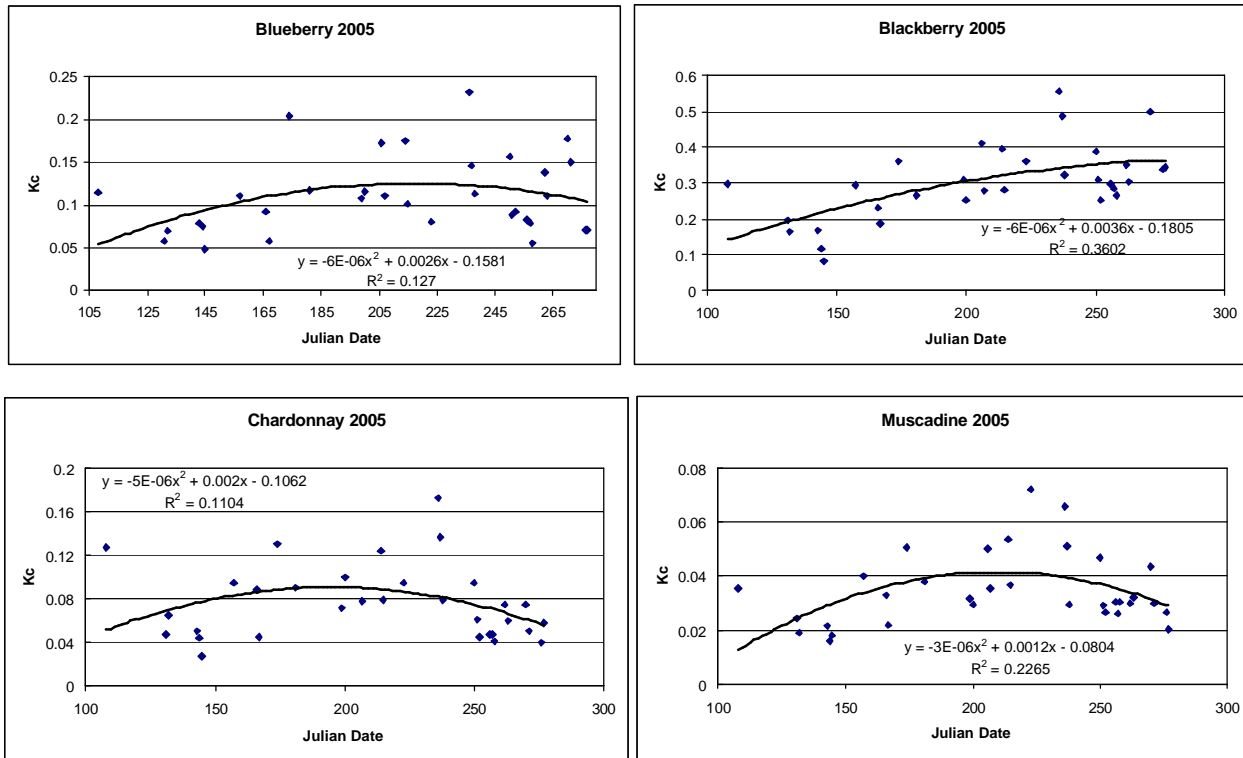
Justification: The water use and crop coefficients of small fruit crops are poorly described in the literature, but essential for proper irrigation scheduling. Weather networks throughout Georgia and adjacent states provide much of the climatic data necessary for irrigation scheduling, but research is needed to quantify water use as a function of weather under southeastern conditions.

Methodology: As in 2004, lysimetry was used to measure water use throughout the 2005 growing season. New containers were purchased to increase the rooting volume available to plants, and avoid problems of evaporation from the container sides which happened during 2004 when wood was used. Containers were 18-bushel commercial fruit bins (Decade Products, Grand Rapids, MI) with a volume of about 0.6 m^3. Plants used in 2004 were transplanted while dormant in February 2005, using a 1:1 pine bark:sand mix. All plants were fertilized with soluble fertilizer (a

Peters 20-10-20 formula) except blueberries, which were fertilized with ammonium sulphate. Approximately 100 ppm N rates were used on 4 occasions during the spring of 2005. Containers were moved by forklift to a digital scale for weighing at 24 hour intervals. This permitted collection of daily water use data from several different crops using only one expensive, high-capacity scale. A "blank" container (no plant) was included to determine the amount of evaporation occurring from the soil surface. The digital scale is accurate to ½ lb (0.25 liters), and has a capacity of 2000 lbs.

Results: Seasonal Kc curves for all species obtained during 2005 are presented below. Grapes and blueberries exhibited gradual increases in Kc over the season, peaked in July and August, and then showed declining Kc through September and early October as expected. However, blackberries exhibited vigorous primocane extension through the entire measurement period, and thus had the highest Kc values

at the end of the season, corresponding to greatest leaf areas. All plants averaged between 2 and 6 liters of water per day, depending on PET, and up 8 liters per day

Blueberry 2005

$y = -6E-06x^2 + 0.0026x - 0.1581$
$R^2 = 0.127$

Blackberry 2005

$y = -6E-06x^2 + 0.0036x - 0.1805$
$R^2 = 0.3602$

Chardonnay 2005

$y = -5E-06x^2 + 0.002x - 0.1062$
$R^2 = 0.1104$

Muscadine 2005

$y = -3E-06x^2 + 0.0012x - 0.0804$
$R^2 = 0.2265$

under peak conditions. Thus, plants used about 50% more water per day compared to 2004, which was expected since they were in their second growing season. Once again, blackberry showed the greatest rates of water use of the four species studied, while grapes showed the least. The r^2 for all species were low, which is typical for Kc research. Variability may be further compounded here by rates of water use approaching the limit of detection of the scales used. As plants age and use more water, these errors will be reduced.

A light meter was purchased with grant funds to develop relationships between light intercepted and Kc for each crop. An example is shown here for blueberries. Although significant (P<.05), correlations coefficients were too low to be useful predictors of Kc in 2005. The main reason is the limited range of canopy light intercepted by these young plants (note x-axis scaling in figure). As plants age, and the light interception

Blueberry - Kc vs light interception

$y = 0.7366x - 0.1119$
$R^2 = 0.1383$
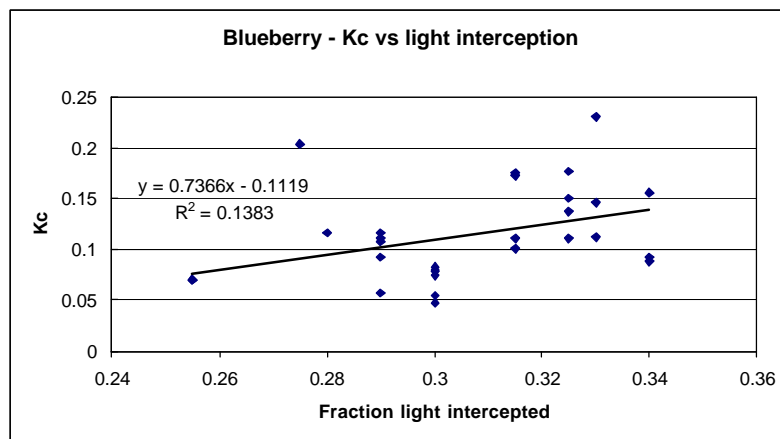
values exhibit a greater seasonal range, better correlations may be expected.

Another sub-objective of the 2005 season was to validate the approach to lysimetry used (i.e., above-ground weight measurements) relative to typical values obtained from in-ground lysimeter measurements. A pit was constructed with dimensions about 2 cm wider than the containers on all sides, and a scale was placed in the pit at a depth that allowed the top of the container to sit flush with the soil surface. The small fruit plants in this study used too little water to be useful for validation, so a red maple, a willow oak, and bermuda grass from a concurrent study were used [these plants used 2-3x more water and were less subject to error than the small fruit crops). When above ground and in-ground Kc values were compared by t-test for the three species, no differences were detected except for one measurement date with one species (bermuda grass), where the in-ground values were lower than above ground. Thus, water use values obtained in this study appear to be similar to those obtained by a traditional in-ground lysimeter. In future years, the small fruits will be used to validate the technique further.

Just underway are measurements of Kc values for plasticulture 'Chandler' strawberries. A section of strawberry bed containing 6 plants was installed in a container similar to that pictured above in October 2005. Preliminary data show that strawberries may have Kc values approaching 1.0 for late October and November, despite relatively low leaf areas at this time. Data will be collected through June 2006, yielding a complete season of Kc values.

The irrigation scheduling web site for peaches is being modified and will serve as the template for a site for small fruits (see www.griffin.uga.edu/aemn/peaches), as well as other crops grown in Georgia. The site is being developed by the College of Agriculture and Environmental Sciences Office of Instructional Technology. OIT solicits projects each year to receive in-kind support for development of computer applications. This project was one of just a few picked for 2005. I will estimate the in-kind contribution of OIT toward this research using their standard rate of $50/hr for web site development once they have finished. They will also provide a limited amount of site support during its first season of use (2006). Crop coefficients used in site calculations are those of mature fruit crops estimated from the literature, not the values developed thus far in this research since they pertain to young plants only.

Conclusions: Similar to first year data, second year data suggest extremely low water use and crop coefficients for young grapes, blueberries, and blackberries, such that drip irrigation applied weekly for just a few hours would likely satisfy crop water requirements.

Impact statement: The research proposed will generate the background data and web application for accurate irrigation scheduling for small fruits in the southeastern USA. Similar systems based on PET and crop coefficient have been successful in California (CIMIS) and Washington state (PAWS). Precise water management is an integral component of sustainable crop production. Reductions in over-watering crops may be expected based on preliminary data. This has the potential to reduce chemical

leaching and runoff, and reduce costs of irrigation.

Citations: No publications were produced during 2005. The research is long-term, and probably will not generate refereed publications until 3-4 years after inception. A popular industry magazine, *The Grower (*Vance Publishers*)*, did a story on the research being conducted with peach simultaneously with the small fruit research, and this will likely reach a larger audience than a refereed article.