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Alternative Flood Management Practices for Citrus Production that Saves Water

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FEATURES

The conventional method of irrigating citrus groves in South Texas is by flooding the entire grove with approximately a 6 inch surface flooding event, with 4 to 8 separate irrigation events per year depending upon annual precipitation amount. Thus, it is not uncommon for a citrus grower to apply an additional 2 to 4 acre-feet/acre of water throughout the growing season to ensure that trees avoid water stress. Recent on-farm estimates of water use with **A**gricultural Water Conservation **D**emonstration **I**nitiative (ADI) collaborating citrus growers has shown that an alternative flood irrigation practice, called narrow border flood (NBF), can save growers 25% or more water over traditional flood (TFld) irrigation. A scientific replicated study was performed to evaluate the water savings of comparing TFld irrigation water use to NBF irrigation. In summary, this is what we observed from our replicated scientific trial, where water quantification by metering showed that NBF saved 50% more water over TFld irrigation.

Conventional large pan flood (TFld) will typically have 3 to 5 rows of trees irrigated between raised berms (Fig. 1a).

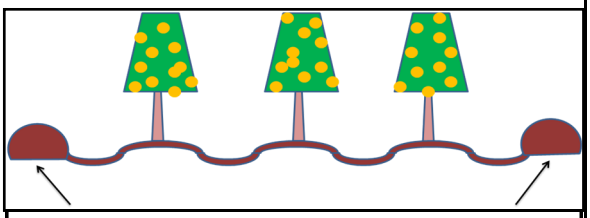

Fig. 1a. TFld with raised berms.

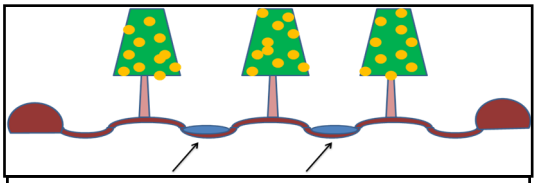

Fig. 1b. Lower soil elevation fills first.

Cultivation and cultural practices between tree rows lead to lower soil elevation than underneath the citrus trees canopy which alters water flow when irrigated (Fig. 1b).

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Water will typically have to fill up the lower elevations between the tree rows and down the entire length of the tree row before the water will fill in underneath the tree canopy. In the short-term, non-uniform watering occurs underneath the trees as water rises to meet the highest soil surface level underneath the tree canopy (Fig. 1c).

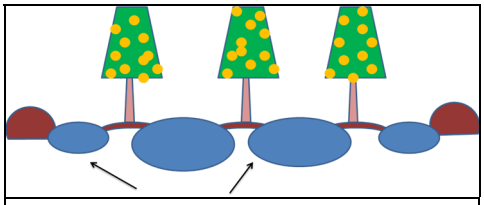


Fig. 1c. Nonuniform watering between rows

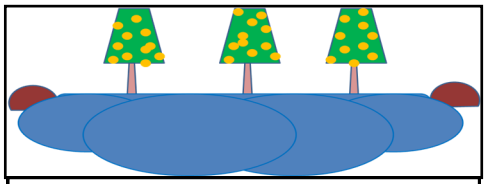


Fig. 1d Deep percolation beyond root zone

As citrus irrigators wait until the entire soil surface is covered with water, resulting in deep percolation and fertilizer loss beyond the rooting depth of trees using TFld (Fig. 1d).

Narrow border flood (NBF) irrigation can save water by establishing raised berms between each tree row (Fig. 2a).

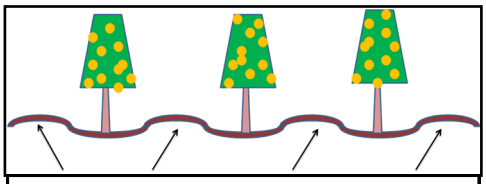


Fig 2a. NBF with raised berms between rows

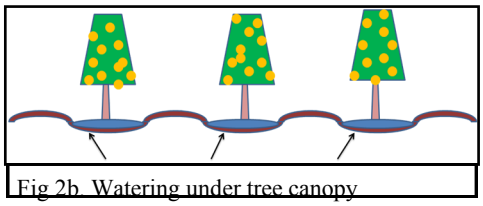


Fig 2b. Watering under tree canopy

Increased irrigation efficiency occurs by channeling water faster down row and underneath the tree canopy (Fig.2b).

NBF irrigation can more adequately target the root zone of citrus trees, while applying water at a faster rate to minimize deep percolation, thus resulting in water saving and retaining fertilizer within the root zone of trees (Fig. 2c).

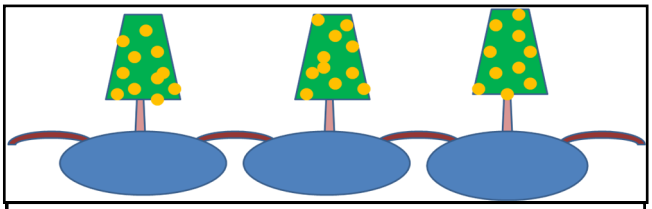


Figure 2c. Targeting root zone saves water

The results of our study with water meters employed to measure total irrigation water applied, showed that 50% less water was used under NBF compared to TFld irrigation. This is equivalent of saving 1 to 2 acre feet/acre of water annually or 27 to 54,000 acre feet of water per year if the entire citrus industry in South Texas used NBF irrigation.

Visiting Scientist from Turkey

John da Graça and Madhu Kunta

Dr Nuket Önelge, Professor of Plant Pathology at Çukurova University in Adana, Turkey has been spending the summer in the Diagnostic Laboratory at the Citrus Center. She is specifically interested to learn detection procedures for citrus greening disease/Huanglongbing (HLB). Although neither HLB nor its vector, the Asian citrus psyllid, has been reported in Turkey, both are now present in eastern Iran, Turkey's neighbor. There is understandably concern in Turkey that the disease and vector could spread into its citrus orchards, and the industry there needs to get prepared.

Dr Önelge is also assisting in some studies at the Citrus Center on citrus viroids and tatter leaf virus. She is familiar with a technique called s-PAGE which can detect the presence of any viroid, and is training the lab on its applications.

In 2007, Dr Önelge chaired the organizing committee for the International Organization of Citrus Virologists 50th anniversary conference. Drs Mani Skaria and John da Graça attended the meeting, and enjoyed experiencing Turkish hospitality and citrus – both Star Ruby and Rio Red grapefruits are produced there.

Lhou Beniken at Citrus Center

Citrus Center Hosts Norman E. Borlaug International Fellow from Morocco

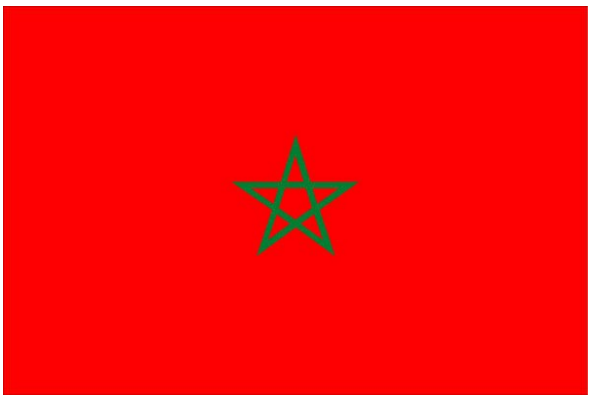
Shad D. Nelson, Mamoudou Sétamou, and John da Graça

Mr. Lhou Beniken, Agricultural Engineer from the National Institute of Agronomic Research, Kenitra, Morocco, spent six weeks in Weslaco working with Drs. Mamoudou Sétamou and Shad Nelson during spring 2011. The Citrus Center director, Dr. John da Graça, received funding for one international scientist from Morocco to work on water conservation and fertility impacts on citrus pests. Mr. Beniken is the first person at Texas A&M University -Kingsville to be funded with a Norman E. Borlaug Fellowship and to work with faculty from TAMUK. During his short stay at the Citrus Center, Mr. Beniken performed three separate experiments looking into the impacts of drought stress and nitrogen application on citrus growth and pest relationships. He worked in collaboration with graduate students in a field trial that specifically focused on water quantity studies using alternative flood irrigation strategies in citrus, comparing narrow border flood (NBF) to conventional flood (CF) irrigation and showing 50% water saved using NBF over CF. These water savings principles are directly relative to Moroccan citrus production practices, as much of Morocco's citrus is flood irrigated.

Drs. Sétamou and Nelson made a reciprocal visit to Morocco for one week in August and toured citrus production along the central Atlantic Coastal regions of Morocco. It was interesting to observe that some of the studies initiated between Mr. Beniken and Dr. Setamou were being replicated in Morocco to more adequately assess the impacts of drought and nitrogen stress on citrus growth. Visits to research stations and field sites near the cities of Kenitra, Rabat and Agadir provided adequate time for discussions of how U.S. and Moroccan scientists can continue collaboration in the future. Dr. Sétamou has already received verbal confirmation that another Borlaug Fellow from Morocco will be coming to work at the Citrus Center, thus continuing the positive relationship between faculty and scientists in both countries.

Citrus research station visit in Kenitra, Morocco

We look forward to future years of support through the Borlaug Fellowship program that will allow others to get to know Texas citrus production better, along with our understanding of how growers in other countries are meeting the challenges facing sustainable citrus production.



Dr. Julian Sauls Retires

John da Graça

Dr. Julian Sauls

On Aug. 31, 2011, Dr Julian Sauls retired as Extension Horticulture Specialist at the Texas A & M AgriLife Research and Extension Center in Weslaco.

Julian was born in Mississippi, but his family settled later in Louisiana where he graduated from high school, and attended Louisiana State University where he obtained both his BS and MS in Horticulture. He then went to the University of Florida for his PhD, after which he worked in Honduras and Mexico for two years. On returning to the USA, he joined the Texas Extension Service in Fort Worth in 1973, moved to the Florida Extension Service in 1975, and then rejoined Texas Extension as Horticulture Specialist in Weslaco. During his tenure in Weslaco, Julian was responsible for the development and coordination of the overall Extension citrus educational program, in cooperation with county Extension personnel, citrus growers, industry representatives and research personnel. Major program emphases were in citrus nutrition, orchard floor management and irrigation management, but his program has included all facets of citrus production management.

In 1997, he created an extension website for citrus and subtropical fruit, which includes a section devoted to the Texas Citrus Fiesta Youth Show which he was intimately associated with. He also wrote a monthly newsletter, updating citrus growers on important developments.

Julian worked closely with faculty at the Citrus Center, and contributed to its own newsletter. He was also an active member of the Rio Grande Valley Horticulture Society, and received the Arthur T. Potts Awards for his services in 2006.

He is a citrus grower himself, and currently serves as President of the Edinburg Citrus Association. The Citrus Center thanks him for all his contributions to the Texas citrus industry, and wishes him well in the future.

Helping Teenagers Catch the Science Bug

Juan Carlos Melgar

On Saturday September 17th, a group of researchers from the Citrus Center visited the Weslaco East High School for giving support to middle school and high school students in their research projects. The group included three graduate students from the Valley (Steven Reyna, Amanda Garcia and Francisco Melgoza), a visiting scientist from Turkey (Dr. Nuket Önelge), a research associate (Ayako Kusakabe) and a faculty member (Dr. Juan C. Melgar). The idea was to talk to the students about the projects we have developed at the Citrus Center, in a simple language, to let them know about the possibilities of research in plant science. The researchers divided according to three topics: entomology, plant physiology, and plant breeding/molecular biology. Likewise, students were divided in three groups: one of high school students and two groups of middle school students. Each group talked to each of us for 30 minutes and then rotated to the next topic.

The results were excellent: Most of the students were very motivated with the ideas received and we were also very happy to receive so many questions. Very young students may not fully understand the physiological/biochemical processes behind a specific plant response but, thanks to these projects, they are starting to learn some of these basic concepts, and what maybe is more important, their interest for science is awakening. After those talks and after getting their feedback and sharing their ideas, some students have already started developing some research projects in collaboration with some of the students. Steven Reyna, for example, is now mentoring a couple of students that are developing alternate pesticides against worms on tomato plants using essential oils.

When to Remove an Unproductive Orchard?

Mani Skaria

A citrus orchard is an organized planting; inherent in it is a commitment to a long-term production. A citrus orchard can often last for decades. Citrus is a long-term investment, requiring heavy capital up front. Growers expect a steady high returns for a long period of time. However, citrus growers are subject to steady changes in consumption- stagnation or decreases in per capita consumption of oranges and grapefruit. Just like any other investors, citrus growers have similar expectations with ROI or return on investments; however, many citrus growers seem to be more passionate about agriculture and appears more forgiving to poor ROI. This is not an article on production economics but an analysis of the situation when you should approach an accountant for an educated decision making on whether or not to push out your orchard and start all over. Please compare the picture and information given in the figure.

The fruit production and quality of fruit are function of the production practices. I have written an article on "Citrus Pack-out and Profitability." in the June 2010 issue of the TAMUK Citrus Center newsletter, please see full text at http://kcc-weslaco.tamu.edu/files/newsletter/2010/June_2010_Vol_28_No_3.pdf

When to remove an unproductive orchard is a difficult decision. One has to ask several questions.

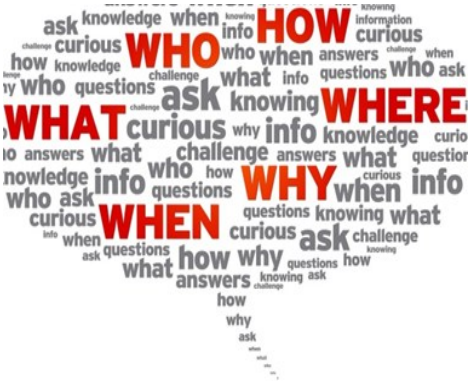


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Figure 1. Left: Severe *Phytophthora* and psorosis infection causing 20.45% tree loss in one section. Right: Mild *Phytophthora* symptoms in one section causing 0.53% tree loss.

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Table 1. Questions that need to be answered when making a decision on when to remove orchard.

Question to Ask	Answer for this block
Is there a difference in soil type?	Soil in both the blocks is Hidalgo fine sandy clay loam, ideal for citrus. The two blocks are separated by a road.
Is there a difference in the scion or rootstock?	Both are sour orange rootstock. The block on the Right side of Figure 1 (the good one) is Rio Red grapefruit and the declining one (Figure 1, Left Side) is a combination of tangerines.
Is there a difference in net returns per acre?	Latest information is not available
Any difference in irrigation practices?	Both are flood irrigated
Any difference in care package?	The grove care of the two blocks is done by two different companies. Are the trees getting similar proactive management practices? This needs to be investigated
How to measure the quality of your grove care?	The visual appearance of the trees, the fruit set and fruit quality, freedom from pest and diseases are manifestations of the quality of your grove care operation. The services of an experienced and effective orchard care manager are very important for profitability.
Is there a salinity problem?	Salinity issue as a result of excess fertilizers or irrigation water can affect fruit production, especially, when the total dissolved salts (TDS) in the irrigation water are between 1,000 and 2,000 ppm; salinity above 2000 ppm TDS can cause yield reduction. An acceptable TDS level is around 1,200 TDS. You can expect an yield loss of about 18% for every 700 ppm TDS increase. (Information, indebted to J. Syvertsen, University of Florida).
Is there a nutrient problem?	The level of fertilizer available to the tree can directly affect root:shoot ratio. Nitrogen deficiency can increase roots and decrease top growth, whereas high nitrogen decreases roots and increases top growth. The available nutrient to the plant should satisfy the crop nutrient requirements.

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Table 1. Questions that need to be answered when making a decision on when to remove orchard.

Question to Ask	Answer for this block
How many stress factors?	We discussed different stress factors – water, nutrient, salinity. Here is a situation where we should re-write math, where 1+1 =3, because of synergism, where the joint action of agents (water, nutrient, and salinity) which when taken together increase each other's effectiveness.
What are the striking differences?	The trees in the declining block show a high incidence of two diseases – *Phytophthora* foot rot and citrus psorosis virus symptoms. When trunk symptoms of *Phytophthora* are rampant, it is possible that the feeder roots are damaged. Damaged feeder roots have reduced ability to absorb water and nutrients. You will see symptoms of nutrient deficiency, water stress, less vigorous trees and reduced fruit size
Can you correct the problem?	Yes, to some extent. There are two ways to try some corrective measures. **a)** *Phytophthora* control treatment with a systemic fungicide such as **Aliette** (active ingredient, aluminum tris (o-ethyl) phosphonate) and **Ridomyl** (common name, metalaxyl, active ingredient, (R)-2-[(2, 6-dimethylphenyl)-methoxyacetylamino]-propionic acid methyl ester). **b)** The volume of the citrus tree canopy and root system are linked. A tree with root damage or root loss will not be able to sustain the shoot growth. The tree will compensate by dropping leaves and reducing the number of shoots. There will be too few roots to transport sufficient water and nutrients into the above-ground portion of the tree. Normally, the root:shoot ratio varies from 1:4 to 1:2. Growers seeking higher fruit yields should minimize changes in the root:shoot ratio and maintain that ratio as low as possible (e.g., 1:4), favoring the above-ground portion of the plant. Increase above-ground growth by maximizing root health with good water and nutrient management. Leaves produce the photosynthetic sugars that, in turn, can be allocated to additional fruit production. However, maintaining a low root:shoot ratio means that the trees must be managed with care to reduce potential root stress that can change the root:shoot ratio

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