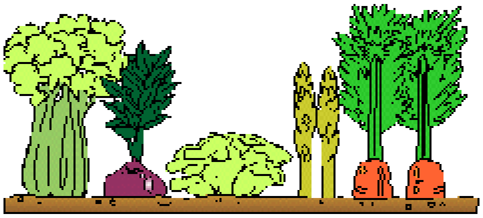

Vegetarian Newsletter

A Vegetable Crops Extension Publication
Vegetarian 02-02
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University of Florida
Institute of Food and Agricultural Sciences
Cooperative Extension Service

Print Version

Events Calender

2002 Postharvest Horticulture Industry Tour - March 4-7, 2002. Visit postharvest operations from harvest through shipping in central and southwest Florida. Special rates are available for county and statewide faculty. Contact Steve Sargent (sasa@mail.ifas.ufl.edu, 352-392-1928, ext. 215) or Mark Ritenour (mrit@gnv.ifas.ufl.edu, 561-467-3877).

Commercial Vegetable Production

Principles of Drip-irrigation Scheduling

for Vegetables in the TMDL and BMP Era

Situation and Background

BMPs and TMDLs are much at the forefront of today's vegetable growers' concerns. BMPs are best management practices; TMDL stands for total maximum daily loads. The TMDL have their legislative origin, the Clean Water Act of 1972, and represent the maximum amount of a compound that a water body may absorb each day and still maintain water quality parameters consistent with its designated use. Each water body will have a TMDL for each compound. BMPs are specific cultural practices that will help reduce load, and thereby the environmental impact of vegetable production.

In Florida, the two main elements targeted by the TMDLs and BMPs and of interest to vegetable growers are nitrate (N-NO3) and phosphorus. Because it is negatively charged, nitrate is not held by the soil colloids and clay minerals (which are negatively charged themselves, and therefore, only tie positively charged ions or cations) and thus moves freely as a solute. When heavy rainfall or excessive irrigation occur, nitrates move vertically in the soil profile and below the root zone. Ultimately, it will reach ground water and will contribute to eutrophication. Phosphate movement, in contrast, is believed to mainly occur during sediment movement at the soil surface. When surface erosion occurs, phosphorus is carried into ditches and streams where it also contributes to eutrophication.

In their intent, BMPs are cultural practices that reduce the environmental impact, while maintaining yields. Hence, the purpose of the BMPs is not to reduce fertilization to an unacceptable level. At first, TMDLs and BMPs were perceived by agriculture in general and the vegetable industry in particular as another round of government regulation. However, with federal and state regulations in place and environmental groups pressing for their enforcement, the TMDL and BMP process has been irreversibly initiated. In recent months, industry members attitudes have changed from hoping the process will stop and go away, to seeking ways to be best prepared for the BMPs. Reasons for this change have included increased incentive programs, increased information, and pilot programs.

So, what is in for vegetable growers to embrace the TMDL concept and implement the BMPs in their operations? The largest incentive, by far, is the 'presumption of compliance'. Growers having a BMP plan (or whatever the final name will be) and following it will be granted presumption of compliance with the TMDL. This is no small incentive. The second group of incentives are the financial help that will be available to implement the BMPs. Hence, in theory, the implementation of the BMPs should be at no financial cost for the farmer. That's the way it looks now.

Objectives of this article. Whatever their final form will be, it is clear that BMPs will require not only a higher level of nutrient management, but also adequate irrigation management. The objective of this article is to present (1) the principles of irrigation scheduling, and (2) how they can be applied in regard to the BMPs.

Basics of Irrigation Scheduling

Scheduling irrigation is to know when to start irrigation and how much to apply, in a way that satisfies crop water needs, conserve water, and does not leach mobile nutrients. Because of the low soil water holding capacity of Florida's coarse-textured soils, irrigation frequency for spring crops is commonly once a day, and sometimes two to three times daily. As an aid to schedule irrigation, the water balance method is a simple process that accounts for all the sources and losses of water from the root zone of actively growing vegetable crops. Water inputs into the root zone are rainfall, irrigation, and upwards vertical capillary movement. Water losses out of the root zone are surface runoff, percolation, and evapotranspiration. For the purpose of scheduling, the water balance may be formulated as: water addition in the root zone should be exactly off set (or balanced) by the water losses, so that the fluctuations in soil moisture the plants are exposed to are small. The only water fractions that the vegetable grower has control over are irrigation, and to a lesser extend, surface run off and deep percolation.

Scheduling irrigation requires (a) a target water amount to be applied, (b) guidelines on how and when to split irrigation, if necessary, (c) a method to account for rainfall, and (d) a practical method to monitor soils water tension (SWT). The IFAS irrigation recommendation for vegetables are based on the Penman-Montheith method for estimating reference evapotranspiration (ETo), and a crop coefficient (Kc) used to adjust ETo to estimated crop evapotranspiration (ETc) using the relation: ETc = ETo x Kc. It is also recommended to maintain SWT between field capacity (6 to 8 cb) and 15 cb.

Principle 1. Irrigation amount must reflect crop water use....no more, no less.

Irrigation amounts may be estimated using historical weather data (H-ETo), climatic measurement in real-time (RT-ETo), class A pan evaporation data (Ep), atmometers (A-ETo), and empirical amounts. While simple, this method has several limitations. First, it does not account for year-to-year variability. Also, historical weather data are available from a limited number of locations. Finally, most Kc values currently available (except for strawberry and tomato) were developed for bare-ground production. As an alternative to historical weather data, RT-ETo may be collected on-farm with a small weather station. Relatively inexpensive weather stations ($1,500 to $2,000) are now available to collect radiation, wind speed, direction and mileage, and rainfall. Data can be stored automatically in a data logger and later downloaded for other usages using a lap-top computer. These automated stations provide a real-time estimate of ETo in time increments as short as a few minutes. Daily estimates (every 24 hours) are usually adequate to schedule irrigation for vegetable crops.

Water evaporation from a class A pan (defined as a galvanized, round, 30-cm deep, 1.20 cm in diameter pan placed in the center of a grassy area) can be used to estimate crop water use (ETc) by adjusting Ep with a coefficient called crop factor (CF) using the equation ETc = Ep x CF. Class A pans cost approximately $500 each. However, research has shown that other less expensive containers (such as No.2 wash tub or sections of 55-gallons drums painted with reflective paint) may be used as practical tools to estimate Ep when class A pans are not available. All pans may be covered by chicken wire to ensure all water losses in the pan are due to weather demand, and not from animals such as birds and small mammals, drinking from the pan. Current research at the North Florida Research and Education Center - Suwannee Valley is also evaluating simple atmometers as a practical tool to estimate ETo. Atmometers are made of a water reservoir and a small, green, sponge-like circular surface. The sponge-like material is connected to the water reservoir. As water demand for weather increases, water is draw from the reservoir through the sponge-like material. A graduated column allows a simple reading of water volumes in the reservoir. The top of the sponge-like material is flanked by two small 4-in long straight wires that help prevent birds from landing and drinking some water. Because these two pieces of metal look like antennae, this type of atmometer is sometimes referred to as ‘the water bug’.

Whatever the device it is collected with (weather station, class A pan, home-made evaporative pans or atmometer), the main advantage of RT-ETo is that it is available in real time. RT-ETo is a true representation of the climatic conditions and water demand the crop has been exposed to. It is therefore a very practical tool to schedule irrigation. Research is currently underway at the North Florida Research and Education Center - Live Oak to develop CF values for real-time irrigation scheduling of watermelon and bell pepper. In contrast, the disadvantages of RT-ETo are limited to reading the equipment, maintaining it, and using the appropriate coefficient (Kc or CF) to estimate Etc. RT-ETo is likely to be a part of the irrigation BMP, in a form that is yet to be determined.

Another possible alternative for use when no weather data are available is to use an empirical value for irrigation amounts. Because of its simplicity, this is the method most commonly used by small-scale vegetable growers. As a general guideline, vegetables receive daily irrigations of 1 hour when they are small (first third of the vegetative period) to 3 hours when they are large (during fruit development and close to harvest). When drip tapes with a flow rate of 0.25 gal/minute/emitter and 12-in emitter spacing (or 15 gal/hr/100ft), this schedule applies 15 gallons/100ft/day for small plants, and 45 gallons/100ft/day for large plants. Intermediate values are used during crop growth. Empirical values have the advantage of being simple. However, they often result in excessive irrigation early in the season, and insufficient ones later in the season. This method alone (without monitoring of soil water tension) is likely not be acceptable for the BMPs.

Principle 2. Irrigation amount should not exceed soil water holding capacity. Otherwise, water is wasted and mobile nutrients are leached.

How far water moves down the soil profile is a rather abstract concept because it is not visible. However, it is possible to visualize soil water movements by using colored dyes. The series of figures show the wetting pattern created by a single or double drip tapes with 24 gal/hour/100ft flow rate and a 12-in emitter spacing. **Figure 1** shows longitudinal profiles, and **Figure 2** and **Figure 3** show transverse profiles. A water soluble dye was injected with a dosatron using 1:69 dilution for the first 10 minutes, and 1:500 for the remaining 50 minutes.

Theoretical highest irrigation amounts can be simply calculated based on the soil physical properties. For a soil where the wetting width is 12 inches (6 inches each side of the drip tape), assuming a 0.75in/foot soil water holding capacity and allowing a 50% soil water depletion, theoretical largest water amounts that can be stored in the soil are 24 gal/100ft within the top 12 inches, 36 gal/100ft within the top 18 inches, and 48 gal/100 ft within the top 24 inches. These numbers can be used as guidelines. Actual amount that can be applied in one irrigation also depends on the rate of crop evapotranspiration, number of drip tapes, and soil type.

Principle 3. Rainfall little contributes to replenish soil moisture ... because of the plastic mulch.

Several IFAS fertilizer recommendations for bare ground production allow for additional N and K fertilizer after leaching rains. Leaching rains are defined as three inches of rain in three days, or four inches in seven days. Since the plastic mulch protects the bed from rainfall, there is no need in theory to apply additional fertilizer after a leaching rain. When the field gets partially flooded, however, some mobile nutrients may be leached out of the root zone or carried out of the field through surface run off. The need for additional fertilizer may be assessed after field drainage by monitoring sap tests levels of nitrate and potassium.

Another consequence of using the plastic mulch is that an irrigation may be still needed after a small rain. Soil water tension measurement (as explained bellow) can be used to assess the need for additional irrigation.

Principle 4. Monitor soil moisture level daily ... and discover how much water stress the crop is exposed to.

Soil moisture is typically reported in terms of soil water tension (SWT) or volumetric water content (VWC). SWT represents the suction force that is necessary to free soil water from the soil attraction. The higher the absolute value of SWT, the greater is the force needed. In some publications, SWT values are reported as negative values. The '-' sign is there to reflect the fact that the attraction is generated by the soil particles and therefore the plant has to spend energy to absorbe water. SWT may be expressed in atmospheres (atm), bar (b), or Pascals (Pa; the international unit). The conversion between units is 1 atm = 1.013 b = 1013 mb = 10^5 Pa. The recommended range for vegetable production is to maintain SWT between 6 to 8 cb (field capacity) and 15 cb. Vegetables may tolerate more extreme SWT (up to 25 cb) without yield reduction. However, sandy soils with SWT above 15 cb may be difficult to re-wet.

VWC represents the volume of water present in a volume of soil. The relationship between SWT and VWC is not linear, but is instead hyperbolic-like. When VWC is high (close to maximum soil water holding capacity), a relatively large change is VWC will result in a small change in SWT. However, when VWC is much less than maximum soil water holding capacity, a small change. Hence, the relationship between SWT and VWC (called water release curve) is typical for each soil type and is necessary to convert the recommendation in terms of tension into a recommendation expressed in terms of volumes.

Instruments used to routinely measure soil moisture either determine SWT (granular matrix sensor or GMS, and tensiometers) or VWC (time domain reflectometry probes or TDR, and electrical conductivity probes or EC probes). Tensiometers are based on the principle that changes in moisture in a porous cup in equilibrium with the soil can be expressed in changes in air pressure inside the cup. The advantages of tensiometers are their relatively low cost ($60 to $90 each, depending on the length of the access tube, and their accuracy. Their disadvantages include (1) they need to be serviced regularly, (2) they are easily breakable, and (3) the contact between the porous cup and the soil may be easily lost in sandy soils, thereby displaying an erroneous SWT reading. For the growers who have learned to use them, tensiometers are a useful tool. For most, they are a nightmare. Another tool available to measure SWT are the GMS. Their principle of operation is based on the fact that in saturated saline condition, electrical conductivity is a function of moisture. GMS are made of a capsule that contains a sand-like material (hence the name 'granular matrix') that embeds two concentric electrodes. The moisture in the granular matric is in equilibrium with that of the soil. GMS are relatively easy to install, cost $35 for a sensor and $350 for a reader, and do not require maintenance. GMS have been successfully tried and adopted by several vegetables growers in North Florida during an on-farm demonstration program. Tensiometers and GMS are usually installed in stations of 2 units, one reading SWT at a 6-in depth, and the other at a 12-in depth. Simultaneous readings at both depths allow proper management of water in the 0-12 in zone, which represents the area of the soil where most of the roots of most vegetable crops are located. Both types of sensors are buried for the entire season, preferably between two representative plants, and require a few hours to be in equilibrium with the soil. Hence, they are not easily movable throughout the field.

A relatively new series of instruments that measure VWC directly or indirectly is now available. The principle of TDR is that the soil dielectric constant depends on soil moisture. A basic TDR unit is comprised of rods, a detector and a display unit, and costs approximately $700. The detector emits a waive that travels along the rod and records the time needed for the waive to travel. Hence, a TDR probe reveals a VWC value that is integrated along the length of the probe. Common probe length are 4, 8 and 12 inches. Because of the nature of the TDR measurement, as soon as the probe in placed into the soil, it is ready to operate. Hence, TDR units are portable, and may be placed anywhere, instantaneously. The advantages of TDR are that the measurement is fast and non destructible, units may be hard-wired to a data logger.

Principle 5. Keep irrigation records daily.

Vegetable growers are required to keep pesticide records. Fertilization records are usually kept in relation to soil testing and implementing the recommendations. However, often times vegetable growers do not document their irrigation practices. For example, a useful daily log should contain soil moisture measurements (SWT or VWC) at selected depths, rainfall and an estimate of weather demand for water (H-ETo, RT-ETo, A-ETo, class A pan), and irrigation amount (gallons/field or duration of irrigation). Most growers who are already keeping irrigation records find them to be a useful management tool.

Conclusions

The environmental impact of vegetable production is not due only to nutrient management. While elements such as nitrogen and phosphorus are regarded as the ‘pollutants’, their fate and movement below the root zone is conditioned by water movements. Hence, nutrient management cannot be accomplished successfully without adequate irrigation management. While the BMP and TMDL process is still in its beginning, the goal is to reduce environmental impact, and not to restrict production. Vegetables growers having a BMP plan and documenting that they follow it will be granted presumption of compliance with the TMDL.

It is increasingly important for vegetable growers to adequately manage irrigation. Currently, the BMPs for vegetables are being defined, and the process is not completed. However, it is likely that in a form or another, these principles (using real-time or empirical water use estimate to determine target volume; adopting and following specific guidelines on how/when to split irrigation; adjust irrigation practices for plasticulture; routinely monitoring soil moisture status, and keeping daily records of irrigation practices) will be included part of the BMPs.

(Eric Simonne, Mike Dukes, Bob Hochmuth, David Studstill and Wayne Davis - Vegetarian 02-02)

Pending Herbicide Labels for Florida

There are a number of new herbicide labels that will be coming this spring in Florida. This article is intended to make you aware of these potential labels so that when they come out they can be used immediately.

Sandea: A state label (24c) is in place at the present time for the use of Sandea (halosulfuron) on cucumbers. Sandea is excellent on the control of emerged nutsedges. It will also control small emerged smooth and spiney amaranth. Recently, we have seen that it will not control emerged livid amaranth in southwest Florida.

A section 18 label is being requested for the use of Sandea in tomato. FFVA is requesting this use. Tomatoes are very tolerant, both pretransplant and POST over-the-top. A tolerance for halosulfuron is pending this quarter at EPA. Do not apply Sandea to over-the-top of pepper. Pepper is very sensitive to POST applications.

EPA has just approved a tolerance for a halosulfuron on muskmelon and watermelon. Growan will be discussing their intentions for labels on these two crops at the WSSA meetings on Feb 11. I should know more at that time.

Aim: Aim (carfentrazone) is labeled for burn down of broadleaf weeds and morning glories in sweet corn in Florida. Residue studies have been carried out through the IR-4 program in tomato and pepper row middles. Aim will control paraquat resistant nightshade among other weeds in the row middles. FMC and FFVA are seeking section 18 label for this use in tomato, pepper and eggplant row middles. The application will be as a directed-shielded application, the same as paraquat is at the present.

Matrix: Matrix (rimsulfuron) is labeled in Florida on potatoes. For a short period of time, rimsulfuron was labeled in Florida under the trade name Shadeout. DuPont pulled all Shadeout labels on fresh market tomatoes, and it is only labeled on processing tomatoes at the present time.

TPR, Inc. has come to an agreement with DuPont and is now in the process of submitting a 24c third-party-registration for Matrix on tomatoes in Florida. Matrix is safe, both PRE and POST on tomatoes, and will control a large number of broadleaf weeds. Again, peppers are not tolerant to POST applications.

Curbit: UAP has informed me that they are going to quit selling Curbit (ethalfluralin). They have, however, received a registration for Stratogy, a premix combination of ethalfluralin + clomozone. The label of Stratogy will be the same as the Curbit label. The product should be safer, however, than Curbit. In my trials, the product has been safer and has a larger control range than Curbit. Again, it should not be used for transplanted melons nor used under mulch.

(Stall - Vegetarian 02-02)

Vegetable Gardening

New Big Vegetable Record - Mustard Greens

A new Florida state record was set in West Palm Beach at the South Florida Fair on January 23, 2002. The grower who brought the giant cooking green to the scales at the fair was Dorothy Fritz, who grew it in her garden.

She planted Florida Broadleaf seeds (obtained from Burpee Seed Co.) on August 1, 2001 and cut the plant at its base on January 18, 2002. It weighed in at 15 pounds and 3 ounces, breaking the old record of 11pounds 13 ounces by over 3 pounds (latter was set by Mr. Thomas in Union County in 1995).

This particular event at the South Florida Fair in West Palm Beach was conducted by County agent Gene Joyner and Vegetable Specialist (R) Jim Stephens. We had almost sixty entries vying for the ample prize money put up by the Fair. Prizes were:

Adult
1st - $200   4th - $75
2nd -$150   5th - $50
3rd - $100   6th - $25
Youth (same amounts)

I accept new state records at any time. However, there is no prize money except at this fair each January. We do send a certificate to anyone who sets a new record (vegetables only).

(Stephens - Vegetarian 02-02)

Floating Hydroponic Gardens - Program Update

The purpose of this article is to provide information to help Extension Agents as they serve their clientele with this very popular program – Hydroponic Floating Gardens.

Educational programs and demonstrations using low-tech non-circulating floating hydroponic gardens have been conducted throughout IFAS Extension District II in the past few years. A floating hydroponic garden is easy to build and inexpensive. It has been a very popular demonstration method for youth and adults, including many Master Gardeners. A fact sheet and IFAS video on building floating gardens were both developed in 2000 to support the educational efforts in the counties. The video was provided to each county extension office, but became so popular (especially among Master Gardeners) it was produced and moved into the "For Sale" category in IFAS. Educational information on the topic was also made available on the North Florida Research and Education Center - Suwannee Valley website, http://nfrec-sv.ifas.ufl.edu/float_system.htm. These materials provide a strong set of educational resources for reaching the educational objectives of providing outreach in a wide variety of county extension programs, including:

- Youth
- Home horticulture
- Commercial small farms

Agents and clientele are invited to attend the May 9, 2002 Twilight Field Day at the North Florida REC – Suwannee Valley. As part of the program, demonstrations on floating gardens, as well as other hydroponic systems, will be featured. Over 650 individuals have benefited by these hands-on tours in the past. We hope to broaden this to include many more. Keep watch on the website (http://nfrec-sv.ifas.ufl.edu) for full details and registration information.

Resources are summarized below for your convenience.

- North Florida REC – Suwannee Valley website http://nfrec-sv.ifas.ufl.edu

- Building a Floating Hydroponic Garden publication http://nfrec-sv.ifas.ufl.edu/float_system.htm

- Building a Floating Hydroponic Garden video ("For Sale" Publication) http://ifasbooks.ufl.edu/merchant2/merchant.mv?Screen=PROD&Store_Code=IFASBOOKS&Product_Code=SV+295&Category_Code=FVVS

(Jacque Breman, Mike Sweat, Bob Hochmuth, Laurie Osborne - Vegetarian 02-02)

Extension Vegetable Crops Specialists

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Donald N. Maynard Professor, varieties	**Charles S. Vavrina** Professor, transplants
Stephen M. Olson Professor, small farms	**James M. White** (retired) Associate Professor, organic farming

Related Links:

University of Florida
Institute of Food and Agricultural Sciences
Horticultural Sciences Department
Florida Cooperative Extension Service
North Florida Research and Education Center - Suwannee Valley

This page is maintained by Susie Futch.... if you have any questions or comments, contact me at zsf@mail.ifas.ufl.edu.