The Washington Irrigator Newsletter

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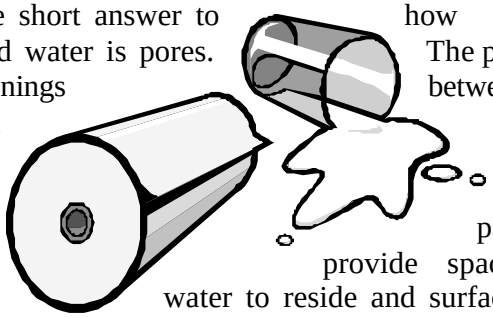
HOW SOILS HOLD WATER,
A HOME EXPERIMENT

The short answer to how soils hold water is pores. The pores or openings between the soil



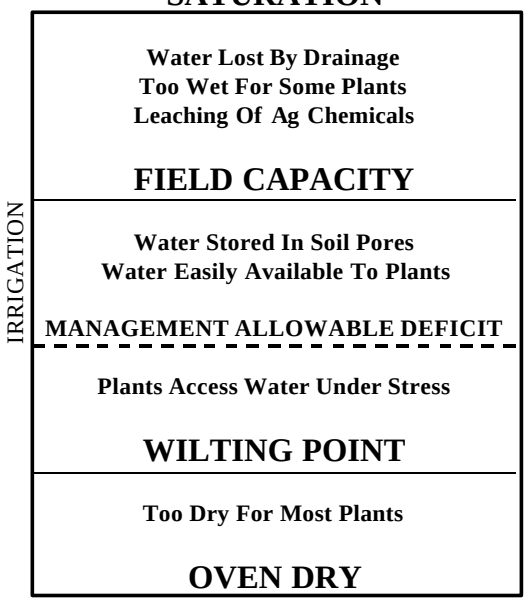
particles provide space for water to reside and surface area on which water can adhere. The scientific community has expended considerable time, money and energy to understand and quantify the properties of the material called soil. However, it is possible to run a simple home-based experiment to better understand how a porous media behaves in the presence of water. Yes this is safe for children to try at home.

The porous media to be studied is the common but extraordinary paper towel. The required apparatus is one dry paper towel and a bowl containing water. First, submerge the paper towel in the bowl of water. *Participants should agree that all pores are now filled with water.* In the same way, a soil can have all it's pore space filled with water, a status known as saturation. Saturation is good for forming wetlands, but most agricultural crops will not grow in a soil devoid of air, and tractor performance is less than desirable in this soupy condition.

Next in the experiment, remove the paper towel and hold it above the bowl for three minutes. *Participants will observe water draining out of the pores and should agree that drainage will stop before all of the moisture is removed from the paper towel*. Similarly, the larger pores in a saturated soil will drain progressively until only the smaller pores are able to hold their water against the force of gravity, a status known as field capacity. All soils will drain to field capacity unless a restrictive layer prevents the downward movement of water. One goal of irrigated agriculture is to keep soil moisture at or below field capacity. If soil water is increased above field capacity, water will percolate through a crop's root zone and leach agricultural fertilizer and chemicals toward groundwater.

After the paper towel has finished draining, proceed to squeeze the paper towel firmly and then squeeze a second time with all your might.

SOIL MOISTURE CONTINUAM



Participants should note that at first a lot of water is released with little effort, then little water is released with a lot of effort and finally, there is water remaining in the paper towel that can not be squeezed out.

In a similar way, plant roots exert their own tension to remove water from soil pores. Plants can extract water from soil until the remaining soil water is held too tightly by the smallest pores and as a surface film on soil particles, a status known as permanent wilting point. The range from field capacity to wilting point is known as available water or the soil water holding capacity. Even though water is available to plants as soil moisture decreases to wilting point, the goal of irrigated agriculture is usually not to stress the plant to death. For each crop, a management allowable deficit (MAD) has been established as the percentage of available water that can be removed without unduly stressing the crop. Proper irrigation scheduling should keep soil moisture between field capacity and the MAD, a fairly small portion of the soil water continuum

As a final note, marketing would have us believe that some paper towels will absorb more moisture than others. This is definitely true of soils. A loamy sand will hold around 1 inch of water per foot of soil while a silt loam will hold over 2 inches per foot. If potatoes with a 1.5-foot root zone and a MAD of 35% are grown on loamy sand, the effective storage of soil water will only be around 0.5 inches. In contrast, alfalfa (4 foot root zone and 65% MAD) grown in silt loam could effectively store over 5 inches of water. The combination of soils and crops can significantly effect the soil water reservoir and the frequency of irrigation.

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Scientific Irrigation Scheduling is supported by The Northwest Energy Efficiency Alliance

For soils information: *County Soil Surveys and the State of Washington Irrigation Guide have been published by the National Resource Conservation Service. Also some general soil information from PNW 475, Soil Water Monitoring and Measurement is available from the internet at* **http://caheinfo.wsu.edu**.

CHEMIGATION AND FERTIGATION, FREQUENTLY ASKED QUESTIONS

Q: ***Can an unlicensed person monitor a chemigation application or perform an emergency shutdown of an irrigation system during a chemigation/fertigation operation?***

A: No. Only licensed applicators may be involved in calibrating, loading, starting up, monitoring, or shutting down a chemigation system. Anyone under the direct supervision of a certified applicator may shut down a system if necessary. An unlicensed person may monitor a chemigation operation under the direct supervision of an appropriately licensed applicator. Commercial Consultants are not properly licensed to carry out the supervisory functions of the chemigation operation. Fertigation applications do not require a pesticide license.

Q: ***What pesticides can be applied to land or to plants through an irrigation system?***

A: A product must state on the label whether or not it can be applied through an irrigation system. The label must also contain information about the approved irrigation systems such as center pivot, linear move, and wheel line systems. In addition, it must list required backflow safety devices, pesticide and water application rates, personal protection equipment, re-entry restriction intervals, environmental hazards or site limitations, and posting requirements. Agricultural adjuvants are considered a pesticide in Washington State, however they are not subject to chemigation laws.

Q: ***Is field posting required for either a chemigation or fertigation operation?***

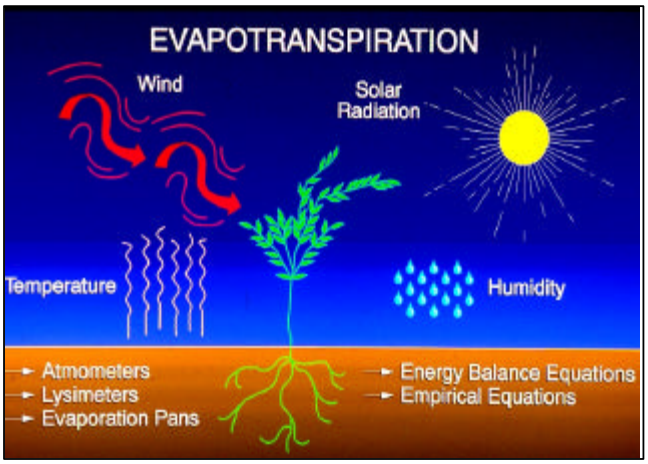
A: Refer to the label for posting requirements. Posting requirements exist for areas being chemigated with "Category I" pesticides. These pesticides are noted by the signal words "DANGER" or "DANGER – POISON" accompanied by the skull and crossbones symbol. Posting requirements for other pesticides vary. Some pesticides do not require posting while others list several requirements. The Worker Protection Standard requirements are also found on the label. Applicators may be required to notify workers

(continued on page 5)

HOW MUCH WATER IS YOUR CROP USING?

Crop water use measurements can be used to make irrigation decisions. An ideal soil moisture environment for your crop is maintained by replacing the amount of water your crop uses at a time interval that does not exceed your soil's ability to store water. This irrigation scheduling concept is simple, but the method of obtaining crop water use measurements is not.

The best method to determine crop water use is with lysimeters, large soil boxes with a crop growing inside that can be accurately weighed for differences in water use. Of course, this is not practical on-farm and is difficult for research stations. The accepted alternative is weather data. A strong correlation has been made between water loss from lysimeters (plant transpiration and soil surface evaporation) and weather data. The factors most effecting evapotranspiration (ET) are



solar radiation, temperature, humidity, and wind. In this sense plants correlate well to our human experience, we find that everything from our hair to a paint job dries or losses moisture faster on a sunny, hot, dry, and windy day. Finally, this potential or reference ET (Etr) derived from weather data is multiplied by a crop coefficient (Kc) that adjusts for the crop type and stage of development to determine the actual crop ET (Eta) or crop water use. ETa = ETr x Kc.

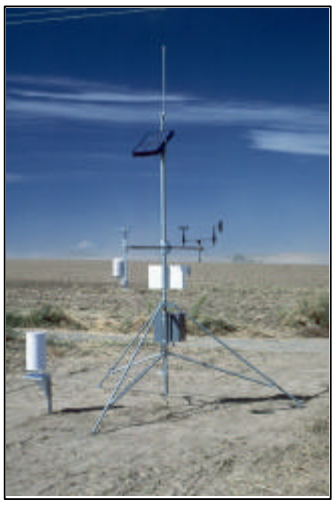
As shown in the table, a timely report on crop water use can aid irrigation decisions. For example, your wheel line applies 3.0 inches in a 12 hour set and the last time you started an irrigation to refill the soil profile was on June 11th. Since the accumulated ET of 2.0 inches on June 17th is less than the 3.0 inch application, you should wait three more days to irrigate, or as another example, your center pivot can apply 0.35 inches in 24 hours. Since the average daily ET is 0.29 inches from June 11th to 17th, you should

CROP WATER USE REPORT

Date	Daily Eta	Accum. ETa
m/d/y	Inches	Inches
6/11/99	0.22	0.22
6/12/99	0.29	0.51
6/13/99	0.27	0.78
6/14/99	0.33	1.11
6/15/99	0.32	1.43
6/16/99	0.30	1.73
6/17/99	0.28	2.01
Average	0.29	

have operated the pivot 139 hours during the week to maintain your present soil moisture (0.29/0.35 = 139/168). The 139 hours of operation is equivalent to five 28-hour revolutions or some other combination of 139 hours.

Washington Public Agricultural Weather System (PAWS) provides historic and "real-time" estimate of crop water use for 59 locations and 25 crops. The **PAWS WEB SITE** can be accessed from the internet at http://frost.prosser.wsu.edu. This site also accesses weather data, frost information, and crop pest/disease models. A PAWS subscription (user id and password) can be obtained by contacting Mary Hattendorf or Todd Elliott telephone, (509) 786-9219 or (509) 786-9367 and by email, wsupaws@perfection.prosser.wsu.edu.



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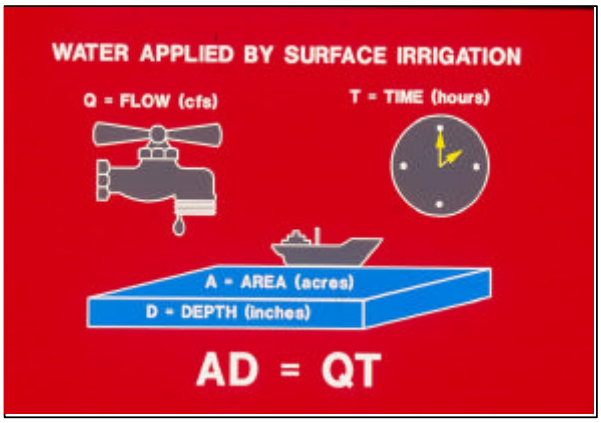
WHAT IS YOUR IRRIGATION SYSTEM'S APPLICATION RATE?

Scientific irrigation scheduling requires calculating the water application rate of your irrigation system. We tend to think of irrigation systems applying water at a specific flow rate such as gallons per minute (gpm) but an application rate in inches per hour is important when scheduling irrigation because crop water use and soil moisture information is reported in inches of water. Fortunately, irrigation system flow rates are easily converted to application rates through the relationship AD = QT.

This relationship can be visualized as a constant flow (Q) from a faucet running into a container that has a constant area (A) in the horizontal



plane. If the faucet is turned on for a specified time (T), the result will be a known depth of water (D) in the container. The same is true of irrigation systems. For example, in rill irrigation, one cubic foot per second of water (Q) set on one acre (A) for one hour (T) will result in a one inch gross application (D). Of course, rill irrigation is not perfectly uniform and water is lost due to evaporation, run-off and deep percolation. Therefore, a net application is calculated by multiplication of an efficiency factor (rill irrigation is 35% to 60%).

The form of the AD = QT equation will change for every type of irrigation system. (See table below.)

The application rate equations do not have to be calculated by hand. Computer software, printed tables and slide rule calculators are available to perform the math necessary for irrigation scheduling. The Washington Irrigation Scheduling Expert (WISE) Software and Tables integrate your irrigation system's application rate with crop water use and soil moisture estimates to determine when and how much to irrigate.

WISE SOFTWARE can be downloaded from the WISE web page at http://wise.prosser.wsu.edu (caution still an alpha version as of June 1999) and WISE TABLES will be available in the near future to be printed or down loaded from the Scientific Irrigation Scheduling web site at http://sis.prosser.wsu.edu. Also, the Fact Sheet EB1305, Sprinkler Irrigation – Application Rates and Depths can be ordered or downloaded from http://caheinfo.wsu.edu.

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Application Rates of Irrigation Systems

Set Sprinklers AR = (96.3 x Qn) / (Ss x Sl) where, AR = gross application rate in inches/hour, Qn = nozzle flow rate in gallons per minute Ss = sprinkler spacing in feet Sl = lateral spacing in feet 60 to 80% efficiency	Drip Emitters AR = (1.6 x Qe) / (Se x Sl) where, AR = gross application rate in inches/hour, Qe = emitter flow rate in gallons per hour Se = emitter spacing in feet Sl = lateral spacing in feet 80 to 95% efficiency
Center Pivot Sprinklers AR = (96.3 x Qc) / (Ac x 43,560) where, AR = gross application rate in inches/hour, Qc = flow for entire system or per acre in gpm Ac = area for entire system in acres or one acre 60 to 85% efficiency	Drip Tubing AR = (0.963 x Qt) / St where, AR = gross application rate in inches/hour, Qt = tubing flow rate in gpm/100 feet St = tubing spacing in feet 80 to 95% efficiency

EITHER orally OR by the posting of entrances to treated areas, OR both. If required, postings must occur within 24 hours of the start of application, and be removed within 72 hours of the end of the re-entry restriction interval. Fertigation operations do not require field postings in Washington State.

Q: Must application records be completed and retained for a chemigation or fertigation operation?

A: Yes. Certified applicators are required to record information about the chemigation operation. No distinction is made between general use and restricted use pesticides in a chemigation operation. Therefore, a pesticide application record must be completed each and every time that a pesticide is applied through an irrigation system. While application records for a fertigation operation are not required, it is a good management practice to keep records tracking plant nutrient applications.

Q: ***How often should the chemigation injection and backflow prevention system be inspected?***

A: Performance and integrity of a chemigation/fertigation system should be determined BEFORE each application. This includes backflow prevention devices and injection apparatus. The chemigation or fertigation operation should also be routinely monitored and the injection system periodically recalibrated during the application.

Q: ***What should I do in the event of a suspected backflow into an irrigation water source?***

A: First, secure the area to prevent human exposure. Then call the Department of Emergency Management at 1-800-258-5990. Then call the Department of Ecology's Regional Spill Response Team 24-hour number for your area:

Eastern: (509) 456-2926
Central: (509) 575-2490
Northwestern: (425) 649-7000
Southwestern: (360) 407-6300

You may also call the WSDA Chemigation and Fertigation Technical Assistance Program at (509) 766-2574. The product supplier may be able to provide assistance in containment of a spill.

Q: ***What requirements exist for field-placed tanks or containers that store agricultural chemicals used in chemigation or fertigation operations?***

A: Field-placed tanks or containers used in a *chemigation* operation must:

- Have the complete pesticide label affixed to the tank,
- Display the tank's maximum net capacity on the affixed label, and
- Display the dealer's EPA establishment number on the pesticide label or on the storage tank.

Although not required, similar precautions should be exercised for a *fertigation* operation. A container should have structural integrity and the capacity displayed. The date and amount of product placed into the tank should also be listed. It is recommended that the name and telephone number of a contact person be placed on a tank in the event of a spill or equipment malfunction.

Q: ***Do only mainline chemigation valves qualify as backflow prevention devices?***

A: No. A mainline chemigation valve apparatus is not required as long as an adequate check valve, inspection port, low pressure drain, and vacuum relief valve are properly installed. It may be possible to retrofit an existing irrigation system with the appropriate backflow safety devices. However, the components must be suitable for the size of the system, properly located and installed on the system, and adequately maintained. The check valve must be "automatic and quick-closing" and capable of a watertight seal. A wafer valve will comply with federal and state requirements if the valve is operating properly, maintained, and installed in conjunction with the other backflow safety devices.

For more information:

Contact the WSDA Chemigation and Fertigation Technical Assistance Program at (509) 766-2574, or write: Tom Hoffmann or Byron Fitch at WSDA Pesticide Management, P.O. Box 2269, Moses Lake, WA 98837.

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