Drip Irrigation Basics for Optimal Hop Production

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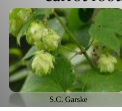
Why Irrigate?

- Irrigation improves crop yield and quality
  - Reduced moisture stress leads to more dry matter production
    - Increased size and/or number of tubers, roots, pods, fruit, or cones
  - Adequate moisture supply produces higher quality
    - Uniform crop maturity, well filled bean and pea pods, full corn ears, and reduction of misshapen potato tubers and carrot roots.



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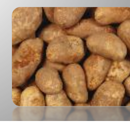


Minimize crop damage

- Fluctuations can lead to fruit cracking, blossom end rot, and fruit deformities

Minimize crop damage

Minimize crop damage

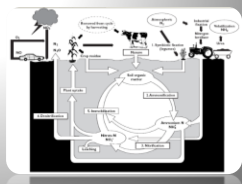
- Excess water increases potential for disease development on fruit and vegetation

Why is irrigation management so important?

- Good irrigation management often plays a role in disease management
- Managing soil moisture at harvest is critical
  - Helps control shatter, impact and black spot bruises
  - Reduces storage problems from tuber decay
- Maintaining proper soil moisture is important from planting through harvest

Why is irrigation management so important?

- Water quality issues
  - Control nutrient and pesticide leaching into the groundwater.
    - An inch of extra water can remove 10 to 30 lbs of nitrogen as it moves from the root zone.
- Energy savings



Soil Water Basics: Bucket Analogy

- Soil is reservoir for moisture
- bucket of water from which crop can drink --BUT
  - bucket can only hold so much
  - straw only reaches part way to bottom

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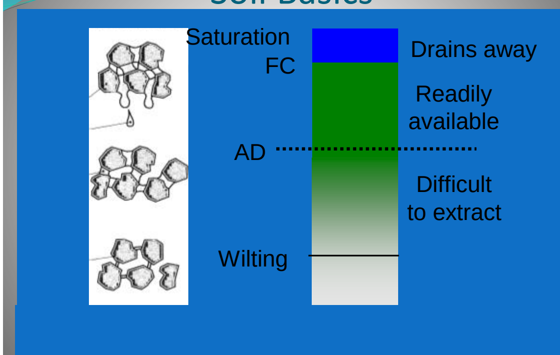
Soil Basics



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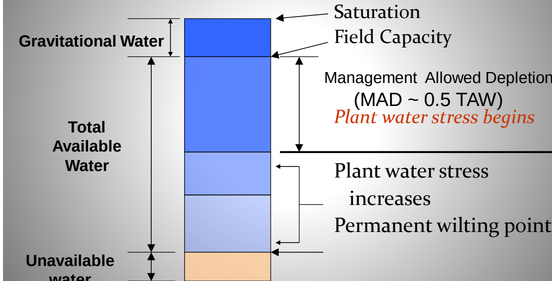
Soil Moisture Primer



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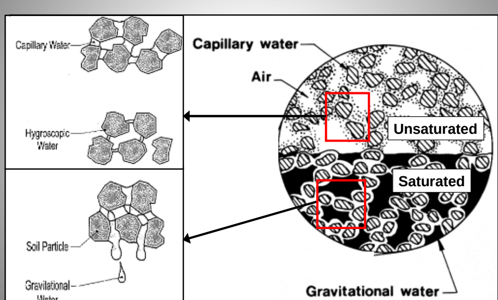
Water in the Soil Profile



Source: Sprinkler Irrigation Systems, Midwest Plan Service, MWPS – 30, 1999

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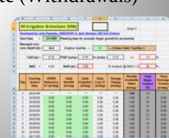
Irrigation Scheduling Tools:

how much and how often?

- Balance water use with supply
- Check book method
  - Allowable depletion level
  - Rainfall and irrigation (deposits)
  - Daily evapotranspiration estimate (Withdrawals)
  - ET adjustment for canopy cover
  - AD (balance)



Allowable Depletion Level

	Allowable Depletion Level (inches)			
		Rooting depth		
Soil texture	per 12"	12"	18"	24"
Sand, loamy sand	0.7	0.7	1.1	1.4
Sandy loam	0.9	0.9	1.3	1.8
Clay, Silty Clay, Sandy Clay Loam,	1.3	1.3	1.8	2.5
Silt Loam, Loam, Silty Clay Loam, Clay Loam	1.5	1.5	2.3	3.0

Crop Rooting Depths

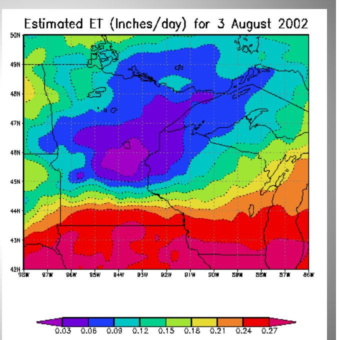
	Rooting depth(inches)	
	Sand	Silt Loam
Corn	24"	36"
Tomato	12"	24"
Pepper	12"	24"
Cucumber, Melon	12"	24"
Pumpkin/squash	24"	48"
Potato	12"	30"
Peas, Beans	12"	24"
Greens	12"	12"
Cole Crops	12"	24"
Hops	**36-48"**	--

Daily ET Estimation

Potential for creation of ET map by satellite

Daily "ET-by-email" service in WI

www.soils.wisc.edu/wimnext/et



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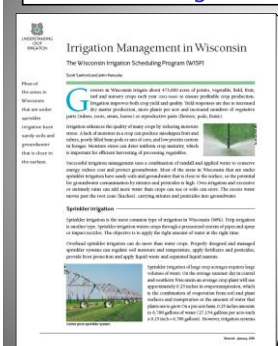
New UWEX Irrigation Publications



LOW PRESSURE CENTER PIVOT: Average nozzle pressure 20 psi, nozzle diameter 9/32 inch			
Air Temperature	% Relative Humidity	Wind Speed (mph)	% Evaporation Loss
70 F	70%	7 mph	1.5 %
70 F	30%	7 mph	2 %
90 F	70%	7 mph	1.8 %
70 F	70%	15 mph	2.2 %
90 F	30%	15 mph	4.5 %
STANDARD PRESSURE CENTER PIVOT: Average nozzle pressure 55 psi, nozzle diameter 7/32 inch			
Air Temperature	% Relative Humidity	Wind Speed (mph)	% Evaporation Loss
70 F	70%	7 mph	4.7 %
70 F	30%	7 mph	6.1 %
90 F	70%	7 mph	5.5 %
70 F	70%	15 mph	7.5 %
90 F	30%	15 mph	16 %

Coming soon to:

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Measuring Soil Moisture

Drought Sensitivity:
Available water to plants is more crucial at certain stages of development

- Stand establishment
  - Inadequate soil moisture can lead to transplant stress or death
- Vegetative growth
  - Leaf and stem growth are affected first

Drought Sensitivity:
Available water to plants is more crucial at certain stages of development

- Initiation of flower buds
  - Drought stress can lead to flower abortion
  - Delay maturation and cause crop losses
- Root and Fruit Sizing
- Drier soils beneficial after fruit formation in some crops
  - Influences flavor

Drip or Micro-Irrigation Methods

- Improved crop quality and water use efficiency
  - May require less than half the water needed for sprinkler irrigation
  - Plants can be supplied with more precise amounts of water
  - Soil erosion and nutrient leaching can be reduced
- Minimizes water contact with the crop canopy
  - Prevents disease development on vegetation and fruit
  - Targets water to the crop, but limits water to weeds

Soaker Hose

- Perforated hose or woven fabric.
- “Sweat" water from tiny holes along the length of the hose.
- Hoses can be set on the ground or buried under mulch.

Soaker Hose

Drip Irrigation for Vegetables

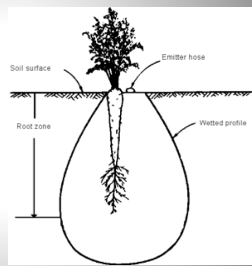
Drip irrigation extends watering times for plants, and prevents soil erosion and nutrient runoff.

Fertilizer can be added and used more efficiently.

Drip irrigation systems use 30 - 50% less water.

Drip Irrigation for Vegetables

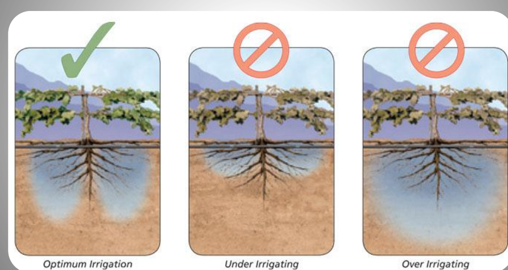
- Provides each plant with near-optimal soil moisture.
- Increases yield and decreases both water requirements and labor.
- Can be automated easily.



Wetting Pattern

- Emitter spacing from 4 to 18 inches
- Typical spacing for vegetables 12 inches

Optimum Irrigation



Water Application Figures

- One inch of water per week.
- It takes 27,000 gallons of water to equal one inch application per acre.
- One inch over 100 square feet equals 60 gallons (. 6 gallons/ Sq. Ft.).
- Increase to 1.5 inch application weekly for sands (two separate applications).

Estimating Square Footage to meet Plant Water Needs.

- Lawns - calculate sq. ft. to be watered
- Trees and shrubs – calculate square footage to drip-line
- <u>Vegetables</u> - calculate 2 sq. ft. per linear foot of row

Calculating How Much?

- Delivery rate
  - Typically specified in gallons per minute per 100 feet of tape
  - 0.2 to 1.0 gpm/100 ft
  - Vegetables 0.5 gpm often used
    - Maturing vegetables require about 2-3 hours of irrigation during hot summer days

Calculating How Long:
To Apply 0.5" of Water

- Delivery rate
  - Vegetables 0.5 gpm/100 ft
- 100 ft row x 2 ft wide = 200 sq ft
- 60 gal for 1" of water on 100 sq ft
  - 0.5" = 30 gal/100 sq ft
- Need 60 gal for 200 sq ft
  - Or 60 gallons/100 ft of row
- 60 gal ÷ 0.5 gpm = 120 minutes (2 hours)

How many acres in 24 hours?

- 30 gpm capacity well
- 0.5 gpm/100 ft drip tape
  - Capacity for 6000 linear feet

- Maximum drip line length to maintain uniformity is 400 to 600 ft.
  - 15 lines 400 feet long
  - 4' row spacing
  - 0.55 acres (15 x 400 x 4 = 24,000/43,560 = 0.55)
  - 2 hours run time per ½ inch of water
  - 0.55 x 12 hours = <u>6.6 acres in 24 hours</u>

Fertigation

Table 2. Soil test and fertilizer recommendations for mineral soils for tomato on 6-foot centers.[1]

		P_2O_5					K_2O				
		VL	L	M	H	VH	VL	L	M	H	VH
Target pH	N lb/A	(lb/A/crop season)									
6.5	200	150	120	100	0	0	225	150	100	0	0

[1] See Chapter 2 section on supplemental fertilizer application and best management practices, pg 11.

Table 3. Fertilization recommendations for tomato grown in Florida on sandy soils testing very low in Mehlich-1 potassium (K_2O)

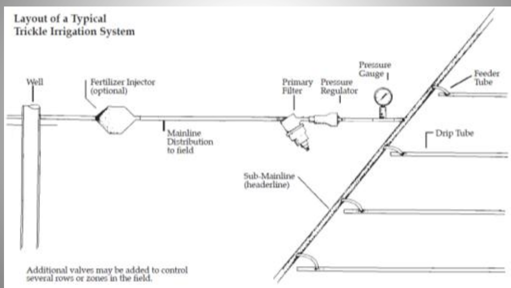
		Recommended-Base fertilization							Recommended-Supplemental fertilization		
				Injected (lbs/A/day) Weeks after transplanting							
Production system	Nutrient	Total (lbs/A)	Preplant (lbs/A)	1-2	3-4	5-11	11	13	Leaching rain	Measured "low" plant nutrient content	Extended harvest season
Drip irrigation, raised beds, and polyethylene mulch (on deep sands or on soils with shallow impermeable layer)	N	200	0-70	1.5	2.0	2.5	2.0	1.5	n/a	1.5 to 2lbs/A/day for 7 days	1.5 to 2 lbs/A/day
	K_2O	220	0-70	2.5	2.0	3.0	2.0	1.5	n/a	1.5 to 2 lbs/A/day for 7 days	1.5 to 2 lbs/A/day

University of Florida Vegetable Production Handbook 2012
http://edis.ifas.ufl.edu/topic_vph

Drip tape

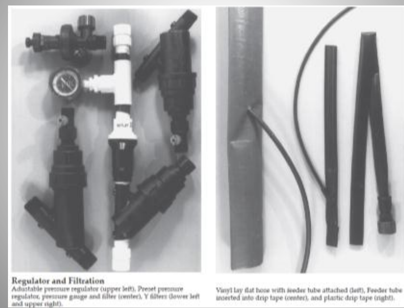
- Wall thickness
  - 4 to 25 mil
    - 10 to 15 inexperienced
    - 6 to 8 experienced
- Type
  - Turbulent flow
  - Internal emitters
  - Pressure compensating emitters

Major Components of Drip



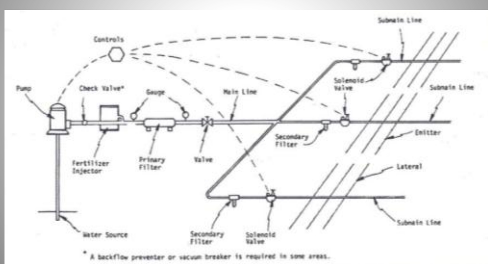
Drip Irrigation for Vegetables, Marr and Rogers 1993

Major Components of Drip



Drip Irrigation for Vegetables, Marr and Rogers 1993

Basic Layout for a Drip System



Drip Irrigation, McConnell and Czemerda 2003

Irrigation Zones

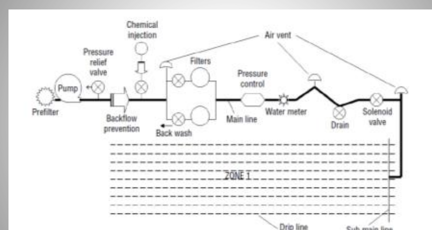


Figure 1. Drip irrigation system with a prefilter, pump station with backflow prevention, and chemical injection site. The chemical injection site can be before or after the main filter station. A pressure control valve is recommended to adjust the water pressure as desired before it enters the drip lines. A water meter can be placed after the pressure control or between a solenoid valve and each zone. An air vent provides vacuum relief. Vacuum relief is necessary between the solenoid valve and the drip tapes to avoid suction of soil into the emitters when the system is shut off.

Drip Irrigation: An Introduction, Shock 2006

System Maintenance

- Daily inspection of filters
- Back flushing of sand filters
- Leaking of drip tubes
- Prevent mineral precipitation by dissolving with phosphoric acid
- Clean bacteria, and algae with 2 ppm chlorine regular maintenance rinses or 30 ppm target treatments to clean slime clogged lines
- Irrigation water acidification with phosphoric, sulfuric, hydrochloric or other acids may be necessary to reduce mineral precipitation.

Questions and Discussion

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