Irrigation Considerations

Corn/Soybean, Fruits, Vegetables

Larry C. Brown
Professor
Extension Agricultural Engineer

The Ohio State University

brown.59@osu.edu
614-292-3826

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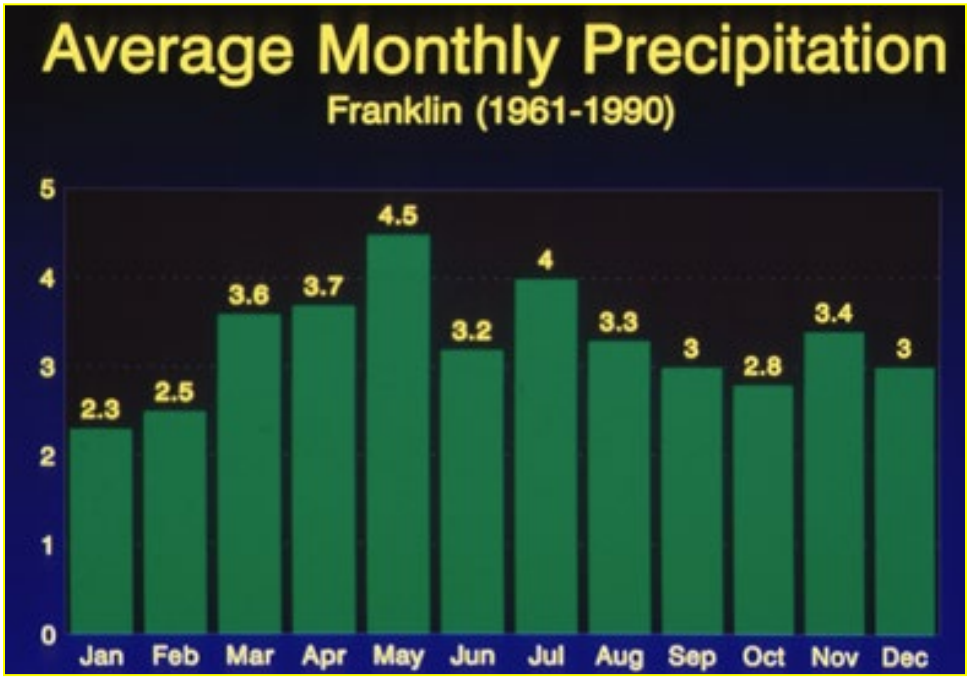
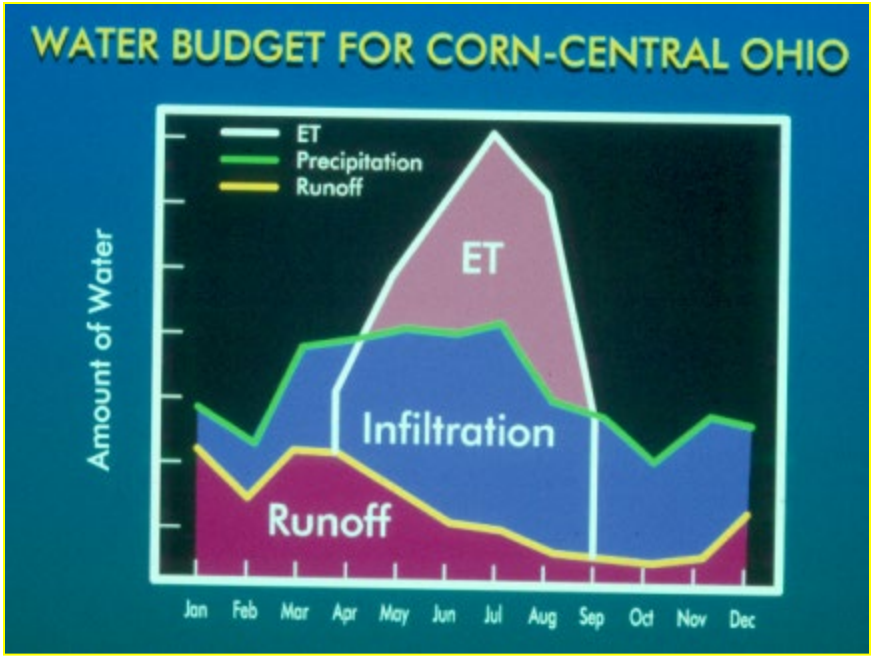
Goal of Irrigation

To provide an optimal soil / water environment for plant growth

Supplemental Water for Crop Growth

Is supplemental water supply adequate and available ??





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Irrigation
Basic Considerations

- Water Supply
- Soil / Geology
- Site / Topography
- Crop Water Requirement
- Labor
- Management
- System Design
- Economics

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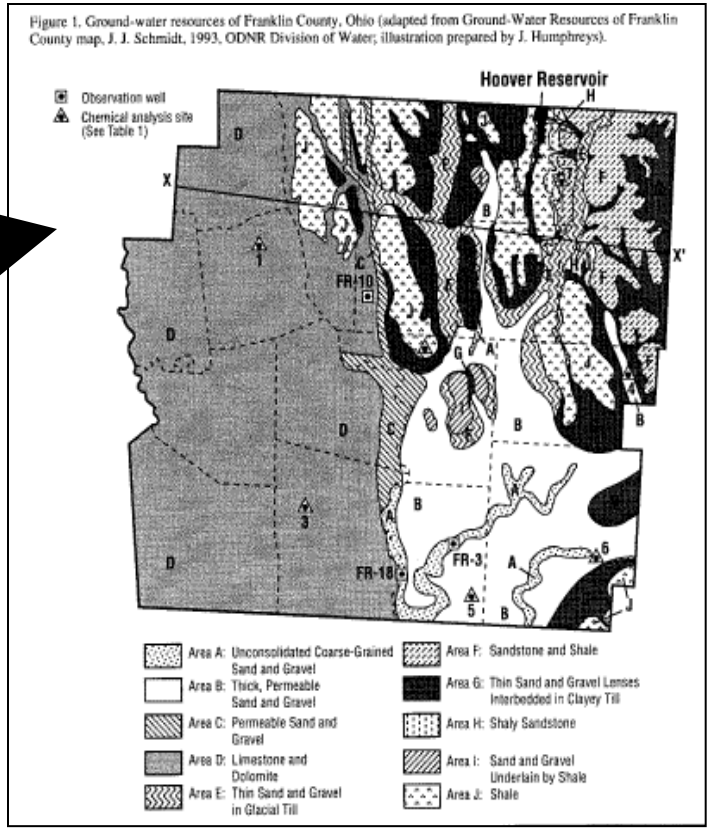
Water Supply Source

- Ground Water
- Surface Water

- Water Harvesting



Water Supply

1 inch of "effective" irrigation on 1 acre requires 30,000 to 37,000 gallons

Water Supply Pond or Reservoir

- Reliability
- Storage
- Design

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Fulton County WRSIS Site, Shininger Farm – August 1996

- Soil predominantly Nappanee loam
- 1 - 8.1 ha (20 ac) subirrigated field. Drain spacing is 4.6 m (15 ft)
- One 8.1 ha (20 acre) field with conventional subsurface drainage. Drain spacing is 13.7 m (45 ft)
- Wetland: 0.57 ha (1.4 ac) area and 3,790 m^3 (1.0 million gal) capacity
- Reservoir: 0.64 ha (1.57 ac) area and 8,706 m^3 (2.3 million gal) capacity
- Stream provides additional water supply

Ohio WRSIS

Photo Courtesy of USDA-NRCS-MVRC&D

Pressure and Elevation Relationship

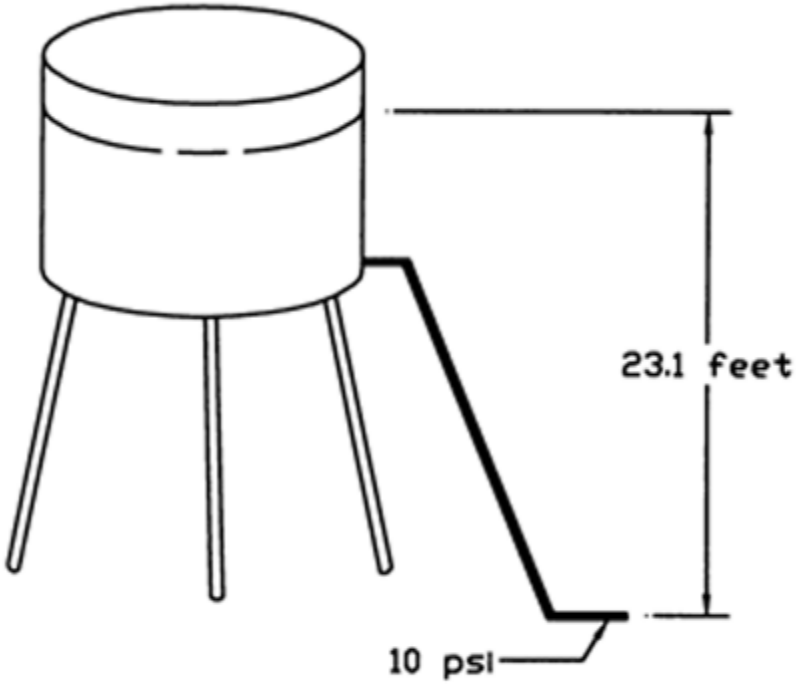

Figure 2.1. Water tank used for storage and pressure.

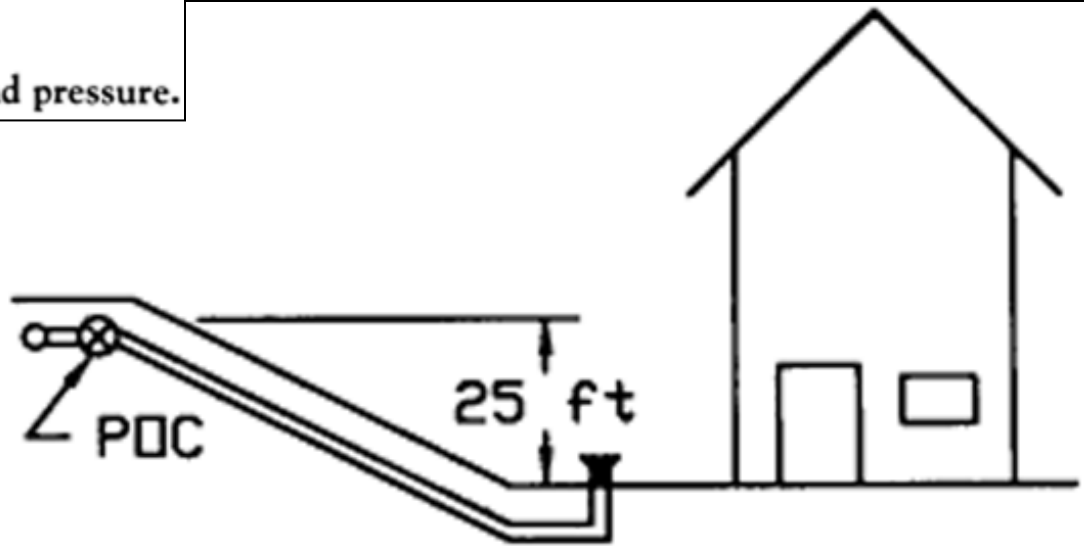

Figure 2.2. Pressure change caused by elevation.

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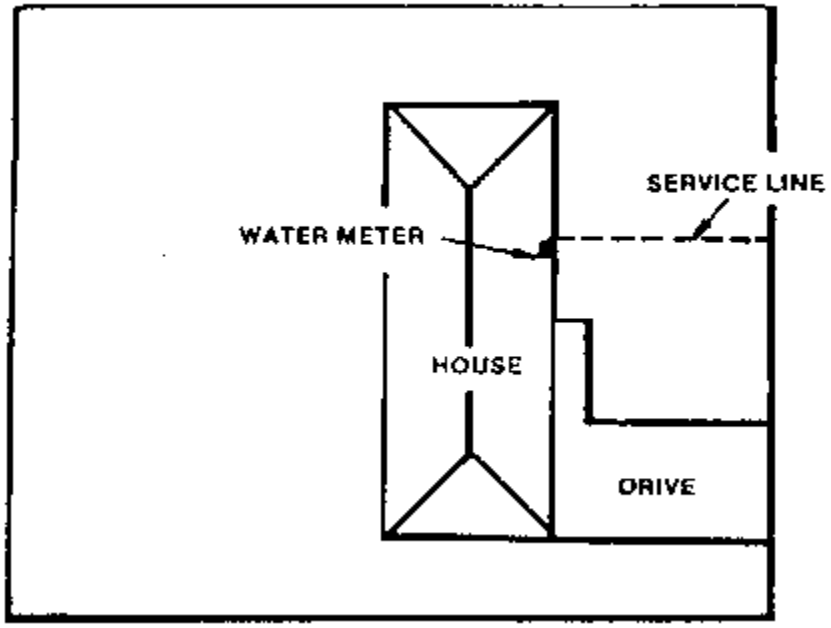
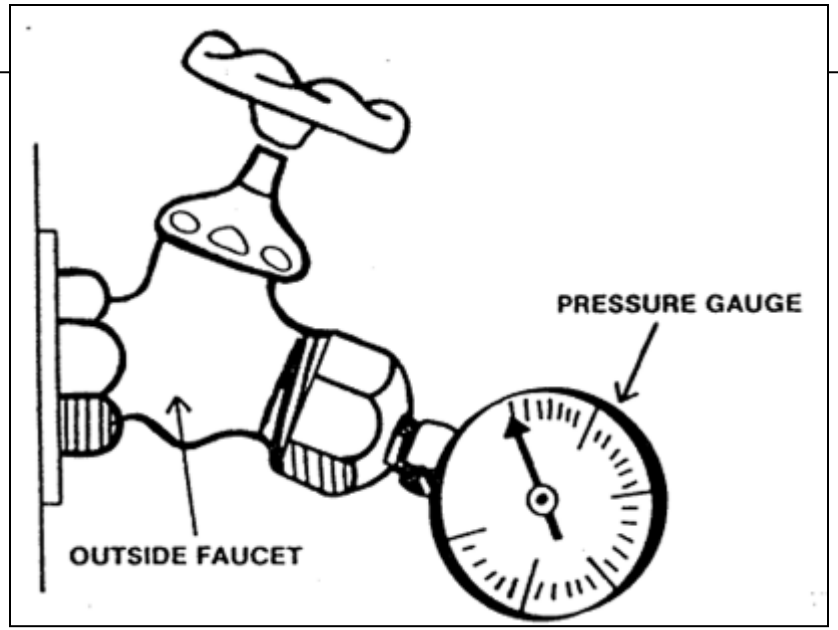


Table 1. Water flow rates through different meter and service line sizes

Meter size	Service line from water main	Gallons per minute available for irrigation system
5/8"	3/4"	10
3/4"	3/4"	10
3/4"	1"	15
1"	3/4"	10
1"	1"	15

Pressure



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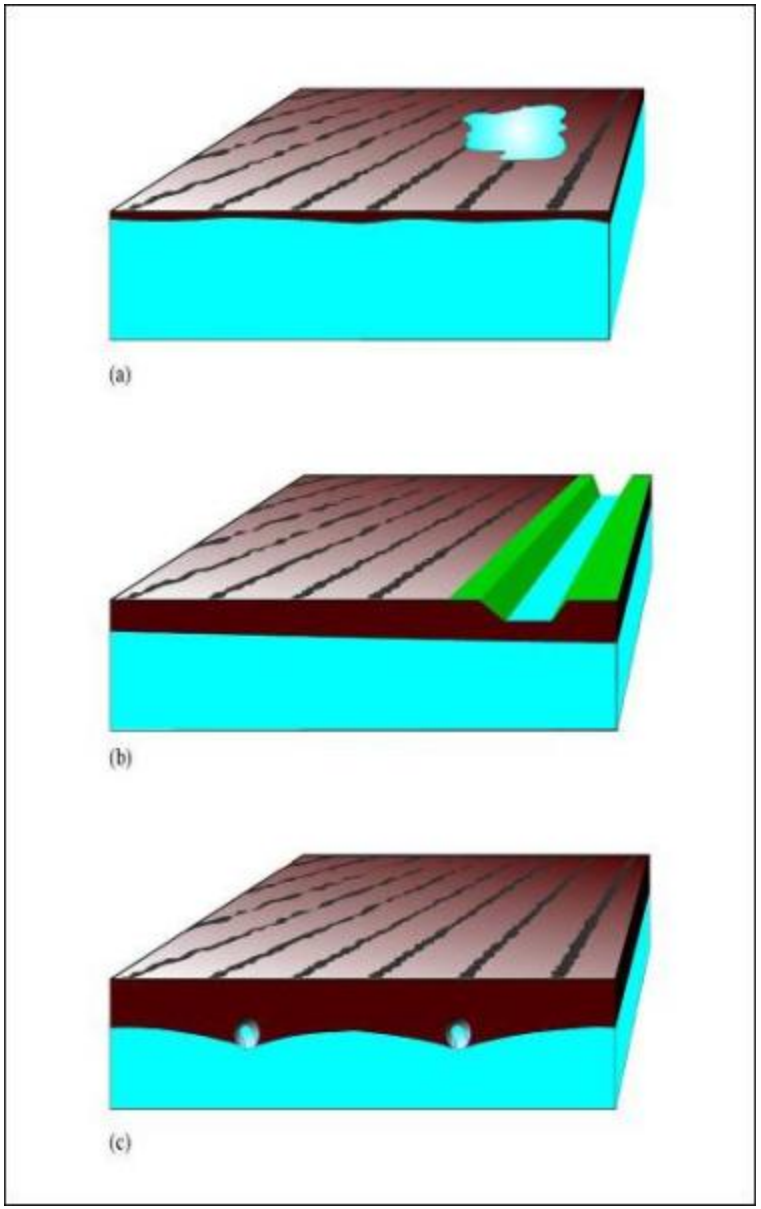
Drainage



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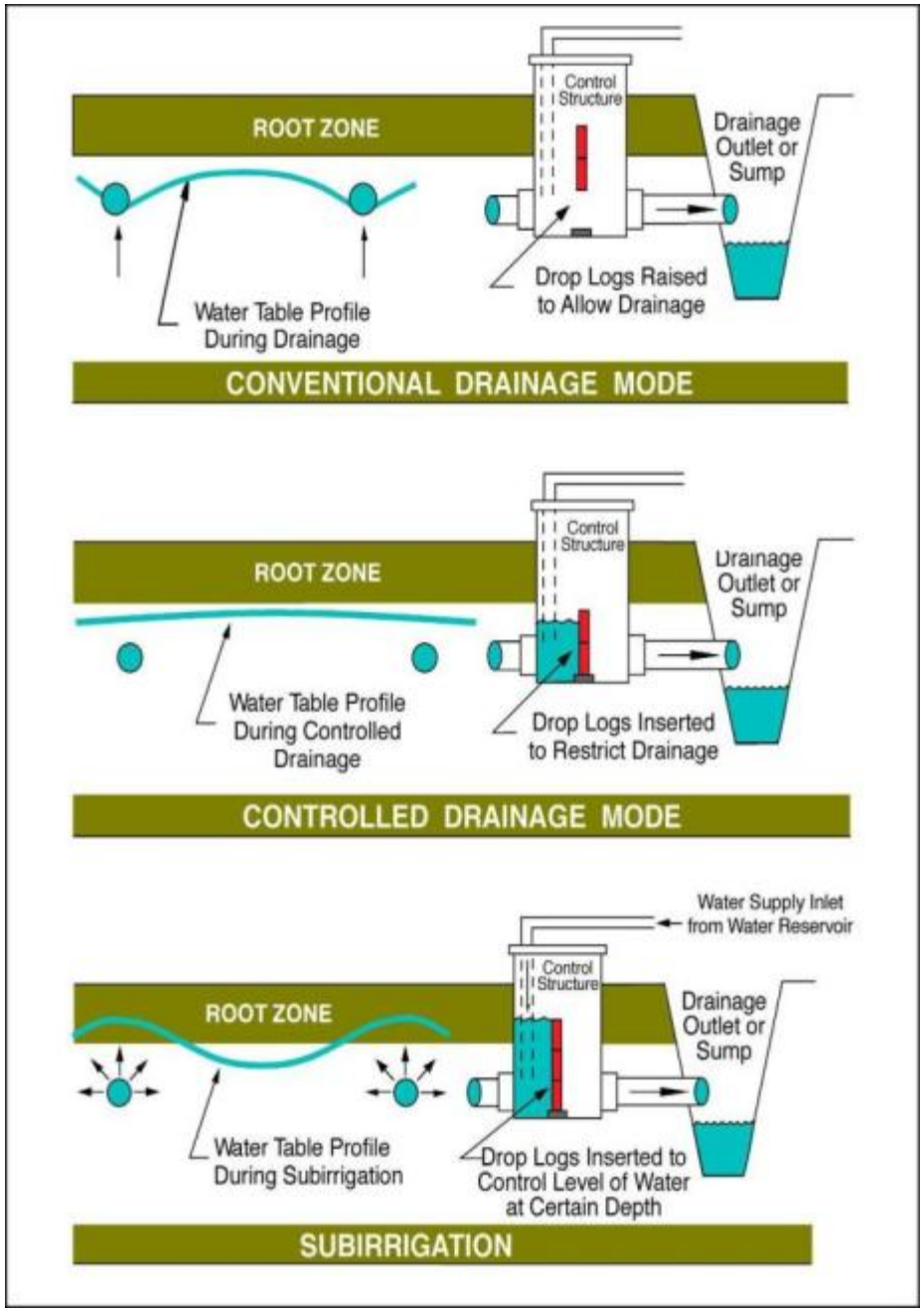
Water Table Management



Conventional Subsurface Drainage

Controlled Drainage

Systems approach for significant water quality improvements, and increased and sustained crop yields

Subirrigation

Brown, Fausey et al.

USDA ARS

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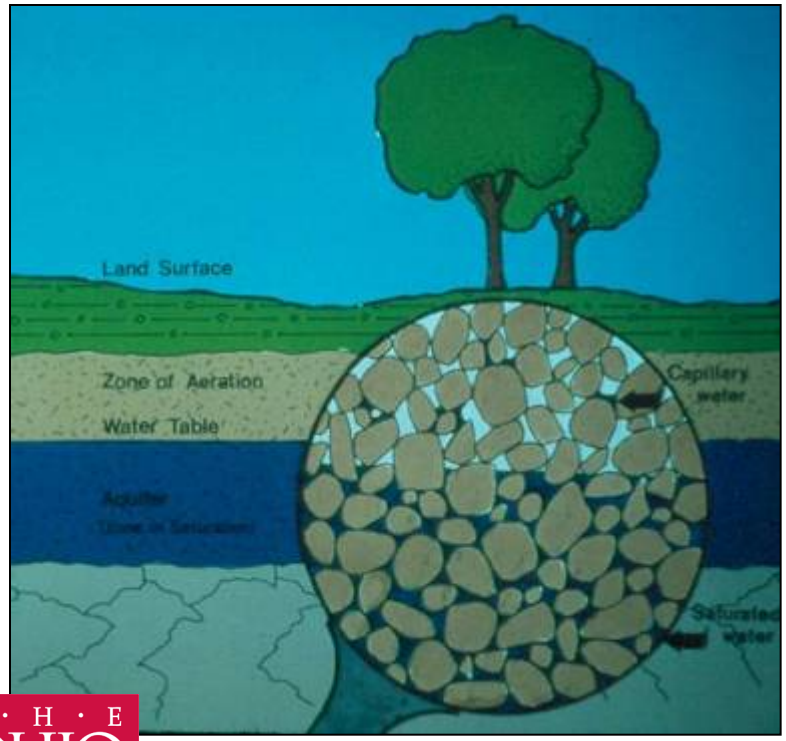
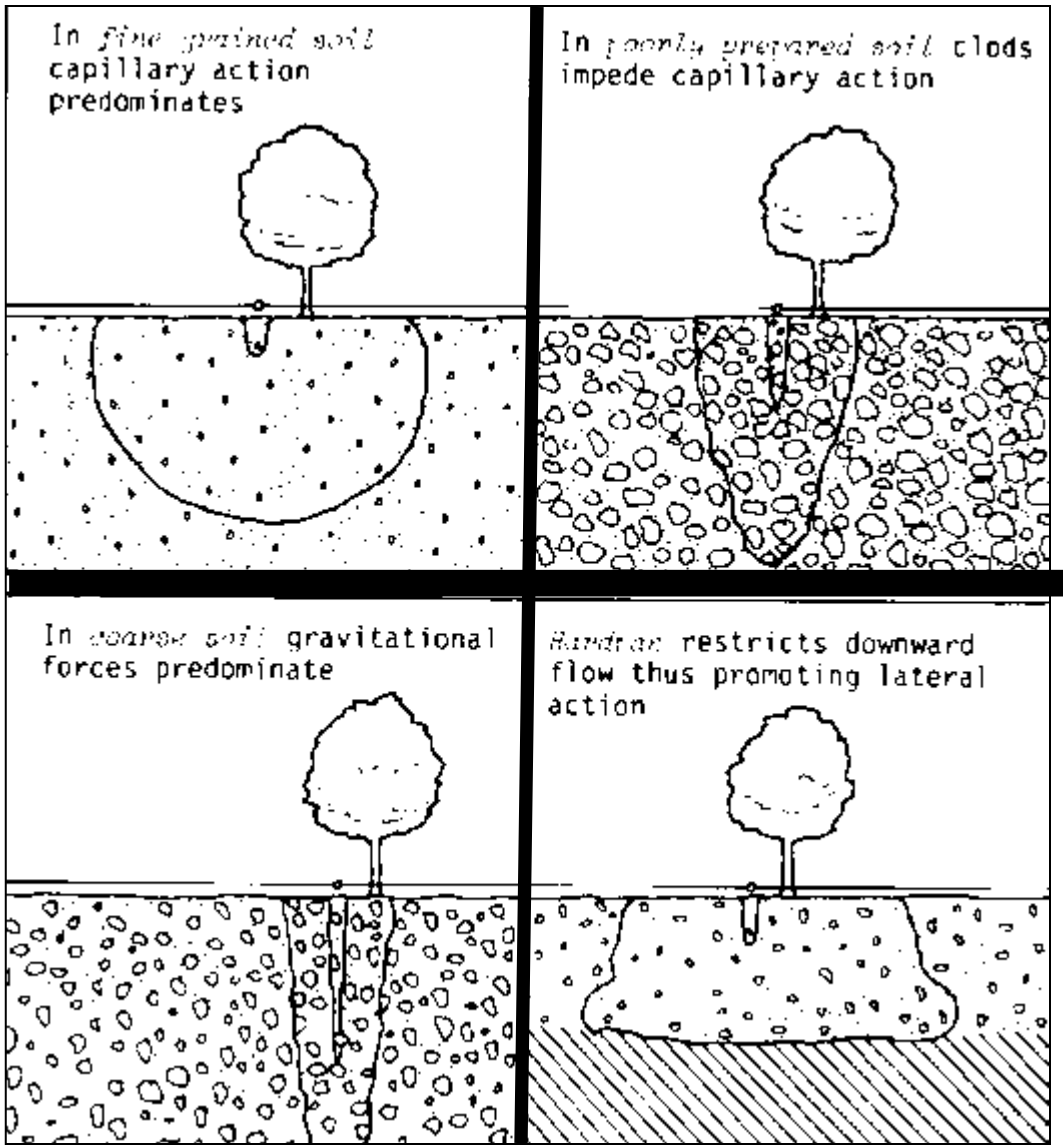
Site Characteristics

- Location to water resources
- Rainfall frequency and amount
- Geological conditions
- Slope





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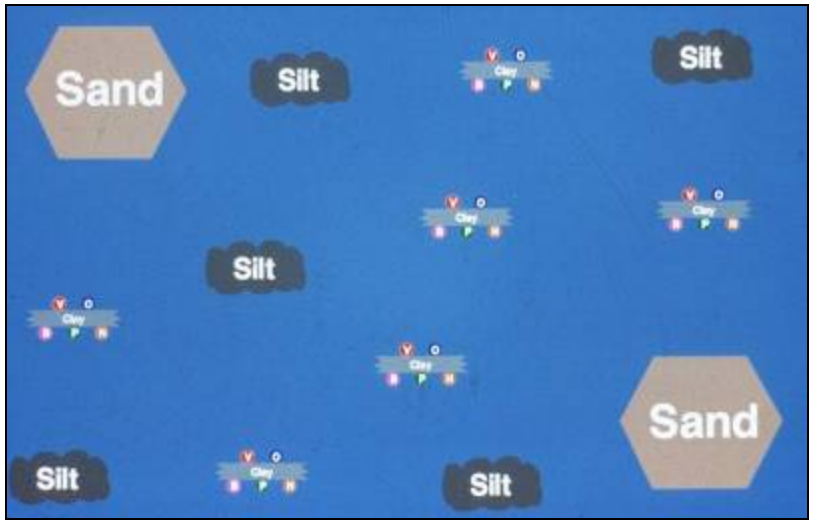
Soil

- Obtain good information on soil properties
- Know how much water to apply
- Know how fast you can apply the water

Soil Texture

Percents of Sand, Silt and Clay sized Particles



Relative Sizes of Sand, Silt and Clay Particles

Infiltration

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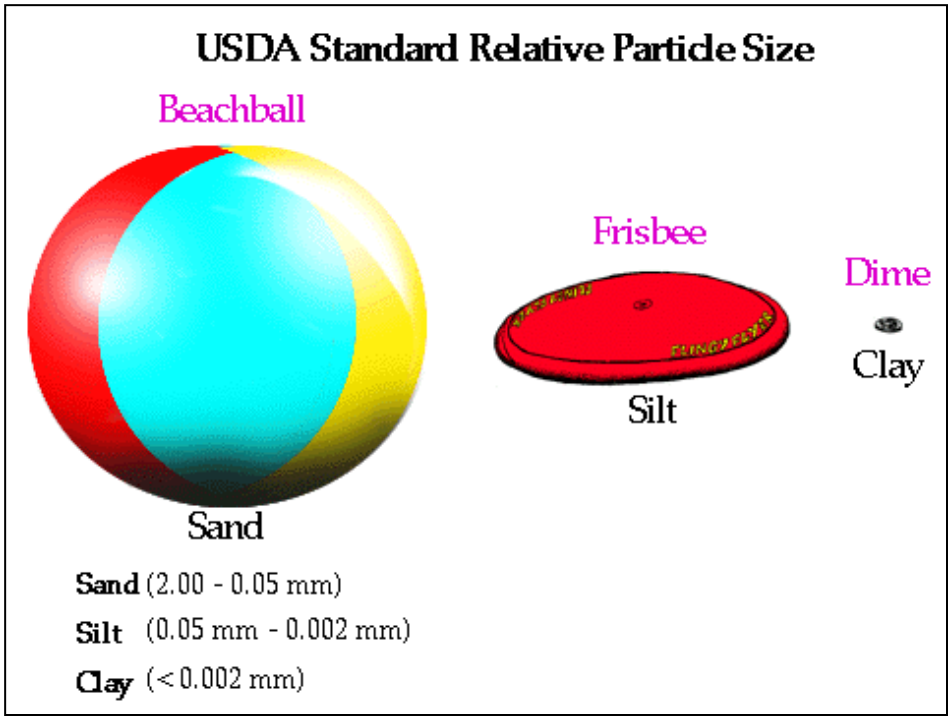
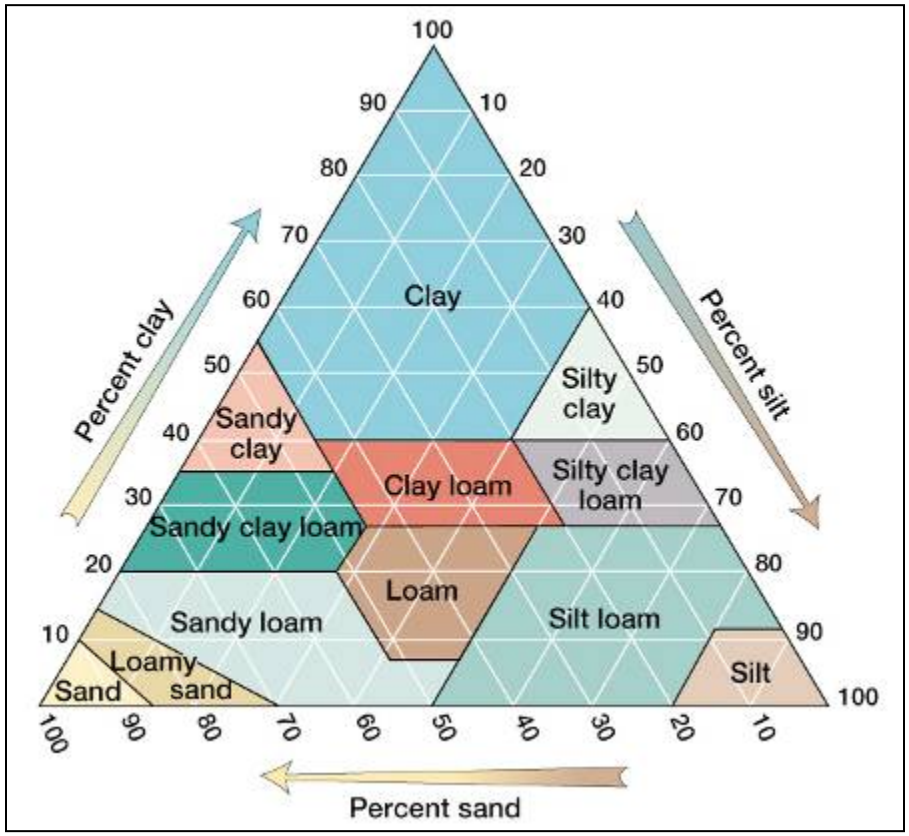
Soil Texture

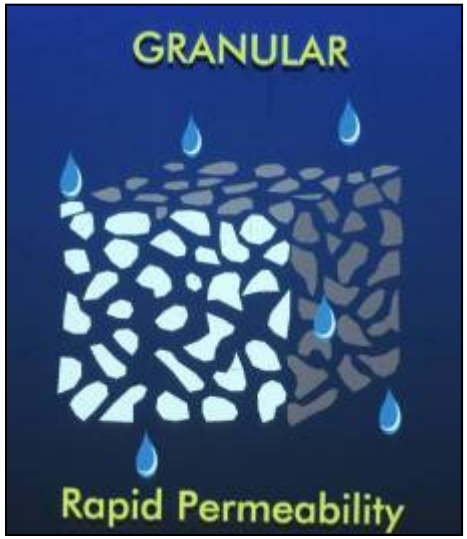


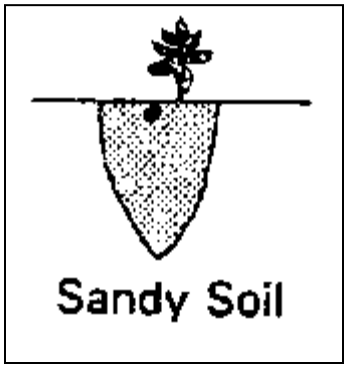


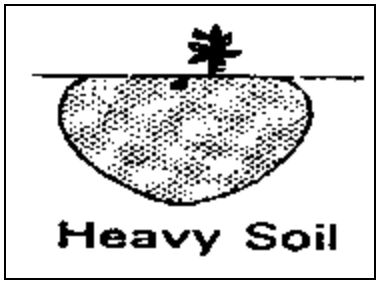
USDA Textural Triangle


TEXTURE
SANDY SOIL
LOAM
CLAYEY SOIL
WATER APPLICATION INTERVAL THE SAME

Soil Structure and Permeability







Soil Texture and Water Holding Ability

Available Water Capacity / Infiltration Rates
Selected Soil Texture

Soil Texture	Available Water (in/ft)	Infiltration Rate* (in/hr)
Course Sand	0.4 - 0.8	0.5 - 1.0
Sandy	0.7 - 0.9	0.5 - 1.0
Sandy Loam	1.2 - 1.8	0.5 - 1.0
Loam	1.7 - 2.3	0.25 - 0.5
Clay Loam	2.0 - 2.5	0.10 - 0.25
Silty Clay	2.0 - 2.8	0.10 - 0.25
Clay	2.4 - 3.0	0.10 - 0.25

* bare, uncompacted soil conditions

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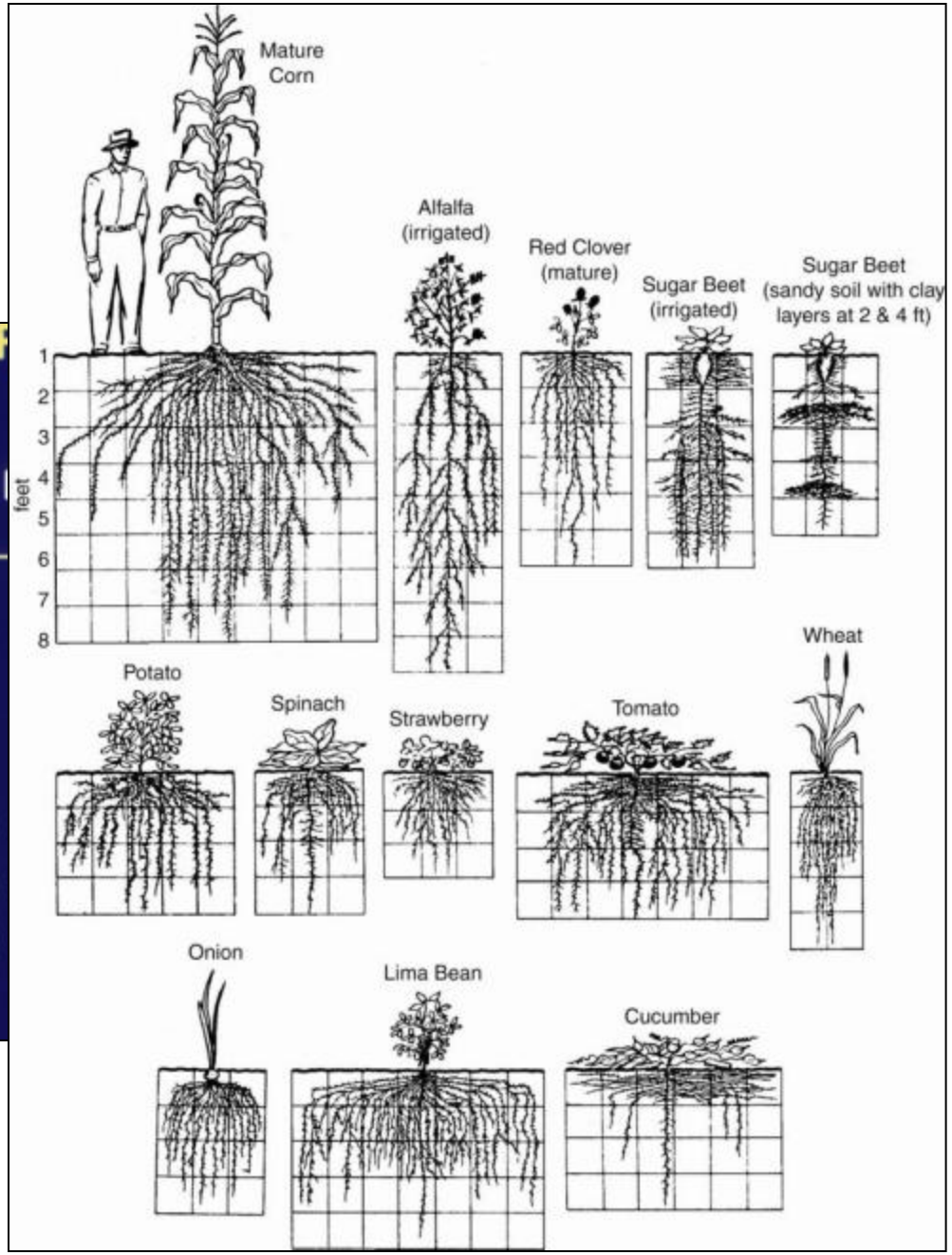
Crop Rooting Zone

Available Water Capacity / Infiltration R
Selected Soil Texture

Soil Texture	Available Water (in/ft)	Infiltration I (in/hr)
Course Sand	0.4 - 0.8	0.5 - 1.0
Sandy	0.7 - 0.9	0.5 - 1.0
Sandy Loam	1.2 - 1.8	0.5 - 1.0
Loam	1.7 - 2.3	0.25 - 0.5
Clay Loam	2.0 - 2.5	0.10 - 0.25
Silty Clay	2.0 - 2.8	0.10 - 0.25
Clay	2.4 - 3.0	0.10 - 0.25

* bare, uncompacted soil conditions



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Water Use - Evapotranspiration

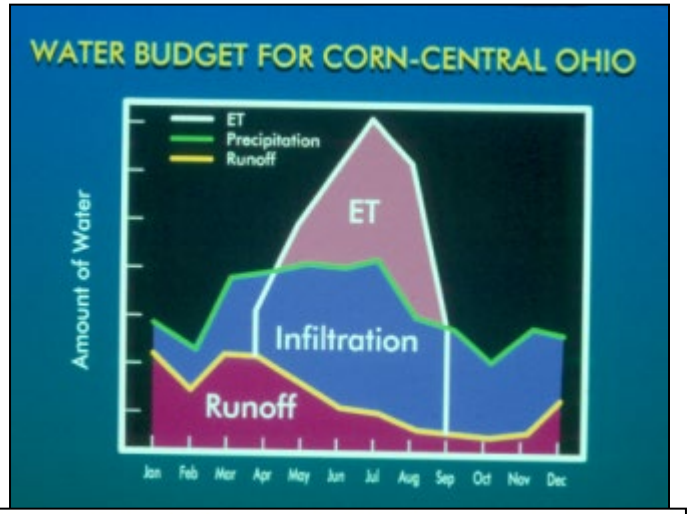
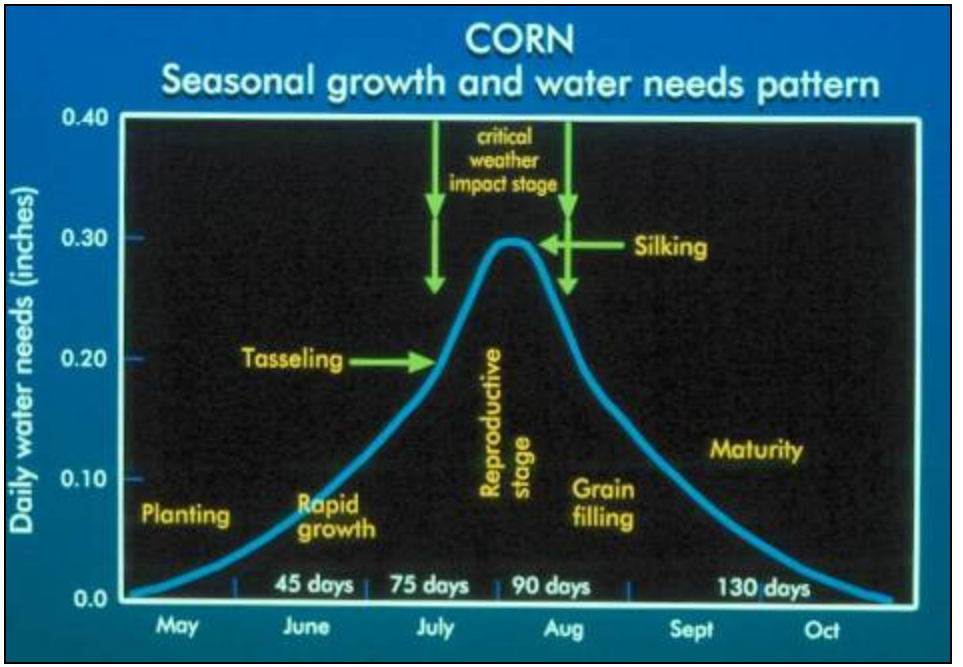
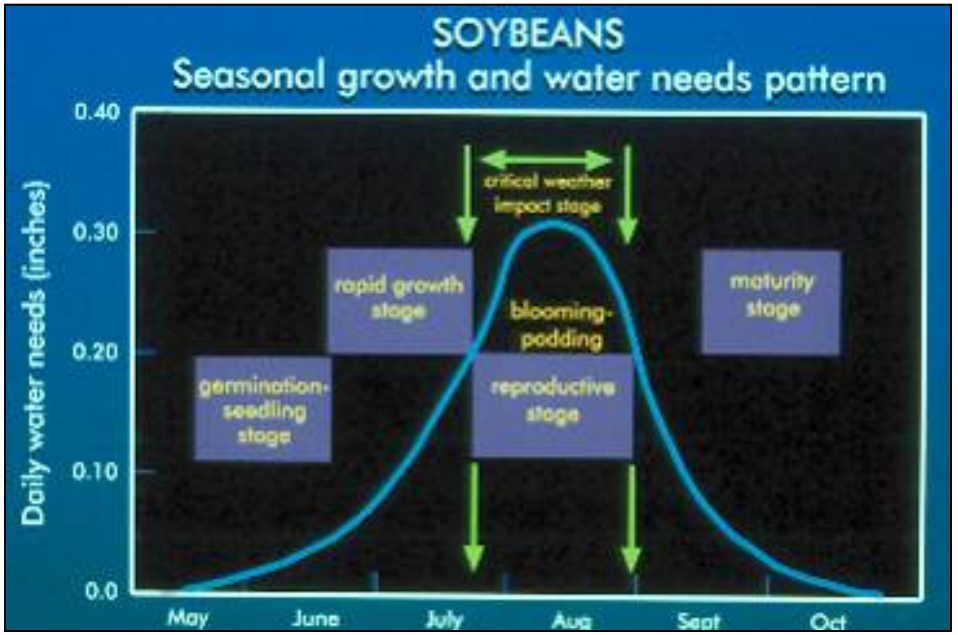


Table 6.4. Potential evapotranspiration (PET) rates (worst case)

Climate	Humidity	Average Max. Temperature (° F)	PET (in./day)
Cool	Dry*	<70	0.15
	Humid	<70	0.10
Moderate	Dry	70 – 80	0.25
	Humid	70 – 80	0.20
Warm	Dry	80 – 100	0.35
	Humid	80 – 100	0.30
Hot	Dry	>100	0.45
	Humid	>100	0.40

* Dry <50% relative humidity. Humid >50% relative humidity.
Source: *Drip irrigation of landscaping, An introductory guide*. 1986. Laguna Niguel, Calif.: James Hardie Irrigation.





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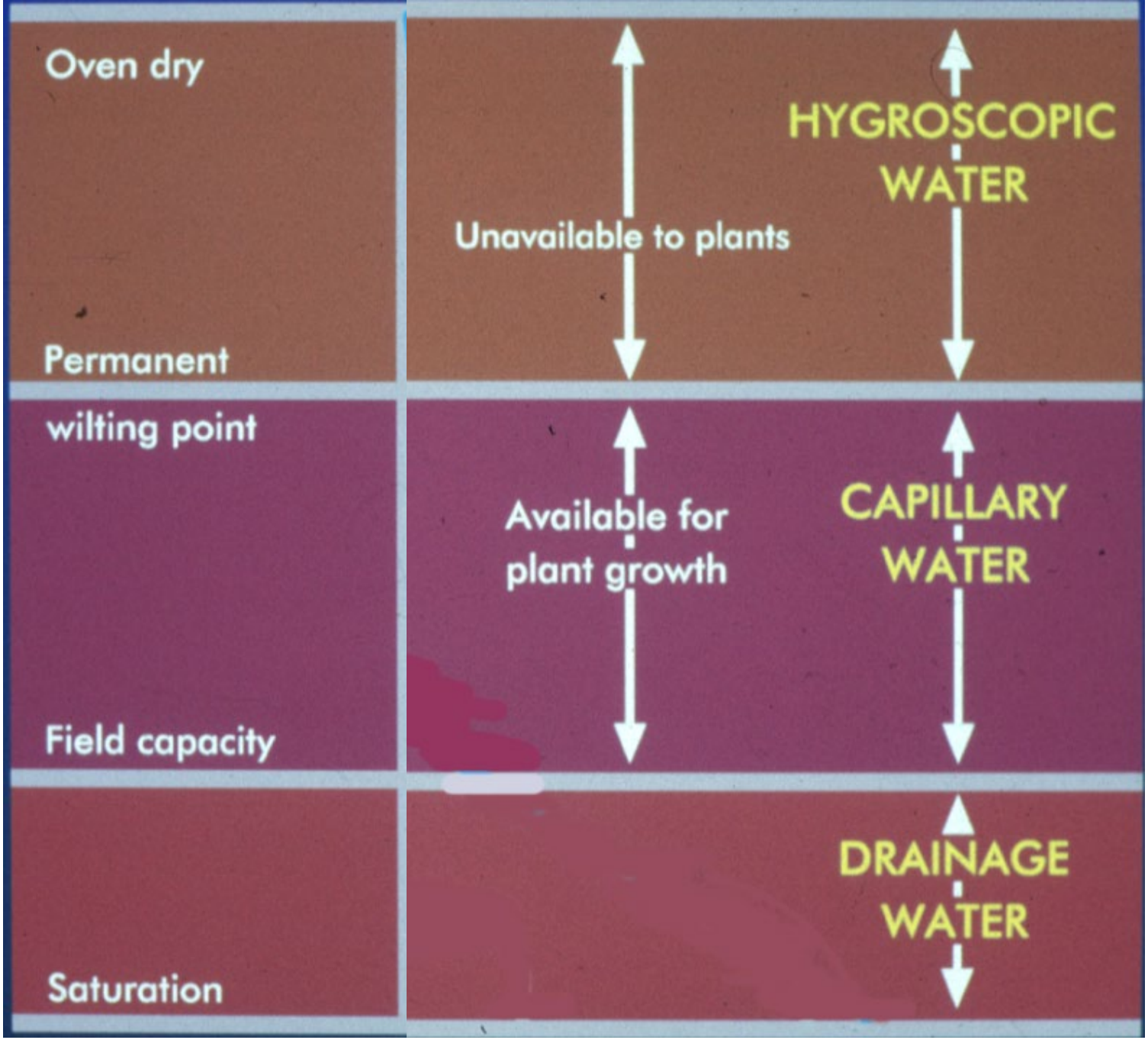

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Explanation of this illustration on following page.

Description for Proceeding Slide

- In terms of water content in the soil profile, specifically the rooting zone, it is important to understand how the water content relates to the plant, for irrigation and drainage. When using artificial drainage, we are trying to remove the excess water in the rooting zone, as drainage water. When using irrigation, we are trying to maintain some portion of the soil-water that is available for plant use, as capillary water. The hygroscopic water is that which is bound tightly to soil particles and plants can not remove or use it.

- Now, consider a saturated soil profile, one where all the pore space is filled with water. Once the soil starts to drain under the force of gravity, and it drains for 24 hours, the water content is said to be at field capacity. Then, if the plants remove all of the plant-available water (and it does not rain, nor do we irrigate), the soil-water content reaches wilting point. It is at or near the wilting point that we may see visible signs of drought stress in plants. Now, if we placed the soil in an oven after it reaches permanent wilting point, we can remove all remaining water to get to oven-dry water content.

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Irrigation
Basic Considerations

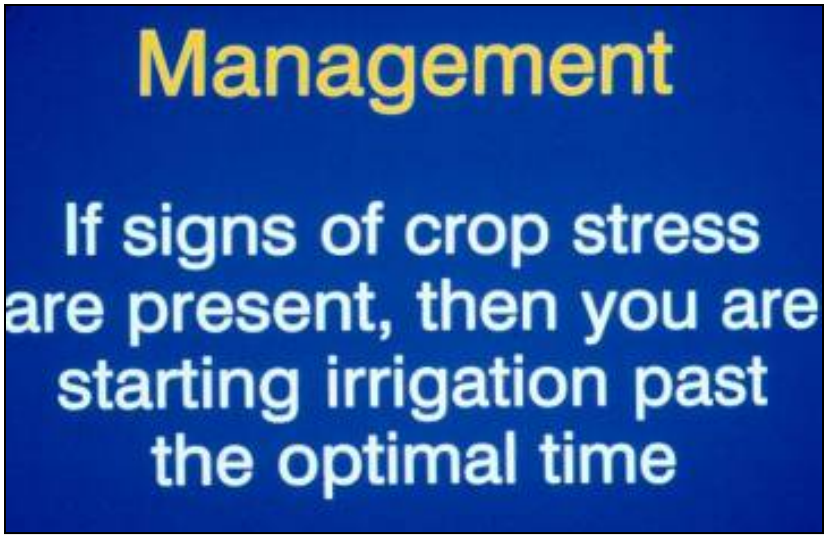
- Labor
- Management
- System Design
- Economics

Irrigation Requires More Management

- Think about your objectives for irrigating
- Develop a proper irrigation plan and schedule
- Follow the plan

Management

Irrigation is not a substitute for poor management



Irrigation Scheduling

System Design

- Obtain good information
- What are the economics ?
- Engineer the entire system... tailor the system to the specific situation
- Consult an engineer, or dealer/consultant trained to perform proper design

Filtration

Other Considerations

- Environmental Aspects
- Chemigation and Fertigation
- Financial Resources
- Lease Versus Purchase
- Dealer Availability and Service

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Information Inventory

- Soils / Geology
- Topography
- Precipitation
- Water Supply

Information Inventory

- Power Source
- Crops
- Farm Operation Schedule
- Financial Resources

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Table 3. Comparison of sprinkler irrigation systems and micro-irrigation systems in relation to site and situation factors.

Site & Situation Factors	Sprinkler Systems			Microirrigation Systems
	Intermittent Mechanical-Move	Continuous Mechanical-Move	Solid-Set and Permanent	Emitters and Porous Tubes
Infiltration rate	All	Medium to high	All	All
Topography	Level to rolling	Level to rolling	Level to rolling	All
Crops	Generally shorter Crops	All but trees and vineyards	All	High value required
Water supply	Small streams nearly continuous	Small streams nearly continuous	Small streams	Small streams, continuous and clean
Water quality	Salty water may harm plants	Salty walter may harm plants	Salty water may Harm plants	All–can potentially use high salt waters
Efficiency	Average 70-80%	Average 80%	Average 70-80%	Average 80-90%
Labor requirement	Moderate, some training	Low, some training	Low to seasonal high, little training	Low to high, some training
Capital requirement	Moderate	Moderate	High	High
Energy requirement	Moderate to high	Moderate to high	Moderate	Low to moderate
Management skill	Moderate	Moderate to high	Moderate	High
Machinery operations	Medium field length, small interference	Some interference circular fields	Some interference	May have considerable interference
Duration of use	Short to medium	Short to medium	Long term	Long term, but durability unknown
Weather	Poor in windy conditions	Better in windy conditions than other sprinklers	Windy conditions Reduce performance, good for cooling	All
Chemical application	Good	Good	Good	Very good

Source: Fangmeier and Biggs (1986); Schwab et al., 1993.

Overhead Sprinkler Irrigation

Center Pivot System (~160 acres)

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Overhead Sprinkler Irrigation

Linear-Move System

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Sprinkler Irrigation

Single Gun Traveler System

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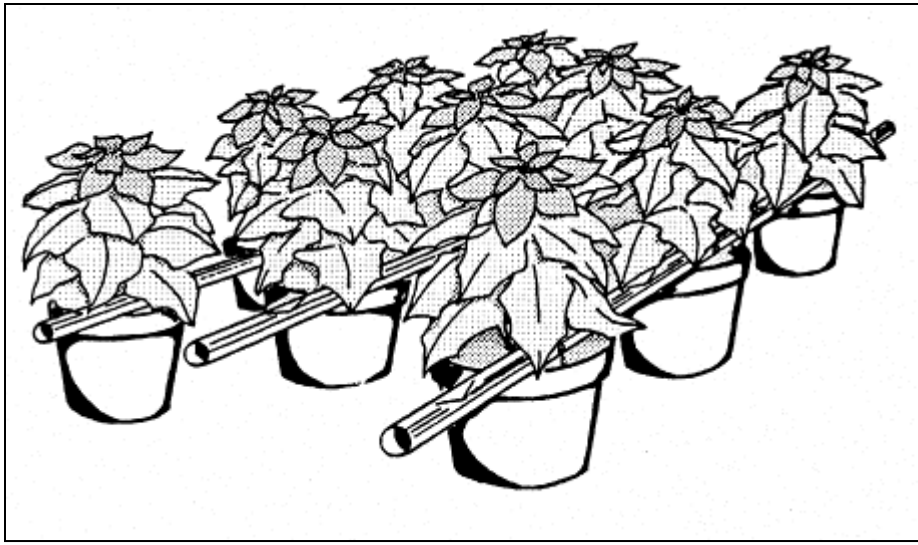
Table 17.1 Comparison of Sprinkler Irrigation Equipment

Type of System	*Relative Investment Cost*[a]	*Relative Labor Cost*	*Practical Hours of Operation per Day*
Hand-move laterals			
(standard sprinklers)	0.4	5.0	16
Hand-move laterals			
(giant sprinklers)	0.5	4.0	12-16
End-pull laterals			
(tractor tow)	0.5	1.4	16
Side-roll laterals			
(powered-wheel move)	0.7	1.7	18-20
Self-propelled			
(center-pivot)	1.0	1.0	24
Solid set	3.0-5.0	1.0	24

aBased on a 65-ha field, 63 l/s from pump, and 80 percent application efficiency.
Source: Berge and Groskopp (1964).

Drip / Trickle / Micro-Irrigation



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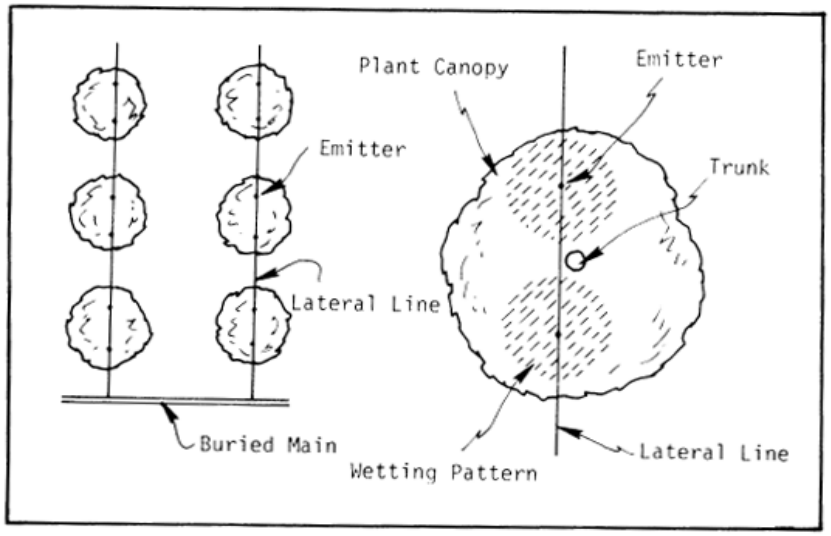

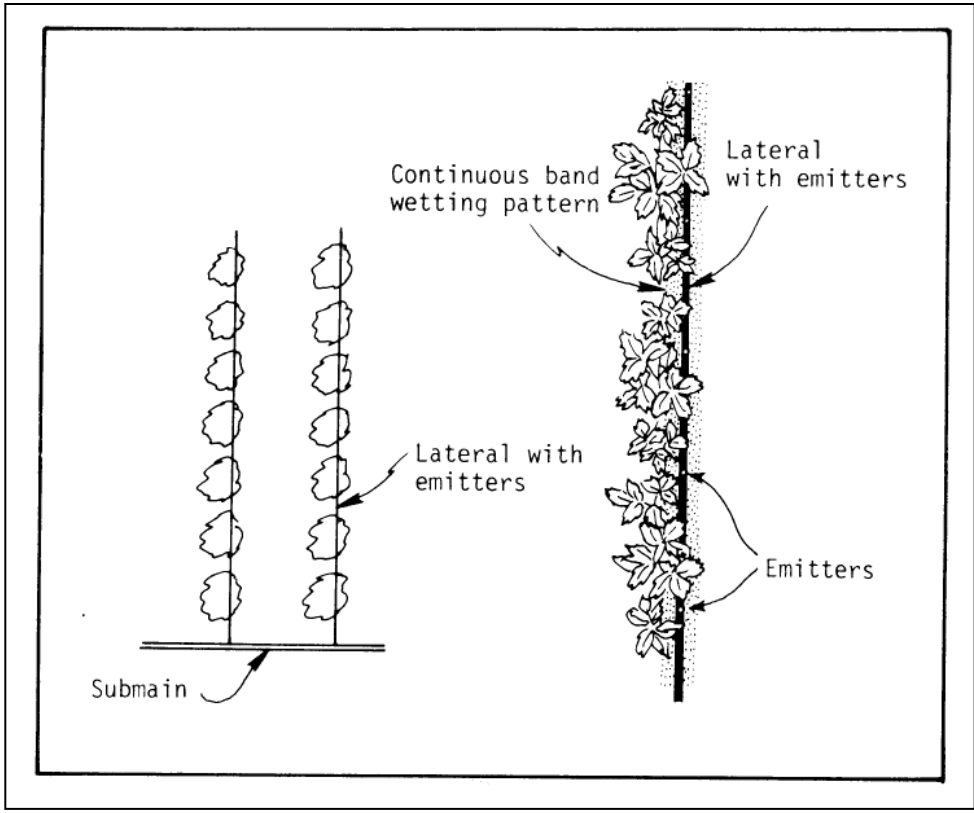

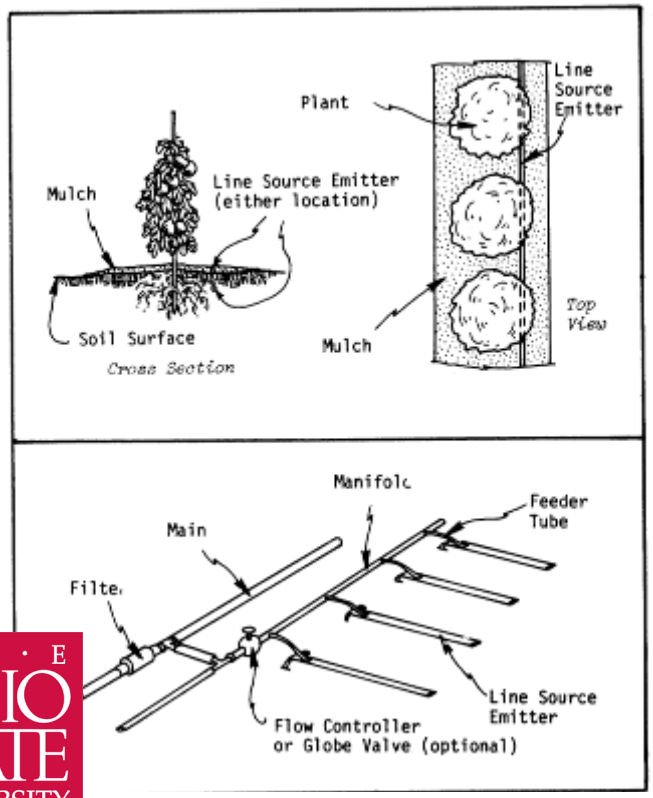

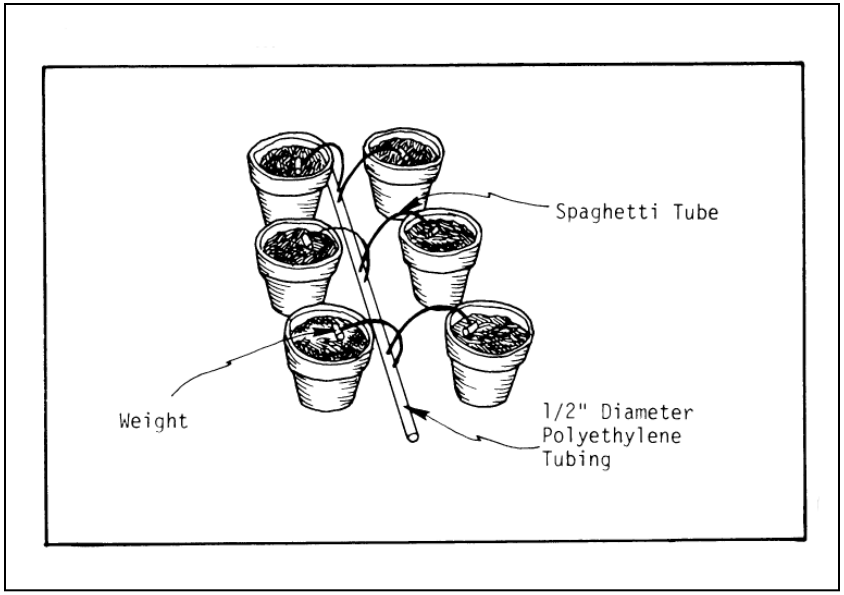

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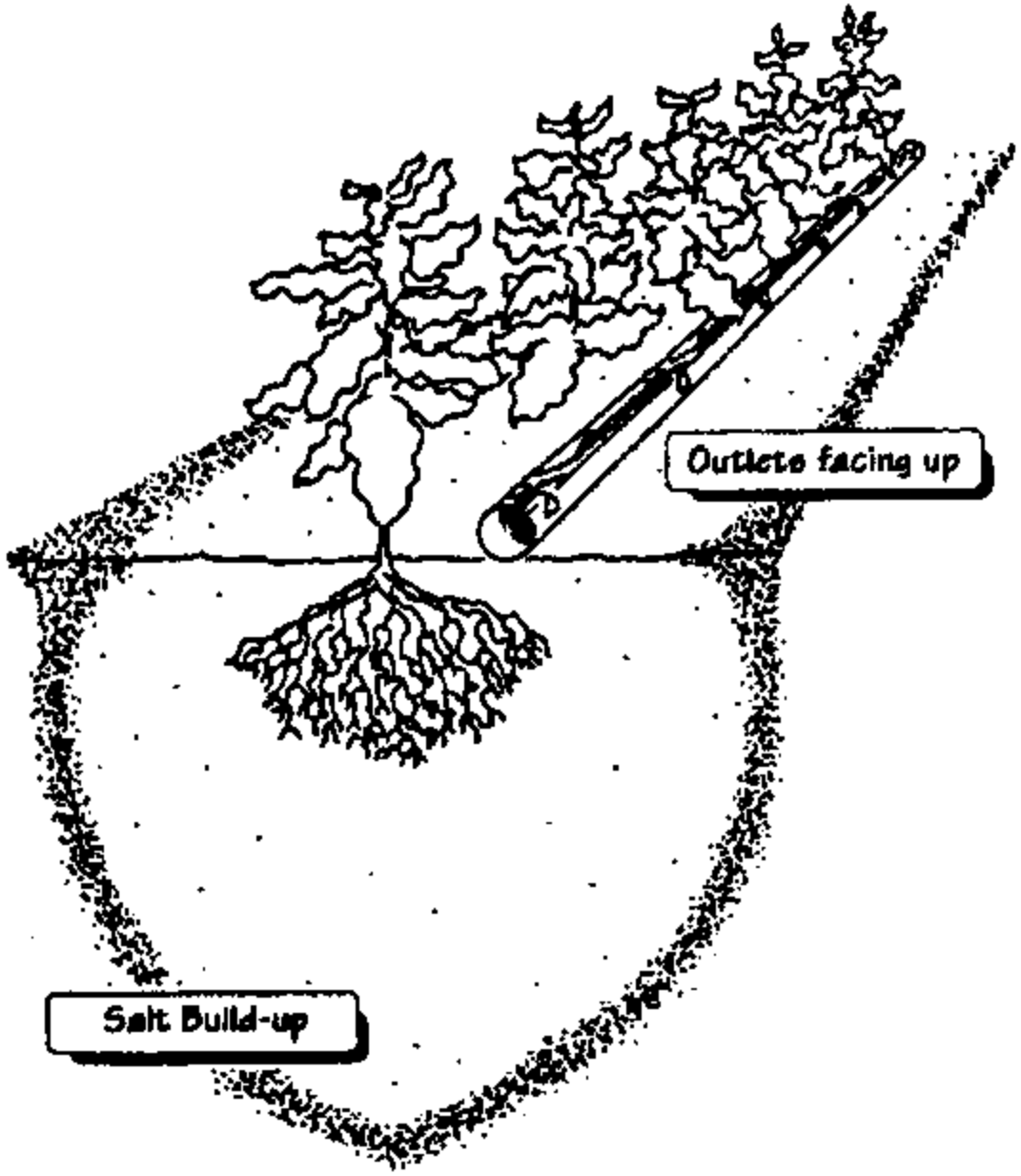
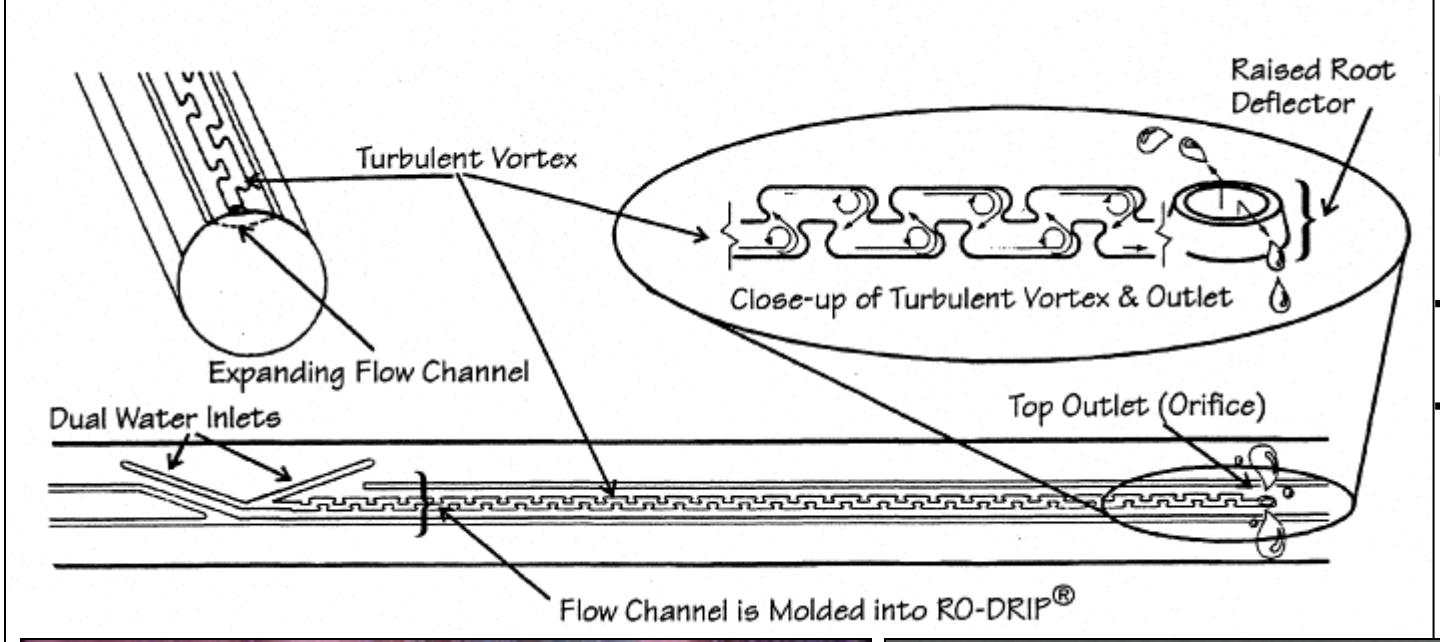
RO-DRIP® Placed on Surface





Drip, Trickle Irrigation Tape, Tubing, etc.

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Wide Beds, with Plastic Mulch, Film, etc.

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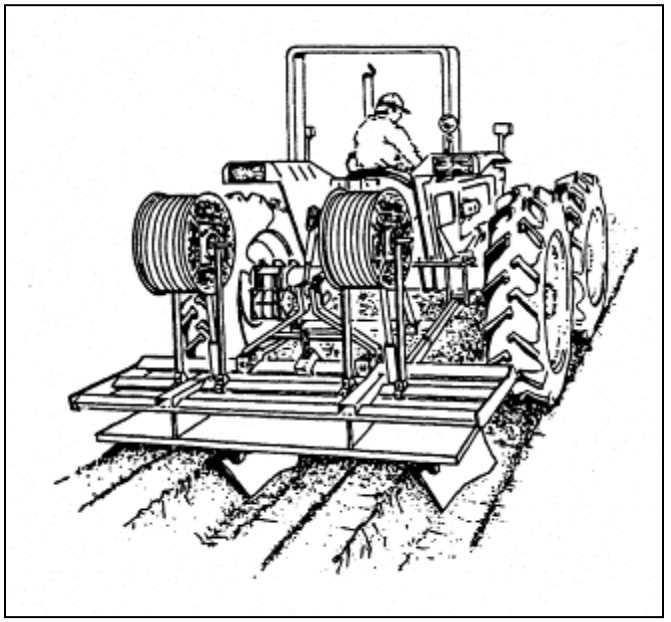

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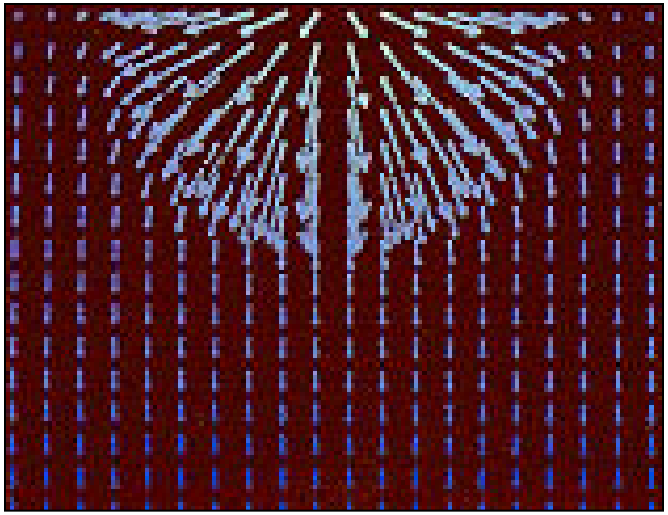
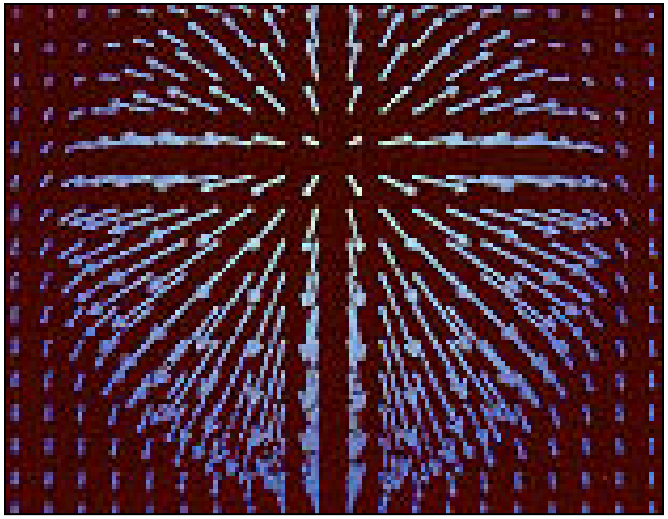
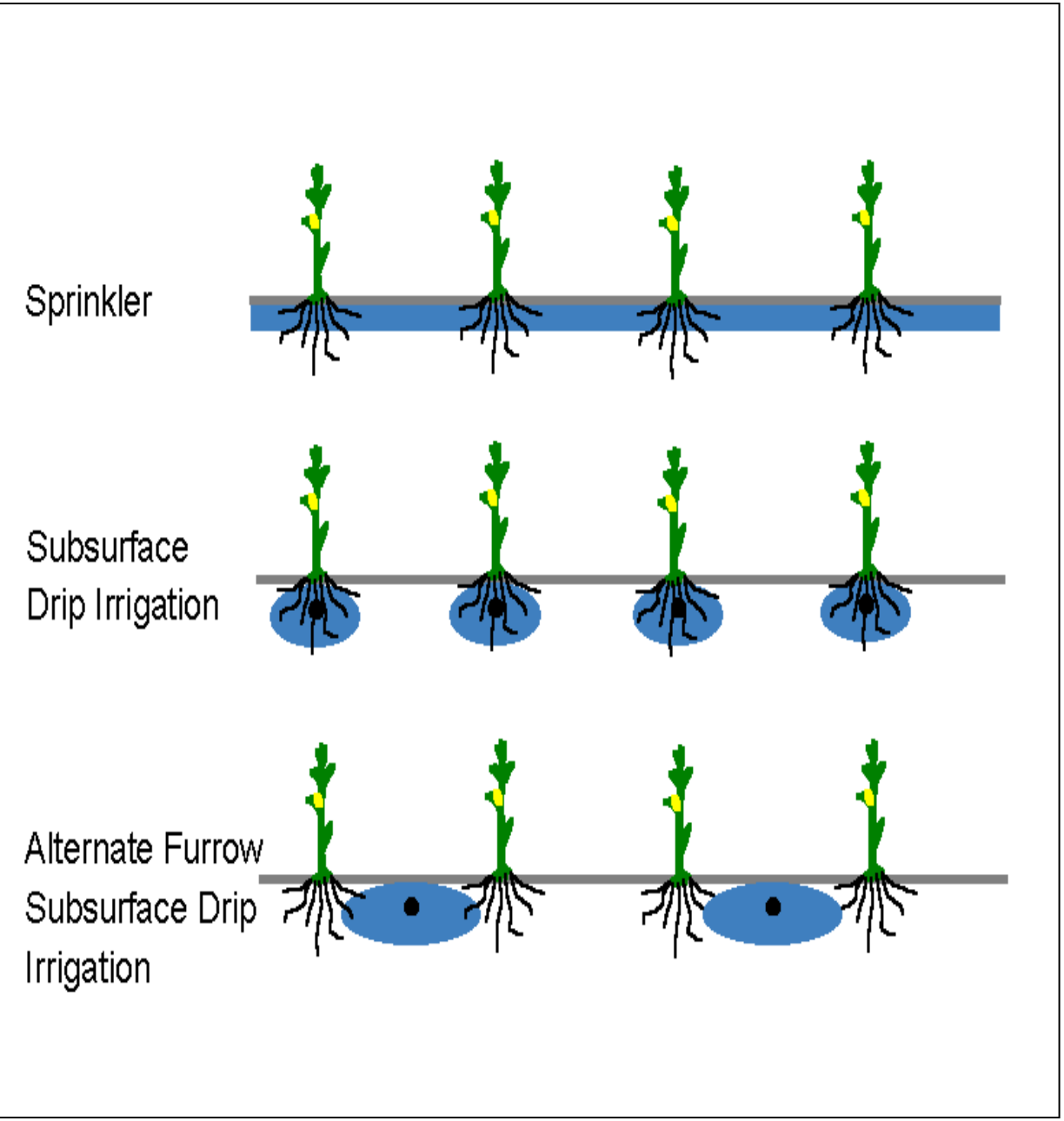
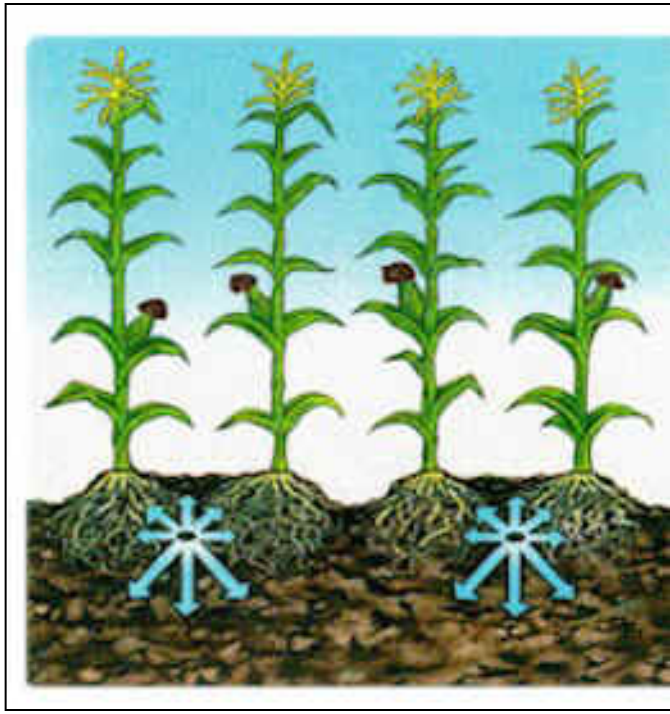
Surface Drip vs Subsurface Drip Irrigation





From: Kansas State U, Cal Institute Tech, UC Davis, U Nebraska, U.Tennessee





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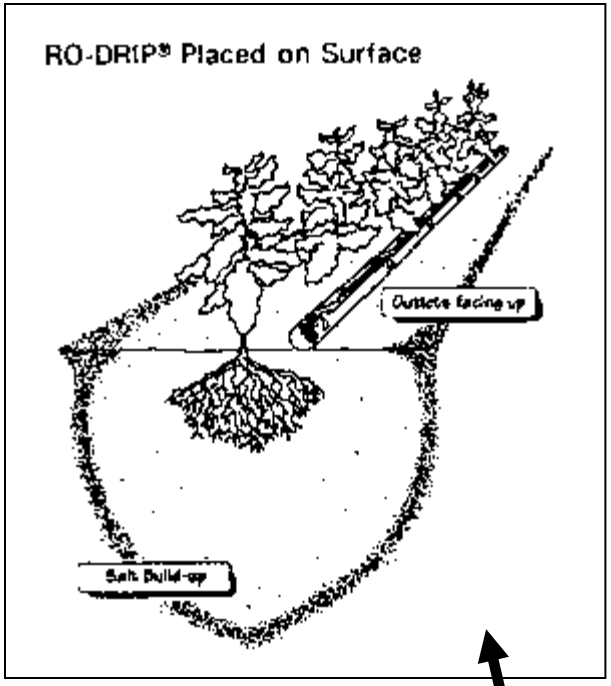
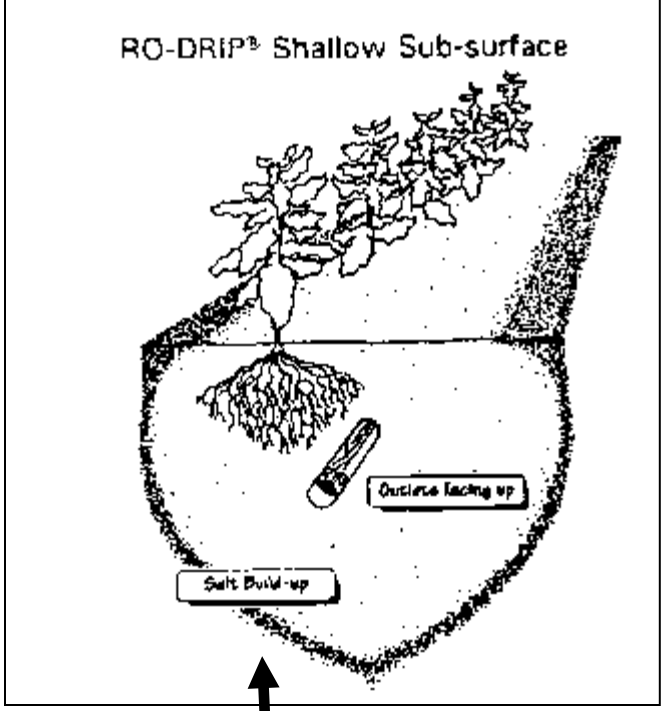
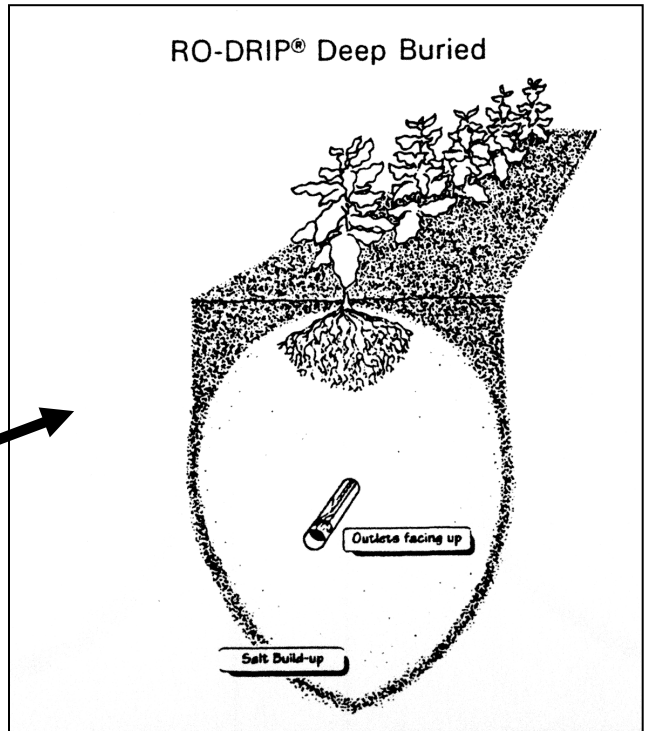


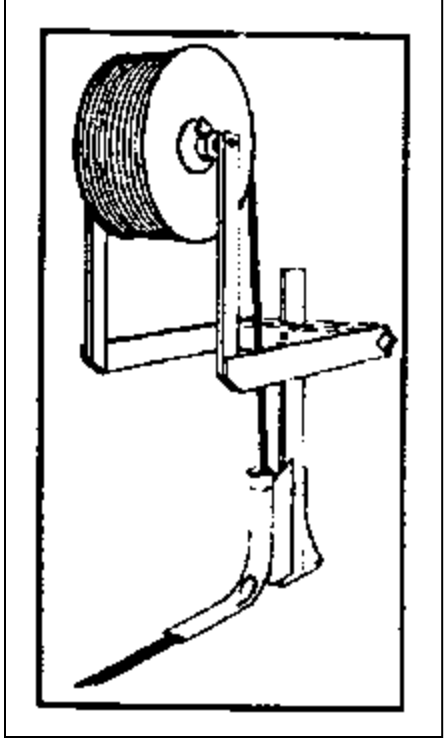


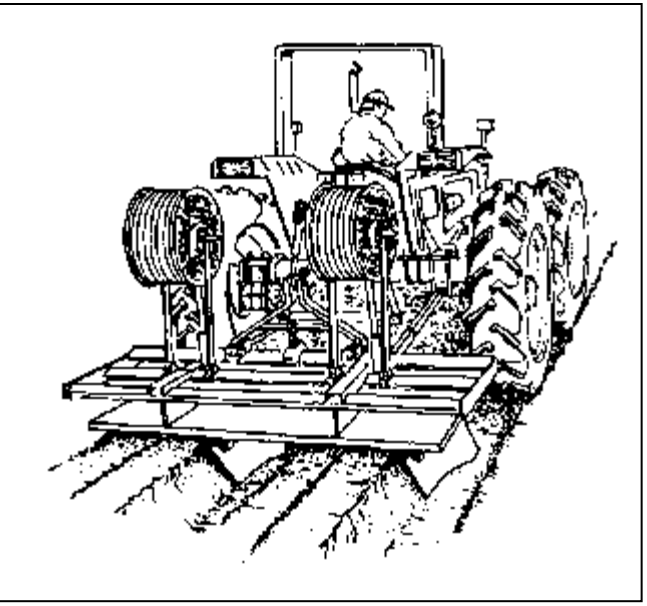


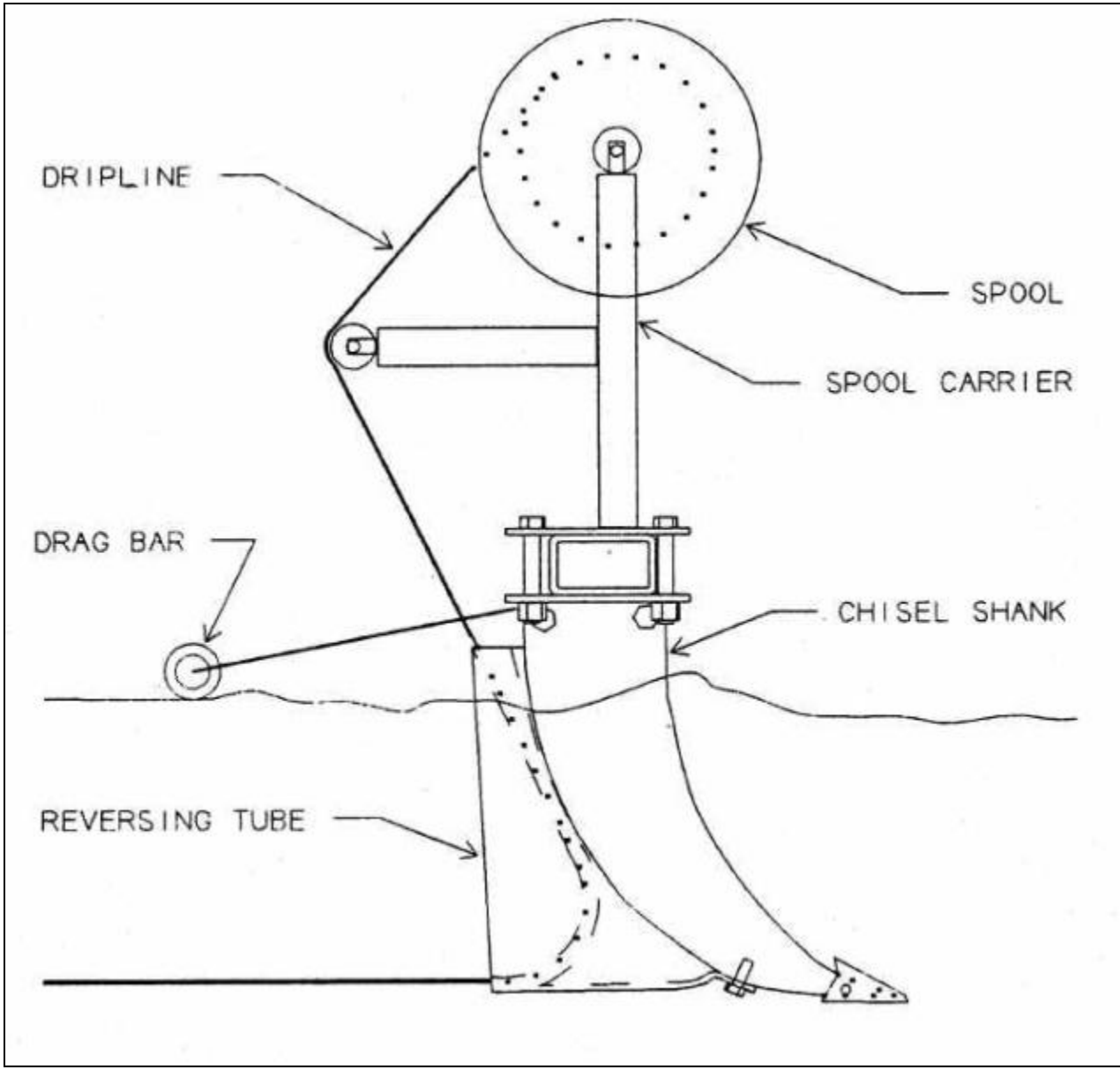
Surface Drip

Subsurface Drip – Shallow

Subsurface Drip - Deep



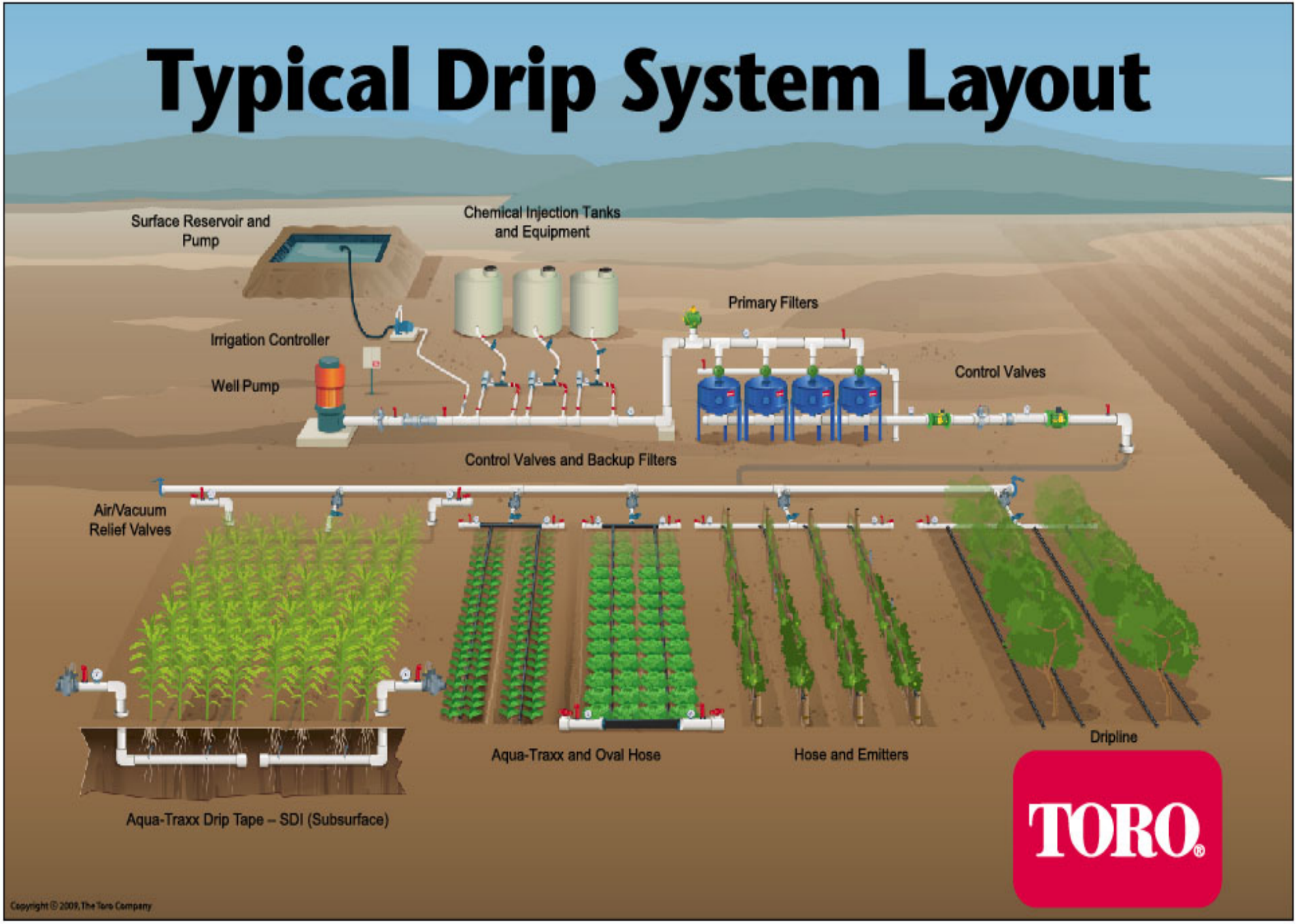


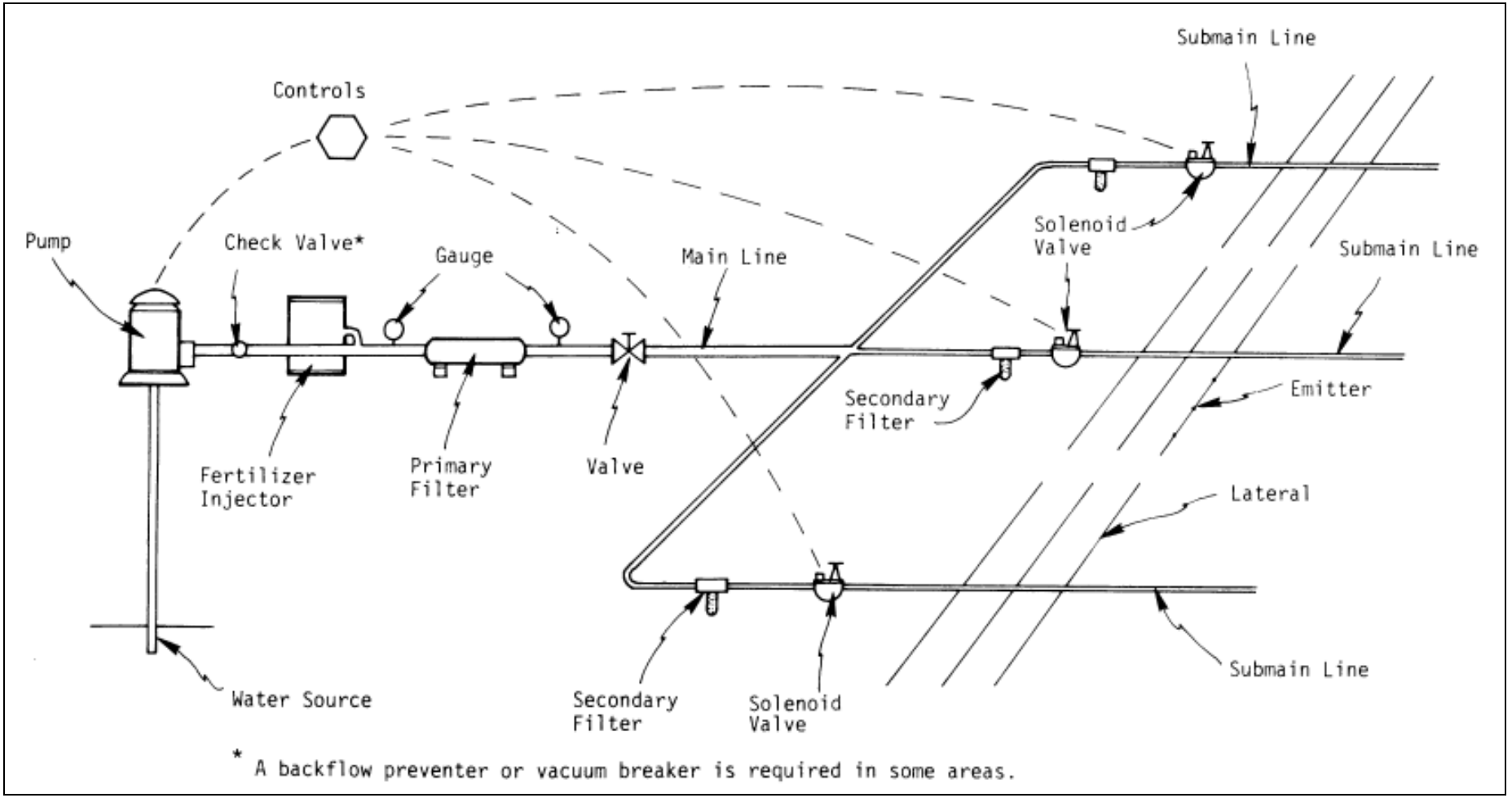


Subsurface Drip Installation


8530
FORD
4 13 99

Typical Drip System Layout





Control Head

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Main Water Quality Problems Encountered Related to Irrigation

- Hydrogen sulfide
- Iron and iron bacteria
- Hardness
- Sediment
- Plugging, clogging

- **TEST WATER**
- **FILTRATION IS REQUIRED!**

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FILTERS
FPD-02MPT-1

Agricultural Water Management Irrigation and Drainage

Larry C. Brown
Professor
Extension Agricultural Engineer

The Ohio State University

brown.59@osu.edu
614.292.3826

THE OHIO STATE UNIVERSITY