Achieving Precision Irrigation with Reduced Costs

Blair Stringam PhD.

(Irrigation Engineer)

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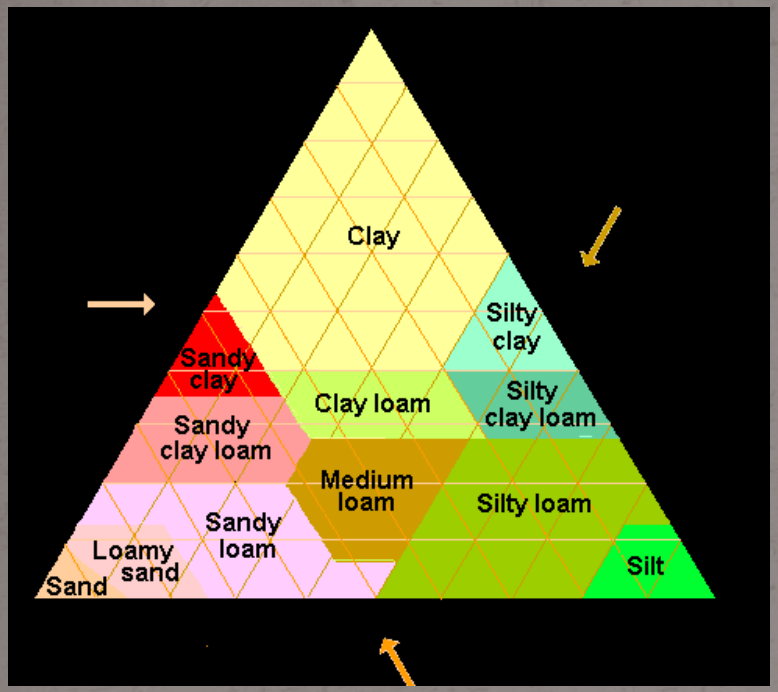
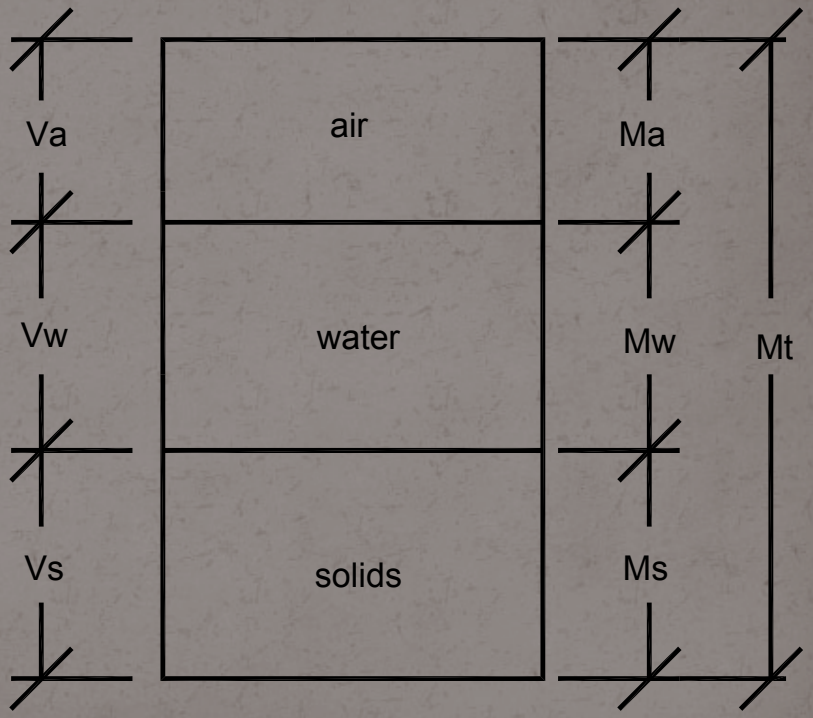
Where and When to Irrigate

- Irrigate the right amount
- At the right time

A Bucket Will Hold so Much Water

Soil Water Properties

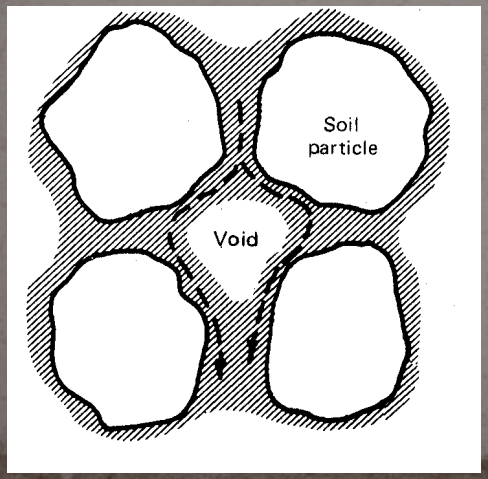


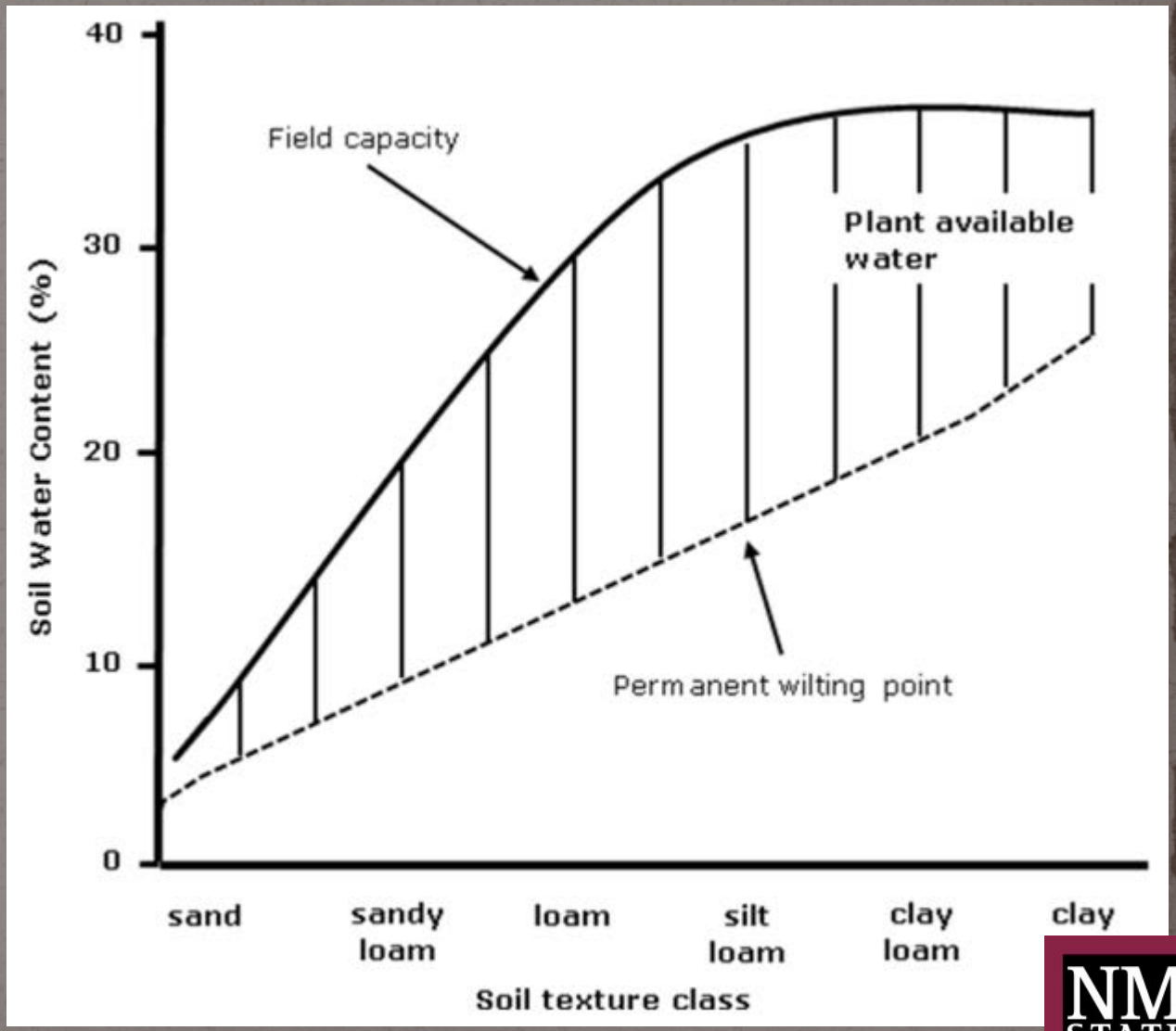


- Need to know about the soil texture to determine how much water the soil can hold

Soil Water Holding Capacity

- Understand your soil
- Finer soils tend to have greater water holding capacity



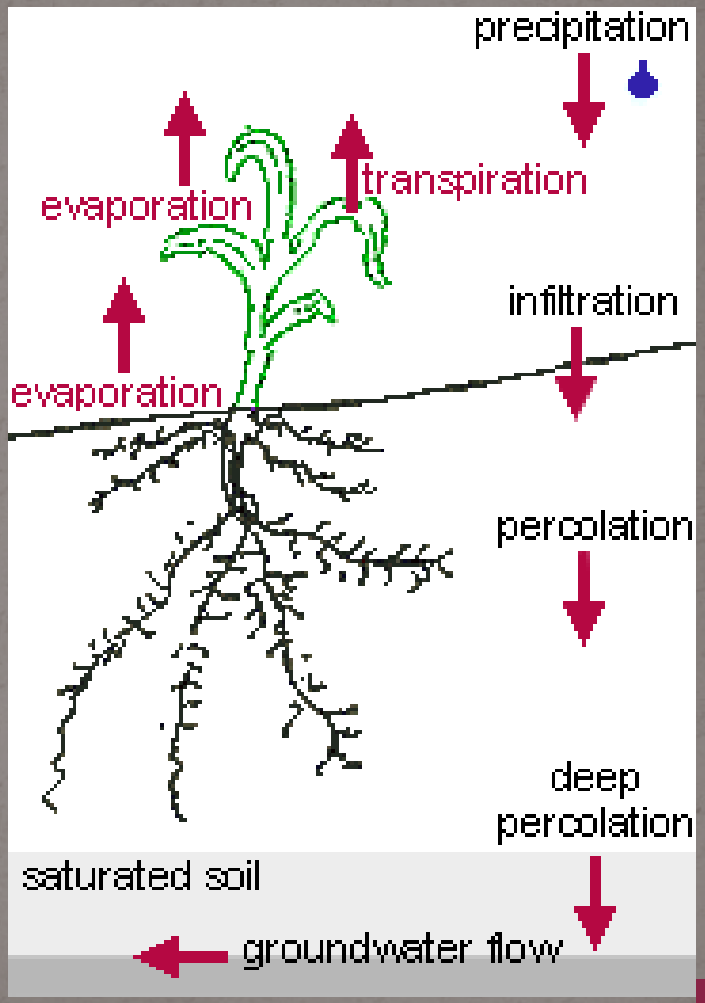


How Much Water is Needed?

How is the water used?

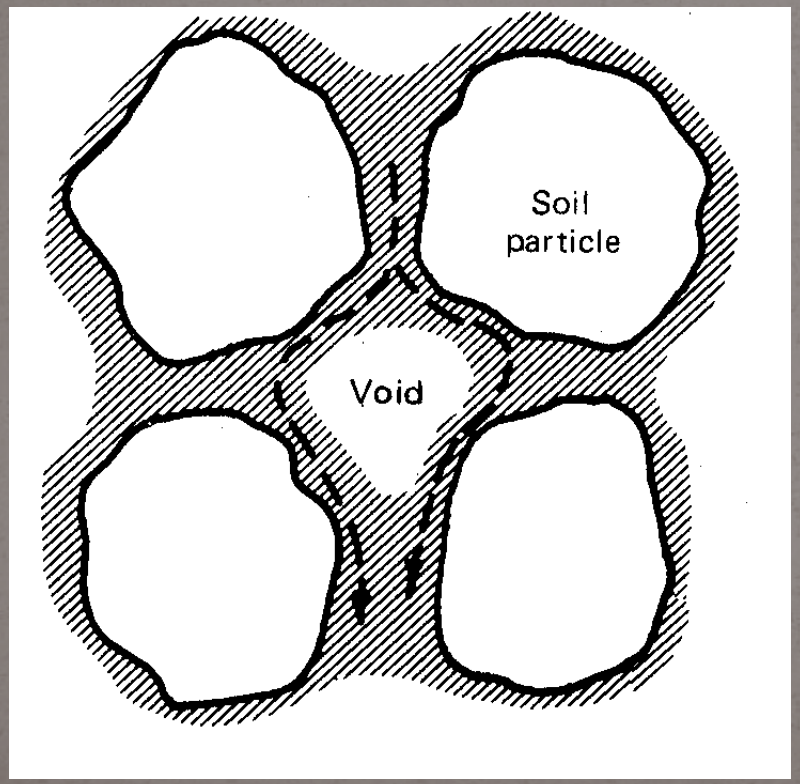
Where does the water go?

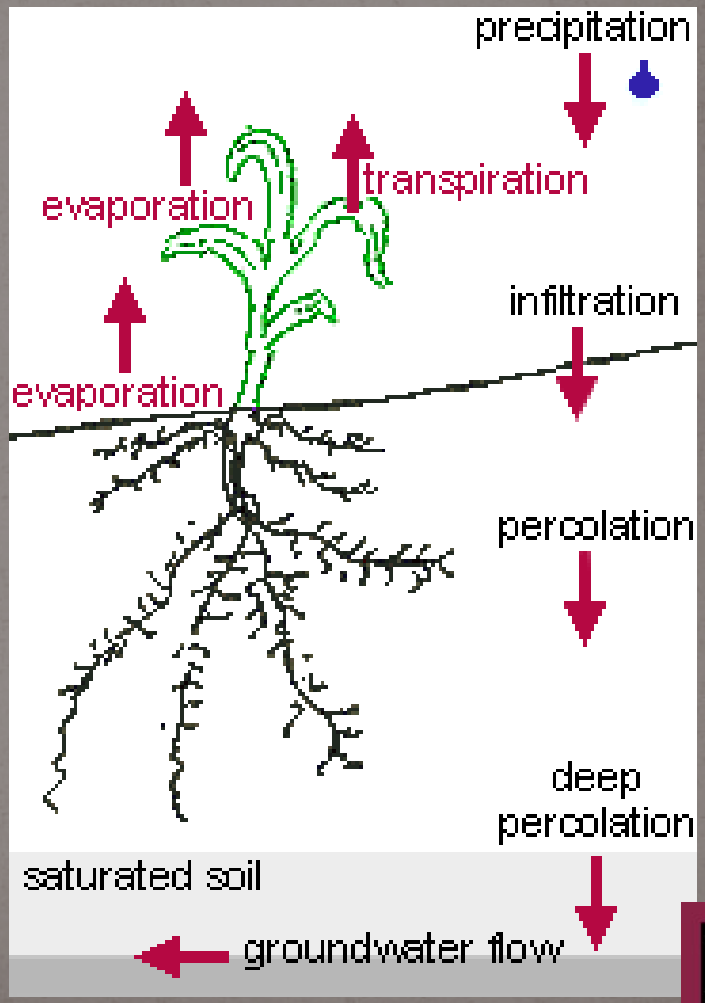
- Evaporation
- Transpiration
- Run off
- Deep Percolation



How Much Water is Needed?

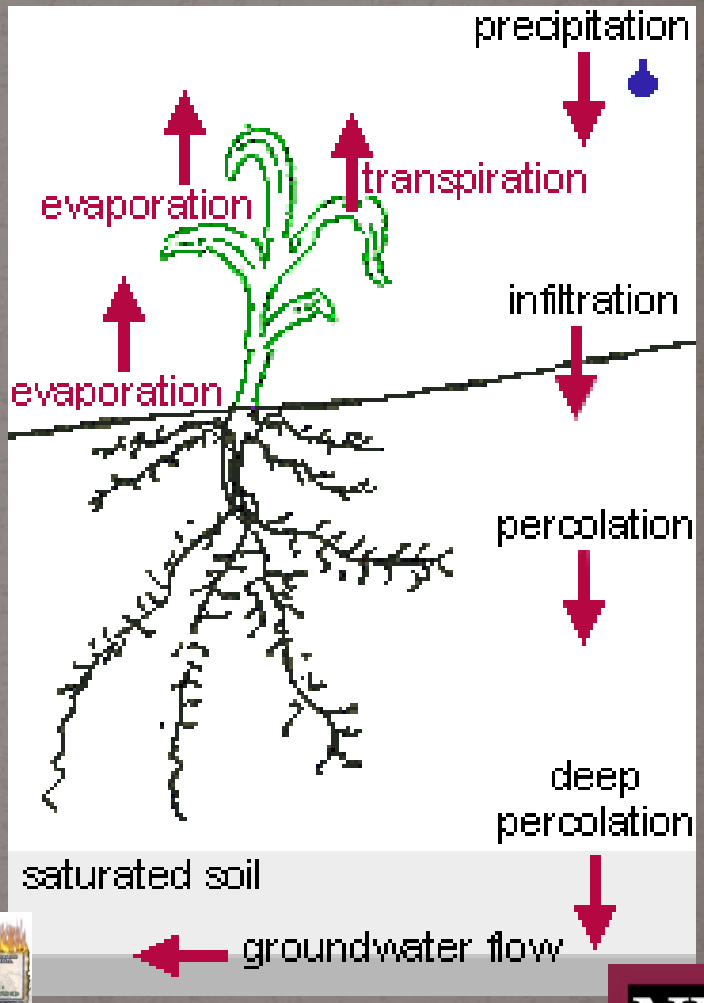
- Do plant roots need air?
- Irrigate to fill the root Zone.



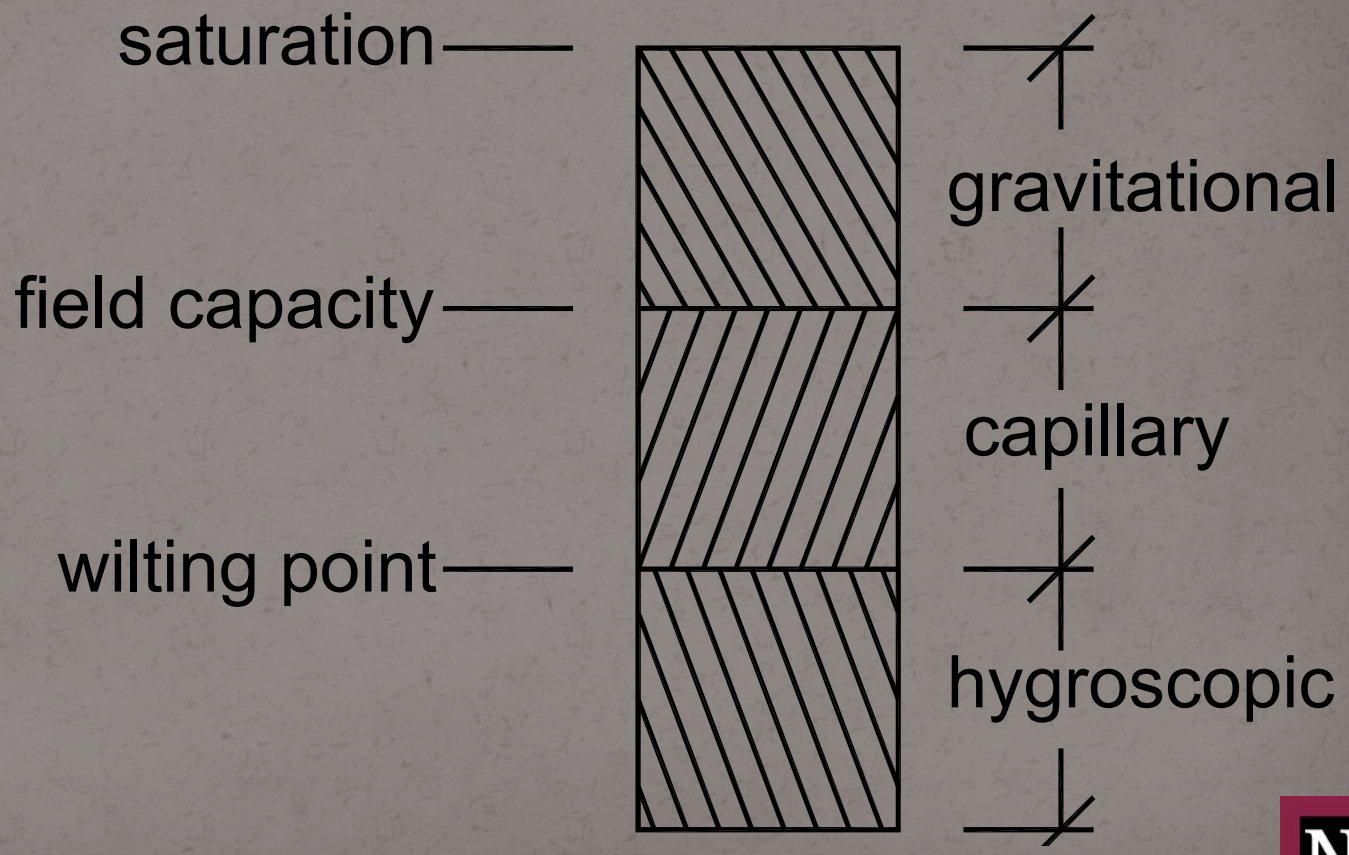


Over Fill the Root Zone

- Lose Water
- Lose fertilizer
- Lose chemicals
- Waste Energy / Fuel
- Waste labor
- Environmental concerns



Soil Water


saturation
field capacity
wilting point
gravitational
capillary
hygroscopic

Fill the Root Zone

- A root zone will only hold so much water
- If water is out of the root zone it is not benefiting your crop

Research Report **773**

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Low-Pressure Drip Irrigation for Small Plots and Urban Landscapes

Research Report 773

Daniel Smeal, Kevin Lombard, Margaret West, Michael O'Neill, and Richard N. Arnold[1]

Agricultural Experiment Station • College of Agricultural, Consumer and Environmental Sciences

Water purveyors in the western U.S. are developing management plans that include incentives to help conserve available water supplies for essential needs. Many cities in New Mexico (Albuquerque, 2009; Farmington, 2010; and Santa Fe, 2010) have implemented inclining block water rate structures in which the cost per unit of water increases with increased water use. Other measures taken to help curb outdoor domestic water use include irrigation restrictions, penalties for obvious water waste, rebates for removal of turfgrass, and building codes (Santa Fe, 2010) or rebates (Albuquerque, 2009) to stimulate the use of rainwater catchment systems. In response to these water conservation incentives, drip (or micro) irrigation is becoming more popular for irrigating small farm plots, vegetable gardens, and landscapes in and around urban centers. Since drip irrigation applies small volumes of water and can operate under low pressure, it represents an effective method of distributing irrigation to plants by gravity from elevated rainwater catchment systems or other tanks. The purpose of this paper is to share information gained while conducting low-pressure drip irrigation research at New Mexico State University's Agricultural Science Center at Farmington (ASCF).

DRIP IRRIGATION COMPONENTS

Pipe and emitters

Drip irrigation uses piping and small outlets (emitters) to apply water near the base of plants at very low application rates. Flexible polyethylene (PE) or vinyl piping is usually used. Plastic emitters may be built into the pipe at a regular spacing by the manufacturer (line source), or they can be independent of the pipe, inserted at selected locations along the pipe by the user (point source).

Line source drip lines are usually used in gardens or orchards where plants are in rows at a consistent spacing within the row. The lines may have rigid walls (tubing), which are usually sold in rolls of less than 1,000 feet, or thin walls that allow the line to lie flat (tape), and which are sold in coil lengths of over 5,000 feet (Figure 1). Emitter spacing may range from 8 to 48 inches or more, and the tubing or tape may be laid above or below the soil surface (subsurface drip or SDI). The flow rate of individual line source emitters is usually 1 gallon per hour (gph) or less, but flow rate is often expressed as gph per 100 feet, in which case the flow rate per emitter is determined by dividing the flow rate per 100 feet by the number of emitters per 100 feet.

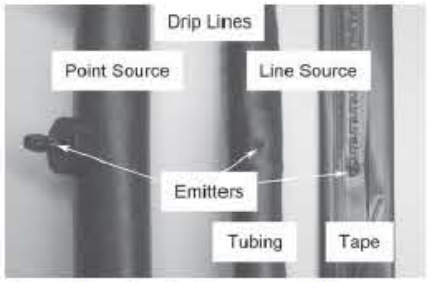


Figure 1. **Examples of point source and line source emitters.**

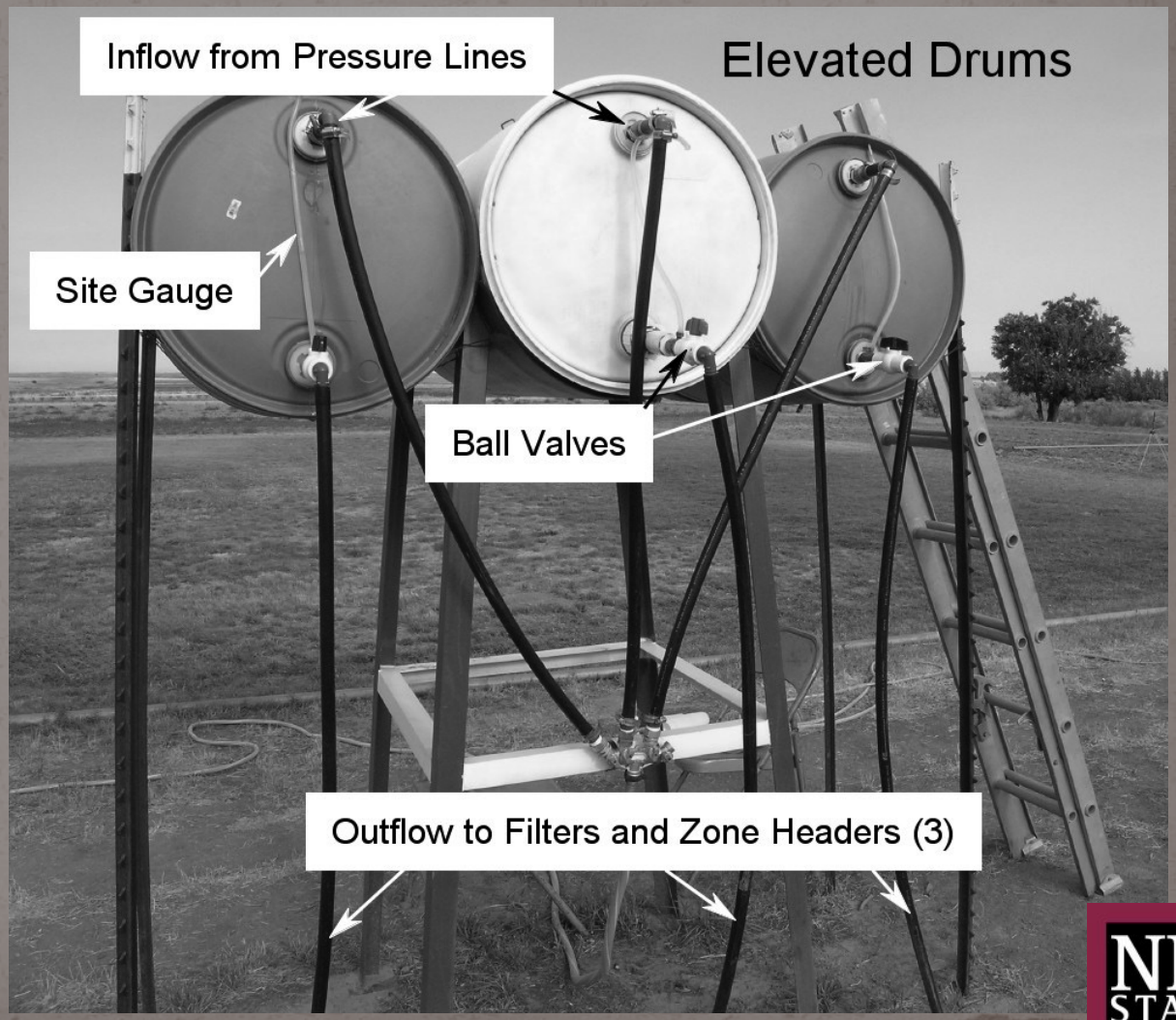
Example: 15 gph per 100 ft / 30 emitters per 100 ft = 0.5 gph per emitter

Point source emitters (Figure 1) are more suitable for irrigating widely or irregularly spaced plants, such as in landscapes or diversified gardens where a number of different plant species are grown. Point source drip systems are usually more expensive than line source sys-

[1]Respectively, College Professor (contact: NMSU Agricultural Science Center at Farmington, P.O. Box 1018, Farmington, NM 87499; phone: 505-960-7757; fax: 505-960-5246; dsmeal@nmsu.edu); Assistant Professor; Research Specialist; Professor; and College Professor, all of the Agricultural Science Center at Farmington, New Mexico State University.

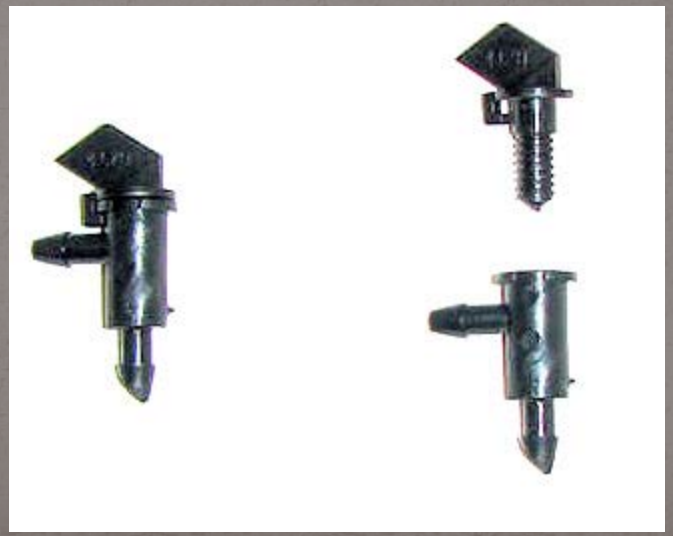
Smeal et al.

- Describe ways to use drip components in at reduced costs



Emitters

- The emitters control how fast the water drips out onto the soil.
- Usually require a specific pressure range to achieve consistent discharges



New Drip Technology

- Does not need a filter (save $$)
  - The emitter is configured to allow debris to pass by
- Does not need a pump (save $$)
- Works on a furrow irrigated field
- Save on capital costs
- Save on operation costs

New Drip System

- Need to provide a constant head for the water supply
- Need to provide a least a 50 cm head

Bubbler Irrigation
Low Inputs – High Efficiency

- Design Advantages
  - Low head pressure
  - Low cost – capital and operating
  - Low maintenance
  - Low tech
  - High efficiency
  - Parts are easy to obtain
    - Use salvage parts

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- By reducing pressure requirements, a low head bubbler system allows ‘least cost’ pipe and fittings to be used.
- The pressure normally required to compensate for friction losses and ground level variations is reduced by adjusting the elevation at each outlet to control flow
- Minor rises & dips in grade are adjusted for at the outlets
- Minor leaks in the system become insignificant due to the lower pressure
- Open pipe discharge eliminates the need for fine filtration
- Because the system is not closed, no anti-siphon, back flow prevention or vacuum break is needed
- No filter is required
- No pump is required

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Getting Started

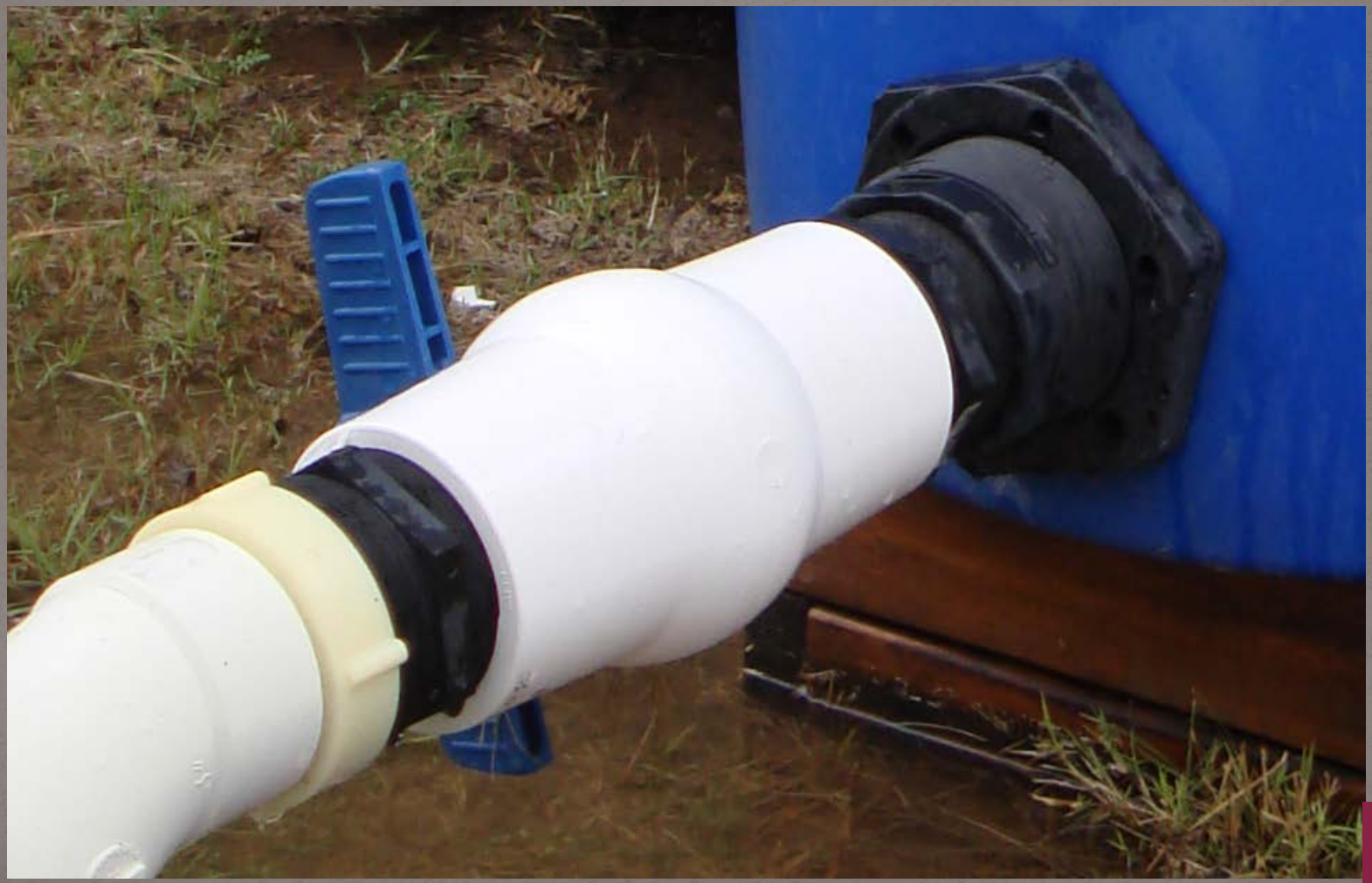
-Use a barrel to provide a constant low pressure for the system

-The barrel delivers water into the main lateral(s)

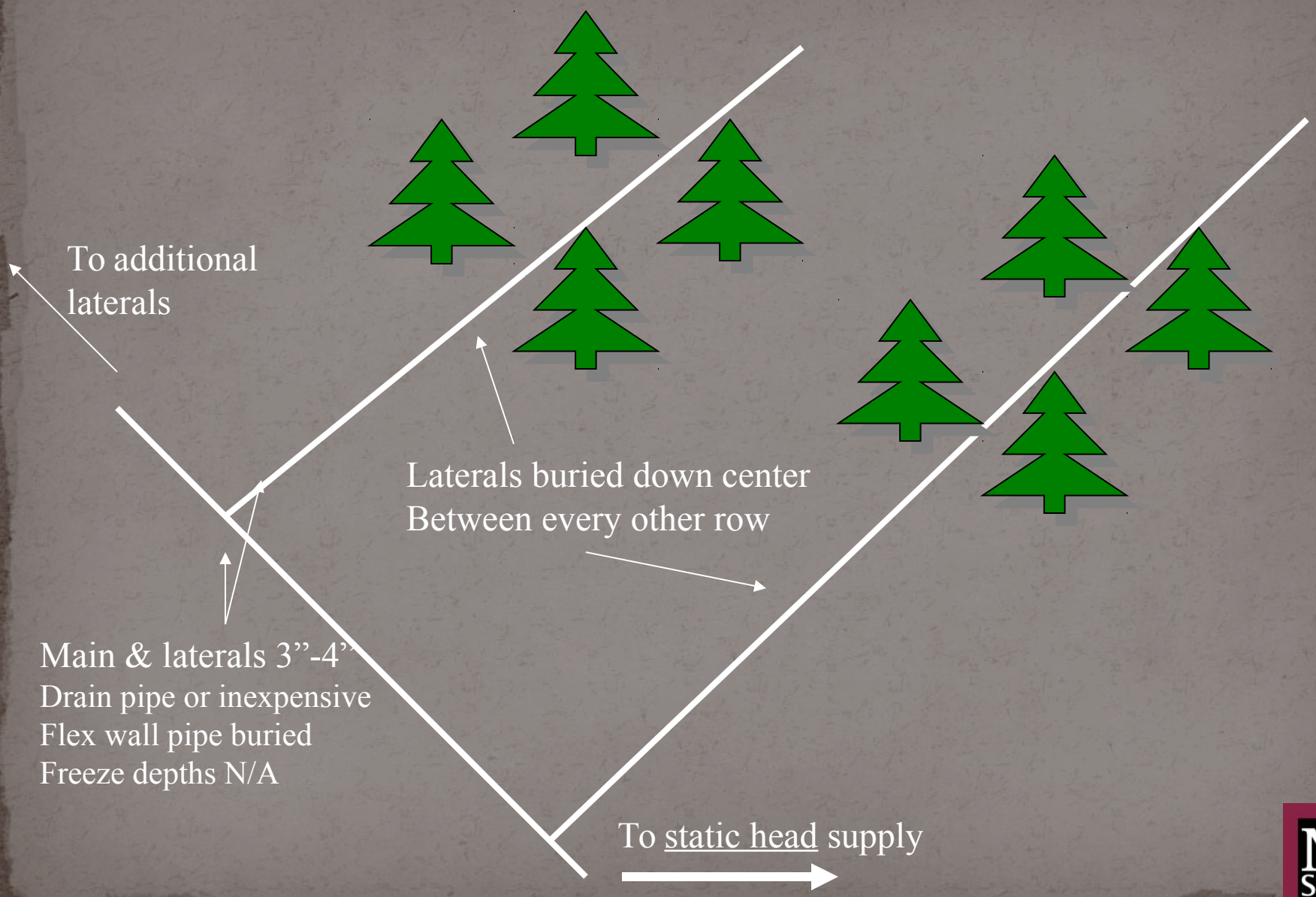
-The supply for the barrel can be a large water storage tank, cistern, pressurized system or any gravity fed or pumped water delivery

-Whatever the source, some **means of maintaining a constant static level** in the barrel is required

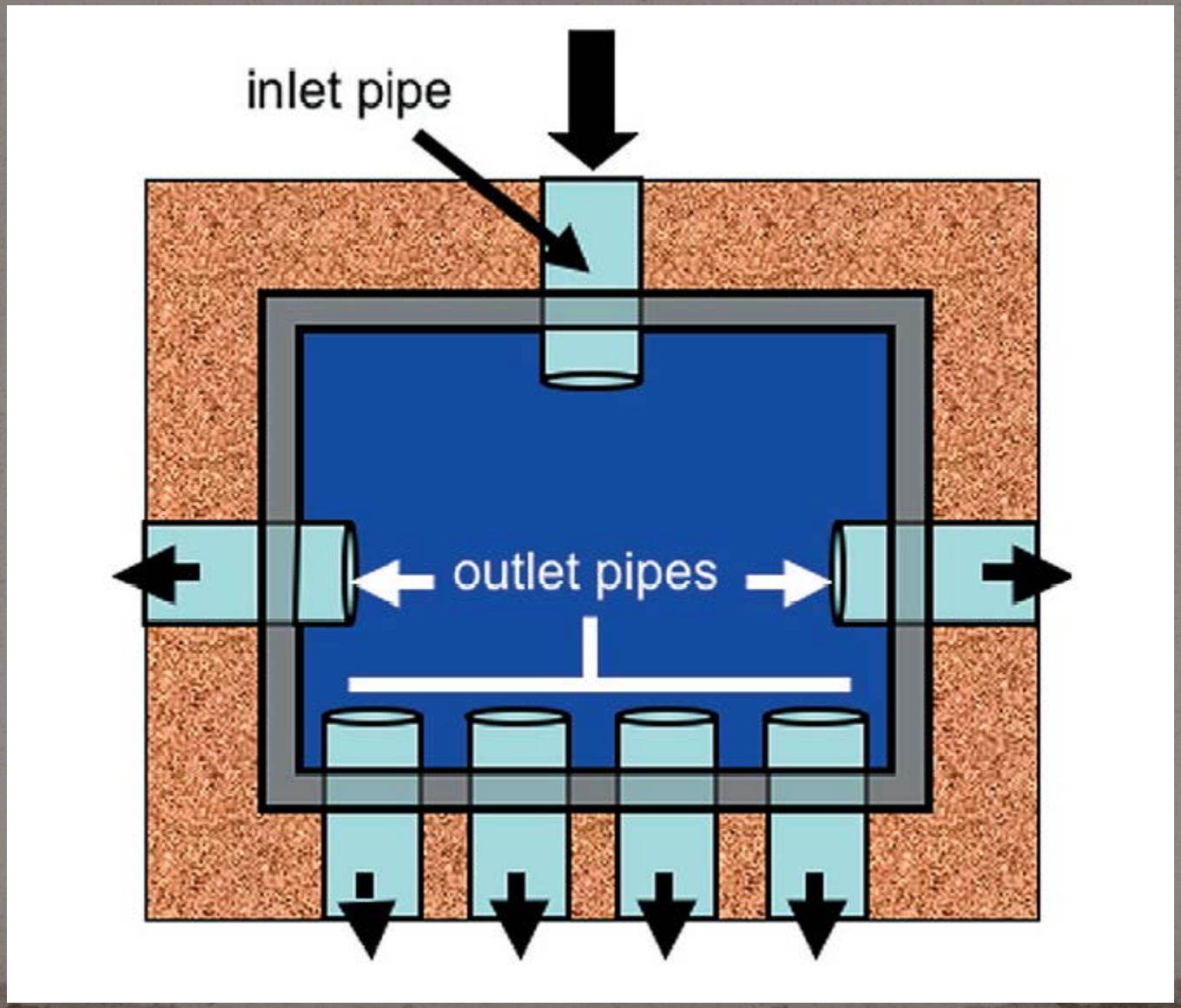
A main lateral valve is desirable.
For multiple mains from a manifold distribution, valves are required



Typical orchard or vineyard layout



A Flow Distribution Box will equalize flow to multiple lateral



-With main & lateral trenches still open, install lines to each plant using ½ inch poly irrigation tubing

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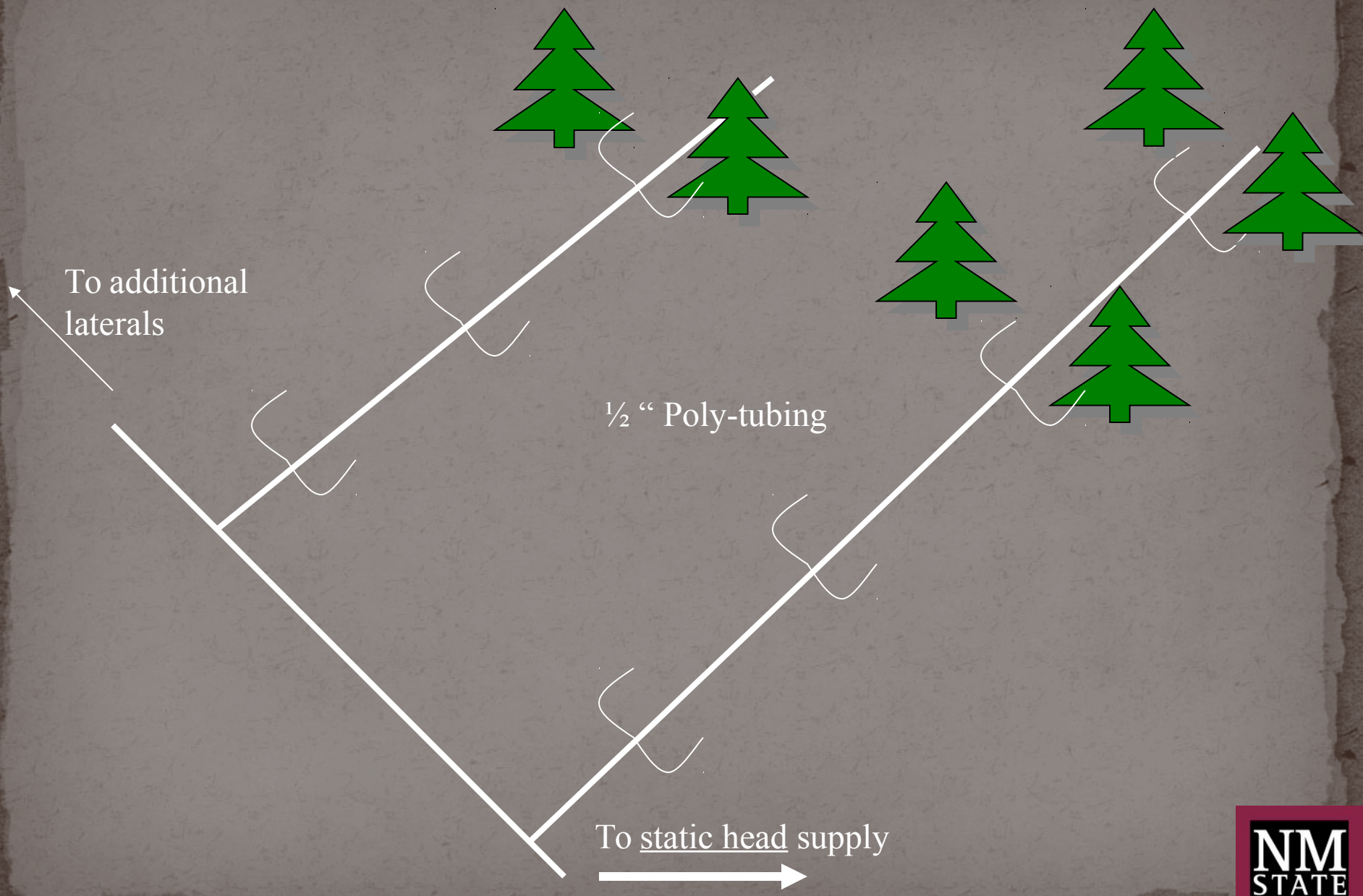
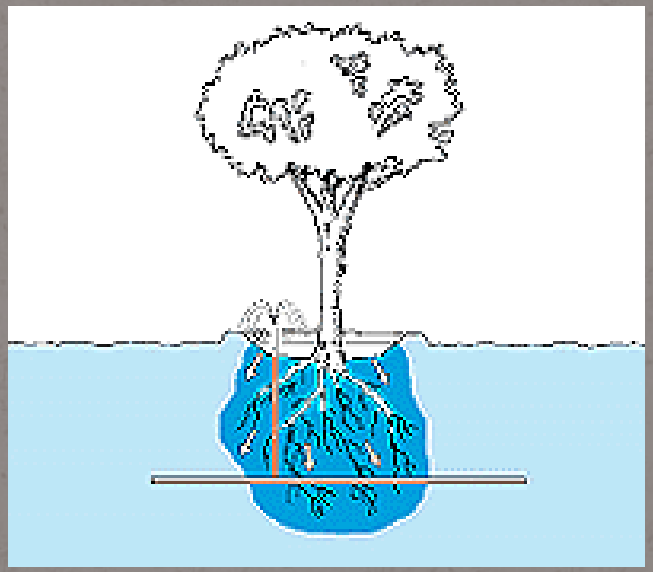
-Leave sufficient tubing length at the plant to extend above height of the static head supply

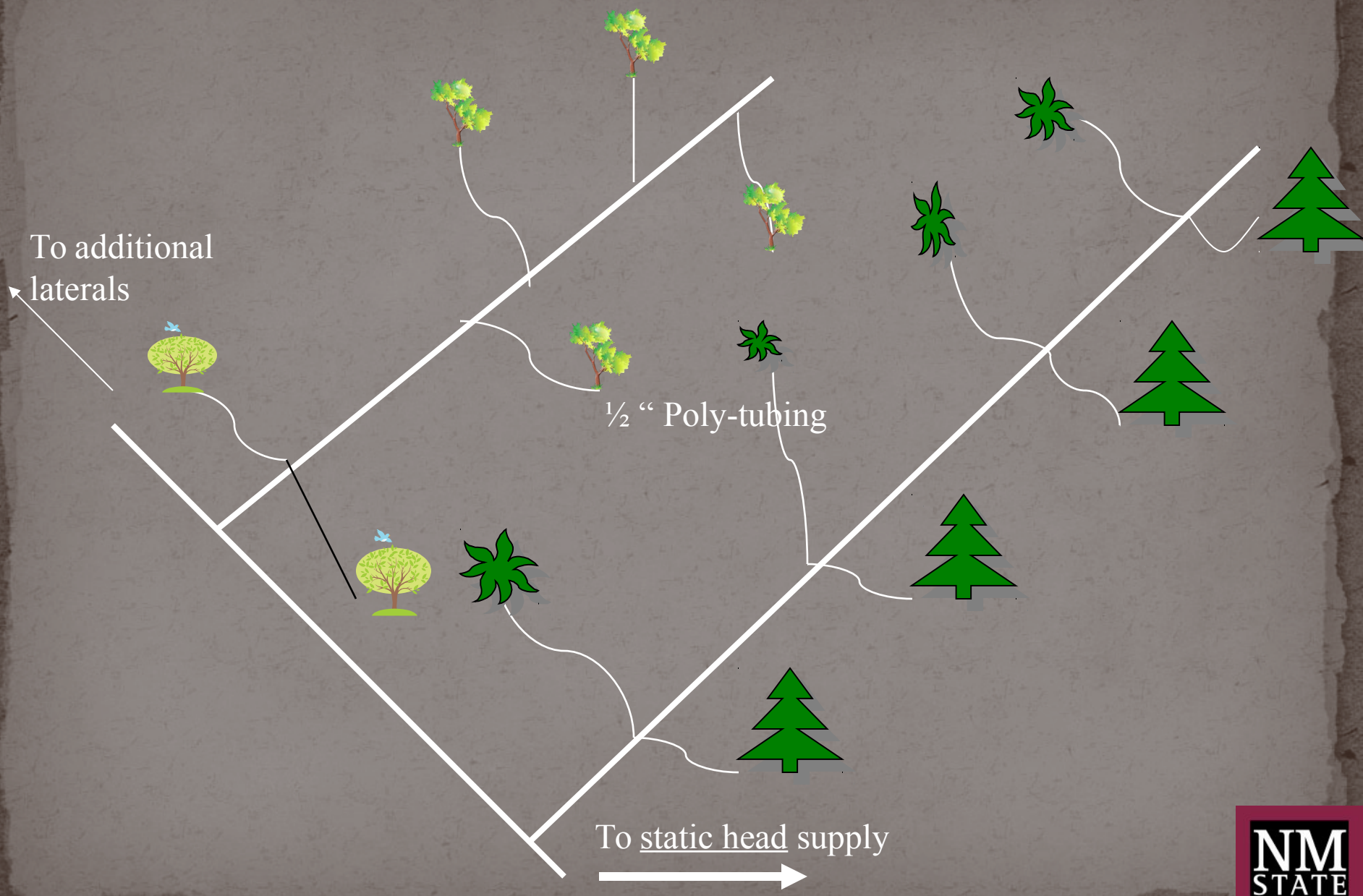
Poly tubing can be buried in a trench or pulled through a water or air jetted bore hole



Buried mainline with riser to tree/plant



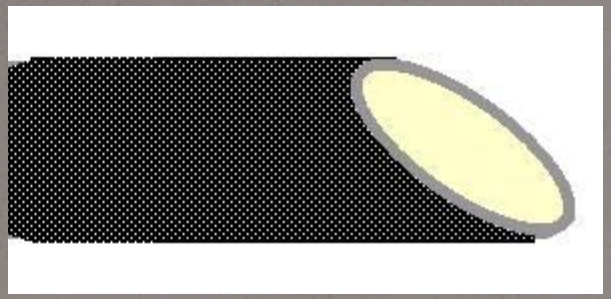
In landscapes, tubing can be routed in various direction toward the plants



Use a spade drill bit

A bit with edge points is desirable

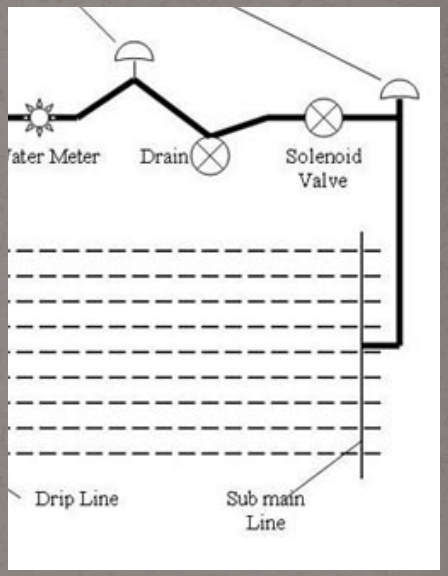
The ploy pipe that is going
to be inserted into the mainline
should be cut at an angle



INSTALLATION REQUIREMENTS

You need about 3 feet of head to operate the system

Make sure the mainline and laterals do not have high points in the line.



Immediately after drilling a hole in the lateral pipe install ½ tubing. The tubing will swell and seal the connection

-Determine the fixed static level in the lateral by raising or lowering the tubing end to the point where water stands just at the opening. This level will vary from one tube to another based on head loss due to field elevation and friction.

-When all the tubing end locations are fixed, go back and lower each tubing an equal distance that will achieve the desired flow rate. Fix this location on a stake or rod with wire or similar tie.

May calibrate for different discharges

Summary: If well designed, managed, and maintained, low-tech, low-cost, low head bubbler irrigation systems can be used effectively in various cropping plans or landscapes.

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