# Surface Irrigation Hydraulics

- Advance
  - Movement of water from the inlet end to the downstream end
  - Curve of Time vs. Distance is NOT linear
  - Rule-of-Thumb: 1/3 of the total advance time is needed to reach midpoint of the furrow length

# Surface Irrigation Hydraulics , Cont'd

- Recession
  - Process of water leaving the surface (through infiltration and/or runoff) after the inflow has been cut off
  - Usually begins to recede at the upstream end
  - Can also be plotted as Time vs. Distance
  - "Flatter" curve than the Advance Curve

# Surface Irrigation Hydraulics, Cont’d

- Infiltration
  - Opportunity Time:  difference between Recession and Advance curves
  - Infiltration Depth: a function of the opportunity time and the infiltration class (rate) of the soil

# Curve of Time Vs. Distance

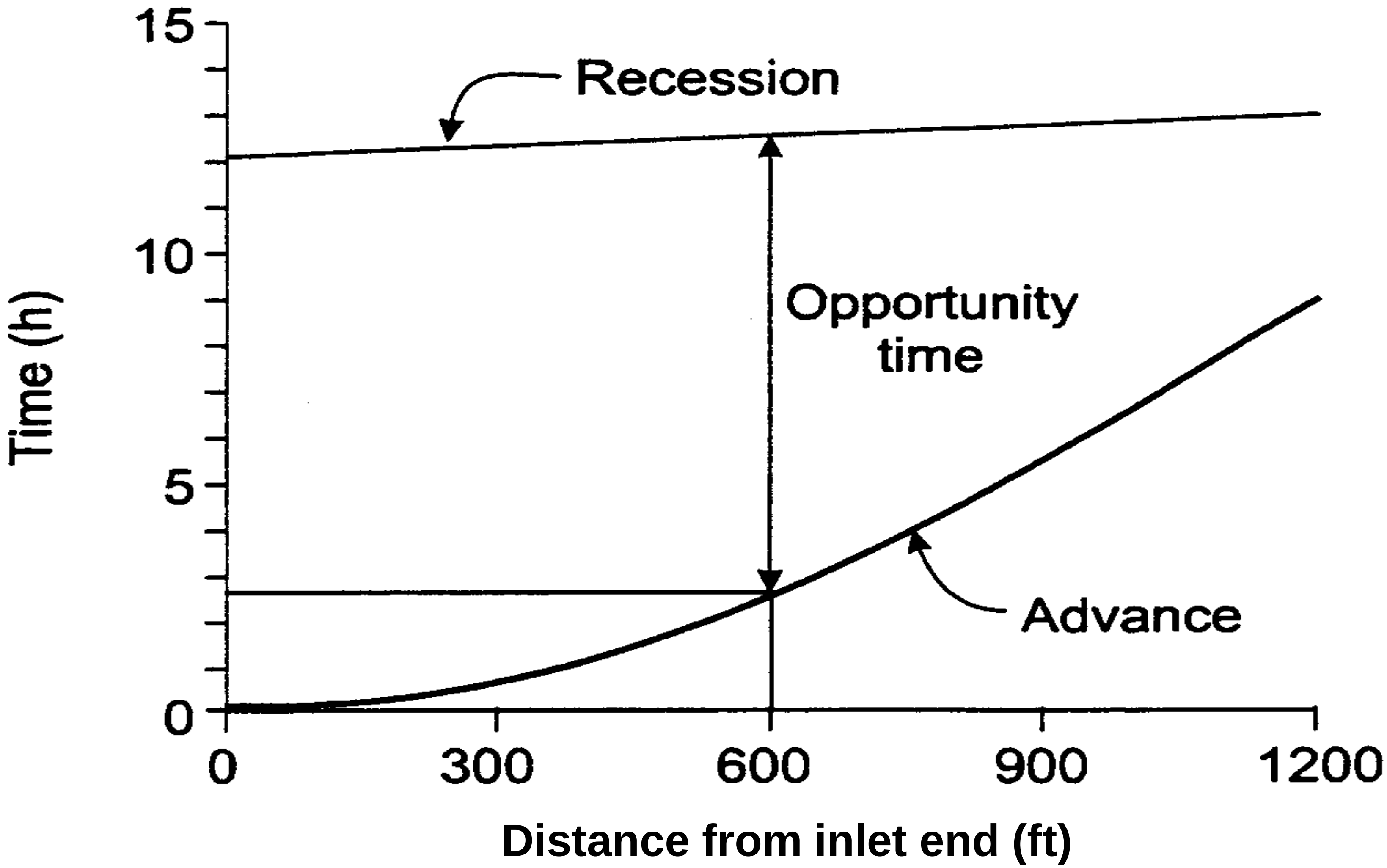



Figure 10.2. Advance and recession curves for surface irrigation.

# Opportunity Time

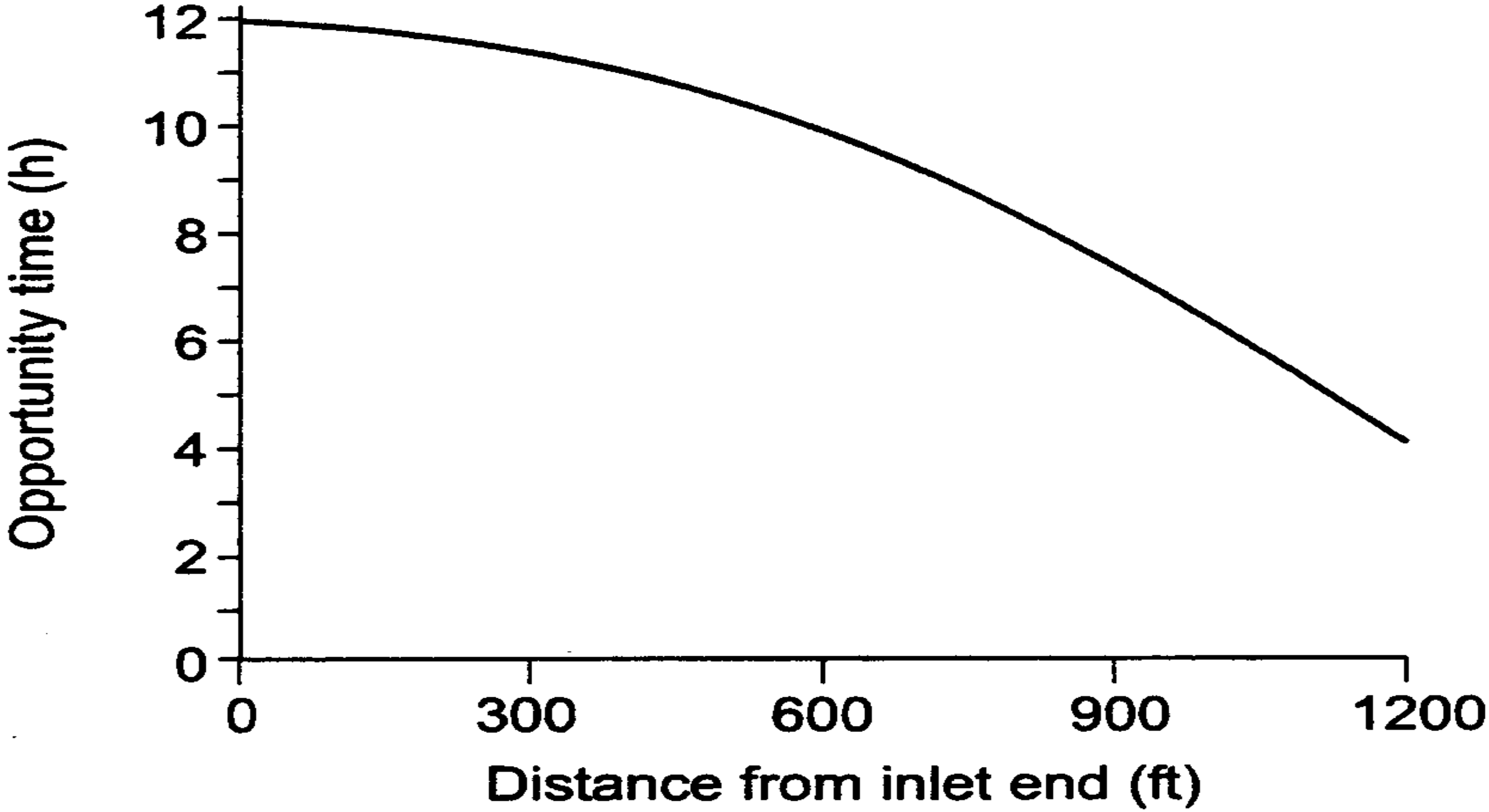



Figure 10.3. Opportunity time for surface irrigation.

# Infiltration vs. Opportunity Time

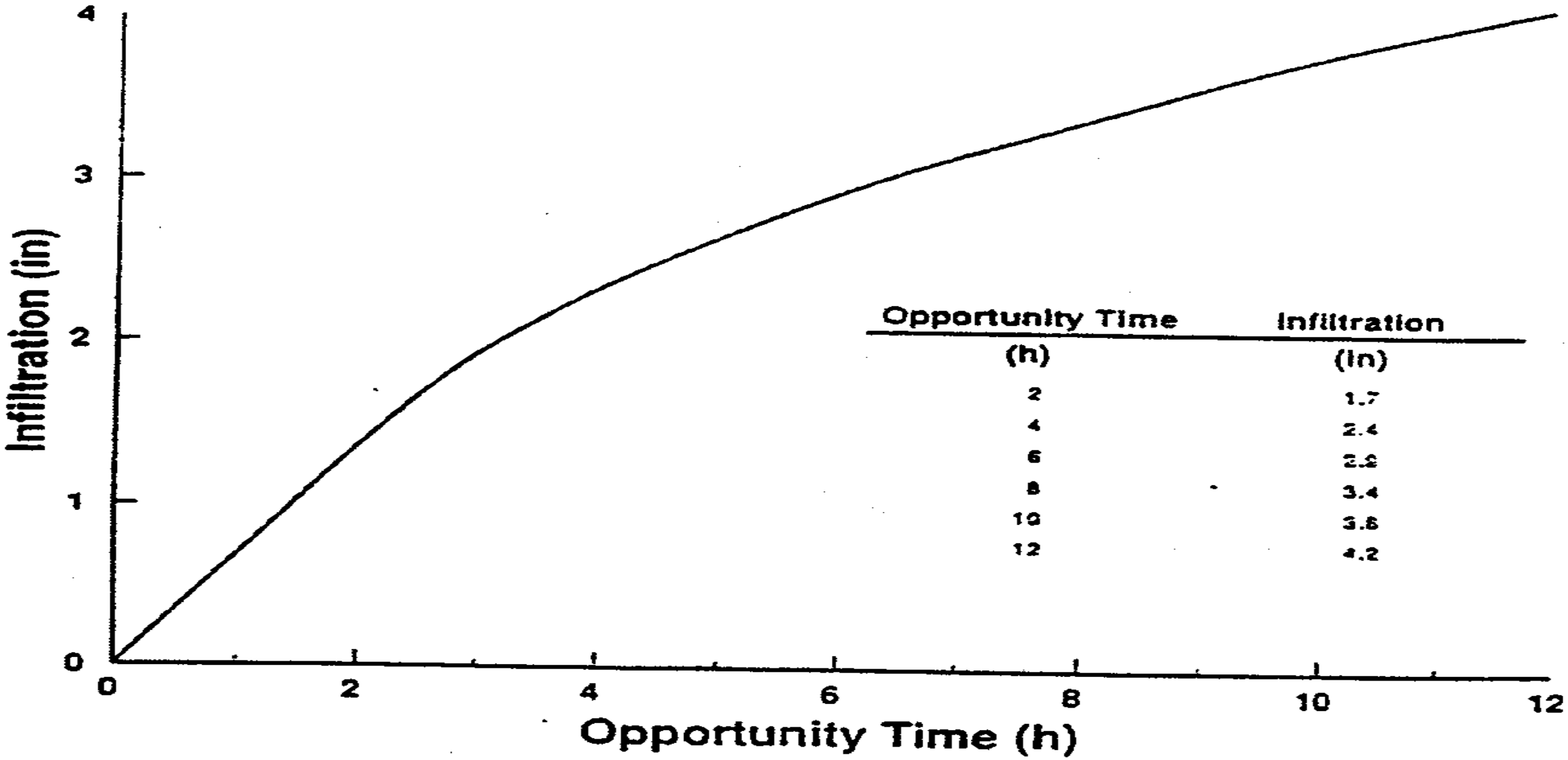



Figure 10.4. Infiltration vs. opportunity time.

# Infiltration Profile

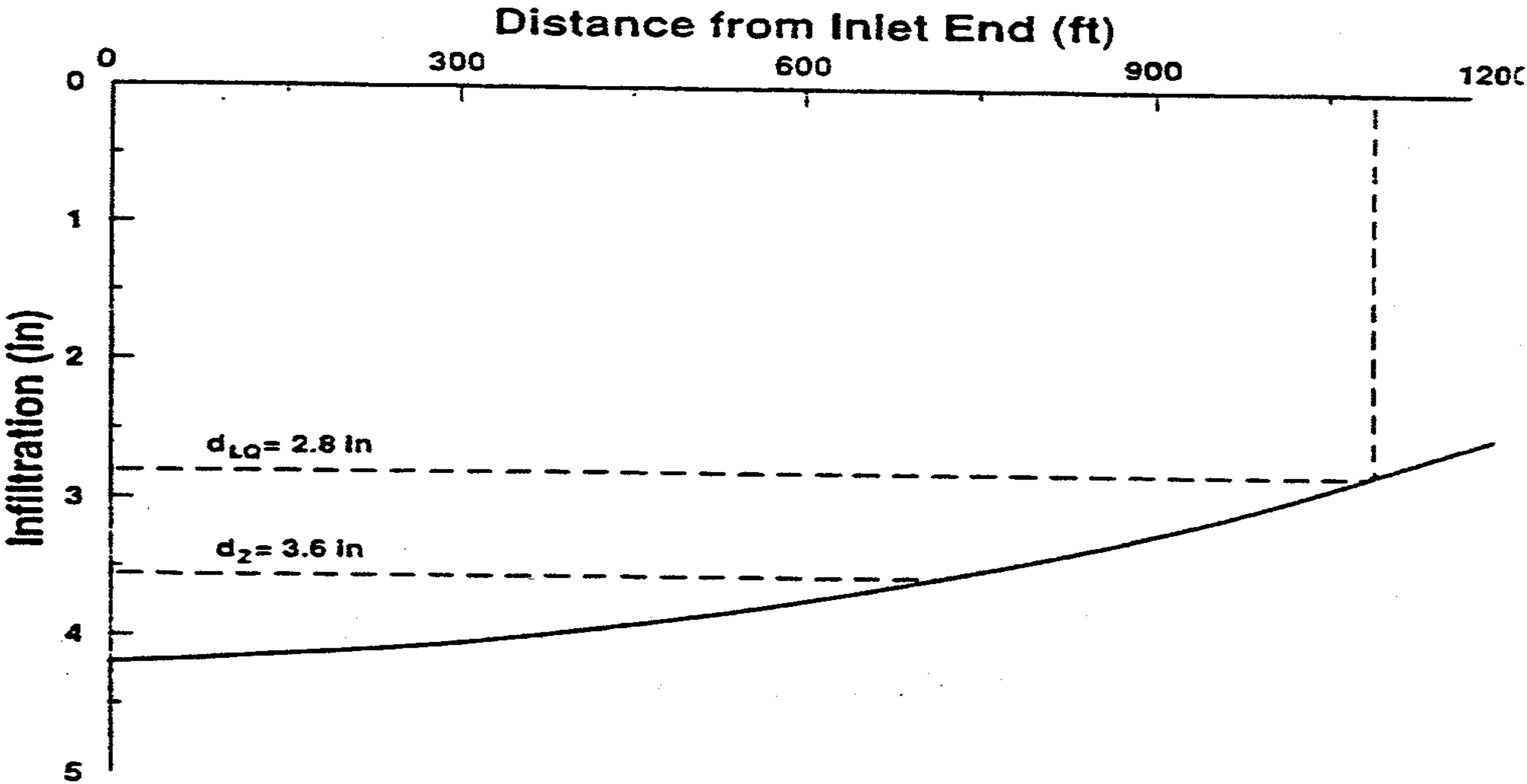



Figure 10.5. Infiltration profile.

# Uniformity

- Inherent non-uniformity because recession and advance curves are not parallel
- Factors affecting
  - Inflow rate
  - Slope
  - Soil infiltration
  - Roughness
  - Channel shape
  - Inflow time
  - Length of run
- Part of infiltration may go to deep percolation

# Improving Irrigation Efficiency

- Alternate furrow irrigation
  - Increases advance time, but reduces average infiltration depth (twice the width)
- Cutback irrigation
  - Use large inflow rate during advance, and then reduce the inflow to match the soil's steady-state infiltration rate
  - Intensive management is required

# Improving Irrigation Efficiency Cont'd

- Land smoothing and laser grading
  - Helps to improve uniformity
- Surge irrigation
  - Alternate on-off periods for applying water
  - Achieve higher efficiencies and uniformities in some soils
  - Lends itself to semi-automation

# Sprinkler Irrigation (impact sprinkler)

- Impact Sprinklers
- High pressure system commonly used prior to current concerns about energy prices and water conservation.
- Application diameters range from 50 to more than 100 ft
- Water loss during application can range from 25-35% or more

Picture from: http://www.irrigationmuseum.org/item1.aspx?id=125

Picture from: http://www.irrigationmuseum.org/item1.aspx?id=125

# Sprinkler Irrigation (impact sprinkler)

- Reducing the upward angle can reduce water loss
- These systems are still used for waste disposal because large nozzles and high evaporation can be beneficial
  - In humid environments excess soil moisture is primary limitation for waste disposal

http://www.irrigationtutorials.com/advice/why-not-use-those-huge-sprinklers/

# Sprinkler Irrigation (Low Pressure Applicators)

- Mid-elevation spray application (MESA)
- Low-elevation spray application (LESA)
- Low energy precision application (LEPA)

# Sprinkler Irrigation (MESA)

- Water is applied above the crop canopy
- Can require 20 to 30 psi operating pressure
- Newer systems can operate on 6-10 psi depending on drop spacing
- Above canopy irrigation reduced efficiency:
  - Interception and evaporation

# Sprinkler Irrigation (MESA)

- In corn production 10 to 12 % of water applied above canopy can be lost by wetting foliage
- Above canopy irrigation will lose 20-25% more water than LESA and LEPA systems

# Sprinkler Irrigation (LESA)

- Apply water at low pressures (as low as 6 pis)
- 12-18 inches above the ground
- Less crop foliage is wet
- Drops are spaced at 60 to 80 inches apart depending on crop row spacing
- Application efficiency is 85 to 90%

# Application Efficiency

- Proportion of water leaving the irrigation nozzle which hits the ground
- Influenced by:
  - Nozzle height
  - Upward angle
  - Droplet size
  - Wind speed
  - Humidity
  - Canopy interception

# Sprinkler Irrigation (LESA)

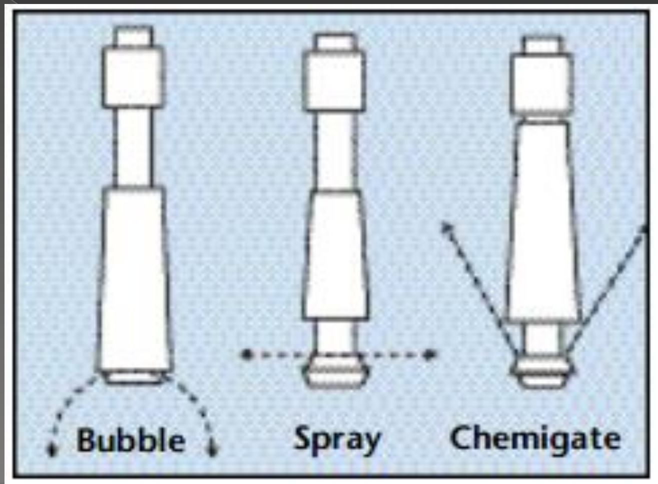
- Can be a problem in narrow row crops when drops drag though canopy which causes uneven water distribution
  - Just through the drops over the truss rods to raise it.
- LESA is currently the most common irrigation system in the Panhandle

# Sprinkler Irrigation (LEPA)

- Applicators are located 12-18 inches above the ground which apply water in a bubble pattern
- Or, drag socks or hoses that release water at the ground are use.

# Sprinkler Irrigation (LEPA)

- Drag socks or bubblers can be replaced with chemigation or spray plates
- Spray plates may be useful for crop emergence

# Sprinkler Irrigation (LEPA)

- Nozzles are place in every other row
- Dry rows improve rainfall storage
- LEPA systems can provide 95-98% application efficiency

# Runoff control in sprinkler irrigation

- Irrigation rate must match soil infiltration rate
- Infiltration can be increased with
  - Furrow diking
  - Deep tillage of compacted soil
  - Maintaining residue

# Subsurface drip Irrigation

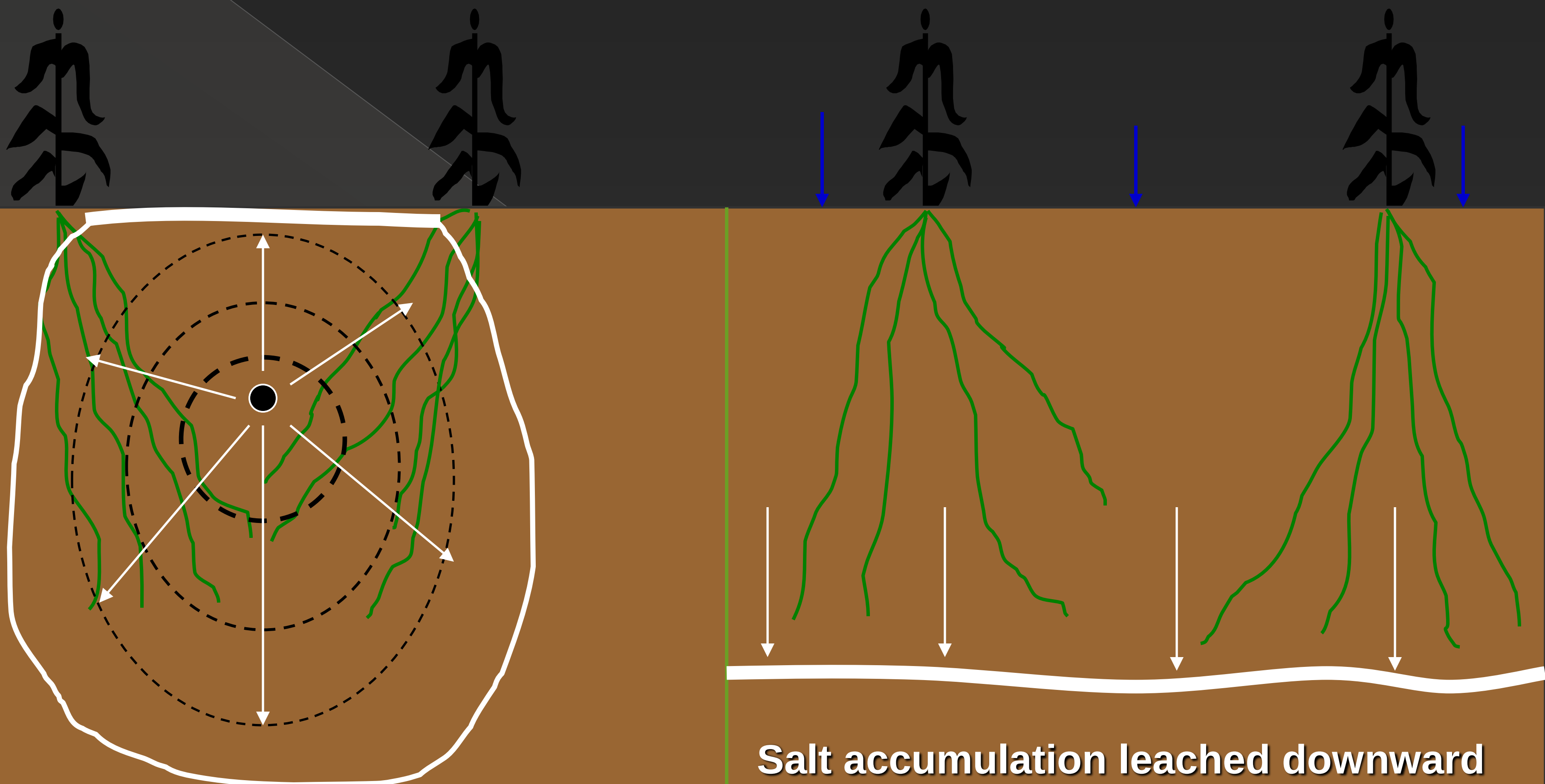
- Provides 100% application efficiency
- High yield/quality
- Field operations can be done during irrigation
- Decreased energy requirements
- Reduced salinity hazard
- Adaptable for chemigation
- Reduced weed growth and disease problems
- Can be highly automated
- No dry corners.

# Subsurface Drip Irrigation

- Disadvantages:
  - High initial cost
  - Maintenance requirements (emitter clogging, etc.)
  - Restricted plant root development
  - Salt accumulation near plants (along the edges of the wetted zone)
  - Crop establishment can be difficult during droughts

# Salt Movement Under Irrigation with Saline Water

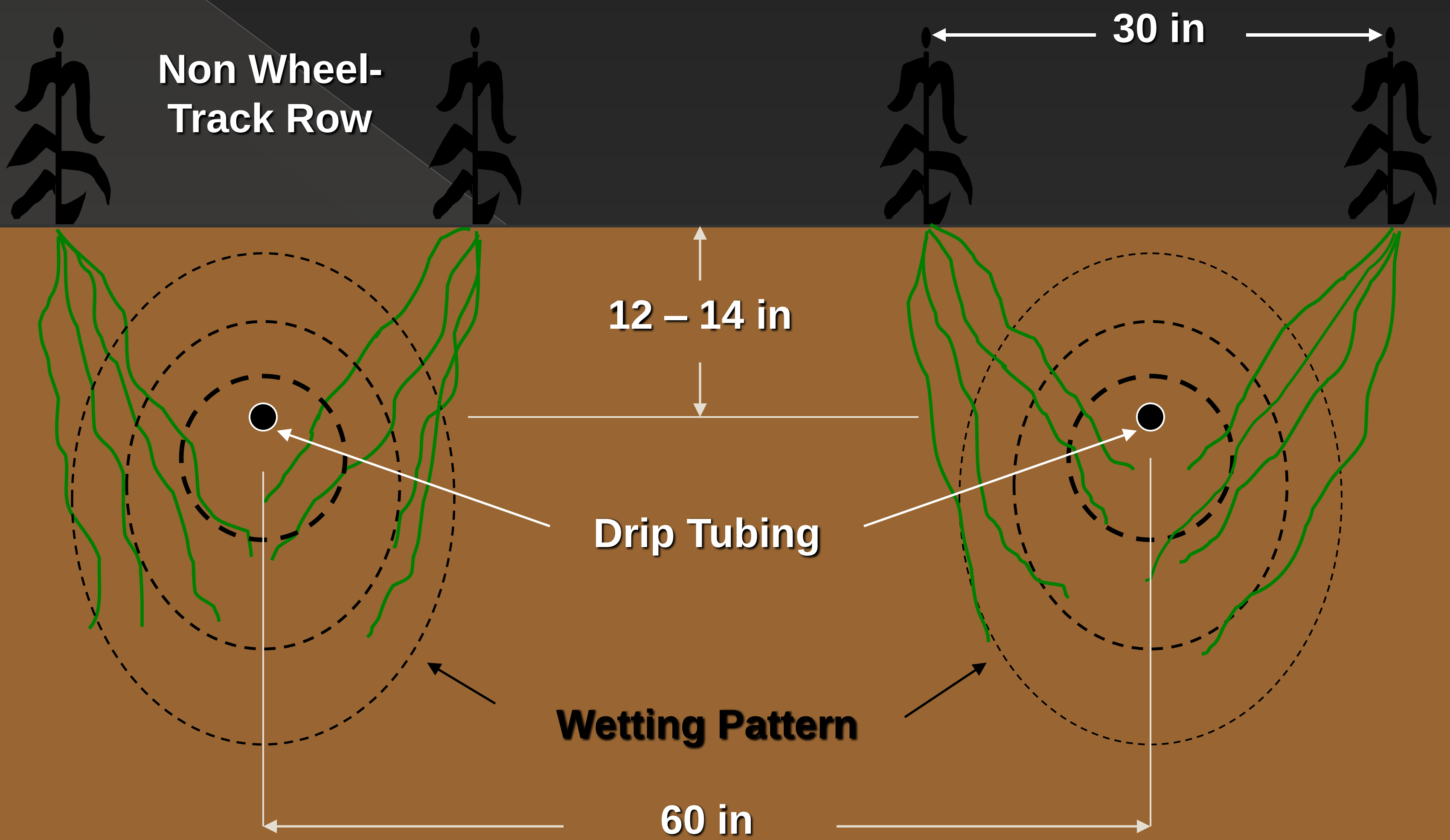
**Subsurface Drip** | **Sprinkler/Flood**



Salt accumulation leached radially outward from drip tubing

Salt accumulation leached downward by successive water applications

# Typical Subsurface Drip Tubing Installation for Row Crops




**60-inch dripline spacing is satisfactory on silt loam & clay loam soils**