Welcome. Today’s webinar is being recorded and will be posted at:

- www.E3Tnw.org
- www.ConduitNW.org

You may submit questions at any time during the webinar. We’ll answer them during the Question & Answer session after the presentation.

The webinar will begin momentarily. Thank you for attending!
Low Energy Precision Application (LEPA)

Emerging Technologies Showcase

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Sponsored by BPA’s E3T Program
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Estimated Water Use in U.S. in 2000

Data from Estimated Use of Water in the United States in 2000, USGS Circular 1268.
Withdrawn or diverted
Water removed from streams, groundwater or other sources.

Consumed
Water not returned to a surface or groundwater system.
Irrigation

- Responsible for 75-90% of water diverted or pumped.
- Irrigation = Consumptive Use
Energy Efficiency

US Total

Washington

Oregon

Idaho

Gravity Sprinkler Drip Subirrigation Gravity Sprinkler Drip Subirrigation Gravity Sprinkler Drip Subirrigation Gravity Sprinkler Drip Subirrigation Gravity Sprinkler Drip Subirrigation
Sprinkler Irrigated Acres

- Center Pivot: 62%
- Solid Set: 16%
- Hand Move: 9%
- Side roll, wheel line: 7%
- Big Gun or Traveler: 4%
- Linear Move: 2%
- Linear Move: 2%
- Big Gun or Traveler: 4%
- Side roll, wheel line: 7%
- Hand Move: 9%
- Solid Set: 16%
Future Water Demand for Energy Production

- Hydroelectric power generation.
- Cooling water demands for nuclear, coal, and natural gas fired power plants (thermoelectric)
• Need electricity to pump and treat water
  2000 – 20,000 kwh/million gallons
  \((\text{mill. gallons} \sim 30 \text{ people for one year})\)

• Need water to generate electricity
  thermoelectric withdraws 420,000 acre-ft day,
  consumes 10,000 acre-ft/day
  \(~7 \text{ gal/kwh (7000 gal/month per home})\)
  \text{average household} \ \text{water use} \sim 5000 \text{ gal/month}
Water Energy

• In CA, 20% of energy in the state is used to move water.
• In CA, 49% of water is used to create energy. Some returns to river.
• It takes from one gallon of water per gallon of oil to get it out of the earth to 350 gallons of water per gallon of oil when it is harder to find.
• It takes at least one gallon of water to create one KWH of electricity.
• Burn a 60W bulb 12hrs/day = 3000-6300 gallons of water/year
• Central air conditioner @ 12 hrs/day = up to 16,800 gallons of water/year.
• Burning Coal & Oil = 1-2 gallons / KWH. Hydroelectric = 18 gallons/KWH. In Arizona power plants use 7 gallons/KWH.
Future Water Demand for Biofuel

- Biofuel crop production will have to take place on existing lands and using already allocated water resources.
- Trading “food for fuel.”
- International Water Management Institute has shown that at a global average, it will take between 1000 and 4000 gallons of water to produce 1 gallon of biofuel.
Water Use by Category

**Idaho**
- **irrigation**
- **aquaculture**

**United States**
- **public supply**
- **thermoelectric**
- **irrigation**

Legend:
- Public Supply
- Domestic
- Irrigation
- Livestock
- Aquaculture
- Industrial
- Mining
- Thermoelectric

US Geologic Survey, 2004
Irrigation Water Management

• When do I turn the water on?
• How long do I leave it on?
• Getting it right saves an average of 15% water and energy.
  – And I get better YIELDS!
  – Save fertilizers
• Save Water, Save Energy, Save Money, Save the Environment, Get Better Crop Yields and Quality.
Power = Flow × Pressure × Efficiency

Pay for power (kW) over time (hrs) = KWH
Irrigation Efficiency Defined

Efficiency = \frac{Water\text{BeneficiallyUsed}}{Water\text{FlowingOntoField}}

\text{Irrig.App.Efficiency} = \frac{Water\text{AppliedToSoil}}{Water\text{LeavingNozzle}}
Forms of Water Loss

- Wind Drift
- Droplet Evaporation
- Evaporation from Foliage
- Evaporation from Soil Surface
- Runoff
- Deep Percolation
  - Over watering
  - Non uniformity
Irrigation Efficiencies

Highly dependent on:

• System Design
• Management
• Maintenance
• Weather
• Operating Conditions
Center Pivots
Center pivots are the most popular form of irrigation.
Irrigation Application Efficiency ~60%
Operating Pressure 60-80 psi
Application rate: Medium
Outlet Spacing ~20-30 ft.
Mid-Elevation Spray Application (MESA)

Irrigation Application Efficiency ~85%
Operating Pressure: ~40 psi.
Application Rate: High
Outlet Spacing: ~10ft
Low Energy(Elevation) Precision Application (LEPA)

Irrigation Application Efficiency ~97%
Operating Pressure: 15psi.
Application rate: Very High
Outlet Spacing: <5ft
Energy Efficiency
Emerging Technologies
Infiltration and Runoff

RATE (in./hr.)

TIME (minutes)

INfiltration

PEAK

POTENTIAL RUNOFF

APPLICATION PATTERN

Soil Dependent

$T_p$
End of 1/4 mile system @ 8 gpm/ac and travel speed of 10 fpm.
WATER APPLICATION RATE PROFILES
AT DIFFERENT POINTS ALONG THE PIVOT

1" application in a 60 hr revolution. Medium pressure impact sprinkler with a 100' foot wetted pattern.
Different Soil Infiltration Rates
Increase Surface Storage
E3T
Energy Efficiency
Emerging Technologies
Increase Soil Organic Matter
Increase the Number of Outlets
LEPA Demonstration Project

Richard Stroh, P.E.
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Idaho Falls, ID
LEPA Demonstration Project

- Will be evaluating various demonstration sites to determine effectiveness on different soil/climate/crop conditions
- Has the potential to save considerable water and energy on the right crop
- LEPA uses very low pressures (6 - 10 psi at the nozzle). This, along with the fact that less water per acre needs to be pumped, can lead to substantial energy savings.
- Could be the next generation of sprinkler upgrades
BPA LEPA Demonstration Project

LEPA  Transition  Typical Spray (MESA)

Soil Moisture Sensors  Data logger  Root Zone

Converted Section  Overhang  Pivot Point  Tower Wheel Tracks
LEPA Demonstration Project
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LEPA Demonstration Project
What is LEPA?
LEPA Management Considerations

- **Level Fields** – Maximum recommended slope is 1%
- **Surface Water** – Not recommended without extremely effective and maintained filtration
- **Circle Planting** – Not necessary but keeps applicator centered in furrow
- **Furrow Diking** – Small basins hold water until it can infiltrate the soil
- **Deep Chiseling or Ripping** – Loosens soil to improve infiltration
- **Soil Moisture Monitoring** – To schedule irrigation to help reduce deep percolation losses
- **Soft Middles** – Leave furrows be as uncompacted as possible.
- **Crop Residue** – To increase surface storage capacity and help prevent soil redistribution
LEPA Modes
LEPA Benefits

- Plant canopy stays dryer, helping to prevent foliage damage due to water quality
- Discharging water very near to, or on the soil surface eliminates wind-drift and minimizes evaporation
- Low pressure operation 6-10 psi saves energy, reduces fuel consumption and operating costs
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Residential Window Treatments
Wednesday, June 19, 2013 at noon Pacific time

More information about emerging technologies:
E3T database: www.E3Tnw.org
E3T Program: www.bpa.gov/energy/n/emerging_technology/
Conduit: www.ConduitNW.org