Farm Energy IQ

Farms Today Securing Our Energy Future

Saving Energy in Tree Fruit Production

NORTHEAST SARE Sustainable Agriculture Research & Education

Saving Energy in Tree Fruit Production

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Penn State Extension

Preview:

PART 1: Energy Use on Tree Fruit Farms

PART 2: Opportunities for Savings: Irrigation

PART 3: Opportunities for Savings: Refrigeration

PART 4: Opportunities for Savings: Field Operations

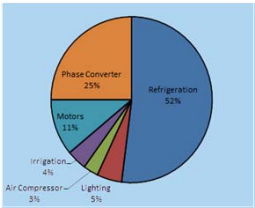
Energy Efficiency

- Energy-efficient practices on the farm bring to mind solar panels, wind turbines, and biofuels.
- But you don't have to jump head-first into buying the latest technology.
- With just a few simple changes, you can start to see real savings at the pump and on your electricity bill.

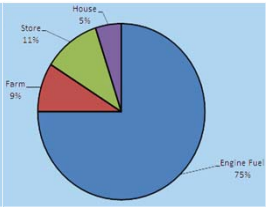
PART 1: Irrigation, the Life-line during Water Stress

- How can we ensure irrigation is energy-efficient?
- How can we assess energy use and waste in irrigation systems?
- What steps can be taken to improve the efficiency of a system?

Where do you use energy on your farm?



Example breakdown of annual electricity use on a fruit farm with an operating cold storage.



Breakdown of energy for all energy uses – fuel and electricity – from a Penn State Extension farm audit.

Did you know…

- On average, irrigation systems use 40% more energy than they would if properly sized, adjusted and maintained?
- About 25% of electricity is wasted from poor pump and motor efficiency?

Three Ways to Save Energy and $$$

- Make mechanical improvements
  - Better equipment and designs use less energy per hour of run time.
- Make management changes
  - Run the system less.
- Reduce the cost per unit of energy
  - Negotiate a better utility rate.
  - Switch fuels.
  - Find a lower price for fuel.

Quick Facts about Energy Waste

- #1 energy waster is the pump itself
- Be aware of these factors:
  - Lack of system maintenance
  - Choosing the wrong pump for the system
  - Pump wear
    - Cavitation
    - Abrasion
  - Improperly sized or designed fittings
  - Water source changes

Mechanical Improvements: Choose the Right Pump

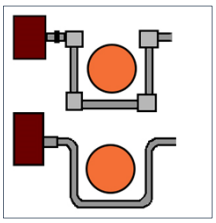
- Match the pump size to the irrigated area.
- An inadequate or oversized pump consumes too much energy.
- Check to see that the correct amount of water is being delivered to the crop.
- And when you're not using it…..shut it off!

Don't Over Pressurize

- Drip irrigation requires operating pressures between 15 to 25 psi at the pump and 10 to 12 psi at the drip tape.
- Pressure can be monitored using pressure gauges.
  - It is common to have one pressure gauge at the field entrance and several more in the field.
  - A pressure gauge costs about $15.

Minimize Kinks and Elbows

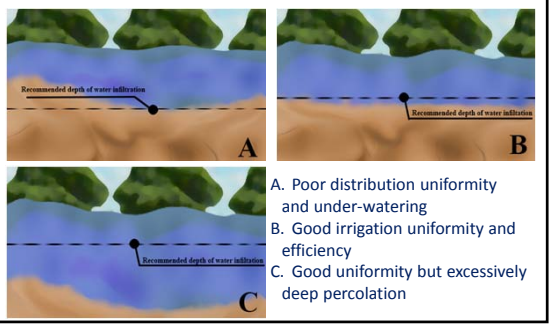
- Simplify your system by reducing the number of elbows, tees, valves and any other unnecessary obstructions.
- A gentle bend creates less friction than a 90 degree turn!



Slide 11

jLS2 Any suggested changes or comments for this slide appear in top 10 presentation
Jeannie, 8/3/2014

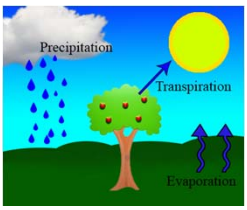
Distribution Uniformity → Irrigation Efficiency



A. Poor distribution uniformity and under-watering
B. Good irrigation uniformity and efficiency
C. Good uniformity but excessively deep percolation

Scheduling Irrigation

- Remove guesswork.
- Water regularly.
- Calculate water requirements based on plant growth and weather conditions.
- Measure moisture levels in soil.



Scheduling Irrigation

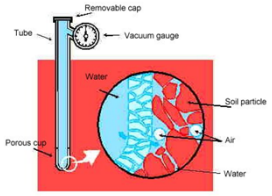
Use of automatic valves to shut the water on/off in certain spots in the field:

- Reduces human error in over- or under-watering
- Saves labor for turning individual valves on and off
- Allows watering specific areas from your house or office
- Is SIMPLE!!!

Soil Moisture Sensors

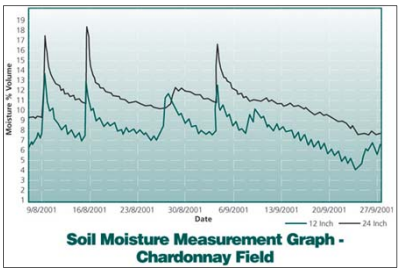
Tensiometers or resistance blocks to determine soil moisture levels:

- Take readings frequently
- Plot readings on a chart
- See trends in response to irrigation



Source: http://archive.agric.wa.gov.au/PC_92495.html

Innovations in Monitoring Soil Moisture: Sensor Networks



In a single irrigation zone at a Maryland nursery, 5 sensors measure moisture levels in the soil. Sensors relay information every 15 minutes to a computer in the office. Data are recorded on a graph, showing the moisture content of the soil.

Source: Raemelton Farm in Frederick, MD

Pump Maintenance

Set a date! Schedule this on your calendar

- Keep it clean!
- Lubricate when necessary.
- Replace leaking or worn pump seals/pipe gaskets.
- Protect from:
  - Dirt
  - Moisture
  - Freeze damage
  - Animals!

Checking Pumps For Efficiency

- 55 to 60% efficiency?
  - Consider adjusting the impeller.
- 50 to 55% efficiency?
  - Adjust impeller; if no effect on efficiency, consider repair or replacement.
- Less than 50% efficiency?
  - It's time for repair or replacement.

- Reduce the total dynamic head by installing variable speed drive controllers.
  - Best for on-peak/off-peak rates and frequent startups.

Pump Tests

- Why do a pump test?
  - To estimate your overall efficiency and cost of running (under the conditions of the test)
  - To identify when to repair or retrofit
  - With a new pump, to establish a baseline of performance
- Who can do it?
  - Public utility companies
  - Pump dealers
  - Independent contractors
- What does it measure?
  - Water flow rate
  - Pumping lift
  - Pump discharge pressure

Rebuilding and Adjusting

- Rebuilding centrifugal pumps
  - Replace shaft sleeves, packing, wear rings, and re-machine or replace impeller.
- Adjusting vertical shaft pumps regularly
  - Neglecting this costs efficiency.
  - Get a qualified technician to do adjustments.
- Rebuilding turbine pumps
  - Replace shaft sleeves, packing bearings and re-machine or replace the bowls.

Special Concerns for Micro-irrigation

- Pressure uniformity
- Device uniformity
- Clean filters
- Buildup of algae, slime, etc.
  - Flush periodically to eliminate precipitates and sediment.
- Subtle system changes
  - By the time you start to see problems, extensive underlying damage has probably occurred.

Flow Meters

- Measure the flow rate and/or total volume of water passing by the meter.
- Can help identify:
  - problems before they develop into catastrophes.

Flow Meters

- Help you evaluate your water management
  - Is the system efficient enough, or is there room for improvement?
- Why can't I just do a pump test?
  - A pump test just gives you one snapshot in time.
  - A flow meter will help you track performance history.
- How much does it cost?
  - $150 (simple models) to several hundred dollars.
  - Weigh options against the annual cost of operation – it may pay for itself many times over!

PART 3: Refrigeration

- Refrigeration can be a huge energy hog, but there are ways to make it more efficient.
- If the storage is *really* inefficient, it may be time to replace the refrigeration system with a higher efficiency unit.
- If you are not familiar with the latest systems, you may benefit from an energy audit

An energy audit can help you calculate the payback time and potential energy savings.

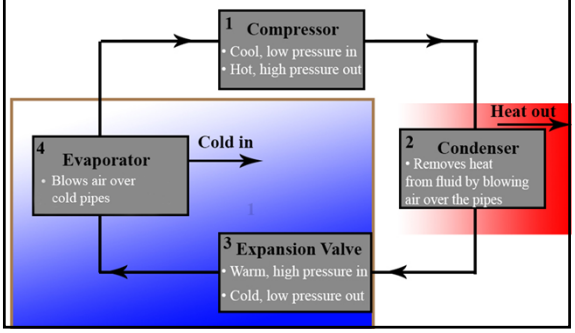
Refrigeration

1. How does a refrigeration system work?
2. How do we improve energy efficiency for refrigeration?
3. Which on-site energy assessments can be done?

Refrigeration Principles

- Refrigeration systems use electrical power to move heat from one space to another.
- This is done by moving a fluid in and out of a space, and manipulating its temperature.
- Vapor compression is the most common.

Refrigeration Principles



Refrigeration Uses Quite a Bit of Electricity

Unit	Typical Annual Electricity Use (kWh)
Walk-in Refrigerator (150 square feet)	16,200
Walk-in Freezer (150 square feet)	21,400

NRC Canada – Walk-in Commercial Refrigeration, 2009

Improving Energy Efficiency

- Minimize air leakage into refrigerated space.
- Clean fans and coils.
- Turn off lights and other heat sources when possible.
- Turn systems down or off when not in use.
- Install energy efficient fan and compressor motors.
- Insulate!

Old polyurethane insulation loses insulating value (up to 30%). Look for higher COP = Coefficient of performance (kW of cooling per kW of electricity).

Typical System Savings from High Efficiency Refrigeration

Measure	Savings (%)
High Efficiency Compressor	7.5%
High Efficiency Fans	11%
Anti-sweat Control	3%
Defrost Control	3.5%

NRC Canada – Walk-in Commercial Refrigeration, 2009

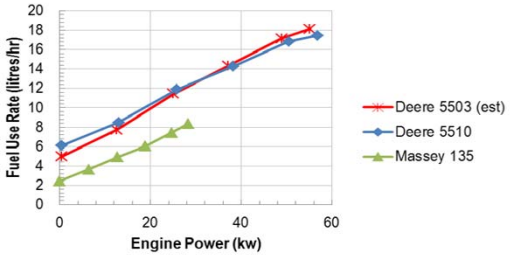
On-site Refrigeration System Check

- Collect name plate data from compressor and evaporator motors.
- Check insulation thickness.
- Check condition of door seals and existence of strip curtains.
- Find out if anti-sweat heaters are used.
- Find out how much the unit is used.
- Find out if unit is turned down or off when not in use.
- Find out if waste heat is recovered for water heating.
- Check refrigerant levels, using a sight glass.
- Check cleanness of fans and coils.
- Collect information on cooler lights—wattage and controls.

PART 4: Field Operations

- Fuel use for tractors, trucks and other farm equipment is the greatest energy consumer for in-field tree fruit operations.
- More precise management methods can help reduce fuel use, as can a move to higher density plantings.
- You can also save fuel (and time) by ensuring that your farm equipment is well-maintained. Quick fixes and neglect will only cause headaches later on—and energy efficiency will suffer, too.
- Be strategic about tractor and truck usage. Proper planning will ensure that you save time and money in the long run.

Choose Efficient Equipment



University of Nebraska Test Database

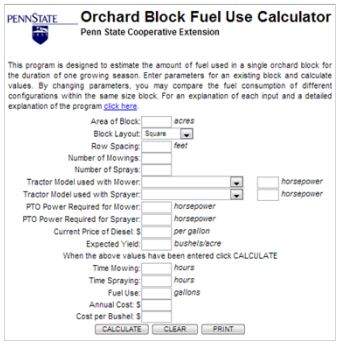
Choose Efficient Equipment

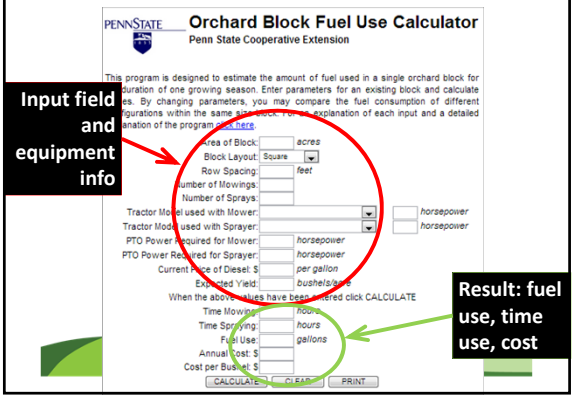
- Power Take Off (PTO)
  - Choose implements such as sprayers and mowers that require a low PTO.

PTO is the method of taking power from a tractor and providing it to a piece of connected equipment. A higher PTO requires the tractor to expend more energy which burns more fuel.

Fuel Use Calculator for Orchards

http://www.personal.psu.edu/users/d/e/dec109/FuelUseCalculator/FuelUseCalculator.htm





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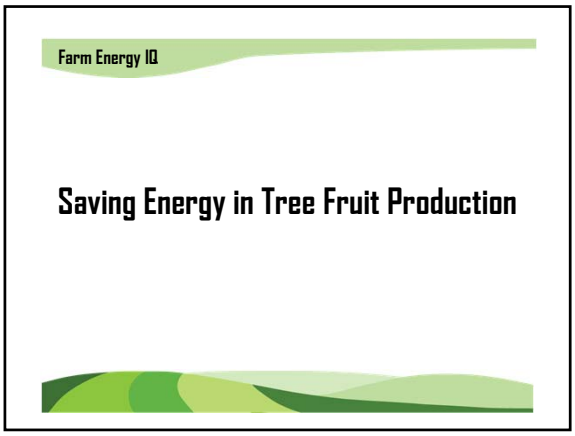
Summary

You don't have to jump head-first into buying the latest technology.

With a few simple changes to your operation, you can start to see real savings at the pump and on your electricity bill!

University Extension Goals as Horticultural Energy Experts

- Minimize energy inputs without reducing production.
- Provide equal or better control over production and post-harvest storage.
- Help farmers better understand their energy use and efficiency options.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