Learning outcomes

- Be able to understand the principle operation of the simple spraying system
- Be able to apprehend the method of crop care for optimizing the yield
Plastic mulch which may cause environmental problems
What are the most common crop care application in the agriculture field?
Function of sprayer

- **Control the application rate** so that application is not excessive.
- **Apply the fluid uniformly** on surfaces.
- **Break the fluid into very fine size**.
- **Too fine droplets may be blown by wind. Sprayer should spray sufficient droplet size that can wet leaf surfaces, stem, etc.**
Equipment for spraying and dusting

Powered by human for house or small orchard

Example?

Powered by machines for fields and orchards

A sprayer is a piece of equipment that uses tanks, pumps, and nozzles to apply liquid materials.

A duster is a piece of equipment used to apply dry powder materials.
<table>
<thead>
<tr>
<th><strong>Fertilizer &amp; Lime</strong></th>
<th>Fertilizer is essential elements for the plant growth. Lime application for controlling the soil pH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weed Control</strong></td>
<td>Different plant, effect; reduce the crop yield, lower product quality, increase pest control cost, interfering with harvest equipment</td>
</tr>
<tr>
<td><strong>Disease Control</strong></td>
<td>Cause the destruction of the crop. Factors: due to pathogens, seed and soil-borne, bacteria, virus, nematodes and plant pathogen</td>
</tr>
<tr>
<td><strong>Insect Control</strong></td>
<td>Most common attack to the crop such as wasps, bees and ants. Chewing the plant leave cause the plant injuries</td>
</tr>
</tbody>
</table>
Fertilizer application

- 3 general approaches to applying fertilizer
  - broadcast application
  - localized placement
  - Spray for foliar application
Fertilizer application - Broadcasting

- Fertilizer spread evenly over the entire field or area to be fertilized
- Mixed into the plow layer by means of tillage, but in some situations it is left on the soil surface and allowed to be carried into the root zone by percolating rain or irrigation water
- Broadcast most appropriate when a large amount of fertilizer is being applied with the aim of raising the fertility level of the soil over wide areas.
Fertilizer application - Localized placement

- Reduces the amount of contact between soil particles and the fertilizer nutrient, thus minimizing the opportunity for adverse fixation reactions.

- Divide by 3:
  - starter fertilizer
  - liquid fertilizer
  - fertigation
Fertilizer application - Foliar application

- Spraying a dilute nutrient solution directly onto the plant leaves
4WD applying insecticide or foliar spray
Chemical application

- Commonly used especially with knapsack sprayer for foliar or pesticide/herbicide application
- Used when crop is broadcasted the chemical is selective type
- Pre-emergent – soil preparation must be good and crop residues degraded
- Post emergent – after the crop had grown
- Equipment for spraying must be calibrated and cleaned after use
Application equipment

- Application equipment is equipment used to apply fertilizer, pesticides, growth regulators, and other materials to crops.
- It must be properly calibrated and operated so the right amount of material is delivered.
- The equipment may use dry or liquid materials.
- Application equipment includes
  - Knapsack sprayer
  - Boom sprayer
  - Pressurized sprayer or dusters.
High clearance sprayer
Weed Control

Chemical: Herbicide
- Instant kill the undesired plant
- Long last effect on the plant and soil

No chemical: Field Cultivator
- Up root the soil or cut the root of the potential weed.

Applied by:
- Knapsack sprayer
- Four wheeled tractor
- Fro air or air blast
Knapsack sprayer - manually powered

Knapsack sprayer – weedicide
- insecticide
- foliar spray
Knapsack Engine Powered Sprayer

- Sprayer powered by engine, electric motor or tractor PTO.
- Types: Hydraulic sprayers
  - Hydro-pneumatic sprayers
  - Blower sprayers
  - Aerosol generators
Hydraulic sprayers

- Most sprayers used today.
- Spray pressure is built by the direct action of the pump on the liquid spray material.
- Pressure forces the liquid through the nozzles which break the spray into proper size droplets and disperse them in the spray pattern desired.
- Sufficient energy is imparted to spray droplets to carry them from nozzle to the surface to be treated.
Components of typical hydraulic sprayers are:

- Pump (with air chamber if required)
- Tank with agitator
- Framework for mounting the sprayer
- Pressure regulator and relief valve
- Pressure gage
- Strainer (Filter) and screen
- Control valve
- Piping and fitting
- Distribution system – hand spray gun, field boom, vertical boom, nozzles
- Power source
Pump

- Pump types: piston and rotary, diaphragm and centrifugal types
- To generate working pressure to deliver the liquid at specific flow rate

Nozzles

- Important part, it breaks the liquid into the desired size of droplet, manufacturer makes inexpensive nozzle tips which can be selected to give the desired spray characteristics and volume.
- The nozzle vary with respect to rate of discharge L/min or L/ha
- The angle of spray, and the type of spray pattern (hollow cone, solid cone or flat-fan).
- Inside nozzle is removable filter. Nozzle drop extension is used when needed for more effective spray.
Boom Sprayer

- Nozzles
- Pressure gauge & regulator
- Agitation system
- Control valves
- Pipe and hoses
- Support frame
- Pump
Direction of spraying
A. Recommended spray distribution for air blast sprayers on orchards tree.

B. If the canopy is of uniform depth, such as a vine, spray distribution should also be uniform, where each nozzle sprays the same rate. These distributions may change when there is fruit to protect.

These water-sensitive papers illustrate a range of coverage from 20-100 fine-to-medium droplets/cm². Ideal coverage is a minimum of 80-90 fine-to-medium droplets/cm² for most fungicide and insecticide applications.
Left to right:
Centrifugal, piston, diaphragm pumps, cutaway views. All pumps should deliver the necessary flow rate at the desired pressure and have sufficient flow to provide proper agitation as well as spray.
Fig. 12-26  Spraying small grain to control weeds. (Tryco Mfg. Co., Inc.)

Fig. 12-24  Method of applying weed and insect-control chemicals to corn. (Tryco Mfg. Co., Inc.)
Animal Power Sprayer
Tractor mounted boom sprayer

- Fitted with a lance that is held by a worker walking behind it or it may be fitted with a folding boom with nozzles fitted at regular intervals.
- Spray guards may be fitted between nozzles to reduce spray drift.
- They consist of a tank made of fiber glass with rounded corners to hold the spray material.
- Course filter is fitted at the inlet and excess spray material is recirculated at its bottom to agitate the spray material hydraulically.
- PTO driven pump draws the spray material from the outlet to the tank, pressurizes it and sends it to the boom to be sprayed out in the various nozzles.
Mist sprayer spraying insecticide or fungicide. In orchards.
Spraying preemergent weedicide
Semi-manual sprayer

Dusting equipment and granular material, knapsack type
Duster
Application by 4WD uses boom sprayer or tank and power sprayer on trailer

Boom sprayer may also be used for insecticides
Pump

To provide sufficient pressure to the tank and to deliver desired rate of the liquid

Pump power

\[ Hp = \frac{Q(gpm) \times P(\text{psi})}{1714 (\text{Eff})} \]  
used \textit{eff} of 50-60 %

Flowrate per nozzle

\[ Q(\text{GPM}) = \frac{\text{GPA} \times \text{MPH} \times W}{5940} \quad \text{or} \quad Q(\text{L}/\text{min}) = \frac{L}{\text{ha}} \times V(\frac{\text{km}}{\text{hr}}) \times W(\text{m})}{60,000} \]

GPA is the spray volume e.g. 15 GPA or L/ha

MPH is the speed in miles per hour or km/hr

W is the nozzle spacing in inches or meter
## Sprayer patterns

<table>
<thead>
<tr>
<th></th>
<th>Extended Range Flat Fan</th>
<th>Standard Flat Fan</th>
<th>Drift Guard Flat Fan</th>
<th>Twin Flat Fan</th>
<th>Turbo Flood Wide Angle</th>
<th>Wide Angle Full Core</th>
<th>Flood Nozzle Wide Angle</th>
<th>Raindrop Hollow Cone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herbicides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil-incorporated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-emerge</td>
<td><strong>Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Good</strong></td>
</tr>
<tr>
<td></td>
<td>(at low pressure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-emerge Contact</td>
<td><strong>Good</strong></td>
<td><strong>Very Good</strong></td>
<td></td>
<td></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Good</strong></td>
</tr>
<tr>
<td>Post-emerge Systemic</td>
<td><strong>Very Good</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(at low pressure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fungicides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact</td>
<td><strong>Very Good</strong></td>
<td><strong>Good</strong></td>
<td></td>
<td></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td></td>
</tr>
<tr>
<td>Systemic</td>
<td><strong>Very Good</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(at low pressure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Insecticides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact</td>
<td><strong>Good</strong></td>
<td><strong>Very Good</strong></td>
<td></td>
<td></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td></td>
</tr>
<tr>
<td>Systemic</td>
<td><strong>Very Good</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td><strong>Very Good</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(at low pressure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
If the pressure gauge needle is bouncing or otherwise suspect, compare it with a known, working, oil-filled gauge. Check to see if the pulsation dampener is malfunctioning. If in doubt, replace the gauge.
NEW SPRAY TIPS
Produce a uniform distribution when properly overlapped.

WORN SPRAY TIPS
Have a higher output with more spray concentrated under each tip.

DAMAGED SPRAY TIPS
Have a very erratic output - overapplying and under applying.
Suggested Minimum Spray Heights

- Consider the minimum overlap required to obtain uniform distribution.
- However, in many cases, typical height adjustments are based on a 1 to 1 nozzle spacing to height ratio.
- For example, 110° flat spray tips spaced 20 inches (50 cm) apart are commonly set 20 inches (50 cm) above the target.
Increase in Pressure, will increase the Q

Increase in target angle and Pressure, will increase the Q
Speed and Pressure relationship

As we increase spray pressure, flow rate increases with a square-root relationship.

In order to double the flow rate, we need to increase spray pressure by a factor of four.

Figure 2 shows three different flow rate tips, each applying 10 US gpa at a range of travel speeds. Assume the operator uses a AIXR11004 to apply 10 US gpa at 12 mph. The nozzle would operate at about 40 psi, producing an Extremely Coarse spray quality. If the sprayer slows down to 7 mph to initiate a turn, spray pressure will drop to 15 psi, producing an Ultra Coarse spray. The spray pattern would likely become noticeably narrower, and poor pest control performance is likely in this situation due to the coarseness of the spray.
Boom Sprayer Calibration
Safe Use Initiative

Boom sprayer calibration

START
CHECK sprayer and mend

Use water only when calibrating the sprayer

Measure tractor SPEED

Measure FLOW-RATE

Calculate SPRAY VOLUME

Adjust SPRAY VOLUME if required

Prepare TANK-MIX

Adjust sprayer to the CROP

Spray

Picture source: Syngenta
Safe Use Initiative

Boom sprayer calibration

Calibration Materials

- Measuring tape 20-50 m
- Poles
- Measuring jug 2 L
- Hoses 30 cm (as many as calibrated nozzles)
- Logbook
- Stopwatch
- Nozzle brush
- Calculator
- Nozzle gauge
- Measuring tape 2-3m
- Knife
- Water sensitive paper & stapler
Safe Use Initiative

Boom sprayer calibration

Before calibration

CHECK sprayer and mend

Tank size (maximum volume of spray mixture) _______L

Hoses in good conditions ☐

Nozzles

All same type and size ☐

Correct nozzles spacing _______cm

Clean nozzles and filters ☐

Check nozzle aligned (flat fan nozzles 10° to the boom) ☐

Boom horizontal (check boom suspension if fitted) ☐
Safe Use Initiative

Boom sprayer calibration
Before calibration

Check with water (fill half tank with clean water)

<table>
<thead>
<tr>
<th>Task</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start sprayer pump and run tractor throttle at 540 rpm (PTO)</td>
<td>☐</td>
</tr>
<tr>
<td>Open boom valve to fill tubing and start spraying</td>
<td>☐</td>
</tr>
<tr>
<td>Clean nozzles producing distorted patterns</td>
<td>☐</td>
</tr>
<tr>
<td>Replace damaged nozzles</td>
<td>☐</td>
</tr>
<tr>
<td>Check and fix</td>
<td>☐</td>
</tr>
<tr>
<td>Leaks</td>
<td>☐</td>
</tr>
<tr>
<td>Valves working properly</td>
<td>☐</td>
</tr>
<tr>
<td>Agitation working</td>
<td>☐</td>
</tr>
<tr>
<td>Read pressure at pressure gauge</td>
<td>______ bar (kg/cm²)</td>
</tr>
</tbody>
</table>
Safe Use Initiative

Boom sprayer calibration
Measure the tractor speed

1) Mark a test strip of e.g. 100 m
2) Fill tank about half with water
3) Set tractor speed (gear, throttle at 540 rpm on PTO) as for spraying
4) Reach selected speed and engine rpm before entering the test strip. Maintain constant speed and record time to travel 100 m
5) Measure time: _____ sec. (example: 45 sec.)
6) Calculate tractor speed

Distance 100 m \times \text{Conversion factor 3.6} = 8.0 \text{ km/h}

Example:

\[ \frac{\text{Time measured}}{\text{Distance}} \times \text{Conversion factor} = \text{Speed} \]

Distance:
- Measuring tape 20-50 m
- Poles

Tools:
- Stopwach
- Calculator
- Logbook
There are two methods to determine the nozzles flow-rate:

- **Precise method:** Measurement of individual nozzle output during 1 min.
- **Good estimation:** Measurement of tank volume sprayed during 2 min.
Safe Use Initiative

**Boom sprayer calibration**

Measurement of individual nozzle output during 1 min.

1) Choose same engine rpm as used in speed measurement
2) Open boom valve to start spraying
3) Collect the water from each nozzle (via hose on nozzle) during 1 minute in a measuring jug
4) Record the water output from each nozzle
5) Calculate the average flow-rate per nozzle (L/min)

For uniform flow rate, variability between the nozzles should be < +/- 5% from the average flow rate

Nozzles differing > +/- 5% should be cleaned or replaced and flow rates checked again
Safe Use Initiative

Boom sprayer calibration
Measurement of tank volume sprayed during 2 min.

1) Fill the spray tank with water up to a clearly defined level, e.g. the top level (including pump, etc.)
2) Leave tractor running throughout the calibration process
3) Spray for 2 min.; pressure and rpm settings as for spraying
4) Measure the volume to refill the sprayer to the defined level
5) Calculate the flow-rate per nozzle

Step 1-3: do not change the position of the sprayer!

Refilled amount
144 L

Spraying time in minutes
2 min

Open nozzles
48 pieces

= 1.5 L/min per nozzle
Safe Use Initiative

Boom sprayer calibration

Calculate the Spray Volume (L/ha)

Spray Volume per ha

\[
\text{Spray Volume per ha} = \text{Flow-rate} \times \text{Conversion factor} \times \text{Open nozzles} \times \text{Boom width} \times \text{Tractor speed}
\]

- Flow-rate: 1.5 L/min
- Conversion factor: 600
- Open nozzles: 48 pieces
- Boom width: 24 m
- Tractor speed: 8.0 km/h

\[
\text{Spray Volume per ha} = 1.5 \times 600 \times 48 \times 24 \times 8.0 = 225 \text{ L/ha}
\]

225 L/ha
Safe Use Initiative

**Boom sprayer calibration**

Recommended spray volumes (L/ha)

If the calculated spray volume is within the recommended range of spray volumes, continue with ‘Adjustment of the sprayer to the crop’

- Follow pesticide label information
- Take crop density into consideration. Increase spray volumes to match denser crop and higher leaf areas

Target and crop density (leaf area)

100-200 L/ha  |  600 L/ha
Safe Use Initiative

Boom sprayer calibration
How to adjust spray volumes (L/ha)

Change nozzle size (large adjustment):
- For large adjustments, change nozzle size (check nozzle manufacturers catalogue)
- See calculation next slides

Adapt tractor speed (medium adjustment):
- Application volumes can be adjusted by altering the tractor speed.
- See calculation next slides

Adapt spray pressure (small adjustment):
- Small adjustments in flow rate can be made by adjusting the pressure
- See calculation next slides
Safe Use Initiative

Boom sprayer calibration
Change nozzle size (large adjustment)

1) Calculate the required flow-rate per nozzle based on the calibrated tractor speed and targeted spray volume

2) Select appropriate nozzle size / colour, e.g. 05 Brown for 2.00 L/min

<table>
<thead>
<tr>
<th>ISO size/colour</th>
<th>bar 1.5</th>
<th>bar 2.0</th>
<th>bar 2.5</th>
<th>bar 3.0</th>
<th>bar 4.0</th>
<th>bar 5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-Blue</td>
<td>0.85</td>
<td>0.98</td>
<td>1.10</td>
<td>1.20</td>
<td>1.39</td>
<td>1.53</td>
</tr>
<tr>
<td>04-Red</td>
<td>1.13</td>
<td>1.31</td>
<td>1.46</td>
<td>1.60</td>
<td>1.85</td>
<td>2.07</td>
</tr>
<tr>
<td>05-Brown</td>
<td>1.41</td>
<td>1.63</td>
<td>1.83</td>
<td>2.00</td>
<td>2.31</td>
<td>2.58</td>
</tr>
<tr>
<td>06-Grey</td>
<td>1.70</td>
<td>1.96</td>
<td>2.19</td>
<td>2.40</td>
<td>2.77</td>
<td>3.10</td>
</tr>
</tbody>
</table>

Measured

Speed
8.0 km/h

Measured

Boom width
24 m

Targeted spray volume
Spray Volume
300 L/ha

Required flow-rate

2.00 L/min per nozzle

Conversion factor
600

km/h – L/min

Open nozzles
48 pieces

Counted
Safe Use Initiative

Boom sprayer calibration
Adapt tractor speed (medium adjustment)

Slower speeds increase the spray volume (L/ha) and faster speeds reduce it

Present tractor speed
8.0 km/h

Present spray volume
225 L/ha

Targeted spray volume
300 L/ha

\[ \times \]

New tractor speed
6.0 km/h
Safe Use Initiative

Boom sprayer calibration
Adapt spray pressure (small adjustment)

Always stay within the optimal pressure range of nozzles (see catalogue). Changes in pressure can change the droplet size and may cause drift or run-off

Present pressure: 3 bar
Present spray volume: 225 L/ha
Targeted spray volume: 250 L/ha

New Pressure: 3.7 bar
Safe Use Initiative

**Boom sprayer calibration**

Adjustment of the sprayer to the crop

- Measuring tape 2-3 m
- Nozzle gauge

Orientation flat-fan nozzles

Correct nozzle type, size and pressure. Tractor speed, flow-rate and spray volume calibrated.

Nozzle orientation and nozzle spacing checked.

**110° nozzles**
- Boom height over target 45-50 cm

**80° nozzles**
- Boom height over target 70-75 cm

Boom height over target (crop/soil) according to nozzle angle for an even spray distribution.
Safe Use Initiative

Boom sprayer calibration
Spray distribution check with water-sensitive paper

Staple water-sensitive paper onto a wooden lath and place the lath across a single run width. Leave gap for tractor wheels. Water sensitive papers can also be stapled on leaves within the crop.
Safe Use Initiative

Prepare tank mix

Calculation of how much pesticide to add to the spray tank
Safe Use Initiative

Prepare tank mix
Calculation of how much pesticide to add to the spray tank

There are two main possibilities how the product dose is indicated on the pesticide label:

- Label indication: Use xxx L/ha or g/ha
- Label indication: Use xxx L or g /100 L water in a specific spray volume, e.g. 1,000 L of water /ha
Safe Use Initiative

Prepare tank mix

Label indication: Use xxx L/ha or g/ha

Example:
1) Pesticide label indication: product use 3 L/ha
2) Sprayer tank content: 800 L of water; the calibrated spray volume is 300 L/ha
3) With 800 L of water 2.666 ha can be treated (800 L / 300 L/ha = 2.666 ha)
4) Product needed in the tank is: 3 L/ha product x 2.666 ha = 8 L

\[
\text{Product in tank} = \frac{\text{Volume of water in spray tank}}{\text{Spray volume}} \times \text{Label indication (product per ha)}
\]

\[
8 L \text{ product} = \frac{800 L}{300 L/ha} \times 3 L/ha
\]
Safe Use Initiative

Prepare tank mix

Label indication: Use xxx L or g /100 L water in a specific spray volume, e.g. 1,000 L of water /ha)

Example:
1) Pesticide label indication: use 300 g/100 L of water ..... Use spray volume of 1,000 L/ha
2) Sprayer tank content: 800 L of water; calibrated spray volume 300 L/ha
3) If **1,000 L /ha** are used then 300 g x (800/100) = **2,400 g** of product must be added to the tank
4) If **300 L/ha** are used then the concentration needs to be 3.333 times higher, i.e. 1,000 L/ha / 300 L/ha =3.333). (This because the same amount per cm² needs to be on leaves / fruits independent whether 300 L/ha or 1000 L/ha are applied). Product in sprayer tank = 2400g x 3.333 = **8,000 g**
Irrigation application
Why we need to irrigate the crop?
Mesopotamia History
Disadvantages of Sprinkler System

- Require high water pressure
- Waste of water due to surface water
- Relatively high in capital cost
- High in operational cost – cost of pumping water

Solution?
Solution: Drip irrigation (micro-irrigation)

Low pressure drip irrigation system

- Lower pressure > reduced horsepower requirements > reduced energy consumption (pumping)
- Subsurface drip irrigation performs better to reduce the surface water runoff and direct into the rooting system, however required an infrastructure i.e. machinery to put the pipe inside the soil.
DRIP-MICRO IRRIGATION PAYBACK WIZARD

<table>
<thead>
<tr>
<th>CURRENT SYSTEM</th>
<th>Drip-Micro System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Costs (per acre)</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>$96.59</td>
</tr>
<tr>
<td>Energy</td>
<td>$37.00</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>$71.47</td>
</tr>
<tr>
<td>Chemical</td>
<td>$236.32</td>
</tr>
<tr>
<td>Irrigation Labor</td>
<td>$2.00</td>
</tr>
<tr>
<td>Maintenance</td>
<td>$4.00</td>
</tr>
<tr>
<td>Cultural</td>
<td>$66.00</td>
</tr>
<tr>
<td>Equipment</td>
<td>$50.00</td>
</tr>
<tr>
<td>Harvest Costs</td>
<td>$600.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revenue (per acre)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>200.00 CWT</td>
</tr>
<tr>
<td>Revenue/Unit</td>
<td>$11.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investment (per acre)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grower net for new system</td>
<td>$1000.00</td>
</tr>
<tr>
<td>Cost Share</td>
<td>$0.00</td>
</tr>
<tr>
<td>Net system investment cost</td>
<td>$1000.00</td>
</tr>
</tbody>
</table>

**Estimated payback period is approximately: 1.97 years**

Estimated additional acres that could be irrigated: **14.41 acres**

THANK YOU
for your input.
The estimated payback period for investing in a DRIP-MICRO IRRIGATION SYSTEM
per the information you entered will be approximately: **1.97 years**

By converting to DRIP-MICRO the water saved could allow you to irrigate an additional

**14.41 acres**
Maintenance
Mechanization for weed control, spraying and dusting
MACHINE FOR WEED CONTROL

- Weed is “thief” ,
- 4 ways to control weeds
  - Move the soil using implement
  - By using fire
  - Use of chemical
  - Cover by plastic
Soil moving device (cultivator)

- Need to move soil at shallow depths
- Do not damage plant roots

Aim;

1. Maintain soil moisture by
   - Kill the weeds
   - Mulching on soil surface
   - Retain rain water

2. Turn the weeds to organic fertilizer
3. Aerate the soil for oxygen exchange in soil
4. Encourage micro-organism activity
Types of implements:

- In this country only the type attached to the rear of tractor is used. There are other types; front and middle attachment.
- A combination of rotating blades or soil mover are fixed to bar at rear of tractor
- A bed is worked by two sets of blades at each side of bed
- The blades are shovel, discs, spring, guard, rotary hoe, side dressing fertilizer applicator.
- Wheels for depth control
- An active implement receiving power from PTO is available. It works between rows. Accompanied by ridger body implement.
Weeding and general care

The limit of 4 wheeled tractor is only when crop grows up to wheel axle. As such 2 wheeled tractor is used and using the same implement.
Review / Questions

- Method in applying liquid application?
- What control the flowrate in the boom sprayer system?
- Why pre-calculation or calibration and planning is necessary for the spraying operation?
- True or False? To avoid spraying overlapping, the ratio between the nozzles distance and the nozzles height from the ground much be 1:2 ratio.
Reading


Link 2: FAO
Thank you.