Pesticides: Safe and Effective Use

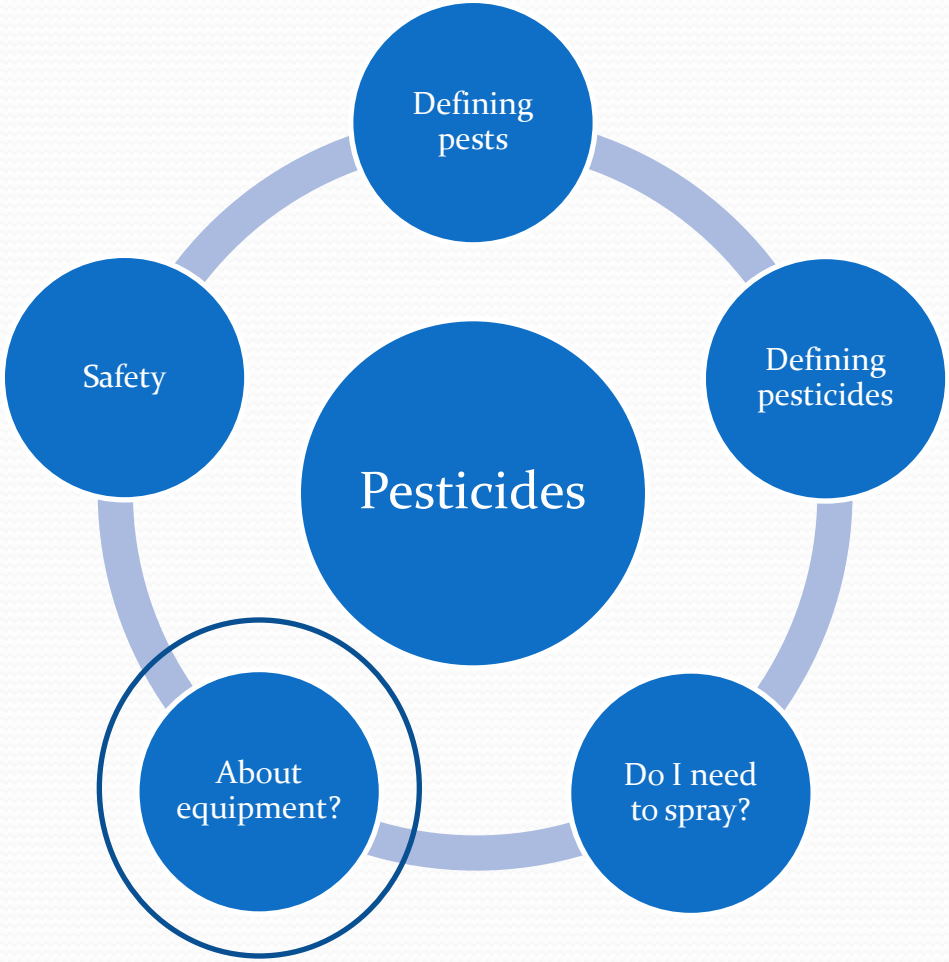
Prepared by Mark Bell, Mark Henderson and Frank Zalom with input from Ehsan Ehsanullah and Tom Brown

UCDAVIS
COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

Course objectives

- Know key points in the application and safe use of pesticides
- Note: At the end, participants will take a review quiz to show they can recall all the key points.
- Support materials – fact sheets and check lists, review quiz,

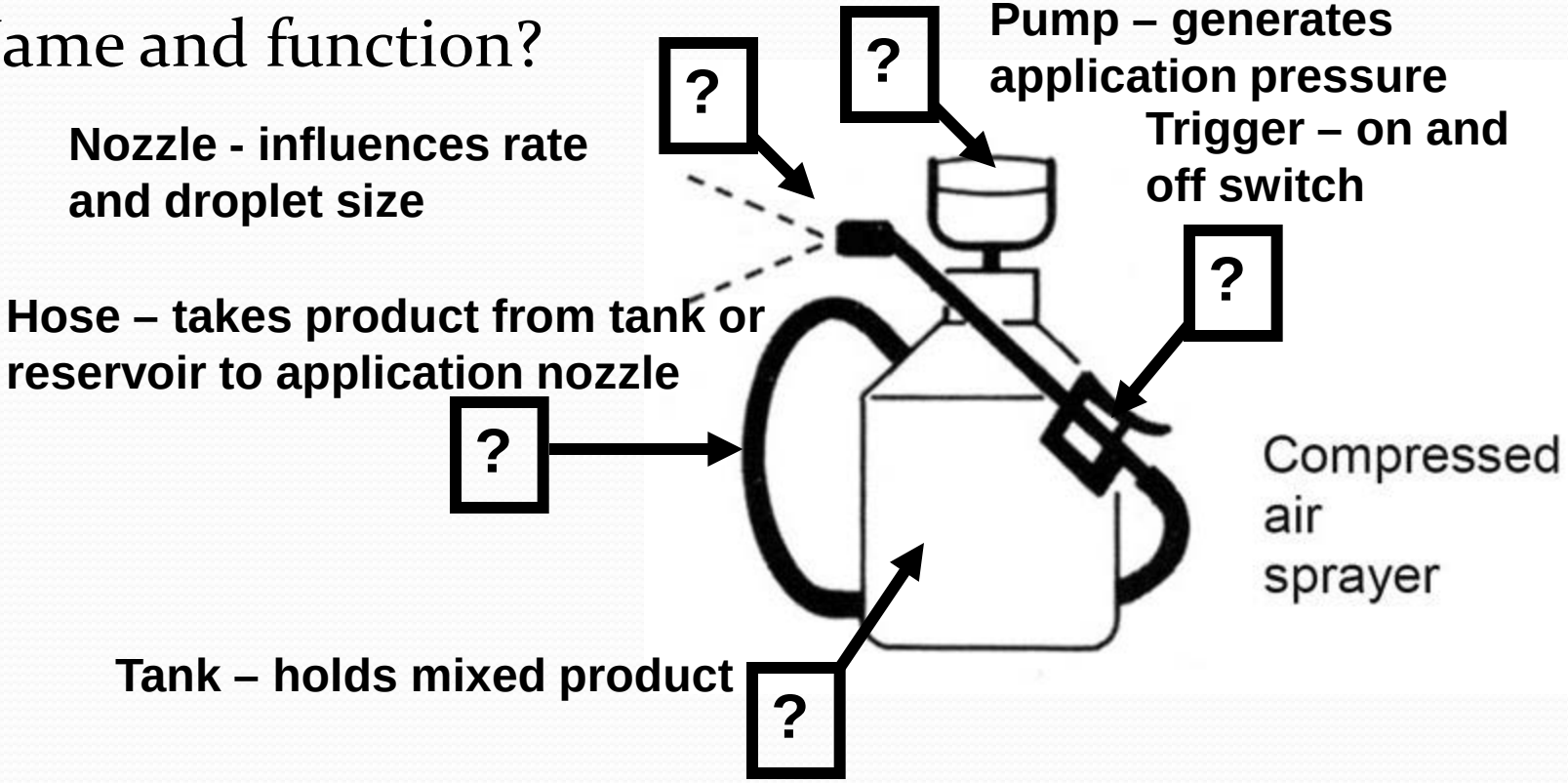
Course structure



About equipment

Parts of a sprayer – even simple sprayers have the same components as more complex ones

- Name and function?



Mid-size Pesticide Sprayer

- 114 Liter (30 gallon) tank on a 4 wheel push cart

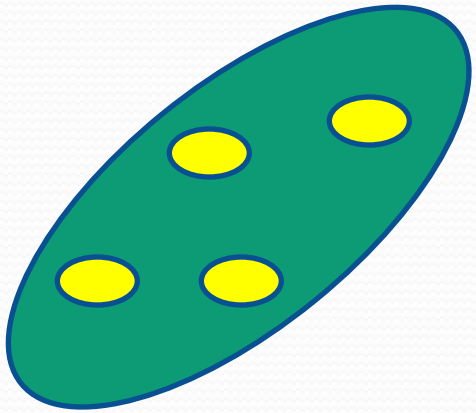
Mid-size Pesticide Sprayer

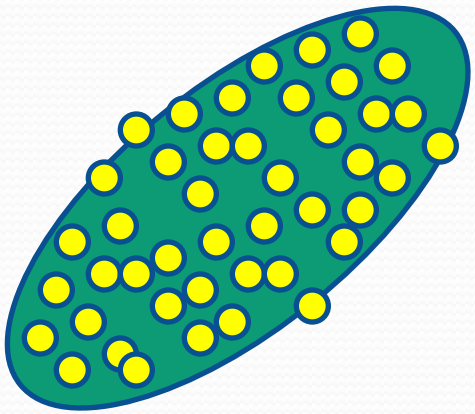
- 3 horse power Honda engine and GE 75 Pump
  - Pump capable of 45.5Liters/minute
  - Pump pressure = 4.57kg/sq cm (65psi)
- 30 meter long 0.95cm hose with hand-size spray gun

About equipment

Droplet size and Coverage?

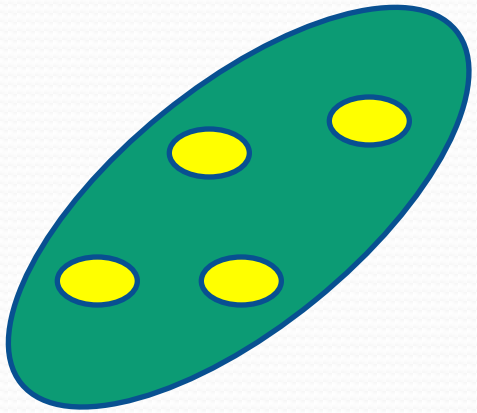
- What size droplets do you want?
  - Big droplets?
  - Small droplets?
- Depends on the product and crop.

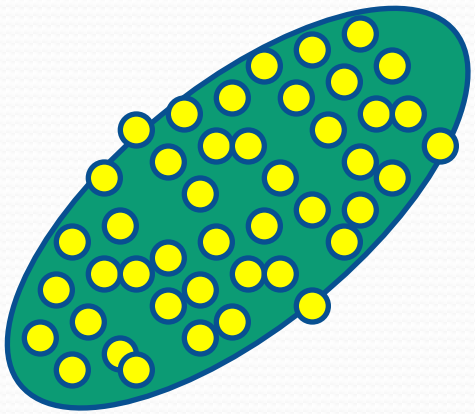




About equipment

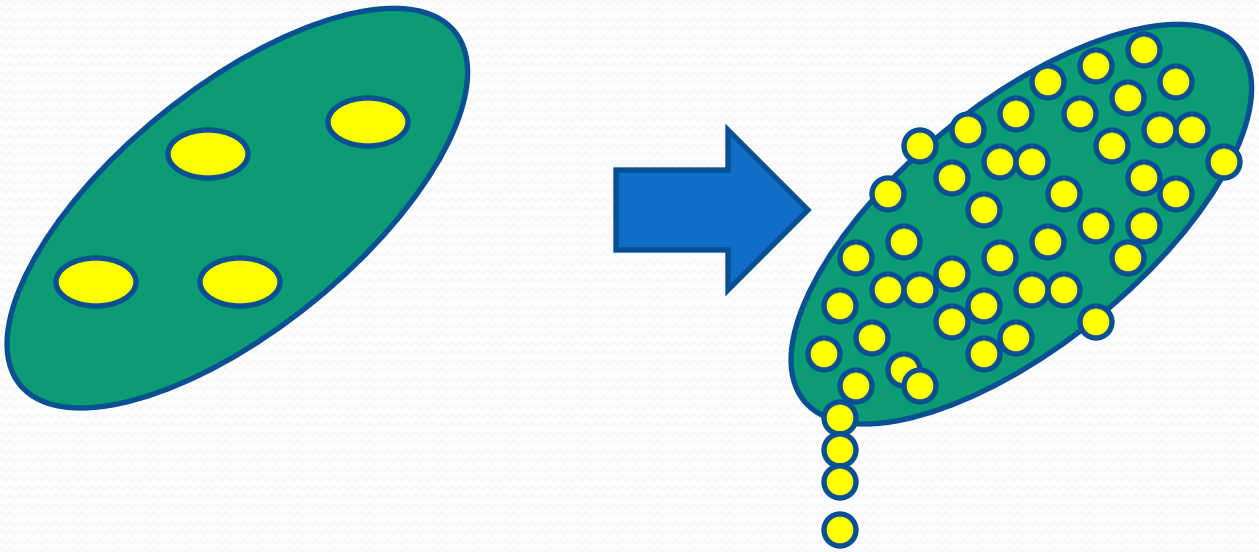
- When are larger droplets and partial coverage okay?
  - If systemic – product will move through the plant to have its effect.
- When are smaller droplets with greater coverage better?
  - For contact products or if the plant is dormant





About equipment

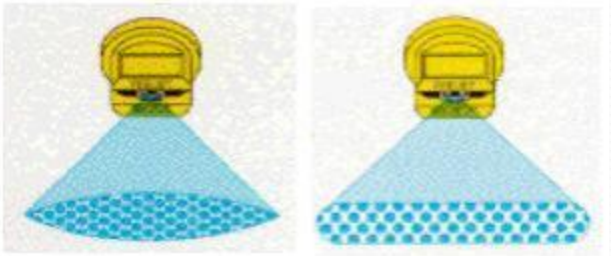
- In orchards, you often want smaller droplets and you should spray to “run-off” or “drip”.

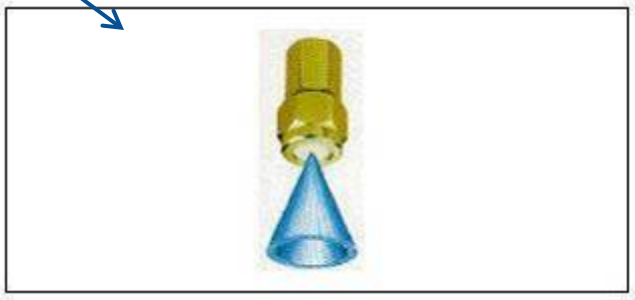


Summary of the main types of spray nozzles, their usage and characteristics.
[Note: 1 psi = 6.89 k Pa or 1 kPa = 0.145 psi]

About equipment

- Nozzles
- Which is a
  - Hollow cone?
  - Flat fan?
  - Solid cone?





(Photos Bugwood and IRRI)

Summary of the main types of spray nozzles, their usage and characteristics.
[Note: 1 psi = 6.89 k Pa or 1 kPa = 0.145 psi]

About equipment

- How do nozzles affect flow rate and droplet size?

Type of nozzle	**Most common use**	**Operating pressure in kilopascals (kPa)**	**Remarks**
Hollow cone	Low volume insecticides and fungicides. Special herbicide application.	400-800	Moderate pressure. Small droplets. Good penetration of foliage
Solid cone	High volume insecticides and fungicides	400-2500	High pressure. Small droplets. Good penetration of foliage
Fan	Herbicides	200-200	Low pressure. Large droplets. Less drift.

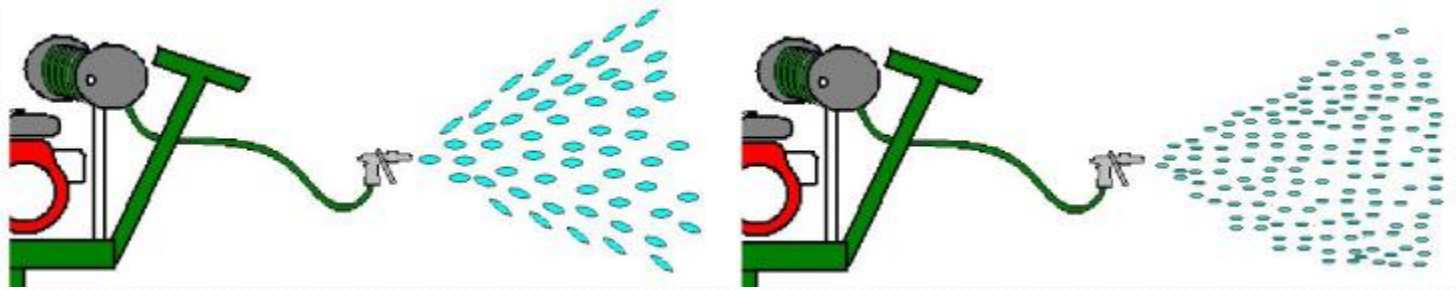
About equipment

About Pressure

- What happens to droplet size if you increase pressure?
  - Decrease droplet size
- What happens if pressure varies?
  - Get variable coverage on target crop
  - Unhappy customers!
  - Constant pressure is critical.

About equipment

- Review
- If the equipment below is the same, then which do you think has the greater application pressure (A or B)?
- Why?

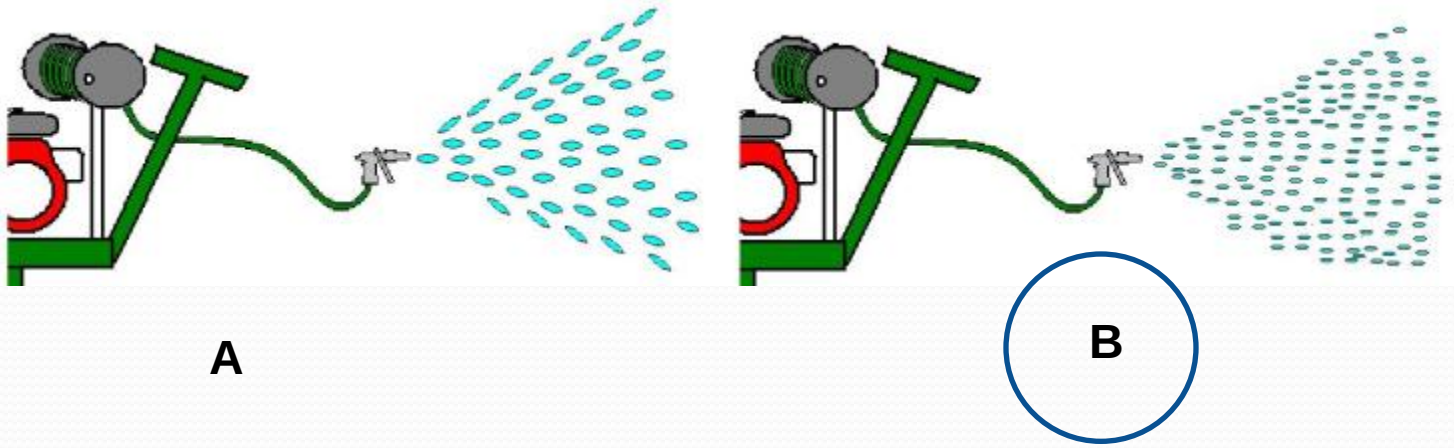


A

B

About equipment

- Review
- Which gives better coverage (A or B)?
- Which should be used for a contact pesticide (A or B)?

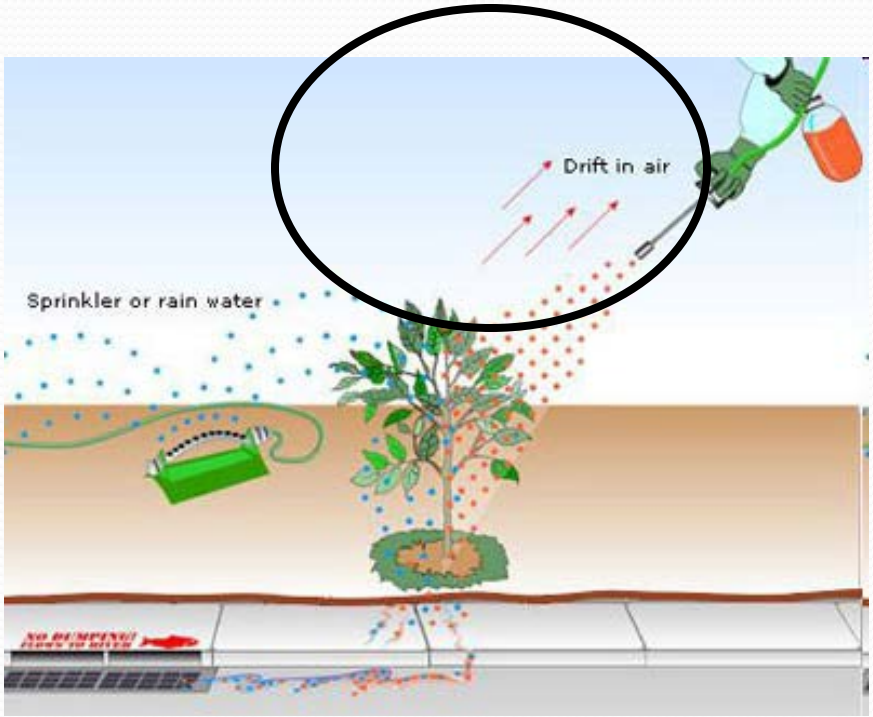


About equipment

- We have seen that droplet size is affected by nozzle type and pressure
- We've seen that smaller droplets lead to better coverage, but….
  - If too small, you get drift

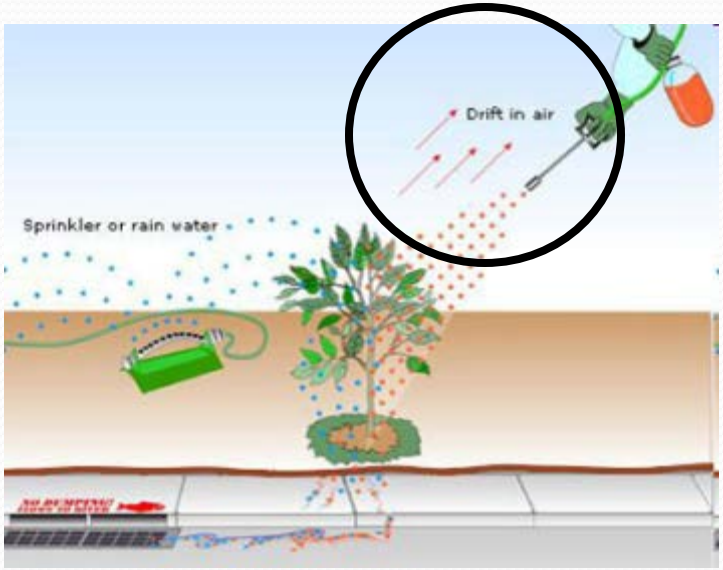
About equipment

- What is drift?
- Drift is when product moves through the air away from the target crop to other areas
- Drift increases as wind speed increases, and
- As droplet size decreases



About equipment

- Is Drift good or bad or it doesn't matter?
  - Bad – Drift wastes product and potentially endangers other crops, people and the environment.
- How do you reduce drift?
  - Avoid spraying in high winds
  - Avoid excessive application pressure and very small droplets



About equipment

- What are the best wind conditions to spray in?
  - It doesn't matter
  - Only when there is no wind
  - Only when there is a light breeze
  - Only when there is a strong breeze

About equipment

Approx. air speed (m/s)	Description	Visible signs	Spraying
<0.3	Calm	Smoke rises vertically	Avoid spraying on warm sunny days
0.6-0.9	Light air	Direction shown by smoke drift	Avoid spraying on warm sunny days
0.9-1.81	Light breeze	Leaves rustle, wind felt on face	Ideal spraying
1.81-2.7	Gentle breeze	Leaves and twigs in constant motion	Avoid spraying herbicides
2.7-4.0	Moderate	Small branches moved, raises dust or loose paper	Spraying inadvisable

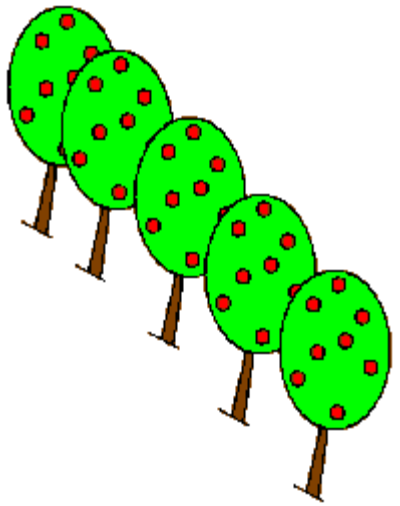
About equipment

Calibration

- What is calibration?
  - The amount of output per unit time from your sprayer – often given as liters/minute
- Why do you need to calibrate your equipment?
  - To know how much product to add.

About equipment

- What is the goal of an application?
- Apply a certain amount of product to each tree
- With small orchards, calibration is best by trial and error
- Many times the goal is spray-to-drip
- What is spray-to-drip?
- The plant is fully covered to the point that further spray will “drip” off.



About equipment

Calibration

- Before calibration and use, always check and repair the sprayer
  - Filters, strainers are clean
  - Tank is clean, free from sediment
  - Nozzle is working properly
- Notes:
  - Never clean nozzles with wire
  - Never clean nozzles by blowing with your mouth

About equipment

Practical : How do I calibrate?

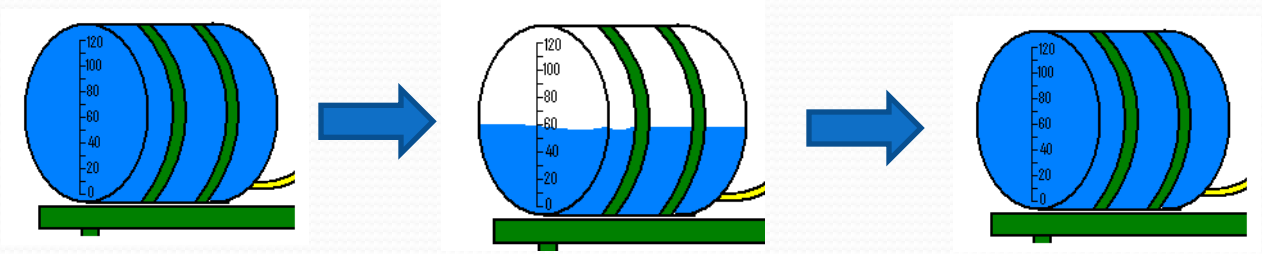
For spraying orchard crops……

- Fill your sprayer with water to a known volume or level
- Set the sprayer at the pressure you will use when spraying
- Spray a known number of trees (e.g., 3, 5 or 10) - spray each tree to “drip”.
- Add up the total time required to spray all trees.
  Note: Only record time spent spraying, not the time moving between trees

About equipment

Practical : How do I calibrate? (continued)

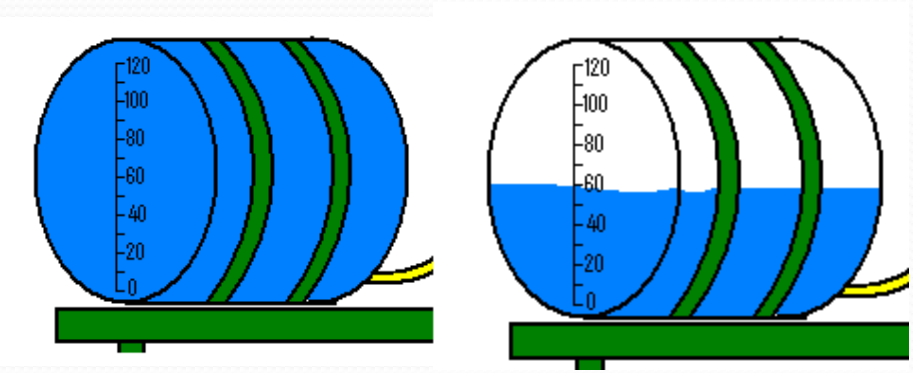
- When finished, note how much liquid was applied?
  - Either read off water remaining in the tank and calculate as Initial volume-final volume = applied volume, or
  - Note the volume of liquid required to refill the tank back to the original level
- As a point of reference: In California, it often takes between 1-2 minutes to spray a single tree of 2-3 m height.



About equipment

Practical

- Your calibration will be =
  (liquid applied)l/(time required to apply)min = l/min



About equipment

Practical

- Now how much product do you need?
- In general, recommendations for
  - Orchards are as ppm or concentration
  - Field crops as rate active ingredient (or product) per ha.

About equipment

Practical

- How much liquid do you need in each tank load?
  - Volume required = # trees x average volume applied per tree
  - Then add 5-10%
- How much product do you need?
  - Calculate based on the volume above to give the concentration needed

About equipment

Practical example

- Total volume required
  - # trees = 10
  - Average volume applied per tree = 5 l
  - Volume required = 10 x 5 = 50 l
  - Volume to add = 50 + 5 = 55 l
- How much product do you need?
  - Target concentration = 5% product
  - So product required = 55 l * 5% = 2.75 l product
- Always check whether recommendation is product or active ingredient

About equipment

Practical example (continued)

- Total volume required = 55 l
- Product required = 2.75 l
- Filling tank
- 52.25 l water + 2.75 l product = 55 l

About equipment

- What happens to sprayer output if…
  - You increase pressure?
    - You apply a higher volume per unit time
  - Do you need more or less product?
    - Same if recommendation is based on concentration of spray
    - However, you should need less time to spray-to-drip.

About equipment

Calibration

- How do you change your application rate?
  - Nozzle
  - Pressure
  - Speed

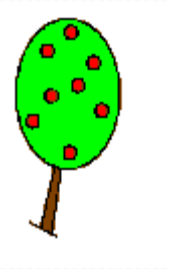
About equipment

- What happens to calibration if…
  - You change nozzle(s)?
    - Nozzles have a direct impact on output
    - Higher flow nozzles increase volume applied for the same amount of time.

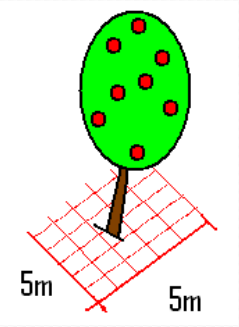
About equipment

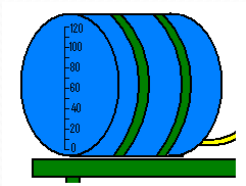
- Before mixing your pesticide find out:
  - How many trees will you spray
  - Remember from earlier experience
    - how much water you spray per tree and
    - how much pesticide you use per liter.

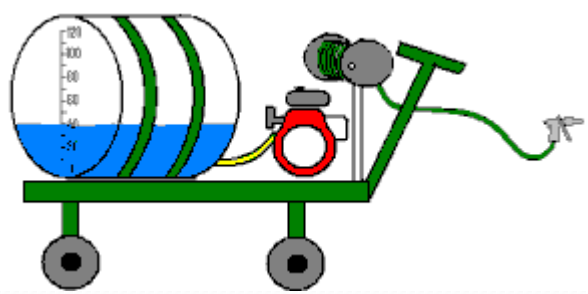
About equipment



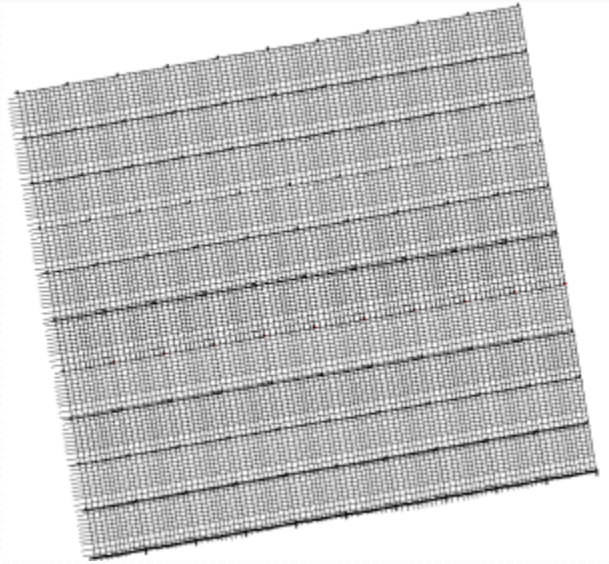
- Now calculate
  - how much pesticide is needed for 20 trees, if you spray 5 l/tree and need a product concentration of 10%?
  - How many tanks do you need if your tank has a 50 l capacity?
  - Discuss

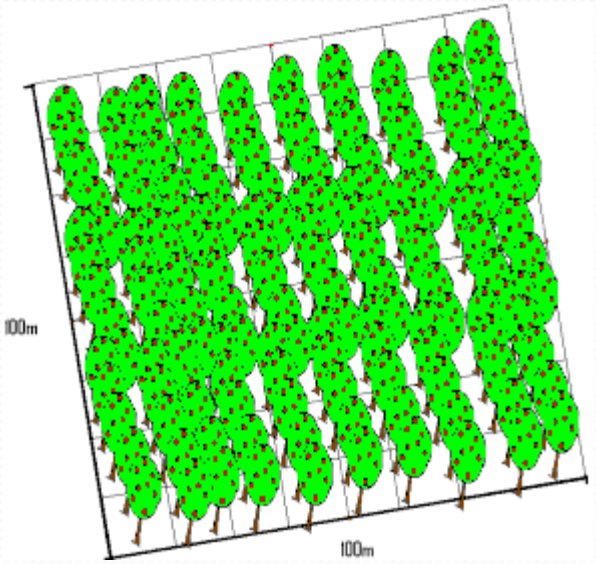




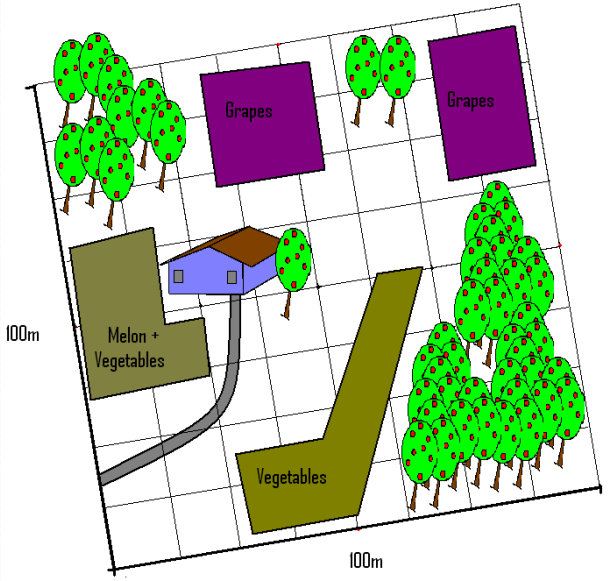


About equipment





Apple Orchard



Mixed Family Farm

- Now you can estimate spray volumes for any number of trees and product required.