PESTICIDE SAFETY
Routes of Human Exposure
Engineering and Administrative Controls

High Plains-Intermountain Center for Agricultural Health and Safety

Colorado State University

PESTICIDES ARE CHEMICALS THAT CONTROL PESTS

- Pesticides are designed to kill or control living organisms
- Pesticides can also harm or kill people
- Pesticides vary in toxicity to man from very mild to extremely toxic
- Important to
  - Have knowledge of the relative toxicity
  - Understand how pesticide exposure occurs

ROUTES OF EXPOSURE

- Dermal - any covered or uncovered skin
- Eyes – direct splash or contact with hands
- Inhalation – carried in with air
- Oral – taken into mouth or on lips

Dermal Exposure

- The majority of all pesticide exposures are dermal
- The most common route is through the hands and forearms

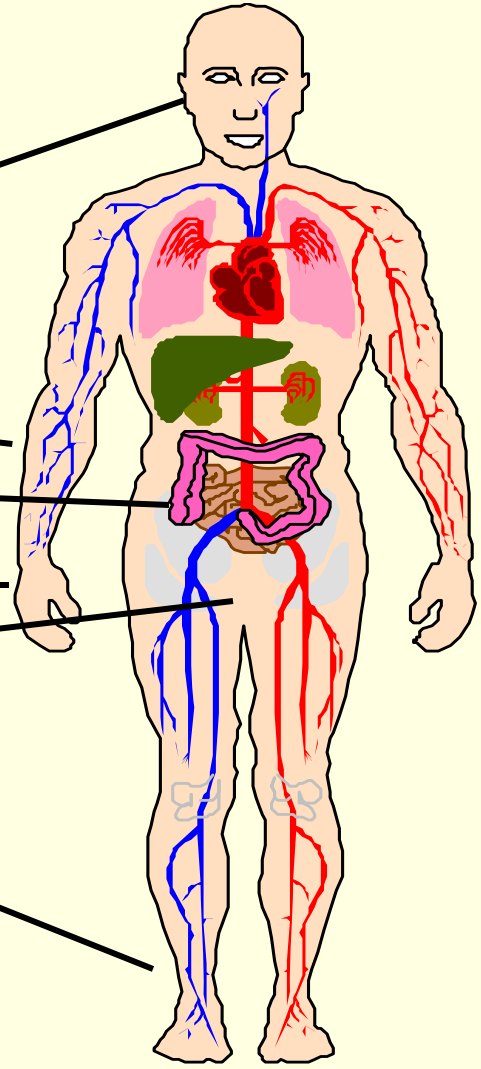
Dermal Exposure

- Can occur from:
  - wearing inadequate personal protective equipment while handling pesticides
  - not washing hands after handling pesticides or their containers
  - splashing or spraying pesticides on unprotected skin
  - wearing pesticide-contaminated clothing (including PPE)
  - applying pesticides in windy weather
  - touching pesticide-treated surfaces

Dermal Exposure

- Parts of the body absorb pesticides at different rates

Area	Rate *
forehead	4.2
forearm	1.0
abdomen	2.1
palm	1.3
scrotum	11.8
ball of foot	1.8



*Absorption rate compared to forearm (1.0)

Dermal Exposure

- Formulations vary in ability to be absorbed through the skin.
- Emulsifiable concentrates are more readily absorbed than other formulations
- All formulations can be absorbed in clothing, thereby becoming a path to skin exposure

Eye Exposure

- Common when
  - Mixing pesticides
  - Whenever the potential for splashing exists
  - Applying pesticides in windy weather
  - Rubbing eyes or forehead with contaminated gloves or hands

Inhalation Exposure

- Typically occurs:
  - When using fine dusts and mists
  - Breathing vapors, dust, or mist
    - mixing and loading concentrates
    - while handling pesticides
    - Drift
    - Re-entering an area too soon
- Lung exposure is the fastest way to the bloodstream

Oral Exposure

- Ingestion through the mouth
  - Not washing hands before eating, drinking, smoking, or chewing
  - Putting contaminated items and hands in or near mouth - such as food or cigarettes
  - Splashing into mouth through carelessness or accident

Oral Exposure

- Pesticides removed from their original containers are the highest cause of pesticide poisonings in adults and children

Exposure

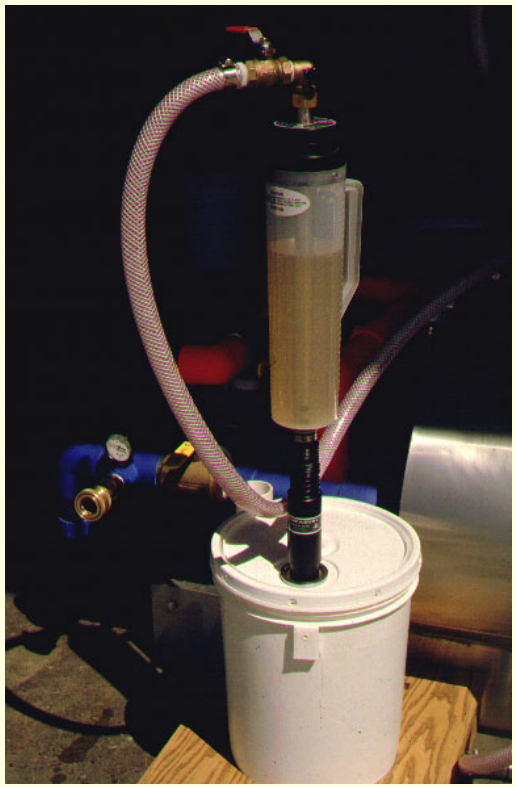
- You cannot control the toxicity of a product
- You can control your exposure to a product

Controlling Exposure

- A basic principle of user protection is that all possible measures should first be taken to reduce exposure at the source
  - **Engineering controls** eliminate or reduce exposure to a chemical or physical hazard through the use of engineered machinery or equipment
  - **Administrative controls** (or **work practice controls**) are changes in work procedures such as written safety policies, supervision, and training with the goal of reducing exposure to hazardous chemicals or situations

Closed Transfer Device

- Sealed transfer of liquid pesticide from original container into mixing equipment, then into the final application equipment
- Reduces operator exposure to concentrated pesticides during filling operation

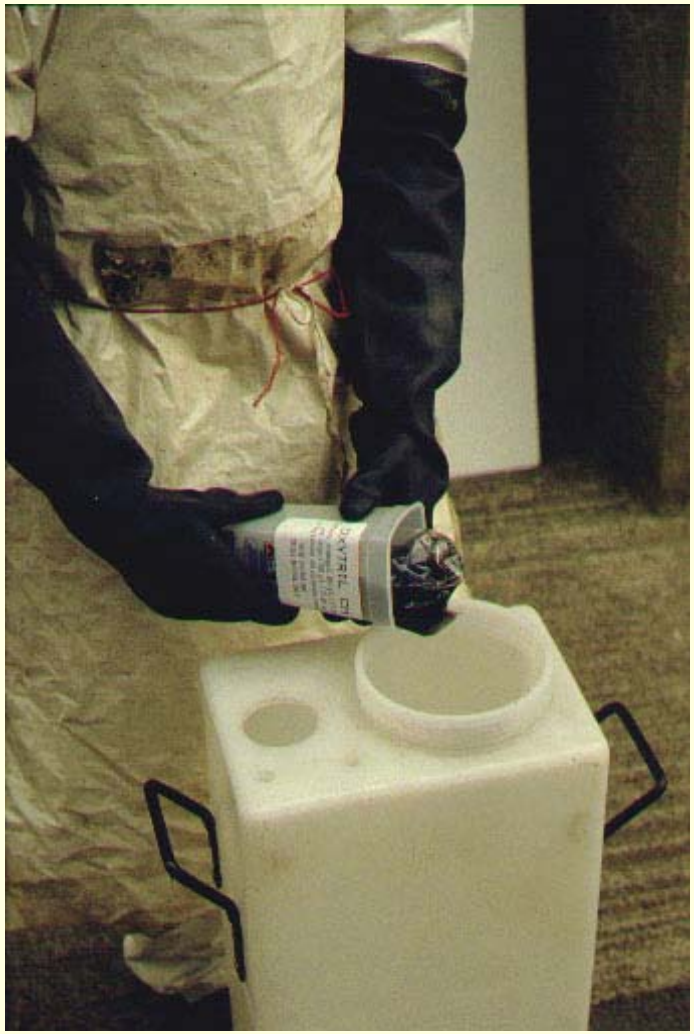


Backpack Sprayers

- Hookup allows workers to transfer chemicals from their mix tanks directly to their backpacks using a common hose and ball valve
- Closed-system- physical contact with pesticide is eliminated

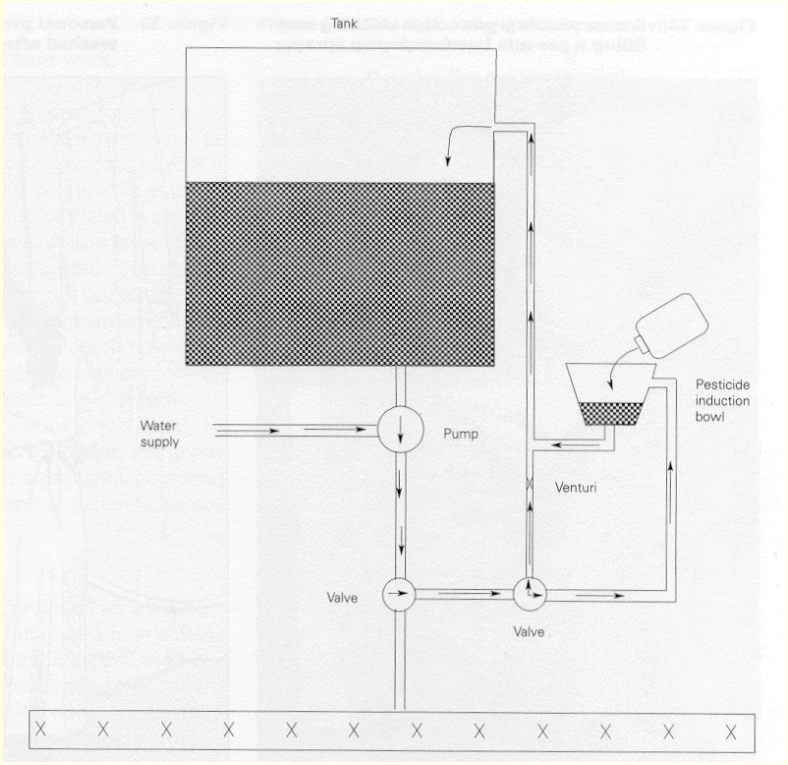
Water Soluble Bags

- The main disadvantages of dust and wettable powder formulations stem from the hazardous dust cloud that may arise during handling
- Packaging of wettable powders in special bags made of polyvinyl alcohol and polyesters
- Before application, the bag together with the component powder are dissolved in water during preparation of the spray solution



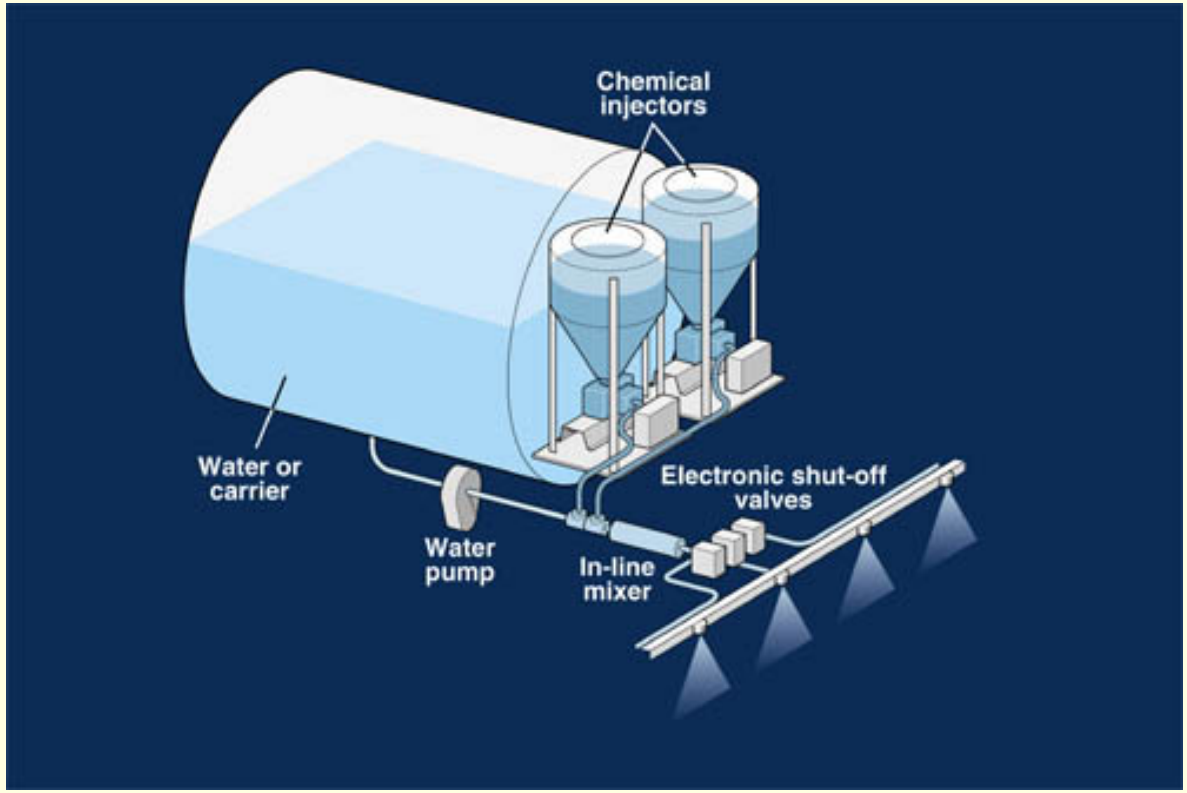
Induction Bowls

- Allows operator to fill sprayer from the ground rather than climbing up onto sprayer



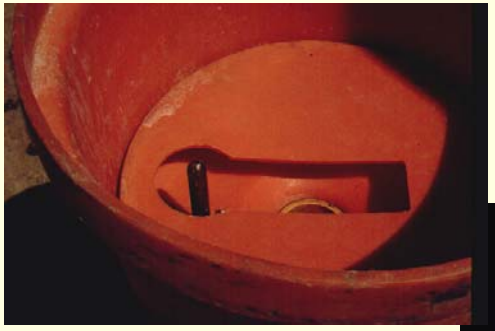
Direct Pesticide Injection System

- ***Direct Pesticide Injection System -*** Allow pesticides to be mixed directly with water in the sprayer plumbing system rather than in the main spray tank.
- Spray tank holds only clean water, no tank rinsing needed, and spray lines can be flushed clean in the field. Reduces or eliminates operator exposure if used with refillable container or closed transfer systems



Container Rinse System

- Consists of a rinse nozzle and a catch bowl that traps the container washings

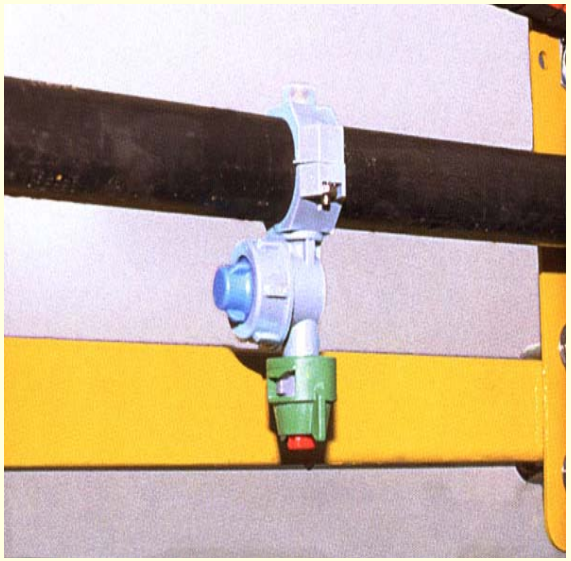


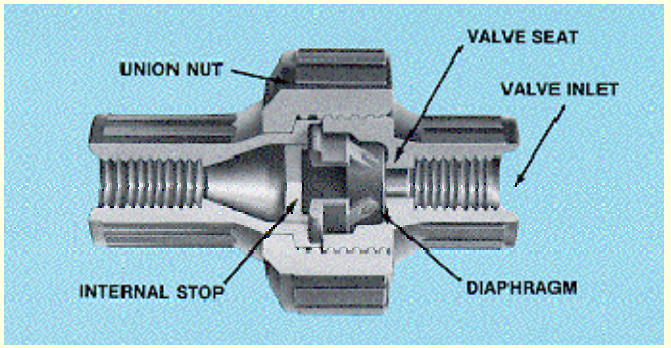
Hydraulic Boom Folding

- Avoids hand contact with pesticides that may occur while folding booms manually

Diaphragm Check Valves

- When sprayer is shut off and pressure drops liquid remaining in boom drips from nozzles
- Prevent drips from nozzles, which may expose operator
  - during nozzle repair/changes
  - while folding/unfolding manual booms





Multiple Nozzle Bodies

- Simplifies changing nozzle tips when switching crops, pesticides or rates

Low-drift Air-assisted Nozzles

- Air-Assisted Booms - use a high-pressure air supply to help push the spray droplets onto the target, reducing the chances for drift
- Minimize spray drift and operator exposure

Knapsack Mistblower Sprayers

- The powered knapsack sprayer, also called a mistblower, has a small engine and fan. It is actually a small back-carried air-blast sprayer.

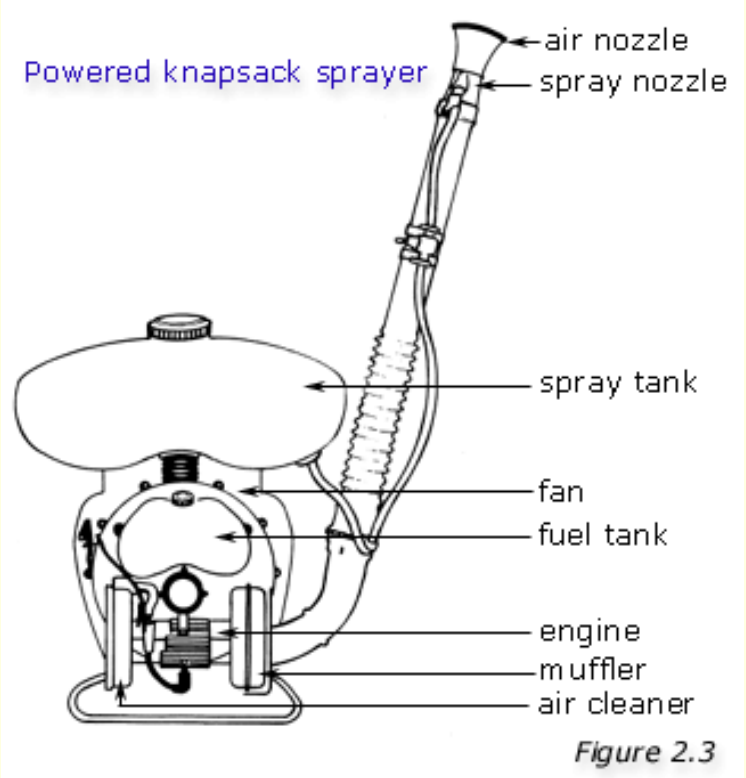
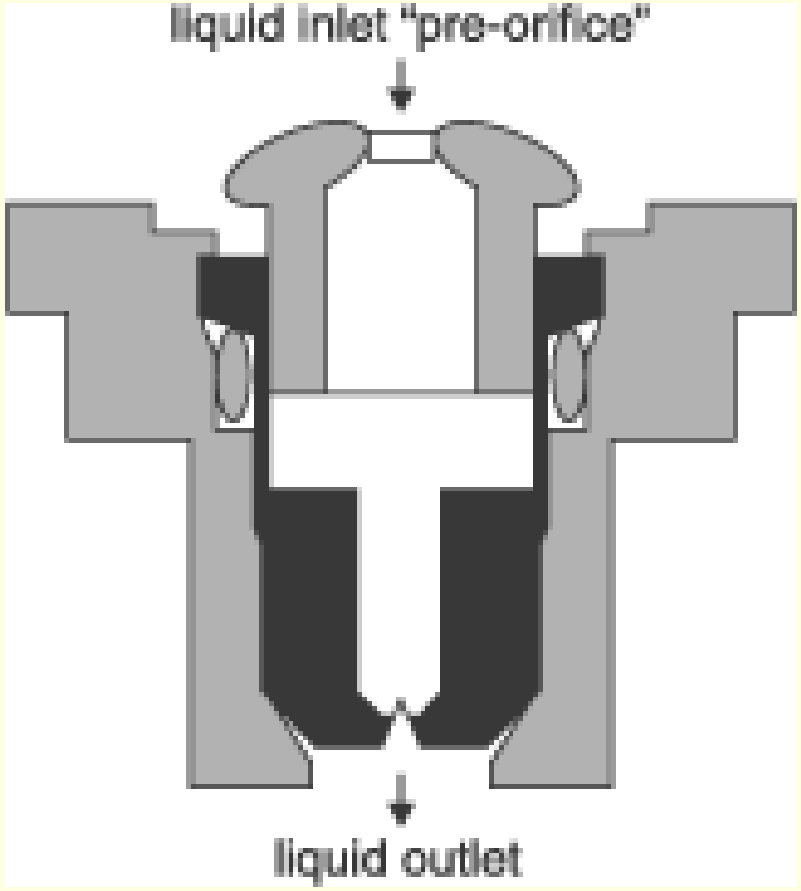


Figure 2.3

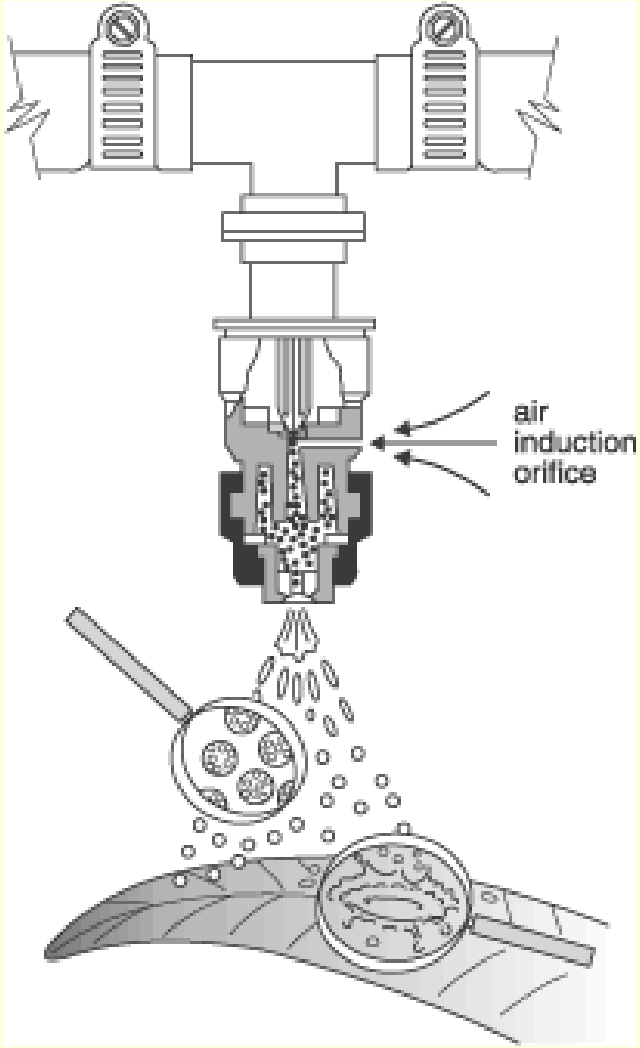
Low-Drift Nozzle

- Low-drift nozzles create larger-size droplets than conventional nozzles.
- The larger droplet sizes are less prone to drift, reducing environmental and operator contamination.



Air Induction Nozzles

- Allow air to mix with the spray liquid
  - Creates large, air-filled droplets that have virtually no fine, drift-prone droplets.
  - Droplets explode when they contact their target
  - Offer similar coverage to droplets from conventional, finer-spray nozzles.

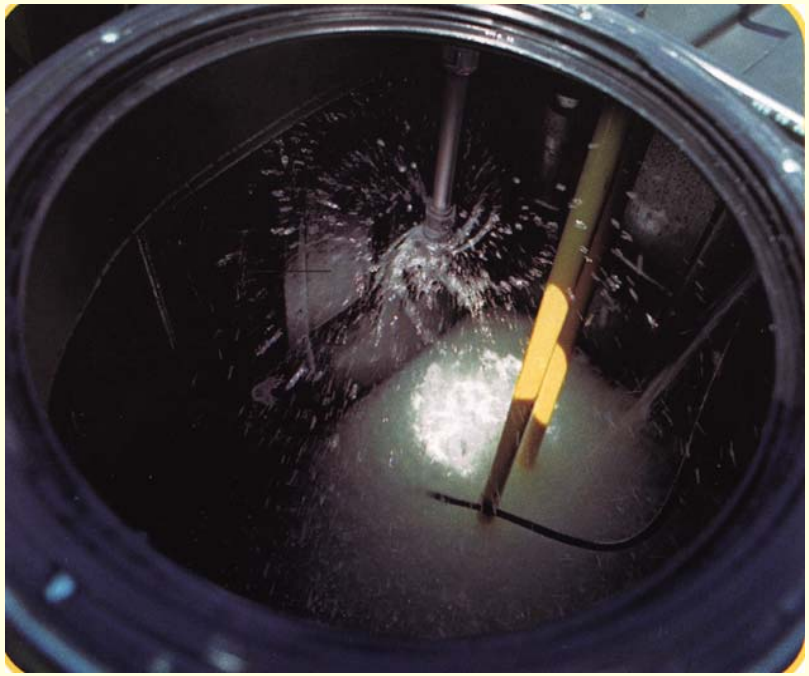


Covered / Hooded Sprayers

- By reducing drift covered sprayers reduce operator exposure and environmental contamination

Cleaning the Sprayer

- **Tank Rinse Systems -** clean water supply tank mounted to the sprayer and one or more rotating nozzles mounted inside the main sprayer tank. Water is pumped from the clean water tank to the rinse nozzles, which spray water around the inside of the spray tank.

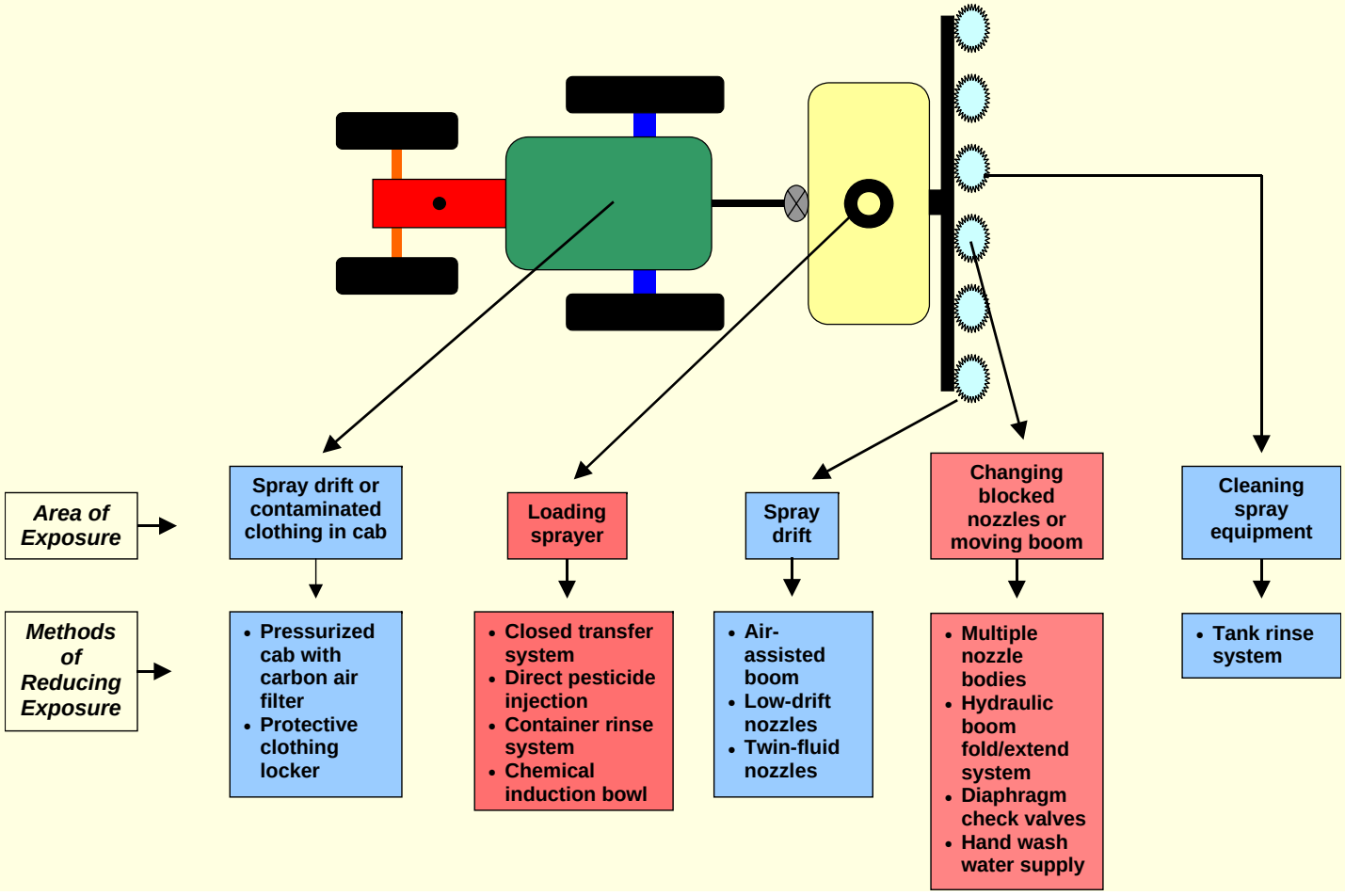


Hand Wash Water Supply

- **Used for hand and contaminated PPE washing** Providing adequate wash water is essential (and often required). A simple container with a hand-operated valve can be mounted on the side of the sprayer to provide clean water for hand washing and personal hygiene.

Engineering Controls Summary

Areas of Potential Pesticide Exposure Risk and Engineering Controls to Reduce Exposure



Administrative / Work practice Controls

- Some fundamental and easily implemented work practices are:
  - Personal hygiene
  - Equipment inspection, maintenance and calibration
  - Use of proper procedures
  - Supervision

Personal Hygiene

- Do not smoke or carry smoking materials while handling or spraying pesticides
- Wash hands and arms thoroughly before eating, smoking or drinking, using the bathroom
- Never attempt unsafe practices, such as blowing through sprayer nozzles to unblock them
- Do not carry contaminated items such as dirty rags, tools or spare nozzles in the pockets of personal clothing;
- Remove and wash separately any contaminated item of personal protective clothing daily

Personal Hygiene cont

- Baseball caps should not be worn when handling pesticides
- Source of repeated contamination

Personal Hygiene

- Leather and cloth gloves should not
  - Offer **no protection** from chemical exposure
  - Absorb material, may lead to pesticide poisoning

Personal Hygiene cont

- At the end of the workday, shower immediately after application of pesticides
- Remove any clothing that is saturated with pesticides and place in a metal container labeled "PESTICIDE CLOTHING". Do not take clothing home

Personal Hygiene cont

- When laundering work clothing and reusable PPE
  - Keep separate from family clothing
  - Wear rubber gloves
  - Wash daily
  - Run washer through complete cycle with detergent and no clothes to remove pesticide residue

Equipment Inspection, Maintenance and Calibration

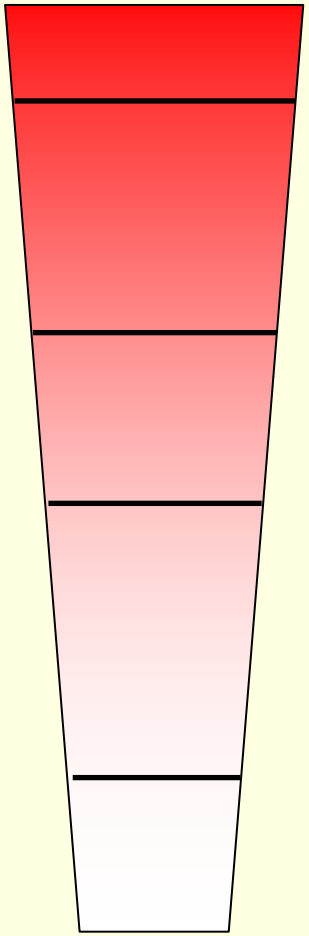
- Periodic inspection and maintenance of equipment are another important work practice control
  - Follow the manufacturer's recommended procedure for periodic cleaning and inspection
- Sprayer Calibration Equipment should be calibrated before each use

Use of Proper Procedures - Training

- Employers must provide training and information to employees
- Workers must know the proper way to perform job tasks to minimize their exposure
- Employees must follow recommendation on pesticides labels – it's the law!
- MSDS

Label Signal Words

- Danger
  Poison
  Peligro
- Danger
- Warning
  Aviso
- Caution



- Highly toxic
  - May enter the body by any route. Peligro, the Spanish word for Danger must also appear on the label
- Highly toxic
  - Can cause severe eye damage or skin irritation
- Moderately toxic
  - May enter through mouth skin or lungs; causes moderate eye or skin irritation. Aviso, the Spanish word for warning must appear on the label
- Slightly toxic
  - May enter through mouth skin or lungs, causes slight eye or skin irritation

Supervision

- Good supervision is another important work practice
- Provides needed support for ensuring that proper work practices are followed by workers

Summary

- Working safely with pesticides is essential
- Engineering and Administrative controls along with appropriate PPE can maximize operator safety
- Your safety and the safety of others depends on you

High Plains Intermountain Center for Agricultural Safety and Health

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Knowledge to Go Places

HI CAHS

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- References:
  - Dr. Andrew Landers – Cornell University http://www.nysaes.cornell.edu/ent/faculty/landers/pestapp/
  - Portions of this presentation were adapted from a presentation developed by the Pennsylvania State University Pesticide Education Program
  - Applicator exposure slides courtesy of University of Illinois