Good Spraying Practices

Safe, effective crop protection
Stewardship Community

Good spraying practice: summary

1. Maintain good hygiene at every stage in the use of crop protection products.
2. Maintain spraying equipment in good condition and repair all leaks.
3. Always ensure you understand and can implement the conditions described on the product label.
4. Use calibrated spraying equipment.
5. Wear appropriate protective equipment when using products.
6. Only make applications when the weather conditions are suitable.
7. Spray in a way that reduces the risk of contamination to the environment and the operator.
8. Wash all equipment after use and store safely.
9. Keep people and livestock out of treated areas until the sprayed deposit has dried

Good spraying practice: key principles for success

To get the maximum effect from any pesticide product, as well as reducing any potential human or environmental contamination, it is important to apply the product in the proven, optimised way described within its label recommendations.

The best maintenance, calibration and use of the spraying equipment is critical to the success of any application.

Product selection, its application method and timing will have a major impact on the quality of pest control achieved.

Good spraying practice: key essentials for optimised effect

Final levels of activity of applied products are dependent on:

- Dose of deposited products on target surfaces
- Timing of application (crop/target growth stage)
- Product mode of action, the way it is deposited on the plant/target and its subsequent mobility

Some terms used to describe product types and post-deposit movement

Fungicides: curative, preventative

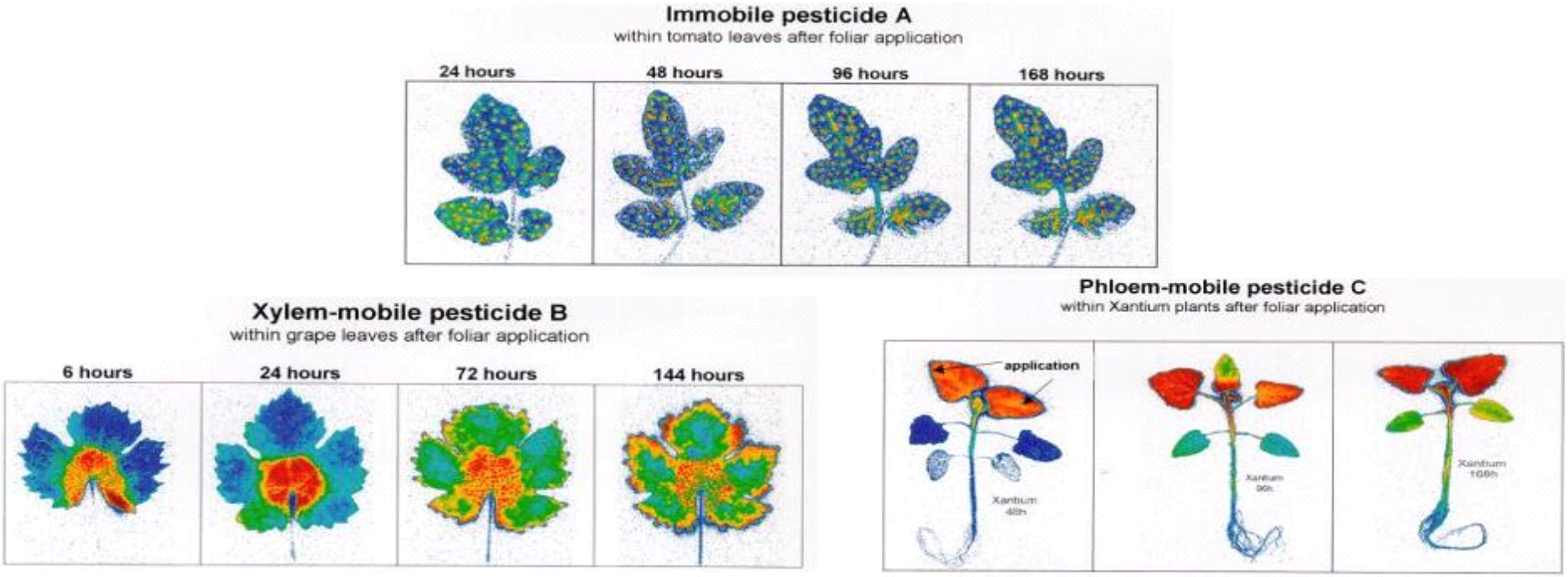
Insecticides: repellant, adulticides, larvacides

Herbicides: pre-emergence, post emergence, selective, total

Post deposit mobility: eg translocated (phloem mobile, xylem mobile), contact, translaminar

Good spraying practice: post-deposit mobility

Product applied as drops onto target surfaces may [to a greater or lesser extent] or may not move from that impact site to other parts of the plant



Good spraying practice: plan well

Before starting any spraying activity always:-

1. Identify the pest to control and level of infestation
2. Select the correct product
3. Read the product label
4. Check the sprayer for leaks and other faults
5. Ensure you have the correct PPE
6. If you feel unwell then do not work with chemicals

Product Label: source of much information

Gramoxone 20 SL is a contact herbicide used to control or suppress a broad spectrum of emerged weeds. It controls most small annual weeds, both broadleaves and grasses and suppresses perennial weeds by destroying green foliage. **Gramoxone 20 SL** is rapidly absorbed by green plant tissue and interacts with the photosynthetic process to produce superoxides which destroy plant cells. It requires actively growing green plant tissue to function. Thorough coverage of all green foliage is essential for effective weed control.

DIRECTIONS FOR USE:

MIXING: To prevent risk of injury during sprayer application, one measure of Gramoxone must be diluted with AT LEAST 100 times equivalent measure of water. You must NEVER use less water than this. Mix the required amount of **Gramoxone 20 SL** with clean water in a spray tank. Be sure to use gloves and avoid splashes to eyes. Apply by knapsack sprayer using 200 – 500 liters of water per hectare. Gramoxone contains a wetting agent. If dilution is greater than 1 liter in 400 liters water, add any non-ionic surfactant at the rate of 25 ml per 100 liters spray solution. DO NOT APPLY with a MIST BLOWER.

RICE – ZERO TILLAGE to save time, water and labor.

1. Harvest previous crop close to the ground and drain field of excess water.
2. Next day, broadcast the recommended amount of fertilizer and spray **Gramoxone 20 SL** on the weeds present, at the rate of 2 – 3 liters in 400 liters of water per hectare (8 – 12 tbsp. per 16 liters of water).
3. On the third day, transplant 18-day-old seedlings if the soil is soft or broadcast pregerminated seed (66 kg / ha).
4. 5 – 8 days after seeding, apply a recommended pre-emergence herbicide.

DO NOT SPRAY **Gramoxone 20 SL** ON RICE AFTER PLANTING.

RICE: AID TO CULTIVATION, BUND AND DITCH WEED CONTROL

Gramoxone 20 SL can also be used to kill weeds in rice fields to reduce cultivation, on bunds to assist in rat control and in irrigation and drainage canals to improve water flow.

ZERO OR MINIMUM TILLAGE IN OTHER CROPS

Gramoxone 20 SL can be used before planting in corn, sorghum – consult your distributor or the local representative of Syngenta in your area.

TREE CROPS – Banana, abaca, rubber, oil palm, citrus, coffee, cacao coconuts, etc.

Program spraying starting at 2 – 3 liters of **Gramoxone 20 SL** in 400 liters of water per hectare. Re-spray initially after 2 – 3 weeks at 1.5 – 2 liters per hectare. Re-spray or spot spray as necessary to keep weeds under control.

SUGARCANE

1.5 – 2 liters **Gramoxone 20 SL** in 300 – 400 liters of water per hectare for pre-crop emergence in plant cane and directed inter-row spray in standing plant and ratoon cane.

VEGETABLES AND OTHER ROW CROPS

2 – 3 liters **Gramoxone 20 SL** in 400 liters of water per hectare as a guarded inter-row spray or as overall spray 2-3 days before crop emergence.

OTHER USES: Canals, roadsides, industrial sites

3 – 4 liters of **Gramoxone 20 SL** in 400 liters water per hectare. Cut back tall growth and spray regrowth to approximately 18 inches tall before treatment application.

RE-ENTRY PERIOD: 24 hours after application. Wear protective clothing when re-entering treated areas/fields less than 24 hours after application.

PESTICIDE STORAGE: Do not contaminate water, food or feed by storage or disposal.

CONTAINER DISPOSAL: Empty containers should be triple rinsed before crushing and burying below topsoil. Empty containers should not be used for other purposes.

WARRANTY: No warranty of any kind, expressed or implied, is made concerning the use of this product. User assumes all risks and liability from handling, use, or application.

"IT IS A VIOLATION OF FPA RULES AND REGULATIONS TO USE THIS PRODUCT IN A MANNER INCONSISTENT WITH ITS LABEL"

® = trademark of a Syngenta group company

The product label is very important. It is the most important piece of information which tells the user everything he needs to know to be able to use the product safely and effectively.

Application conditions and mixing recommendations -

- Chemical properties/action
- Dose rates of product
- Water volumes
- Sprayer recommendations
- Crop cultural techniques
- Safety information
- Container disposal
- PPE requirements

Preparing a spray solution

Special care is necessary when handling undiluted products. Follow the label recommendations for PPE.

Use a graduated measuring jug to measure out products**. Never use food containers or spoons.**

See the “Mixing and Preparing Crop Protection Products” training module for more detailed information

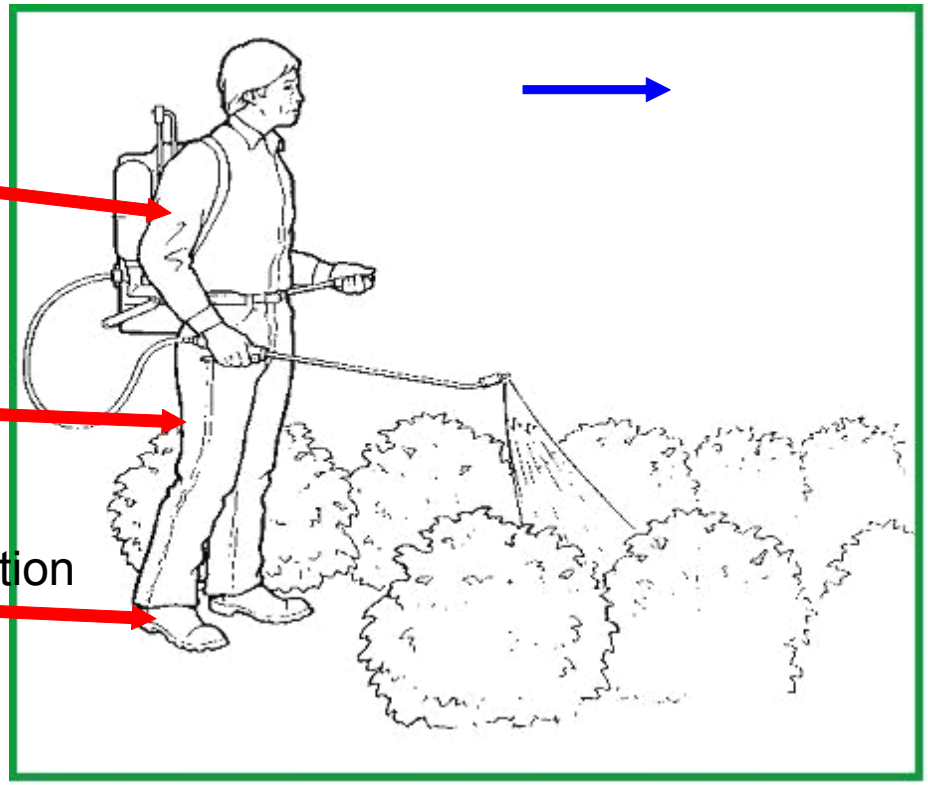
Minimum protective equipment when spraying diluted product

Read and follow the label

Long sleeved shirt

Long trousers

Rubber boots



Personal protective equipment (PPE)

- PPE should be considered as the last line of defence to your safety.
- Always reduce the risk of contamination through good sprayer maintenance and the way you use products for spraying.
- Operator exposure studies have found that most contamination comes during the mixing process and using leaking equipment.
- PPE should be practical and comfortable.
- PPE requirements will vary. For example, the size of the crop may influence choice.
- Always follow the product label recommendations for PPE. Do note these are the minimum needs. Extra requirements might include a visor, eye protection, a respiratory mask or chemical resistant suit.
- The use of a hat can give protection from both spray drift and the sun.

See the “Personal Protection Equipment (PPE)” training module for more detailed information

Good spraying practice: consider weather conditions

Rain and wind

- Do not spray if target leaves and stems are wet or if it is about to rain
  - product will be lost due to run-off
  - many products require around 2 to 3 hours of dry weather after application to be fully effective (refer to product label)
  - if working in tropical conditions, consider using products with rapid activity
- Do not spray in moderate to high winds. Spray will be lost as drift and distribution patterns may be at risk. Acceptable maximum wind speeds are dependent on application method, nozzles and crop.

Good spraying practice: consider weather conditions cont.

Temperature

- The activity as well as the safe and effective use of some products is temperature dependant
- Labels may describe constraints for -
  - Minimum temperature
    - Too low temperatures may decrease the activity of the applied products or cause phytotoxicity
    - Reduced vapour activity
  - Maximum temperature
    - Too rapid drying of spray droplets
    - Too much increased vapour activity
    - Operator at risk of heat exhaustion
- In general, avoid spraying during the hottest part of the day

Good spraying practice: consider weather conditions cont.

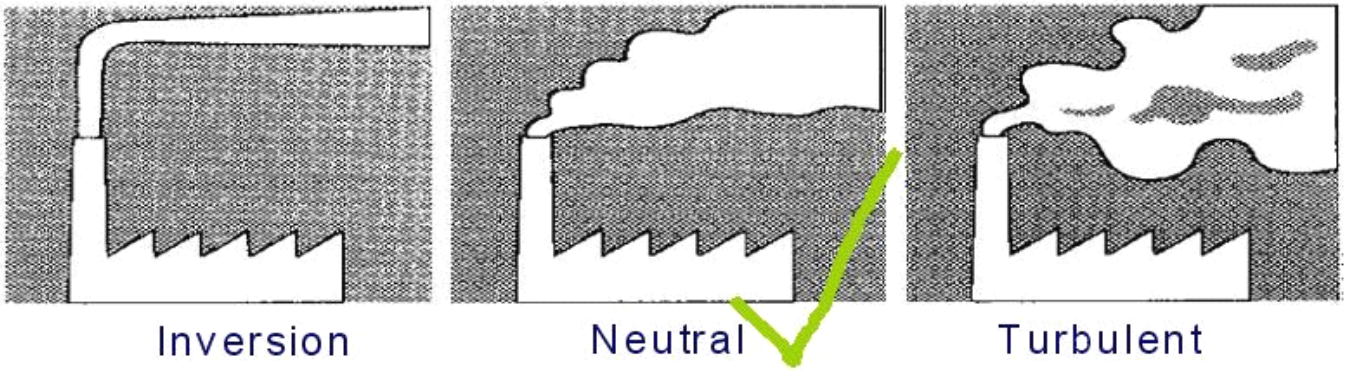
Wind and Spray Timing

Wrong wind speeds limit the number of safe hours for spraying; too high causes drift and too low risks thermal inversion.

The general recommendation is -

DO NOT spray at wind speed below 0.5 m/sec and above 2 m/sec at nozzle height. Use indicators around you to help judge these speeds.

Conditions are OK if smoke is not rising vertically and is not turbulent; leaves are 'rustling' and not constantly moving



Good spraying practice: consider air inversions

Under certain weather conditions spray drops can be conveyed upwards by ambient air to form a cloud or layer of pesticide in the atmosphere. This is caused by air inversions.

This is not only wasteful of product but is a pollution risk and a threat to other crops.

Despite the fact there is no or very little wind, small spray droplets can be moved short or even very long distances.

Nozzles producing coarser droplets are less affected by air inversions than those producing medium to fine droplets.

Good spraying practice: wind speed; the field signs to judge speeds and any risks

Wind Description	Visible signs	Spraying	Risk
Calm	Smoke rises vertically	Use only medium or course nozzles	Risk of drift through inversion
Light air	Direction shown by drift of smoke	Acceptable spraying conditions	Minimal
Light breeze	Leaves rustle, wind felt on face	Ideal spraying conditions	Minimal but drift may be a risk with Fine sprays. Spray with nozzle down wind
Gentle breeze	Leaves and twigs in constant motion	Increased risk of spray drift, take extra care	Use low drift nozzles, reduce pressure. Spray with nozzle down wind
Moderate breeze	Small branches move, lifts dust and paper	Spraying inadvisable	Risk of environmental and operator contamination

Good spraying practice: setting up the sprayer

Always use clean, non leaking, calibrated spraying equipment.

Before spraying, check everything is working properly using clean water only, with a working nozzle capable of giving the required operating pressure and output.

Correct nozzles will ensure:

- droplet retention
- target coverage with no gaps or excess
- optimal distribution on the plants target surfaces

Identify the location of the target for the spray that may be under the leaf, top of the plant or elswhere. Ensure the sprayer is set up to enable spray to reach and be retained by the target.

See “Efficient Knapsack Sprayer Use” training module for more detailed information

Knapsack sprayers and nozzle choice

Product type	Nozzle choice	Drop size Pressure; ideally controlled with Constant Flow Valve
Herbicide	**Deflector/Flood/Anvil Nozzle** *or* **Even Flat Fan**	**Coarse to avoid spray drift** **1.0 bar**
Fungicide	**Flat Fan nozzle** *or* **Hollow cone nozzle**	**Medium** **2.0 bar**
Insecticide	**Hollow cone nozzle** *or* **Flat Fan nozzle**	**Medium to Fine** **3.0 bar**

Boom sprayers and nozzle choice

Product type	**Flat Fan**	**Low Drift**	Air **Induction**	**Spray (l/ha)**
Herbicide:				
Non-selective	xxx	xxx	xx	200 – 1000
Pre-emergent	xxx	xxx	xxx	200
Post-emergent -contact	xxx	xxx	x	200
-systemic	xxx	xxx	xx	200
Growth regulators	xxx	xxx	xxx	200
Fungicides e.g. cereals**:**				
early	xx	xxx	xxx	200
Leaf	xxx	xxx	xxx	200
Late	xxx	xxx	xx	200
Fungicides e.g. potato**:**				
early – mid	xxx	xxx	xxx	200 – 400
mid –late	xx	xxx	xxx	400 –600
Fungicides e.g. s-beet**:**	xxx	xxx	xx	200 - 400
Insecticide all crops **:**	xxx	xxx	x	200 – 400

xxx = very good xx = good

x = works in combination with higher amounts of spray mixture and higher pressure (e.g. ID: > 5 bar)

Application quality: avoid drift

Off-target application must be minimised!

Spray drift increases risk of:

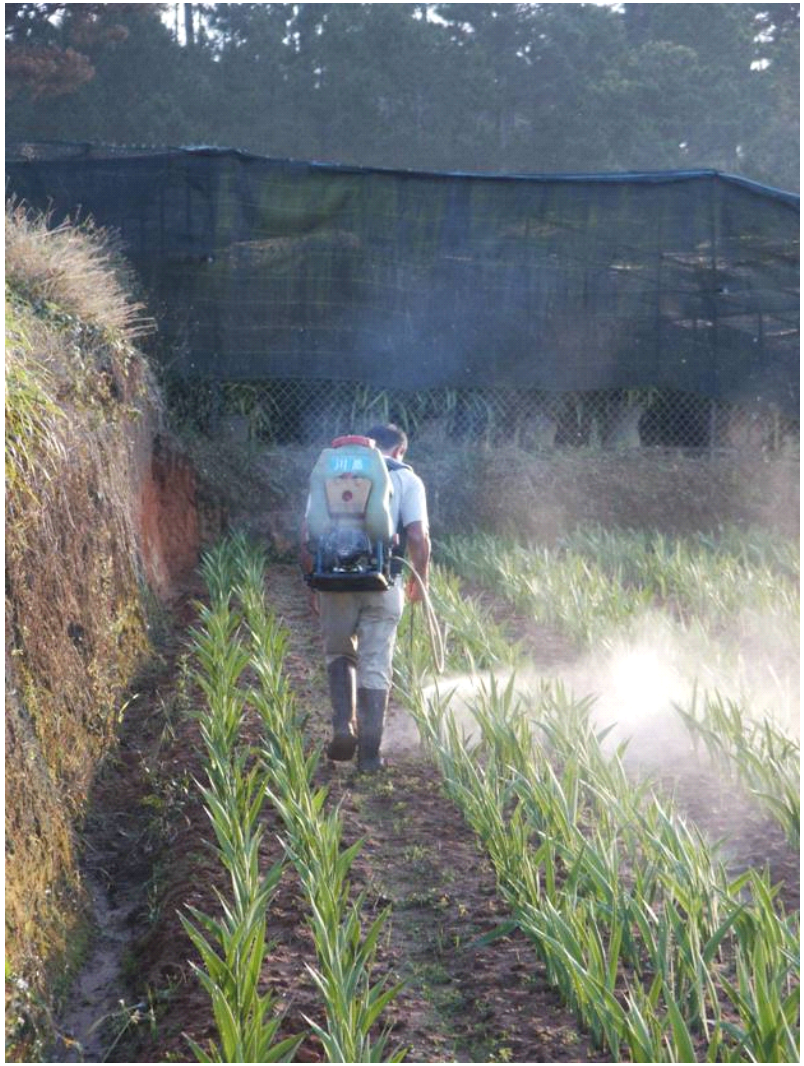
- contamination of the environment & the farmer
- loss of intended and applied dose and product on target.

Spray drift loss can be limited by using low drift spray technology such as low drift nozzles and baffles to direct the air flow.

Application quality: avoid drift cont.

Lever operated knapsack sprayers do not pose a great drift risk when used properly.

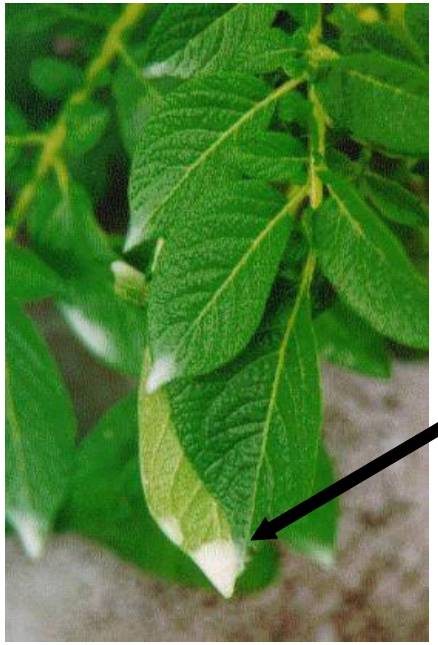
In contrast, motorised knapsacks, high pressure hand lances and mist blowers can produce significant drift if used incorrectly.



Application quality: check spray coverage

Increasing water volumes can lead to better coverage but, too much may result in run-off and loss of product. Do use water volume rates advised on the label.

Altering droplet spectra will also change target surface coverage and its movement:- smaller [finer] droplets move more effectively through crop canopies such as potatoes whereas large droplets give better penetration in upright crops like cereals.



Run-off - too high application volume

Poor application – uneven coverage

Application quality: check spray coverage using water sensitive paper

If available, use water sensitive papers to check likely target surface coverage [see below]. If no paper available, spray with water only. If the leaves are soaked and water drips from the leaves then the application volume is too high.

- Using water sensitive paper –
  - Using paper clips or staplers, fix water sensitive papers in the crop, particularly in target areas where you need to get good spray coverage.
  - Spray the area following your normal spray practice with clean water.
  - Collect up the papers and look at the droplet coverage.

Application quality: using water sensitive papers to ensure optimal coverage

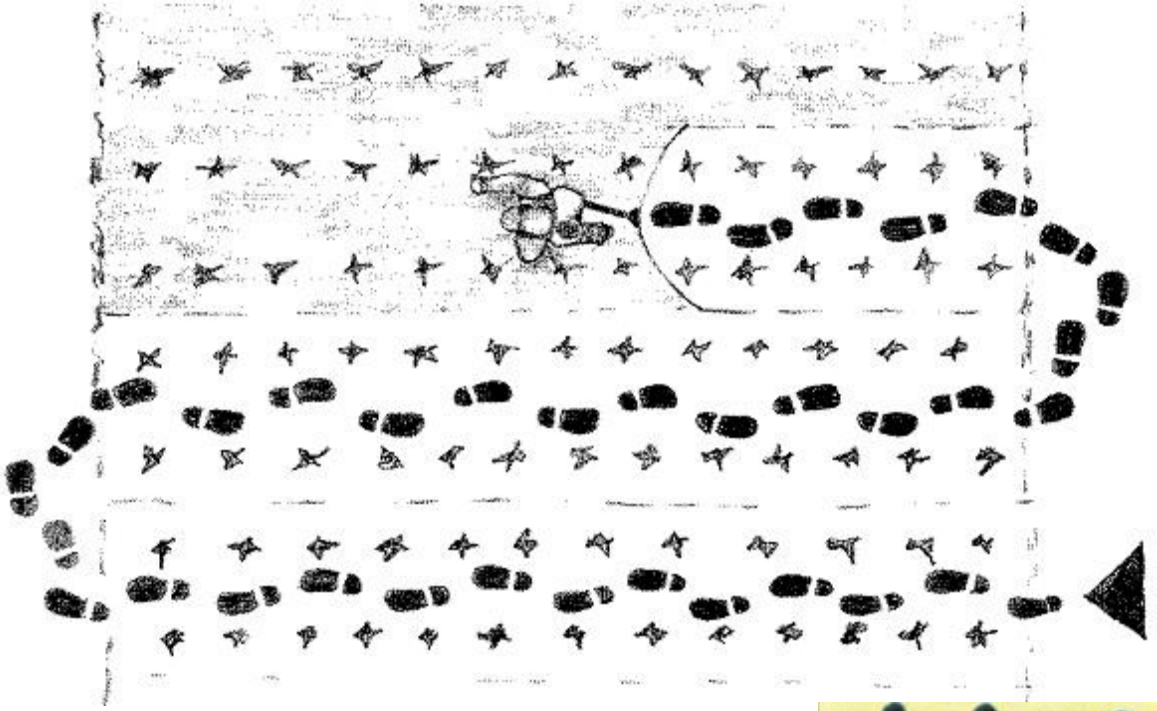
Good

Not uniform

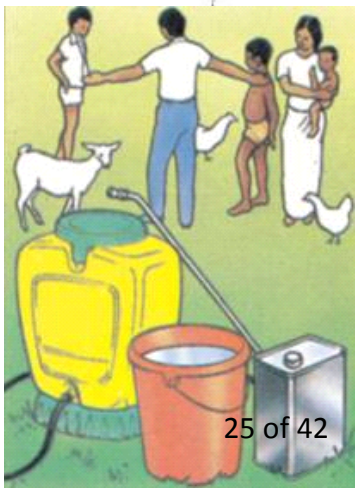
Excessive – run off

Application quality: spraying with a knapsack-sprayer

Maintain nozzle height



Use a system

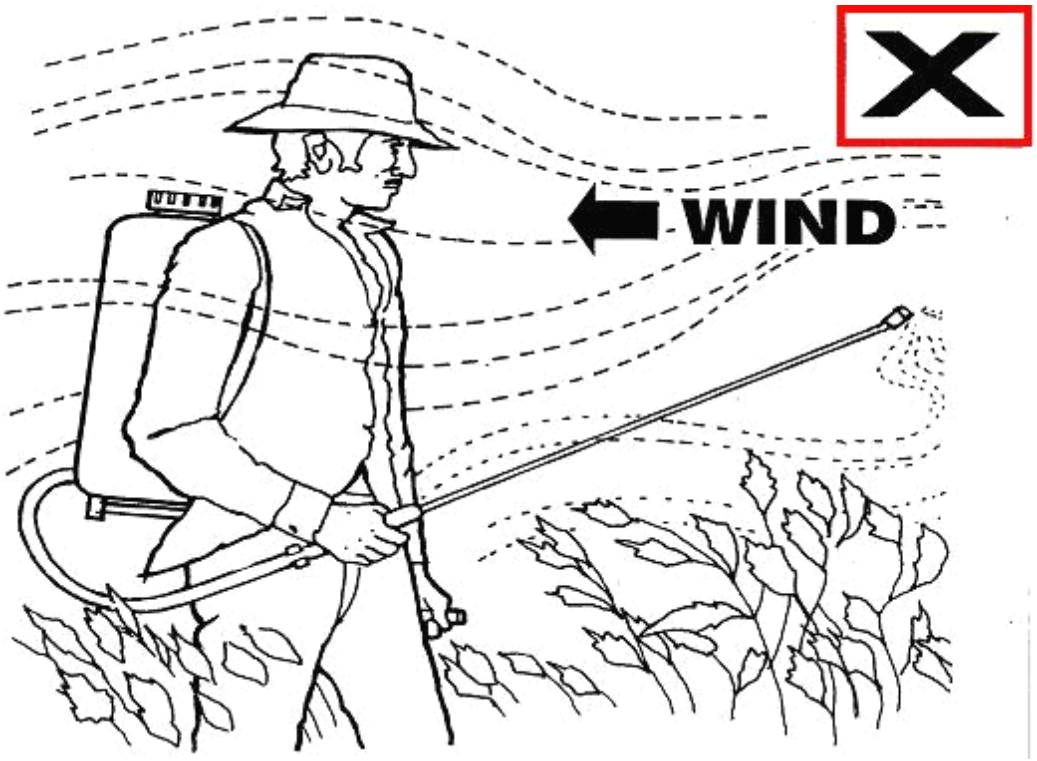


AND Maintain an even uniform forward speed

AND Keep children and livestock away from your working area

Application quality: never spray against the wind direction

Wind may move drops onto operator. The higher the nozzle, the closer the nozzle is to operator, the finer the spray……. so exposure risks increase.



Application quality: spraying with a knapsack-sprayer

For herbicides: keep the spray lance steadily in front of you; do not swing the lance.

For insecticides and fungicides in field crops: swinging of the lance is acceptable but care must be taken to ensure that a regular spray pattern is achieved.

Where ever possible spray to the side of the swath to avoid contamination of the legs.

Always position the nozzle down wind

Application quality: spraying with knapsack sprayer cont.

Use a shielded boom when applying herbicides especially when treating bands or inter-row application.

This will reduce potential drift onto adjacent plants.

Application quality: booms more efficient than nozzle swinging

For insecticides and fungicides in field crops: swinging of the lance is acceptable but care must be taken to ensure that a regular spray pattern is achieved.

Much more uniform coverage is obtained from using a boom sprayer than a single nozzle lance with a swinging movement

A Syngenta study in Vietnam showed that a swinging nozzle put 64% of the application volume on the target compared with 98% from a boom sprayer

Clean emptied containers with the manual Triple Rinse method

a) Drain the container

b) Add clean water 25-30% of container capacity

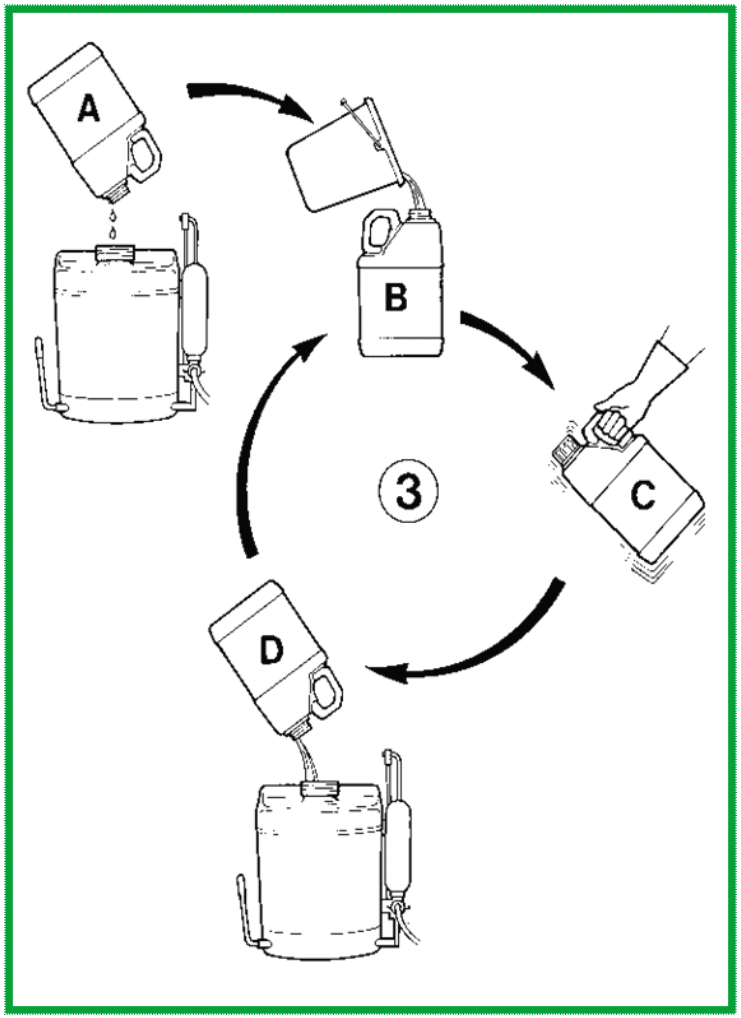
c) Replace cap firmly and shake vigourously for at least 30 seconds

d) Empty rinsings into spray tank and drain container for 30 seconds

e) Spray the rinsings.

Repeat steps B-D at least twice more (until rinse water is clear)

Wear suitable protective clothing when rinsing containers.



Comply with local legislation where relevant

Notes to slide 30

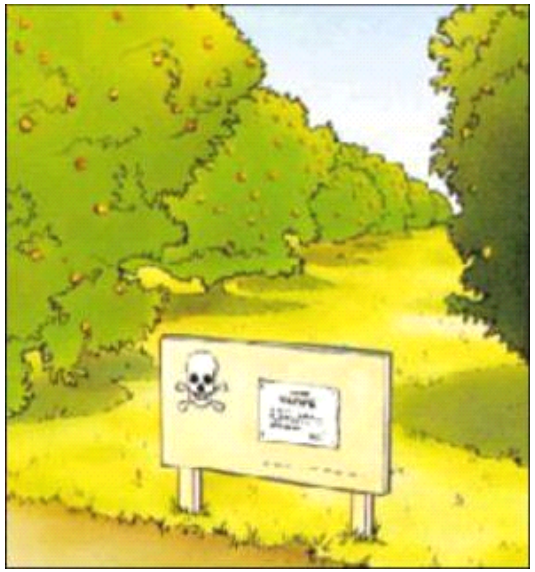
- It is important to reduce the hazard of empty pesticide containers before disposal. This should be done whenever a container is emptied during mixing, and is known as *triple rinsing*. The procedure to follow for triple rinsing is:
-
- 1. Drain the remaining pesticide from the container for at least 30 seconds into the sprayer tank.
-
- 2. Add clean water to the empty container until it is approximately one quarter full.
-
- 3. Replace the container cap securely, then shake the container for about 30 seconds, making sure that all the inner surfaces of the container are well rinsed (it is recommended to vary the shaking movement i.e. side to side, up and down, circular motion etc). Large containers may need to be rotated or rolled.
- 4. Remove the cap and empty the rinsings into the sprayer tank, so that it forms part of the spray mix. Allow it to drain for at least 30 seconds.
-
- 5. Repeat steps A-D twice more. If the rinse water is still coloured or milky after three rinses, then repeat the rinsing process until the rinse water is clear

Keeping safe the area sprayed

Following application of product -

- Put up a sign indicating that the area has recently been sprayed.
- Do not re-enter treated crop until it is safe to do so (normally keep out for 12-24 hours but read label recommendations)
- Keep other people and animals out until it is safe

Always start spraying at the downwind end of the field, to avoid having to walk through crop which has been contaminated by drifting spray



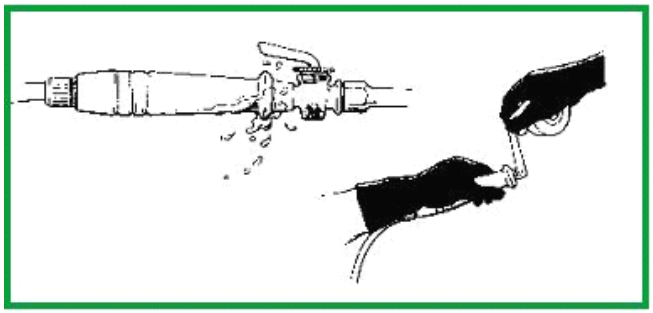
Knapsack sprayer maintenance

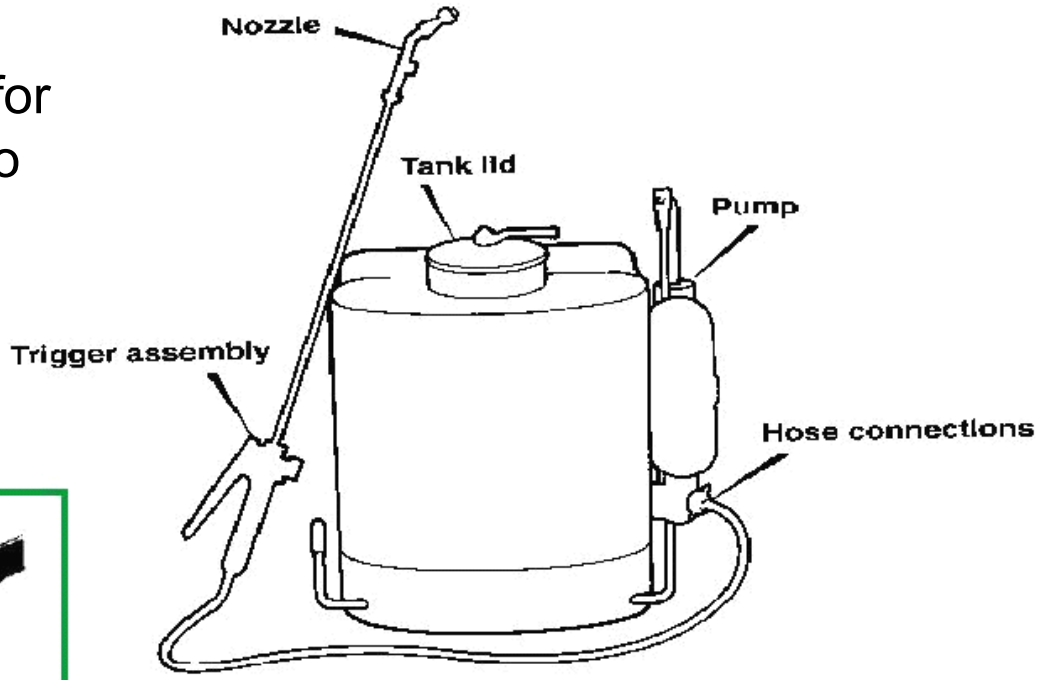
- Cleaning sprayers after use:
  - Maintains the equipment better
  - Allows for safety checks including wear
  - Ensures faster, safer use next time
- Equipment cleaning includes:
  - Use of personal protective equipment while cleaning
  - Periodic cleaning of filters
  - Disposal of water in proper manner

Knapsack sprayer: parts liable to leak

Refer to the sprayer operators manual.

Have spare parts available for components that are likely to wear and/or damage easily.





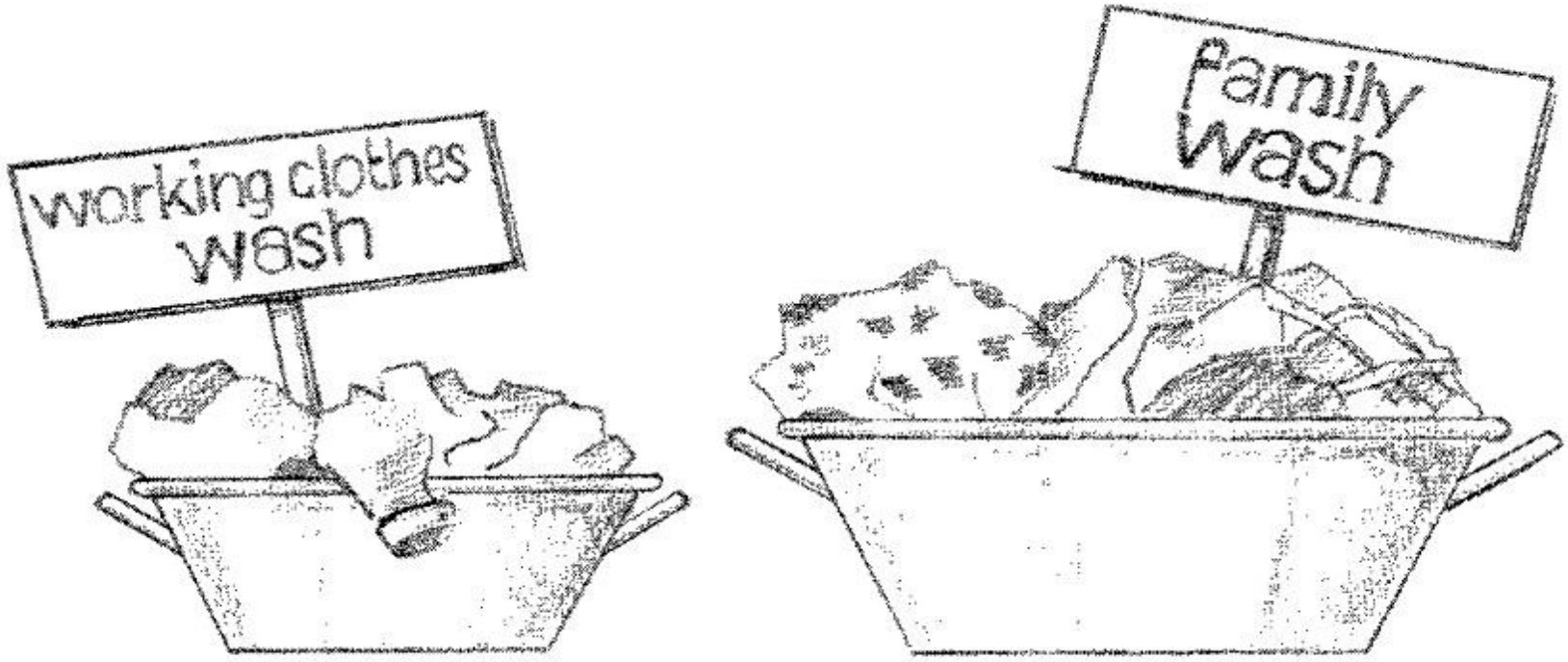
Notes to slide 35

- Dismantling a sprayer to Check for Worn Parts
- IT IS VERY IMPORTANT TO CHECK THERE IS NO PRESSURE IN A SPRAYER BEFORE STARTING TO DISMANTLE IT. A SPRAYER CAN CAUSE DANGEROUS CONTAMINATION, ESPECIALLY OF THE EYES, IF IT IS TAKEN APART WHILE STILL PRESSURISED. ENSURE THERE IS NO PRESSURE BY OPERATING THE TRIGGER UNTIL SPRAY NO LONGER COMES OUT OF THE NOZZLE.
-
- Remember too that even cleaned sprayers may contain harmful residues, and it is advisable to wear gloves when dismantling a sprayer.
-
- Even if leaks are not found when checking the sprayer with water, the sprayer should be dismantled to check for signs of wear which could lead to leaks while spraying.
-
- When dismantling the sprayer, there important parts to check are those that are likely to leak. The most common parts of the sprayer which leak are any joints e.g. screw thread connections and connections of the hose, and any rubber parts such as seals or 'O' rings which are liable to wear. The nozzle assembly, trigger valve on the lance, and the pump should all be checked carefully. Screw connections that leak should be tightened, and if necessary plumber's tape (PTFE tape) can be wrapped around the screw thread to correct leaks). Alternatively any worn seals can be replaced at the join.

Washing clothes used for spraying

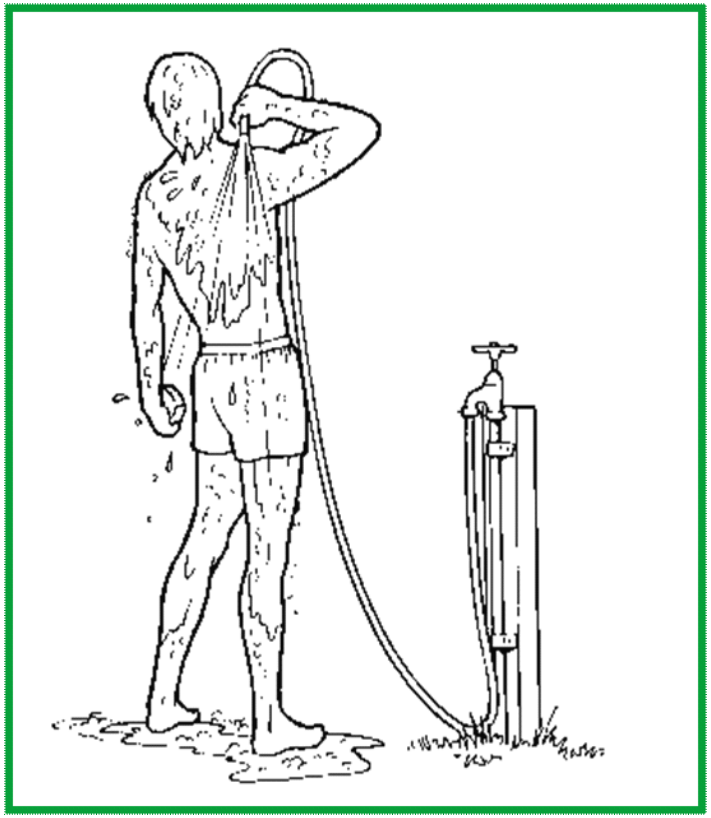
Store clothes used for spraying separate from all other clothes.

Wash clothes used for spraying separately.



Personal hygiene

- Wash thoroughly after any activity involving the use of crop protection products
- Wash body from top downwards
- Do not contaminate drinking water sources or water courses

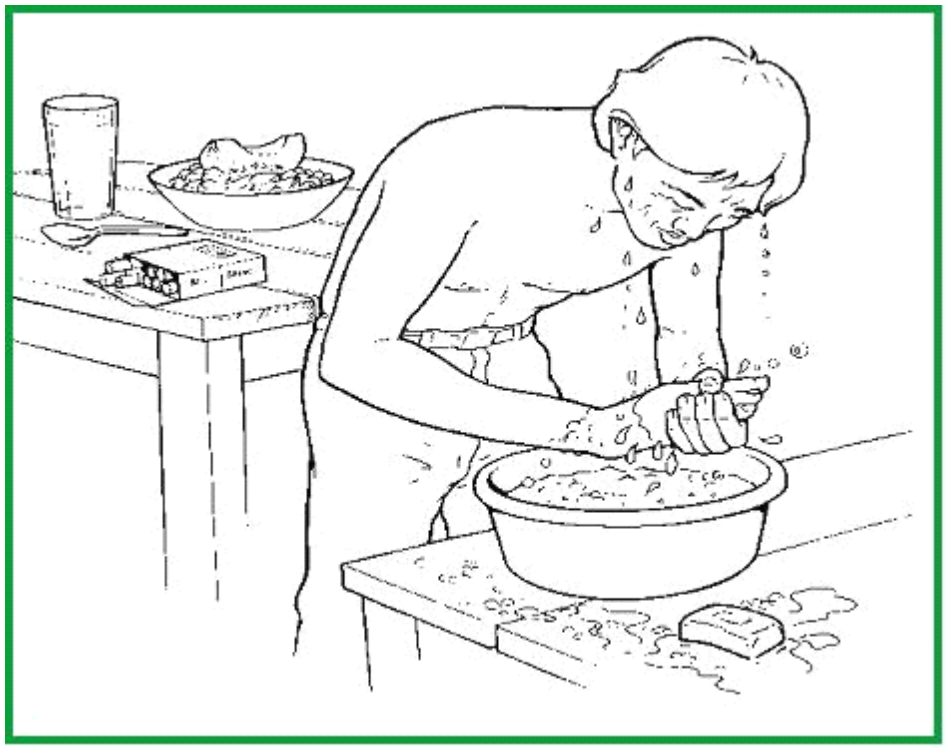


Notes to slide 37

- Practising good personal hygiene is a very important way to prevent chemicals passing through the skin into the body. When chemicals get onto the skin, the key factors which affect whether the chemicals cause poisoning by this route are the amount of active ingredient present (related to volume and concentration) and time on skin. Concentrated chemicals on the skin are more dangerous than dilute ones, and so it is very important to wash immediately with plenty of water if the skin is contaminated with concentrated pesticide.
- Pesticide users must be encouraged to practise regular washing as part of their normal routine of work. Keeping clean water and soap available at all times during mixing and spraying is good practice which must always be stressed.

Personal hygiene cont.

If full body washing not possible immediately then ALWAYS wash hands and face as a minimum and particularly before eating, drinking or smoking.



Notes to slide: When working with pesticides, a user may wish to stop for a break to smoke, drink, eat or urinate. If smoking eating or drinking is carried out with contaminated hands there is the possibility that pesticide will be transferred to the mouth and swallowed. Urinating with contaminated hands can cause contamination of the skin in the groin area, where uptake is most rapid. It is therefore very important to wash before eating, drinking smoking or urinating.

Preventing contamination of sprayer operators: the 5 Golden Rules

1. Exercise caution at all times.
2. Read and understand the product label.
3. Practice good personal hygiene.
4. Take care of and maintain application equipment.
5. Wear appropriate Personal Protective clothing and Equipment (PPE).

See “Five Golden Rules” training module for more detailed information

Notes to slide: When most people are asked about how they can prevent skin contamination, the most common response is to use protective clothing. There is no doubt that protective clothing is an important means of controlling exposure, but its limitations mean that it must be considered the last line of defence. There are other, better ways to prevent or minimise the effects of contamination. This can be summed up as five golden rules

Safety summary

Minimise operator contamination by:

- Less exposure to spray mixture and undiluted product
- Use of appropriate PPE
- Washing and cleaning all equipment after use (triple rinse)

Minimise environmental contamination by:

- Less drift
- Correct disposal of excess spray solution and cleaning water
- Avoiding any contamination of surface water
- Disposal of old containers following local guidelines. Never leave in the field or throw in water courses.

Questions

1. Before starting spraying what should you have done?
2. How do you dispose of empty containers?
3. What are the minimum protective equipment requirements for:-
   a) mixing b) spraying?
4. What are the best weather conditions for making an application?
5. How can you minimise the risk of operator contamination?
6. How do you maximise the effect of any application?
7. What details are available on a product label that will help ensure its effective, efficient and safe use?