Better Training for Safer Food Initiative

Hand held PAE and knapsack sprayers

Specific risk, maintenance and calibration needs

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Outline

• Special characteristics of hand held and knapsack sprayers
• Operator’s risk and methods to prevent
• Need for an accurate use to reduce food residues
• Particular problems regarding crops and situations
Special characteristics of hand held and knapsack sprayers

Hand held sprayers:
- simpel
- small tank
- non-professional use
Special characteristics of hand held and knapsack sprayers

Lever operated knapsack:
• up to 20 l
• manually driven pump
• carried on the operator’s back
Special characteristics of hand held and knapsack sprayers

Compression knapsack:
• tank pressurised with air
• low nominal volume (10 l)
• carried on the back or shoulder
Special characteristics of hand held and knapsack sprayers

**Motorised knapsack:**
- driven by engine or motor
- hydraulic atomisation
- similar to lever-operated
Special characteristics of hand held and knapsack sprayers

Motorised mistblowers:
- engine-driven
- atomisation by air shear
- air-blast (1500 m³/h)
- with or without pump
Special characteristics of hand held and knapsack sprayers

ULV sprayers:
• rotary atomiser
• very low volume rate
• often undiluted chemicals
Special characteristics of hand held and knapsack sprayers

• the majority of agrochemicals world wide is applied using knapsack sprayers
• carried by the operator – operator very close to the spot where the chemical is released
• environmental issues, such as leakage, often result in unintended operator’s contact to the chemical
• often of poor design and quality
Special characteristics of hand held and knapsack sprayers

Standards on requirements and test methods for manually operated as well as motor-driven knapsack sprayers with hydraulic atomisation:

EN ISO 19932 Equipment for crop protection - Knapsack sprayers
Part 1: Safety and environmental requirements
Part 2: Test methods
Part 3: Sprayer inspection (draft)
Special characteristics of hand held and knapsack sprayers

Standards on requirements and test methods for combustion engine mistblowers:

• ISO 10988 Equipment for crop protection - Knapsack motorized air-assisted sprayers — Test methods and performance limits

• EN ISO 28139 Agricultural and forestry machinery - Knapsack combustion engine driven mistblowers — Safety requirements
Which of the following knapsack equipment does not provide hydraulic atomisation?

1. Lever-operated knapsack sprayer
2. Compression sprayer
3. Motorised mistblower
Operator’s risk and methods to prevent

- mechanical
- physical loads
- hazardous substances
- ergonomics
- heat
- electricity
- noise and vibrations
Operator’s risk and methods to prevent mechanical risks – dropping

- stable straps and fixing parts
- stable design of the sprayer
Operator’s risk and methods to prevent mechanical risks – high pressure

• must withstand twice the maximum working pressure
Operator’s risk and methods to prevent physical loads – lasting carry

• maximum weight of 25 kg
• padded straps
Operator’s risk and methods to prevent

physical loads – load transmission

• maximum distance of center of gravity from back plane 150 mm
Operator’s risk and methods to prevent

hasardous substances – plant protection products

• no leakage!
• non absorbent strap material
• minimum length of spray lance 500 mm
• shut-off valve
Operator’s risk and methods to prevent

ergonomics – design and position of controls
- all controls in reach of operator
- pump lever mountable at both sides
Operator’s risk and methods to prevent

heat – exhaust system

• protection against contact with hot parts
Operator’s risk and methods to prevent

electricity – electric motor and engine ignition system

• insulation of all electric parts
Operator’s risk and methods to prevent

noise and vibration – engine and pump

• noise and vibration should be considered in design
• i. e. elastic mounting of engine
• no requirements
What is the maximum acceptable gross weight of a knapsack sprayer?

A) 20 Kg
B) 25 Kg
C) 30 Kg
Need for an accurate use to reduce food residues

• residues of products in food may harm the consumer
• potential effects on consumer depend on toxicity and intake of residues
• residues are determined by **dose** and time after application
• **essential not to exceed the maximum dose given on the product label**
• underdosing can cause low efficacy of the product and could require another application
Need for an accurate use to reduce food residues

Proper preparation of spray liquid

• needed **dose** (product) $d$ in l/ha or kg/ha
• **area** $A$ to be treated in ha
• intended **application rate** (spray liquid) $R$ in l/ha

\[
V_p = d \times A
\]

\[
V = R \times A
\]
Need for an accurate use to reduce food residues

Proper preparation of spray liquid

concentration of product: \[ c_p \approx \frac{V_p}{V} \]

amount of product needed for a volume of spray liquid \( V_l \): \[ V_c = c_p \times V_l \]
Need for an accurate use to reduce food residues

Proper preparation of spray liquid

- Product dose: 2 l/ha
- Tank size: 15 l
- Add 150 ml per full tank
- 200 l/ha
Need for an accurate use to reduce food residues

Factors influencing dose and application rate:

- operator walking speed
- nozzle
- spray pressure
- operator behaviour
Need for an accurate use to reduce food residues

Calibration of the sprayer – items required

• means of measuring swath width and area to spray
• graduated measuring jug or Kalibottle
• clean water
• stopwatch
Need for an accurate use to reduce food residues

Operator walking speed:

• affected by ground and canopy conditions
• varies between individual operators

Calibrate in the actual spraying situation!
Need for an accurate use to reduce food residues

Nozzle:

• flexibility in output rate and droplet size

• shape of spray jet (flat fan, cone)

• colour coded
Need for an accurate use to reduce food residues

**Spray pressure:**

- influences output rate and droplet size
- to be kept constant once chosen
- control valves that can be fitted before the nozzle for constant pressure (also adjustable)
Need for an accurate use to reduce food residues

Operator behaviour:
• can have a major input on application
• variations in forward speed, nozzle height, nozzle movement
• variations in pumping action for lever-operated sprayers

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Need for an accurate use to reduce food residues

Operator behaviour:

• ways of application in arable crops
Particular problems regarding crops and situations

Knapsack sprayers – adjustable cone nozzles

• from solid jet to cone
• setting not reproducible, can change during spraying
• not recommended since hard to calibrate
• often made of brass (soft material)

Replace by standard nozzle!
Particular problems regarding crops and situations

Motorised mistblowers – output rate
Particular problems regarding crops and situations

Motorised mistblowers – distribution

- when directed horizontally, width and position of spray deposit depends on sprayer type and adjustment
What is the most suitable knapsack equipment for spraying in arable crops?

1. Lever-operated knapsack sprayer with small spray boom
2. Compression sprayer with an adjustable cone nozzle
3. Motorised mistblower
Knapsack sprayers calibration

Empty the tank, pump and hose.

Fill in a precisely measured amount of water.

Example: Filled in = 15 l (e.g. to the “Full” mark)

Photo: Syngenta
Knapsack sprayers calibration

Spray the marked area as usual

Photo: Syngenta
Knapsack sprayers calibration

Measure the remaining amount of water by emptying the entire sprayer.

Calculate the used amount.

Example:

Filled in 15.0 l
Remaining 7.0 l
Used amount 8.0 l

Photo: Syngenta
Knapsack sprayers calibration

Calculate the spray volume per hectare

Used amount: 8.0 l
One ha: 10'000 m²
Crop Area: 100 m²

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\text{Spray Volume} = \frac{8.0 \text{ l}}{10'000 \text{ m}^2} \times 100 \text{ m}^2
\]

\[
= \frac{800}{100} \text{ l/ha}
\]

Photo: Syngenta
Thank you for your attention.

Prof. Andreas HERBST