



# **Better Training for Safer Food** *Initiative*

**Hand held PAE and  
knapsack sprayers**

***Specific risk, maintenance and  
calibration needs***

## 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:

- simple
- 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:

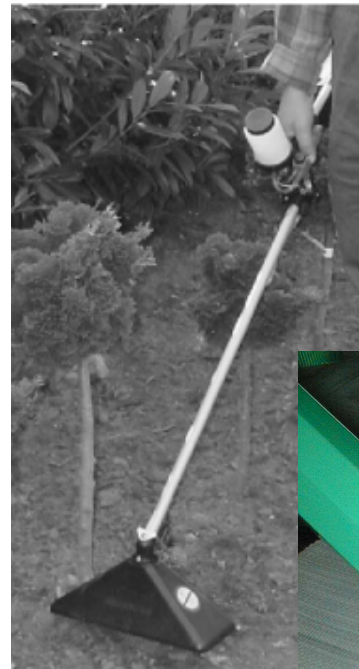
- engine-driven
- atomisation by air shear
- air-blast (1500 m<sup>3</sup>/h)
- with or without pump



## 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)

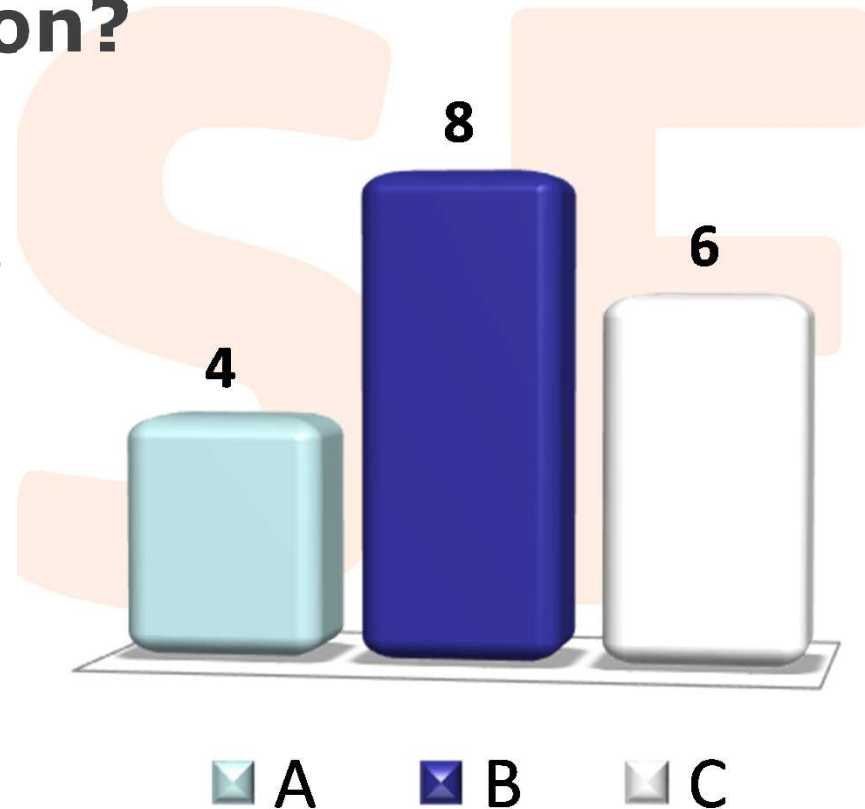
## **Special characteristics of hand held and knapsack sprayers**

### **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 provides 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

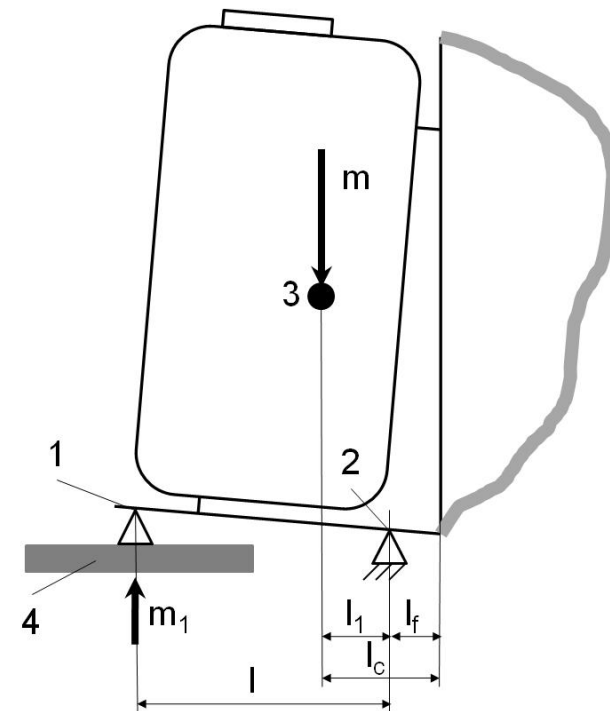




## Operator's risk and methods to prevent

### physical loads – load transmission

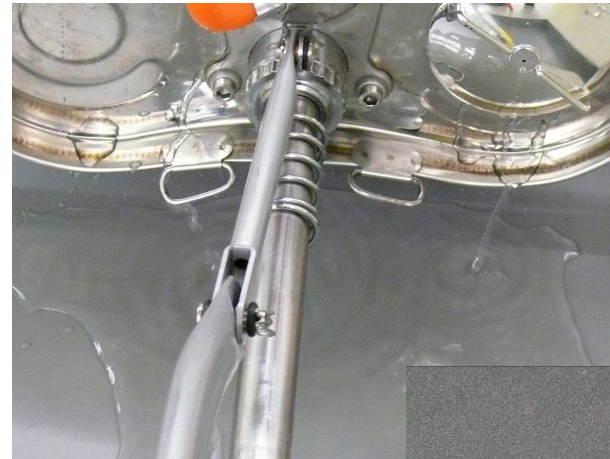
- maximum distance of center of gravity from back plane 150 mm



## 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

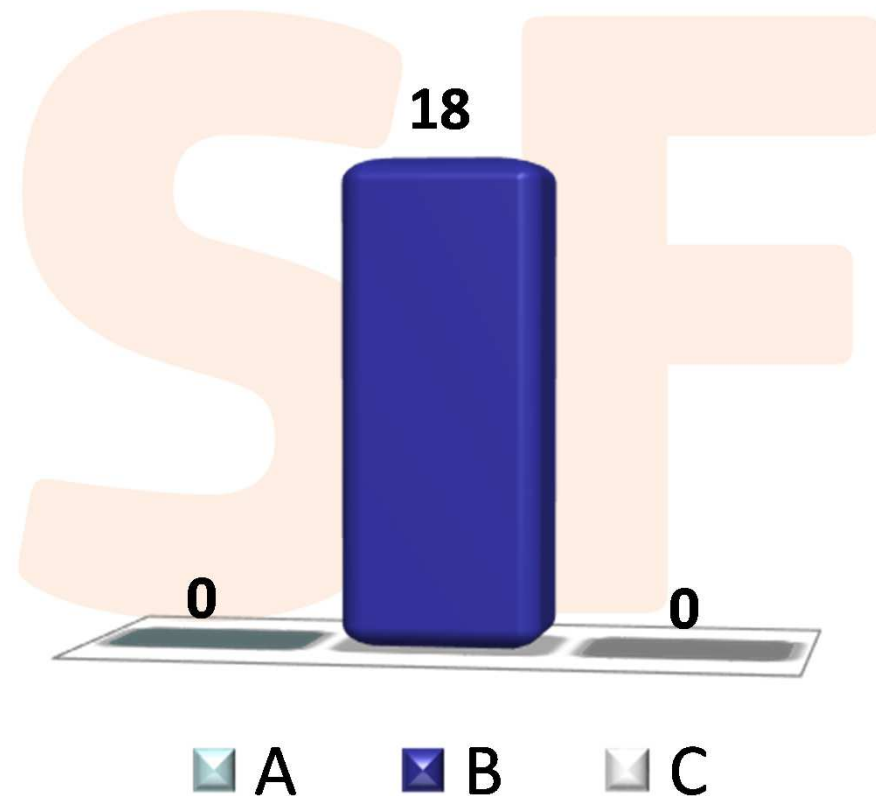
## **Operator's risk and methods to prevent**

### **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

total amount of product needed:  $V_p = d \times A$

total amount of spray liquid needed:  $V = R \times A$

## Need for an accurate use to reduce food residues

### Proper preparation of spray liquid

concentration of product:

$$c_p \approx V_p / V$$

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

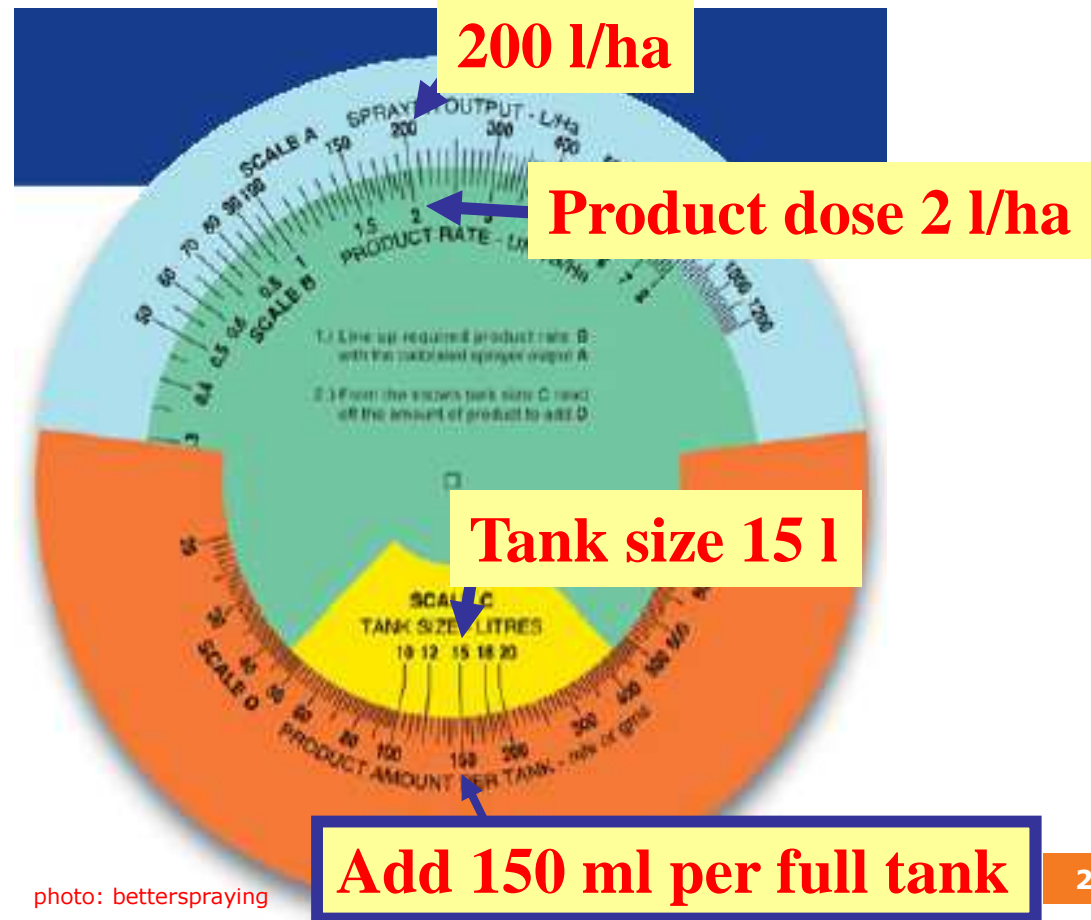


photo: betterspraying

## **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)

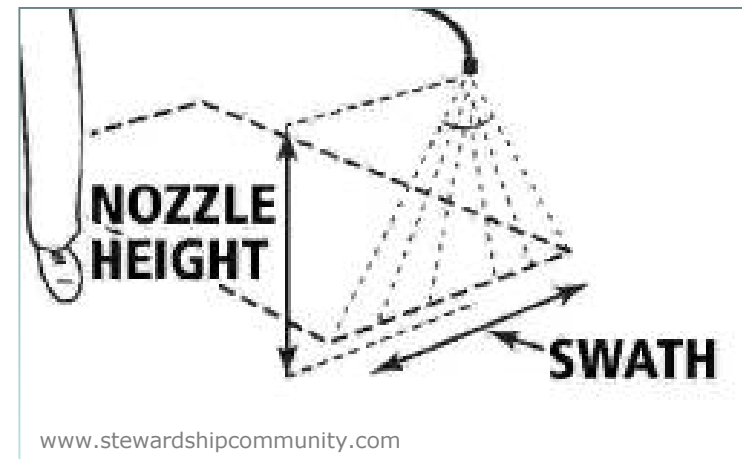




## Need for an accurate use to reduce food residues

### Operator behaviour:

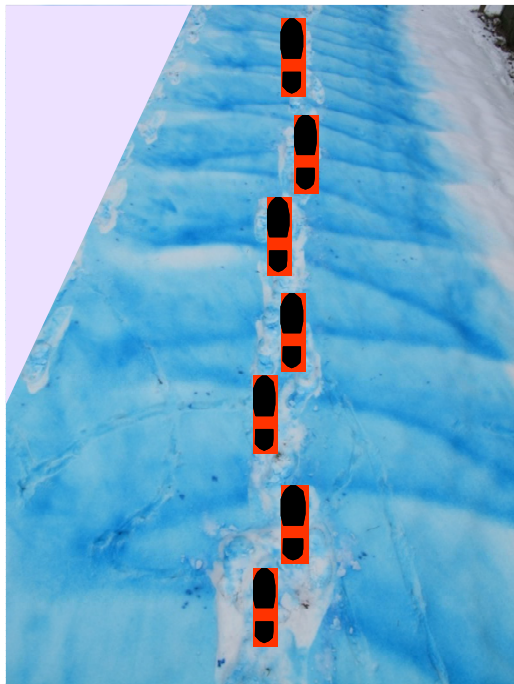
- can have a major input on application
- variations in forward speed, nozzle height, nozzle movement
- variations in pumping action for lever-operated sprayers



## 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

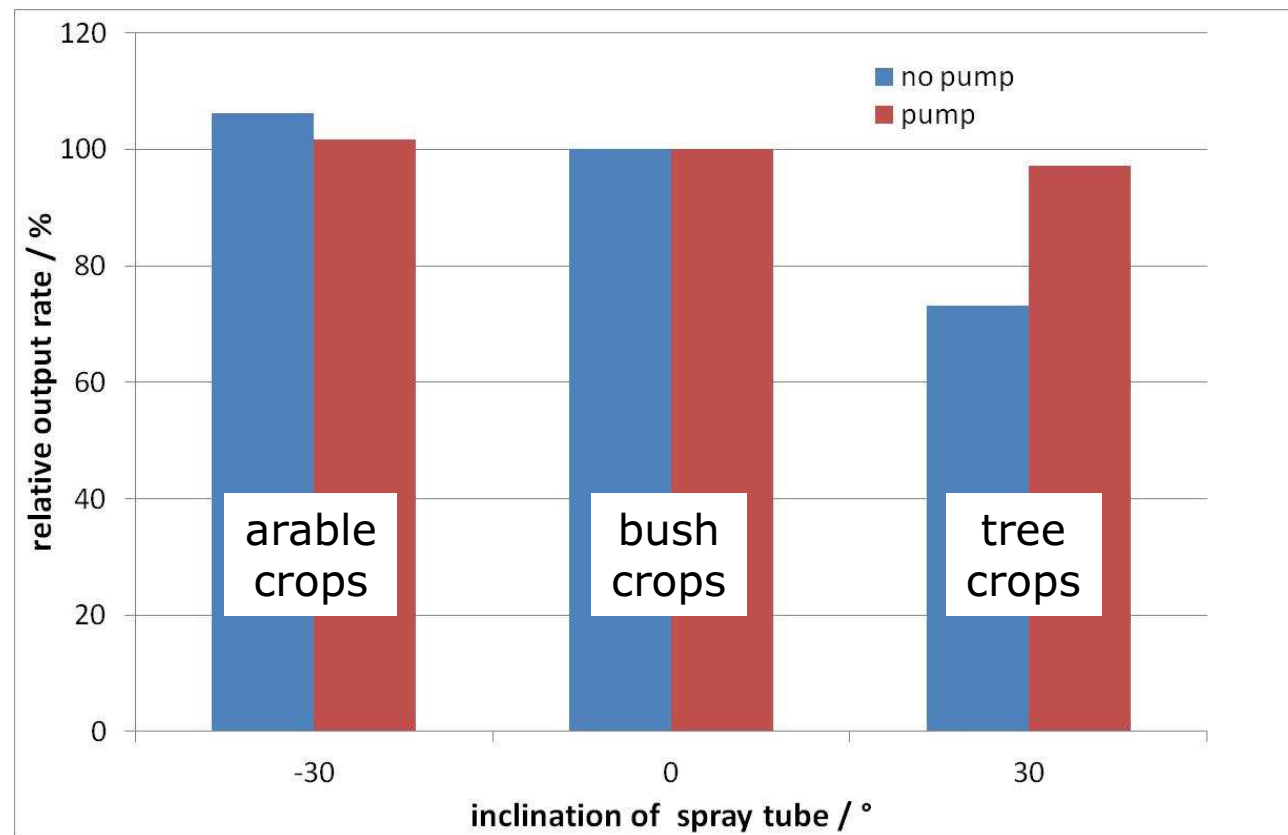
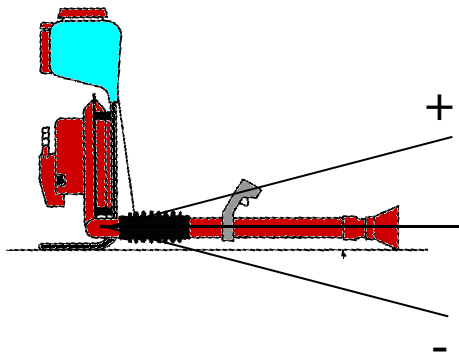
- from solid jet to cone
- setting not reproducible, can change during spraying
- not recommended since hard to calibrate
- often made of brass (soft material)



Replace by standard nozzle!

## Particular problems regarding crops and situations

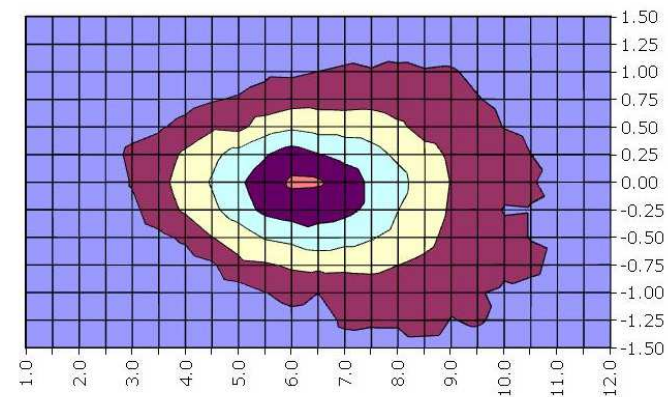
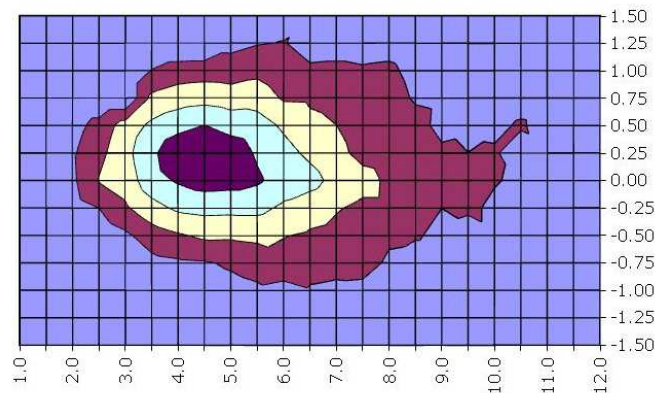
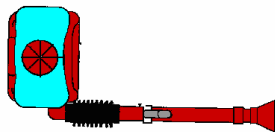
### Motorised mistblowers – output rate



## Particular problems regarding crops and situations

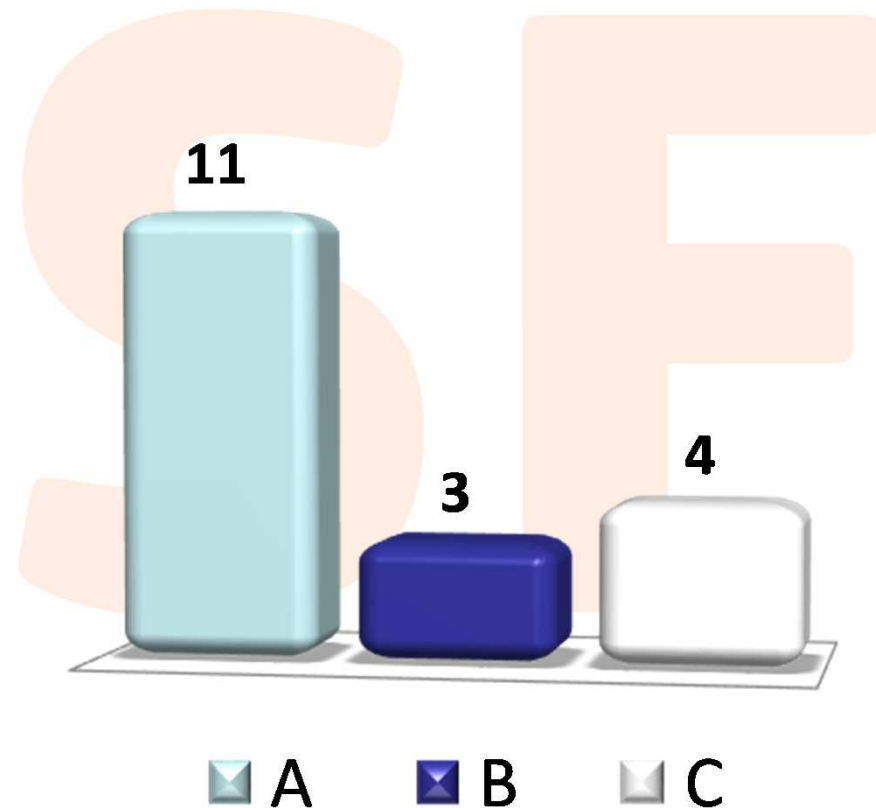
### Motorised mistblowers – distribution

- when directed horizontally, width and position of spray deposit depends on sprayer type and adjustment

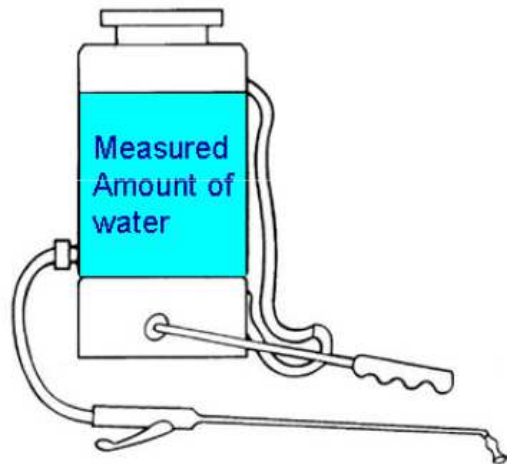


## What is the most suitable knapsack equipment for spraying in arable crops?

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



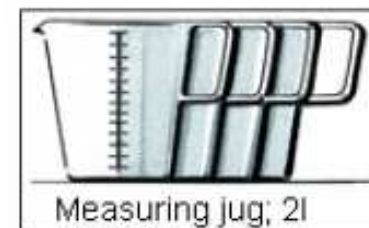
# Knapsack sprayers calibration



Empty the tank, pump and hose.

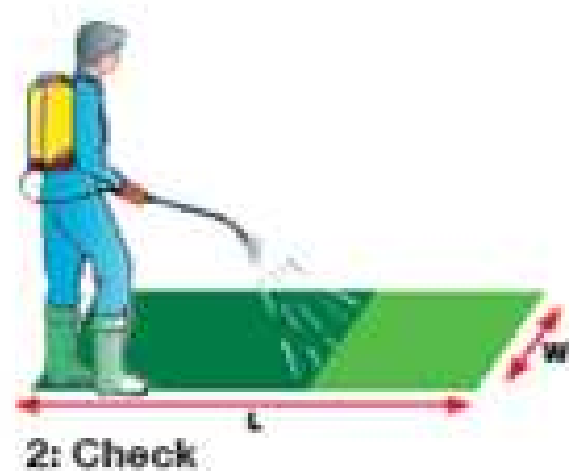
Fill in a precisely measured amount of water.

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



# Knapsack sprayers calibration

Spray the marked area as usual





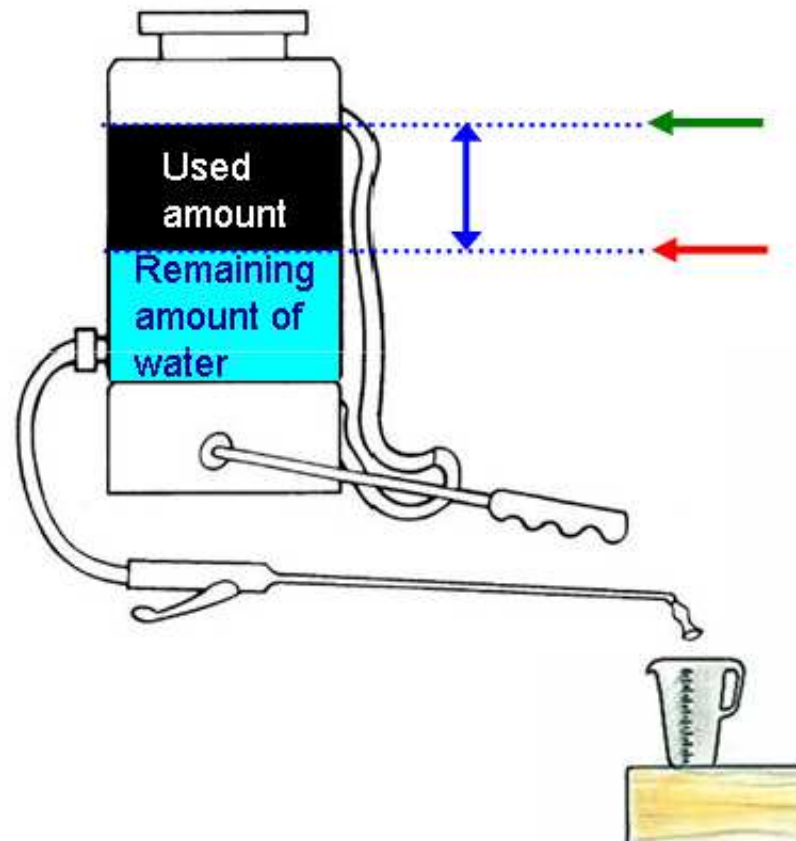
# Knapsack sprayers calibration

Measure the remaining amount of water by emptying the entire sprayer

Calculate the used amount.

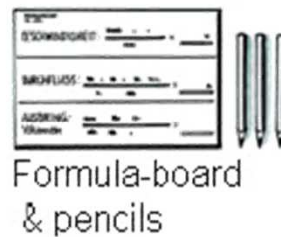
Example:

Filled in 15.0 l
Remaining 7.0 l
<b>Used amount 8.0 l</b>



# Knapsack sprayers calibration

Calculate the spray volume per hectare



$$\frac{\text{Used amount } 8.0 \text{ l}}{\text{Crop Area } 100 \text{ m}^2} \times \text{One ha } 10'000 \text{ m}^2 = 800 \text{ l/ha}$$



*Thank you for your attention.*

• *Prof. Andreas HERBST*

**Better Training for Safer Food**  
**BTSF**

• *European Commission*  
*Consumers, Health and Food Executive Agency*  
*DRB A3/042*  
*L-2920 Luxembourg*

*Consumers,  
Health And Food  
Executive Agency*