Contents

Mistblowing Technique

673702-GB-96/2

Introduction

Successful crop protection depends on right choice of chemical product, spraying at the correct moment and use of suitable, precisely adjusted application equipment.

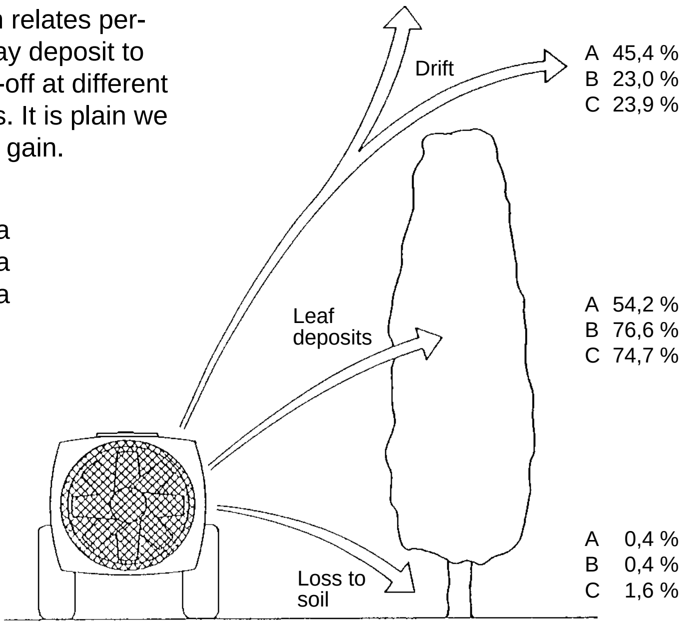
Precision and accuracy are key factors in application. Your command of these factors will be rewarded with opportunities to:

- exploit lower water volume rates and the
- use of minimal appropriate dose of product.
- reduce drift and run-off and
- improve targeting to yield
- higher quality crops with
- minimal residues and
- lower costs.

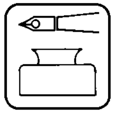
This entails that the application equipment is operated correctly. Nozzle size, forward speed, spray volume rate, blower setting etc. must be suitable (optimal) for the conditions of which weather and crop characteristics are the most important.

The diagram relates percentage spray deposit to drift and run-off at different volume rates. It is plain we have a lot to gain.

A 100 l/ha
B 400 l/ha
C 1600 l/ha



Planas & Pons BCPC 1991



Personal safety together with cleaning and sprayer maintenance become still more important. If a routine is made of these points, many problems and loss of time will be avoided.

Good spray technique therefore entails:

- Correct choice of parameters (nozzles, blower setting etc.)
- Use of an effective calibration method
- Personal safety in connection with crop protection
- Cleaning the sprayer effectively

This booklet is intended to give you basic, step by step guidelines for the calibration and setting up of your sprayer. (A video on mistblower calibration is also available). Do not be afraid if it initially takes time. It is well spent and will soon be part of the spray routine.

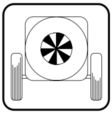
In some cases more than one method is described. Pick the one best suited to **your needs.** Use your sprayer to its maximum potential: as a **PRECISION IMPLEMENT**.

Calibration without problems

The following is a calibration check list. Use it if you are unsure as to where to start.

1. Check the sprayer is clean. If in doubt, clean again. Fill the sprayer with clean water.
2. Read the chemical label. Follow recommendations.
3. Choose the liquid volume rate. See page 13.
4. Calculate the forward speed. See page 15.
5. Check forward speed. See page 16.
6. Choose nozzles and pressure. See page 17.
7. Adjust blower settings to crop.
8. Check flow rate.
9. Check deposition in crop. See page 27.
10. Add chemical following label and safety precautions.
11. Clean sprayer after use.

Do remember that where official guidelines and codes of practice exist, they must be adhered along with the recommendations on the chemical label. Local organizations eg. Dept of Agriculture, may be able to supply more information.



The blower

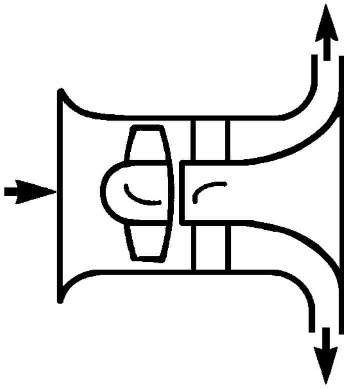
When using mistblowers with nozzles, (ie. not pneumatic sprayers) the spray pressure is responsible for metering and atomizing the liquid into fine drops. These drops will then be transported into the crop by the air stream generated by the fan.
When using pneumatic sprayers the air stream is also responsible for the atomization of the liquid.

Main blower characteristics are:
a) Air volume (m^3/h)
b) Air speed (m/s)
c) Air orientation and distribution.

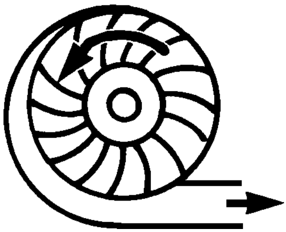
Blower fan types

There are 2 main fan types;

- Axial fans produce high turbulent air volumes at low air speeds and low air pressures. The turbulence induces leaf movement that permits drops to penetrate and to be deposited on both sides of the leaves. Som axial fans have adjustable blade angles.



- Centrifugal fans produce high air speeds and high air pressures but low air volumes. The blower typically has hoses and spouts to localize the air.



The blower housing may direct the air out to both sides or to one side.

m^3/h

Air volume

Volume is related to the aerodynamic characteristics of the blower housing and the rotation speed of the fan.

The theoretical volume (m^3/h) required for a given crop can be calculated:

$$\frac{1000 \text{ x speed (km/h) x spray width (m) x tree height (m)}}{3 \text{ (factor*)}} = \text{air volume (m}^3\text{/h)}$$

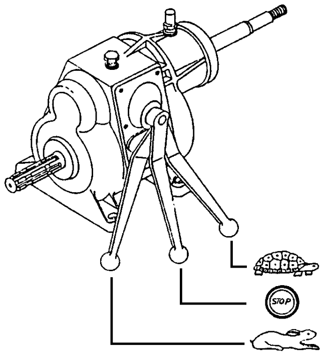
*For light foliage use factor 3.0 to 3.5, for dense foliage use factor 2.5 to 3.0

Once the required volume is established, consult the sprayer instruction book for settings eg. fan rotation speed, blade angling and gear.

Increasing the fan blade angle will move a greater volume of air but also consume more power.

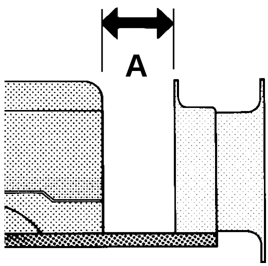
Gearbox

Some sprayers have a gearbox enabling a change in ratio between P.T.O. and fan. Its function is to allow higher fan rotation speed and or disengagement of the blower, eg. whilst filling, spraying with guns etc.



Air speed

There is an inverse relationship between air speed and outlet area. As outlet area decreases, air speed increases. Some blowers permit adjustment of outlet area **A**. This is set in accordance to volume of air (bigger volume, bigger area) and crop stage. If trees are in flower, outlet area can be increased to obtain a lower, less aggressive air speed. When trees are in full canopy, outlet area can be reduced thereby increasing air speed and drop penetration.

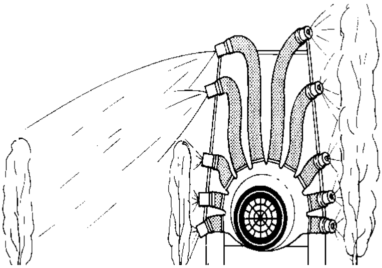


Deflectors/spouts

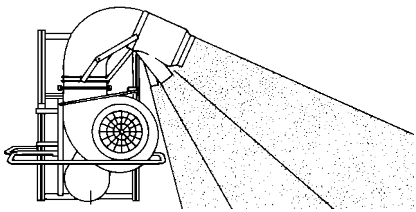
Some sprayers have internal deflectors. These ensure a uniform air distribution on both sides of the fan or duct the air from the bottom of the blower to where it is most needed.

External deflectors or spouts may be fitted to localize the spray cloud into the vegetation. They also help reduce drift. If spouts are fitted the air volume can be increased to certain parts of the crop by directing 2 or more spouts to that area.

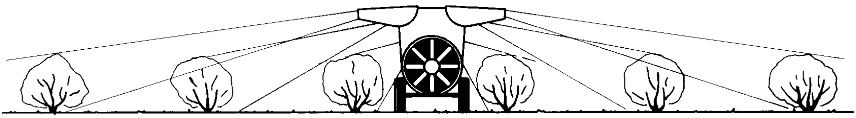
Some sprayers are specific for low row crops. Here the deflectors/ spouts direct the spray downward.



Spouts for localizing spray cloud.



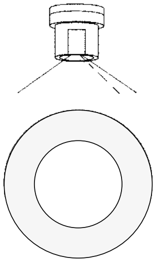
Single-sided spouts for low crops.



Deflectors for bushes.

Nozzles

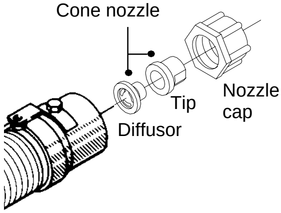
The nozzles are a critical component on a mistblower. Their task, to meter and atomise the spray liquid is related to nozzle type and nozzle material used.

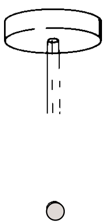


Pattern for hollow cone spray nozzle

Hollow cone spray nozzle-type 1299

Commonly used in mistblowers. Produces a hollow cone pattern. Consists of two parts; the tip and the diffusor. Angle is not adjustable but affected somewhat by pressure; higher pressure producing a wider angle.

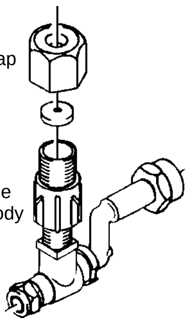




Pattern for solid stream nozzle

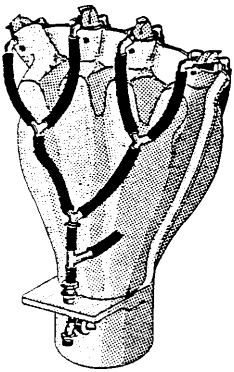
Solid stream nozzle-type 1099

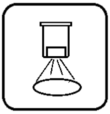
Used in the adjustable cone nozzles (pistol nozzles). Pattern can be adjusted from solid stream to cone pattern. Narrow angle increases drop size and flow rate. Flow must therefore be checked after adjustment.
If used as a metering disc, the output can be altered a little by placing the nozzle with or against the direction of flow.



Air shear nozzle

Used on pneumatic sprayers where atomization of the liquid is caused by high air speed at outlet. Typically fine atomization of the liquid. The higher the air speed, the smaller the drops.

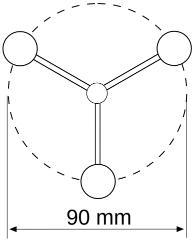


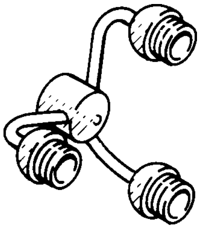


The majority of nozzles for mistblowers are made of ceramic material. This ensures long life even at high working pressures but even so they do wear. If nozzle output is more than 10 % in relation to the theoretical (table) value, the nozzle should be replaced.

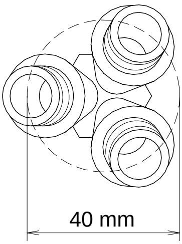
Fittings
Cluster fitting (increasing quantity of nozzles) are used to increase the liquid output, reduce drop size or both. Different diameters are to suit different sized spouts as the spray mist should remain in the airstream.

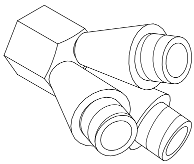
The below cluster fittings all have 3/8” BSP thread.



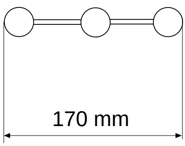


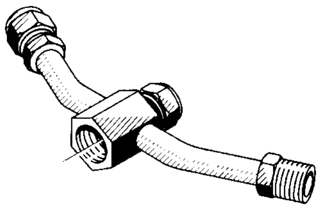
Cluster dia. 90 mm
Ref. No. 635611





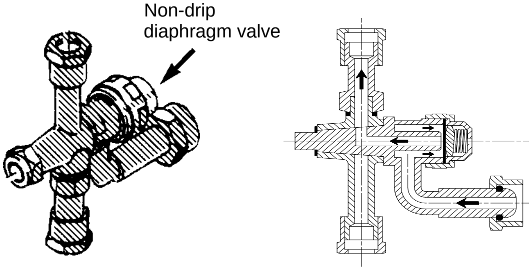
Cluster dia. 40 mm
Ref. No. 631304





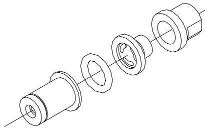
Cluster length = 170 mm
Ref. No. 631912

Flip-over nozzle holders facilitate closure of a nozzle or change from one nozzle size to another.

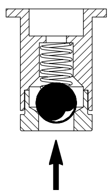


Flip-over double nozzle holder with non-drip diaphragm valves

Non-drip valves ensure the spray liquid does not drip from the nozzles when the distribution valves are closed.



Non-drip ball valve
Re.No. 702984



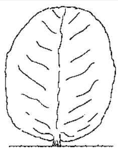
Crop stage and development

l/ha

Different tree sizes and shapes require different liquid volumes rates, nozzles and blower settings.

At the same time, seasonal development of the tree changes application requirements.

Generally, smaller trees are not difficult to spray but be wary of large trees with full foliage.

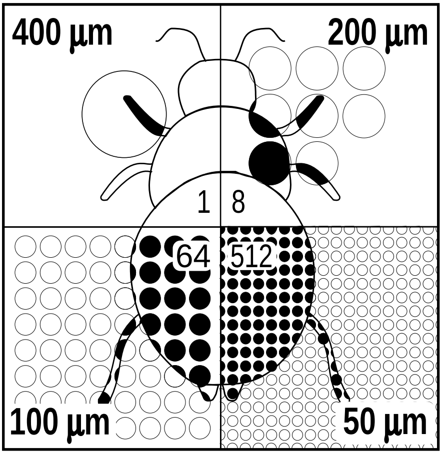
General guidelines	 small	 large
Reduce speeds		✔
Increase air volumes		✔
Increase liquid volumes		✔
Use of deflectors	✔	✔

Drop size

The nozzle produces a range of drop sizes. The nozzle can be characterized by the average drop size based on volume (Volume median diameter - VMD).
Nozzle size and pressure are chosen to yield drop size and number of drops per area (cm^2) required. In practice, mistblower nozzles typically only produce a narrow range of drop sizes. This permits good buoyancy in the airstream and yet will still impact readily on target surfaces.

The reduction of drop diameter has a dramatic effect on the number of drops produced. Each time we halve the diameter, 8 drops are produced.

Basic nozzle characteristics:
- Coverage is better with fine drops
- Drift and evaporation is reduced with larger drops
- Penetration is enhanced with larger drops



Halving one 400 mm drop produces 8 drops of 200 µm. With these smaller drops, it is possible to cover about twice the area.

Once again the chemical label may give some indication. If not, the following have been traditionally quoted:

Product	Drop size	Minimum number drops
Insecticide	200-300 µm	20-30/cm^2
Fungicide	100-250 µm	50-70/cm^2

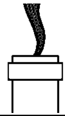
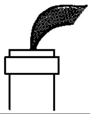
The chemical products mode of action (systemic or contact) and whether the pest is mobile, static or concealed are other issues influencing choice of drop size.

Avoiding drift

Avoid spraying on windy days. Wind drift results in losses of sprayed chemical and decreases the uniformity of distribution. It may also damage neighboring crops and be an environmental hazard.

To minimize drift:

- Use bigger nozzles
- Reduce pressure
- Direct spray cloud only to the intended parts of the tree
- Where possible, use a downward trajectory for drops
- Reduce air speed/volume so the spray cloud is not carried beyond the target
- Do not spray whilst turning out of the rows
- Do not spray whilst inversion conditions prevail
- Avoid spraying at the hotter part of the day

Approx airspeed at tractor height	Beaufort scale (at height at 10 m)	Descrip-tion	Visible signs		Spraying
Less than 2 km/h (0.6 m/s)	Force 0	Calm		Smokes rises vertically	Avoid spraying on warm sunny days
2-3.2 km/h (0.6-0.9 m/s)	Force 1	Light air		Direction shown by smoke drift	Avoid spraying on warm sunny days
3.2-6.5 km/h (0.9-1.8 m/s)	Force 2	Light breeze		Leaves rustle, wind felt on face	Ideal spraying
6.5-9.6 km/h (1.8-2.7 m/s)	Force 3	Gentle breeze		Leaves and twigs in constant motion	Avoid spraying herbicides
9.6-14.5 km/h (2.7-4.0 m/s)	Force 4	Moderate		Small branches moved, raises dust or loose paper	Spraying inadvisable

BCPC 1992

Temperature will influence the effect of certain chemicals so check the label for notes on upper and lower limits. High temperatures also increase evaporation.

Differences in air temperature may lead to inversion conditions which reduce deposition of the smaller drops and increase the risk of drift. Fog or early morning mist are a result of inversion. Do not spray if there is a risk of inversion.

Sunlight and temperature may also affect the forage periods for beneficial insects eg. bees. Again, check the label for recommendations.

Calibrating the sprayer

The basic plan for calibration is as follows:

1. The volume rate (l/ha) to be applied is established.
2. The forward speed (km/h) is chosen and verified.
3. The total nozzle output (l/min) is determined.
4. The nozzles and pressure are chosen and checked.

A number of methods are described. Choose the ones best suited to you. It is good practice to keep a record of the spray tasks and therefore blank data sheets are included at the back of this booklet. Use them to record setting etc.

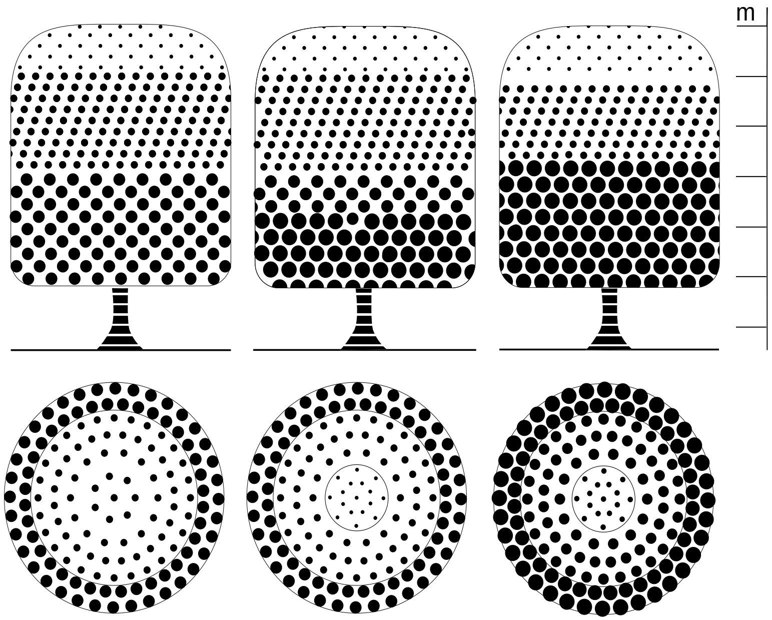
Volume rate

Some chemical labels indicate what liquid volume per area (l/ha) to use. By using a chart, formula or Mistblower Calibrator you can then go on to calibrate the sprayer.

Spray volume rate classification for trees and bushes	
High	>1000 l/ha
Medium	500-1000 l/ha
Low	200-500 l/ha
Very low	50-200 l/ha
Ultra low	<50 l/ha

Deposit from mistblowers

The following illustrates the tendency towards lower and less uniform chemical deposits in the tree when applying higher spray volume rates.



Min. ← Spray volume rate l/ha —— **Max.**

Max. —— Chemical deposit per tree → **Min.**

l/ha

Tree - Row - Volume method

Some chemical labels indicate liquid volume per vegetation volume (Tree-Row-Volume).

This method is based on measuring the vegetation volume present in one hectare (ha) and dosing liquid (l/m^3) according to this volume.

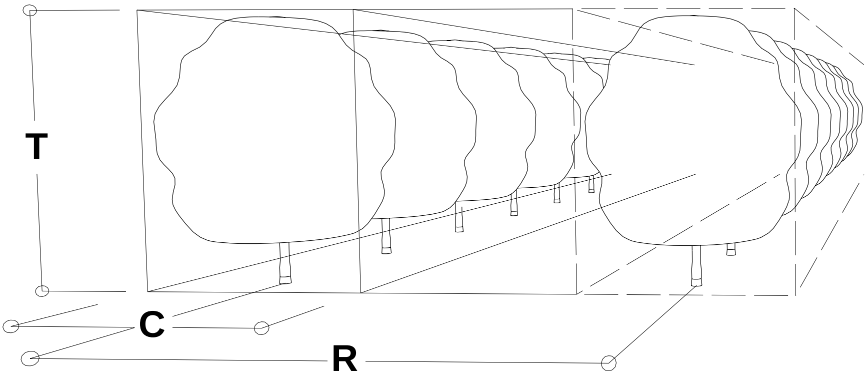
Calculations are as follows:

$$\frac{\text{tree height (m) x crown width (m) x 10,000 } m^2/ha}{\text{row width (m)}} = \text{T-R-V } m^3 \text{ vegetation/ha}$$

Example:

Tree height .... 6 m
Crown width .... 4 m
Row width .... 6 m

$$\frac{6 \text{ m x } 4 \text{ m x } 10{,}000 \ m^2/ha}{6 \text{ m}} = 40.000 \ m^3 /ha$$



The amount of liquid recommended may vary between 10 to 125 litre. per 1,000 m^3 of vegetation although 20 to 30 l is often the tendency. Check the label.

$$\frac{\text{T-R-V } (m^3/ha) \text{ x dose } (l/m^3)}{1{,}000} = l/ha$$

Example

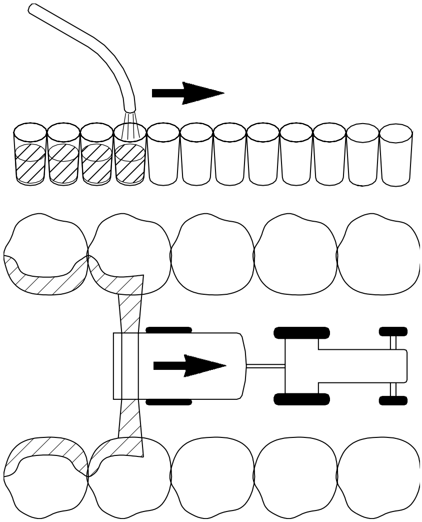
$$\frac{40{,}000 \ m^3/ha \text{ x } 50 \ l/m^3}{1{,}000} = 2{,}000 \ l/ha$$

Forward speed

Correct application requires exact forward speed. The speed shown on the tractormeter will not be true if standard wheels are not fitted or tyres are worn.

Forward speed also affects penetration of the air generated by the fan. A similarity can be drawn from filling glasses with water from a hose (the water representing the air). Move the hose too fast and you will not fill the glasses.

The same happens if you drive too fast. You do not fill the tree with spray laden air.



km/h

Theoretical maximum forward speed

Maximum forward speed is related to fan performance. Penetration will be reduced if the forward speed is to high. Likewise a relatively small fan can perform well if the forward speed is reduced. The following formula is a guide for max. speed:

$$\frac{\text{fan output } (m^3/h) \times 3 \text{ (factor*)}}{1000 \times \text{spray width (m)} \times \text{tree height (m)}} = \text{speed (km/h)}$$

*For light foliage use factor 3.0 to 3.5, for dense foliage use factor 2.5 to 3.0

Methods for verification of forward speed

Measured distance method

To verify the forward speed, drive a distance in the field not less than 50 metres. The sprayer should be half filled with water and the fan engaged. Start a little before the first marker so forward speed is reached before you start timing. Calculate as follows:

$$\frac{\text{metres driven} \times 3.6}{\text{time taken in seconds}} = \text{speed in km/h}$$

km/h

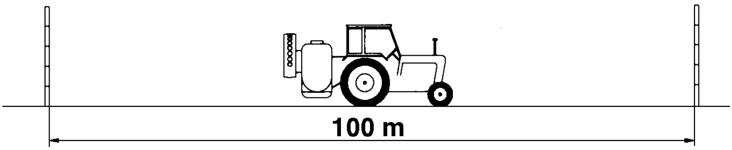
Example:

If it takes 75 seconds to drive 100 m;

$$\frac{100\ \text{m} \times 3.6}{75\ \text{s}} = 4.8\ \text{km/h}$$

100 metre method

Mark out 100 m and note the time to drive the distance. If it takes 72 seconds to drive 100 m the forward speed is 5.0 km/h. The following table is also found on the Mistblower Calibrator.



s/100m	**60**	62	64	67	69	**72**	75	78	82	**90**	95	100	106	113	**120**	129	138	150	164	**180**
km/h	**6,0**	5,8	5,6	5,4	5,2	**5,0**	4,8	4,6	4,4	**4,0**	3,8	3,6	3,4	3,2	**3,0**	2,8	2,6	2,4	2,2	**2,0**

Tree distance method

Measure the distance between 2 trees in the row and note the time in seconds taken to pass 20 trees.

Time in seconds to pass 20 trees in a row								
Speed	Tree spacing (m)							
km/h	8	6	5	4	3	2	1.5	1
3.0	192	144	120	96	72	48	36	24
3.5	165	123	103	82	62	41	31	21
4.0	144	108	90	72	54	36	27	18
4.5	128	96	80	64	48	32	24	16
5.0	115	86	72	58	43	29	22	15
5.5	105	79	65	52	39	26	20	13
6.0	96	72	60	48	36	24	18	12

Total nozzle output

Once the volume rate, forward speed and spray width have been determined, the total nozzle output (l/min) can be calculated.
Once calculated we can choose the nozzles. Depending on the sprayer and tree geometry, we may choose nozzles of the same nozzle size (capacity) or choose nozzles of different nozzle sizes.

Verification is done by either Tank Method for total output or with a measuring jug for individual nozzle output.

NOTE: Correct nozzles and pressure is the goal and therefore the pressure gauge must be in good working order. Field surveys indicate over 50% of gauges in use do not function properly. Check the gauge regularly; correct dosage depends on it. A spare gauge of good quality should be used to check sprayer gauge.

Tank Method
This is a quick method to verify total nozzle output but usually takes little account of the tree geometry. You simply use what nozzles are on the sprayer.

- Fill tank with clean water.
- Open or close for agitation as required.
- If possible, set nozzles/blower to suit tree geometry and foliage density.
- With the tractor in neutral, set the P.T.O. revolutions to match the intended travel/fan speed.
- Open distribution valves for blower.
- Set pressure.
- Spray out known volume of water and note time in minutes.

Calculate as follows:

$$\frac{\text{volume sprayed out in litres}}{\text{time taken in minutes}} = \text{total nozzle output in l/min}$$

Example:

$$\frac{200\ \text{l}}{10\ \text{min}} = 20\ \text{l/min}$$

l/min

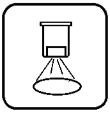
Formula method

$$\frac{\text{volume rate (l/ha) x forward speed (km/h) x spray width (m)}}{\text{600 (factor)}} = \text{total nozzle output (l/min)}$$

Example:

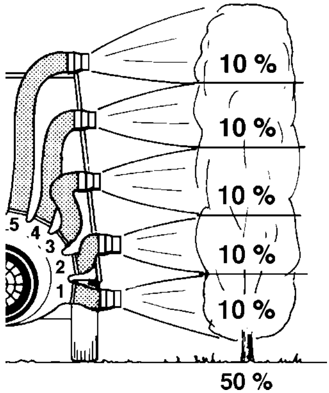
Volume rate .... 400 l/ha
Forward speed .... 4.8 km/h
Spray width .... 4 m

$$\frac{\text{400 l/ha x 4.8 km/h x 4 m}}{600} = \text{12.80 l/min}$$



Using he same nozzle size

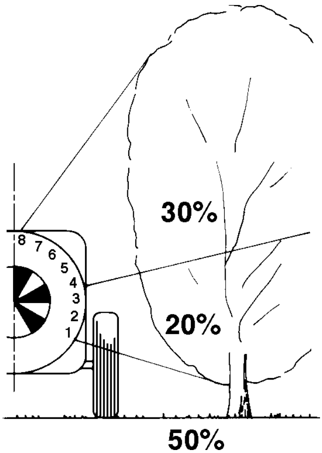
Some sprayers have adjustable nozzle locations. Certain crops eg. vines, require an even distribution of spray liquid from top to bottom. In these cases, nozzles of the same size (capacity) can be used.



If spraying with 10 nozzles and the total nozzle output is 12.80 l/min, this requires 1.28 l/min per nozzle. The nozzle size and pressure can now be identified from the relevant nozzle table or Mistblower Calibrator.

Using different nozzle sizes

If the nozzle location is fixed and the tree shape hinders good distribution, you need to calculate the individual nozzle output. This is related to the tree geometry. The sprayed liquid must be distributed in different percentages that will cover the different parts of the tree in relation to the vegetation.



Generally, more liquid is directed to the upper half of the tree. The ratio is usually

30% upper and 20% lower. Also blower characteristics and volume rate influence nozzle combination choice.

Example:

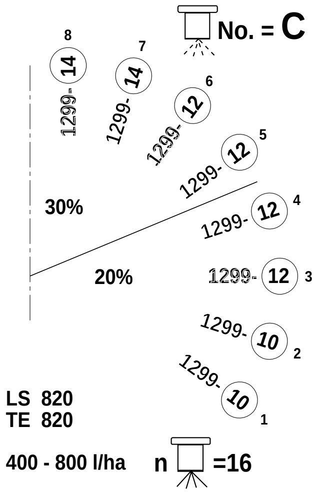
Volume rate .... 400 l/ha
Forward speed .... 4.8 km/h
Spray width .... 4 m

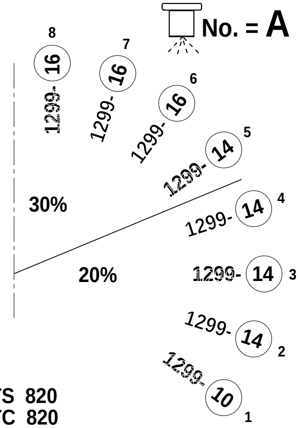
$$\frac{400\ \text{l/ha} \times 4.8\ \text{km/h} \times 4\ \text{m}}{600} = 12.80\ \text{l/min total}$$

Position	%	Nozzle no.	Colour	Actual l/min	Pressure bar
8		1299-14	Orange	1.07	
7	30	1299-14	Orange	1.07	
6		1299-12	Yellow	0.81	
5		1299-12	Yellow	0.81	6
4		1299-12	Yellow	0.81	
3	20	1299-12	Yellow	0.81	
2		1299-10	Brown	0.53	
1		1299-10	Brown	0.53	
Total	50			6.44	

The actual total nozzle output is 12.88 l/min (2 x 6.44 l/min) and effective application will be 402 l/ha. Correct pressure can be calculated with a formula (see section on Useful formulae) if 400 l/ha is required although in practice it may be difficult to adjust the pressure accurately to 5.94 bar.

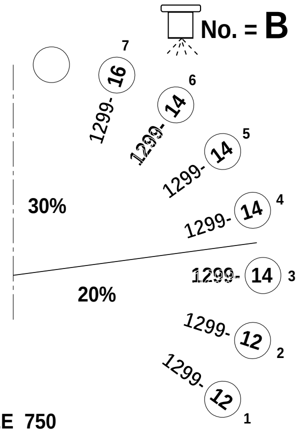
The examples may be used as a guideline. These are also found on the back of the Mistblower Calibrator. The sprayer instruction booklet shows recommended nozzle combinations.





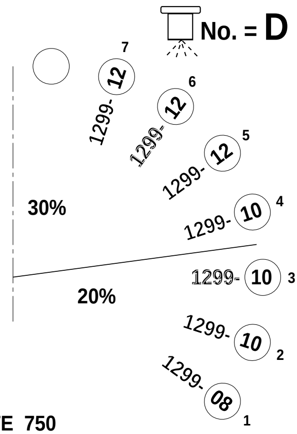
TS 820
TC 820

800 - 1500 l/ha n =16



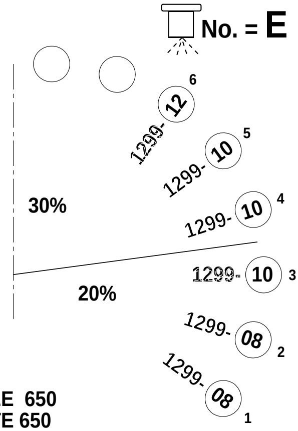
LE 750

500 - 1000 l/ha n =14



TE 750

400 - 1000 l/ha n =14



LE 650
TE 650

200 - 800 l/ha n =12

Nozzle tables

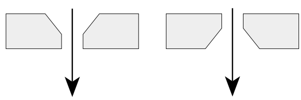
Capacities (l/min) at various pressures of nozzle type 1299

bar	Flow rate in l/min						
	1299-08 Lilac	1299-10 Brown	1299-12 Yellow	1299-14 Orange	1299-16 Red	1299-18 Green	1299-20 Blue
3	0,29	0,37	0,57	0,76	1,08	1,37	1,90
5	0,37	0,48	0,74	0,98	1,39	1,77	2,45
6	0,41	0,53	0,81	1,07	1,52	1,94	2,68
8	0,47	0,61	0,94	1,24	1,76	2,24	3,10
10	0,52	0,68	1,05	1,39	1,97	2,50	3,46
15	0,64	0,83	1,28	1,70	2,41	3,07	4,24
20	0,74	0,96	1,48	1,96	2,78	3,54	4,90
25	0,83	1,07	1,65	2,19	3,11	3,96	5,48
Ref. No.	371508	371509	371510	371511	371512	371513	371514

Capacities (l/min) at various pressures of nozzle type 1099

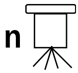
bar	Orientation of nozzle													
	1099-08		1099-10		1099-12		1099-15		1099-18		1099-20		1099-23	
2	0,52	0,42	0,89	0,60	1,20	0,85	1,80	1,39	2,50	2,02	3,35	2,37	4,05	3,10
5	0,82	0,67	0,40	0,95	1,90	1,35	2,85	2,20	3,95	3,20	5,30	3,74	6,40	4,90
8	1,04	0,85	1,77	1,20	2,40	1,71	3,60	2,78	5,00	4,05	6,70	4,74	8,10	6,20
10	1,16	0,95	1,98	1,34	2,69	1,91	4,03	3,11	5,59	4,53	7,50	5,30	9,05	6,93
15	1,42	1,16	2,42	1,65	3,29	2,34	4,94	3,81	6,84	5,54	9,18	6,50	11,09	8,49
20	1,64	1,34	2,80	1,90	3,80	2,70	5,70	4,40	7,90	6,40	10,60	7,50	12,80	9,80
30	2,01	1,64	3,43	2,33	4,65	3,31	6,98	5,39	9,68	7,84	12,98	9,19	15,68	12,00
50	2,59	2,12	4,43	3,00	6,01	4,27	9,01	6,96	12,49	10,12	16,76	11,86	20,24	15,50
Ref. No.	371309		371310		371311		371312		371313		371314		371315	

If used as a metering disc, the output can be altered by orientating the nozzle with or against the direction of flow.

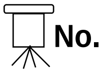


Using the Mistblower Calibrator

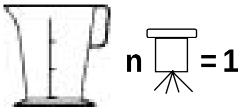
Symbols



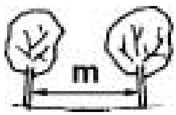
Number of nozzles.



Nozzle size.



Jug symbol and number of nozzles is one; for checking capacity of one nozzle.

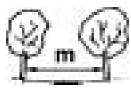


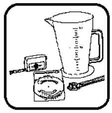
Spray width; row spacing x number of rows treated in one run. If driving in every row, two “half” rows are treated at a time and the spray width equals row width.

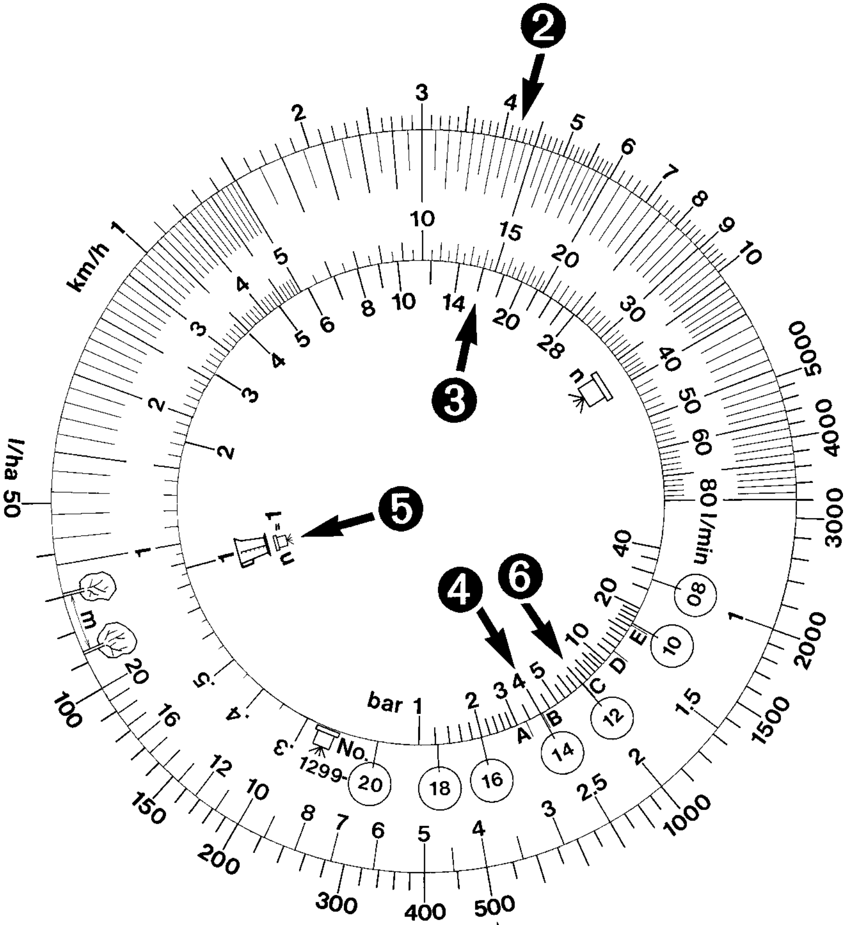
Example 1.

If spraying with the same nozzle size.

Known:	Volume rate	= 500 l/ha
	Spray width	= 4 m
	Forward speed	= 4.2 km/h
Find:	Total nozzle output (l/min)	

Turn the big disc and align **500 l/ha** with spray width  **4 m ❶**.
Total nozzle output in l/min is now automatically aligned with forward speed in km/h.
Find **4.2 km/h** on the top scale and read total nozzle output; **14 l/min ❷**.





Known: Total number of nozzles to be employed. **n = 16**

Find: Nozzle size and pressure.

Turn centre disc and align n **= 16** with total nozzle output; **14 l/min ❸**.

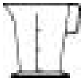
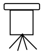
Choose a suitable nozzle from the possibilities now shown on the inner scales on the lower part of the disc, eg. nozzle **1299-14 Orange** at **4 bar ❹**.

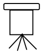
Find: Capacity for one nozzle.

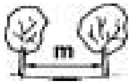
Find the **jug symbol** **n =1** and read **0.88 l/min ❺**.

If <u>measured capacity</u> turned out to be **0.95 l/min** instead of **0.88** l/min reduce pressure or recalculate a new volume rate.

<u>Recalculation of new volume rate:</u>
Align actual, measured capacity of **0.95 l/min** for one nozzle with the

jug symbol  **n**  **= 1** .

Find number of nozzles **n**  **= 16** and read total nozzle output here **15.2 l/min**.
Align the speed **4.2 km/h** with new total nozzle output.

Look at lower half of Calibrator and find spray width 

= 4 m.
Read off actual volume rate **543 l/ha (approx. 540 l/ha)**.

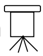
Example 2.

If spraying with different nozzle sizes.
On the back of the Calibrator, 5 different nozzle combinations are shown. Each combination has its own letter, which can also be found on the front side among the nozzle sizes.

Locate **:** **Total nozzle output** as in Example 1 (**14 l/min**).

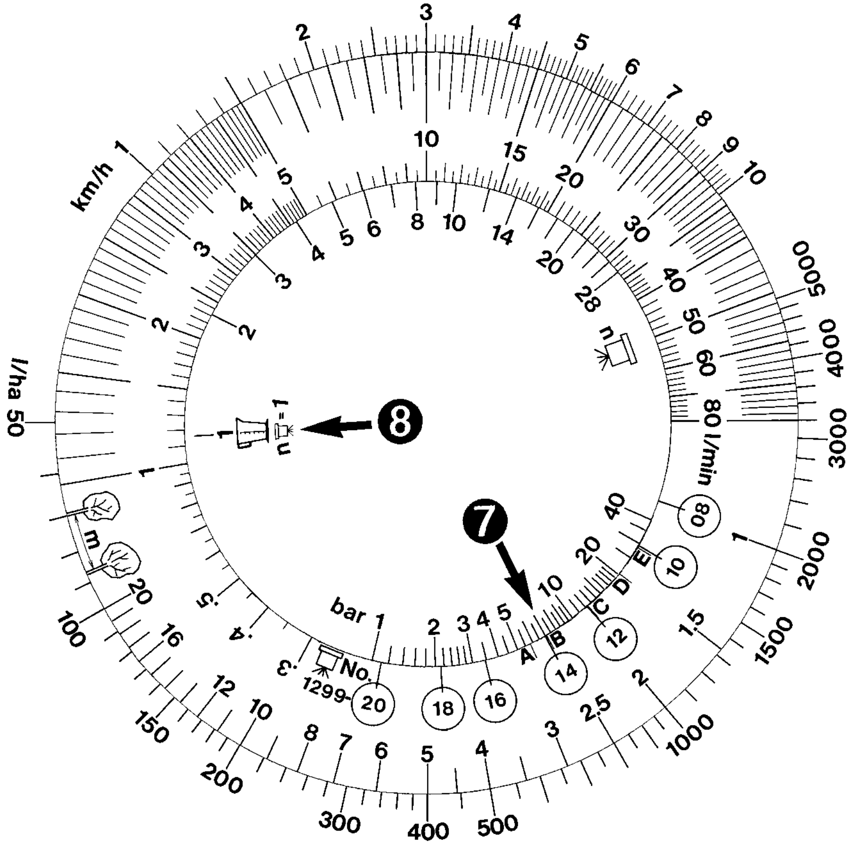
Choose a suitable nozzle combination from the Calibrator. As an example, choose **combination C** with **16 nozzles**.

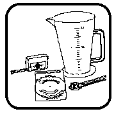
Find: Pressure.

Align total nozzle output, **14 l/min** with **n**  **= 16 ❸**.
Find **combination C** on the nozzle size scale and read off pressure; **7.1 bar ❻**.

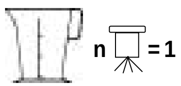
Find: Capacity for each nozzle in the combination.

Combination C for one side of the blower consists of;
2 nozzles of **1299-14 Orange**
4 nozzles of **1299-12 Yellow**
2 nozzles of **1299-10 Brown**.





Align the nozzle sizes one by one with 7.1 bar

and read the capacity at the **jug symbol** 

:

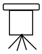
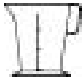
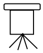
1299-14 Orange aligned with **7.1 bar** ❼ gives **1.17 l/min** ❽.

1299-12 Yellow aligned with **7.1 bar** gives **0.88 l/min.**

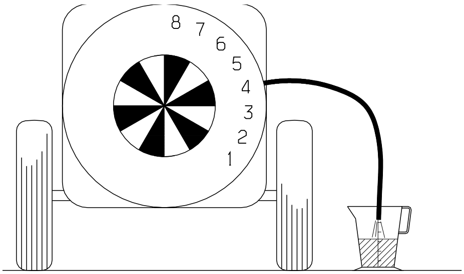
1299-10 Brown aligned with **7.1 bar** gives **0.57 l/min**.

Special cases.

CANNON/COMBI. **Total nozzle output** can be calculated as in Example 1, but instead of row spacing we use the **total spray width** of the sprayer.
Total nozzle output can be checked by using Tank Method, ie.noting how long it takes the sprayer to spray out for example, 100 litres at a set pressure. Divide 100 l with the time it took to spray and the total nozzle output is found.

Pneumatic. **Total nozzle output** can be calculated as in Example 1. If all spouts are fitted with the same size metering disc (nozzle), align number of spouts **n**  with total nozzle output and read capacity for one metering disc at the **jug symbol**  **n**  **= 1.**

REMEMBER: The Calibrator has an accuracy almost as high as using the formulas, <u>BUT</u> whether you are using formulas or Calibrator, they are only aids. What counts are the CHECKED VALUES:
Do check the forward speed in the field and do check nozzle output.



Air distribution and spray deposition

Having adjusted the blower setting and calibrated the sprayer, these can now be checked by a couple of simple tests.

Air distribution

The following method can be used to check blowers with deflectors or spouts.

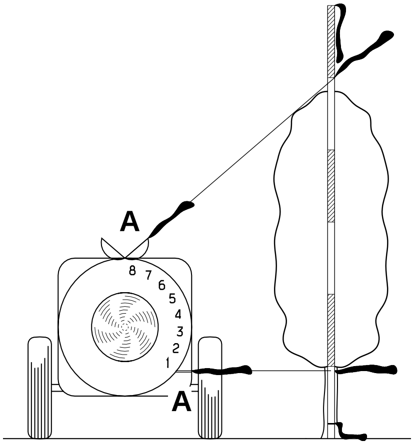
Equipment needed;
- 2 long poles (0.5 m higher than trees)
- Ribbon

1. With the sprayer in crop, attach ribbon to upper and lower deflectors or spouts.

2. Attach 4 ribbons to each pole, marking upper and lower end of foliage and 0.5 m over and under the foliage.

3. Locate poles in rows and start blower.

4. Adjust the deflectors / spouts **A** until ribbons on sprayer and foliage are aligned. The upper and lower ribbons are to hang loose.



5. Note or the mark position for future reference.

Spray deposition

The following method can be used to check the deposition and distribution of the liquid sprayed in the tree.

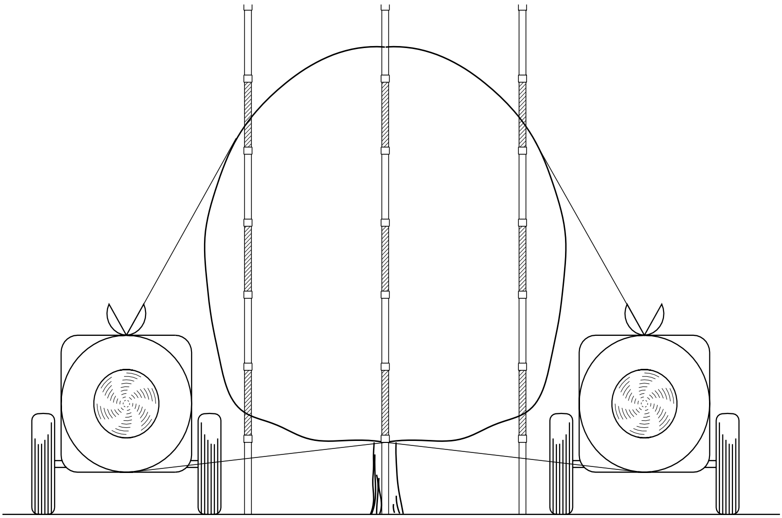
Equipment needed;
- 2 to 5 long poles (0.5 m higher than trees)
- Spray Test Paper (STP)
- Clothes pegs
- Small lens (helpful when counting drops)

Note: The ideal method would be to clip the STP to the leaves but it is often difficult to find them again and if the trees are high, long ladders are also needed.

Avoid touching the yellow surface when handling STP. Reseal bag immediately after use.

For narrow rows:	Place 2 poles in the middle along the row.
For wide rows:	Place 2 poles along the row and 3 across the row thereby forming a cross at the tree.

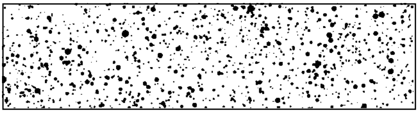
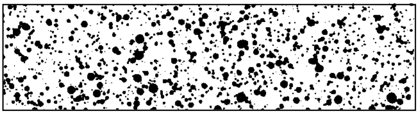
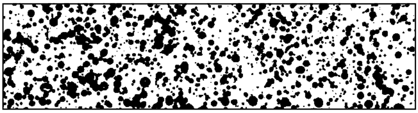
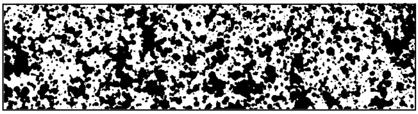
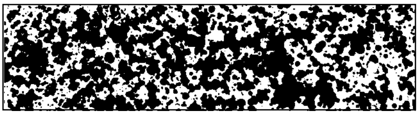
1. Fold in half and peg the STP at 0.5 m spacing on the poles, starting 0.5 m under and finishing 0.5 m over the canopy. Orientate the STP so they all face the same way.
2. Place the poles as indicated in foliage representative of the crop. Turn the poles so the STP is parallel with the row.
3. Spray the row from both sides. Spray at least 20 m before and after the poles.
4. Check STP. No or very few drops is acceptable on STP outside the foliage. The rest should have an even distribution.
5. If the distribution is not satisfactory, re-adjust sprayer. (See section on Fine tuning distribution and penetration).



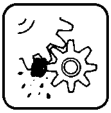
Assessment with Spray Test Paper

For a visual assessment of number of drops per cm^2, the STP can be compared to the references below.
Look for at least 20% as minimum coverage and avoid totally blue ("washed") papers.

The below references are sprayed with water only and the paper has a spread factor of approx. 2.5.

Drops/cm^2	Percent coverage	Drop size (VMD) μm	STP reference
85	10 %	250	
70	20 %	275	
60	30 %	300	
55	40 %	312	
40	50 %	325	

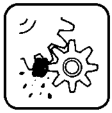
If the drops are to be counted, use the lens and compare figures with the guidelines in the section on Drop size.



Fine tuning distribution and penetration

Fault	Probable cause	Remedy
Drops not reaching top of tree.	Insufficient air volume.	Reduce forward speed.
		Increase fan r/min.
		Increase blade angle.
		Select higher gear on blower.
	Drops too small.	Use larger nozzle size at lower pressure.
	Deflectors/spouts not set correctly.	Readjust.
	Drops escaping air stream.	Lower pressure to reduce spray angle. For pistol nozzles, readjust.
	Insufficient liquid.	Increase number of nozzles.
		Increase nozzle size.
		Increase pressure.
	Poor weather condit-ions ie. too windy, too dry or too hot.	Spray when weather conditions have improved.
Poor penetra-tion and general underspray.	Insufficient air volume.	Reduce forward speed.
		Increase fan r/min.
		Increase blade angle.
		Select higher gear on blower.
	Deflectors/spouts not set correctly.	Readjust.
	Insufficient liquid.	Increase number of nozzles.
		Increase nozzle size.
		Increase pressure.

Fault	Probable cause	Remedy
Partial overspray.	Nozzle output too big.	Relocate or reduce number of nozzles and/or nozzle size.
	Deflectors/spouts not set correctly.	Readjust.
Partial underspray.	Nozzle output too small.	Increase number of nozzle.
		Increase nozzle size.
	Deflectors/spouts not set correctly.	Readjust.
General overspray.	Excessive air volume.	Increase forward speed.
		Decrease fan r/min.
		Decrease blad angle.
		Select lower gear on blower.



Safety precautions

Take care when working with crop protection chemicals. Follow the recommendations on the chemical label.

Personal Protection
If in doubt, the following protective clothing/equipment should be worn:

- Gloves
- Waterproof boots
- Headgear
- Respirator
- Safety goggles
- Suitable overall

This equipment should be worn to avoid contact with the chemicals.

Protective clothing/equipment should be used when preparing the spray liquid, during the spraying work and when cleaning the sprayer. The clothing/equipment should be made of chemical resistant material.

It is always advisable to have clean water available, especially when filling the sprayer with the chemical, as this is when you are handling the concentrated chemicals.

Do not eat, drink or smoke during work with plant protection chemicals. Always wash hands, etc. after handling chemicals.

Be cautious with those parts of the sprayer that are in movement, especially the transmission shaft and fan.

Preparing and adding chemical

The amount of chemical product to be added to the tank to achieve the intended dose may be calculated as follows:

$$\frac{\text{water in tank (l) x dose/ha}}{\text{volume rate (l/ha)}} = \text{quantity per tank}$$

Example:

Water in tank .... 2000 litres
Dose .... 1.5 kg/ha
Volume rate .... 660 l/ha

$$\frac{2000\ \text{l}\ \text{x}\ 1.5\ \text{kg/ha}}{660\ \text{l/ha}} = 4.55\ \text{kg/tank}$$

Liquid chemicals may be directly added to the tank. Powder chemicals may need to be mixed with water before adding to the tank. Follow label recommendations.

Do not forget to turn on the agitation system before adding chemical.

Cleaning the sprayer

Guidelines

Read the whole label of the chemical. Take note of any particular instructions regarding recommended protective clothing, deactivating agents, etc. Read the detergent and deactivating agent labels. If cleaning procedures are given, follow them closely.

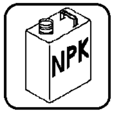
Be familiar with local legislation regarding disposal of pesticides washings, mandatory decontamination methods, etc. Contact the appropriate body, eg. Dept of Agriculture.

Pesticide washings can usually be sprayed out on a soakaway. This is an area of ground that is not used for cropping. You must avoid seepage or run-off of residues into streams, water courses, ditches, wells, springs, etc. The washings from the cleaning area must not enter sewers. Drainage must lead to a soakaway.

Cleaning starts with the calibration, as a well calibrated sprayer will ensure the minimal amount of remaining spray liquid.
It is good practice to clean the sprayer immediately after use thereby rendering the sprayer safe and ready for the next pesticide application. This also prolongs the life of the components.

It is sometimes necessary to leave spray liquid in the tank for short periods, eg. overnight, or until the weather becomes suitable for spraying again. Unauthorized persons and animals must not have access to the sprayer under these circumstances.

If the product applied is corrosive, it is recommended to coat all metal parts of the sprayer before and after use with a suitable rust inhibitor.



Remember: Clean sprayers are safe sprayers.
Clean sprayers are ready for action.
Clean sprayers can not be damaged by pesticides and their solvents.

Cleaning

1. Dilute remaining spray liquid in the tank with at least 10 parts water and spray the liquid out in the orchard you have just sprayed.

NOTE: It is advisable to increase the forward speed (double if possible) and reduce the pressure.

2. Select and use the appropriate protective clothing. Select detergent suitable for cleaning and suitable deactivating agents if necessary.

3. Rinse and clean sprayer and tractor externally. Use detergent if necessary.

4. Remove suction filter and clean. Be careful not to damage the mesh. Reassemble the filter housing without the filter. Replace filter when the sprayer is completely clean.

5. With the pump running, rinse the inside of the tank. Remember the tank roof. Rinse and operate all components and any equipment that has been in contact with the chemical.
Before opening the distribution valves and spraying the liquid out, decide whether this should be done in the orchard again or on the soakaway.
If pressure filters are fitted with a drain valve, open valve and flush filter.

6. After spraying the liquid out, stop the pump and fill at least 1/5 of the tank with clean water. Note that some chemicals require the tank to be completely filled. Add appropriate detergent and/or deactivating agent, eg. Washing soda or Triple ammonia.

NOTE: If a cleaning procedure is given on the chemical label, follow it closely.

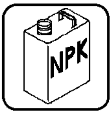
7. Start the pump and operate all controls enabling the liquid to come in contact with all the components. Leave the distribution valves until last. Some detergents and deactivating agents work best if left in the tank for a short period. Check the label.

8. Drain the tank and let pump run dry. Rinse inside of tank, again letting the pump run dry. Remember that piston pumps must not run dry for more than a minute.

9. Stop the pump. If the pesticides used have a tendency to block nozzles and filters, remove and clean them now.

10. Replace all the filters and nozzles and store the sprayer. If, from previous experiences, it is noted that the solvents in the pesticide are particularly aggressive, store the sprayer with the tank lid open.

NOTE: If the sprayer is cleaned with a high pressure cleaner we recommend lubrication of the entire machine.



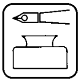
If corrosive products eg. crystallized urea or chelates have been used, it is recommended to protect the metal parts of the sprayer. Pay particular attention to all metal parts when cleaning the sprayer. In some cases, use of a neutralizing agent is recommended. Recoat unpainted metal parts with a rust inhibitor and lubricate the sprayer.

Unforeseen stop of spraying.

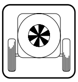
If spraying has unexpectedly stopped, for example due to poor weather conditions or breakdown, and there is still spray liquid in the tank, it is advisable to flush the pump, operating unit and lines.

Turn off the valve of the pump suction hose and start pump. Remove suction hose and when a gurgling sound can be heard, introduce clean water down the suction hose and after a few seconds open the distribution valves to the nozzles. Flush until clean water comes out from the nozzles. Stop pump and replace suction hose.

Pictorial symbols

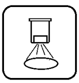
 Introduction

 Calibration

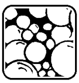
 Blower

Air volume

 Service/adjustment

 Nozzle

Volume rate

 Drop size/deposition

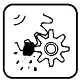
 Drift

Forward speed

Nozzle output

 Warning

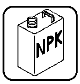
 Calibrator

 Fault/Remedy

 Protective clothing

 Adding chemical

 Cleaning



Corrosive products

 Formulae/data

Useful formulae

Theoretical air volume

$$\frac{1000 \text{ x speed (km/h) x spray width (m) x tree height (m)}}{3 \text{ (factor*)}} = \text{air volume } (m^3/h)$$

*For light foliage use factor 3.0 to 3.5, for dense foliage use factor 2.5 to 3.0

Tree - Row - Volume

$$\frac{\text{tree height (m) x tree crown width (m) x } 10{,}000 \text{ } m^2/\text{ha}}{\text{row width (m)}} = \text{T-R-V } m^3 \text{ vegetation/ha}$$

Chemical per tank

$$\frac{\text{water in tank (l) x dose/ha}}{\text{volume rate (l/ha)}} = \text{dose per tank}$$

Forward speed

$$\frac{\text{distance (m) x 3.6}}{\text{time (seconds)}} = \text{km/h} \qquad \frac{\text{600 x l/min total}}{\text{work width (m) x l/ha}} = \text{km/h}$$

Calculating new pressure

$$\left(\frac{\text{new output}}{\text{known output}}\right)^2 \text{ x known pressure} = \text{new pressure}$$

Calculating new output

$$\sqrt{\frac{\text{new pressure}}{\text{known pressure}}} \text{ x known output} = \text{new output}$$

Volume rate

$$\frac{\text{600 x l/min total}}{\text{work width (m) x km/h}} = \text{l/ha}$$

Total nozzle output

$$\frac{\text{work width (m) x l/ha x km/h}}{600} = \text{l/min total}$$

Data sheet

	Ex.				
Time/crop					
Date	*20.6.93*				
Start	*6.30*				
End	*8.30*				
Crop	*Apples*				
Crop stage	*3*				
Spray width (m)	*4*				
Orchard (ha)	*B*				
Wind (m/s)	*2*				
Temperature (°c)	*12*				
Humidity (%)	*60-70*				
Chemicals					
1. Chemical	*APLET*				
dose rate					
2. Chemical					
dose rate					
3. Chemical					
dose rate					
Volume rate (l/ha)	*400*				
1. Chemical/tank					
2. Chemical/tank					
3. Chemical/tank					
Tractor					
Registration No.	*AB-123*				
Wheel size	*36“*				
Forward speed (km/h)	*4.8*				
Gear	*2.H*				
Engine (r/min)	*1450*				
Sprayer					
Nozzle comb./colour	*Yellow*				
Total flow rate (l/min)	*12.8*				
Pressure (bar)	*6*				
Gear	II				
Blade angle	*40*				
Deflector setting					

Data sheet

	Ex.				
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Orchard (ha)	B				
Wind (m/s)	2				
Temperature (°c)	12				
Humidity (%)	60-70				
Chemicals					
1. Chemical	APLET				
dose rate					
2. Chemical					
dose rate					
3. Chemical					
dose rate					
Volume rate (l/ha)	400				
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Deflector setting					

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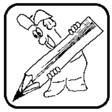

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