Better Training for Safer Food
Initiative

BTSF

Richard Glass

Exposure Assessment
Eurofins Agroscience Services
United Kingdom
richardglass@eurofins.com

Lecture 5

Consumers, Health And Food Executive Agency

European Commission

Environmental aspects and sustainable use of PPPs: Drift

Consumers, Health and Food Executive Agency (CHAFEA)

Consumers, Health And Food Executive Agency

European Commission

Content

- Sources and routes of exposure for aquatic and terrestrial non-target organisms
- Application techniques and operational settings
- Risks to non-target plants, beneficial insects, wildlife, biodiversity and the environment in general;
- Risk mitigation measures such as buffer zones for water protection, specific spraying techniques (e.g. low-volume spraying, low-drift nozzles, dust reducing sowing equipment), etc;
- Drift reduction strategy

European Commission

Exposure of non-target organisms

- **Terrestrial organisms**
  - Birds, mammals, arthropods, earthworms
  - Field boundary (direct effect)
  - Plants in field boundaries (to maintain biodiversity and support other organisms)
- **Aquatic organisms**
  - Watercourses at or near the field boundary
  - Streams, rivers, ponds, including dry watercourses
- **Bystanders and Residents**
  - Drift during application
  - Volatilisation and drift after application
  - Deposits of drift in garden etc.

Sources of exposure to PPPs - overview

- **Product type**
  - Applied as liquid with water carrier
  - Low volume or ultra low volume formulation (no addition of carrier)
  - Granular formulation
  - Seed dressing
- **Application techniques**
  - Hydraulic boom sprayer (arable)
  - Broadcast air assisted (orchard/vineyard)
  - Hand held application
- **Crop type**
  - Dictates the application technique
- **Aspect of the field**
  - Slope, field boundaries, water courses etc.

Drift with use of PPPs (1)

- **Drift of PPPs occurs during application of PPPs or during drilling of seed treated with a PPP**
- **Common scenario for EU MS involves the use of boom sprayers for the application of PPPs in liquid form**
  - Boom application also with application of granules
- **Application in downward direction towards the target**
  - Boom width generally 12-24m, but can be >36m
- **Release height (boom height) key factor**
- **Forward speed of equipment (can be >16 km/h)**
  - Wind shear effects, boom stability, boom height etc.

Drift with use of PPPs (2)

- **Use of broadcast air assisted sprayers for tree and bush crops**
  - Vertical boom sprayers less common
- **Release of spray in horizontal and upward direction**
- **Velocity of air assistance affects distance travelled by spray droplets**
  - Sedimentation time
- **Forward speed of equipment is restricted due to crop terrain and crop types (rarely >8 km/h)**

Key factors affecting drift (PPP not retained within field boundaries)

- **Droplet size**
  - Nozzle size and type
  - Spray pressure
  - Wind (air) shear
- **Droplet velocity**
- **Release direction**
- **Environmental conditions**
  - Wind speed, relative humidity, temperature
- **Formulation type**
- **Field boundary type**

Do you read the label?


Can you read the label?
DIPAMAL®
50 EC
MALATHION (ΜΑΛΑΘΕΙΟ) 50%
ΓΑΛΑΚΤΩΜΑΤΟΠΟΙΗΣΙΜΟ ΣΚΕΥΑΣΜΑ EC
ΕΓΓΥΗΜΕΝΗ ΣΥΝΘΕΣΗ
Malathion (Μαλαθείον) 50% β/ο
Βοηθητικές ουσίες 50% β/β
Διαλύτης: Ξυλόλιο
ΟΡΓΑΝΟΦΩΣΦΟΡΙΚΟ ΕΝΤΟΜΟΚΤΟΝΟ ΕΠΑΦΗΣ ΣΤΟΜΑΧΟΥ ΚΑΙ ΑΝΑΠΝΟΗΣ
ΦΥΛΑΞΤΕ ΤΟ ΚΛΕΙΔΩΜΕΝΟ ΚΑΙ ΜΑΚΡΙΑ ΑΠΟ ΠΑΙΔΙΑ
Xn
ΕΠΙΚΙΝΔΥΝΟ
Βλαβερό σε περίπτωση κατάποσης.
Βλαβερό όταν εισπνέεται.
Εύφλεκτο.
Αριθμ. Έγκρ. Κυκλοφορίας: 1662/18-8-1995
ΠΑΡΑΓΩΓΗ - ΣΥΣΚΕΥΑΣΙΑ - ΔΙΑΝΟΜΗ
Παπαοικονόμου Αγροχημικά ΑΒΕΕ
Βι.Πε.Θ. 570 22 ΣΙΝΔΟΣ - ΤΗΛ. 0310 796.556 - FAX: 0310 796.506
www.pap-agro.gr

Drift mitigation (1)

- **Drift reduction technology (DRT)**
  - Drift reducing nozzles
    - Reduce the proportion of droplets in the driftable fraction, i.e. < 100µm
    - e.g. Air Inclusion (AI) nozzles
    - Nozzle size and type
    - Spray pressure
    - Wind (air) shear
  - Downward air assistance
    - e.g. Hardi Twin
  - Nozzle shields
  - Tunnel sprayers
  - Precision agriculture (LIDAR etc.)

Drift mitigation (2)

- **Application and operational conditions**
  - Select appropriate application technique
    - Settings of sprayer appropriate for the crop height, density of foliage, spaces between trees
  - Use of DRT when possible
  - Use of controlled droplet application (CDA) techniques
    - e.g. spinning discs to apply herbicide with ultra low volume (ULV) technique
  - Avoid unfavourable environmental conditions
  - Operational settings – low forward speed, low boom height, low pressure

Drift mitigation (3)

- **Use of buffer zones**
  - Label requirements for minimum unsprayed buffer zone (UBZ) size to protect water courses
    - No UBZ requirements yet for terrestrial compartment
  - Some MS have mechanism to reduce the UBZ size if approved DRT is used, e.g. LERAP in the UK
  - UBZ with crop cover will reduce drift more than bare soil
  - Riparian vegetation (growing adjacent to water courses) reduces drift
  - Wind breaks commonly used around tree crops to reduce drift
  - Select crops adjacent to water courses where DRT can be used for application of PPPs

Drift reduction strategy

- **Crop selection in sensitive areas**
- **Use lowest recommended dose rate if possible**
- **Application technique with minimum drift**
- **Drift reducing technology**
- **Operator awareness**
  - Environmental conditions e.g. wind
  - Time of day e.g. when beneficial insects not active
- **Encourage growth of vegetation around field boundaries**
- **Use Unsprayed buffer zones and uncropped strips around fields.**

European Commission

Drivers for change/compliance

- **Economic sustainability**
  - **(e.g. CAP payments)**
- **Selling produce to supermarkets etc.**
- **Farm assurance/certification (e.g. GlobalGap)**
- **Continuous Professional Development (CPD)**

European Commission

Case Study 2

European Commission

Understanding drift

- Why does drift occur
- How can it be reduced
- Why should it be reduced
- Negative effects of drift
- What should be protected from drift
- How to set up a drift reduction strategy


28
29
2011/07/06

TUNNELSPRAYER

OTHER

- 600 LTR HERBICIDE SPRAYER
- 200-300-400 LTR HERBICIDE SPRAYER

ORCHARD

MUNCKHOF AIR SYSTEM

Tunnel sprayer


househamsprayers.com

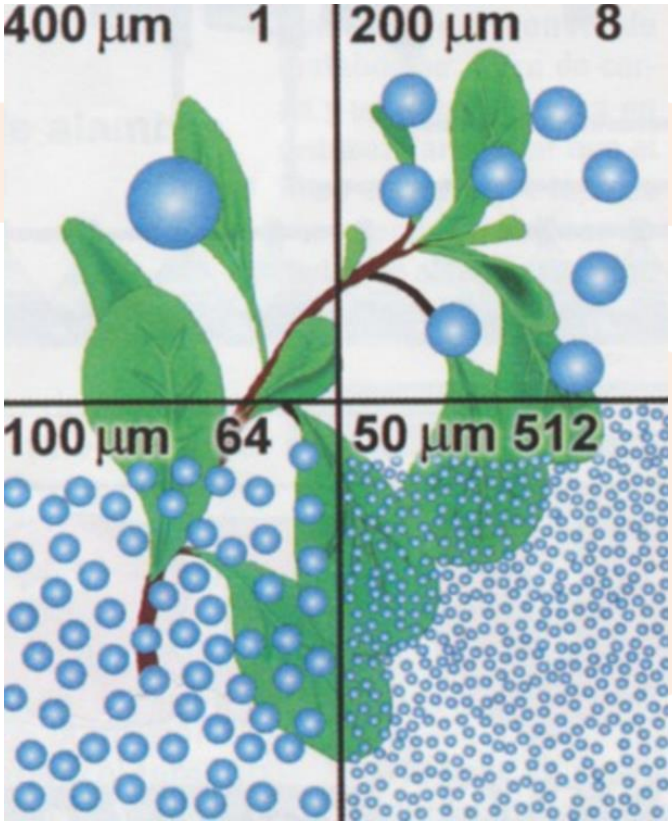

HOUSEHAM

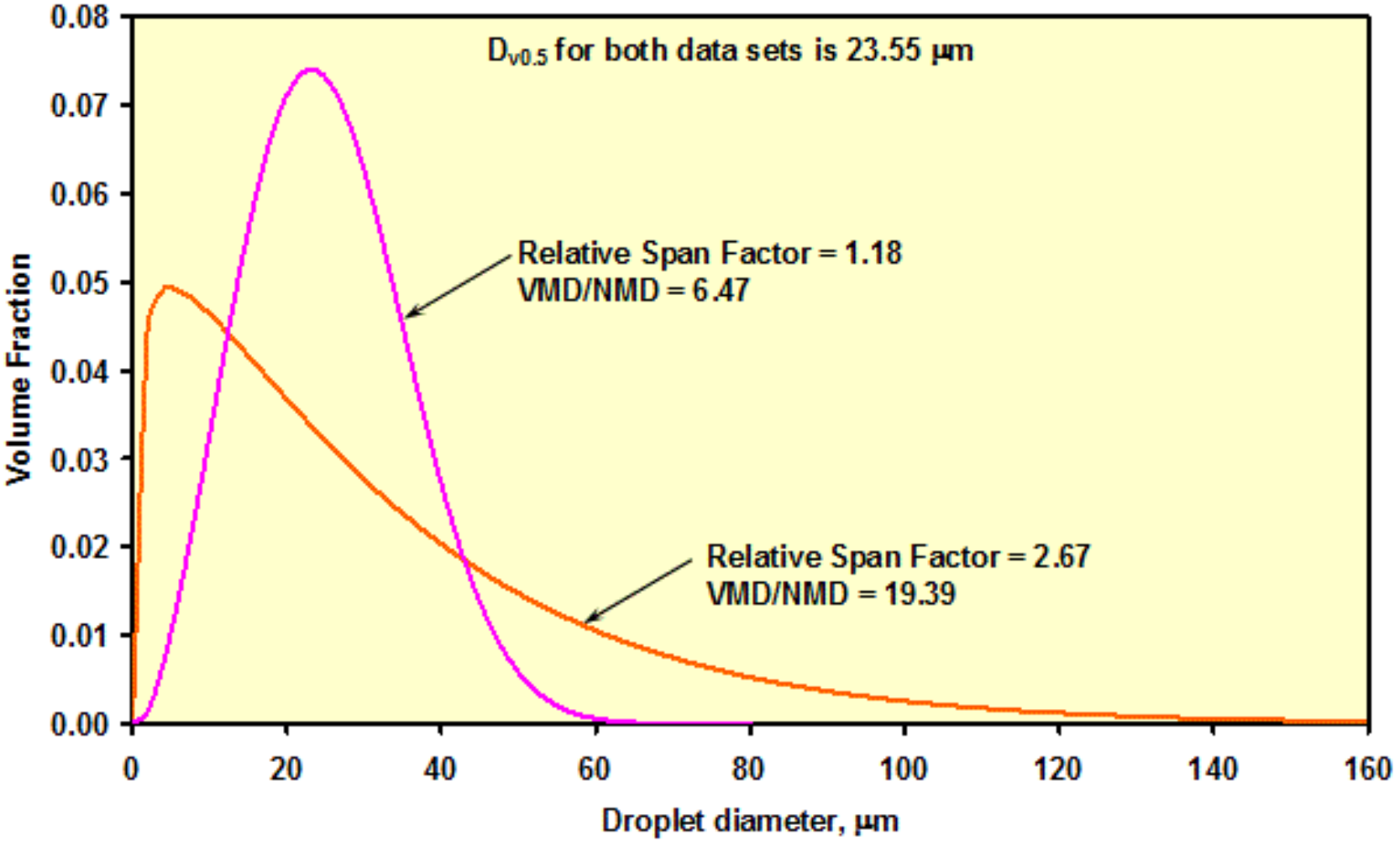

RAU IKARUS A38
2011/10/12

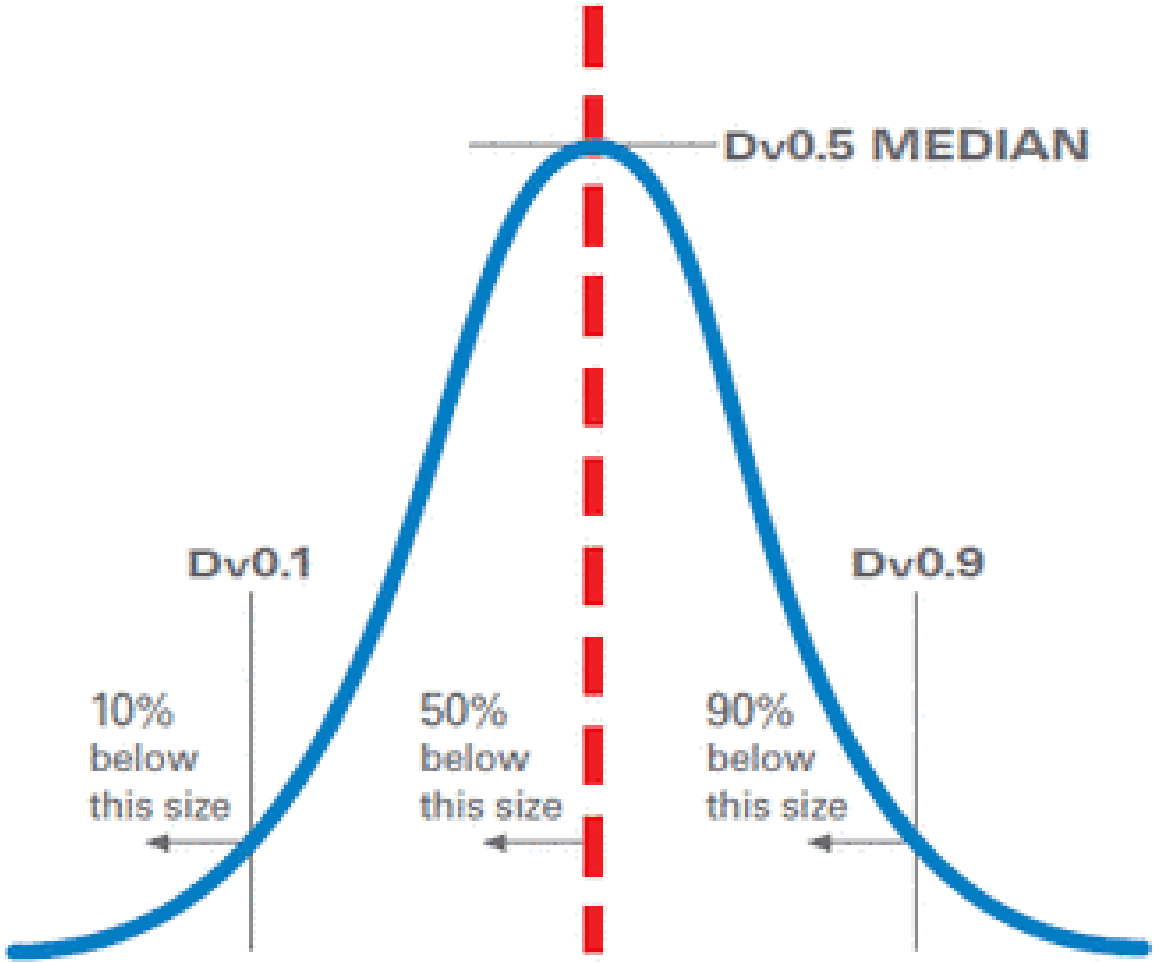

BATEMAN
BATEMAN CONTOUR
4000
2011/09/13

European Commission

Effect of drop size. Balancing drift risk and efficacy

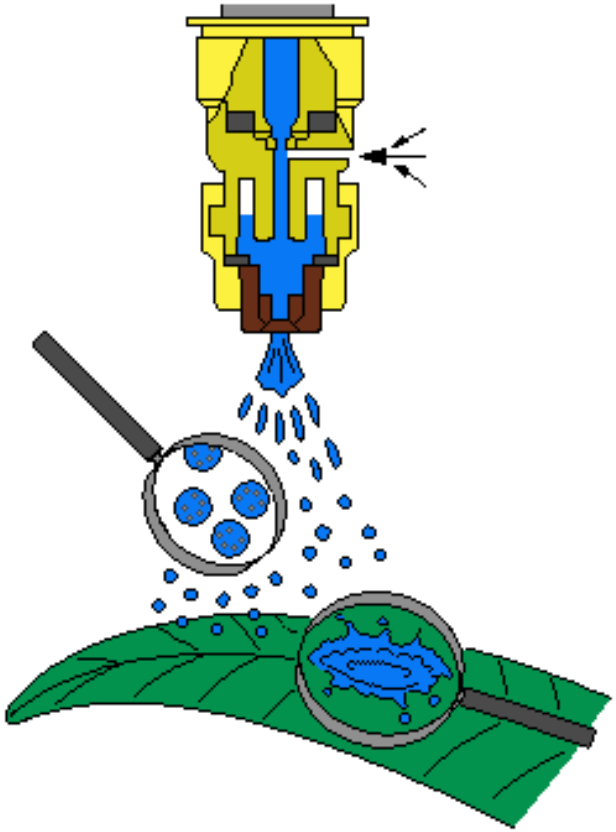



$D_{v0.5}$ for both data sets is 23.55 µm
Relative Span Factor = 1.18
VMD/NMD = 6.47
Relative Span Factor = 2.67
VMD/NMD = 19.39
Volume Fraction
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
100
120
140
160
Droplet diameter, µm

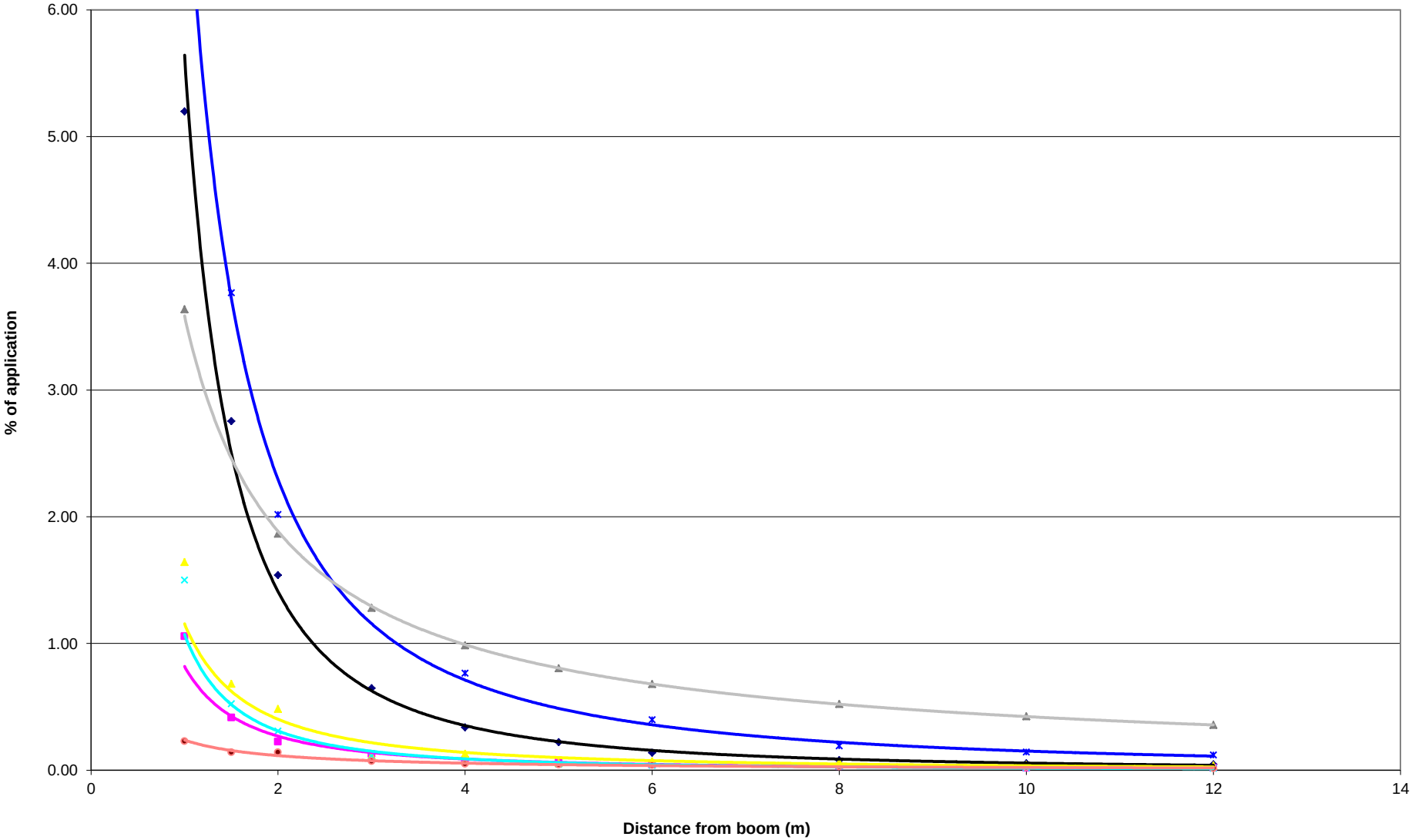

Dv0.5 MEDIAN
Dv0.1
Dv0.9
10% below this size
50% below this size
90% below this size

Low Drift Nozzles

How a Venturi nozzle (AI) works



Examples of drift decay curves



TeeJet® Broadcast Nozzle Selection Guide

	HERBICIDES			FUNGICIDES	
		POST-EMERGENCE			
	SOIL APPLIED	CONTACT	SYSTEMIC	CONTACT	SYSTEMIC
 *Turbo TeeJet®* Reference page 9		VERY GOOD	VERY GOOD	VERY GOOD	VERY GOOD
 *Turbo TeeJet®* at pressures below 30 PSI (2.0 bar) Reference page 9	GOOD	GOOD	EXCELLENT	GOOD	EXCELLENT
 *Turbo TwinJet®* Reference page 10	GOOD	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
 *Turbo TwinJet®* at pressures below 30 PSI (2.0 bar) Reference page 10	VERY GOOD	VERY GOOD	EXCELLENT	VERY GOOD	EXCELLENT
 *Turbo TeeJet® Induction* Reference page 11	EXCELLENT		EXCELLENT		EXCELLENT
 *XR, XRC TeeJet®* Reference pages 12–13		EXCELLENT	GOOD	EXCELLENT	GOOD
 *XR, XRC TeeJet®* at pressures below 30 PSI (2.0 bar) Reference pages 12–13	GOOD	GOOD	VERY GOOD	GOOD	VERY GOOD
 *AIXR TeeJet®* Reference page 14	VERY GOOD	GOOD	EXCELLENT	GOOD	EXCELLENT
 *AI, AIC TeeJet®* Reference pages 15–16	VERY GOOD	GOOD	EXCELLENT	GOOD	EXCELLENT
 *TwinJet®* Reference page 17		EXCELLENT		EXCELLENT	
 *DG TwinJet®* Reference page 18	VERY GOOD	VERY GOOD	EXCELLENT	VERY GOOD	EXCELLENT
 *Turbo TeeJet® Duo* Reference page 19		EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
 *Turbo TeeJet® Duo* at lower pressures Reference page 19	VERY GOOD	VERY GOOD	EXCELLENT	VERY GOOD	EXCELLENT
 *Turbo FloodJet®* Reference page 23	EXCELLENT		VERY GOOD		VERY GOOD
 *TurfJet®* Reference page 24	EXCELLENT		EXCELLENT		EXCELLENT

Nozzle selection

for conventional boom sprayers treating cereals and oilseed rape

HGCA

AHDB Agriculture & Horticulture DEVELOPMENT BOARD

Nozzle type	Air induction		Conventional					Low drift (pre-orifice)			
	Flat fan		Flat fan			Hollow cone		Flat fan		Deflector	
Likely spray quality	Small droplet	Large droplet	Fine	Medium	Coarse	Fine	Medium	Medium	Coarse	Medium	Coarse
Soil-acting herbicides											
Pre- and early post-emergence	▲	▲✱		▲	▲			▲	▲	▲	▲
Foliage-acting herbicides											
Grass weeds – 3 leaves or less			▲▲	▲✱		▲	▲				
Grass weeds – more than 3 leaves	▲✱		▲	▲▲				▲		▲	
Broad-leaved weeds – up to 2cm across			▲▲	▲▲✱							
Broad-leaved weeds – 2–5cm across	▲✱		▲	▲▲			▲			▲	
Broad-leaved weeds – more than 5cm	▲▲✱			▲▲			▲	▲		▲	
Non-selective (eg glyphosate)	▲▲	▲✱		▲▲	▲			▲▲	▲	▲	▲
Cereal plant growth regulators (PGR) and eyespot fungicides											
Up to GS32	▲✱			▲▲				▲		▲	
After GS32	▲▲✱			▲▲				▲		▲	
Cereal fungicides											
Up to GS23	▲✱		▲	▲▲			▲	▲		▲	
Up to GS24–49	▲▲	▲✱	▲	▲▲			▲	▲		▲	
After GS50 (ear spray)	▲▲✱			▲▲			▲				
Cereal insecticides											
Cereals: autumn spray	▲✱		▲	▲▲			▲				
Cereals: ear spray			▲▲	▲✱		▲	▲				
Oilseed rape fungicides											
Vegetative stage	▲✱		▲	▲▲			▲	▲		▲	
From green bud	▲▲✱		▲	▲▲			▲	▲		▲	
Oilseed rape insecticides											
Vegetative stage			▲	▲▲✱			▲				
From green bud			▲▲	▲✱		▲	▲				

Key

▲ = nozzles offering acceptable efficacy

▲▲ = preferred nozzles for efficacy

✱ = nozzles offering best drift control

Nozzle selections indicated are based on spray volumes of 100-200 l/ha and forward speeds of 8–16km/h and using a typical range of pressures for each nozzle design. Generally, higher spray pressures give a smaller droplet size distribution therefore, a finer spray; wider spray angles give a finer spray.

Spray deposits and efficacy

Timing
Application timing is critical for

Application volume
For a given dose, higher volumes

When choosing an application volume,

Nozzle colour

Industry standards specify that nozzles

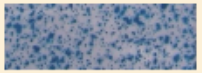
Colour	Flow rate at 3.0 bar pressure, l/min	Common designation
Orange	0.4	'01'

Nozzles and droplet size

Different commercial designs of air induction (AI) nozzle produce different droplet sizes. Those giving a small droplet size will often give higher levels of efficacy, but can also produce more drift than those generating a large droplet size. Recommendations are therefore given on the main chart (left) for AI nozzles giving small or large droplets.

Nozzles producing small or large droplets can be identified from the bar charts (right). Average droplet sizes from different designs of AI nozzles are shown relative to the same size conventional (flat fan) nozzle.

All measurements were made under standard testing conditions with all nozzles operating at 3.0 bar pressure. In each bar chart small droplet designs appear at the lower end, whereas large droplet designs are in the upper part.



small droplet

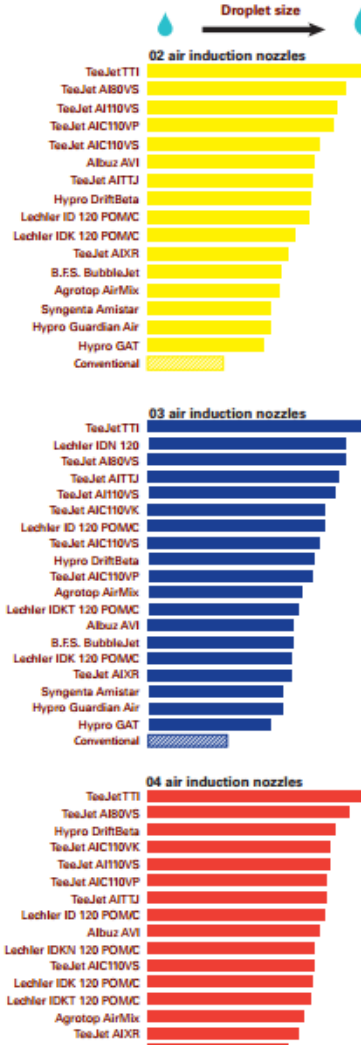
large droplet

conventional

Spray drift

The risk of drift is mainly related to:

- **Boom height** – for 110° nozzles, the boom should be stable and 500mm or less from the top of the crop.
- **Nozzle type, size and**



Case Study Exercise 1

Below are some examples of multiple choice questions

Please discuss and select your answer

Case Study Exercise 2

What are the most important factors to consider in reducing drift as part of a drift reduction strategy

List them in order of importance in the opinion of your group

This action/ training/ seminar is carried out by Eurofins Agroscience Services under the contract no. 2013 96 11 with the Consumers, Health and Food Executive Agency (former Executive Agency for Health and Consumers).

Richard Glass

Eurofins Agroscience Services
Slade Lane, Wilson, DE73 8AG. UK
+44 1332 864800
richardglass@eurofins.com

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