# Application and Drift Management

GRDC
Grains Research & Development Corporation
Your GRDC working with you

Developed by Bill Gordon
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Lawrence, New South Wales, Australia

# Advanced Spray Workshops

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Bill Gordon and Andrew Storrie

# Main Topics Discussed

- Nozzles and how they work, affect on spray quality
- Conditions for spraying – Surface Inversions
- Targets, Products, Volume, Spray Quality Issues
- Issues with Water Quality & Adjuvants
- Nozzle Selection and things to think about

# Main Topics Covered

- Labels & Application (what's new?)
- Nozzles and how they work, affect on spray quality
- Conditions for spraying – Surface Inversions
- Targets, Products, Volume, Spray Quality Issues
- Issues with Water Quality & Adjuvants
- Nozzle Selection and things to think about

# Changes To Labeling

New mandatory statements on labels may affect your application technique and timing.

changes include;

- Required Spray Qualities (changes to definition of coarse)
- Defined Wind Speed Ranges
- **No-spray zones / down wind buffer distances**
- **Additional Record Keeping (Federal Requirement)**

# SPRAY DRIFT RESTRAINTS

**DO NOT** apply with spray droplets smaller than a **COARSE** spray droplet size category according to the "*APVMA compliance Instructions for Mandatory COARSE or larger Droplet Size Categories*" located under this title in the GENERAL INSTRUCTIONS section of this label.

***For ground application this will accept the ASAE S572 or the BCPC standard. For aircraft it will recognise appropriate droplet size models and will accept the Dv 0.1 value for coarse.***

# SPRAY DRIFT RESTRAINTS

**Wind speed may change on some labels for ground application, and extra warnings about inversions.**

- **DO NOT** apply when the wind speed is less than 3 or more than 20 kilometres per hour as measured at the application site.

- **DO NOT** apply during surface temperature inversion conditions at the application site

# No Spray Zones

NO Spray Zones are **Downwind** Distances to:

- areas occupied by humans
- aquatic areas
- terrestrial vegetation
- livestock or pastures

**MANDATORY NO-SPRAY ZONES**

**DO NOT** apply if there are people, structures that people occupy or parks and recreation areas within **xxx metres** downwind from the application area.

**DO NOT** apply if there are aquatic and wetland areas including aquacultural ponds, surface streams and rivers within **yyy metres** downwind from the application area.

**DO NOT** apply if there are sensitive crops, gardens, landscaping vegetation, protected native vegetation or protected animal habitat within **zzz metres** downwind from the application area.

**DO NOT** apply if there are livestock, pasture or any land that is producing feed for livestock within **uuu metres** downwind from the application area.

# Record Keeping Requirements

- Some labels will include instructions on record keeping.
- These will be in addition to the State requirements

# MANDATORY LABEL INSTRUCTION
# TO KEEP A SPRAY RECORD

Users of this product **MUST make an accurate written record** of the details of each spray application within 24 hours following application and **KEEP** this record for a minimum of 2 years. The spray application details that must be recorded are:

1. date with start and finish times of application;
2. locations address and paddock/s sprayed;
3. full name of this product;
4. amount of product used per hectare and number of hectares applied to;
5. crop/situation and weed/pest;

6. wind speed and direction during application;
7. air temperature and relative humidity during application;
8. nozzle brand, type, spray angle, nozzle capacity and spray system pressure measured during application;
9. name and address of person applying this product.

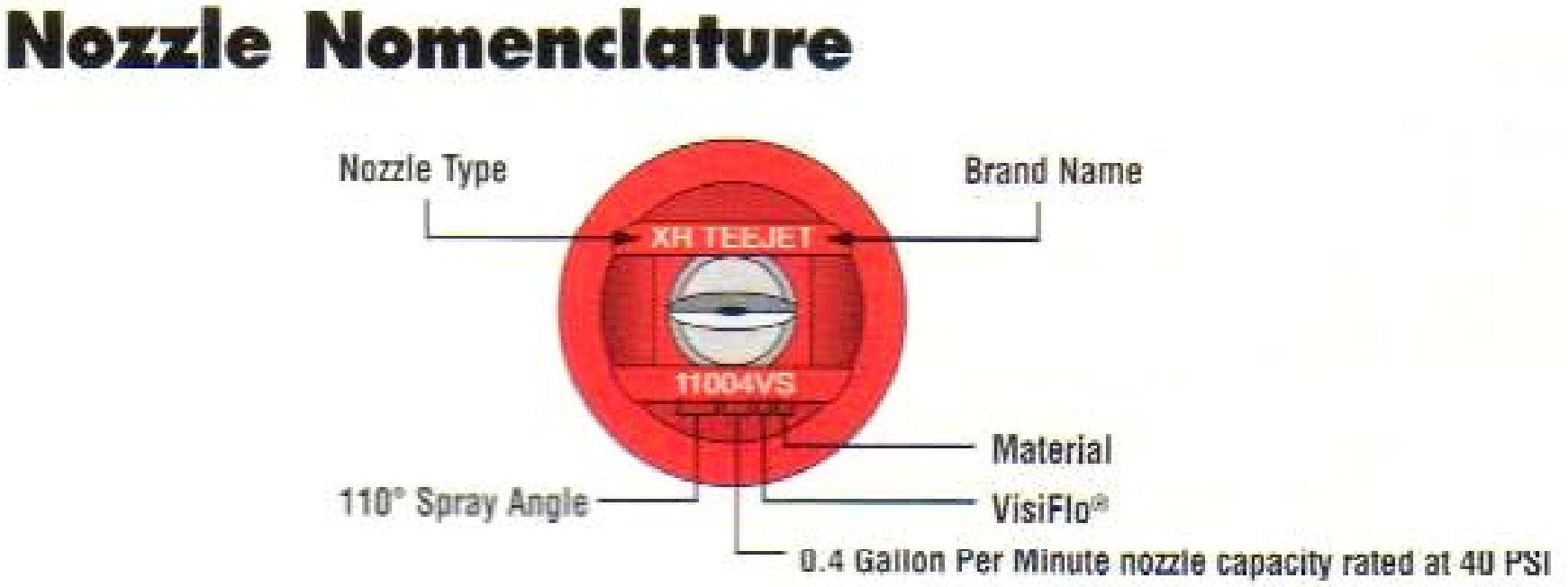
*Additional record details may be required by the state or territory where this product is used.

# Mandatory Statements

- For Growers it is worth remembering that;

  In the event that some product does move off target and there is a claim for compensation against you, your insurance may not cover you if you have performed an illegal application by contravening a label instruction.

# Nozzle Naming Systems



# ISO Colour codes and Nozzle Materials

| Characteristics of Common Spray Tip Materials | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
| **Ceramic**<br>Superior wear life; highly resistant to abrasive and corrosive chemicals | **Hardened Stainless Steel**<br>Very good wear life; good durability and chemical resistance | **Stainless Steel**<br>Good wear life; excellent chemical resistance; durable orifice | **Polymer**<br>Good wear life; good chemical resistance; orifice susceptible to damage when cleaned improperly | **Brass**<br>Poor wear life; susceptible to corrosion, especially with fertilizers |

# Spray Quality Charts

From the spraying systems nozzle selection guide, 2011

| Turbo Teejet | bar | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 5.5 | 6 |
| TT11001-VP | C | M | M | M | F | F | F | F | F | F | F |
| TT110015-VP | C | C | M | M | M | M | M | F | F | F | F |
| TT11002-VP | C | C | C | M | M | M | M | M | M | M | F |
| TT110025-VP | VC | C | C | M | M | M | M | M | M | M | M |
| TT11003-VP | VC | C | C | C | C | M | M | M | M | M | M |
| TT11004-VP | XC | VC | C | C | C | C | C | C | M | M | M |

Nozzle nomenclature (ISO):

**Type:** TT (*for TurboTeejet*)

**Fan angle:** 110 degrees

**Orifice Size:** e.g. 04

SPRAY QUALITY (e.g. M for MEDIUM)

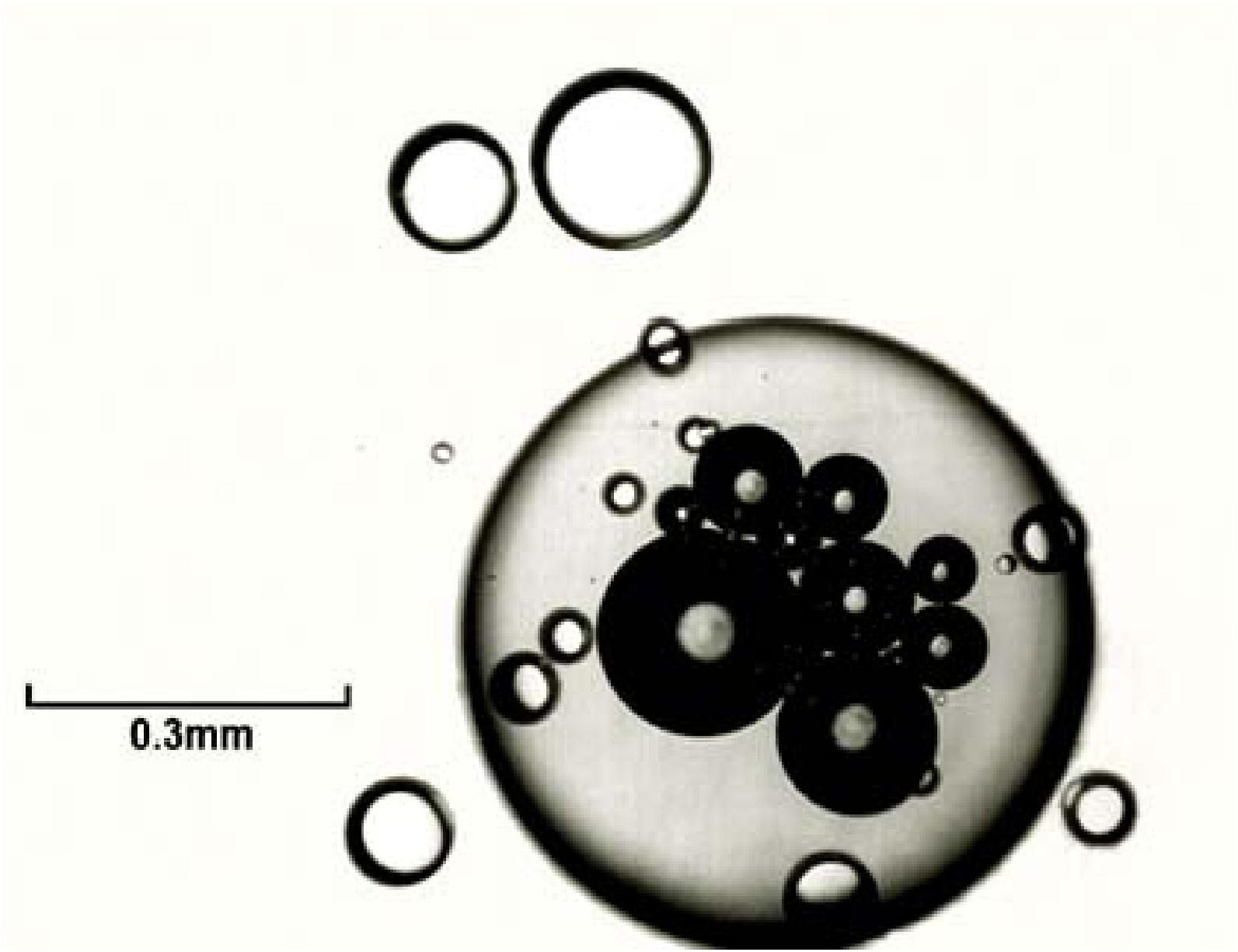
Colours assigned to spray qualities (e.g. medium or coarse) ARE NOT related to the ISO colours assigned to indicate orifice size (e.g. 02 or 025).

# Tapered Fan and Even Fan

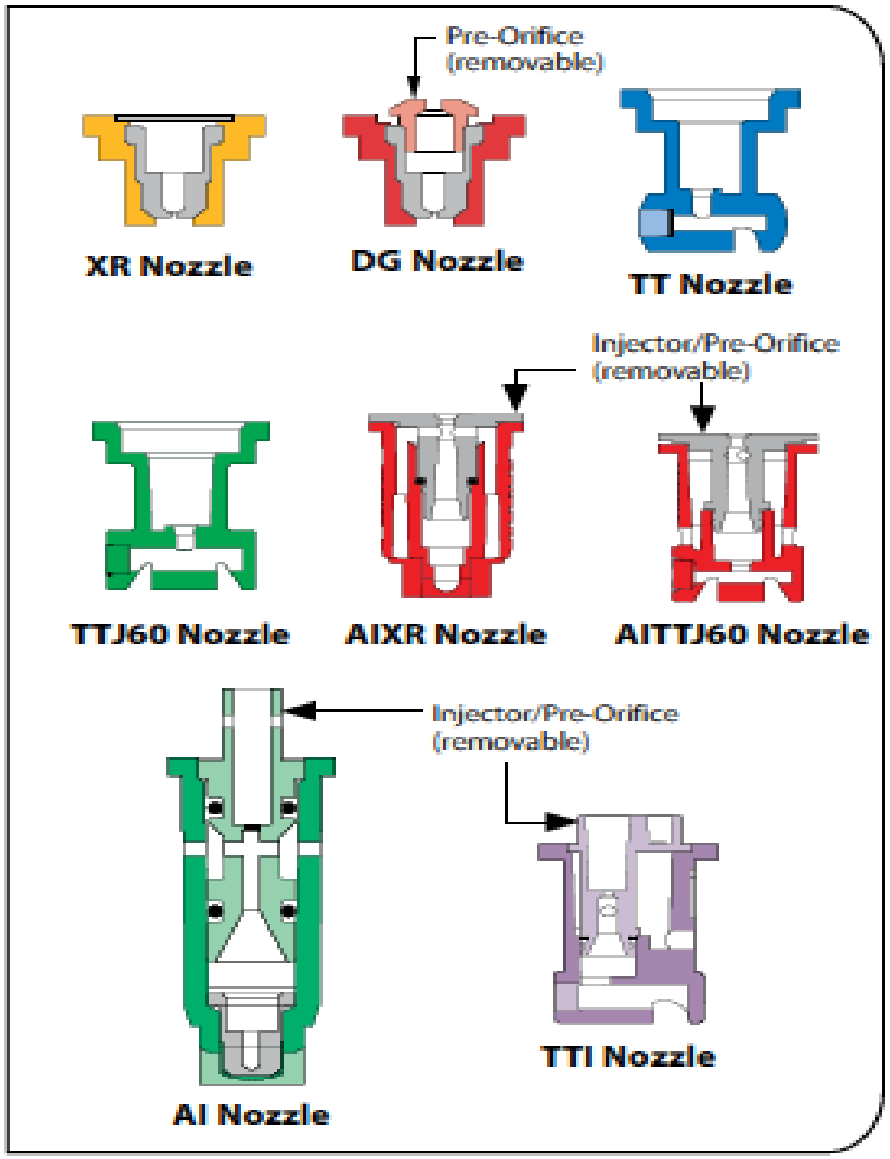

Tapered Fan


Even Fan

# Mechanism of Droplet Formation (hydraulic pressure – fan type)



0.3mm

# Examples of types of Nozzles that are available.




- The simplest way to change spray quality is to change nozzle type.
- If you need to produce coarse or very coarse spray qualities then standard flat fans and low drift nozzles may not be suitable at reasonable volumes.
- You will probably need to look at anvil types or air induction nozzles

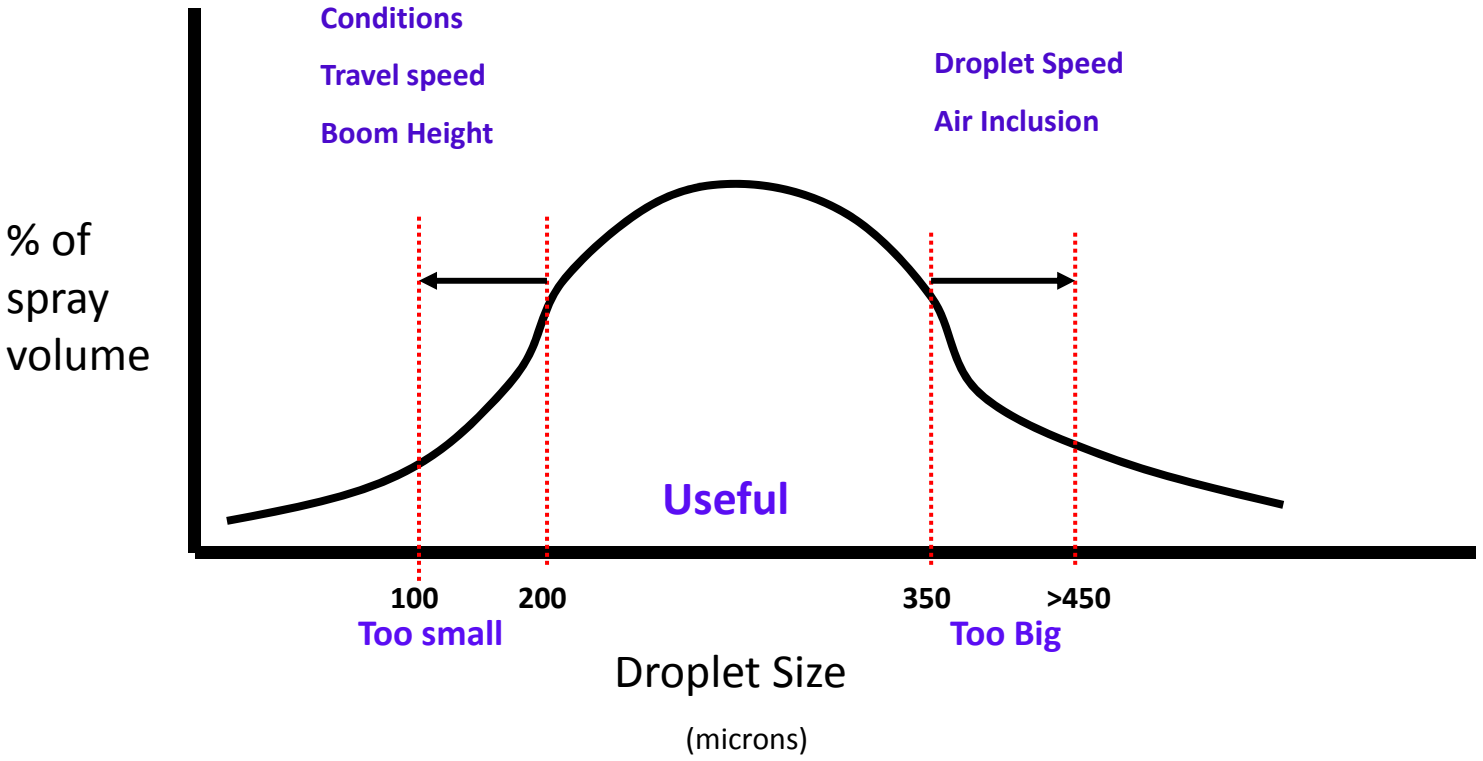
Source: Teejet Catalogue 51M

What do fine, medium, coarse, very coarse and extremely coarse spray qualities actually look like ?

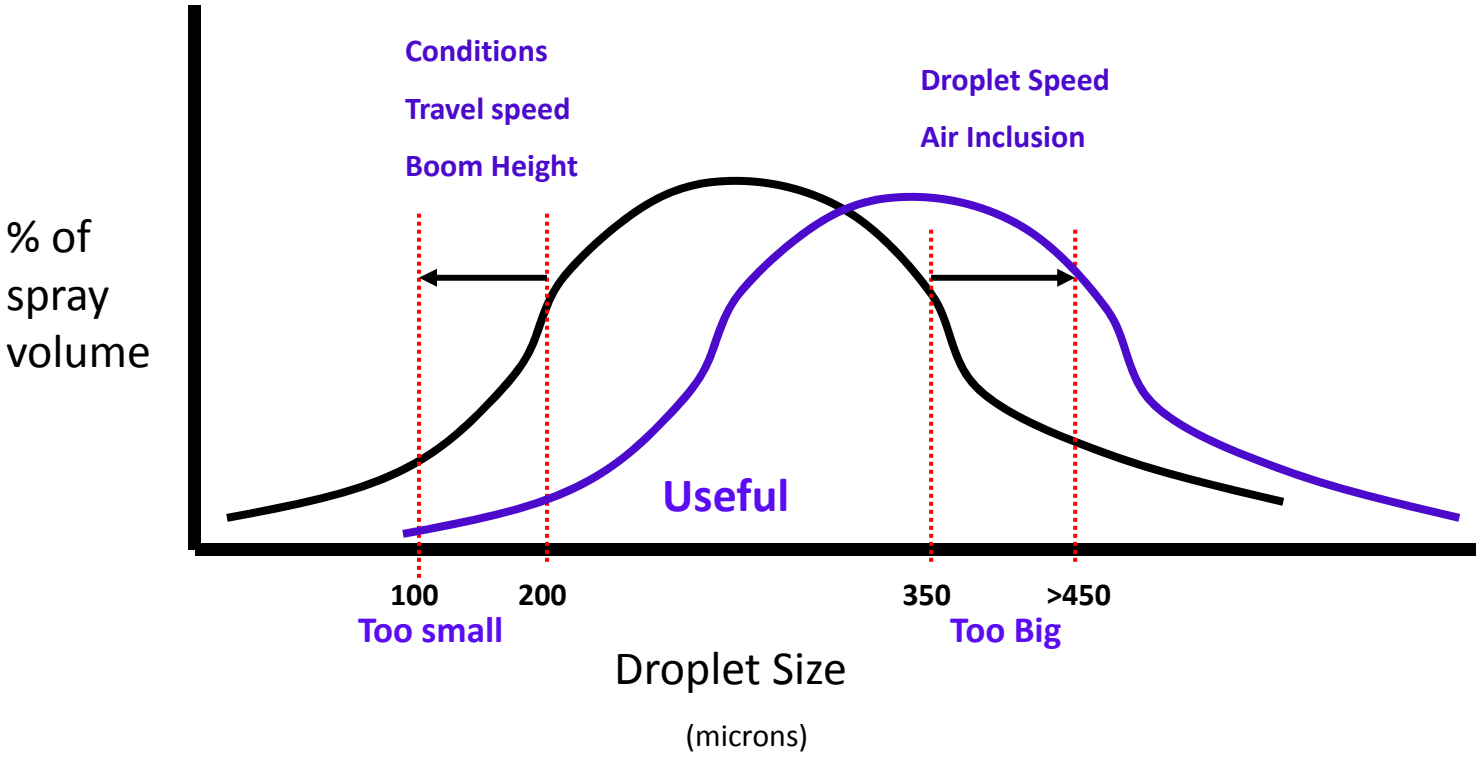
**Outside Demonstration**

**(best done with some breeze)**

# Hydraulic nozzle outputs

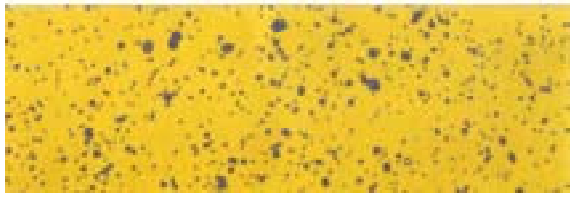


# Changing nozzle type shifts the curve, less small droplets, but more big droplets



# Bigger droplets = fewer droplets
## (but when is that important?)

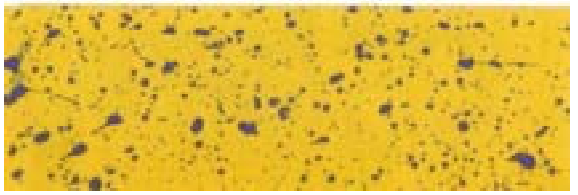
### Medium Droplets



- More even deposition
- More sites for uptake
- Faster rate of evaporation
- Less time for absorption

- Good for surface active products, poorly translocated products

### Coarse Droplets



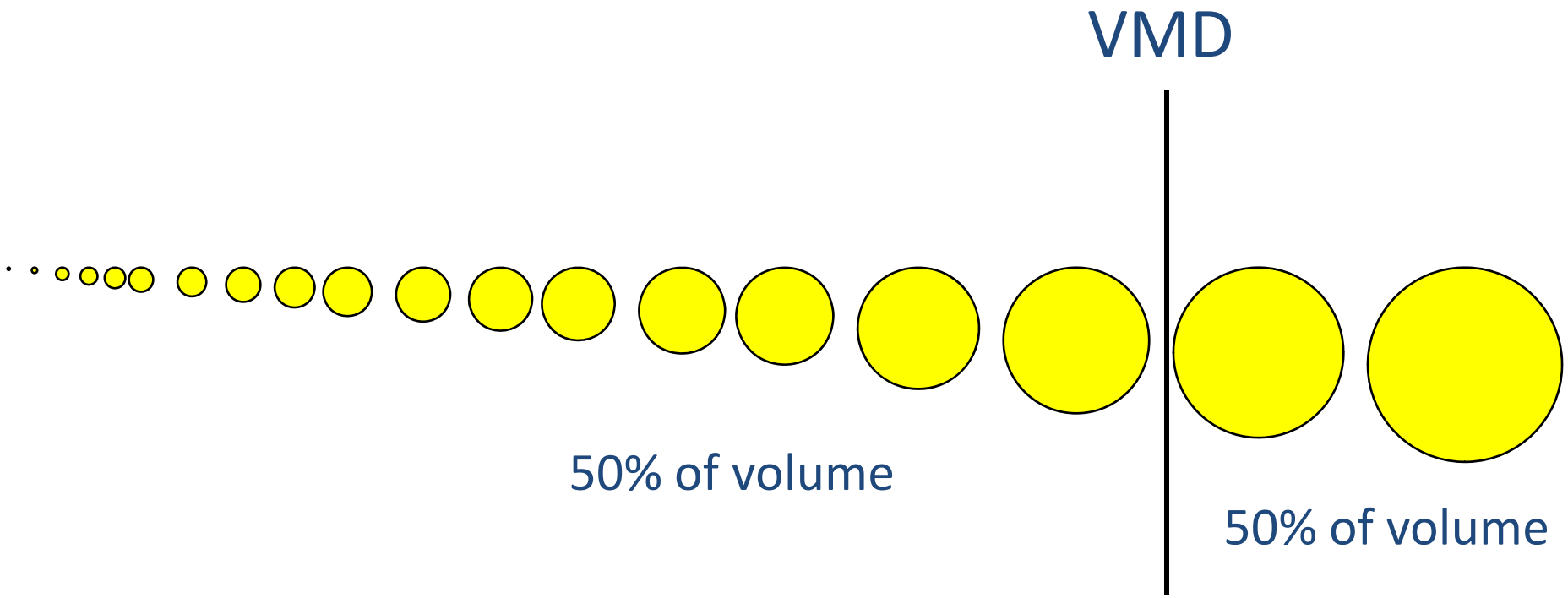
- Less even deposition
- Less sites for uptake
- Slower evaporation
- More time for absorption

- Good for fully translocated products

# Droplet behaviour


| Approximate Droplet Size (microns) | Expected behaviour under suitable spraying conditions. |
|---|---|
| Less than 50 microns | Will evaporate quickly and will typically be lost before reaching the target. |
| Droplets 50 to 150 microns. | Will move with the wind, hence present some risk as they may move off target. But are also very useful under good spraying conditions. |
| Droplets less than 200 microns | Considered 'driftable' because they may reduce in size due to evaporation, hence move with the wind. |
| Droplets > 250 microns | Will typically fall due to gravity |
| Droplets over 350 microns | Many may bounce or runoff without the addition of adjuvants, hence may not be useful for spraying foliage (but do provide good absorbtion for translocated products) |
| Droplets between 100 and 350 um | Considered the MOST USEABLE fraction when spraying foliage. |

# Older terminology - VMD




VMD = volume median diameter

# New asabe s572.1

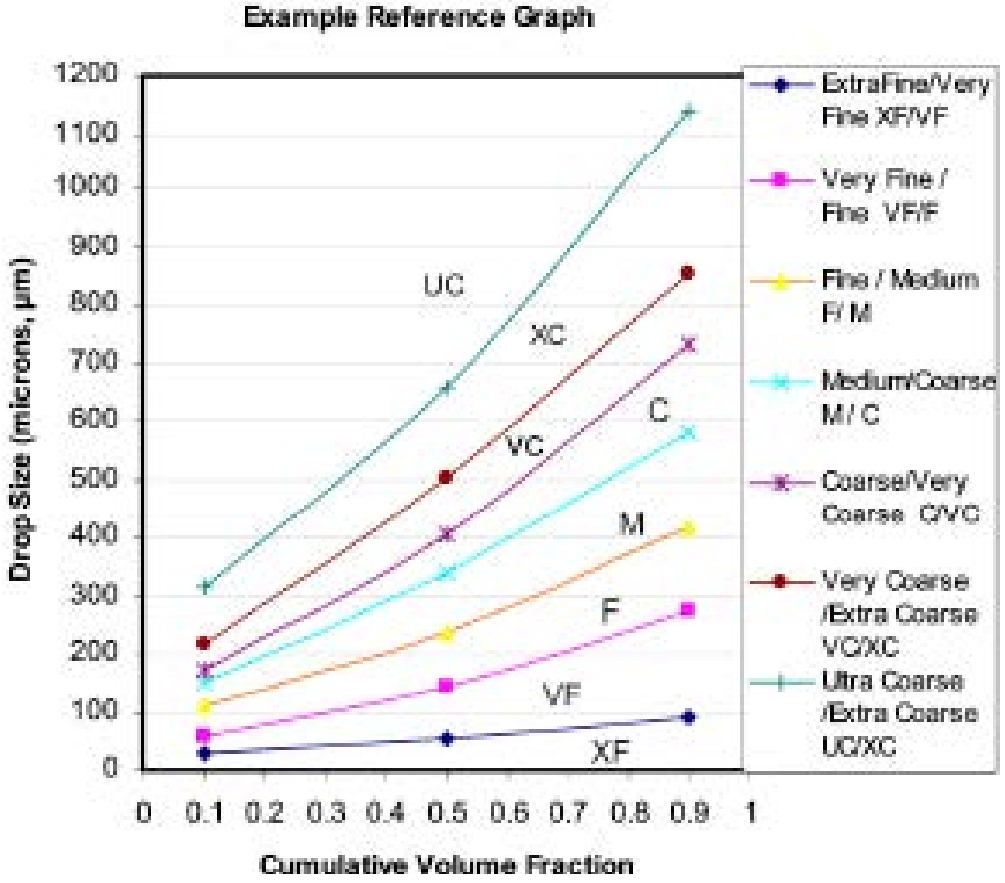



Figure 1 – Sample reference graph developed from measurements averaged from three types of laser instruments. NOTE: To view figure in color please go to http://www.asabe.org/standards/images/s572images.html

# Summary

- Fine spray quality approximately 40-50% susceptible
- Medium spray quality approximately 20% susceptible
- Coarse spray quality approximately 10% susceptible
- Very Coarse quality approximately 5 % susceptible
- Extremely Coarse spray quality approx. 3 % susceptible

# How many sets of nozzles do you need? (Broad-acre example).

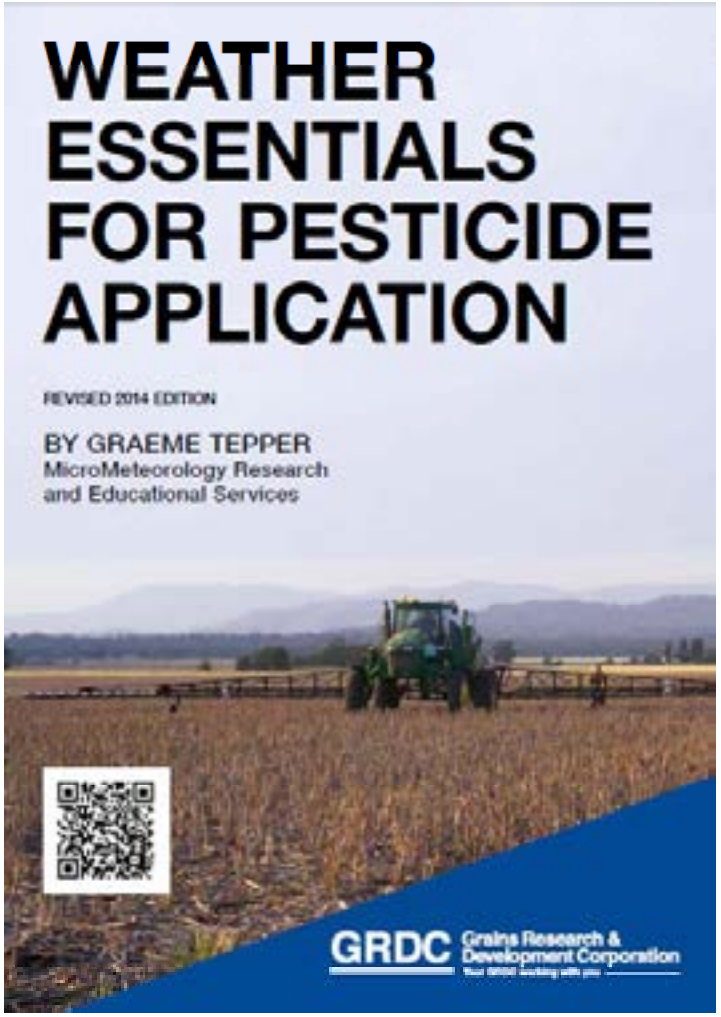
| Typical Application Volume | Medium Spray Quality (lower drift risk areas) | Coarse Spray Quality | Extremely Coarse Spray Quality (higher drift risk areas) |
|---|---|---|---|
| **Lower range**<br>**50 -60 L/ha**<br>**(Low stubble load)**<br>**to**<br>**70-80 L/ha**<br>**(High stubble load)** | *Only where permitted on label:<br>Fully translocated herbicides<br>Small to medium sized targets. | Fallow Spraying<br>Fully translocated herbicides such as Glyphosate, MCPA.<br>Mandatory for 2,4-D, | Fully translocated herbicides, medium targets,<br>Very sensitive areas or NIGHT SPRAYING |
| **Higher range**<br>**70-80 L/ha**<br>**(Low stubble load)**<br>**to**<br>**100 + L/ha**<br>**(High stubble load/ dense crop canopy)** | *Only where permitted on label:<br>Contact type products.<br>Small targets.<br>In crop spraying.<br>Penetration and coverage in large & broadleaf crops. | Good stubble penetration.<br>Pre-emergent's.<br>Fully Translocated herbicides,<br>Some contact herbicides at the higher application volumes. | Pre-emergent's.<br>Medium sized targets with fully translocated summer fallow herbicides.<br>Very sensitive areas or NIGHT SPRAYING |

# What are suitable conditions for Spraying ?

(it really depends product, target & droplet size)

## Critical Factors

- What the product label says is MANDATORY
- Wind Speed (depends on label) and Wind direction
- Delta T (Temperature & Relative Humidity)
- Release Height & Speed (depending on spray quality)
- Local weather effects (especially night spraying)



If you can't measure the conditions at the site of application, you can't make an informed decision about when to change setup or when to stop

- Monitor and record conditions at least every load.

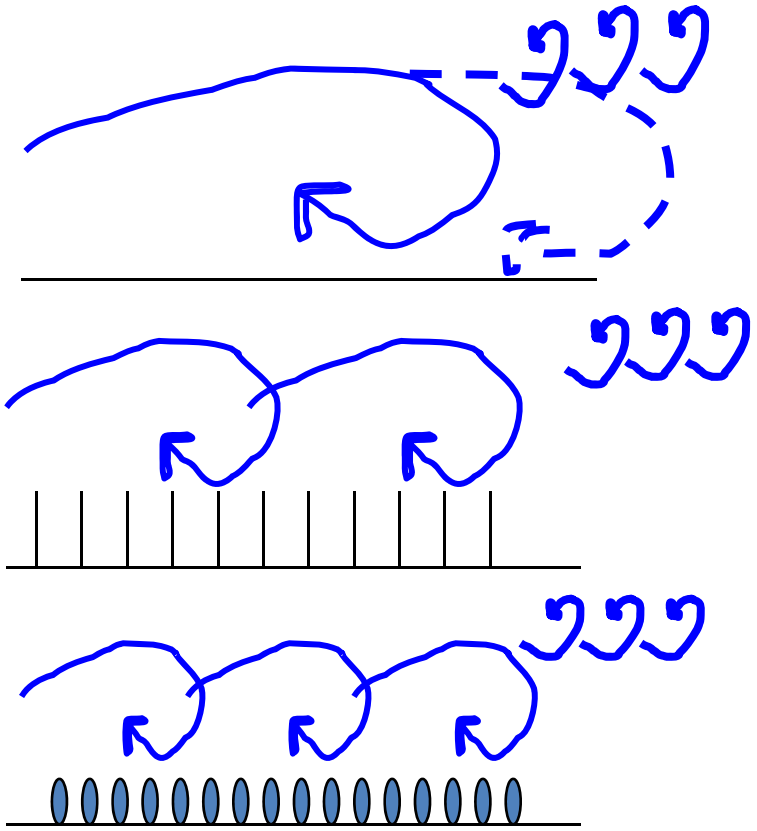
- **More often at night ..if the wind drops, STOP spraying**


Photograph by Graham Betts

# What are suitable wind speeds?

- The maximum wind speed should not be above 20 km/h and preferably around 15 km/h….
- Higher wind speed can be managed when we have a canopy to catch the droplets, and with droplet size and buffers (no spray zones) provided gusts are not too strong.
- …..during the day a minimum of about 3-4 km/h is essential to ensure the air moves and mixes, at night this should be above 12 km/h for the whole time between sunset and sunrise.

# Wind Movement Over Different Surfaces



**FALLOW GROUND**

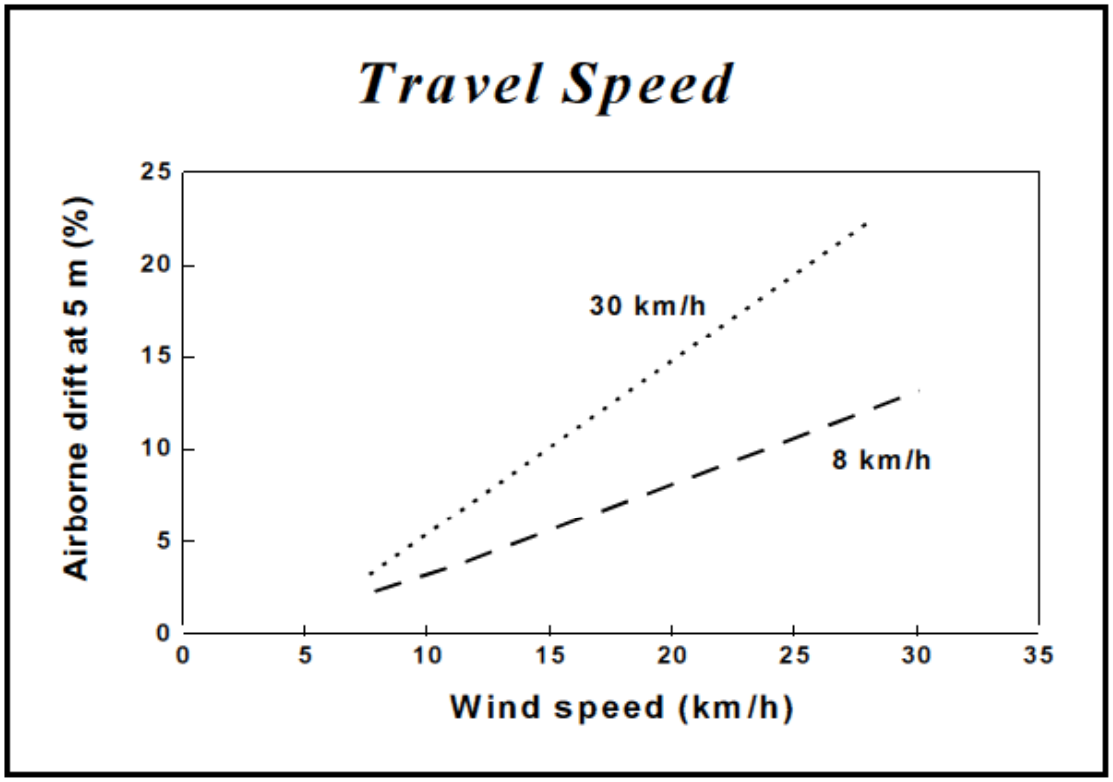
**HEAVY STUBBLE**

**IN CROP SITUATIONS**

Comments about angled nozzles and travel speed by Professor Paul Miller NIAB-TAG (UK):

**Speed?**

Going slowly certainly helps boom stability, but timeliness will suffer. **Going beyond 15kph risks running into a new set of problems. The faster the sprayer travels, the more turbulence or "wake" it creates behind it. Small droplets tend to be pulled into areas of high turbulence, creating drift, and these areas also produce greater levels of deposition on to plant targets.**



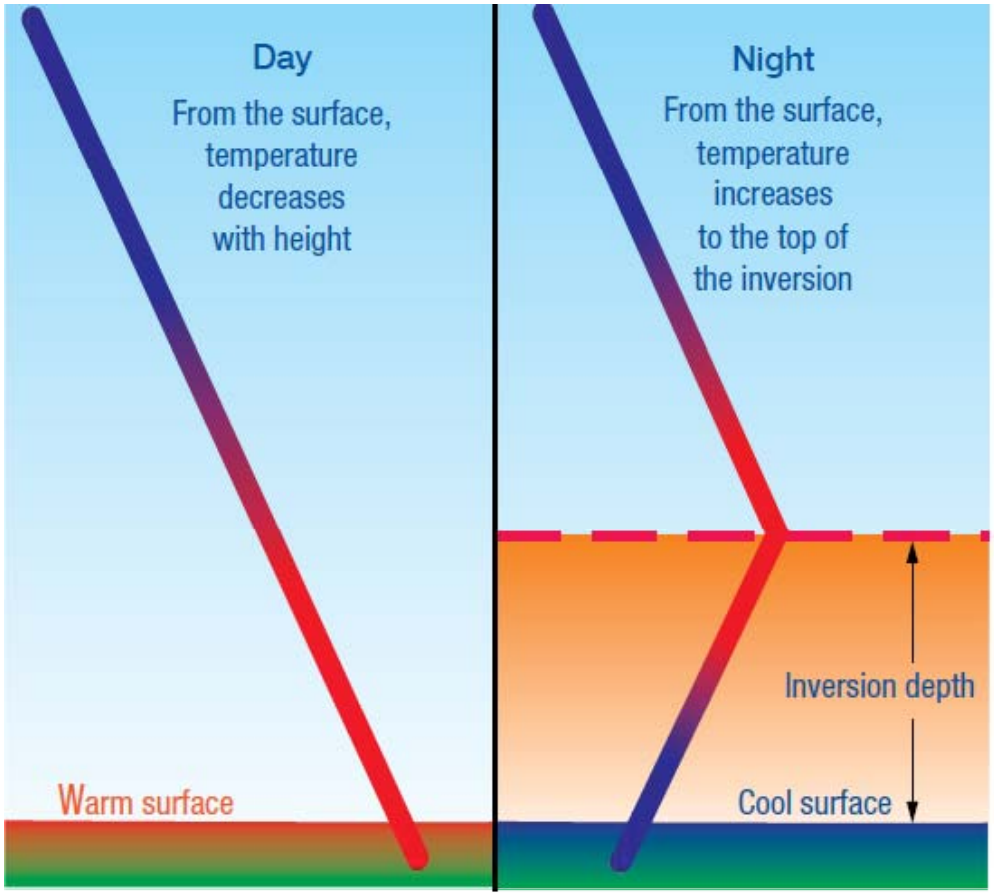

**Effect of travel speed on spray drift. 30 km/h travel speed conducted using XR11002 tips applying 30 L/ha. 8 km/h travel speed done using XR8001 tips applying 50 L/ha.**

Fast travel speeds have three main effects on how spray behaves after it leaves the nozzle. Faster speeds:

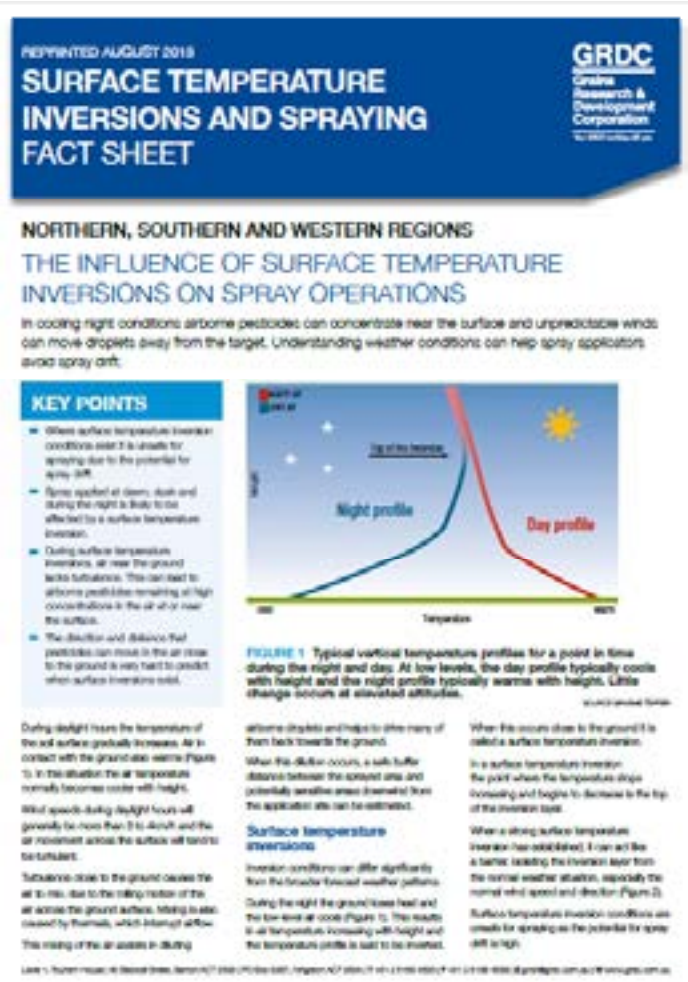
- increase sheet break-up and cause a finer, more drift-prone spray to be produced;
- cause the spray to stay aloft longer because it gets swept back due to air resistance;
- often require higher boom heights on uneven ground;

**Thomas M. Wolf**, Agriculture and Agri-Food Canada, Saskatoon Research Centre, 107 Science Place, Saskatoon, SK, S7N 0X2, WolfT@agr.gc.ca +01 306 956 7635

# Temperature at the surface drives the formation of inversions




SOURCE: GRAEME TEPPER



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**SURFACE TEMPERATURE INVERSIONS AND SPRAYING FACT SHEET**

GRDC Grains Research & Development Corporation

**NORTHERN, SOUTHERN AND WESTERN REGIONS**

THE INFLUENCE OF SURFACE TEMPERATURE INVERSIONS ON SPRAY OPERATIONS

In cooling night conditions airborne pesticides can concentrate near the surface and unpredictable winds can move droplets away from the target. Understanding weather conditions can help spray applicators avoid spray drift.

**KEY POINTS**

Night profile

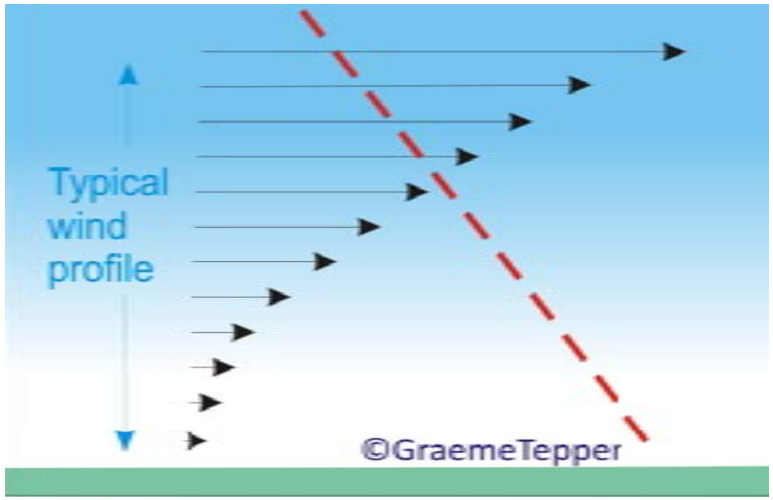
Day profile

Temperature

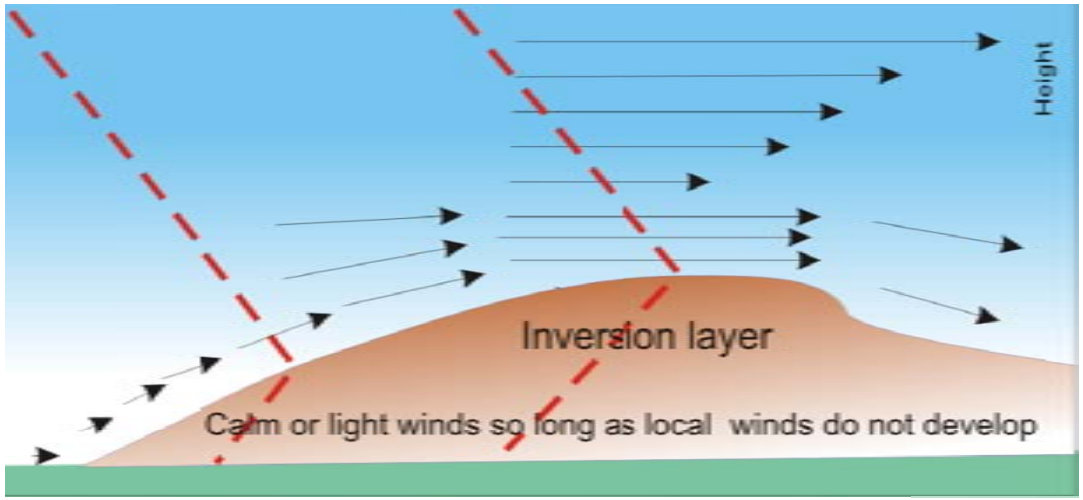
FIGURE 1 Typical vertical temperature profiles for a point in time during the night and day. At low levels, the day profile typically cools with height and the night profile typically warms with height. Little change occurs at elevated altitudes.

Surface temperature inversions

Typical daytime situation



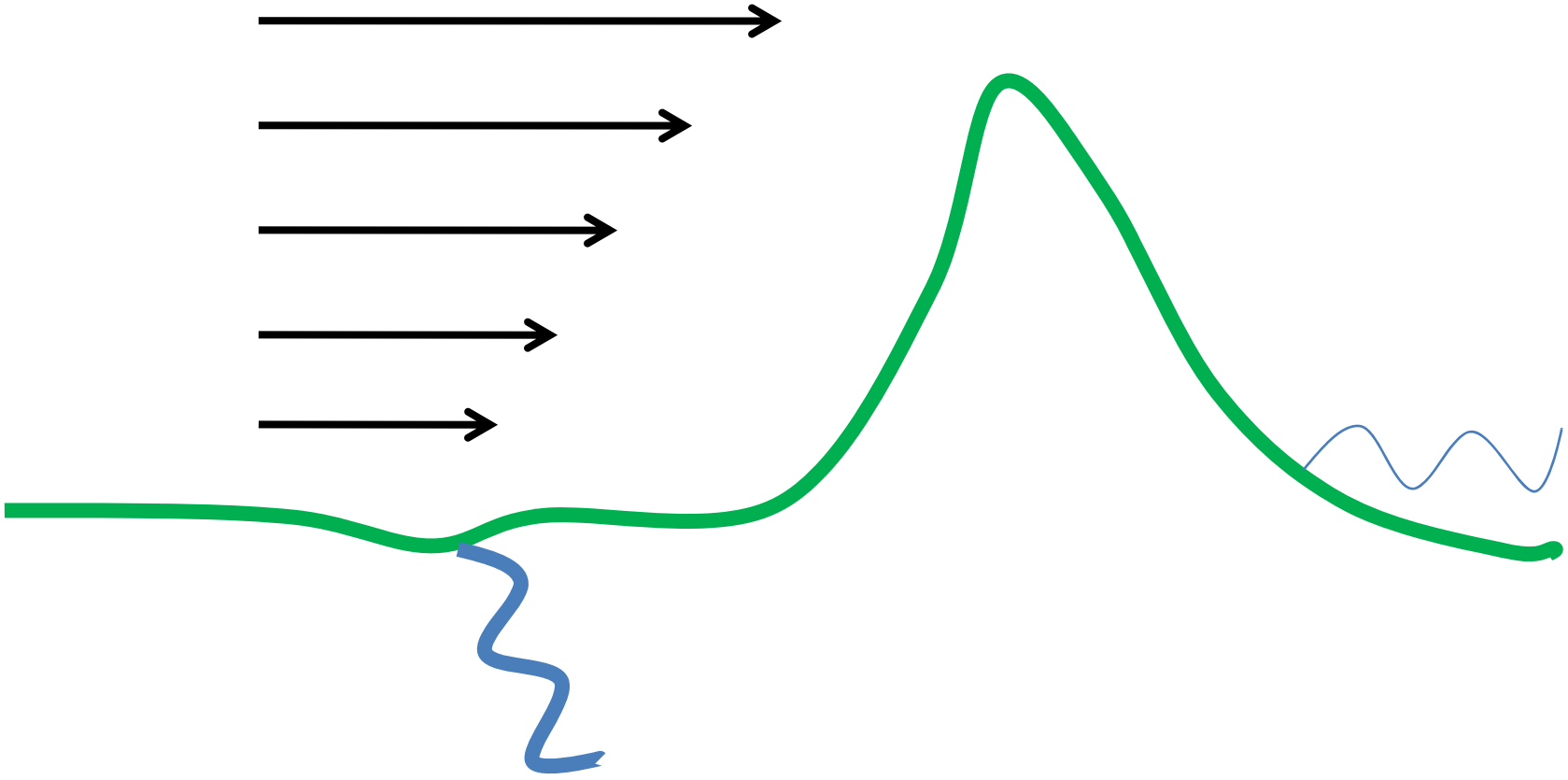

Typical Night time situation



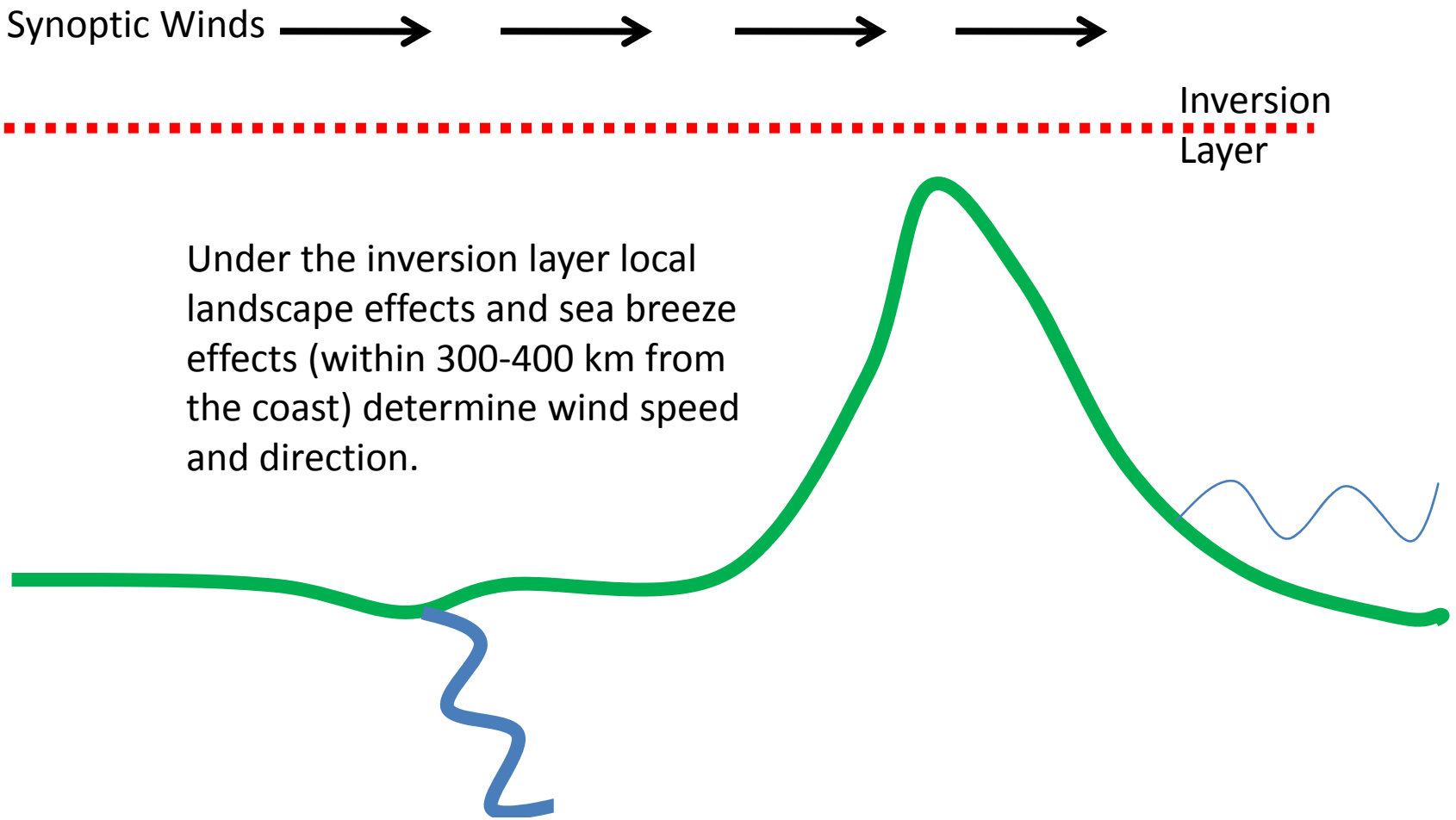
# Effect of inversions over a landscape

- Through out a 24 hour cycle wind direction and strength can vary greatly, depending on where you are….

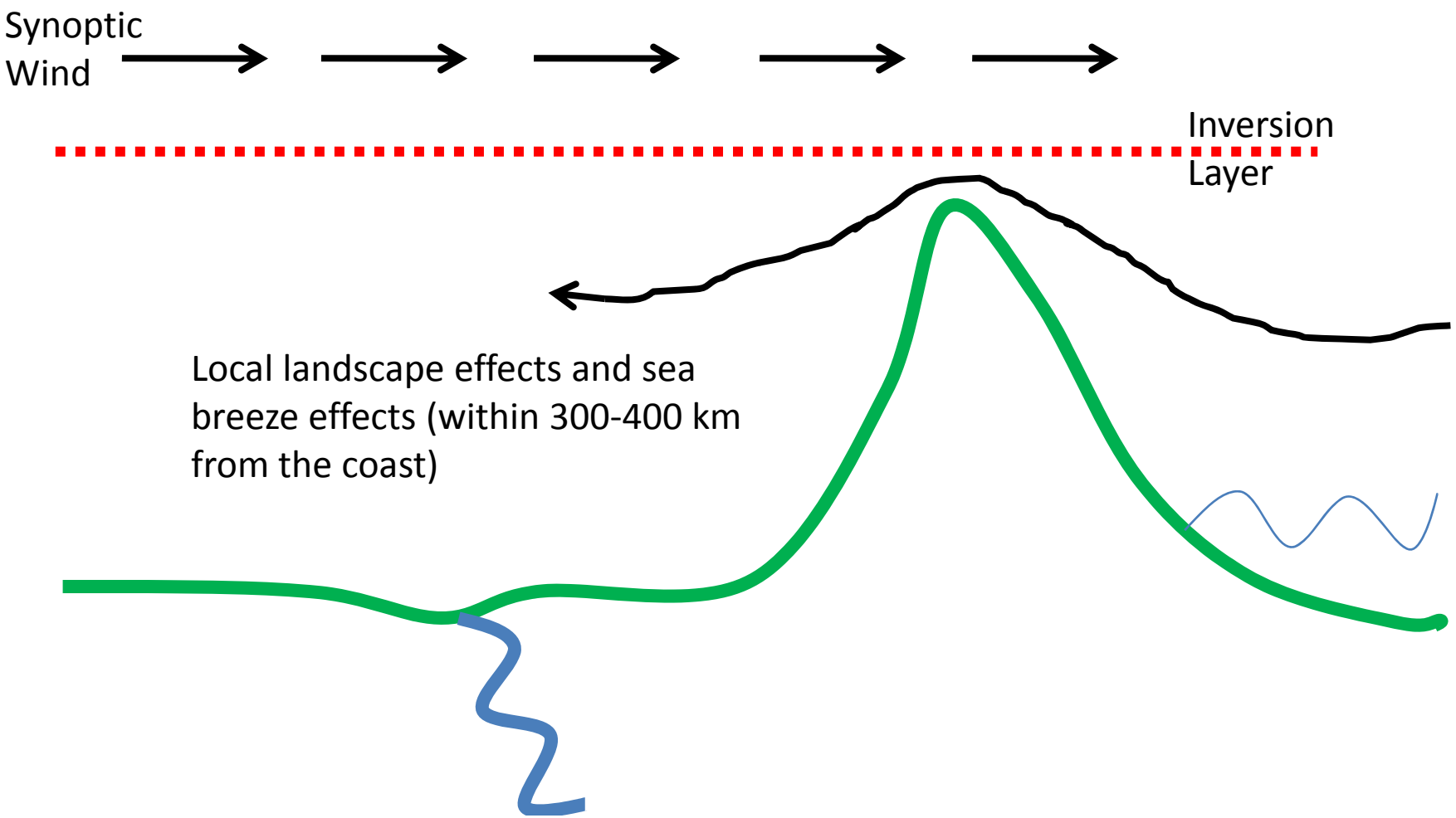
# Synoptic winds, dominating during the daylight hours – following the weather pattern

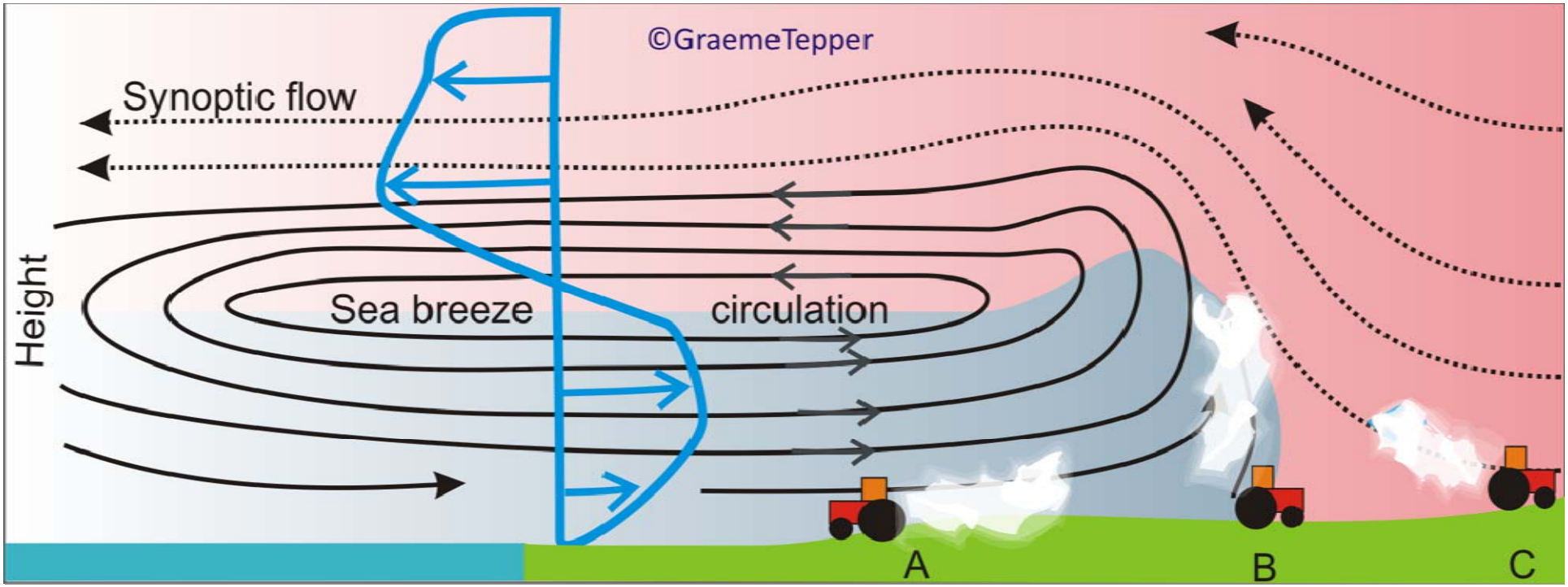


# Late in the afternoon the landscape can be cut off from the Synoptic Wind when the inversion forms

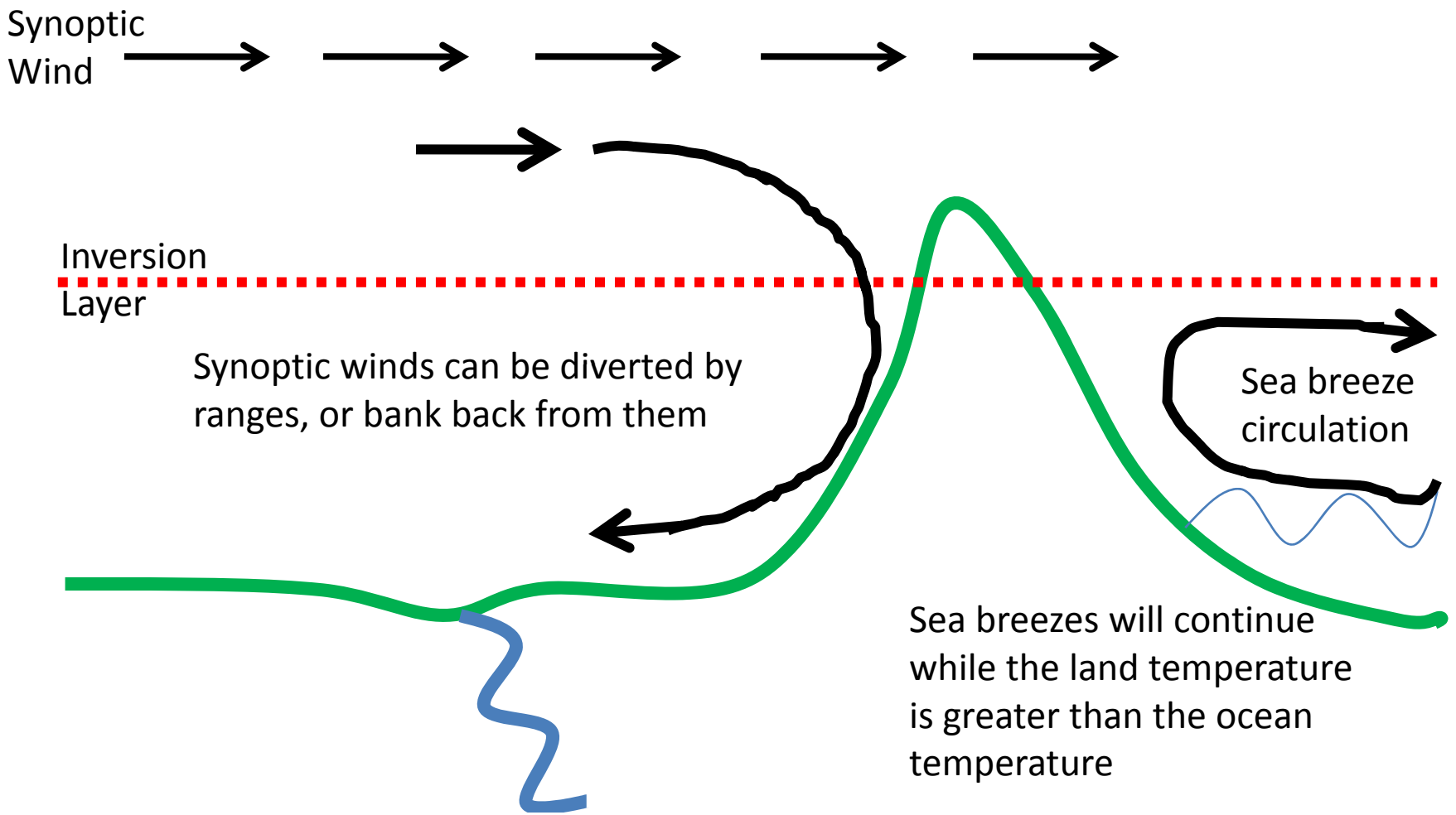


# Effects of an inversion on a whole of landscape scale

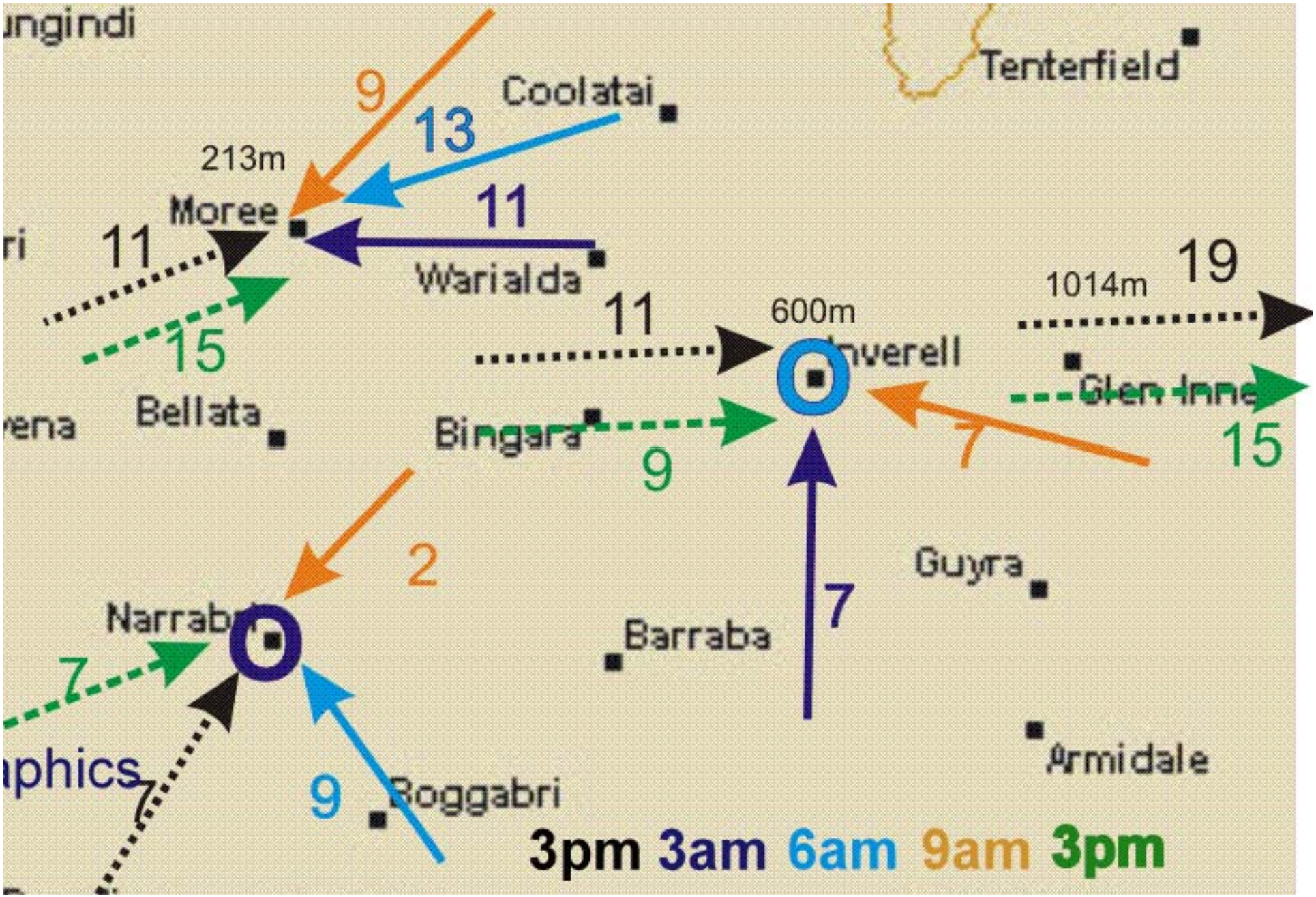



©GraemeTepper
Synoptic flow
Height
Sea breeze
circulation
A
B
C

# Effects of an inversion on a whole of landscape scale




© Graeme Tepper Graphics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Coolatai
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Moree
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Glen Inne
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Narrabri
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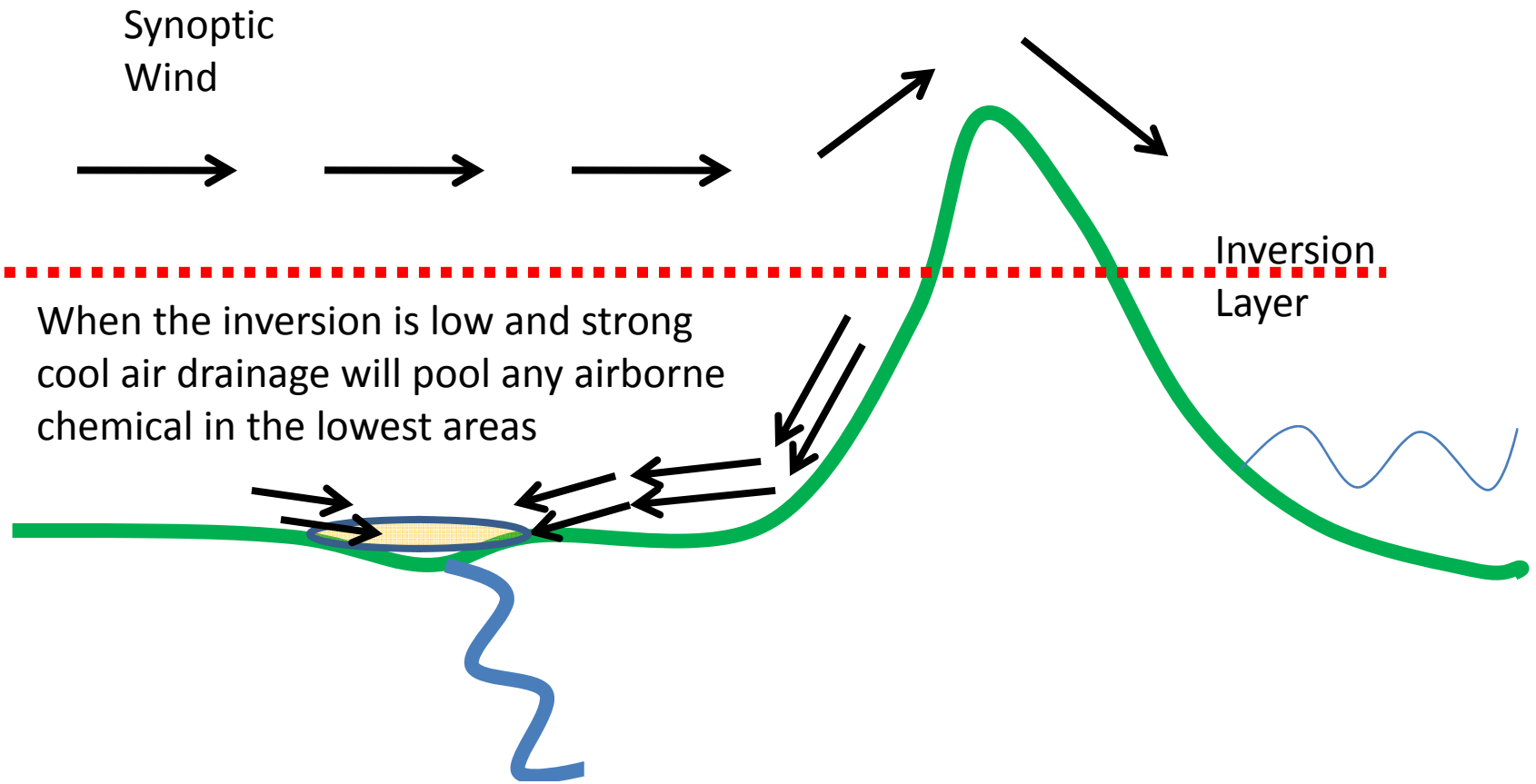
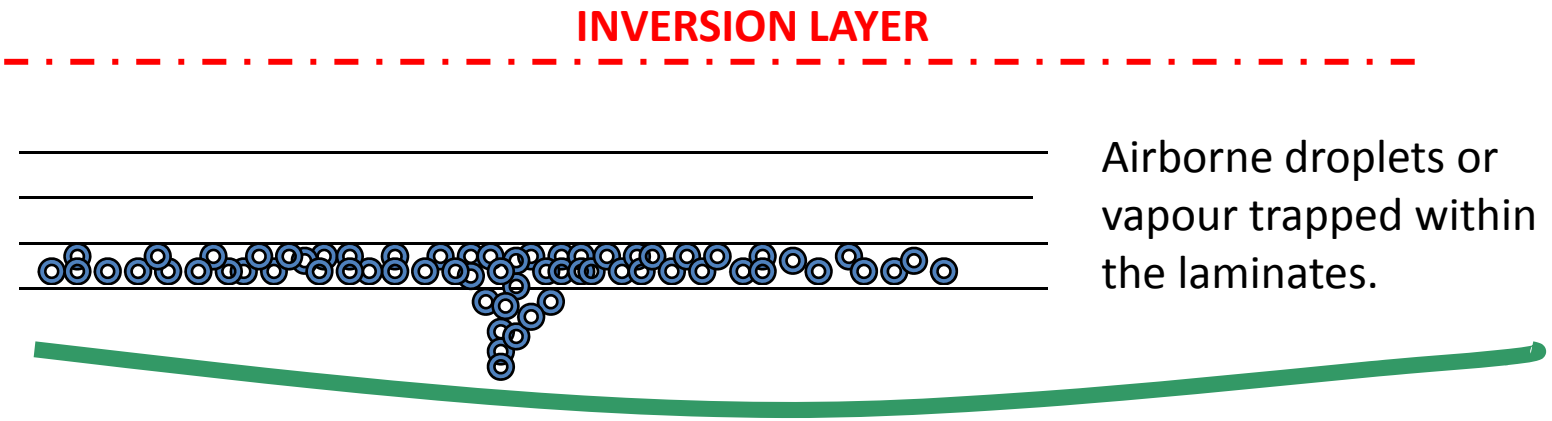
Boggabri
Armidale
3pm 3am 6am 9am 3pm

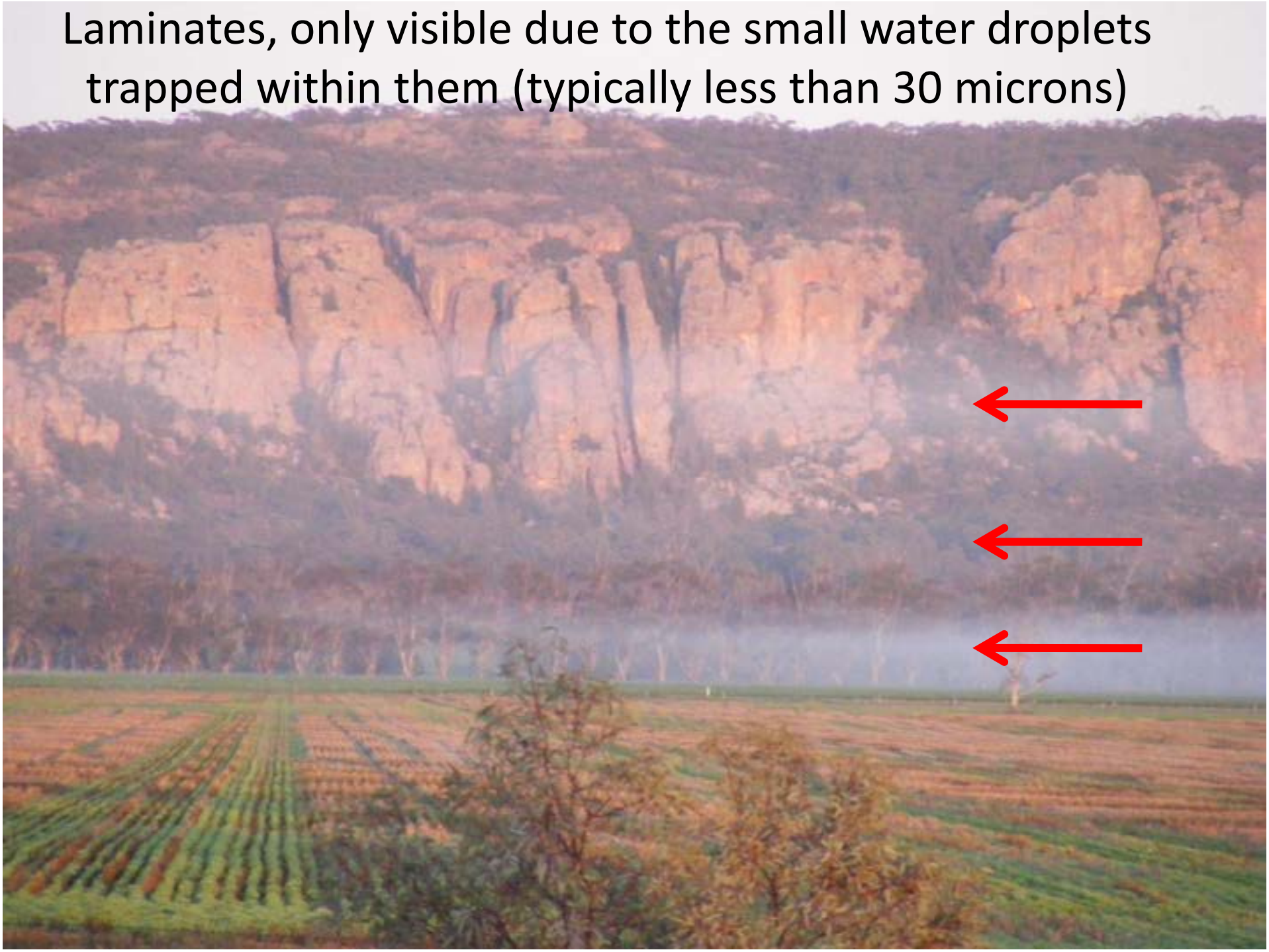
# Drainage winds under the inversion layer will typically be laminar (not turbulent).

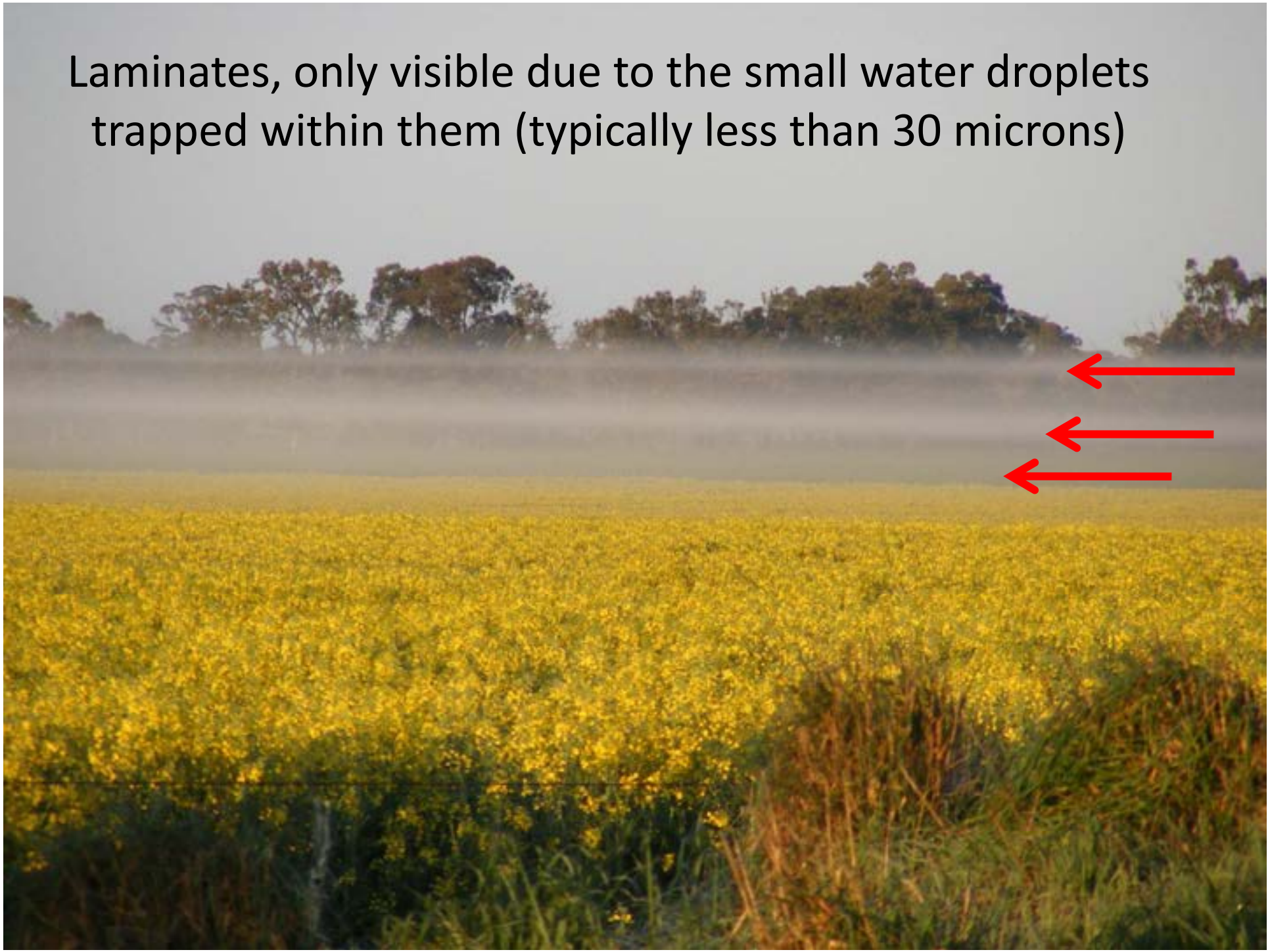


Small droplets can become trapped within the laminates and move towards the lowest point in the catchment.



Laminates, only visible due to the small water droplets trapped within them (typically less than 30 microns)

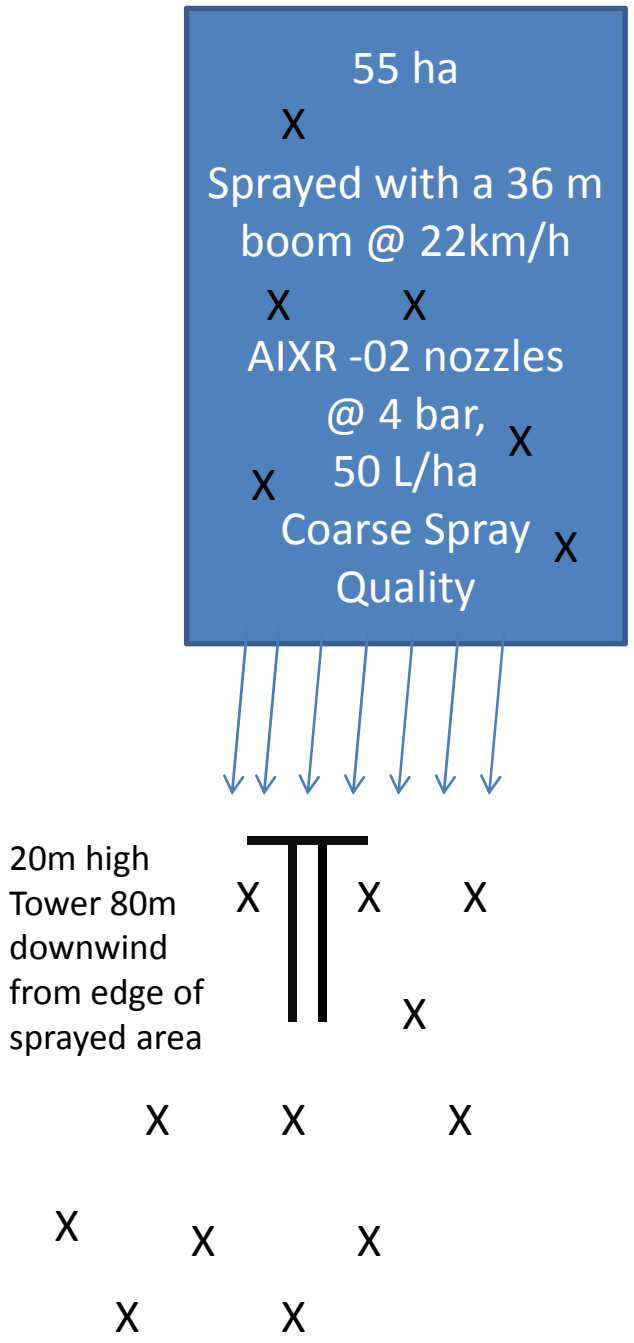



Laminates, only visible due to the small water droplets trapped within them (typically less than 30 microns)

# Millee Drift Study
# Night vs Day Spraying
# Feb, 2011

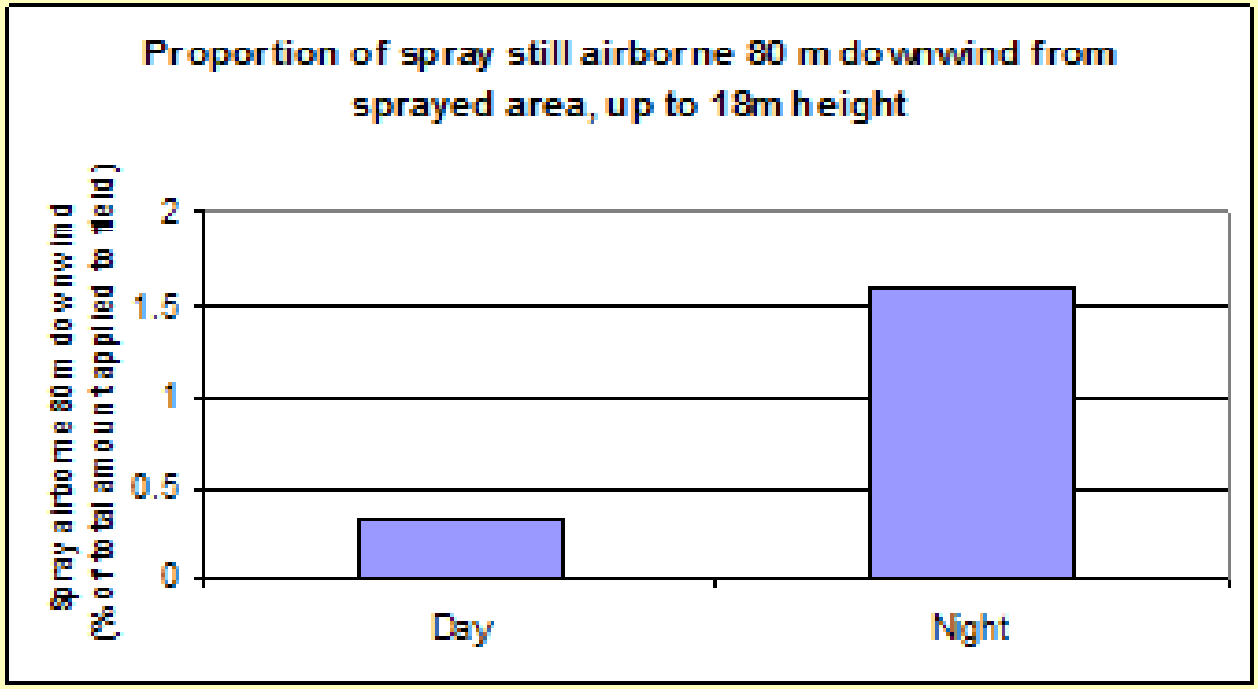
- Night Time Spraying conducted around 2.30am

- Daytime spraying conducted around 7.30am



# Night vs Day (Feb 2011, Millee)

| | Wind Speed (km/hr) | Wind Direction (°) | Temperature (°C) | Relative Humidity (%) | Stability Ratio |
|---|---|---|---|---|---|
| Night | 11.6 | 19 | 25.5 | 64 | 0.26 |
| Day | 18.3 | 4 | 28.7 | 61 | -0.29 |



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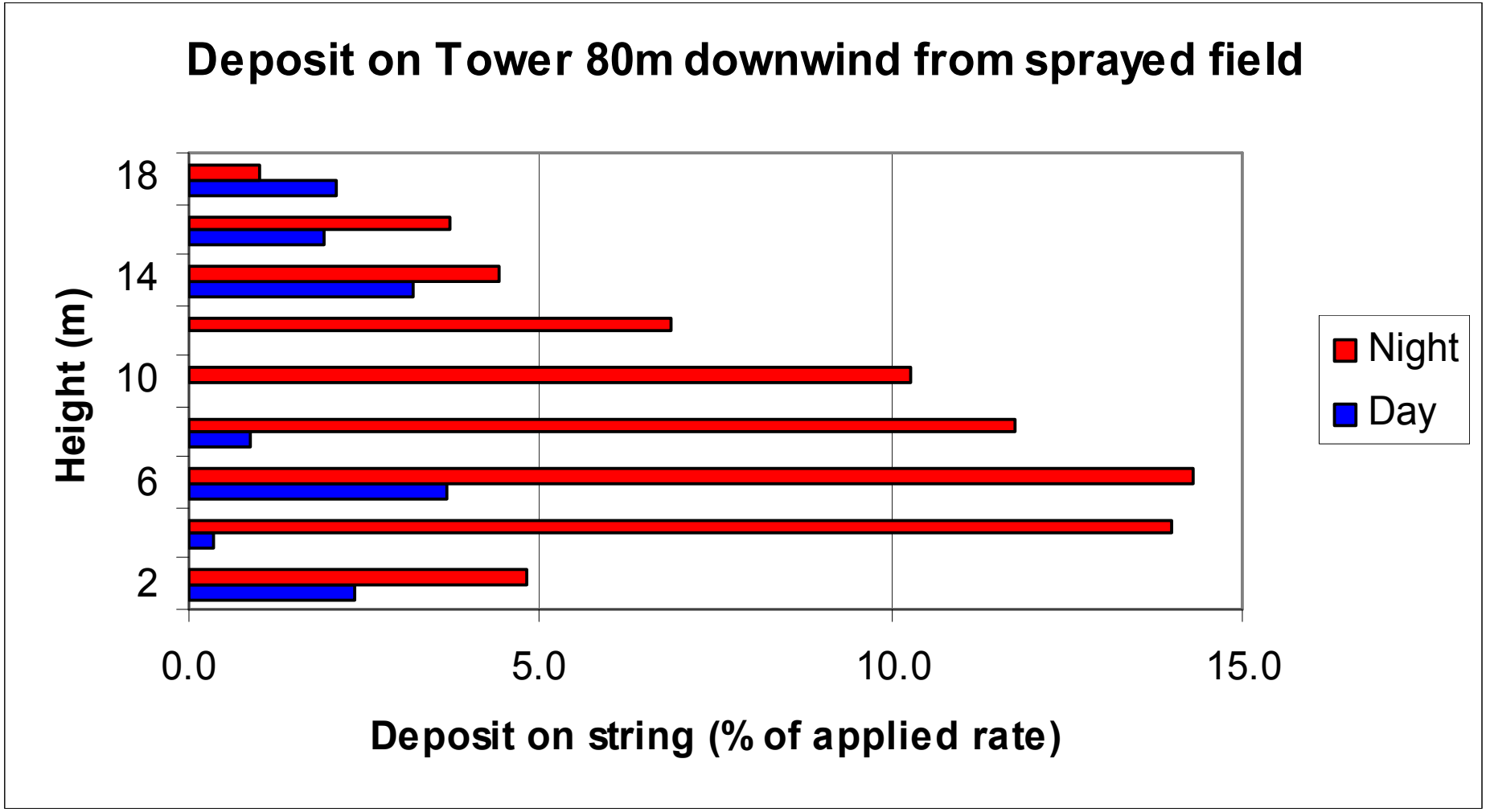
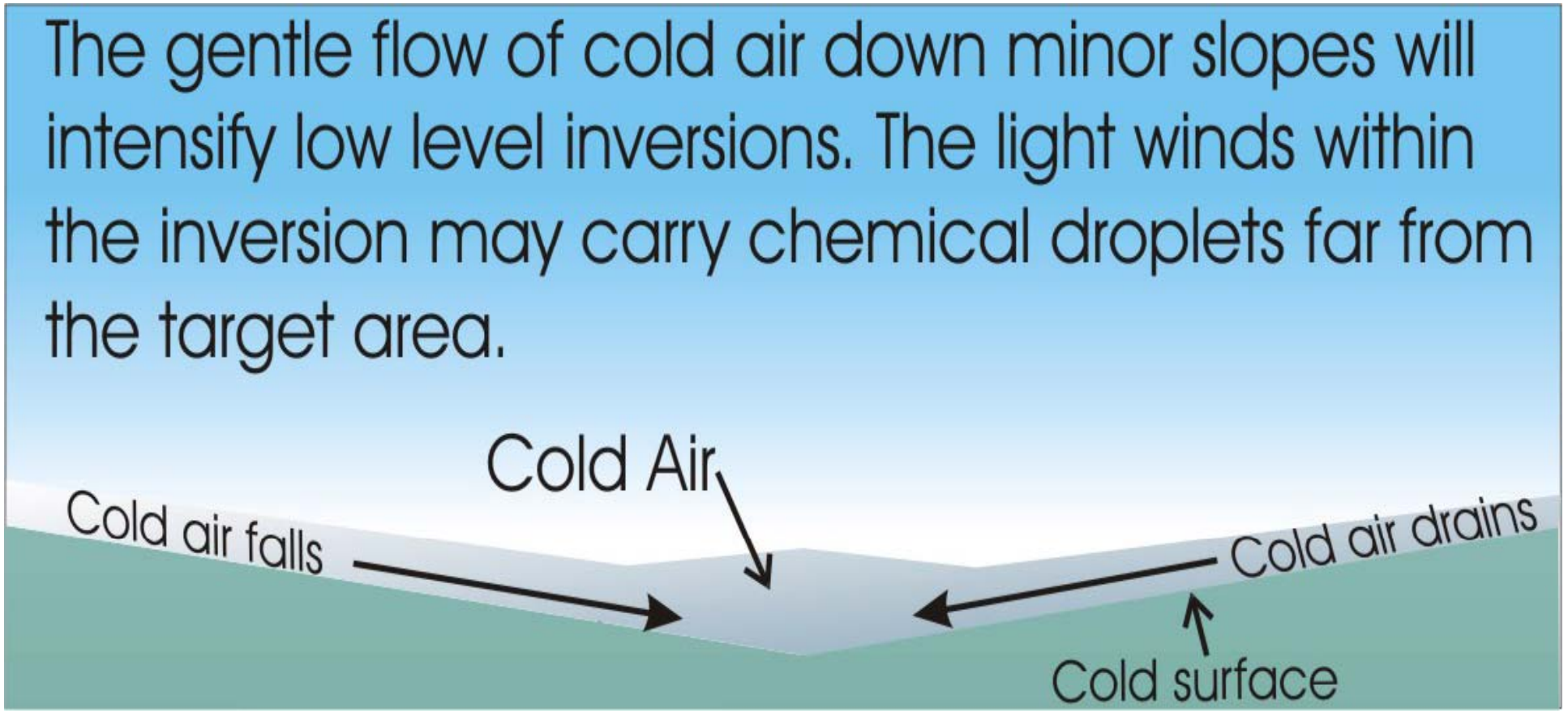
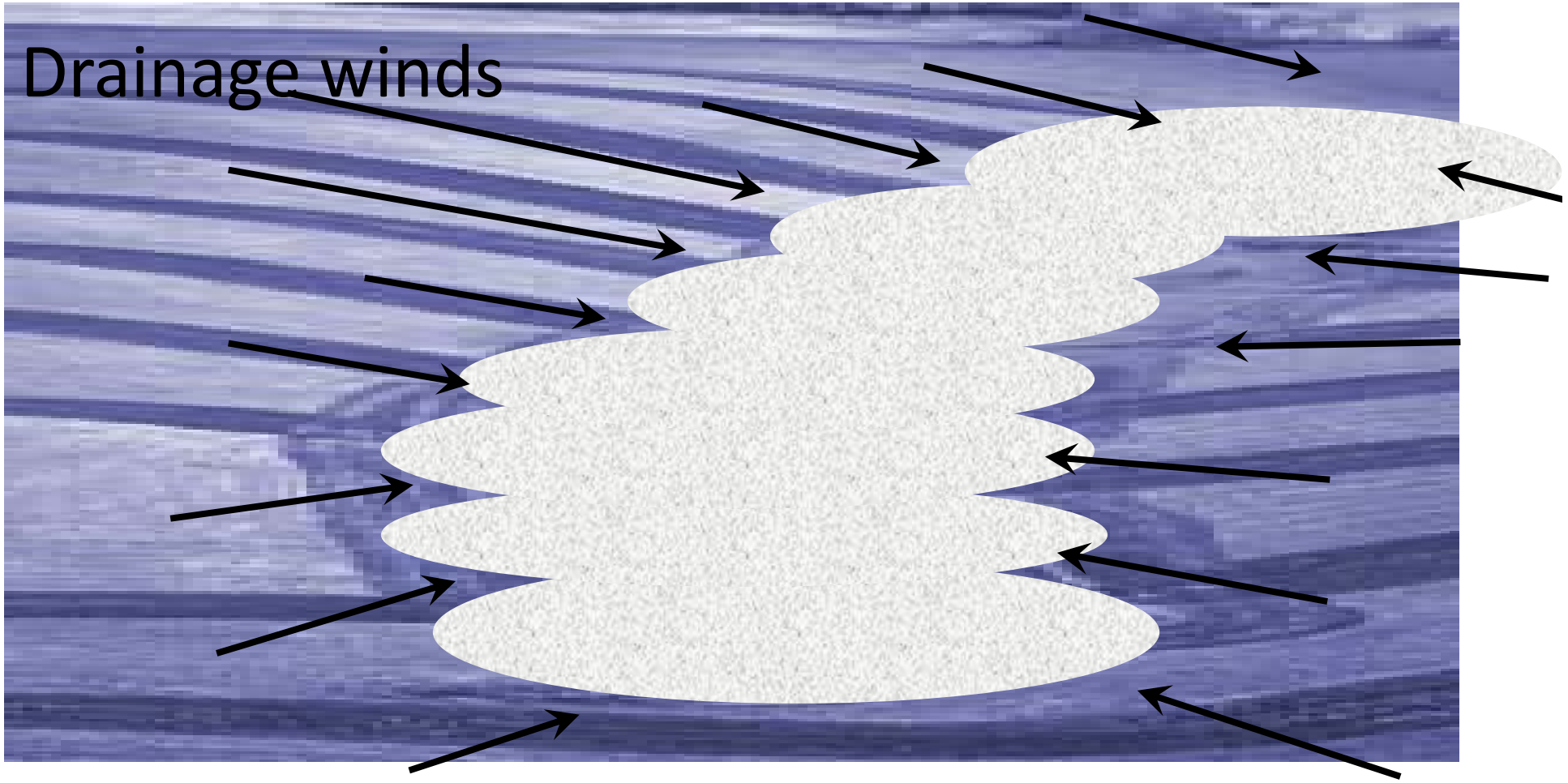





Source: BOM, Australia.

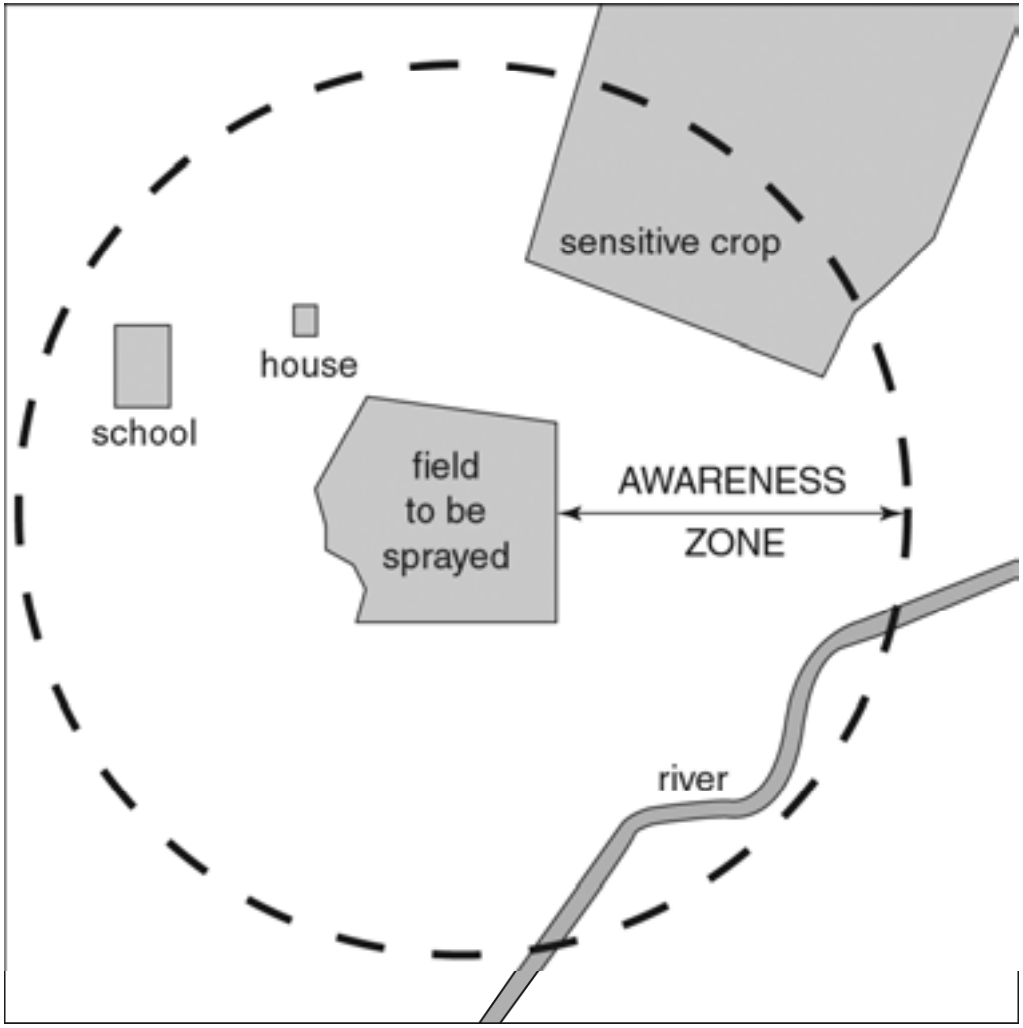
# Where are the low points on your farm, in the catchment?



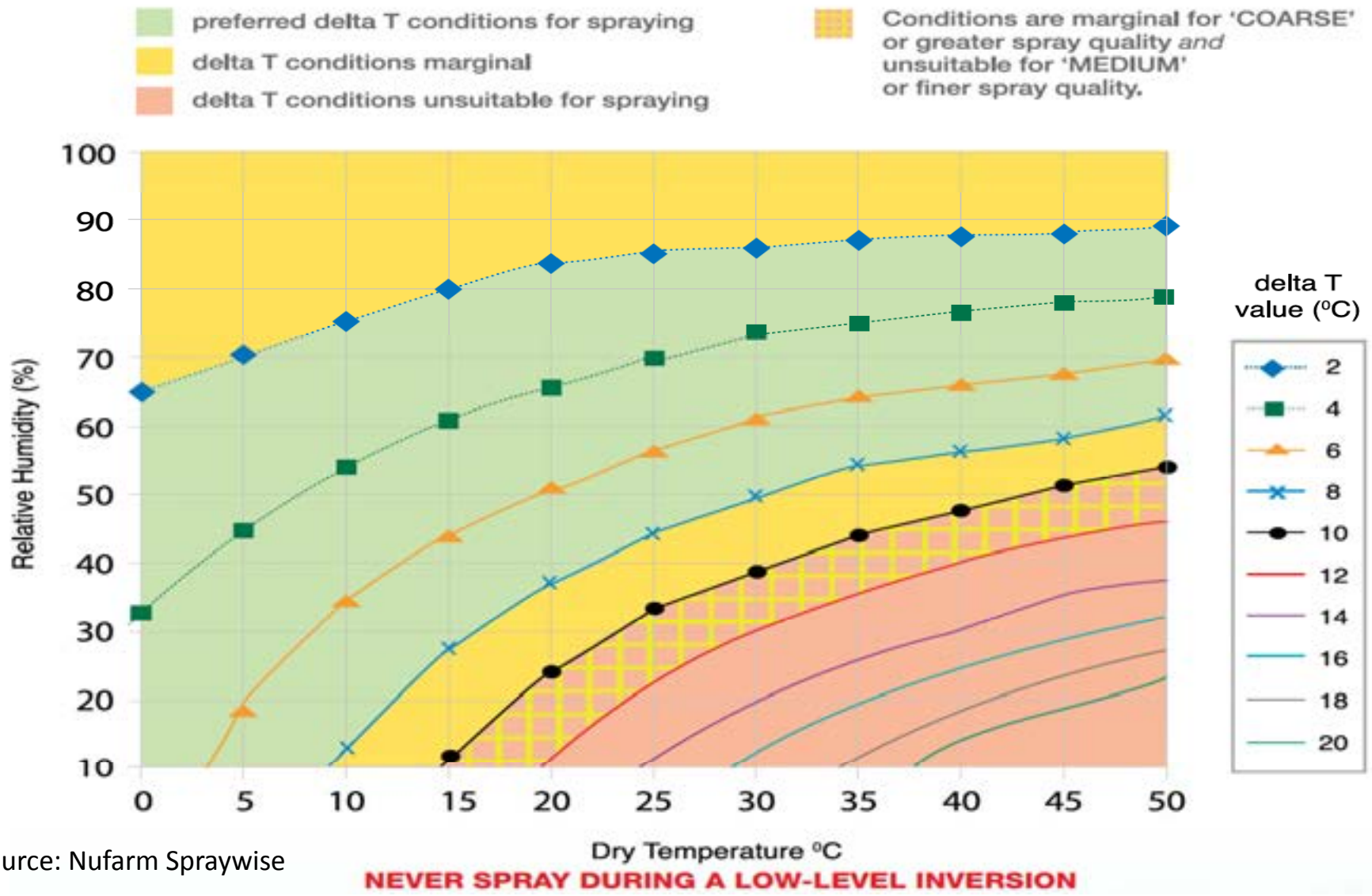

Source : Graeme Tepper

# Awareness zones

If the applicator is spraying in the evening or early morning then the slope of the land towards sensitive areas should also be taken into account.



# Selecting the right delta T conditions for spraying




Source: Nufarm Spraywise

## Evaporation of water droplets

| | | Temperate: cool | | Temperate summer, Dry sub-tropical | | Humid tropical | |
|---|---|---|---|---|---|---|---|
| | **T (°C)** | **16** | | **25** | | **30** | |
| Droplet | RH (%) | 58 | | 50 | | 89 | |
| diameter | **Δ T =** | **4.5** | | **7** | | **1.5** | |
| **µm** | | lifetime (s) | fall dist. (m) | lifetime (s) | fall dist. (m) | lifetime (s) | fall dist. (m) |
| 10 | | 0.3 | 0.0004 | 0.2 | 0.0003 | 0.8 | 0.0013 |
| 20 | | 1.1 | 0.007 | 0.7 | 0.004 | 3.3 | 0.020 |
| 30 | | 2.5 | 0.03 | 1.6 | 0.02 | 7.5 | 0.10 |
| 40 | | 4.4 | 0.11 | 2.9 | 0.07 | 13 | 0.32 |
| 50 | | 6.9 | 0.26 | 4.5 | 0.17 | 21 | 0.78 |
| 75 | | 16 | 1.3 | 10 | 0.85 | 47 | 3.96 |
| 100 | | 28 | 4.2 | 18 | 2.7 | 83 | 12.5 |
| 150 | | 63 | 21 | 40 | 14 | 188 | 63 |
| 200 | | 111 | 67 | 71 | 43 | 333 | 200 |
| 300 | | 250 | 338 | 161 | 217 | 750 | 1013 |
| 500 | | 694 | 2604 | 446 | 1674 | 2083 | 7813 |
| 1000 | | 2778 | 41667 | 1786 | 26786 | 8333 | 125000 |

(estimates based on Amsden, 1962)

# We should make better use of planning tools

Nufarm have the Spraywise decisions website with planning tools (subscription cost).

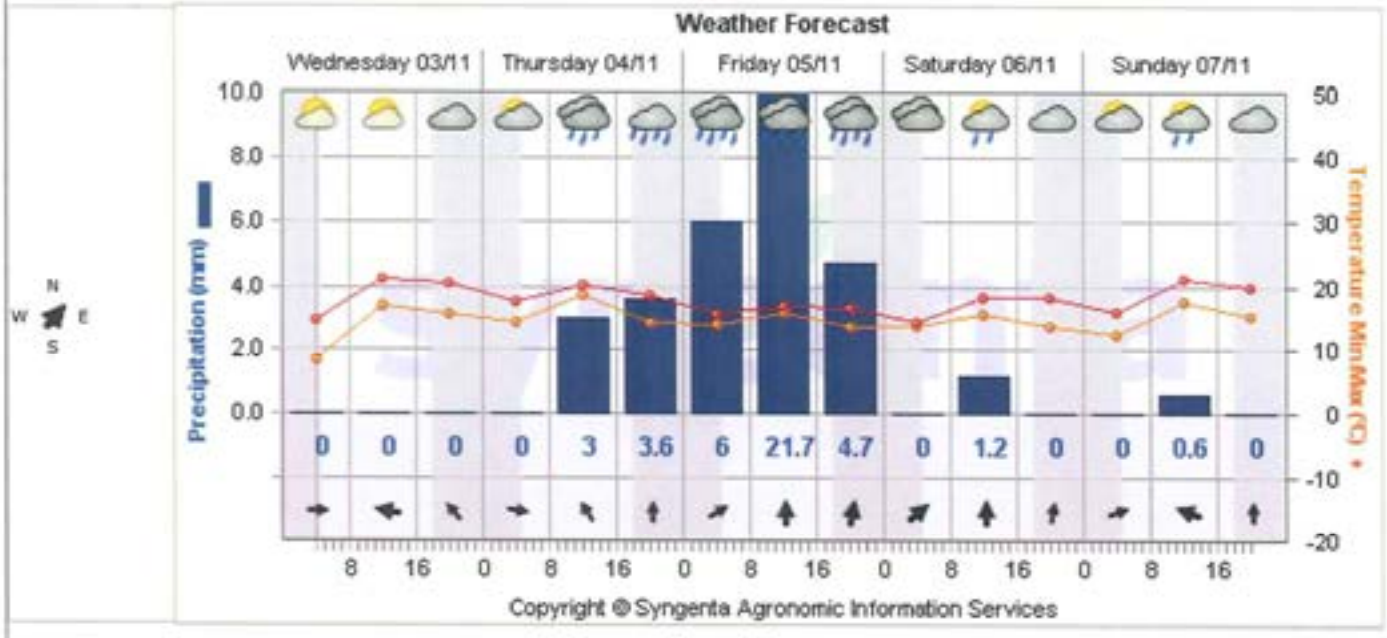
Syngenta have there Agricast service available through their website (free).

**Lawrence**
Sunrise: 04:52 Sunset: 18:10 +10 GMT, 0 DST.

**5 Day Forecast**
3 November - 7 November

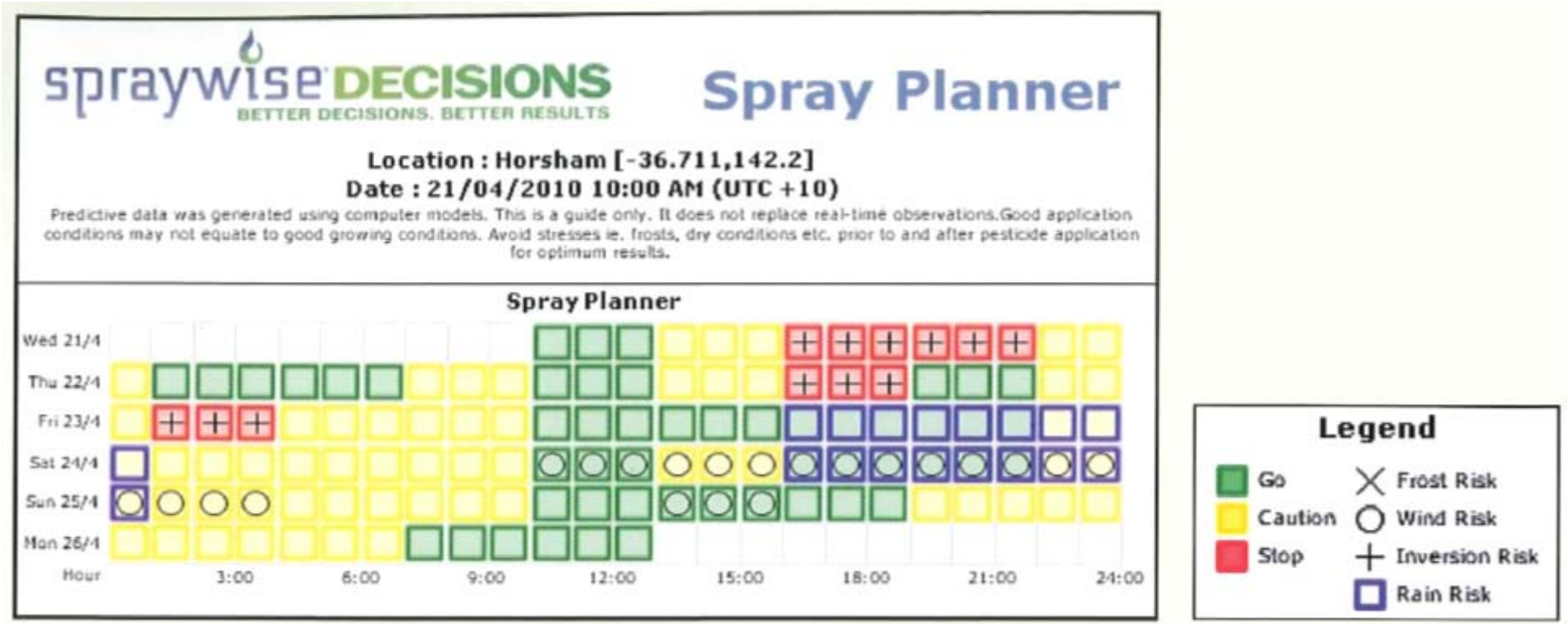
Grafton Res. Weather Station

Distance: 19km SW from **Lawrence**, elevation 26m asl




| | Wednesday 03/11 | | Thursday 04/11 | | Friday 05/11 | | Saturday 06/11 | | Sunday 07/11 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Hours of the Day: | 0-12 | 12-0 | 0-12 | 12-0 | 0-12 | 12-0 | 0-12 | 12-0 | 0-12 | 12-0 |
| Cloud cover (%) | 46 | 70 | 86 | 92 | 94 | 95 | 93 | 86 | 82 | 81 |
| Precipitation (mm) | 0 | 0 | 0.9 | 5.7 | 17 | 15.4 | 0.6 | 0.6 | 0 | 0.6 |
| Probability of Rainfall (%) | 5 | 20 | 60 | 75 | 100 | 100 | 50 | 50 | 25 | 50 |

# Spraywisedecisions.com.au




cottonmap
COTTON AWARENESS MAPPING
Information
Search
Manage
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Link
Help
Map
Satellite
Hybrid
Terrain
Moree
Internet

Guidelines for WIND SPEED, Delta T & SPRAY QUALITY

When Label Information on Application is Insufficient.

| | FINE | MEDIUM | COARSE or Larger |
|---|---|---|---|
| Conditions suitable for that spray quality | Wind speeds 4-12 kph<br><br>at 4 kph consistent for at least 45 min before spraying starts | Wind speeds 4-20 kph<br><br>at 4 kph consistent for at least 45 min before spraying starts | Wind speeds 4-20 kph<br><br>at 4 kph consistent for at least 45 min before spraying starts |
| Minimum distance to sensitive areas | Greater than 30 km | Greater than 1.5 km | Greater than 400 m |
| Delta T Values | Delta T value 2-8<br><br>….but only when targets are not stressed | Delta T value 2-10<br><br>….but only when targets are not stressed | Delta T value 2-12<br><br>….but only when targets are not stressed, and all other factors are considered suitable |

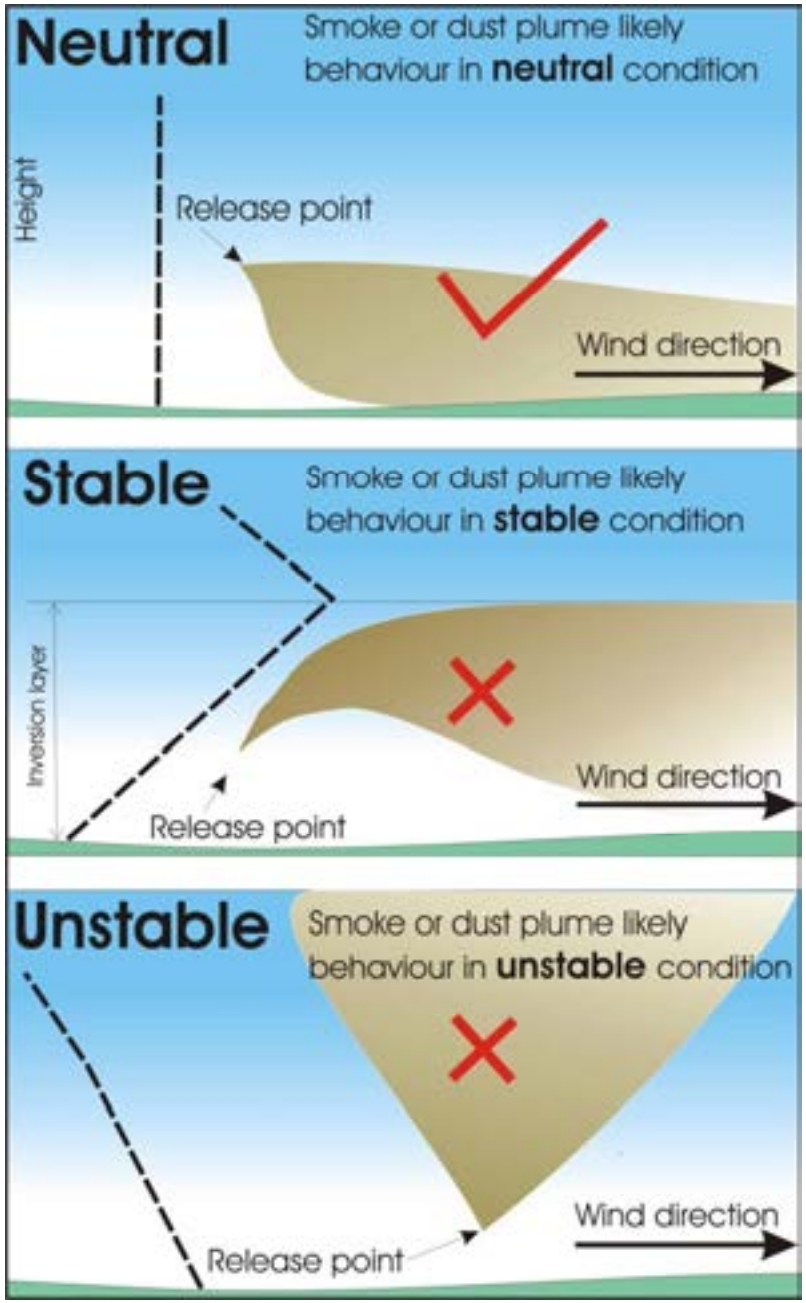
**Label Guidelines Will Always Over-ride Any of the Information Provided Above.**

**Always avoid inversions and thermal activity.**

# WIND and Visual Clues

**Why it's important to have air movement**

- **You need wind to get the air mixing and moving**
- **No wind means that it is much easier for the air to separate into layers… that's what happens under an inversion**
- **Even when we do have some wind present we can have unstable conditions, such as late afternoons and early evenings.**



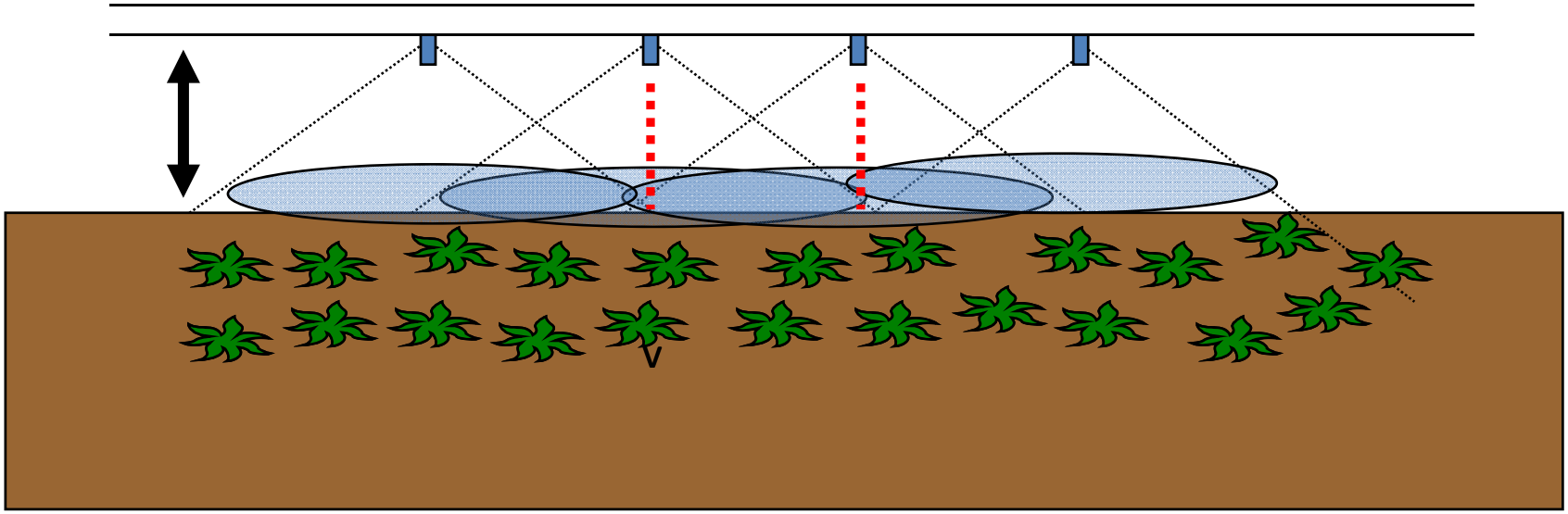

Source: BOM, Australia.

# Factors affecting drift potential

- Timing and Conditions
- Nozzle Design (type, pressure & spray quality)
- Rate of Product & Adjuvant Selection
- Height above the target
- Travel Speed
- Boom Stability
- Machine Design

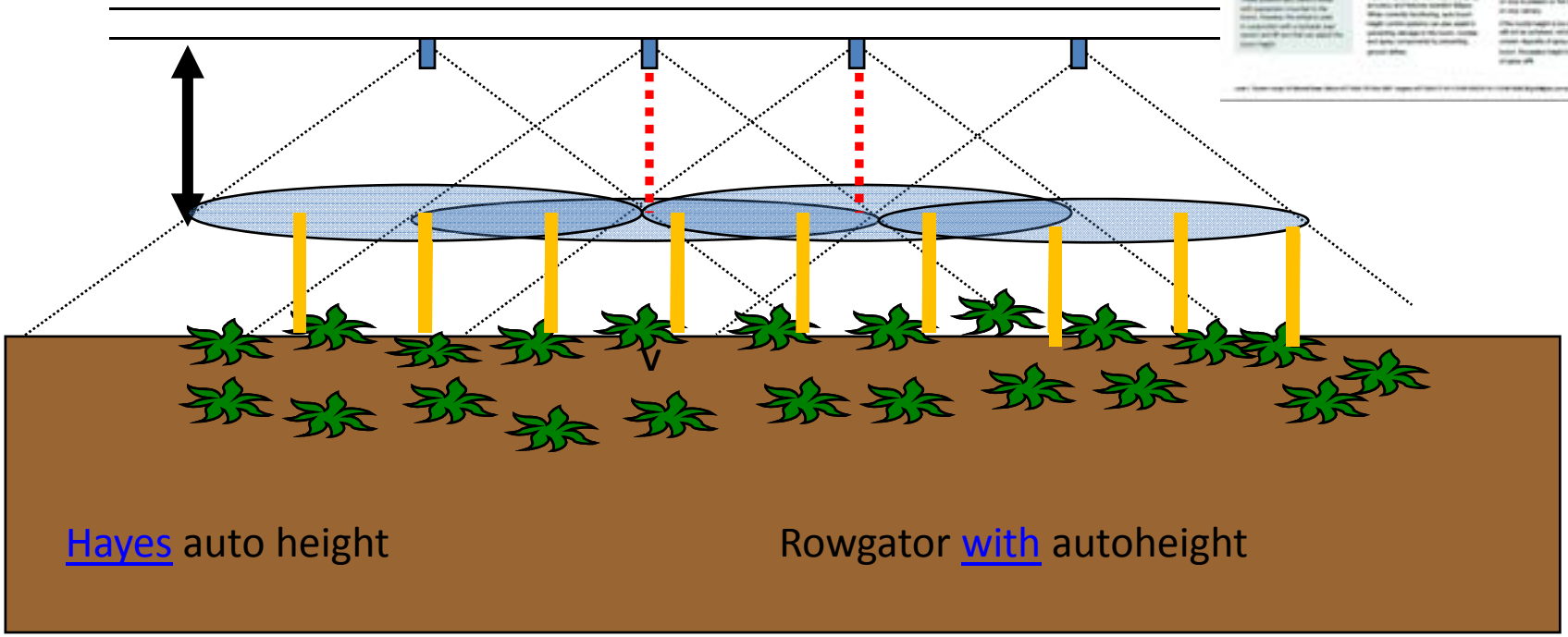
# Ideal Nozzle Height – No Stubble

Double Overlap at the target area



# Nozzle Height for Stubble/Crop

Double overlap at top of stubble or crop


**•BOOM HEIGHT IS THE MOST COMMON MISTAKE MADE BY APPLICATORS**

# Boom Height is critical for drift reduction

- Increasing boom height from 50cm to 70cm will increase the drift potential by up to **4x**.
- Doubling the boom height from 50cm to 100cm can increase drift by up to **10 X.**
- This will undo the most of the benefits of using most air induction nozzles

# KEY QUESTIONS TO ASK ABOUT THE APPLICATION PROCESS

What kind of target are we aiming at ?

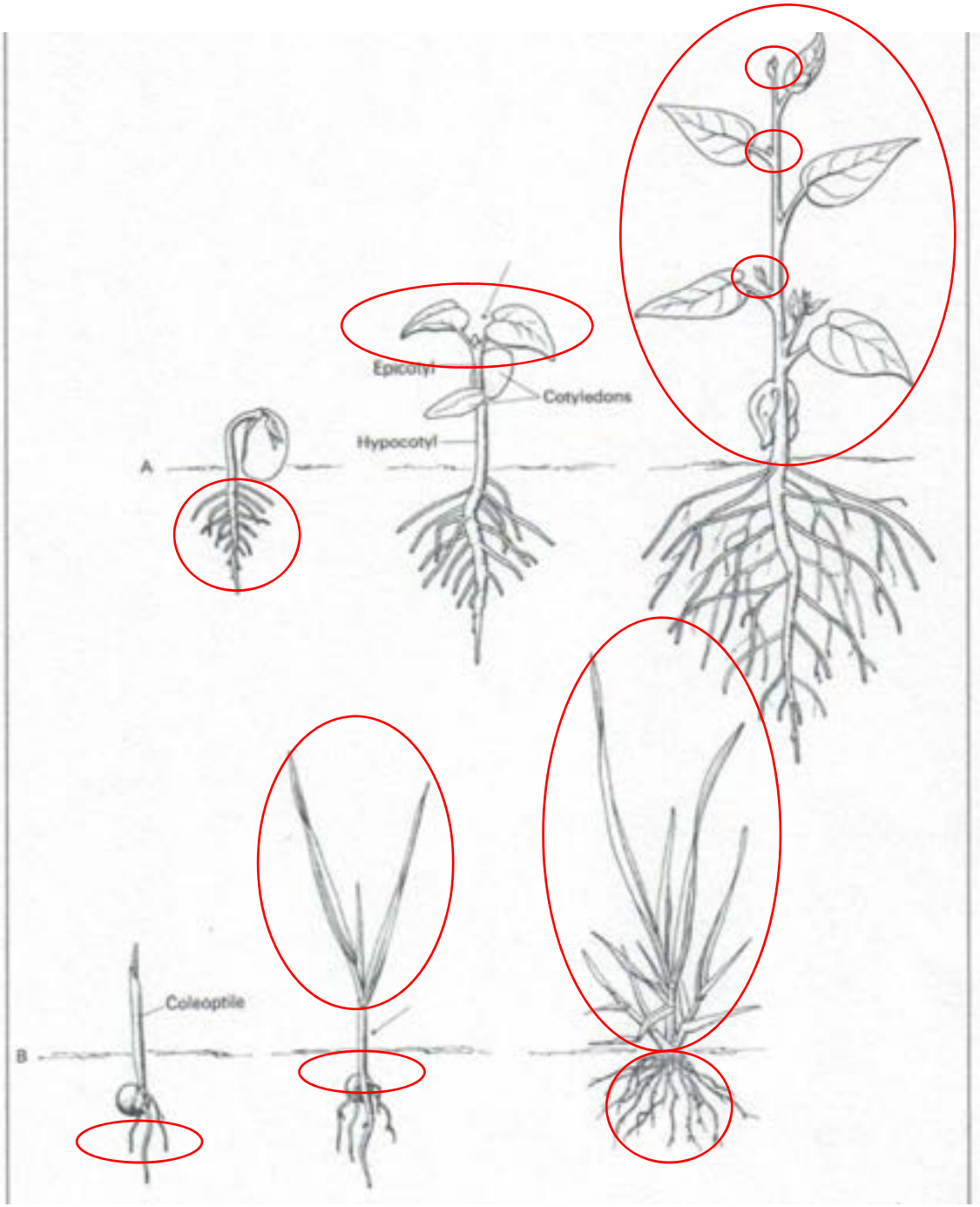
What kind of droplets are most appropriate to hit this target ?

What does the product do once it deposits on the target ?

# What is the actual TARGET

What is the actual target for our application ?

That can depend on how the product works and how it moves within the plant



Guidelines for selecting Spray Quality When Label Information on Application is Insufficient.

| | FINE | MEDIUM | COARSE or LARGER |
|---|---|---|---|
| Conditions suitable for that spray quality | Wind speeds 4-12 kph at 4 kph consistent for at least 45 min before spraying starts<br><br>Delta T value 2-8<br><br>….but only when targets are not stressed | Wind speeds 4-20 kph at 4 kph consistent for at least 45 min before spraying starts<br><br>Delta T value 2-10<br><br>….but only when targets are not stressed | Wind speeds 4-20 kph at 4 kph consistent for at least 45 min before spraying starts<br><br>Delta T value 2-12<br><br>….but only when targets are not stressed, and all other factors are considered suitable |
| Minimum distance to sensitive areas | Greater than 30 km | Greater than 1.5 km | Greater than 400 m |
| Targets suited to this spray quality | Mainly fine, vertical targets such as small grasses | All targets<br><br>(reduced efficacy may occur with contact products on fine targets without increasing application volume ) | Soils<br>Prostrate & large Broadleaf<br>Canopy & Stubble penetration |

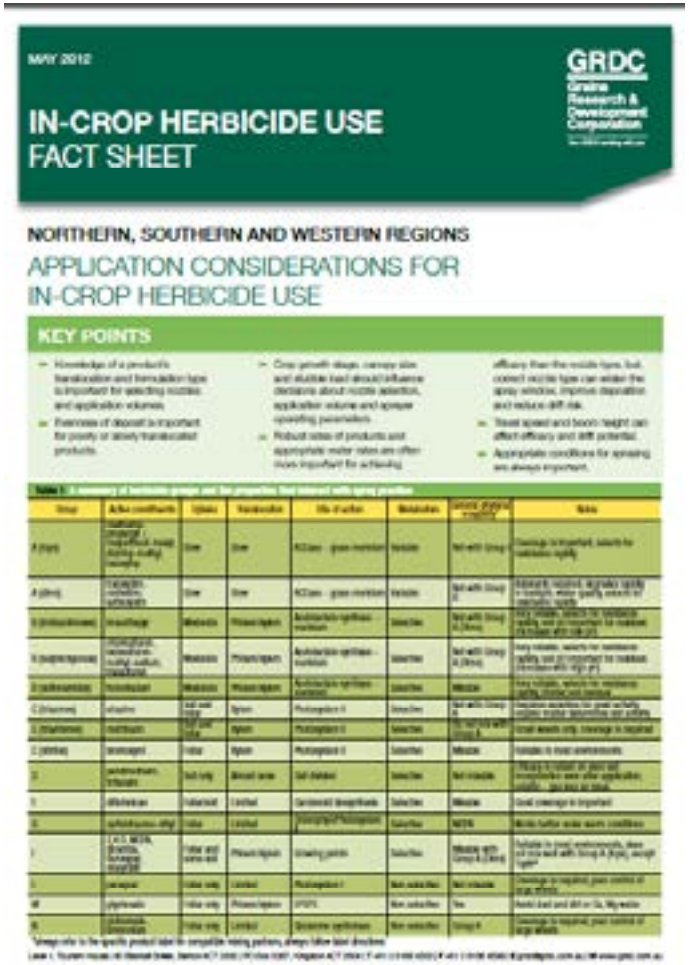
**Label Guidelines Will Always Over-ride Any of the Information Provided Above.**

**Always avoid inversions and thermal activity.**

# Uptake, Mode of Action & Coverage Requirements

(what does the product do once it lands on the target ?)

- Surface Active / Contact
- Translaminar *(only into the leaf)*
- Partially Translocated *(up only)*
- Fully Translocated *(Two-way)*
- Soil Applied *(root uptake or shoot uptake ?)*



MAY 2012

GRDC Grains Research & Development Corporation

IN-CROP HERBICIDE USE
FACT SHEET

NORTHERN, SOUTHERN AND WESTERN REGIONS

APPLICATION CONSIDERATIONS FOR IN-CROP HERBICIDE USE

KEY POINTS

| Group | | Examples | Uptake | Translocation | Site of Action | Metabolism | Mixing | Notes |
|---|---|---|---|---|---|---|---|---|
| **A** | (FOPS) | ***clodinafop-propargyl*** ***diclofop-methyl*** ***haloxyfop-R*** | Slow | Slow | ***ACCase-grass meristem*** | **Variable Selective with grasses** | **Not with Group I** | **Adjuvants required, Good coverage critical, Sensitive to plant stress, rapidly selects for resistance** |
| | (DIMS) | ***tralkoxydim*** ***sethoxydim*** ***clethodim*** | Slow | Slow | | **Variable Selective with grasses** | **Not with Group B** | **Adjuvants required, Good coverage critical, Sensitive to plant stress, degrades rapidly in sunlight, Avoid hard water - particularly if high in bicarbonate, rapidly selects for resistance** |
| **B** | imidazolinones | ***imazamox*** ***imazethapyr*** | Moderate | Phloem / Xylem | ***Acetolactate synthase-meristem*** | **Selective** | **Not with Group A (Dims)** | **Very reliable, rapidly selects for resistance, soil pH important for residues (increase with low pH)** |
| | sulphonamides | ***flumetsulam*** ***metosulam*** | Moderate | Phloem / Xylem | | **Selective** | **Mixable** | **Very reliable, rapidly selects for resistance, limited soil residual** |
| | sulfonylureas | ***chlorsulfuron*** ***metsulfuron*** ***triasulfuron*** | Moderate | Phloem / Xylem | | **Selective** | **Caution with Group I** | **Very reliable, rapidly selects for resistance, soil pH important for residues (increase with high pH)** |
| **C** | triazines | ***atrazine,*** ***simazine*** | Soil and foliar | Xylem | ***Photo-system II*** | **Selective** | Not with Group A | **Small weeds only for post emergent application, Bare soil for pre-emergent application requires sunshine for good foliar activity, organic matter and moisture determines soil activity** |
| | triazinones | *metribuzin* | Soil and foliar | Xylem | | **Selective** | Not with Group A | As above |
| | nitriles | *bromoxynil* | Soil and foliar | Limited | | **Selective** | Mixable | Small weeds only. Good coverage and robust rate essential |
| **D** | dinitroanilines | ***pendimethalin*** ***trifluralin*** | Soil only | Almost none | ***Formation of cell walls*** | **Crop selectivity by separation of crop seed from herbicide** | **OK with Group L.** | **Level of control is reliant on even soil incorporation soon after application; volatile - lost to atmosphere if not covered especially in moist soil.** |
| | benzamide | ***propyzamide*** | Roots | Limited xylem | | **Selective** | **OK with Group L.** | **Non volatile at lower temps, moderately persistent, some movement in low OM soils, breaks down by light if on soil surface, broken down by microorganisms.** |

| Group | Examples | Uptake | Translocation | Site of Action | Metabolism | Mixing | *Notes* |
|---|---|---|---|---|---|---|---|
| ***F*** | ***diflufenican picolinafen*** | Foliar / soil | Limited | ***Carotenoid bio-synthesis (PDS) inhibitor*** | **Selective** | **Mixable** | **Good coverage is important** |
| ***G*** | ***oxyfluorfen carfentrazone*** | Foliar | Limited | ***Chlorophyll / Photosystem II*** | **Selective** | **MCPA** | **Works better under warm conditions** |
| ***H*** | ***pyrasulfotole isoxaflutole*** | Foliar | Limited - phloem / xylem | ***HPPD inhibitor – leads to bleaching*** | **Selective** | **Mixable - not with trifluralin / propyzamide** | **Organic matter and clay content determines soil activity. Good coverage is important. Precept & Velocity best in sunny conditions.** |
| ***I*** | ***2,4-D …. MCPA …. dicamba …. fluroxypyr …. clopyralid …. picloram*** | Foliar and some soil | Phloem / Xylem | ***Growing points*** | **Selective** | **Mixable with Group A (Dims)** | **Reliable in most environments, do not mix well with Group A (Fops), except Topik®** |
| ***J*** | ***2,2-DPA molinate triallate*** | Soil and foliar depending on herbicide | Absorbed by coleoptile and emerging shoots | ***Inhibits fat production*** | **Selective by separation of herbicide from crop seed** | **Compatible** | **Triallate works better with incorporation. Lost via volatilisation under higher temperatures and moist soil.** |

| Group | Examples | Uptake | Translocation | Site of Action | Metabolism | Mixing | *Notes* |
|---|---|---|---|---|---|---|---|
| ***L*** | ***paraquat*** | Foliar only | Limited | ***Photosystem I*** | **Non selective** | **Good with soil applied herbicides. If tank mixed with translocated herbicides the rapid action can reduce effectiveness of partner herbicide.** | **Good coverage required, poor control of large weeds. Rapidly absorbed by leaves. Avoid water with high clay (murky) and organic matter content. Dusty leaves. Control improves when applied on cloudy days or later in afternoon.** |
| ***M*** | ***glyphosate*** | Foliar only | Phloem / Xylem | ***EPSPS*** | **Non selective** | **Yes** | **Avoid muddy and hard (Ca, Mg & bicarbonate) water. Dusty leaves.** |
| ***N*** | ***glufosinate*** | Foliar only | Limited | ***Glutamine synthetase*** | **Non selective** | **Group A** | **Good coverage required. Best under warm temperatures and high humidity. Poor control of large grasses. Residues on plastic** |
| ***O*** | ***isoxaben*** | Pre-emergent | Limited | ***Inhibitor of cell wall production*** | **Selective** | **Yes** | **Applied to bare soil. Absorbed through shoots and roots of germinating broadleaf seedlings** |
| ***Q*** | ***amitrole*** | Foliar | Phloem / Xylem | ***Bleacher - stops caretenoid synthesis*** | **Non selective** | **Yes** | **Very slow acting compared to glyphosate. Mobile in soil but rapidly degraded.** |

Guidelines for selecting Spray Quality When Label Information on Application is Insufficient.

| | FINE | MEDIUM | COARSE/VERY COARSE |
|---|---|---|---|
| Conditions suitable for that spray quality<br><br>Minimum distance to sensitive areas | Wind speeds<br>4-12 kph<br>at 4 kph consistent for at least 45 min before spraying starts<br><br>Delta T value 2-8<br>….but only when targets are not stressed<br><br>Greater than 30 km | Wind speeds<br>4-20 kph<br>at 4 kph consistent for at least 45 min before spraying starts<br><br>Delta T value 2-10<br>….but only when targets are not stressed<br><br>Greater than 1.5 km | Wind speeds<br>4-20 kph<br>at 4 kph consistent for at least 45 min before spraying starts<br><br>Delta T value 2-12<br>….but only when targets are not stressed, and all other factors are considered suitable<br><br>Greater than 400 m |
| Targets suited to this spray quality | Mainly fine, vertical targets such as small grasses | All targets<br>(reduced efficacy may occur with contact products on fine targets without increasing application volume ) | Soils<br>Prostrate & large Broadleaf<br>Canopy & Stubble penetration<br>Most at higher volumes |
| Product Modes of Action suited to this spray quality | Contacts<br>(mainly on fine targets where canopy / stubble penetration is not required) | Contacts<br>Translaminar<br>Translocated<br>Systemic | Soil Applied & Incorporated<br>Fully Translocated Products<br>Others at increased application volumes |

**Label Guidelines Will Always Over-ride Any of the Information Provided Above.**

**Always avoid inversions and thermal activity.**

# Typical Spray Quality and Application Volumes

| Typical Application Volume | Medium Spray Quality (lower drift risk areas) | Coarse Spray Quality | Extremely Coarse Spray Quality (higher drift risk areas) |
|---|---|---|---|
| **Lower range**<br>**50 -60 L/ha**<br>**(Low stubble load)**<br>**to**<br>**70-80 L/ha**<br>**(High stubble load)** | *Only where permitted on label:<br>Fully translocated herbicides<br>Small to medium sized targets. | Fallow Spraying<br>Fully translocated herbicides such as Glyphosate, MCPA.<br>Mandatory for 2,4-D, | Fully translocated herbicides, medium targets,<br>Very sensitive areas or NIGHT SPRAYING |
| **Higher range**<br>**70-80 L/ha**<br>**(Low stubble load)**<br>**to**<br>**100 + L/ha**<br>**(High stubble load/ dense crop canopy)** | *Only where permitted on label:<br>Contact type products.<br>Small targets.<br>In crop spraying.<br>Penetration and coverage in large & broadleaf crops. | Good stubble penetration.<br>Pre-emergent's.<br>Fully Translocated herbicides,<br>Some contact herbicides at the higher application volumes. | Pre-emergent's.<br>Medium sized targets with fully translocated summer fallow herbicides.<br>Very sensitive areas or NIGHT SPRAYING |

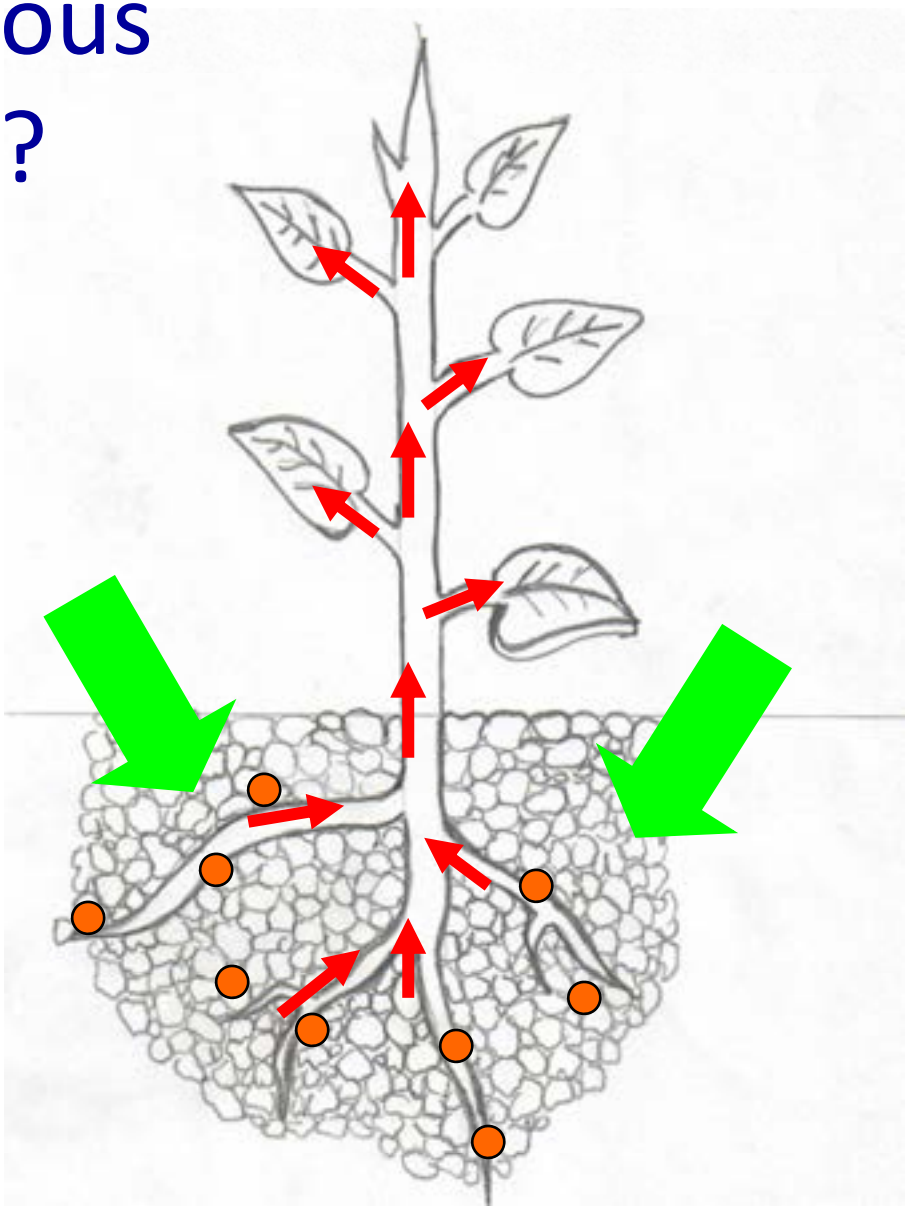
# Translocation of various herbicides groups?

Key to this Presentation

= placement of product

= site of uptake

= translocation from point of uptake

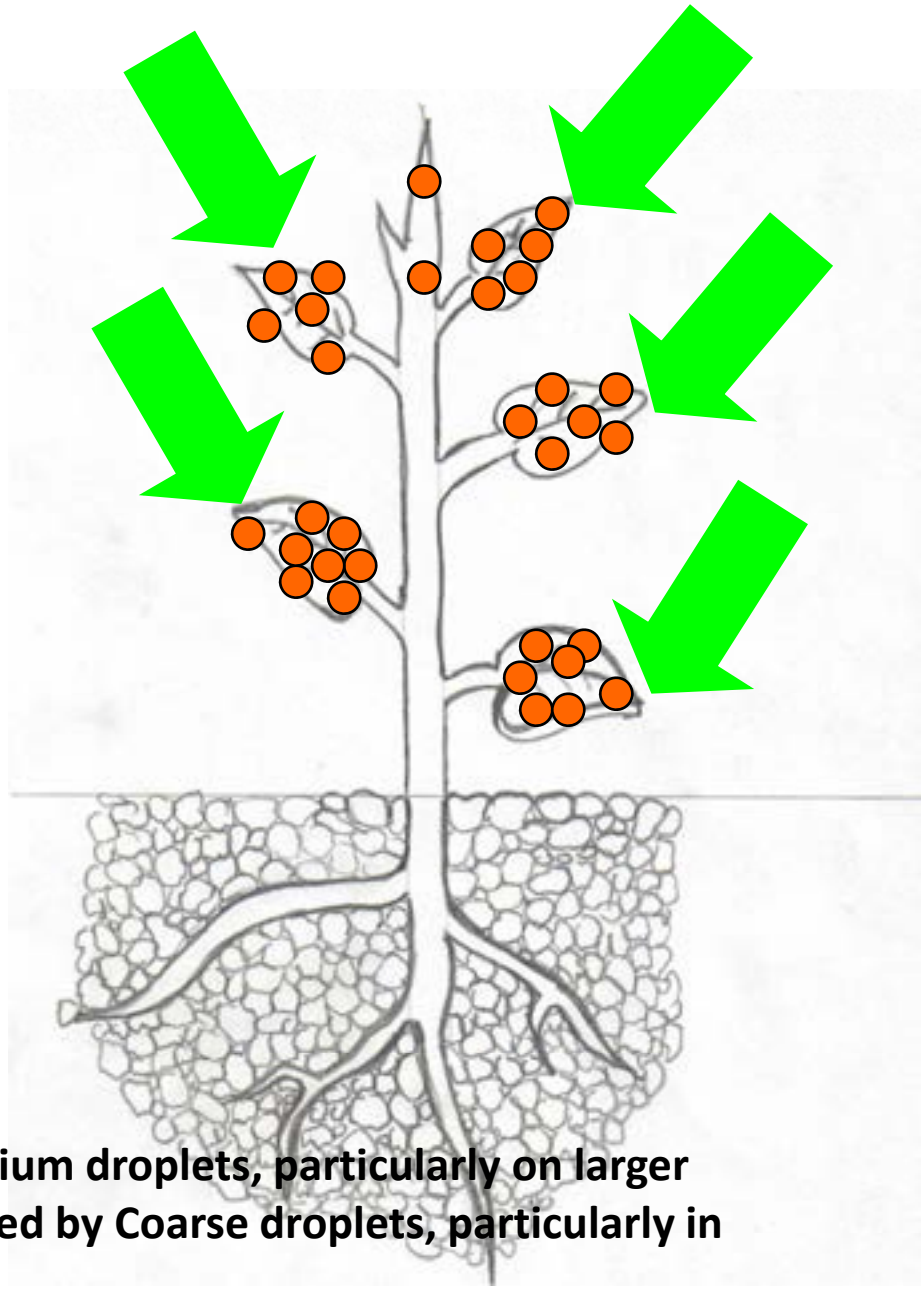


# Group L

inhibitors of photosynthesis
at photosystem I

## Bipyridyls (paraquat, diquat)

- Contact herbicides activated by sunlight - minimal translocation if cells destroyed (there is some translaminar movement at night).
- Destroy cell membranes and disrupt photosynthesis,
- Thorough coverage required, older plants with well established roots will probably recover.

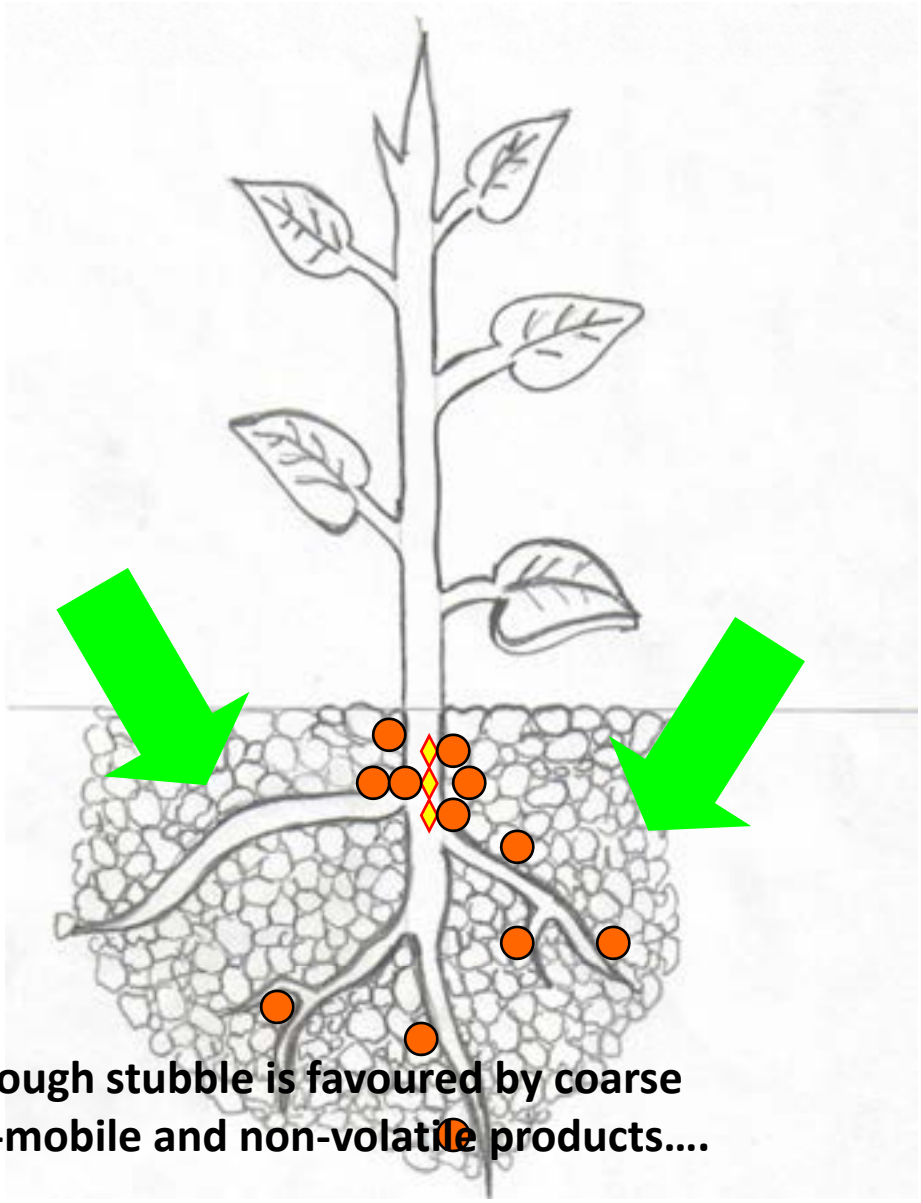


**Retention and evenness is favoured by Medium droplets, particularly on larger broadleaves, however penetration is favoured by Coarse droplets, particularly in large grasses, cereals and stubble.**

# Group D

Inhibitors of tubulin formation

- Trifluralin, Pendimethalin (dinitroanalines)
- Soil applied- incorporated
- Very limited, if any translocation (to apical meristem)
- Shoot elongation and lateral root formation (cell division) are inhibited
- Inhibition of enzymes or uncoupling of oxidative phosphorylation
- Roots appear to be pruned, roots and coleoptiles may grow thicker
- Grass shoots may turn red or purple (phosphorus deficiency symptoms)
- Broadleaves may have swollen and cracked hypocotyls



**Deposition onto soils and penetration through stubble is favoured by coarse droplets, evenness is important with non-mobile and non-volatile products…. application volume is important.**

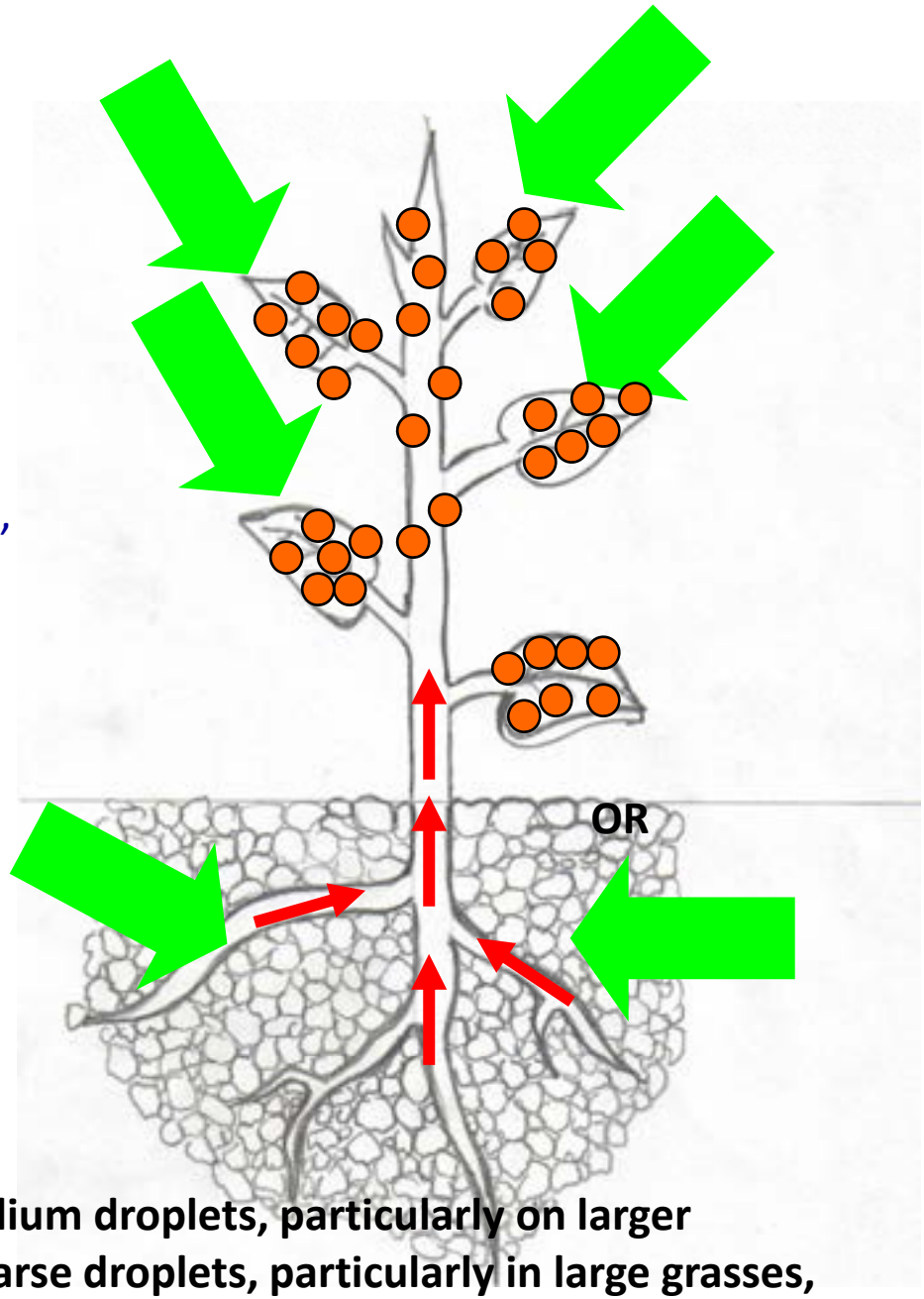
# Group C

## Photosynthesis Inhibitors

(inhibit photosystem II)

- Benzothidiazoles (basagran) contact only.
- Nitriles (bromoxynil), contact, little if any translocation,
- Phenyl-pyrazidines (tough) contact
- Triazines (atrazine, simazine, gesagaurd etc), soil applied, root absorbed, xylem transported to the leaves.
- Triazinones (sencor) soil acting,

  NO downward movement, chemical concentrates in leaves, stems, shoots
- Substituted Ureas (diuron) similar to triazines (xylem only),
- Selectivity varies, bromoxynil mostly due to number of growing points exposed, others by deactivation of metabolite.



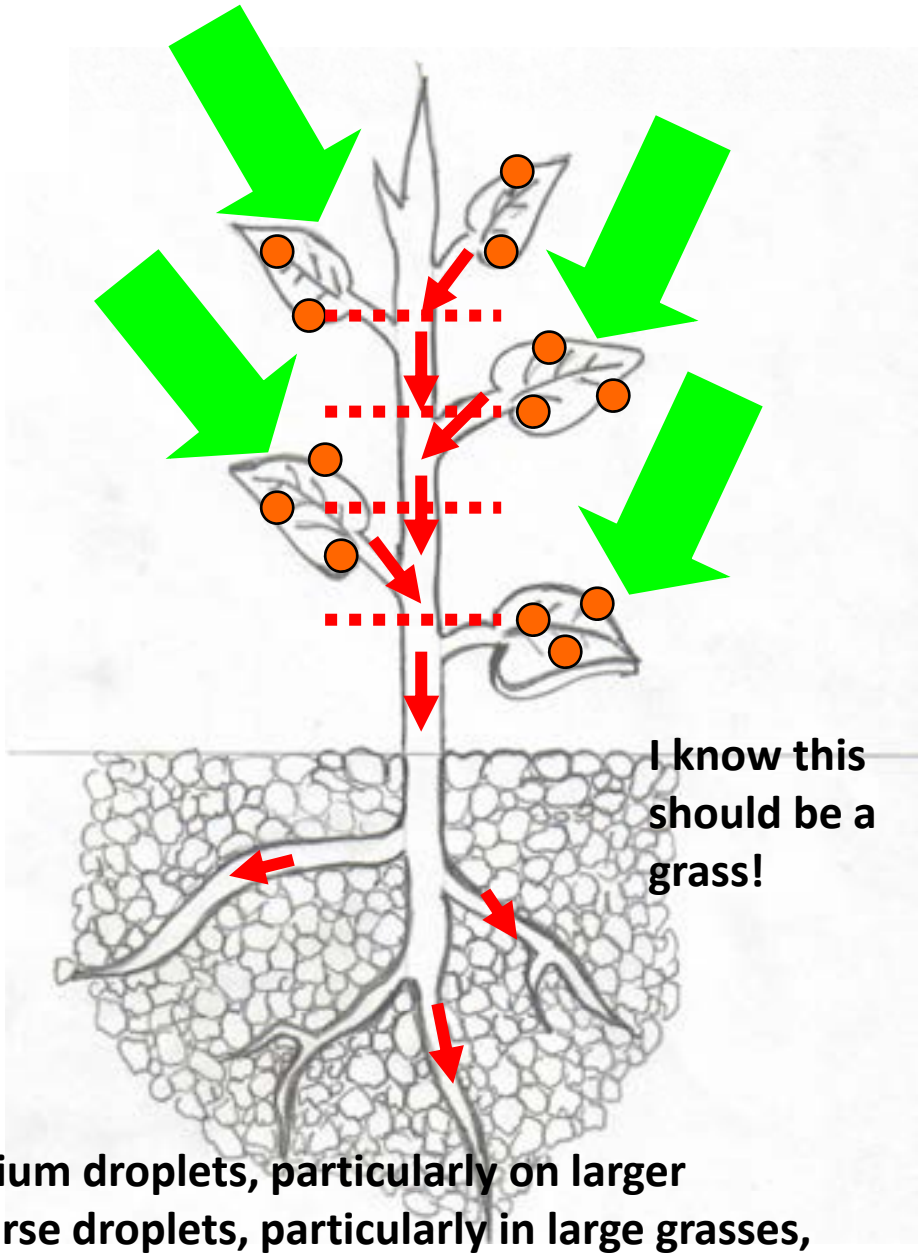

**Retention and evenness is favoured by Medium droplets, particularly on larger broadleaves, penetration is favoured by Coarse droplets, particularly in large grasses, cereals and stubble.**

# Group A

## Lipid Inhibitors

(inhibit the enzyme acetyl CoA carboxylase)

- 'Fops' & 'Dims'
- Block the formation of lipids in the shoot (meristem) and roots of GRASSES, broadleaves are tolerant to this group.
- Absorbed into foliage & move in the phloem to areas of new growth
- Symptoms slow to develop, first symptoms may be on growing points, but can differ widely
- Can cause crop injury when used with oils and adjuvants
- Possible antagonism when mixed with auxin type herbicides (2,4-D, Dicamba, less with MCPA)




**Retention and evenness is favoured by Medium droplets, particularly on larger broadleaves, penetration is favoured by Coarse droplets, particularly in large grasses, cereals and stubble.**

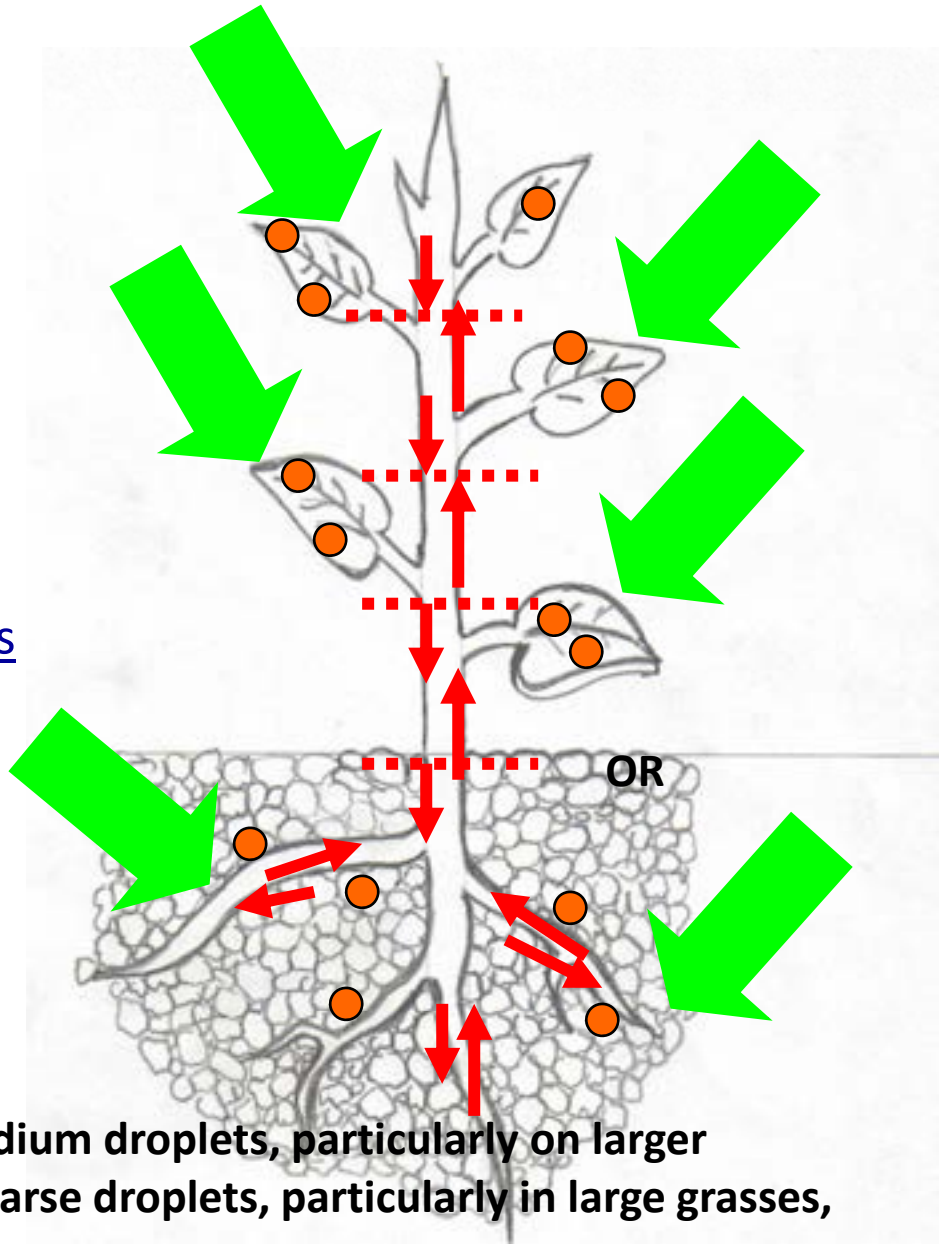
# Group B

## ALS Inhibitors

(inhibit the enzyme acetolactate synthase)

- Imidazolinones (spinnaker), Sulfanamides (broadstrike), Sulfonyl Ureas (Ally, glean, logran)

- All can inhibit formation of specific branched chain amino acids.
- Move in the xylem and phloem to areas of new growth, has root and shoot uptake. Can be soil or foliage applied.
- Kills a wide range of weeds
- Selectivity may be lost when crop stressed



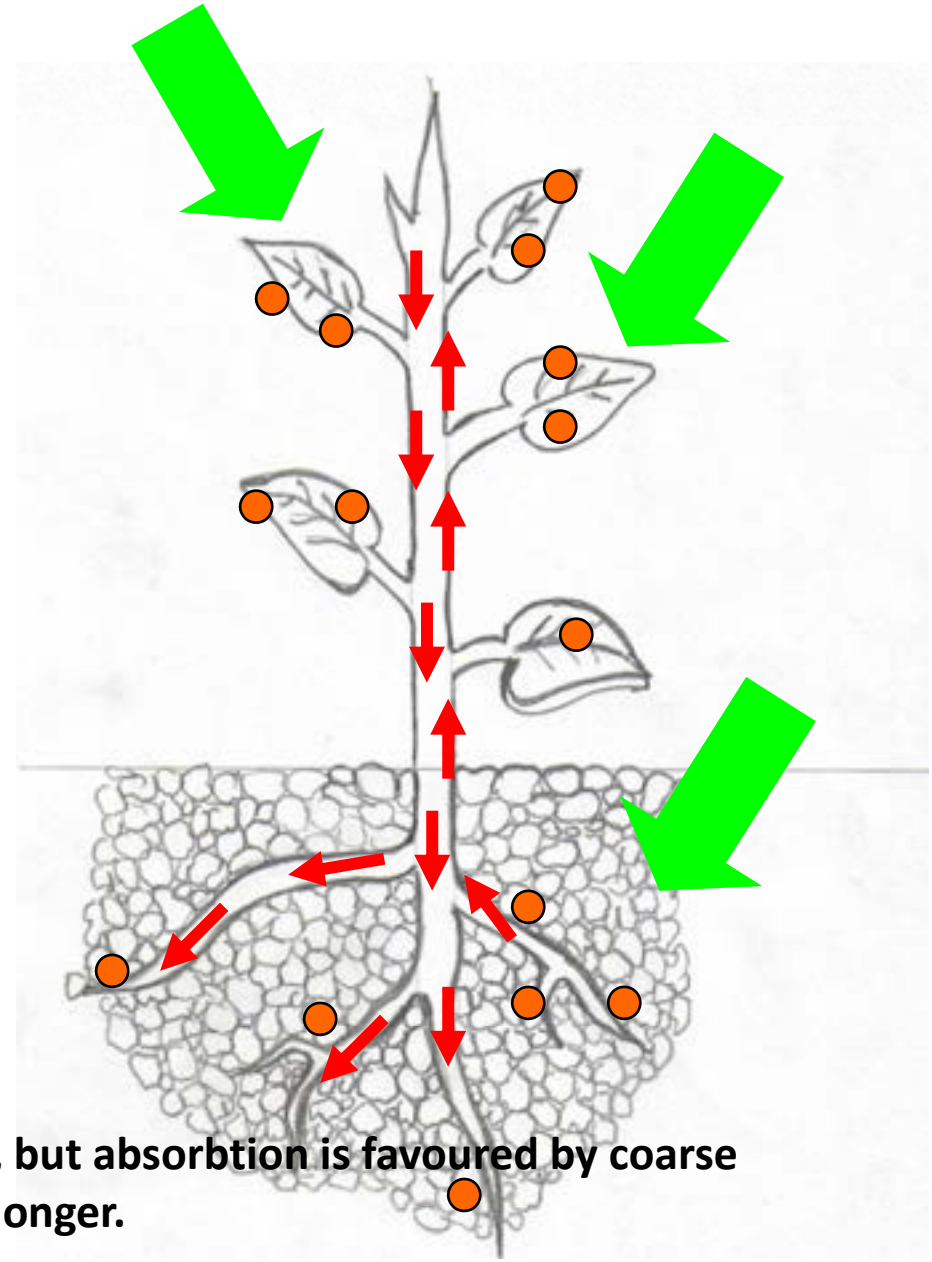

**Retention and evenness is favoured by Medium droplets, particularly on larger broadleaves, penetration is favoured by Coarse droplets, particularly in large grasses, cereals and stubble.**

# Group I

disruptors of cell growth

Benzoic acids (dicamba),
Phenoxy acetic acids (2,4-D, MCPA),
Pyridines (starane, tordon)

- Most post emergent, broadleaf control
- Upset hormone balance and cell growth (multiple sites in plant).
- Move in xylem and phloem to areas of new growth. Primarily absorbed through foliage, but roots possible
- Excessive rates can cause localised damage and restrict translocation
- Pyridines have greater soil activity, act as general growth inhibitors, especially to the roots.



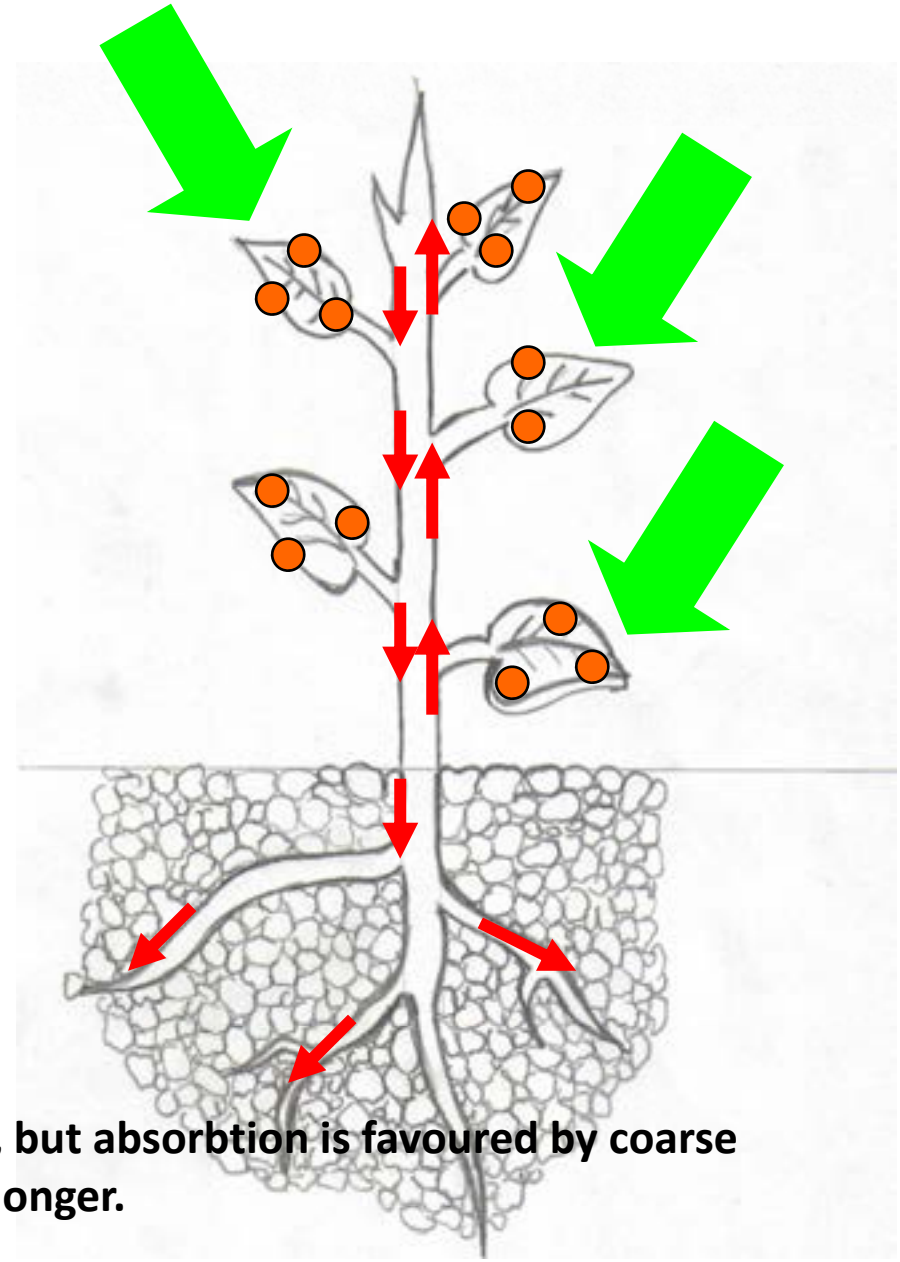
**Retention is favoured by medium droplets, but absorbtion is favoured by coarse droplets, as the product stays in solutions longer.**

# Group M

inhibitors of EPSP synthase

- Phosphorus Compounds (Glyphosate)

- Glyphosate is an organic acid formulated as an amine salt
- Post emergent, non-selective
- Acts on an enzyme pathway to disrupt the production of 3 essential amino acids.
- Moves freely, mainly in the phloem, some say xylem as well (some up & all the way DOWN ), no soil activity…..probably the most mobile of all herbicides once in the plant…if plant not stressed.

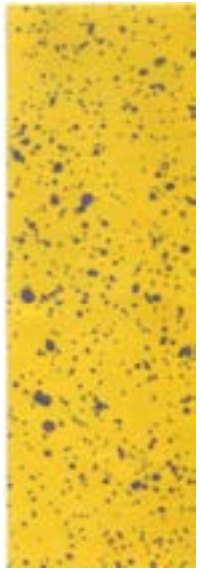


**Retention is favoured by medium droplets, but absorbtion is favoured by coarse droplets, as the product stays in solutions longer.**

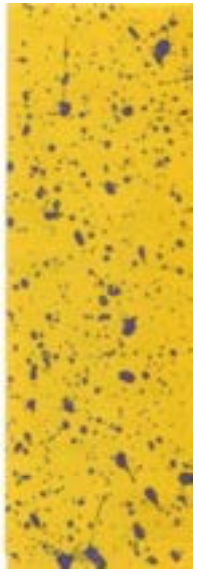
# What is good coverage ?

…that depends on the mode of action.

**Fine,**
**45L/Ha**
**88drops/cm**
**8.5% covered**



**Medium,**
**45L/Ha**
**32 drops/cm**
**8.5% covered**

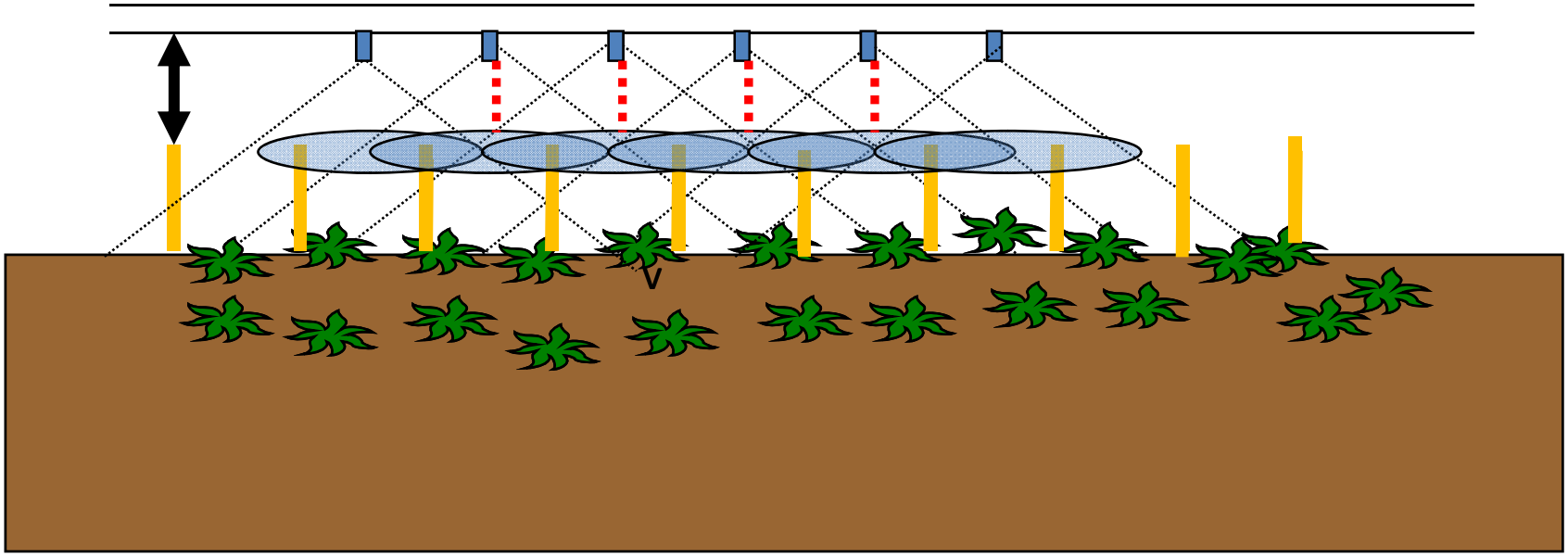


**Coarse, 45L/Ha**
**35drops/cm**
**9.3% covered**

# Nozzle Height for Stubble/Crop

Double Overlap top of stubble or crop

(narrower spacing = allows reduced boom height)



# Recent Trial Results

SEPTEMBER 2012

GRDC Grains Research & Development Corporation

## SUMMER FALLOW SPRAYING FACT SHEET

NORTHERN, SOUTHERN AND WESTERN REGIONS

### IMPLICATIONS FOR NOZZLE SELECTION AND SPRAY QUALITY FROM RECENT TRIAL RESULTS

**KEY POINTS**

- Plan to control summer weeds as early as possible.
- Have the machine ready to go.
- Select an appropriate application volume for the product and situation.
- Choose the coarsest spray quality that will provide efficacy with the products selected.
- Monitor and record application details and weather parameters.

**Plan to control summer weeds early and have the sprayer ready to go**

If spraying to conserve soil moisture and retain nutrients over summer, early weed follow control can increase the yield potential of future crops. Waiting for late germinations of summer weeds may not provide the same return on the dollars invested in control measures as a spray program that starts earlier.

Often the most important factor is getting the timing right in relation to weed susceptibility and using a robust rate of product. However, it is worth remembering that delayed control, which will result in reduced moisture and nitrogen in the soil, is better than no control at all.

As part of the planning process, ensure that the sprayer is ready to go as soon as it is needed. This means that the sprayer and the mixing equipment are clean and decontaminated, the correct nozzles are available and calibrated, and the machine is functioning correctly.

**Select an application volume to match the target weeds, stubble situation and the herbicides' mode of action**

The majority of fully translocated herbicides require the use of a coarse spray quality or larger, particularly Group M, Group I and Group B herbicides. When using a coarse spray quality to apply fully translocated products to summer weeds, it is often best to keep water volumes at or above 50 litres per hectare in low stubble environments and at more than 60L/ha as stubble loads increase. Consider using higher application rates for poorly translocated products or when mixing products with a high loading of active ingredient.

Self propelled sprayer

**Choose the coarsest spray quality that will provide efficacy**

In situations where sensitive summer crops are grown and there is potential for off-target movement of product to cause damage or result in residues, consider a spray quality that is larger than coarse, such as extremely coarse, to further minimise risk.

Summer fallow trials over the last six years have shown that equivalent efficacy can be obtained for Group I and Group M products with extremely coarse droplets provided that nozzles are operated appropriately (for example, sufficient pressure with the air induction types).

REVISED JUNE 2014

GRDC Grains Research & Development Corporation

## IN-CROP HERBICIDE USE FACT SHEET

NORTHERN, SOUTHERN AND WESTERN REGIONS

### APPLICATION CONSIDERATIONS FOR IN-CROP HERBICIDE USE

**KEY POINTS**

- Knowledge of a product's translocation and formulation type is important for selecting nozzles and application volumes.
- Awareness of deposit is important for poorly or slowly translocated products.
- Crop growth stage, canopy size and stubble load should influence decisions about nozzle selection, application volume and sprayer operating parameters.
- Robust rates of products and appropriate water rates are often more important for achieving efficacy than the nozzle type, but correct nozzle type can retain the spray window, improve deposition and reduce drift risk.
- Travel speed and boom height can affect efficacy and drift potential.
- Appropriate conditions for spraying are always important.

Test controller settings and nozzle performance well before cropping starts

**Know how a herbicide works**

Knowledge of how a product enters the plant and how it is translocated is important for determining the most appropriate application volume, adjuvant type and nozzle style.

**Uptake, translocation and application volume**

Products that have a slow uptake or slow or limited translocation (such as Group A herbicides) should be applied at higher water rates (typically 70-100L/ha in cereals and higher in many pulses).

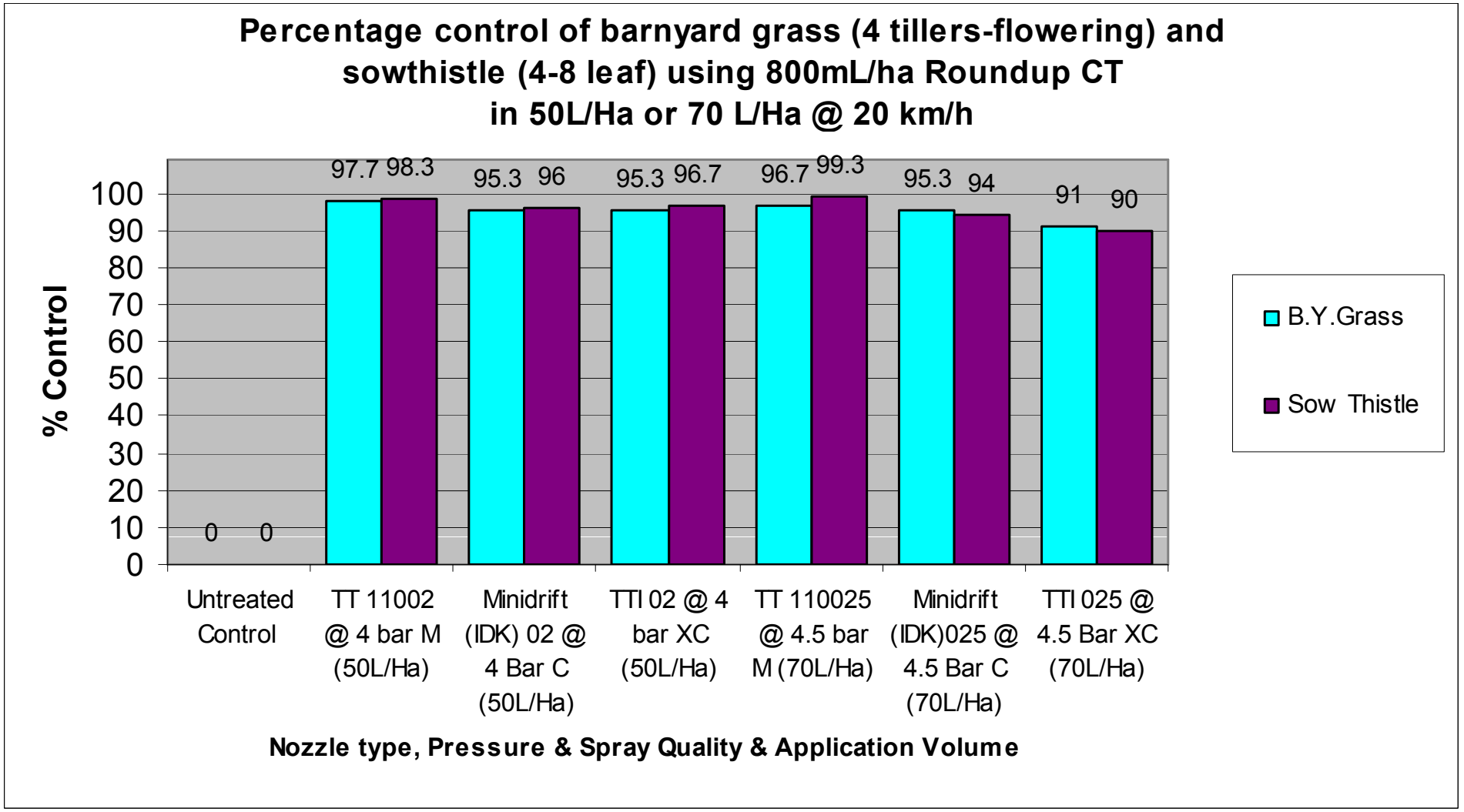
Products that are phloem and xylem transported (such as Groups B, I and M herbicides) can often be applied at lower application volumes – 50-70L/ha in low stubble situations and small crop canopy – but normally need to be applied at 70L/ha or more where high stubble loads exist or the crop canopy is dense. Always check product labels and the manufacturer's technical information for specific advice about appropriate application volumes and timing in relation to a crop's growth stage.

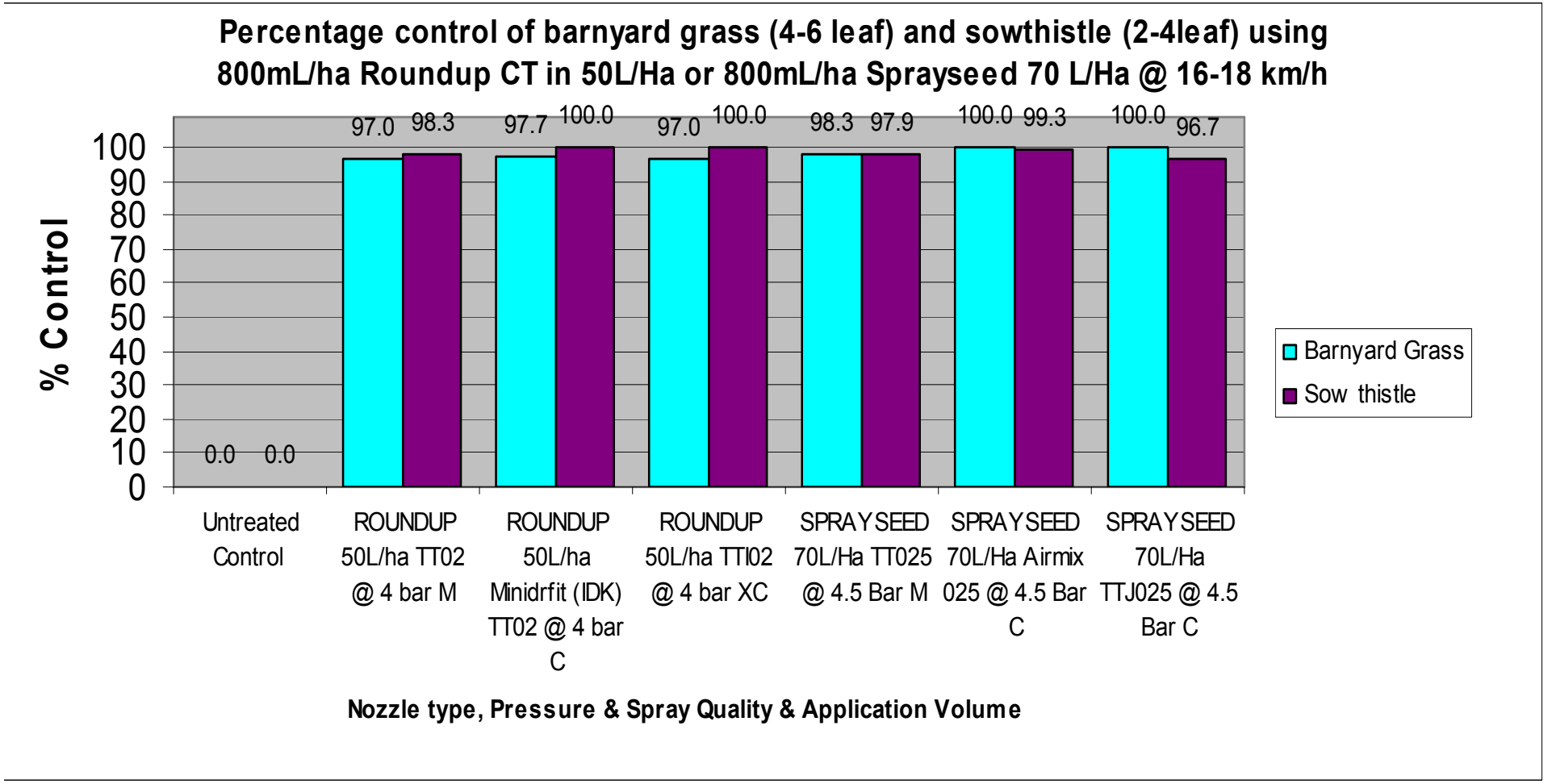
**Water volume and spray quality**

Depositing droplets onto foliar targets is a numbers game. Increasing application volumes produces more droplets, which usually increases the coverage of the application, provided droplets reach where they are required.

Anything that is situated between the nozzle and the desired target weed, such as stubble or a large crop canopy, has the potential to intercept spray droplets. Where crop canopies are large or stubble load is heavy, it is always advisable to use robust or higher water rates.

More droplets can be produced by increasing the droplet size. However, this spray qualities do not penetrate dense canopies as well as medium spray qualities from non-air induction nozzles or air-inducted coarse droplets (unless they are used with an air-assisted spray system). Finer spray qualities also increase spray drift risk and are likely to be intercepted by stubble when the load is high.


Percentage control of barnyard grass (4 tillers-flowering) and sowthistle (4-8 leaf) using 800mL/ha Roundup CT in 50L/Ha or 70 L/Ha @ 20 km/h
% Control
100
90
80
70
60
50
40
30
20
10
0
97.7 98.3
95.3 96
95.3 96.7
96.7 99.3
95.3 94
91 90
0 0
Untreated Control
TT 11002 @ 4 bar M (50L/Ha)
Minidrift (IDK) 02 @ 4 Bar C (50L/Ha)
TTI 02 @ 4 bar XC (50L/Ha)
TT 110025 @ 4.5 bar M (70L/Ha)
Minidrift (IDK)025 @ 4.5 Bar C (70L/Ha)
TTI 025 @ 4.5 Bar XC (70L/Ha)
B.Y.Grass
Sow Thistle
Nozzle type, Pressure & Spray Quality & Application Volume


Percentage control of barnyard grass (4-6 leaf) and sowthistle (2-4leaf) using 800mL/ha Roundup CT in 50L/Ha or 800mL/ha Sprayseed 70 L/Ha @ 16-18 km/h
% Control
100
90
80
70
60
50
40
30
20
10
0
0.0
0.0
97.0
98.3
97.7
100.0
97.0
100.0
98.3
97.9
100.0
99.3
100.0
96.7
Untreated Control
ROUNDUP 50L/ha TT02 @ 4 bar M
ROUNDUP 50L/ha Minidrfit (IDK) TT02 @ 4 bar C
ROUNDUP 50L/ha TTI02 @ 4 bar XC
SPRAYSEED 70L/Ha TT025 @ 4.5 Bar M
SPRAYSEED 70L/Ha Airmix 025 @ 4.5 Bar C
SPRAYSEED 70L/Ha TTJ025 @ 4.5 Bar C
Barnyard Grass
Sow thistle
Nozzle type, Pressure & Spray Quality & Application Volume

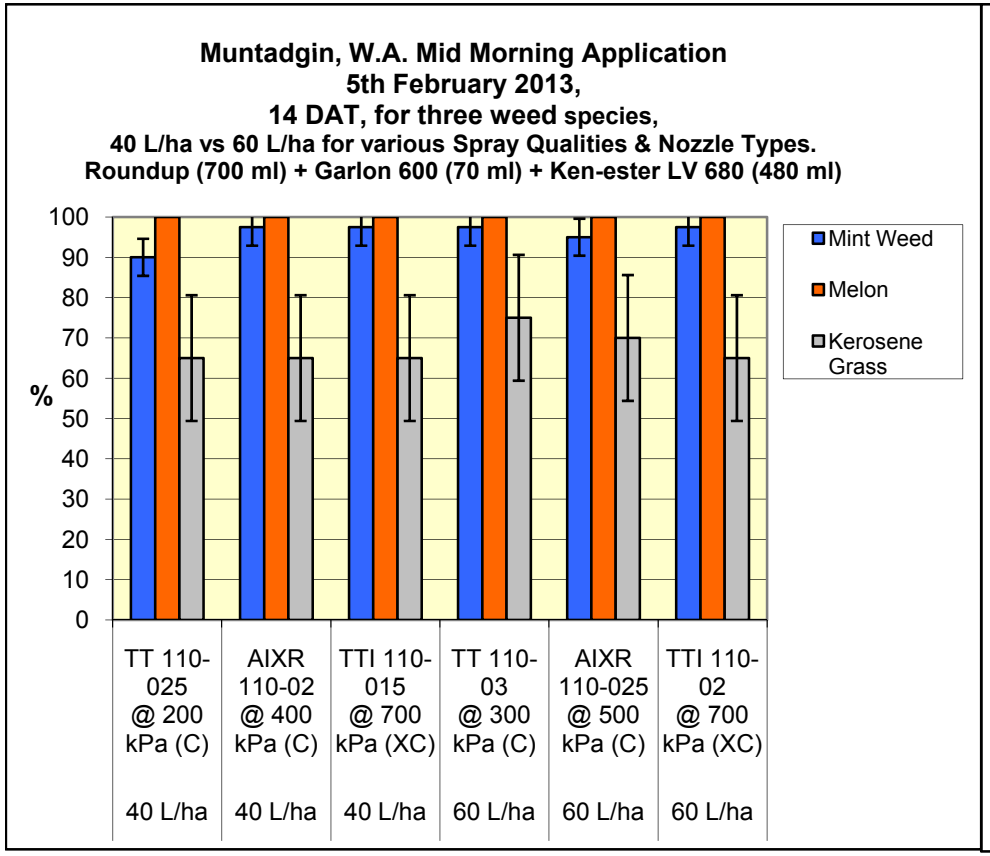

## *Control (% desiccation or stunting) of heliotrope Glyphosate/Phenoxy Mix vs. Sprayseed®, 60 L/ha vs. 90 L/ha using a range of nozzle types.*

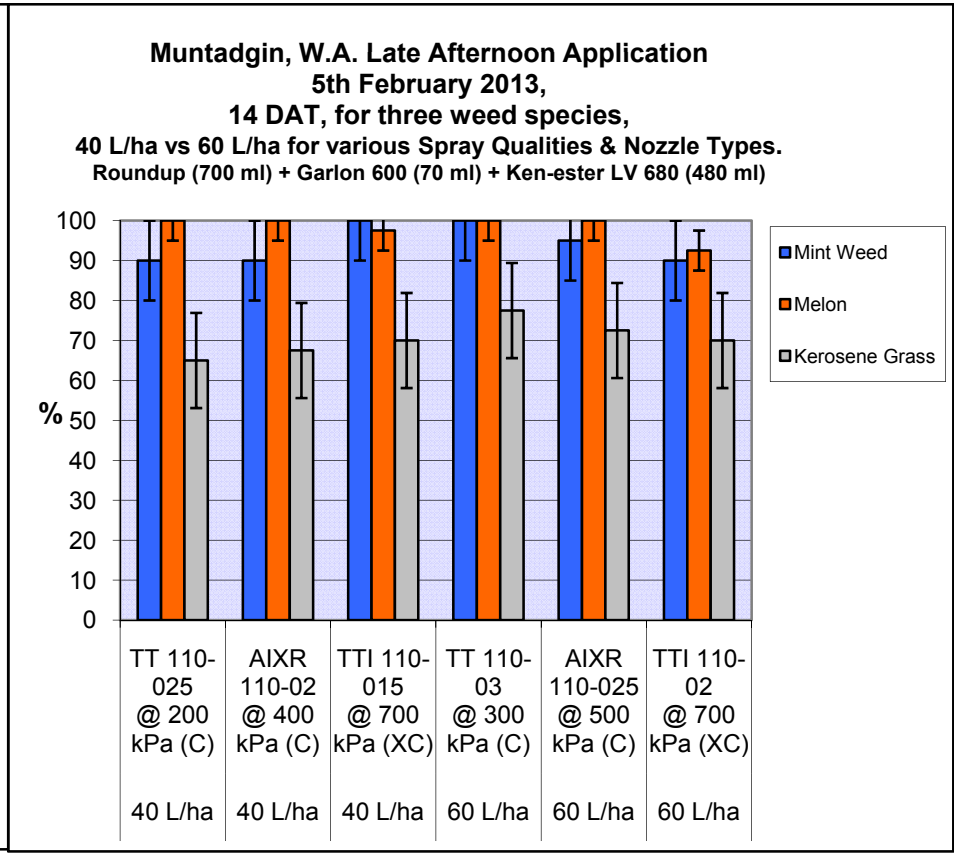
*Mintaro, S.A. Feb,2012 Mid-Afternoon*

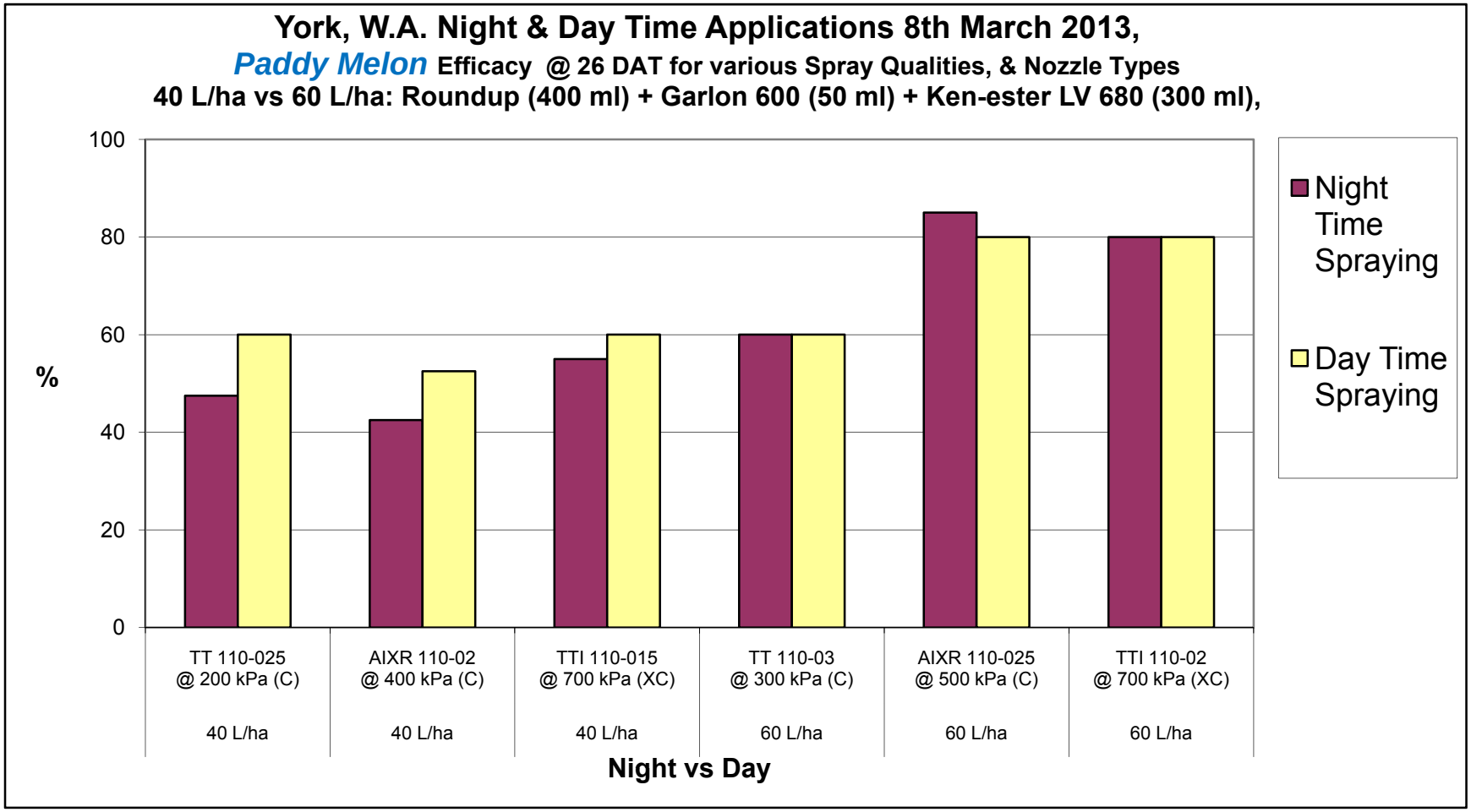
*(Delta T = 14.5-15.5)*

| Water Rate (L/ha) | Nozzle Type and Size | Spray Quality | SpraySeed % dessication | | Glyphosate Mix % Stunting | |
|---|---|---|---|---|---|---|
| | | | 16 DAT | **24 DAT** | 16 DAT | **24 DAT** |
| 60 L/ha | Untreated Control | | 0.0 | **0.0** | 0.0 | **0.0** |
| | TurboTeejet TT11002-VP (forward) | M | 87.5 | **92.5a** | 27.5 | **72.5ab** |
| | TeeJet AIXR11002VP | C | 88.8 | **98.0a** | 30.0 | **78.8a** |
| | TurboTwinJet TTJ60-11002VP | C | 88.8 | **94.0a** | 30.0 | **68.8ab** |
| | TeeJet AITTJ60-11002VP | C | 92.5 | **93.8a** | 27.5 | **70.0ab** |
| | TurboTeejet Induction TTI11002-VP (alternating forward and backward) | XC | 72.5 | **82.5b** | 25.0 | **63.8b** |
| | | | | | | |
| 90 L/ha | Untreated Control | | 0.0 | **0.0** | 0.0 | **0.0** |
| | TurboTeejet TT110-025-VP (forward) | M | 92.0 | **94.5a** | 23.8 | **63.8b** |
| | TeeJet AIXR110025-VP | C | 89.5 | **95.5a** | 25.0 | **68.8ab** |
| | TurboTwinJet TTJ60-110025VP | C | 85.0 | **95.5a** | 38.8 | **72.5ab** |
| | Teejet AITTJ60-11002VP | C | 94.8 | **96.8a** | 18.8 | **61.2b** |
| | TurboTeejet Induction TTI1102-VP (alternating forward and backward) | XC | 86.0 | **92.3a** | 21.2 | **66.2b** |
| | | *LSD (0.05)* | *8.6* | ***5.9*** | *8.3* | ***11.5*** |

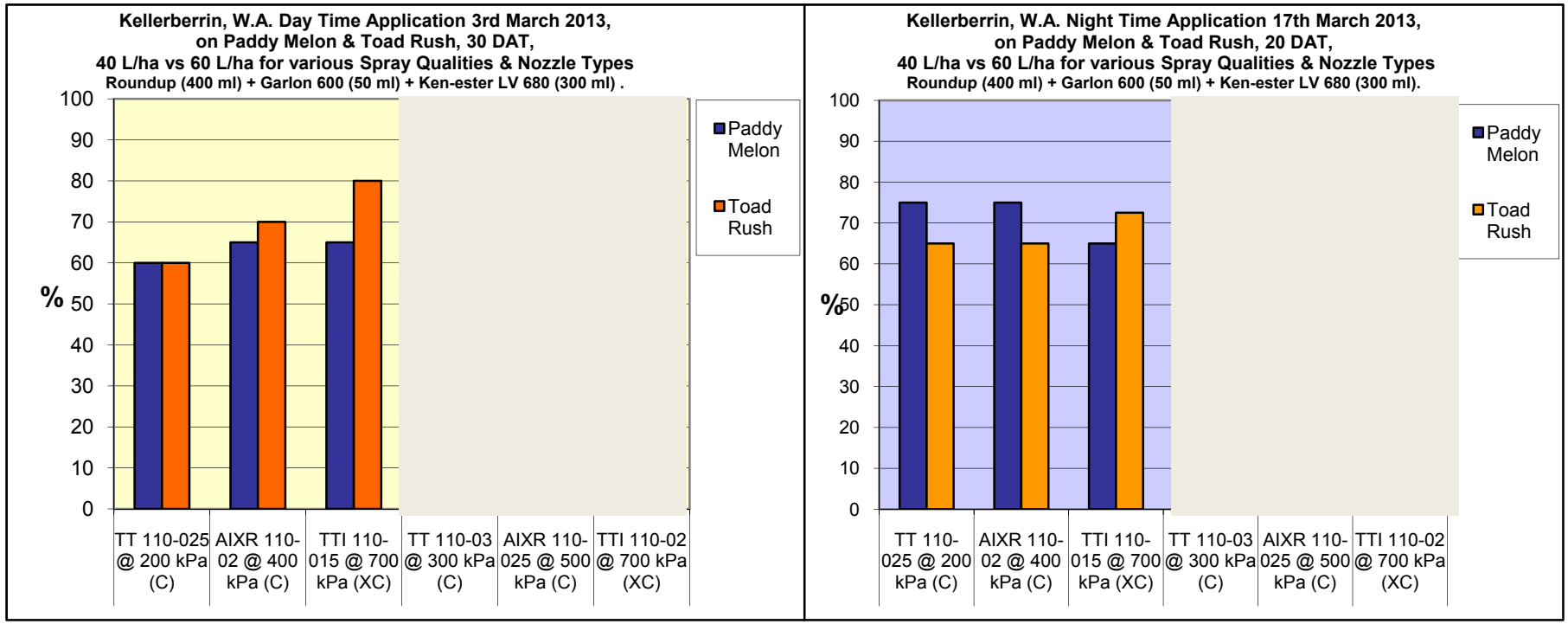
# Morning vs Late afternoon Application



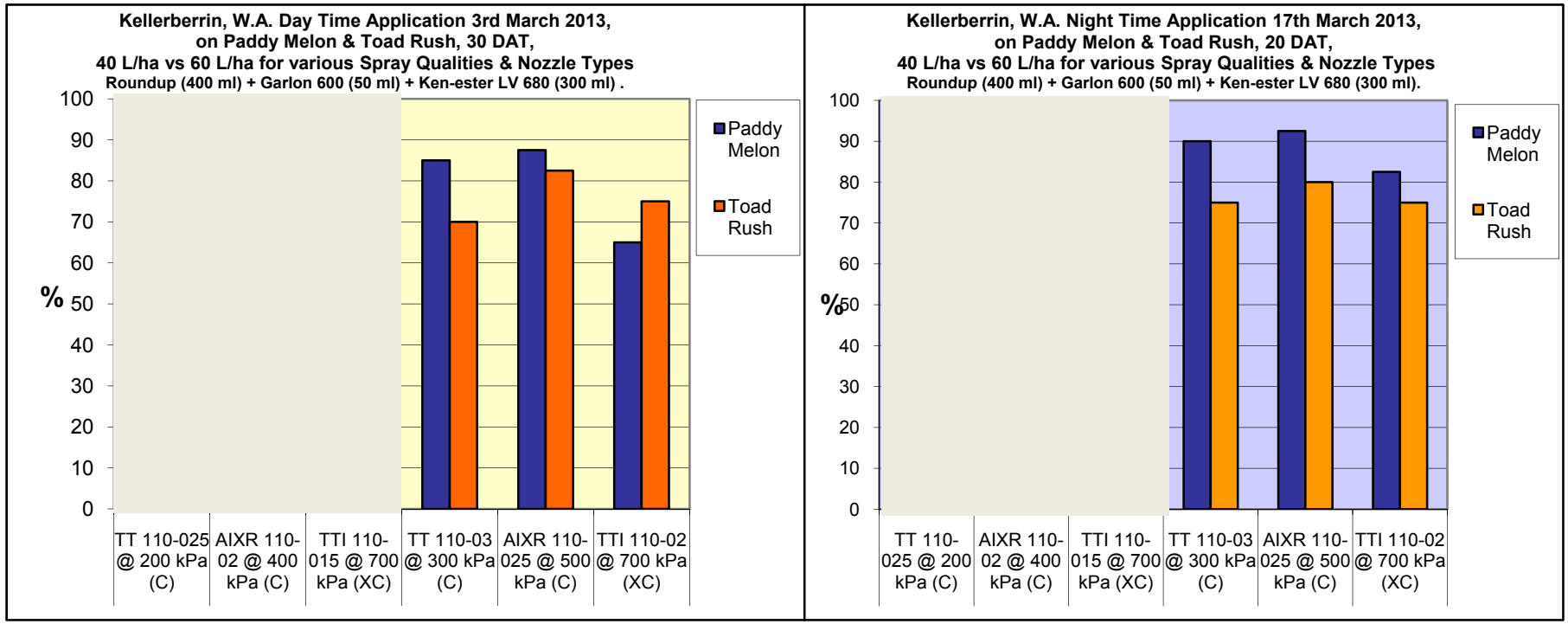




York, W.A. Night & Day Time Applications 8th March 2013,
Paddy Melon Efficacy @ 26 DAT for various Spray Qualities, & Nozzle Types
40 L/ha vs 60 L/ha: Roundup (400 ml) + Garlon 600 (50 ml) + Ken-ester LV 680 (300 ml),
100
80
60
40
20
0
%
Night Time Spraying
Day Time Spraying
TT 110-025 @ 200 kPa (C)
AIXR 110-02 @ 400 kPa (C)
TTI 110-015 @ 700 kPa (XC)
TT 110-03 @ 300 kPa (C)
AIXR 110-025 @ 500 kPa (C)
TTI 110-02 @ 700 kPa (XC)
40 L/ha
40 L/ha
40 L/ha
60 L/ha
60 L/ha
60 L/ha
Night vs Day

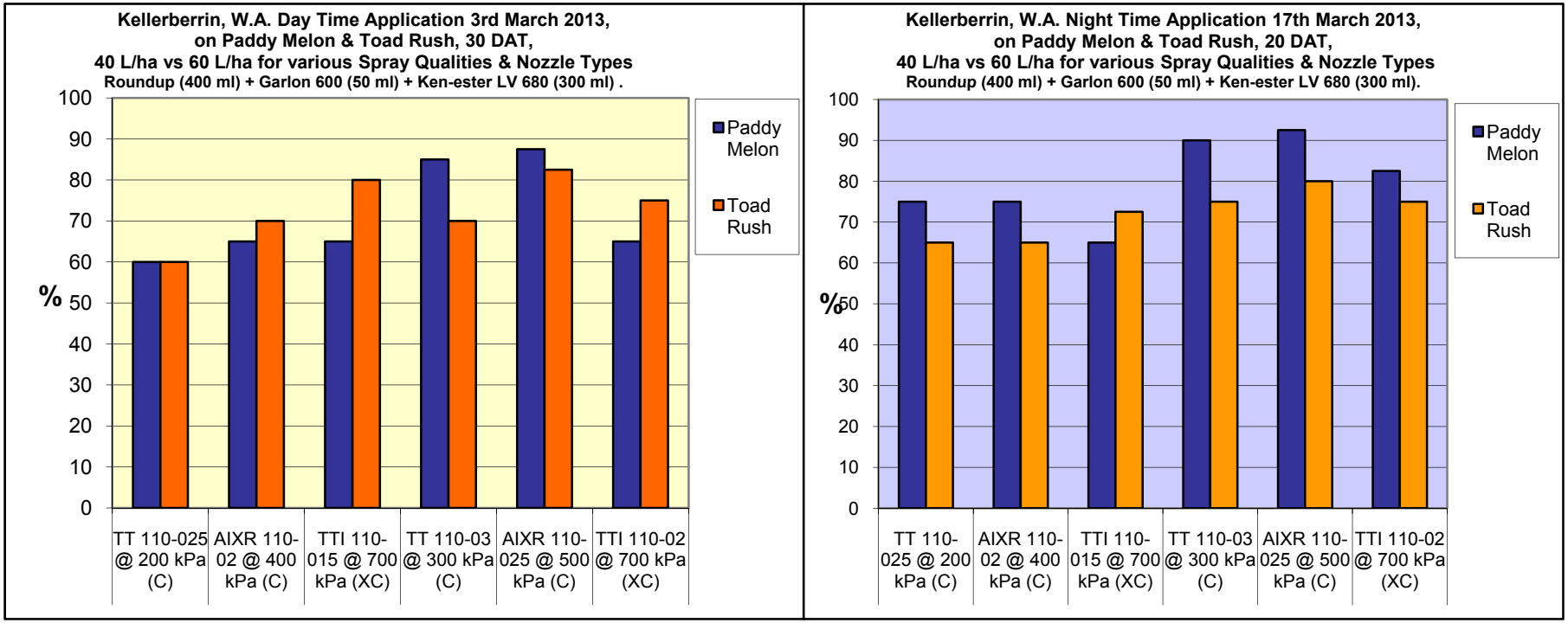
# Waiting for weeds to freshen up



# Waiting for weeds to freshen up



# Waiting for weeds to freshen up

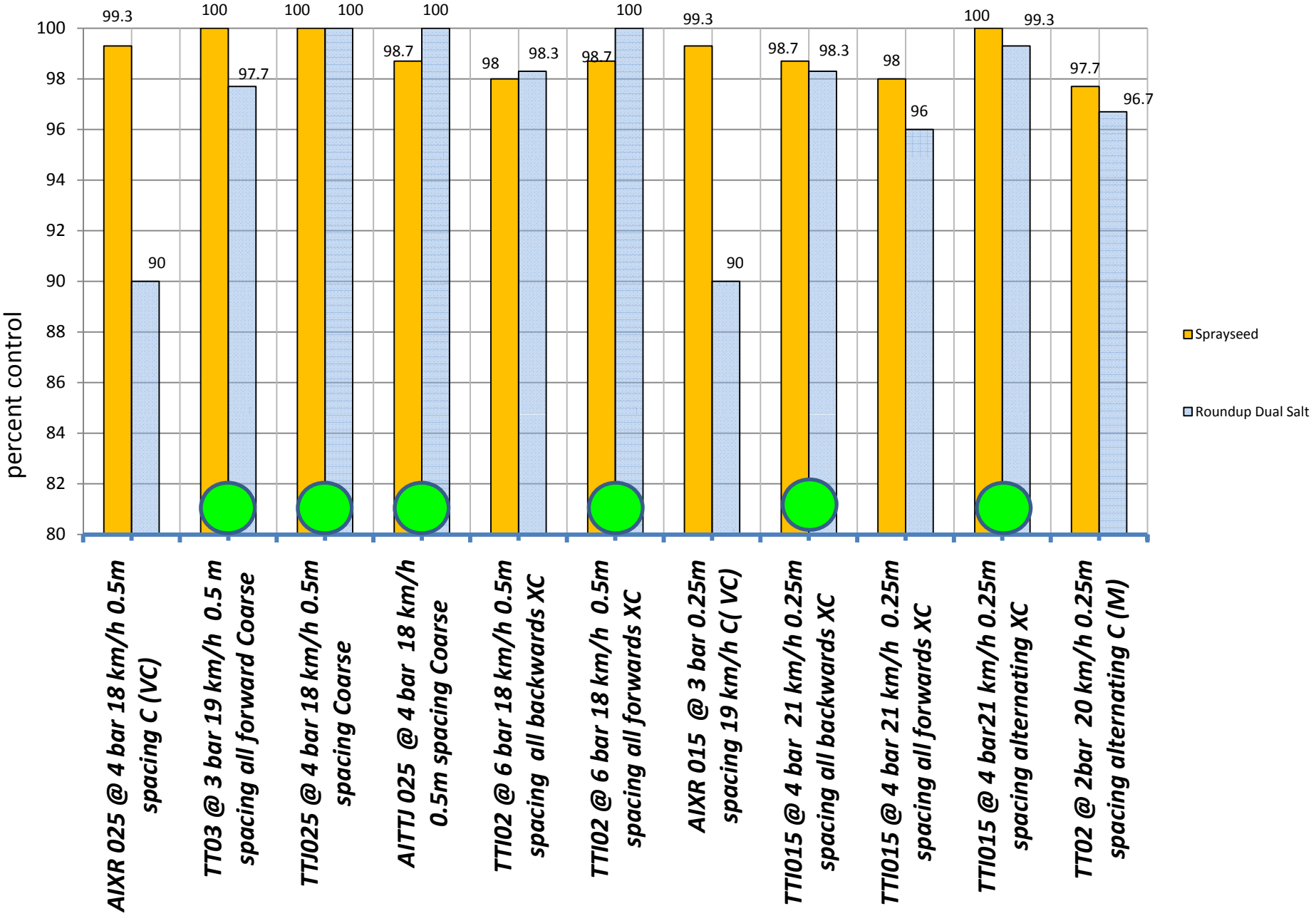


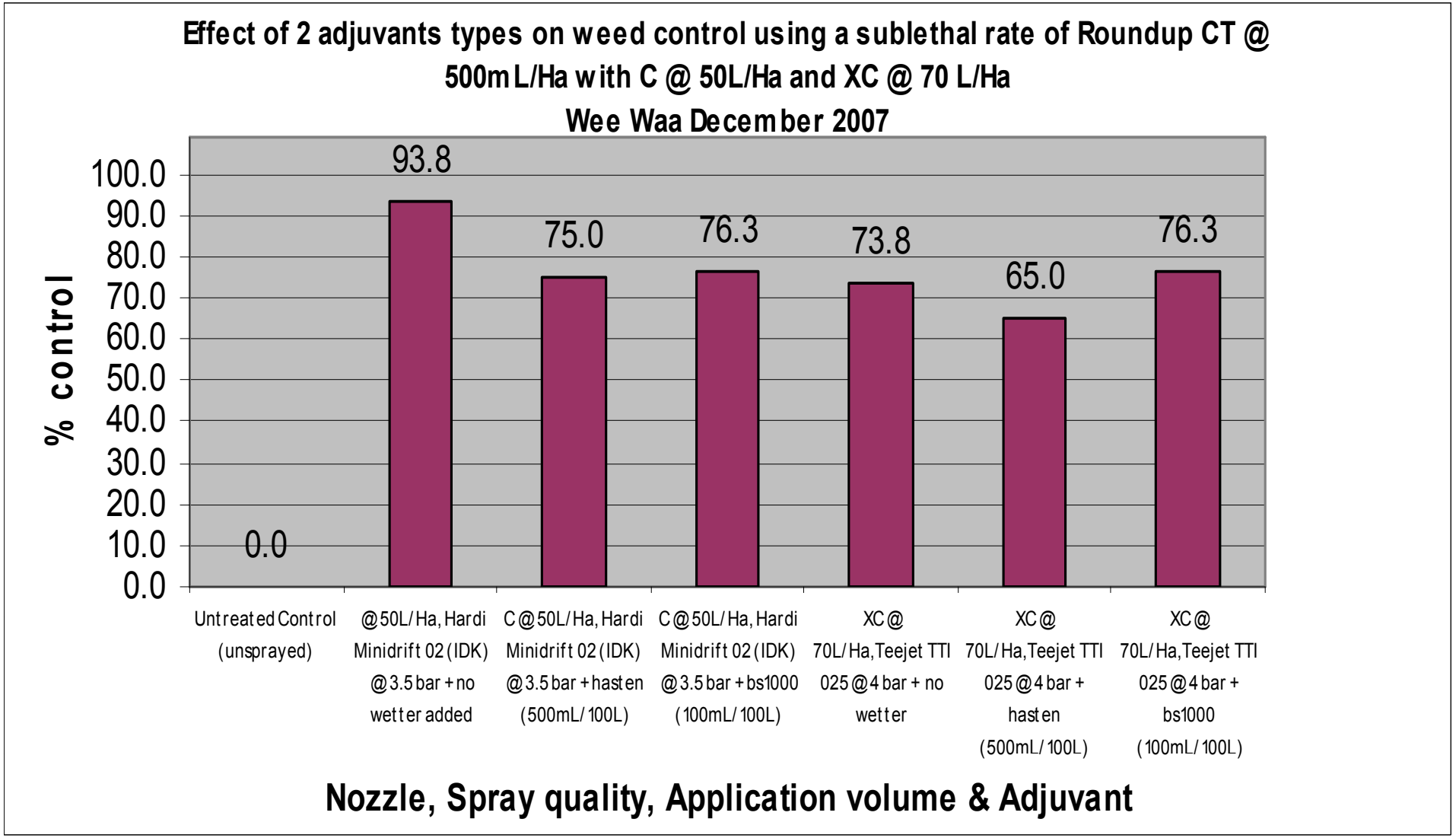
Comments about angled nozzles and travel speed by Professor Paul Miller NIAB-TAG (UK):

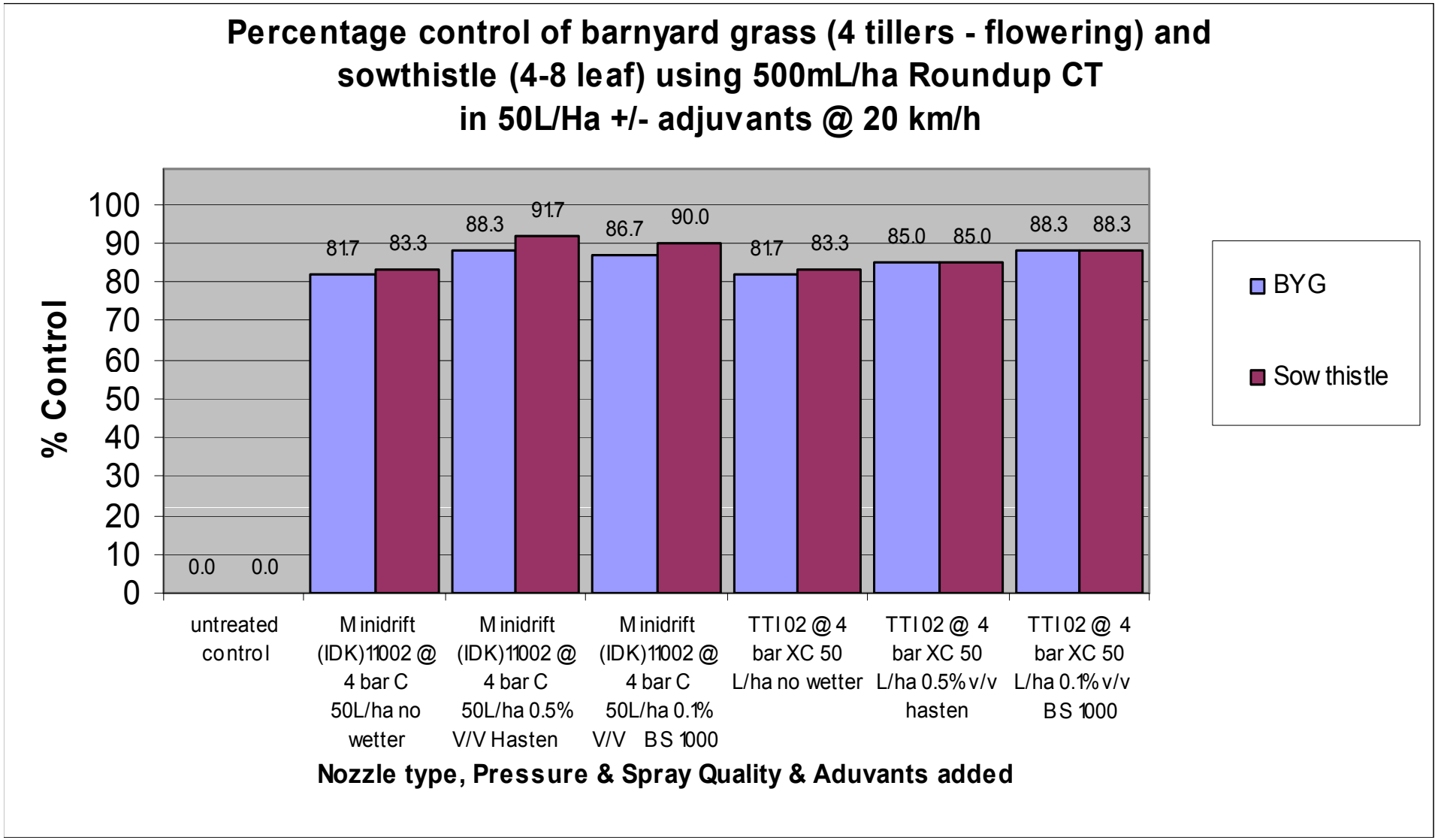
**Angled Nozzles?**

Angling nozzles will also generate horizontal spray movement but again care is needed to control the risk of drift by keeping the boom as low as possible. The minimum boom height will be lower when nozzles are angled than when they are directed straight down. **Alternating angled nozzles also reduces drift when compared with those all angled forwards or backwards.**

**Level of Control Accross the whole plot of Canaray Seed (4-6 Tillers) from 2 trials:**
**Trial 1 Using Sprayseed @ 0.8 L/ha (14 DAT)** *LSD 5% 1.8.* **Trial 2 Roundup Dual Salt @ 1L/ha (15 DAT)** *LSD 5% 6.4*
**April 2011, Kalkee, Victoria.**

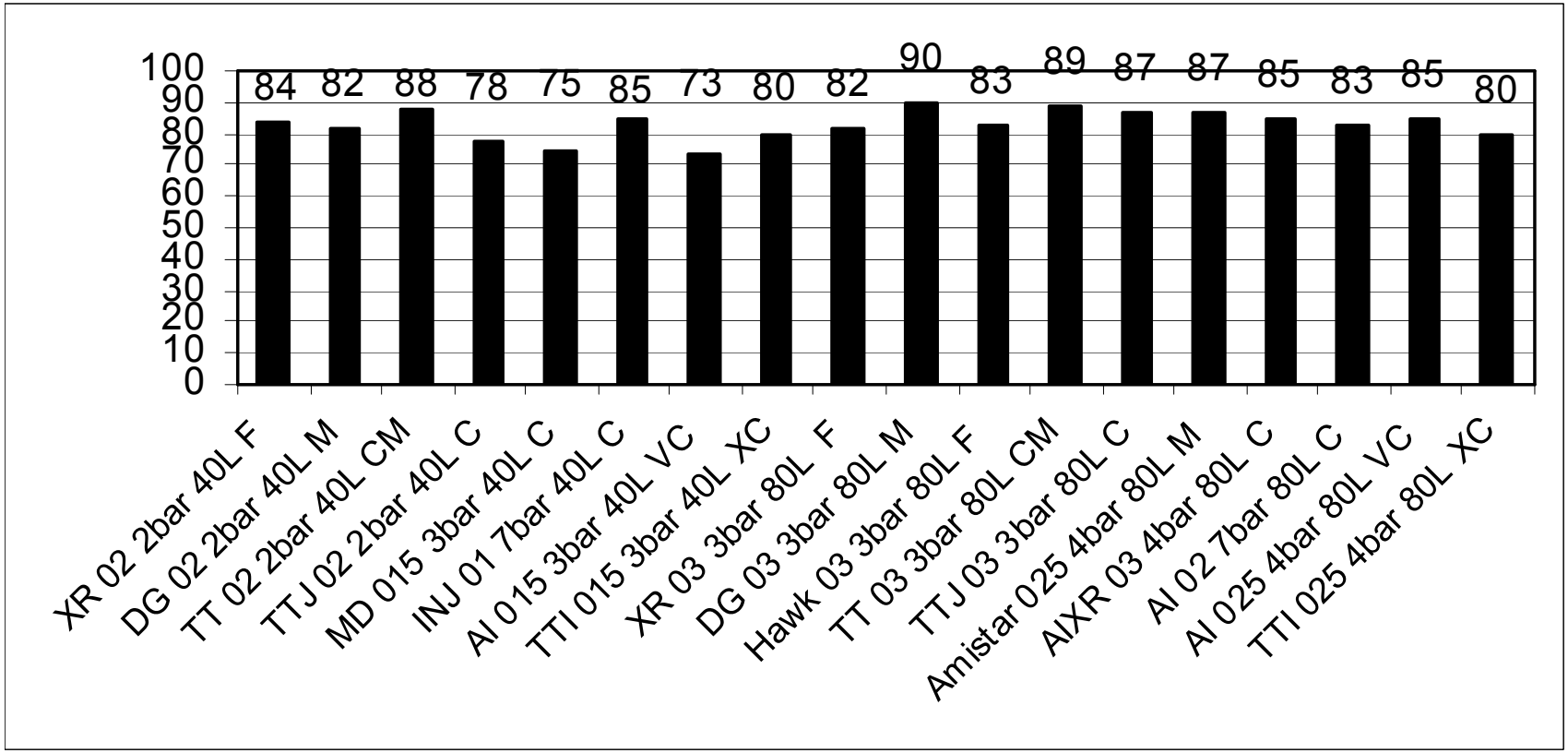



Effect of 2 adjuvants types on weed control using a sublethal rate of Roundup CT @ 500mL/Ha with C @ 50L/Ha and XC @ 70 L/Ha
Wee Waa December 2007
% control
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
93.8
75.0
76.3
73.8
65.0
76.3
Untreated Control (unsprayed)
@50L/Ha, Hardi Minidrift 02 (IDK) @3.5 bar + no wetter added
C@50L/Ha, Hardi Minidrift 02 (IDK) @3.5 bar + hasten (500mL/100L)
C@50L/Ha, Hardi Minidrift 02 (IDK) @3.5 bar + bs1000 (100mL/100L)
XC@ 70L/Ha, Teejet TTI 025 @4 bar + no wetter
XC@ 70L/Ha, Teejet TTI 025 @4 bar + hasten (500mL/100L)
XC@ 70L/Ha, Teejet TTI 025 @4 bar + bs1000 (100mL/100L)
Nozzle, Spray quality, Application volume & Adjuvant


Percentage control of barnyard grass (4 tillers - flowering) and sowthistle (4-8 leaf) using 500mL/ha Roundup CT in 50L/Ha +/- adjuvants @ 20 km/h
% Control
100
90
80
70
60
50
40
30
20
10
0
0.0
0.0
81.7
83.3
88.3
91.7
86.7
90.0
81.7
83.3
85.0
85.0
88.3
88.3
BYG
Sow thistle
untreated control
Minidrift (IDK)11002 @ 4 bar C 50L/ha no wetter
Minidrift (IDK)11002 @ 4 bar C 50L/ha 0.5% V/V Hasten
Minidrift (IDK)11002 @ 4 bar C 50L/ha 0.1% V/V BS 1000
TTI02 @ 4 bar XC 50 L/ha no wetter
TTI02 @ 4 bar XC 50 L/ha 0.5% v/v hasten
TTI02 @ 4 bar XC 50 L/ha 0.1% v/v BS 1000
Nozzle type, Pressure & Spray Quality & Aduvants added

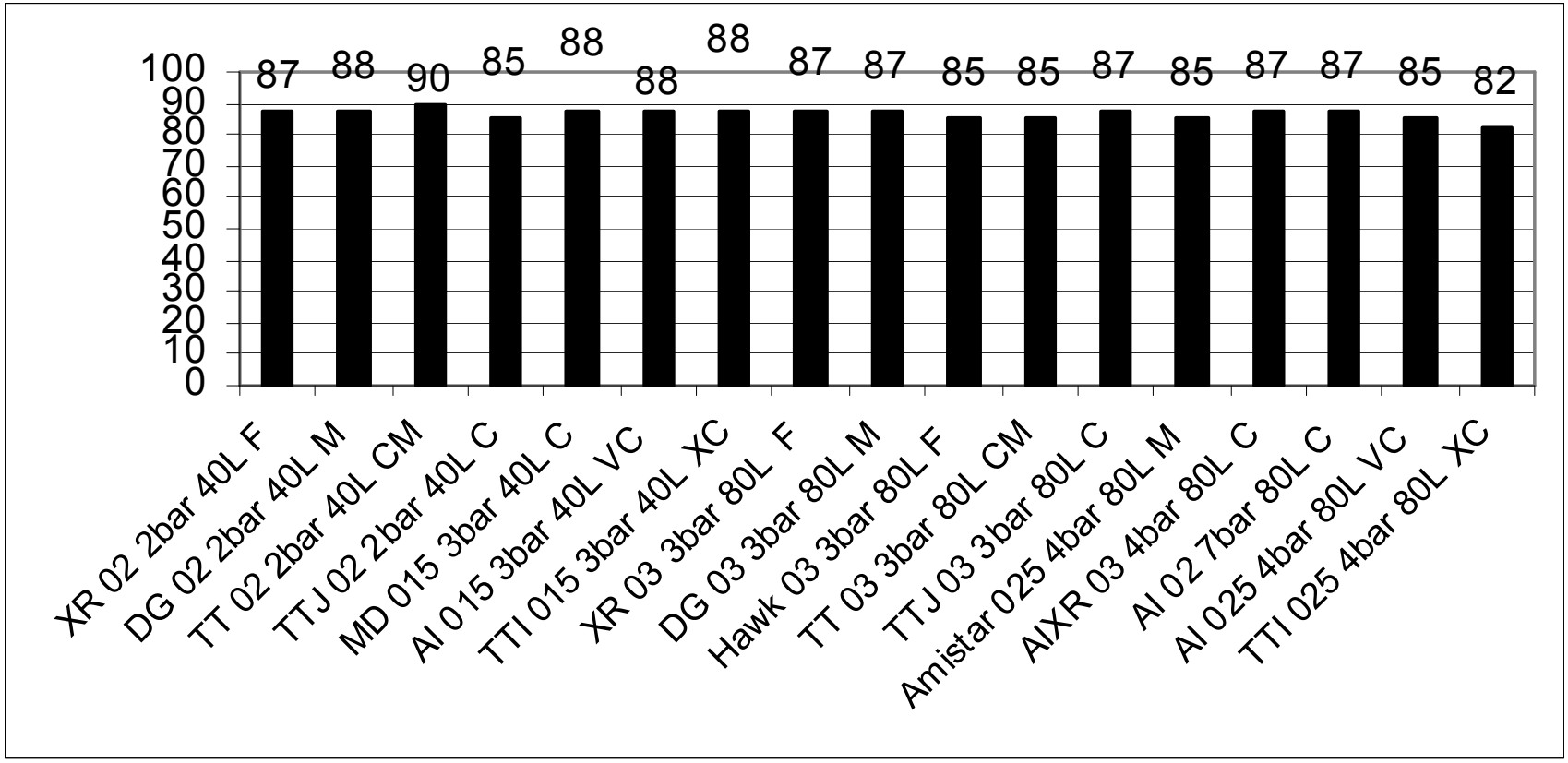
# Trial Results presented by Jason Sabeeney of Syngenta at the 2008 GRDC Northern Region Updates (Spray Seed and Axial)

**Figure 3:** % Annual Ryegrass Control with Spray Seed, 1.2L/ha, 22 DAA, Paskeville, SA, 2007
Spray Quality: Fine (F), Medium (M), Coarse (C), Very Coarse (VC), Extremely Coarse (XC). Nozzle Type: TeeJet XR (XR), TeeJet Drift Guard (DG), Turbo TeeJet (TT), Turbo Twinjet (TTJ), Hardi MiniDrift (MD), Hardi INJET (INJ), TeeJet AI (AI), Turbo TeeJet Induction (TTI), TeeJet (AIXR). Nozzle Size: 01, 015, 02, 025, 03. Spray Volume: 40L/ha (40L), 80L/ha (80L).



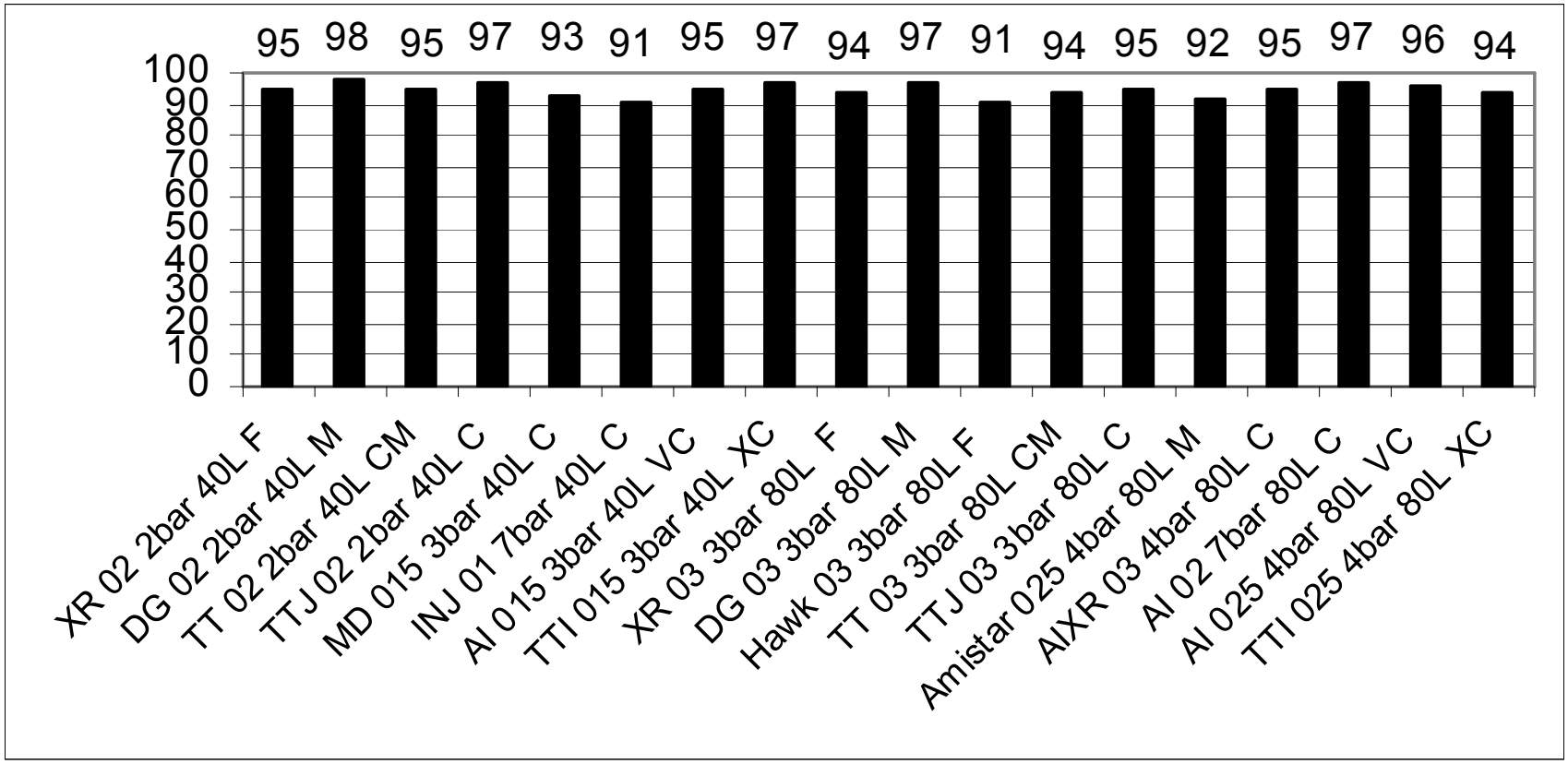
# Trial Results presented by Jason Sabeeney of Syngenta at the 2008 GRDC Northern Region Updates (Spray Seed and Axial)

**Figure 4:** % Annual Ryegrass Control with Spray Seed, 1.2L/ha, 22 DAA, Harcourt, Vic, 2007
Spray Quality: Fine (F), Medium (M), Coarse (C), Very Coarse (VC), Extremely Coarse (XC).
Nozzle Type: TeeJet XR (XR), TeeJet Drift Guard (DG), Turbo TeeJet (TT), Turbo Twinjet (TTJ), Hardi MiniDrift (MD), Hardi INJET (INJ), TeeJet AI (AI), Turbo TeeJet Induction (TTI), TeeJet (AIXR). Nozzle Size: 01, 015, 02, 025, 03. Spray Volume: 40L/ha (40L), 80L/ha (80L).



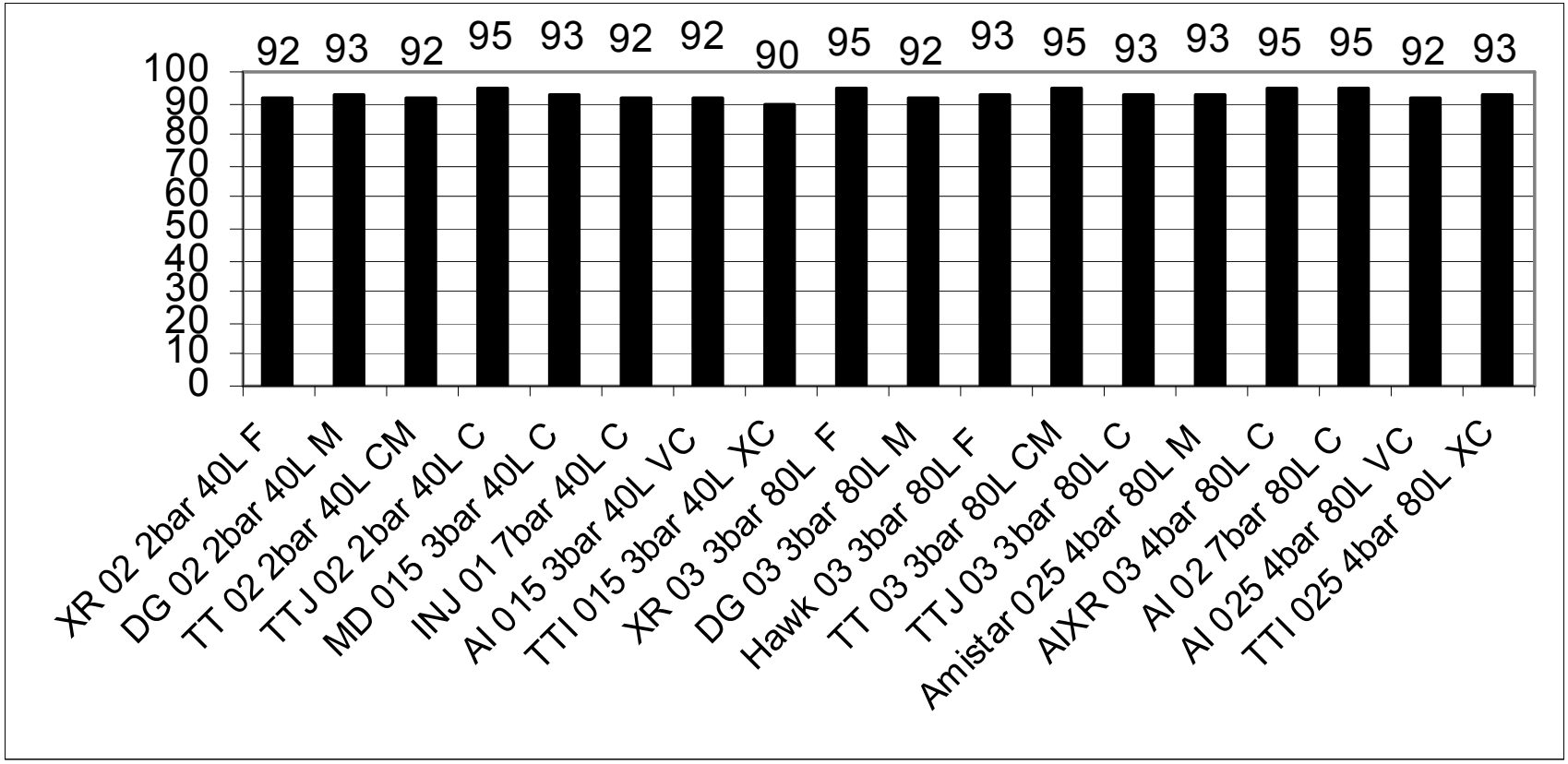
# Trial Results presented by Jason Sabeeney of Syngenta at the 2008 GRDC Northern Region Updates (Spray Seed and Axial)

**Figure 5:** % Annual Ryegrass Control with Axial, 250mL/ha, 70 DAA Paskeville, SA, 2007 Spray Quality: Fine (F), Medium (M), Coarse (C), Very Coarse (VC), Extremely Coarse (XC). Nozzle Type: TeeJet XR (XR), TeeJet Drift Guard (DG), Turbo TeeJet (TT), Turbo Twinjet (TTJ), Hardi MiniDrift (MD), Hardi INJET (INJ), TeeJet AI (AI), Turbo TeeJet Induction (TTI), TeeJet (AIXR). Nozzle Size: 01, 015, 02, 025, 03. Spray Volume: 40L/ha (40L), 80L/ha (80L).



# Trial Results presented by Jason Sabeeney of Syngenta at the 2008 GRDC Northern Region Updates (Spray Seed and Axial)

**Figure 6: %** Annual Ryegrass Control with Axial, 250mL/ha, 56 DAA Harcourt, Vic, 2007
Spray Quality: Fine (F), Medium (M), Coarse (C), Very Coarse (VC), Extremely Coarse (XC). Nozzle Type: TeeJet XR (XR), TeeJet Drift Guard (DG), Turbo TeeJet (TT), Turbo Twinjet (TTJ), Hardi MiniDrift (MD), Hardi INJET (INJ), TeeJet AI (AI), Turbo TeeJet Induction (TTI), TeeJet (AIXR). Nozzle Size: 01, 015, 02, 025, 03. Spray Volume: 40L/ha (40L), 80L/ha (80L).



# Typical Spray Quality and Application Volumes

| Typical Application Volume | Medium Spray Quality (lower drift risk areas) | Coarse Spray Quality | Extremely Coarse Spray Quality (higher drift risk areas) |
|---|---|---|---|
| **Lower range**<br>**50 -60 L/ha**<br>**(Low stubble load)**<br>**to**<br>**70-80 L/ha**<br>**(High stubble load)** | *Only where permitted on label:<br>Fully translocated herbicides<br>Small to medium sized targets. | Fallow Spraying<br>Fully translocated herbicides such as Glyphosate, MCPA.<br>Mandatory for 2,4-D, | Fully translocated herbicides, medium targets,<br>Very sensitive areas or NIGHT SPRAYING |
| **Higher range**<br>**70-80 L/ha**<br>**(Low stubble load)**<br>**to**<br>**100 + L/ha**<br>**(High stubble load/ dense crop canopy)** | *Only where permitted on label:<br>Contact type products.<br>Small targets.<br>In crop spraying.<br>Penetration and coverage in large & broadleaf crops. | Good stubble penetration.<br>Pre-emergent's.<br>Fully Translocated herbicides,<br>Some contact herbicides at the higher application volumes. | Pre-emergent's.<br>Medium sized targets with fully translocated summer fallow herbicides.<br>Very sensitive areas or NIGHT SPRAYING |

# Where do the droplets need to land?

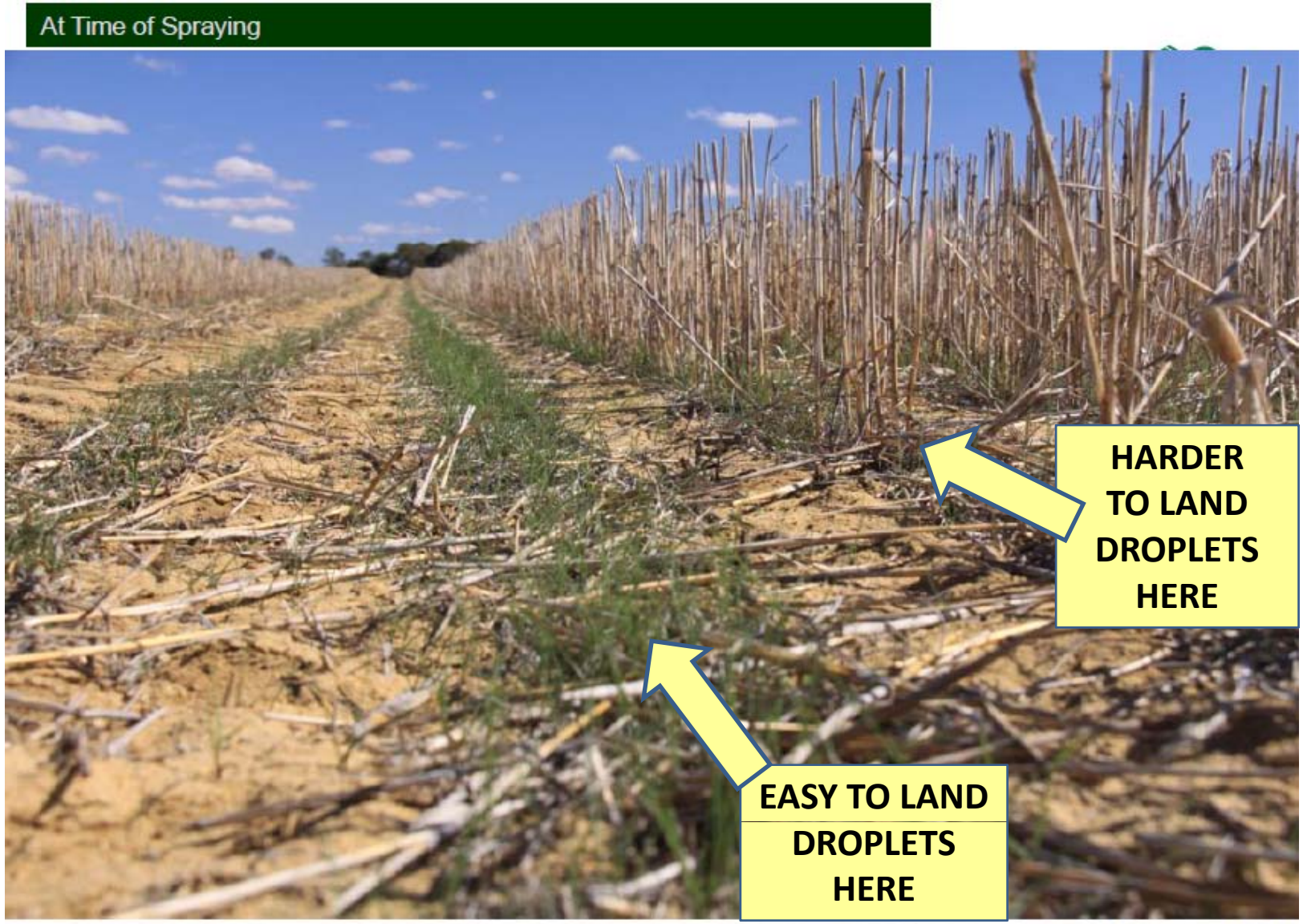
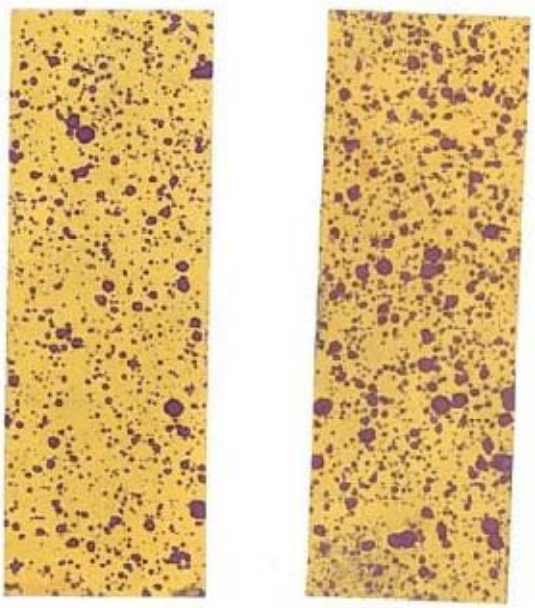



Photo: W Campbell, 2012

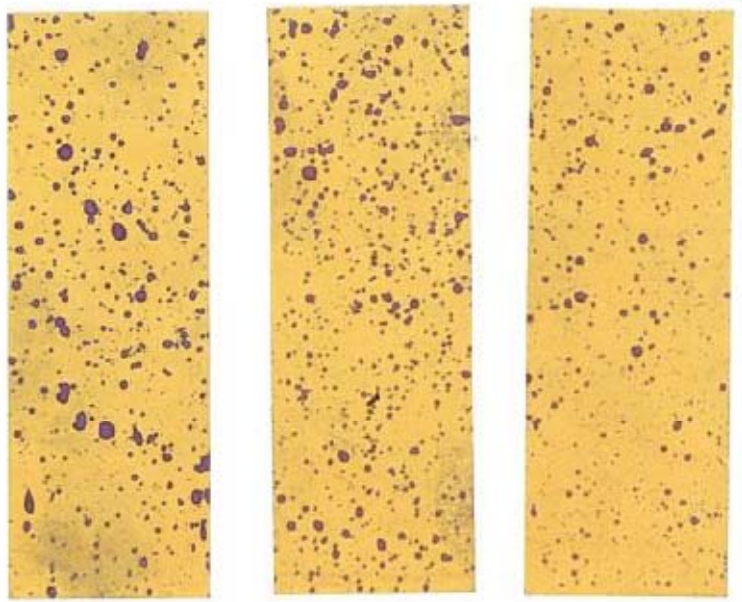
# Effect on coverage from stubble- 75 liters Medium-

Dalwallinu May 2012- Knockdown investigation on Ryegrass- Bill Campbell, Nufarm, WA

Agrotop AM 110-01 at 2.2 bar with handboom



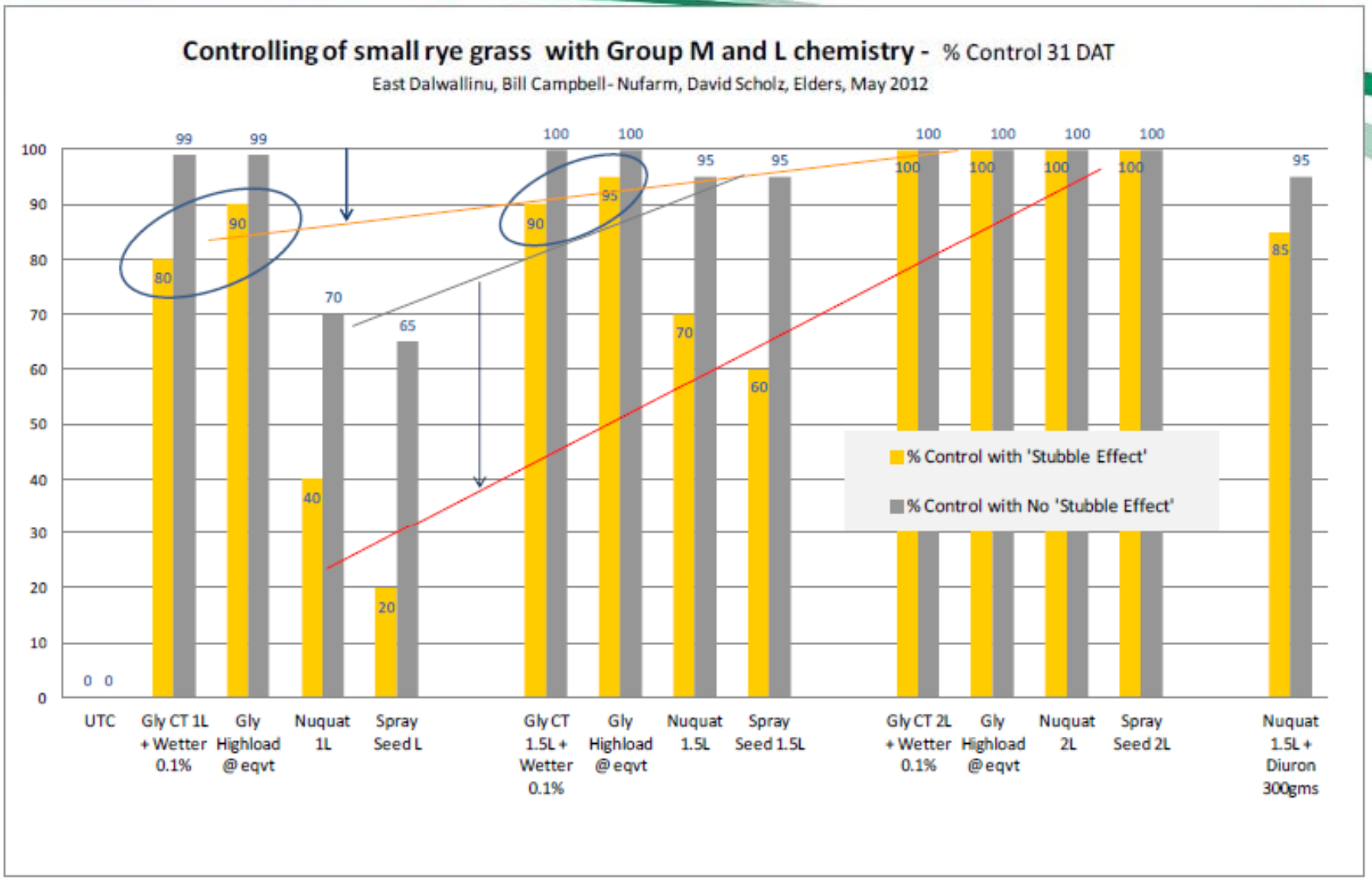
No stubble



Plus stubble

# Combined date- with and without stubble effect

May 2012- Knockdown investigation on Ryegrass



# Some effects of higher travel speeds and larger droplets on deposition

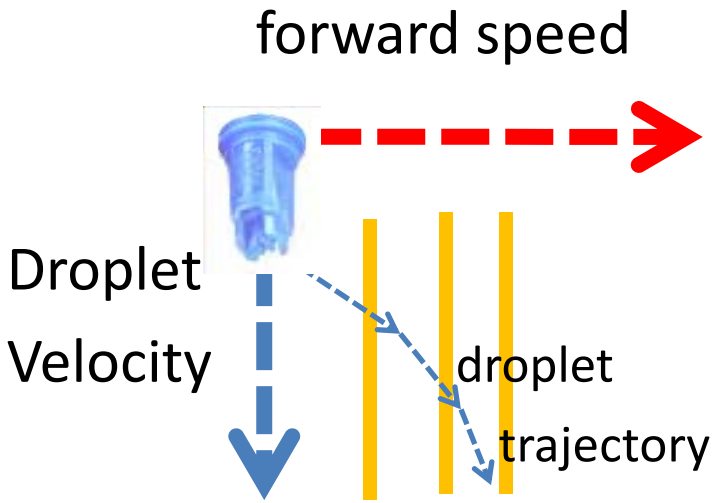
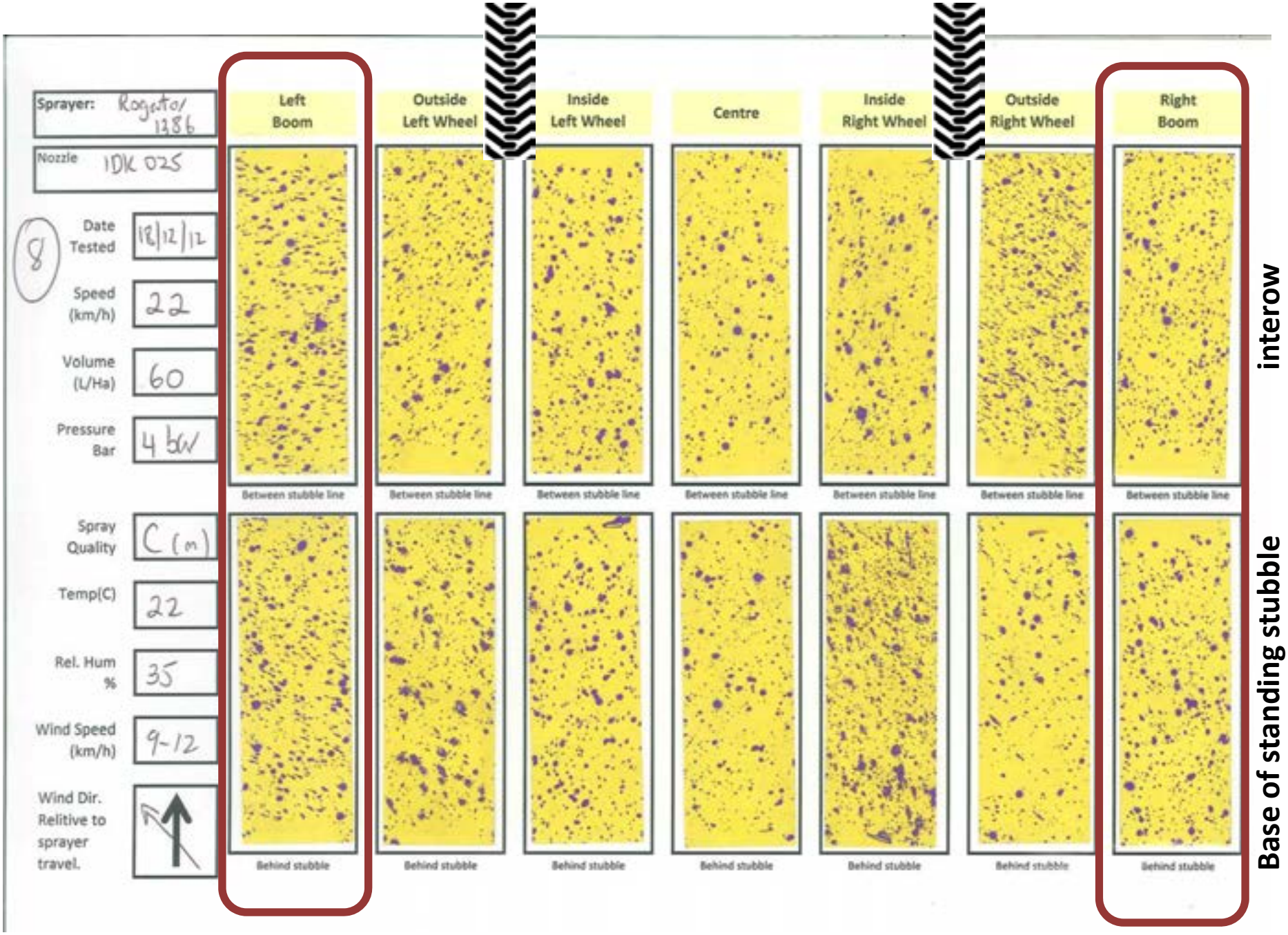
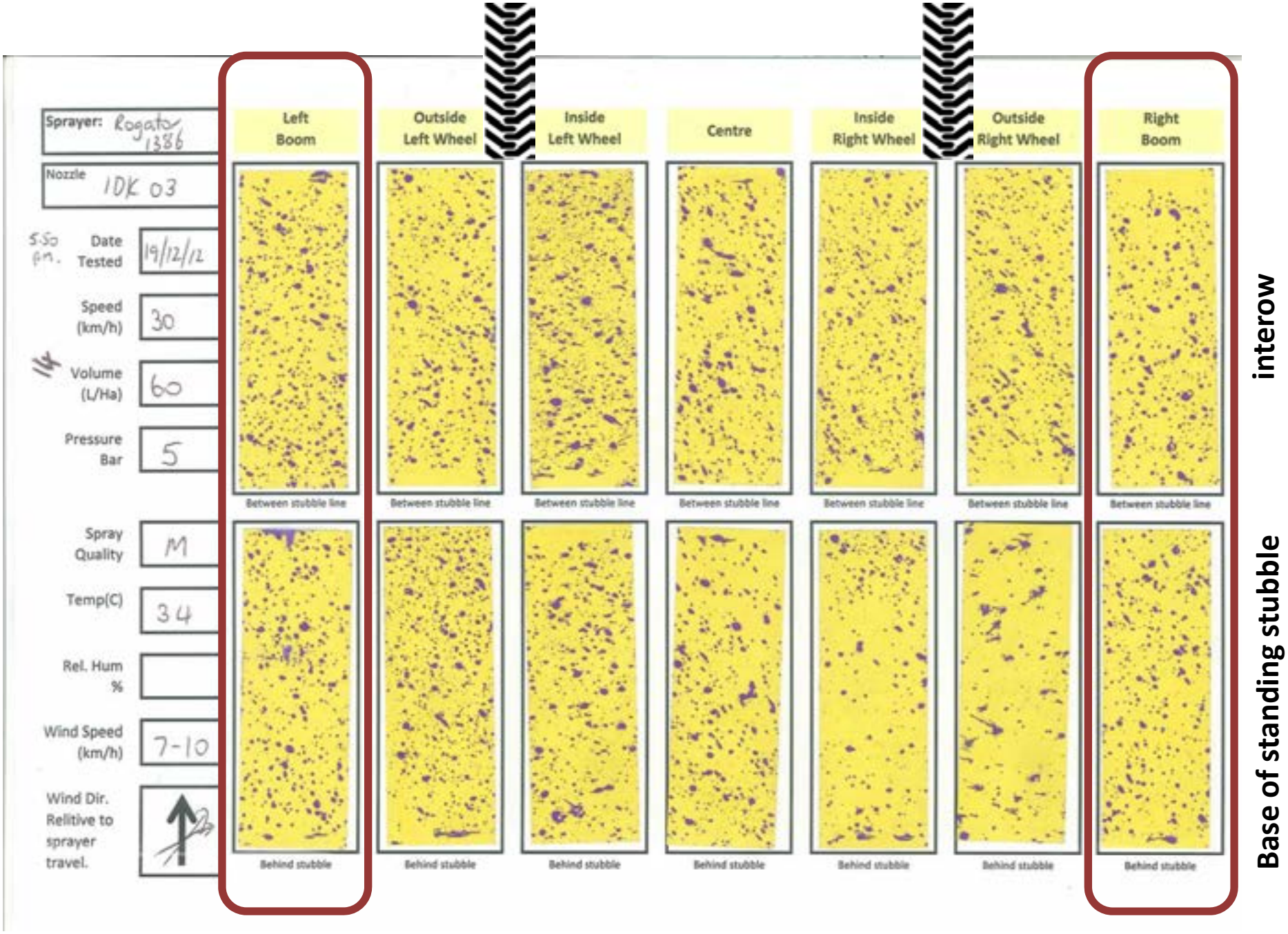
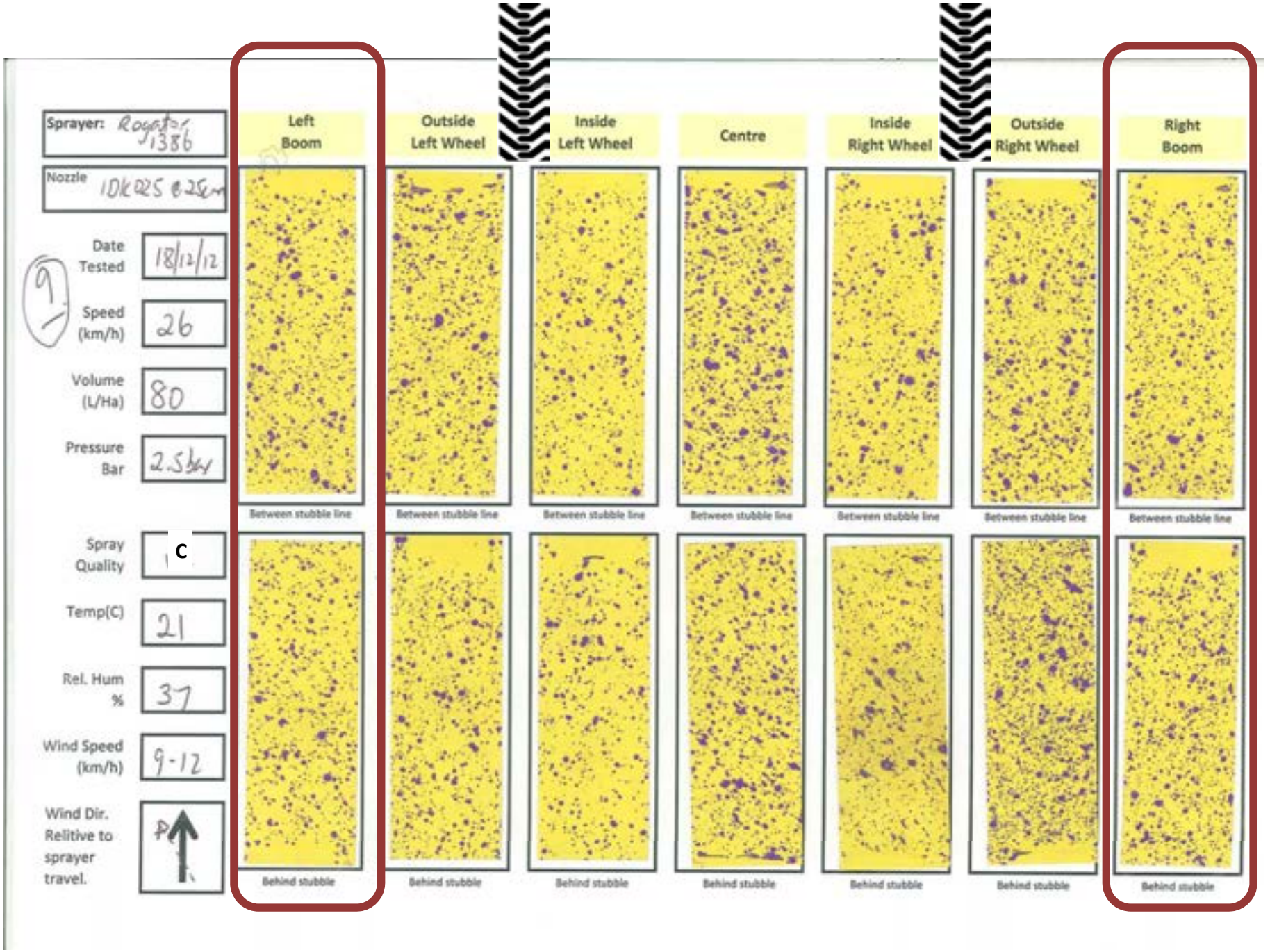



Photo by Simon Rogers (sprayed @ 33 km/h C/VC)

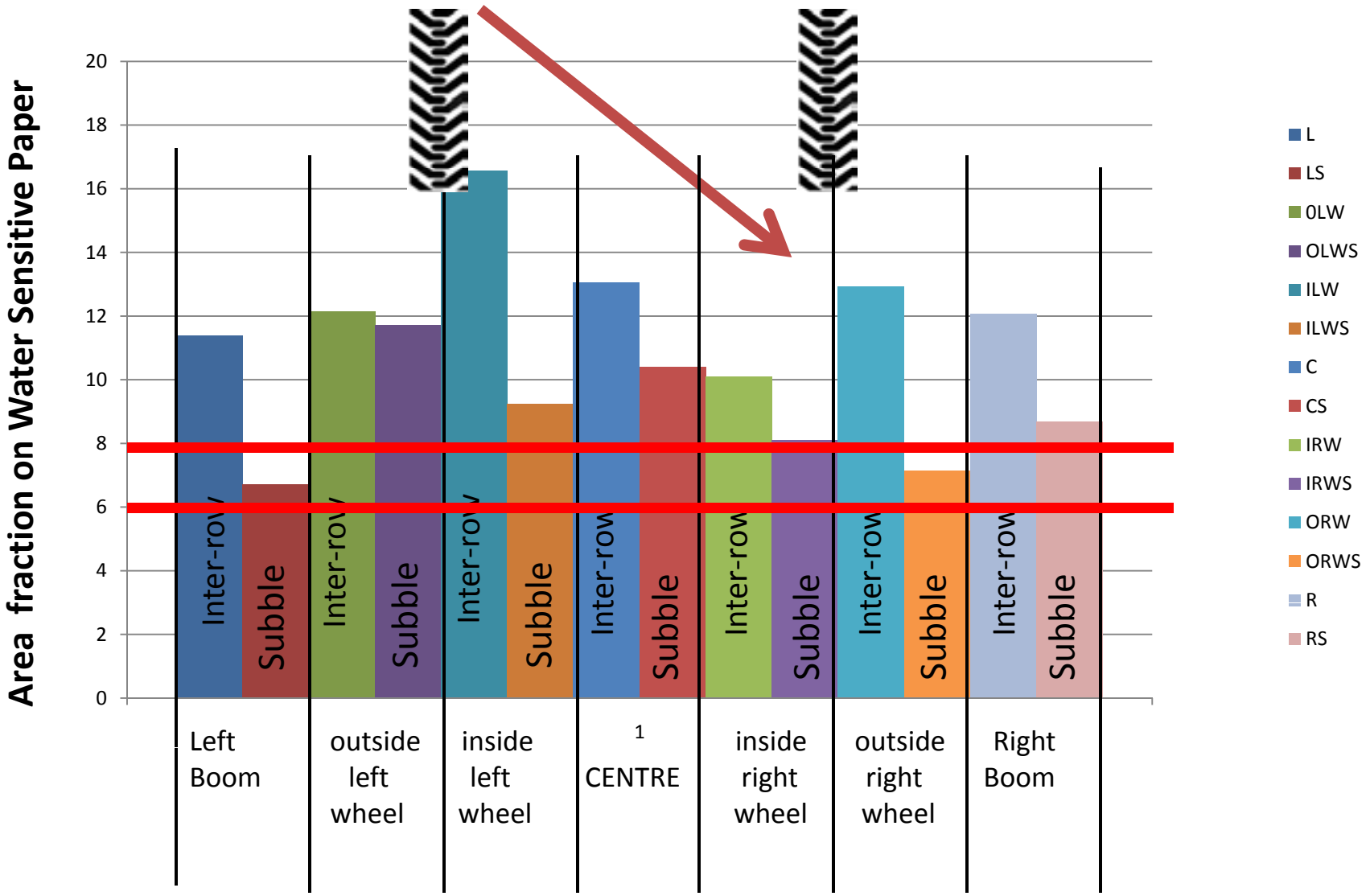
- increased interception by one side of the plants.
- increased shadowing behind standing stubble
- increased dust
- increased displacement of droplets by the tyres


Sprayer: Rogator 1286
Nozzle IDK 025
8
Date Tested 18/12/12
Speed (km/h) 22
Volume (L/Ha) 60
Pressure Bar 4 bar
Spray Quality C (m)
Temp(C) 22
Rel. Hum % 35
Wind Speed (km/h) 9-12
Wind Dir. Relitive to sprayer travel.
Left Boom
Outside Left Wheel
Inside Left Wheel
Centre
Inside Right Wheel
Outside Right Wheel
Right Boom
Between stubble line
Behind stubble
interow
Base of standing stubble

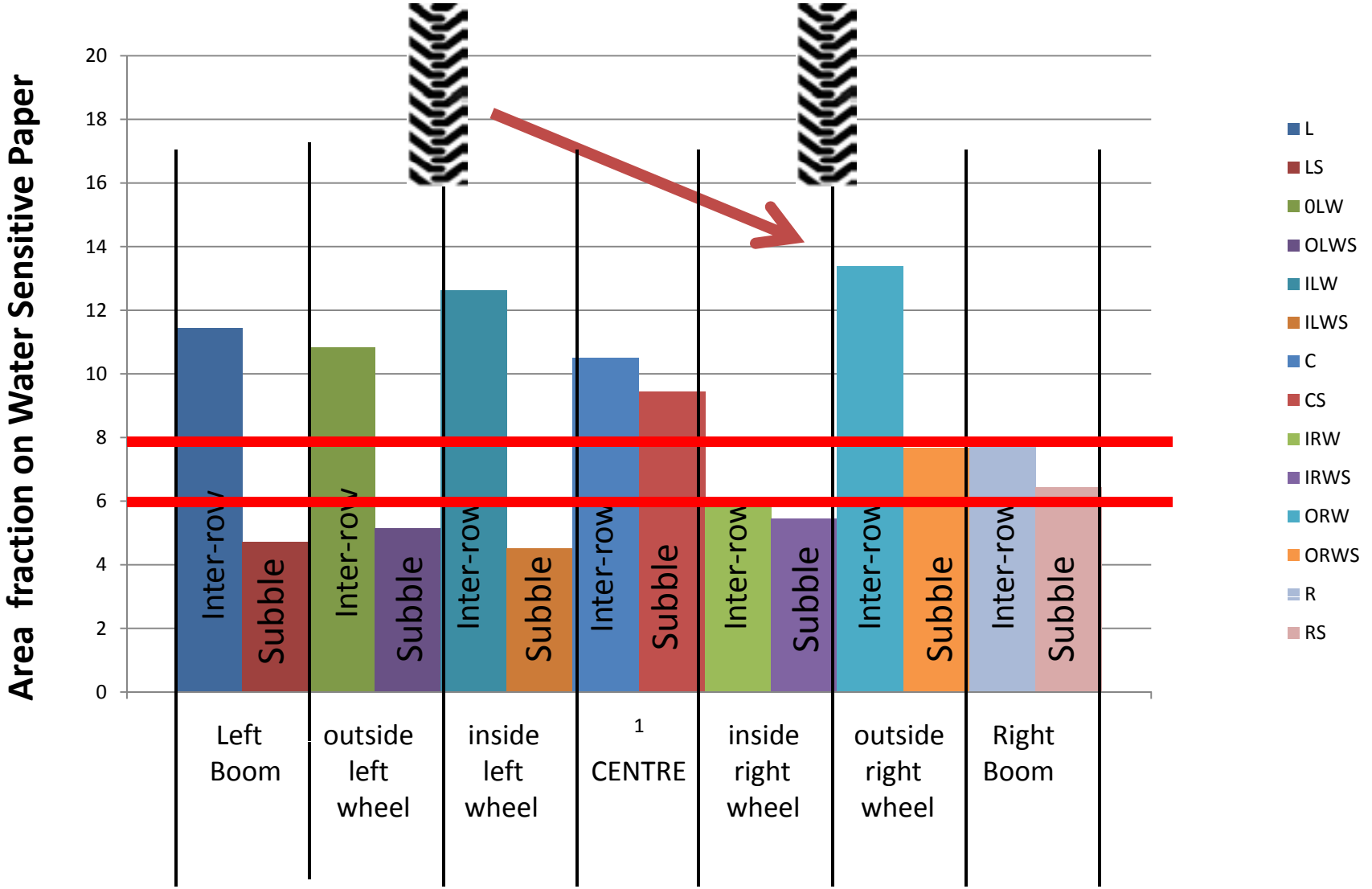

Sprayer: Rogator 1386
Nozzle IDK 03
5.50 p.m.
Date Tested 19/12/12
Speed (km/h) 30
Volume (L/Ha) 60
Pressure Bar 5
Spray Quality M
Temp(C) 34
Rel. Hum %
Wind Speed (km/h) 7-10
Wind Dir. Relitive to sprayer travel.
Left Boom
Outside Left Wheel
Inside Left Wheel
Centre
Inside Right Wheel
Outside Right Wheel
Right Boom
Between stubble line
Behind stubble
interow
Base of standing stubble


Sprayer: Rogator 1386
Nozzle 10K025 @25cm
Date Tested 18/12/12
Speed (km/h) 26
Volume (L/Ha) 80
Pressure Bar 2.5bar
Spray Quality C
Temp(C) 21
Rel. Hum % 37
Wind Speed (km/h) 9-12
Wind Dir. Relitive to sprayer travel.
Left Boom
Outside Left Wheel
Inside Left Wheel
Centre
Inside Right Wheel
Outside Right Wheel
Right Boom
Between stubble line
Behind stubble
interow
Base of standing stubble

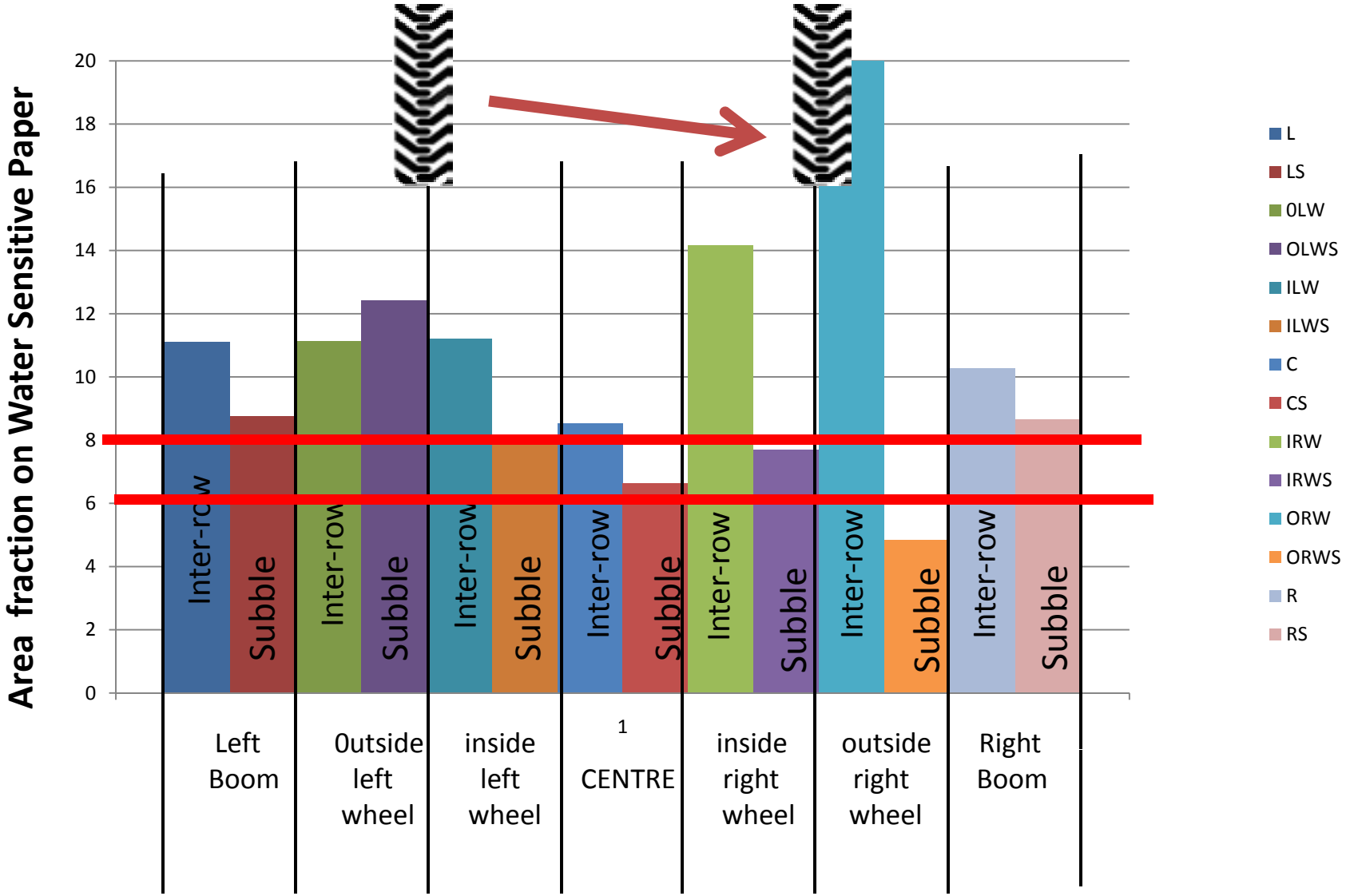
# 18 km/h, 60 L/ha, 50cm spacing
# AIXR 02 @ 4 bar (small end of Coarse)



# 26 km/h, 60 L/ha, 25cm spacing
# AIXR 015 and 02 @ 2.5bar (very coarse)



# 31 km/h, 60 L/ha, 25cm spacing
# AIXR 015 and 02 @ 4 bar (small end of coarse)



# Results from a single trial evaluating efficacy in standing stubble

## (Awnless Barnyard Grass & other weeds) Narrabri - 2014

North ↑

wind direction at application ↓

Direction of sprayer travel ←

Strip length 166m x 12m

Subsamples 4 m x 25 cm, row spacing 33 cm

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Strip 7 | | | UTC | | | | |
| Strip 6 | 6 | 5 | TTJ60 025 27 kph | 4 | 3 | 2 | 1 |
| Strip 5 | 6 | 5 | AIXR 025 27 kph | 4 | 3 | 2 | 1 |
| Strip 4 | 6 | 5 | TTI025 27 kph | 4 | 3 | 2 | 1 |
| Strip 3 | 6 | 5 | TTJ60 20 kph | 4 | 3 | 2 | 1 |
| Strip 2 | 6 | 5 | TTI 02 20kph | 4 | 3 | 2 | 1 |
| strip 1 | 6 | 5 | AIXR 02 20 kph | 4 | 3 | 2 | 1 |

| Trt No. | | Rate | Nozzle Type and size | Application speed | Volume |
|---|---|---|---|---|---|
| 1 | Weedmaster DST | 1 L/ha | AIXR02 | 20 kph | 50 L/ha |
| 2 | Weedmaster DST | 1 L/ha | TTI02 | 20 kph | 50 L/ha |
| 2 | Weedmaster DST | 1 L/ha | TTJ602 | 20 kph | 50 L/ha |
| 4 | Weedmaster DST | 1 L/ha | TTI025 | 27 kph | 50 L/ha |
| 5 | Weedmaster DST | 1 L/ha | AIXR025 | 27 kph | 50 L/ha |
| 6 | Weedmaster DST | 1 L/ha | TTJ6025 | 27 kph | 50 L/ha |
| 7 | Untreated Control | - | - | - | |

# Efficacy results in stubble

**Table 1** **Barnyard grass - Counts per $m^2$ 27 DAT - Distance Downwind from Wheel Track**

| Sampling Zone | | % Reduction* |
|---|---|---|
| 3 m from wheel track | 3.9 b | 16.5% |
| 50 cm from wheel track | 2.4 a | |
| Centre boom | 2.8 a | |
| Fprob - cov | <.001 | |
| F Prob - Tment | <.001 | |
| LSD | 0.755 | |

* Untreated control omitted from analysis, Percent reduction in efficacy calculated on weed numbers

**Table 2** **Barnyard grass - Counts per $m^2$ 27 DAT - Nozzle Effect**

| Nozzles | | Nozzles - No UTC | | % Reduction |
|---|---|---|---|---|
| AIXR | 2.6 a | AIXR | 2.8 a | |
| TTI | 3.7 b | TTI | 3.7 b | 12.0% |
| TTJ60 | 2.4 a | TTJ60 | 2.5 a | |
| UTC | 3.2 a | | * | |
| | | Fprob - cov | <.001 | |
| F Prob - Tment | 0.019 | F Prob - Tment | 0.008 | |
| LSD | 1.013 | LSD | 0.775 | |

Percent reduction in efficacy calculated on weed numbers

**Table 3 Barnyard grass - Counts per $m^2$ 27 DAT - Distance from wheel track x Application Speed Interaction**

| Sampling Zone | 20 kph | % Reduction* 20 kph | 27 kph | |
|---|---|---|---|---|
| 3 m from wheel track | 4.2 b | 26% | Centre boom | 3.5 a |
| 50 cm from wheel track | 2.1 a | | 50 cm from tyre | 2.7 a |
| Centre boom | 2.1 a | | 3 m from tyre | 3.5 a |
| Fprob - cov | <.001 | | | |
| F Prob - Tment | 0.02 | | | |
| LSD | 1.071 | | | |

* Untreated control omitted from analysis, Percent reduction in efficacy calculated on weed numbers

**Table 4 Wireweed - Counts per $m^2$ 27 DAT - Nozzle Effect**

| Nozzles | | % Reduction* |
|---|---|---|
| AIXR | 0.48 a | |
| TTI | 0.96 b | 33% |
| TTJ60 | 0.37 a | |
| Fprob - cov | <.001 | |
| F Prob - Tment | 0.012 | |
| LSD | 0.41 | |

* Untreated control omitted from analysis, Percent reduction in efficacy calculated on weed numbers

**Table 5 Yellowvine - Counts per $m^2$ 27 DAT - Distance Downwind from Wheel Track**

| Sampling Zone | | % Reduction* |
|---|---|---|
| 3 m from wheel track | 0.426 b | 42% |
| 50 cm from wheel track | 0.181 ab | 29% |
| Centre boom | 0.004 a | |
| Fprob - cov | <.001 | |
| F Prob - Tment | 0.037 | |
| LSD | 0.323 | |

* Untreated control omitted from analysis, Percent reduction in efficacy calculated on weed numbers

**Table 6 Total Weeds - Counts per $m^2$ 27 DAT - Nozzle Effect**

| Nozzles | | % Reduction* |
|---|---|---|
| AIXR | 3.3 a | |
| TTI | 4.8 b | 13% |
| TTJ60 | 3.8 a | |
| Fprob - cov | <.001 | |
| F Prob - Tment | <.001 | |
| LSD | 0.718 | |

* Untreated control omitted from analysis, Percent reduction in efficacy calculated on weed numbers

# Interactions:

**Table 7 Total Weed Population - Counts per $m^2$ 27 DAT - Distance from wheel track x Application Speed Interaction**

| sampling zone.speed | 20 kph | % Reduction* | 27 kph | % Reduction |
|---|---|---|---|---|
| 3 m from tyre | 4.7 b | 10% | 3.2 a | |
| 50 cm from tyre | 4.1 a | | 4.1 a | |
| Centre boom | 3.5 a | | 4.3 b | 9.4% |
| Fprob - cov | <.001 | | | |
| F Prob - Tment | 0.007 | | | |
| LSD | 1.005 | | | |

* Untreated control omitted from analysis, Percent reduction in efficacy calculated on weed numbers

**Table 8 Total Weed Population - Counts per $m^2$ 27 DAT - Speed x Nozzle Interaction**

| speed.nozzle | AIXR | TTI | TTJ60 | % Reduction |
|---|---|---|---|---|
| 20 kph | 3.0 a | 4.9 a | 4.4 b | 16% |
| 27 kph | 3.6 a | 4.8 a | 3.2 a | |
| Fprob - cov | <.001 | | | |
| F Prob - Tment | 0.047 | | | |
| LSD | 1.014 | | | |

**Notes:** Means followed by the same letter do not significantly differ (P > 0.05). Only significant results are presented. Percent reduction in control is relative to the best result and is calculated using the difference between the best and worst value divided by the total.

- Wake effect

APRIL 2018

GRDC
Grains Research & Development Corporation

# WEED CONTROL IN WHEEL TRACKS
FACT SHEET

**NORTHERN, SOUTHERN AND WESTERN REGIONS**

## IMPROVING WEED CONTROL IN WHEEL TRACKS DURING SUMMER FALLOW SPRAYING

### KEY POINTS

- Poor control of weeds in the sprayer's wheel tracks and the adjacent areas during summer fallow applications can be the result of poor spray deposition, excessive dust or a combination of the two.
- Using additional wheel track nozzles for knock down herbicides (non-residual) can improve deposition and the level of control in the wheel tracks and adjacent areas
- Generally, dust is only reduced when soil moisture is present, speed is reduced or more permanent wheel tracks are used.

*Reduced travel speeds will generally decrease the level of dust raised by the sprayer to increase spray performance.*

### Factors contributing to a reduced level of weed control in the wheel tracks

Poor weed control in the wheel tracks of the sprayer can result from a number of factors, such as those below, which often interact with each other.

- The additional stress placed on the weeds due to the physical damage to the plant that occurs when they are run over. This leads to poorer uptake and translocation of many products.
- Poor deposition of spray resulting from droplets being pushed away from the wheel track by air displaced by the sprayer's tyres. This effect increases with increased travel speed, wider tyres and more aggressive lug patterns.
- Increased dust produced by higher travel speeds and dry soil can interact with many products on the leaf surface (such as glyphosate and paraquat), potentially reducing their efficacy.

These factors should not be confused with secondary germinations of weeds that may occur shortly after the application.

Secondary germinations occur as a result of increased contact between the soil and the weed seed when the weight on the sprayer's tyres acts to produce a 'press wheel' effect on the soil.

Careful monitoring of weed germinations after an application, particularly in the wheel track, is required to determine if this is contributing to apparent poor control.

### Timing of sprays and drift potential

It is common for many spray operators who have problems with dust during summer fallow spraying to spray when the wind speed is low and the soil surface is moist. Spraying after a rainfall event, provided the target weeds are not too wet, can result in excellent weed control.

However, many applicators also make applications during periods of low wind speed immediately after an early morning dew event and after a clear night. Unfortunately this is also a time where there is a very high risk that a surface

Level 1, Tourism House | 40 Blackall Street, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604 | T +61 2 6166 4500 | F +61 2 6166 4599 | E grdc@grdc.com.au | W www.grdc.com.au

# What can improve deposition around the wheels?

- Higher clearance sprayers
- Front mounted booms (up to 22 km/h)
- Wheel track Nozzles (for knockdowns)
- Narrower nozzle spacing (25cm vs 50cm), at least adjacent to the wheels
- Higher Application Volumes
- Slower travel speeds
- Mud guards & tread patterns?

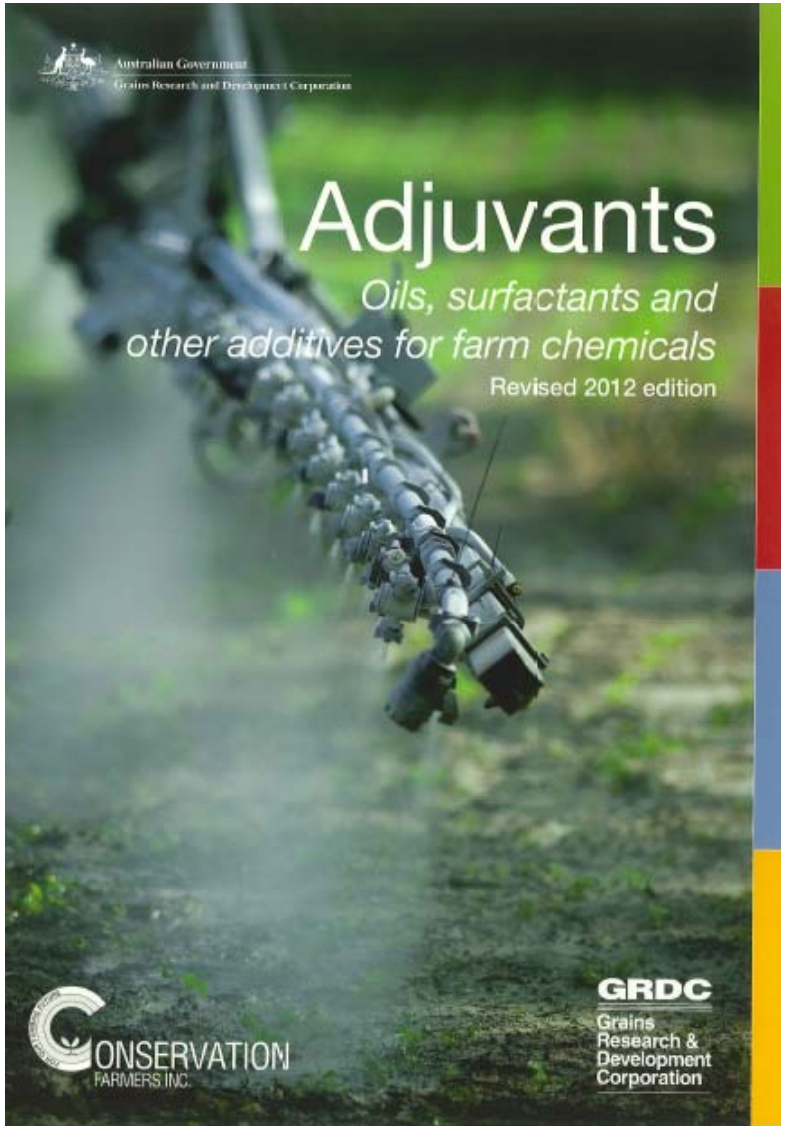
# What can improve droplet deposition into standing stubble ?

- A cross wind (wind direction is a big factor)
- Nozzles at the smaller end of the Coarse spectrum
- Narrower nozzle spacing (25cm vs 50cm)
- Higher water rates (>60L/ha, 80L/ha better!)
- Minimising boom height (but must be at least double overlap)
- Slower travel speeds

# Other things to consider

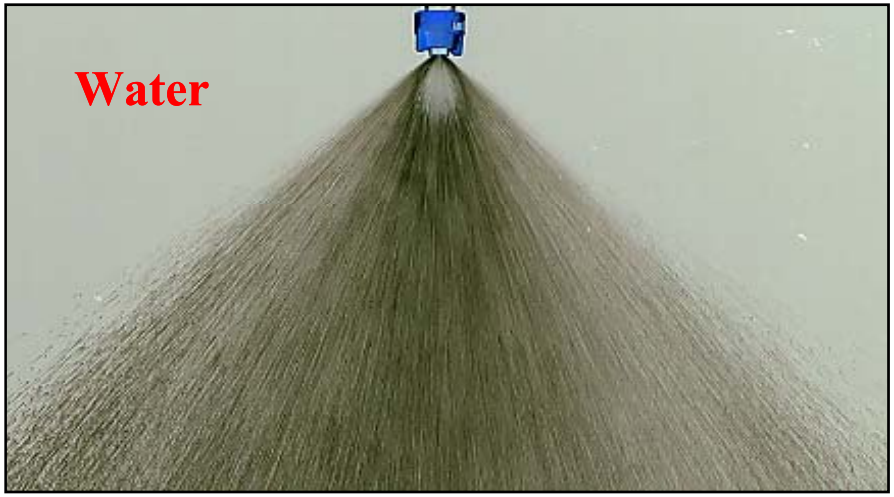
When selecting your nozzles and products, especially ***adjuvants***

...think about the impact that may have on the droplet size and drift potential?



# Adjuvants / Formulation affect Spray Uniformity

# & droplet size by changing the sheet



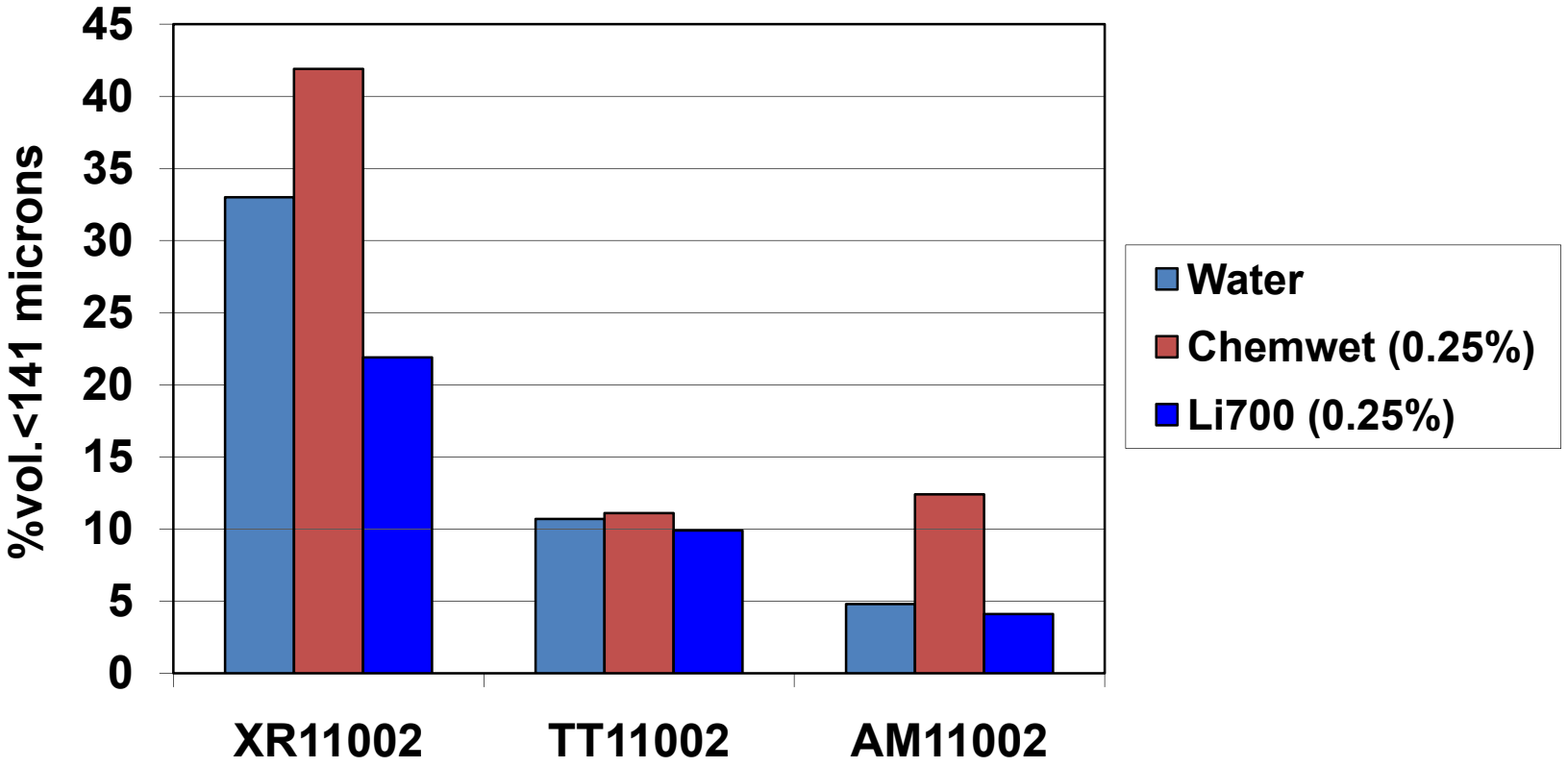



Source : FRI, New Zealand

# Adjuvants - effect on spray quality

**What is the key message on this graph ?**

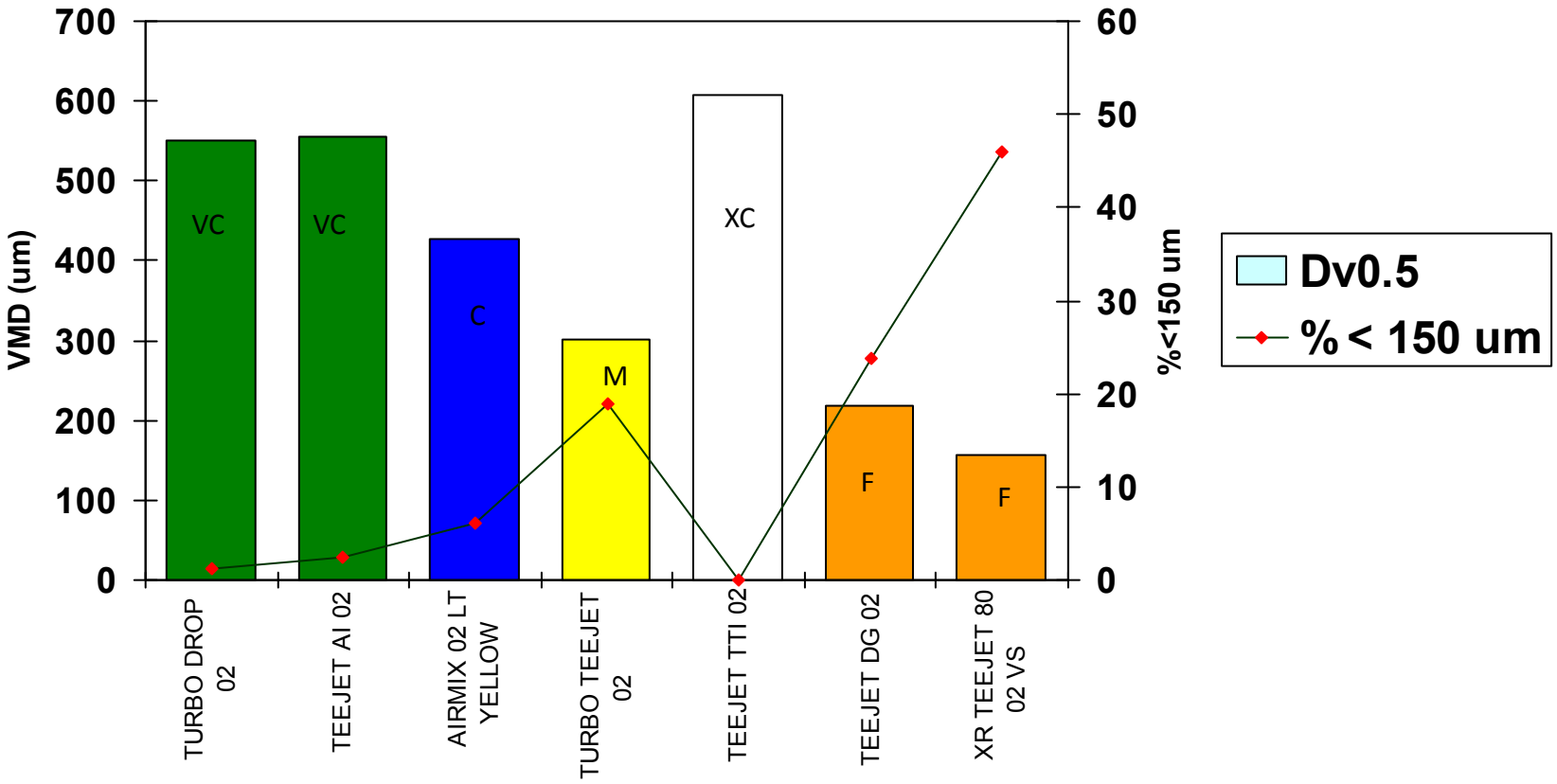
Ground application – 20 km/h, 200 kPa  Water + adjuvants




Source : Droplet Spectrum Analysis conducted for Nufarm by CPAS, 2003

# Nozzle selection with 2,4 D – low pressure

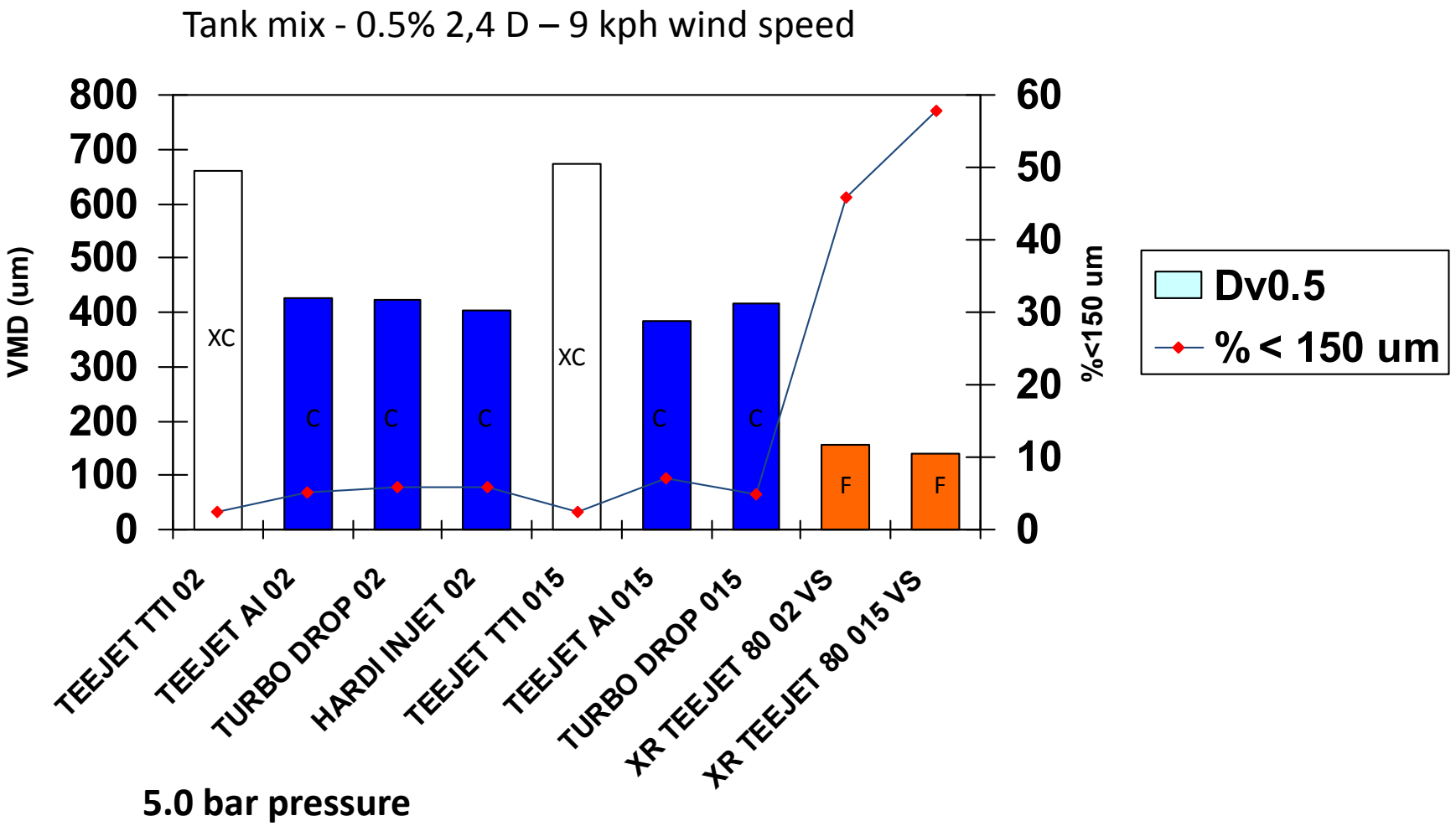
Tank mix - 0.5% 2,4 D – 9 kph wind speed




**2.75 bar pressure**

Source : C-PAS GRDC Project UQ 00032

# Nozzle selection with 2,4 D – high pressure




Source : C-PAS GRDC Project UQ 00032

# Water quality and Adjuvants

- pH (solubility, alkaline hydrolysis, stability)
- Hardness
  (Calcium, Magnesium, Bicarbonates)
- Turbidity (suspended solids)
- Salt (EC)
- Temperature

MARCH 2012

GRDC Grains Research & Development Corporation

**SPRAY WATER QUALITY**
FACT SHEET

**NORTHERN, SOUTHERN AND WESTERN REGIONS**

WATER QUALITY FOR SPRAYING OPERATIONS

**KEY POINTS**

- Poor water quality can adversely affect many products. Always consult product labels and the manufacturer's technical information about water quality requirements.
- Water testing should be done on a regular basis when using bore water, water from streams and rivers, reticulated (piped) water sourced from ground water, and water stored in unlined dams or concrete tanks.
- Water tests should analyse the following to be useful: pH, total hardness (including a measure of bi-carbonate levels) and total dissolved salts (TDS) or salinity (electrical conductivity).

Water quality test strips can be used to assess pH and water hardness in the field.

**Why test water quality?**

The quality of the water used for spraying operations can be critical to ensuring the best spray results for many farm chemicals. Many products can be affected by poor water quality.

When considering if the water quality is suitable for a particular product, you need to have accurate information about what may be present in the water that could affect the products you intend using.

The starting point should always be an accurate water test from a reputable laboratory and a thorough check of the product label and technical information from the manufacturer.

**What should tests measure?**

Water tests for spraying operations should include:

- pH;
- total hardness;
- bicarbonate levels; and
- either total dissolved salts (TDS) or salinity (EC or electrical conductivity).

While pH levels and total hardness can be assessed in the field using water test strips or simple titrations (jar tests), other measurements will typically require laboratory analysis.

If using test strips it may be useful to compare laboratory results to test strip results by wetting waste water collected for analysis to check the accuracy of the strips. The strips can then be used to assess if significant changes in water quality have occurred and when another laboratory test may be required.

Commonly available water test strips include those supplied by Hach Pty Ltd (ranging from simple pool test strips to more accurate individual test strips and titration kits) or individual pH and hardness test strips supplied by Rowe Scientific Pty Ltd.

Typically, these will be able to measure hardness or pH at varying levels of precision depending on the type of strips purchased. It is worth researching which may best suit your situation after receiving results from a laboratory.

# pH

- pH is a Logarithmic scale (10 x between units)

Acid 1 2 3 4 5 6 7 8 9 10 11 12 13 14 Alkaline



Unstable
Tank Mixes

neutral

Alkaline Hydrolysis
changes solubility
Poor droplet contact angle

- High pH's, due to the increased solubility of some salts tends to make problems with hardness even worse.

# Water hardness

- Mainly due to the presence of Calcium and Magnesium in the water, these are positively charged ions (cations)

+ Ca + + Mg +

- many products, like glyphosate are negatively charged and will bind with the cations.

- Gly -

MARCH 2012

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FACT SHEET

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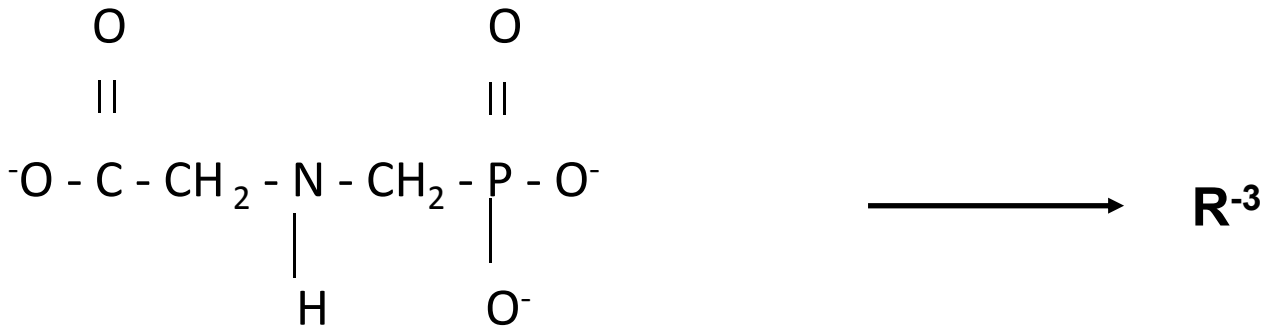
Typically, these will be able to measure hardness or pH at varying levels of precision depending on the type of strips purchased. It is worth researching which may best suit your situation after receiving results from a laboratory.

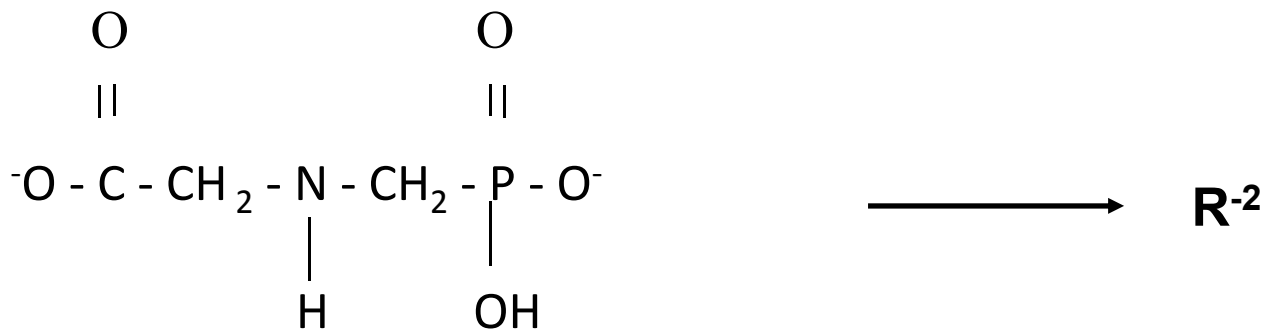
# GLYPHOSATE RESPONSE TO DECREASING THE pH OF THE SPRAY SOLUTION

Disassociation States

At pH 8 - 12, net charge: -3



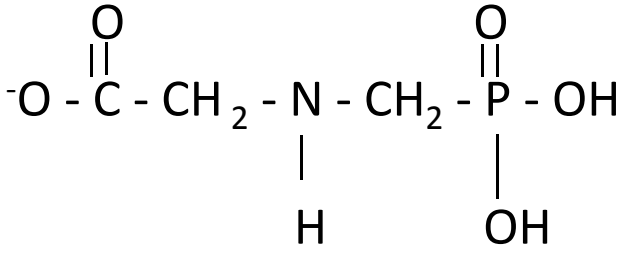

At pH 4 - 8, net charge: -2



# GLYPHOSATE RESPONSE TO DECREASING THE pH OF THE SPRAY SOLUTION

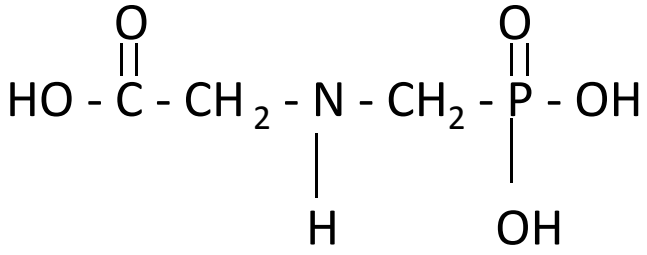
Dissociation State, continued

At pH 2.3 - 4, net charge: -1



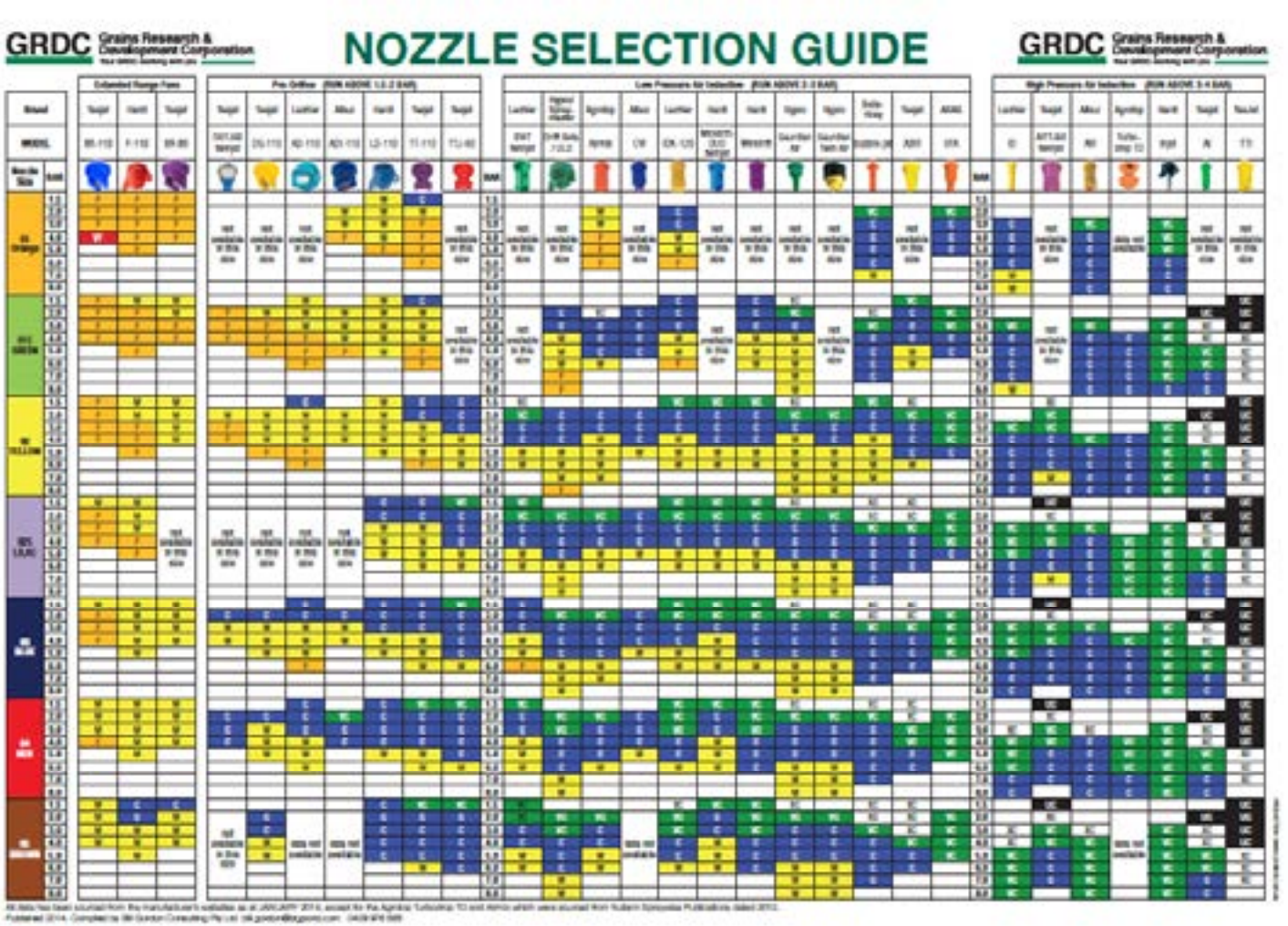
$R^{-1}$

Extremely low pH (<2), net charge: 0



$R^{0}$

# Nozzle Selection

| Nozzle Types | Images | Main Uses | Examples & Pressure Ranges | Drift Control: |
|---|---|---|---|---|
| ***Pre-orifice*** |  | Mostly used for in-crop spraying or for products requiring a medium spray quality. Larger orifices may produce coarse spray qualities at lower pressures (for sprayers with limited pressure *e.g. < 3 bar maximum*) | TeeJet® DG 2 - 4 bar,<br>HARDI ISO LD 1.5 - 5 bar<br>TeeJet® TT 1 - 6 bar<br>***best above 2 bar*** | ***Poor to Moderate.*** |
| ***Low Pressure Air Induction*** |  | Mostly used for fallow spraying and some in-crop spraying. Most produce a coarse spray quality, but some can produce a medium spray quality at higher pressures. | HARDI ISO MINIDRIFT<br>agrotop AirMix®<br>TeeJet® AIXR<br>Lechler IDK<br>2 - 5 or 6 bar,<br>***best above 3 bar*** | ***Moderate to Good*** |
| ***High Pressure Air Induction*** |  | Good for fallow spraying with fully translocated products and for pre-emergent applications.<br>Good drift control, mostly coarse to very coarse spray qualities. | TeeJet® AI,<br>HARDI INJET,<br>Lechler ID.<br>2 - 8 bar,<br>***best above 5 bar, never below 3 bar*** | ***Good to Very Good*** |
| ***Extended Range Flat Fans*** |  | Not legal for many herbicide applications. Larger orifices may be suitable for some foliar applications where a medium spray quality is required at higher volumes. | Hardi F,<br>TeeJet® XR<br>1 - 1.5 bar to<br>4 or 5 bar | ***VERY POOR*** |

# How many sets of nozzles do you need? (Broad-acre example).

| Typical Application Volume | Medium Spray Quality (lower drift risk areas) | Coarse Spray Quality | Extremely Coarse Spray Quality (higher drift risk areas) |
|---|---|---|---|
| **Lower range**<br>**50 -60 L/ha**<br>**(Low stubble load)**<br>**to**<br>**70-80 L/ha**<br>**(High stubble load)** | *Only where permitted on label:<br>Fully translocated herbicides<br>Small to medium sized targets. | Fallow Spraying<br>Fully translocated herbicides such as Glyphosate, MCPA.<br>Mandatory for 2,4-D, | Fully translocated herbicides, medium targets,<br>Very sensitive areas or NIGHT SPRAYING |
| **Higher range**<br>**70-80 L/ha**<br>**(Low stubble load)**<br>**to**<br>**100 + L/ha**<br>**(High stubble load/ dense crop canopy)** | *Only where permitted on label:<br>Contact type products.<br>Small targets.<br>In crop spraying.<br>Penetration and coverage in large & broadleaf crops. | Good stubble penetration.<br>Pre-emergent's.<br>Fully Translocated herbicides,<br>Some contact herbicides at the higher application volumes. | Pre-emergent's.<br>Medium sized targets with fully translocated summer fallow herbicides.<br>Very sensitive areas or NIGHT SPRAYING |

# An example of trying to find a suitable nozzle with a 36m @ 50cm nozzle spacing & automatic rate controller

( USING A STANDARD NOZZLE CHART FOR 50CM NOZZLE SPACING)

- Suppose I wanted to do a summer fallow spray for broadleaves & grasses with Roundup Attack and Amicide Advance 700 at a total volume of 75L/Ha with an average speed of 18 km/h.

- I have a few heavy patches and a couple of trees in the paddock, so I expect my speed might drop down several km/h.

## What nozzle/s could I use ?

| | | | speed (km/h) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **nozzle size** | **pressure** (bar) | **flowrate** (L/min/nozzle) | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** | **26** | **28** | **30** |
| **O1** 1 | 2 | 0.32 | 48 | 38 | 32 | 27 | 24 | 21 | 19 | 17 | 16 | 15 | 14 | 13 |
| | 3 | 0.39 | 59 | 47 | 39 | 33 | 29 | 26 | 23 | 21 | 20 | 18 | 17 | 16 |
| | 4 | 0.45 | 68 | 54 | 45 | 39 | 34 | 30 | 27 | 25 | 23 | 21 | 19 | 18 |
| | 5 | 0.5 | 75 | 60 | 50 | 43 | 38 | 33 | 30 | 27 | 25 | 23 | 21 | 20 |
| | 6 | 0.55 | 83 | 66 | 55 | 47 | 41 | 37 | 33 | 30 | 28 | 25 | 24 | 22 |
| | 7 | 0.59 | 89 | 71 | 59 | 51 | 44 | 39 | 35 | 32 | 30 | 27 | 25 | 24 |
| **O15** | 2 | 0.48 | 72 | 58 | 48 | 41 | 36 | 32 | 29 | 26 | 24 | 22 | 21 | 19 |
| | 3 | 0.59 | 88 | 70 | 59 | 50 | 44 | 39 | 35 | 32 | 29 | 27 | 25 | 23 |
| | 4 | 0.68 | 101 | 81 | 68 | 58 | 51 | 45 | 41 | 37 | 34 | 31 | 29 | 27 |
| | 5 | 0.75 | 113 | 90 | 75 | 64 | 56 | 50 | 45 | 41 | 38 | 35 | 32 | 30 |
| | 6 | 0.83 | 124 | 99 | 83 | 71 | 62 | 55 | 50 | 45 | 41 | 38 | 35 | 33 |
| | 7 | 0.89 | 133 | 106 | 89 | 76 | 66 | 59 | 53 | 48 | 44 | 41 | 38 | 35 |
| **O2** | 2 | 0.64 | 96 | 77 | 64 | 55 | 48 | 43 | 38 | 35 | 32 | 30 | 27 | 26 |
| | 3 | 0.78 | 117 | 94 | 78 | 67 | 59 | 52 | 47 | 43 | 39 | 36 | 33 | 31 |
| | 4 | 0.90 | 135 | 108 | 90 | 77 | 68 | 60 | 54 | 49 | 45 | 42 | 39 | 36 |
| | 5 | 1.00 | 150 | 120 | 100 | 86 | 75 | 67 | 60 | 55 | 50 | 46 | 43 | 40 |
| | 6 | 1.10 | 165 | 132 | 110 | 94 | 83 | 73 | 66 | 60 | 55 | 51 | 47 | 44 |
| | 7 | 1.18 | 177 | 142 | 118 | 101 | 89 | 79 | 71 | 64 | 59 | 54 | 51 | 47 |
| **O25** 2.5 | 2 | 0.80 | 120 | 96 | 80 | 69 | 60 | 53 | 48 | 44 | 40 | 37 | 34 | 32 |
| | 3 | 0.98 | 146 | 117 | 98 | 84 | 73 | 65 | 59 | 53 | 49 | 45 | 42 | 39 |
| | 4 | 1.13 | 169 | 135 | 113 | 96 | 84 | 75 | 68 | 61 | 56 | 52 | 48 | 45 |
| | 5 | 1.25 | 188 | 150 | 125 | 107 | 94 | 83 | 75 | 68 | 63 | 58 | 54 | 50 |
| | 6 | 1.38 | 206 | 165 | 138 | 118 | 103 | 92 | 83 | 75 | 69 | 63 | 59 | 55 |
| | 7 | 1.48 | 221 | 177 | 148 | 126 | 111 | 98 | 89 | 80 | 74 | 68 | 63 | 59 |
| **O3** 3 | 2 | 0.96 | 144 | 115 | 96 | 82 | 72 | 64 | 58 | 52 | 48 | 44 | 41 | 38 |
| | 3 | 1.17 | 176 | 140 | 117 | 100 | 88 | 78 | 70 | 64 | 59 | 54 | 50 | 47 |
| | 4 | 1.35 | 203 | 162 | 135 | 116 | 101 | 90 | 81 | 74 | 68 | 62 | 58 | 54 |
| | 5 | 1.50 | 225 | 180 | 150 | 129 | 113 | 100 | 90 | 82 | 75 | 69 | 64 | 60 |
| | 6 | 1.65 | 248 | 198 | 165 | 141 | 124 | 110 | 99 | 90 | 83 | 76 | 71 | 66 |
| | 7 | 1.77 | 266 | 212 | 177 | 152 | 133 | 118 | 106 | 97 | 89 | 82 | 76 | 71 |
| **O4** | 2 | 1.28 | 192 | 154 | 128 | 110 | 96 | 85 | 77 | 70 | 64 | 59 | 55 | 51 |
| | 3 | 1.56 | 234 | 187 | 156 | 134 | 117 | 104 | 94 | 85 | 78 | 72 | 67 | 62 |
| | 4 | 1.80 | 270 | 216 | 180 | 154 | 135 | 120 | 108 | 98 | 90 | 83 | 77 | 72 |
| | 5 | 2.00 | 300 | 240 | 200 | 171 | 150 | 133 | 120 | 109 | 100 | 92 | 86 | 80 |
| | 6 | 2.20 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 |
| | 7 | 2.36 | 354 | 283 | 236 | 202 | 177 | 157 | 142 | 129 | 118 | 109 | 101 | 94 |

# Spray Quality Information for Selected Nozzles

| Teejet AI | Bar | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | 7.0 | 8.0 |
| 01 | Not available in this size | | | | | | | | | | |
| 015 | UC | XC | XC | XC | XC | VC | VC | VC | VC | C | C |
| 02 | UC | XC | XC | XC | XC | VC | VC | VC | VC | C | C |
| 03 | UC | UC | XC | XC | XC | XC | VC | VC | VC | C | C |
| 04 | UC | UC | XC | XC | XC | XC | VC | VC | VC | C | C |

| Hardi ISO Injet | Bar | | | | | |
|---|---|---|---|---|---|---|
| | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 |
| 01 | VC | VC | VC | C | C | C |
| 015 | VC | VC | VC | VC | VC | C |
| 02 | VC | VC | VC | VC | VC | VC |
| 025 | VC | VC | VC | VC | VC | VC |
| 03 | VC | VC | VC | VC | VC | VC |

| TurboTeejt Induction (TTI) | Bar | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 |
| 015 | UC | UC | UC | UC | XC | XC | XC | XC | XC | XC | XC |
| 02 | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |
| 025 | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |
| 03 | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |
| 04 | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |

| Hardi ISO Minidrift | Bar | | | | | |
|---|---|---|---|---|---|---|
| | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 |
| 015 | C | C | C | C | M | M |
| 02 | VC | C | C | C | C | M |
| 025 | VC | VC | C | C | C | M |
| 03 | VC | VC | VC | C | C | C |
| 04 | VC | VC | VC | VC | C | C |

| AIXR TeeJet | Bar | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 |
| 015 | VC | C | C | C | C | M | M | M | M |
| 02 | VC | VC | C | C | C | C | C | M | M |
| 025 | XC | XC | VC | C | C | C | C | C | C |
| 03 | XC | XC | VC | VC | C | C | C | C | C |
| 04 | XC | XC | XC | VC | VC | VC | C | C | C |

| Hardi ISO LD | Bar | | | | | |
|---|---|---|---|---|---|---|
| | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 |
| 015 | M | M | M | M | M | M |
| 02 | M | M | M | M | M | M |
| 025 | C | C | M | M | M | M |
| 03 | C | C | C | C | M | M |
| 04 | C | C | C | C | C | M |

| TurboTeejet | Bar | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 |
| 015 | C | C | M | M | M | M | M | F | F | F | F |
| 02 | C | C | C | M | M | M | M | M | M | M | F |
| 025 | VC | C | C | M | M | M | M | M | M | M | M |
| 03 | VC | C | C | C | C | M | M | M | M | M | M |
| 04 | XC | VC | C | C | C | C | C | C | M | M | M |

| Hardi ISO F-110 | Bar | | | | | |
|---|---|---|---|---|---|---|
| | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 |
| 015 | M | F | F | F | F | F |
| 02 | M | M | F | F | F | F |
| 025 | M | M | M | M | F | F |
| 03 | M | M | M | M | M | M |
| 04 | M | M | M | M | M | M |

GRDC Grains Research & Development Corporation
Your GRDC working with you

# NOZZLE SELECTION GUIDE

GRDC Grains Research & Development Corporation
Your GRDC working with you

| Brand | | Extended Range Fans | | | Pre-Orifice (RUN ABOVE 1.5-2 BAR) | | | | | | | Low Pressure Air Induction (RUN ABOVE 2-3 BAR) | | | | | | | | | | | High Pressure Air Induction (RUN ABOVE 3-4 BAR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Teejet | Hardi | Teejet | Teejet | Teejet | Lechler | Albuz | Hardi | Teejet | Teejet | Lechler | Hypro/ Spray-master | Agrotop | Albuz | Lechler | Hardi | Hardi | Hypro | Hypro | Bolle-rissy | Teejet | ARAG | Lechler | Teejet | Albuz | Agrotop | Hardi | Teejet | TeeJet |
| MODEL | | XR-110 | F-110 | XR-80 | DGTJ60 twinjet | DG-110 | AD-110 | ADI-110 | LD-110 | TT-110 | TTJ-60 | IDKT twinjet | Drift Bete / ULD | Airmix | CVI | IDK-120 | Minidrift-DUO twinjet | Minidrift | Gaurdian Air | Gaurdian Twin Air | Bubble-Jet | ADR | SFA | ID | AITTJ60 twinjet | AVI | Turbo-drop TD | Injet | AI | TTI |
| Nozzle Size | BAR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 01 Orange | 1.5 | F | F | F | | | | | M | C | | | | | | | | | | | | | | | | | | | | |
| | 2.0 | F | F | F | | | | M | M | M | | | | M | | C | | | | | VC | | VC | | | | | | | |
| | 3.0 | F | F | F | not available in this size | not available in this size | not available in this size | M | M | F | not available in this size | not available in this size | not available in this size | M | not available in this size | C | not available in this size | not available in this size | not available in this size | not available in this size | C | not available in this size | C | C | not available in this size | VC | not available in this size | VC | not available in this size | not available in this size |
| | 4.0 | VF | F | F | | | | F | M | F | | | | F | | M | | | | | C | | C | C | | C | data not available | VC | | |
| | 5.0 | | F | | | | | | F | F | | | | F | | M | | | | | C | | C | C | | C | | VC | | |
| | 6.0 | | | | | | | | | F | | | | F | | F | | | | | C | | | C | | C | | C | | |
| | 7.0 | | | | | | | | | | | | | | | | | | | | M | | | M | | C | | C | | |
| | 8.0 | | | | | | | | | | | | | | | | | | | | | | | M | | C | | C | | |
| 015 GREEN | 1.5 | F | M | M | | | M | | M | C | | | | | | C | | C | XC | | | VC | | | | | | | | UC |
| | 2.0 | F | F | M | F | M | M | M | M | M | | | C | XC | C | C | | C | VC | | XC | C | VC | | | | | UC | UC |
| | 3.0 | F | F | F | F | F | M | M | M | M | not available in this size | not available in this size | C | C | C | C | not available in this size | C | C | not available in this size | VC | C | VC | VC | | VC | | VC | XC | UC |
| | 4.0 | F | F | F | F | F | F | M | M | M | | | M | C | C | M | | M | M | | C | C | C | C | | C | C | VC | XC | XC |
| | 5.0 | | F | | | F | F | F | M | F | | | M | C | C | M | | M | M | | C | M | C | C | | C | C | VC | VC | XC |
| | 6.0 | | | | | | F | | | F | | | M | M | | F | | M | M | | C | M | | C | | C | C | VC | VC | XC |
| | 7.0 | | | | | | | | | | | | F | | | | | | M | | C | | | C | | C | C | VC | C | XC |
| | 8.0 | | | | | | | | | | | | F | | | | | | M | | | | | M | | C | C | C | C | |
| 02 YELLOW | 1.5 | F | M | M | | | C | | M | C | C | XC | | | | VC | VC | VC | XC | | VC | XC | | 1.5 | | XC | | | | UC |
| | 2.0 | F | M | M | M | M | M | M | M | C | C | VC | C | C | C | C | C | C | VC | VC | C | VC | VC | 2.0 | | VC | | | UC | UC |
| | 3.0 | F | F | M | F | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C | C | C | VC | 3.0 | VC | VC | | | VC | XC | UC |
| | 4.0 | F | F | M | F | M | M | M | M | M | M | C | C | C | C | M | C | C | M | C | M | C | VC | 4.0 | C | C | VC | C | VC | XC | UC |
| | 5.0 | | F | | | F | F | | M | M | M | M | M | M | M | M | M | M | M | M | M | C | C | 5.0 | C | C | C | C | VC | VC | XC |
| | 6.0 | | | | | | F | | | F | M | M | M | M | | M | M | M | M | M | M | M | | 6.0 | C | C | C | C | VC | VC | XC |
| | 7.0 | | | | | | | | | | | | M | M | | | | | M | M | M | | | 7.0 | C | M | C | C | VC | C | XC |
| | 8.0 | | | | | | | | | | | | F | | | | | | M | M | | | | 8.0 | C | | C | C | VC | C | |
| 025 LILAC | 1.5 | M | M | | | | | | C | C | VC | VC | | | | VC | VC | VC | XC | | XC | XC | | 1.5 | | UC | | | | | UC |
| | 2.0 | F | M | | | | | | C | C | C | VC | VC | VC | C | VC | VC | VC | VC | VC | XC | XC | VC | 2.0 | | XC | | | UC | UC | UC |
| | 3.0 | F | M | | | | | | M | M | C | C | C | C | C | C | C | C | C | C | VC | VC | VC | 3.0 | VC | VC | VC | | VC | XC | UC |
| | 4.0 | F | F | not available in this size | not available in this size | not available in this size | not available in this size | not available in this size | M | M | C | C | C | C | C | C | C | C | C | C | C | C | VC | 4.0 | VC | VC | C | VC | VC | XC | UC |
| | 5.0 | | F | | | | | | M | M | M | M | C | M | M | M | M | M | C | C | C | C | C | 5.0 | VC | C | C | VC | VC | VC | XC |
| | 6.0 | | | | | | | | | M | M | M | C | M | M | M | M | M | M | M | C | C | | 6.0 | C | C | C | VC | VC | VC | XC |
| | 7.0 | | | | | | | | | | | | M | | | | | | M | M | C | | | 7.0 | C | M | C | VC | VC | C | XC |
| | 8.0 | | | | | | | | | | | | M | | | | | | M | M | | | | 8.0 | C | | C | VC | VC | C | |
| 03 BLUE | 1.5 | M | M | M | | | C | | C | C | VC | C | | | | VC | VC | VC | XC | | XC | XC | | 1.5 | | UC | | | | | UC |
| | 2.0 | F | M | M | C | C | C | C | C | C | C | C | VC | VC | C | VC | VC | VC | VC | VC | XC | XC | VC | 2.0 | | XC | | | UC | UC | UC |
| | 3.0 | F | M | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C | C | C | VC | VC | VC | 3.0 | VC | VC | VC | | VC | XC | UC |
| | 4.0 | F | M | M | M | M | M | M | M | M | C | C | M | C | C | C | C | M | C | C | C | C | VC | 4.0 | VC | VC | C | VC | VC | XC | UC |
| | 5.0 | | M | | | M | M | | M | M | C | C | M | C | C | M | M | M | C | C | C | C | VC | 5.0 | VC | C | C | C | VC | VC | XC |
| | 6.0 | | | | | | F | | | M | M | C | M | M | | M | M | C | M | M | C | C | | 6.0 | C | C | C | C | VC | VC | XC |
| | 7.0 | | | | | | | | | | | C | M | M | | | | | M | M | C | | | 7.0 | C | C | C | C | VC | C | XC |
| | 8.0 | | | | | | | | | | | C | M | | | | | | M | M | | | | 8.0 | C | | C | C | VC | C | |
| 04 RED | 1.5 | M | M | M | | | C | | C | VC | VC | VC | | | | VC | VC | VC | XC | | XC | XC | | 1.5 | | UC | | | | | UC |
| | 2.0 | M | M | M | C | C | C | VC | C | C | C | C | VC | VC | C | VC | C | VC | VC | VC | VC | XC | VC | 2.0 | | XC | | | UC | UC | UC |
| | 3.0 | M | M | M | C | M | C | C | C | C | C | C | VC | C | C | VC | C | VC | C | C | C | VC | VC | 3.0 | XC | VC | XC | | VC | XC | UC |
| | 4.0 | F | M | M | C | M | M | C | C | C | C | M | C | C | C | C | M | C | C | C | C | VC | VC | 4.0 | VC | VC | C | VC | VC | XC | UC |
| | 5.0 | | M | | | M | M | | M | M | C | M | C | C | M | C | M | C | C | C | C | C | VC | 5.0 | VC | C | C | VC | VC | VC | XC |
| | 6.0 | | | | | | M | | | M | M | M | C | M | | M | M | C | M | M | C | C | | 6.0 | VC | C | C | VC | VC | VC | XC |
| | 7.0 | | | | | | | | | | | | M | | | | | | M | M | C | | | 7.0 | C | C | C | C | VC | C | XC |
| | 8.0 | | | | | | | | | | | | M | | | | | | M | M | | | | 8.0 | C | | C | C | VC | C | |
| 05 BROWN | 1.5 | M | C | C | | | | | C | VC | VC | VC | | | | XC | VC | VC | XC | | XC | XC | | 1.5 | | UC | | | | | UC |
| | 2.0 | M | C | M | | C | | | C | C | C | VC | VC | VC | | VC | C | VC | VC | VC | XC | XC | VC | 2.0 | | XC | | | UC | UC | UC |
| | 3.0 | M | M | M | not available in this size | C | | | C | C | C | C | VC | C | | VC | C | VC | C | C | VC | XC | VC | 3.0 | XC | VC | XC | | VC | XC | UC |
| | 4.0 | M | M | M | | M | data not available | data not available | C | C | C | C | C | C | data not available | C | M | C | C | C | C | VC | VC | 4.0 | XC | VC | VC | data not available | VC | XC | UC |
| | 5.0 | | M | | | M | | | C | C | C | C | C | M | | C | M | C | C | C | C | C | VC | 5.0 | VC | C | VC | | VC | VC | XC |
| | 6.0 | | | | | | | | | M | C | C | C | M | | M | M | C | M | M | C | C | | 6.0 | VC | C | VC | | VC | VC | XC |
| | 7.0 | | | | | | | | | | | | M | | | | | | M | M | C | | | 7.0 | VC | C | VC | | VC | C | XC |
| | 8.0 | | | | | | | | | | | | M | | | | | | M | M | | | | 8.0 | VC | | VC | | VC | C | |

All data has been sourced from the manufacturer's websites as at JANUARY 2014, except for the Agrotop Turbodrop TD and Airmix which were sourced from Nufarm Spraywise Publications dated 2012.

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| Nozzle Spacing on the Boom: | | Average Speed (km/h) | | Application Volume (L/ha) | | Spray Quality Required | |
|---|---|---|---|---|---|---|---|
| Number of Nozzles on the Boom: | | | | | | | |

## Speed & Spray Quality: Compare up to *Three Nozzle Size and Pressure Choices* for the selected L/ha

| *Give an Example of a* ***HIGH PRESSURE AIR INDUCTION*** *nozzle* | | | ***Pressure*** | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Orifice Size*** | ***Pressure (BAR)*** | ***Name of the Nozzle Chosen*** | ***Speed*** | | | | | | | |
| | | | ***Spray Quality*** | | | | | | | |

| *Give an Example of a* ***LOW PRESSURE AIR INDUCTION*** *nozzle* | | | ***Pressure*** | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Orifice Size*** | ***Pressure (BAR)*** | ***Name of the Nozzle Chosen*** | ***Speed*** | | | | | | | |
| | | | ***Spray Quality*** | | | | | | | |

| *Give an Example of a* ***PRE-ORIFICE or XR FAN*** *nozzle* | | | ***Pressure*** | 1.5 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Orifice Size*** | ***Pressure (BAR)*** | ***Name of the Nozzle Chosen*** | ***Speed*** | | | | | | | |
| | | | ***Spray Quality*** | | | | | | | |

Select **ONE** of these nozzles and determine what the **minimum speed and controller settings** should be for this nozzle

| ***Name of Nozzle Chosen*** | ***Suggested Minimum Pressure*** | ***Determine Minimum Speed (km/h)*** *from the nozzle chart* | ***Calculate the Total Flowrate (L/min) through the boom at the minimum pressure = (L/min/nozzle @ min. pressure X the no. of nozzles on the boom)*** |
|---|---|---|---|
| | | | |

| | | | speed (km/h) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **nozzle size** | **pressure** (bar) | **flowrate** (L/min/nozzle) | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** | **26** | **28** | **30** |
| **O1** 1 | 2 | 0.32 | 48 | 38 | 32 | 27 | 24 | 21 | 19 | 17 | 16 | 15 | 14 | 13 |
| | 3 | 0.39 | 59 | 47 | 39 | 33 | 29 | 26 | 23 | 21 | 20 | 18 | 17 | 16 |
| | 4 | 0.45 | 68 | 54 | 45 | 39 | 34 | 30 | 27 | 25 | 23 | 21 | 19 | 18 |
| | 5 | 0.5 | 75 | 60 | 50 | 43 | 38 | 33 | 30 | 27 | 25 | 23 | 21 | 20 |
| | 6 | 0.55 | 83 | 66 | 55 | 47 | 41 | 37 | 33 | 30 | 28 | 25 | 24 | 22 |
| | 7 | 0.59 | 89 | 71 | 59 | 51 | 44 | 39 | 35 | 32 | 30 | 27 | 25 | 24 |
| **O15** | 2 | 0.48 | 72 | 58 | 48 | 41 | 36 | 32 | 29 | 26 | 24 | 22 | 21 | 19 |
| | 3 | 0.59 | 88 | 70 | 59 | 50 | 44 | 39 | 35 | 32 | 29 | 27 | 25 | 23 |
| | 4 | 0.68 | 101 | 81 | 68 | 58 | 51 | 45 | 41 | 37 | 34 | 31 | 29 | 27 |
| | 5 | 0.75 | 113 | 90 | 75 | 64 | 56 | 50 | 45 | 41 | 38 | 35 | 32 | 30 |
| | 6 | 0.83 | 124 | 99 | 83 | 71 | 62 | 55 | 50 | 45 | 41 | 38 | 35 | 33 |
| | 7 | 0.89 | 133 | 106 | 89 | 76 | 66 | 59 | 53 | 48 | 44 | 41 | 38 | 35 |
| **O2** | 2 | 0.64 | 96 | 77 | 64 | 55 | 48 | 43 | 38 | 35 | 32 | 30 | 27 | 26 |
| | 3 | 0.78 | 117 | 94 | 78 | 67 | 59 | 52 | 47 | 43 | 39 | 36 | 33 | 31 |
| | 4 | 0.90 | 135 | 108 | 90 | 77 | 68 | 60 | 54 | 49 | 45 | 42 | 39 | 36 |
| | 5 | 1.00 | 150 | 120 | 100 | 86 | 75 | 67 | 60 | 55 | 50 | 46 | 43 | 40 |
| | 6 | 1.10 | 165 | 132 | 110 | 94 | 83 | 73 | 66 | 60 | 55 | 51 | 47 | 44 |
| | 7 | 1.18 | 177 | 142 | 118 | 101 | 89 | 79 | 71 | 64 | 59 | 54 | 51 | 47 |
| **O25** 2.5 | 2 | 0.80 | 120 | 96 | 80 | 69 | 60 | 53 | 48 | 44 | 40 | 37 | 34 | 32 |
| | 3 | 0.98 | 146 | 117 | 98 | 84 | 73 | 65 | 59 | 53 | 49 | 45 | 42 | 39 |
| | 4 | 1.13 | 169 | 135 | 113 | 96 | 84 | 75 | 68 | 61 | 56 | 52 | 48 | 45 |
| | 5 | 1.25 | 188 | 150 | 125 | 107 | 94 | 83 | 75 | 68 | 63 | 58 | 54 | 50 |
| | 6 | 1.38 | 206 | 165 | 138 | 118 | 103 | 92 | 83 | 75 | 69 | 63 | 59 | 55 |
| | 7 | 1.48 | 221 | 177 | 148 | 126 | 111 | 98 | 89 | 80 | 74 | 68 | 63 | 59 |
| **O3** 3 | 2 | 0.96 | 144 | 115 | 96 | 82 | 72 | 64 | 58 | 52 | 48 | 44 | 41 | 38 |
| | 3 | 1.17 | 176 | 140 | 117 | 100 | 88 | 78 | 70 | 64 | 59 | 54 | 50 | 47 |
| | 4 | 1.35 | 203 | 162 | 135 | 116 | 101 | 90 | 81 | 74 | 68 | 62 | 58 | 54 |
| | 5 | 1.50 | 225 | 180 | 150 | 129 | 113 | 100 | 90 | 82 | 75 | 69 | 64 | 60 |
| | 6 | 1.65 | 248 | 198 | 165 | 141 | 124 | 110 | 99 | 90 | 83 | 76 | 71 | 66 |
| | 7 | 1.77 | 266 | 212 | 177 | 152 | 133 | 118 | 106 | 97 | 89 | 82 | 76 | 71 |
| **O4** | 2 | 1.28 | 192 | 154 | 128 | 110 | 96 | 85 | 77 | 70 | 64 | 59 | 55 | 51 |
| | 3 | 1.56 | 234 | 187 | 156 | 134 | 117 | 104 | 94 | 85 | 78 | 72 | 67 | 62 |
| | 4 | 1.80 | 270 | 216 | 180 | 154 | 135 | 120 | 108 | 98 | 90 | 83 | 77 | 72 |
| | 5 | 2.00 | 300 | 240 | 200 | 171 | 150 | 133 | 120 | 109 | 100 | 92 | 86 | 80 |
| | 6 | 2.20 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 |
| | 7 | 2.36 | 354 | 283 | 236 | 202 | 177 | 157 | 142 | 129 | 118 | 109 | 101 | 94 |

| Nozzle Spacing on the Boom: | | Average Speed (km/h) | | Application Volume (L/ha) | | Spray Quality Required | |
|---|---|---|---|---|---|---|---|
| Number of Nozzles on the Boom: | | | | | | | |

## Average Speed: Compare up to *Three Nozzle Size and Pressure Choices* for the selected L/ha

| *Give an Example of a* ***HIGH PRESSURE AIR INDUCTION*** *nozzle* | | | ***Pressure*** | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Orifice Size*** | ***Pressure (BAR)*** | ***Name of the Nozzle Chosen*** | ***Speed*** | | | | | | | |
| | | | ***Spray Quality*** | | | | | | | |

| *Give an Example of a* ***LOW PRESSURE AIR INDUCTION*** *nozzle* | | | ***Pressure*** | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Orifice Size*** | ***Pressure (BAR)*** | ***Name of the Nozzle Chosen*** | ***Speed*** | | | | | | | |
| | | | ***Spray Quality*** | | | | | | | |

| *Give an Example of a* ***PRE-ORIFICE or XR FAN*** *nozzle* | | | ***Pressure*** | 1.5 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Orifice Size*** | ***Pressure (BAR)*** | ***Name of the Nozzle Chosen*** | ***Speed*** | | | | | | | |
| | | | ***Spray Quality*** | | | | | | | |

Select **ONE** of these nozzles and determine what the **minimum speed and controller settings** should be for this nozzle

| ***Name of Nozzle Chosen*** | ***Suggested Minimum Pressure*** | ***Determine Minimum Speed (km/h)*** *from the nozzle chart* | ***Calculate the Total Flowrate (L/min) through the boom at the minimum pressure = (L/min/nozzle @ min. pressure X the no. of nozzles on the boom)*** |
|---|---|---|---|
| | | | |

ozzle spacing in (m enter → 0.5

speed (km/h)

| nozzle size | pressure (bar) | flowrate (L/min/nozzle) | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O1 1 | 2 | 0.32 | 48 | 38 | 32 | 27 | 24 | 21 | 19 | 17 | 16 | 15 | 14 | 13 |
| | 3 | 0.39 | 59 | 47 | 39 | 33 | 29 | 26 | 23 | 21 | 20 | 18 | 17 | 16 |
| | 4 | 0.45 | 68 | 54 | 45 | 39 | 34 | 30 | 27 | 25 | 23 | 21 | 19 | 18 |
| | 5 | 0.5 | 75 | 60 | 50 | 43 | 38 | 33 | 30 | 27 | 25 | 23 | 21 | 20 |
| | 6 | 0.55 | 83 | 66 | 55 | 47 | 41 | 37 | 33 | 30 | 28 | 25 | 24 | 22 |
| | 7 | 0.59 | 89 | 71 | 59 | 51 | 44 | 39 | 35 | 32 | 30 | 27 | 25 | 24 |
| O15 | 2 | 0.48 | 72 | 58 | 48 | 41 | 36 | 32 | 29 | 26 | 24 | 22 | 21 | 19 |
| | 3 | 0.59 | 88 | 70 | 59 | 50 | 44 | 39 | 35 | 32 | 29 | 27 | 25 | 23 |
| | 4 | 0.68 | 101 | 81 | 68 | 58 | 51 | 45 | 41 | 37 | 34 | 31 | 29 | 27 |
| | 5 | 0.75 | 113 | 90 | 75 | 64 | 56 | 50 | 45 | 41 | 38 | 35 | 32 | 30 |
| | 6 | 0.83 | 124 | 99 | 83 | 71 | 62 | 55 | 50 | 45 | 41 | 38 | 35 | 33 |
| | 7 | 0.89 | 133 | 106 | 89 | 76 | 66 | 59 | 53 | 48 | 44 | 41 | 38 | 35 |
| O2 | 2 | 0.64 | 96 | 77 | 64 | 55 | 48 | 43 | 38 | 35 | 32 | 30 | 27 | 26 |
| | 3 | **0.78** | 117 | [illegible] | 78 | 67 | 59 | 52 | 47 | 43 | 39 | 36 | 33 | 31 |
| | 4 | 0.90 | 135 | 108 | 90 | 77 | 68 | 60 | 54 | 49 | 45 | 42 | 39 | 36 |
| | 5 | 1.00 | 150 | 120 | 100 | 86 | 75 | 67 | 60 | 55 | 50 | 46 | 43 | 40 |
| | 6 | 1.10 | 165 | 132 | 110 | 94 | 83 | 73 | 66 | 60 | 55 | 51 | 47 | 44 |
| | 7 | 1.18 | 177 | 142 | 118 | 101 | 89 | 79 | 71 | 64 | 59 | 54 | 51 | 47 |
| O25 2.5 | 2 | **0.80** | 120 | [illegible] | 80 | 69 | 60 | 53 | 48 | 44 | 40 | 37 | 34 | 32 |
| | 3 | 0.98 | 146 | 117 | 98 | 84 | 73 | 65 | 59 | 53 | 49 | 45 | 42 | 39 |
| | 4 | 1.13 | 169 | 135 | 113 | 96 | 84 | 75 | 68 | 61 | 56 | 52 | 48 | 45 |
| | 5 | 1.25 | 188 | 150 | 125 | 107 | 94 | 83 | 75 | 68 | 63 | 58 | 54 | 50 |
| | 6 | 1.38 | 206 | 165 | 138 | 118 | 103 | 92 | 83 | 75 | 69 | 63 | 59 | 55 |
| | 7 | 1.48 | 221 | 177 | 148 | 126 | 111 | 98 | 89 | 80 | 74 | 68 | 63 | 59 |
| O3 3 | 2 | **0.96** | 144 | 115 | 96 | 82 | 72 | 64 | 58 | 52 | 48 | 44 | 41 | 38 |
| | 3 | 1.17 | 176 | 140 | 117 | 100 | 88 | 78 | 70 | 64 | 59 | 54 | 50 | 47 |
| | 4 | 1.35 | 203 | 162 | 135 | 116 | 101 | 90 | 81 | 74 | 68 | 62 | 58 | 54 |
| | 5 | 1.50 | 225 | 180 | 150 | 129 | 113 | 100 | 90 | 82 | 75 | 69 | 64 | 60 |
| | 6 | 1.65 | 248 | 198 | 165 | 141 | 124 | 110 | 99 | 90 | 83 | 76 | 71 | 66 |
| | 7 | 1.77 | 266 | 212 | 177 | 152 | 133 | 118 | 106 | 97 | 89 | 82 | 76 | 71 |
| O4 | 2 | 1.28 | 192 | 154 | 128 | 110 | 96 | 85 | 77 | 70 | 64 | 59 | 55 | 51 |
| | 3 | 1.56 | 234 | 187 | 156 | 134 | 117 | 104 | 94 | 85 | 78 | 72 | 67 | 62 |
| | 4 | 1.80 | 270 | 216 | 180 | 154 | 135 | 120 | 108 | 98 | 90 | 83 | 77 | 72 |
| | 5 | 2.00 | 300 | 240 | 200 | 171 | 150 | 133 | 120 | 109 | 100 | 92 | 86 | 80 |
| | 6 | 2.20 | 330 | 264 | 220 | 189 | 165 | 147 | 132 | 120 | 110 | 102 | 94 | 88 |

# Spray Quality Information for Selected Nozzles

| Teejet AI | Bar | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | 7.0 | 8.0 |
| 01 | Not available in this size | | | | | | | | | | |
| 015 | UC | XC | XC | XC | XC | VC | VC | VC | VC | C | C |
| 02 | UC | XC | XC | XC | XC | VC | VC | VC | VC | C | C |
| 03 | UC | UC | XC | XC | XC | XC | VC | VC | VC | C | C |
| 04 | UC | UC | XC | XC | XC | XC | VC | VC | VC | C | C |

| Hardi ISO Injet | Bar | | | | | |
|---|---|---|---|---|---|---|
| | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 |
| 01 | VC | VC | VC | C | C | C |
| 015 | VC | VC | VC | VC | VC | C |
| 02 | VC | VC | VC | VC | VC | VC |
| 025 | VC | VC | VC | VC | VC | VC |
| 03 | VC | VC | VC | VC | VC | VC |

| TurboTeejt Induction (TTI) | Bar | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 |
| 015 | UC | UC | UC | UC | XC | XC | XC | XC | XC | XC | XC |
| 02 | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |
| 025 | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |
| 03 | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |
| 04 | UC | UC | UC | UC | UC | UC | XC | XC | XC | XC | XC |

| Hardi ISO Minidrift | Bar | | | | | |
|---|---|---|---|---|---|---|
| | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 |
| 015 | C | C | C | C | M | M |
| 02 | VC | C | C | C | C | M |
| 025 | VC | VC | C | C | C | M |
| 03 | VC | VC | VC | C | C | C |
| 04 | VC | VC | VC | VC | C | C |

| AIXR TeeJet | Bar | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 |
| 015 | VC | C | C | C | C | M | M | M | M |
| 02 | VC | VC | C | C | C | C | C | M | M |
| 025 | XC | XC | VC | C | C | C | C | C | C |
| 03 | XC | XC | VC | VC | C | C | C | C | C |
| 04 | XC | XC | XC | VC | VC | VC | C | C | C |

| Hardi ISO LD | Bar | | | | | |
|---|---|---|---|---|---|---|
| | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 |
| 015 | M | M | M | M | M | M |
| 02 | M | M | M | M | M | M |
| 025 | C | C | M | M | M | M |
| 03 | C | C | C | C | M | M |
| 04 | C | C | C | C | C | M |

| TurboTeejet | Bar | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 |
| 015 | C | C | M | M | M | M | M | F | F | F | F |
| 02 | C | C | C | M | M | M | M | M | M | M | F |
| 025 | VC | C | C | M | M | M | M | M | M | M | M |
| 03 | VC | C | C | C | C | M | M | M | M | M | M |
| 04 | XC | VC | C | C | C | C | C | C | M | M | M |

| Hardi ISO F-110 | Bar | | | | | |
|---|---|---|---|---|---|---|
| | 1.5 | 2.0 | 2.5 | 3.0 | 4.0 | 5.0 |
| 015 | M | F | F | F | F | F |
| 02 | M | M | F | F | F | F |
| 025 | M | M | M | M | F | F |
| 03 | M | M | M | M | M | M |
| 04 | M | M | M | M | M | M |

# What are your nozzle choices?

| Typical Application Volume | Medium Spray Quality (lower drift risk areas) | Coarse Spray Quality | Extremely Coarse Spray Quality (higher drift risk areas) |
|---|---|---|---|
| **Your Lower range**<br><br>**(Low stubble load)**<br><br>**(High stubble load)** | *Only where permitted on label:<br><br>Fully translocated herbicides<br>Small to medium sized targets. | Fallow Spraying<br>Fully translocated herbicides such as Glyphosate, MCPA.<br>Mandatory for 2,4-D, | Fully translocated herbicides, medium targets,<br>Very sensitive areas or<br>NIGHT SPRAYING |
| **Your Higher range**<br><br>**(Low stubble load)**<br>**To**<br><br>**(High stubble load/ dense crop canopy)** | *Only where permitted on label:<br><br>Contact type products.<br>Small targets.<br>In crop spraying.<br>Penetration and coverage in large & broadleaf crops. | Good stubble penetration.<br><br>Pre-emergent's.<br>Fully Translocated herbicides,<br>Some contact herbicides at the higher application volumes. | Pre-emergent's.<br><br>Medium sized targets with fully translocated summer fallow herbicides.<br>Very sensitive areas or<br>NIGHT SPRAYING |

| | | . | speed (km/h) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **nozzle size** | **pressure** (bar) | **flowrate** (L / min /nozzle) | **6** | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** | **26** | **28** | **30** | **32** |
| 0 1 | 2 | 0.32 | 64.0 | 48.0 | 38.4 | 32.0 | 27.4 | 24.0 | 21.3 | 19.2 | 17.5 | 16.0 | 14.8 | 13.7 | 12.8 | 12.0 |
| | 3 | 0.39 | 78.0 | 58.5 | 46.8 | 39.0 | 33.4 | 29.3 | 26.0 | 23.4 | 21.3 | 19.5 | 18.0 | 16.7 | 15.6 | 14.6 |
| | 4 | 0.45 | 90.0 | 67.5 | 54.0 | 45.0 | 38.6 | 33.8 | 30.0 | 27.0 | 24.5 | 22.5 | 20.8 | 19.3 | 18.0 | 16.9 |
| | 5 | 0.5 | 100.0 | 75.0 | 60.0 | 50.0 | 42.9 | 37.5 | 33.3 | 30.0 | 27.3 | 25.0 | 23.1 | 21.4 | 20.0 | 18.8 |
| | 6 | 0.55 | 110.0 | 82.5 | 66.0 | 55.0 | 47.1 | 41.3 | 36.7 | 33.0 | 30.0 | 27.5 | 25.4 | 23.6 | 22.0 | 20.6 |
| | 7 | 0.59 | 118.0 | 88.5 | 70.8 | 59.0 | 50.6 | 44.3 | 39.3 | 35.4 | 32.2 | 29.5 | 27.2 | 25.3 | 23.6 | 22.1 |
| | | | | | | | | | | | | | | | | |
| 0 1.5 | 2 | 0.48 | 96.0 | 72.0 | 57.6 | 48.0 | 41.1 | 36.0 | 32.0 | 28.8 | 26.2 | 24.0 | 22.2 | 20.6 | 19.2 | 18.0 |
| | 3 | 0.59 | 117.0 | 87.8 | 70.2 | 58.5 | 50.1 | 43.9 | 39.0 | 35.1 | 31.9 | 29.3 | 27.0 | 25.1 | 23.4 | 21.9 |
| | 4 | 0.68 | 135.0 | 101.3 | 81.0 | 67.5 | 57.9 | 50.6 | 45.0 | 40.5 | 36.8 | 33.8 | 31.2 | 28.9 | 27.0 | 25.3 |
| | 5 | 0.75 | 150.0 | 112.5 | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 | 34.6 | 32.1 | 30.0 | 28.1 |
| | 6 | 0.83 | 165.0 | 123.8 | 99.0 | 82.5 | 70.7 | 61.9 | 55.0 | 49.5 | 45.0 | 41.3 | 38.1 | 35.4 | 33.0 | 30.9 |
| | 7 | 0.89 | 177.0 | 132.8 | 106.2 | 88.5 | 75.9 | 66.4 | 59.0 | 53.1 | 48.3 | 44.3 | 40.8 | 37.9 | 35.4 | 33.2 |
| | | | | | | | | | | | | | | | | |
| 0 2 | 2 | 0.64 | 128.0 | 96.0 | 76.8 | 64.0 | 54.9 | 48.0 | 42.7 | 38.4 | 34.9 | 32.0 | 29.5 | 27.4 | 25.6 | 24.0 |
| | 3 | 0.78 | 156.0 | 117.0 | 93.6 | 78.0 | 66.9 | 58.5 | 52.0 | 46.8 | 42.5 | 39.0 | 36.0 | 33.4 | 31.2 | 29.3 |
| | 4 | 0.90 | 180.0 | 135.0 | 108.0 | 90.0 | 77.1 | 67.5 | 60.0 | 54.0 | 49.1 | 45.0 | 41.5 | 38.6 | 36.0 | 33.8 |
| | 5 | 1.00 | 200.0 | 150.0 | 120.0 | 100.0 | 85.7 | 75.0 | 66.7 | 60.0 | 54.5 | 50.0 | 46.2 | 42.9 | 40.0 | 37.5 |
| | 6 | 1.10 | 220.0 | 165.0 | 132.0 | 110.0 | 94.3 | 82.5 | 73.3 | 66.0 | 60.0 | 55.0 | 50.8 | 47.1 | 44.0 | 41.3 |
| | 7 | 1.18 | 236.0 | 177.0 | 141.6 | 118.0 | 101.1 | 88.5 | 78.7 | 70.8 | 64.4 | 59.0 | 54.5 | 50.6 | 47.2 | 44.3 |
| | | | | | | | | | | | | | | | | |
| **TOO LOW** | 2 | 1.12 | 224.0 | 168.0 | 134.4 | 112.0 | 96.0 | 84.0 | 74.7 | 67.2 | 61.1 | 56.0 | 51.7 | 48.0 | 44.8 | 42.0 |
| 0 3.5 | 3 | 1.37 | 273.0 | 204.8 | 163.8 | 136.5 | 117.0 | 102.4 | 91.0 | 81.9 | 74.5 | 68.3 | 63.0 | 58.5 | 54.6 | 51.2 |
| | 4 | 1.58 | 315.0 | 236.3 | 189.0 | 157.5 | 135.0 | 118.1 | 105.0 | 94.5 | 85.9 | 78.8 | 72.7 | 67.5 | 63.0 | 59.1 |
| | 5 | 1.75 | 350.0 | 262.5 | 210.0 | 175.0 | 150.0 | 131.3 | 116.7 | 105.0 | 95.5 | 87.5 | 80.8 | 75.0 | 70.0 | 65.6 |
| | 6 | 1.93 | 385.0 | 288.8 | 231.0 | 192.5 | 165.0 | 144.4 | 128.3 | 115.5 | 105.0 | 96.3 | 88.8 | 82.5 | 77.0 | 72.2 |
| | 7 | 2.07 | 413.0 | 309.8 | 247.8 | 206.5 | 177.0 | 154.9 | 137.7 | 123.9 | 112.6 | 103.3 | 95.3 | 88.5 | 82.6 | 77.4 |
| | | | | | | | | | | | | | | | | |

# QJS SERIES

## MULTIPLE OUTLET NOZZLE BODIES