GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

GRDC Spray Days – presentations

Jondaryan – 22 March 2023

Narrabri – 23 March 2023

Osborne – 28 March 2023

ICAN
Independent Consultants Australia Network

Contents

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SOCIAL LICENSE, MRL's &HERBICIDE RESIDUES

BY PAUL McINTOSH- WEEDSMART & PULSE AUSTRALIA

NOV 2022 AND MARCH 2023

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1

SOCIAL LICENCE and its DEFINITION

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

Is the level of acceptance or approval that stakeholders and communities extend to a project , site , company or industry.

Gaining social license means gaining support for the project from concerned groups or stakeholders over and above any legal requirements

Granting of social license is rooted in the beliefs, reputation and opinions held by the local population and other stakeholders in society.

2

What about E S G

Environmental, Social, & Governance

The three pillars of sustainable business

ESG is seen as a way of safeguarding businesses from future risk

3

Environmental factors involve the protection of natural resources or Impact on the planet

- Air and Water quality
- Biodiversity
- Deforestation
- Energy Performance
- Carbon Footprint
- Natural Resource Depletion
- Waste mgt and Pollution

4

ENVIRONMENTAL

5

6

Bee deaths spark investigation after traces of chemical Fipronil found in hives

ABC Southern Qld / By Lucy Robinson and Belinda Sanders

Posted Thu 18 Feb 2021 at 11:10am, updated Thu 18 Feb 2021 at 4:34pm

7

Social

Involves anticipating every possible customer reaction to your brand and to determine who is best suited to respond , creating a map of how the interaction should unfold , deciding who is authorized to continue the relationship etc .

When executed correctly . The outcome of social governance is simple;

Customers enjoy a positive seamless brand experience

How businesses interact with communities where it operates

8

GOVERNANCE– Internally with ;

Compliance

Security

Control

How an organisation is governed- and Transparency ?

9

All these key elements are inter-twined and will impact our Agricultural industry

eg in Banking

10

Toxic nation: Australia's pesticide problem
Pesticides

How big pesticide reaches into every element of rural life in Australia

Multinational chemical firms subsidise agronomists, provide scholarships, sponsor farm safety programs and even fund the pesticide regulator

- There are real alternatives to widespread pesticide use
- Who tests your food for pesticides in Australia?
- 12 pesticides banned elsewhere but still used in Australia
- Get our free news app, morning email briefing or daily news podcast

Anne Davies
@annefdavies
Fri 7 Oct 2022 03.30 AEDT

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Toxic nation: Australia's pesticide problem
Food safety

The dirty dozen: 12 pesticides that are banned elsewhere but still used in Australia

Australia still uses dozens of chemicals that are banned in other countries – including the UK and US – because they are toxic to humans, animals or the environment

- Australian food is grown with dangerous chemicals banned in other countries
- Get our free news app, morning email briefing or daily news podcast

Anne Davies *and* Donna Lu
Tue 27 Sep 2022 03.30 AEST

Australia continues to allow the use of pesticides that have been banned by the European Union – and in some cases the United States – because they are harmful to human health or cause significant environmental damage. This includes the highly poisonous chemical paraquat, which has been linked to Parkinson's disease, and the common herbicide atrazine, which interferes with reproduction and may cause cancer.

Here are 12 of the most toxic pesticides still being used on Australian food crops and animals.

12

13

Maximum residue levels (MRLs)

- MRLs are a safe level for human or animal ingestion within the diet and are determined for every crop protection product as part of the registration process.
- The label instructions ensure that the MRL is not exceeded for the registered crops and use patterns.

GRDC NORTHERN PULSE CHECK COASTAL AND TABLELANDS

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HERBICIDE RESIDUES IN GRAIN

APVMA Reviews

All old actives over time are being re-evaluated by APVMA

- Glyphosate has been reviewed
- 2,4-D has been reviewed
- Fipronil is current on review
- Imidacloprid is current on review
- Paraquat/Diquat is current on review

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HERBICIDE RESIDUES IN GRAIN

Maximum Residue Limits – (MRLs)

- Defined as the Maximum concentration of residue which is legally permitted as acceptable to be present in agricultural commodity
- Importing countries may have lower or nil MRL compared to Australian MRLs
- National Residue Surveys (NRS)

  2020-21 – 5445 samples collected

  Compliance rate % - 99.3 %

Wheat crop 2020 @ Bathurst

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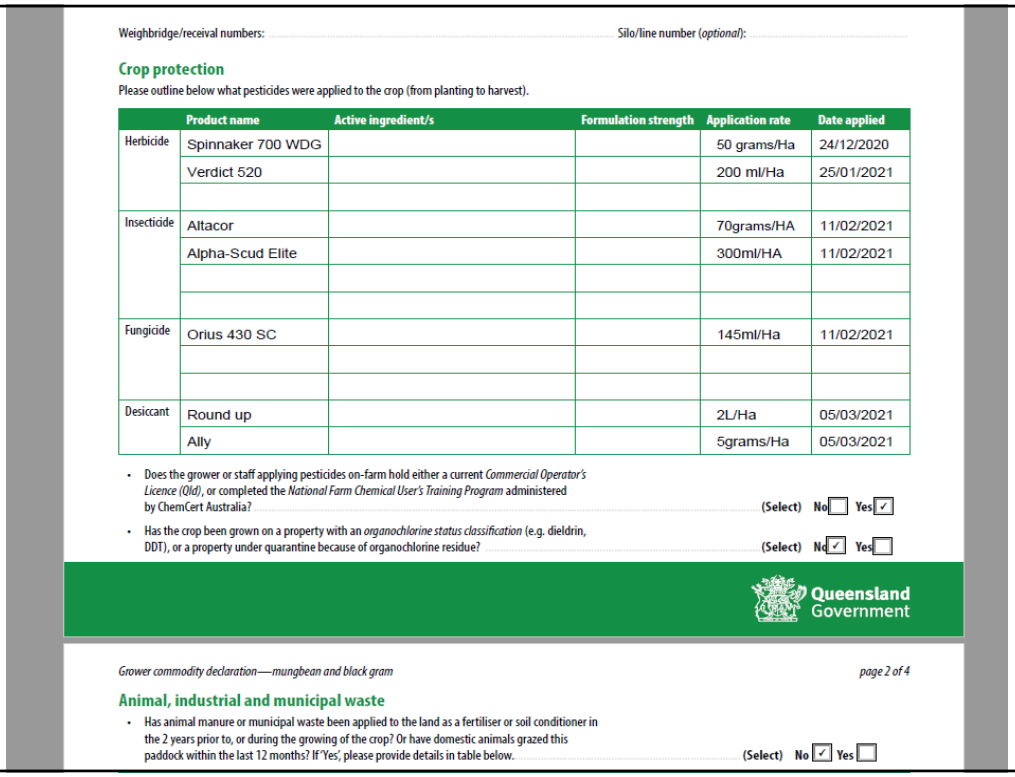

Weighbridge/receival numbers: ..... Silo/line number (*optional*): .....

Crop protection

Please outline below what pesticides were applied to the crop (from planting to harvest).

	Product name	Active ingredient/s	Formulation strength	Application rate	Date applied
Herbicide	Spinnaker 700 WDG			50 grams/Ha	24/12/2020
	Verdict 520			200 ml/Ha	25/01/2021
Insecticide	Altacor			70grams/HA	11/02/2021
	Alpha-Scud Elite			300ml/HA	11/02/2021
Fungicide	Orius 430 SC			145ml/Ha	11/02/2021
Desiccant	Round up			2L/Ha	05/03/2021
	Ally			5grams/Ha	05/03/2021

- Does the grower or staff applying pesticides on-farm hold either a current *Commercial Operator's Licence (Qld)*, or completed the *National Farm Chemical User's Training Program* administered by ChemCert Australia? ..... (Select) No ☐ Yes ☑
- Has the crop been grown on a property with an *organochlorine status classification* (e.g. dieldrin, DDT), or a property under quarantine because of organochlorine residue? ..... (Select) No ☑ Yes ☐

Queensland Government

Grower commodity declaration—mungbean and black gram *page 2 of 4*

Animal, industrial and municipal waste

- Has animal manure or municipal waste been applied to the land as a fertiliser or soil conditioner in the 2 years prior to, or during the growing of the crop? Or have domestic animals grazed this paddock within the last 12 months? If 'Yes', please provide details in table below. ..... (Select) No ☑ Yes ☐

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Collector: [redacted]

[redacted]

DALBY QLD 4405

Sample Date: 22 Mar 2021

Lab Receipt Date: 12 Apr 2021

Report Date: 05 May 2021

Ship DEACON

Sample No	Product	Customer Reference No	Destination Country	Marketer	Chemicals/ Contaminants	Residue mg/kg	Aust MRL mg/kg
0320400B	Mung bean	M4510	Viet Nam	[redacted]	fluazifop-p-butyl	0.096	0.5
					glyphosate	0.41	10
					haloxyfop	0.90	0.1*
					Remaining analytes (overleaf)	<LOR	

* Note: The residue of haloxyfop detected at 0.90mg/kg exceeds the Australian MRL of 0.1mg/kg

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ADAMS AUSTRALIA

GRAIN SORGHUM to CHINA and GLYPHOSATE residues

Food (Alcohol) mkt – Proceeding with caution for NIL tolerance red flags warnings

Feed mkt - continuing to export to China.

Haloxyfop free Chickpeas to USA & Canada customers

Heightened awareness in weed seeds in various overseas markets.

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Market	Active Ingredient	Commodity (for chickpeas)	MRL (ppm)
Egypt	Acetamiprid	Peas (with pods)	0.6
Egypt	Acetamiprid	Peas (without pods)	0.3
Egypt	Acetamiprid	Pulses; Peas	0.15
India	Acetamiprid		0.01
Turkey	Acetamiprid	Peas (with pods)	0.4
Turkey	Acetamiprid	Peas (without pods)	0.3
Turkey	Acetamiprid	Pulses; Peas	0.07
United Arab Emirates	Acetamiprid	Peas (with pods)	0.6
United Arab Emirates	Acetamiprid	Peas (without pods)	0.3
United Arab Emirates	Acetamiprid	Pulses; Peas	0.15
Egypt	Emamectin	Peas (with pods)	0.03
Egypt	Emamectin	Peas (without pods)	0.01
Egypt	Emamectin	Pulses; Peas	0.01
India	Emamectin		0.01
Turkey	Emamectin	Peas (with pods)	0.01
Turkey	Emamectin	Peas (without pods)	0.01
Turkey	Emamectin	Pulses; Peas	0.01
United Arab Emirates	Emamectin	Peas (with pods)	0.03
United Arab Emirates	Emamectin	Peas (without pods)	0.01
United Arab Emirates	Emamectin	Pulses; Peas	0.01

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Intruder/ Skope Insecticide

Affirm <u>Insecticide</u>

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Table 3b. Summer crop growth stage application windows

Crop	Crop Growth Stage
Lucerne	Apply from 2nd trifoliate leaf onwards
Cowpea, Mung beans, Navy beans, Soybeans	Apply from 2nd leaf to flowering
Peanuts	Apply from 5cm to pegging
Cotton	Apply from 2nd leaf to before the onset of flowering
Sunflowers	Apply from 2nd leaf to head initiation

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NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION.

HARVESTING WITHHOLDING PERIODS

NOT REQUIRED WHEN USED AS DIRECTED FOR:

Canola, Chickpeas, Cotton, Cowpea, Faba beans, Field peas, Lentils, Linola, Linseed, Lupins, Mung beans, Navy beans, Peanuts, Soybeans, Sunflowers and Vetch

DO NOT HARVEST FOR:

Medic and Clover seed crops **7 DAYS AFTER APPLICATION**

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TAIWAN and GLYPHOSATE

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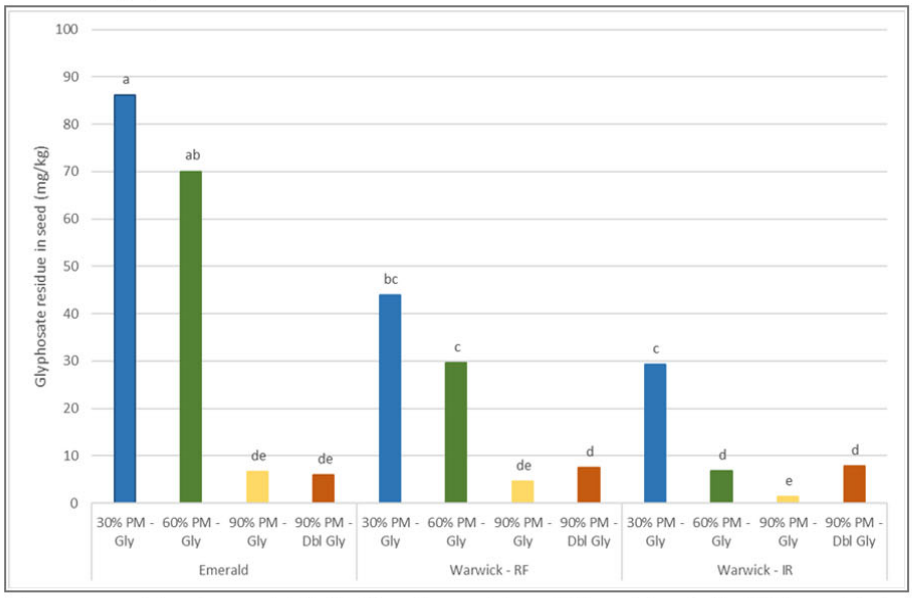
Glyphosate residues from 2021



Glyphosate residue in seed @ 7 DAT at Emerald and Warwick rainfed (RF) and irrigated (IR) trials. *Means with same subscript are not significantly different at the P=0.05 level.*

- Early desiccation will increases residues
- Need to accurately assess physiological maturity
- DANGER spraying green pods

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DRIFT AND PRODUCTION SYSTEM

What's the problem?

- Movement of chemical outside farm boundaries and off intend target
- Spray Drift is a whole of community issues and everyone has a responsibility to understand their obligations in managing it

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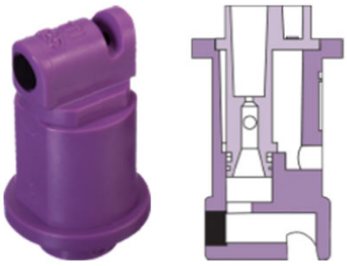
DRIFT AND PRODUCTION SYSTEMS

2,4-D label changes 2018

- Minimum mandatory droplet size of Very Coarse (aerial application remains at Very Coarse)
- Advisory – ground boom sprayers minimum of Extremely Coarse between 1st October and 15th April (recommended not legally required)
- Ground boom height restricted to 50cm above the target canopy/crop
- Introduction of – downwind buffer zones
- Addition of – do not apply if there are surface temperature inversions



Turbo TeeJet Induction (TTI)

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- When we ***Choose to Spray***, will determine where and how far the spray driftable fraction of our application will move
- The ***Sprayer Set-up*** will determine how much product will be left in the air.
- ***Coarser Spray Qualities / Nozzles*** will lower drift risk but can also impact efficacy
- Having a set of ***Spray-Plans*** for different paddock situations will enable efficient, safe and effective spraying.

PLUS - reading all the small print of our labels and even re-check with your marketers

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TAKE HOME FUTURE CHALLENGES

- Social licence can't be taken for granted
- Pesticide application beyond the label can leave to a potential residues in the grain that could potentially affect Australia's Market access
- Ineffective application of pesticides may result in significant label changes through government regulation

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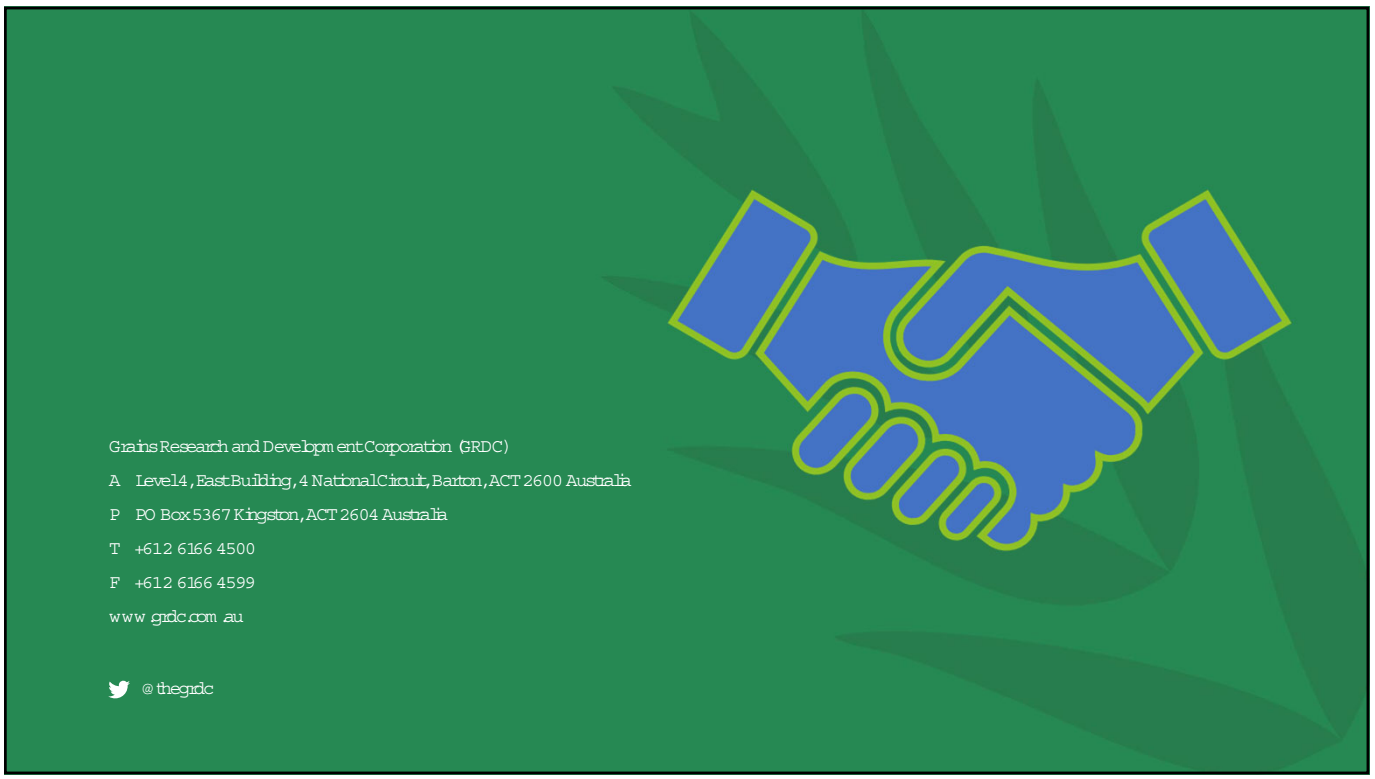
Grains Research and Development Corporation (GRDC)
A Level 4, East Building, 4 National Circuit, Barton, ACT 2600 Australia
P PO Box 5367 Kingston, ACT 2604 Australia
T +61 2 6166 4500
F +61 2 6166 4599
www.grdc.com.au
@thegrdc

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SOCIAL LICENSE, MRL'S & SPRAY DRIFT

MITCH CUELL – OUTLOOK AG

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1

SOCIAL LICENCE

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"ON TREND" theme

- Definition – ' level of acceptance or approval that stakeholders and communities extend to a project, site, company or industry.'

- Outside Industry
  - Media platforms drive perception
  - Important to advocate and teach

- Inside Industry
  - Operate with understanding
  - MRL's & Spray Drift

2

HERBICIDE RESIDUES IN GRAIN

What's happening?

- Some grain is being delivered with pesticides exceeding the Maximum Residue Limit (MRL).

What are MRL's?

- *'The maximum amount of chemical residue that is legally allowed in a food product sold in Australia.'*

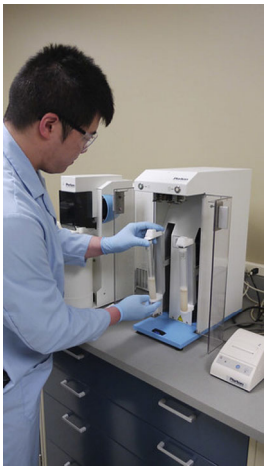
- How does this happen?
- A pesticide is applied outside the timing that is outlined on the label or at rates exceeding the label. This is either by crop stage and/or withholding period.

3

HERBICIDE RESIDUES IN GRAIN

How much testing do they do for MRL's?

- Wheat – 2597 samples
- Barley – 1084 samples
- Canola – 504 samples
- Chickpeas – 60 samples
- Lupins – 47
- Faba beans – 148 samples



4

HERBICIDE RESIDUES IN GRAIN

What products exceeded the MRL's 2020-21?

- Wheat:

seed/fert treatment insecticides/fungicides, grain insecticides & Imazapyr

- Barley:

seed/fert treatment insecticides/fungicides, grain insecticides & Paraquat

- Canola:

Imidacloprid, Haloxyfop, Simazine & Imazapyr

- Chickpeas, Lupins & Faba beans:

seed/fert treatment insecticides/fungicides, grain insecticides, Imazapic & Haloxyfop

5

HERBICIDE RESIDUES IN GRAIN

"DO NOT apply after the 8th leaf stage of the crop"

"DO NOT apply after the commencement of stem elongation"

"This means that application must not occur after the 8th leaf stage, or if stem elongation commences before the 8th leaf stage, application must not occur after stem elongation has commenced."

adhere to label application directions

6

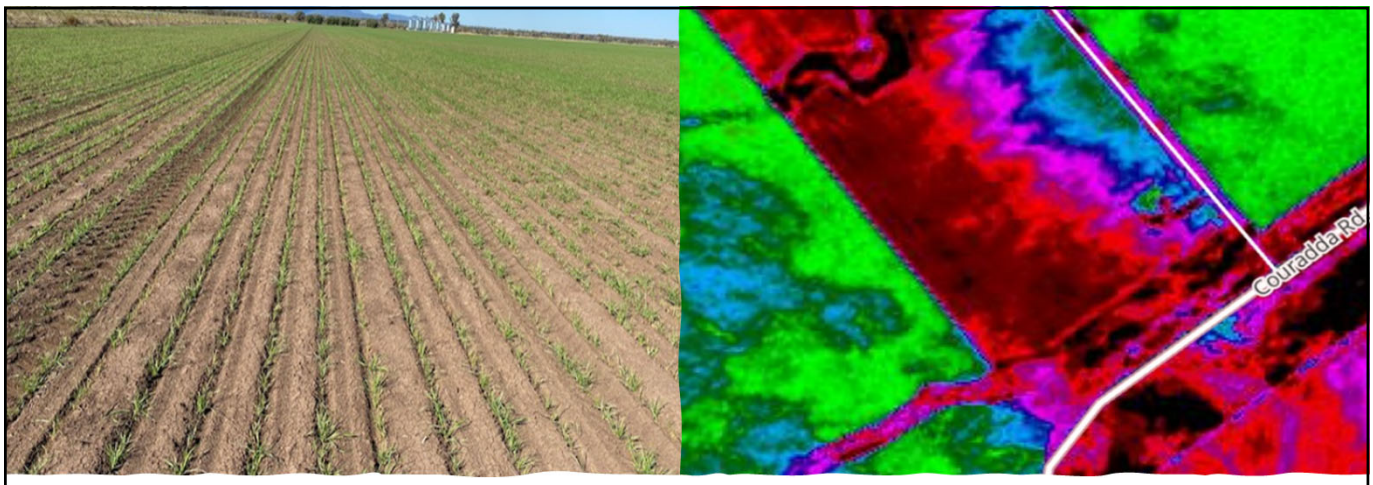
DRIFT AND PRODUCTION SYSTEM

What's the problem?

- Movement of chemical outside farm boundaries and off intend target
- Spray Drift is a whole of community issues and everyone has a responsibility to understand their obligations in managing it
- It's worth knowing what crops/vegetation is about, so that the sensitivity to this chemical is known.

7

8



GLY DRIFT

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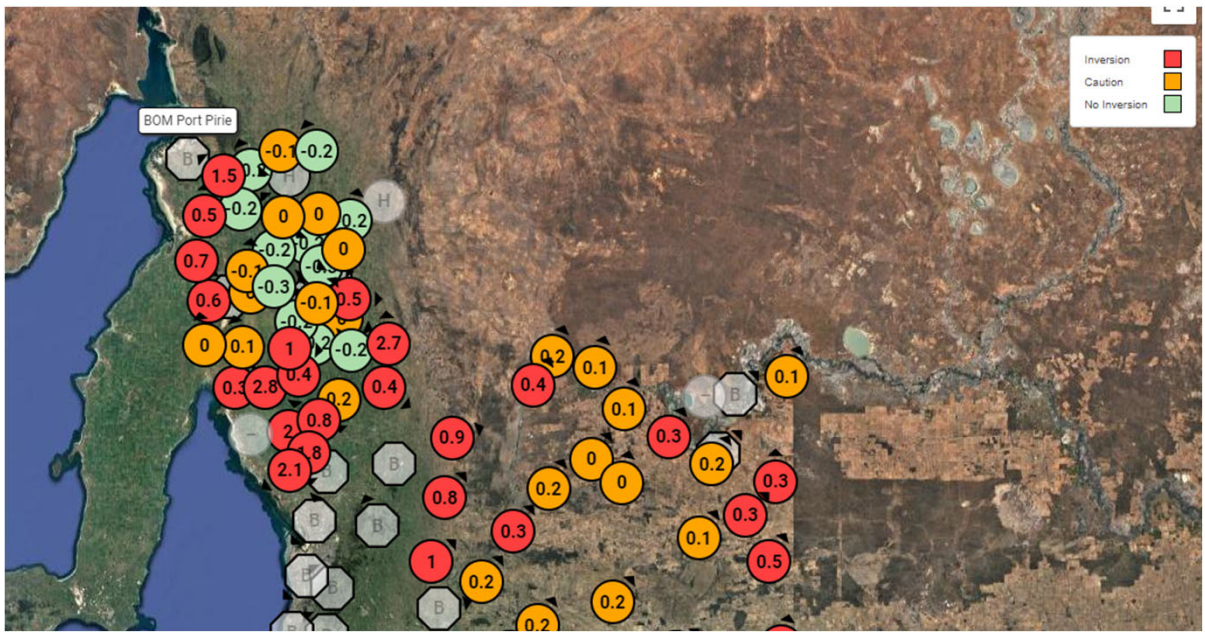

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DRIFT AND PRODUCTION SYSTEMS

Industry example: 2,4-D label changes

- Minimum mandatory droplet size of Very Coarse
- Advisory – ground boom sprayers minimum of Extremely Coarse between 1st October and 15th April (recommended not legally required)
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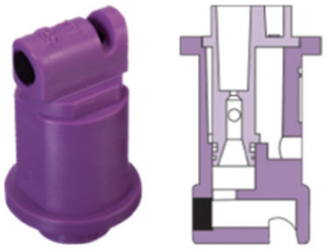

Turbo TeeJet Induction (TTI)

11

TAKE HOME MESSAGES

- Don't take social licence for granted... Important to operate with under standing
- If MRL's are exceeded there could be a direct cost to the business or an indirect cost through lose of markets
- Ineffective application of pesticides may result in significant label changes or even deregistration of products

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Grains Research and Development Corporation (GRDC)
A Level 4, East Building, 4 National Circuit, Barton, ACT 2600 Australia
P PO Box 5367 Kingston, ACT 2604 Australia
T +61 2 6166 4500
F +61 2 6166 4599
www.grdc.com.au

@thegrdc

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SOCIAL LICENCE AND TRADE

EMMA AYLIFFE – SUMMIT AG

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

1

SOCIAL LICENCE

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Is this just another buzz-word in Agriculture..?

"Social licence refers to the level of public trust granted to an industry sector by the community at large and its key customer base."

- Who cares... while its alive and well

- If it comes into question...

Practices that have been considered normal or acceptable for generations can suddenly be under threat!

2

SOCIAL LICENCE

Why should I or you care..?

80% of the voters in Australia live East of the great divide…

What is their impression of Ag?

How do we present ourselves?

What do our consumers think or hear?

3

HERBICIDE RESIDUES IN GRAIN

What's happening?

- Some grain is being delivered with pesticides exceeding the Maximum Residue Limit (MRL).

What are MRL's?

- *'The maximum amount of chemical residue that is legally allowed in a food product sold in Australia.' It is considered the safe level for human or animal ingestion*

How does this happen?

- A pesticide is applied outside the timing that is outlined on the label or at rates exceeding the label. This is either by crop stage and/or withholding period.

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HERBICIDE RESIDUES IN GRAIN

What products exceeded the MRL's 2020-21?

- Wheat: (2597 samples tested)

seed/fert treatment, insecticides/fungicides, grain insecticides & Imazapyr

- Barley: (1084 samples tested)

Seed treatment, Imazapyr, Paraquat, Chlorpyrifos

- Canola: (504 samples tested)

Imidacloprid, Haloxyfop, Simazine & Imazapyr

- Chickpeas, Lupins & Faba beans: (60, 47, 48 samples tested)

seed/fert treatment insecticides/fungicides, grain insecticides, Imazapic & Haloxyfop

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HERBICIDE RESIDUES IN GRAIN

APVMA Reviews

All old actives over time are being re-evaluated by APVMA

- Glyphosate has been reviewed
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DRIFT AND PRODUCTION SYSTEM

What's the problem?

- Movement of chemical outside farm boundaries and off intend target
- Spray Drift is a whole of community issues and everyone has a responsibility to understand their obligations in managing it

8

DRIFT AND PRODUCTION SYSTEM

What's the problem?

- There is no problem... as long as the applied chemical doesn't leave the farm.
- It's worth knowing what crops/vegetation is about, so that the sensitivity to this chemical is known.
- Economic damage, environmental damage, reputational damage, community damage…
- What is the cost to your business? Using higher rates then needed, sub lethal doses, poor results

Isn't this an old problem?

- Yes, but its still happening in winter and summer crops

9

DRIFT AND PRODUCTION SYSTEMS

Industry example: 2,4-D label changes

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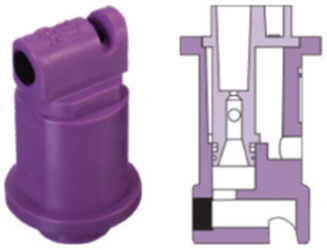

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- Having a set of ***Spray-Plans*** for different paddock situations will enable efficient, safe and effective spraying.

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TAKE HOME MESSAGES

- Don't take social licence for granted... the value of it is the value of your ability to operate as you are! Or how you want.
- If MRL's are exceeded there could be a direct cost to the business or an indirect cost through lose of markets
- Ineffective application of pesticides may result in significant label changes or even deregistration of products and is A WASTE OF YOUR TIME AND HARD EARNED $$

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Acknowledgments:
John Cameron – ICAN
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Crop Consultants Australia – CCA survey data 2021-22
Department of Agriculture, Fisheries & Forestry – plant product monitoring datasets 2020-21

Thank you

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A Level 4, East Building, 4 National Circuit, Barton, ACT 2600 Australia
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www.grdc.com.au

@thegrdc

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SPRAYING WITH CONTROLLED EFFECTIVENESS

BY DAVID JOHNSON – (FMC)

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1

Take Home Message

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Spray with the fewest fines that gets the job done well.

No fines means no drift.

2

Drift risk is about size, not content

This is a symptom seen in a spray drift complaint:

- The tank mixture, sprayed with a *Coarse* spray quality in an upwind paddock, contained:
  - Glyphosate 450
  - 2,4-D amine
  - Ammonium sulphate
  - Wetter

Question:

- Which chemical drifted?

3

Drift risk is about size, not content

Answer:

- All of them.

- Chemicals with visual signals of activity are just billboards that say:

  "*Fines* were here"

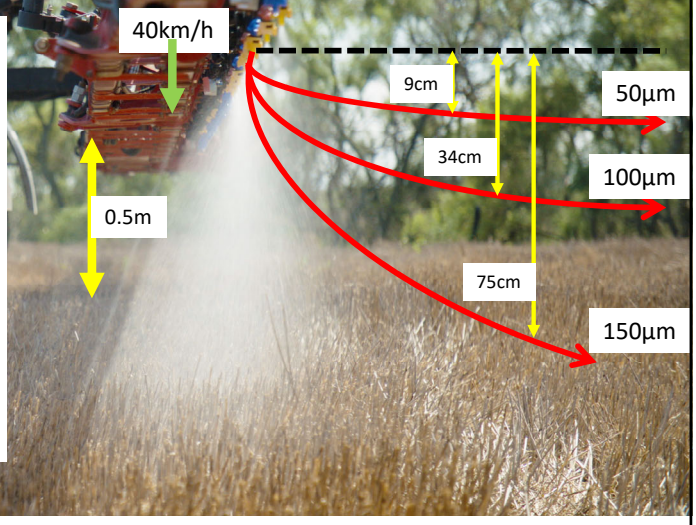
- Every *Fine* contains all of the chemicals in the tank mix, not just the one with the visual signal.

- It's only the size of the droplet, not its contents, that determines its drift risk.

4

Fines don't get to ground

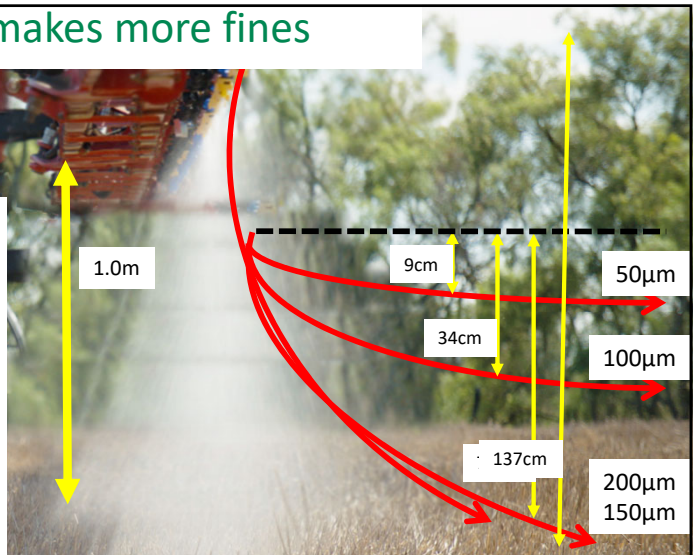
- A fine is a droplet that is too small to get to ground directly out of the nozzle.
- Fines at 0.5m boom height:
  - are droplets smaller than 150µm
  - cannot be controlled out of the nozzle, only ***managed*** by the right wind conditions.
  - Will be more likely caught by stubble than the ground.
  - when spraying with a *medium* spray quality, are up to 20% of the spray volume; 10% for *coarse*; 6% for *very coarse* and 1% for *ultra-coarse.*



5

Raising the boom makes more fines

- A fine is a droplet that is too small to get to ground directly out of the nozzle.
- Fines at 1m boom height:
  - are double the volume of 0.5m boom height
  - are droplets smaller than 200µm.
  - when spraying with a *medium* spray quality, are up to 40% of the spray volume; 20% for *coarse*; 12% for *very coarse* and 2% for *ultra-coarse.*
  - Can access wind streams, turbulence or wake effects not felt closer to ground.



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Raising the boom makes more fines

Spraying with a higher boom:

- Is a greater drift risk factor than wind speed
- Increases downwind drift risk zones
- Can be counteracted by using coarser spray qualities

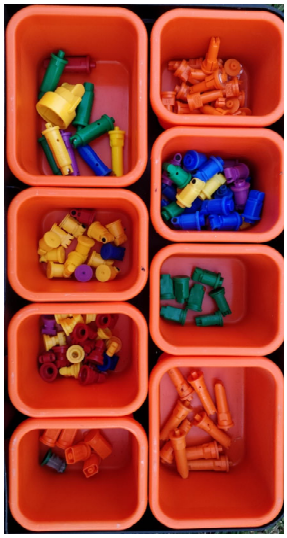
Example: Boom height of 0.5 m, Terrestrial vegetation RAL 1.9 g ai/ha Wind speed 7 to 20 km/hr

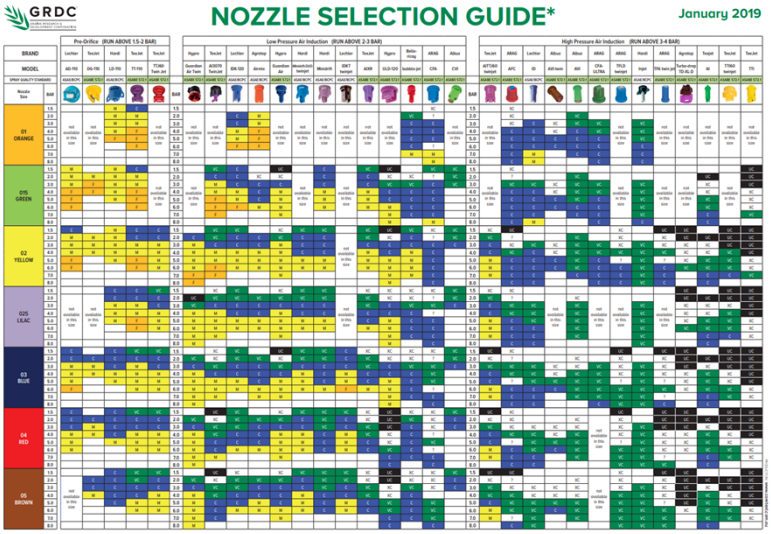
Wind = 7km/h Spray Quality	Boom Height (m)				
	0.5	0.6	0.8	1.0	1.2
Fine	236	278	324	342	>400
Medium	44	66	116	158	198
Coarse	30	36	60	88	120
Very Coarse	24	30	38	56	78
Ultra-coarse	0	4	24	30	32

Wind = 20km/h Spray Quality	Boom Height (m)				
	0.5	0.6	0.8	1.0	1.2
Fine	228	234	238	258	280
Medium	56	78	124	166	206
Coarse	34	48	76	102	130
Very Coarse	30	36	56	72	86
Ultra-coarse	14	24	32	40	46

7

Nozzle choice and spray pressure are the greatest source of fines





8

All nozzle spray qualities in the manufacturer charts are measured with water only.

- Citing ASABE 572.1 or 2 or 3 does not mean the nozzle's spray quality was measured with a non-ionic surfactant in the mix
- Tank mix can dramatically alter the nozzle's spray quality – up to 2 full categories finer e.g. VC on the chart could be M with a tank mix
- Formulation types have different fining-up effects e.g. NIS > SL > EC > WDG > SC
- Choose adjuvant very carefully
- Plan to use the lowest pressure of a nozzle within its optimum operating range (2-4 bar for low pressure AI, 4-6 bar for high pressure AI)

9

Spraying for max treated area instead of herbicide performance makes more fines

- Promotes horizontal droplet paths, allowing *Fines* to escape or be captured by stubble and 'shadowing' effects on weed control.
- Creates wake effects behind the rig disturbing original downward trajectory
- Increases displacement around the wheels
- Promotes boom bounce on the wing tips and whipping motions
- Pulls *Fine* droplets out of the spray plume
- Promotes upward trajectories of *Fines*

10

Spraying for max treated area instead of herbicide performance makes more fines.

Slow down for better performance in stubble

Standing stubble captures horizontally moving droplets

- Great for capturing fines
- Reduce horizontal movement of escapes

But

- Better to travel slower to get more vertical directionality to droplet trajectory
- Less horizontal movement to begin with = more droplets on the weeds
- Bigger droplets travel more vertically = more droplets on the weeds
- Increase volume to create more droplets to reach the weed

11

What happens to fines depends on the conditions you were spraying in.

Concentrating conditions - inversions

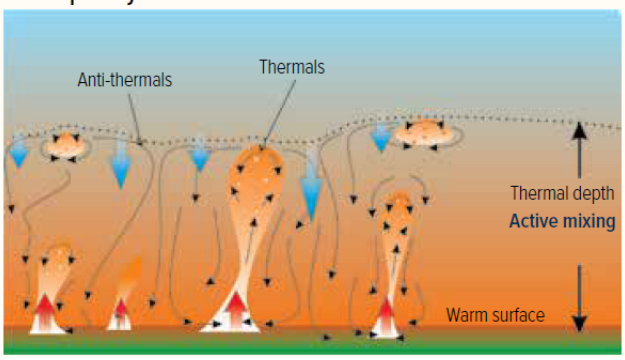
- Cooler air at the surface, warmer air above
- Form in the evening as the sun descends
- Stay overnight and several hours after dawn
- No vertical dilution of *escapes*
- 'Community drift' concentrates the whole district's *escapes*
- *Escapes* sit in this thin layer of air and remain concentrated

12

What happens to fines depends on the conditions you were spraying in.

Diluting conditions

FIGURE 20 With surface heating, a daytime mixed layer is developed by thermals and 'anti-thermals'.



WEATHER ESSENTIALS FOR PESTICIDE APPLICATION BY GRAEME TEPPER MicroMeteorology Research and Educational Services

- When the sun heats the ground, the first few metres above it warm.
- Air temperature drops quickly with further height.
- This leads to vertical updrafts of warm air into which pesticides can dilute.
- At the cooler heights, the air drops again creating turbulence and mixing of air
- Extinguished by the onset of inversions.

13

Spray planning

1. Determine what area you can cover at a responsible, effective speed in the likely spraying window. Do you need extra resources? Manage your expectations if you're planting area exceeds your spray equipment resources limit.
2. Get to really know your spraying equipment. What are its limitations? (Speed, tyre rating, boom height, section operating information, malfunction notifications)
3. Know how many fines your set up is likely to produce in all situations.
4. Check all nozzles' condition before starting a job. Replace worn nozzles.
5. Review labels in advance, noting correct mixing order.
6. Keep extra nozzles, clamps and nozzle bodies in the cab.
7. Plan to spray effectively with as few *Fines* as possible (nozzle, pressure, volume, speed, height).
8. Plan to spray only in conditions in which escapes are diluted as much as possible.

14

Spraying tips

While spraying

1. In stubble, slow down/increase volume.
2. If your equipment can't comply with all of these recommendations, then make some other compromise. e.g. if minimum boom height possible is 70cm above target then travel more slowly, use a higher volume and a coarser spray quality. Don't push any other boundaries.
3. Take advantage of ideal spraying conditions by spraying perimeter buffer areas first on all paddocks to be sprayed.
4. Apply tank mixtures with the *coarsest* of the spray qualities recommended on the label of the components. In a mixture, *Coarser* spray qualities trump *Finer* ones.
5. Travel as slowly, and with boom as low as possible, especially if intentionally spraying with a *Coarse* or *Finer* spray quality.
6. Do your own trials – with a tank mixture you feel needs a *Coarse, Medium* or *Fine* spray job, compare it to a VC or coarser nozzle/tank mix set up with higher volume and slower travel speed.

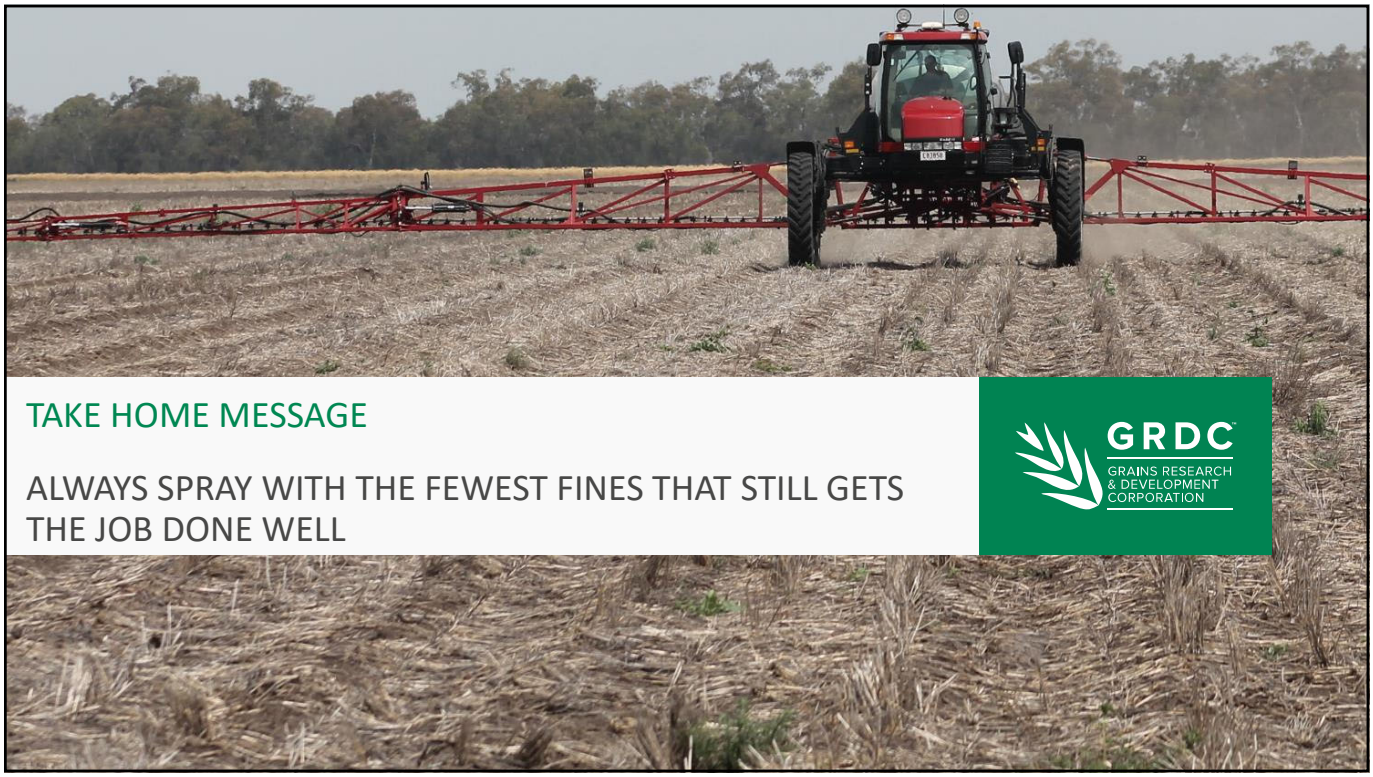
15

Take Home Message

Spray with the fewest fines that gets the job done well.

No fines means no drift.

16



17

Grains Research and Development Corporation (GRDC)
A Level 4, East Building, 4 National Circuit, Barton, ACT 2600 Australia
P PO Box 5367 Kingston, ACT 2604 Australia
T +61 2 6166 4500
F +61 2 6166 4599
www.grdc.com.au

@thegrdc

18

OPTIONS TO REDUCE SPRAY DRIFT RISK

HARRY PICKERING – ADAMA AUSTRALIA

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

1

TAKE HOME MESSAGES

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

- When we ***Choose to Spray***, will determine where and how far the spray driftable fraction of our application will move
- The ***Sprayer Set-up*** will determine how much product will be left in the air.
- ***Coarser Spray Qualities / Nozzles*** will lower drift risk but can also impact efficacy
- Having a set of ***Spray-Plans*** for different paddock situations will enable efficient, safe and effective spraying.

2

ALL PESTICIDES DRIFT

Glyphosate Drift Simulation - Barley

Untreated

5% Drift Simulation
of Wipeout Pro - 1L/ha

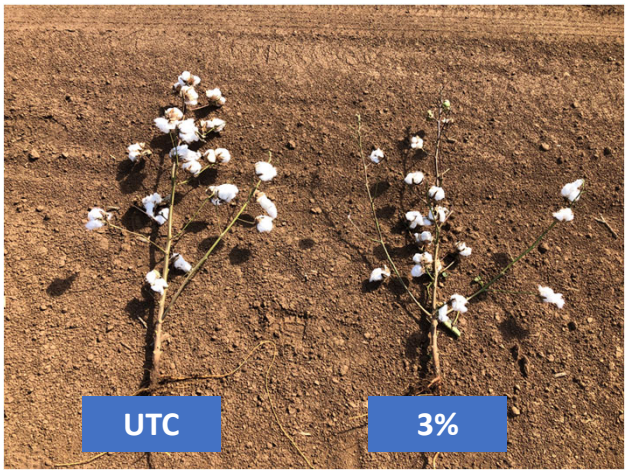
15 DAT

Crop Growth Stage at App - Z22

3

ALL PESTICIDES DRIFT

2,4-D Drift Simulation - Cotton



3% Drift Simulation
Of 2,4-D Amine - 750 ml/ha

Overwatch Drift Simulation - Lupins

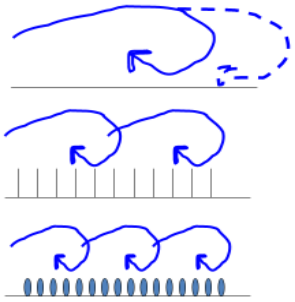
2% Drift Simulation
Of Overwatch - 1.25 L/ha

4

"WHEN WE CHOOSE TO SPRAY"

Air Movement is Key for Spray Drift Management

Air Movement During the Day
" Turbulent Air"

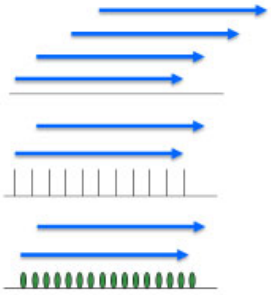


FALLOW GROUND

HEAVY STUBBLE

IN CROP SITUATIONS

Air Movement During
" Hazardous Temperature Surface Inversion



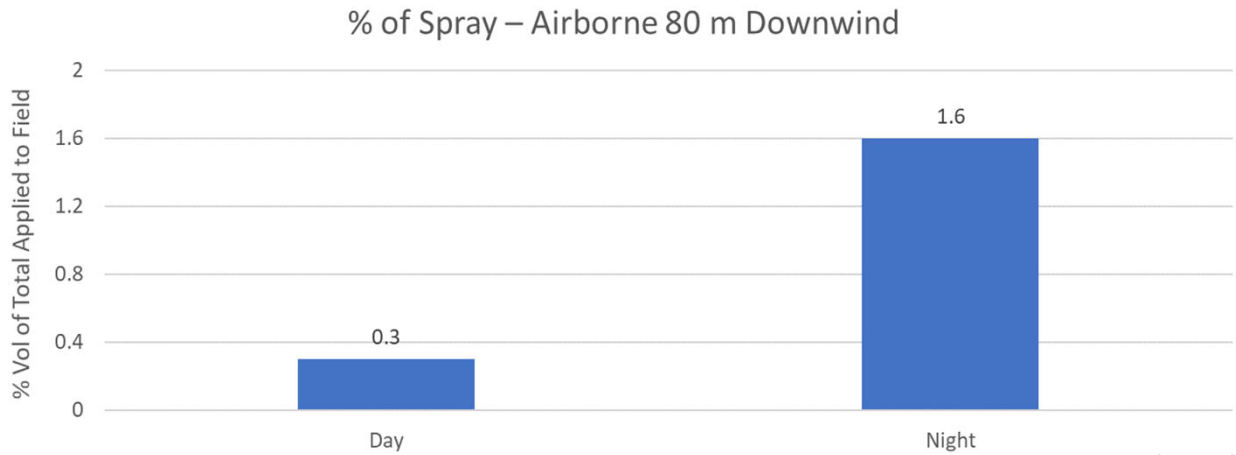
Daytime Spraying > 4km/h Wind

Nightime Spraying

5

'WHEN WE CHOOSE TO SPRAY"

Air Movement is Key for Spray Drift Management



Environmental Conditions during application			
	Wind Speed (km/hr)	Temperature	Relative Humidity (%)
Night	11.6	25.5	64
Day	18.3	28.7	61

Source – GRDC Tips and Tactics Reducing herbicide damage

AIXR 11002 – Medium (Coarse-End)

4 Bar

22 km/ha travel speed

50 L/ha Water Volume

6

"SPRAYER SET-UP"

The Sprayer Set-Up will Determine How Much Product is left in the Air

Un-Assisted - Droplet Penetration through the Air

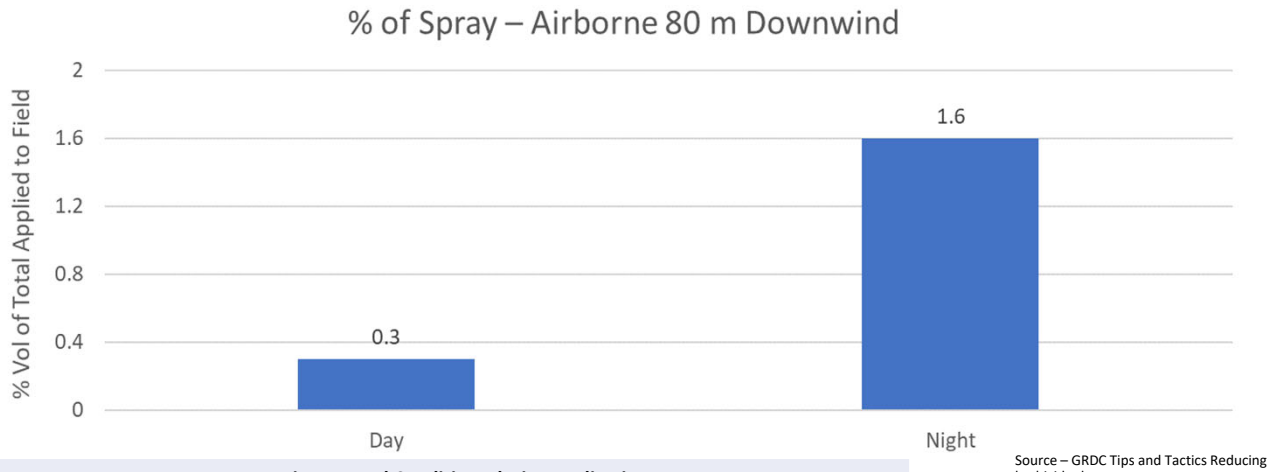
50 um	100 um	200 um
9 cm	34 cm	137 cm

Spray Quality	% of spray below 150 microns
Fine (F)	40-50
Medium (M)	20
Coarse (C)	10
Very Coarse (VC)	5
Extremely Coarse (XC)	2
Ultra Coarse (UC)	<1

7

"SPRAYER SET-UP"

Air Movement and Nozzle Selection



Environmental Conditions during application			
	Wind Speed (km/hr)	Temperature	Relative Humidity (%)
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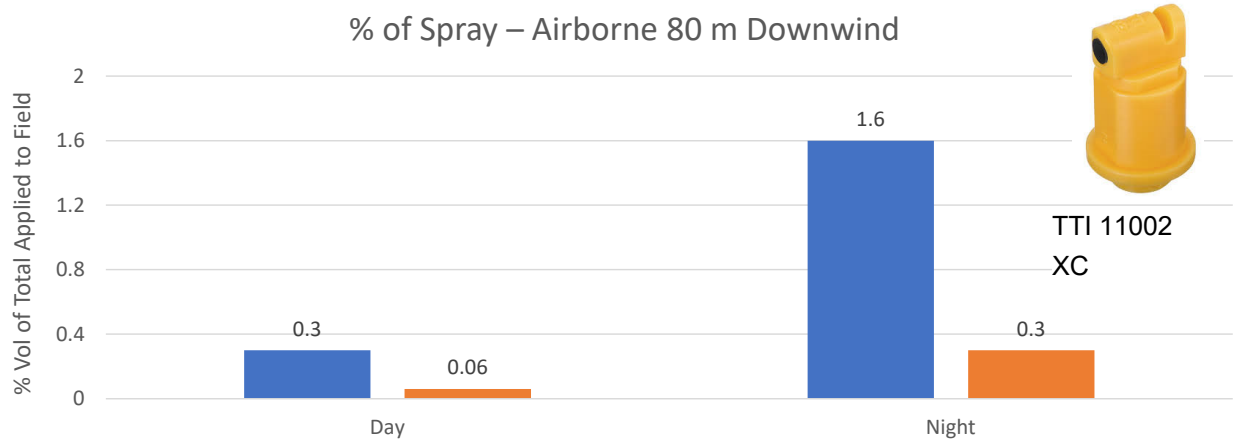
"SPRAYER SET-UP"

Air Movement and Nozzle Selection

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION



TTI 11002
XC

Environmental Conditions during application			
	Wind Speed (km/hr)	Temperature	Relative Humidity (%)
Night	11.6	25.5	64
Day	18.3	28.7	61

Source – GRDC Tips and Tactics Reducing herbicide damage

AIXR 11002 – Medium (Coarse End)

4 Bar

22 km/ha travel speed

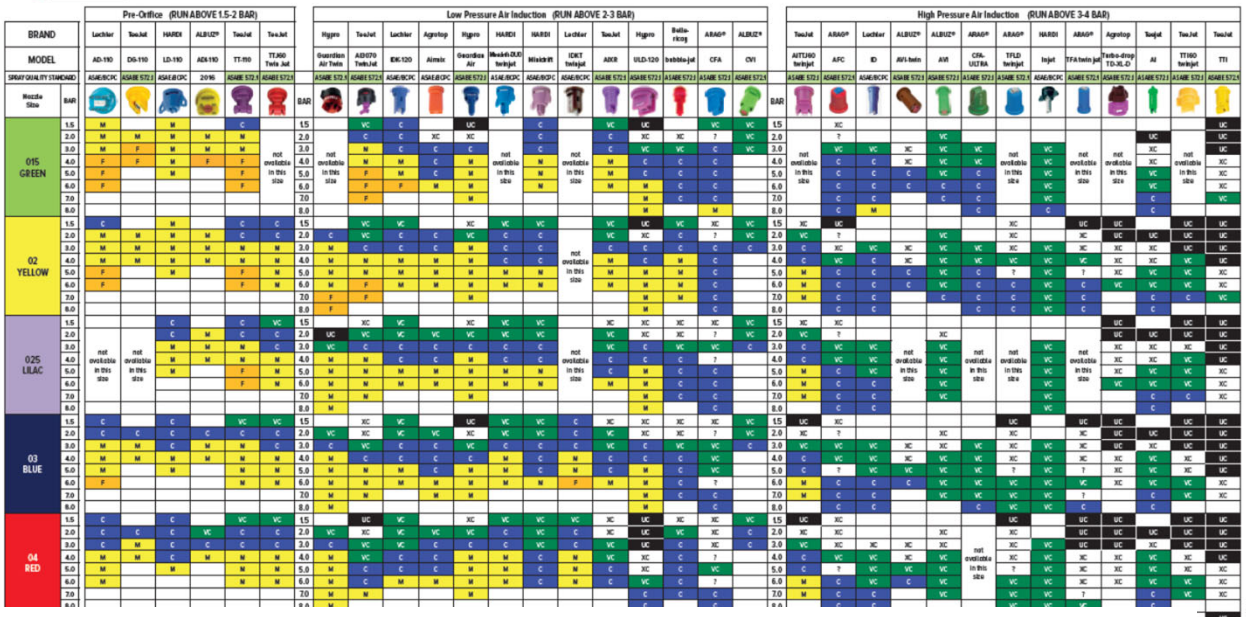
50 L/ha Water Volume

9

GRDC

STANDARD NOZZLE SELECTION GUIDE*

January 2021

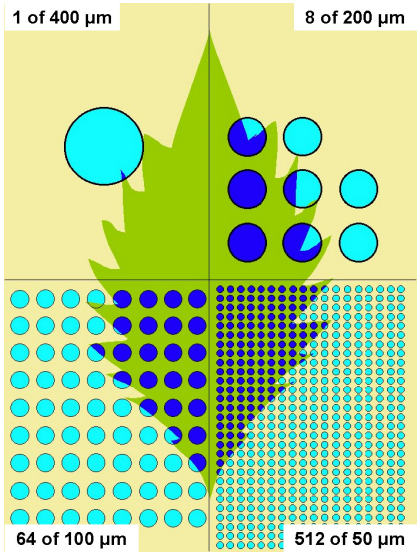


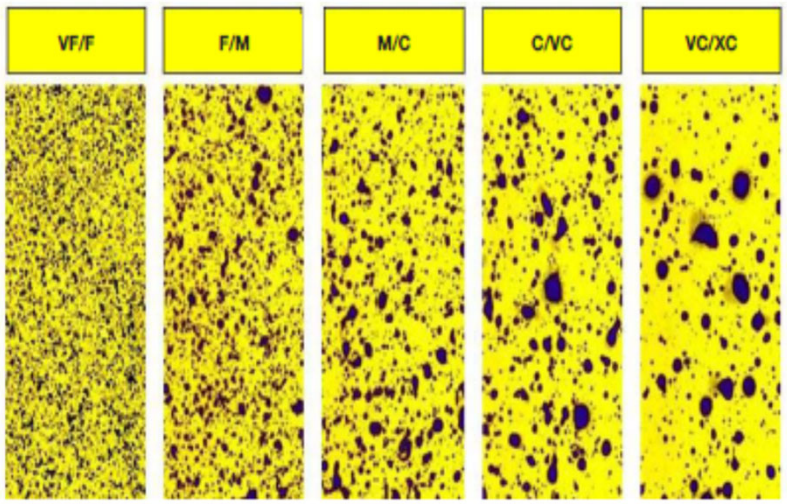
https://grdc.com.au/resources-and-publications/all-publications/publications/2019/grdc-nozzle-selection-guide

10

DRIFT REDUCTION AND EFFICACY

Efficacy Needs to be Maintained – Plan Ahead with a Spray Plan



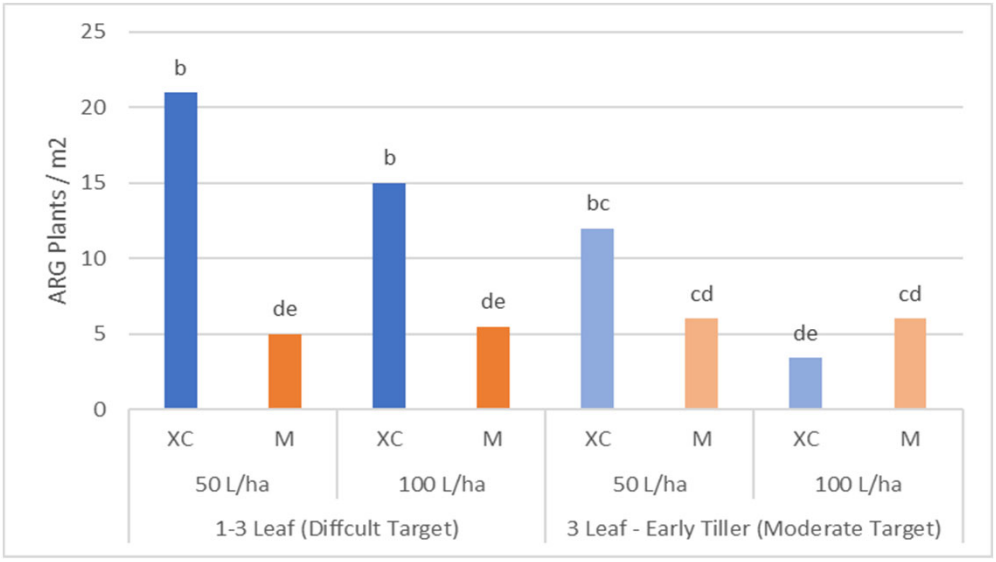


Assess % Coverage with Snapcard app

11

SPRAY QUALITY IMPACT ON EFFICACY

Impact of Spray Quality, Water Volume & Target



Source – Killing glyphosate resistant ryegrass? Application does matter.

M.Street & B.Obrien – GOA, 2022

Target

Annual Rye Grass

Difficult Target - 1 to 3 Leaf

Moderate Target – 3 leaf to early tiller

Water Volume

Low = 50 L/ha

High = 100 L/ha

Spray Quality

Applied at 4 bar

TT Teejet 110015 – Fine

AIXR Teejet 110015 – Medium (Coarse End)

TTI Teejet - Xtra Coarse

UTC Plant population = 300 plant per m2

12

SPRAY QUALITY IMPACT ON EFFICACY

Impact of Spray Quality, Water Volume & Target

Have a Set of "Spray Plans" for different spray situations on farm

UTC Plant population = 300 plant per m2

13

ADDITIONAL FACTORS - INFLUENCING SPRAY DRIFT RISK

- Boom Height
- Spraying Speed
- Adjuvant Choice
- Sensitive Areas and Buffer Zone Requirements
- Product Choice and Rate

14

TAKE HOME MESSAGES

- When we ***Choose to Spray***, will determine where and how far the spray driftable fraction of our application will move
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ADDITIONAL FACTORS
- INFLUENCING SPRAY DRIFT RISK

- Boom Height
- Spraying Speed
- Adjuvant Choice

Impact of Common Summer Fallow Herbicides on Spray Quality

Nozzle Type	GRDC Spray Quality Chart - 4 Bar	% Volume <150 microns	
		Average	Range
Teejet TT 110-02	Medium (Fine End)	26.7	16.4 - 38
Teejet AIXR 110-02	Medium (Coarse End)	8.1	5.2-13.2
Teejet TTI 110-02	Ultra Coarse (XC End)	1.4	0.8-2.3

Source – GRDC – Drift mitigation, efficacy and 2,4-D. B. Gordon, 2019

- Sensitive Areas and Buffer Zone Requirements
- Product Choice and Rate

17


Quick 'N' Safe
Chemical Protection Apron
Variety of sizes –
S, M, L, XL, XXL

1


ONE
TWO
THREE
2,4-D
Practical & Accredited Training Solutions
Spray Safe and Save - "the name says it all"

2


ONE – Sprayer Setup & Operation
TWO
THREE
2,4-D
Practical & Accredited Training Solutions
Spray Safe and Save - "the name says it all"

3


ONE – Sprayer Setup & Operation
TWO – Tank Mix
THREE
2,4-D
Practical & Accredited Training Solutions
Spray Safe and Save - "the name says it all"

4

5

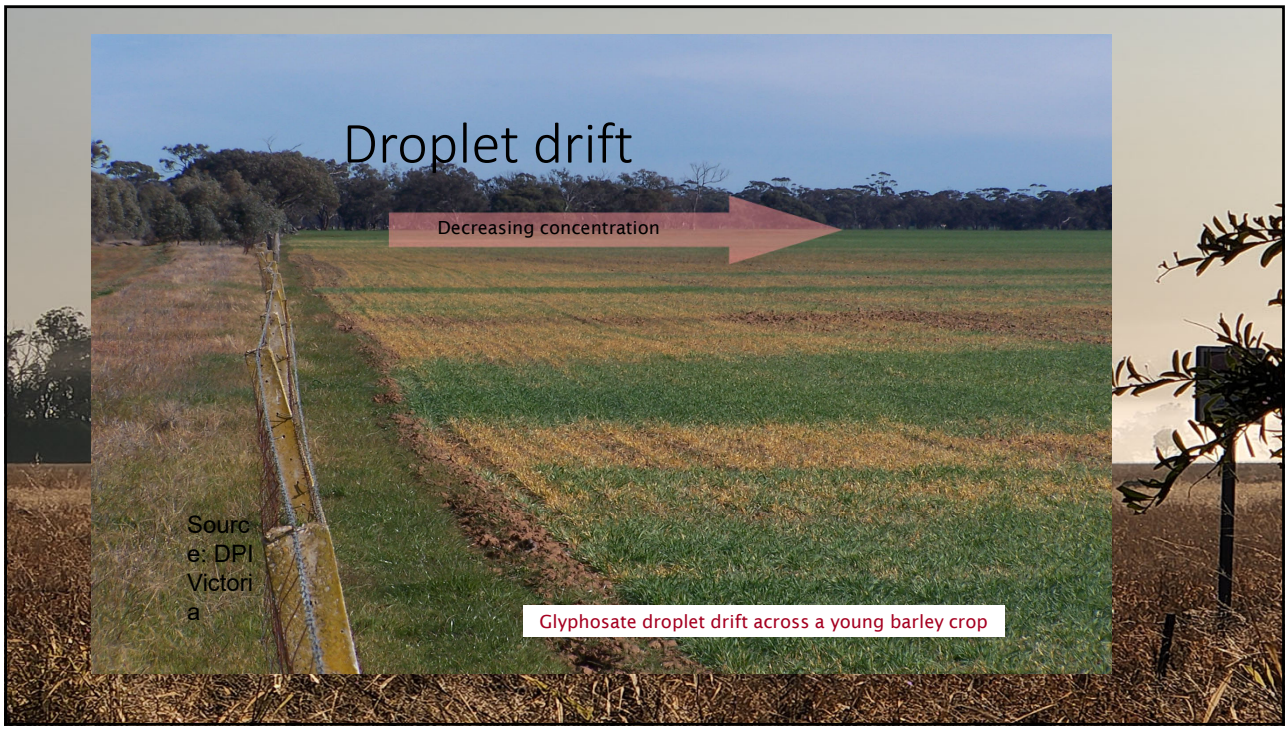
6

Practical & Accredited Training Solutions
Spray Safe and Save - "the name says it all"

7

8

Practical & Accredited Training Solutions
Spray Safe and Save - "the name says it all"



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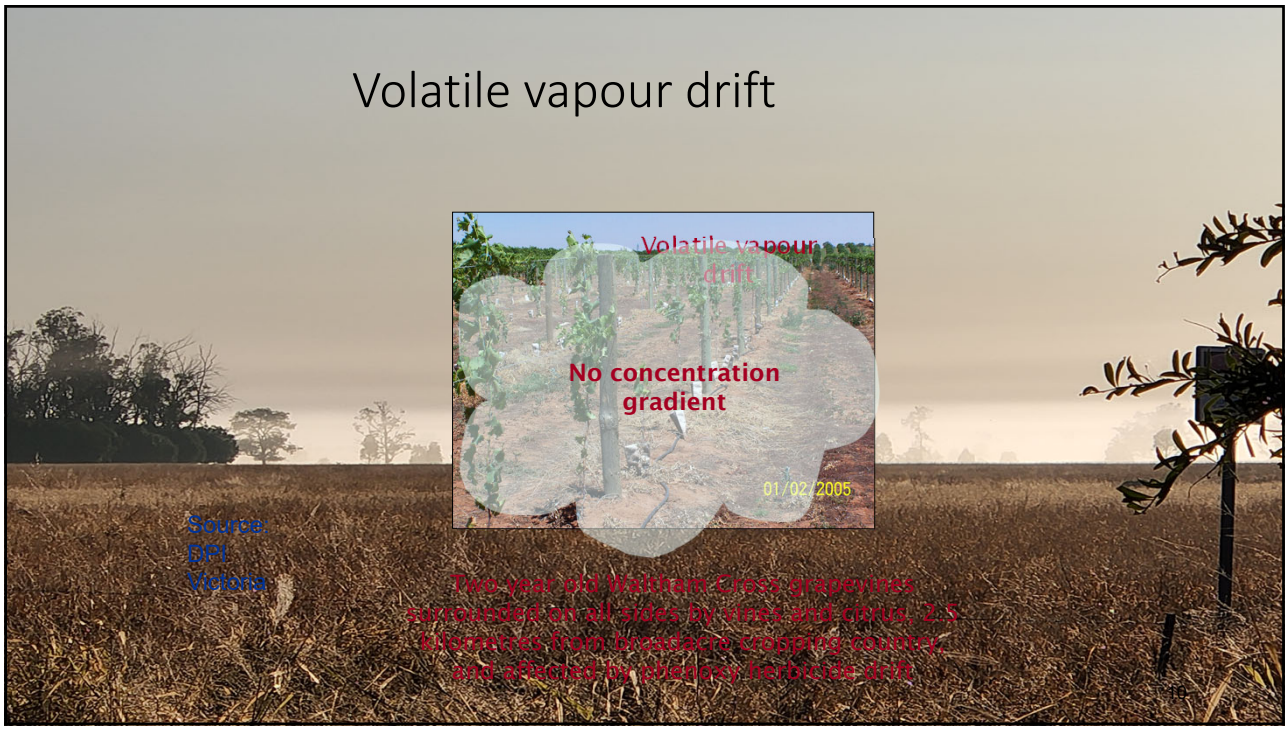

10

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Spray Safe and Save - "the name says it all"

Cotton and Grapevine sensitivity to 2,4-D

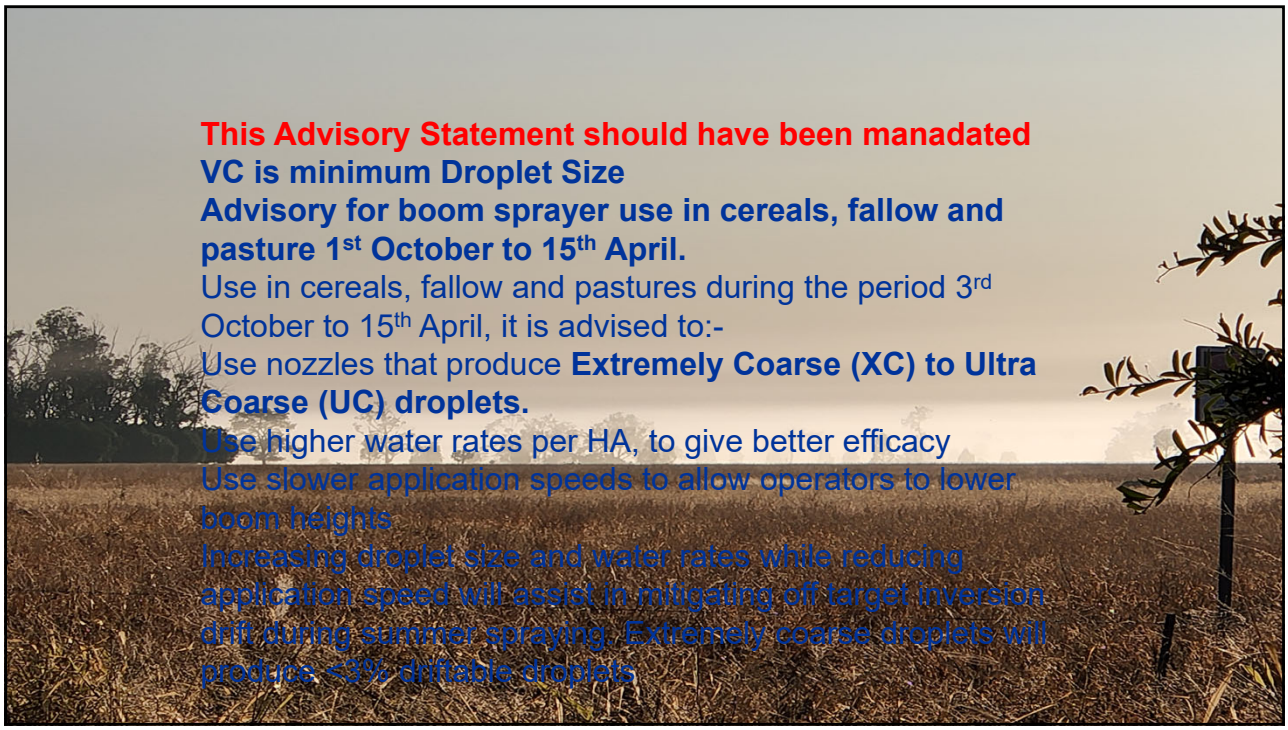
- As little as 0.73 grams per hectare of 2,4-D can have an adverse affect on grape vines and cotton

11

Which nozzle should I pick?

12

Spray Safe & Save
Practical & Accredited Training Solutions
Spray Safe and Save - "the name says it all"



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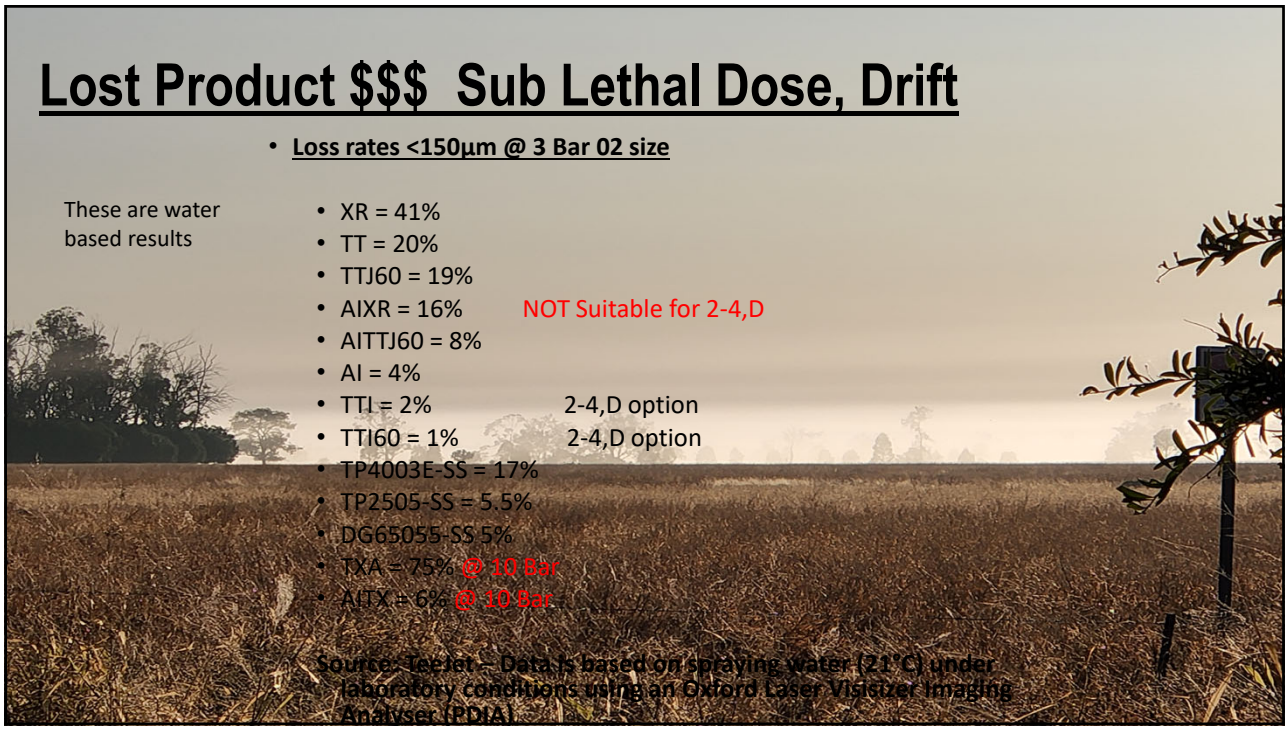

14

Spray Safe & Save
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Spray Safe and Save - "the name says it all"

Understand Nozzle identification coding & standards

15

S572 spray quality Note No UC class

TeeJet

NOZZLE SELECTION GUIDE

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

AIXR TeeJet	bar 1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
AIXR110015	VC	VC	C	C	C	C	M	M	M	M
AIXR11002	XC	VC	VC	C	C	C	C	C	M	M
AIXR110025	XC	XC	VC	VC	C	C	C	C	C	C
AIXR11003	XC	XC	VC	VC	C	C	C	C	C	C
AIXR11004	XC	XC	XC	VC	VC	VC	C	C	C	C

Turbo Twinjet	bar 1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
TTJ60-11002	C	C	C	C	M	M	M	M	M	M
TTJ60-110025	VC	C	C	C	C	C	C	M	M	M
TTJ60-11003	VC	C	C	C	C	C	C	C	M	M
TTJ60-11004	VC	C	C	C	C	C	C	C	C	M

Air Induction Turbo Twinjet	bar 1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
AITTJ60-11002	XC	VC	VC	VC	C	C	C	C	C	C
AITTJ60-110025	XC	VC	VC	VC	C	C	C	C	C	C
AITTJ60-11003	XC	XC	XC	VC	VC	VC	C	C	C	C
AITTJ60-11004	XC	XC	XC	VC	VC	VC	C	C	C	C

Turbo TeeJet Induction	bar 1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
ALL CAPACITIES	XC	XC	XC	XC	XC	XC	XC	XC	XC	XC	XC	XC	XC

AI TeeJet AIC TeeJet	bar 3	4	5	6	7	8
AI110015	VC	C	C	C	C	C
AI11002	VC	VC	C	C	C	C
AI110025	VC	VC	VC	C	C	C
AI11003	VC	VC	VC	C	C	C
AI11004	VC	VC	VC	VC	C	C

TeeJet

PO Box 8128, Newtown VIC 3220
Email: teejetoz@teejet.com
Web: www.teejet.com
Phone: 03 5223 3020
Fax: 03 5223 3015

Droplet size classifications are based on BCPC specifications and in accordance with ASAE Standard S-572 at the date of printing. Classifications are subject to change.

16

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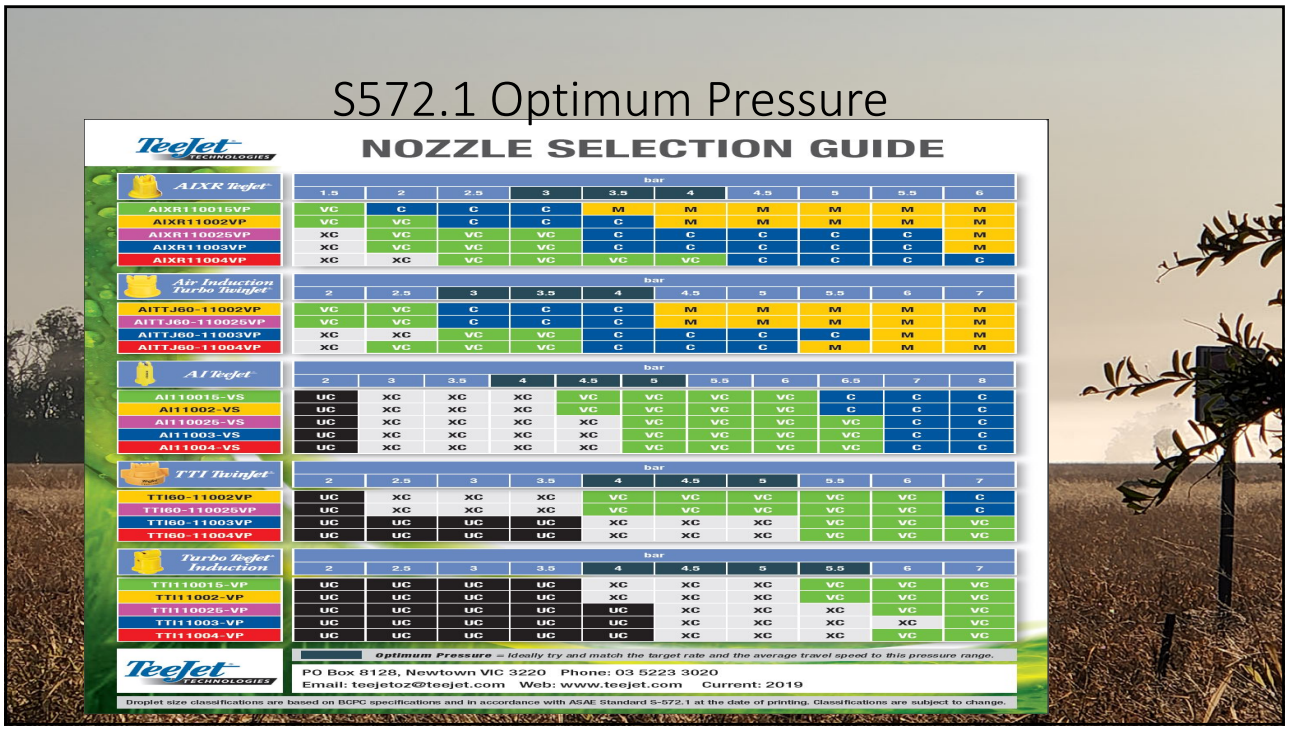
S572.1 Optimum Pressure



NOZZLE SELECTION GUIDE

AIXR Teejet

	bar									
	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
AIXR110015VP	VC	C	C	C	M	M	M	M	M	M
AIXR11002VP	VC	VC	C	C	C	M	M	M	M	M
AIXR110025VP	XC	VC	VC	VC	C	C	C	C	C	M
AIXR11003VP	XC	VC	VC	VC	C	C	C	C	C	M
AIXR11004VP	XC	XC	VC	VC	VC	VC	C	C	C	C

Air Induction Turbo Twinjet

	bar									
	2	2.5	3	3.5	4	4.5	5	5.5	6	7
AITTJ60-11002VP	VC	VC	C	C	C	M	M	M	M	M
AITTJ60-110025VP	VC	VC	C	C	C	M	M	M	M	M
AITTJ60-11003VP	XC	XC	VC	VC	C	C	C	C	M	M
AITTJ60-11004VP	XC	VC	VC	VC	C	C	C	M	M	M

AI Teejet

	bar										
	2	3	3.5	4	4.5	5	5.5	6	6.5	7	8
AI110015-VS	UC	XC	XC	XC	VC	VC	VC	VC	C	C	C
AI11002-VS	UC	XC	XC	XC	VC	VC	VC	VC	C	C	C
AI110025-VS	UC	XC	XC	XC	XC	VC	VC	VC	VC	C	C
AI11003-VS	UC	XC	XC	XC	XC	VC	VC	VC	VC	C	C
AI11004-VS	UC	XC	XC	XC	XC	VC	VC	VC	VC	C	C

TTI Twinjet

	bar									
	2	2.5	3	3.5	4	4.5	5	5.5	6	7
TTI60-11002VP	UC	XC	XC	XC	VC	VC	VC	VC	VC	C
TTI60-110025VP	UC	XC	XC	XC	VC	VC	VC	VC	VC	C
TTI60-11003VP	UC	UC	UC	UC	XC	XC	XC	VC	VC	VC
TTI60-11004VP	UC	UC	UC	UC	XC	XC	XC	VC	VC	VC

Turbo Teejet Induction

	bar									
	2	2.5	3	3.5	4	4.5	5	5.5	6	7
TTI110015-VP	UC	UC	UC	UC	XC	XC	XC	VC	VC	VC
TTI11002-VP	UC	UC	UC	UC	XC	XC	XC	VC	VC	VC
TTI110025-VP	UC	UC	UC	UC	UC	XC	XC	XC	VC	VC
TTI11003-VP	UC	UC	UC	UC	UC	XC	XC	XC	XC	VC
TTI11004-VP	UC	UC	UC	UC	UC	XC	XC	XC	VC	VC

Optimum Pressure – Ideally try and match the target rate and the average travel speed to this pressure range.

PO Box 8128, Newtown VIC 3220 Phone: 03 5223 3020
Email: teejetoz@teejet.com Web: www.teejet.com Current: 2019

Droplet size classifications are based on BCPC specifications and in accordance with ASAE Standard S-572.1 at the date of printing. Classifications are subject to change.

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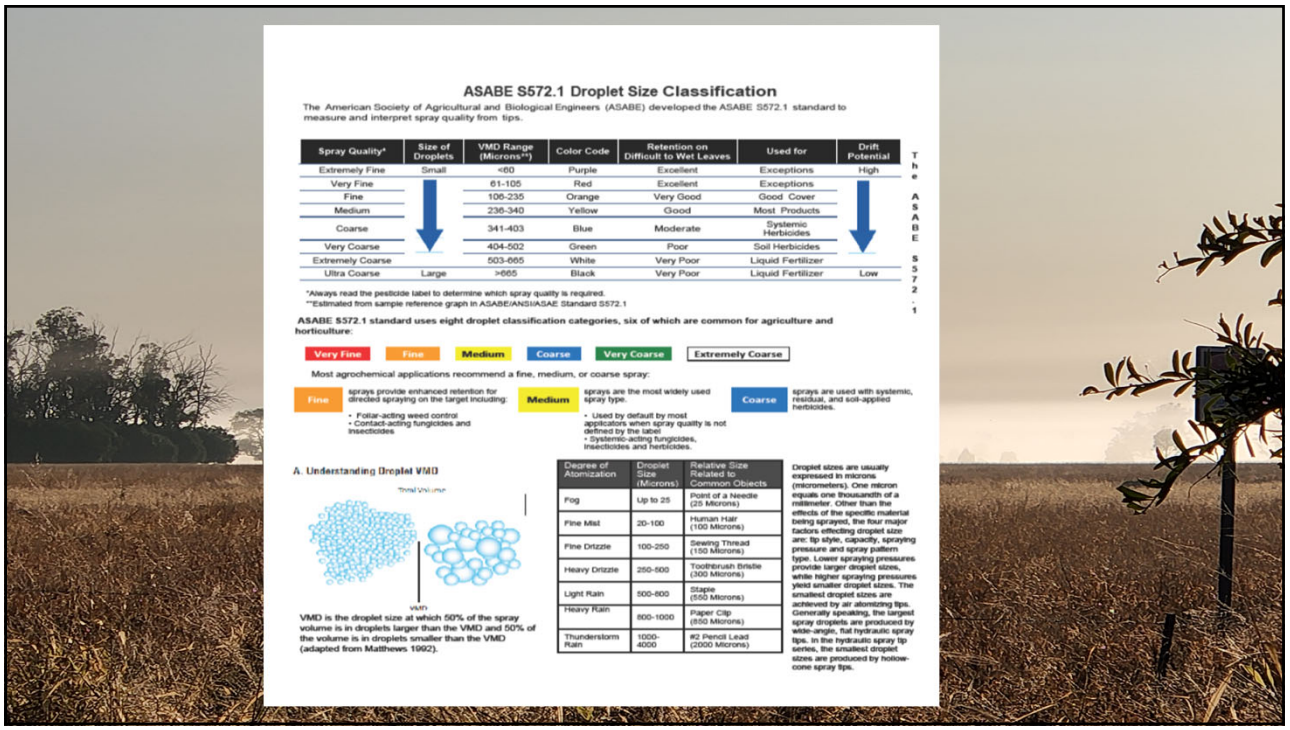

ASABE S572.1 Droplet Size Classification

The American Society of Agricultural and Biological Engineers (ASABE) developed the ASABE S572.1 standard to measure and interpret spray quality from tips.

Spray Quality*	Size of Droplets	VMD Range (Microns**)	Color Code	Retention on Difficult to Wet Leaves	Used for	Drift Potential
Extremely Fine	Small	<60	Purple	Excellent	Exceptions	High
Very Fine		61-105	Red	Excellent	Exceptions	
Fine		106-235	Orange	Very Good	Good Cover	
Medium		236-340	Yellow	Good	Most Products	
Coarse		341-403	Blue	Moderate	Systemic Herbicides	
Very Coarse		404-502	Green	Poor	Soil Herbicides	
Extremely Coarse		503-665	White	Very Poor	Liquid Fertilizer	
Ultra Coarse	Large	>665	Black	Very Poor	Liquid Fertilizer	Low

*Always read the pesticide label to determine which spray quality is required.
**Estimated from sample reference graph in ASABE/ANSI/ASAE Standard S572.1

The ASABE S572.1

ASABE S572.1 standard uses eight droplet classification categories, six of which are common for agriculture and horticulture:

Very Fine | Fine | Medium | Coarse | Very Coarse | Extremely Coarse

Most agrochemical applications recommend a fine, medium, or coarse spray:

Fine – sprays provide enhanced retention for directed spraying on the target including:
- Foliar-acting weed control
- Contact-acting fungicides and insecticides

Medium – sprays are the most widely used spray type.
- Used by default by most applicators when spray quality is not defined by the label
- Systemic-acting fungicides, insecticides and herbicides.

Coarse – sprays are used with systemic, residual, and soil-applied herbicides.

A. Understanding Droplet VMD

VMD is the droplet size at which 50% of the spray volume is in droplets larger than the VMD and 50% of the volume is in droplets smaller than the VMD (adapted from Matthews 1992).

Degree of Atomization	Droplet Size (Microns)	Relative Size Related to Common Objects
Fog	Up to 25	Point of a Needle (25 Microns)
Fine Mist	20-100	Human Hair (100 Microns)
Fine Drizzle	100-250	Sewing Thread (150 Microns)
Heavy Drizzle	250-500	Toothbrush Bristle (300 Microns)
Light Rain	500-800	Staple (550 Microns)
Heavy Rain	800-1000	Paper Clip (850 Microns)
Thunderstorm Rain	1000-4000	#2 Pencil Lead (2000 Microns)

Droplet sizes are usually expressed in microns (micrometers). One micron equals one thousandth of a millimeter. Other than the effects of the specific material being sprayed, the four major factors effecting droplet size are: tip style, capacity, spraying pressure and spray pattern type. Lower spraying pressures provide larger droplet sizes, while higher spraying pressures yield smaller droplet sizes. The smallest droplet sizes are achieved by air atomizing tips. Generally speaking, the largest spray droplets are produced by wide-angle, flat hydraulic spray tips. In the hydraulic spray tip series, the smallest droplet sizes are produced by hollow-cone spray tips.

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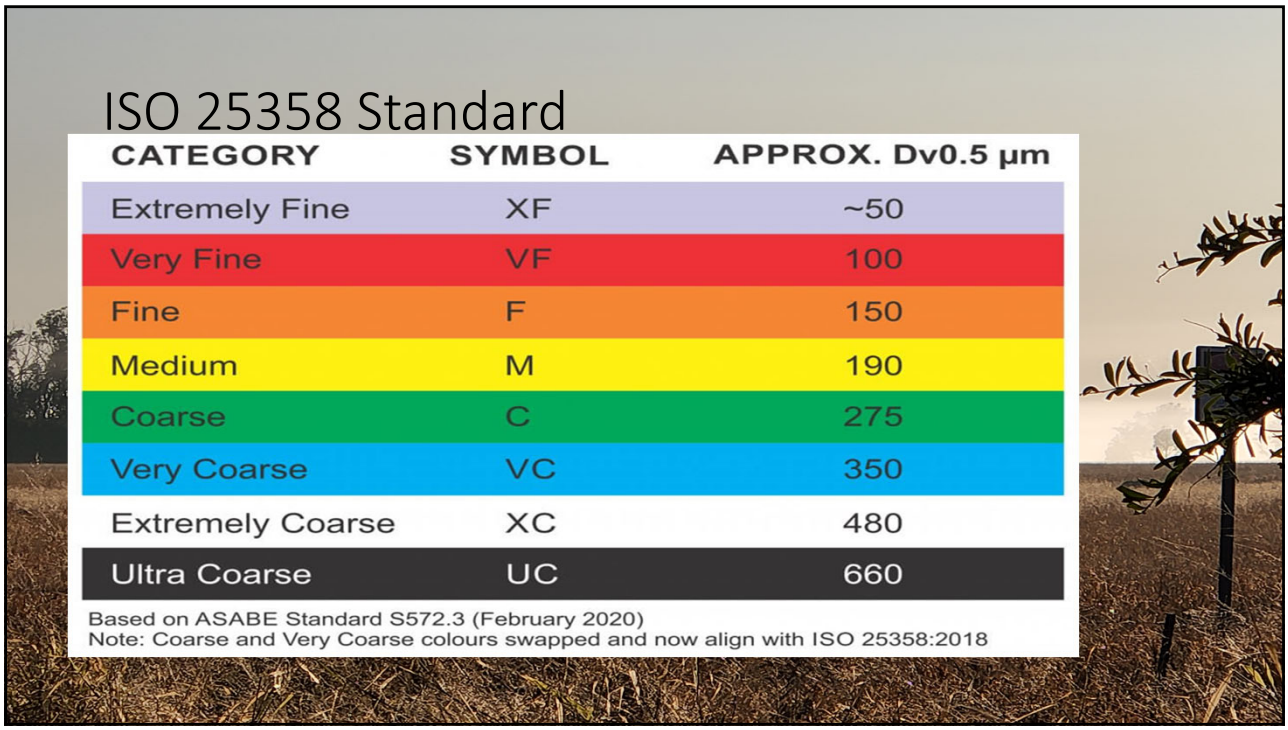

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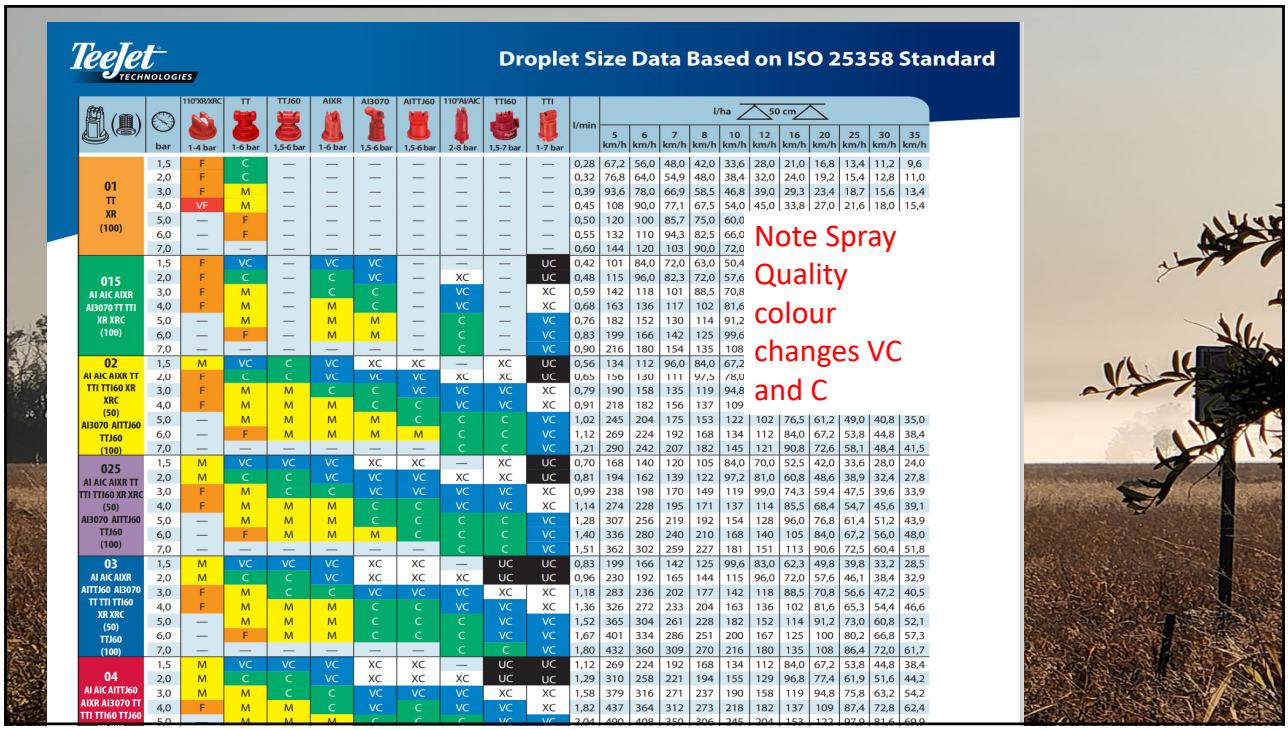

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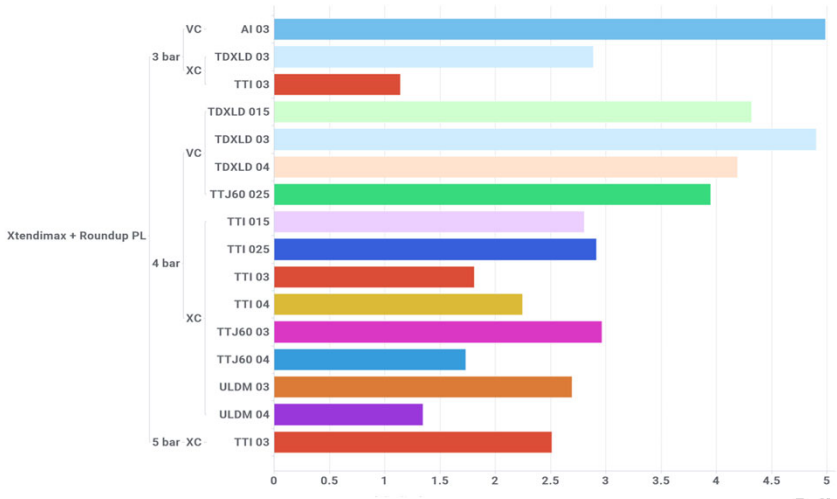
Driftable fines with range of nozzles and Roundup Ready PL Herbicide + Low volatile Dicamba Herbicide tank-mix



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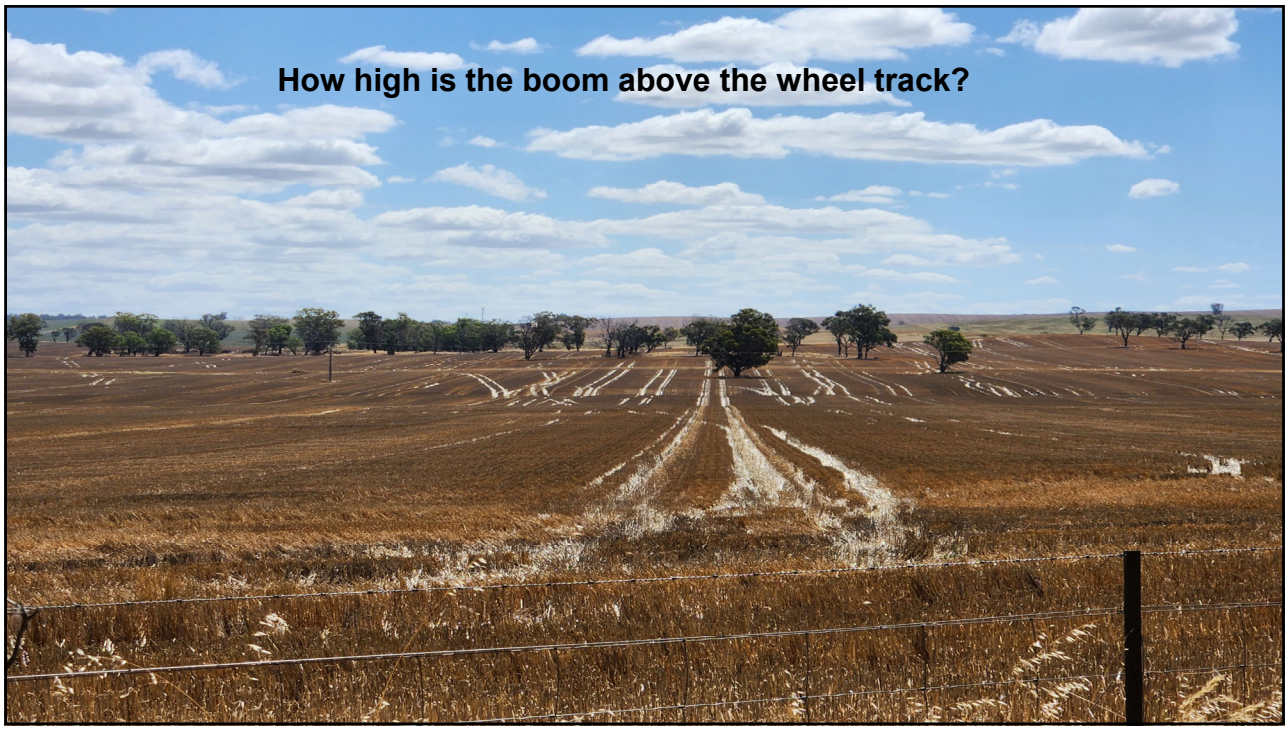

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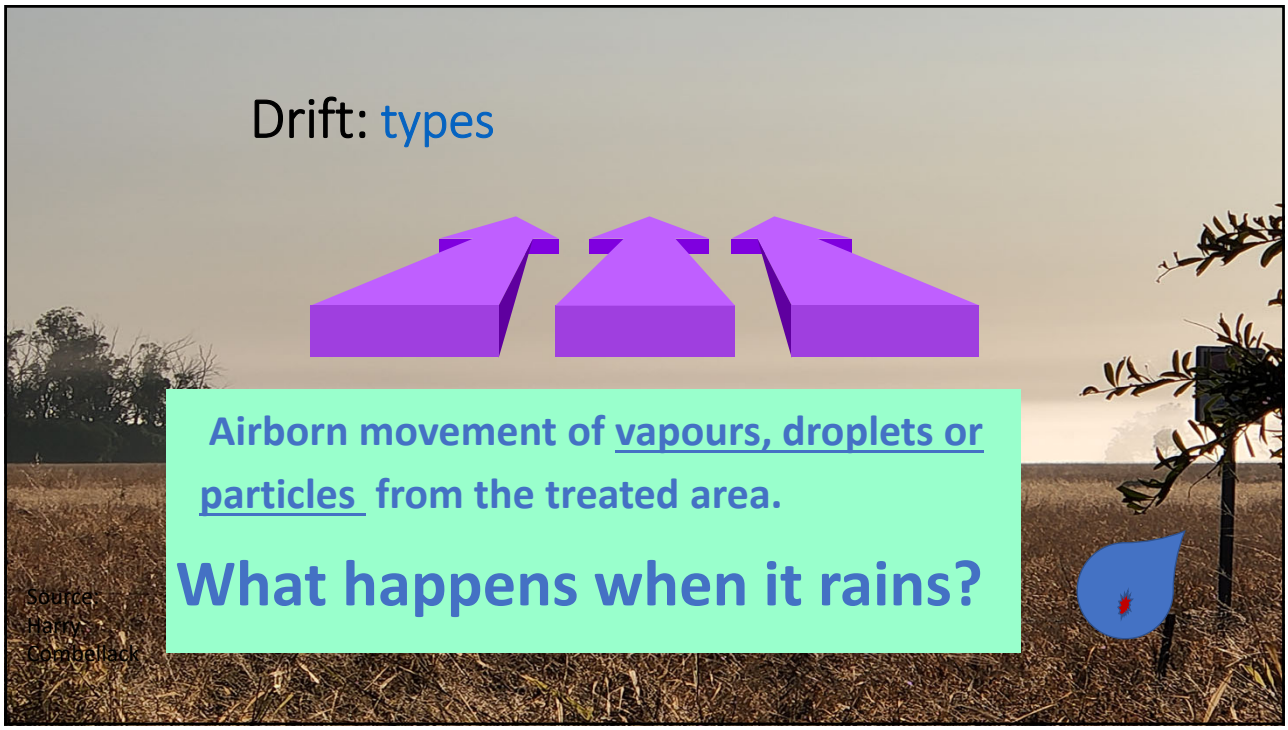

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TWO – Tank Mix

- Water Quality issues.
- Water Quality adjuvants.
- Mixing order.
- Influence of tank mix on nozzle performance.

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Water Quality

Key

✓	OK.
X	Do not use.
NR	Not recommended but use quickly if there is no alternative.
Test	Mix herbicides and water in proportion and observe any instability.
Marginal	Not ideal, but acceptable.

Herbicide	Water quality				
	Muddy	Saline	Hard	Alkaline (> pH 8)	Acidic (< pH 5)
2,4-DB	–	–	X	NR	–
2,4-D or MCPA amine	✓	✓	X	NR	–
2,4-D or MCPA ester	✓	Test	Test	✓	✓
Associate®	✓	✓	✓	Marginal	X
Brodal®	–	✓	✓	X	–
Dicamba	✓	✓	NR	NR	–
Diuron	✓	Test	✓	✓	–
Diuron + 2,4-D amine	✓	Test	X	NR	–
Diuron + MCPA amine	✓	Test	X	NR	–
Fusilade® Forte	✓	✓	✓	NR	X
Tackle®	✓	✓	✓	Marginal	X
Glyphosate	X	✓	X	–	✓
Gramoxone® 360 Pro	X	✓	✓	✓	✓
Logran®B-Power	✓	✓	✓	Marginal	X
Lontrel™ Advanced	✓	✓	X	X	–
Simazine	✓	X	✓	NR	–
Spray.Seed®	X	✓	✓	✓	✓
Elantra® Xtreme®	✓	✓	✓	✓	✓
Tigrex®	✓	X	X	NR	
Trifluralin		✓	✓	✓	✓
Verdict™	✓	✓	✓	NR	✓

Source: Weed Control in Winter Crops 2019, NSW DPI

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Scale of the poor water quality issue

Table 4. Summary of rating of suitability for sampled water as carrier for application of 21 pesticides assessed in the SOS Macquarie bore water quality project.

Mode of Action Group and name	pH	Total Hardness	Bicarbonate	Salinity
A Aramo	OK	OK	88% Soften	OK
A Axial	78% Acidify	OK	88% Soften	OK
A Fusilade Forte	78% Use Quickly	OK	No Data	OK
A Hoegrass	78% Use Quickly	OK	OK	OK
A Select	78% Acidify	OK	88% Soften	OK
A Sertin	OK	OK	88% Neutralize	OK
A Targa	OK	OK	No Data	OK
A Verdict	78% Use Quickly	OK	No Data	OK
B Ally	78% Acidify	OK	No Data	OK
B Glean	78% Not Ideal	OK	OK	OK
B Logran	78% Not Ideal	OK	No Data	OK
B OnDuty	OK	OK	No Data	OK
B Raptor	OK	OK	No Data	OK

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C Diuron	78% Acidify	OK	OK	32% Test
C Simazine	78% Use Quickly	OK	OK	32% Do Not Use
C + H Velocity	OK	OK	OK	OK
D Trifluralin	OK	OK	No Data	OK
F Brodal	78% Acidify	21% Soften	OK	OK
F + I Tigrex	78% Use Quickly	OK	OK	32% Do Not Use
G Affinity	78% Acidify	OK	No Data	OK
I 2,4-D or MCPA amine	78% Acidify	OK	88% Do Not Use	OK
I 2,4-D or MCPA ester	OK	OK	OK	32% Test
I 2,4-DB	No Data	No Data	No Data	32% Do Not Use
I Dicamba	78% Acidify	21% Use Quickly	OK	OK
I Lontrel	78% Acidify	21% Soften	OK	OK
I + H Precept	OK	OK	OK	OK
L Sprayseed	OK	OK	OK	OK
M Glyphosate	78% Acidify	21% Soften	OK	OK
Chlorpyrifos	78% Acidify	21% Test	No Data	OK
Cypermethrin	78% Acidify	21% Test	No Data	OK
Dimethoate	78% Acidify	21% Test	No Data	OK

SOS Macquarie Valley Inc 2018 Bore Water Sampling Project

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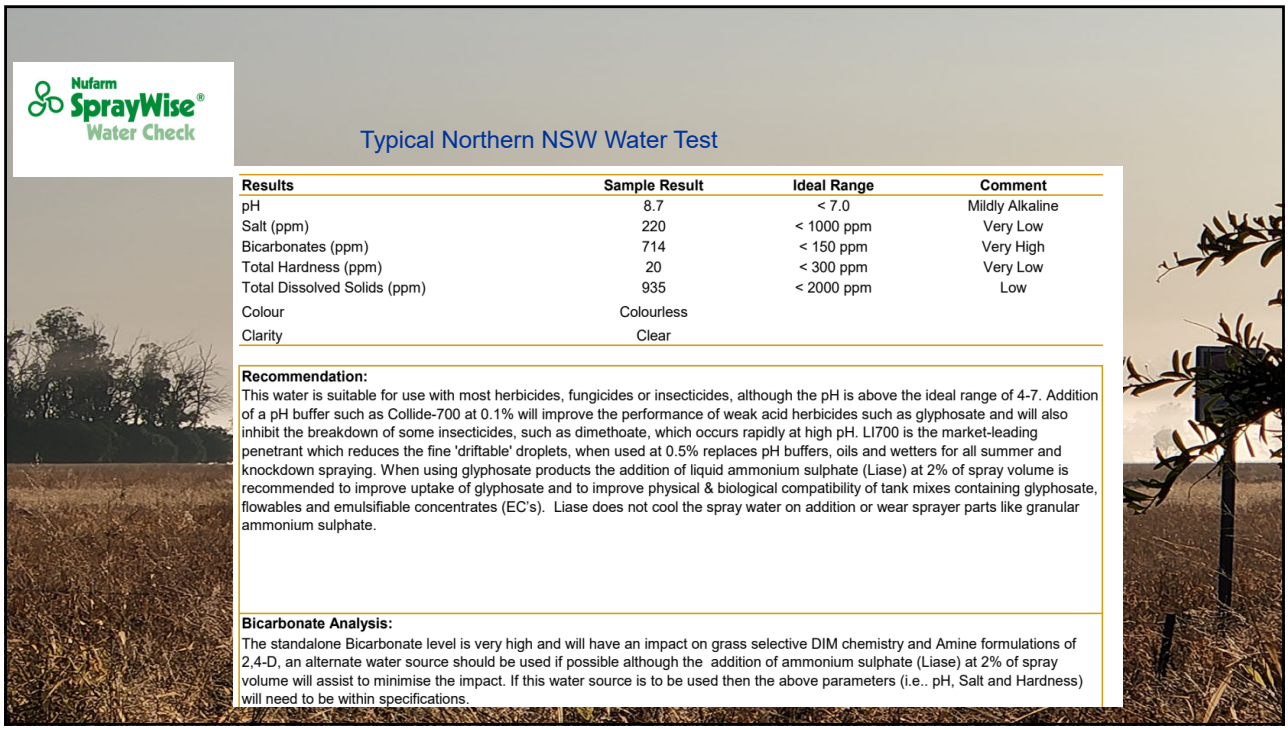

Results	Sample Result	Ideal Range	Comment
pH	8.7	< 7.0	Mildly Alkaline
Salt (ppm)	220	< 1000 ppm	Very Low
Bicarbonates (ppm)	714	< 150 ppm	Very High
Total Hardness (ppm)	20	< 300 ppm	Very Low
Total Dissolved Solids (ppm)	935	< 2000 ppm	Low
Colour	Colourless		
Clarity	Clear		

Recommendation:
This water is suitable for use with most herbicides, fungicides or insecticides, although the pH is above the ideal range of 4-7. Addition of a pH buffer such as Collide-700 at 0.1% will improve the performance of weak acid herbicides such as glyphosate and will also inhibit the breakdown of some insecticides, such as dimethoate, which occurs rapidly at high pH. LI700 is the market-leading penetrant which reduces the fine 'driftable' droplets, when used at 0.5% replaces pH buffers, oils and wetters for all summer and knockdown spraying. When using glyphosate products the addition of liquid ammonium sulphate (Liase) at 2% of spray volume is recommended to improve uptake of glyphosate and to improve physical & biological compatibility of tank mixes containing glyphosate, flowables and emulsifiable concentrates (EC's). Liase does not cool the spray water on addition or wear sprayer parts like granular ammonium sulphate.

Bicarbonate Analysis:
The standalone Bicarbonate level is very high and will have an impact on grass selective DIM chemistry and Amine formulations of 2,4-D, an alternate water source should be used if possible although the addition of ammonium sulphate (Liase) at 2% of spray volume will assist to minimise the impact. If this water source is to be used then the above parameters (i.e.. pH, Salt and Hardness) will need to be within specifications.

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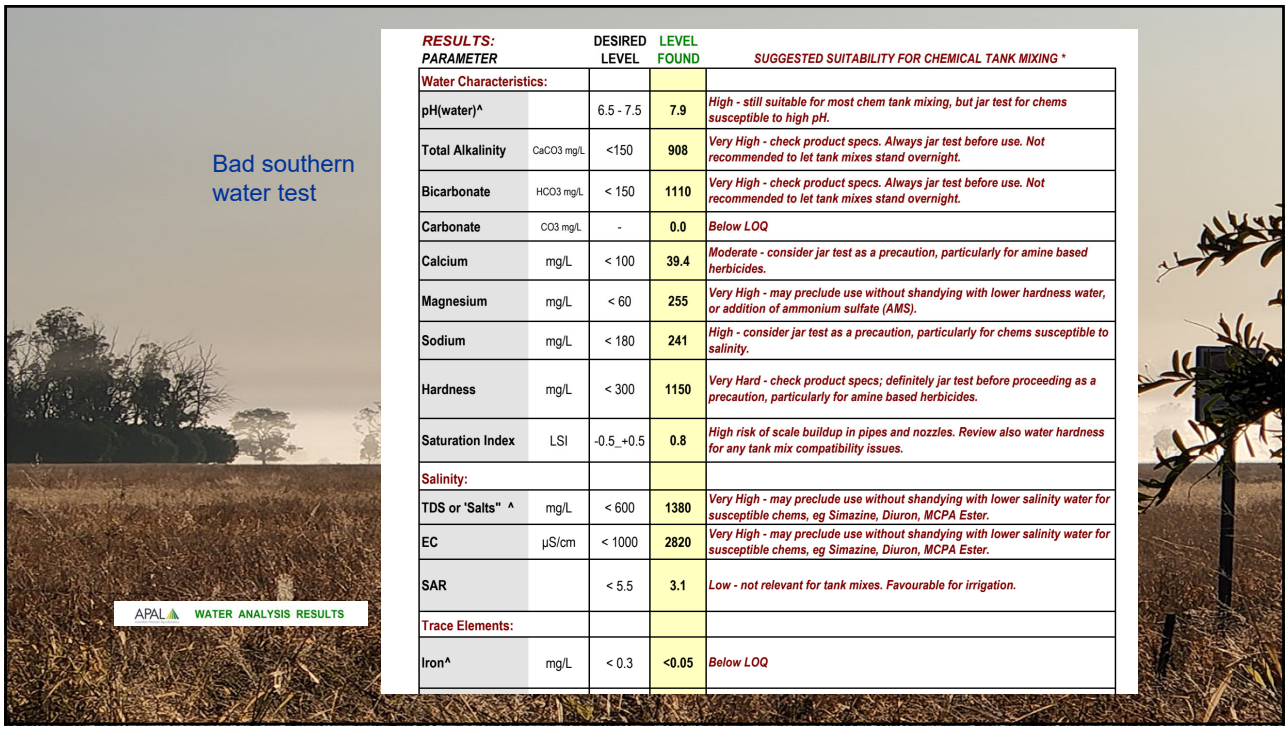

RESULTS: PARAMETER		DESIRED LEVEL	LEVEL FOUND	SUGGESTED SUITABILITY FOR CHEMICAL TANK MIXING *
Water Characteristics:				
pH(water)^		6.5 - 7.5	7.9	High - still suitable for most chem tank mixing, but jar test for chems susceptible to high pH.
Total Alkalinity	CaCO3 mg/L	<150	908	Very High - check product specs. Always jar test before use. Not recommended to let tank mixes stand overnight.
Bicarbonate	HCO3 mg/L	< 150	1110	Very High - check product specs. Always jar test before use. Not recommended to let tank mixes stand overnight.
Carbonate	CO3 mg/L	-	0.0	Below LOQ
Calcium	mg/L	< 100	39.4	Moderate - consider jar test as a precaution, particularly for amine based herbicides.
Magnesium	mg/L	< 60	255	Very High - may preclude use without shandying with lower hardness water, or addition of ammonium sulfate (AMS).
Sodium	mg/L	< 180	241	High - consider jar test as a precaution, particularly for chems susceptible to salinity.
Hardness	mg/L	< 300	1150	Very Hard - check product specs; definitely jar test before proceeding as a precaution, particularly for amine based herbicides.
Saturation Index	LSI	-0.5_+0.5	0.8	High risk of scale buildup in pipes and nozzles. Review also water hardness for any tank mix compatibility issues.
Salinity:				
TDS or 'Salts" ^	mg/L	< 600	1380	Very High - may preclude use without shandying with lower salinity water for susceptible chems, eg Simazine, Diuron, MCPA Ester.
EC	µS/cm	< 1000	2820	Very High - may preclude use without shandying with lower salinity water for susceptible chems, eg Simazine, Diuron, MCPA Ester.
SAR		< 5.5	3.1	Low - not relevant for tank mixes. Favourable for irrigation.
Trace Elements:				
Iron^	mg/L	< 0.3	<0.05	Below LOQ

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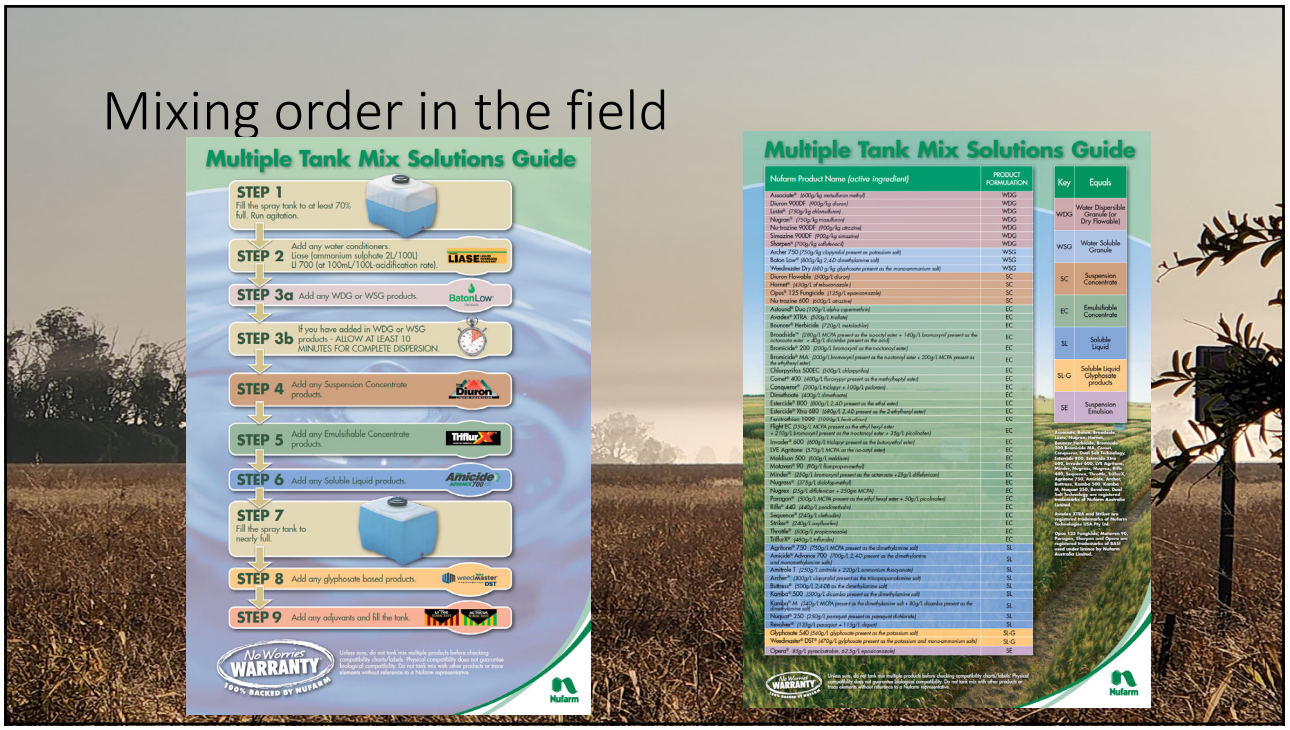

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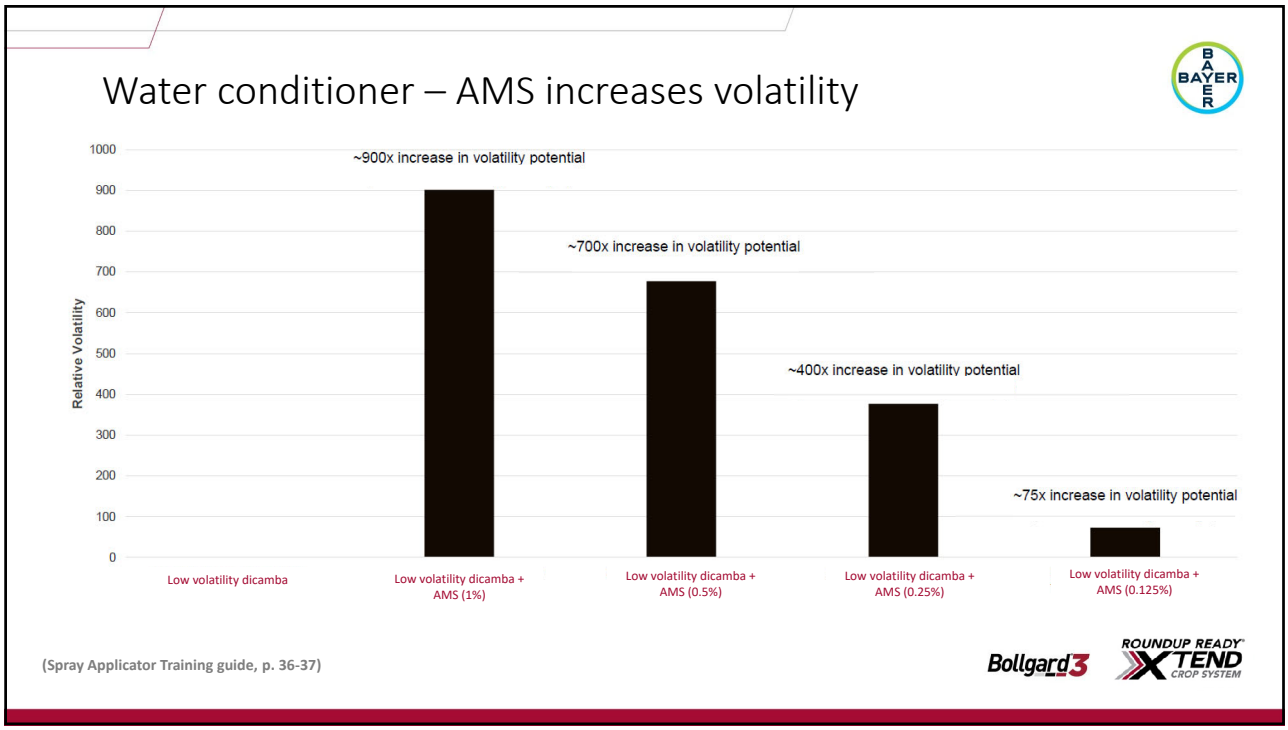

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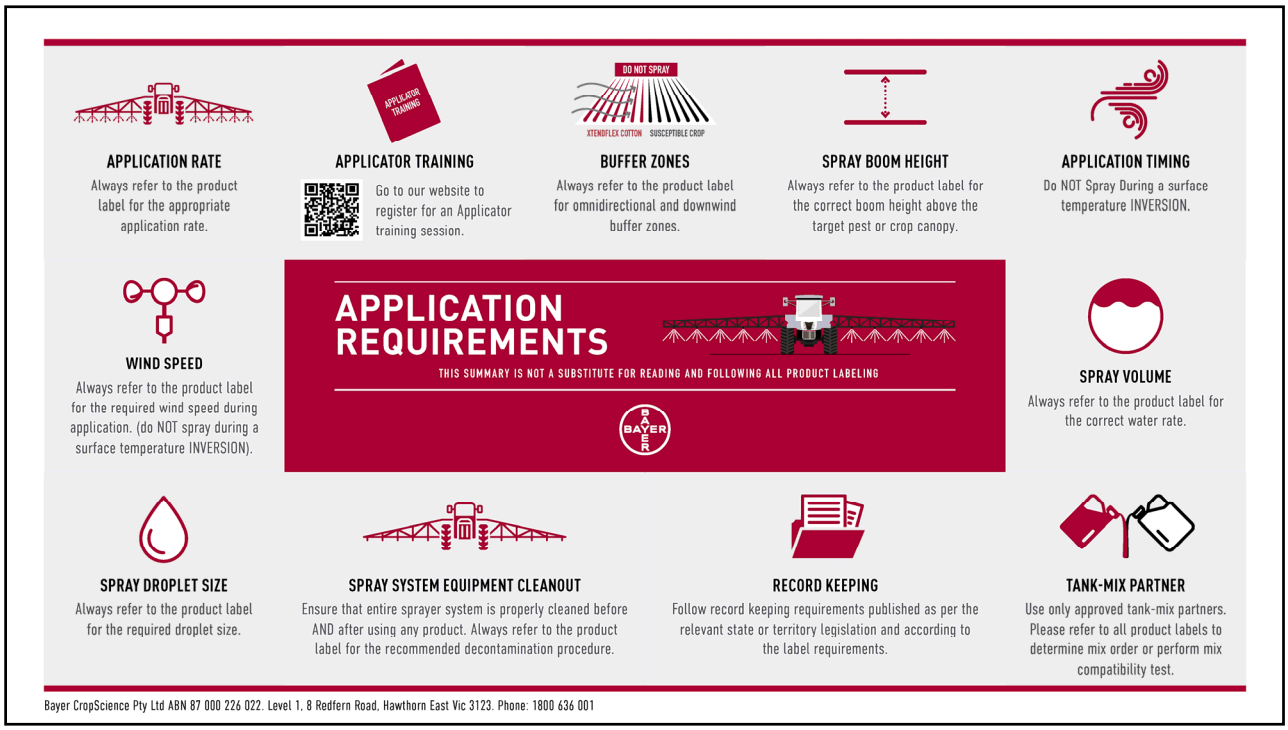

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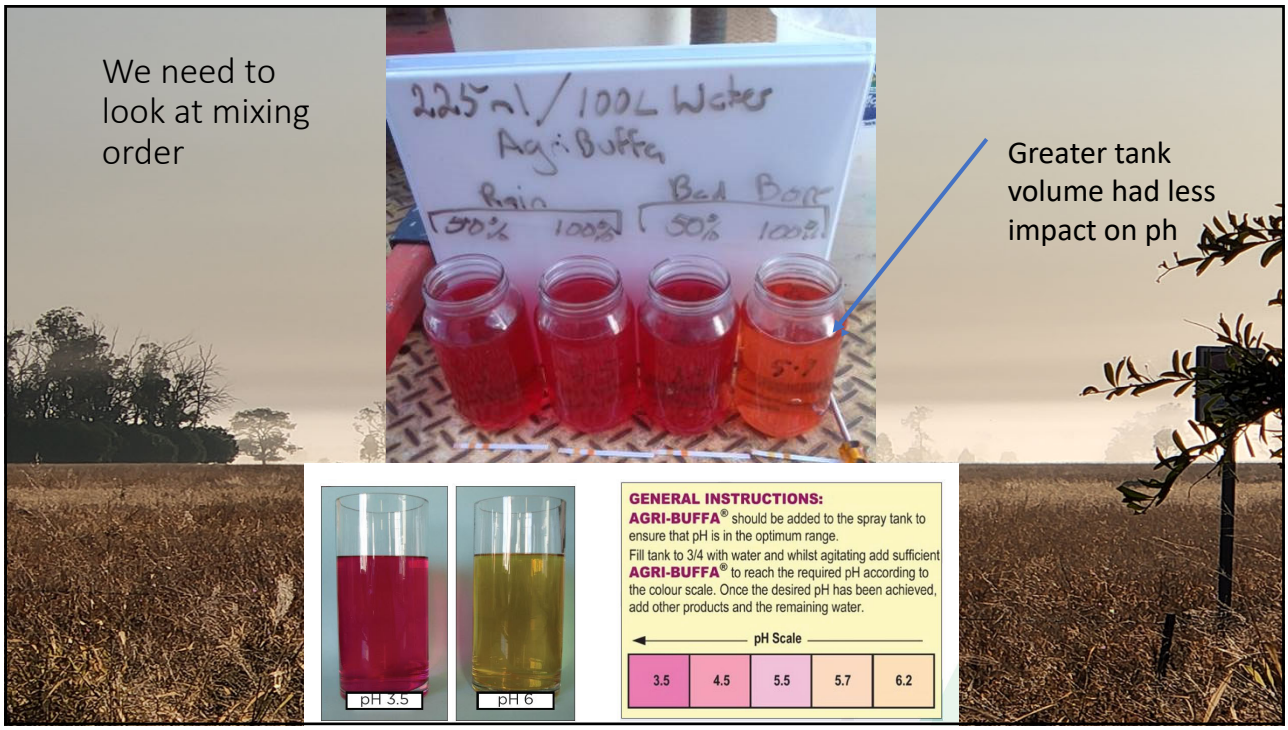

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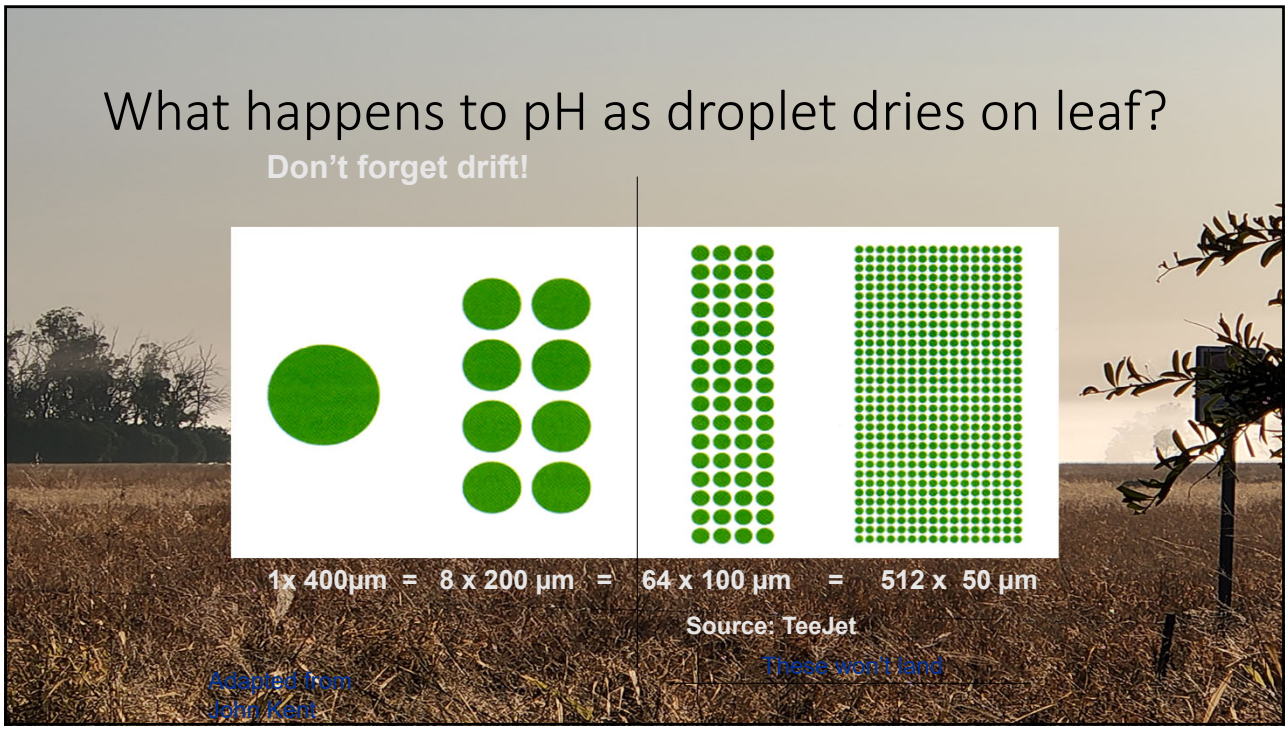

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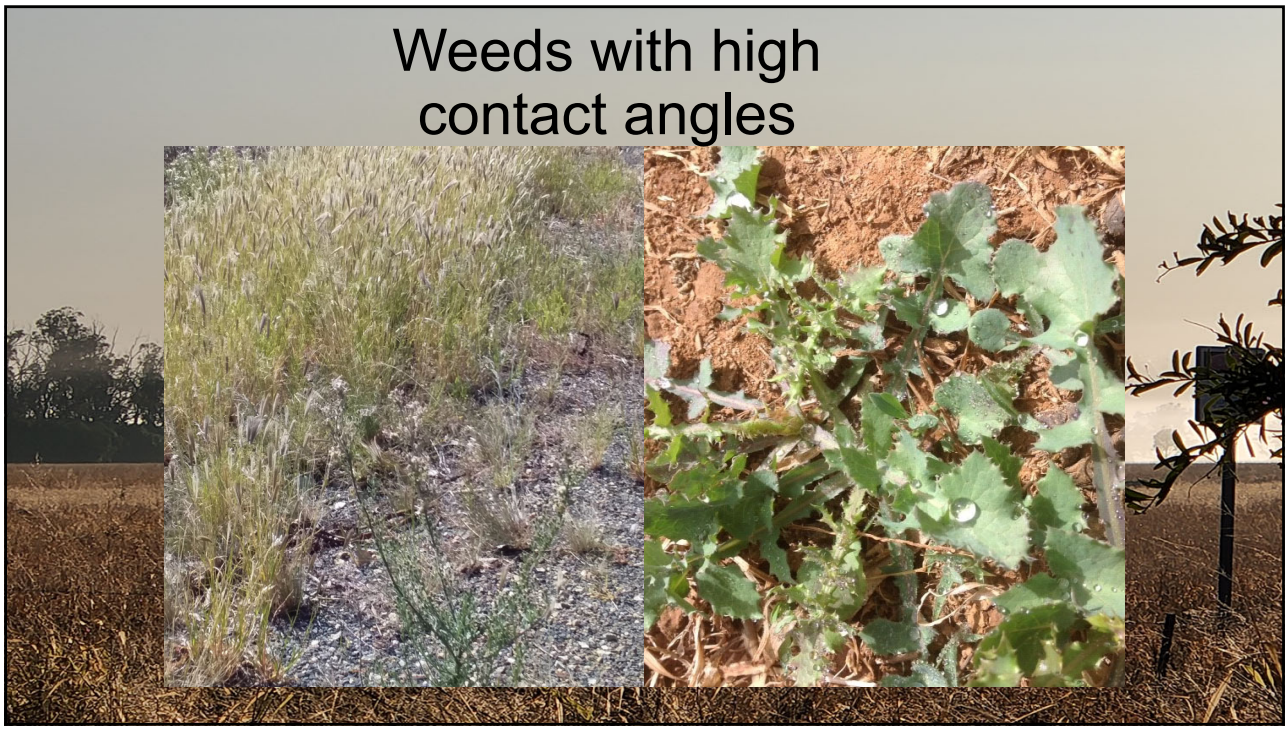

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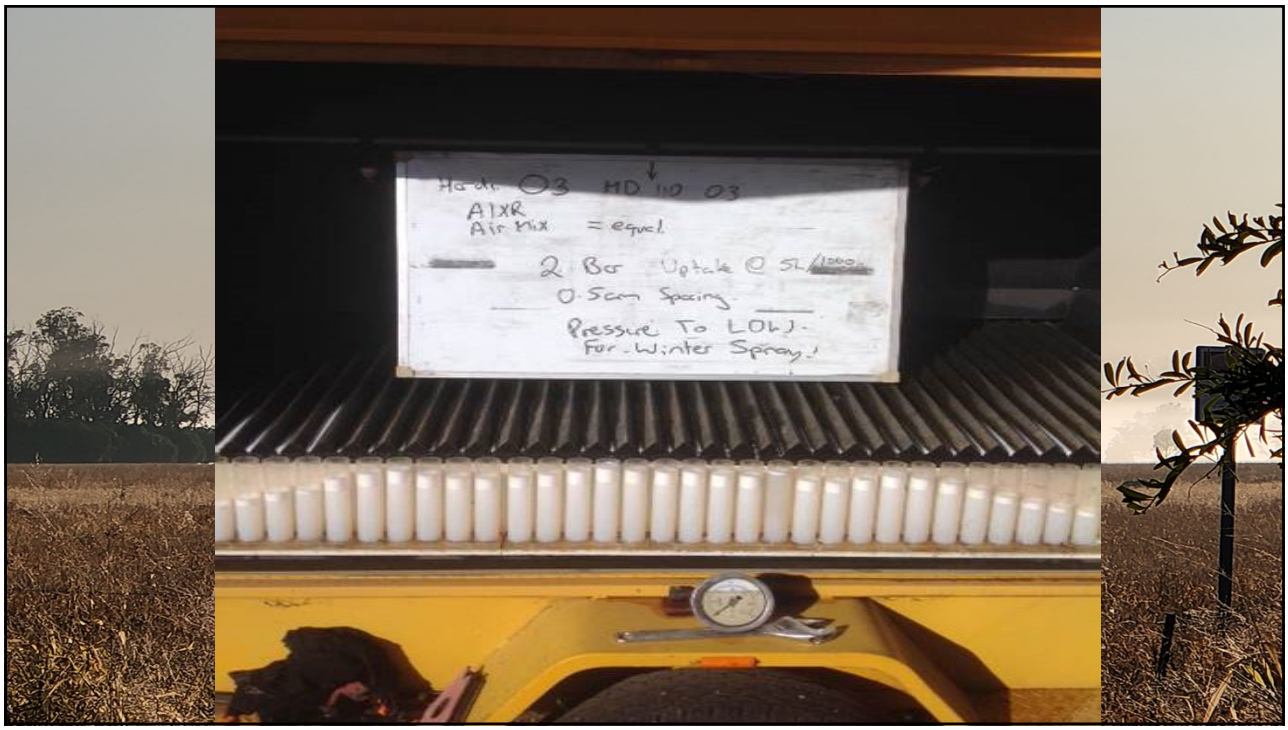

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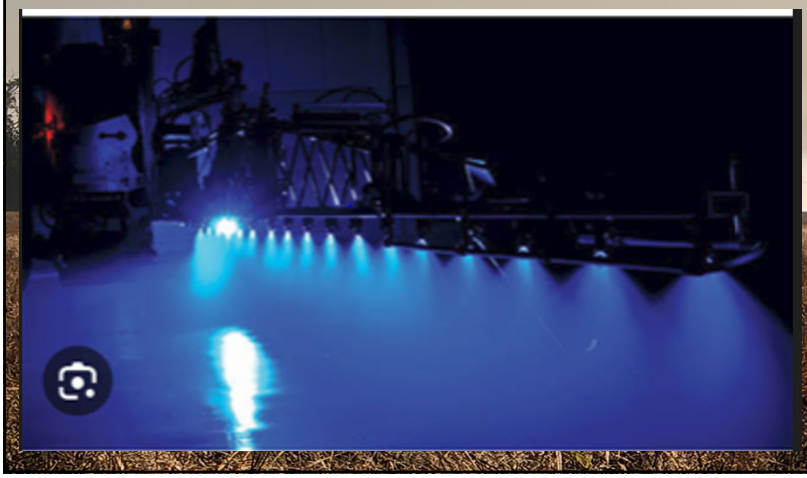
THREE – Timing

- Do not spray 2,4-D at night



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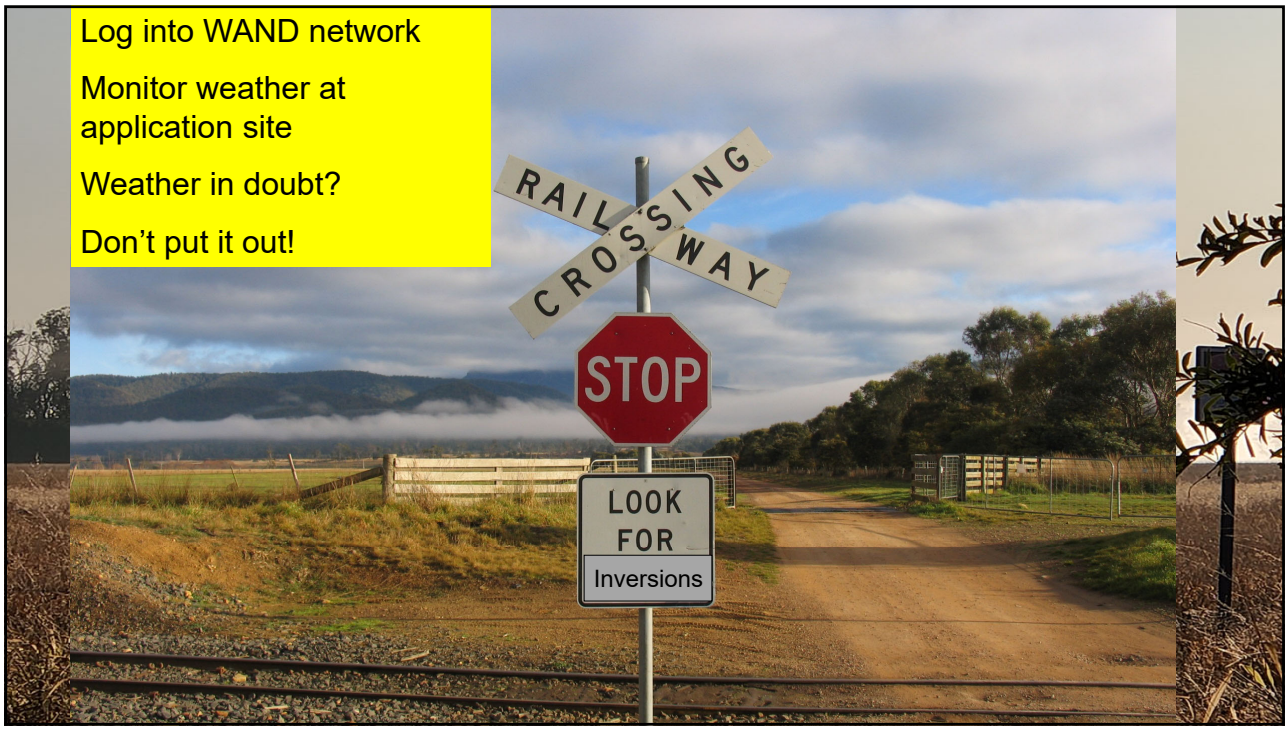

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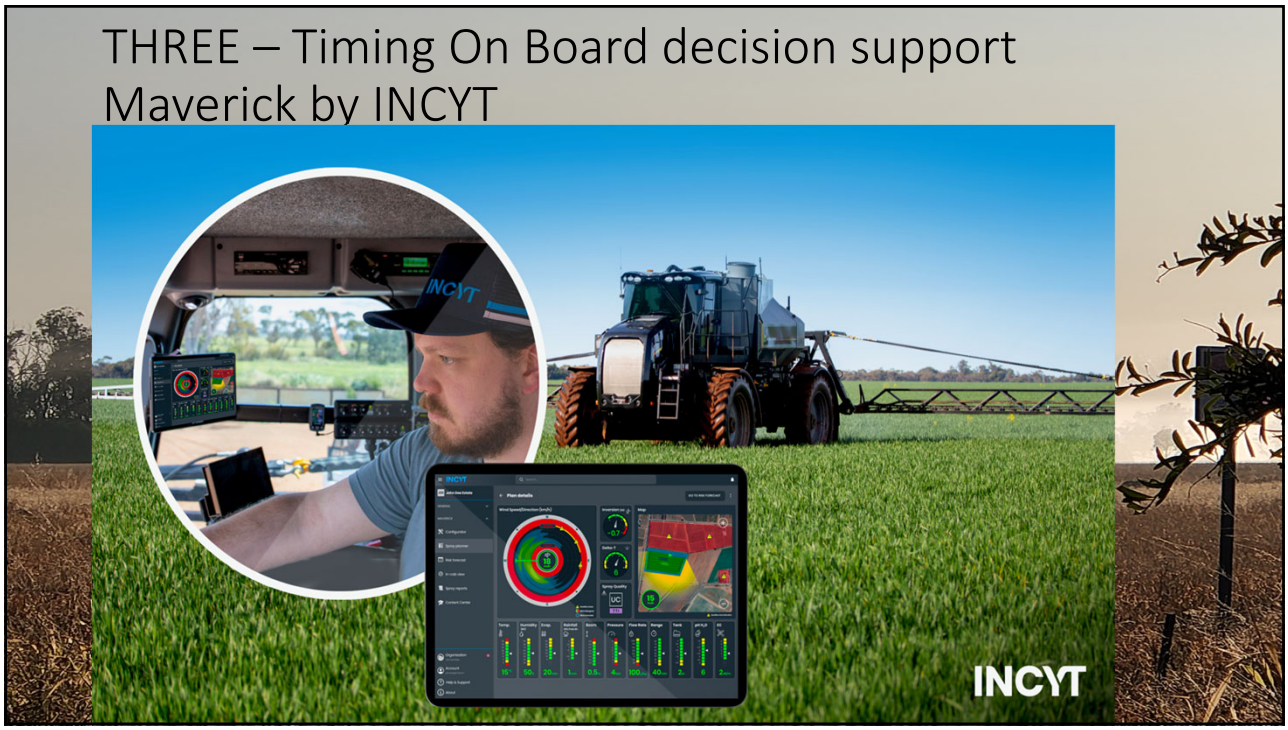

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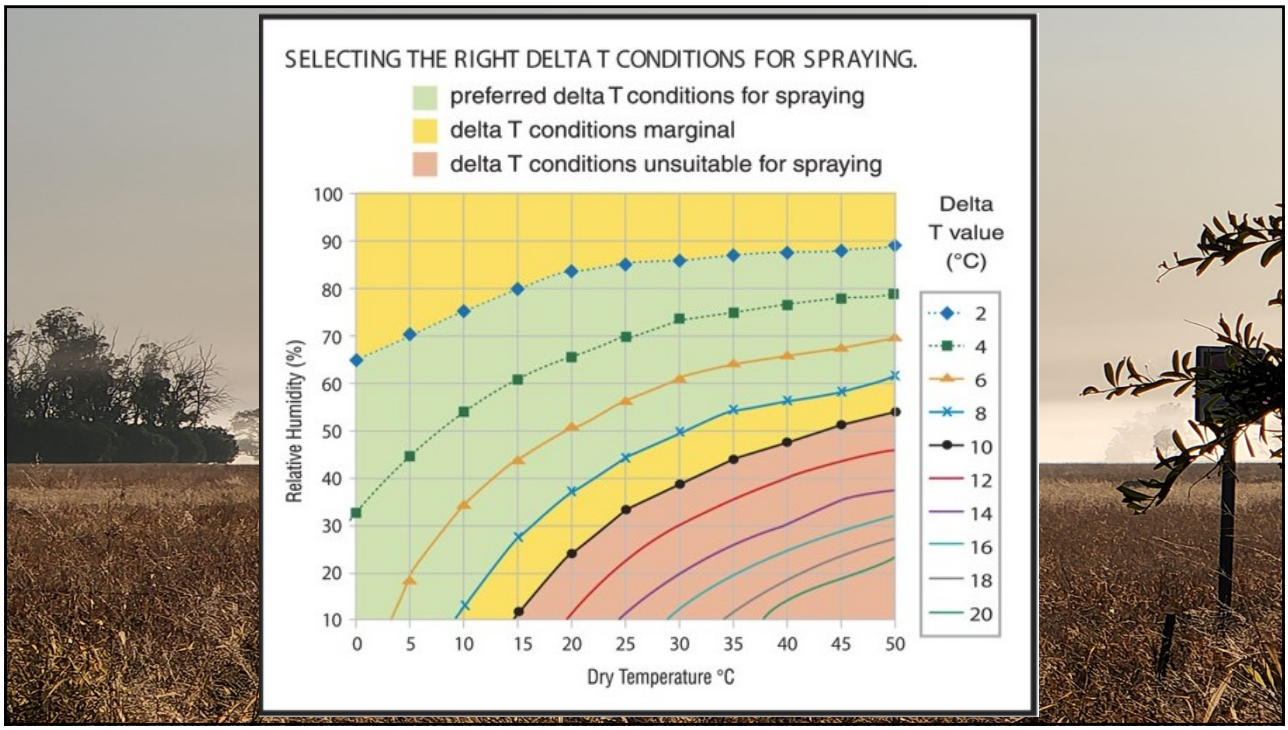

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OPTIMISING GLYPHOSATE EFFICACY

MARK CONGREVE (ICAN)

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

1

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Glyphosate resistance

2

Glyphosate resistance

Initially target site resistance is 'weak' i.e. 2-6 fold

- **Glyphosate may still work if <u>rate is high and no mitigating factors</u>**

GOA resistance testing 2021 – 3 annual ryegrass trial sites

	% Ryegrass survival (resistance test)	
	Forbes	Peak Hill
Roundup® UltraMAX @ 0.5L/ha	40	10
Roundup® UltraMAX @ 0.95L/ha	15	0
Roundup® UltraMAX @ 1.5L/ha	0	0

Street & O'Brien (2022) Killing glyphosate resistant ryegrass? Application does matter. GRDC Updates

Dealing with weak resistance

- ***Robust rate + Optimise application + Avoid antagonistic mixes + Double knock every application***

3

Glyphosate resistance

Some species out-cross e.g. annual ryegrass, feathertop Rhodes

- Crossing 'weak resistance' parents leads to 'strong resistance'
- Strong resistance unlikely to be controlled by commercial application rates

GOA resistance testing 2021 – 3 annual ryegrass trial sites

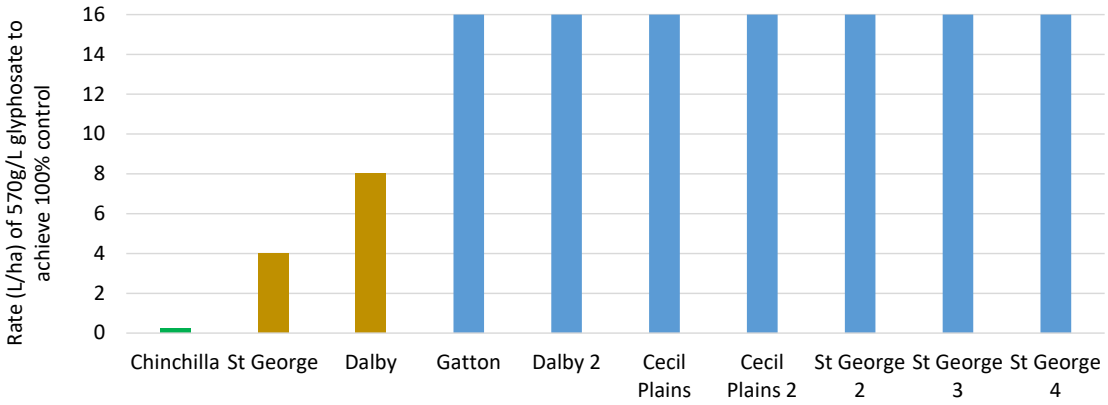
	% Ryegrass survival (resistance test)		
	Forbes	Peak Hill	Coolah
Roundup® UltraMAX @ 0.5L/ha	40	10	100
Roundup® UltraMAX @ 0.95L/ha	15	0	100
Roundup® UltraMAX @ 1.5L/ha	0	0	80

Street & O'Brien (2022) Killing glyphosate resistant ryegrass? Application does matter. GRDC Updates

4

Feathertop Rhodes grass

10 Qld populations collected March / April 2017
(Gatton, Chinchilla, Dalby x 2, Cecil Plains x 2, St George x 4)



Desai, Thompson & Chauhan (2020) Target-Site Resistance to glyphosate in *Chloris Virgata* biotypes and alternative herbicide options for its control. 570g/L glyphosate applied under optimal conditions.

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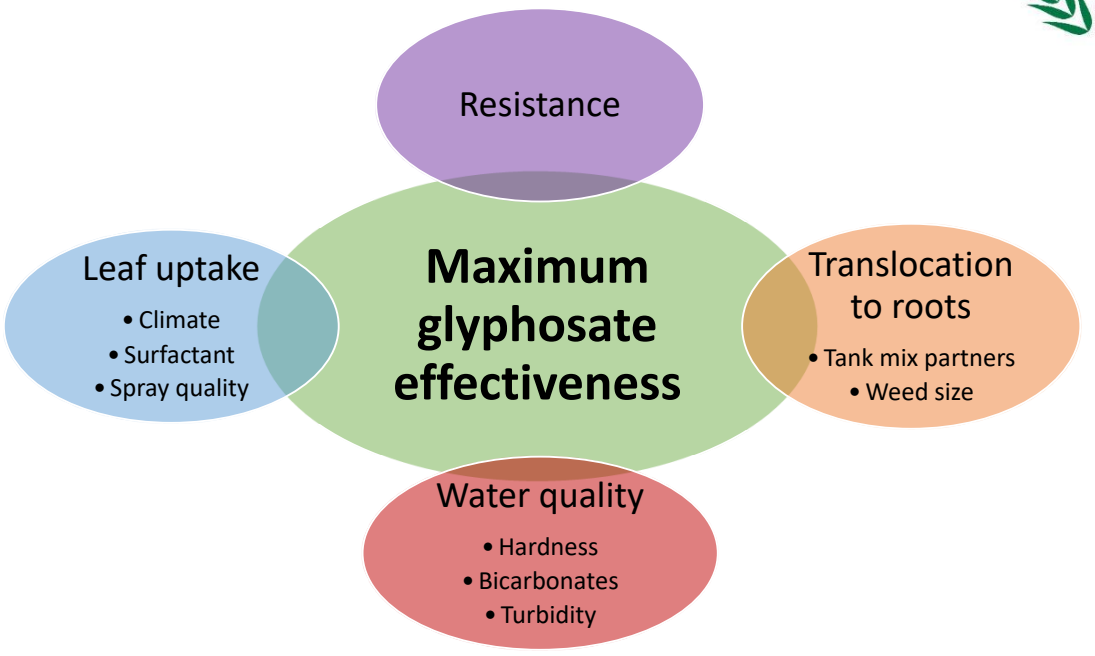

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Getting more glyphosate into the weed

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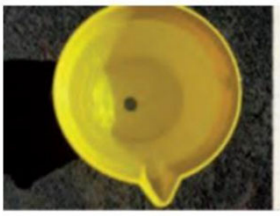
Glyphosate binds tightly to dirt / OM

- Spray water needs to be clean
- Clay based partner herbicides
  - Especially those applied at high rates
- Excessive dust



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Water quality

pH

- 5 to 8.5 ok for most spraying
- If pH is > 8.5 then water will have other problems. Address these.

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Water quality

Total hardness (esp calcium for glyphosate)

Soft	Intermediate	Hard
< 200 ppm (mg/L)	200 – 400 ppm	> 400 ppm

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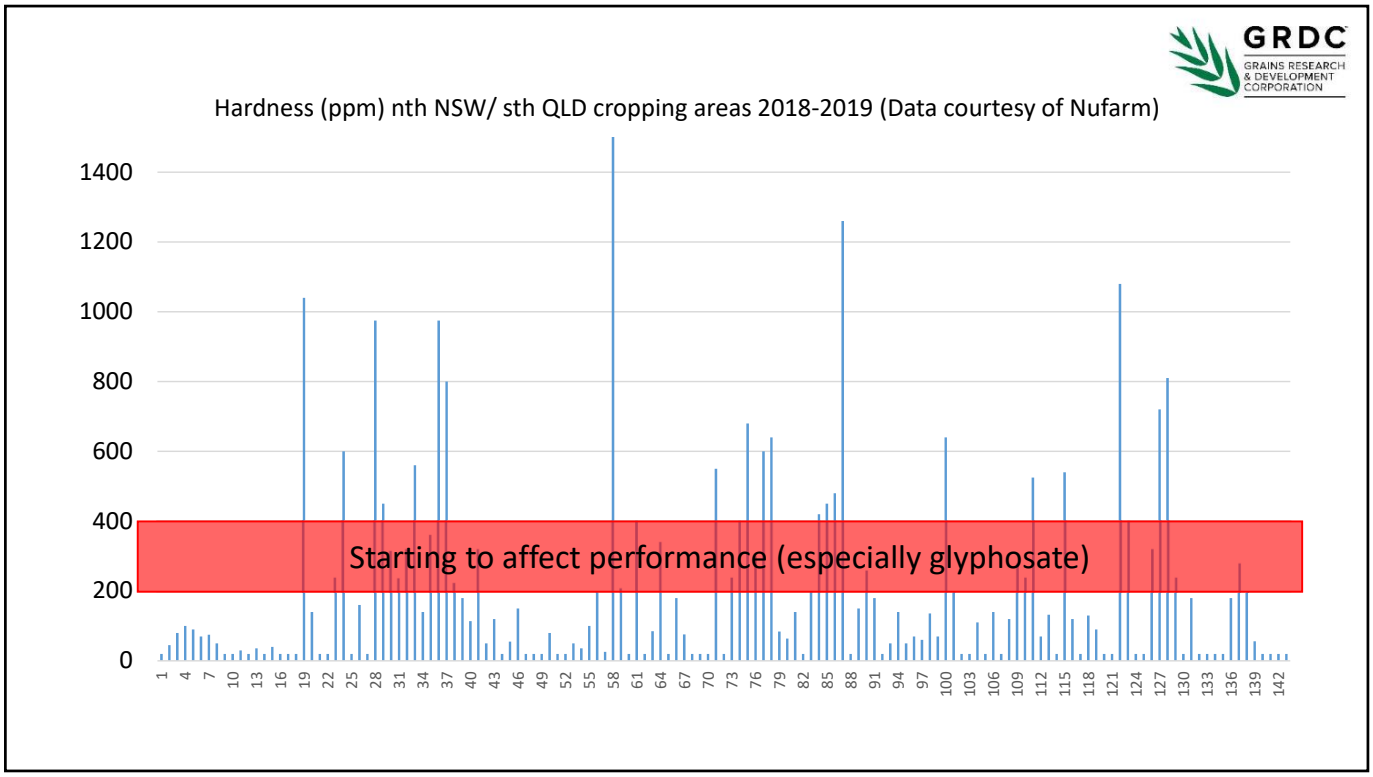

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Water quality

Total alkalinity (bicarbonates)

- Dims (clethodim) & amine formulations (2,4-D, glyphosate)

Good	Intermediate	Poor
< 75 ppm (mg/L)	75 – 150 ppm	> 150 ppm

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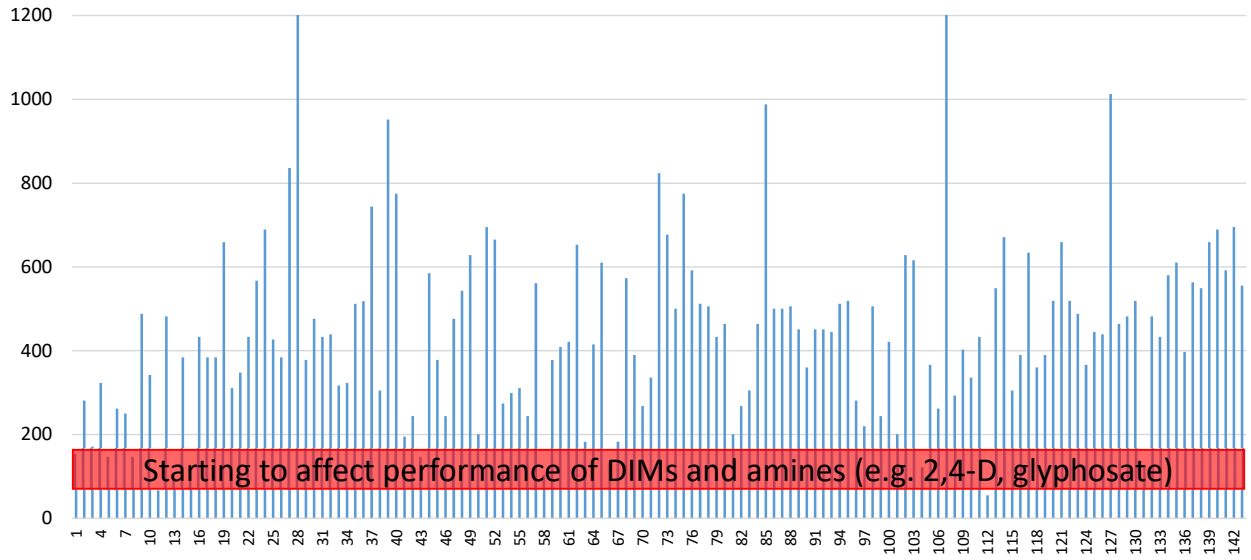
Bicarbonates (ppm) nth NSW/ sth QLD cropping areas 2018-2019 (Data courtesy of Nufarm)



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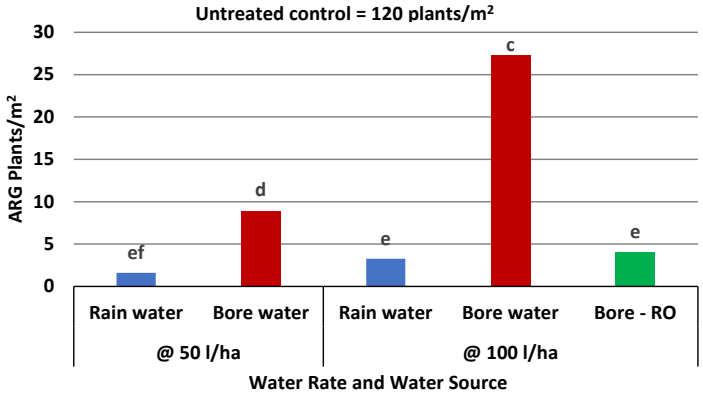
Water quality / Spray Volume



Sprayed Mid-April

12°C, 62% RH, Wind 3-6 kph, AIXR015 @ 3 bar (C)

Roundup Ultramax	Resistance	
0.5 L/ha	80%	RR
0.95 L/ha	10%	R
1.5 L/ha	0%	S

Water quality	Test	Optimum
pH	8.0	5.0-8.6
Chloride	910	< 350
Sodium	410	< 70
Total alkalinity	480	< 75
Total hardness	1000	< 200

Grain Orana Alliance Narromine, NSW

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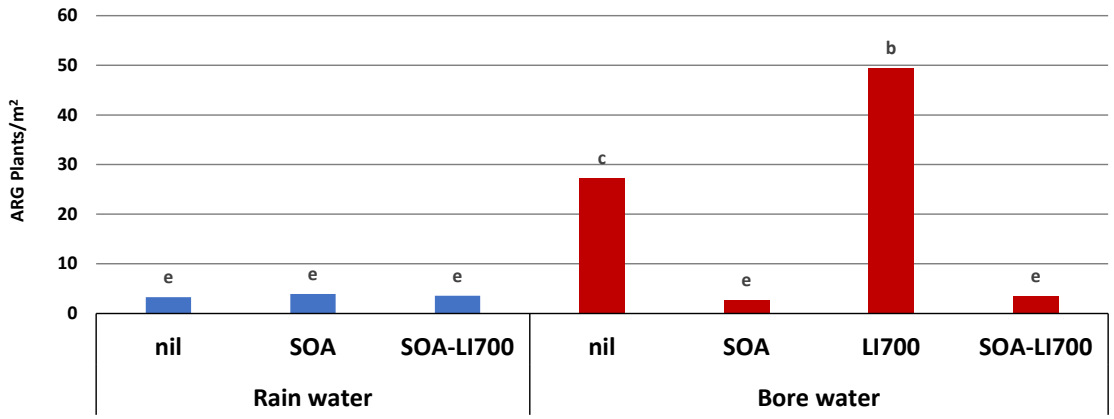
Water conditioning



Grain Orana Alliance Narromine, NSW

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Ammonium sulphate (AMS)

Glyphosate's favourite 'wing man'

- 'Fixes' hard water
- Partially fixes high bicarbonates
- Helps with tank mix compatibility
- Assists cell membrane transfer

But needs time

- Fully dissolve in spray tank
  - If impatient – use a liquid formation
- Further 5-10 minutes under agitation

Kg ammonium sulphate /100 L = (0.001 x Ca (ppm)) + (0.0006 x Na) + (0.0002 x K) + (0.0017 x Mg)

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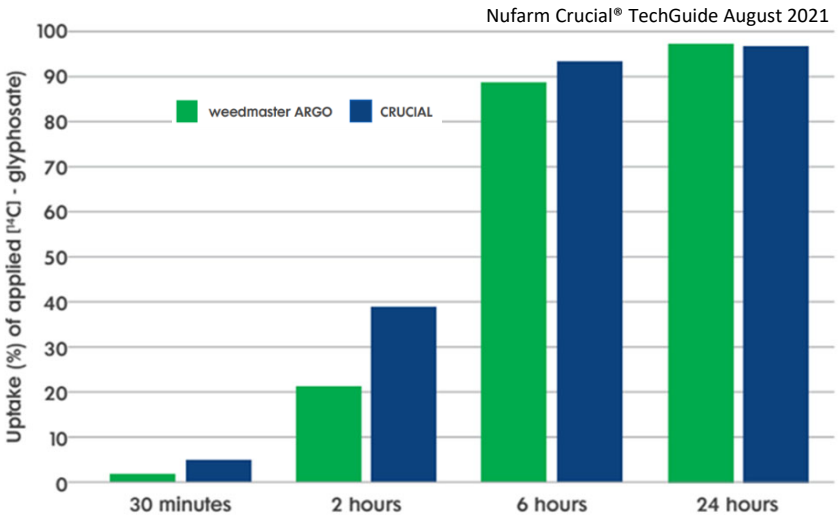
Leaf uptake

17

Glyphosate is slow to enter the leaf

Nufarm Crucial® TechGuide August 2021



Glyphosate (hydrophilic = water loving) is very slow to penetrate waxy cuticle

Ryegrass under lab conditions = **good conditions for leaf uptake**

18

Summer applications

Weeds adapted for hot / low humidity conditions (control transpiration losses)

- Leaf hairs (trichomes)
- More cuticle waxes
  - Harder for droplet deposition
  - Reduced penetration (for water-loving herbicides)

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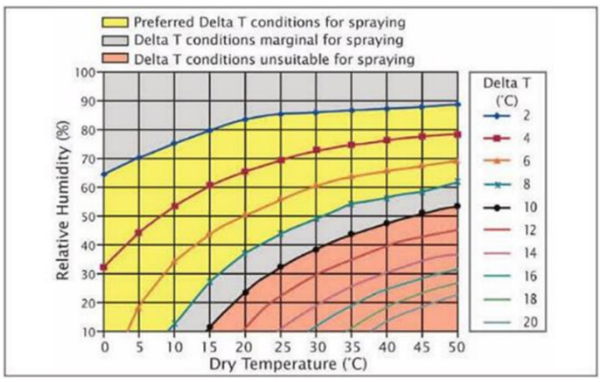
Droplet survival in summer

Delta T at & post application

- Evaporation from nozzle to leaf surface (keep boom height low)
- Leaf cuticle receptiveness for uptake
- Time on leaf surface before glyphosate crystallisation

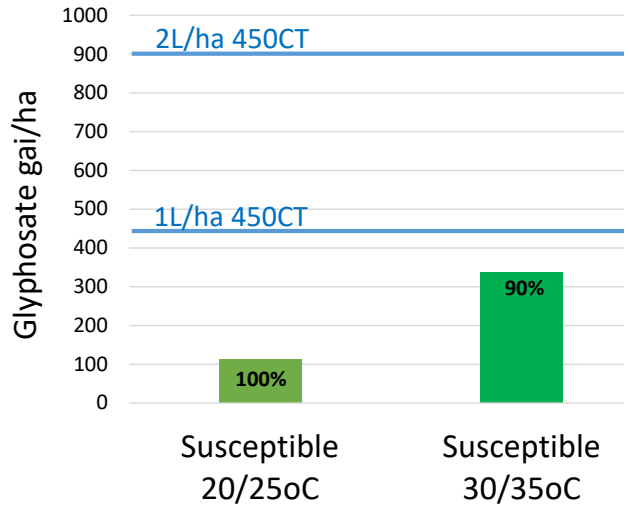
Rule of thumb for maximum glyphosate uptake
Delta T of 4 to 6 for 4 to 6 hours after application

If air temp is > 30°C, require RH > 60%
Glufosinate (Basta) is even more sensitive to this



20

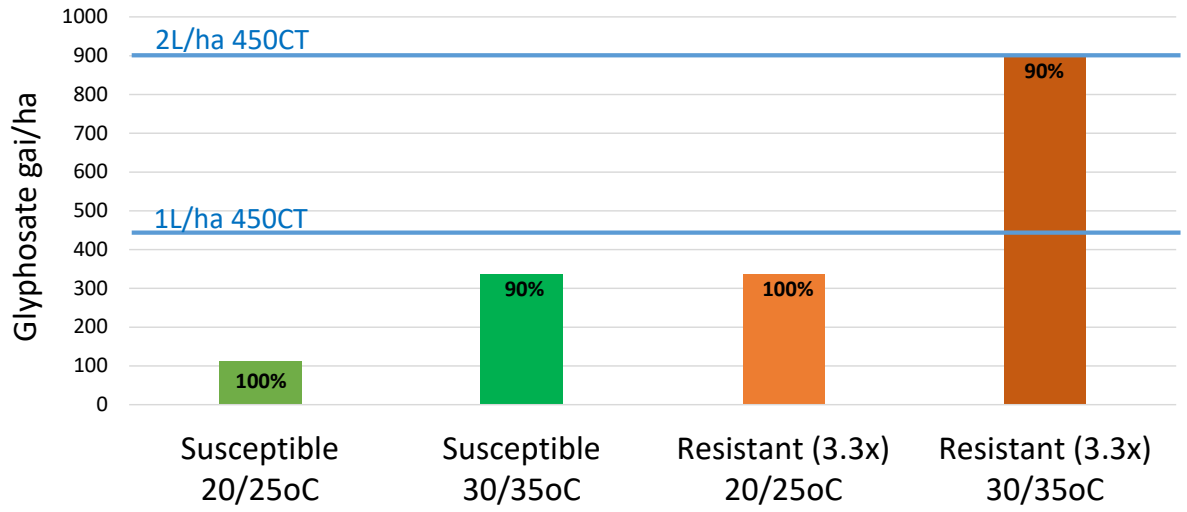
Barnyard grass (3-4 leaf)



Adapted from Target-site EPSPS Pro-106 mutations: sufficient to endow glyphosate resistance in polyploid *Echinochloa colona*? (Han, Yu, Widderick, & Powles. 2015)

21

Barnyard grass (3-4 leaf)



Adapted from Target-site EPSPS Pro-106 mutations: sufficient to endow glyphosate resistance in polyploid *Echinochloa colona*? (Han, Yu, Widderick, & Powles. 2015)

22

Spray quality & concentration

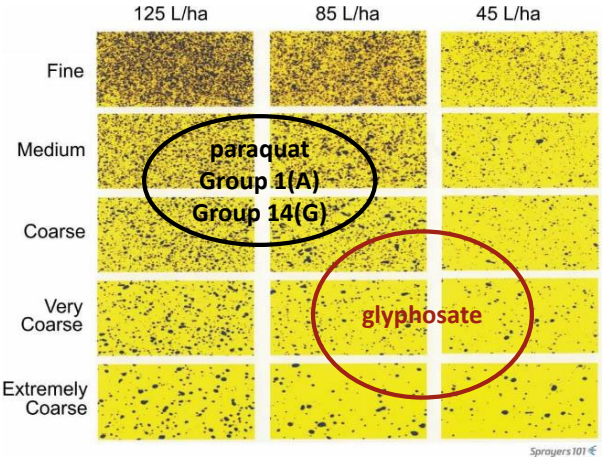
Large droplet (VC+)

- Increases droplet survival
- Reduces off-target losses (drift)

High concentration gradient (robust rate + low carrier volume)

- Assists cuticle uptake

BUT



23

Small, upright grass weeds

Difficult to contact

- Very large droplets may miss or bounce off

Increase number of droplets (water rate) if using large droplets on small weeds

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VC or larger

- **ALL 2,4-D mixes**
- Drift reduction
- Required by some labels
- Summer applications
- 'Easy' surfaces for droplet to stick
- High stubble environment

Increase water rate (80-100L/ha) for v. small upright targets

Medium - Coarse

- Group 14(G) mixes
- Group 1(A) mixes
- Hard to wet surfaces
  - Hairy
  - Small, upright grasses

Don't use

- In summer / high DT situations
- High stubble loads
- Drift sensitive situations

25

Adjuvants for glyphosate

- **Follow label advice**
  - **When to add additional adjuvant**
  - **What type to use**
- Non-ionic surfactants are not all the same
- 'Oil' can antagonise glyphosate on summer grasses

In-built surfactant varies with different salts, loading and brands

Not just selected for efficacy

- Cost
- Loading
- Aquatic uses
- Eye / skin irritation
- Smell
- Evaporation rate
- Dilution (e.g. broadacre v home garden)
- Viscosity (summer or winter use?)
- Patent

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In-built surfactant load

Target active load of around 150-200 gai/100L (**0.15 to 0.2 %**) for surfactants

Glyphosate 450 CT containing		Spray volume				
		50 L/ha	75 L/ha	100 L/ha	150 L/ha	200 L/ha
144g/L polyethanoxy (15) tallow amine surfactant	0.5L/ha	0.14	0.10	0.07	0.05	0.04
	1 L/ha	0.29	0.19	0.14	0.10	0.07
	2L/ha	0.58	0.38	0.29	0.19	0.14

Inadequate	Marginal	Optimal	Excess

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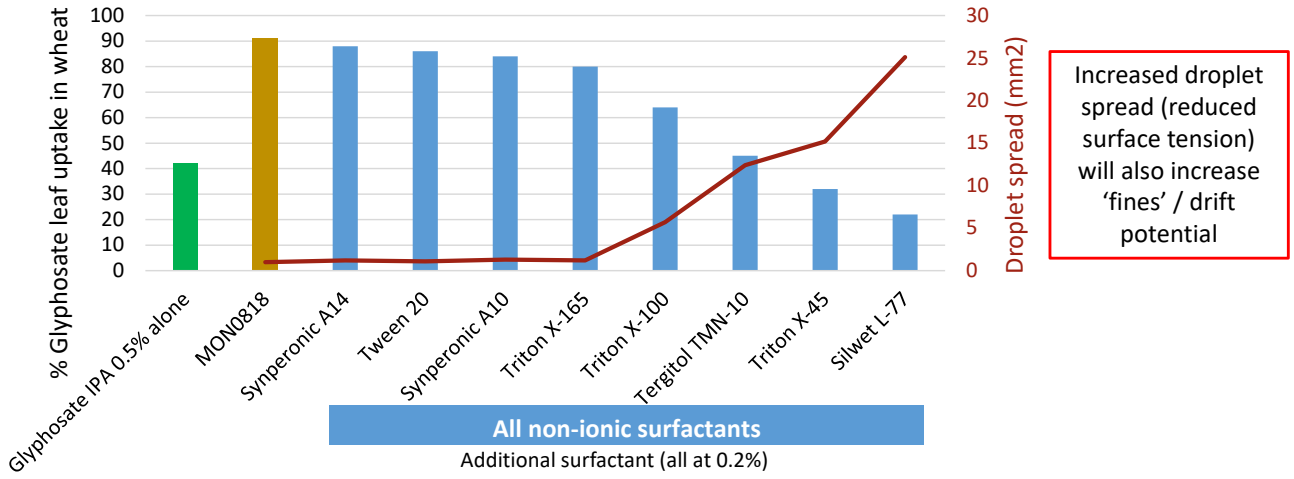
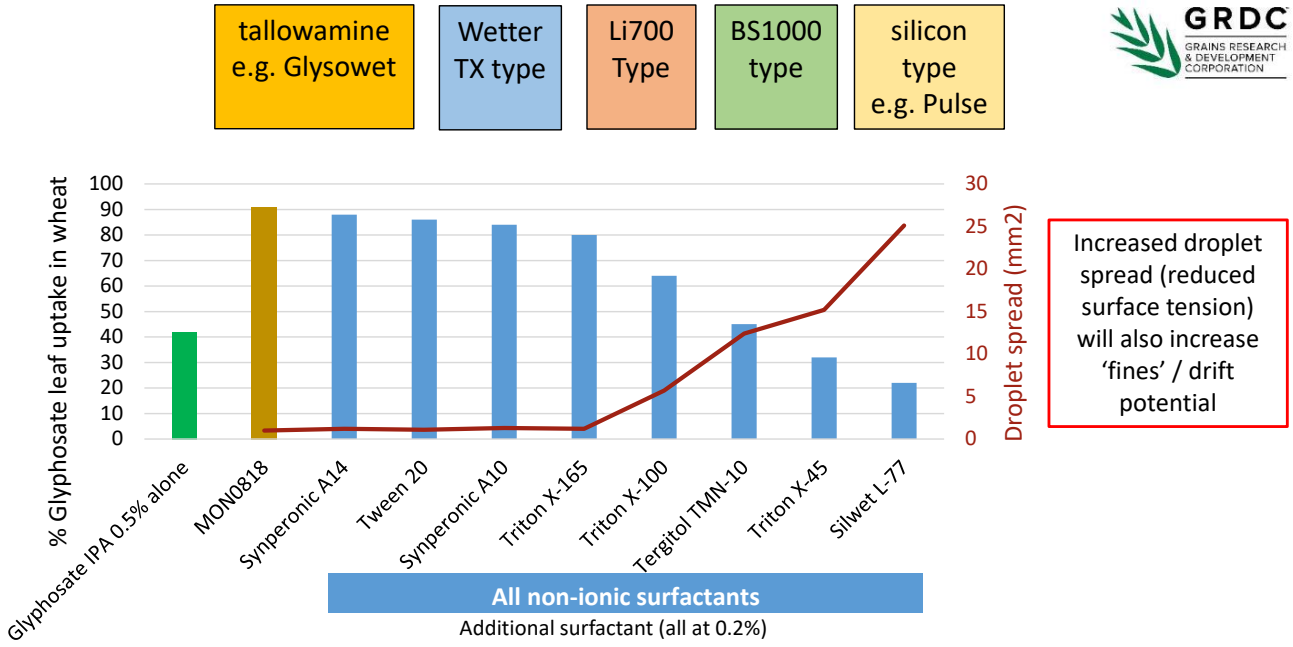
Surfactant type



Increased droplet spread (reduced surface tension) will also increase 'fines' / drift potential

Plants grown at 20/25ºC & 70% RH
Adapted from Liu. Z.Q. (2003) Characterization of glyphosate uptake into grass species.

28



Plants grown at 20/25ºC & 70% RH
Adapted from Liu. Z.Q. (2003) Characterization of glyphosate uptake into grass species.

29

Translocation within the plant

30

Translocation

Glyphosate requires 2-3 days to fully translocate

Reduced glyphosate translocation

- Weeds are stressed (e.g. very dry, waterlogged)
- Tank mix partners
  - Affecting plant hormones e.g. Group 4(I)
  - Fast acting mix partners that destroy vascular bundle e.g. paraquat, glufosinate, Group 14(G)
    - Faster they work (higher rates, higher light intensity) the more glyphosate translocation is reduced

'Fast brownout' is NOT a desired feature for glyphosate mixes

Antagonism is more noticeable:

- Glyphosate resistance
- Higher rates of tank mix partner
- Summer conditions
- Resistant populations

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Glyphosate antagonism

- Most broadleaf partners antagonise grass control
  - More complex the tank mix = more glyphosate needed to counter antagonism
- Glyphosate susceptible grasses
  - If mixing glyphosate + 2,4-D keep ratio at least 3:1

Roundup® UltraMax 1.3L/ha

Roundup® UltraMax 1.3L/ha plus 2,4-D 1L/ha

B. Chauhan. QAAFI, Gatton 2021

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Summary

Best chance of achieving control for summer applications

- ✓Mild / warm (not hot & dry) – Delta T in range 3-6 following application
- ✓Large (VC) droplets
- ✓Minimum water rate (that still achieves coverage)
- ✓Small weeds
- ✓No rain for >6 hours
- ✓Robust application rates
- ✓AMS
- ✓Good water quality
- ✓Quality formulation (adjuvant package)
- ✓No antagonistic adjuvants or partners
- ✓Slow down / boom lower
- ✓Susceptible population

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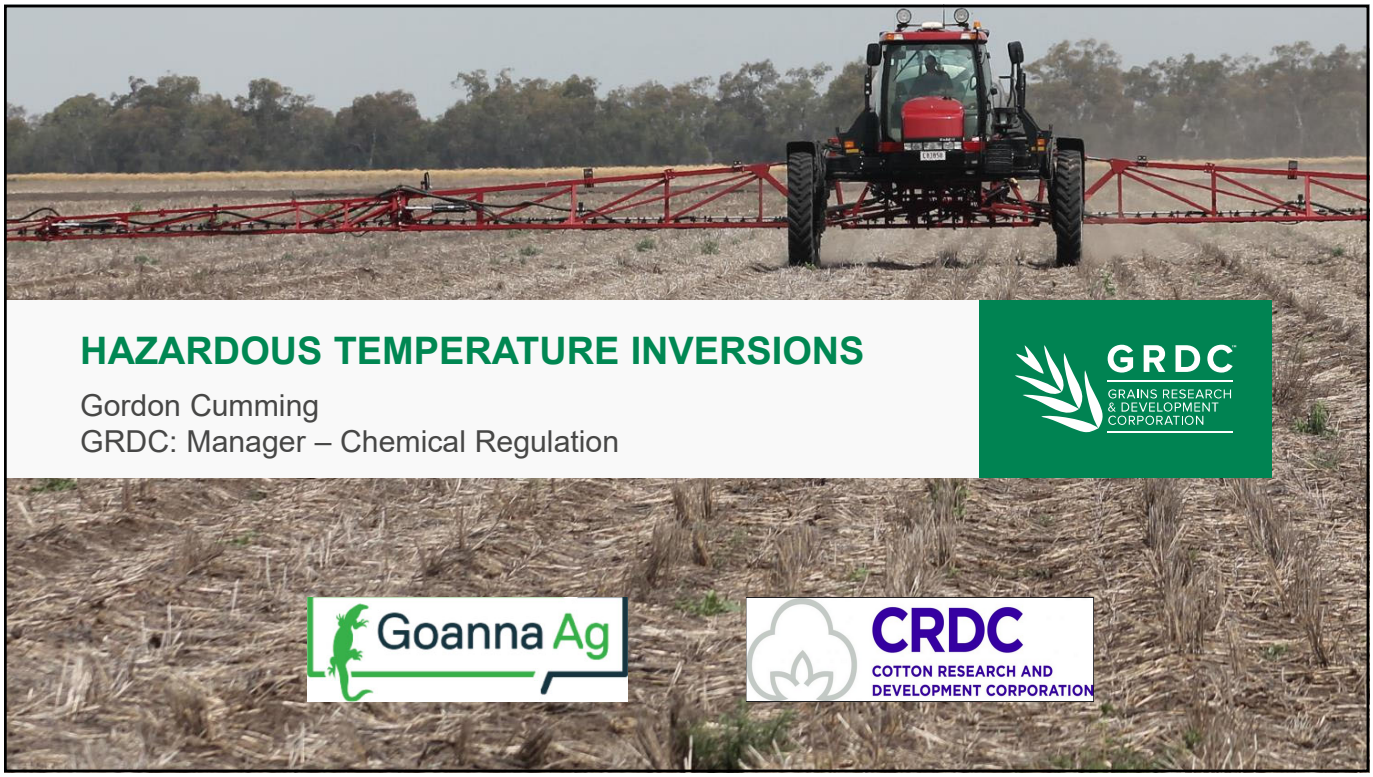
Grains Research and Development Corporation (GRDC)
A Level 4, East Building, 4 National Circuit, Barton, ACT 2600 Australia
P PO Box 5367 Kingston, ACT 2604 Australia
T +612 6166 4500
F +612 6166 4599
www.grdc.com.au

@thegrdc

35



1

Sprayer Set-Up

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Will determine how much product is left in the air

Un-Assisted - Droplet Penetration through the Air

50 um	100 um	200 um
9 cm	34 cm	137 cm

Spray Quality	% of spray below 150 microns
Fine (F)	40-50
Medium (M)	20
Coarse (C)	10
Very Coarse (VC)	5
Extremely Coarse (XC)	2
Ultra Coarse (UC)	<1

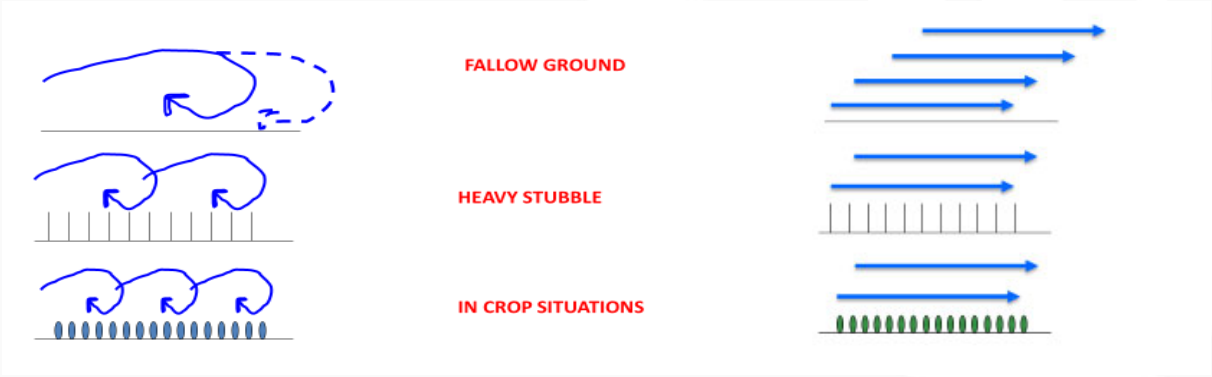
2

When We Choose To Spray

Air movement is key for spray drift management

" Turbulent Air"

" Hazardous Temperature Surface Inversion



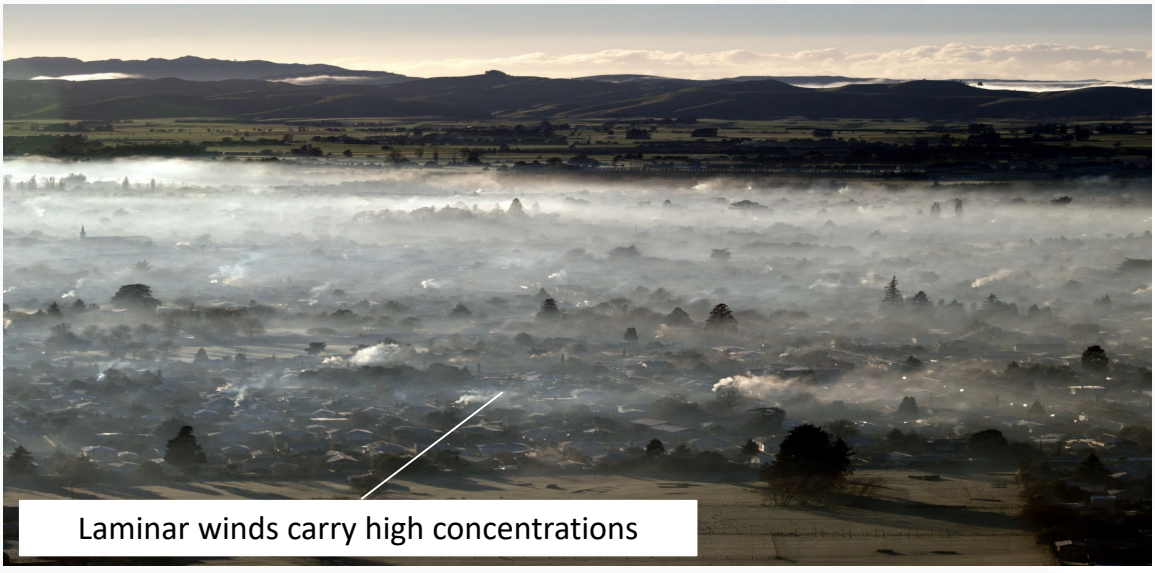
Daytime Spraying > 4km/h Wind

Night-time Spraying

3

Combined and Concentrated

Hazardous inversions trap pesticides and transported in laminar winds



4

Label Statements

Nufarm Crucial Herbicide & Titan Amine 720 Herbicide

DO NOT apply if there are hazardous surface temperature inversion conditions present at the application site during the time of application.

Surface temperature inversion conditions exist most evenings one to two hours before sunset and persist until one to two hours after sunrise.

Guesswork
is the current Go-To method
for inversion detection and label compliance

5

Inversion - Sensory Clues

Clues take time to develop or may not even occur at all

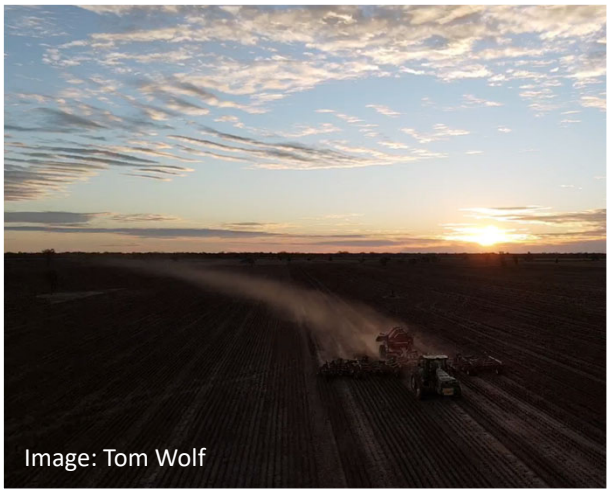


Image: Tom Wolf


Image: Nicola Cottee

Dust, Fog, Dew, Clarity of noise, High odour; may not always be present during application

6

Research

Detailed examination of inversion conditions

- 29 towers
  - WA, SA, NSW, Qld
- 37 sites
- Over 6 years
  - Capturing data every 10 minutes

7

Discovery's Challenging Beliefs

While clear skies and light winds are the ideal inversion conditions.

- Inversions can still exists when;
  - It can be overcast / cloudy
  - Rarely is it Calm
    - Cup type wind sensors often record calm even when winds are up to 5 kph
    - These undetected laminar winds carry drift
  - Winds are most often 2 to 11 kph
- Ultimately; Laminar Winds cause inversions to be Hazardous
  - 5 kph laminar winds can transport drift 50 km on a mid summers night
- Laminar wind flows can be up to 18 kph when VTD is 4 to 6 degrees

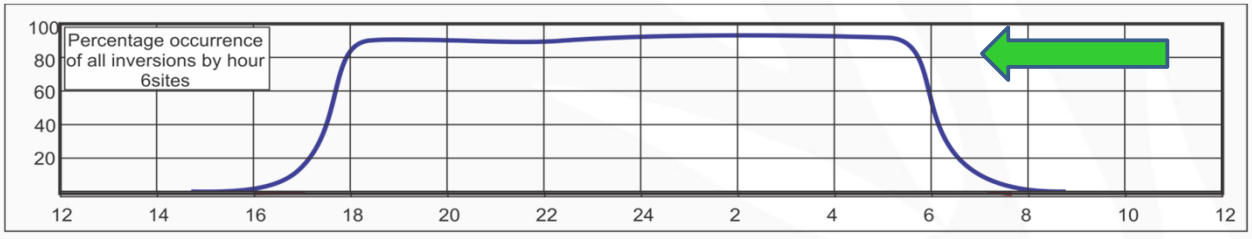
8

Recording Meteorological Conditions

9

Hazardous times of the day

Spray guides need to be formulated for different regions

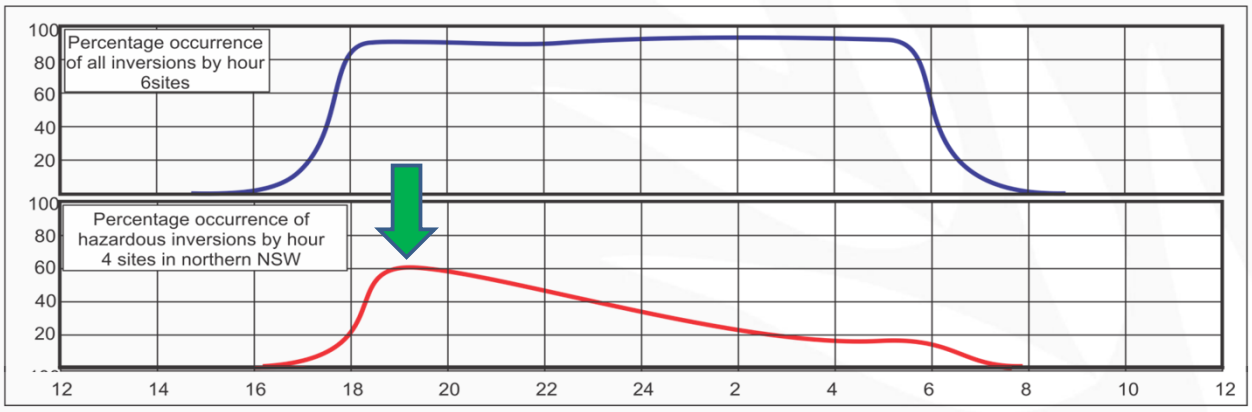


Surface temperature inversion conditions exist most evenings one to two hours before sunset and persist until one to two hours after sunrise.

10

Hazardous times of the day

Spray guides need to be formulated for different regions

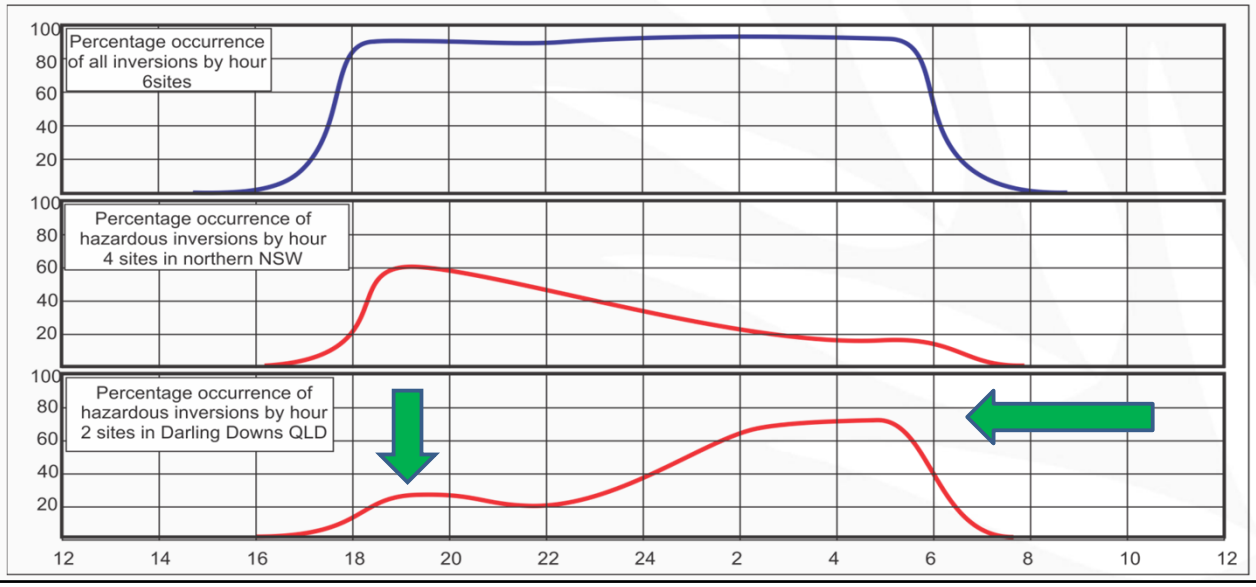


- NSW open plains
  - Highest frequency of hazardous inversions is during Early Evening

11

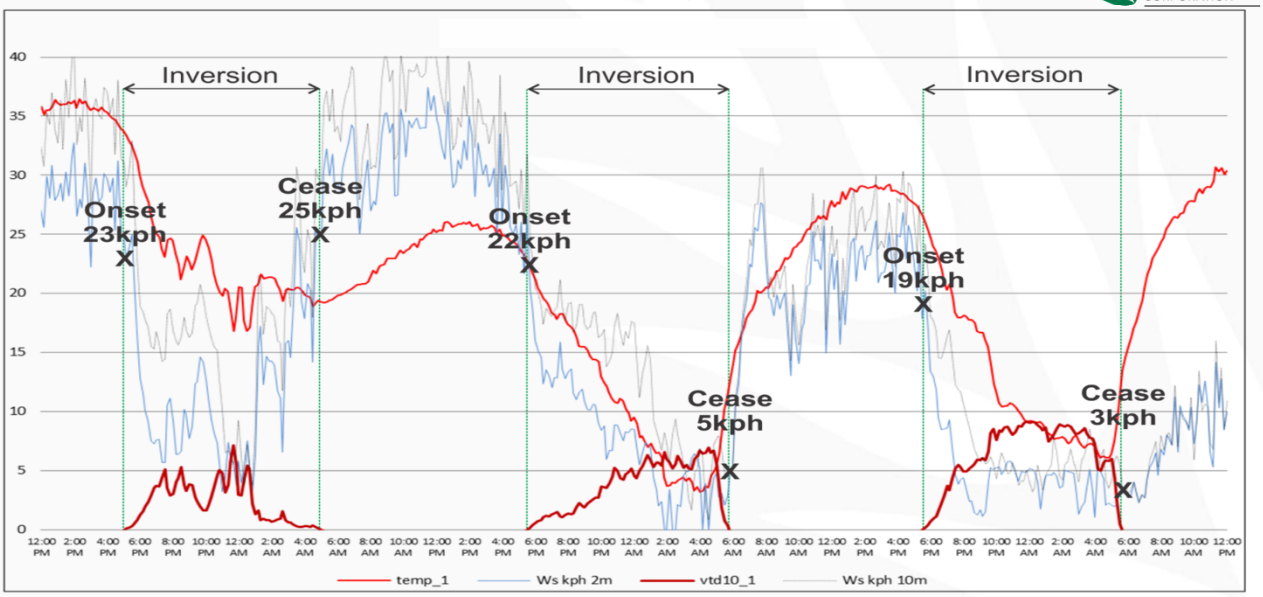
Hazardous times of the day

Spray guides need to be formulated for different regions



12

Inversion Winds – Rarely Calm

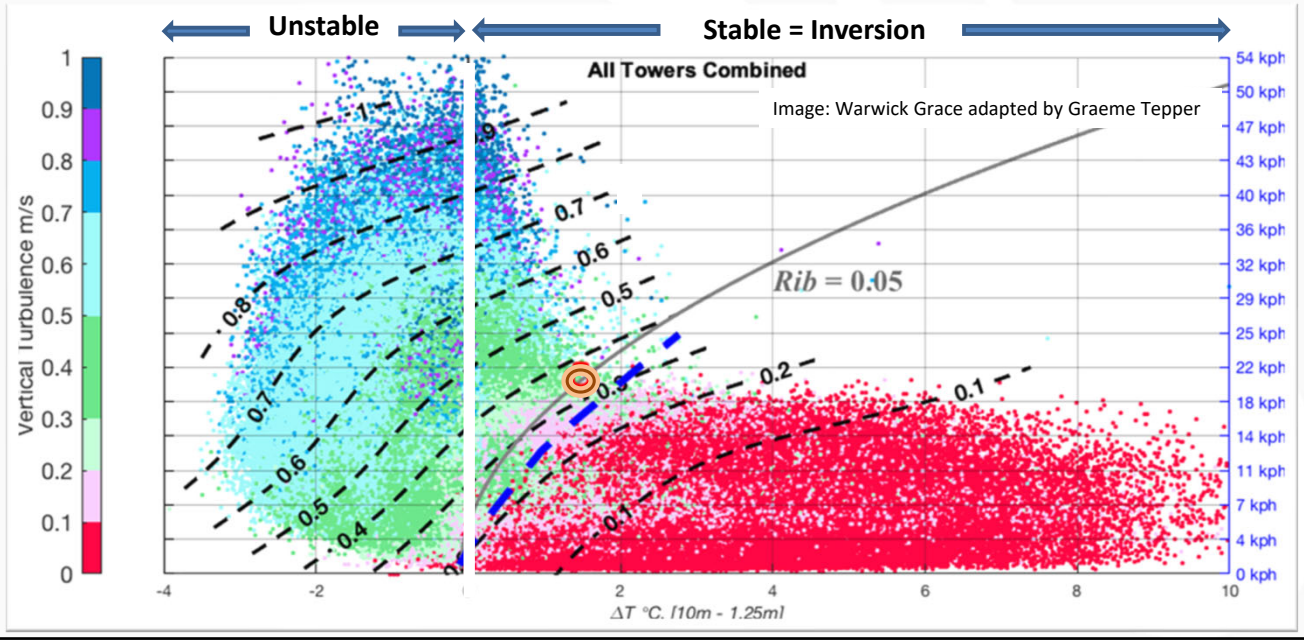


2m winds average 2 to 12 kph

10m winds average 2 to 17 kph

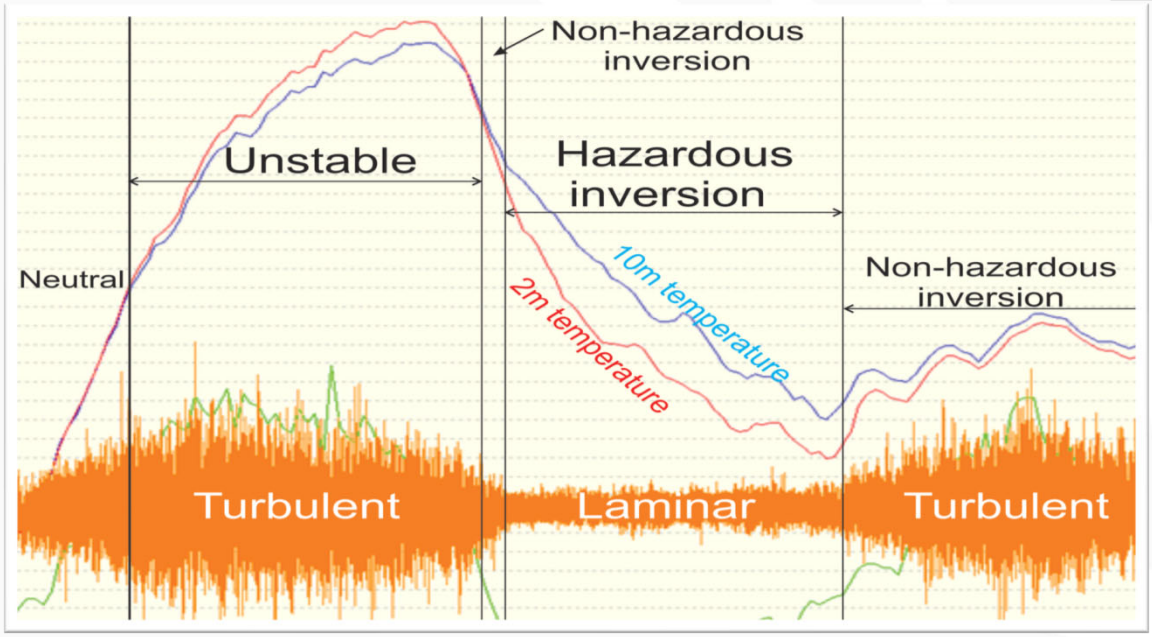
13

Vertical Turbulence Data



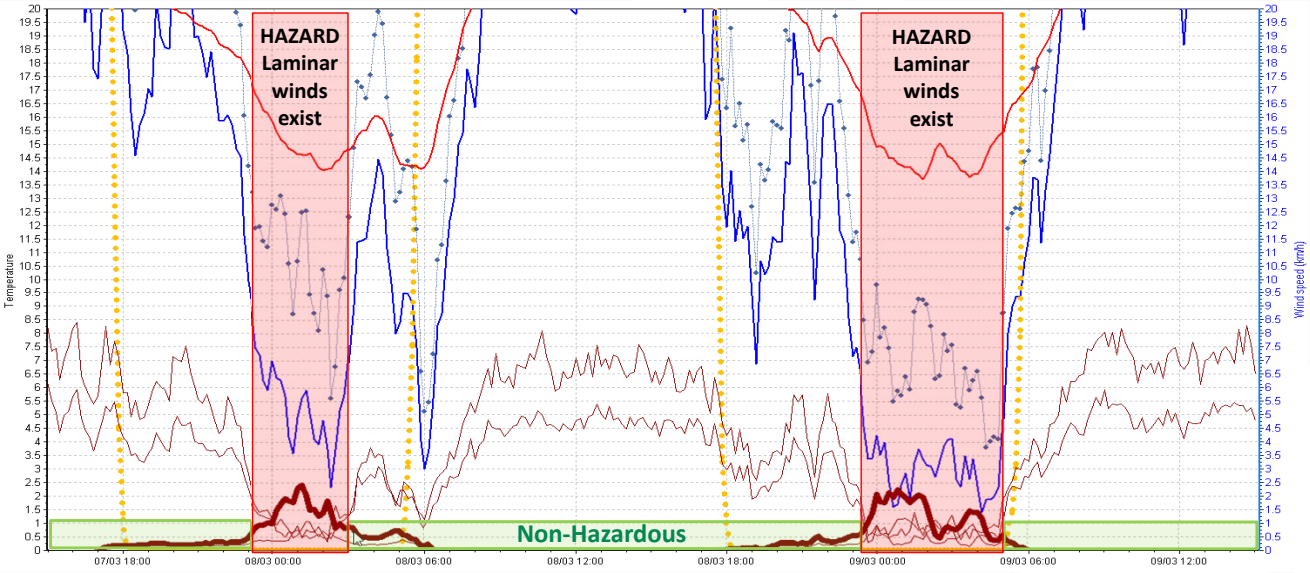
14

Laminar Winds Are Hazardous



15

How Many Spray Hours Gained?



13.5 hrs of Inversion – 4 hrs Hazardous

12 hrs of Inversion – 6 hrs Hazardous

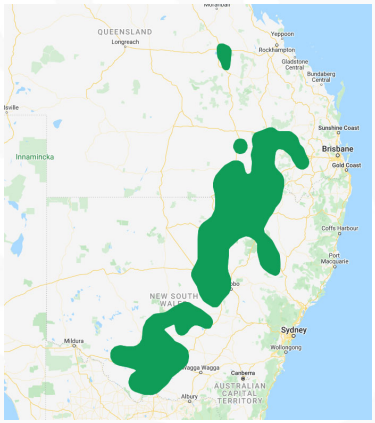
16

Spray Drift Warning System

WAND: Weather and Networked Data

Goanna Ag is establishing 100 Profiling Automatic Weather Stations (PAWS) across the grain and cotton regions of NSW and southern and central QLD.

- **Delivers to Growers**:
  - Accurate and real time data updated every 10 minutes
  - 2 hour 'Nowcasting'
  - Plus;
    - wind (2 m gust @ 2m and 10 m)
    - wind direction
    - temperature
    - delta T
    - rainfall

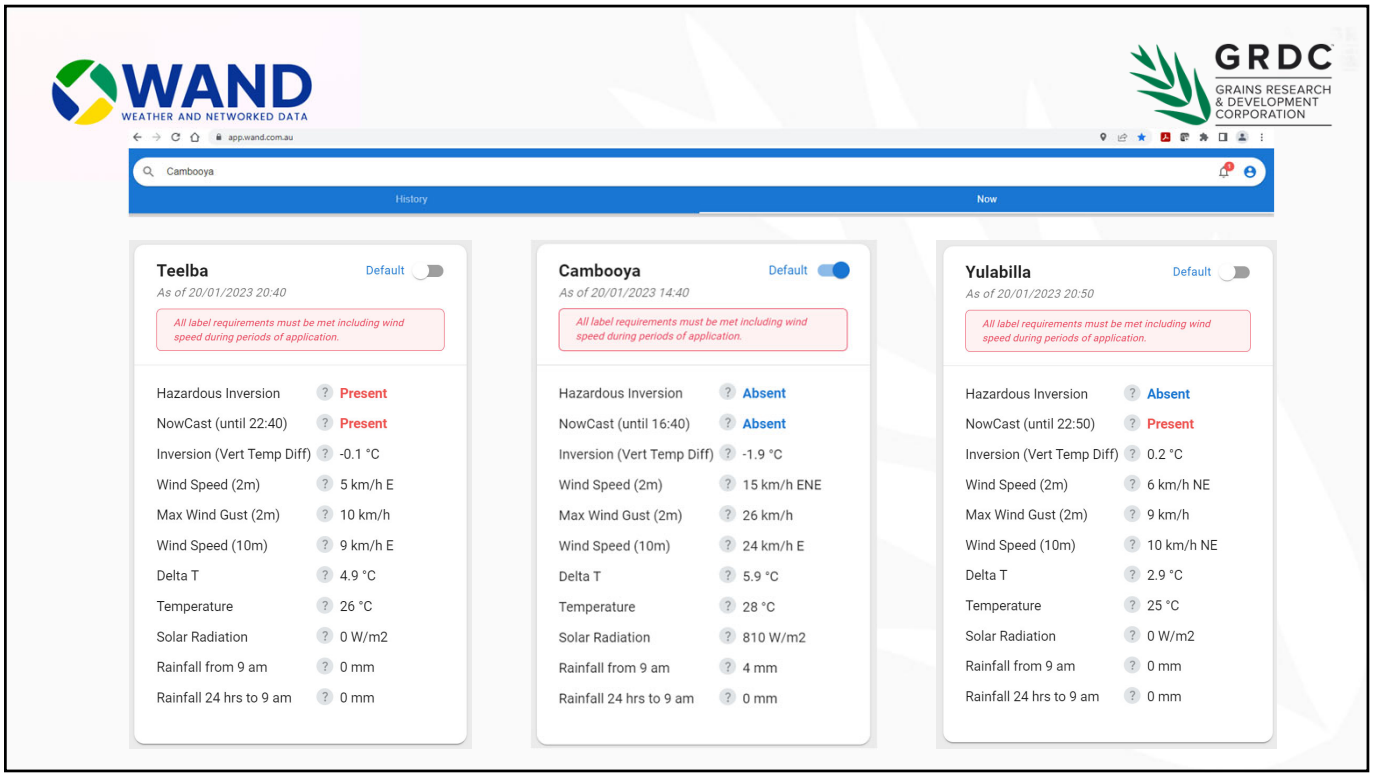


17

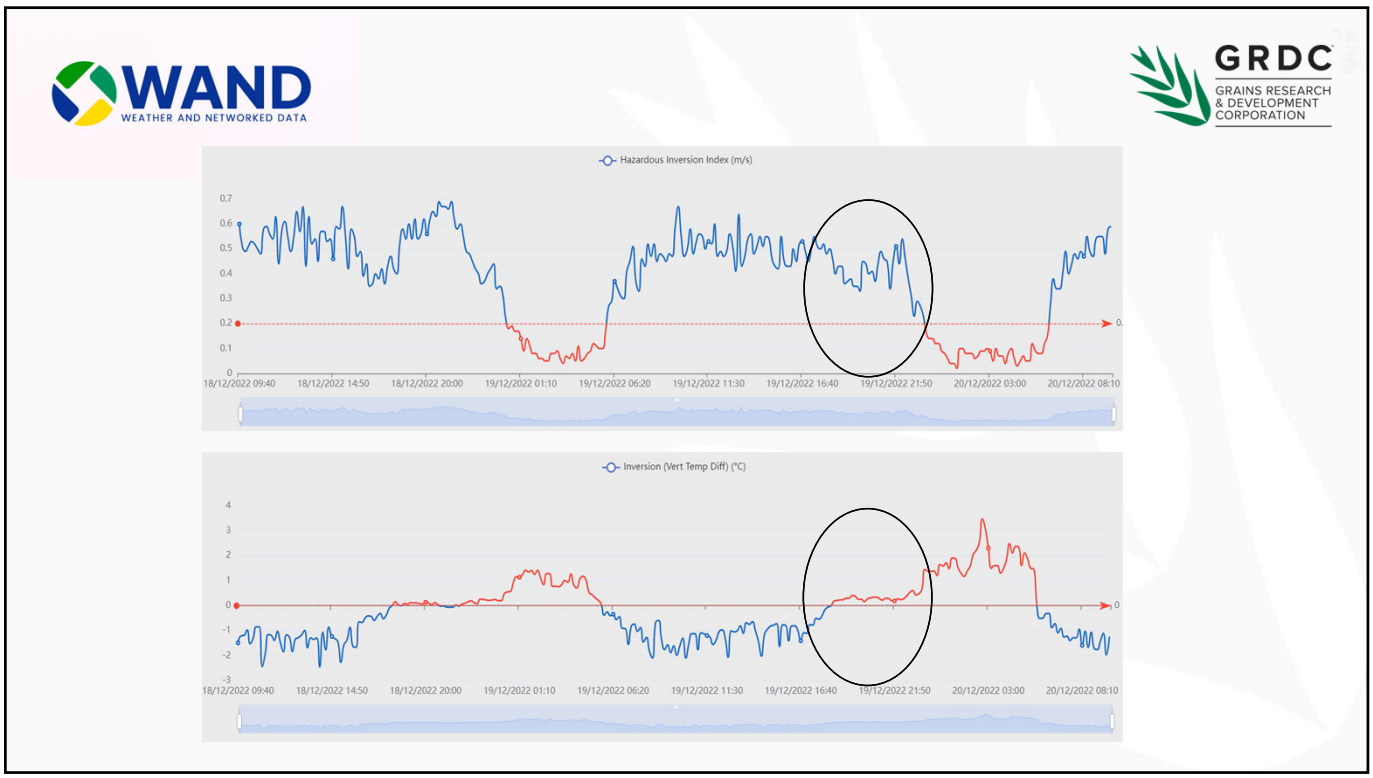
WAND: Weather and Networked Data

Provides information supporting Growers making informed decisions

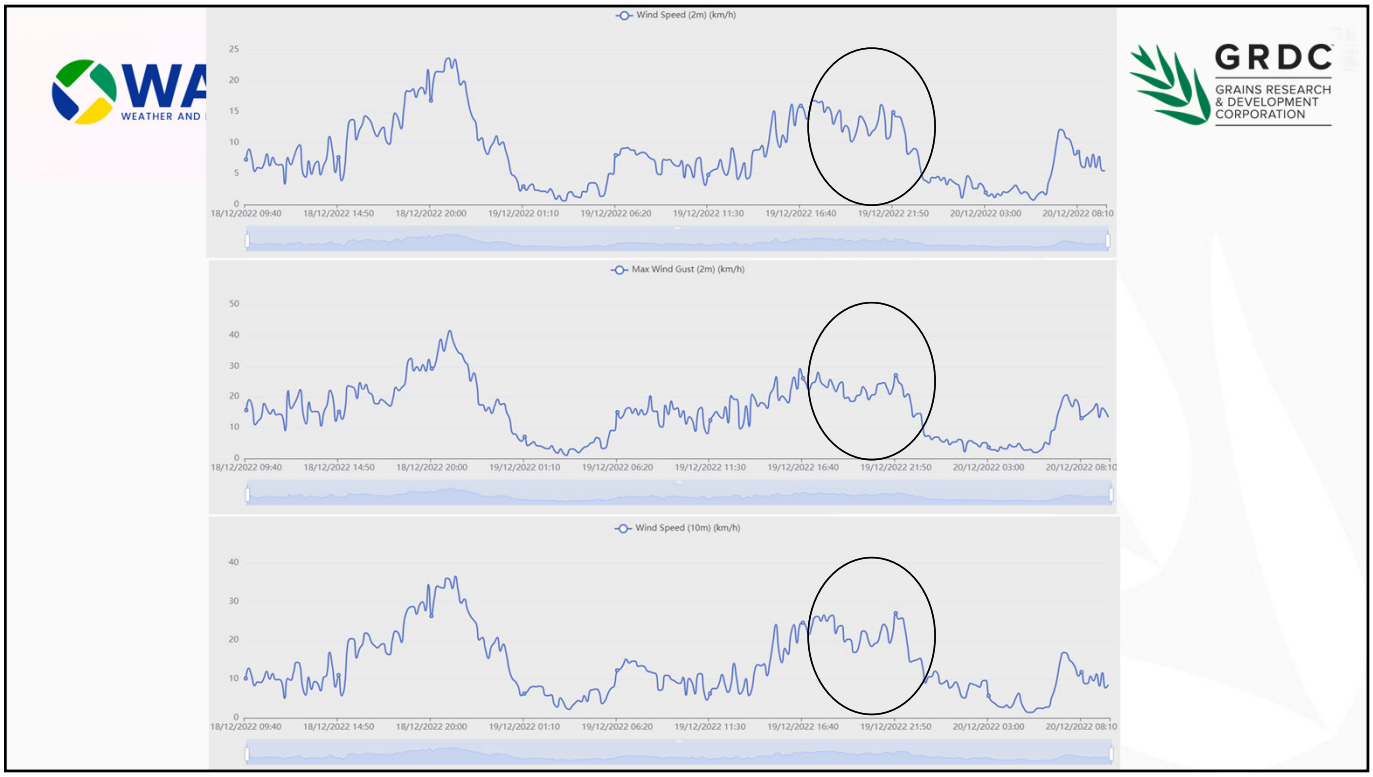
18


WAND
WEATHER AND NETWORKED DATA
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
app.wand.com.au
Cambooya
History
Now
Teelba
Default
As of 20/01/2023 20:40
All label requirements must be met including wind speed during periods of application.
Hazardous Inversion Present
NowCast (until 22:40) Present
Inversion (Vert Temp Diff) -0.1 °C
Wind Speed (2m) 5 km/h E
Max Wind Gust (2m) 10 km/h
Wind Speed (10m) 9 km/h E
Delta T 4.9 °C
Temperature 26 °C
Solar Radiation 0 W/m2
Rainfall from 9 am 0 mm
Rainfall 24 hrs to 9 am 0 mm
Cambooya
Default
As of 20/01/2023 14:40
All label requirements must be met including wind speed during periods of application.
Hazardous Inversion Absent
NowCast (until 16:40) Absent
Inversion (Vert Temp Diff) -1.9 °C
Wind Speed (2m) 15 km/h ENE
Max Wind Gust (2m) 26 km/h
Wind Speed (10m) 24 km/h E
Delta T 5.9 °C
Temperature 28 °C
Solar Radiation 810 W/m2
Rainfall from 9 am 4 mm
Rainfall 24 hrs to 9 am 0 mm
Yulabilla
Default
As of 20/01/2023 20:50
All label requirements must be met including wind speed during periods of application.
Hazardous Inversion Absent
NowCast (until 22:50) Present
Inversion (Vert Temp Diff) 0.2 °C
Wind Speed (2m) 6 km/h NE
Max Wind Gust (2m) 9 km/h
Wind Speed (10m) 10 km/h NE
Delta T 2.9 °C
Temperature 25 °C
Solar Radiation 0 W/m2
Rainfall from 9 am 0 mm
Rainfall 24 hrs to 9 am 0 mm

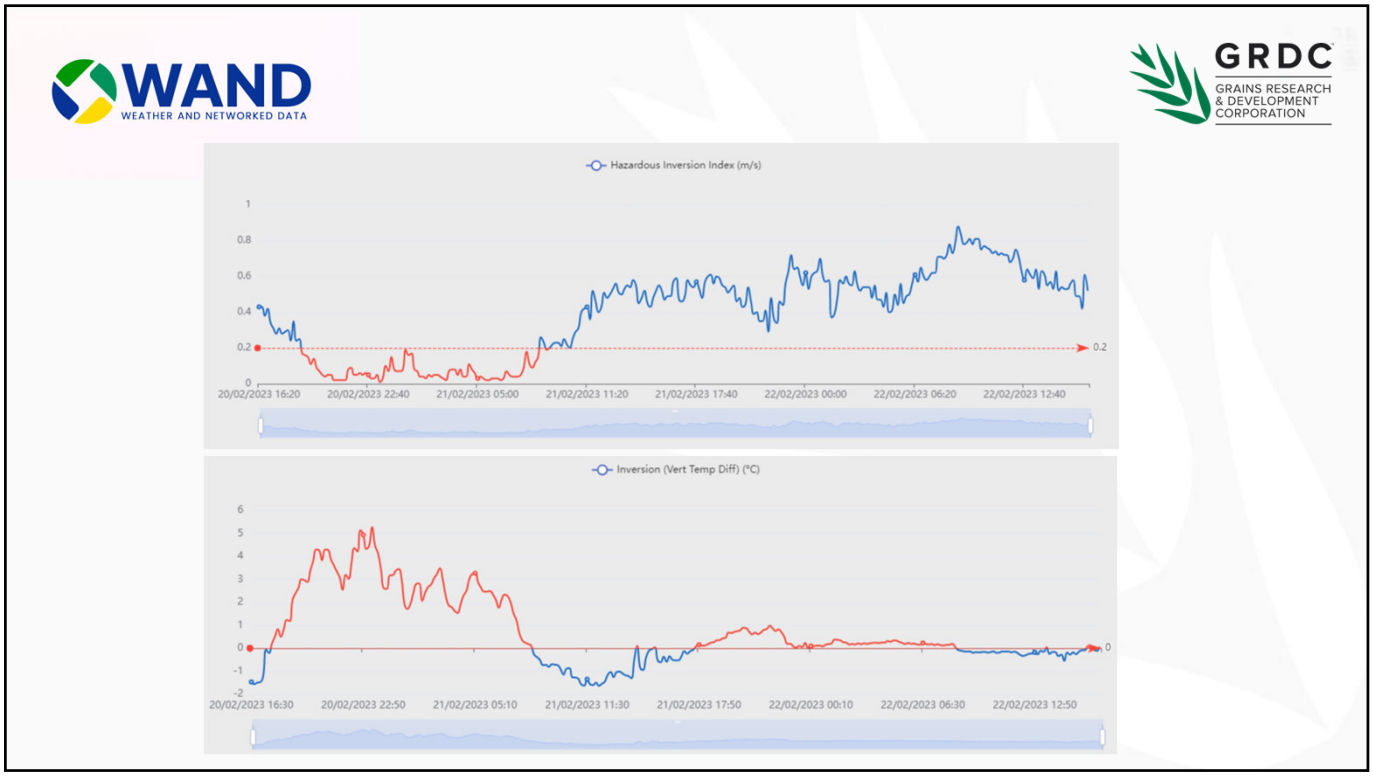
19


WAND
WEATHER AND NETWORKED DATA
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION
Hazardous Inversion Index (m/s)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
18/12/2022 09:40
18/12/2022 14:50
18/12/2022 20:00
19/12/2022 01:10
19/12/2022 06:20
19/12/2022 11:30
19/12/2022 16:40
19/12/2022 21:50
20/12/2022 03:00
20/12/2022 08:10
Inversion (Vert Temp Diff) (°C)
4
3
2
1
0
-1
-2
-3
18/12/2022 09:40
18/12/2022 14:50
18/12/2022 20:00
19/12/2022 01:10
19/12/2022 06:20
19/12/2022 11:30
19/12/2022 16:40
19/12/2022 21:50
20/12/2022 03:00
20/12/2022 08:10

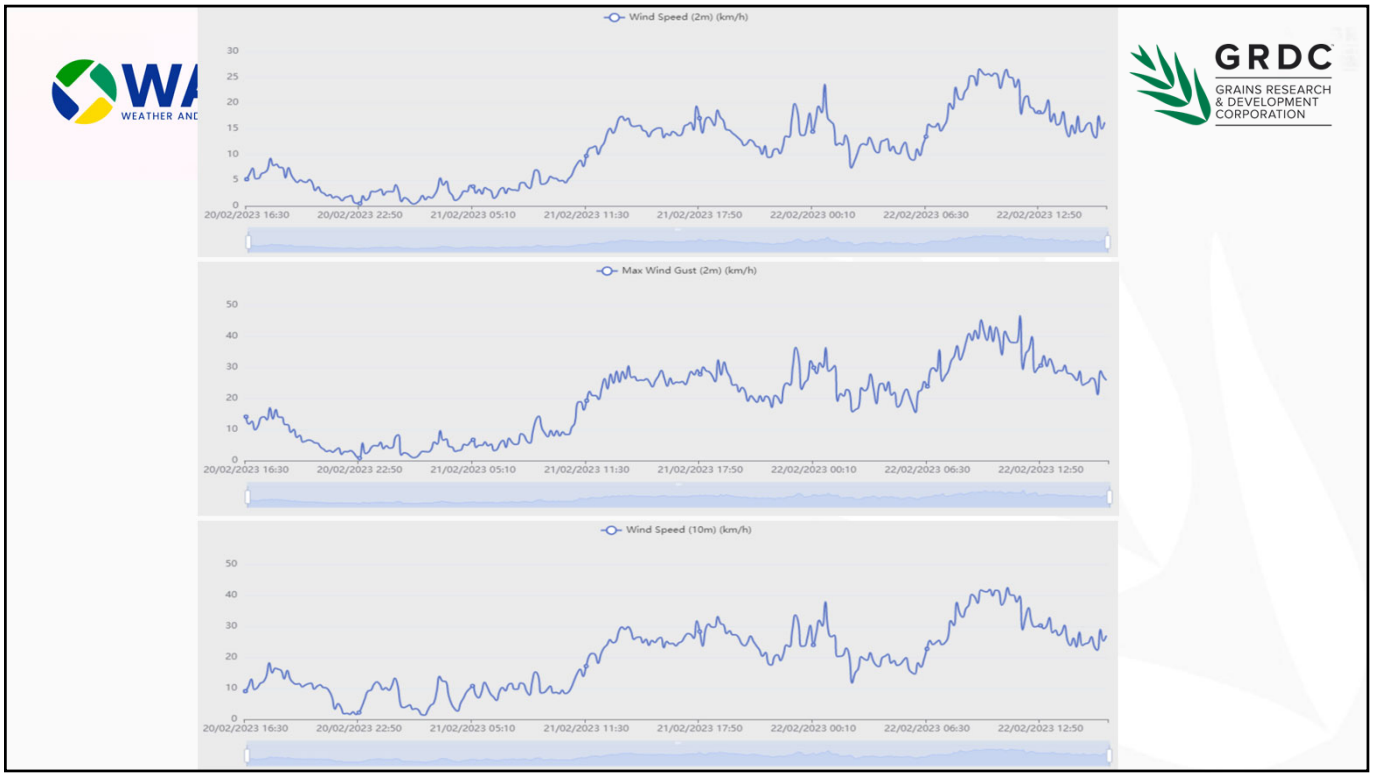
20


Wind Speed (2m) (km/h)
Max Wind Gust (2m) (km/h)
Wind Speed (10m) (km/h)
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

21


WAND
WEATHER AND NETWORKED DATA
Hazardous Inversion Index (m/s)
Inversion (Vert Temp Diff) (°C)
GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

22



23

System Benefits

Supports improved on-farm practices

- Identifies the most hazardous spray conditions
- Reveals more hours to spray at night
- Maximizes operator and machine productivity by revealing optimal hours to spray
- Eliminates guesswork
- Reduces the risk of spray drift which is crucial for social, environmental and financial reasons for agriculture and the wider community

Experienced operators combine wisdom with scientific data to make the best informed decisions

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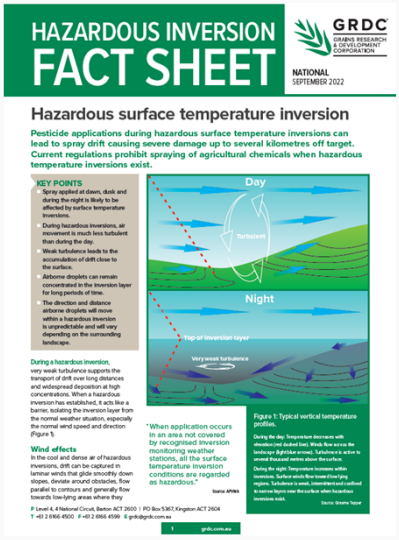
Additional Factors

Influencing spray drift risk

- Maximum wind speed
- Boom height
- Boom stability
- Spraying speed
- Relative humidity / Delta T
- Adjuvant Choice
- Sensitive Areas and Buffer Zone Requirements
- Product Choice and Rate

25


HAZARDOUS INVERSION FACT SHEET

NATIONAL SEPTEMBER 2022

Hazardous surface temperature inversion

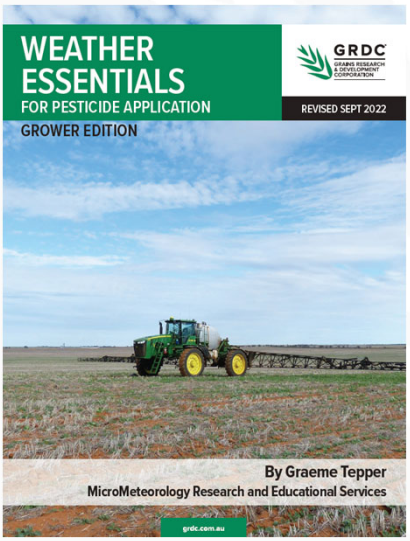
Pesticide applications during hazardous surface temperature inversions can lead to spray drift causing severe damage up to several kilometres off target. Current regulations prohibit spraying of agricultural chemicals when hazardous temperature inversions exist.

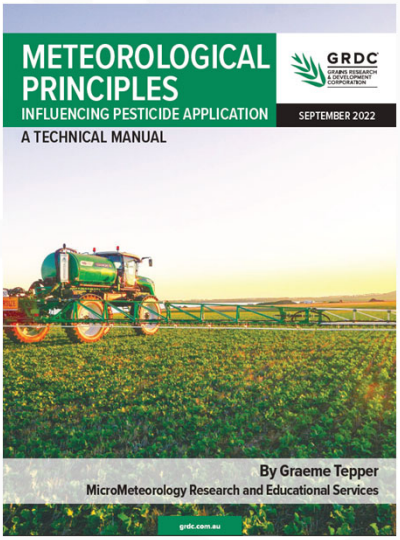
KEY POINTS

Day

Night

Wind effects





26

Spray drift is a significant issue for agriculture.
This investment represents a vital cross industry collaboration to improve spray outcomes.

THANK YOU

Grains Research and Development Corporation (GRDC)
A 214 Herries Street, Toowoomba Qld 4350 Australia

Gordon Cumming - Manager: Chemical Regulation
T 0428 637 642
E Gordon.cumming@grdc.com.au

www.grdc.com.au

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Crop Protection Australia

www.cropprotectionaustralia.com

Industry adaptation and regulatory challenges for new technologies

Dr Rohan Rainbow – Managing Director - Crop Protection Australia

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1

Adaptation and regulatory challenges for new technologies

- Drift mitigation and monitoring
  - Spray Drift Management Tool (SDMT) – Pending national APVMA permit
  - Parallel use with WANDS and SA Mesonet to manage hazardous temperature inversions
  - Future pesticide sensor technologies
- Autonomous spraying
  - Autonomy Code of Practice
  - Future eLabels to support autonomy
- Green on green optical spot spraying
  - Compliance with current labels
  - Tools to support Green-on-Green regulation and permits

2

Eliminate spray drift at the time of application……

Direct pesticide spray drift impacts

- Use of Spray Drift Management Tool (SDMT) can assist to manage these risks

Hazardous surface temperature inversions increase pesticide spray drift impact

- SDMT and drift management must be used in parallel with WANDS and SA Mesonet

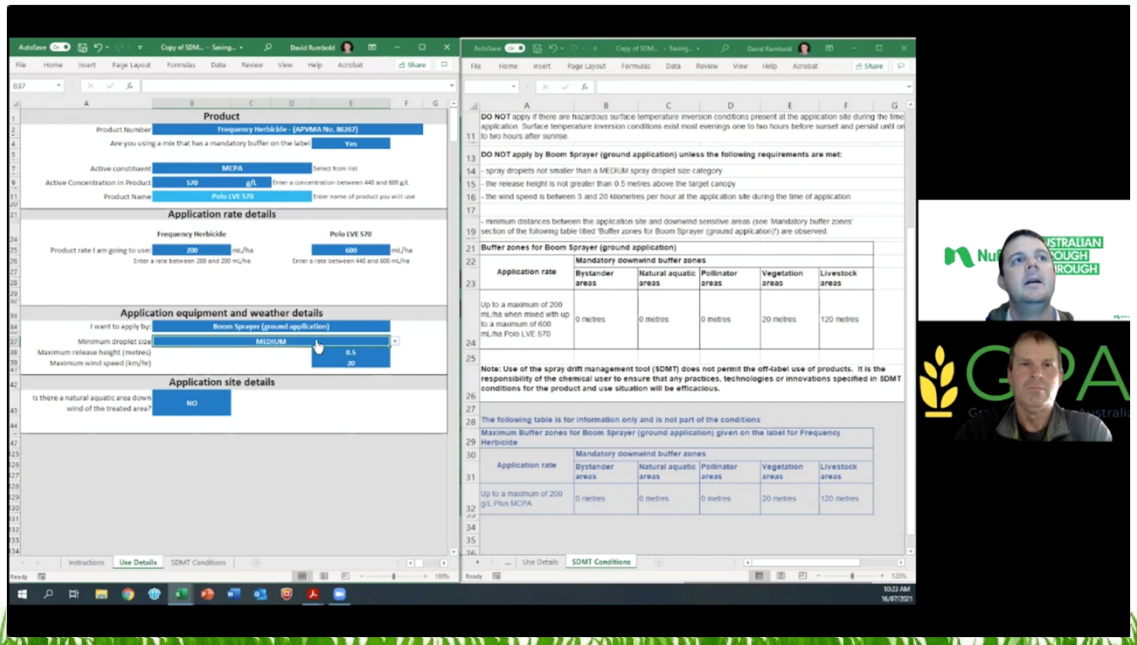
3

Spray Drift Management Tool (SDMT) Pilot NSW Permit

- SDMT has its genesis following outcomes of an APVMA spray drift review which began in 2010
- Subsequent industry funding including from GRDC and with broad industry input through the National Working Party for Pesticide Applications over a number of years
- Spray Drift Management Tool (SDMT) APVMA Permit PER91156 which expired on 31 July 2022 was held by Grain Producers Australia (GPA)
- To assist with selected modern pesticide labels, which contain spray drift buffer zone restraints for selected products in cereals and fallow situations in NSW only
- Restraints included mandatory recommended buffers, which are determined by the APVMA using the maximum use rate on the label and calculated using the SDMT
- Reduces 20-30+ pages of some pesticide labels to a simple user friendly tool

4

SDMT Video at https://www.grainproducers.com.au/industry-pesticide-permits



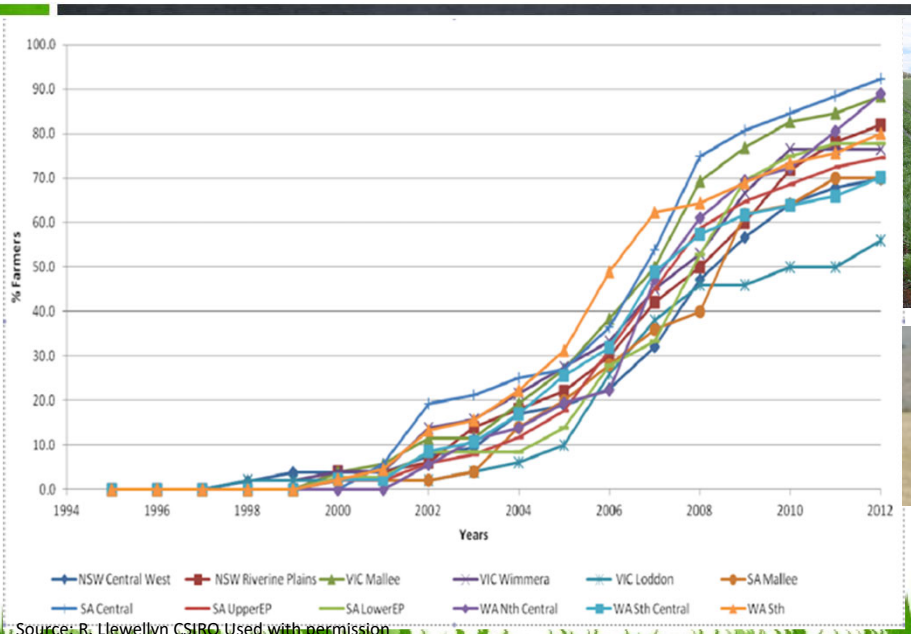
5

National SDMT permit is pending approval

- User survey feedback - 90% indicated they are likely or very likely to use the SDMT in the future if the APVMA permit is extended
- Additional improvements suggested:
  - Unique use case no and date to certify use
  - Improved Product Mix guidelines - When mixing of different products in the same mix
  - Build into an improved phone/web app
- GPA Pesticides & Technology Sub-committee agreed to prepare and submit a national permit application an behalf of Australian producers with NWPPA support
- Support for a national permit from all 12 pilot permit registrants
- Any new product requests for inclusion in the SDMT will require direct registrant contact and request to the APVMA
- National permit is currently in APVMA review process
- Opportunity to include in spray application training

6

Autosteer, GPS and semi-automation driving pesticide application change



Source: R. Llewellyn CSIRO Used with permission

8

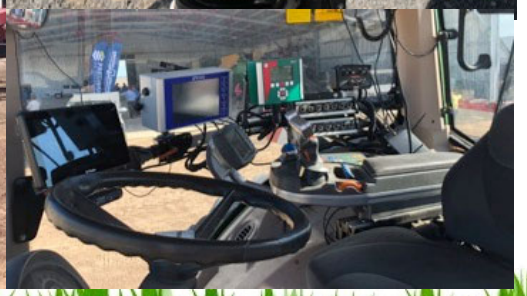
Potential digital agriculture impacts in the Grains industry

Practice/decision	Impact	Impact on GVP ($ million)
Planting	Beyond NVT - Improved variety matching to climate and soils. Increase in yield of 10% Equates to a productivity increase of 3.28%	1152.2
Crop weed and pest control	Targeted application using sensing and automation Chemical use reduced by 4%	91.0
Crop nutrition	Optimised fertiliser use results in 2% lift in output and 5% reduction in fertiliser costs	97.6
Yield Forecasting	Forecasting using remote sensed data allows higher confidence in marketing programs Overall productivity increased by 2%	702.8
Labour saving	Labour costs reduced by 12%	878.0

https://www.crdc.com.au/sites/default/files/P2D%20Ecomomic%20impact%20of%20digital%20ag%20-%20AFI%20Final%20Report.pdf

9

Autonomy will accelerate use of optical camera and targeted spray technology



10

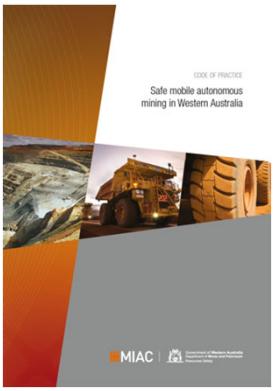
Small platform autonomy – Australia one of the first!

Swarm Farm Robotics

Source https://www.swarmfarm.com/

11

Autonomy Code of Practice



- Builds on existing industry Codes of Practice
- Legislative obligations under the Safe Work Australia Model Work Health and Safety laws and Agricultural and Veterinary Chemicals Code Act 1994
- Autonomy COP is about on-farm implementation and practice
- Alignment with emerging ISO standards

GPA Grain Producers Australia
SPAA Society of Precision Agriculture AUSTRALIA
TMA TRACTOR AND MACHINERY ASSOCIATION OF AUSTRALIA EMPOWERING YOUR FUTURE
JOHN DEERE CNH INDUSTRIAL AGCO Kubota CROPLANDS

12

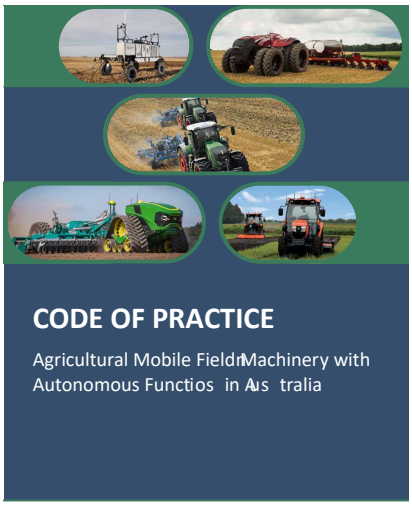
Code of Practice - Sections

1 Introduction .
2 Safety and risk management process
3 Information, instruction, training and supervision
4 Introduction to general hazard controls
5 Farm planning and design for hazard control
6 System planning and design for hazard control and functional safety
7 Commissioning hazard controls
8 Operational hazard controls
9 Vehicle transport between fields
10 Maintenance and repair requirements
11 Emergency management
Appendix 1 - Legislative provisions
Appendix 2 - Selected standards
Appendix 3 - Glossary
Appendix 4 - Farm project management planning and implementation
Appendix 5 – Introducing mobile machinery with autonomous functions to farming operations
Appendix 6 - Potential autonomous field equipment risks
Appendix 7 - Incident reporting

GPA Grain Producers Australia
TMA TRACTOR AND MACHINERY ASSOCIATION OF AUSTRALIA EMPOWERING YOUR FUTURE
SPAA Society of Precision Agriculture AUSTRALIA

13

Autonomy Code of Practice - Finalised by Industry



- The Code of Practice (COP) is for in-field, on-farm operation only
- COP does not cover the use of autonomous equipment for on-road use or on public land
- Excludes UAVs, Forestry and fixed infrastructure
- Pesticide application decisions are manual
- Government engagement for COP endorsement currently underway
- Significant overseas interest - OEDC Tractor Codes, UK and USA
- COP will be reviewed within 12-18 months of wide scale commercialisation
- COP will evolve with with new technology

14

OSST - Optical spot spraying technology – Australia was first!

Estimated 2000 WeedSeeker units and 1000 Weedit units

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Green-on-Brown OSST APVMA Permits

- Original Green-on-Brown OSST APVMA permit 'PER11163' expired in February 2019 - held by Crop Optics Australia
- Grain Producers Australia (GPA) today holds an APVMA permit 'PER90223' for the legal use of optical Green-on-Brown OSST – expires 31 December 2026
- There is an APVMA requirement that all products on permit PER90223 must have a label application beyond 2026

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New Green-on-Green OSST entrants

JOHN DEERE

Bilberry

BOSCH
Technik fürs Leben

Greeneye™ TECHNOLOGY

17

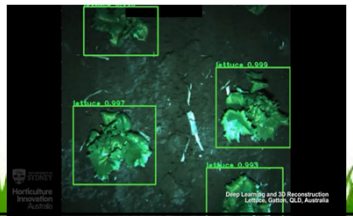
New OSST pesticide targeting technology entrants

JOHN DEERE

BLUE RIVER TECHNOLOGY

ecorobotix

AGERRIS Field Robotics and Intelligent Systems



18

Green-on-Brown and Green-on-Green OSST

	Availability	Green on Brown	Green on Green
Weed Seeker & Weed Seeker 2 (Owned by Trimble)			
WeedIt & Weed-It Quadro (Licenced by Nufarm-Croplands in Aust/NZ)			
SenseSpray (AgTechnic)			
Bilberry (Licenced to Agrifac, Dammann, Miller and Goldacres Australia)			
Bosch – SmartSprayer (Investment by BASF – licenced to Amazone, Stara & AGCO)			
Carbon Bee –SmartStriker (licenced to Kuhn, Berthoud)			
Greeneye Technology (Investment by Syngenta)	*Availability in Australia unknown*		
John Deere - See and Spray (Includes IP from John Deere owned Blue River Technologies, plus includes University of Southern Queensland IP with previous investment by SRA, CRDC & HIA)			*See & Spray Ultimate* Limited USA Release 2023
AutoWeed (James Cook University IP - Previous investment by Sugar Research Australia)	*Limited availability*		
Agerris- VIIPA (University of Sydney IP – Previous investment by Hort Innovation Australia)	*In development*		
Agrointelli (incorporating RoboWeedMaPS fitted to Robotti platform)	*In development*		
Ecorobotics (Investment by BASF)	*In development*		

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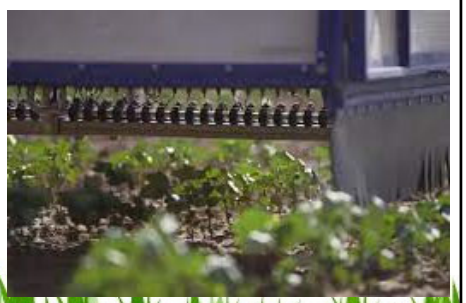
Future Risk Assessment Framework for Emerging Application Technologies

- OSST technology development is accelerating
- New patented pesticides and formulations using new specific targeting and application technologies
- Opportunity for a broad range generic pesticides and formulations using specific or similar targeting and application technologies
- Many pesticide x application technology x geospatial area combinations to consider
- Role of site specific weed monitoring prior to application – eg Single Shot for % coverage
- Industry will need Green-on-Green permits for generic herbicide products



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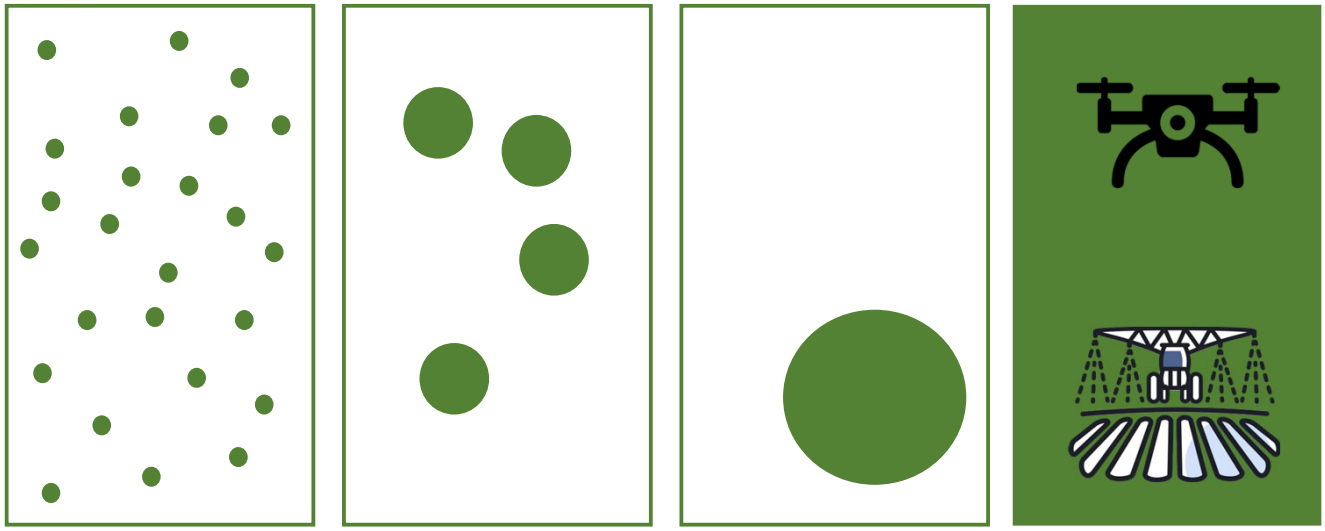
Managing crop safety, plant-back and trade risks – eg 5-10% field coverage



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Future Green-on-Green OSST APVMA Permit?

- Only registered products for use in the correct crop and growth stage can legally be used with Green-on- Green OSST
- Increasing beyond registered rate is off-label
- Change of crop or use type is off-label
- Change of timing of application to registered crop use is off-label
- A key industry risk from use of Green-on-Green OSST is pesticide residues and trade risks
- Grain pesticide residues are monitored through the industry funded National Residue Survey
- A future Green-on-Green OSST permit will be needed to manage trade risks to provide industry guidance on use, esp for generic pesticide products

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Future Risk Assessment Framework for Emerging Application Technologies

- Crop phytotoxicity, environment and residue studies will potentially need to be assessed under different criteria from traditional GAP studies
- Need to develop a geospatial OSST risk assessment model which be used in submission of an Item 25 risk assessment to the APVMA.
- A lack of a clear regulatory pathway will stifle investment and commercialisation of new technology in the small Australian market
- RDCs, machinery manufacturers and pesticide companies will need to work together to deliver cost effective outcome for industry
- Potential role of NWPPA in facilitating industry coordination on introduction of these technologies?

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Take Home Messages

- Digital tools, eLabels, autonomy and sensors will deliver profound industry benefits and beneficial outcomes
- There is still much work to be done!
- Leadership plus collaborative pre-commercial expert input required
- Rural Research and Development Corporations, machinery manufacturers and pesticide companies will need to work together
  - To deliver an effective outcome to support the APVMA in delivering effective Green-on Green Optical Spot Spraying Technology (OSST) regulation determinations

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Crop Protection Australia

www.cropprotectionaustralia.com

Rohan Rainbow Crop Protection Australia
E: r.rainbow@cropprotectionaustralia.com M: 0418 422 482

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Thank You

26

1

Drone Weed Mapping – What are we discussing?

- The process
- What information is produced?
  - Weed size
  - Location
  - Spray percentages
- How can we best use this information? Know what to spray before you spray:
  - Size discrimination
  - Green – on – green
  - Scouting
- Summary

SINGLE AG REVOLUTIONARY WEED CONTROL 2

2

Drone Weed Mapping explained

- Step 1 – Flying the drone and sensor
  - Enter paddock boundary on satellite imagery then largely autonomous process
  - Average coverage rate: 200ha/hr
  - Base station recording for flight duration, no link to drone
  - If correction source different to boom, simple one-off process to marry up
- Step 2 – Process captured data on standard laptop
  - Internet connection required, but minimal data needed for upload/downloads
  - Same day processing and less time than flying paddock
- Step 3 – Select weed sensitivity & generate prescription/coverage map
  - Software calculates area to be spot sprayed
  - Upload map to compatible GPS section controller

SINGLE AG REVOLUTIONARY WEED CONTROL

3

3

Drone Weed Mapping explained

- Step 1 – Flying the drone and sensor
  - Enter paddock boundary on satellite imagery then largely autonomous process
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  - If correction source different to boom, simple one-off process to marry up
- Step 2 – Process captured data on standard laptop
  - Internet connection required, but minimal data needed for upload/downloads
  - Processing time is roughly equal to flight time
- Step 3 – Select weed sensitivity & generate prescription/coverage map
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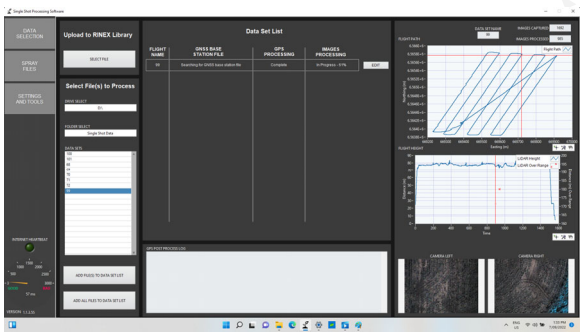
  - Upload map to compatible GPS section controller



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4

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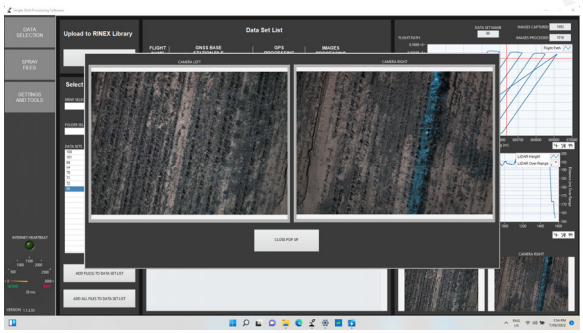

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5

5

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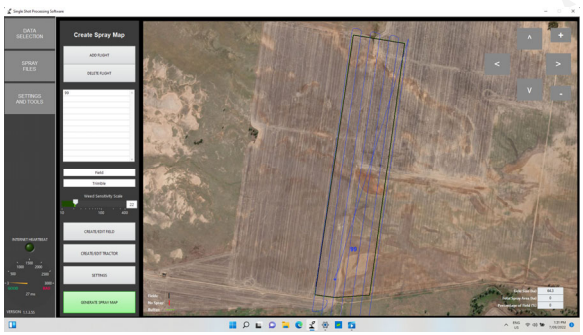


SINGLE AG REVOLUTIONARY WEED CONTROL

6

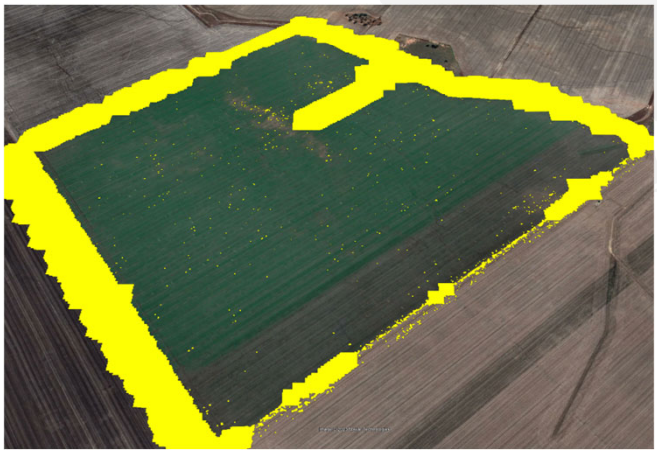
6

The Product – Spray File

- Output is a prescription file
- Upload to sprayer only sprays weeds – yellow in this image

- Data:
  - Weed Size
  - Weed Location
  - Calculates spray area

How can we use this data to maximise spray efficacy at minimum cost???



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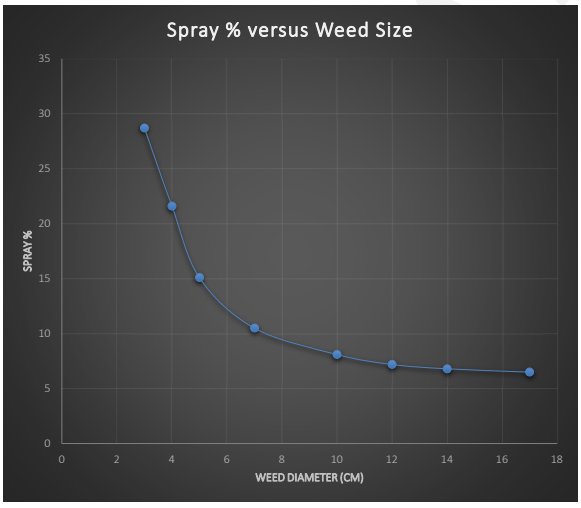
Know what to spray before you spray

- Typical spray event from July 22
- Germination after rain event with sporadic milk thistle that had survived from previous spray in heavy wheat stubble
- Blanket spray $42.40 per ha

- Mapped with Single Shot and now we know spray area compared with weed size
- Clearly see high percentage of small weed
- From 7cm to 17cm, 11% to 7% spray
- Simultaneous blanket and spot @ 11% spot - use higher than normal rates on spot spray and lower rates on blanket spray
- Outcome: Excellent result all round with high rates on difficult to kill weeds and a saving of $13.40 per ha



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Examples of weeds detected – green on green

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Crop Scouting – fast, efficient, quantitative

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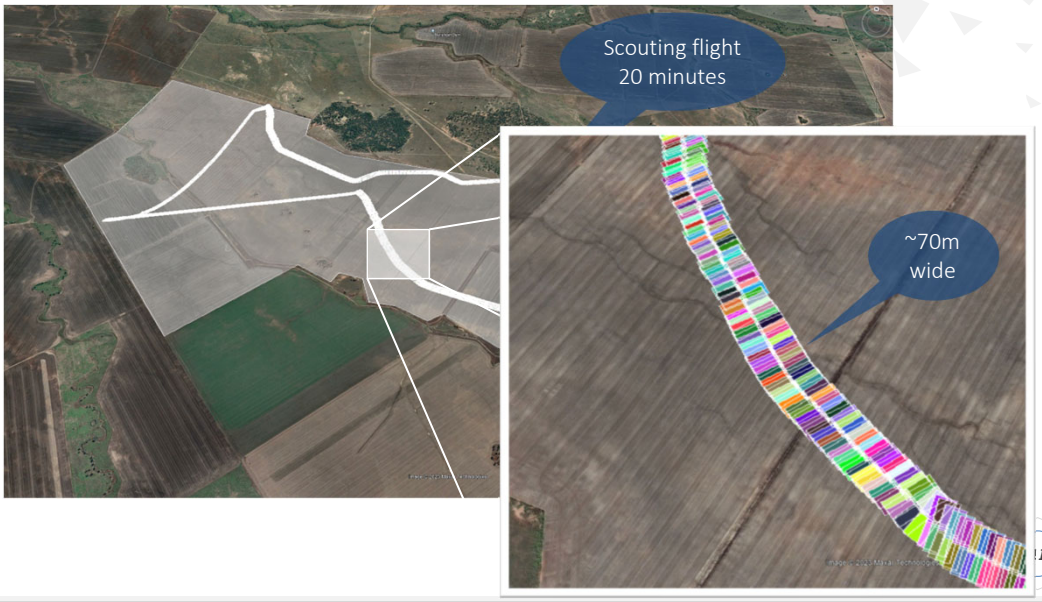
Crop Scouting – fast, efficient, quantitative



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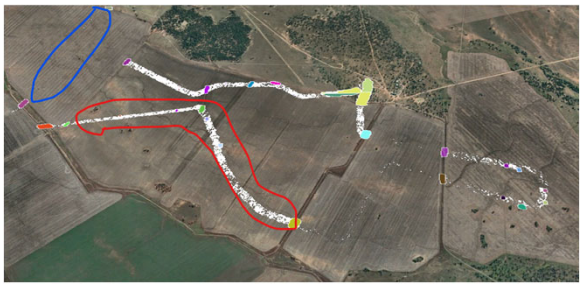
Scouting mission showing weed density



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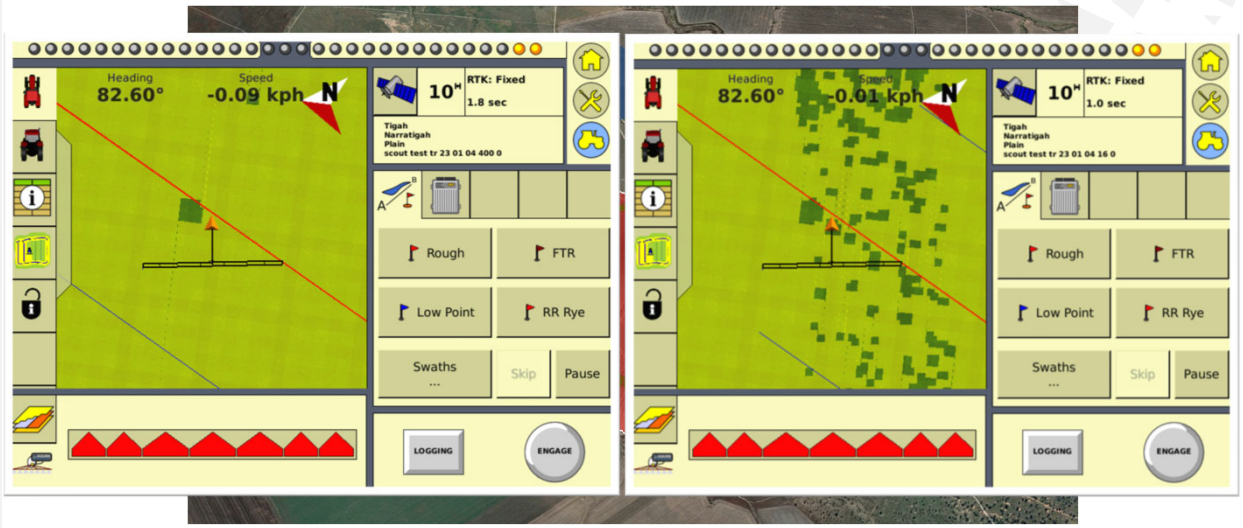
Crop Scouting – fast, efficient, quantitative



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Crop Scouting – fast, efficient, quantitative

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Crop Scouting - Quantitative

- Feathertop Rhodes grass - $100/ha+ spray application
- 66% spot = $66/ha – all weeds
- 7% spot = $7/ha – large weeds only
- $59/ha difference

- 400ha field - 2 hours flying
- Typical spot spray = 66% spot or $66/ha - $26,400

- Target bigger weeds = 7% spot or $7/ha - $2,800
- 2 hours flying = $37,200 saved versus blanket

Ability to select on size = $23,600 saving (of the $37,200)

Ability to control FTR = Priceless

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Crop Scouting – fast, efficient, quantitative

SINGLE AG REVOLUTIONARY WEED CONTROL

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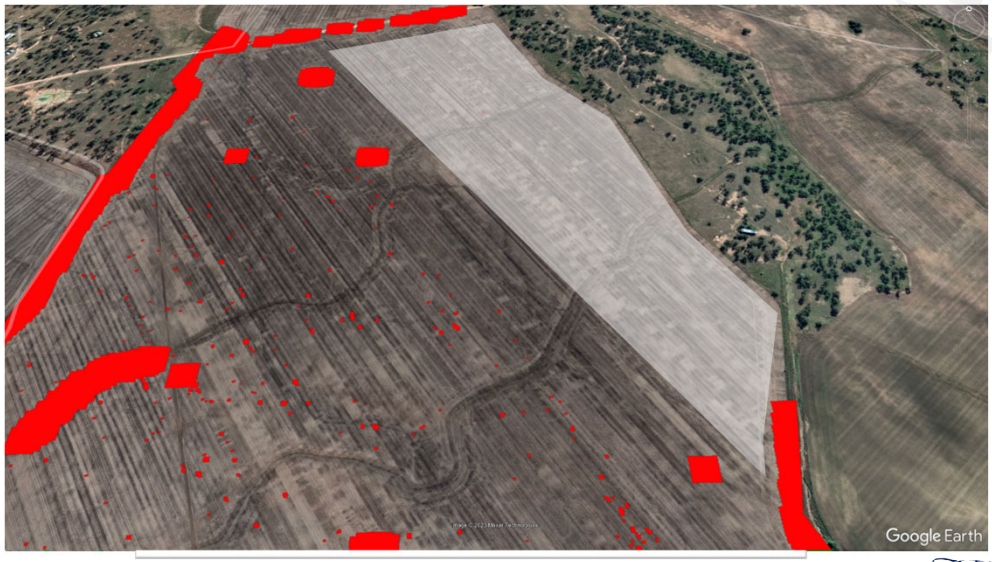
Crop Scouting – fast, efficient, quantitative



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Weed Mapping – Know what to spray before you spray

- Fleabane - $60/ha with Gramoxone Pro @ 6L/ha
- 22% spot = $13.20/ha
- $46.80/ha saved
- 280ha field = $13, 104

- 1 hour 20 minutes of flying
- Spot spray rate - we knew we were on label
- Sprayed at full speed @ 200L/ha – 7 loads to 1.5
- Minimised drift with AI nozzles
- We knew how much to mix

Know what to spray before you spray

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Case Study* – Increased savings, spot spray with increased boom sections

Savings with current unmodified booms – 7 sections, 36m

Total Area Covered	Total Area Sprayed	Percentage Spot Sprayed	Average Chemical Cost of Blanket per ha	Average Value Saved per ha	Total Value Saved
4837ha	1018ha	21%	$28.30	$22.36	$108,155

Modelled additional savings with boom modifications – 18 sections, 36m

Paddock Size	Area to Spot Spray		% of Paddock to Spray		% Reduction from Modifications
	7 Section	18 Section	7 Section	18 Section	
189ha	26.7ha	17.3ha	14%	9%	35%

** Case study from Tigah Farming, Coonamble, NSW*

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Summary

Know what to spray before you spray

- Process – simple and quick
- Knowledge of weed location and size
- The % of spray is known before you spray – combined with size discrimination – hugely powerful tool
- Powerful tool for scouting and effective weed identification

20

20


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More Information
Single Agriculture
Ben Single
0417 060 561
info@singleagriculture.com.au
www.singleagriculture.com.au

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Trade display exhibitors

SINGLE AG REVOLUTIONARY WEED CONTROL	Know what's there before you spray. Want to spot spray with your existing sprayer? Want to blanket spray and spot spray simultaneously? Want to know the area to spot spray before you spray? Want to scout for herbicide resistant weeds? Find out how, with weed mapping at 200ha per hour at Single Agriculture.	www.singleagriculture.com.au
CORTEVA™ agriscience	Colex-D Herbicide contains a novel 2,4-D salt and formulation technology that reduces drift potential, volatility and 2,4-D odour. The proposed label will contain specific criteria and compatibility statements to support these claims. With efficacy equal to 2,4-D amine, this is a 2,4-D that can be applied with confidence.	https://www.corteva.com.au/
HARDI	GeoSelect, a new spraying solution designed to save farmers money, time and create greater efficiency while working the harsh Australian landscape.	https://www.hardi.com.au/
McINTOSH DISTRIBUTION Miller Sprayers Since 1899 WeedSeeker 2 bilberry	McIntosh Distribution is leading Australian machinery distributor for national brands including Miller Sprayers and WeedSeeker 2. With a commitment to excellent customer service, McIntosh Distribution aims to provide growers with industry-leading equipment, service and after-sales support.	http://www.mcintoshdistribution.com.au/
WEED·IT precision spraying	With over 20,000 WEEDIT sensors sold in Australia makes WEEDIT a clear market leader because it works and it's simple to use. Brendan Williams has been working with WEEDIT for 15 years so has a wealth of experience to share.	https://www.weedit.com.au/
FMC An Agricultural Sciences Company	Nobody likes to get a fine. FMC developed On Coarse® DRA (Drift Reducing Adjuvant) to provide applicators with the confidence and knowledge to apply 2,4-D/glyphosate mixtures with a wide range of nozzles to produce genuine Very Coarse (VC), Extremely Coarse (XC) or Ultra Coarse (UC) spray qualities. Make less fines with On Coarse® DRA	www.fmccrop.com.au
MILNE BROS TRUCK AND TRACTORS	Detailed discussion on updated Agtronics equipment built to suit the Central Queensland environment, customisation to suit specific needs of farmers.	https://milnebros.com.au/
RDO® EQUIPMENT	Using See & Spray Select, farmers and contractors can apply complex tank mixes more efficiently and easily switch from targeted to broadcast spraying without leaving the tractor cab. See & Spray Select has an integrated camera technology that rapidly detects green plants within fallow ground and automatically triggers an application to those plants. In doing so, it achieves a similar hit rate to traditional broadcast spraying but uses, on average, 77% less herbicide.	https://www.rdoequipment.com.au/application-equipment/

Quick 'N' Safe	The Quick 'N' Safe Chemical Protection Apron is a simple & practical chemical personal protective suit (PPE) for farm & industrial use, providing protection from harmful chemical exposure & contamination. Made in Forbes from material that meets Australian Standards AS 2001.2.17-1987 (hydrostatic pressure test) and ASNZS ISO 6530-2006 (protective clothing).	https://quicknsafe.com.au/
DARLING DOWNS PRECISION	Darling Downs Precision are specialists in Precision Ag Technology. We aim to provide growers with high quality technology that can help them improve their farming practices, be more productive, reduce input costs as well as increase profit. We also want this technology to help growers be better stewards of their land.	https://www.darlingdownsprecision.com.au/
DARLING DOWNS SPRAYTECH	As growers look to constantly spray to control hard to kill weeds, Swarmfarm and WEEDit have become a useful synergy for growers struggling with tying up a worker and a tractor to spray. Swarmfarm have developed a robotic platform that can spray with Weedit implements for targeted spraying on widths from 9m to 18m as linkage setups and 18 to 24m as trailing options.	jeremy@ddst.com.au 0439 003 439
sTs SpraySMART® Chemical Accreditation Training	SpraySMART is a Registered Training Organisation and leader of **Face to Face, Online, Zoom and in house AQF3 Chemical Accreditation Training** throughout Australia. Ask us about our customized Accredited Training in Broadacre/Cotton, Dairy, 1080, and Livestock.	www.spraysmart.com.au
CROPLANDS	Croplands Equipment is a leading manufacturer and supplier of agriculture spraying equipment. We have been partnering with growers around the world to bring out the very best in their operations for over 50 years.	https://croplands.com/au/
Nufarm AUSTRALIAN THROUGH & THROUGH	With a more uniform and effective spray pattern, Nufarm DROPZONE ensures more of the total spray volume is delivered in the optimal size range (150 to 720 µm), by not only reducing drift, but also reducing oversized droplets that can lead to poor weed control. Nufarm DROPZONE's unique 2,4-D amine formulation technology is a low odour and non-volatile solution that provides less impact to users and the community.	https://nufarm.com/au/dropzone/
HP HUTCHEON & PEARCE TECSIGHT	Hutcheon and Pearce will be showcasing the world's first factory installed original equipment manufacturer camera sprayer. Static demonstrations will be showcasing the technology throughout the day. Talk to Hutcheon and Pearce's TECSight and John Deere's equipment, technology and digital specialists about our collective journey to automation.	www.hutcheonandpearce.com.au www.tecsight.com.au