

GRDC Spray Days – presentations



Narromine – 12 September 2022

Temora – 13 September 2022



Contents

Social licence and trade.....	3
<i>Ryan Pratten, MPAC</i>	
Social licence and trade.....	9
<i>Benjamin Romeo, Summit Ag</i>	
Advanced weather sensors and information supporting spray decisions.....	15
<i>Gordon Cumming, GRDC</i>	
2,4-D labels following APVMA review	25
<i>Gordon Cumming, GRDC</i>	
Matching spray capacity to the farm – optimising efficiency to improve capacity.....	33
<i>Greg Rummery, OutlookAg</i>	
Options to reduce spray drift risk	42
<i>Harry Pickering, Adama Australia</i>	
Update on spray drift reduction technologies for grain crops.....	49
<i>Andrew Hewitt, CPAS, UQ</i>	
Optimising glyphosate efficacy.....	60
<i>Mark Congreve , ICAN & Maurie Street, GOA</i>	
Weed recognition technology – past, present, future	76
<i>Guy Coleman, University of Sydney</i>	
Trade display exhibitors	93

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SOCIAL LICENCE AND TRADE

RYAN PRATTEN – MPAC



1

SOCIAL LICENCE



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 treat!

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.

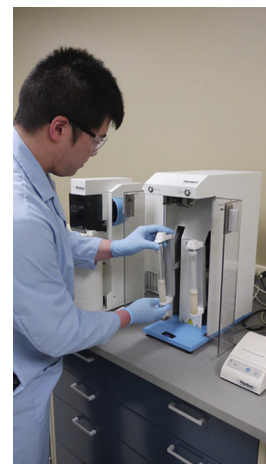
3

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
- ...23 different types of grain crops
- 256 active ingredients in wheat alone



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



Industry examples:

- Issues with Australian IMI tolerant barley in Japan and South Korea in 2019
- Change in label for Haloxyfop in 2014 and industry wide effort in 2019 from GRDC reminding canola growers to adhere to label application directions

Barley grain imidazolinone MRLs (mg/kg) as at 5 March 2019

Barley grain	Australia	Codex	Japan	EU	South Korea
<i>Imazamox</i>	0.05	0.02	0.01	0.05	0.01
<i>Imazapic</i>	0.02	-	0.01	0.01	0.01
<i>Imazapyr</i>	0.7	0.7	0.01	0.01	0.01

6

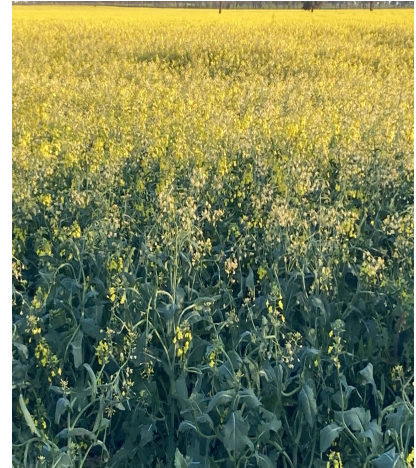
DRIFT AND PRODUCTION SYSTEM

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.

Isn't this an old problem?

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



7

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.

Isn't this an old problem?

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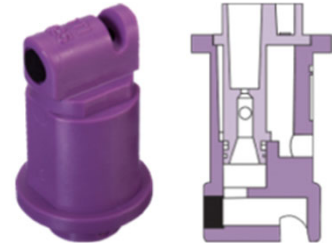
8

DRIIFT 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)
- 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)

9

DRIIFT AND PRODUCTION SYSTEMS



What's happening?

All of the old actives are being re-evaluated to make sure they meet the current standards:

- Glyphosate has been reviewed
- 2,4-D has been reviewed
- Fipronil is currently being reviewed
- Imidacloprid is currently being reviewed
- Paraquat/Diquat is currently being reviewed

10



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!
- 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

11

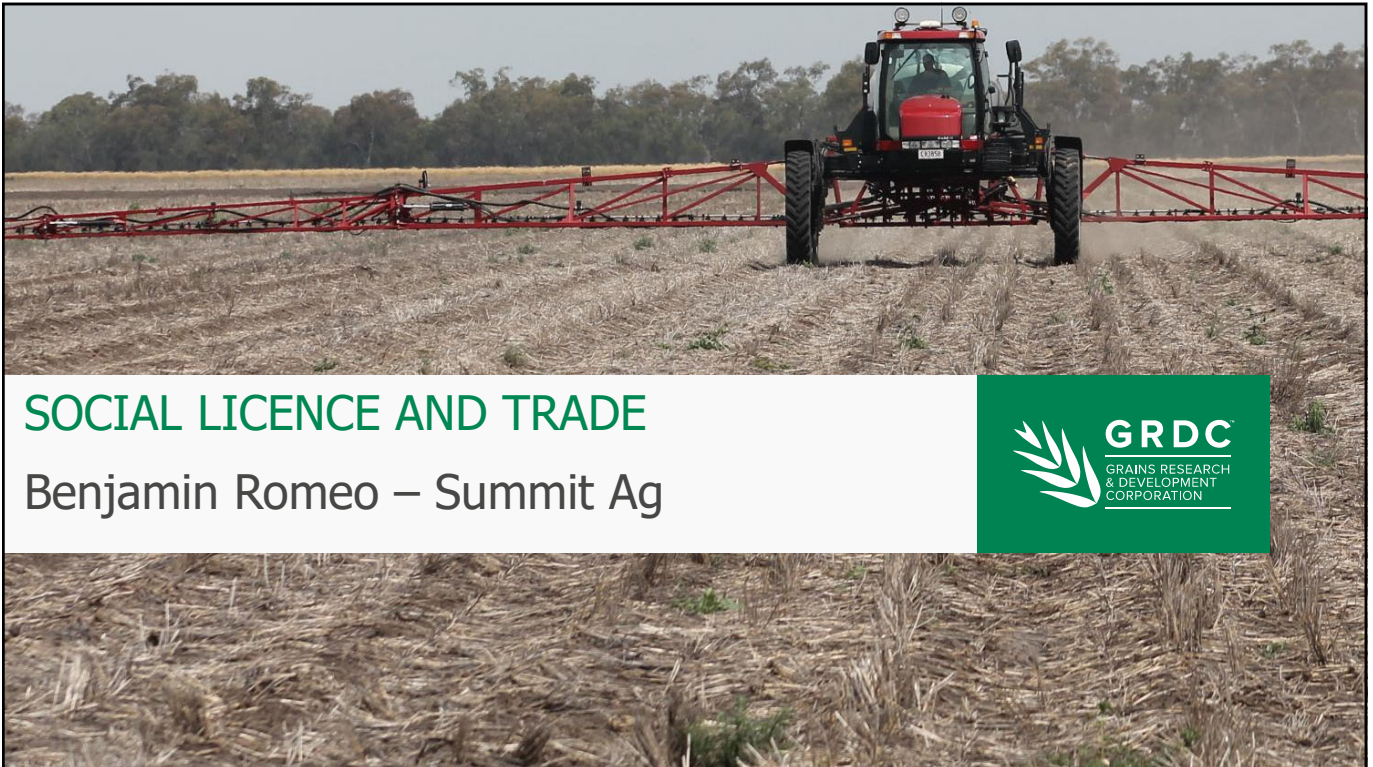
Acknowledgments:

John Cameron – ICAN
Harry Pickering – Adama
Ben Romeo – Summit Ag
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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12



SOCIAL LICENCE AND TRADE

Benjamin Romeo – Summit Ag



1

SOCIAL LICENCE



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.”

- No one 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 treat with more government regulation and International Market access!

2

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

3

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

4

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

5

HERBICIDE RESIDUES IN GRAIN



Industry Examples

- Issues with Australian IMI tolerant barley in Japan and South Korea in 2019
- Change in label for Haloxyfop in 2014 and industry wide effort in 2019 from GRDC reminding canola growers to adhere to label application directions

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<i>Imazapyr</i>	0.7	0.7	0.01	0.01	0.01

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



7

DRIFT AND PRODUCTION SYSTEM

Impacts of spray drift on cotton crop

- Grower Surveys for southern NSW

Years	% of cotton growers affected	Average % of cotton crop area impacted	Average yield cost (in bales / ha)	Average financial cost (in \$)
2018	19%	54%	0.7	\$47,938
2019	23%	14%	2	\$16,440



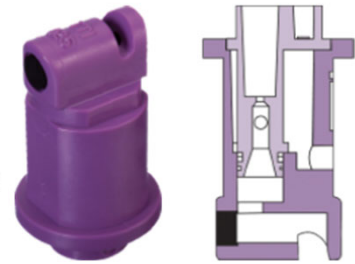
8

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)

9

TAKE HOME MESSAGES



- 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

10



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Advanced Weather Sensors and Information Supporting Spray Decisions



1

TAKE HOME MESSAGE

Stability
Wind
Turbulence
Dispersion

STRONGLY STABLE



Image: Graeme Tepper

2

NIGHT – COMBINED AND CONCENTRATED






Hazardous inversions trap pesticides.

Laminar winds transport pesticides

Laminar winds carry high concentrations

3

LABEL STATEMENTS




Nufarm Crucial Herbicide & Titan Amine 720 Herbicide

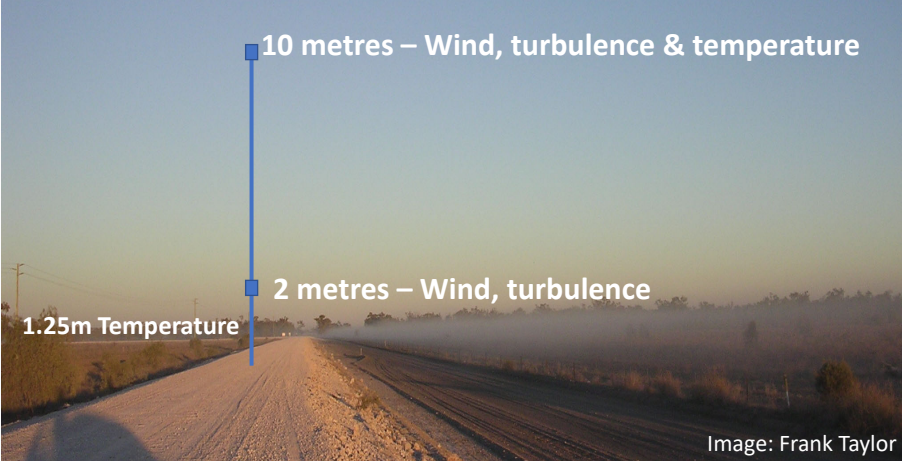
DO NOT apply if there are hazardous surface temperature inversion conditions present at the application site during the time of application.

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 GoTo method
for inversion detection and label compliance

4

RESEARCH Detailed examination of inversion conditions 




10 metres – Wind, turbulence & temperature
2 metres – Wind, turbulence
1.25m Temperature

Image: Frank Taylor

29 towers
WA, SA, NSW, QLD
37 sites
Extensive data set
Over 6 years - every 10 minutes

Research conducted by Graeme Tepper: (MRES) and Dr Warwick Grace (Grace Research Network)

5

DISCOVERY 

Clear skies and calm are ideal
BUT
It can be overcast/cloudy
Winds can exceed 20kph
Calm* is rare
Winds are most often 2 to 11kph
Ultimately
laminar winds
cause inversions to be hazardous

These discoveries challenge traditional beliefs

*Cup type wind sensors often record calm even when winds are up to 5 kph.

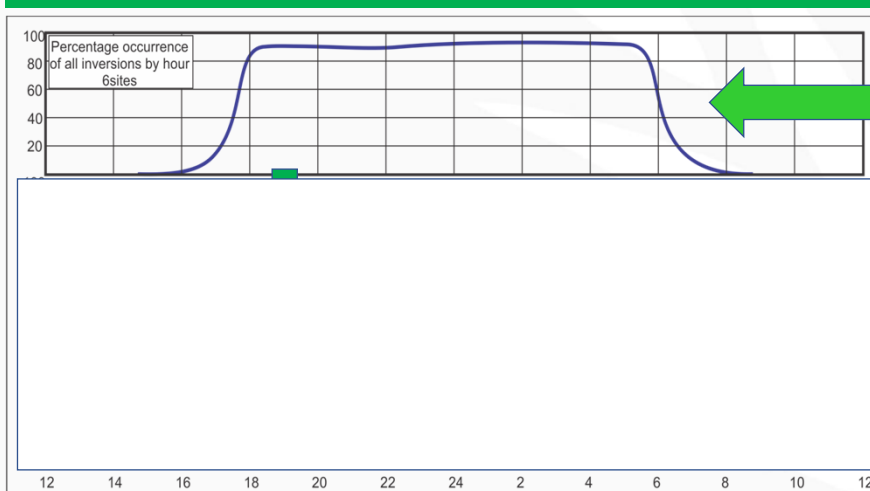
6

RECORDING METEOROLOGICAL CONDITIONS



7

WHEN DO INVERSIONS OCCUR?

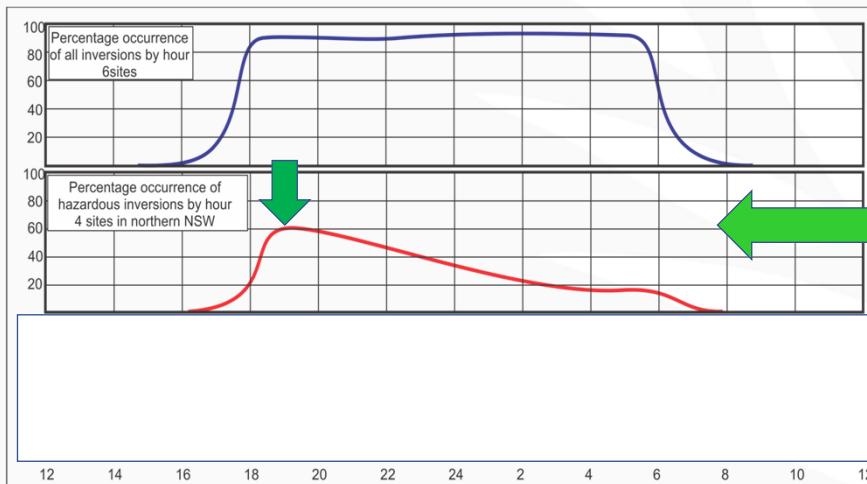


Inversions form most nights.

Some are weak, others are very hazardous

8

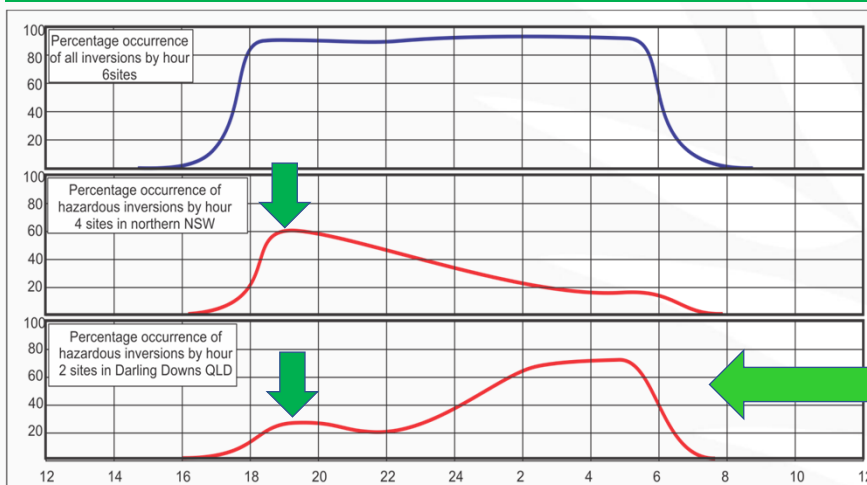
WHEN ARE INVERSIONS MOST HAZARDOUS



**NSW open plains
Early evening**

9

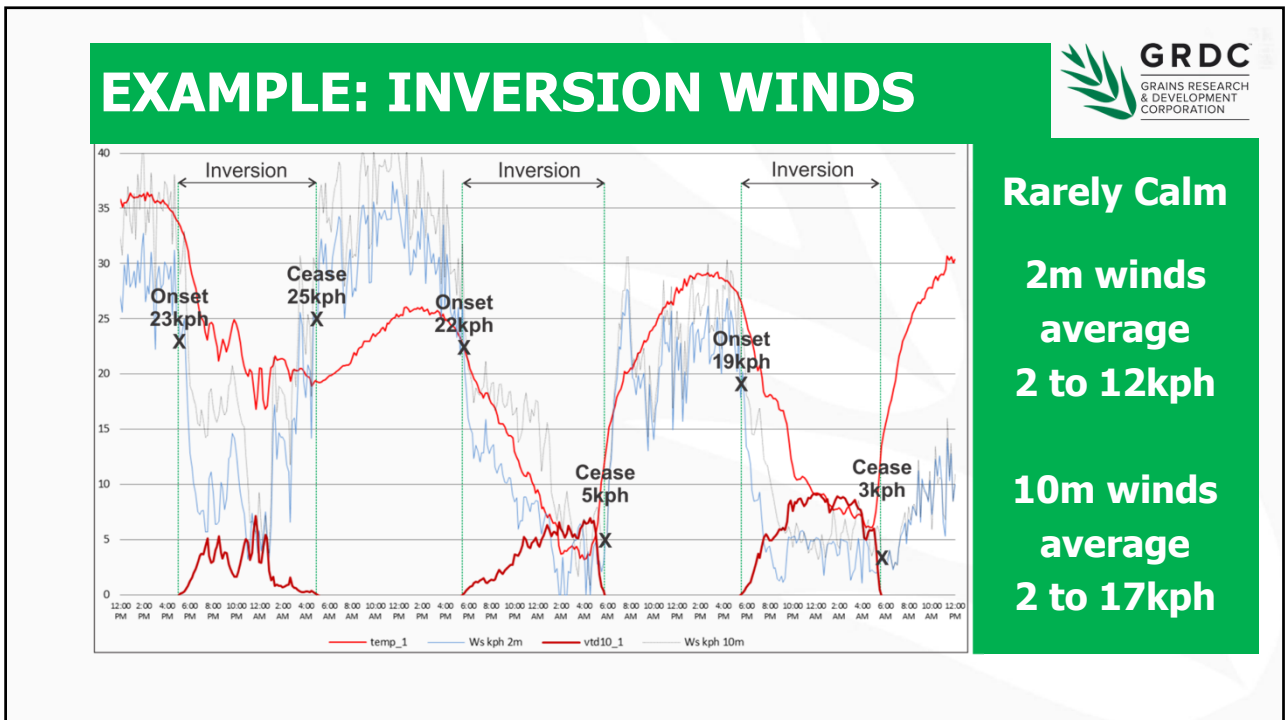
MOST HAZARDOUS



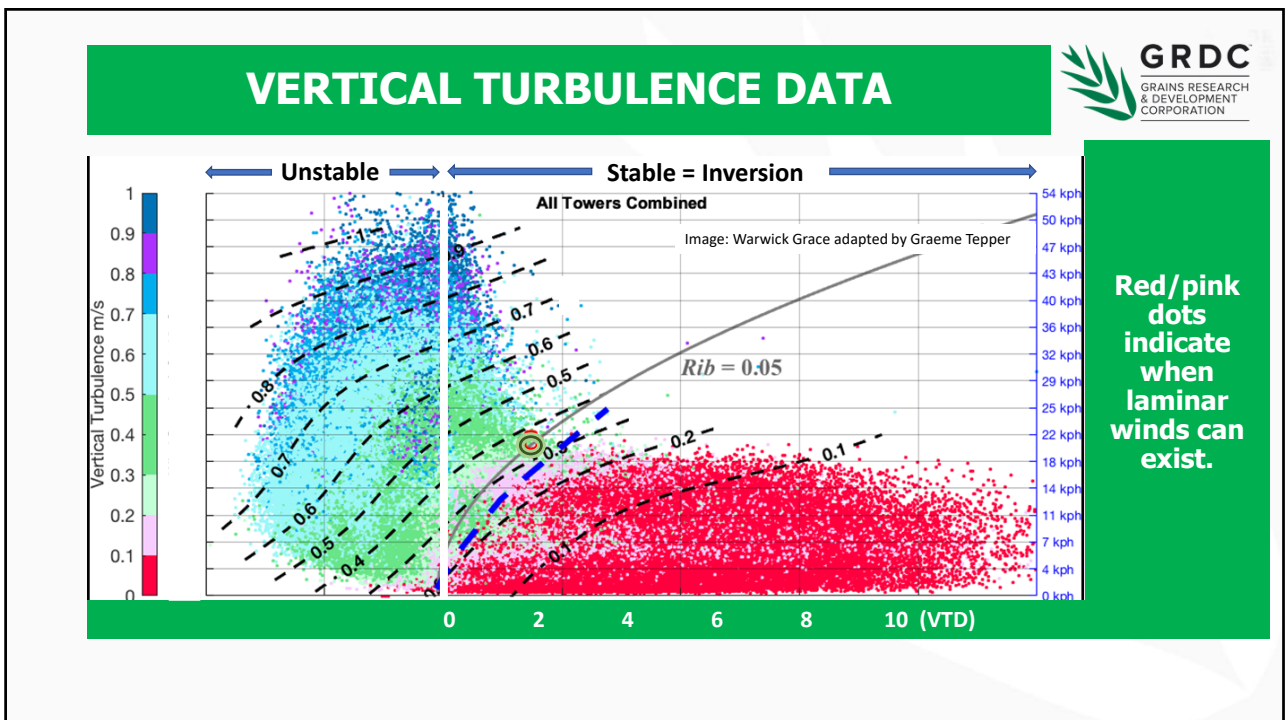
**Spray guides
need to be
formulated for
regions.**

**Darling Downs
Two peaks
Early evening
And 2 to 5am**

10



11



12

LAMINAR WINDS ARE HAZARDOUS

Image: Graeme Tepper

Laminar winds can carry concentrated drift long distances

Note the sharp separation between laminar and turbulent conditions

13

HOW MANY SPRAY HOURS GAINED?

In these cases adopting the SDWS increase spray hours by 9.5 & 6 hours

14

SPRAY DRIFT WARNING SYSTEM



System: 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:

1. Accurate and real time data updated every 10 minutes.
2. 24 hour forecasts of spray conditions in 2 hour segments updated every 10 minutes.
3. Plus wind, temperature, delta T and rainfall

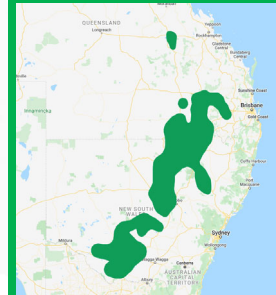


Image: Goanna Ag

The research for the system was made possible by the significant contributions of growers and the support of GRDC, CRDC, AND DPIRD.

15

WAND WEATHER AND NETWORKED DATA

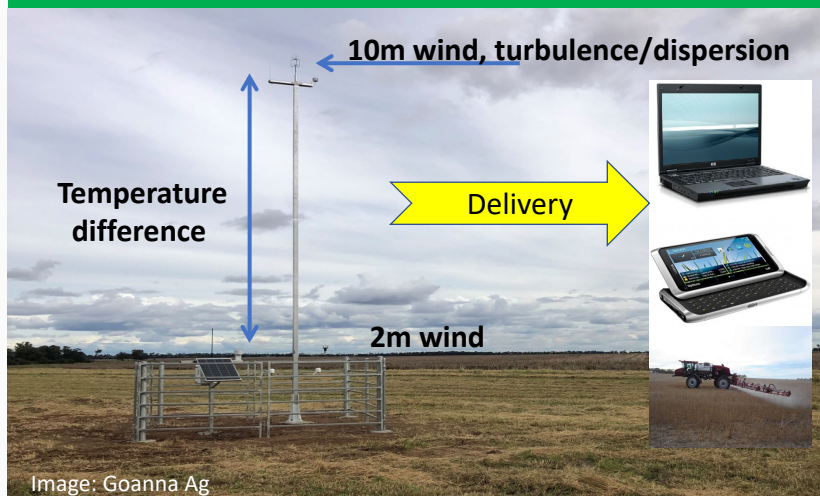


Image: Goanna Ag

WAND provides information

Growers make informed decisions

16

WAND
WEATHER AND NETWORKED DATA

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

First Name
Last Name
Work Email
Work Phone
Company Name
ABN Number
Grower Number
Notes
 I accept the [Terms of Use](#)
Sign Up

Tower 01, NSW
distance: 120km, south
[\[Link\]](#)

Tower 02, QLD
distance: 1,020km, west
[\[Link\]](#)

Tower 05, QLD
distance: 1,018km, south
[\[Link\]](#) [\[Link\]](#)

Tower 08, QLD
distance: 1,018km, east
[\[Link\]](#)

Tower 09, QLD
distance: 1,705km, west
[\[Link\]](#)

Haymarket Tower
History Now Forecast
As of 10:40 am, 6 July 2022
Hazardous Inversion Present or Absent
Delta T 3.7 °C
Temperature (at 2m) 37.2 °C
Temperature (at 10m) 38.2 °C
Vertical Temp Diff -0.1 °C
Wind Speed (at 2m) 8.8 km/h
Wind Direction (at 2m) NE
Wind Speed (at 10m) 8.8 km/h
Wind Direction (at 10m) NE
Solar Radiation 200
Rain 2.7 mm
Rain 200
Rain 200

Haymarket Tower
History Now Forecast
As of 10:40 am, 6 July 2022
Hazardous Inversion
A P A A A
7 pm 8 pm 9 pm 11 pm 1 am
A Absent P Present

www.wand.com.au

17

SYSTEM BENEFITS
SUPPORTS IMPROVED ON-FARM PRACTICES

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

- 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 farm decisions

www.wand.com.au

18

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

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2,4-D Labels following APVMA 2,4-D Review

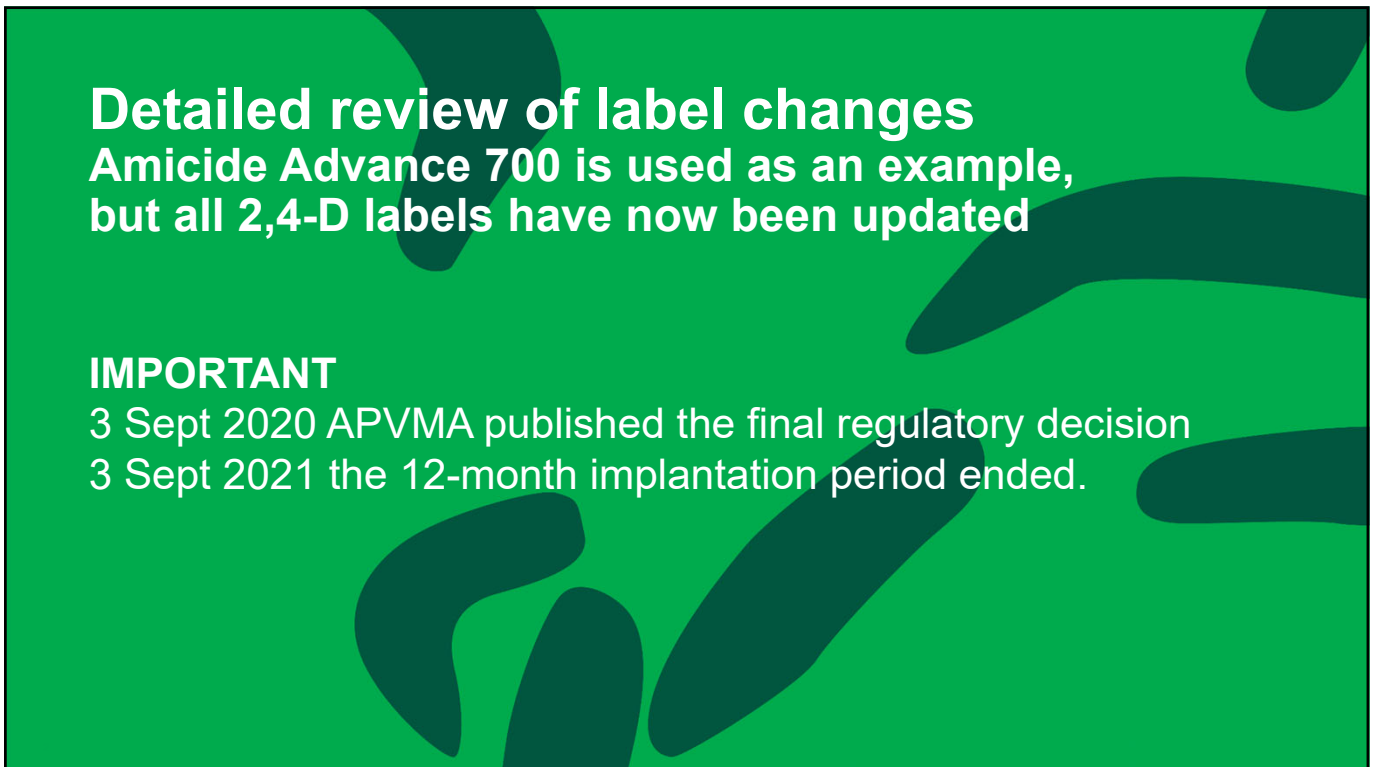
Christine Kelly & Dave Rumbold

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Nufarm
Grow a better tomorrow

The slide features a green background with a stylized landscape of hills and a field. The field is divided into orange and purple sections. The GRDC logo is in the top right, and the Nufarm logo is in the bottom right.

1



Detailed review of label changes
Amicide Advance 700 is used as an example,
but all 2,4-D labels have now been updated

IMPORTANT
3 Sept 2020 APVMA published the final regulatory decision
3 Sept 2021 the 12-month implantation period ended.

The slide has a green background with dark green abstract shapes. The text is white and bold.

2

Key Points

- **Mandatory statement** to use nozzles that produce droplets no smaller than the Very Coarse (VC) spray quality category
- **Advisory statements** for summer spray application between Oct 1st and April 15th to use nozzles that produce Extremely Coarse (XC) to Ultra Coarse (UC) spray quality
- **DO NOT** spray when hazardous inversion conditions exist
- Downwind mandatory no spray zones for both aquatic and terrestrial off target vegetation (including sensitive crops, gardens, landscaping vegetation, protected native vegetation or protected animal habitat)



3

3

General restraints

New requirement related to run-off concerns. Neither APVMA or the BoM have defined "heavy rain or storms". Definitions overseas range from greater than 7.6 mm per hour (US) or 10 mm per hour (UK).

New requirement related to run-off concerns. For the TAS/SA/WA restriction it means you can't use 2,4-D unless you are practicing no-till (ie. no cultivation)

GENERAL RESTRAINTS

DO NOT exceed maximum application rate of 4.75 L/ha.

DO NOT exceed the maximum daily application rate by backpack spraying of 5.7 L/day.

DO NOT apply if **heavy rains or storms** are forecast within 3 days, or if any rain is expected within 6 hours.

DO NOT irrigate to the point of runoff for at least 3 days after application.

DO NOT apply if crop or weeds are stressed due to dry or excessively moist conditions.

Additional USAGE restrictions apply in certain states (listed below) and in peanut, pasture and sugarcane situations (refer to Section 7 of the Directions for Use Tables):

Tasmania & South Australia:

- Only apply in no-till farming systems for the following situations:
 - Preparatory sprays in dryland cropping
 - Pre-emergent application in winter cereals, summer cereals and legumes

Western Australia:

- Only apply in no-till farming systems for pre-emergent applications in winter cereals and legumes.



4

Spray drift restraints

This is to prohibit the use of misters, etc.

The terms in bold are defined at this website. This is a **very important** reference to help understand how the requirements apply in individual circumstances.

SPRAY DRIFT RESTRAINTS

DO NOT apply by a **vertical sprayer**.

Specific definitions for terms used in this section of the label can be found at www.apvma.gov.au/spraydrift

DO NOT allow **bystanders** to come into contact with the spray cloud.

DO NOT apply in a manner that may cause an **unacceptable impact to native vegetation, agricultural crops, landscaped gardens and aquaculture production**, or cause contamination of plant or livestock commodities, outside the application site from **spray drift**. The **buffer zones** in the relevant buffer zone table/s below provide guidance but may not be sufficient in all situations.

Wherever possible, correctly use application equipment designed to reduce spray drift and apply when the wind direction is away from these sensitive areas.

DO NOT apply unless the **wind speed** is between 3 and 20 kilometres per hour at the **application site** during the time of application.

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.



5

5

Spray drift restraints (examples of definitions)

'Native vegetation' means any terrestrial plant species native to Australia as defined under local, state or commonwealth legislation with the following exceptions:

- Species that are declared noxious or invasive to the area of application by local, state or commonwealth legislation.
- Plants that the chemical user, or the person the chemical user is applying agricultural chemical product/s on behalf of, is legally allowed to remove under local, state or commonwealth legislation.

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6

6

Spray drift restraints (examples of definitions)

The 'application site' refers to the area or field where it is intended for the spray to be applied.

A 'buffer zone' is an area where pesticide application does not occur between the application site and an identified sensitive area that is downwind from the application site.

However, 'buffer zones' are determined for 'native vegetation' and are based on survival at a population or ecosystem level and they may not be sufficient if yield loss or replacement cost is the issue.

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7

7

Spray drift restraints (examples of definitions)

Wind speed should be measured 2 metres above the ground at the application site. The point where the wind speed is measured should be representative of the application area and should be free of obstructions that may impact the measurement.

The average **wind speed** at the application site during the time of application must not exceed the maximum given on the product label. The maximum wind speed (gusts) should not be more than one-third of the average wind speed above the average wind speed.

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8

8

Spray drift restraints – boom sprayer buffer zones

BOOM SPRAYERS

DO NOT apply by a boom sprayer (except with Optical Spot Spraying Technology) unless the following requirements are met:

- Spray droplets are not smaller than a **VERY COARSE spray droplet size category**
- Minimum distances between the **application site** and downwind **sensitive areas** (see 'Mandatory buffer zones' section of the following table titled 'Buffer zones for boom sprayers') are observed.

Buffer Zones for Boom Sprayers

Application rate	Boom Height above target canopy	Mandatory buffer zones (distances given in metres)				
		Bystander Areas	Natural Aquatic Areas	Pollinator Areas	Vegetation Areas	Livestock Areas
Up to 250 mL/ha	0.5 m or lower	Not Required	Not required	Not Required	Not required	Not Required
	1.0 m or lower		15		15	
Up to 500 mL/ha	0.5 m or lower	Not required	Not required	30	Not required	30
	1.0 m or lower		30		30	
Up to 1 L/ha	0.5 m or lower	20	20	45	15	45
	1.0 m or lower		45		45	
Up to 1.5 L/ha	0.5 m or lower	25	25	60	25	60
	1.0 m or lower		60		60	
Up to 3 L/ha	0.5 m or lower	35	35	110	35	100
	1.0 m or lower		110		100	
Up to 4 L/ha	0.5 m or lower	45	45	140	45	130
	1.0 m or lower		140		130	
Up to 4.75 L/ha	0.5 m or lower	55	55	160	50	160
	1.0 m or lower		160		160	

9

Spray drift restraints – OSST buffer zones

OPTICAL SPOT SPRAYING TECHNOLOGY

DO NOT apply with Optical Spot Spraying Technology unless the following requirements are met:

- Spray droplets are not smaller than a **COARSE spray droplet size category**
- Minimum distances between the **application site** and downwind **sensitive areas** (see 'Mandatory buffer zones' section of the following table titled 'Buffer zones for Optical Spot Spraying Technology') are observed.
- Equipment is calibrated to deliver the equivalent of 100 L/ha.
- Boom height above the target canopy is 0.75 m or lower.

OSST application with COARSE droplets is exclusive to Nufarm and under data protection.

Buffer Zones for Optical Spot Spraying Technology

Minimum droplet size	Rate	Maximum water volume per hectare	Mandatory buffer zones (distances given in metres)				
			Bystander Areas	Natural Aquatic Areas	Pollinator Areas	Vegetation Areas	Livestock Areas
COARSE	Up to 4.8 L/100 L	10 L (equivalent to 480 mL product/ha) to treat up to 10% weed cover	Not Required	20	Not Required	20	Not Required
VERY COARSE or larger		15 L (equivalent to 720 mL product/ha) to treat up to 15% weed cover		20		20	
		30 L (equivalent to 1.44 L product/ha) to treat up to 30% weed cover		60		60	

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Spray Drift Restraints - Aerial Buffer Zones

AIRCRAFT

DO NOT apply by aircraft unless the following requirements are met:

- Spray droplets are no smaller than a VERY COARSE **spray droplet size category**
- For maximum release heights above the target canopy of 3 metres or 25 per cent of wingspan or 25 per cent of rotor diameter whichever is the greatest, minimum distances between the application site and downwind sensitive areas (see 'Mandatory buffer zones' section of the following table titled 'Buffer zones for aircraft') are observed.

Table 1: Buffer Zones For Aircraft

Application rate	Aircraft Type	Mandatory buffer zones (distances given in meters)				
		Bystander Areas	Natural Aquatic Areas	Pollinator Areas	Vegetation Areas	Livestock Areas
Up to 250 mL/ha	Fixed Wing	Not Required	50	Not Required	50	Not Required
	Helicopter		40		40	
Up to 500 mL/ha	Fixed Wing		85		85	
	Helicopter		65		65	
Up to 1 L/ha	Fixed Wing		140		130	
	Helicopter		95		95	
Up to 1.5 L/ha	Fixed Wing		180		180	
	Helicopter		130		120	
Up to 3 L/ha	Fixed Wing		300		300	
	Helicopter		200		190	
Up to 4 L/ha	Fixed Wing		400		375	
	Helicopter		240		230	
Up to 4.75 L/ha	Fixed Wing		475		450	
	Helicopter		275		275	

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11

PER91156 – Spray Drift Management Tool

Issued: 14-July-2021

Expired: 31-July 2022

- The result of more than 10 years of collaborative work between various industry bodies, including the Grains Research and Development Corporation (GRDC), research institutes, Grain Producers Australia (GPA) and the Agricultural Pesticides and Veterinary Medicine Authority (APVMA).
- Pilot permit enables New South Wales growers to trial a new Spray Drift Management Tool (SDMT)
- To calculate reduced spray drift buffer zones, based on the rate of application, growers' spray equipment and the environmental conditions at the time.
- If successful, it will provide growers with increased flexibility when applying crop protection products.
- Products included;
 - various 2,4-D and MCPA,
 - Altacor,
 - Sharpen,
 - Sukura,
 - Voraxor,
 - Callisto

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& DEVELOPMENT
CORPORATION

12

12

Example 1:

- Product Rate: 1000 mL/ha
- Spray Quality: Very Coarse
- Release height: 0.5 m
- Wind speed: 20 km/hr

Buffer zones for Boom Sprayer (ground application)					
Application rate	Mandatory downwind buffer zones				
	Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
Up to a maximum of 1000 mL/ha	0 metres	20 metres	0 metres	15 metres	0 metres

Example 2:

- Product Rate: 1000 mL/ha
- Spray Quality: Very Coarse
- Release height: 1.0 m
- Wind speed: 20 km/hr

Buffer zones for Boom Sprayer (ground application)					
Application rate	Mandatory downwind buffer zones				
	Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
Up to a maximum of 1000 mL/ha	0 metres	45 metres	0 metres	45 metres	0 metres



13

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Example 2:

- Product Rate: 1000 mL/ha
- Spray Quality: Very Coarse
- Release height: 1.0 m
- Wind speed: 20 km/hr

Buffer zones for Boom Sprayer (ground application)					
Application rate	Mandatory downwind buffer zones				
	Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
Up to a maximum of 1000 mL/ha	0 metres	45 metres	0 metres	45 metres	0 metres

Example 3:

- Product Rate: 1000 mL/ha
- Spray Quality: Extremely Coarse
- Release height: 1.0 m
- Wind speed: 20 km/hr

Buffer zones for Boom Sprayer (ground application)					
Application rate	Mandatory downwind buffer zones				
	Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
Up to a maximum of 1000 mL/ha	0 metres	35 metres	0 metres	35 metres	0 metres

Example 4:

- Product Rate: 1000 mL/ha
- Spray Quality: Extremely Coarse
- Release height: 0.5 m
- Wind speed: 20 km/hr

Buffer zones for Boom Sprayer (ground application)					
Application rate	Mandatory downwind buffer zones				
	Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
Up to a maximum of 1000 mL/ha	0 metres	10 metres	0 metres	10 metres	0 metres

14

14

Thank you

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 **OUTLOOKAG**

MATCHING SPRAY CAPACITY TO THE FARM

OPTIMISING EFFICIENCY TO IMPROVE CAPACITY

GREG RUMMERY, OUTLOOKAG PTY LIMITED, WALGETT



1



HISTORY



- Walgett 30 plus years
- Witnessed the great zero tillage revolution
- Spaying has become the most important activity on the farm
- Timeliness is critical
- Another change is coming



2

YES, it is wet in the north also!



3

WHERE HAVE WE COME FROM IN REGARD TO SPRAY CAPACITY?



- 60 spray hours was the rule
- 100ha an hour gave us the benchmark of 1 sprayer per 6000ha
- 36m at 28km/hr will achieve this capacity

- BUT?
 - The system is now too complex for this to work efficiently
- WHY?
 - Spraying became an endless chore that no one wants to do

4

WHY HAVE WE CHANGED?



- Stubble loads have increased
- Crop diversity means a more considered approach to spraying required
- Resistant weeds more prevalent
- Much better understanding of spray conditions
- ZT weed spectrum has changed over time and requires different tools

5

WHAT HAVE WE CHANGED?



- Use of residual products more common place (spraying prior to rainfall)
- Optical sprayers for cost effective HR weed control & DK's
- Fallow sprays are still the most critical in our system

6



Sort out the obvious inefficiencies



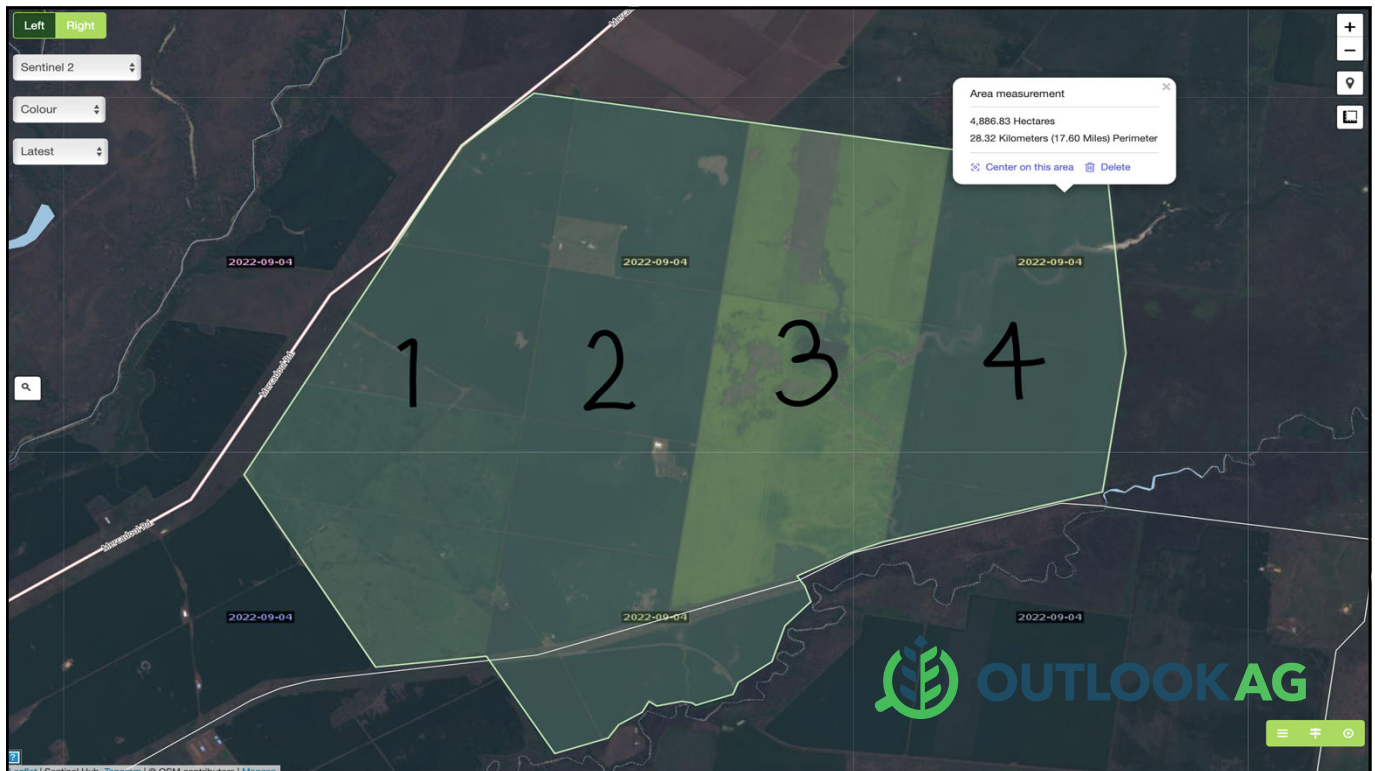
7



Farm layout is critical



8



9

FURTHER THINGS TO CONSIDER



- Use of batch tanks to keep the spray boom in the paddock
- Use of generic rates across zones and then use a DK as the final nail
- Higher water rates and lower ground speeds required for weed control in higher stubble loads
- Don't forget about the importance of droplet concentration!
- Generally, more applications per year than ever before

10

THE FUTURE?



- Turn-key autonomous spray platforms are needed
- Over reliance on optical sprayers is an issue
- Drones and weed mapping, where is the best fit
- Zero tolerance to weeds is critical in keeping the seed bank low

11



12

2021/22 SUMMER ISSUES



- Trafficability due to continued wet ground conditions was a major issue
- Aerial application had serious limitations
- SCALE BECAME OUR BIGGEST THREAT TO THE SYSTEM

13

WHATS THE FUTURE LOOK LIKE?



- 60hr rule still applies but start thinking of DK's + residuals applied pre-rain to gain efficiency of machinery
- Spray capacity adjusted to account for slower application speed and higher water volumes
- More passes with DK's and residual applications so spraying is more of a chore than ever unless these adjustments to capacity have been made
- Now we typically run 2x36m SP + 1xOSS per 6000-8000ha – You don't need to own it all!
- Capacity is as much about labour as it is about machines
- Finding and refining the fit of new and emerging tech. No need to all be pioneers!
- TIMELINESS IS THE KEY

14



**PUTTING ALL THE PIECES TOGETHER
PAYS BIG DIVIDENDS!!**

15



QUESTIONS?

16



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OPTIONS TO REDUCE SPRAY DRIFT RISK

HARRY PICKERING – ADAMA AUSTRALIA



1

TAKE HOME MESSAGES



- 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



Overwatch Drift Simulation - Lupins



Untreated



2% Drift Simulation
Of Overwatch - 1.25 L/ha

15 DAT

Crop Growth Stage at App – 4 to 5 nodes

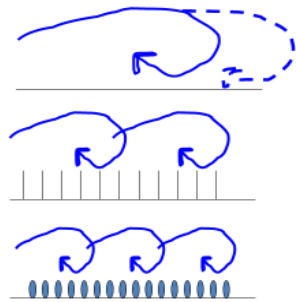
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"WHEN WE CHOOSE TO SPRAY"

Air Movement is Key for Spray Drift Management



Air Movement During the Day
"Turbulent Air"

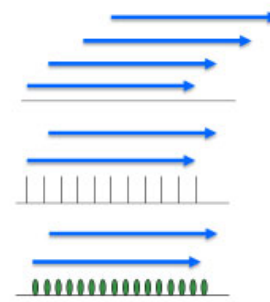


FALLOW GROUND

HEAVY STUBBLE

IN CROP SITUATIONS

Air Movement During
"Hazardous Temperature Surface Inversion"



Daytime Spraying > 4km/h Wind

Nighttime Spraying

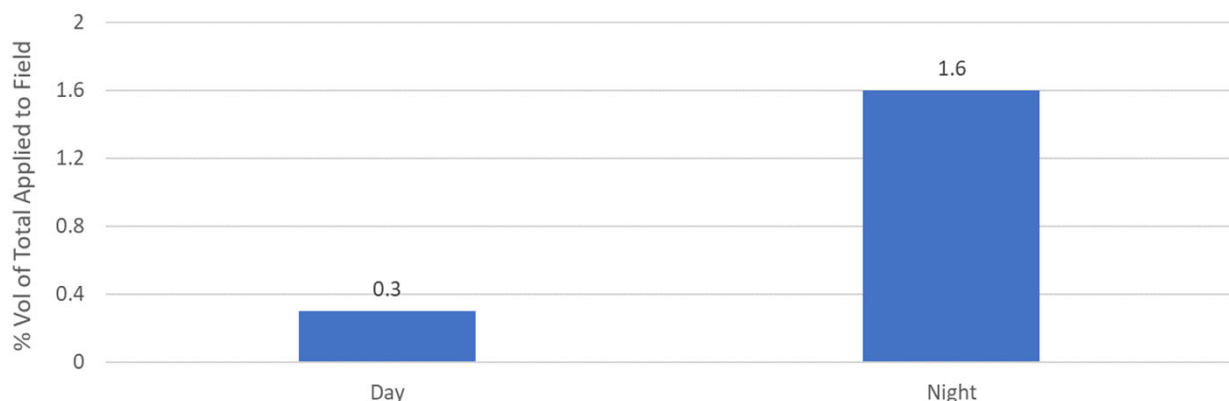
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'WHEN WE CHOOSE TO SPRAY'

Air Movement is Key for Spray Drift Management



% of Spray – Airborne 80 m Downwind



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 – Coarse
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

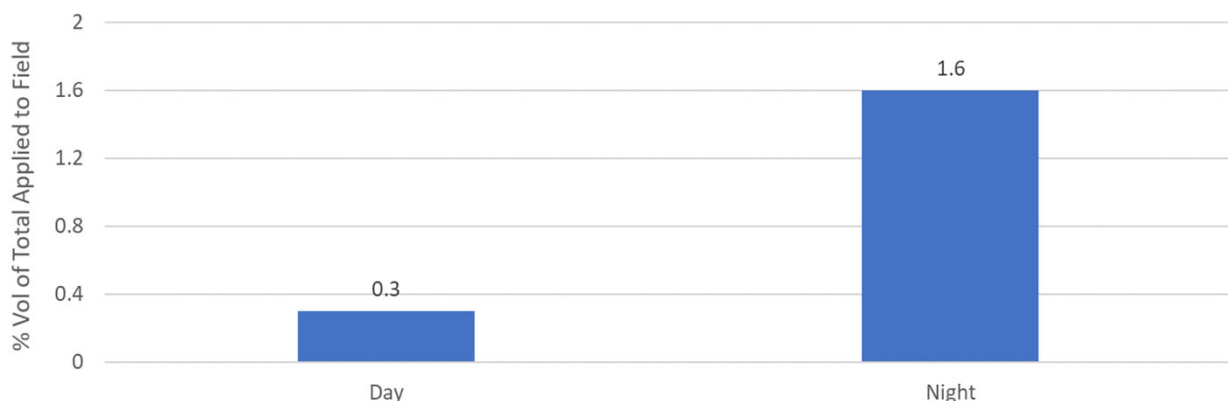
Spray Quality	% of spray below 150 microns
Fine (F)	40-50
Medium (M)	20
Coarse (C)	10
Very Coarse (VC)	5
Extremely Coarse (XC)	2
Ultra Coarse (UC)	<1

7

Air Movement and Nozzle Selection



% of Spray – Airborne 80 m Downwind



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

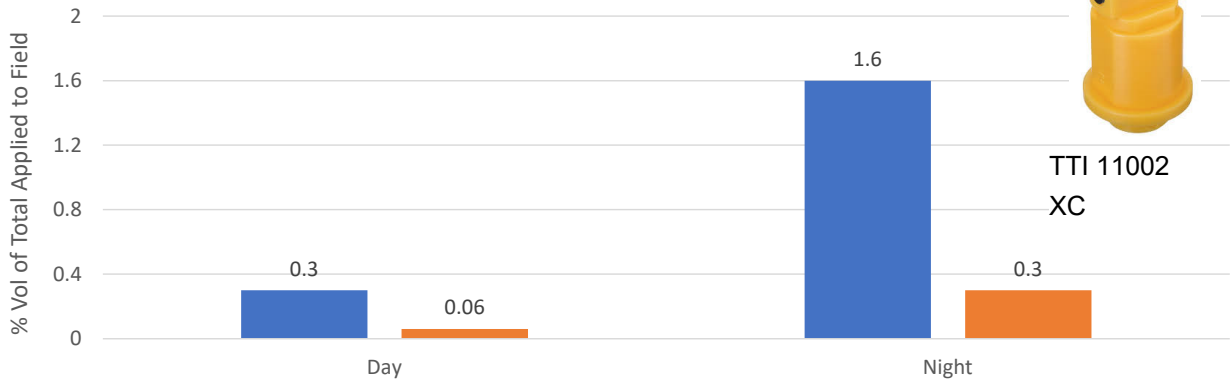
Source – GRDC Tips and Tactics
 Reducing herbicide damage
 AIXR 11002 – Coarse
 4 Bar
 22 km/ha travel speed
 50 L/ha Water Volume

8

Air Movement and Nozzle Selection



% of Spray – Airborne 80 m Downwind



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 – Coarse
4 Bar
22 km/ha travel speed
50 L/ha Water Volume

9

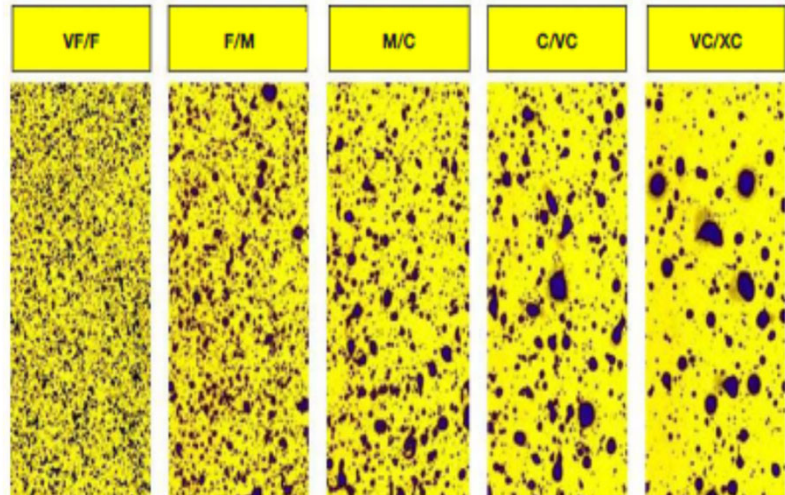
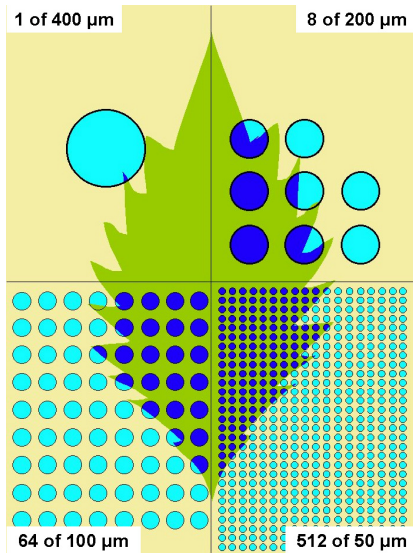
STANDARD NOZZLE SELECTION GUIDE* January 2021

BRAND	Pre-Orifice (RUN ABOVE 1.5-2 BAR)										Low Pressure Air Induction (RUN ABOVE 2-3 BAR)										High Pressure Air Induction (RUN ABOVE 3-4 BAR)																
	Lactar		VAREX		ALBIZ2*		Tactical		Tactical		Higres		Tactical		Agrijet		Higres		VAREX		HARBI		Lactar		Tactical		Higres		Ball-rivory		ARAP*		ALBIZ*				
	AD-110	DS-110	LD-110	AD-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110	TT-110					
SPRAY QUALITY STANDARD	ASABERCK	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*	ASABE152*				
Nozzle Size	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0				
015 GREEN	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			
02 YELLOW	C	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		
025 BLUE	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C		
03 BLUE	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
04 RED	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
05 BROWN	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

10

DRIFT REDUCTION AND EFFICACY

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



Assess % Coverage with Snapcard app

11

ADDITIONAL FACTORS - INFLUENCING SPRAY DRIFT RISK



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

12

TAKE HOME MESSAGES





- 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.

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14



Update on Spray Drift Reduction Technologies for Grain Crops

Andrew Hewitt

THE CENTRE FOR PESTICIDE APPLICATION and SAFETY
THE UNIVERSITY OF QUEENSLAND, GATTON




C-PAS

1

Background

- Spray drift management is complex and involves optimising the:
 - Equipment setup and nozzle choice
 - Application speed (which can affect the wake, stability, coverage uniformity and choice of nozzle/ pressure)
 - Boom height
 - Tank mix



2

Continued

- Meteorological conditions
- Atmospheric stability
- Buffers and barriers

- Using drift reduction technologies should be a key part of any drift management approach but not all of these support spraying in adverse conditions or too close to non-target sensitive areas



3

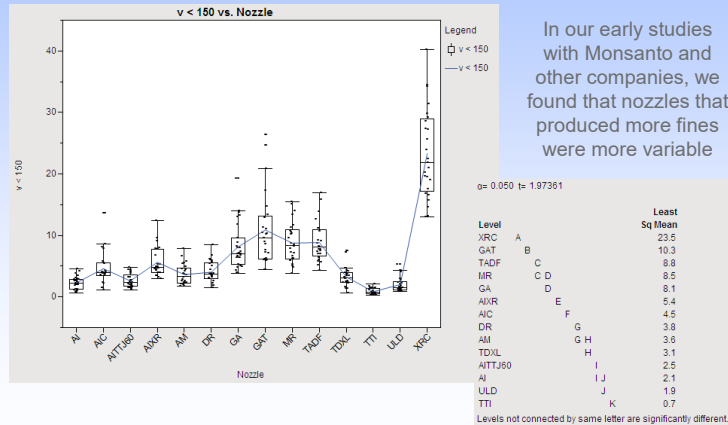
Labels

- Always read and follow the label and all applicable local and federal regulations



4

How Critical Is the Tank Mix for Different Nozzles?



5

Nozzles for lowest drift potential

- CPAS has tested a wide range of nozzles, pressures and tank mixes for herbicide drift management with and without adjuvants in recent months
- Here are some examples of leading options for maximum drift potential reduction



6

TTI and TTI60 Nozzles

- These single and twin exit orifice nozzles are well suited for drift management with a wide range of tank mixes
- Generally <1% Fines and smaller orifices not always finer
- In US, some companies give away TTI nozzles with herbicides that are high drift concern



7

Magnojet Nozzles

- Tested various Magnojet nozzles in wind tunnel. Example – MUG04 and 05 at 3 to 5.5 bar - percent fines (<100 μ m) was zero for tank mixes with herbicides, surfactant and DRAs, and <150 μ m was <1% for all tank mixes.



8

Greenleaf AVI-UC Nozzles

- Minimal Fines across pressures 3 to 5.5 bar
- Single and twin fan options



9

Pentair Hypro 3D Nozzles

- Coarsest sprays with this nozzle are at pressures up to 3.5 bar



10

Hypro PSLDMQ and PSULD MQ Nozzles

- Generally good at pressures up to 3.5 bar



11

Agrotop TDXLD Nozzles

- Good for pressures up to at least 3.5 bar



12

Pentair/ Hypro ULD and ULDM Nozzles

- Coarsest sprays at pressures up to at least 3.5 bar and even higher for M (Max) design



13

Wilger UR Nozzles

- Optimised for Pulsed Width Modulation (PWM) spraying systems (also valuable with conventional non-pulsed systems)



14

Tank Mixing

- Some low pH tank mix partners can increase the volatility of some herbicides so take care with AMS and some glyphosates when using low volatile Dicamba products for example
- Most tank mix partners will change the droplet size, particularly where the surface tension decreases with high surfactant loading products



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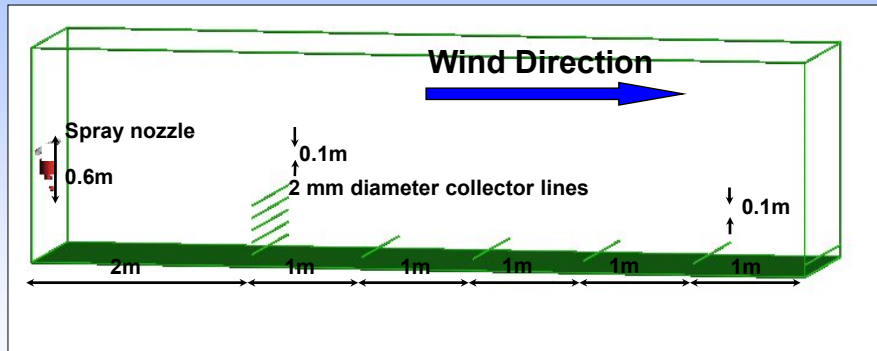
Drift Reduction Adjuvants (DRAs)

- APVMA has a standard test approach for proving DRA performance where nozzles appropriate to the application are selected and the effect of the DRA on droplet size and drift potential are measured in a wind tunnel



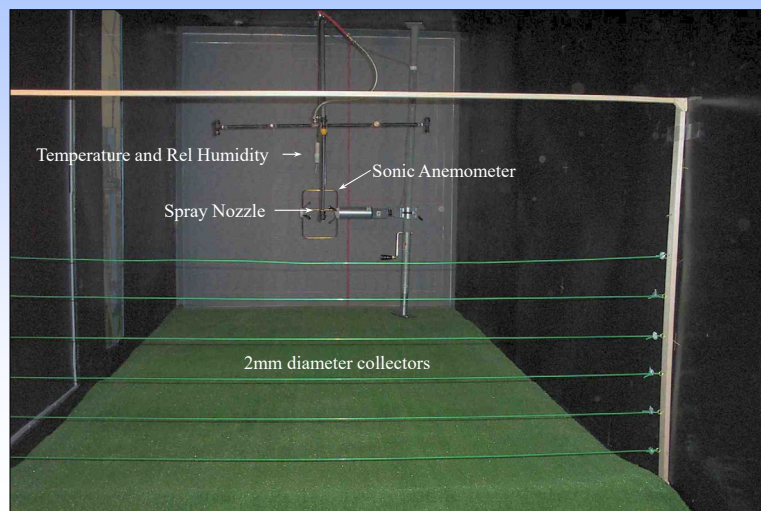
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Wind Tunnel Measurement of Spray Drift Potential



17

Wind Tunnel Drift Potential Measurement at UQ



18

Examples of DRAs

- Encapsulators of active ingredients to prevent smaller (driftable) droplets containing as much a.i. – but are there solid data to back such claims in all cases?
- Guar gums to increase the extensional viscosity which can reduce Fines with suitable nozzles. Some polymers can help as well, but some broaden the droplet size spectrum and narrow the spray angle



19

Examples to help control droplet size for narrower size spectra

- Some emulsion chemistries rather than solutions when choosing how to reduce surface tension for optimal spray sticking/ wetting/ rainfastness/ uptake/ spreading on leaves – but performance isn't always as good with some tank mixes as with water tests



20

Summary

- Newer nozzles and adjuvants can reduce or eliminate Fines, but be aware that hitting narrow (e.g. grass) weeds and reducing application volume rates can be problematic with sprays that are too coarse
- One size doesn't fit all – some situations may require other technologies such as hoods, shields, barriers, air-assistance etc.



21

Future

- Sensors, robotics, and some drones may help with targeting sprays better at up to 90% lower use rates – we are working on weed control in a 2-year project using sensors
- Tools for applicators to assess the spraying conditions before and during application
- Low volatile products and guidance on tank mixing as well as nozzle interactions



22

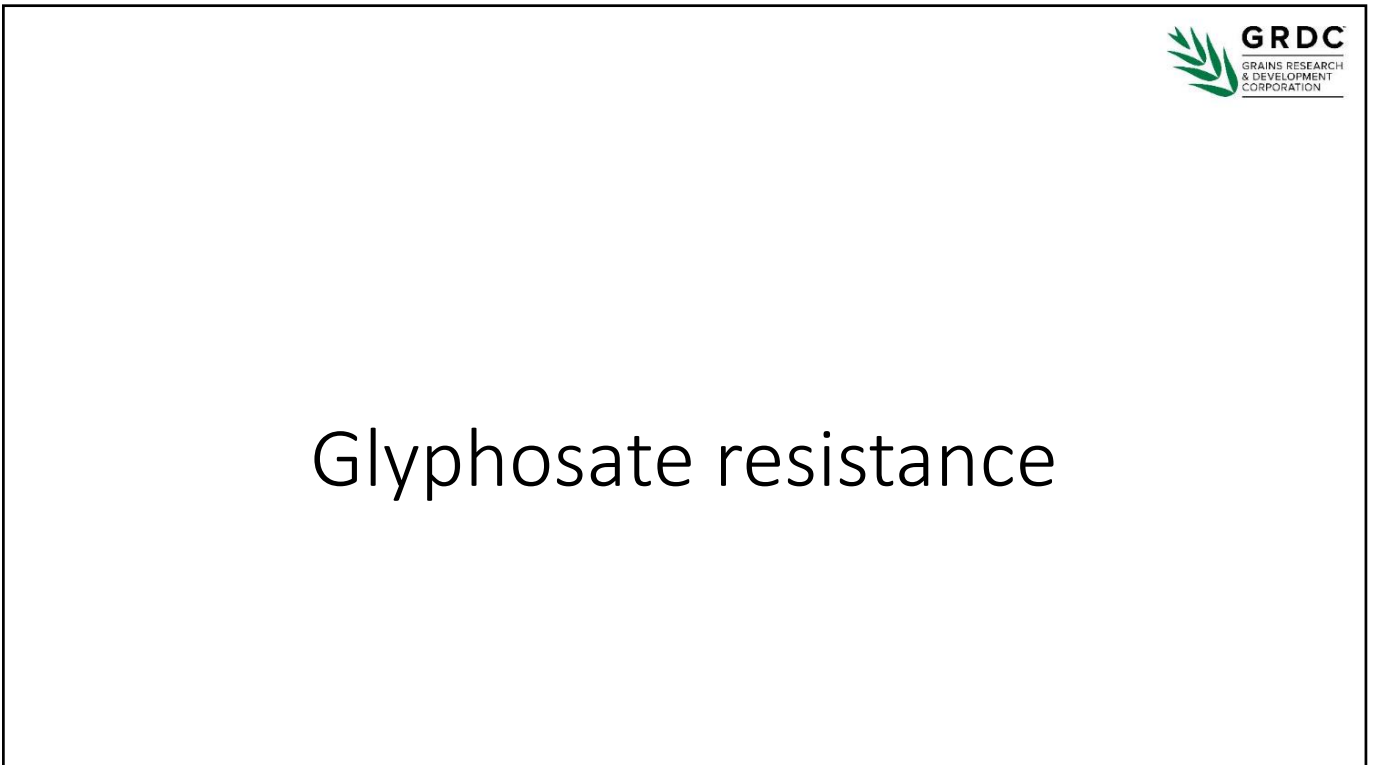


OPTIMISING GLYPHOSATE EFFICACY

MARK CONGREVE (ICAN), MAURIE STREET (GOA)



1



Glyphosate resistance

2

Glyphosate resistance

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

- **Glyphosate may still work if rate is high and no mitigating factors**

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

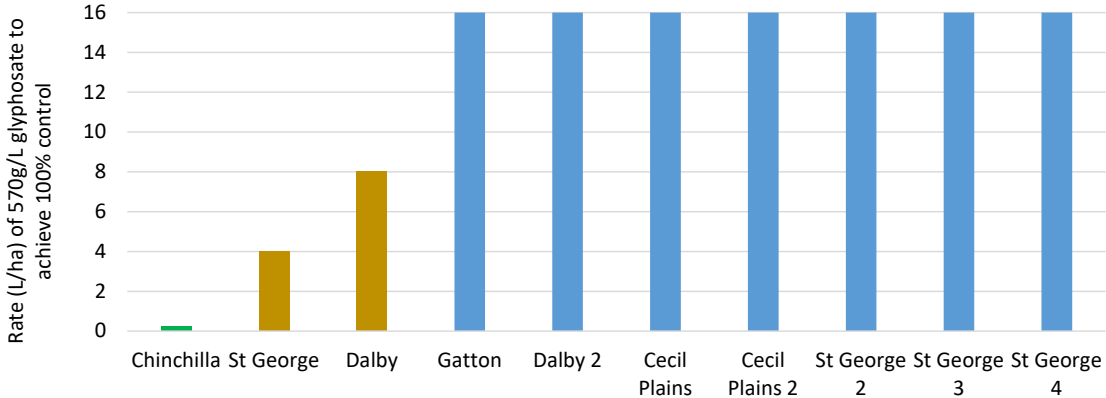
Street & O'Brien (2022) Killing glyphosate resistant ryegrass? Application does matter. GRDC Updates

4



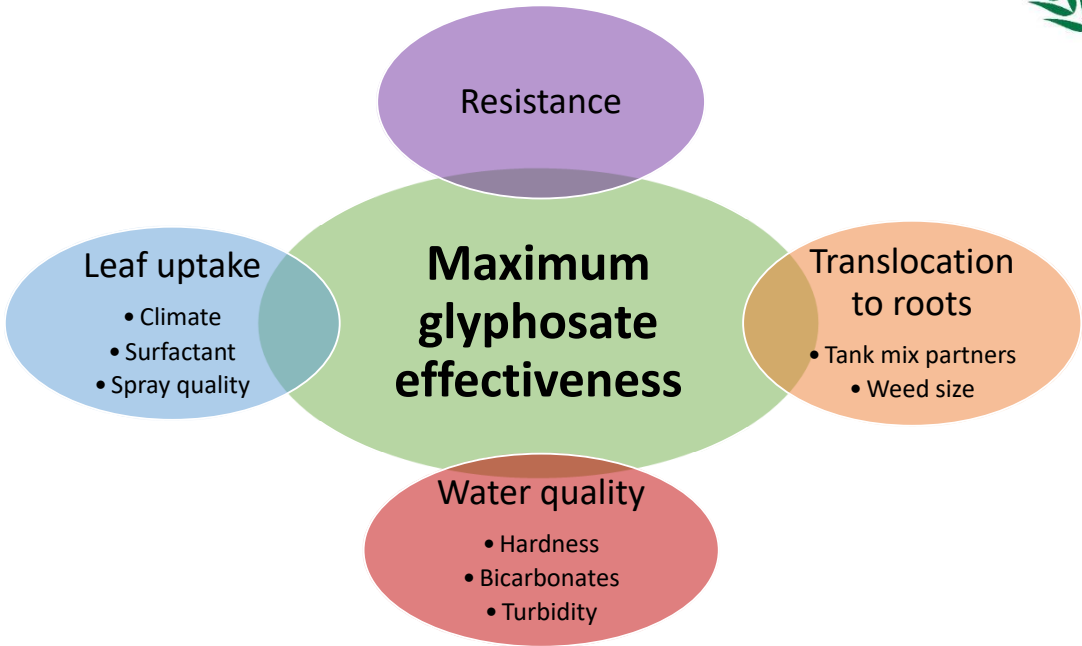
Feathertop Rhodes grass

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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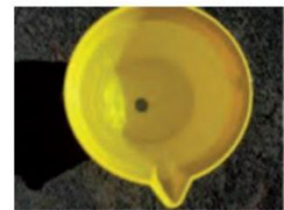
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Getting more glyphosate into the weed

7

Glyphosate binds tightly to dirt / OM

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



8

Water quality

pH

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



9

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

Total hardness (esp calcium for glyphosate)

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

SOS survey of CW NSW bores = 80% poor quality for spraying

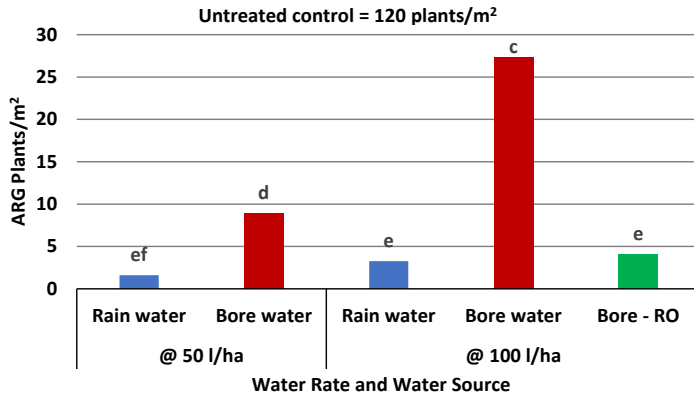
10



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

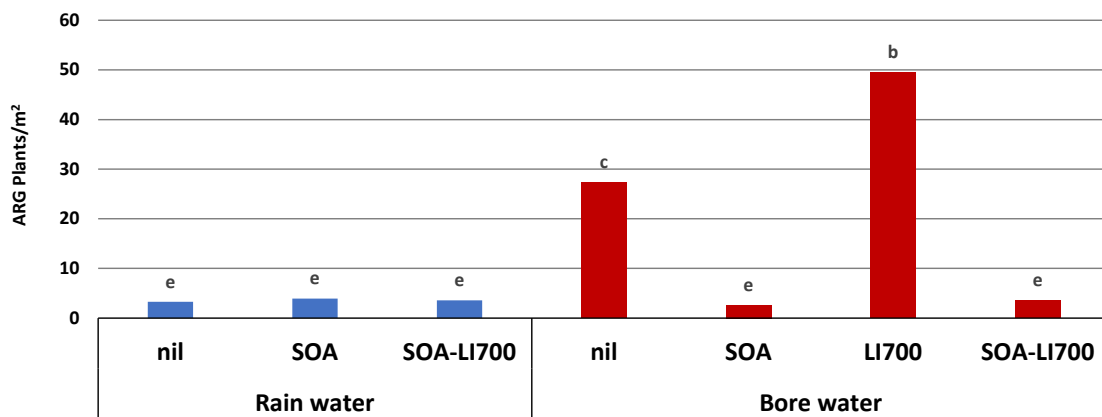
Water quality	Test	Optimum
pH	8.0	5.0-8.6
Chloride	910	< 350
Sodium	410	< 70
Total alkalinity	480	< 75
Total hardness	1000	< 200

Grain Orana Alliance Narromine, NSW

11



Water conditioning



Grain Orana Alliance Narromine, NSW

12

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

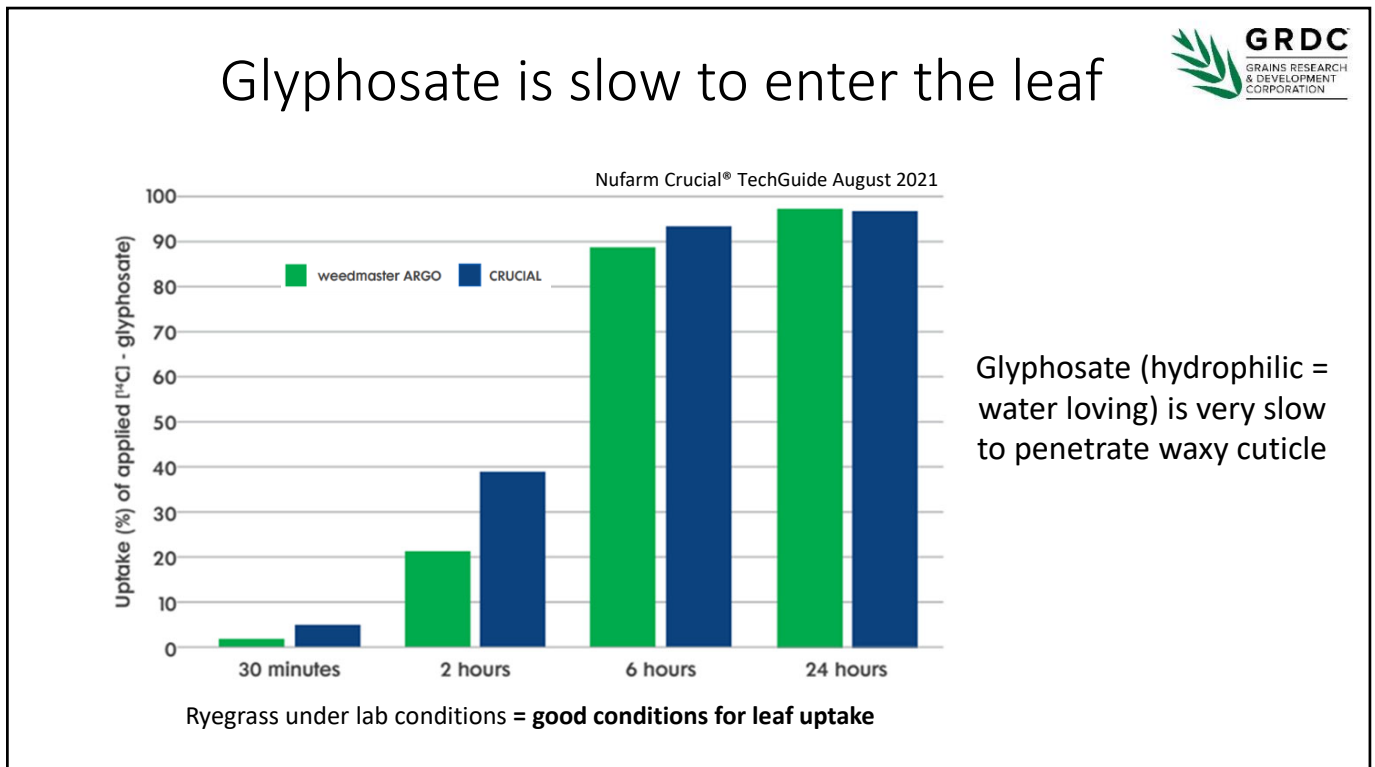
- Fully dissolve in spray tank
 - If impatient – use a liquid formation
- Further 5-10 minutes under agitation

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

13

Leaf uptake

14






15

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)

16

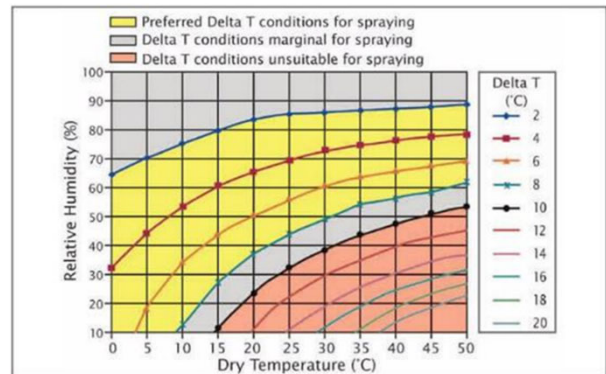


Droplet survival in summer

Delta T at & post application

- Evaporation from nozzle to leaf surface (keep boom height low)
- Time on leaf surface before glyphosate crystallisation

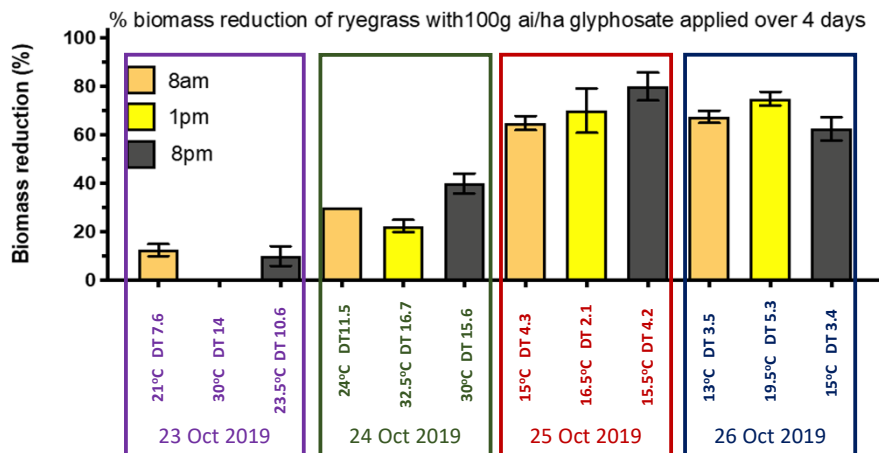
Rule of thumb for maximum uptake
Delta T of 4 to 6 for 4 to 6 hours after application



17



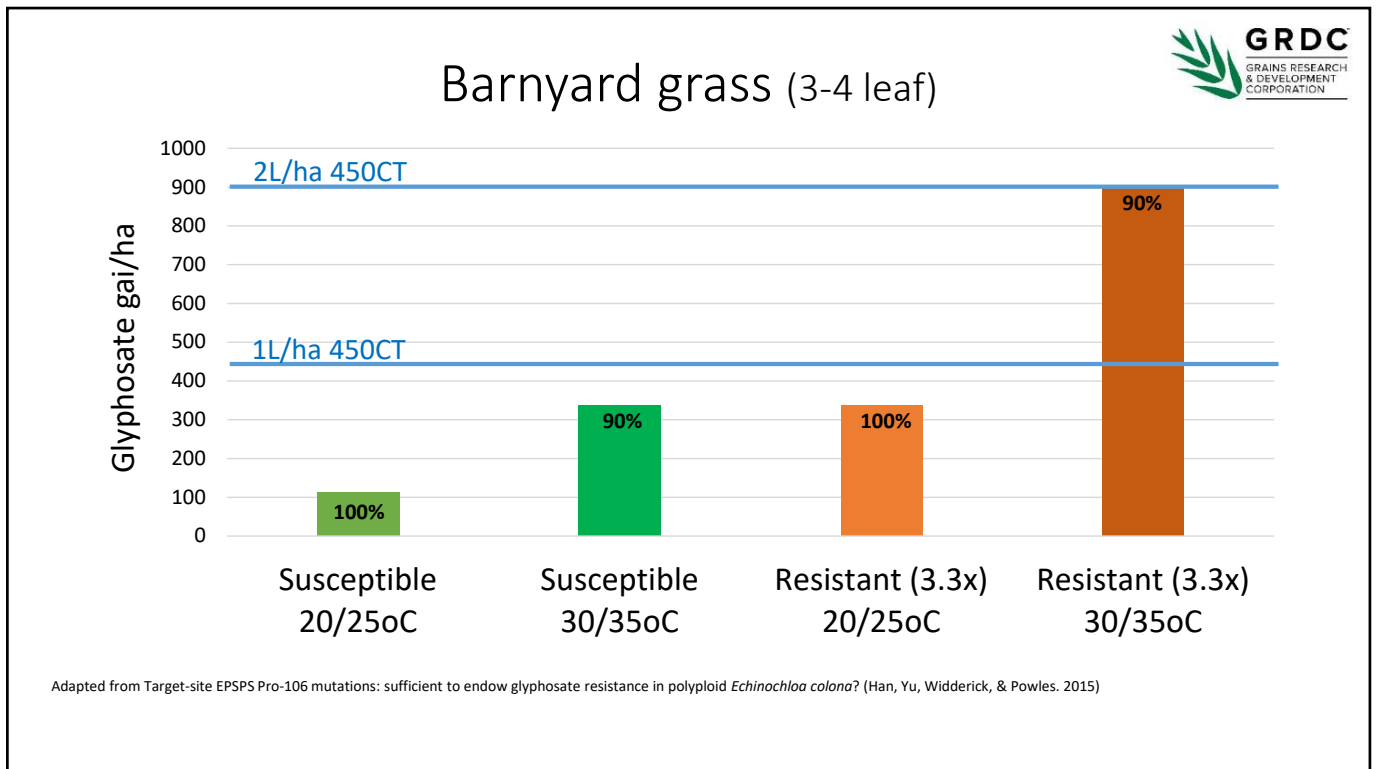
Environmental conditions



Peter Boutsalis. 2021 GRDC Updates

Without resistance – compensated by increasing rate for summer applications

18



19

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

Sprayers 101 €

20

Small, upright grass weeds

Difficult to contact

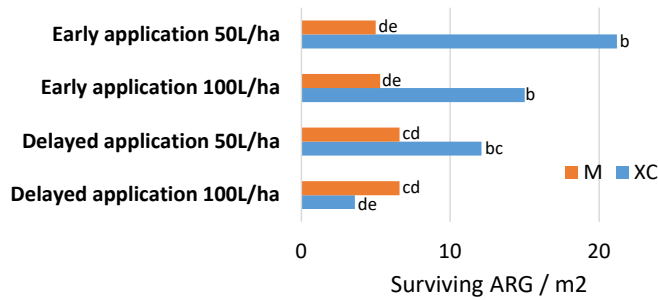
- Very large droplets may miss or bounce off

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

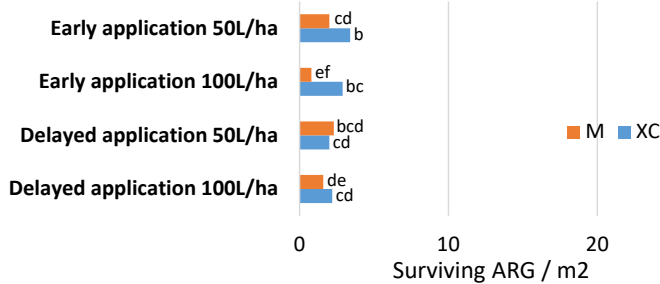


21

Small, upright grass weeds



GOA trial. Forbes 2021
 'Weak' glyphosate resistant population. 300 plants/m²
 Autumn application.
 First timing 7/4/21, second timing 16/4/21



GOA trial. Peak Hill 2021
 'Weak' glyphosate resistant population. 200 plants/m²
 Autumn application.
 First timing 8/4/21, second timing 19/4/21

22



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

23

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

24



In-built surfactant load

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

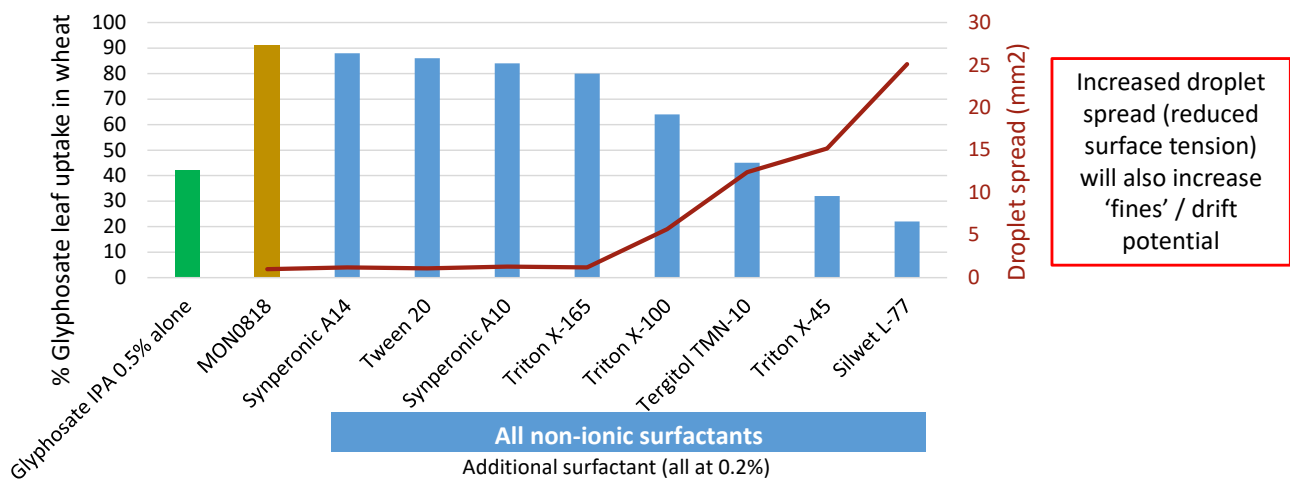
Glyphosate 450 CT containing		Spray volume				
		50 L/ha	75 L/ha	100 L/ha	150 L/ha	200 L/ha
144g/L polyethanoxo (15) tallow amine surfactant	0.5L/ha	0.14	0.10	0.07	0.05	0.04
	1 L/ha	0.29	0.19	0.14	0.10	0.07
	2L/ha	0.58	0.38	0.29	0.19	0.14



25

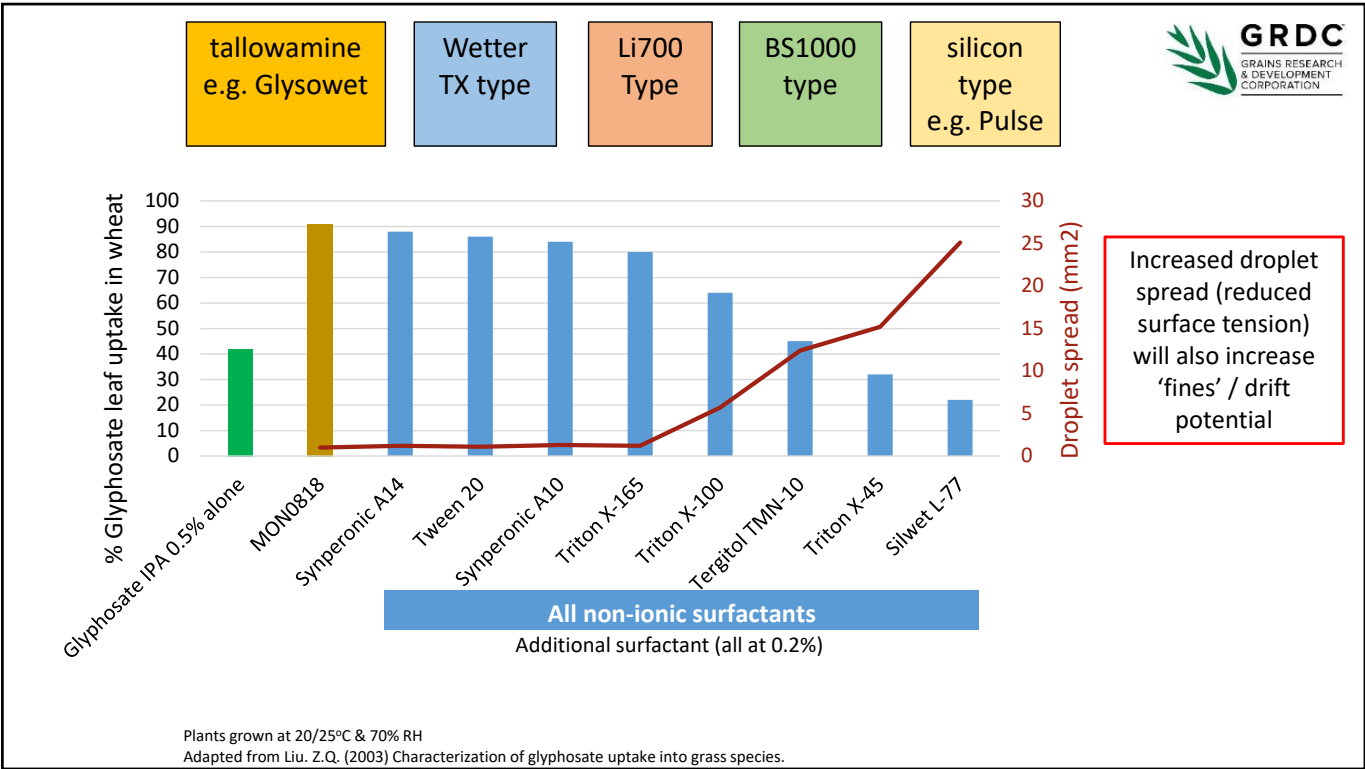


Surfactant type



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

26



27

Translocation within the plant

28

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

29

Glyphosate antagonism

Alone



Photos courtesy of Nufarm.

Weedmaster DST @ 0.65 L/ha
 plus Bonza @ 0.5% (v/v)



plus Amicide Advance
 @ 1L/ha



plus Amicide Advance
 @ 1L/ha & Bonza 0.5%



If mixing glyphosate + 2,4-D keep ratio at least 3:1

The more complex you make the tank mix, the more glyphosate you need to add to counter antagonism

30



Summary

Best chance of achieving control for summer applications

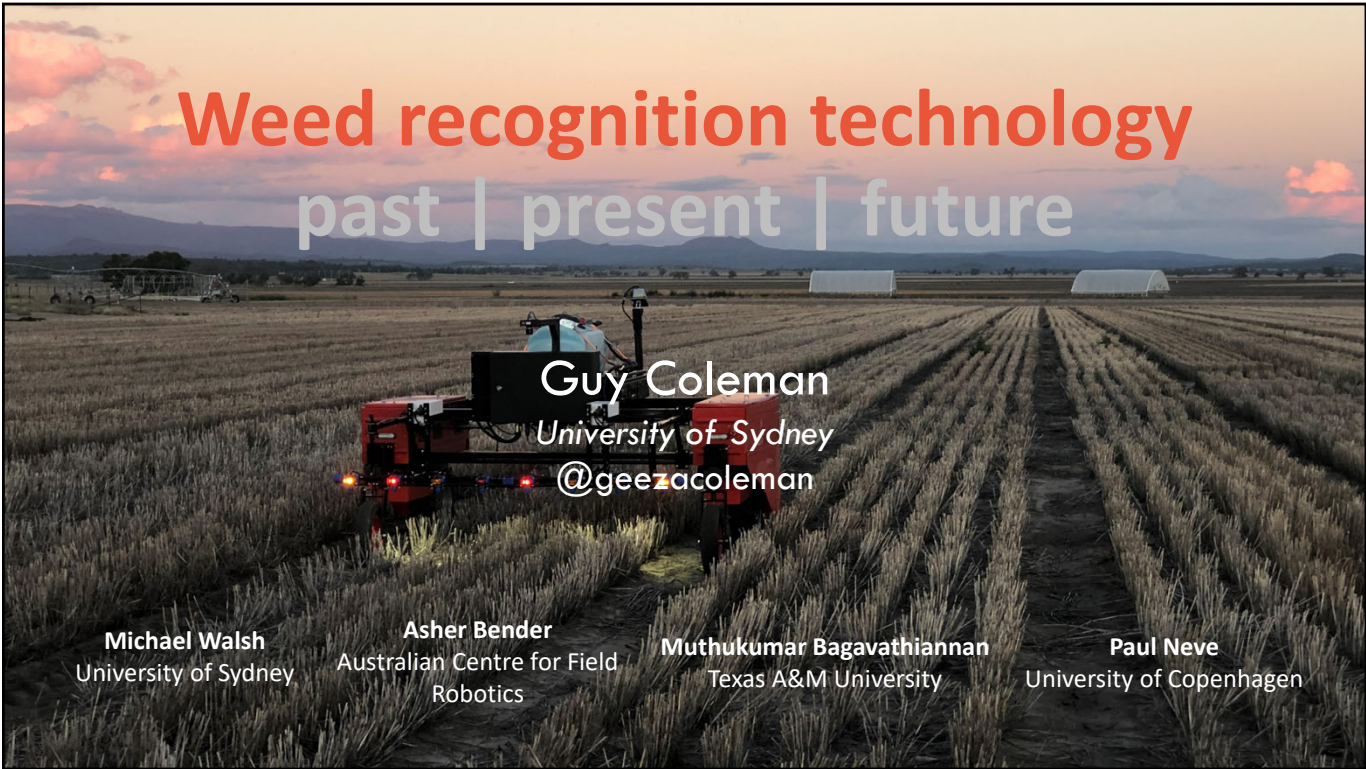
- ✓ Mild / warm (not hot & dry) – Delta T in range 3-6 following application
- ✓ Large (VC) droplets
- ✓ Minimum water rate (that still achieves coverage)
- ✓ Small weeds
- ✓ No rain for >6 hours
- ✓ Robust application rates
- ✓ AMS
- ✓ Good water quality
- ✓ Quality formulation (adjuvant package)
-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

31

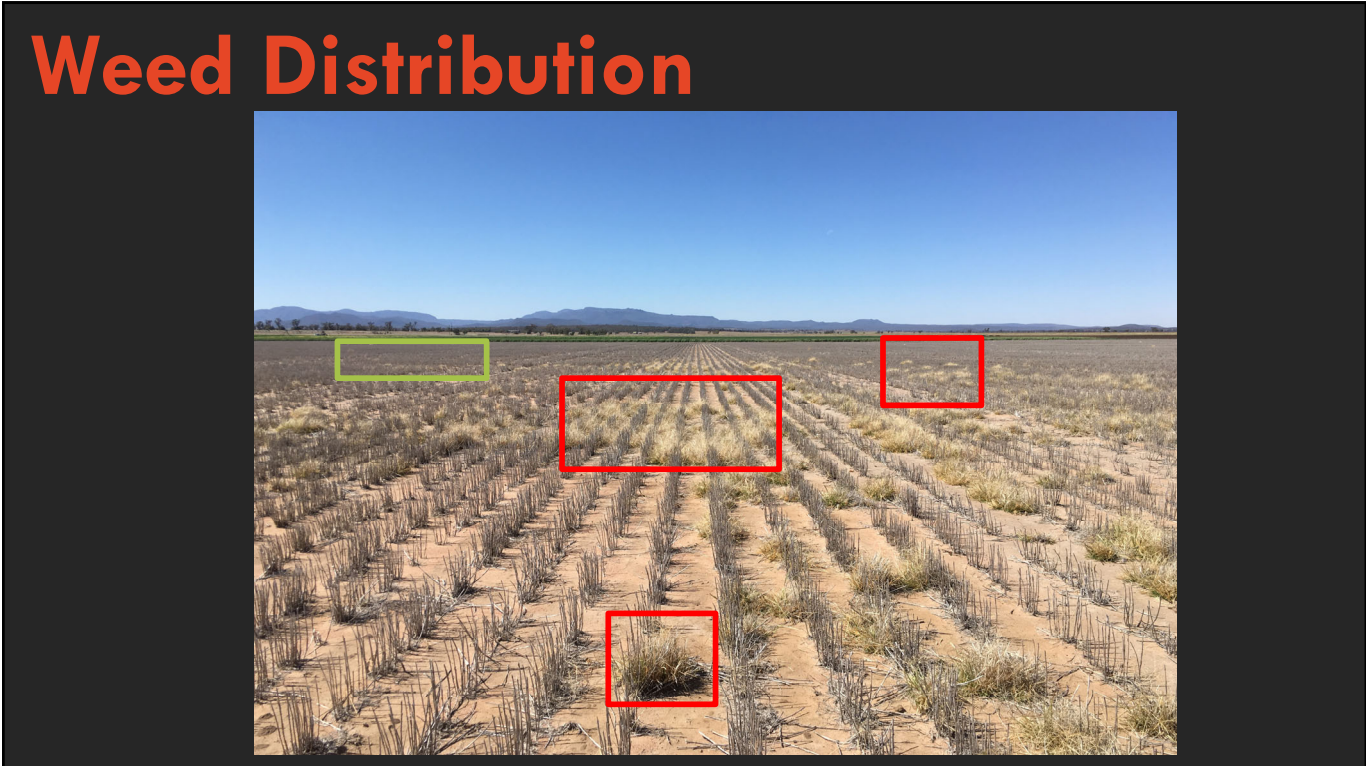


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www.grdc.com.au
🐦 @thegrdc

32



1



2

Site-Specific Weed Control


“Treat the weeds not the paddock”

Benefits

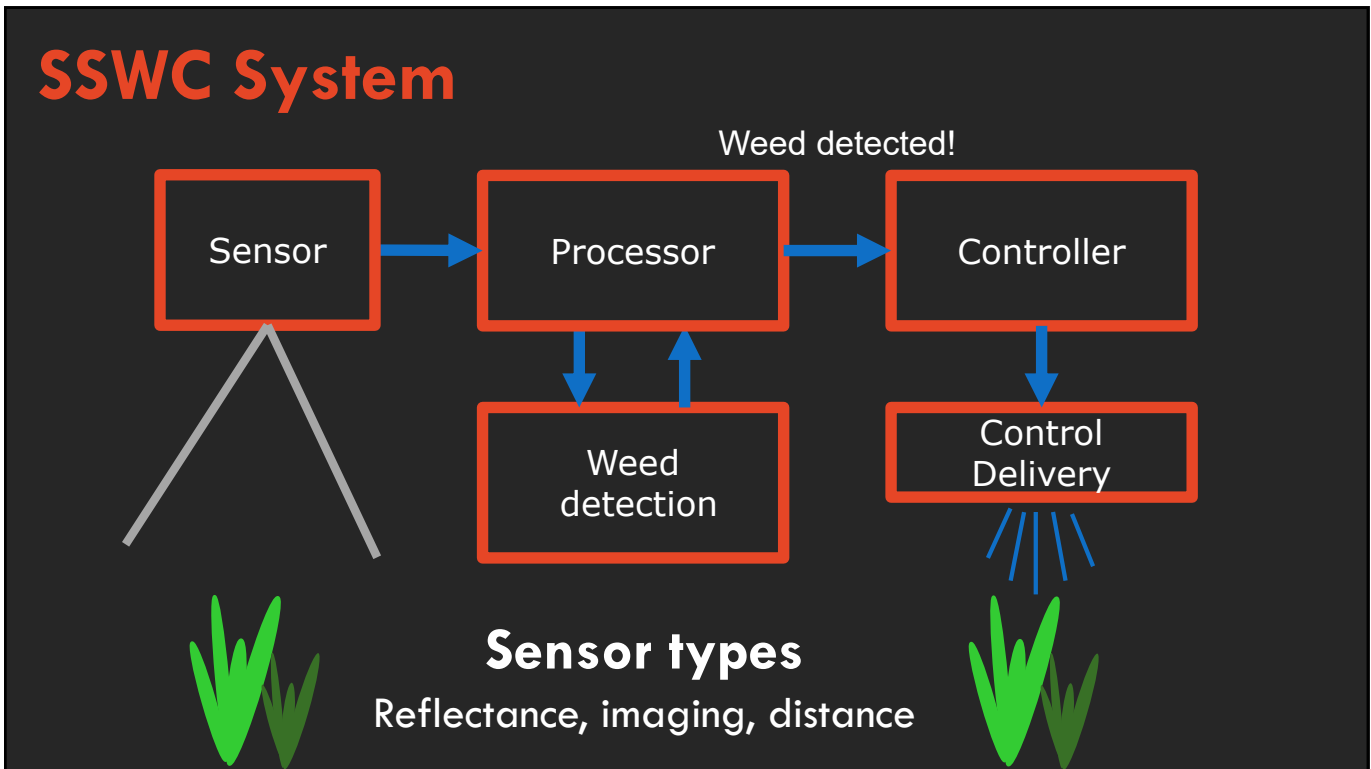
1. Reduce inputs by 40 to 90%
2. Additional weed control options
 - New herbicides
 - Alternative control

A good idea, but how?

...weed recognition



3



4

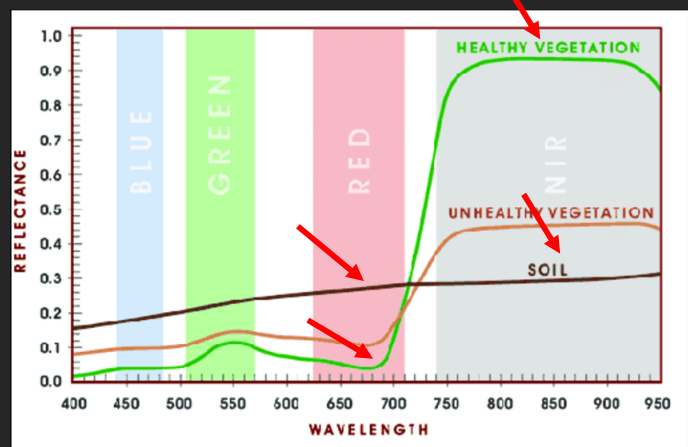
Weed Detection: Ground-based



Manual detection of skeleton weed (*Chondrilla juncea*) in Western Australia in the 1980s (Source: Department of Agriculture, WA)

5

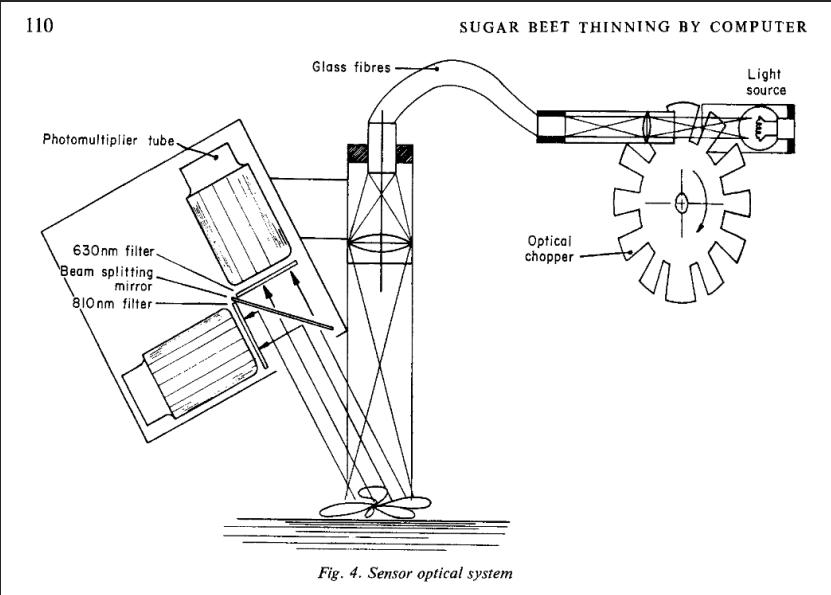
Where's Wally: Easy



Source: Chang et al. 2013

6

Found It



Source: Palmer and Owen, 1971

7

Weed Detection: fallow

“Green-on-brown”

- Differences in reflectance (NOT a camera!)
- Looking for “greenness” (active chlorophyll)

WEED-IT Quadro



WeedSeeker 2



8

Targeted Tillage



9

Where's Wally: Hard

Optical spot spray technology (OSST)

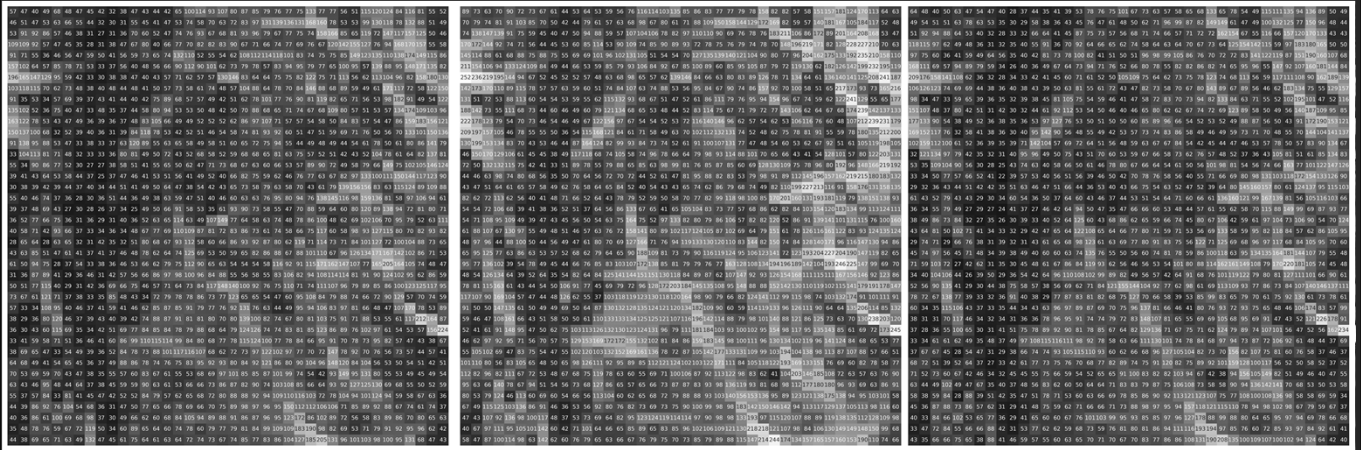


10

Camera Sprayers

What are they?

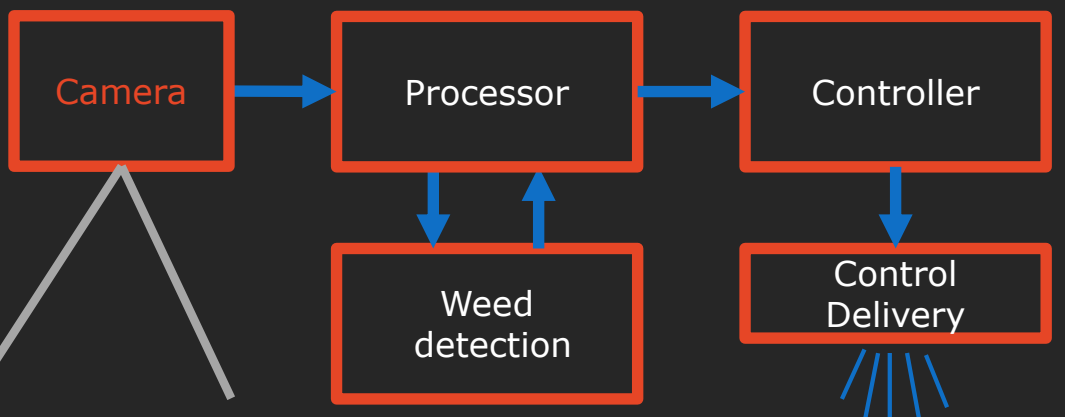
- Digital cameras (RGB)
- Millions of pixels
- Green-on-brown or green-on-green



11

SSWC System

Weed detected!



Sensor types

Reflectance, imaging, distance

12

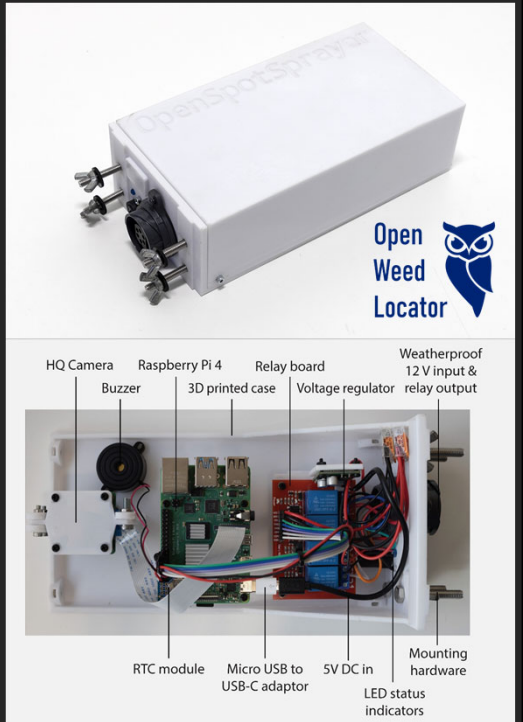
OpenWeedLocator

Aims

- Educational, practical tool
- DIY detection + actuation
- Colour-based validation – ExG/HSV



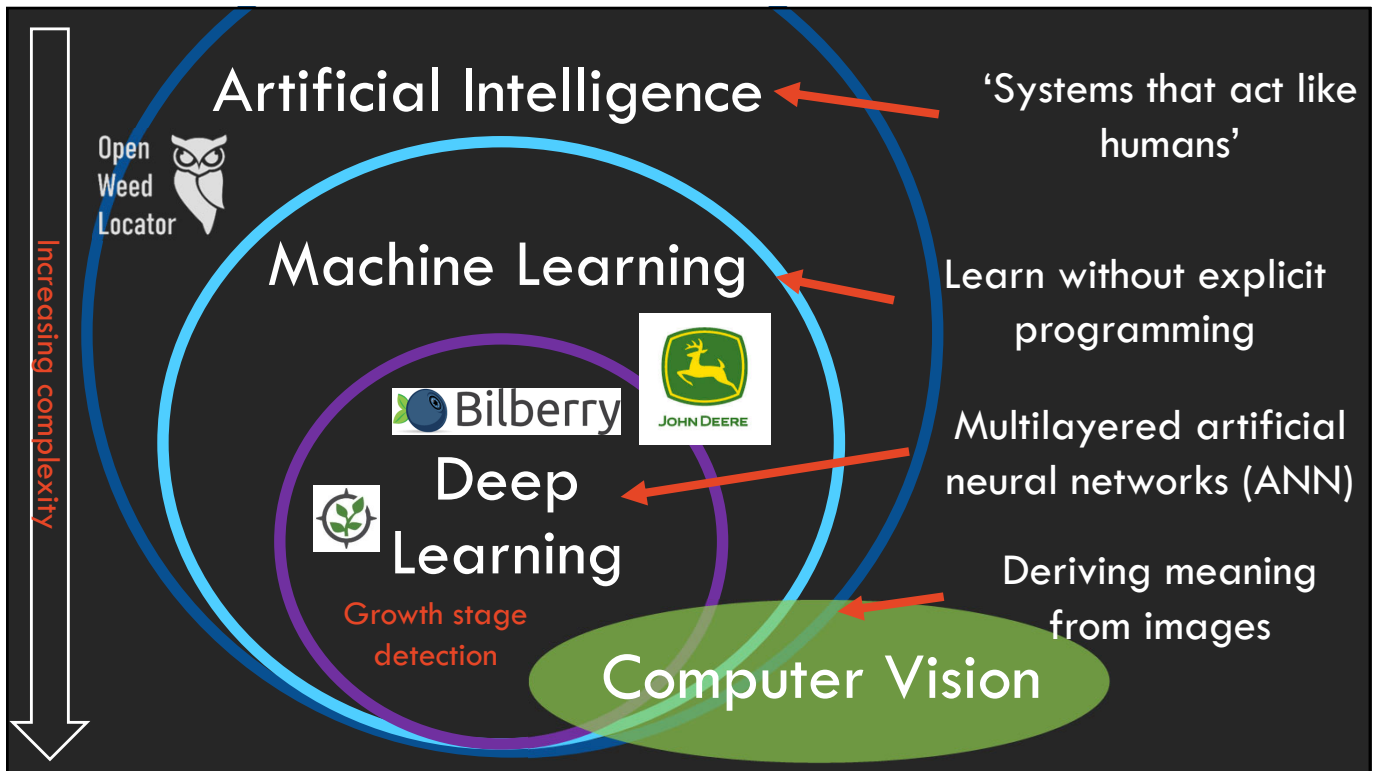
Repository: <https://github.com/geezacoleman/OpenWeedLocator>



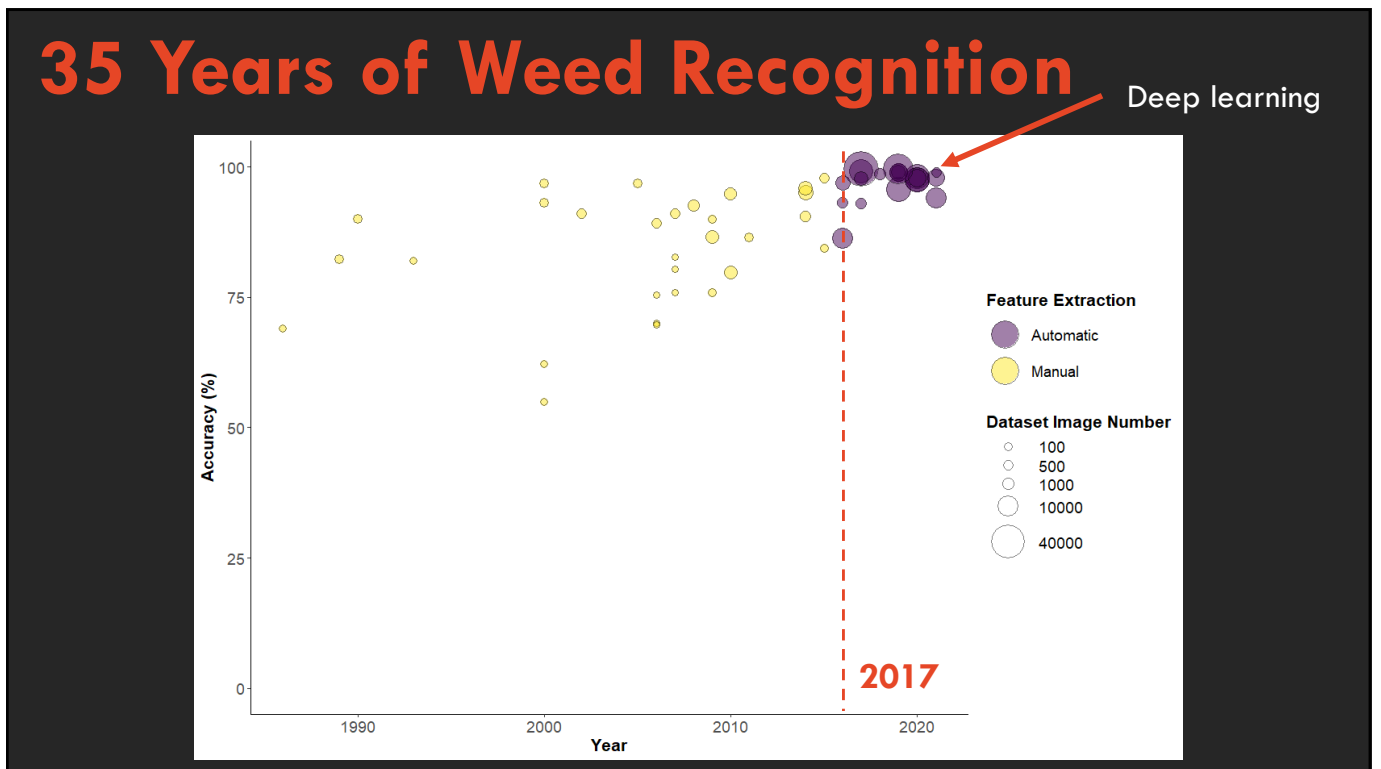
13



14



15



16

Drawbacks: Algorithms need to learn

Input image (data)

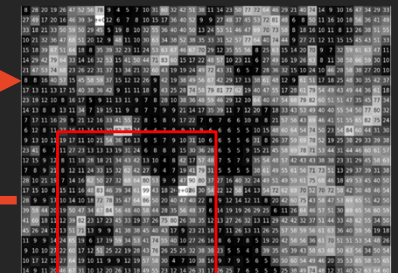
Annotation (groundtruth)

Model training (learning)



learns

checks



> 1000s of images needed for effective algorithms

The Future of Weed Recognition

Complexity

+

Variability

Ryegrass in Wheat



19

Growth Stage Detection



20

Why just weeds?



21

The Future of Weed Recognition

Weed recognition

- Species
- Growth stage
- Biomass estimation

Paddock history

↓
Square metre history

Resistance status

Yield impact

Local area risk



22

Weed Recognition

1. Opportunities to use alternatives
2. Requires significant data
3. Opensource technology
4. Not just weeds

23



Thank You

Michael Walsh
University of Sydney

Asher Bender
Australian Centre for Field Robotics

Muthukumar Bagavathiannan
Texas A&M University

William Salter
University of Sydney

Paul Neve
University of Copenhagen

TEXAS A&M AGRILIFE RESEARCH

 **THE UNIVERSITY OF SYDNEY**

 **GRDC**
GRAINS RESEARCH & DEVELOPMENT CORPORATION

 **FULBRIGHT Australia**

24


Questions

Open-source images
weed-ai.sydney.edu.au



DIY weed detector
github.com/geezacoleman/OpenWeedLocator

Contact

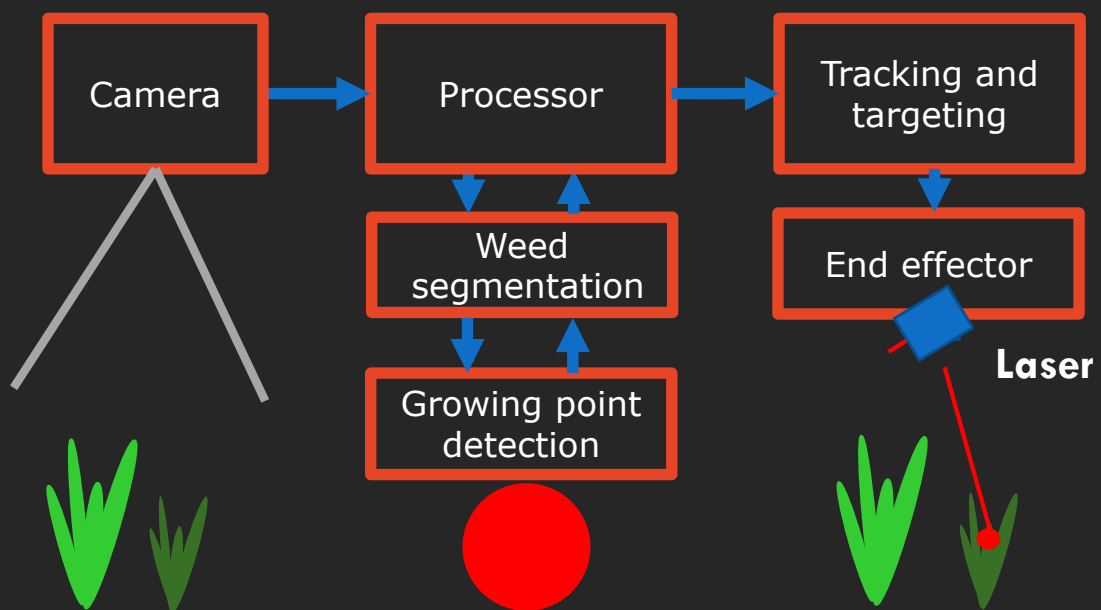
 [geezacoleman](https://twitter.com/geezacoleman)
guy.coleman@sydney.edu.au



Kieran Shepherd
University of Sydney, Research Farm 2021

25

Targeted Alternative System

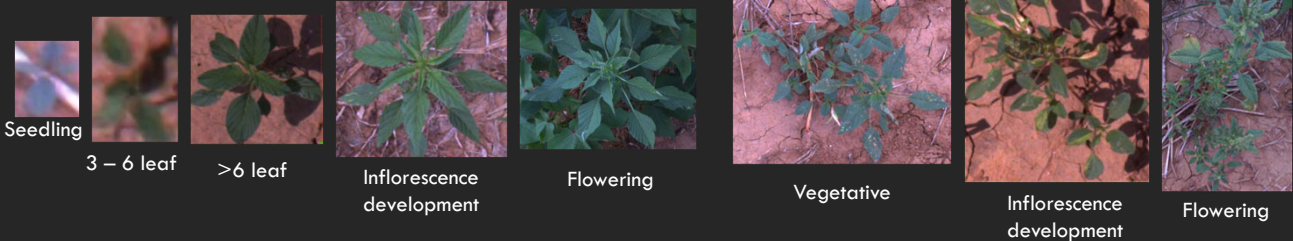
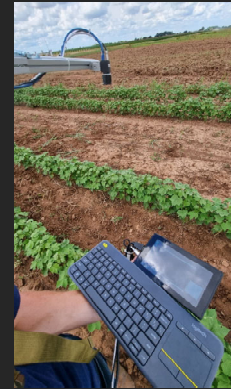


26

Impact of Plant Morphology

How does weed growth stage influence detection performance?

- Palmer amaranth (*Amaranthus palmeri*) in cotton
- 8 different morphologies
- Compare performance
 - Multi-class – growth stage
 - Single class



27

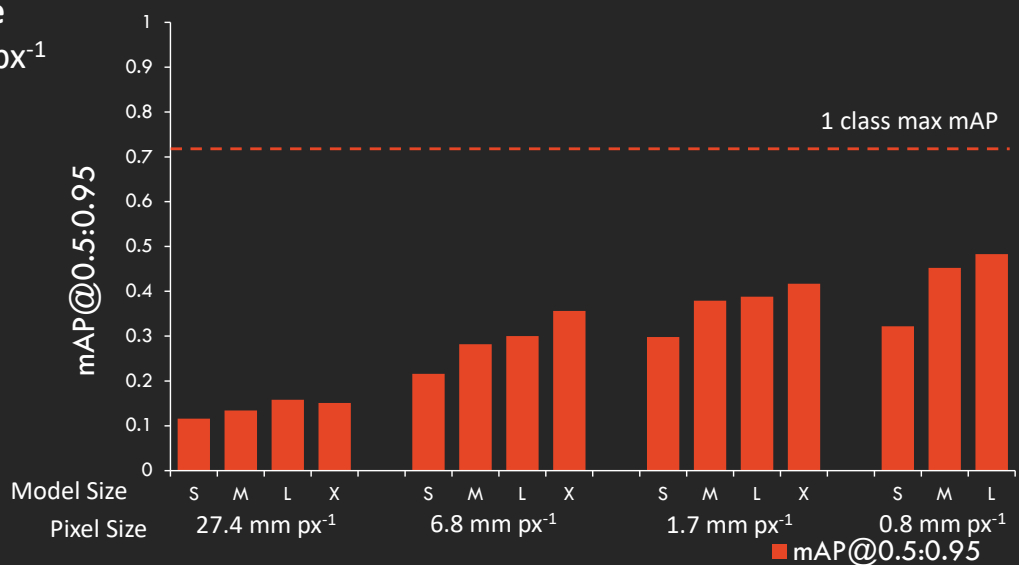
Results: 8 Class Detection

Best performance

- v5L – 0.8 mm px⁻¹
- mAP: 0.48

Improved mAP

- Image size
- Algorithm size
- *S plateaued earlier*



28

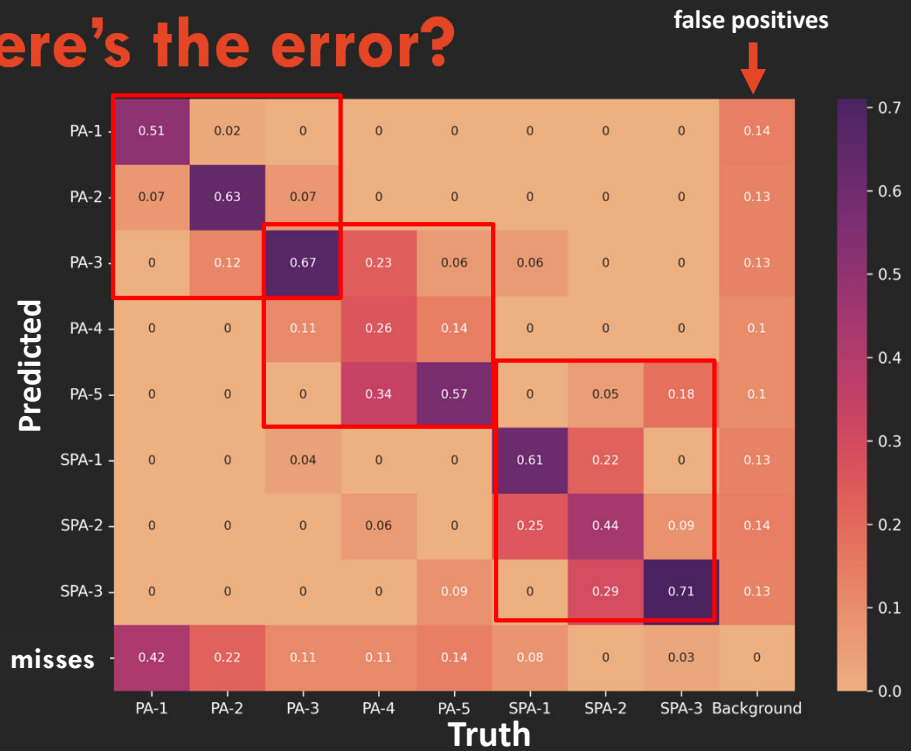
Results: Where's the error?

Inter-class confusion

- 5L 0.8 mm px⁻¹
- Confusion among visually similar classes
- Small classes missed
- Growth stage, at what cost?

Comparison

Classes	Misses
1	14%
8	17%



29

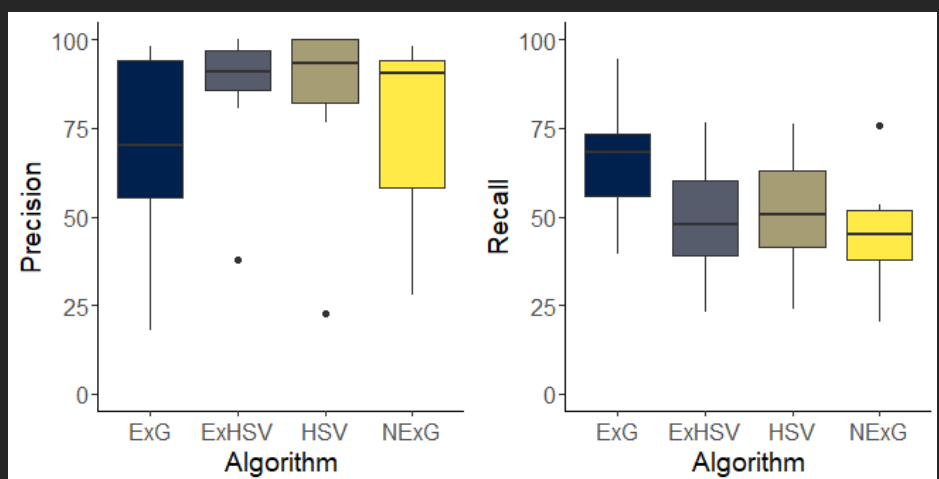
Performance: OpenWeedLocator

Avg. performance

- Precision: 79%
- Recall: 52%

Best performance

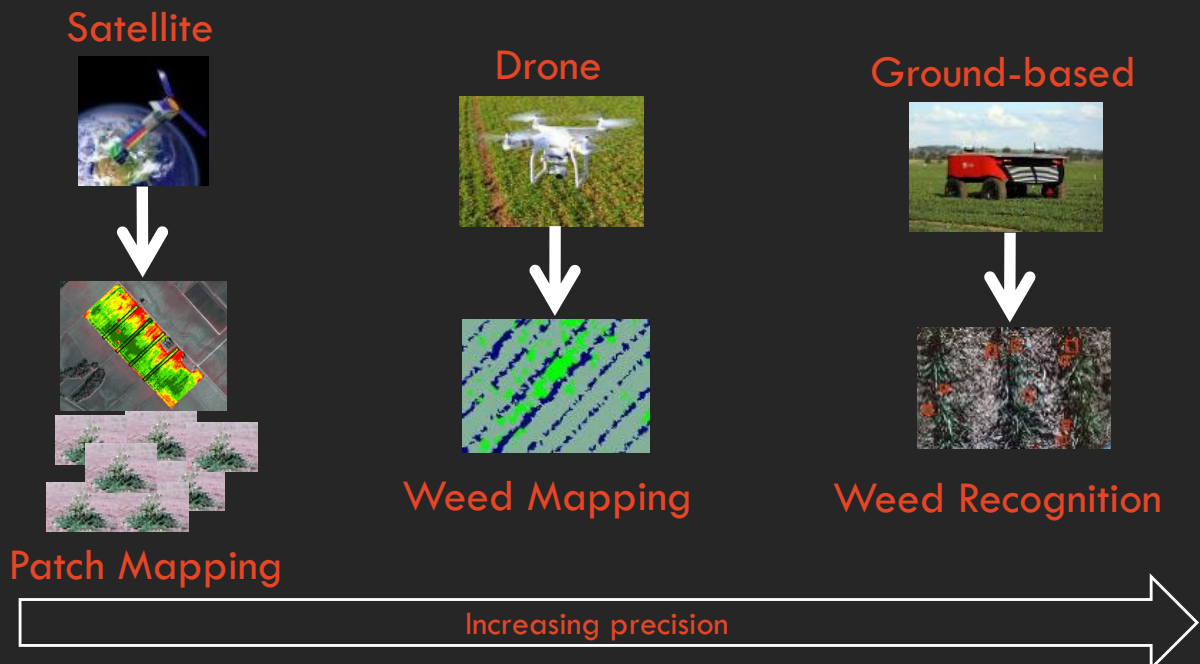
- Precision: 92%
- Recall: 74%



Repository: <https://github.com/geezacoleman/OpenWeedLocator>

30

Weed detection: what scale?



31

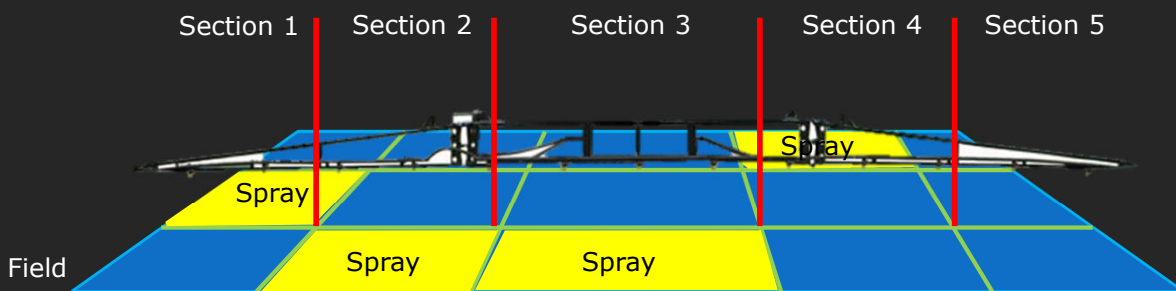
Weed Mapping

Map and control

- Weed map using UAV
- Export to a sprayer
- Activate sections/nozzles over weeds

Constraints

- Drone flying required
- Not real time
- Reduced precision (may change)



32

Weed Mapping



33

Trade display exhibitors

	<p>Nobody likes to get a fine.</p> <p>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</p>	<p>www.fmccrop.com.au</p> 
	<p>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.</p>	<p>https://www.corteva.com.au/</p> 
	<p>GeoSelect, a new spraying solution designed to save farmers money, time and create greater efficiency while working the harsh Australian landscape.</p>	<p>https://www.hardi.com.au/</p> 
	<p>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.</p>	<p>www.hutcheonandpearce.com.au www.tecsight.com.au</p> 
	<p>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.</p>	<p>http://www.mcintoshdistribution.com.au/</p> 



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<https://croplands.com/au/>

