

GRDC Grains Research Update



Herbicide resistance: Globally & Locally

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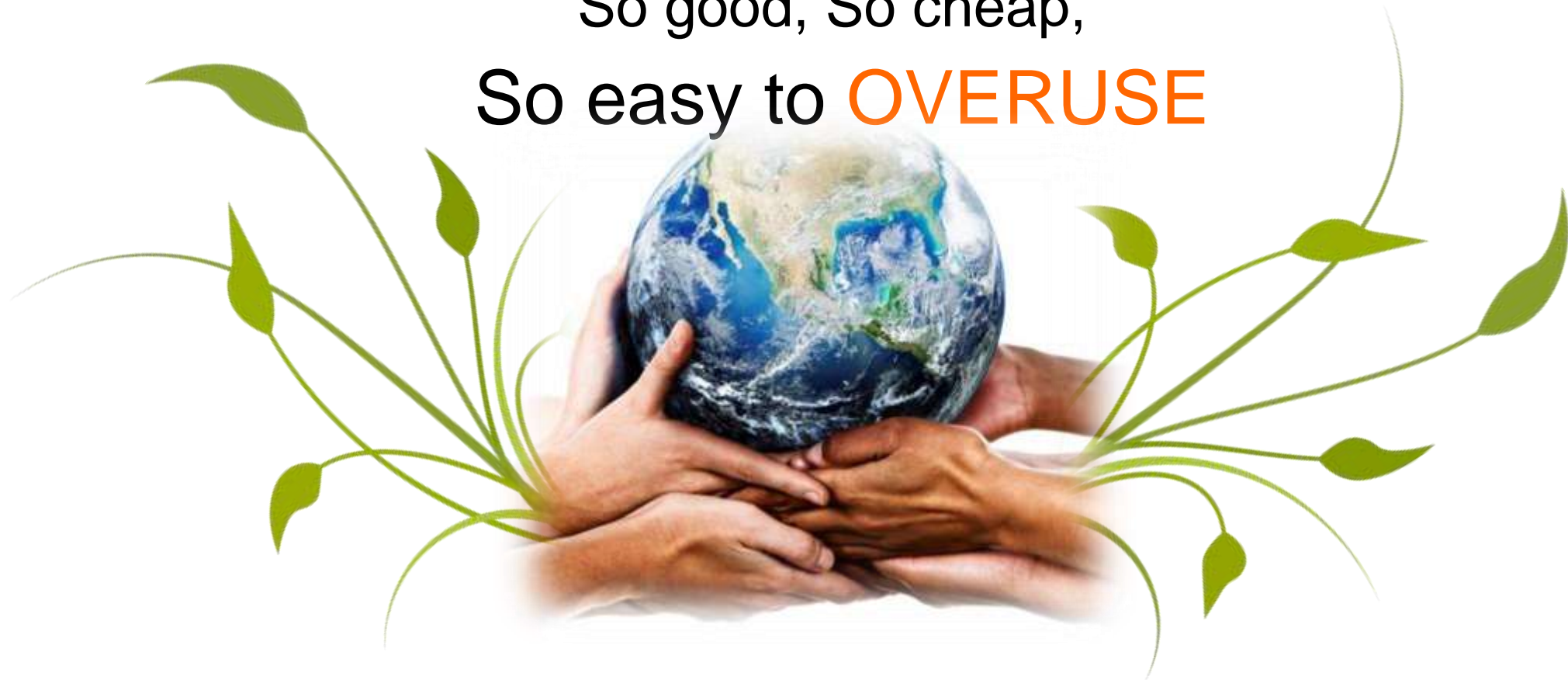
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Herbicides- a great tool for crop productivity

So good, So cheap,
So easy to **OVERUSE**



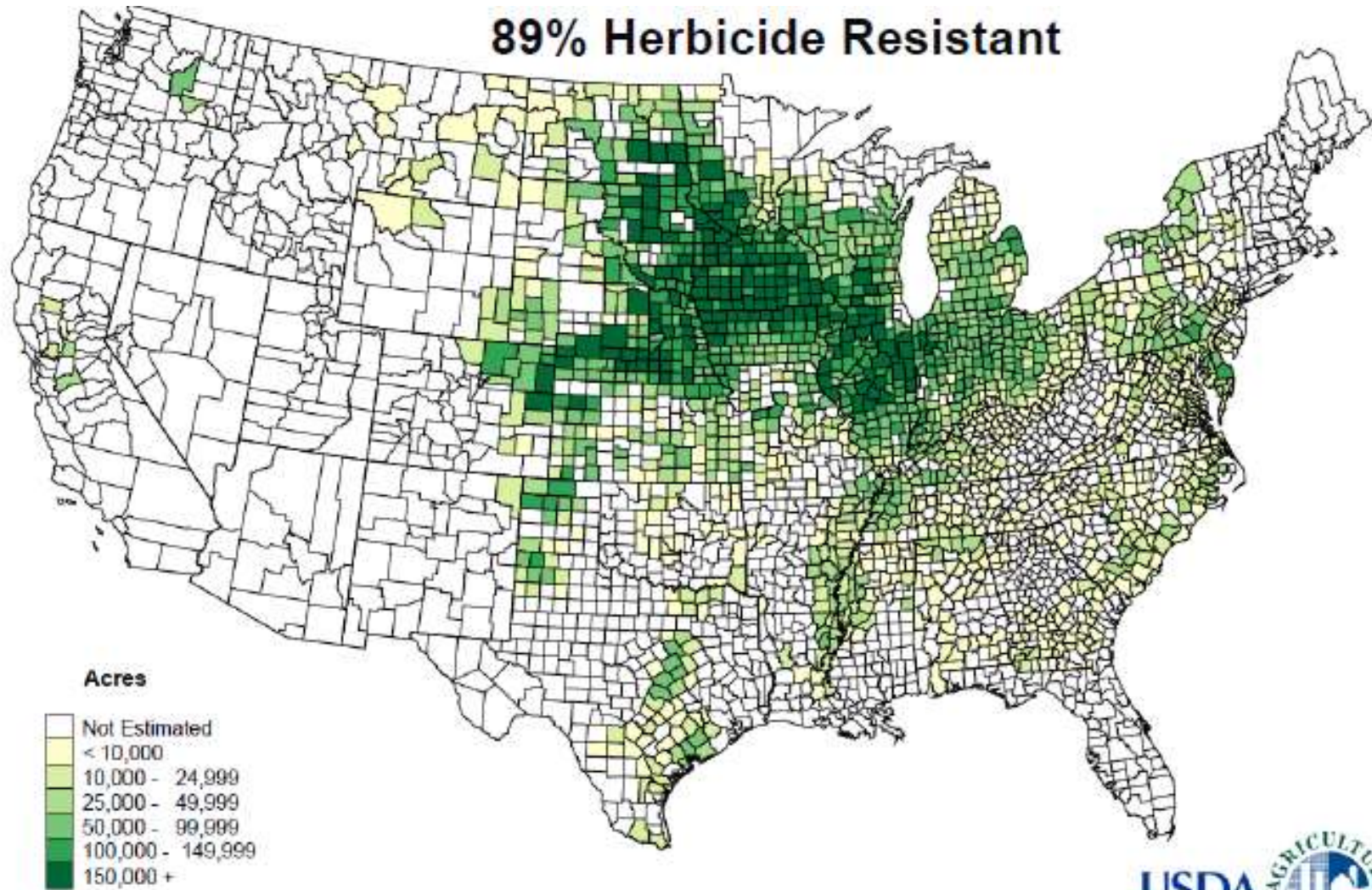
BIG HR weed issues on BIG cropping farms without diversity

Corn
Soybean
Cotton
Wheat



Corn: 36 million ha

89% Herbicide Resistant

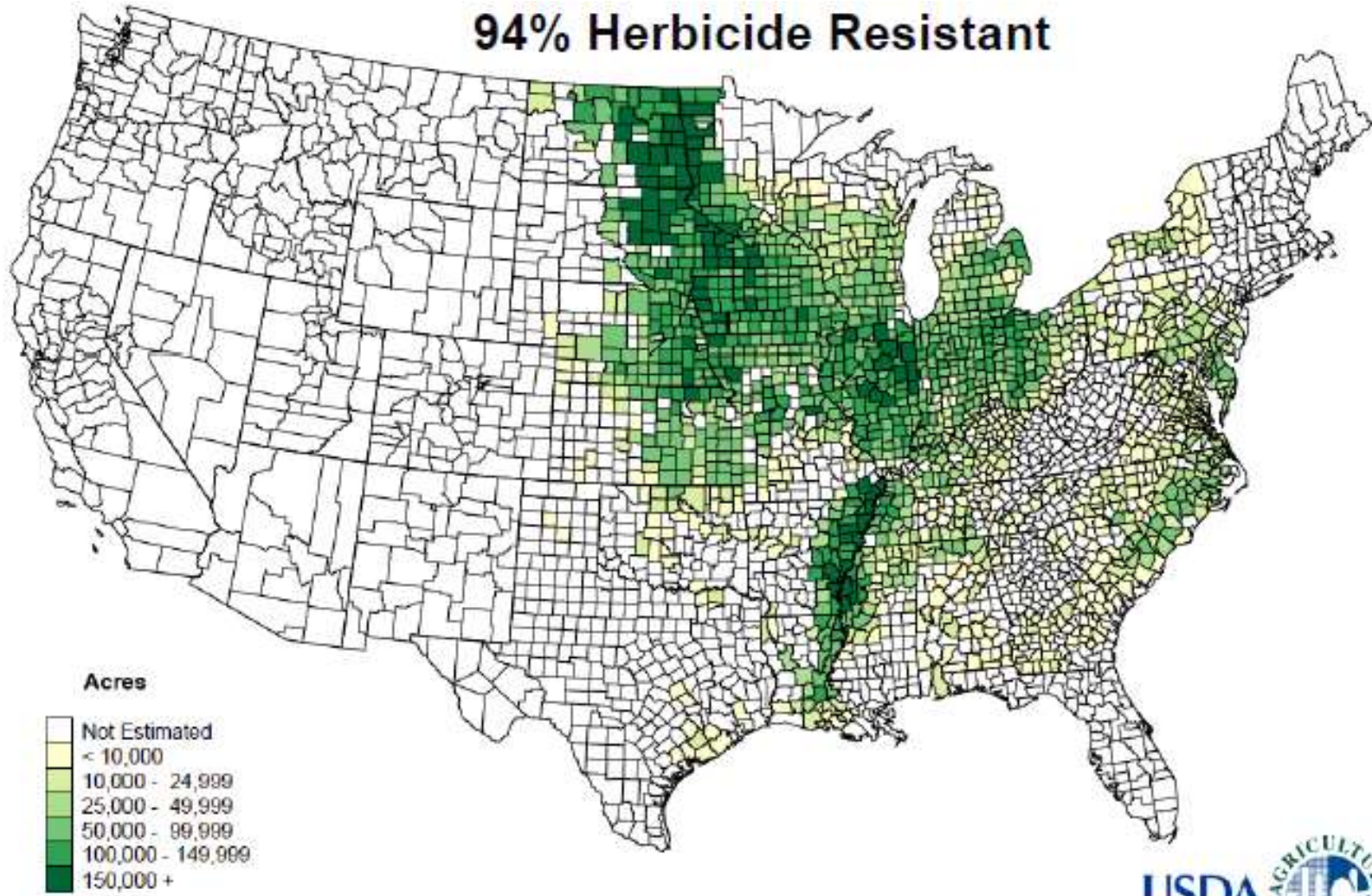


U.S. Department of Agriculture, National Agricultural Statistics Service



Soybean: 35 million ha

94% Herbicide Resistant



U.S. Department of Agriculture, National Agricultural Statistics Service

Soybean weed control

PAST

UP TO 7
MODES OF
ACTION AND
43 DIFFERENT
HERBICIDES



1996-2010

ONLY
GLYPHOSATE

USA = #1 in HR

70 million ha GR
corn, soy, cotton

34 million ha
GR weeds, esp.
Amaranthus.

Weeds remember R
to previous herbicides

= **MULTIPLE
RESISTANT**

Glyphosate resistant weeds have **tripled \$\$\$ herbicide spend** for US corn & soybean growers

	Before Gly R weeds	With Gly R weeds
Corn	\$75 /ha	\$200 /ha
Soybean	\$75 /ha	\$250 /ha

Latin America



55 million hectares Soybeans in Latin America

Argentina.....19 million hectares

Brazil.....32 million hectares

Paraguay/Uruguay....4 million ha

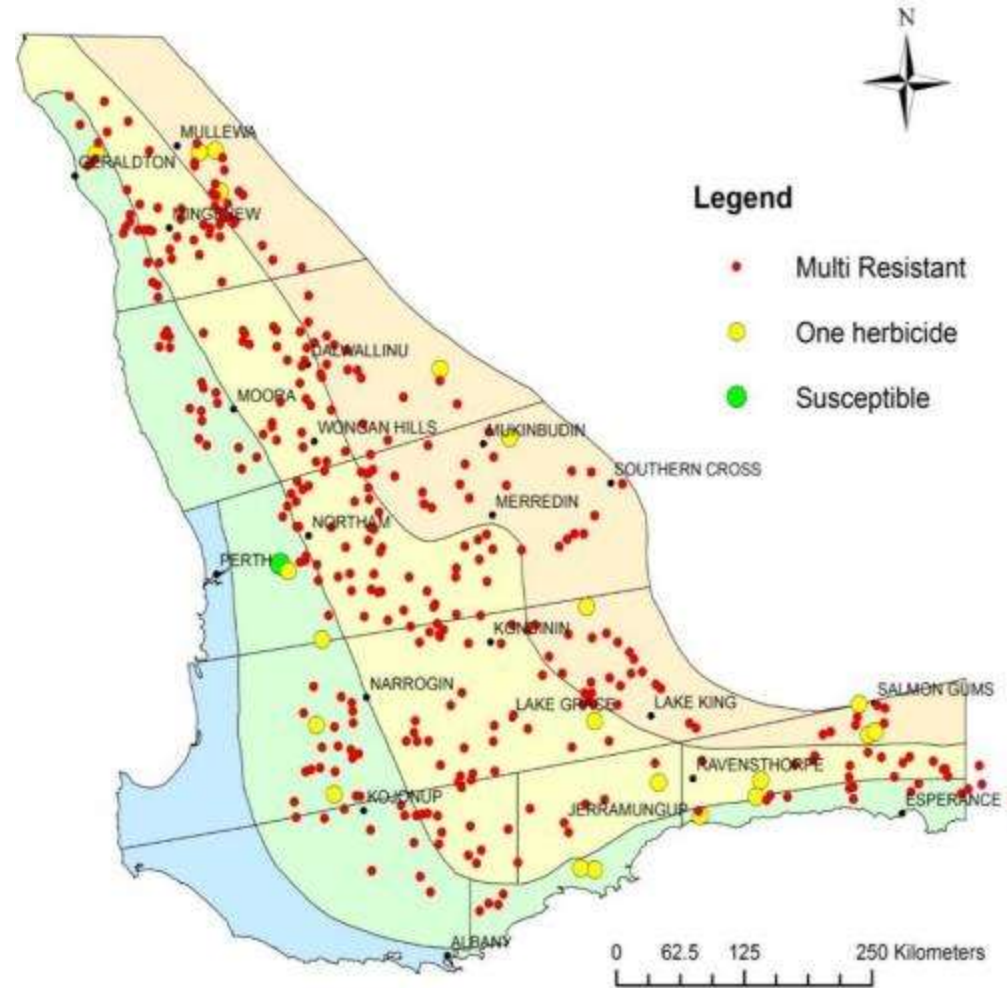
Nearly all glyphosate resistant!

148 million ha corn, soybean, cotton USA, Brazil, Argentina

- USA 34 million ha → GR weeds
- Brazil 15 million ha → GR weeds
- Argentina 1 million ha → GR weeds

= 50 million ha of the world's best crop
land infested with GR weeds & often
multi-resistant = a threat to global food

Local Glyphosate resistance

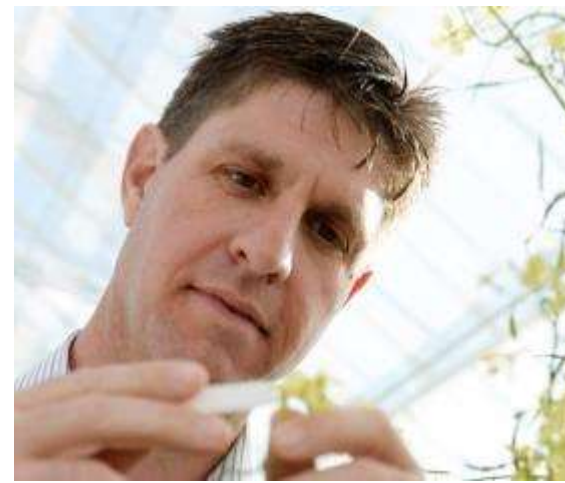


2010 M. Owen 500 field WA grain-belt **RANDOM** crop field surveys



Year	Species	% Glyphosate resistant
2010	Lolium	7
	Bromus	0
	Hordeum	0
	Conyza	0
	Avena	0
	Raphanus	0

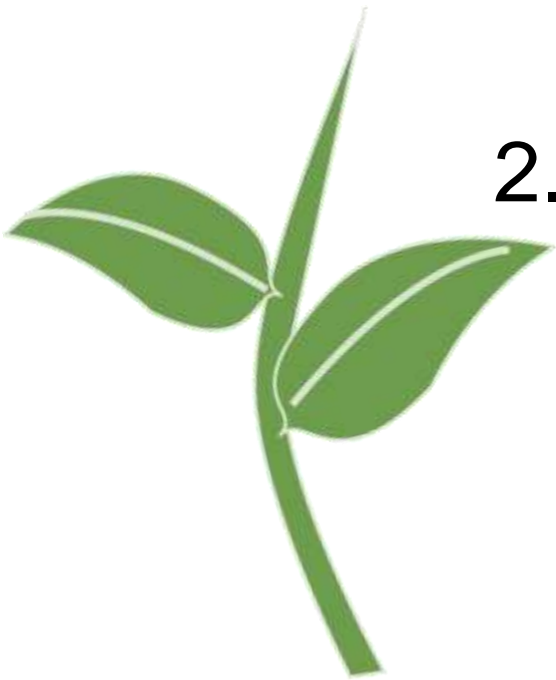
M. Ashworth 2010 + 2011 239 RR canola fields



Species	% Glyphosate resistant
Lolium	3.3
Raphanus (wild radish)	0.4
Avena (wild oat)	0
Bromus (brome)	0
Hordeum (barley grass)	0
Arctotheca (capeweed)	0
Malva (marshmallow)	0

Good news: Glyphosate effective on most WA farms

1. Glyphosate at-risk where over-used
2. **Diversify** glyphosate use for sustainability.



Australian techniques for sustainable weed control

- **Seeding**

- Double knock, delayed seeding, high seed rate, E-W seeding, Pre-em herbicides (rotate)

- **Early post emergence**

- Healthy crop out-competes weeds, Post-em herbicides

- **Late post-emergent**

- Crop-topping

Australian techniques for sustainable weed control

- **Harvest**

- HWSC (narrow windrows for burning, chaff cart, bale direct, chaff tramlining, HSD)

- **Low weed seedbanks**

- Mouldboard ploughing, pasture/hay etc phases with zero seed set

Potential new technologies

- Truly new herbicides – yes but rare
- RNAi genetic herbicides – maybe
- Integrated in header HSD – yes
- Weed sensor precision spraying
- Virtual fence precision weed grazing

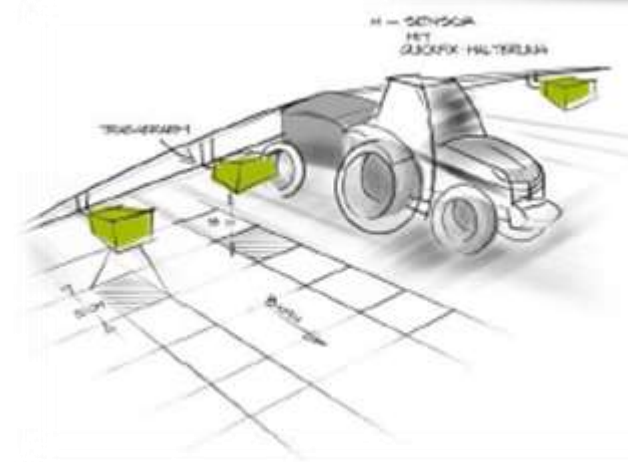
The integrated HSD: mill efficacy on weed species

Weed species	Seed kill %	SE
Annual ryegrass	93	0.7
Wild radish	99.75	0.2
Wild oat	99.875	0.1
Brome grass	99	0.2

M Walsh

The H-Sensor

- In-crop weed sensor
- Distinguishes crop from dicot or grass weeds
- Spray boom mounted
- Up to 10fps, up to 12 kmh (online)
- 0.5 by 0.5mm pixel resolution
- Independent of ambient light





Summary

Herbicide resistant weed challenge in major food producing regions around the world

We **CAN** sustain herbicides in Australian agriculture

- Diversity
- When on a good thing, don't stick to it
- Farming with very low weed seedbanks

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Photo: R. Smith

Thank-you



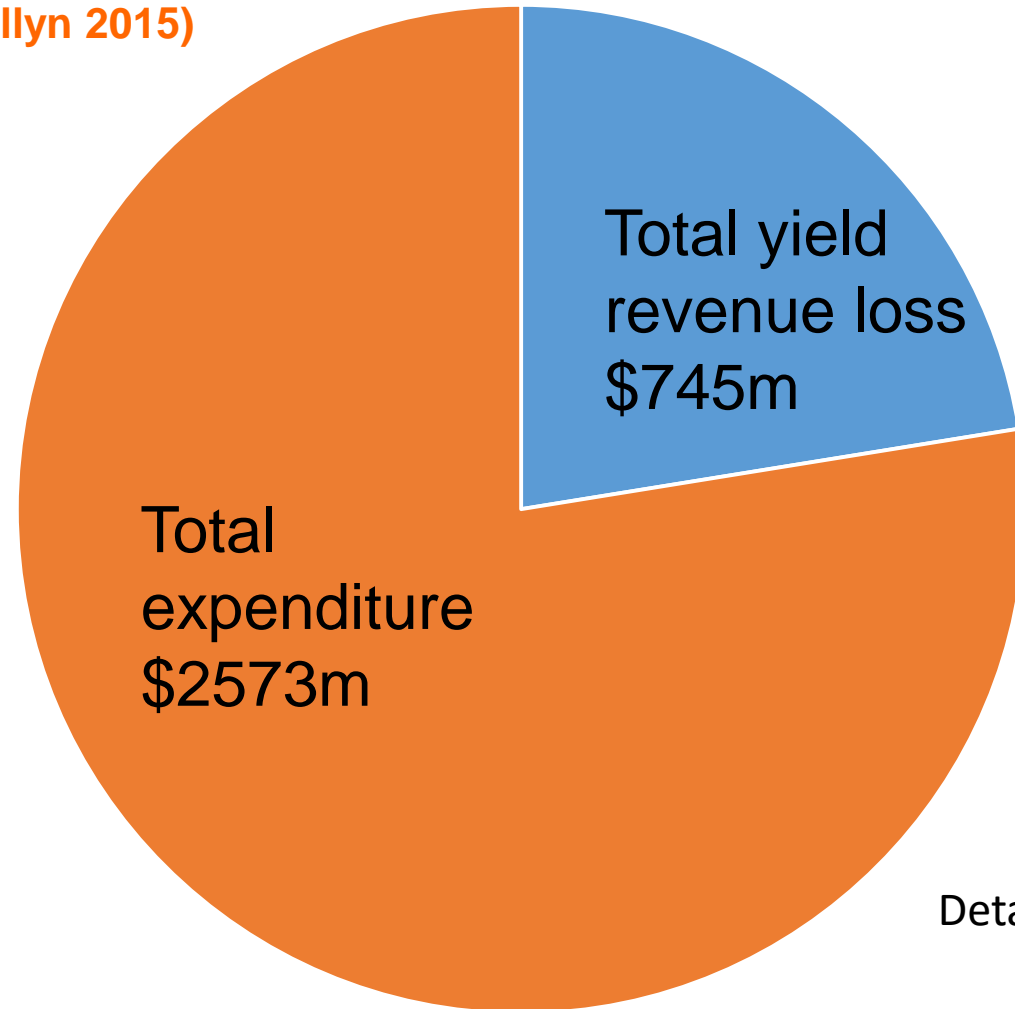
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MORE CROP less weeds costs **\$3.3 billion pa** (Llewellyn 2015)

Yield Loss: \$33/ha



Management: \$113/ha



Detailed analysis of 600 farms
2014-2015