

Understanding interactions between pre-emergent herbicides and inversion tillage – Tom Edwards DPIRD Esperance



Department of
Primary Industries and
Regional Development



Benefits of Strategic tillage



Amelioration	Non wetting reduction	Improved weed control	Reduce compaction	pH
Mouldboard	***	***	***	***
Spading	***	**	**	***

First year management concerns



Amelioration	Poor structure of seed bed	Potential to introduce toxic soil elements	Low organic matter	Increased Erosion risk
Mouldboard	Y	Y	Y	Y
Spading	Y	Y	Y	Y

Increased phytotoxicity of pre-emergent herbicides

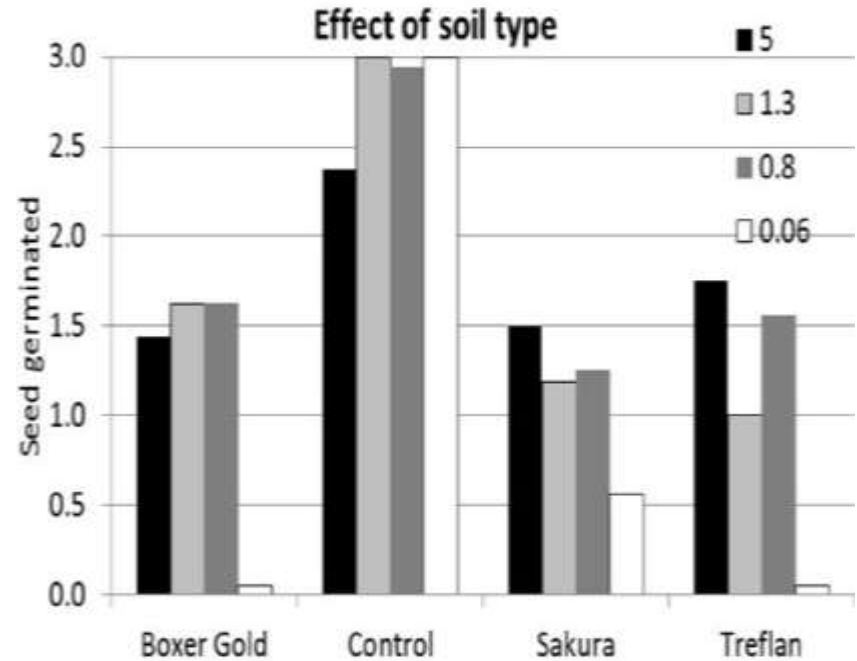
CHAPTER FIVE

The Soil Behavior of Herbicides as Influenced by Their Physical Properties

V. H. FREED, J. B. VERNETTI, and M. L. MONTGOMERY

The number of herbicides for application to the soil increases every year. It has been found that a higher degree of selectivity and a longer period of weed control may be achieved with chemicals applied to the soil in contrast to those applied to foliage (Klingman, 1961; Robbins, Crafts, and Raynor, 1952). However, those chemicals applied to the soil are more subject to varied degrees of changes in environment which determine the effectiveness of the treatment than are those chemicals applied to foliage (Freed, 1958; Klingman, 1961). For this reason, it is important to develop a basic understanding of the laws and principles governing the behavior of these chemicals. A thorough understanding of such phenomena would permit development of a program for more rational use of these chemicals and the attainment of a higher degree of effectiveness under more varied conditions.

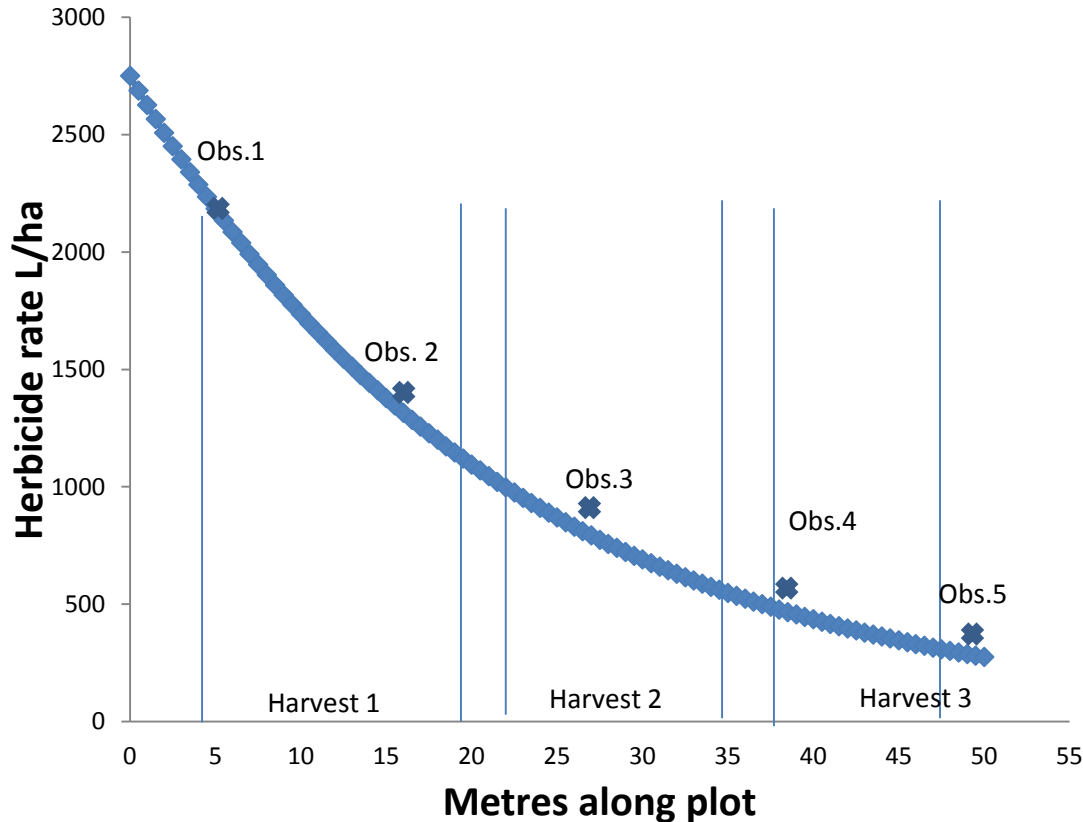
Environmental and Other Factors in the Response of Plants to Herbicides (1967): 107.
Previously Ennis (1954)



Effect of organic matter percentage on seed germination under different herbicides. Bakker and Poulish 2015 crop updates

Logarithmic sprayer

Corrigin Trial



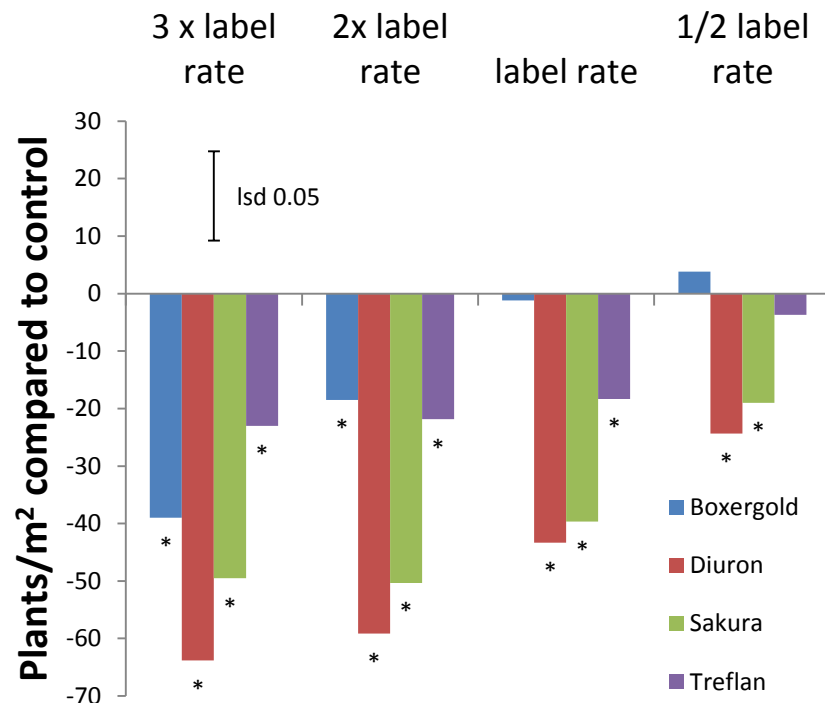
- Mouldboarded 2017
- 4 pre-em herbicides log sprayed
 - Treflan
 - Sakura
 - Boxer-gold
 - Diuron
- Sown to Barley 2017, knifepoints
- Six replicates compared control

Corrigin Trial - Establishment 6 weeks

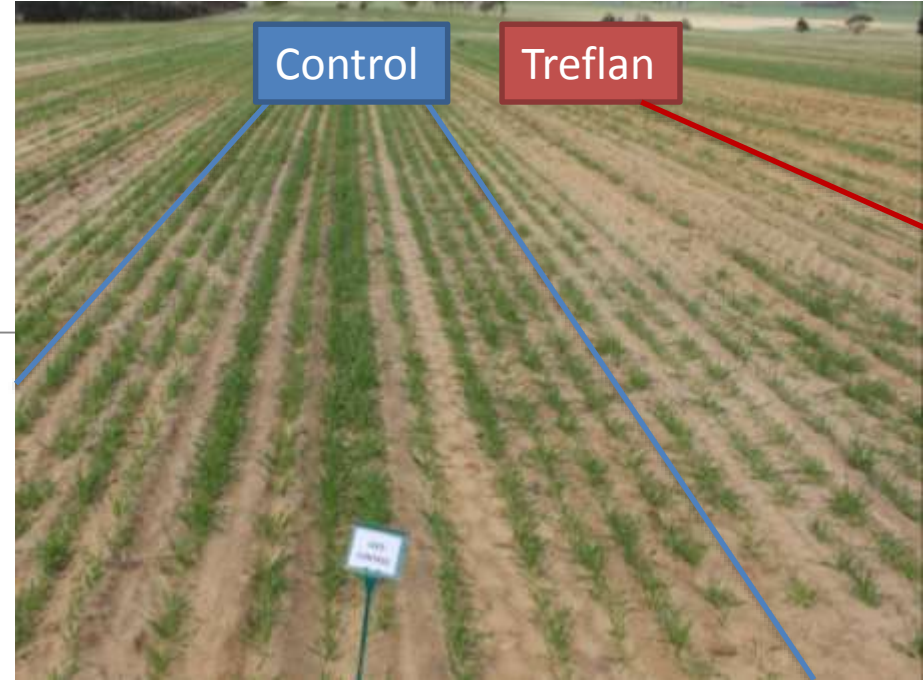
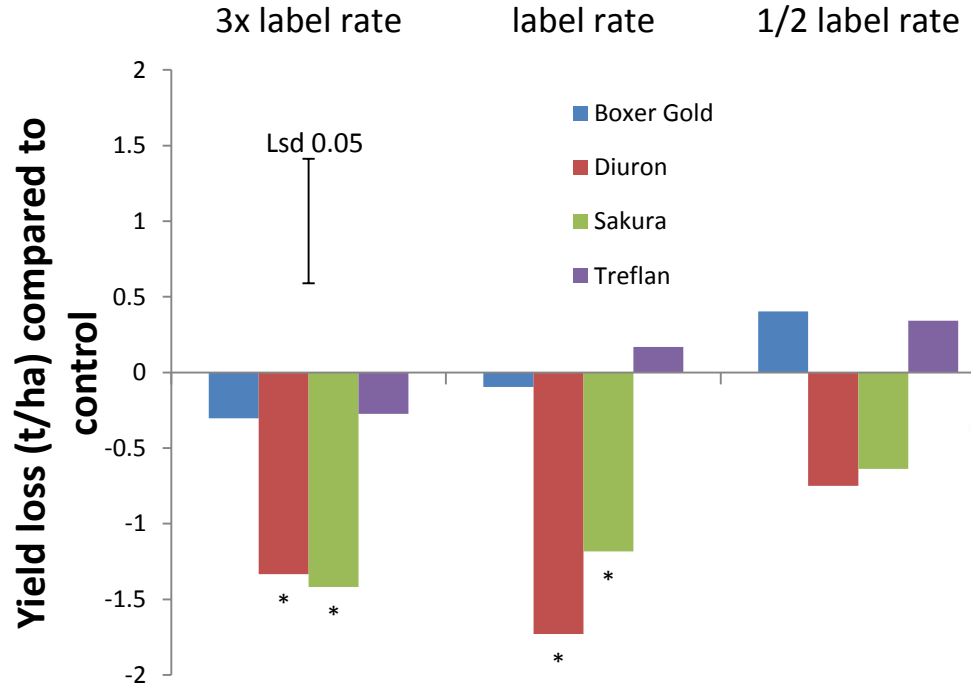


Highest Conc

Lowest conc



Corrigin Trial yield



Coomalbidgup trial



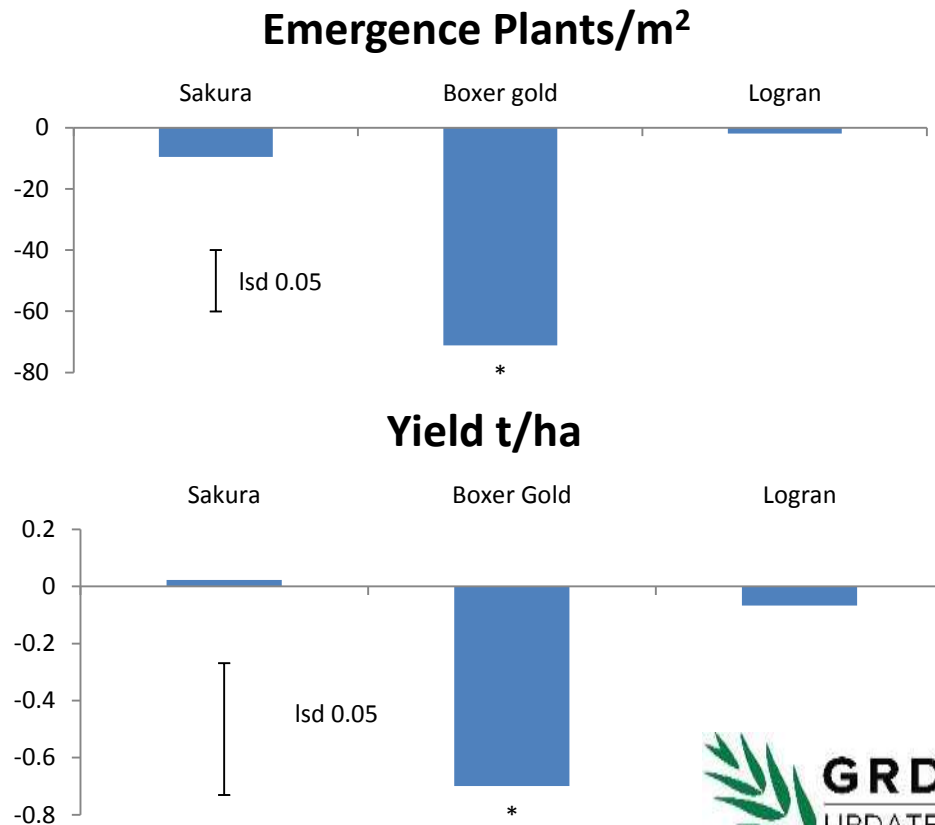
- Mouldboarded 2017
- 3 pre-emergent herbicides + control
 - Boxer-gold
 - Sakura
 - Logran
- Sown to Wheat with roller seeder
- Criss-cross design with nitrogen timing interactions

Coomalbidgup Trial results

Control



Boxer gold treatment, 4 weeks after sowing

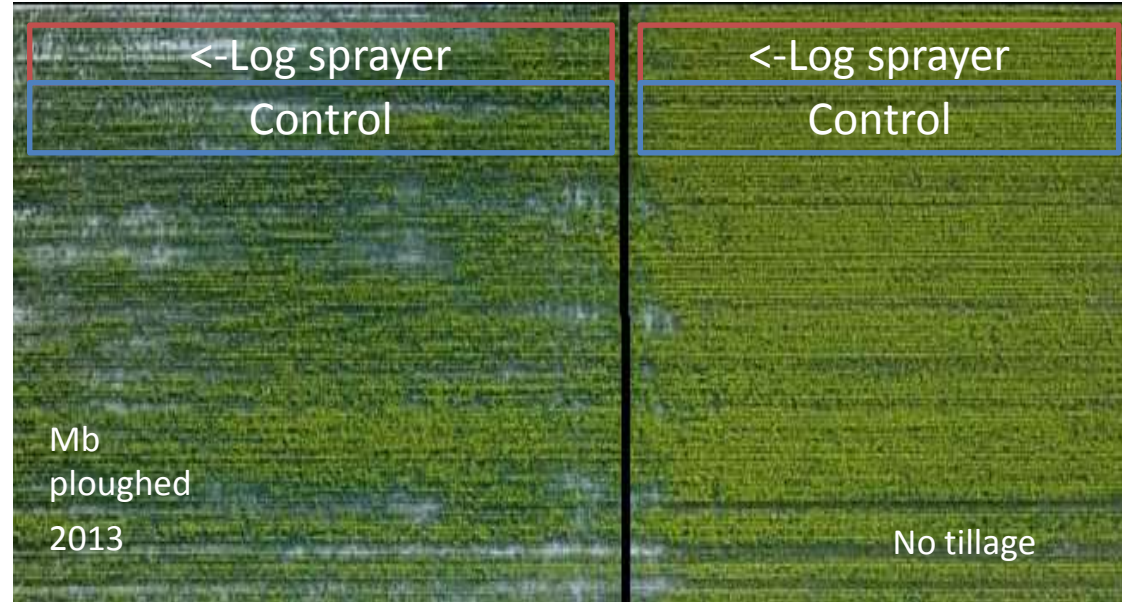


Issues with break crops in subsequent years

Canola trial at Prickle farm Nerridup

- Blocks of Mb ploughed 2013 and no renovation
- 3 herbicides: Propyzamide, Butisan, Trifluralin
- Logarithmic sprayer with paired controls for every plot
- Seeding rates only looking at 4kg/ha

		Mb	No soil renovation
Control	Plants/m ²	39.1	40.8
Control	NDVI	0.32	0.39
Control	Yield t/ha	2.19	1.72



Canola canopy cover at Prickle farm Nerridup August 2017 rep 3 of 3

Canola log sprayer trial

Yield gain/loss t/ha sown at 4kg/ha						
Herbicide	Soil renovation	2.5x label rate	1.5x label rate	label rate	2/3 label rate	2/5 label rate
Butisan	Mouldboarded	-0.39	0.16	0.05	0.02	-0.03
	No soil renovation	0.24	0.22	0.26	0.35	0.29
Propyzamide	Mouldboarded	-0.01	-0.08	-0.03	0.24	0.00
	No soil renovation	0.05	0.10	-0.12	-0.02	0.00
Trifluralin	Mouldboarded	-0.14	-0.06	-0.05	-0.59	-0.58
	No soil renovation	-0.14	-0.21	-0.14	-0.21	-0.29



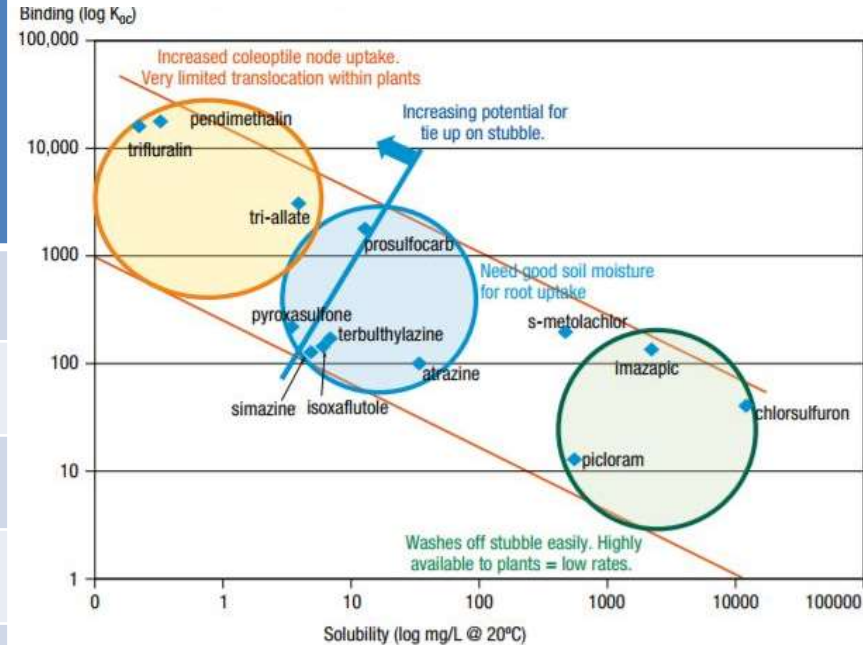
Butisan plot high conc in foreground to low conc in background, August 2018

Summary of Trial Results

Trial	Season	Sown	Crop	Boxer-gold	Sakura	Diuron	Treflan	Logran
Corrigin	First	Knife point	Barley	ND	YL	YL	ND	X
Coomalbidgup	First	Roller	Wheat	YL	ND	X	X	ND
				Propyz a-mide	Butisan	Treflan		
Nerridup	5 th	Knife point	Canola	ND	ND	ND		

Things that will influence result: Herbicide type

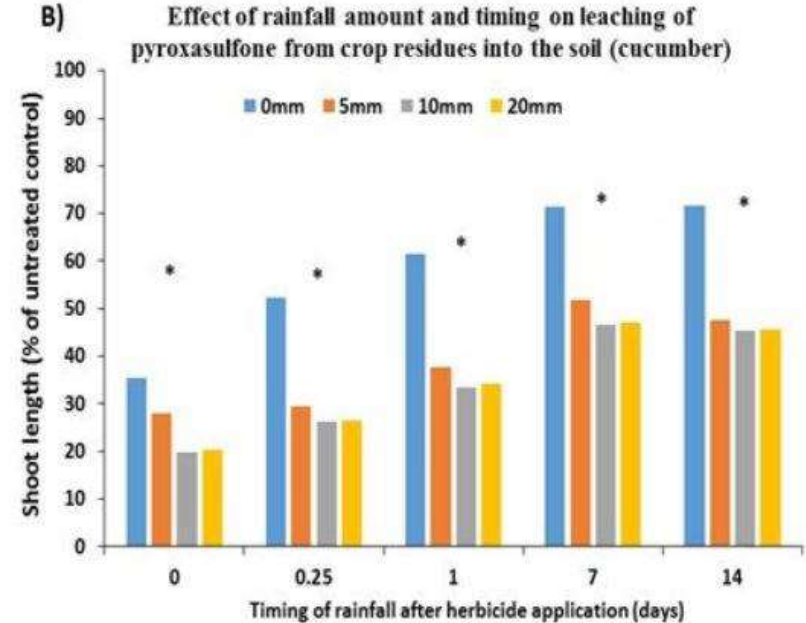
Registered herbicide	Label rate	Active	Conc	K_{oc} mL/g	Solb mg/L	K_{ow}
Sakura®	118g/ha	Pyroxasulfone	850g/kg	95	3.49	2.39
Logran®	35g/ha	Triasulfuron	750g/kg	191	815	0.31
Diuron®	550g/ha	Diuron	900g/kg	480	42	589
Boxer-Gold®	2.5L/ha	S-metalachor	800g/L	200	488	794
		Prosulfocarb	120g/L	1853	13.2	4.65
Treflan®	2L/ha	Trifluralin	480g/L	8765	0.3	118,000



GRDC pre-emergent herbicide fact sheet December 2015

Things that will influence result: Rainfall and pre-emergent herbicides

	Corrigin	Coomalbidgup	Nerridup
Sown	20/06/2017	30/05/2017	2/05/2017
Harvested	13/12/2017	4/12/2017	16/11/2017
Rainfall (mm) 30 days prior to sowing	14.2	30.2	64.8
Rainfall (mm) 2 weeks after sowing	36.2	1.8	2.4
Largest Rainfall (mm)/ 24hr in first 2 weeks after sowing	18.6	1	0.8
Days after sowing	2	5	8
Growing season rainfall	242.8	332.2	234.8
	7km away	20km away	27.12km away



Yaseen Khalil, Ken flowers AHRI

<https://ahri.uwa.edu.au/herbicides-and-stubble-some-wash-off-some-dont/>

Soil movement in the first year



Increased wind erosion risk in the first year until biomass is sufficient, this can:

- Be the most limiting constraint for emergence in the first year
- Increase pre-emergent herbicide damage through collapsed furrows
- Herbicide damage can prolong erosion risk

Conclusions

- Confirmation that, in the first year after inversion ploughing, low organic matter and unstable stable soil surface can increase the risk of pre-emergent herbicide damage on cereals.
- Can reduce this risk by applying herbicides that:
 - The Crop is highly tolerant of
 - Have low risk of leaching under low O.M, provided there is good separation from seed
- Soil moisture conditions, rainfall amount and intensity will also strongly influence this risk

Future work and opportunities

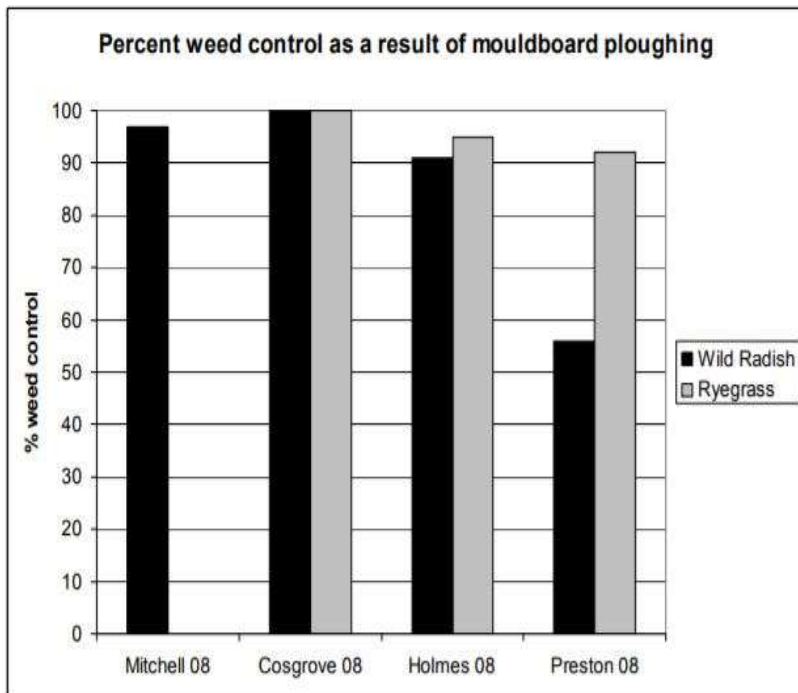
A) Managing risk

- How many seasons does this increased risk last ?
- Is the plant back of some herbicides increased?
- Does Herbicide toxicity contribute to isolated Canola emergence failures after tillage?
- What are the herbicide options for one pass renovation-seeding in the first year? (under rainfall leaching conditions)



Gibson Soil profile, tillage occurred 7 years ago : photo courtesy of David Hall

Future work and opportunities



Percentage weed control at four properties that have been mouldboard ploughed from Newman P, and Davies S., 2009. Mouldboard plough Crop updates Perth

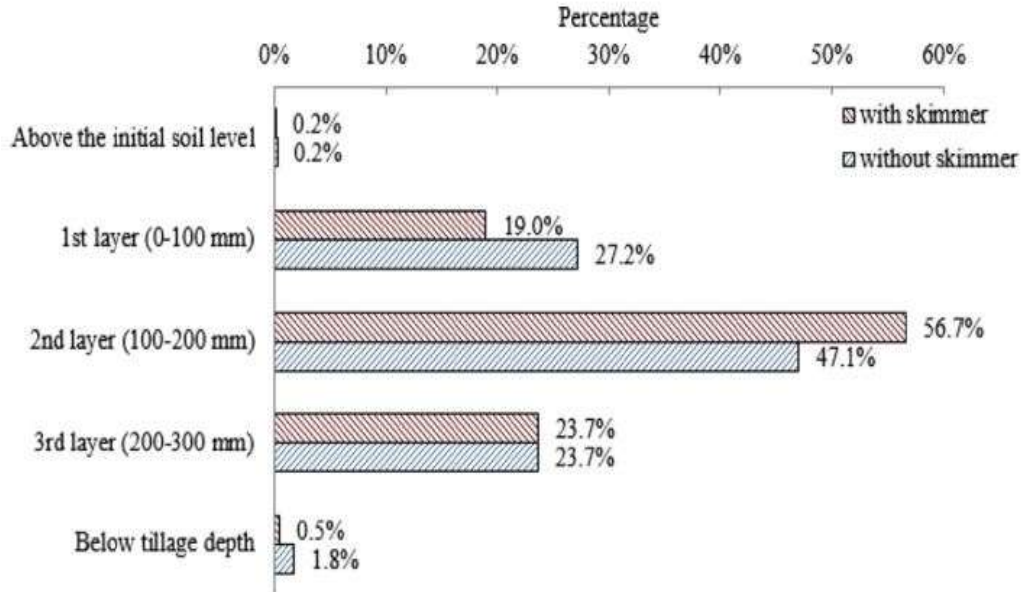


Hard to control silver grass with staggered emergence on severely non-wetting soil. Photo courtesy of David Dodge

B) Improving weed management

- Inversion ploughing additionally provides mechanical burial of weed seed bank
- Eliminating non-wetting is very beneficial for increasing herbicide efficacy

Future use in IWM



Percentage of top soil burial in each layer, with and without a skimmer at 300 mm operation depth from: UCGUL, M., et al. 2017. Discrete element modelling of top soil burial using a full scale mouldboard plough under field conditions. *Biosystems Engineering*, 160, 140-153.

B) Improving weed management

- Can we make weed seed burial more effective ?
- How do we change the ecology of the weed seed bank ?
- Does this change the types of herbicides we want to use?

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