DELIVERING FOR QUEENSLAND | Queensland Government

Soil Health and Tillage – Practical insights from sugar-based farming systems

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Crop and Food Science - DPI

Who am I?

From Bundaberg
Parents farmed 64ha Sugarcane/tobacco/fresh beans
QAC 1985/86
Soil Con Research Emerald 1987-1994
Conservation cropping systems and nutrition
Ag Branch Bundaberg 1995 – Current
Sugarcane farming systems / soil health / sustainability
UQ Gatton 2005/6

All, Some or None of what I am about to expose you to will work in your farming system

When we started our research activities as part of the Sugar Yield Decline Joint Venture the sugar industry had gone off it's rails

BIOLOGICAL CROP PROTECTION

Australian Government
Sugar Research and Development Corporation

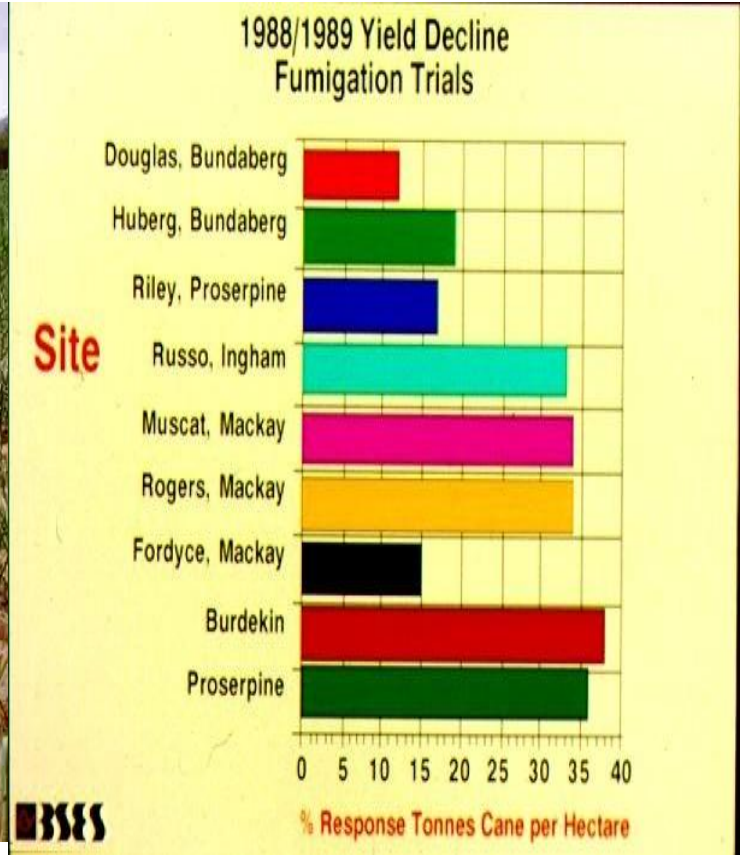
SUGAR YIELD DECLINE JOINT VENTURE

BSES
Sugarcane for the future

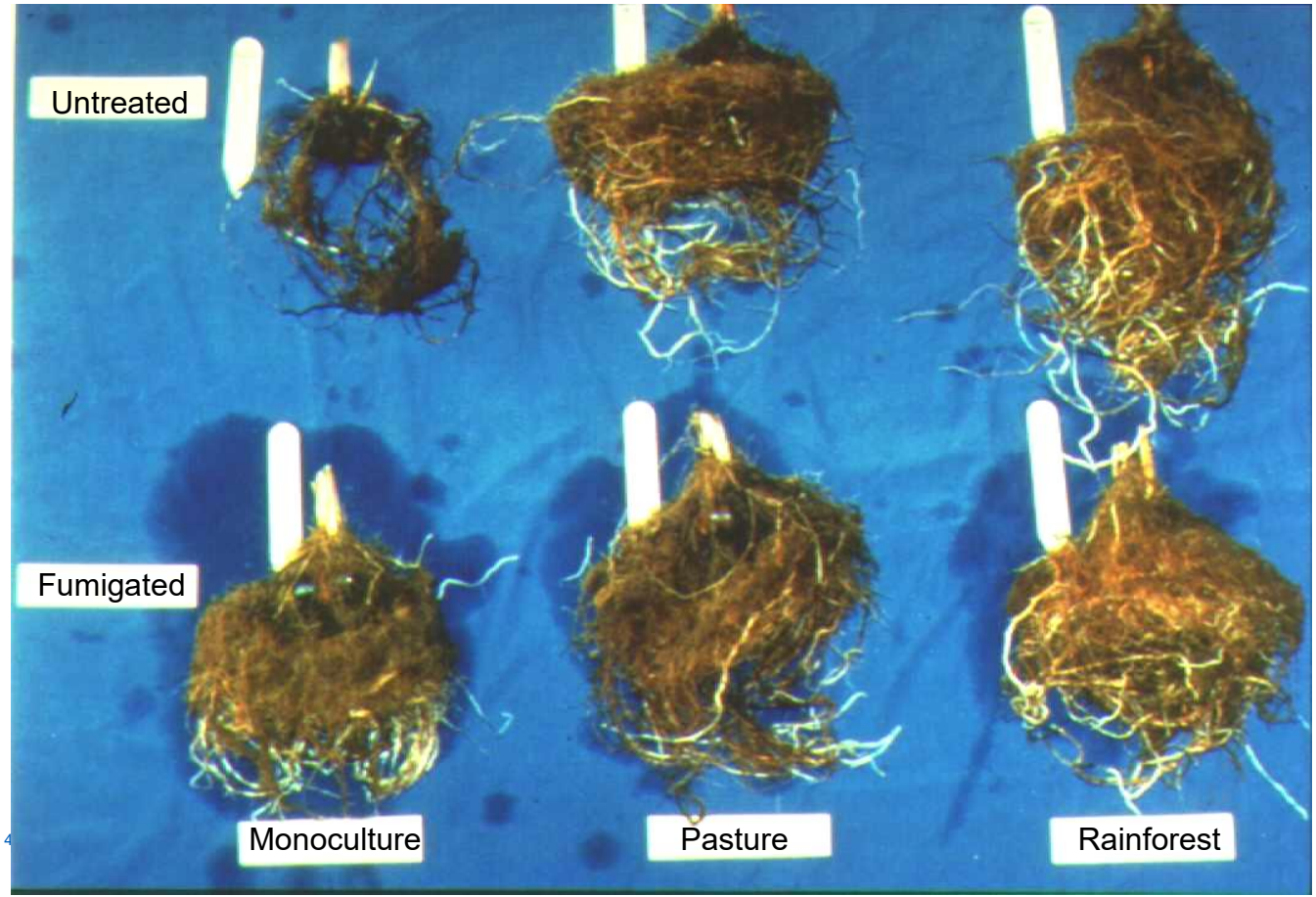
Queensland Government
Natural Resources, Mines and Water

Queensland Government
Department of Primary Industries and Fisheries

Field Evidence of Yield Decline

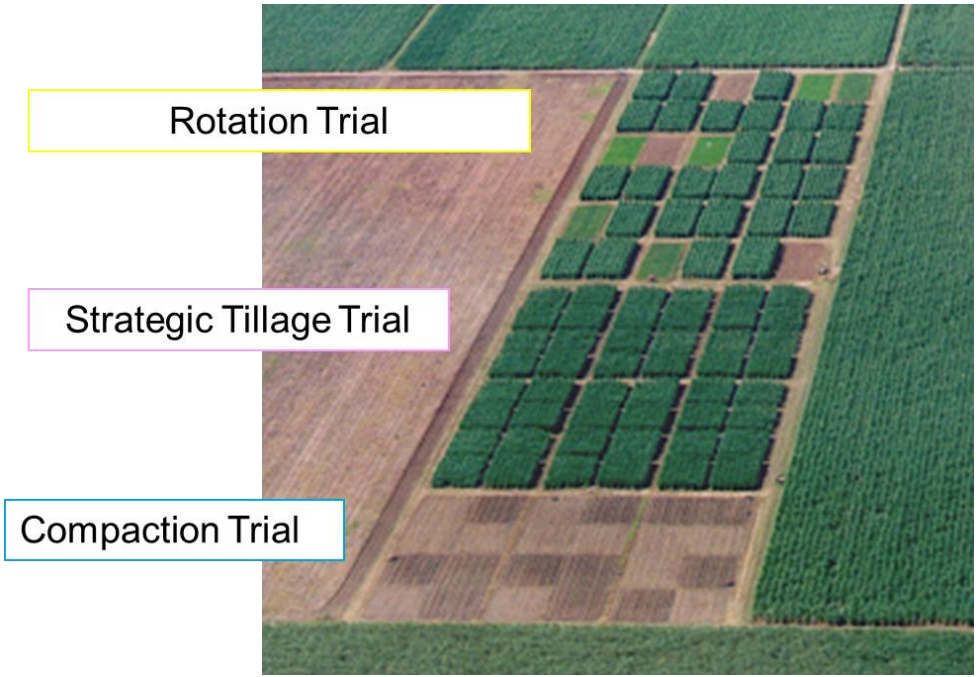


Sugarcane root growth in soil from different histories +/- fumigation

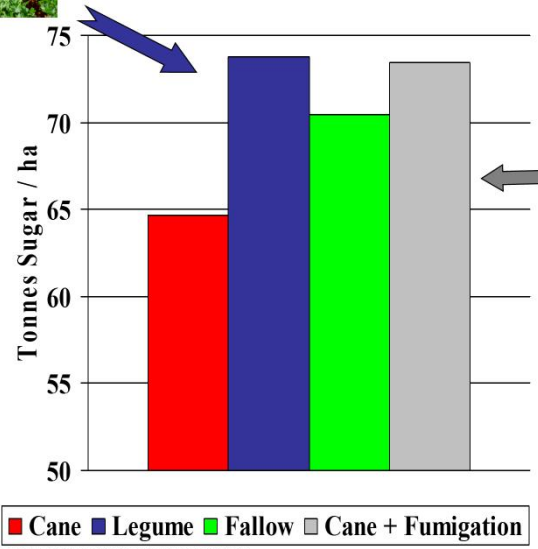


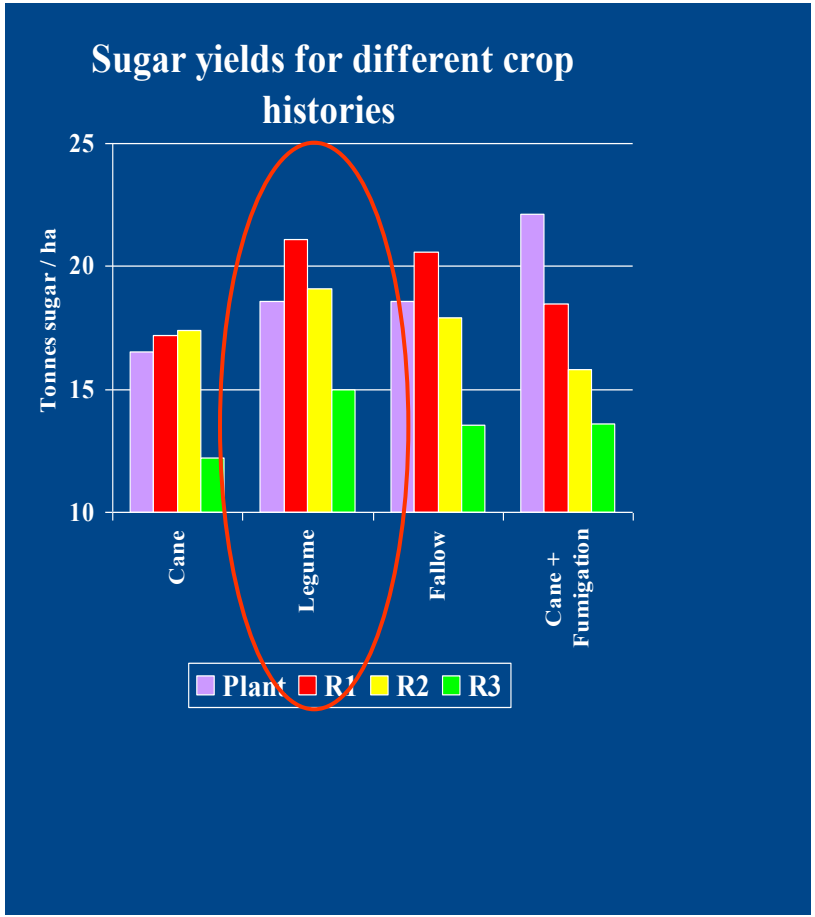
Only sugarcane soil was responsive to fumigation. We were dealing with cane specific pathogens?

Bundaberg site



Legume rotations grew as much cane a 1,000 kg/ha methyl bromide soil sterilisation

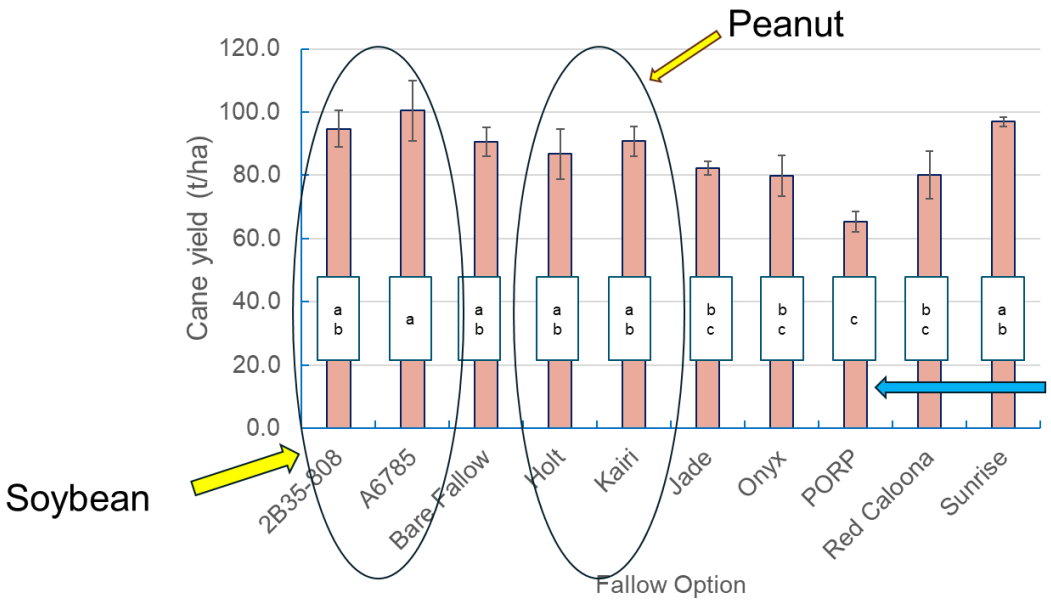




Legumes significantly improve soil biology

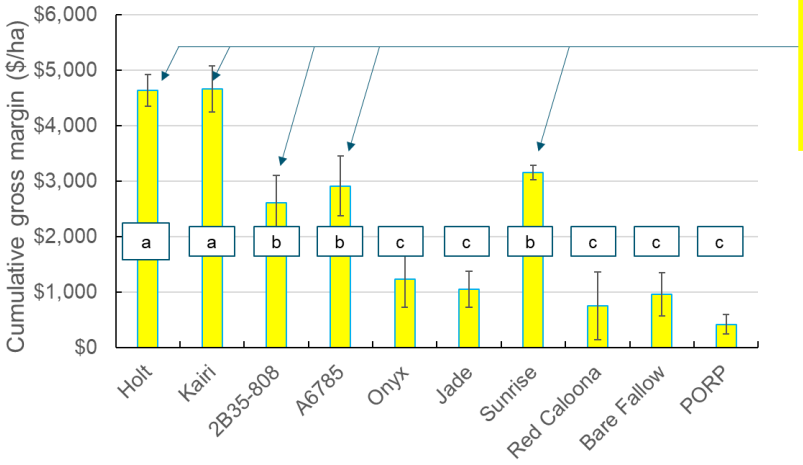
	No. nematodes/200 ml soil	
	After cane	After legume
Lesion	49	14
Reniform	309	23
Stubby root	9	1
Spiral	199	28
TOTAL	566	66
Bacterial feeders	1905	6997
Fungal feeders	1258	1958
TOTAL	3163	8955
Beneficial/Pests	6:1	136:1

Soybean and peanut rotations



Soybean and peanut rotations improved sugarcane productivity by 49-36% with 59-94kg N/ha less N fertiliser

Large impact on grower viability



Peanut, soybean and pigeon pea rotations are significantly more profitable rotations options

Linkage to Prosper 2050
Profitable, productive and sustainable primary industries

Treatments with the same letter are NOT statistically different P=0.05
Error bars are +/- SE of treatment mean

Crop rotations were only part of the solution

- Organic matter retention is extremely important as it drives microbial activity – The goal is developing soil suppression to adverse biology. Dr G Stirling was heavily involved in this project.
- Reduced tillage is important as the biology that drives suppression is easily disrupted by aggressive tillage.
- If we can't control traffic (constrain traffic to traffic zones) then we are locked into the 'tillage treadmill'

This a story about the soil & soil health

Soil health = chemical, physical and biological

The “New Farming System” has 4 key components

Grain legume rotations

Reduced Tillage

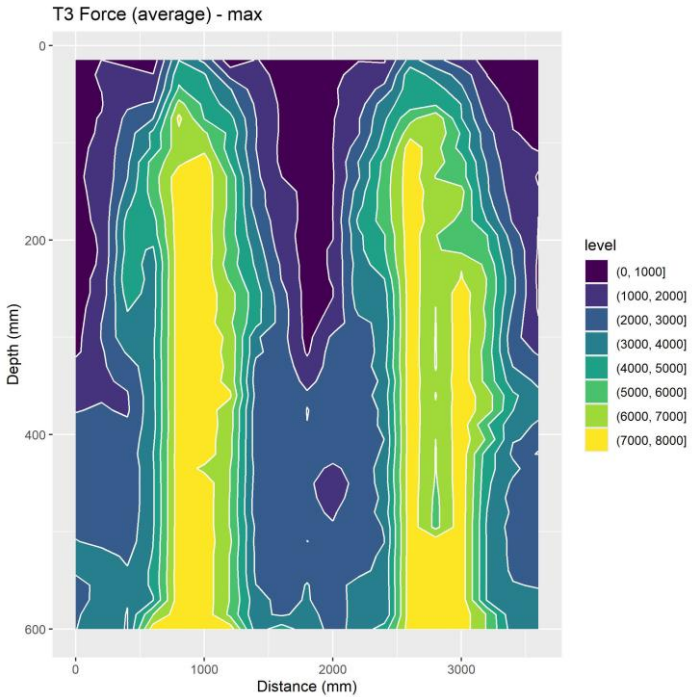
Controlled traffic

Trash retention

Why control traffic?

This is a story about machinery driving agronomy

Data driven constraint – Soil Structural Degradation



I would argue that most districts have no idea of how massive their soils are. We are growing sugarcane in a 'bonsai' pot

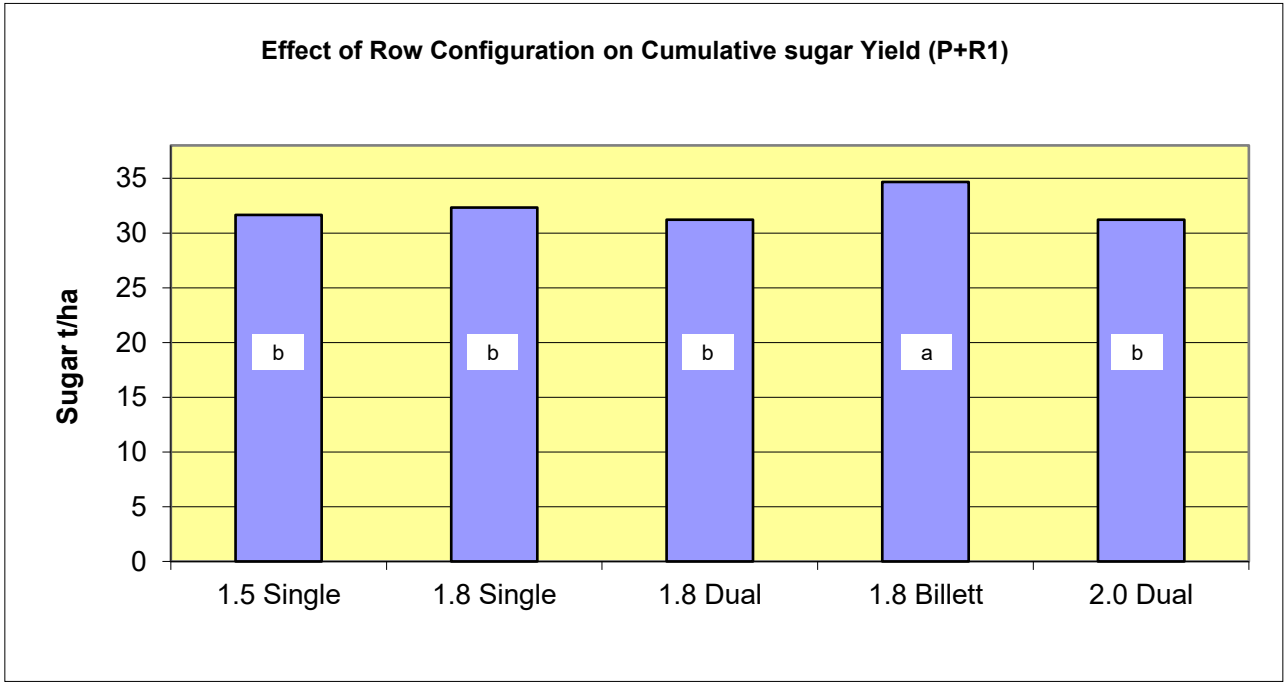
How much traffic at cane harvest?

A typical harvester operation can cut 1000 Tonne / day

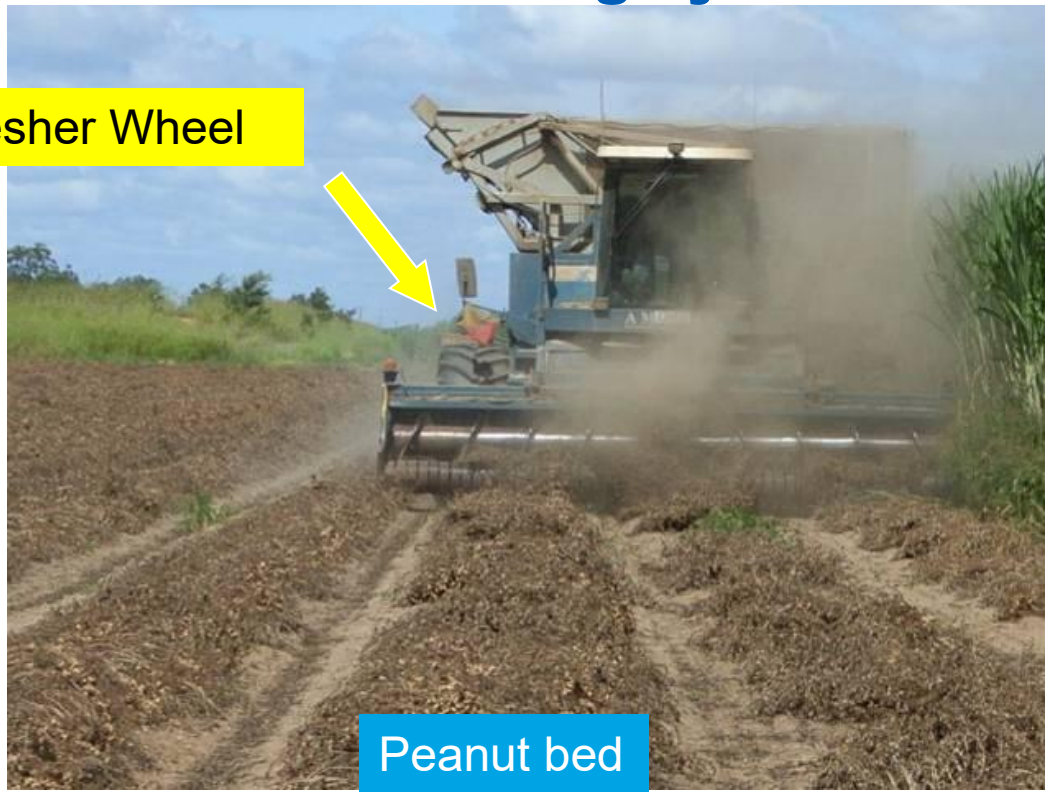
On 1.5m rows this operation results in 372 TonneKm/ha

In the grains industry the equivalent operation results in 52 TonneKm/ha

Controlled traffic = altering row configuration. What was the impact on yield?



The challenge of bringing principles together in a farming system



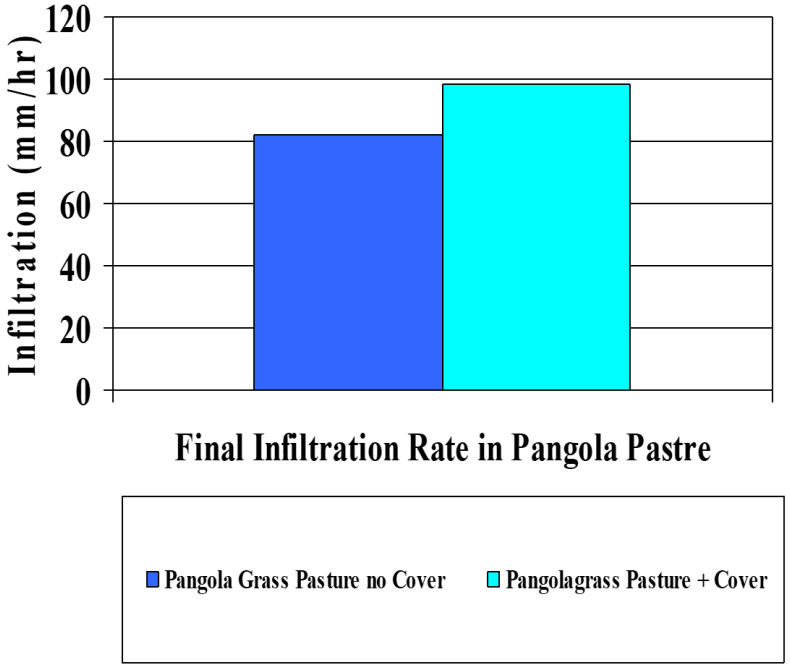
Can you tell where the thresher drove???

Controlled traffic and min till go hand in hand

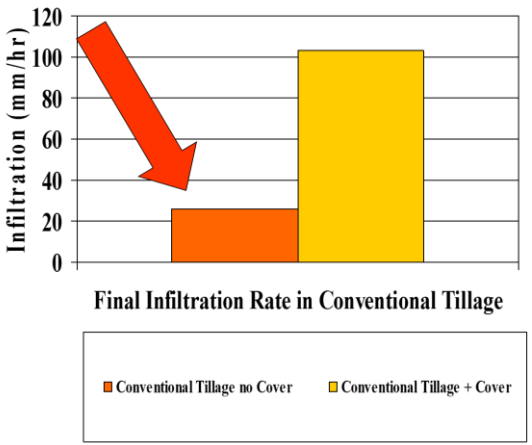
If you don’t drive on the bed you’re a long way in front!

There are solutions you just have to look for them

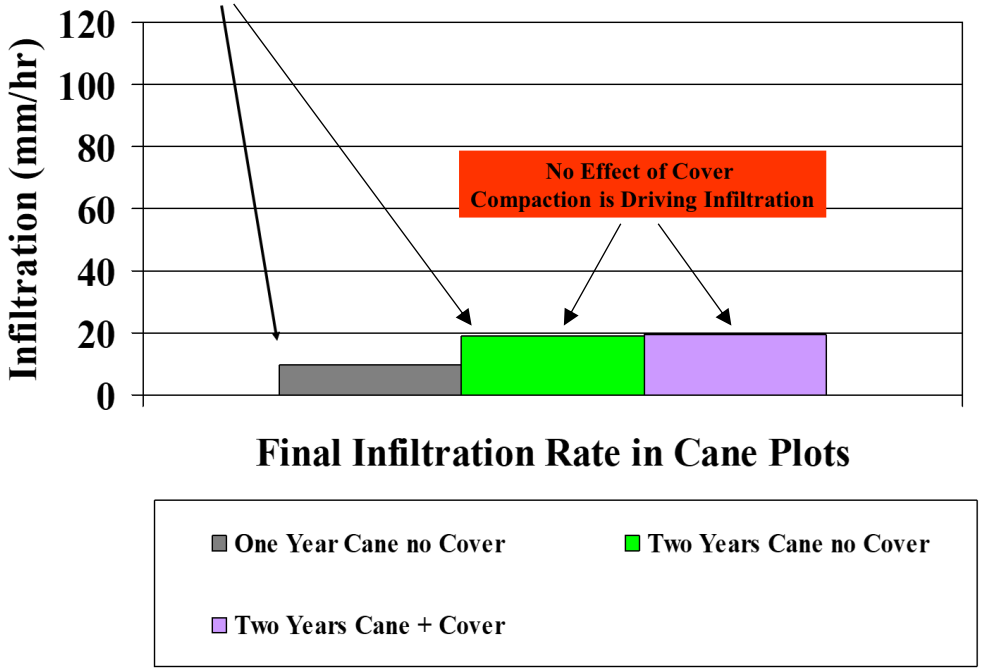
Very Little Cover Effect due to Stable Aggregates



Surface Sealing Reducing Infiltration



1 Year Trash Blanketing has improved Aggregate Stability

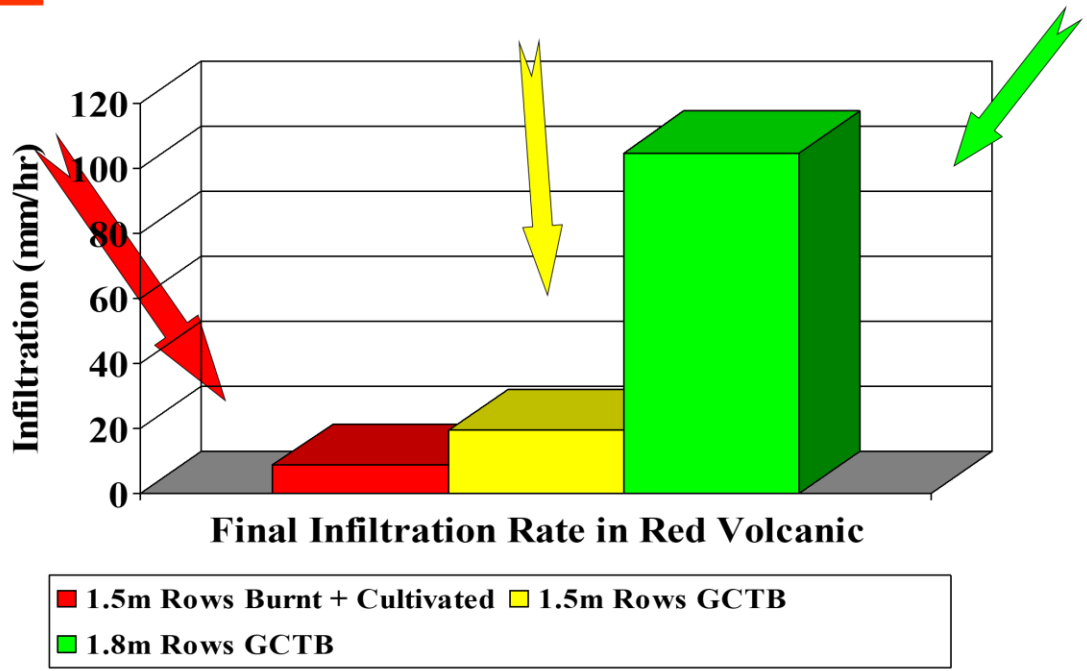


Combination of Compaction and unstable aggregates

Row Spacing Effect on Final Infiltration Rate in a Red Volcanic

Low haulout axle Loads and matching rows

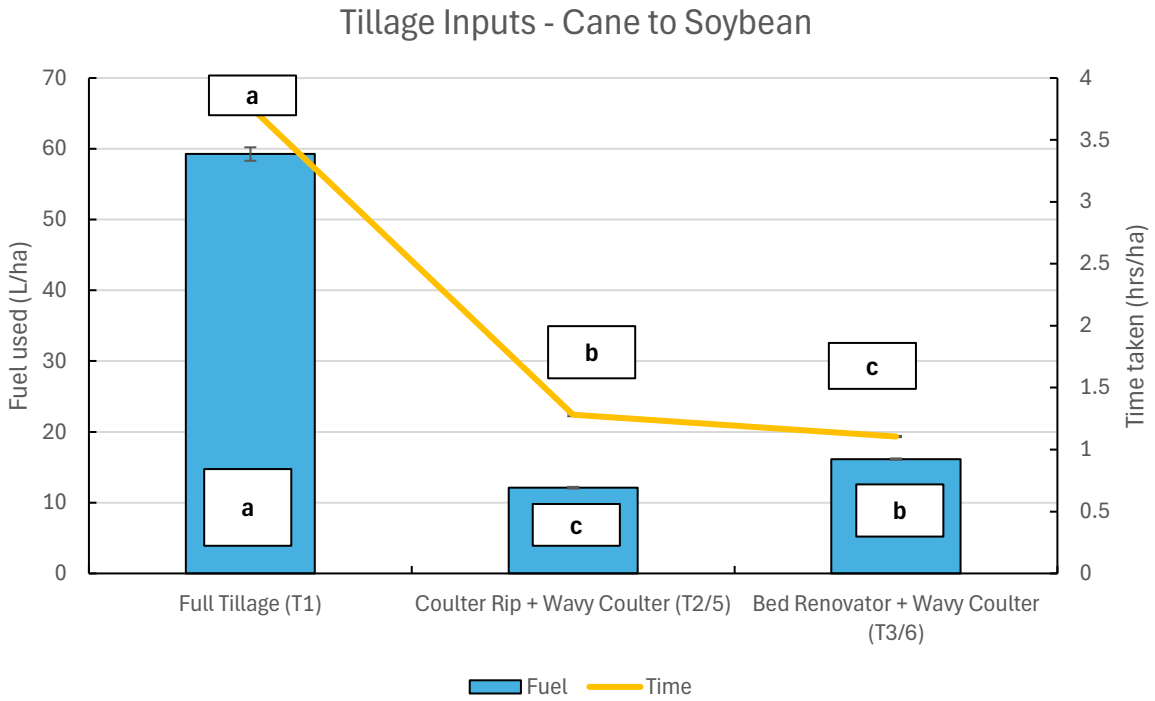
Compaction effect still present



Most current work – cycling from cane to legumes and back to cane

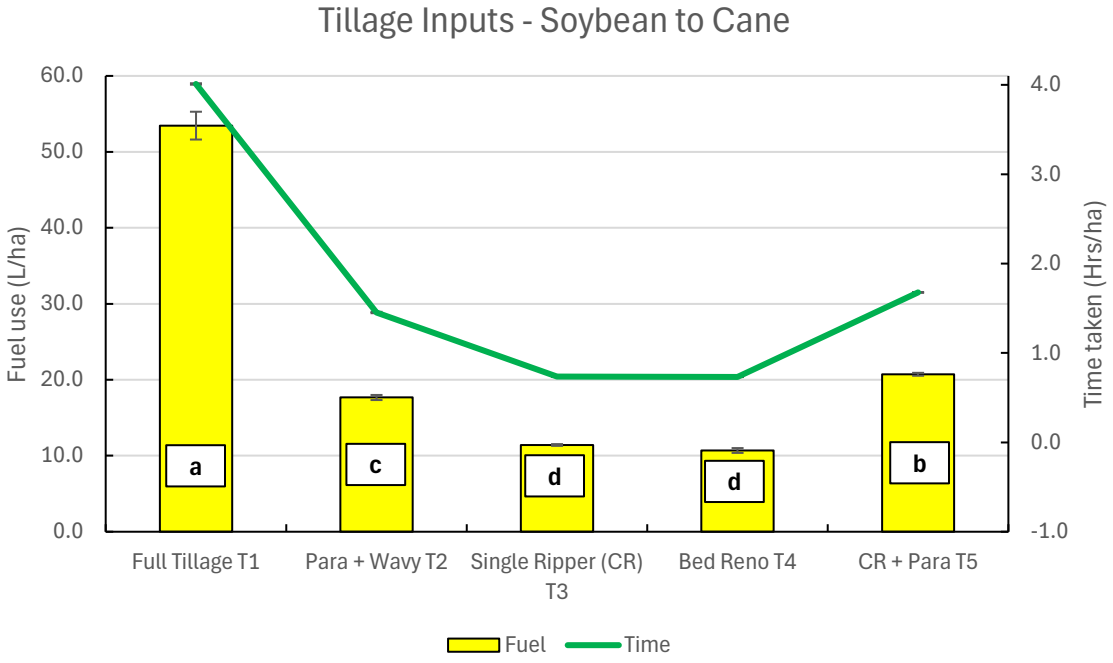
Large scale tillage trial

Cycling from cane to legumes and back again with as little tillage as possible

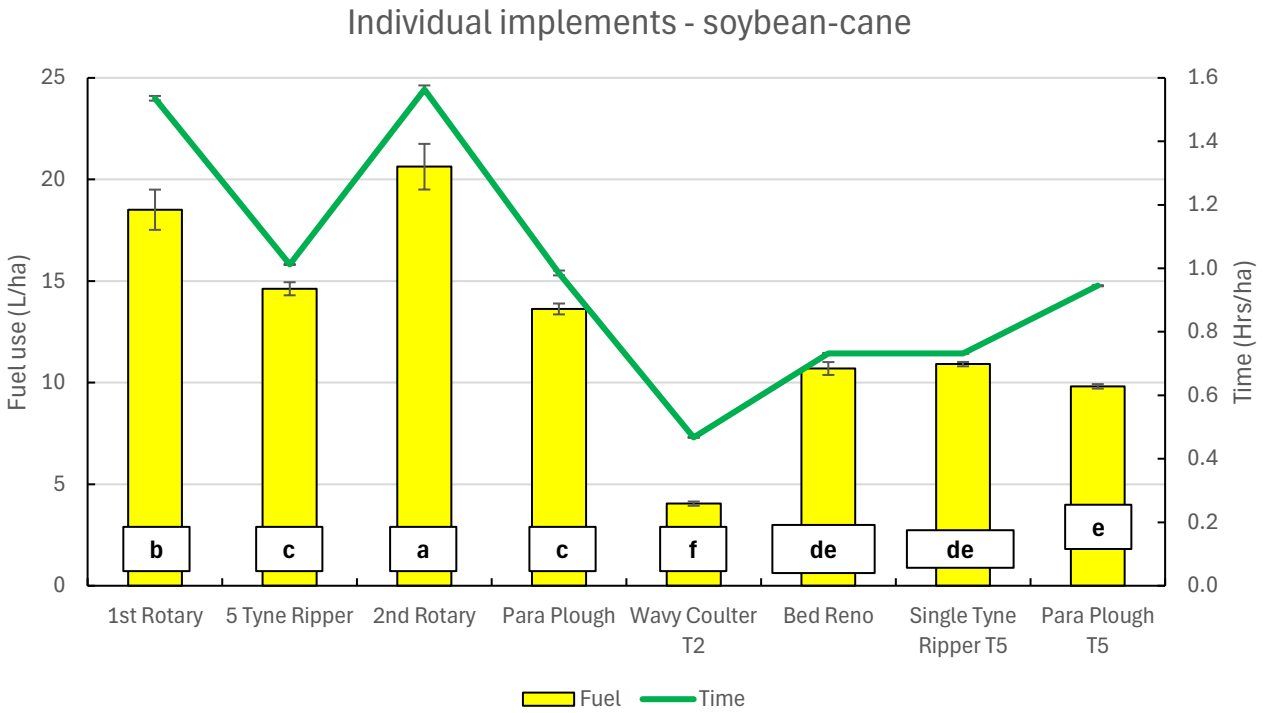


Alternative tillage gear

Cycling from cane to legumes and back again with as little tillage as possible



Cycling from cane to legumes and back again with as little tillage as possible



We have contributed significantly to getting the industry back on track!

However, horticulture is part of our farming system too!

Does this fit intensive vegetable farming system?

Cane Trash Raked for Removal – Will interfere with fertiliser additions

OM Removal

Reduced Tillage? Operations (may not be entire list)

- Rotary hoe * 2
- Square plough
- Rotary hoe
- Rip
- Power harrow
- Rotary hoe with fertiliser bin and bedformer
- Lay plastic mulch

Controlled traffic? Stops the spray rig getting bogged!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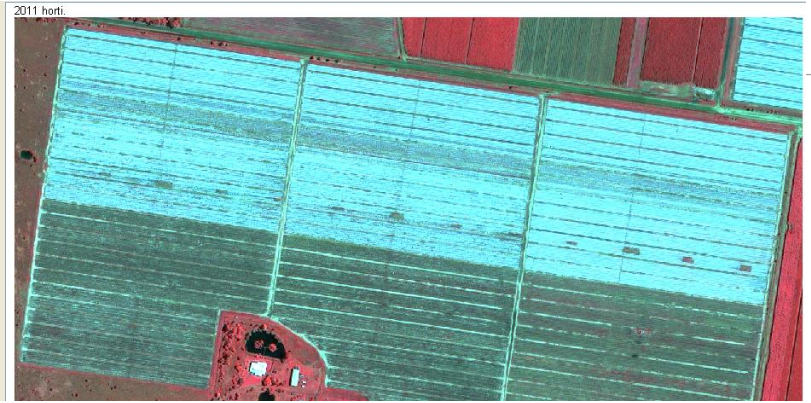
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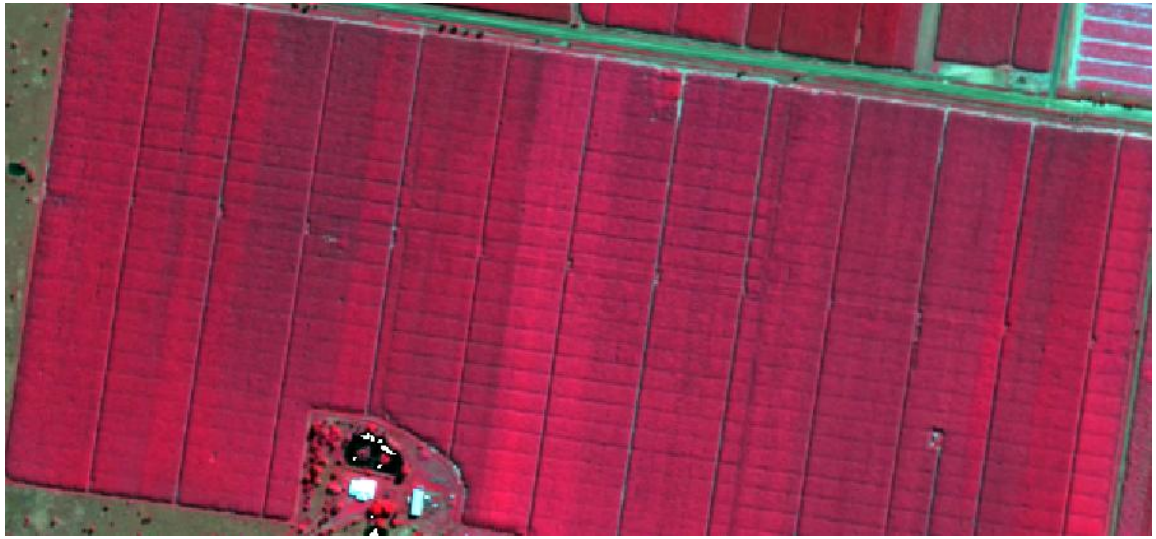
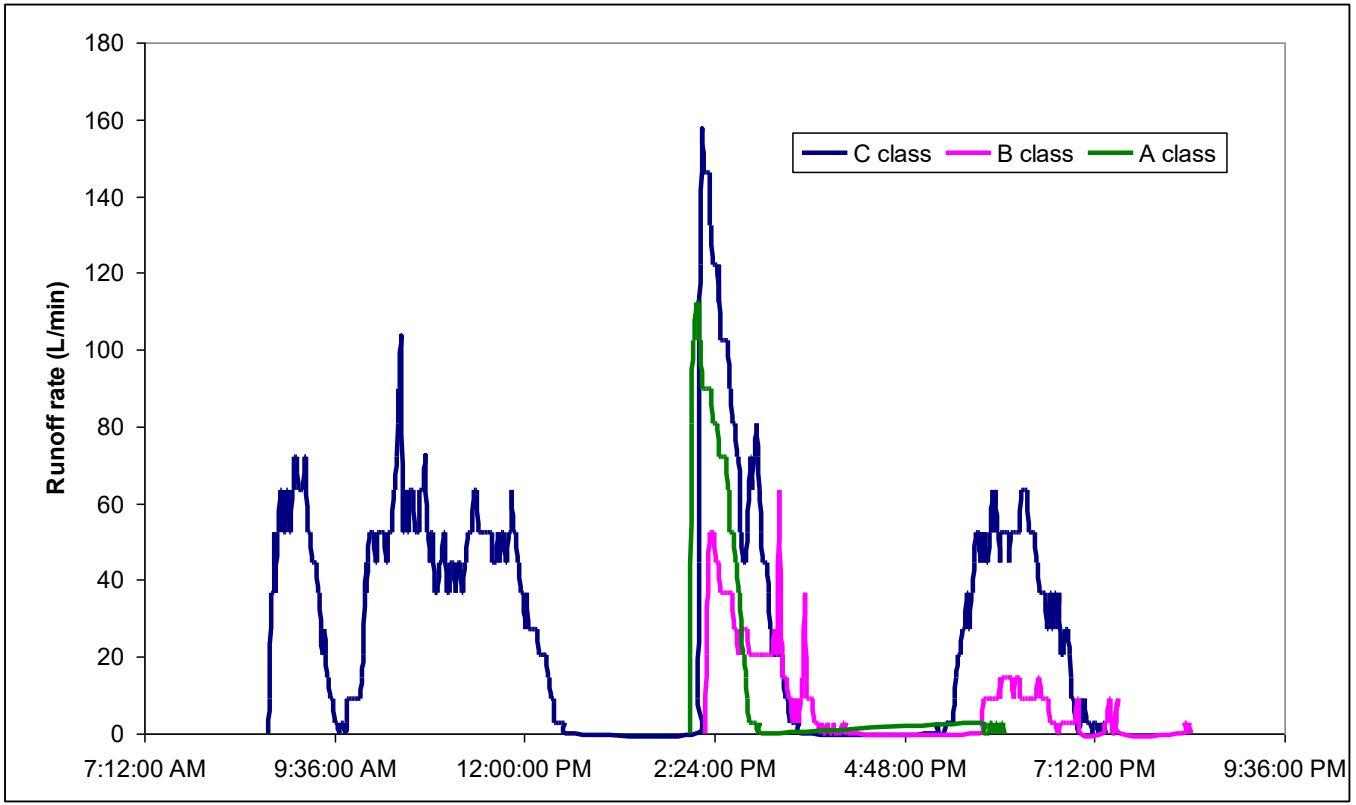


Management systems at the site

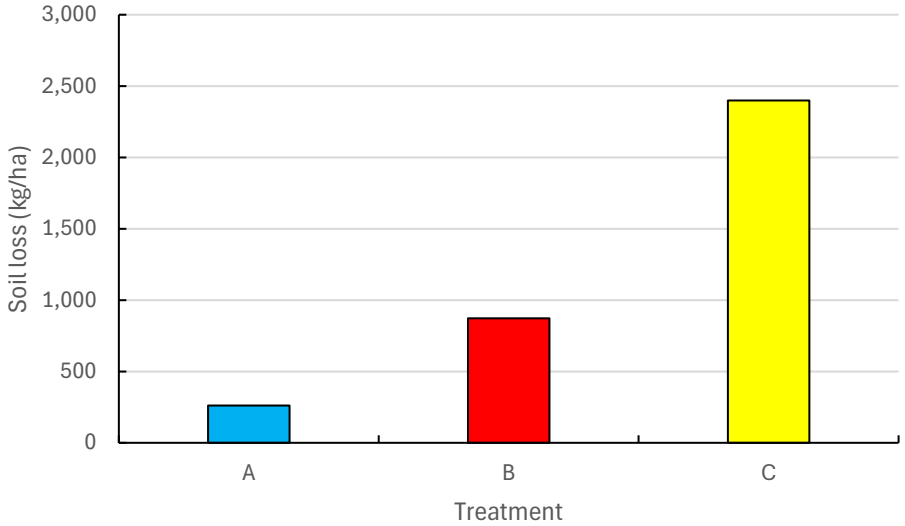
C Class Horticulture -cane	B Class Horticulture - cane	A Class Horticulture - cane	New sugar farming system Cane -soybeans	A Class Horticulture only (H)
Sugarcane – harvested green				
Land management prior to break crop establishment				
Cane trash burnt	Cane trash burnt	Trash blanket retained	Trash blanket retained	Rhodes Grass retained
Full Cultivation	Full Cultivation	Bed centre rip	Direct Drill	Bed centre rip
Plastic Mulch	Plastic Mulch	Trash mulch	Trash mulch	Grass mulch
Bare inter-row	Millett inter-row	Trash mulch	Trash mulch	Grass mulch
Spring/summer				
Capsicum	**Capsicum**	**Capsicum**	**Soybean**	**Capsicum**
Fertiliser Input (kg/ha) – current crop				
315 N 130 P 306 K 172 Ca 38 Mg 73 S	147 N 35 P 175 K 87 Ca 26 Mg 35 S	200 N 24 P 200 K 97 Ca 26 Mg 38 S	50 K	200 N 24 P 200 K 97 Ca 26 Mg 38 S

Plastic mulch laid and Jap Millett sown

Example from a single event

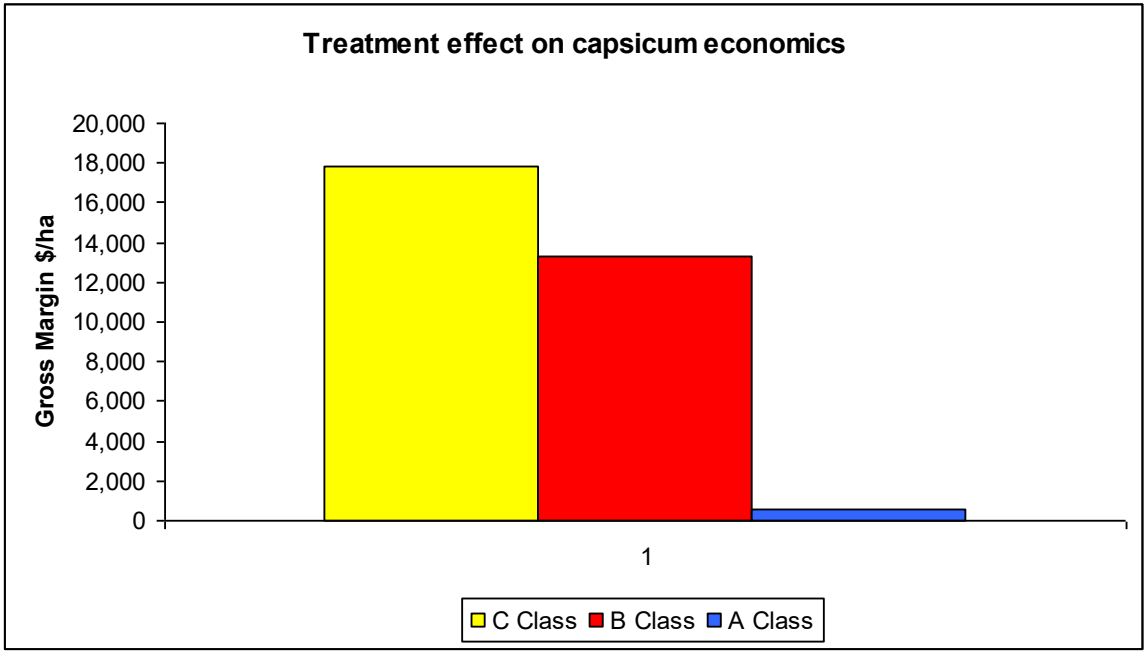


Treatment effect on soil loss

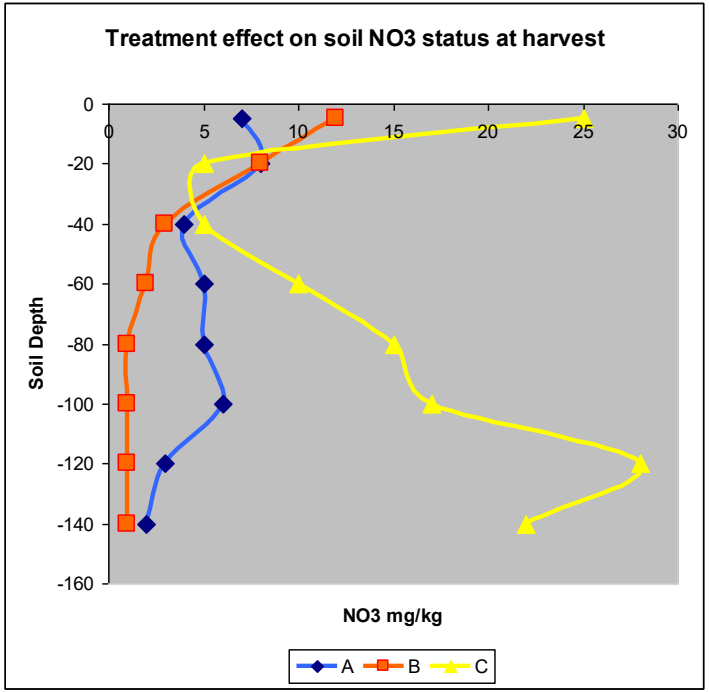


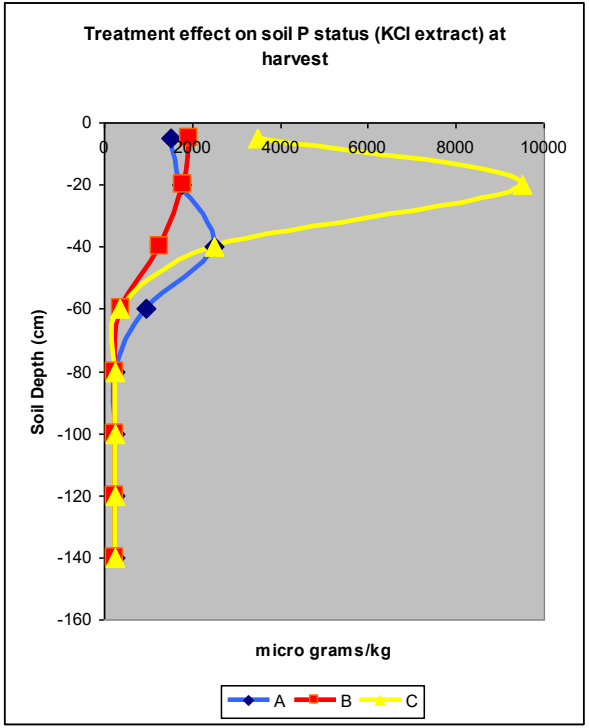
Treatment effect on economics

	Crop value $/8kg box		
	Green	Mixed	Red
Week average	22.4	11	22



What is left in the soil at harvest?





There are no problems – only solutions

The challenge is real, balancing productivity, profitability and positive environmental outcomes.

Having good agricultural practitioners embedded in RD&E programs is key to realising these goals

Acknowledgements

My Coastal Farming Systems Team
Sugar Yield Deline Joint Venture
DAQ00204 GRDC funded ‘Grower solutions project for coastal/hinterland Queensland and NSW North Coast;
SRA funded 2017/0012 Southern Sugar Solutions project
Department of Primary Industries; Queensland Reef Water Quality Program

These trials are not possible without the co-operation of growers allowing us access to their farms and assistance from their farm staff .