Productivity and Sustainability Effects of Conservation Agriculture

Jeff Tullberg

CONTROLLED TRAFFIC FARMING
CTF solutions

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

This Presentation:

- **Summarises the evidence on yield impact of conservation agriculture (v. traditional tillage).**
- **Discusses the effect of management system impacts on the fundamental inputs to yield.**
- **Relates crop performance and environmental impact to effective targetting of inputs.**

Cropping System Definitions

Traditional Tillage (TT): multiple tillage operations/crop to bury residue, control weeds, prepare seedbed. Random traffic.

Zero Tillage (ZT): less than one tillage operation/crop to level surfaces or break compaction. Herbicide weed control and an advanced planter to seed hard soil through crop residue. Random traffic.

Controlled Traffic or Permanent Raised Bed (CTF or PRB): maximum of one non-inverting tillage or bed-forming operation. Herbicide weed control. Controlled traffic

System Change- Yield Experience

Traditional Tillage (TT): Improved crop yields in early phase of mechanisation (deeper ploughing, timeliness etc).

BUT: **erosion and related problems became obvious.**

Zero Tillage (ZT): Erosion fixed, yield increased slowly after initial decline with system rebalancing, farmers learning.

BUT**: compaction and herbicide issues continue.**

Controlled Traffic or Permanent Raised Bed (CTF or PRB): Compaction fixed, yield improves with new learning. New approaches to weed control.

What Controls Yield (Potential)?

(with apologies to plant breeders!)

- Water: Usually the major limitation.
  timing is also important
- Nutrition: Must be available *and* accessible to roots.
- Sunlight: Largely out or our control.
  but we will return to this later

Cropping System Yield Effect

Traditional Tillage (TT) with multiple tillage operations to bury residue, control weeds, prepare for planter.

Water: Primary tillage improves infiltration where surface has been compacted and stripped bare by grazing.

Nutrition: Tillage breaks soil aggregates, speeds organic matter mineralisation, increases nutrient availability, particularly when going steadily deeper.

Problems: Aggregate breakdown and organic matter loss soon result in structural damage, surface sealing, no more organic matter to mineralize etc.

Cropping System Yield Effect

Zero Tillage (ZT): Tillage functions replaced by herbicide weed control and a planter able to seed hard soil through crop residue.

Water: Surface protection by anchored residue improves infiltration. Better soil health improves water availability.

Nutrition: Often the initial problem- but relatively cheap fertiliser can fix most problems (or cause pollution).

Problems: Soil compaction. Surface effects complicate planting, subsurface effects limit roots and available water. (Problems appear faster with big machinery) Herbicide issues.

Cropping System Yield Effect

Controlled Traffic or Permanent Raised Bed (CTF or PRB): fixes compaction, improves trafficability and precision.

Water: further improvement in infiltration and water availability. Runoff and drainage management system.

Nutrients: improved root exploration and improved soil health = better fertiliser efficiency.

Sunlight: permanent traffic lanes mean 20% less sunlight harvested in 1st weeks of growth (before full cover)

Evidence

- Crop Yield
- Rainfall Infiltration

Mean Grain Yield Over 6 Years, 9 Crops - (Australia)

t /ha

	Wheeled	Controlled Traffic
Tilled	**3.5**	**3.8**
Zero Till	**3.7**	**4.0**

Mean Wheeling Effect = 10%

Mean Zero Till

Effect = 5%

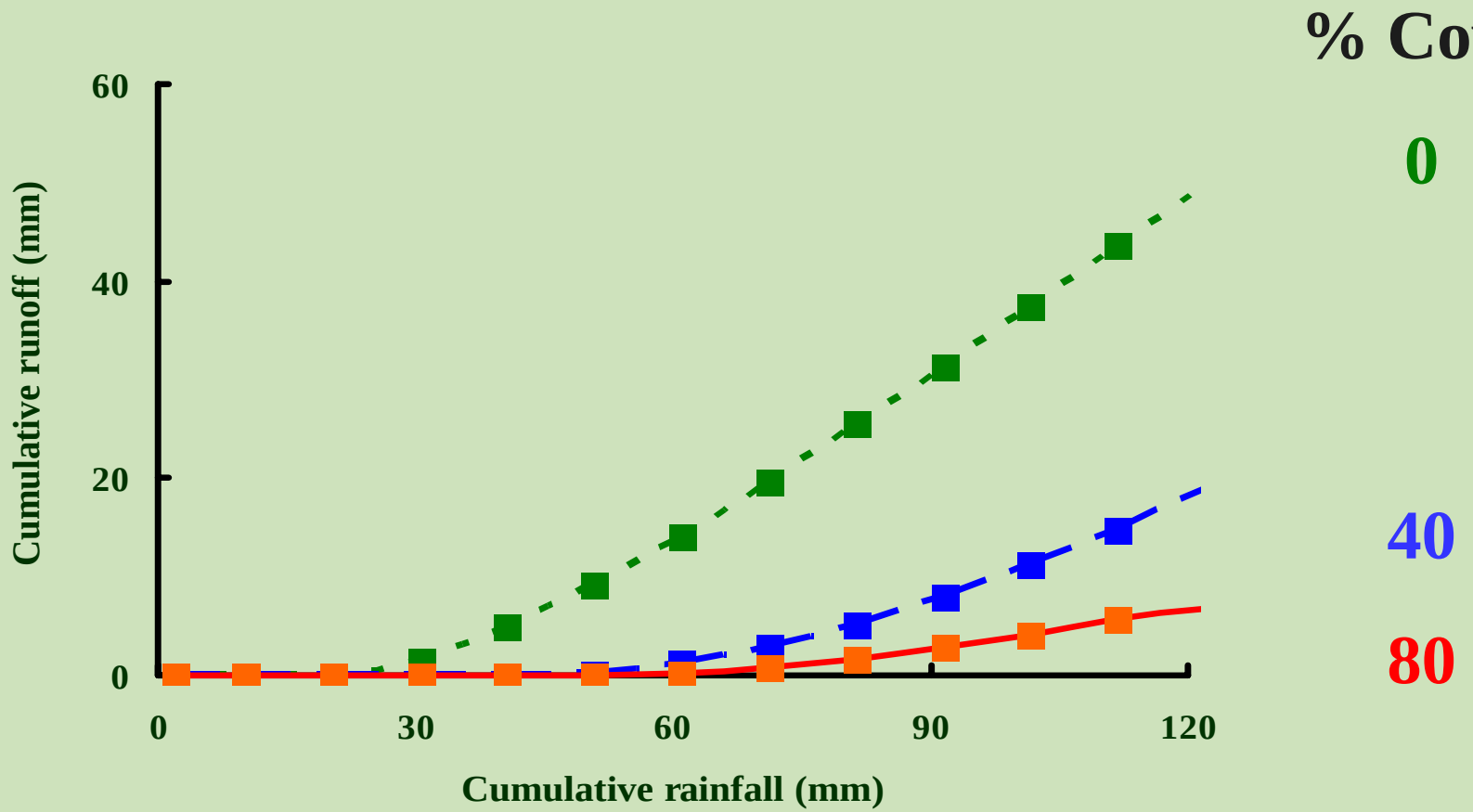
Problem of side-by-side plot comparisons

Planting Timeliness,etc

Rainfall Simulator Results

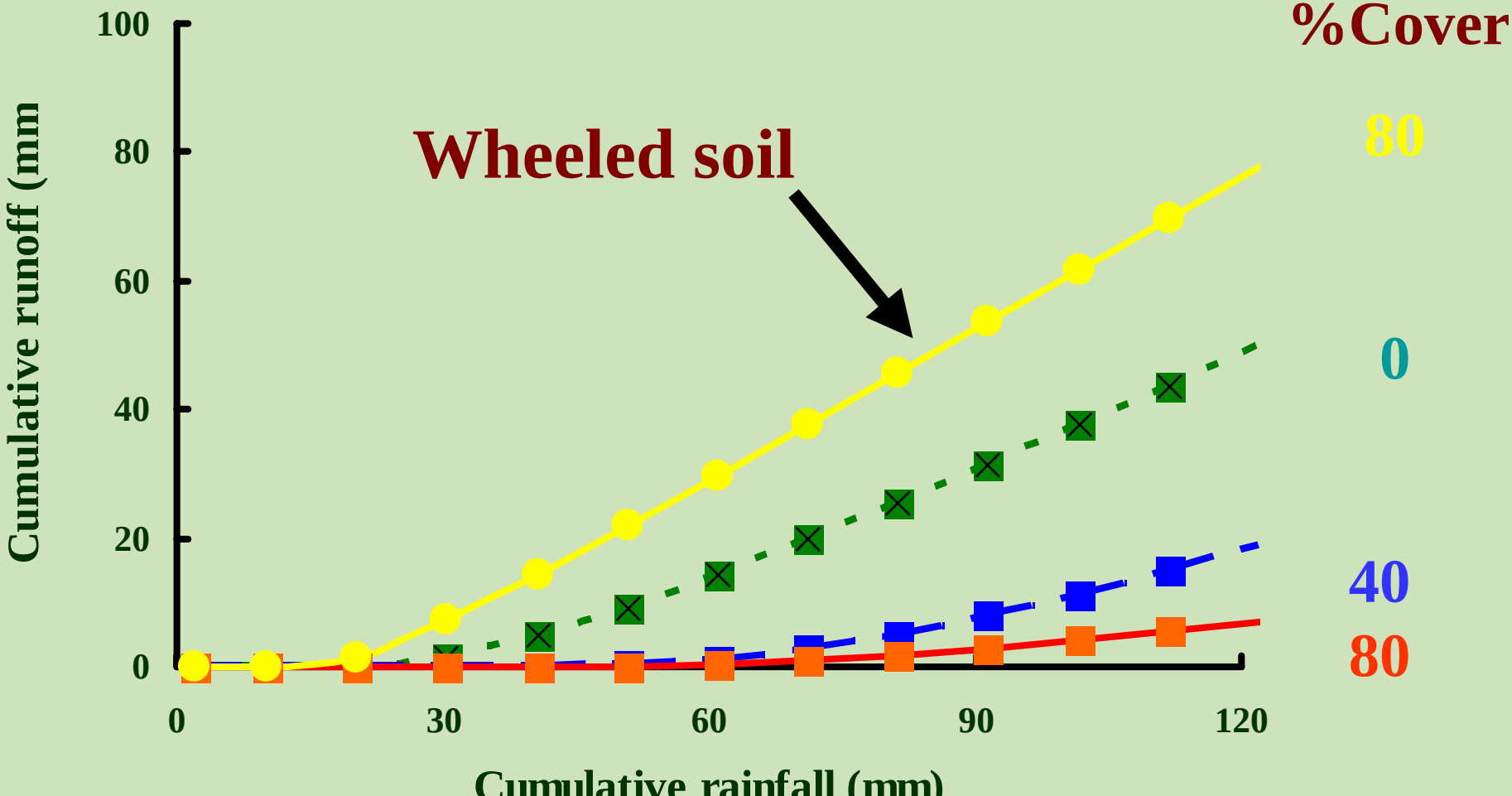
Runoff from non-wheeled soil Li

Message: Residue cover reduces runoff and soil loss.



Runoff from wheeled and non-wheeled soil

Message: Wheeling destroys residue benefits.



We waste energy driving wheels everywhere, compacting soil

and

Reduce Infiltration

Increase Runoff, Erosion, Nutrient Loss and Pollution

We waste energy driving wheels everywhere, compacting soil

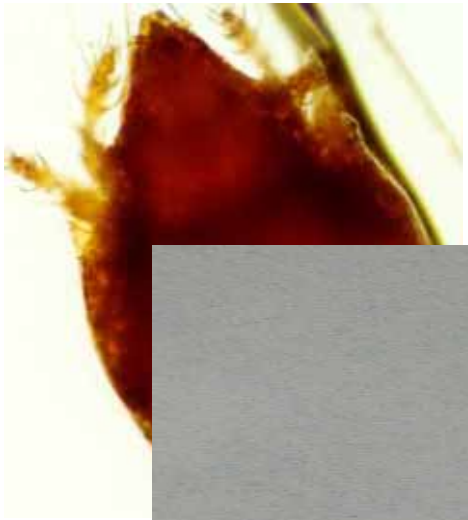
and

Destroy Soil Life

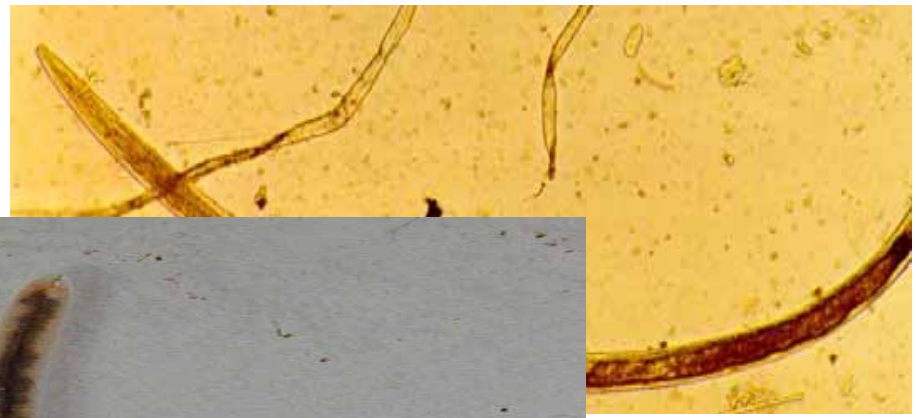
Compaction Damages Soil Health, Reducing its ability to Hold Nutrients Available for Crops

Sampling for soil organisms

- Acarina (mites)



- Free-living nematode



- Collem

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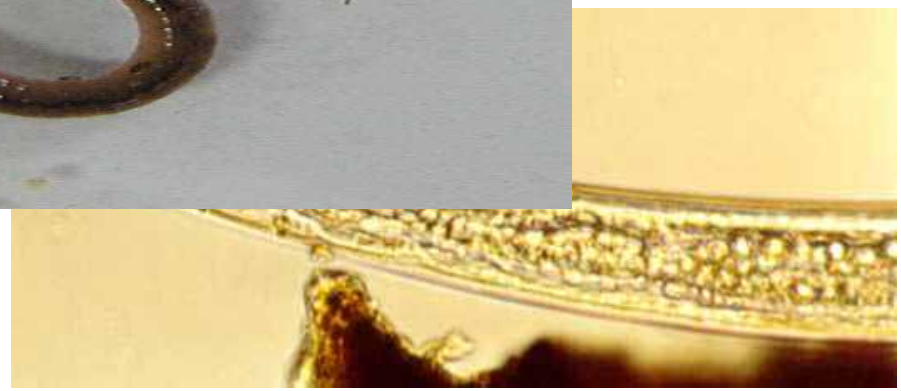
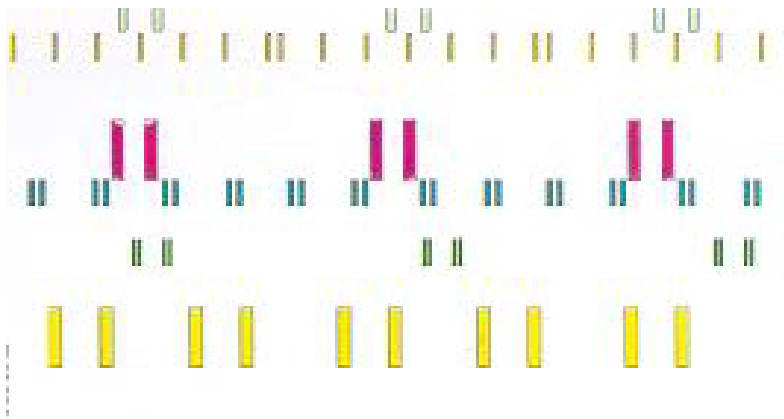
Earthworms



We waste energy driving wheels everywhere, compacting soil

Plan View:
Tractor
and
Machine
Wheels



1 Tillage

1 Planting

1 Spraying

1 Harvest

We waste energy driving wheels everywhere, compacting soil

……and then apply nitrogen in a slot in the moist compacted root zone.

Ideal conditions for Denitrification!

Compaction is part of the reason more than 50% of Fertiliser N is often Wasted

(as Greenhouse Gas or Water Pollution)

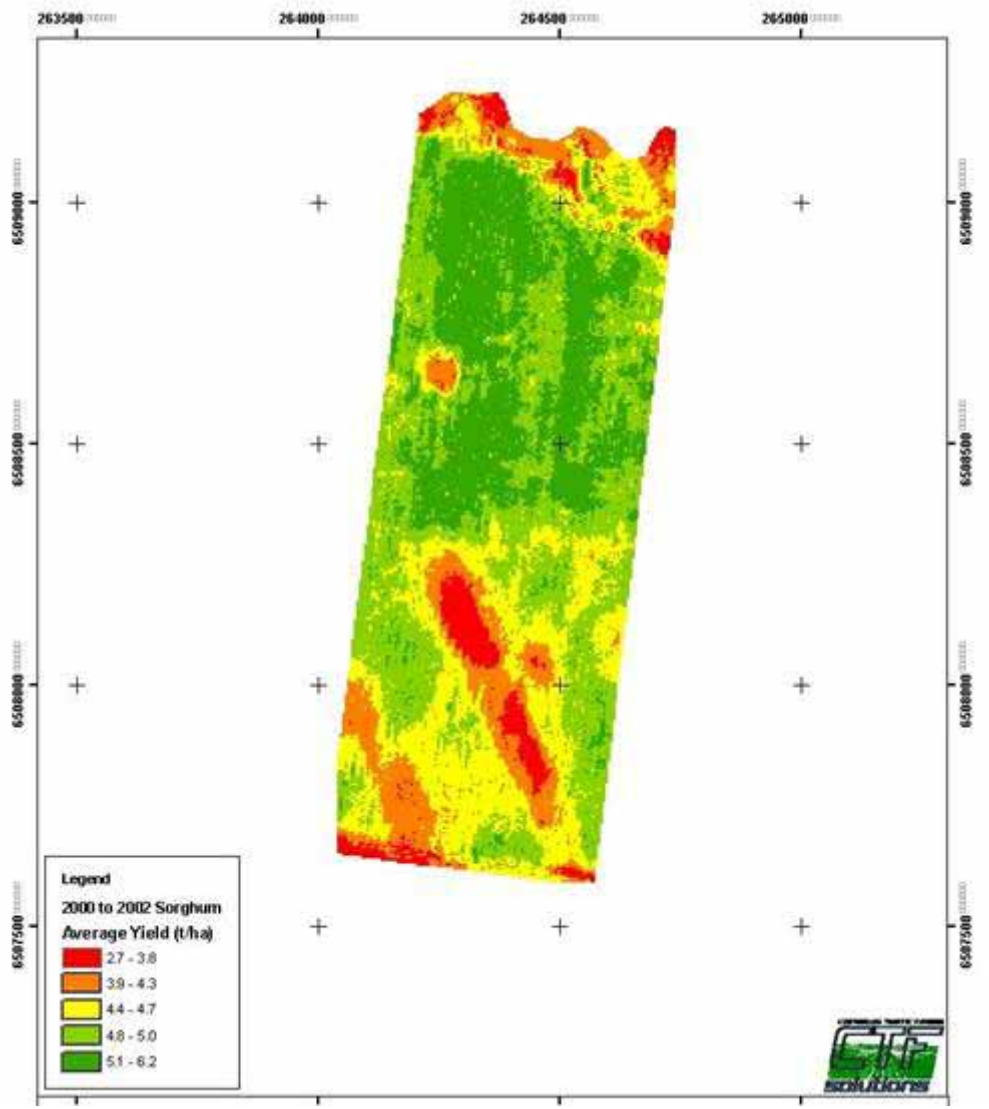
General Message

- The environmental damage of agriculture is largely caused by wasted, or poorly targeted, expensive inputs!

- Energy - to random soil compaction
  loss of water, soil, nutrients

- Fertiliser and Crop Chemicals
  overall, rather than placed or banded.

Precision Agriculture In Australia



Precision Agriculture In Australia

- Mapping production zones
  - "Traditional" Precision Agriculture
  - Limited uptake by farmers
- Precision guidance (2cm gps)
  - Used for CTF, PRB, Banding, Placement
  - Rapid Adoption for range of reasons,
  - Good economic and environmental results.
- More Productive and Sustainable

The Important Component!

Thank You