Compost characteristics and compost use, including soil carbon credits

Johannes Biala
Director, Centre for Recycling of Organic Waste and Nutrients (CROWN), School of Agriculture and Food Sciences, University of Queensland

1

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Using Compost Wisely and Beneficially

Johannes Biala
Centre for Recycling of Organic Waste and Nutrients (CROWN)
The University of Queensland

2

Finally – You Have Successfully Navigated Regulatory and Technical Hurdles, Made Compost and its Ready to Use!

Source: http://managingnutrients.blogspot.com.au/

Some Important Questions

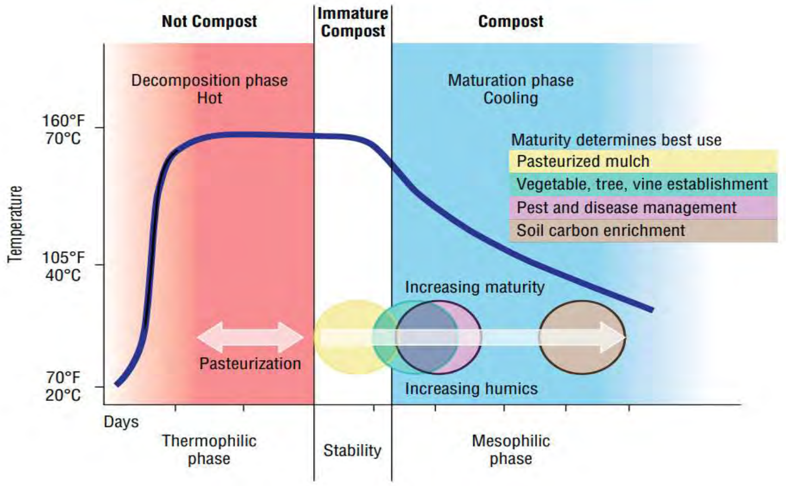
- What type of compost do you have?
- Where and for what purpose do you want to use it?
- What benefits do you want to achieve?

What Determines Compost Characteristics?

Compost characteristics & the benefits of using compost depend on

- feedstock materials
- processing (duration, temperature, moisture, aeration, **i.e. management**)
- storage (duration, conditions)
- value-adding (e.g. screening, adding lime / gypsum / nutrients / inoculants)

Composting Process and Product Quality



Modified from: Bob Paulin
WA Dept of Agriculture

Compost Characteristics

- Macro nutrients (N, P, K, Mg, Ca) – you need total & available content - often limited N but considerable P and K
- Micro nutrients (S, Zn, Mn, B, Mo….)
- Neutral pH (7 - >8) / Liming Effect
- Both labile and stable carbon compounds
- High cation exchange capacity
- High water holding capacity
- Low bulk density
- Diverse microbial population

What to watch out for

- Heavy metals
- High soluble salts (Na & Cl = bad salts, plant nutrients = good salts)
- Biosecurity risks (weeds, animal & human pathogens)
- Herbicide residues (Clopyralid, Picloram, Aminopyralid)
- High C/N ratio
- Impurities (e.g. plastic, metal, rocks, twine)
- Inappropriate particle size
- Moisture content (too high / too low)

AS 4454 Provides Limited Quality Assurance

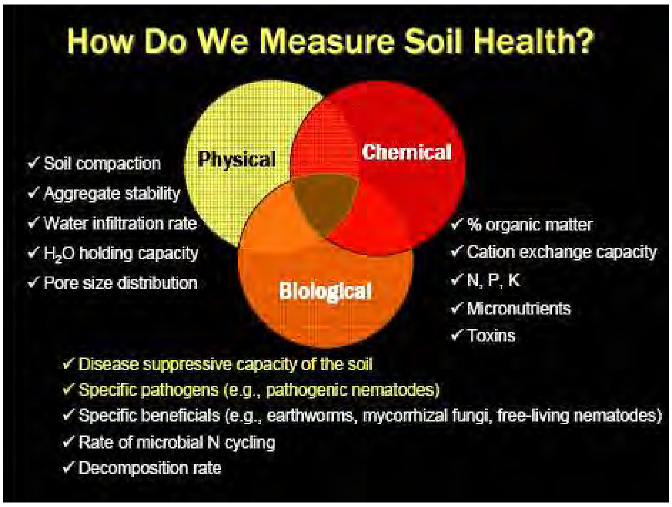
Australian Standard AS 4454
Composts, soil conditioners
and mulches

Voluntary Standard that provides
Minimum quality requirements
for public health protection and
to prevent major end-use problems

Certified Product ™
Australian Standard

Compost Products are Multi-Purpose Products

Able to improve Chemical, Physical, Biological Soil Properties



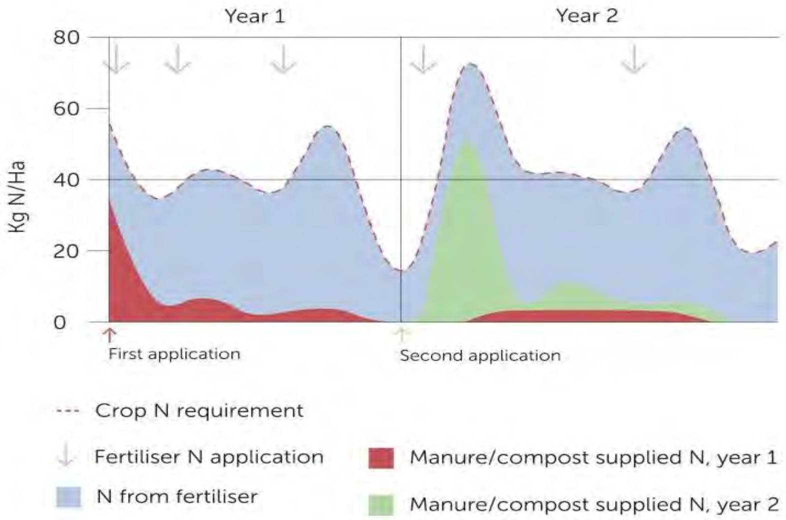
Source: Gugino, 2005

Benefits of Using Compost

- Many agricultural benefits (e.g. soil properties & crop productivity)
- Many environmental benefits (biosecurity, nutrient management)

Today, focusing on
- Contributions to plant nutrient supply
- Contributions to soil carbon stocks

Integrated Organo-Mineral Nutrient Supply



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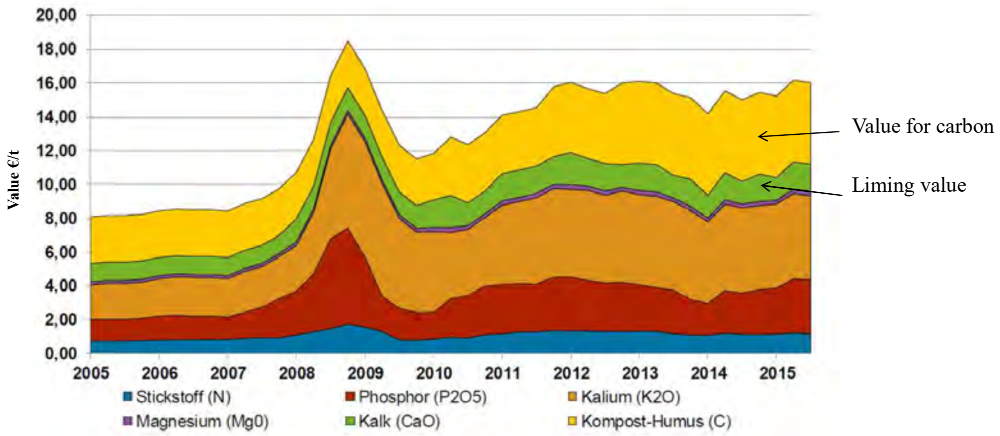
Value of Nutrients, Lime & Carbon in Compost (Germany)



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14

14

Fertiliser Replacement Capacity (Trial Results, Germany)

- Annual use of compost for 9 / 12 years at 5 sites
  (sandy, loamy, clay soils)
- Urban derived compost made from vegetation + food residues
  (1.4% N, 0.3% P, 0.9% K, 38% OM, C/N 17)
- Application rates: 0, 5, 10, 20 t DM /ha annually
- + 0, 50%, 100% recommended N
- Rotation: corn / wheat / barley

Overall Results

Optimum Application Rate
6 – 10 t DM/ha/year

Nutrient Balance - *Total Nutrients*
- about balanced for N, P and K
- large surplus for Mg

Results – P, K & Mg

Compost can replace P, K & Mg fertiliser and substitute liming

Nutrient Balance – Plant Available Nutrients

- **Phosphorus**
  - 15 – 25% soluble (high fertilising efficiency)
  - increased soil P
  - longer-term: 80 – 100% accountable
- **Potassium**
  - 65 – 70% soluble (high fertilising efficiency)
  - increased soil K
- **Magnesium**
  - 7 – 10% soluble (low fertilising efficiency)
  - no increased soil Mg

Compost Nitrogen Use Efficiency

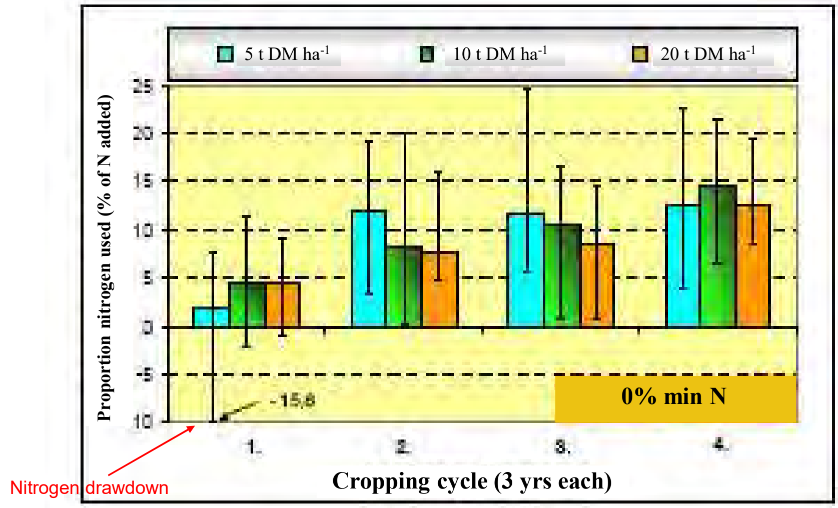
Mineral fertiliser NUE has gone down as N-rates increased

Generally

- 0 – 10% uptake of added N
- < 5% during initial 3 - 4 years
- 5 – 15% if compost applied > 4 years
- N use efficiency higher (5 – 25%) if no / little use of mineral N
- N use efficiency higher if used for crops with high N demand
- Increase of soil mineral N with some utilised later

Increasing Nitrogen Use Efficiency Over Time

(12 years = 4 cropping cycles)



Source: Haber *et al.* 2008

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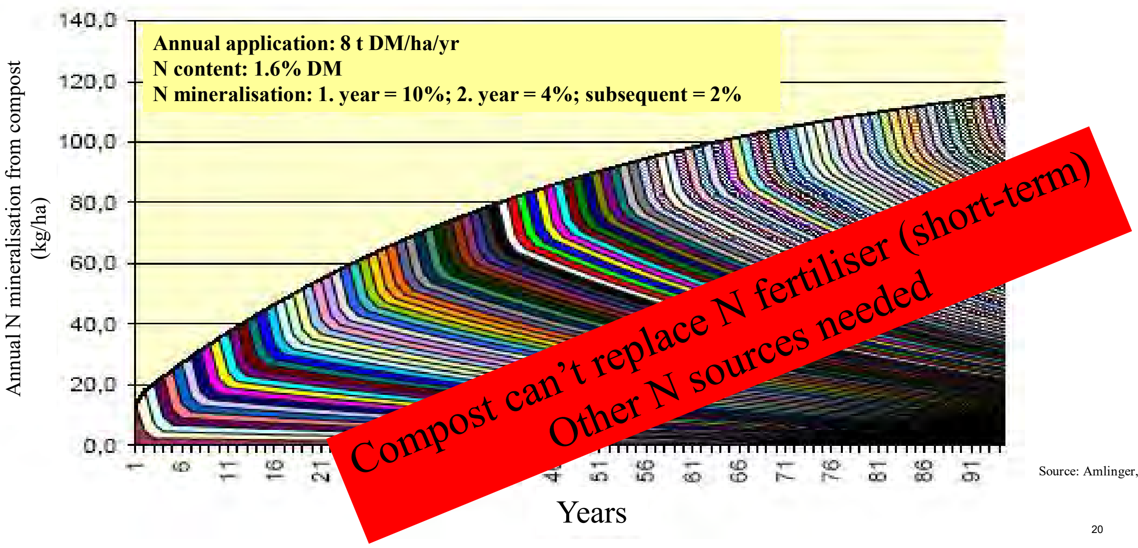
Annual Compost Use = Long-term Nitrogen Supply



Source: Amlinger, 2003

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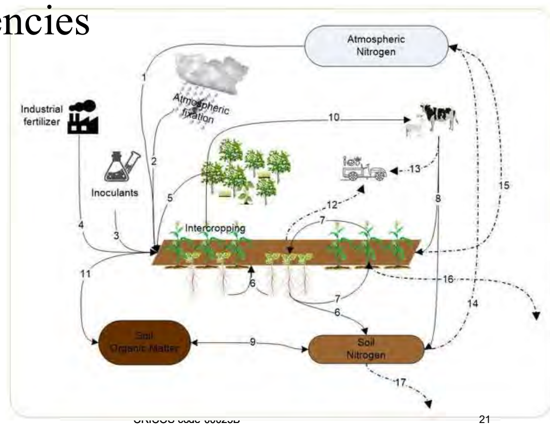
Account for Compost Nutrient Supply in Nutrient Budget

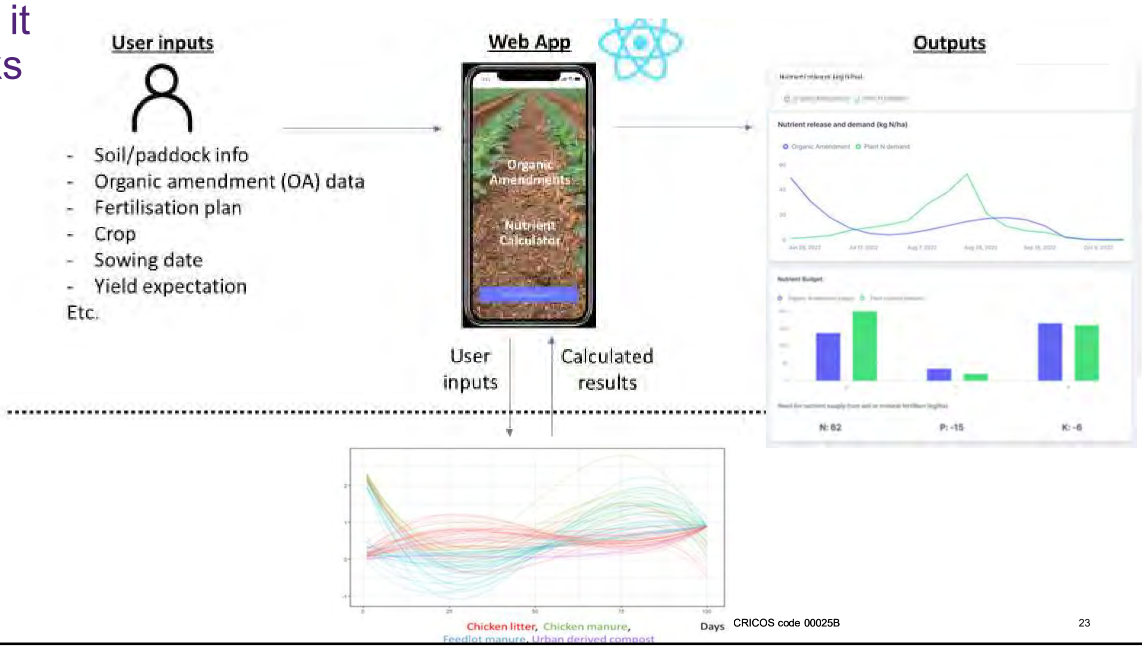
- to see and realise mineral fertiliser savings ($)
- to minimise risks of nutrient deficiencies
- to avert risk of P oversupply
- to prevent environmental problems



Nutrient Calculator for Organic Amendments

A decision-support tool for farmers to…
- integrate nutrient supply from organic amendments into farm nutrient budgets, and
- gauge the mineral fertiliser replacement potential of organic amendments

How it works

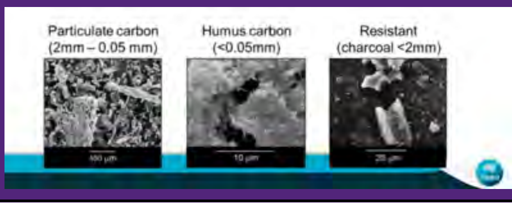


Check it Out and Give us Feedback

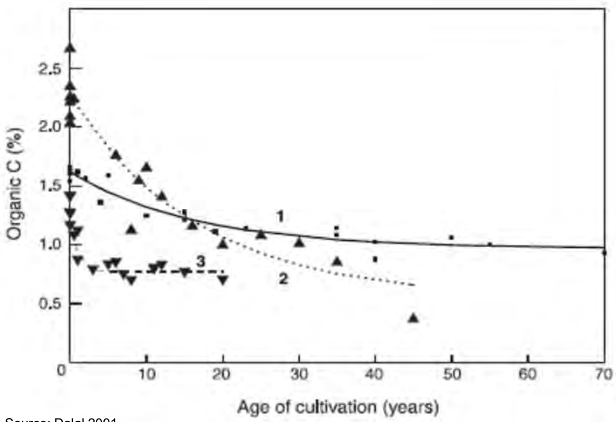
https://oa-nutrient-calculator.netlify.app/

https://docs.google.com/forms/d/1-8xB861sx8mx16ZicZXXsrHvNG5pXBflsEuosqdALmg/edit

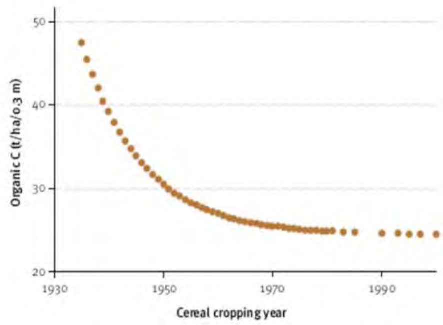
Using Compost
to Enhance Soil Carbon Levels



Soil Cultivation Results in Declining Soil Carbon Stocks

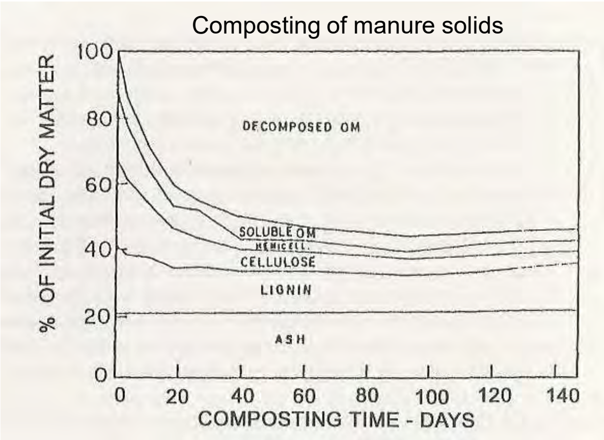


Source: Dalal 2001



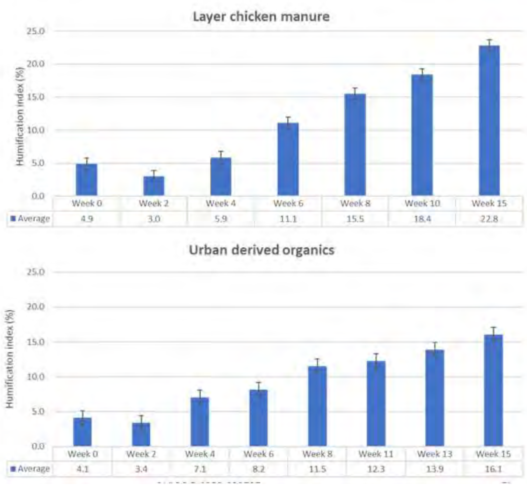
Modelled decline in soil organic carbon since 1935 after land under brigalow was cleared for cereal cropping on the Darling Downs (Dalal et al. 2003)

Composting = Carbon Transformations



Source: Inbar *et al.* 1989 in Epstein 1997

Production of humic acid as proportion (%) of total organic carbon during composting

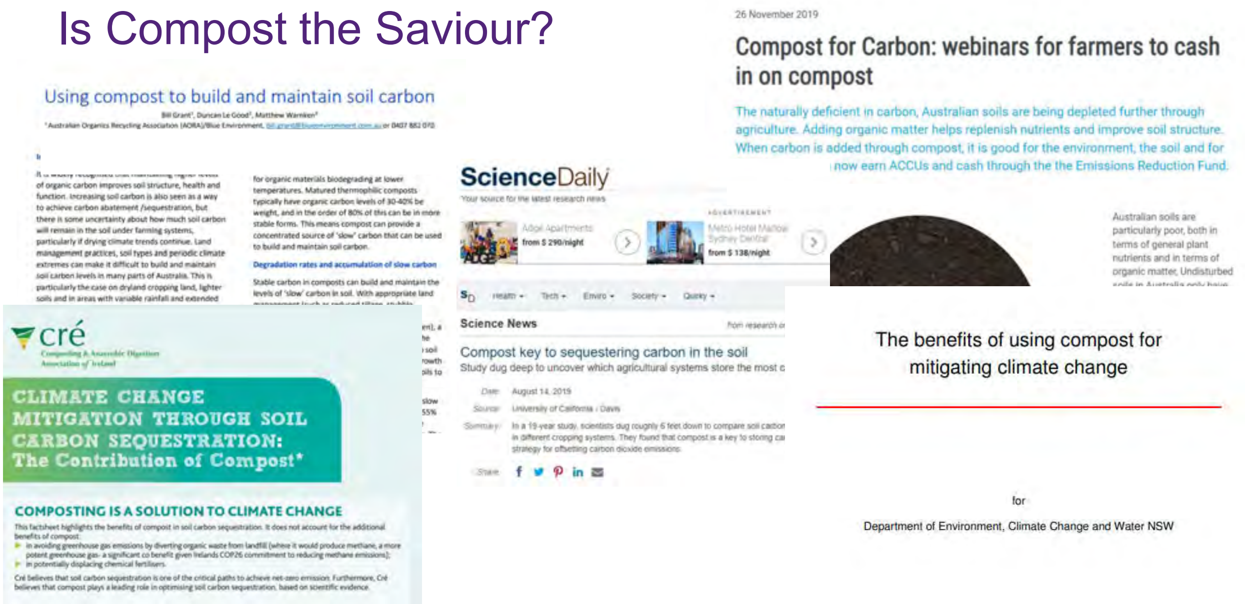


Source: Bennett-Jones 2022

Soil C sequestration as a Priority for Offsetting Australia's GHG emissions

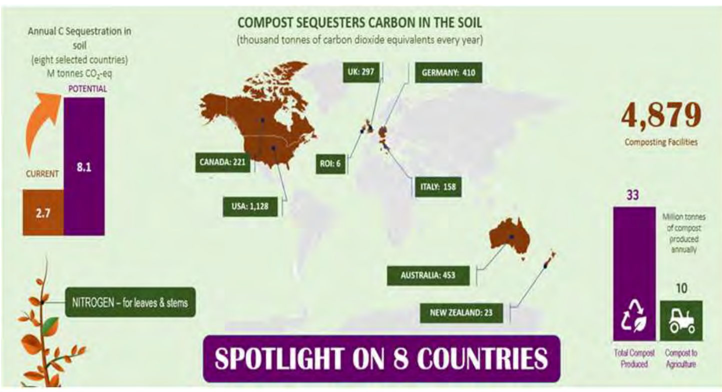
- Significant government investment delivered major scientific, data and technological advances;
- Great potential for SOC sequestration in existing agricultural systems;
- Development of first approved soil carbon sequestration methodology in 2014 (CFI) included compost use as approved practice;
- New ERF methodology allows use of '**non-synthetic fertilisers**' if generated from a dedicated waste stream and if their use is new or significantly different management practice;

Is Compost the Saviour?



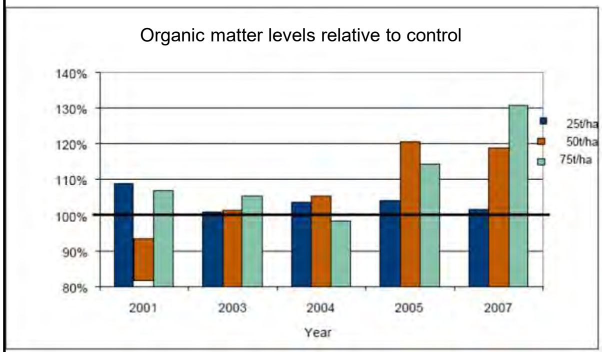
Many Claims, but where is the Evidence?

No systematic quantitative and qualitative assessment of organic amendments despite their obvious contribution to SOC turnover and stocks



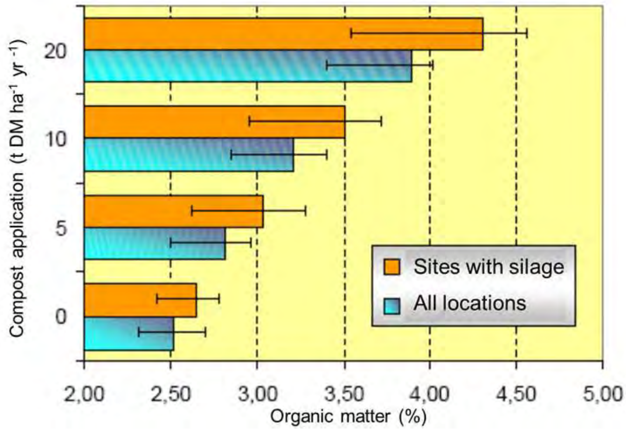
Effect of Urban-Derived Compost on Soil Organic Matter

Five fields / 2 farms in UK over 7 years



Source: Davison 2008

Five farms in Germany over 9 / 12 years



Source: LTZ 2008

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31

Simulating the effects of using manure & compost in QLD

Example:
20 years of continuous sorghum cropping at 3 locations in Queensland with varying soils and climatic conditions.
Simulated scenarios (fresh matter application rates):

- Manure application at 3 t/ha and 10 t/ha annually and at 3-year intervals
- Compost application at 5 t/ha and 15 t/ha annually and at 3-year intervals
- No compost or manure application

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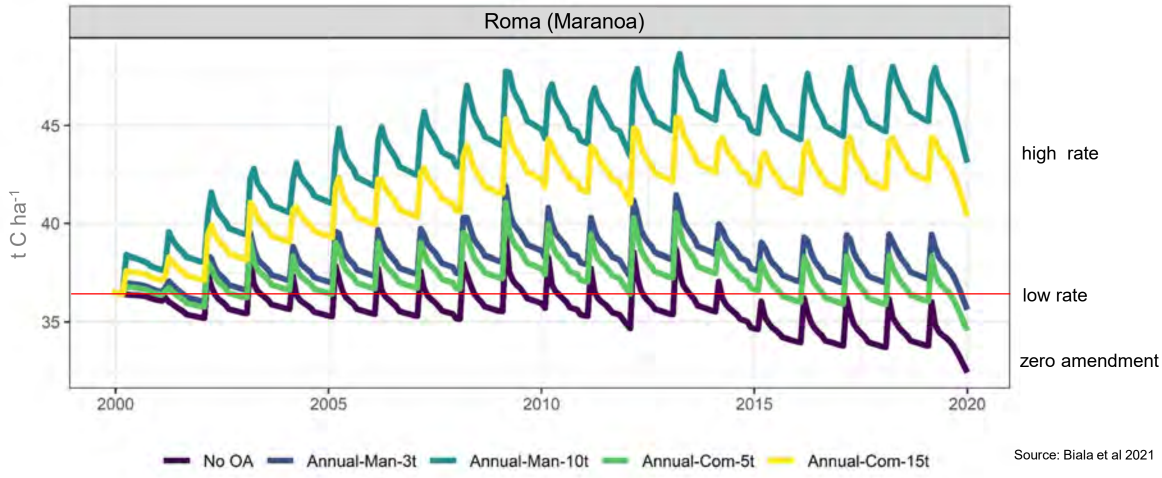
Results – Simulated effects of annual manure & compost use (I)



Source: Biala et al 2021

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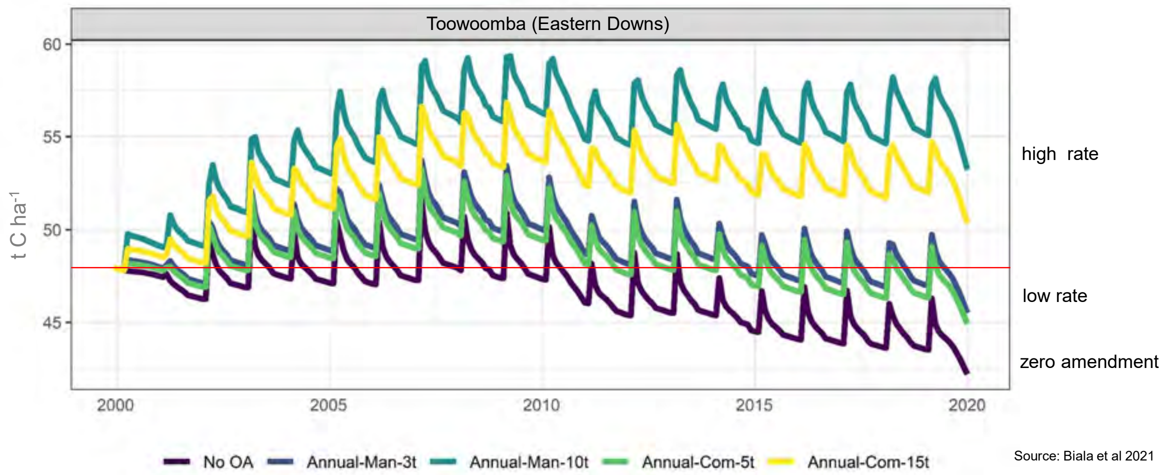
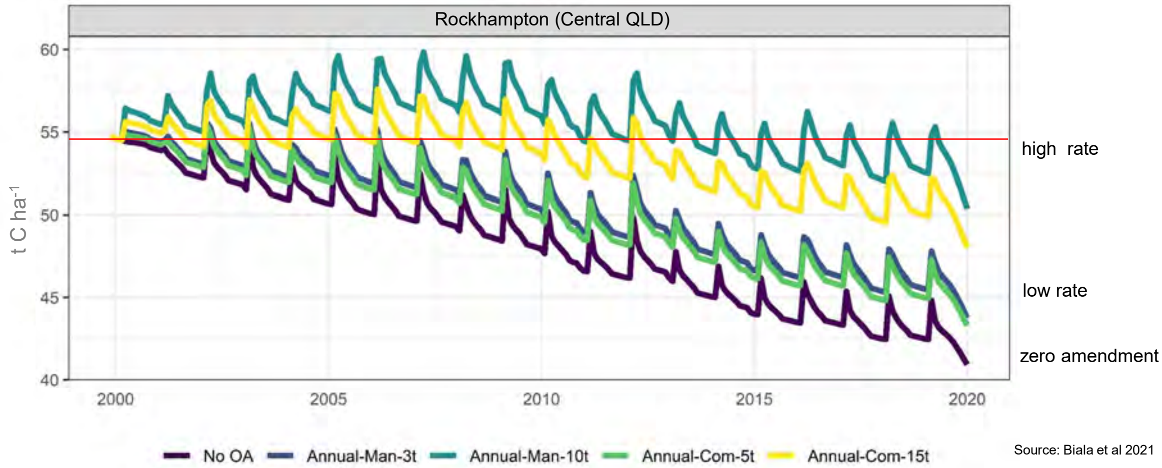
Results – Simulated effects of annual manure & compost use (II)



Source: Biala et al 2021

Results – Simulated effects of annual manure & compost use (III)



Source: Biala et al 2021

Results – Simulated changes in soil organic carbon

Scenario	Application (t fm ha-1)	Modelled change in SOC		
		Maranoa	Eastern Downs	Central QLD
No Amendments	0	-11%	-12%	-25%
Annual-Manure-3t	3	-2%	-5%	-20%
Annual-Manure-10t	10	18%	11%	-8%
Annual-Compost-5t	5	-5%	-6%	-21%
Annual-Compost-15t	15	11%	5%	-12%
3Year-Manure-3t	3	-8%	-10%	-24%
3Year-Manure-10t	10	-1%	-4%	-19%
3Year-Compost-5t	5	-9%	-10%	-24%
3Year-Compost-15t	15	-4%	-6%	-21%

Source: Biala et al 2021

However, the Current Humus Formation, Stable Organic Carbon Input Model is Being Challenged…..

Compost Use can Help Achieve Sustainable Soil and Farm Management!