

Assessing agronomic values of chars to an Australian hardsetting soil

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NSW DEPARTMENT OF
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Char as a soil amendment

- Agronomic values of chars

- Previous research

- Rates = 0.5 t/ha - 135 t/ha
- Responses = -29 % - 324 %
- Char properties often not reported – all char products the same ?

Char properties - variability

Chars	C %	N %	P %	K %	EC, dS/m	pH _{ca}
range	33-84	0.06-2.4	0.018-3.4	0.07-2.1	0.14-14	6.2-13
mean	54	1.00	1.12	0.87	5.44	9.45
CV %	99	97	130	105	94	16

N=16

EC = electrolytic conductivity

Chars	Avail P mg/kg	minN mg/kg	%CO ₃	SA m ² /g	PWP g/100g
range	14-11,600	6.2-11	<0.5-33	27-454	22.6-73.8
mean	1664	2.4	8.3	192	37
CV %	167	83	160	101	30

minN = mineral N, SA = surface area, PWP= permanent wilting point

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- Laboratory characterisation –using standard soil tests
- Pot experiments

Chars used –

1. Green waste: GW
450°C, non-activated
2. Poultry litter: L1
550°C, activated
3. Poultry litter: L2
450°C, non-activated

Soil - 0-10 cm of a Chromosol (Alfisol)

- Organic carbon = 1.8 %
- Colwell P = 34 mg/kg
- $\text{pH}_{\text{Ca}} = 4.5$

Australian Hardsetting Soils

- Fragile in structure – physical limitations
- Low organic carbon - ~ 1%
- 100 million ha



Poor soil surface conditions due to hardsetting

HARDSETTING A HORIZON

BLEACHED

HEAVY CLAY B HORIZON



Pot trials

- Temperature controlled glasshouse (20 -26°C)
- Treatments
 - Char rates 0 -100 t/ha
 - N fertiliser (± 100 N kg/ha)
- Randomised block design with 4 replication
- Plant - Radish (*Raphanus sativus* var Long Scarlet)



RESULTS: Properties of the 3 chars

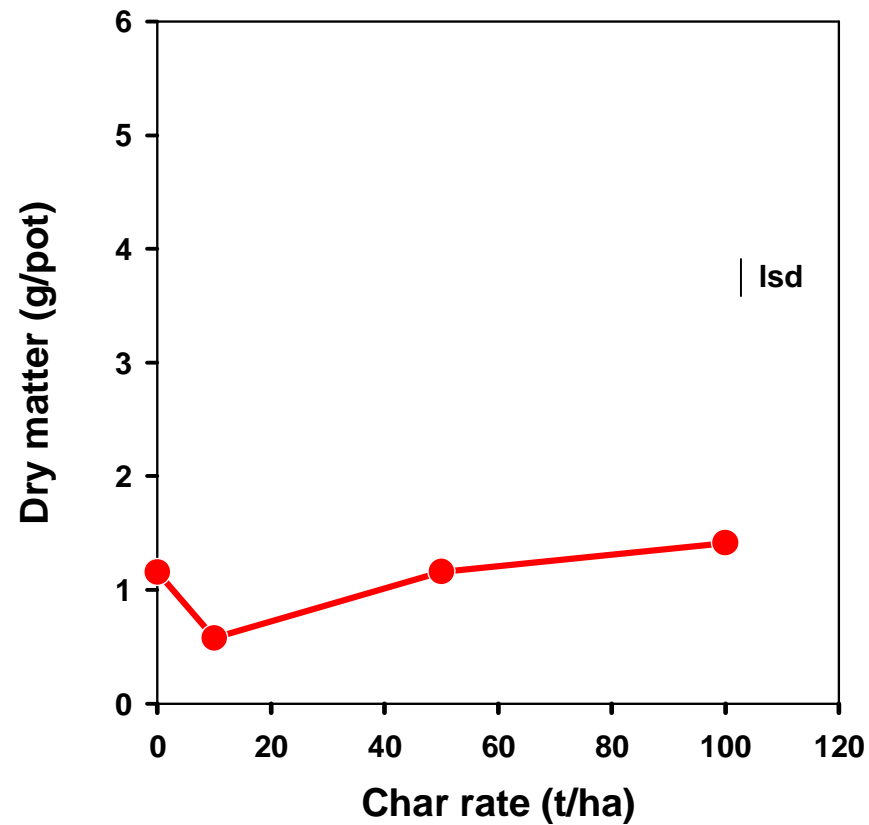
Parameters	unit	GW	L1	L2
pH		9.4	13	9.9
EC	dS/m	3.2	14	5.6
Carbon	%	36	33	38
Nitrogen	%	0.18	0.85	2.0
C/N	-	200	39	19
Potassium	%	-	1.8	2.21
Phosphorus	%	-	3.6	2.52
Mineral N	mg/kg	<0.5	0.51	0.42
Colwell P	mg/kg	400	1,800	11,600
% CaCO ₃ equi.	%	<0.5	35	15

GW – green waste

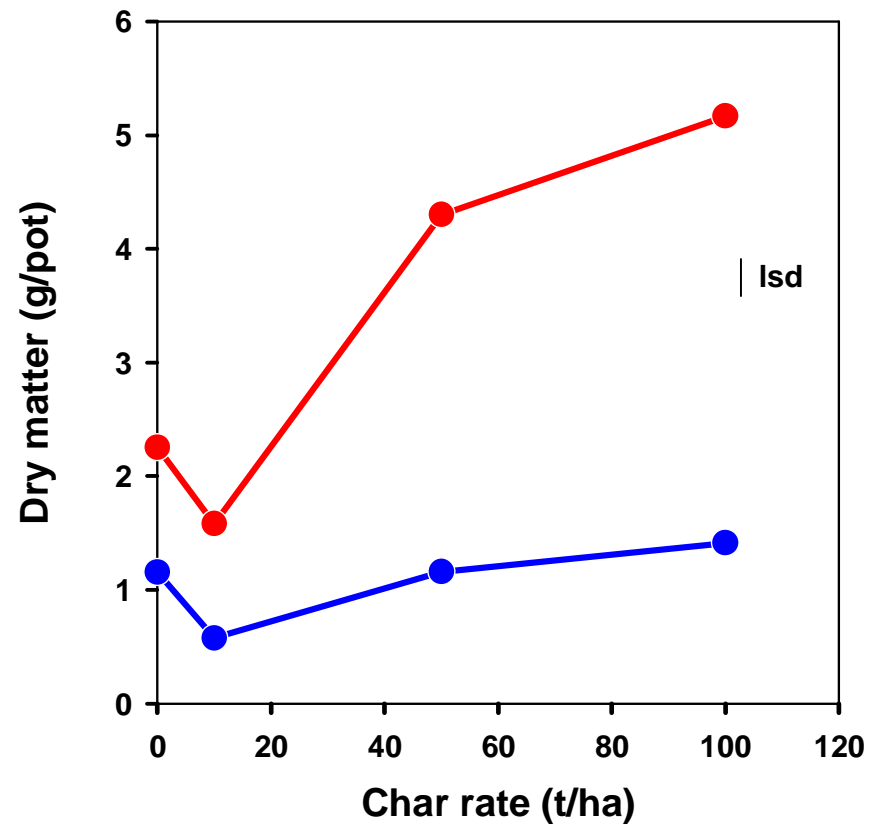
L1 – poultry litter,
activated

L2 – poultry litter,
non-activated

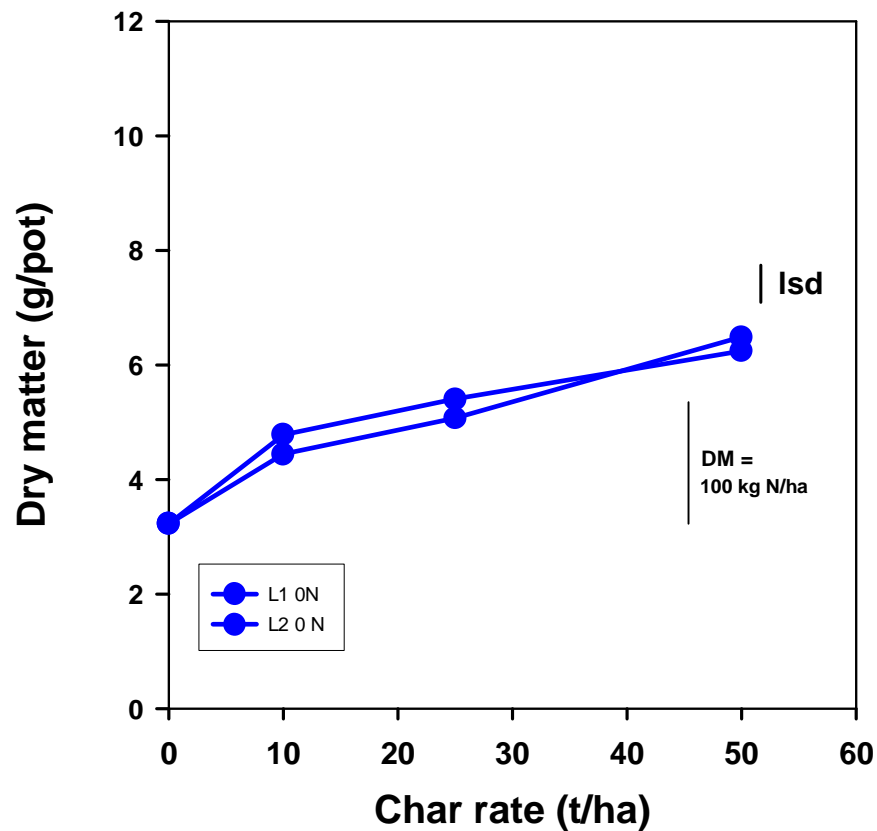
Plant response : Green waste char



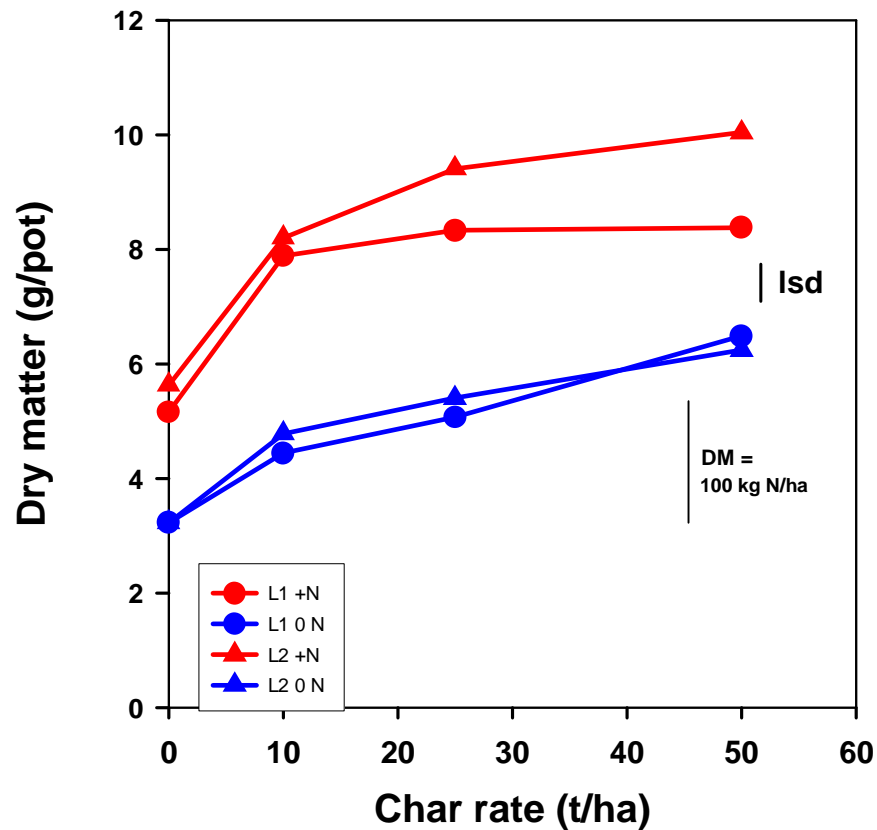
Plant response : Green waste char



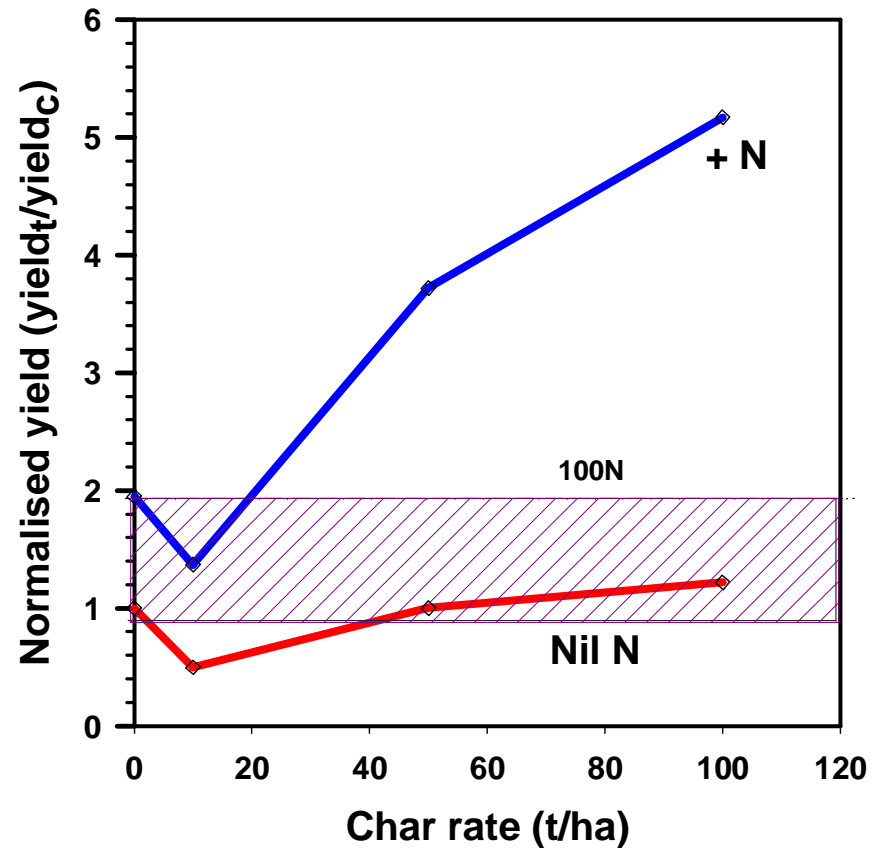
Plant responses : Poultry litter chars



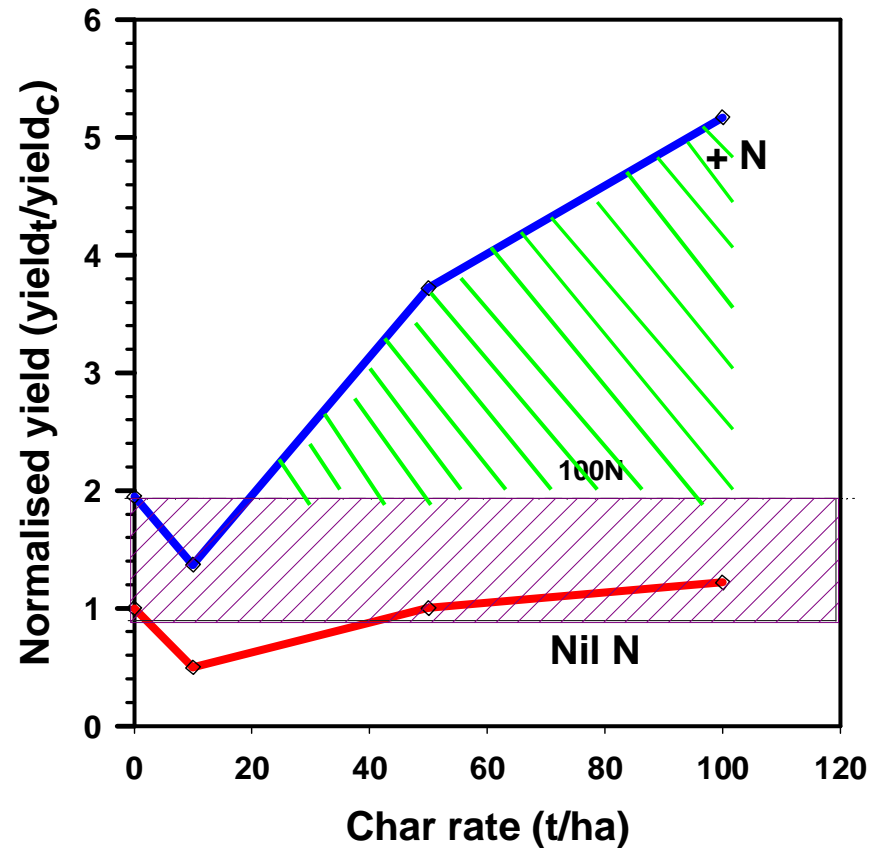
Plant responses : Poultry litter chars



Non-fertiliser value of greenwaste char



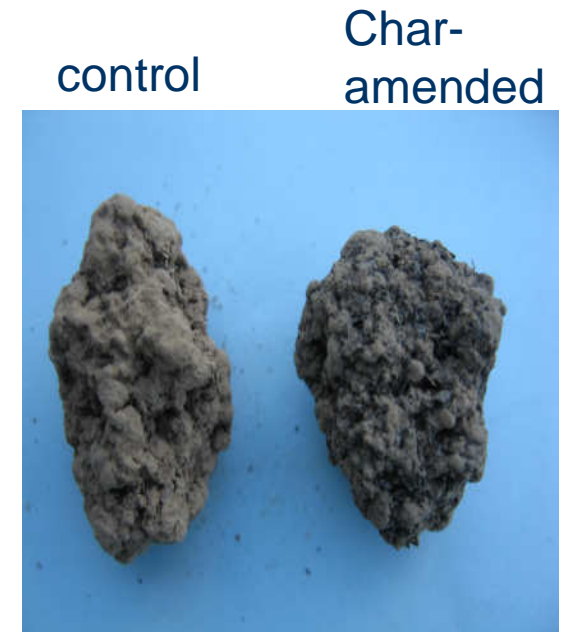
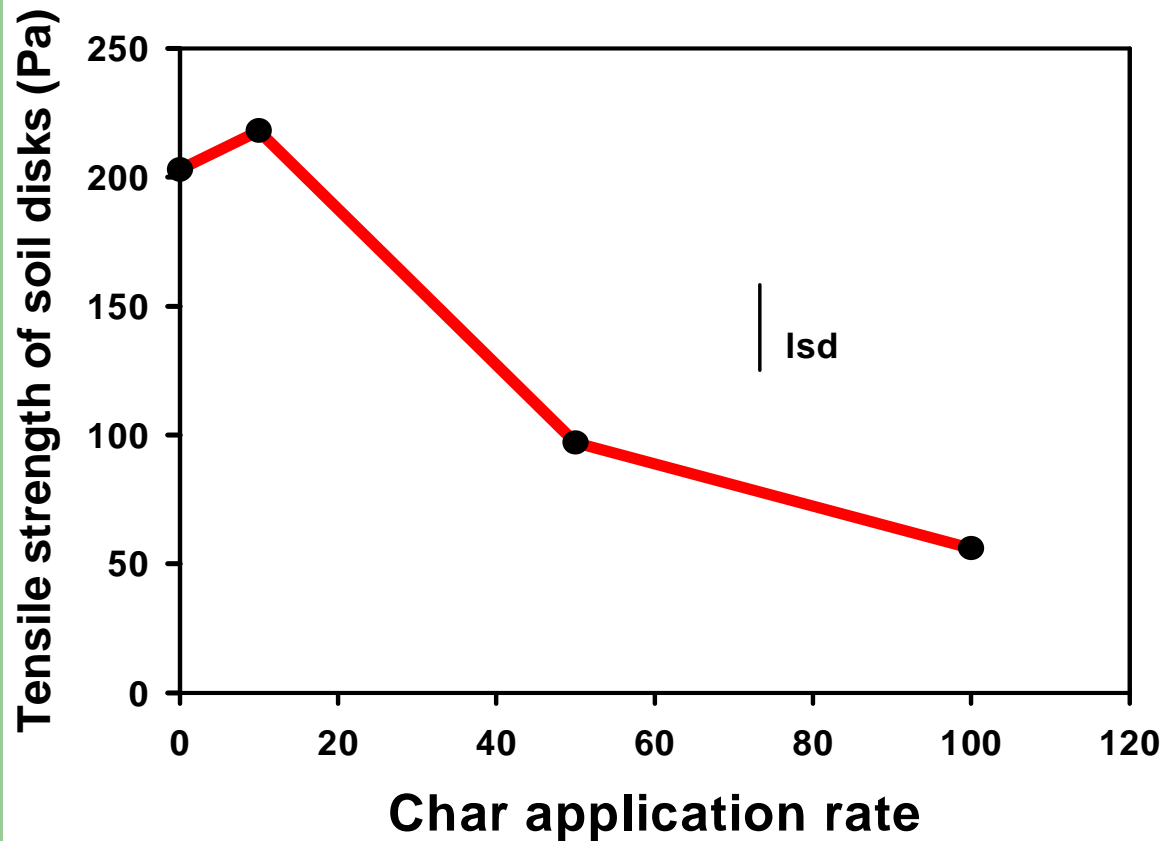
Non-fertiliser value of greenwaste char



Non-fertiliser values of char

- **Improvement in soil physical properties**
 - Reduction in soil strength
 - Increases in water holding capacity
- Changes in soil biology ?

Char on soil strength of hardsetting soil

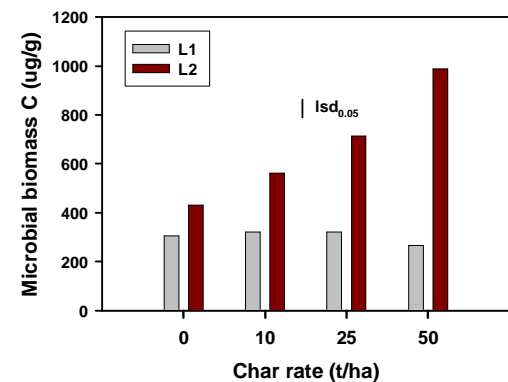


Non-fertiliser values of char

- Improvement in soil physical properties
 - Reduction in soil strength
 - Increases in water holding capacity

● Changes in soil biology ?

- Earthworm avoidance
- Microbial biomass



Conclusions

- All char products not the same
- Agronomic values can be assessed using a combination of laboratory characterisation and short term pot trial
- Non-fertiliser values need further research
- Field trials needed to assess longer term benefits, soil health and soil carbon sequestration

Acknowledgements

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Department of **Environment and Conservation** NSW

