tiar
TASMANIAN INSTITUTE OF AGRICULTURAL RESEARCH

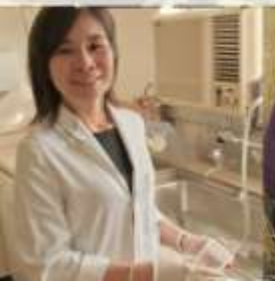
Managing soil organic matter

Bill Cotching

UTAS

TIAR is a joint venture of the University of Tasmania and the Tasmanian Government

Tasmania
Explore the possibilities



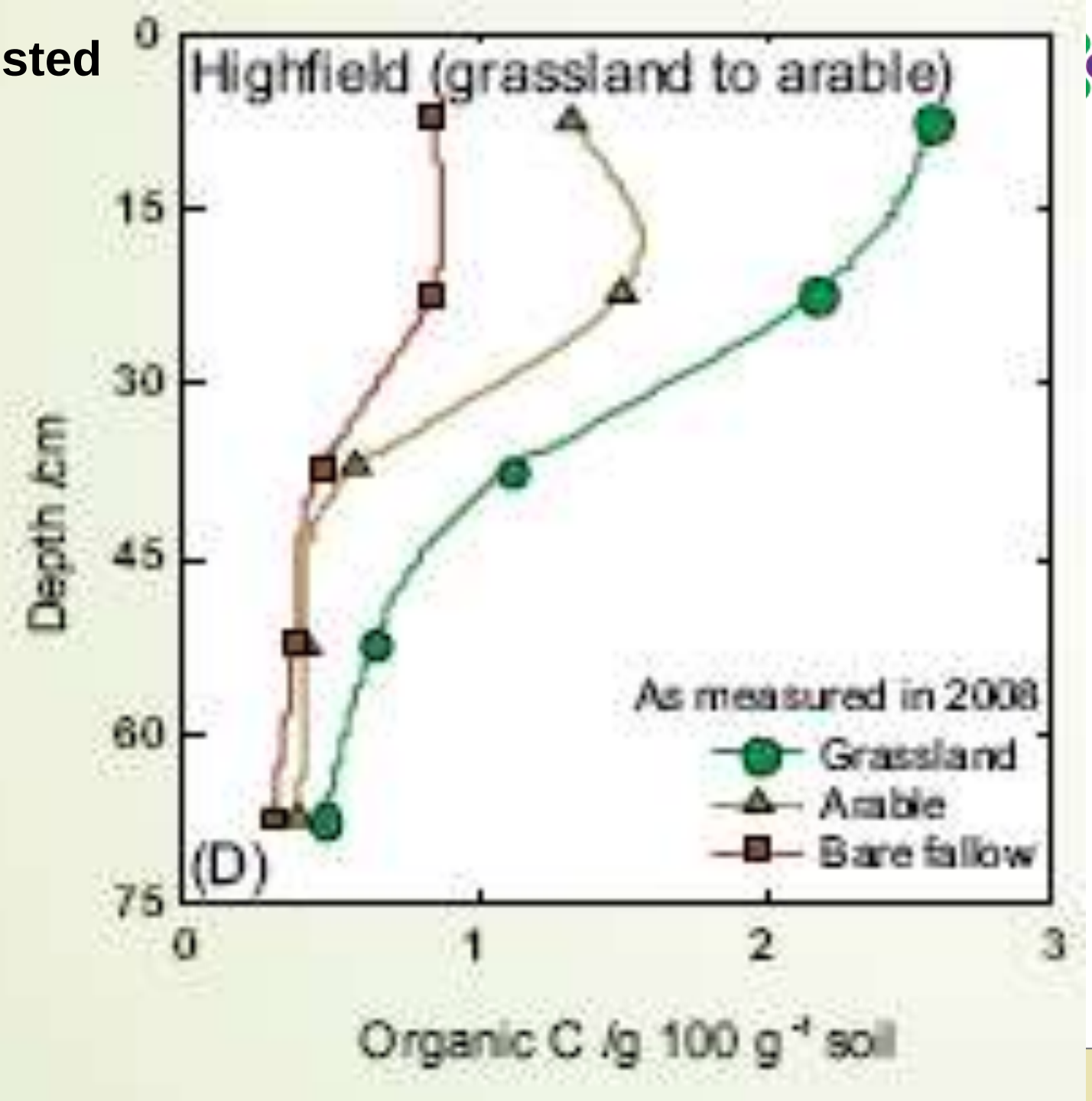



Dynamics of soil Carbon levels

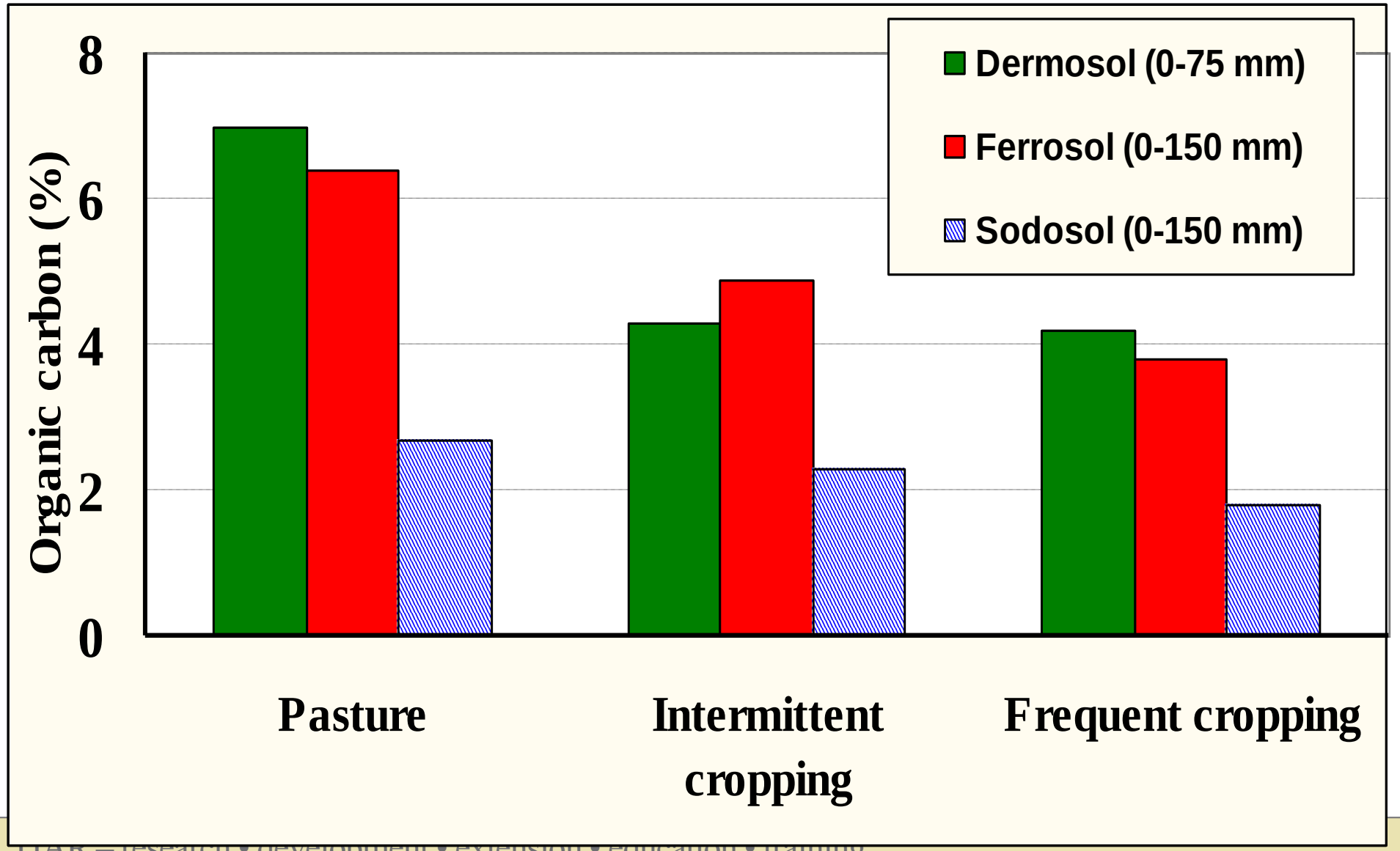
Black Magic model

Management of organic matter

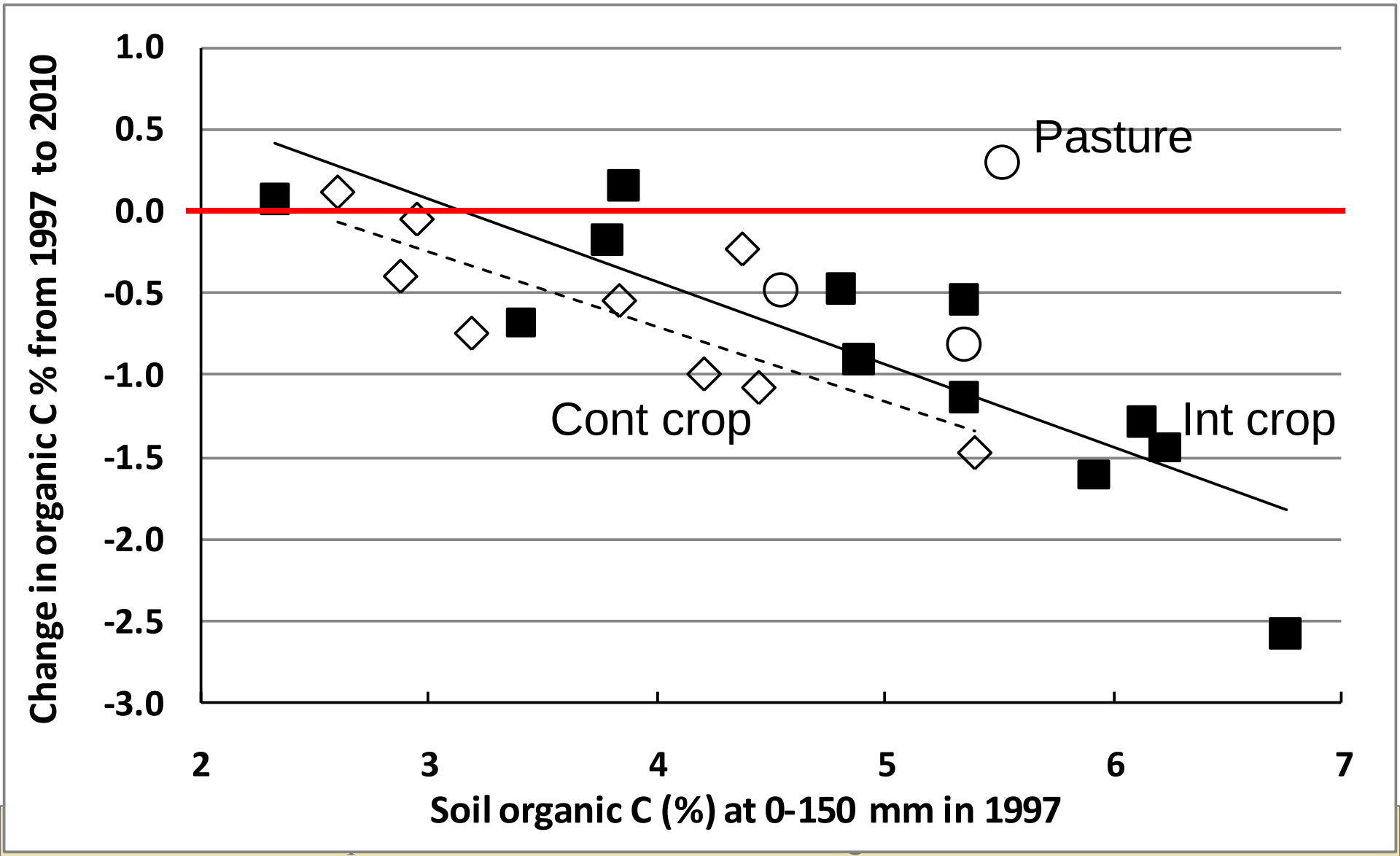
Rothamsted


Highfield (grassland to arable)
Depth /cm
0
15
30
45
60
75
0
1
2
3
Organic C /g 100 g⁻¹ soil
As measured in 2008
Grassland
Arable
Bare fallow
(D)

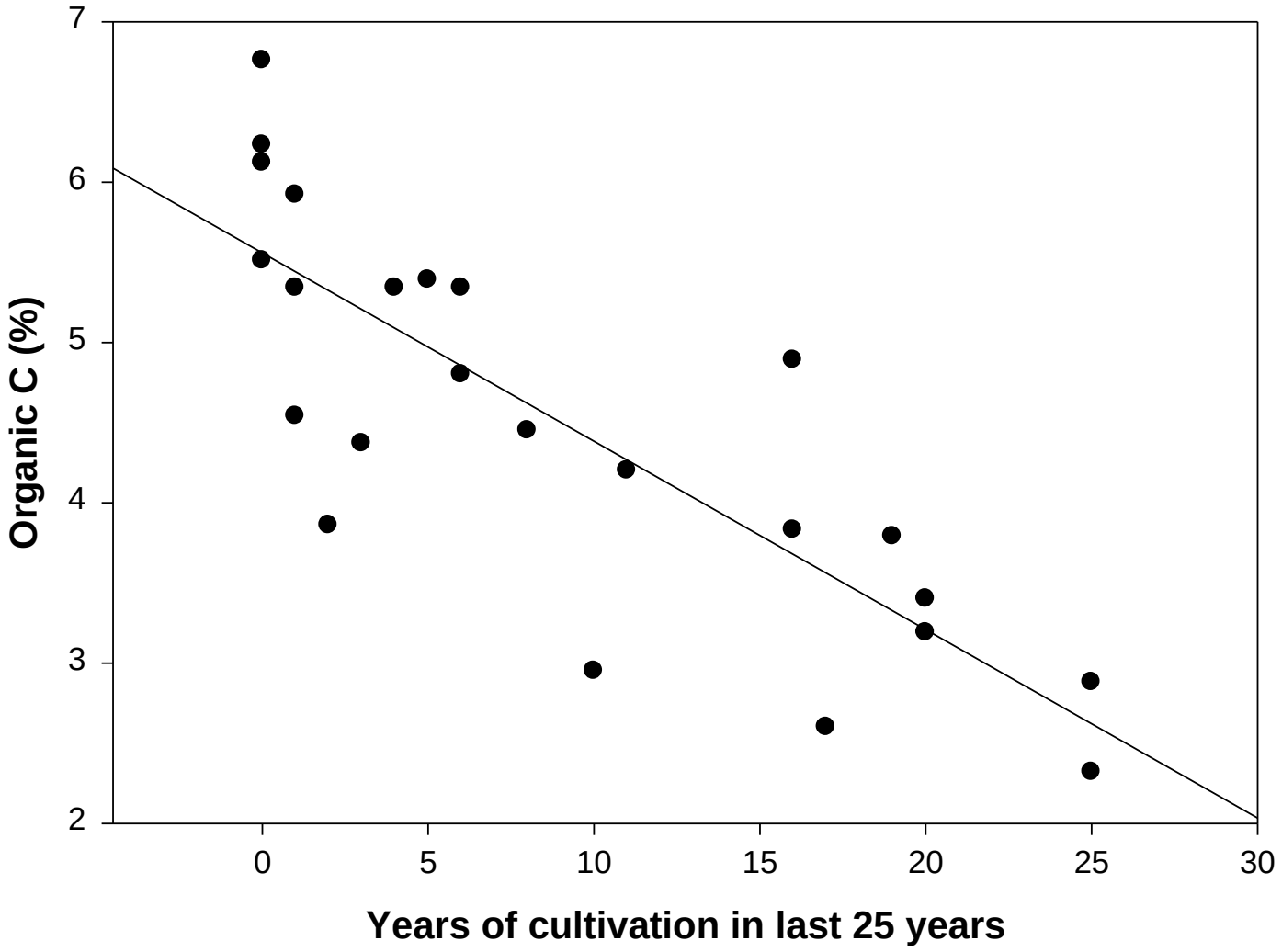
Effect of cropping rotation on soil carbon



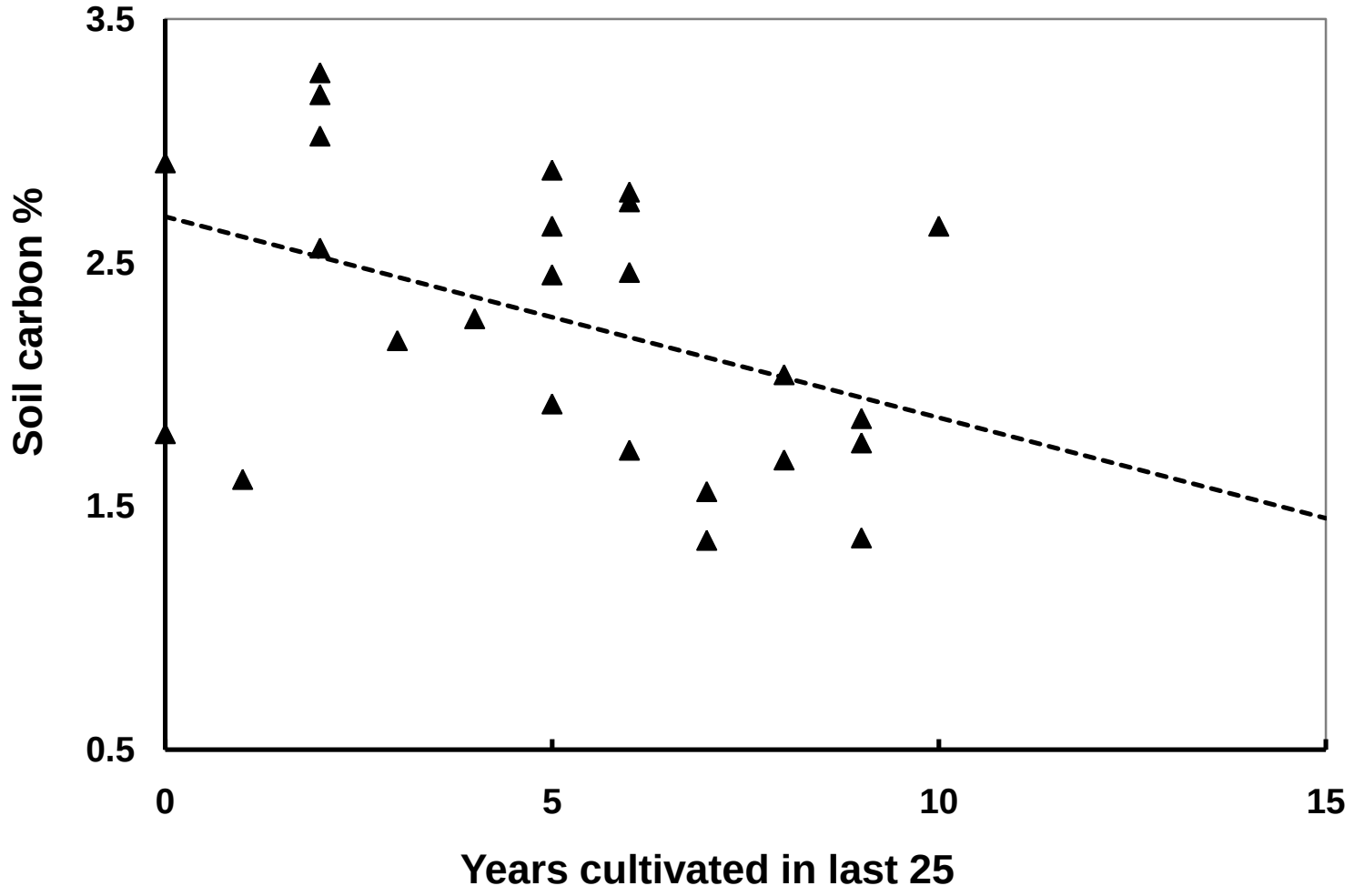
Change in soil carbon on Tasmanian Ferrosols between 1997 and 2010

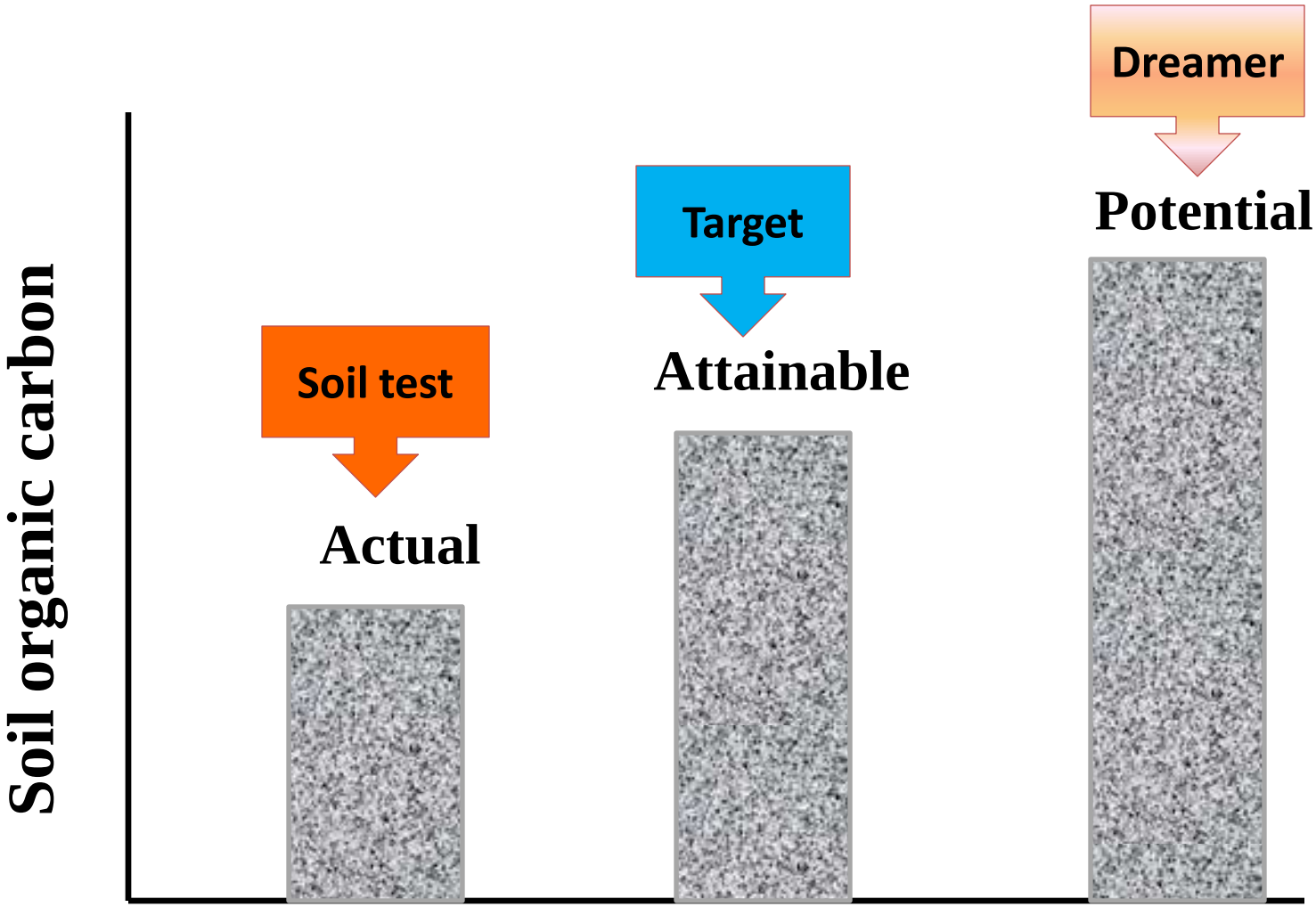


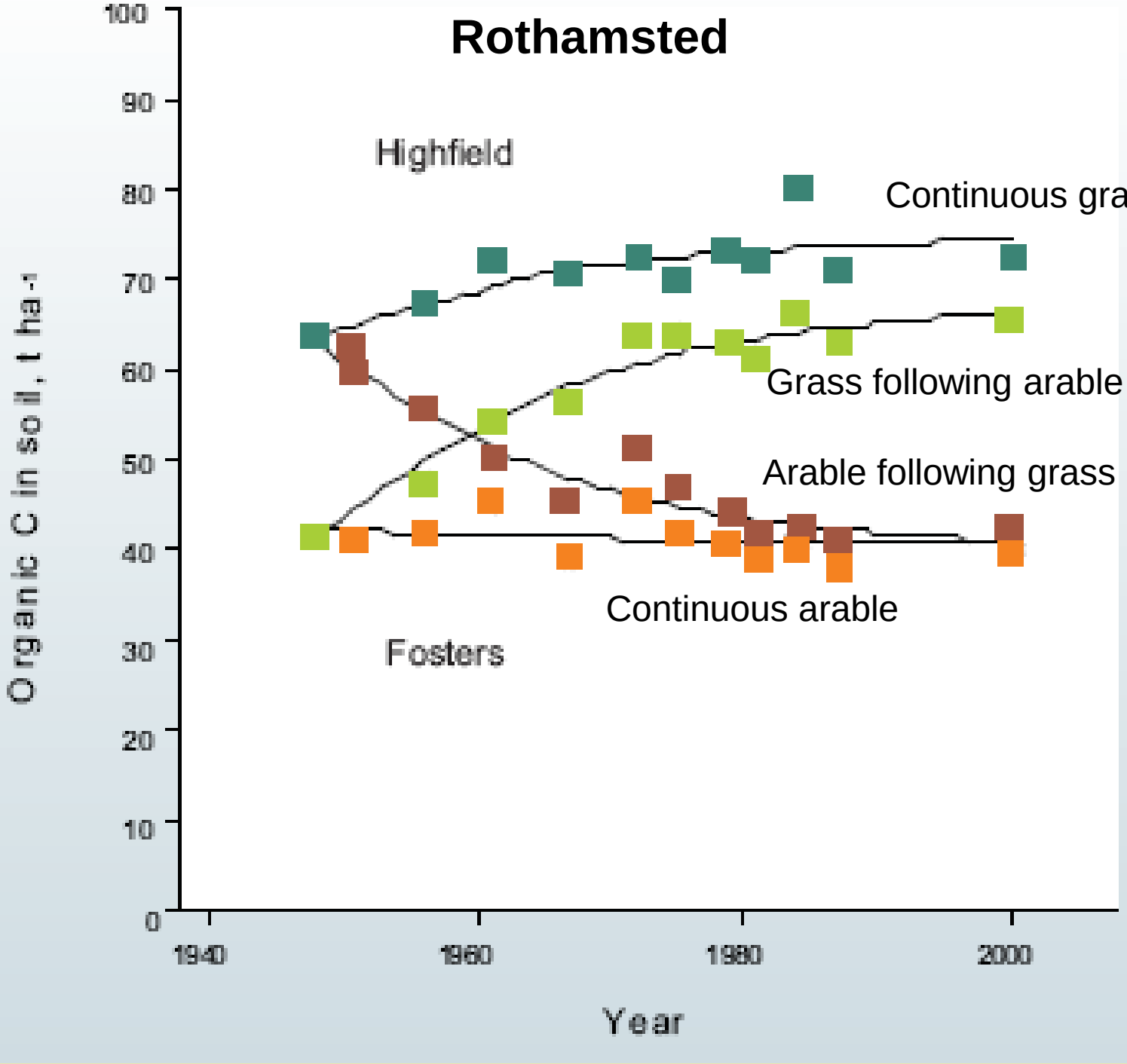
Effect of long term cropping on soil carbon in Ferrosols



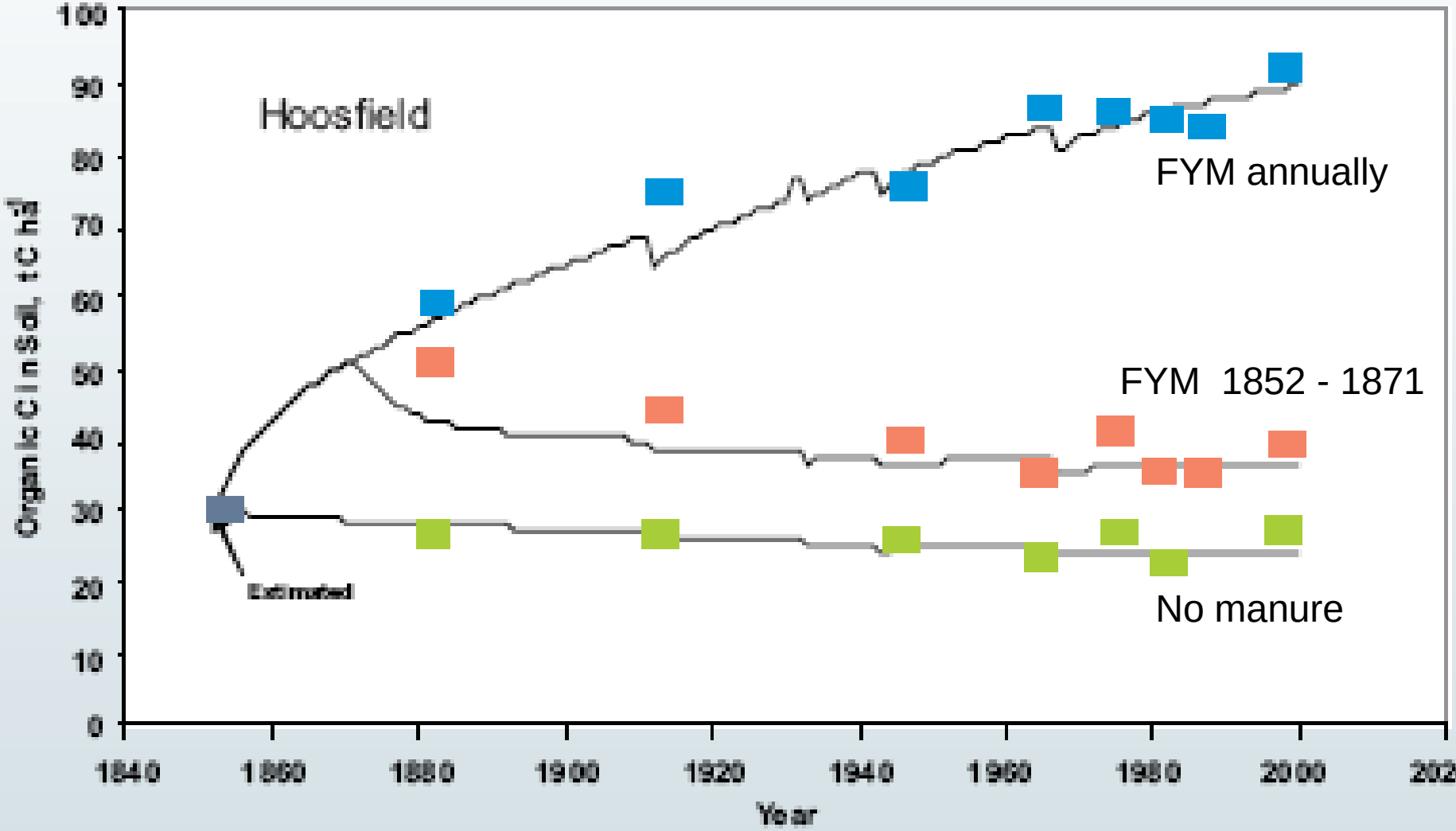
Effect of long term cropping on soil carbon in Duplex sandy loams




Soil organic carbon
Soil test
Actual
Target
Attainable
Dreamer
Potential


Rothamsted
Highfield
Continuous grass
Grass following arable
Arable following grass
Continuous arable
Fosters
Organic C in soil, t ha-1
100
90
80
70
60
50
40
30
20
10
0
1940
1960
1980
2000
Year

Rothamsted


Hoosfield
FYM annually
FYM 1852 - 1871
No manure
Estimated
Organic C in Soil, tC ha-1
Year
0
10
20
30
40
50
60
70
80
90
100
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020

Coal Valley cropping

Paddock Parameters

Soil Type	Black Cracking Clay (Coal River Valley)	
Organic Carbon Content	1.77 %	**Reduced tillage** ☐
Meteorology	CAMPANIA	
Simulation Period	100 years	

Coal Valley cropping

Rotation

	Crop	Irrigated	From	To	Residue Management	Yield (t/ha)
1	Barley	☑	Jul	Jan	Grazed	5
2	Peas - Green	☑	Aug	Dec	Grazed	6
3	Peas - Green	☑	Aug	Dec	Removed	5
4	Poppies	☑	Jul	Feb	Incorporated	2
5	Wheat	☑	Mar	Jan	Grazed	4
6	Pasture (Grass)	☐	Mar	Mar	Grazed	
7	Barley	☑	Jul	Jan	Grazed	4
8	Carrots - Standard	☑	Mar	Feb	Left Standing	1
9	Barley	☐	Jun	Oct	Grazed	
10	Barley	☐	Jun	Jan	Grazed + Hay	5

Settings | Crops | Graph | Print

Rotation Summary

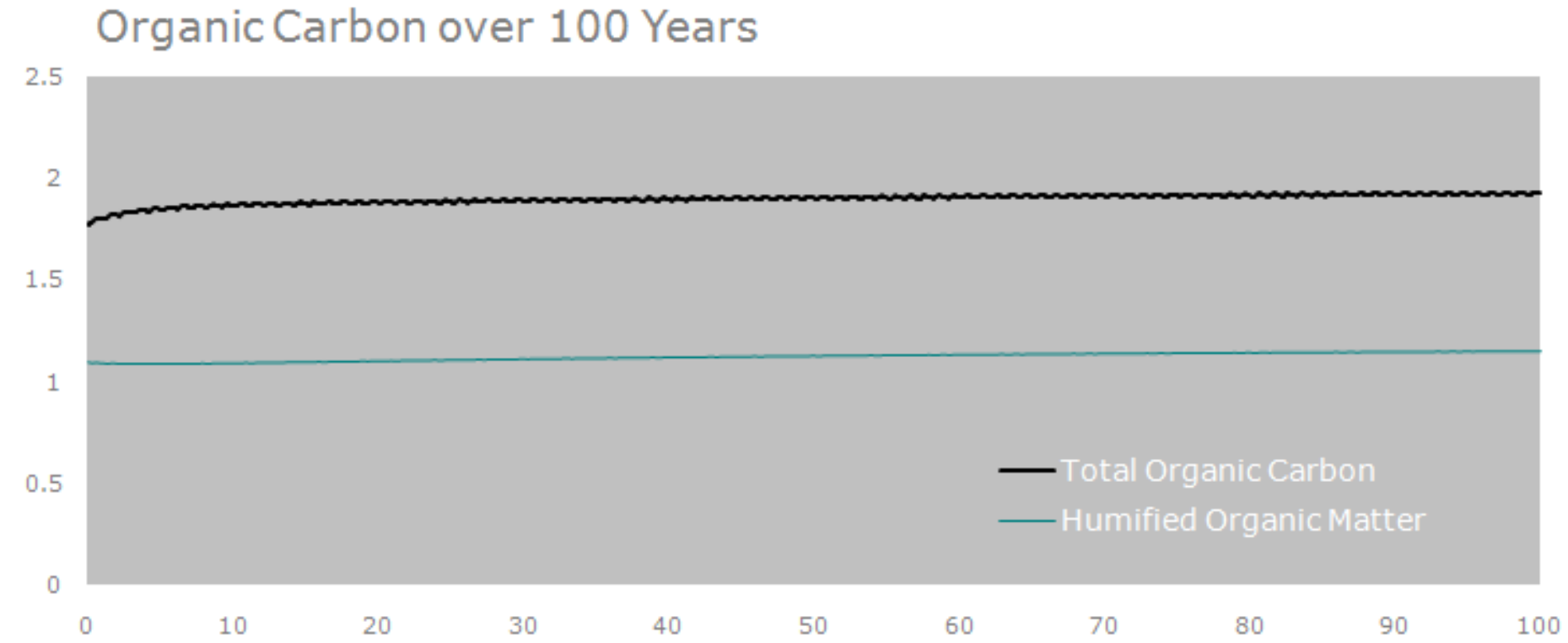
Length of Rotation	10 Yrs	**Initial OC Level**	1.77 %
Number of Crops	10	**Final OC Level**	1.92 %
Simulation Period	100 Yrs		

Coal Valley cropping

Carbon Dioxide Flux

This change in soil organic carbon over the simulation period equates to locking up **130** kg of carbon dioxide per hectare per year

Rotation | Settings



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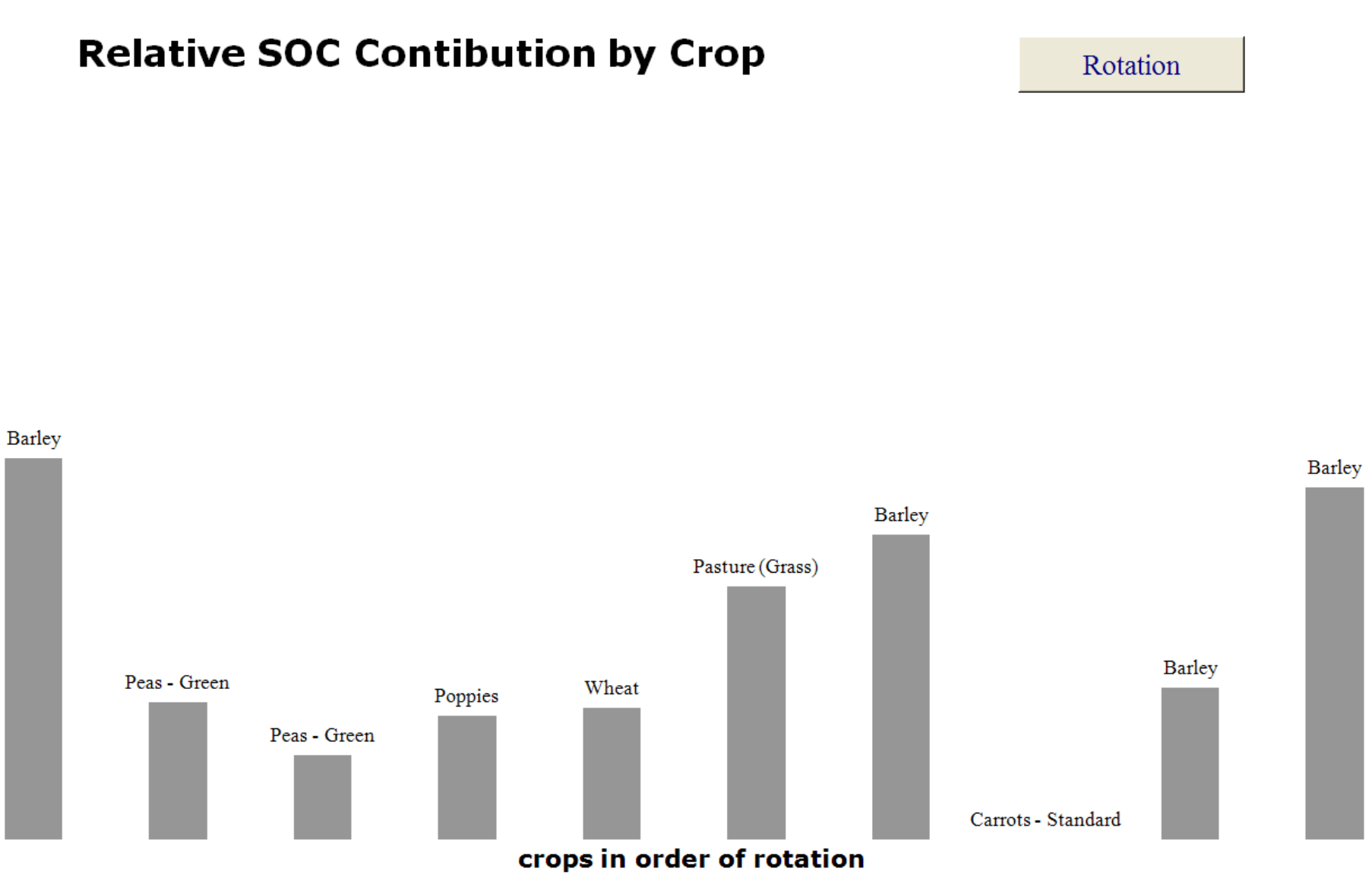
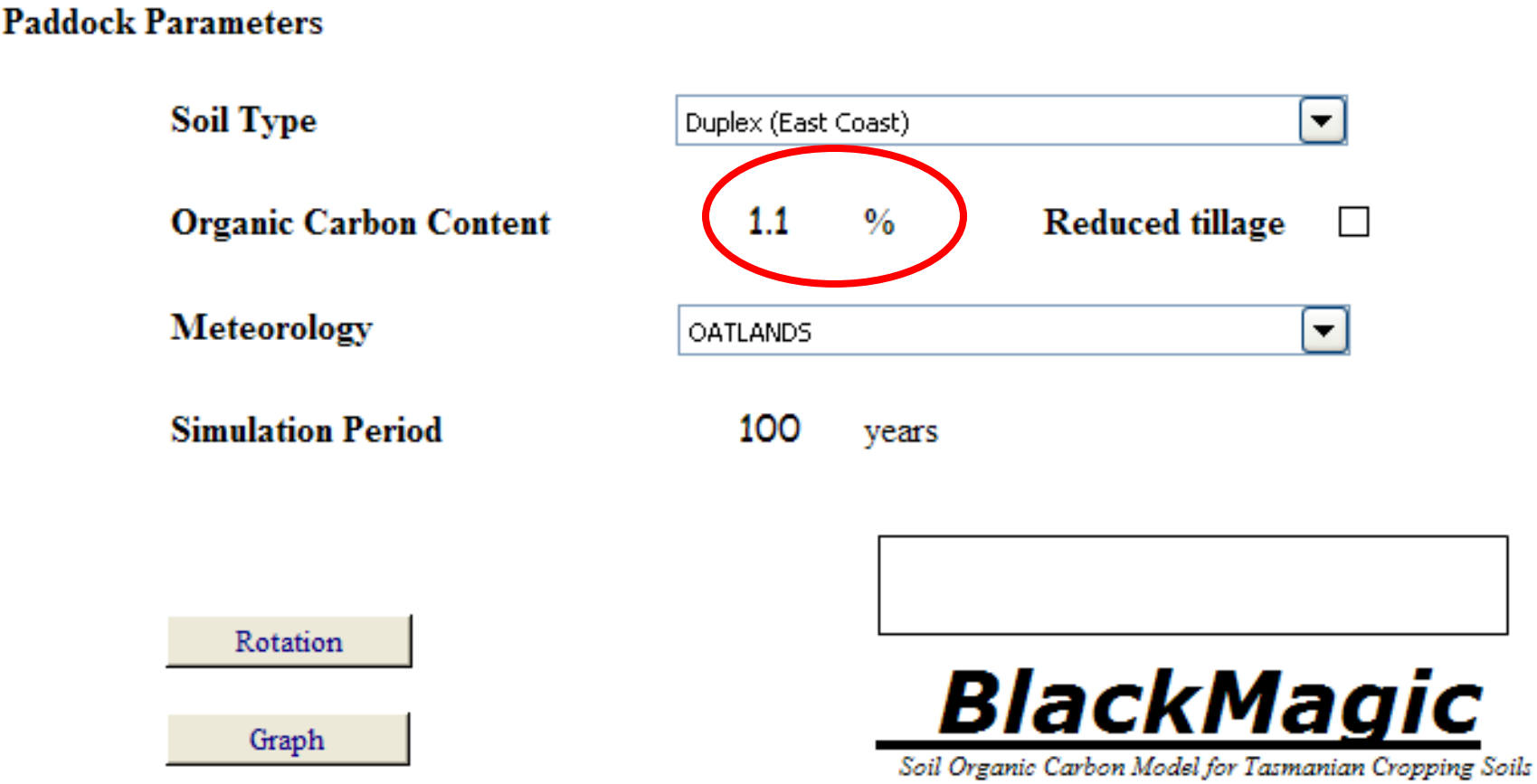
Coal Valley cropping



Oatlands - pasture



Oatlands - pasture

Rotation

	Crop	Irrigated	From	To	Residue Management	Yield (t/ha)
1	Pasture (Grass)	☐	Apr	Mar	Grazed	4
2	Pasture (Grass)	☐	Apr	Mar	Grazed	4
3	Pasture (Grass)	☐	Apr	Mar	Grazed	4
4	Pasture (Grass)	☐	Apr	Mar	Grazed	4
5	Pasture (Grass)	☐	Apr	Mar	Grazed	4
6	Pasture (Grass)	☐	Apr	Mar	Grazed	4
7	Pasture (Grass)	☐	Apr	Mar	Grazed	4
8	Pasture (Grass)	☐	Apr	Mar	Grazed	4
9	Pasture (Grass)	☐	Apr	Mar	Grazed	4
10	Pasture (Grass)	☐	Apr	Mar	Grazed	4

Settings | Crops | Graph | Print

Rotation Summary

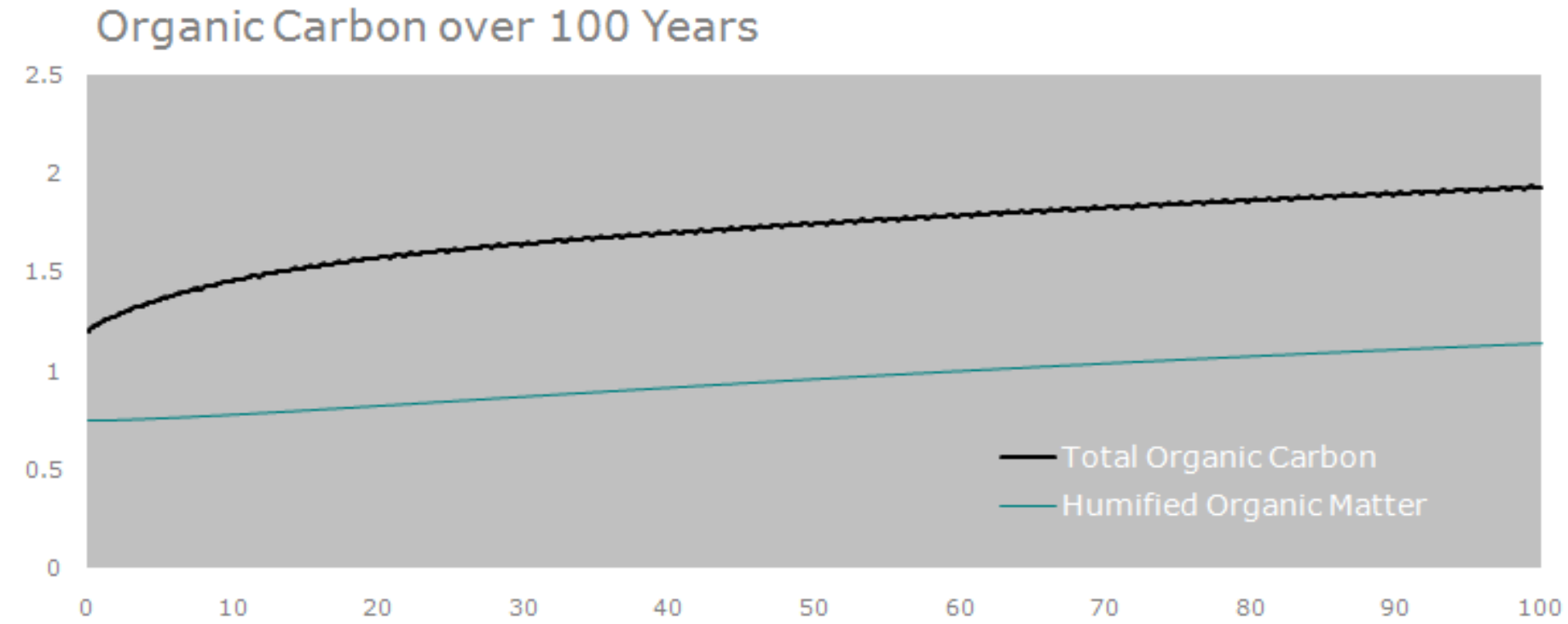
Length of Rotation	**10 Yrs**	**Initial OC Level**	**1.10 %**
Number of Crops	**10**	**Final OC Level**	**2.00 %**
Simulation Period	**100 Yrs**		

Oatlands - pasture

Carbon Dioxide Flux

This change in soil organic carbon over the simulation period equates to locking up **640** kg of carbon dioxide per hectare per year

Rotation | Settings



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Ferrosol cropping

Paddock Parameters

Soil Type	Krasnozem (NW, North, NE)	
Organic Carbon Content	5 %	**Reduced tillage** ☑
Meteorology	FORTH	
Simulation Period	100 years	

Ferrosol cropping

Rotation

	Crop	Irrigated	From	To	Residue Management	Yield (t/ha)
1	Potatoes - Processing	☑	Oct	Feb		67
2	Poppies	☑	Sep	Feb	Incorporated	
3	Wheat	☐	Mar	Feb	Removed	
4	Broccoli	☑	Sep	Feb	Incorporated	
5	Onions	☑	May	Feb	Mulch	
6	Peas - Green	☑	Aug	Dec	Removed	
7	Wheat	☐	Mar	Feb	Removed	
8	Wheat	☐	Mar	Feb	Removed	
9	Potatoes - Processing	☑	Oct	Mar		
10	Beans - Green Slicing	☑	Nov	Feb	Incorporated	

Settings | Crops | Graph | Print

Rotation Summary

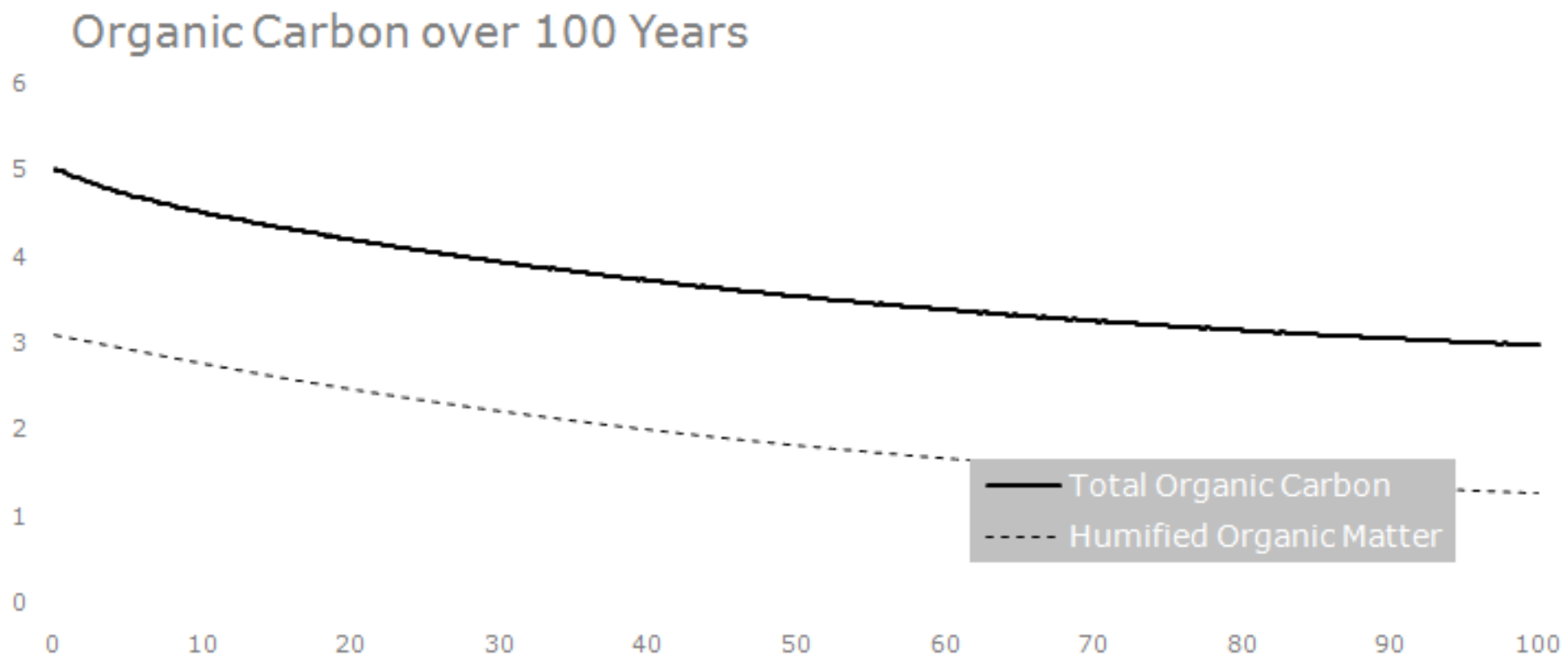
Length of Rotation	10 Yrs	**Initial OC Level**	5.00 %
Number of Crops	10	**Final OC Level**	2.97 %
Simulation Period	100 Yrs		

Ferrosol cropping

Carbon Dioxide Flux

This change in soil organic carbon over the simulation period equates to liberating **1,480** kg of carbon dioxide per hectare per year

Rotation | Settings



Ferrosol cropping + green manure

Rotation

	Crop	Irrigated	From	To	Residue Management	Yield (t/ha)
1	Potatoes - Processing	☑	Oct	Feb		67
2	Green Manure (Ryegrass	☐	Apr	Oct	Grazed	
3	Beans - Green Slicing	☑	Dec	Mar	Incorporated	
4	Green Manure (Ryegrass	☐	Apr	Aug	Grazed	
5	Poppies	☐	Sep	Feb	Incorporated	
6	Green Manure (Ryegrass	☐	Apr	Aug	Grazed	
7	Broccoli	☑	Sep	Feb	Mulch	
8	Wheat	☐	Mar	Feb	Incorporated	
9	Pasture (Grass)	☐	Mar	Mar	Grazed	
10	Pasture (Grass)	☐	Mar	Mar	Grazed	

Settings | Crops | Graph | Print

Rotation Summary

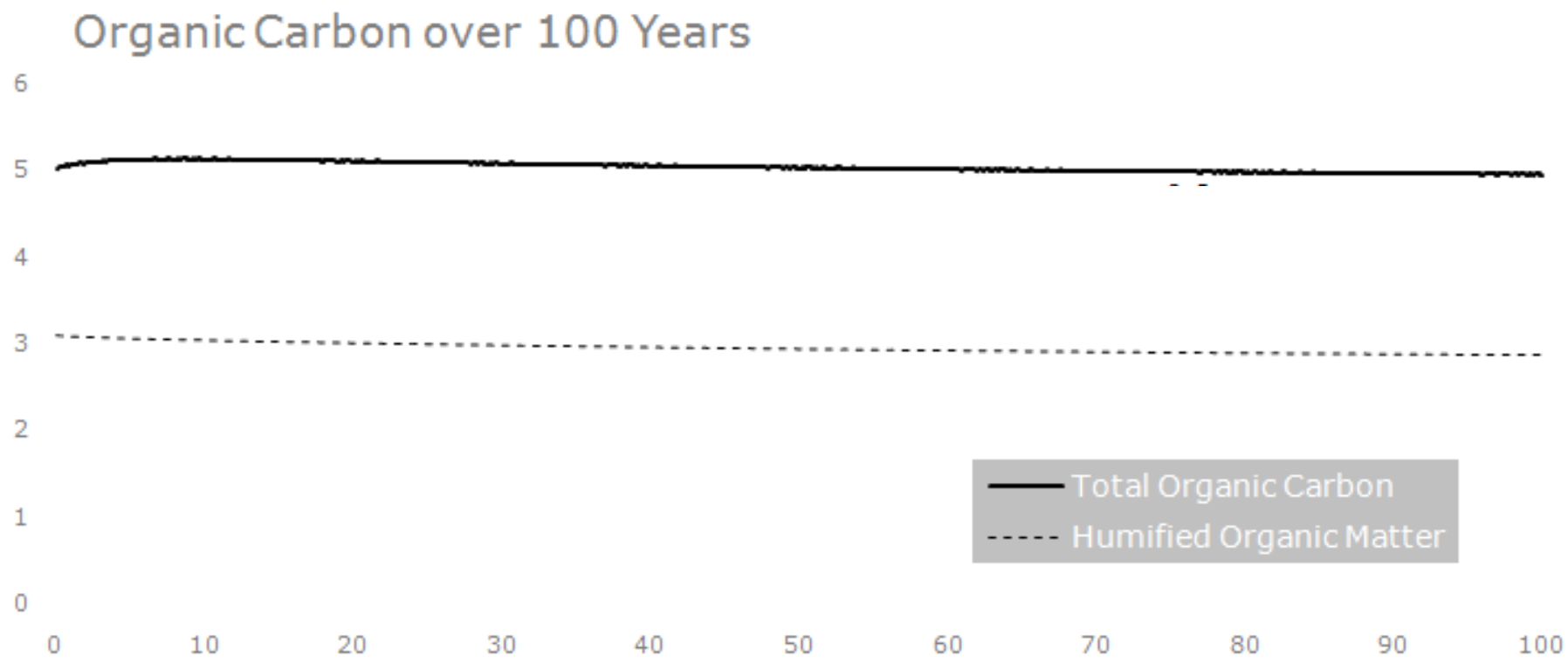
Length of Rotation	7 Yrs	**Initial OC Level**	5.00 %
Number of Crops	10	**Final OC Level**	4.94 %
Simulation Period	100 Yrs		

Ferrosol cropping + green manure

Carbon Dioxide Flux

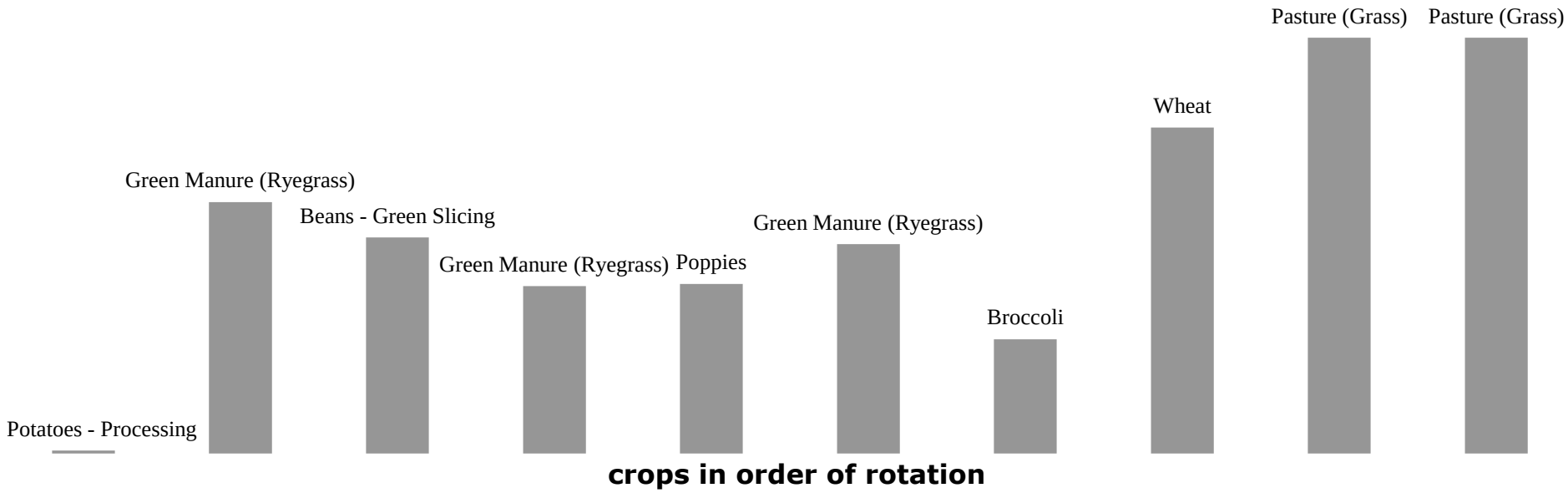
This change in soil organic carbon over the simulation period equates to liberating **40** kg of carbon dioxide per hectare per year

Rotation | Settings



Ferrosol cropping + green manure

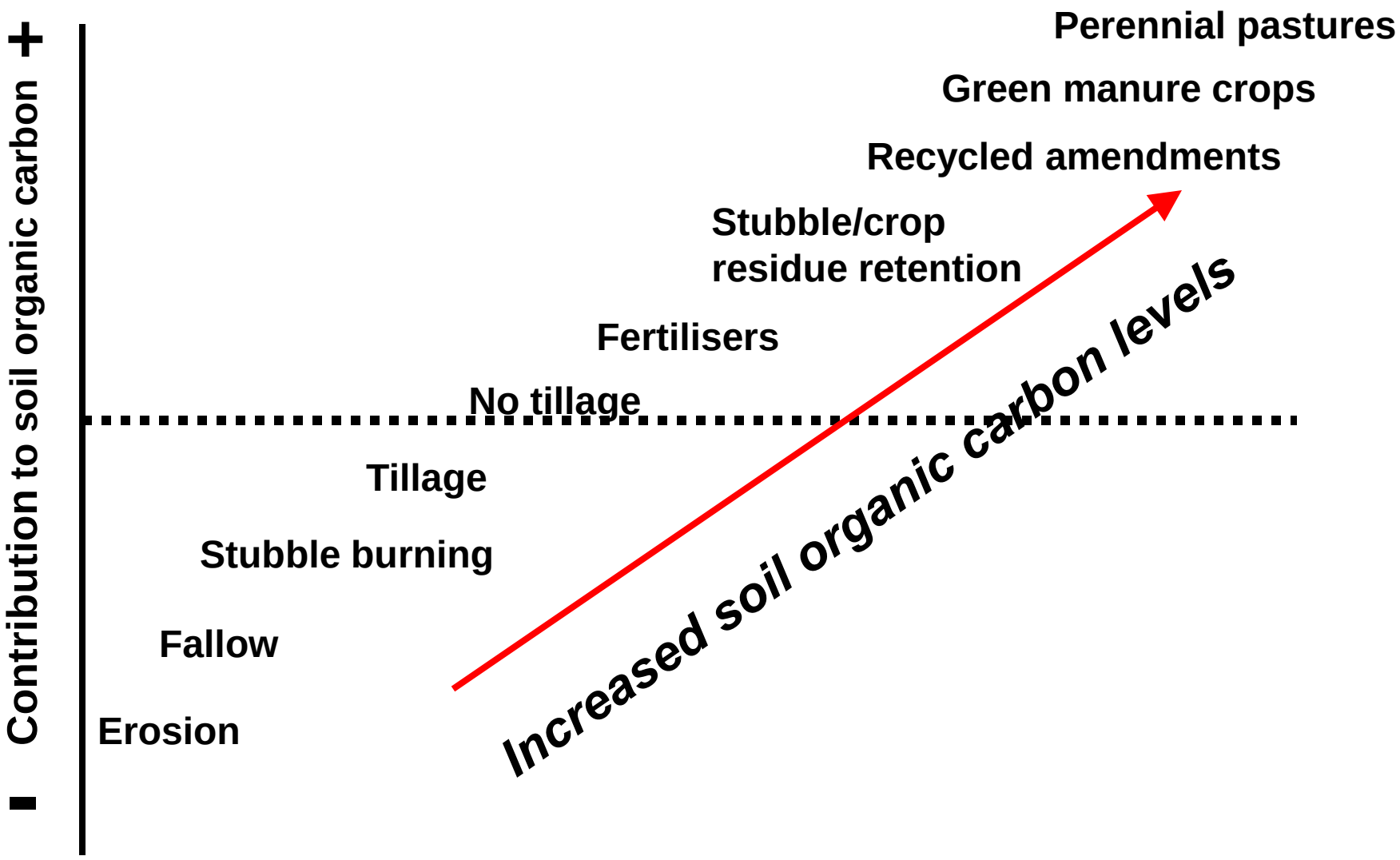
Relative SOC Contibution by Crop



So what's good

and what's not so good

for soil organic matter


Contribution to soil organic carbon
+
-
Perennial pastures
Green manure crops
Recycled amendments
Stubble/crop residue retention
Fertilisers
No tillage
Tillage
Stubble burning
Fallow
Erosion
Increased soil organic carbon levels

Points to remember

- Research has NOT been able to demonstrate practices that increase soil C in any cropping system (no-till slows rate of decline).

- Avoid bare fallows as these contribute the most to organic matter decline.

- Maximising inputs of organic matter by incorporating crop residues and including green manures and pastures in the rotation, where practical, should be a goal for all farmers.