

# Pasture-tree systems: effect on soil carbon accumulation



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# Outline

- **Introduction**
- **Materials and Methods**
- **Results**
- **Conclusions**

# Introduction

- **Soil organic C is a significant component of global C e.g. 1200-1550 Pg (0-1 m) and 2370-2450 Pg (0-2 m)**
- **560 Pg in living biomass; 760 Pg in atmospheric pool**
- **Manipulating soil C  $\longrightarrow$  atmospheric pool**
- **Pastoral hill country: erosion biggest threat to C accumulation**
- **Information on effects of wide-spaced trees is scarce...**



## Pasture-tree (PT) system



# Objective

**Determine the effect of established trees at varying densities on soil C concentration and mass to 1 m depth in geoclimatically different environments**

**Other objectives relating to implications for GHG emissions from livestock in pasture-tree vs. open pasture systems, and modelling consequences at farm-scale**

# Materials and Methods

- 4 x North Island sites with trees in Nelder partial radial planting designs
- 2 x hybrid poplar (*P. deltoides* x *P. nigra*) clone 'Tasman'
- 2 x Italian alder (*Alnus cordata*); N-fixing
- Planted 1996-98; limited baseline data (tree age < 5 yrs)

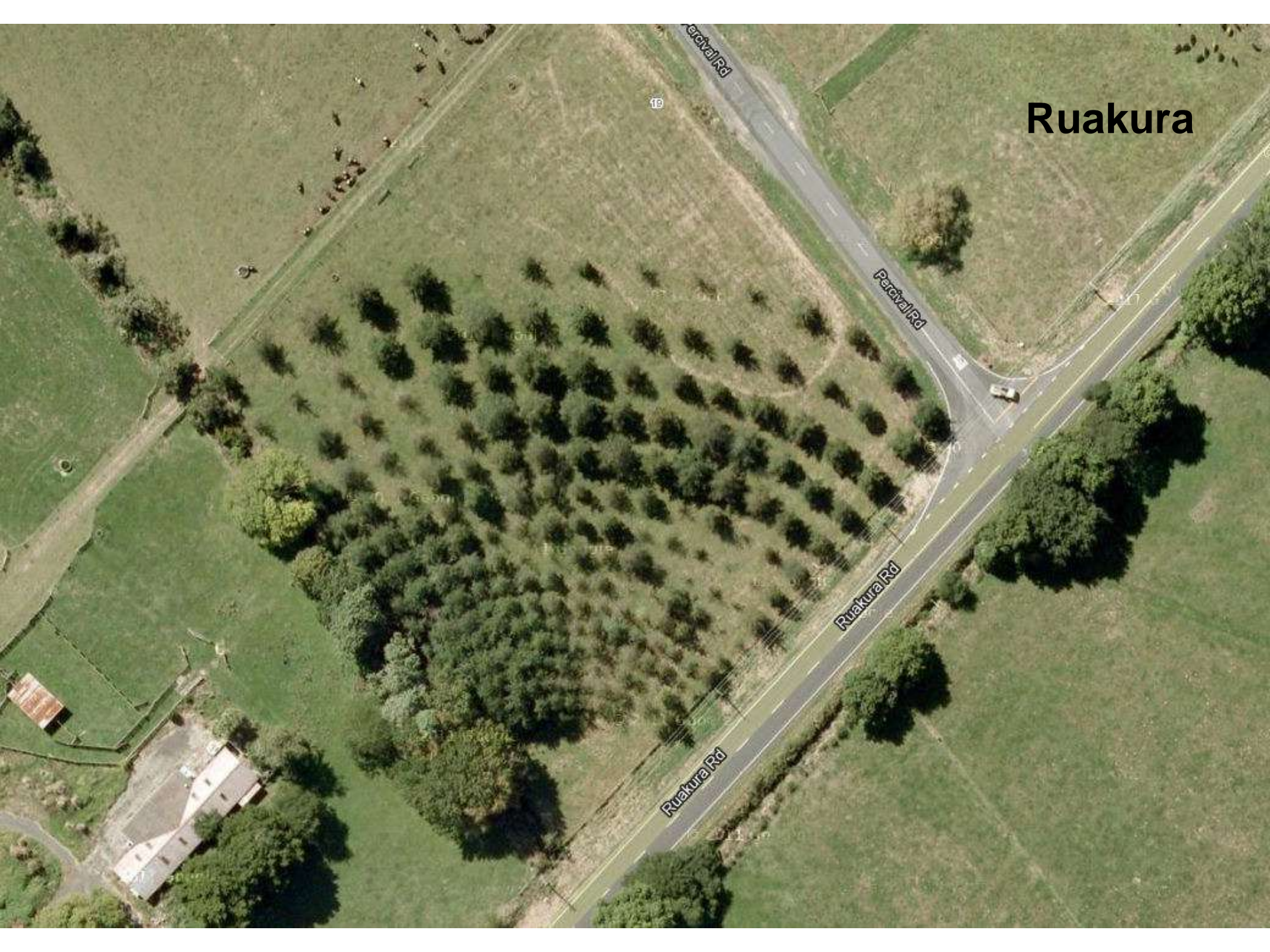
# Sites



	Site			
	Poukawa	Ruakura	Tikokino	Woodville
<b>Environment</b>	Summer-dry	Summer-moist	Summer-dry	Summer-moist
<b>Location</b>	39°45'18" S	37°46'34" S	39°50'16" S	40°18'57" S
	176°43'29" E	175°19'27" E	176°18'28" E	175°50'23" E
<b>Elevation (m)</b>	53	42	354	129
<b>Slope angle</b>	<5°	Flat	Flat	<15°
<b>Soil</b>	Silt loam	Silt loam	Sandy loam	Silt loam
<b>Species</b>	Alder	Alder	Poplar	Poplar
<b>Tree density (sph)</b>	95-734	112-1276	76-777	67-818
<b>Planting date</b>	Sept 1998	Sept 1998	Sept 1996	Sept 1996



# Ruakura





**Poukawa**



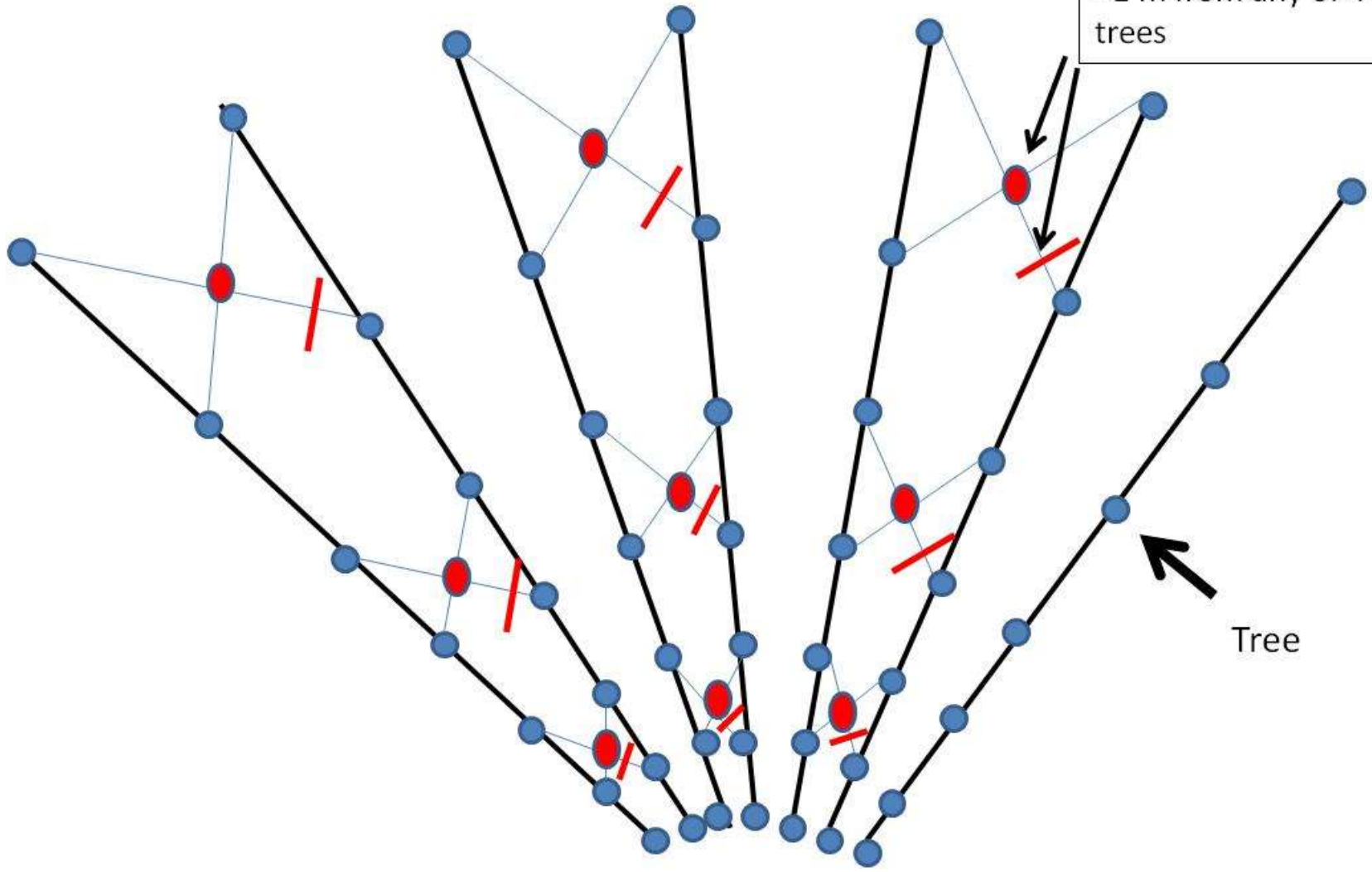
**Woodville**



# Measurements

- **5 tree densities + open pasture**  
**Low: Poukawa (95 sph), Ruakura (112), Tikokino (76), Woodville (67)**
- **Roots, bulk density, soil C – cores**
- **Depths: 0-75, 75-150, 150-300, 300-600, 600-1000 mm**
- **Sampling conducted late Nov12 (Ruakura) and early Dec12 (other sites) (trees aged 14-16 yrs)**
- **Manual digging and machine**

Sampling positions  
-Diagonal intersection  
- 1 m from any of 4 trees

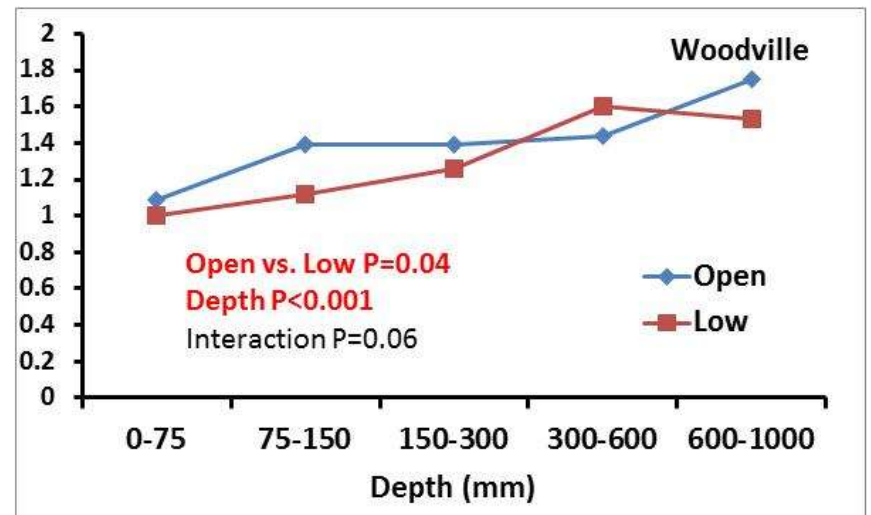
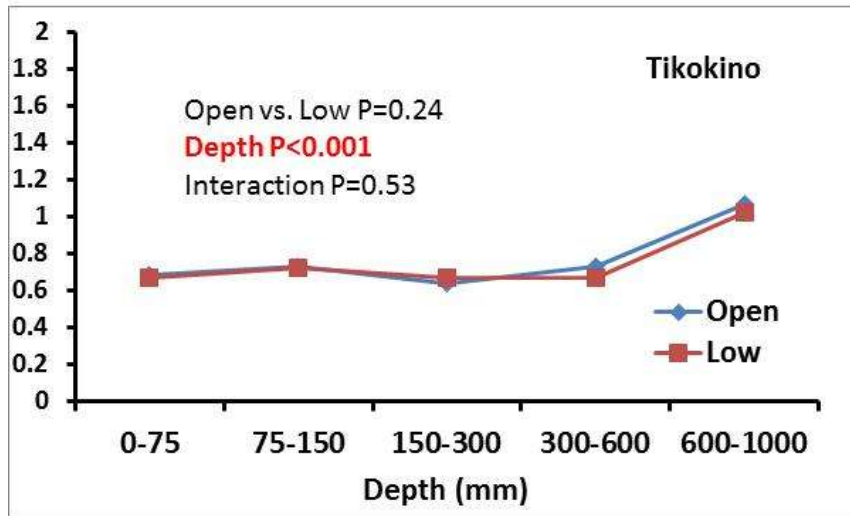
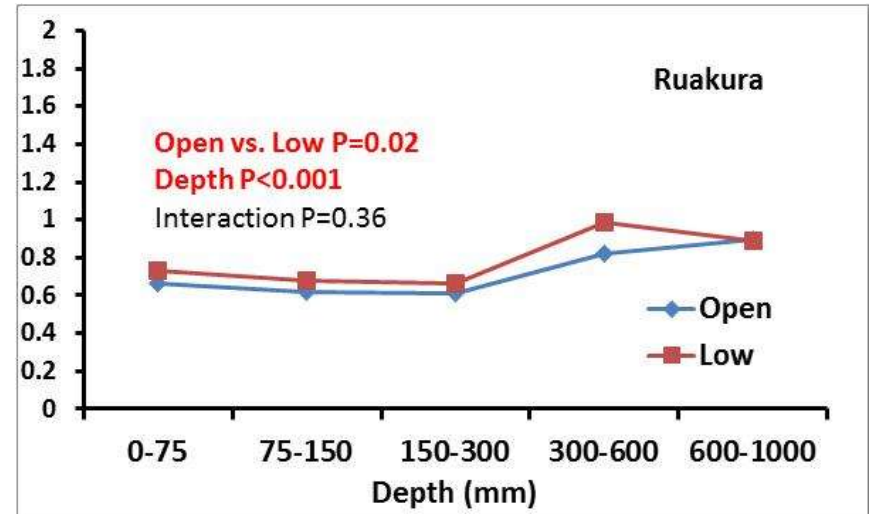
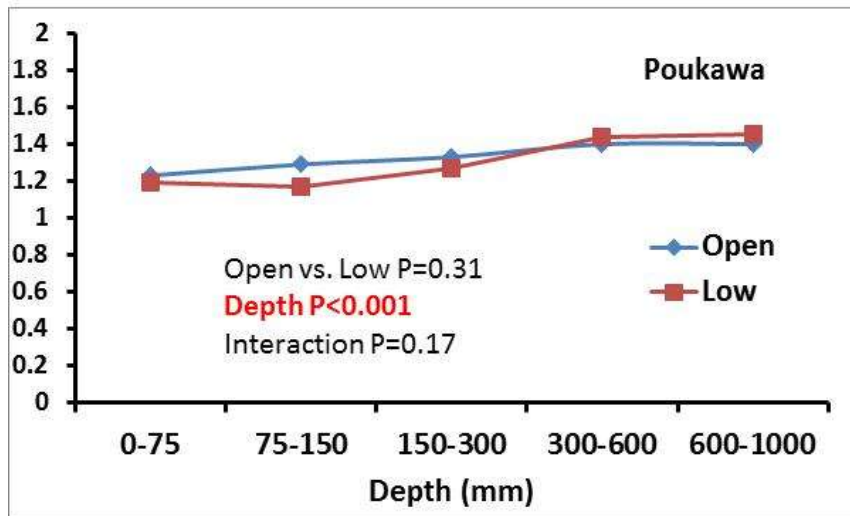


Tree

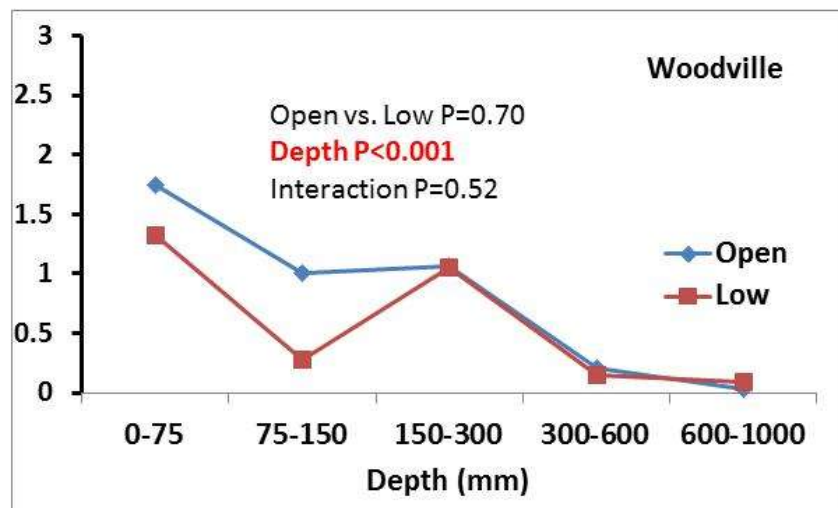
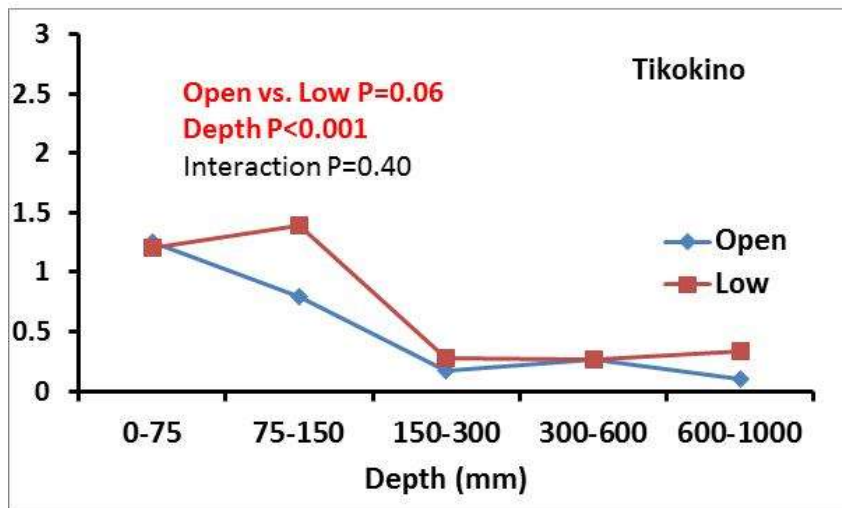
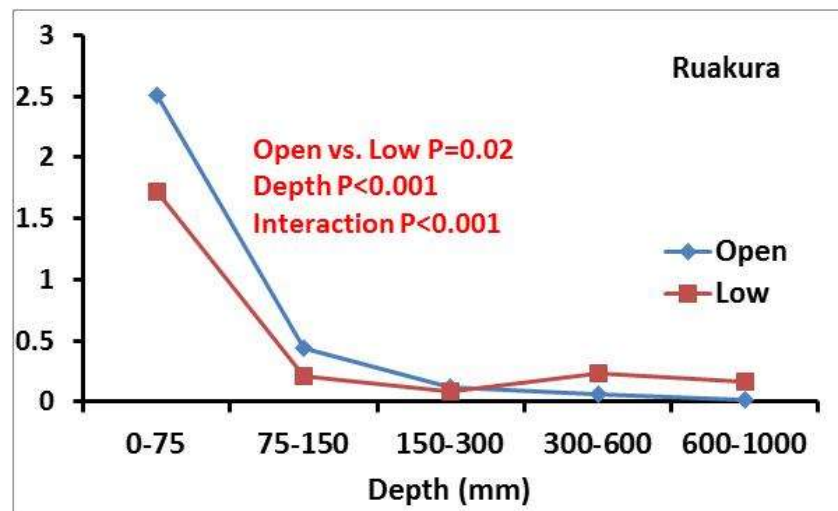
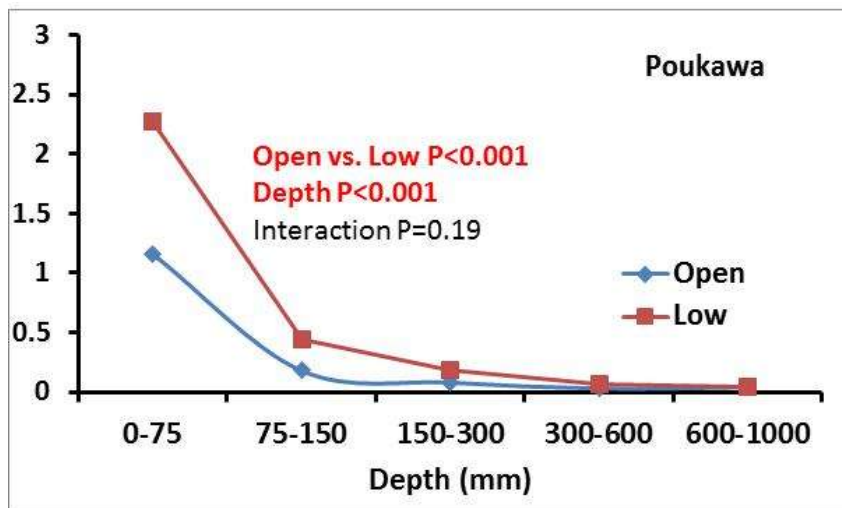




# Bulk density (g/cm<sup>3</sup>)

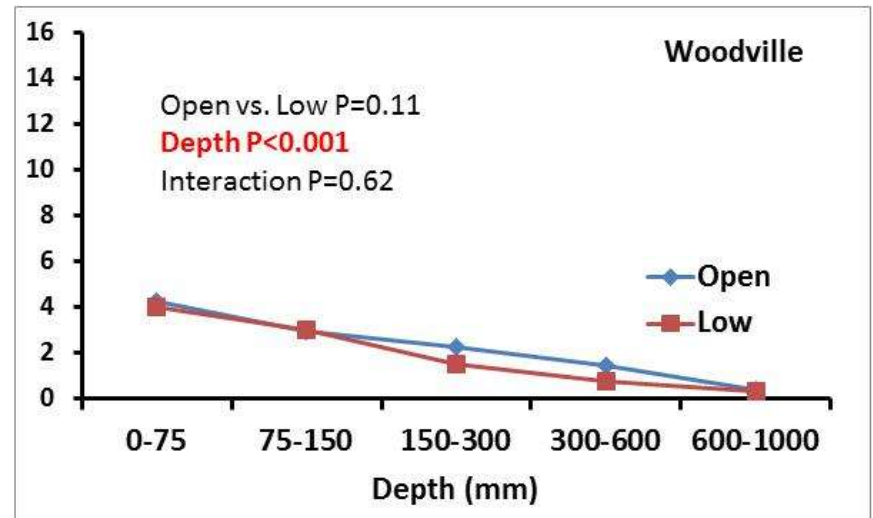
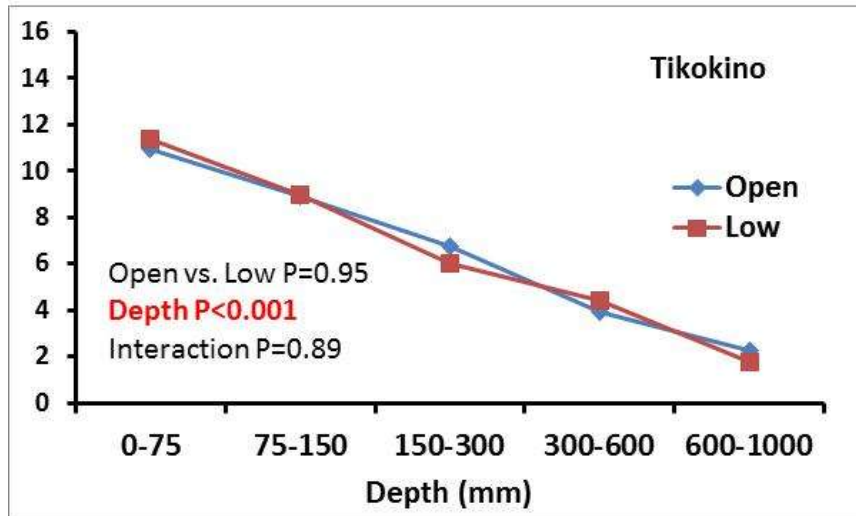
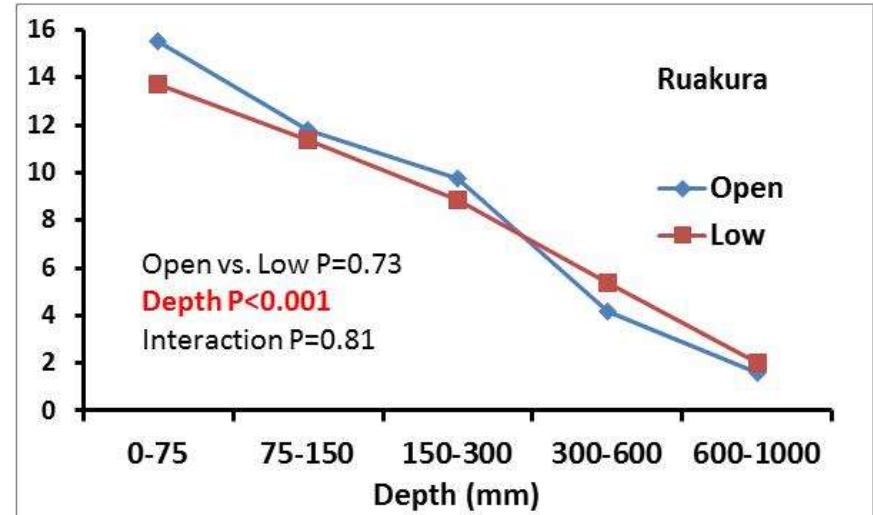
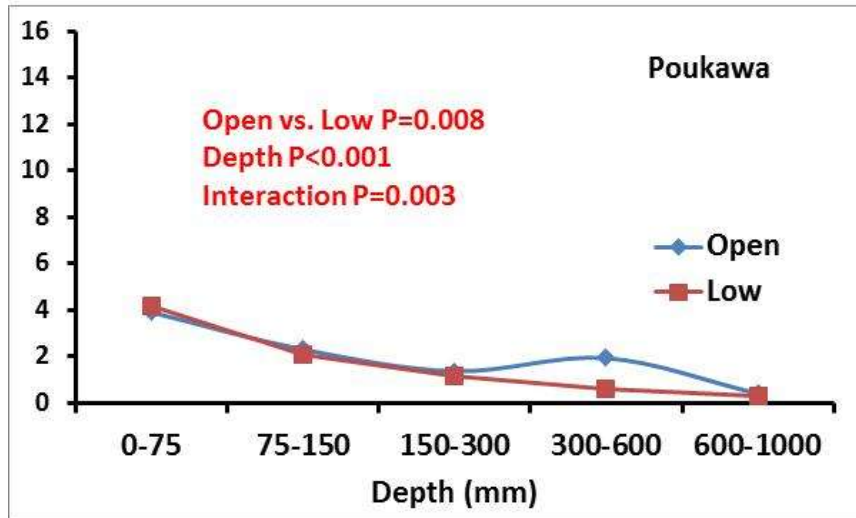


# Root mass density (mg/cm<sup>3</sup>)



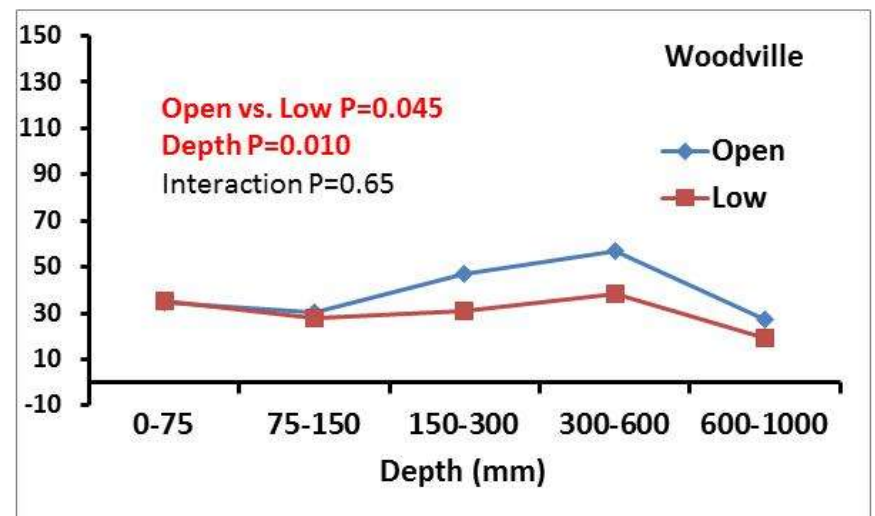
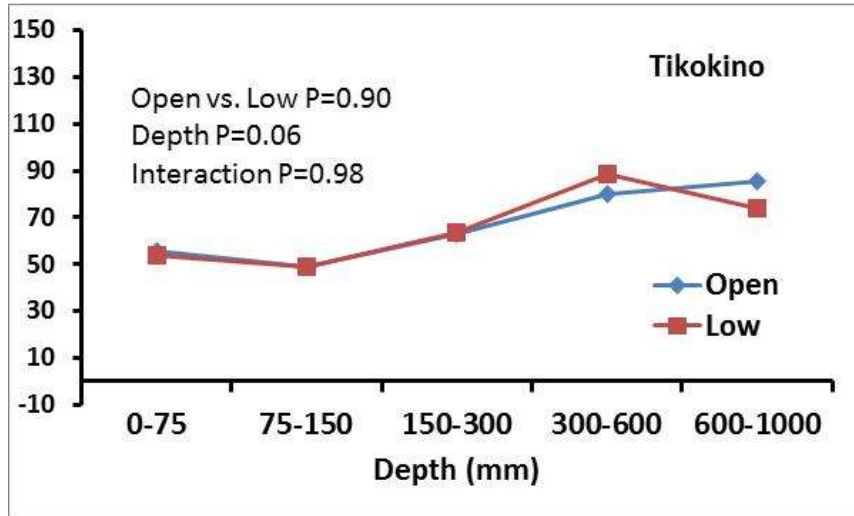
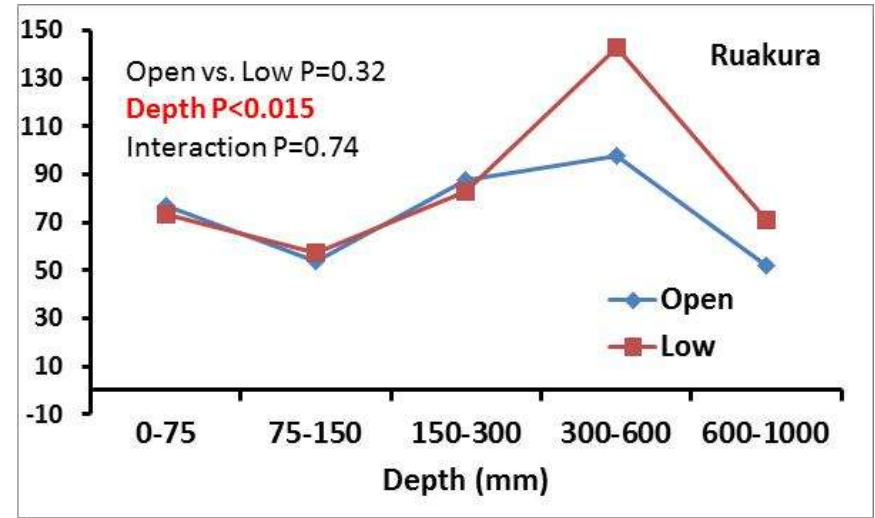
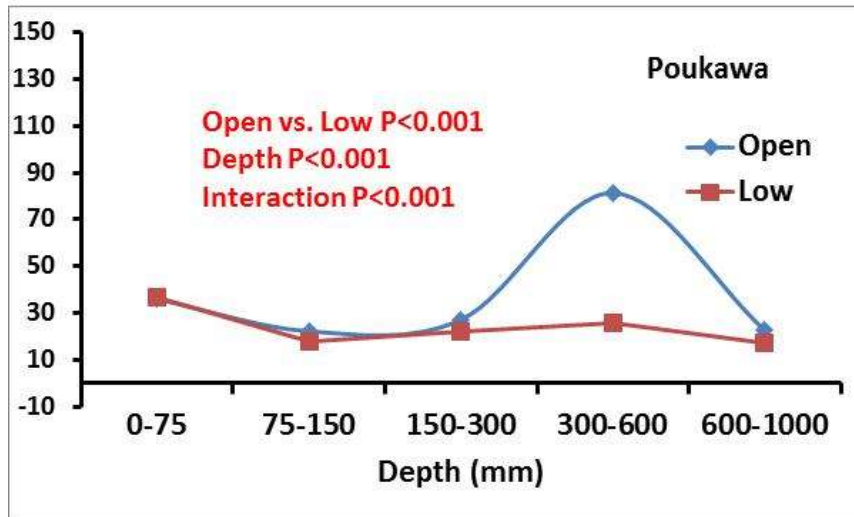


# Carbon concentration (%)





# Carbon mass (t/ha)



## Total carbon mass (0-1 m depth, t/ha)

System	<i>n</i>	Poukawa (alder)	Ruakura (alder)	Tikokino (poplar)	Woodville (poplar)
Open	3	189 ↓	374 ↑	352 ↓	202 ↓
PT (Low)	2	120 ↓	455 ↑	328 ↓	154 ↓
Probability		<0.01	0.41	0.78	0.22

- Poukawa: PT system 37% < Open; trend also at Tikokino and Woodville
- Ruakura: trend of PT > Open

# Conclusions

- **Soil to 1 m depth is an important store of C**
- **Soil (300-1,000 mm depth) comprised 36-55% of total C to 1 m depth**
- **Soil C (0-1 m) at Poukawa was 37% less beneath alder trees than in the open**
- **Poplar trees did not enhance soil C**
- **Tree species may influence soil C mass but results are equivocal**

# Thank you

## Acknowledgements

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