



# **EFFECTS OF HARVEST RESIDUE MANAGEMENT ON PRODUCTIVITY, ORGANIC C STOCK AND SOIL CHARACTERISTICS IN *EUCALYPTUS GLOBULUS* COPPICE STANDS**

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# OBJECTIVES

To evaluate the impact of organic residue (forest floor litter layer and harvesting residue) management in an *Eucalyptus* coppice stand (2<sup>nd</sup> rotation) on:

- Tree growth and amount of understory biomass;
- Mass of forest floor litter layer and changes in soil organic carbon accumulation;
- Nutrient availability;
- Soil physical and chemical properties.

# SITE CHARACTERISTICS

## FURADOURO (FU)

**LOCATION:** Óbidos (39° 20' N, 9° 13' W; 30 m asl)

**CLIMATE:** Mediterranean type, tempered by an oceanic influence

Mean annual rainfall:  $\cong$  600 mm

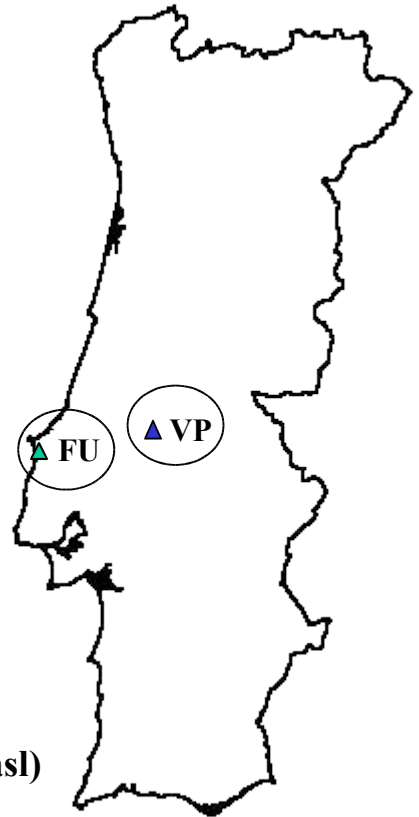
Mean annual temperature: 15,2 °C

Relative humidity: 80%

**LITHOLOGY:** Sandstones (Jurassic)

**TOPOGRAPHY:** Flat to undulating

**SOILS:** Dystric Cambisols



## VALE PEQUENO (VP)

**LOCATION:** Chamusca (39° 22' N, 8° 20' W; 170 m asl)

**CLIMATE:** Mediterranean type

Mean annual rainfall:  $\cong$  650 mm

Mean annual temperature: 16 °C

Relative humidity: 60%

**LITHOLOGY:** Miocenic sandstones

**TOPOGRAPHY:** Flat

**SOILS:** Gley-Aplic Lixisols

# **TREATMENTS AND EXPERIMENTAL DESIGN**

**Sites were a first rotation, in which the harvesting of the previous crop had taken place in 1992**

**R - Removal of organic residues (forest floor litter layer and harvesting residues) from the soil surface;**

**S - Broadcasting of organic residues on the soil surface;**

**W - As for treatment S, but woody residues accumulated between rows;**

**I - Incorporation of organic residues in the top soil by harrowing up to 20 cm depth.**

**Treatments were laid out (March 1993) in five blocks in a fully randomised design:**

**Measured plot area (m): 18 x 18;**

**Buffer zone (m): 6 - 6;**

**Tree spacing (m): 3 x 3.**

# AMOUNTS OF NUTRIENTS IN THE FOREST FLOOR LITTER LAYER (FFLL) AND HARVESTING RESIDUES (HR)

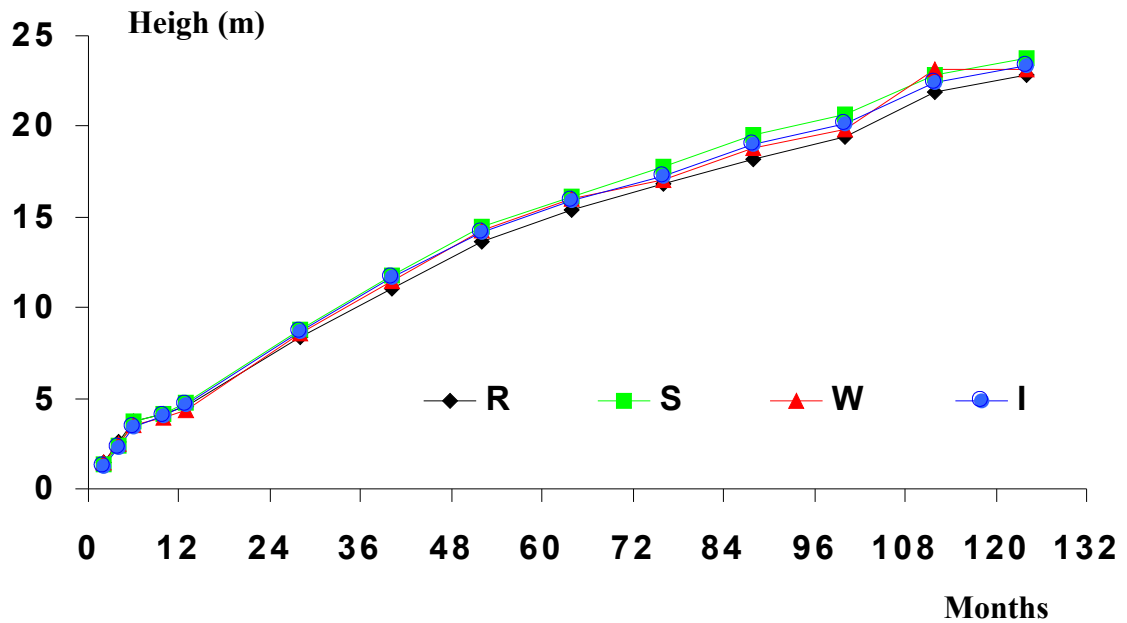
	Mass	Nutrients (kg ha <sup>-1</sup> )				
	t ha <sup>-1</sup>	N	P	K	Ca	Mg
FURADOURO						
FFLL	28,9	218	13,0	37	515	49
HR	31,8	145	14,2	68	321	32
VALE PEQUENO						
FFLL	19,5	92	6,0	18	308	25
HR	29,4	146	6,3	44	319	37

# MEASUREMENTS

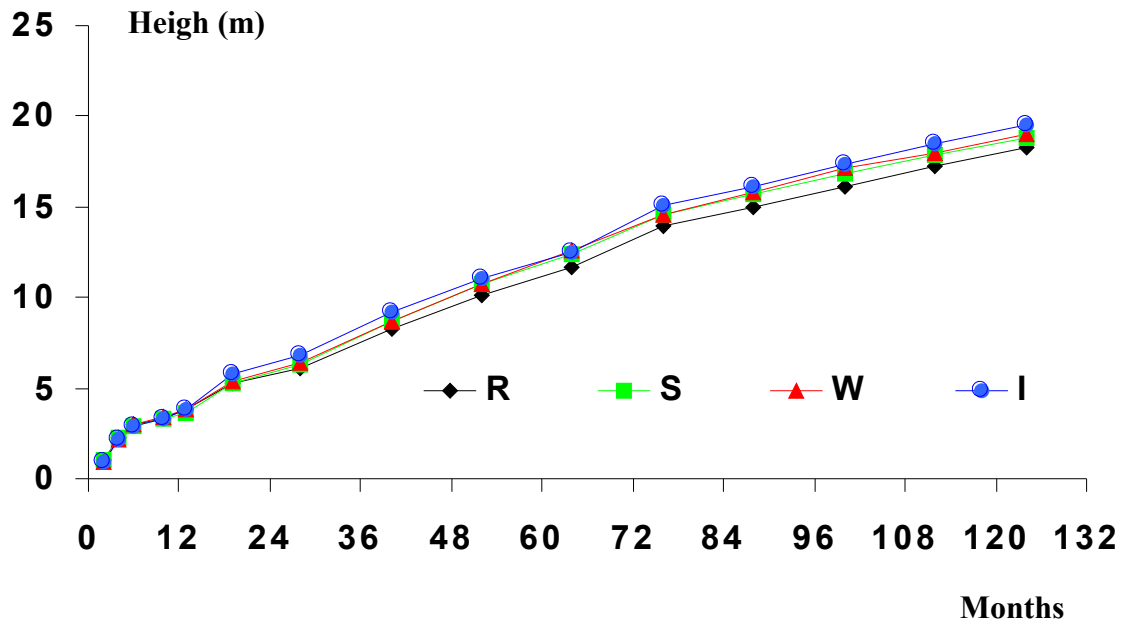
- **Weight of harvest residue components was assessed at the start of the experiment; harvest residue decomposition was measured from weigh loss in litter bags;**
- **The mass of the forest floor litter layer was measured before treatments set up and along the experiment period;**
- **Coppiced tree growth (height, DBH,...);**
- **Bulk density was determined from undisturbed samples; soil aggregation index was determined on samples taken from the top soil;**
- **Concentrations of organic C, N, base cations, extractable P were determined up to 30 cm depth;**
- **Nitrogen mineralization was assessed in laboratory through aerobic and anaerobic incubation;**

# TREE GROWTH

## Furadouro

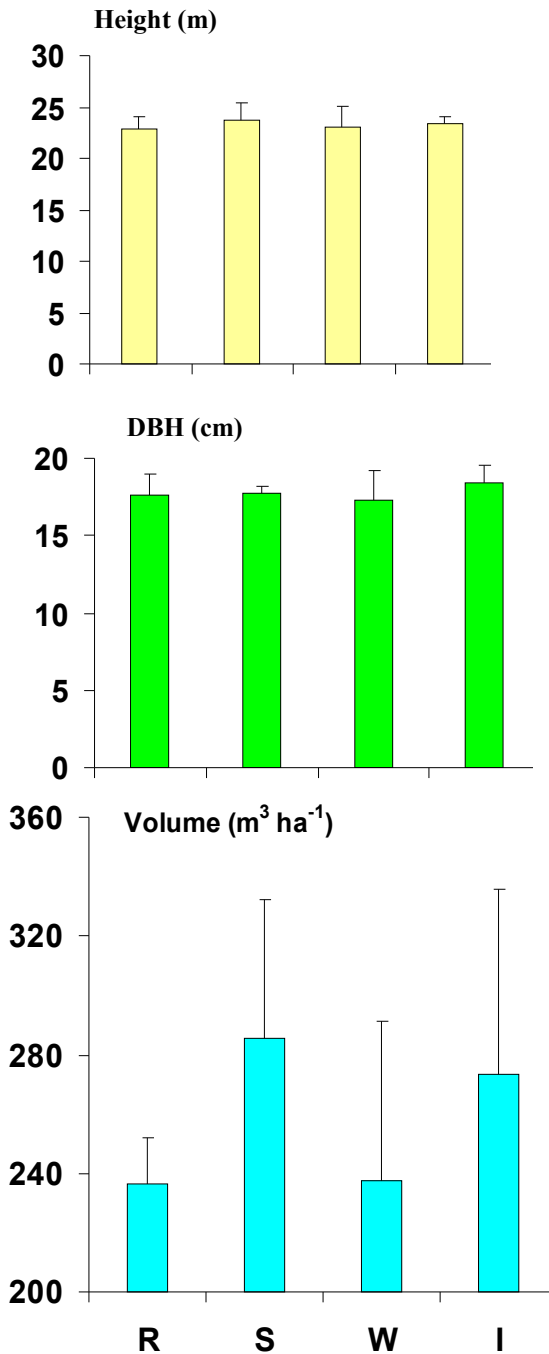


## Vale Pequeno

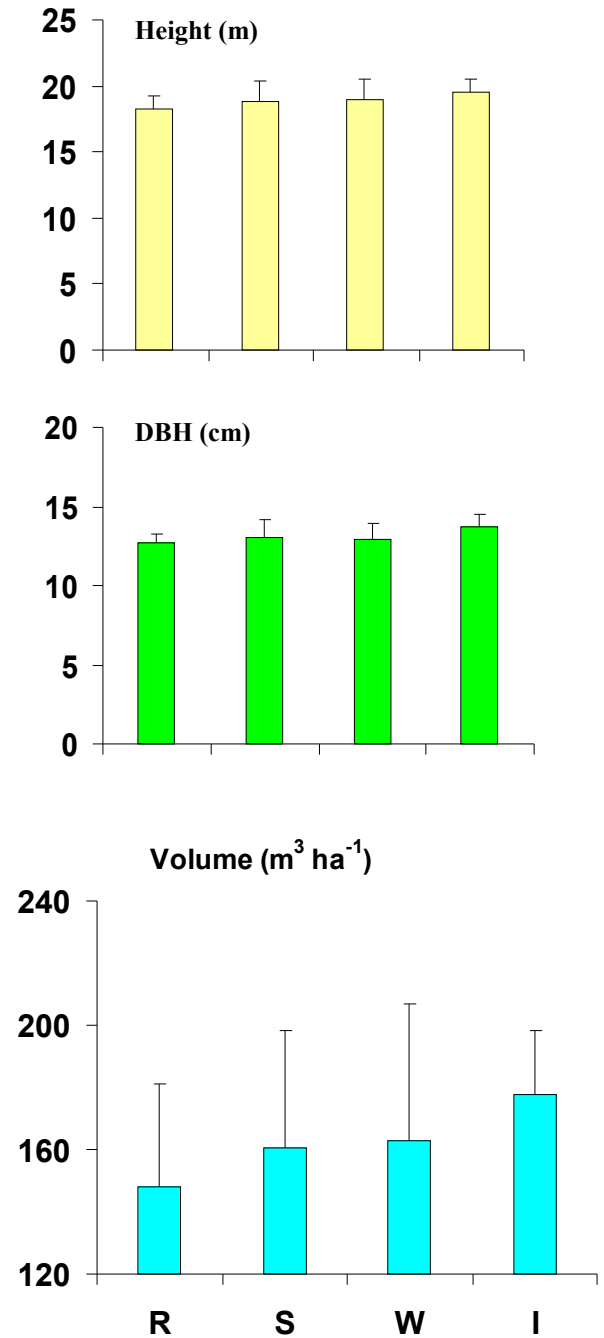


# TREE GROWTH

## Furadouro

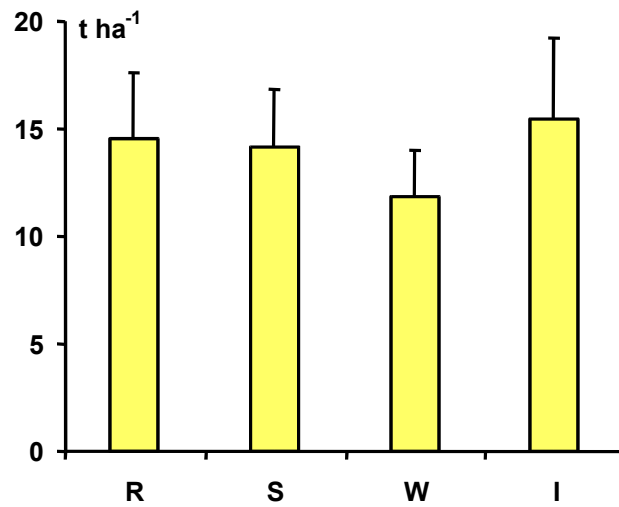


## Vale Pequeno

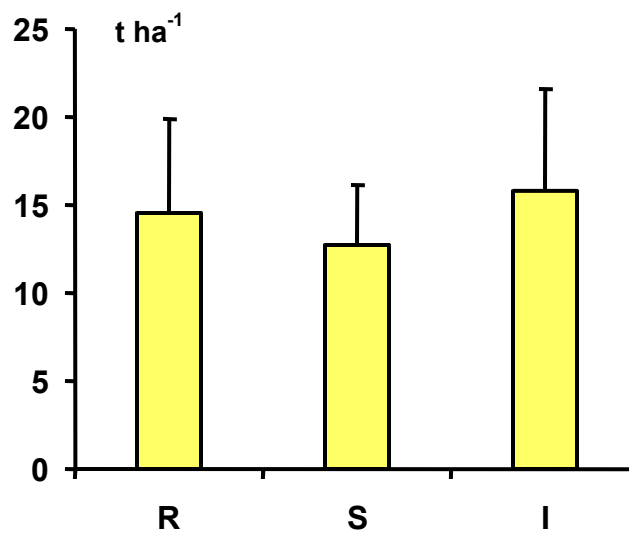


# FOREST FLOOR LITTER LAYERS

## FURADOURO

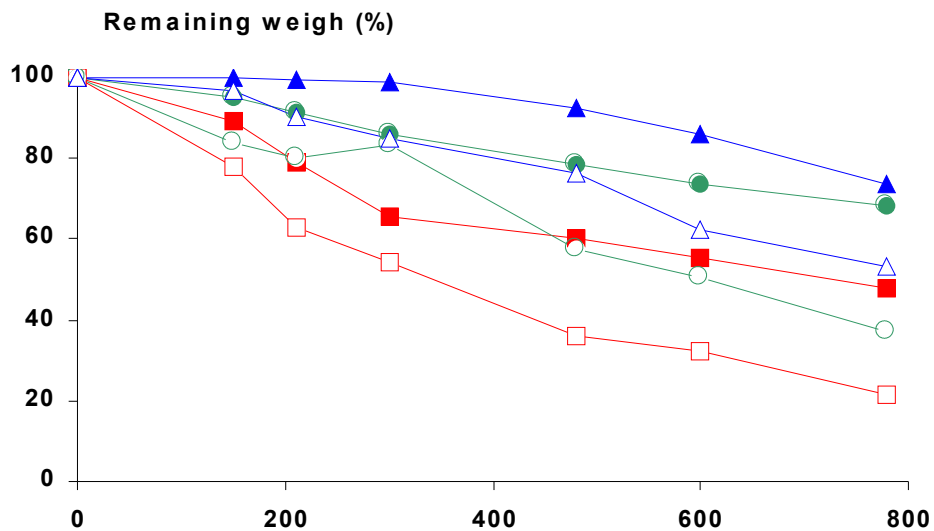


## VALE PEQUENO

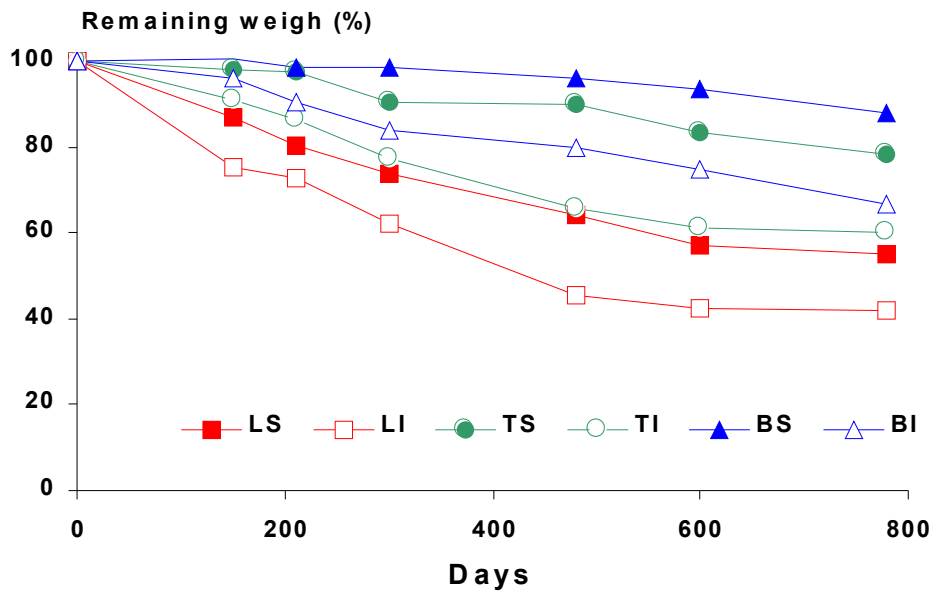


# DECOMPOSITION OF HARVESTING RESIDUES

## FURADOURO

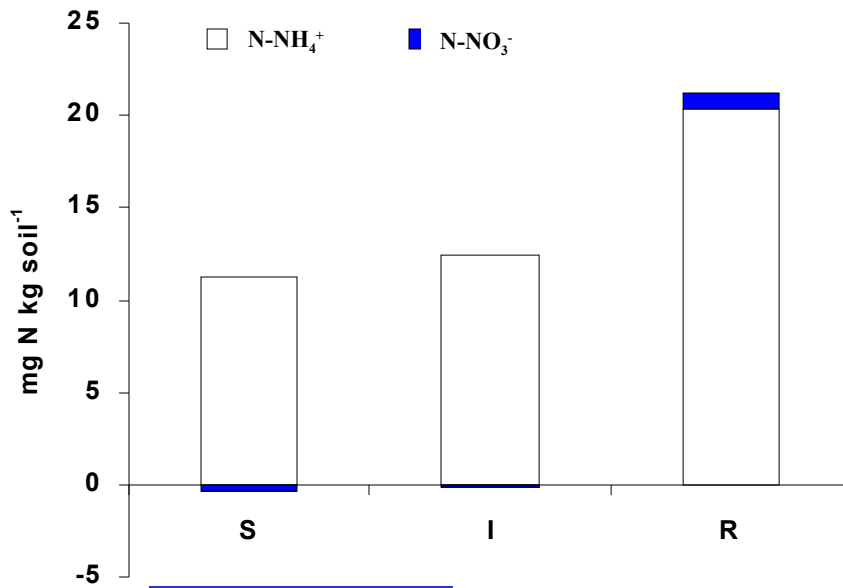


## VALE PEQUENO

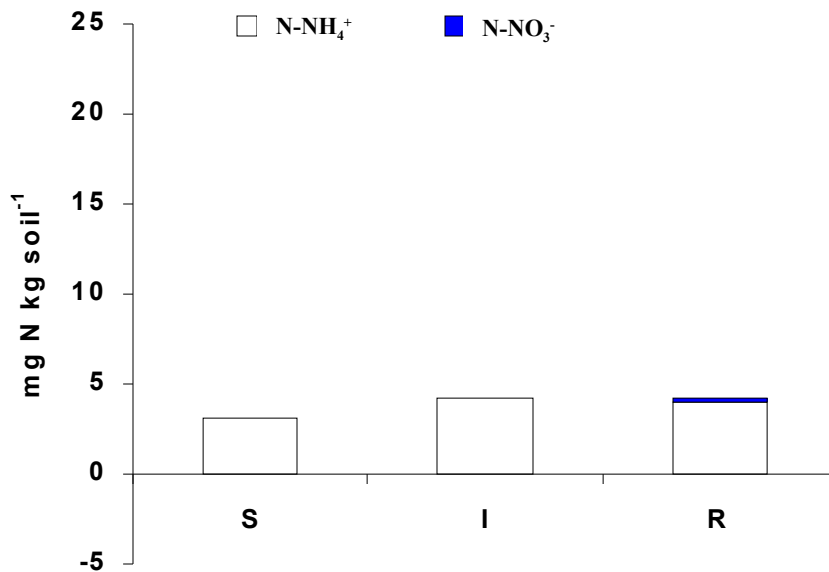


# Nitrogen Mineralisation

0-10 cm



10-20 cm



## SOIL CHARACTERISTICS

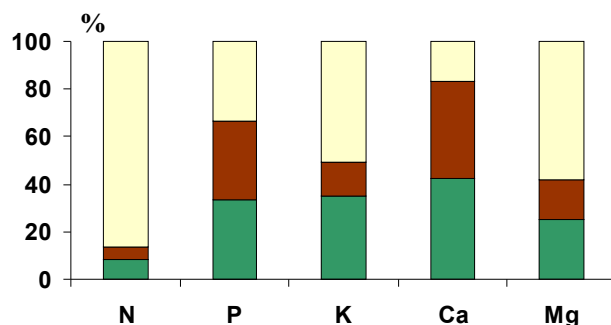
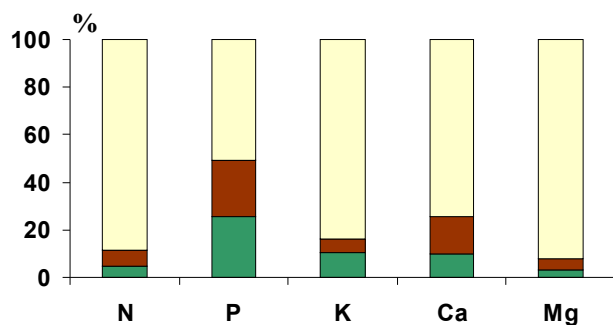
Prof. (cm)	R	S	W	I
Bulk density (g cm <sup>-3</sup> )				
0-10	1,35±0,13	1,32±0,13	-	1,35±0,12
10-20	1,60±0,08	1,62±0,11	-	1,45±0,12
Organic C (g kg <sup>-1</sup> )				
0 – 5	20,5±12,1	16,0±6,7	19,3±5,0	17,6±5,6
5 –10	8,4±3,2	7,3±3,1	8,5±1,7	12,0±3,6
10 –20	6,4±1,8	6,1±2,2	7,1±1,4	8,9±4,0
Extractable Ca (cmol <sub>c</sub> kg <sup>-1</sup> )				
0-5	3,7±2,5	3,1±1,5	3,3±2,2	3,0±1,7
5-10	1,9±1,7	6,7±0,6	1,8±1,3	1,6±1,2
10-20	1,1±2,0	0,9±0,5	1,9±1,3	1,3±1,4
pH (H <sub>2</sub> O)				
0-5	4,72±0,18	4,78±0,12	4,81±0,26	4,79±0,21
5-10	4,61±0,09 <sup>b</sup>	4,58±0,16 <sup>ab</sup>	4,37±0,21 <sup>a</sup>	4,41±0,26 <sup>ab</sup>
10-20	4,50±0,17	4,54±0,14	4,47±0,19	4,55±0,21
Extractable P (µg g <sup>-1</sup> )				
0-5	8,0±5,6	6,6±2,2	5,5±2,1	4,3±2,2
5-10	6,2±5,1	6,0±2,1	4,2±2,0	4,3±1,9
10-20	8,6±5,8	6,7±4,4	7,0±4,4	5,3±1,7

# AMOUNTS (KG HA<sup>-1</sup>) AND PROPORTION OF NUTRIENTS IN THE FOREST FLOOR LITTER LAYERS (FFLL), HARVESTING RESIDUES (HR) AND MINERAL SOIL LAYERS (ML)

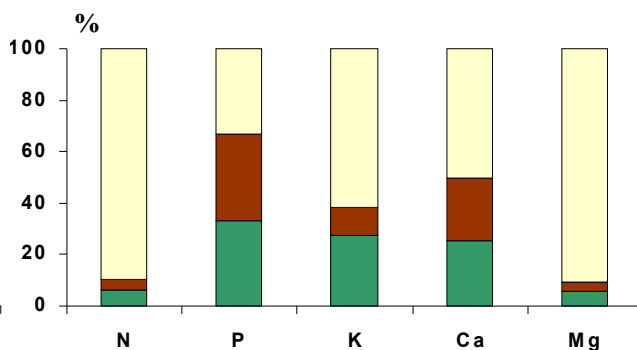
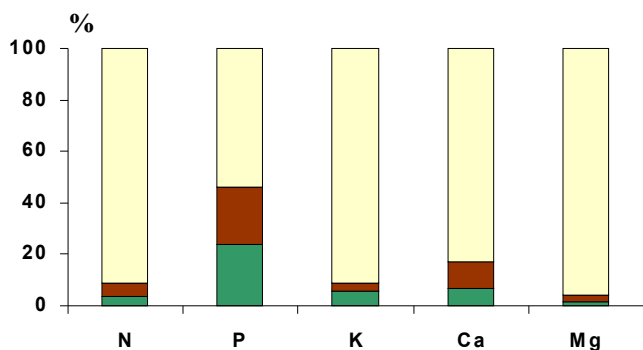
## FURADOURO

## VALE PEQUENO

HR FFLL ML



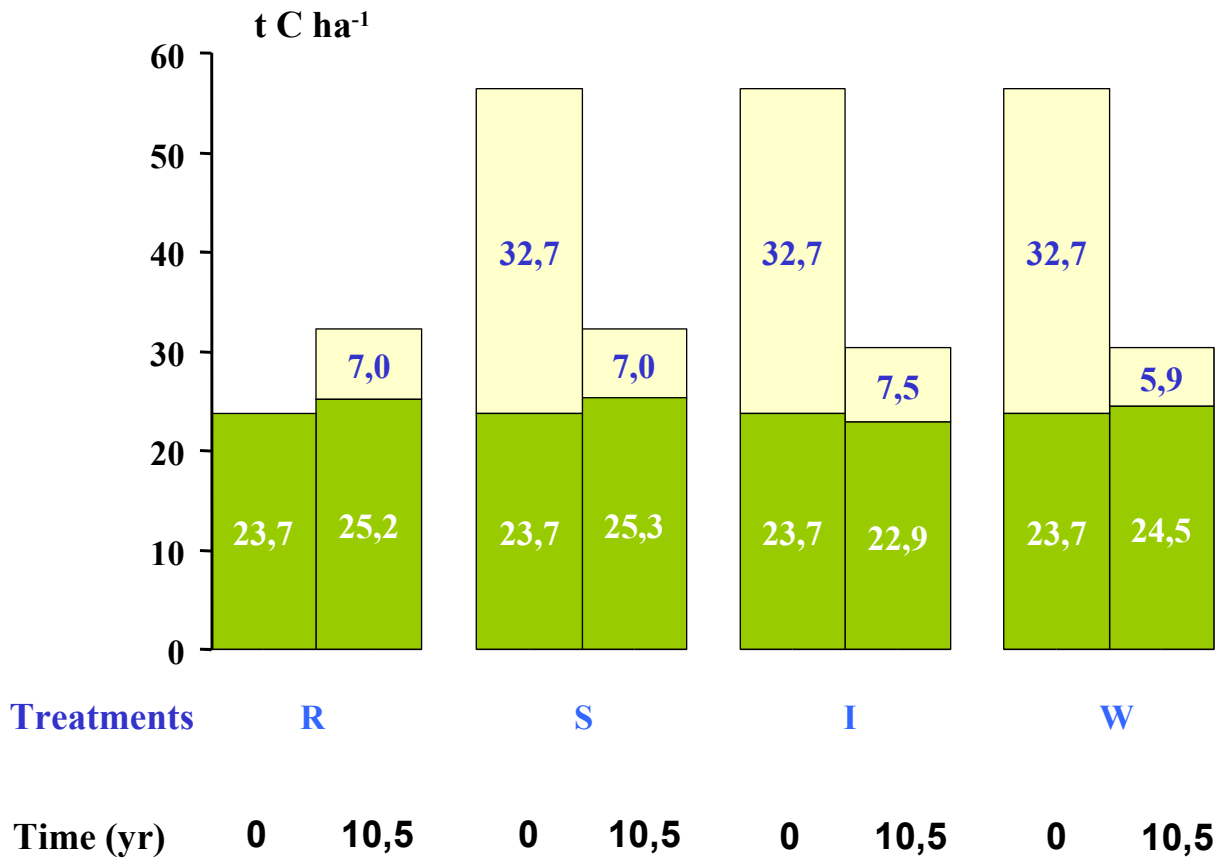
### Up to 40 cm depth



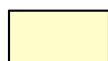
### Up to 60 cm depth



## ORGANIC C STOCK



**Mineral soil layer (0-20 cm)**



**Harvesting residues and/or organic layers**

## CONCLUSIONS

- Removal of organic residues did not significantly affect tree growth; additionally, incorporation of residues did not give significant differences with respect to the placement of residues on the surface;
- Nitrogen availability and physical and chemical characteristics of soils were not affected by the treatments;
- As organic C in both organic and mineral layers was similar among treatments, most of the organic C in the residues was lost to the atmosphere;
- Both sites (especially Furadouro) showed a strong resilience to the removal of organic C and nutrients, suggesting that harvesting residue can be used for other purposes (e.g. bioenergy) without detriment effects on the site quality;
- Productivity of Eucalyptus plantations can be sustained under intensive management regime.