R3Forest

R3Forest –
Invasive species compost as a win-win opportunity?

Fundação
para a Ciência
e a Tecnologia

ce3c
CHANGE

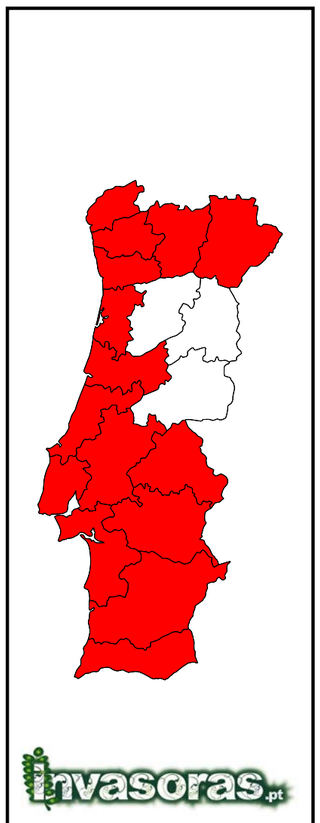
Overview

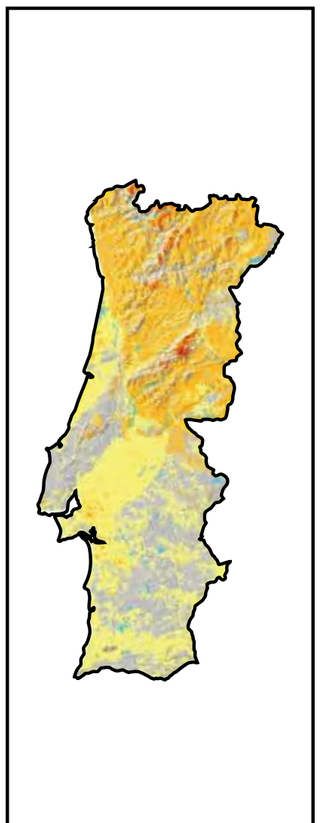
- Intro
- Background *Acacia* compost
- The R3forest project
- R3forest results

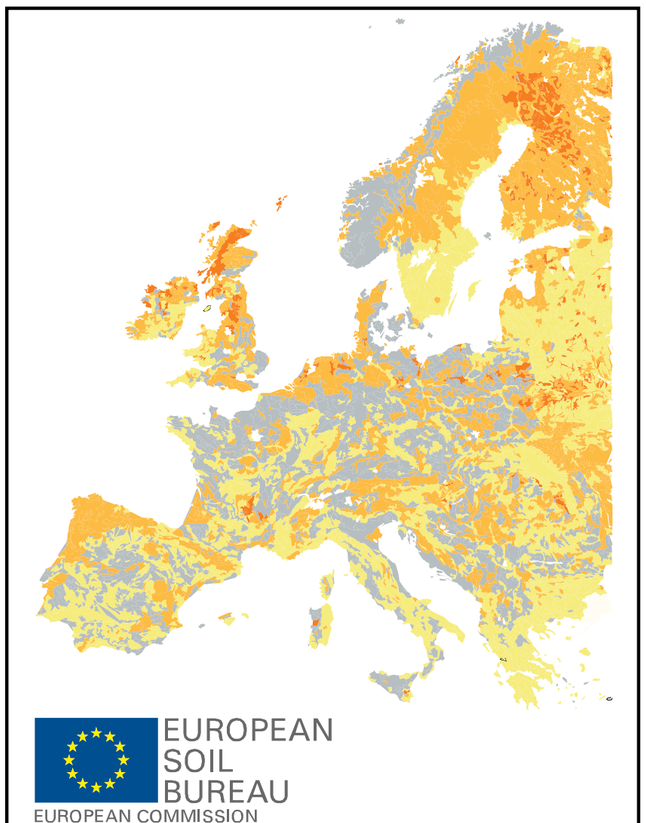
Intro - Why invasive species compost?

R3forest

***A. longifolia* invasion**		**Soil organic carbon distribution**	
Portugal	Europe	Portugal	Europe

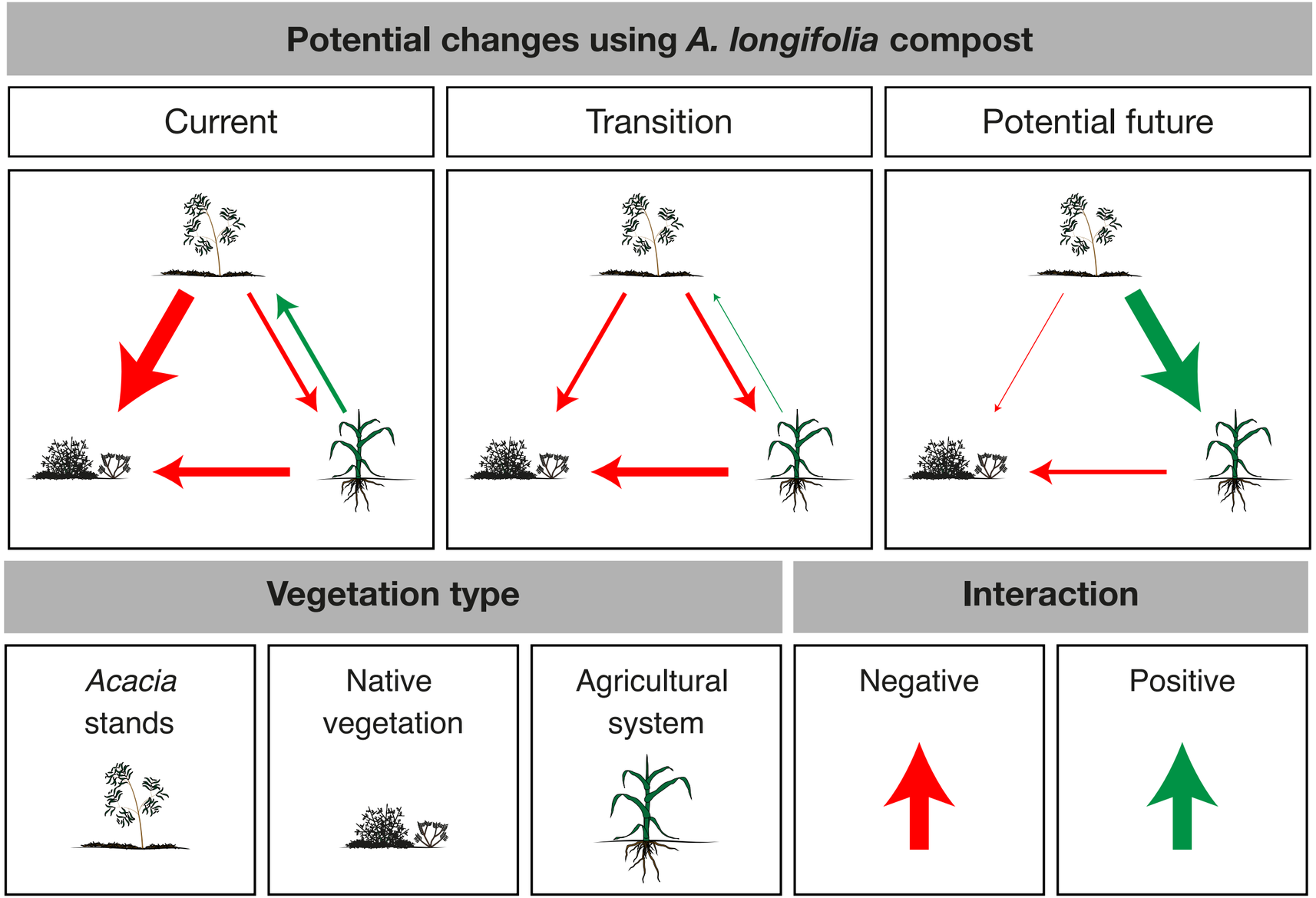






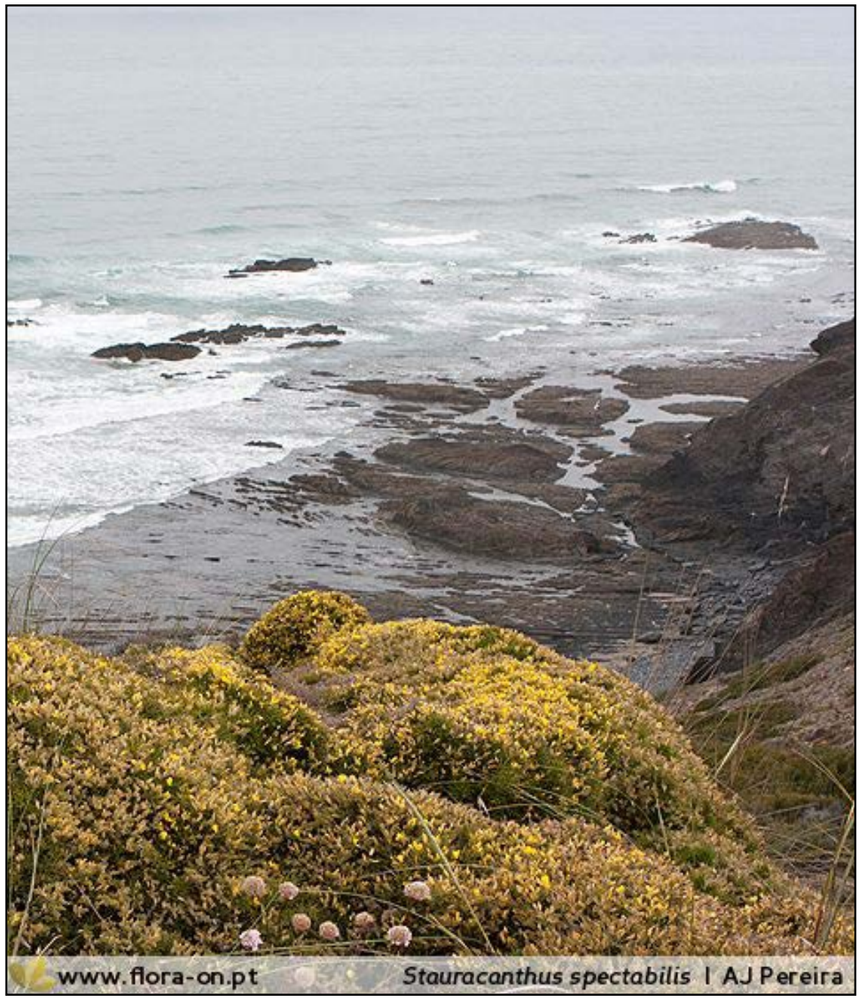
Invaded	Non-Invaded	Very low (< 1%)	Low (1 - 2%)
		Medium (2 - 6 %)	High (> 6 %)

Intro - Lose Lose to Win win?



- Is it good for the soil?
- How to estimate production?
- Implementation costs?
- Does it help in reforestation?

Soil effects? - Natural setting



Acacia longifolia

Stauracanthus spectabilis

Comparison between **invasive** and **native** legume

Ulm, F., Hellmann, C., Cruz, C. and Máguas, C., 2017. N/P imbalance as a key driver for the invasion of oligotrophic dune systems by a woody legume. Oikos, 126(2).

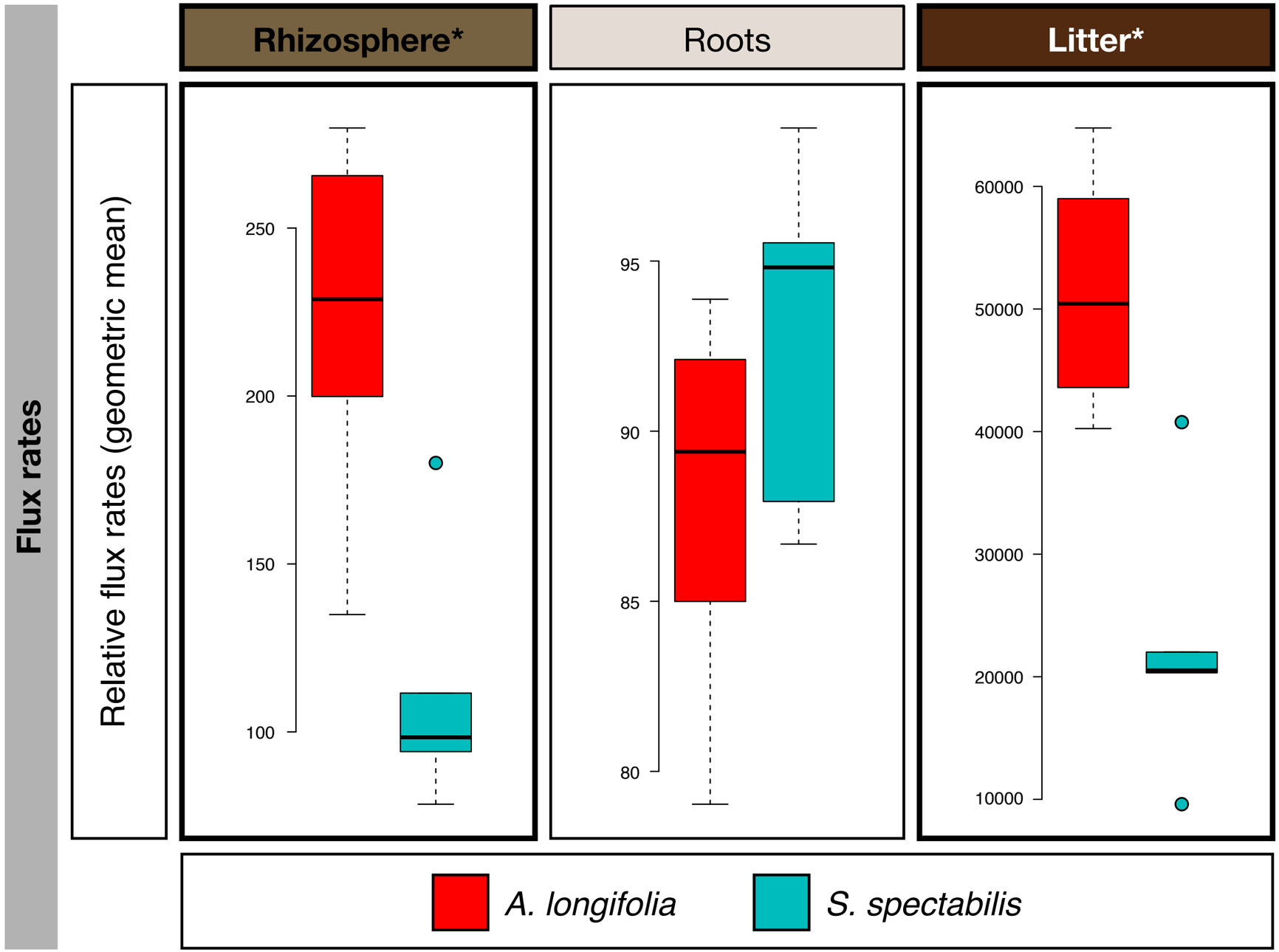
Soil effects? - Natural setting

Soil compartment size	Biomass pools (kg m^{-2})	*A. longifolia*	*S. spectabilis*
	Litter	3.3	3.6
	Roots	2.9	0.9
	Rhizosphere*	**79.2**	**15.5**

A. longifolia

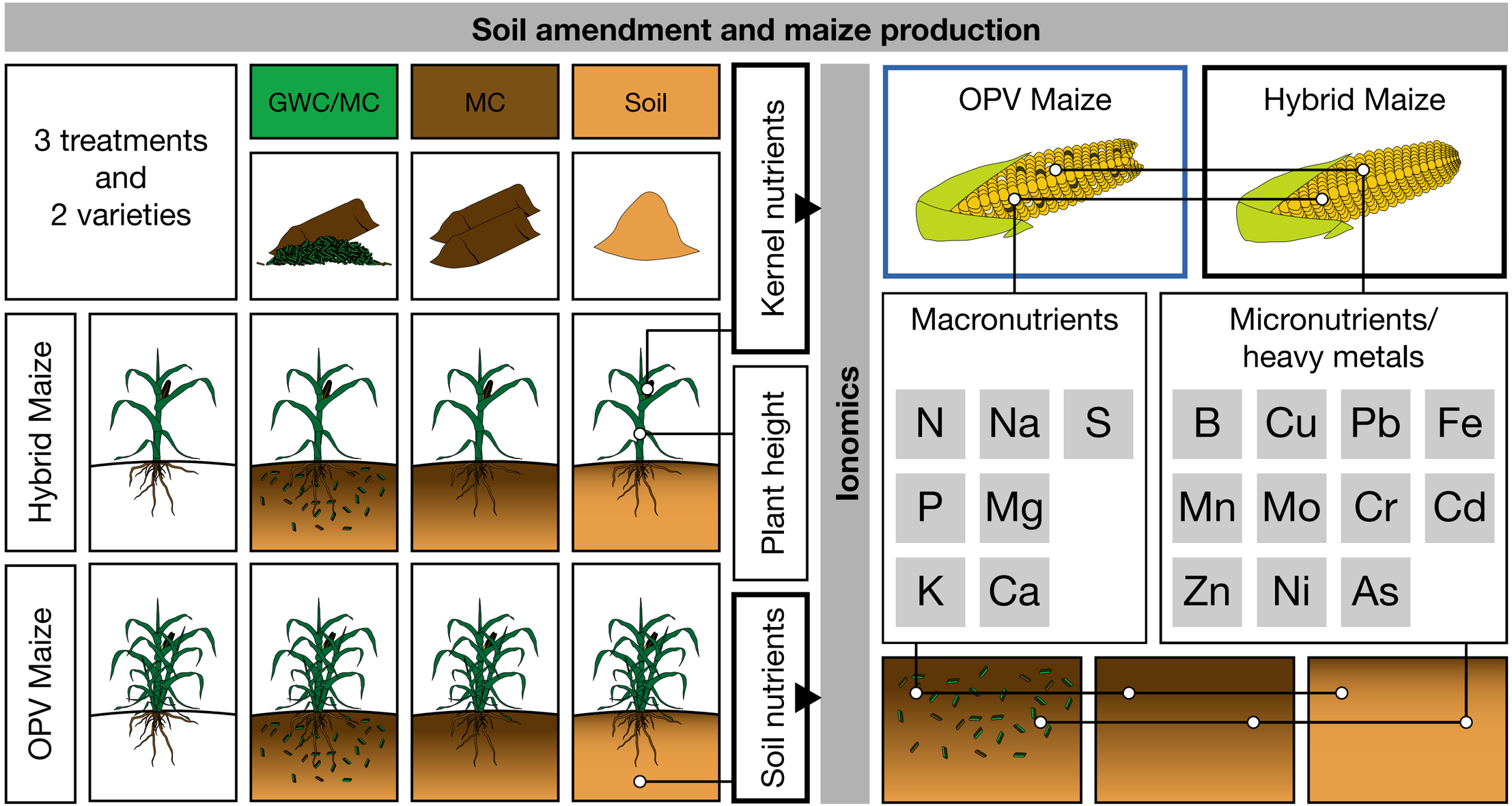
S. spectabilis

Soil effects? - Natural setting



A. longifolia exhibited strongly increased roots and rhizosphere mass, as well as turnover

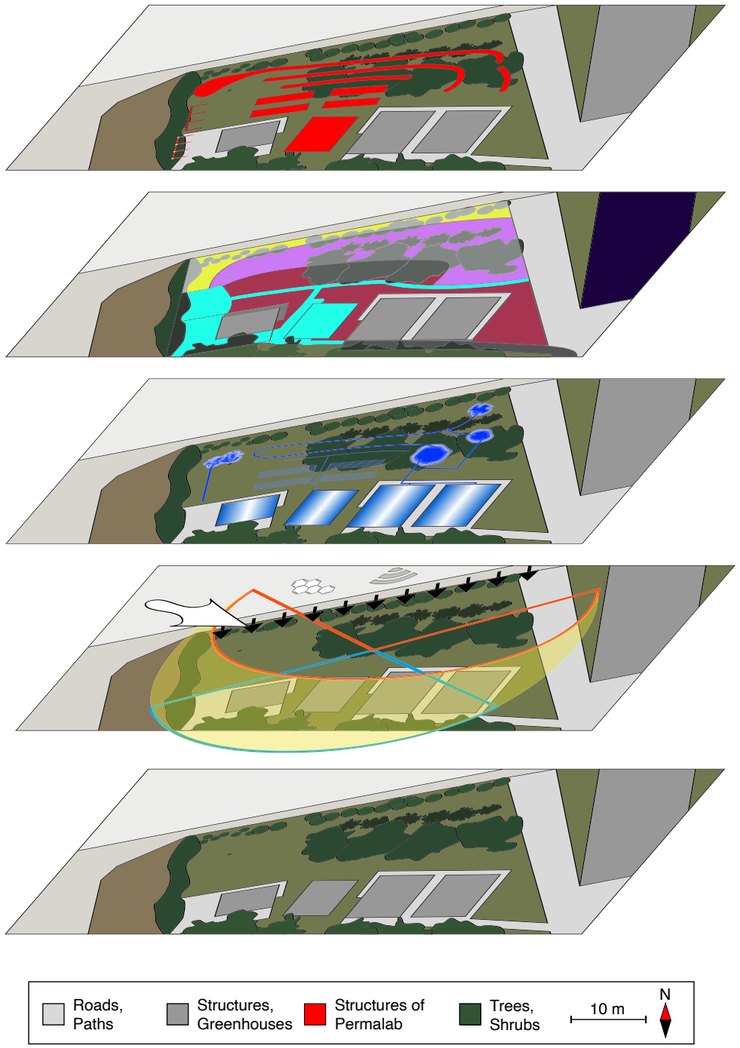
Soil effects? - *Acacia* Compost

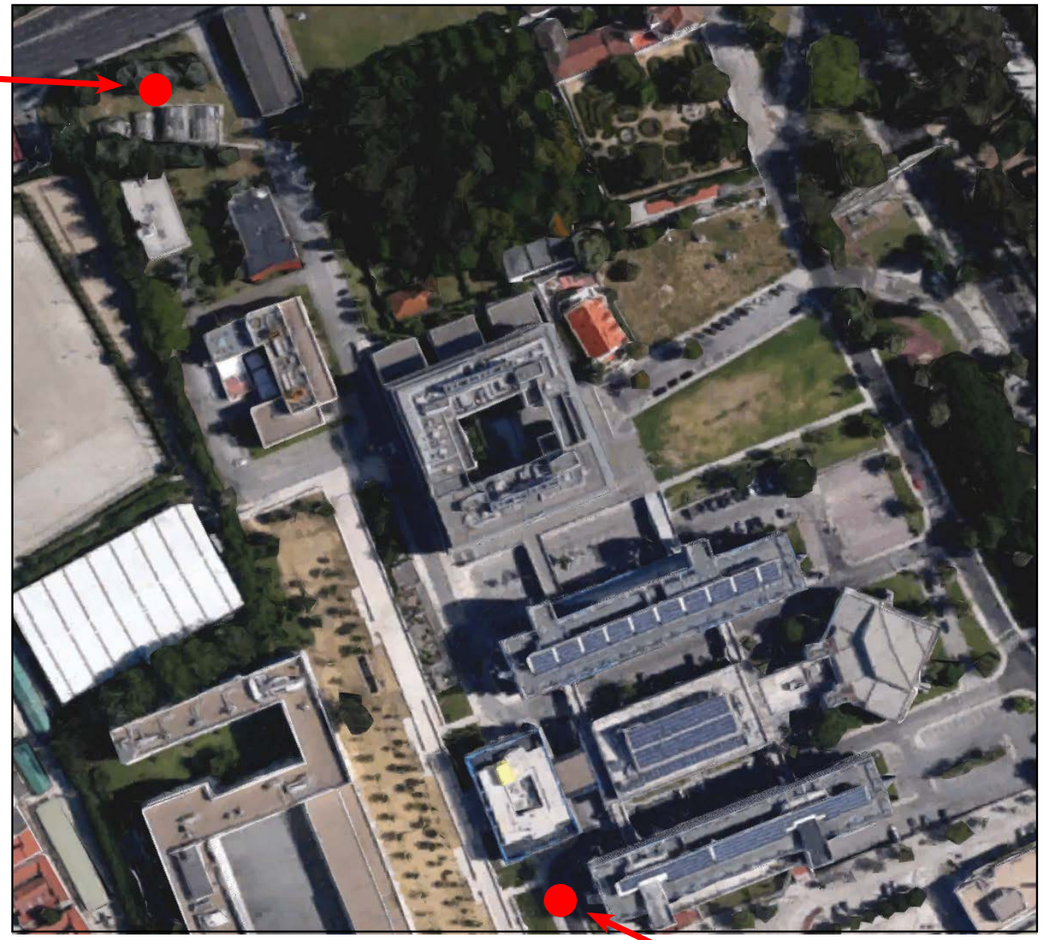


The PermaLab - Testing at FCUL

R3forest

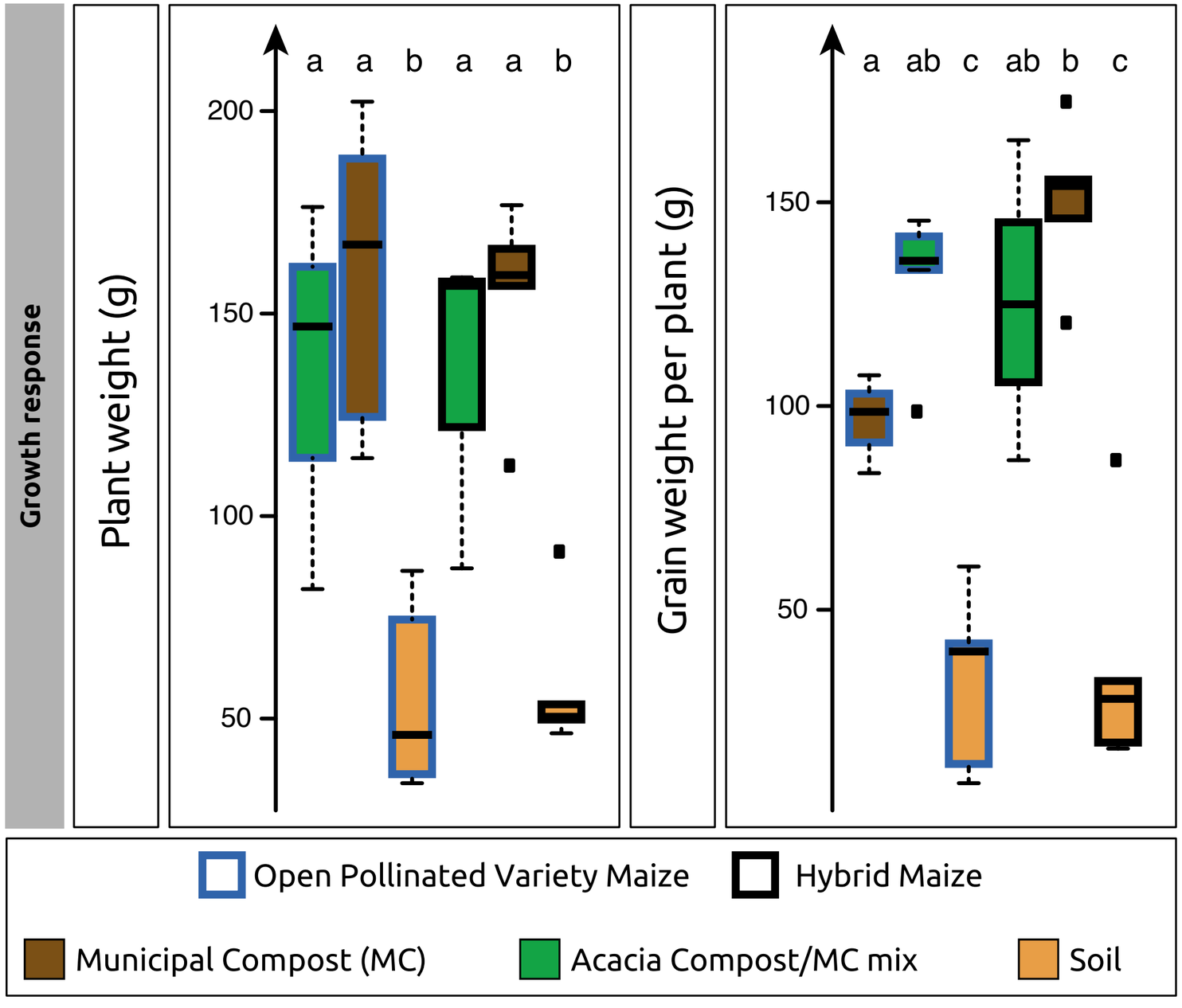
Permaculture Living Lab





HORTA Fc ul

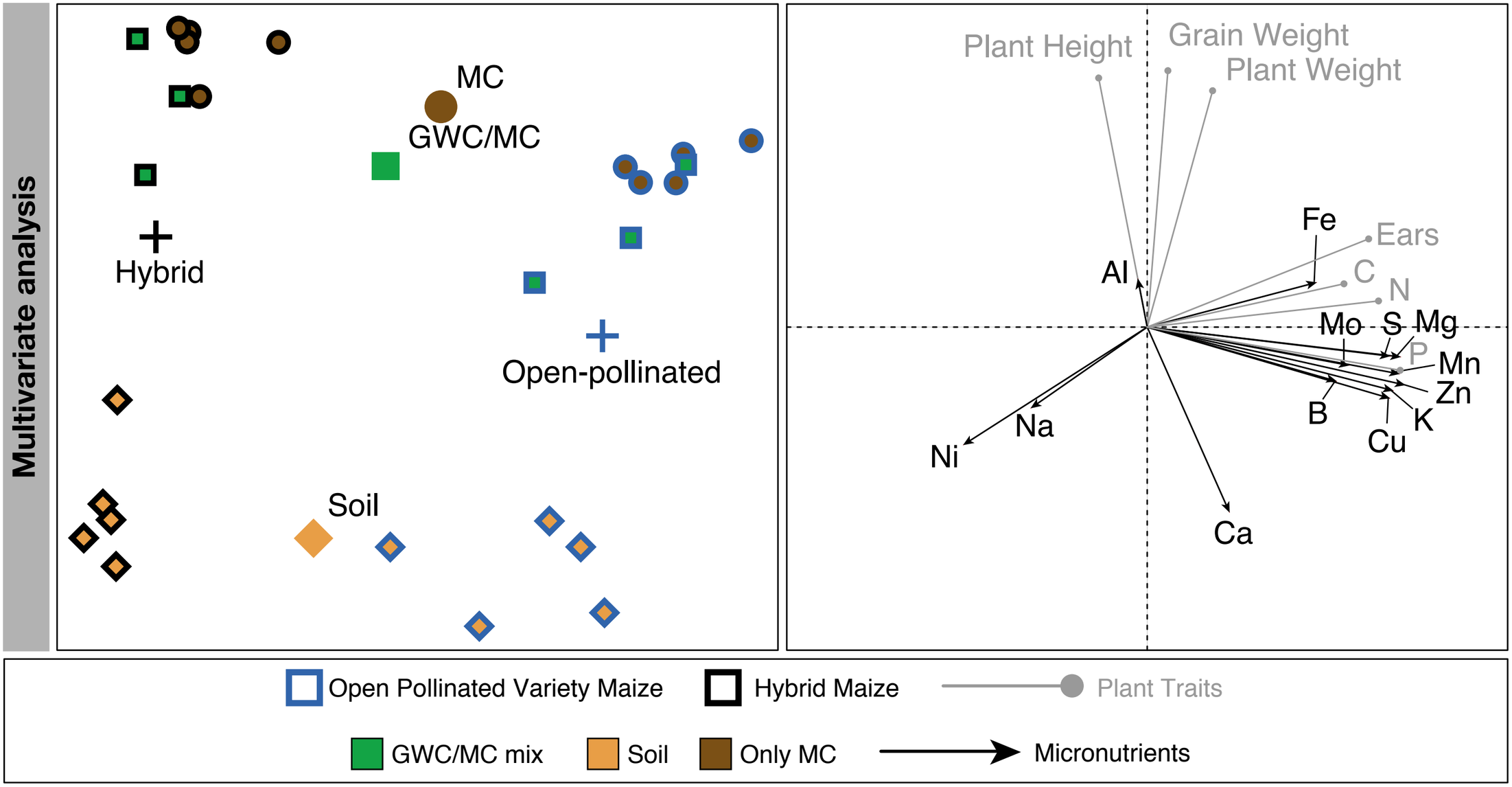
Soil effects? - *Acacia* Compost



Hybrid and OPV responded with similar growth and grain yield, dependent mainly on treatment

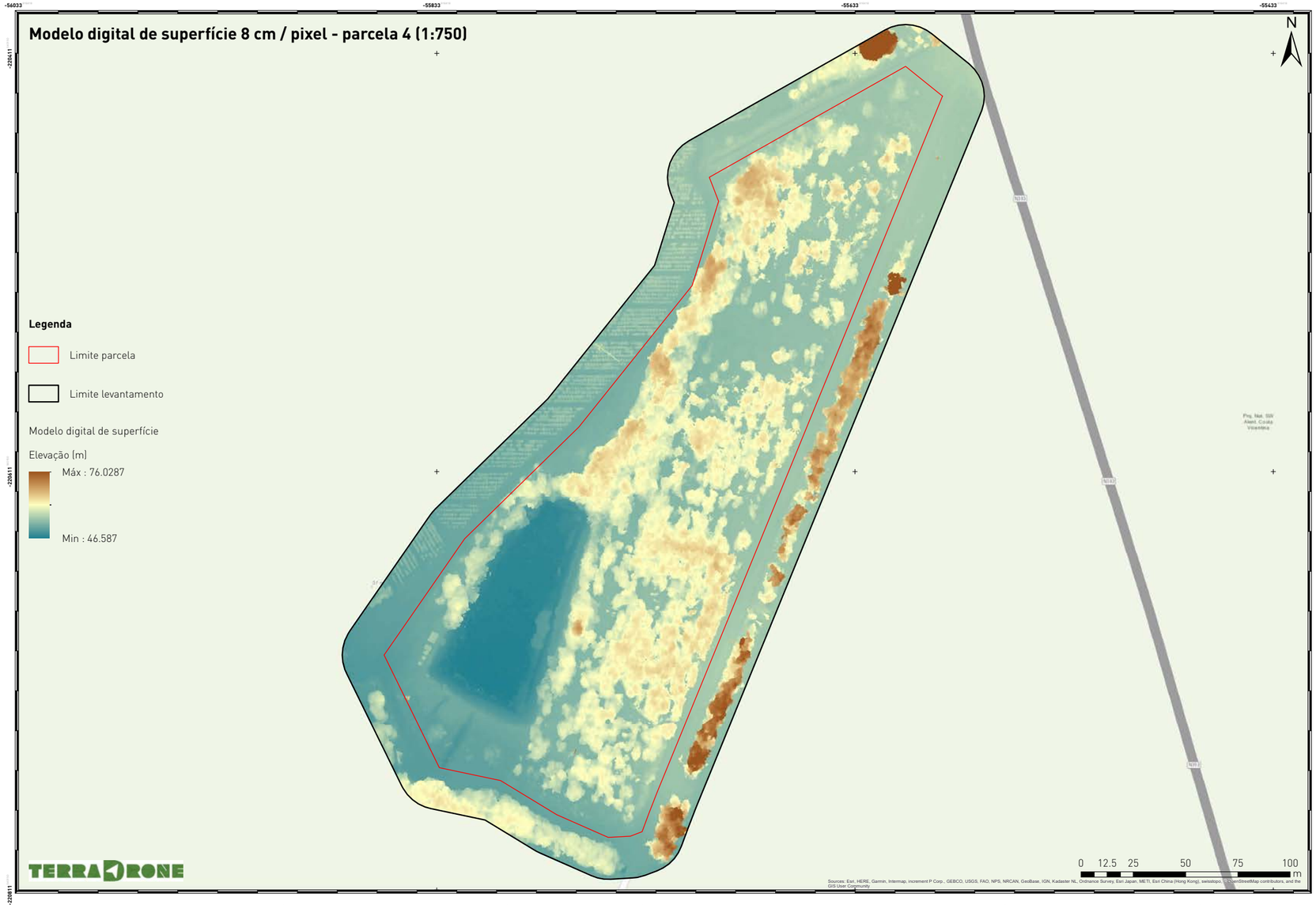
Ulm, F., Avelar, D., Hobson, P., Penha-Lopes, G., Dias, T., Máguas, C., & Cruz, C. (2019). Sustainable urban agriculture using compost and an open-pollinated maize variety. Journal of Cleaner Production, 212, 622-629.

Soil effects? - *Acacia* Compost



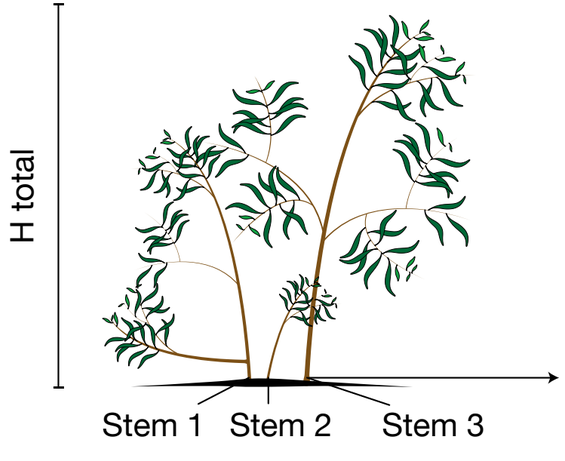
Biomass model - Drone flight

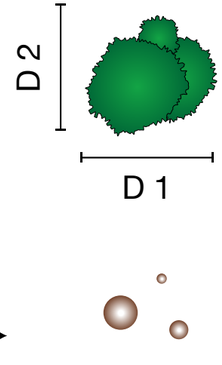
- High-resolution drone imaging (8 cm/pixel)
- DTM (digital terrain model) by photogrammetry
- Destructive biomass harvest



Data do voo: 26 Setembro 2019 | Condições atmosféricas: céu limpo | Altura de voo: 100 m | Sensor: RGB | Sistema de Coordenadas: ETRS89 PT TM06 | Resolução das imagens: 2 cm / pixel

Biomass model - Harvest





Canopy

D0: Diameters at soil height

Biomass separation

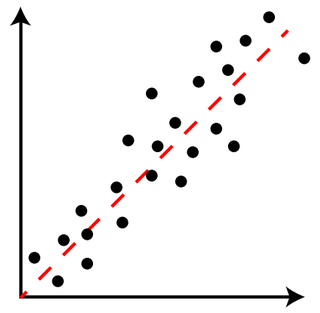
Trunk

Branches (ø < 1 cm)

Foliage

Biomass model

Extrapolation



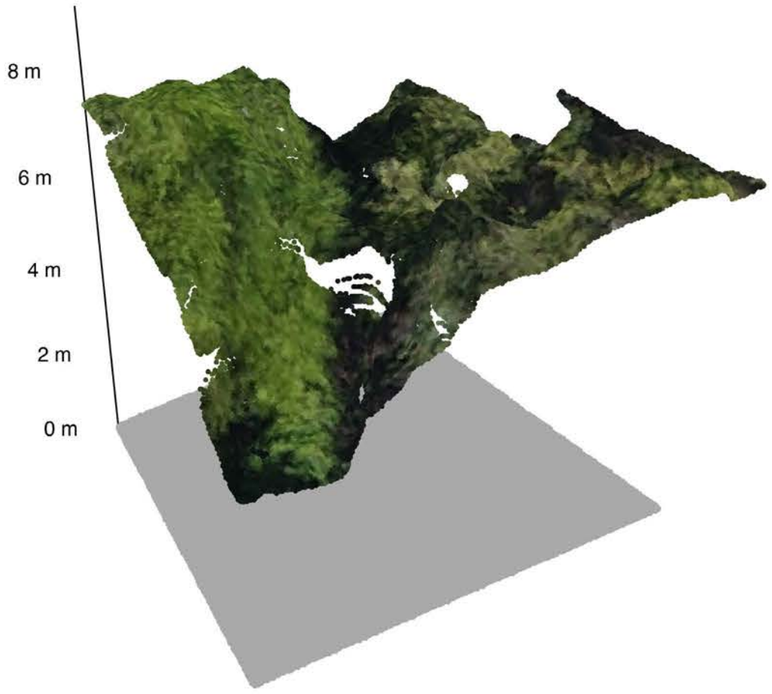
Diameter?

Volume?

Photogrammetry

Biomass model - Final models

Digital terrain model point cloud
(Plant Volume = 188m³)



Simplified Volumetric Model

BM ~ 6.297 + 0.982 * Vol

Complex Models
Volume + *in situ* measurements

Predicted Variables

Total Biomass 191 kg

Trunk Biomass 134 kg

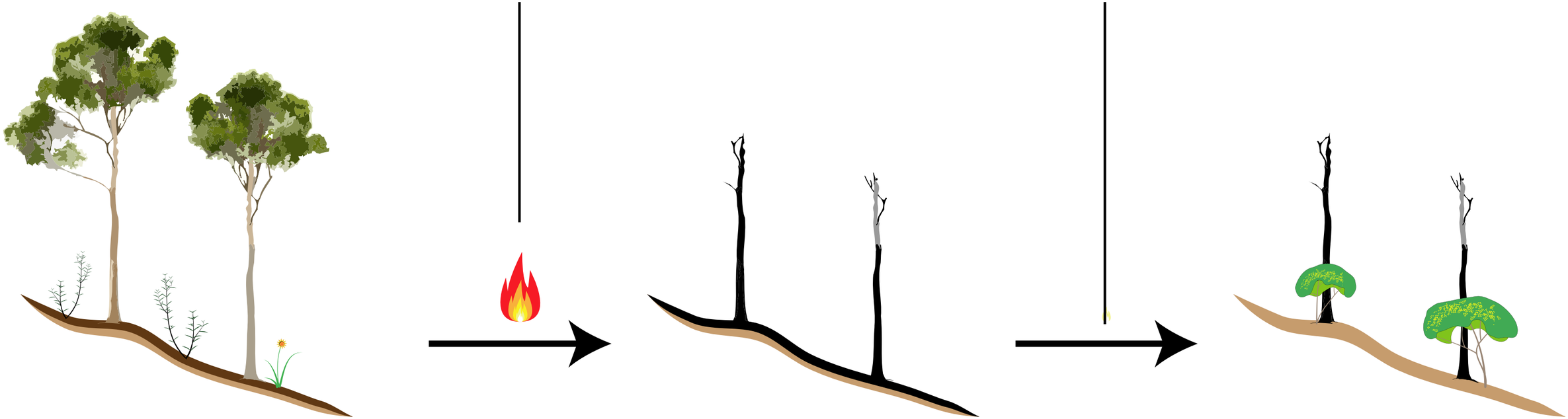
Branches + Foliage Biomass 50 kg

Litter Biomass 3 kg

SOM 0.81 %

Ulm, F., Estorninho, M., de Jesus, J. G., de Sousa Prado, M. G., Cruz, C., & Máguas, C. (2022). From a Lose–Lose to a Win–Win Situation: User-Friendly Biomass Models for Acacia longifolia to Aid Research, Management and Valorisation. Plants, 11(21), 2865.

Implementation - The Challenge

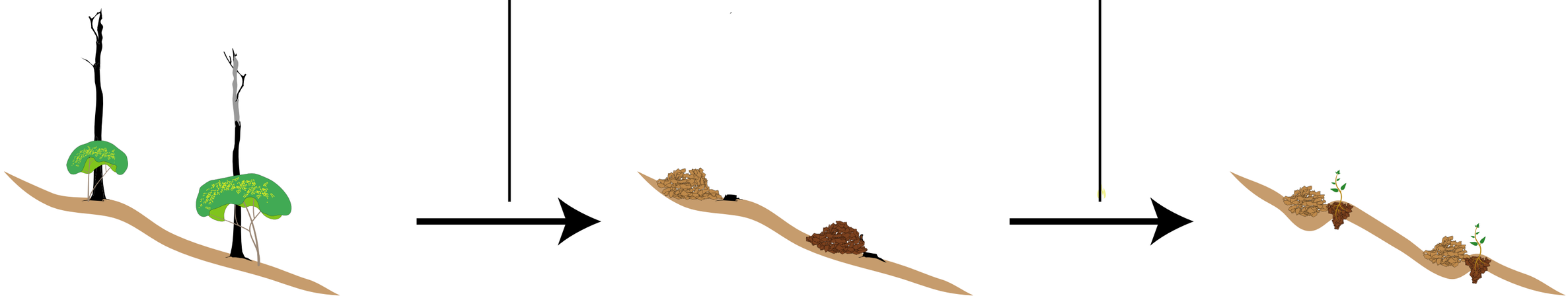


- Loss of SOM, topsoil and seed bank
- Detrimental microclimatic conditions
- Invasion by pyrophytic exotic species
- Monospecific reforestation

Background - Solutions?

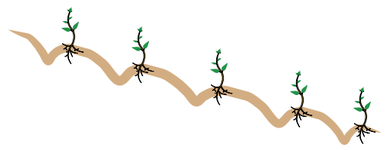
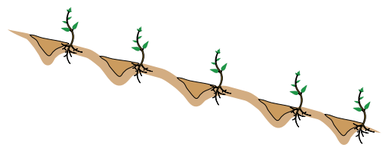
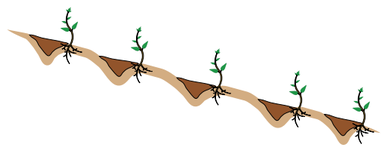
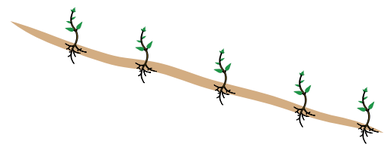
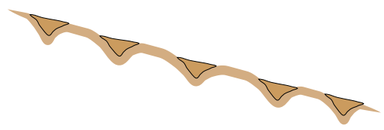
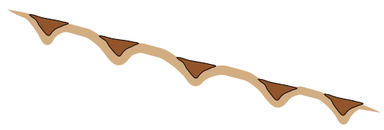
Chipping + Composting

Swales + Planting

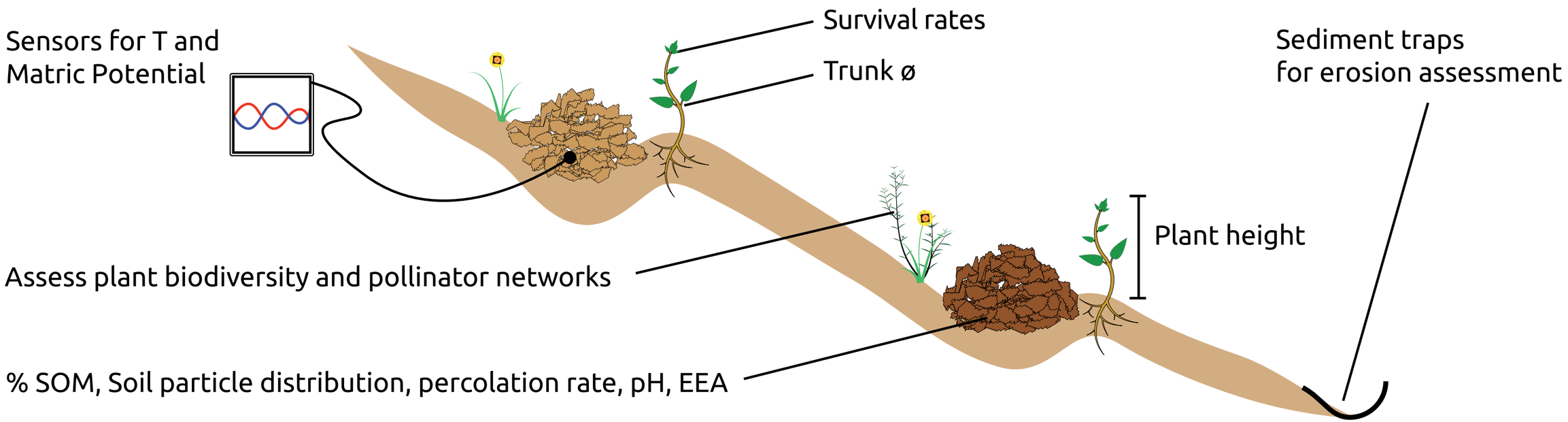


- Green waste compost (GWC) from invasive biomass (*Acacia longifolia*)
- Wood chips (WC) from exotic biomass
- Contour bunds (Swales) and ditches with WC and GWC
- Planted 8 shrubby and tree species, native and exotic

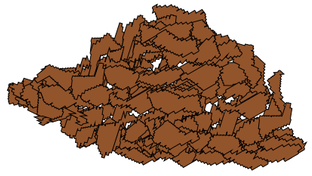
The Project - Treatments

	+ Countour bunds		- Countour bunds
Planting				
Regeneration				
		+ Wood Chips (WC)	+ Compost (GWC)	Vegetation removal only

The Project - Measurements



Woodchips from
exotic biomass (WC)

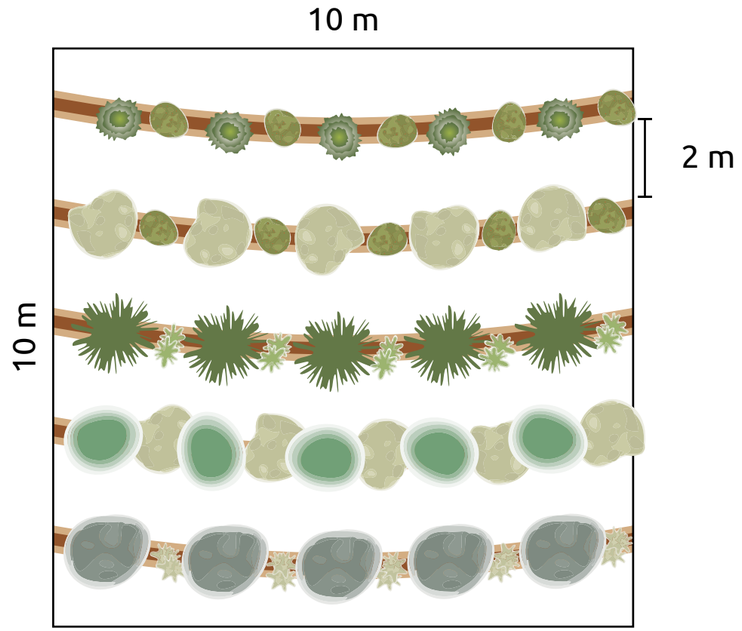


Green waste compost from
invasive biomass (GWC)

- Sensor data online
- Soil samples from various time points

The Project - Species

8 Species were selected for planting



Large trees:

- Eucalipto (*Eucalyptus globulus*)
- Cipreste (*Cupressus sempervirens*)
- Pinheiro manso (*Pinus pinea*)

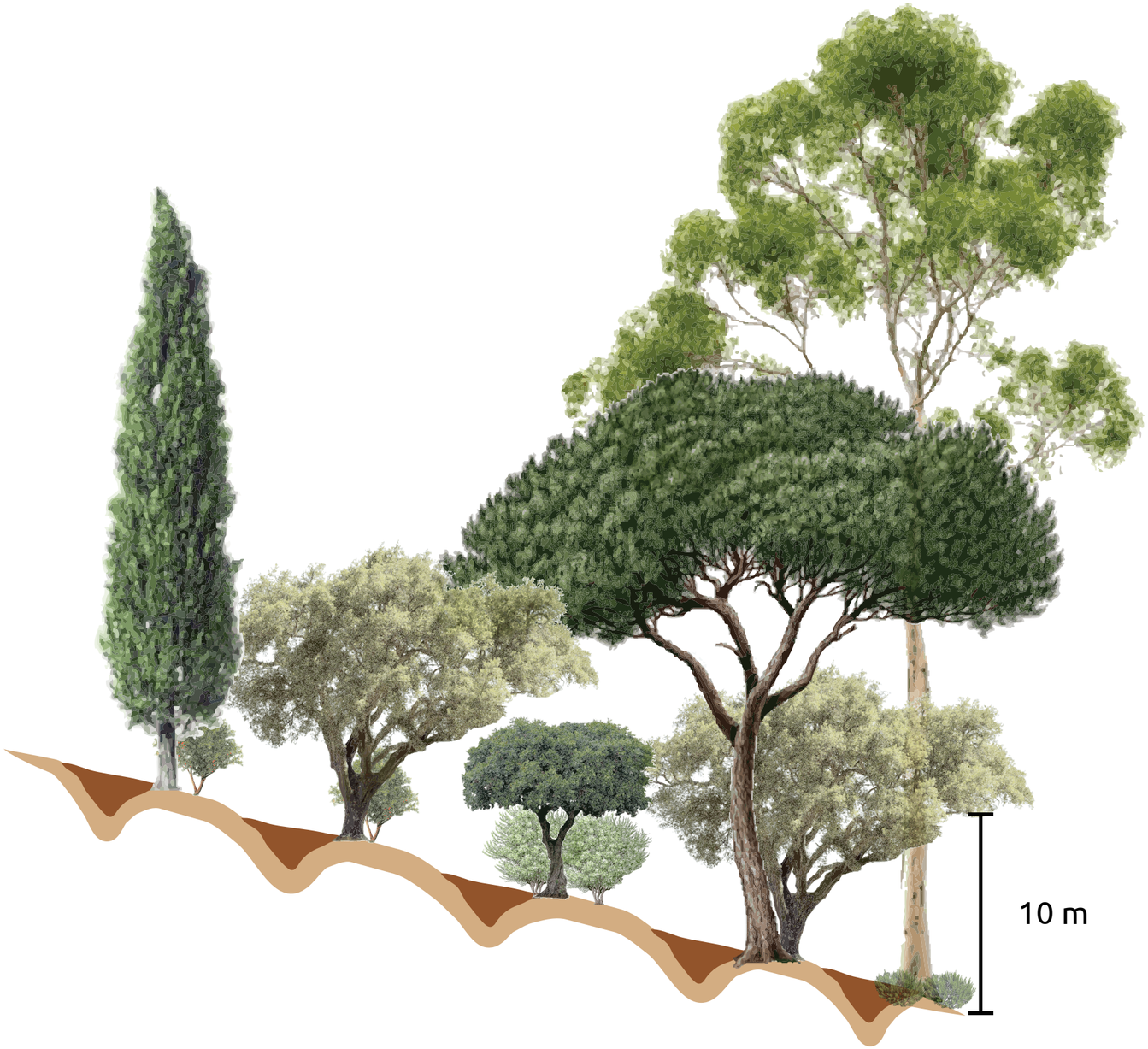
Small trees:

- Alfarrobeira (*Ceratonia siliqua*)
- Medronheiro (*Arbutus unedo*)
- Sobreiro (*Quercus suber*)

Shrubs:

- Alecrim (*Rosmarinus officinalis*)
- Murta (*Myrtus communis*)

The Project - Stratification

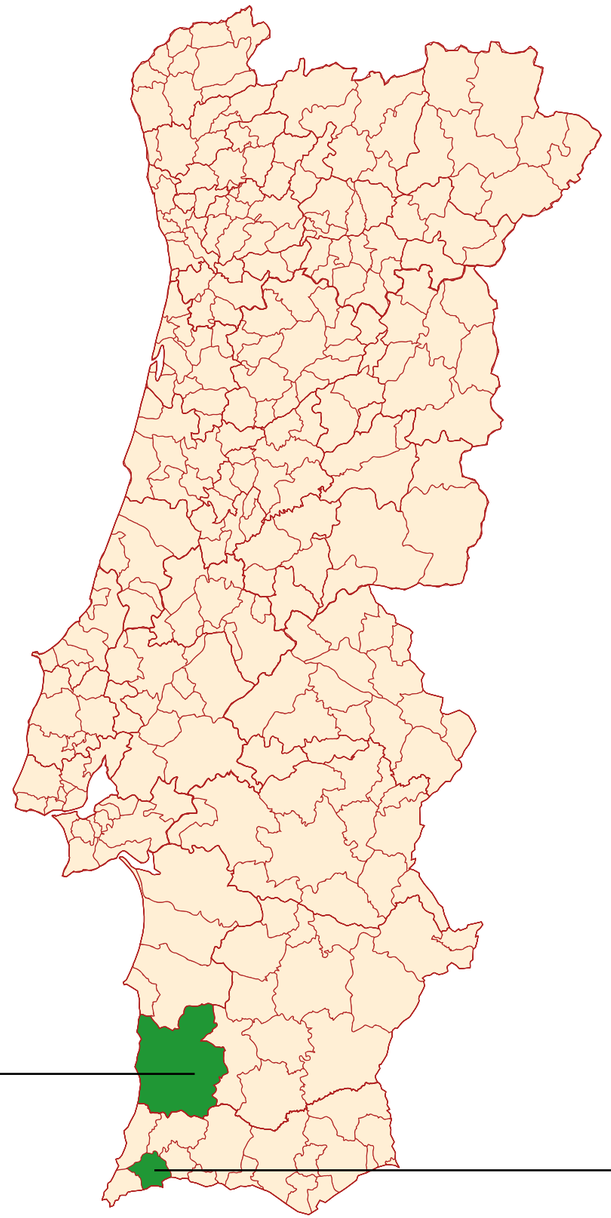


- Trees and shrubs planted to create multi-strata system
- Each plant species has an economic potential
- Plants adapted to local climatic conditions

The Project - Field Sites

Odemira
Vila Nova de Milfontes

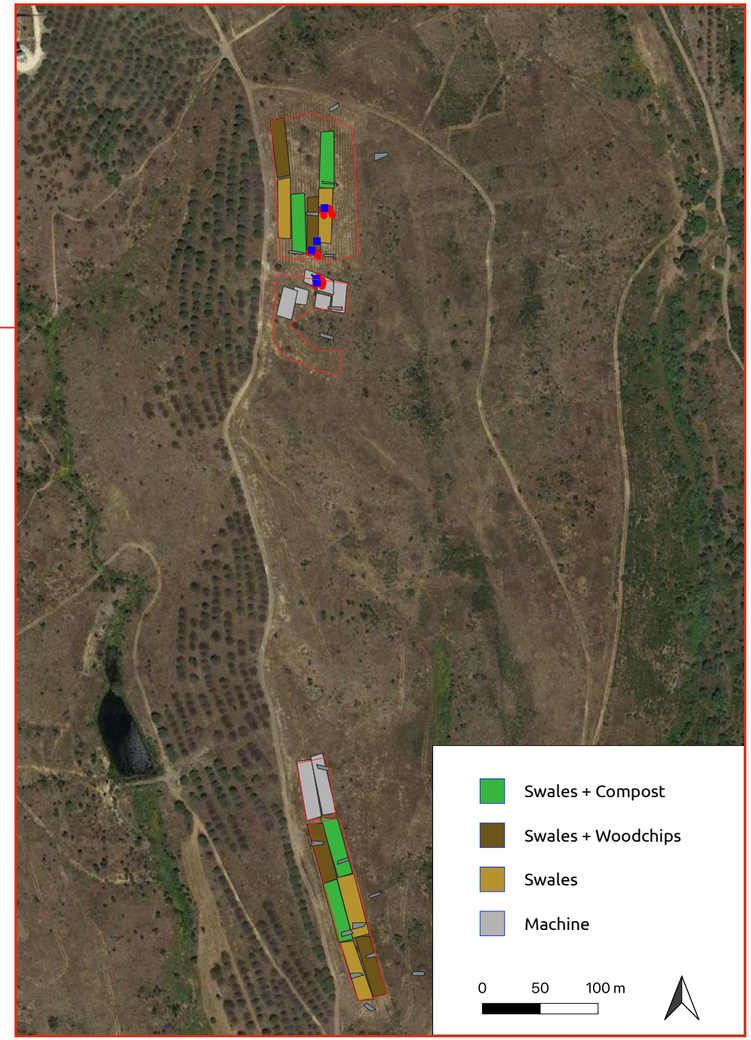
- Degradation by highly intensive agriculture
- Continuous soil removal for turf roll production



Lagos
Barão de São João

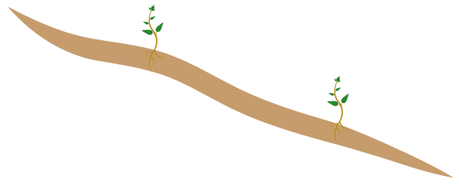
- Fire in June 2020, devastated ca. 2200 ha
- Affected Aljezur, Vila do Bispo and Lagos

The Project - Barão de São João

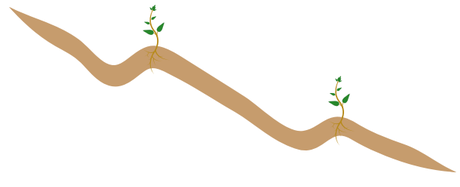


- Ca 10892 m^2 of implemented area
- 2 sites, both oriented east
- 10 - 15° inclination
- 150 m to 180 m elevation

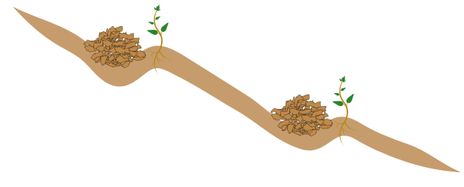
Implementation Cost



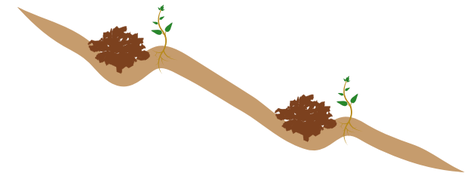
Vegetation removal
+ Plantation



Vegetation removal
+ Swales
+ Plantation



Vegetation removal
+ Swales
+ Woodchips
+ Plantation

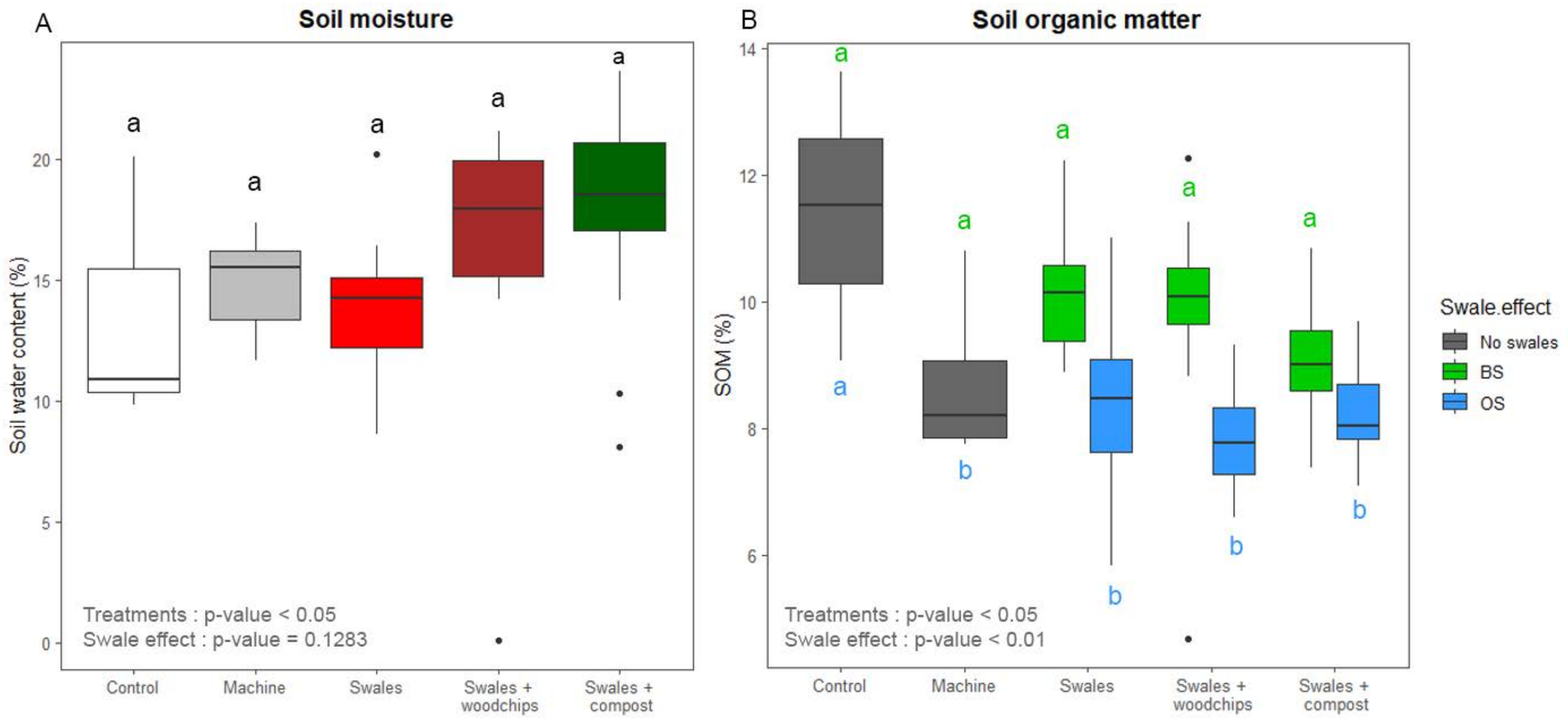


Vegetation removal
+ Swales
+ Compost
+ Plantation

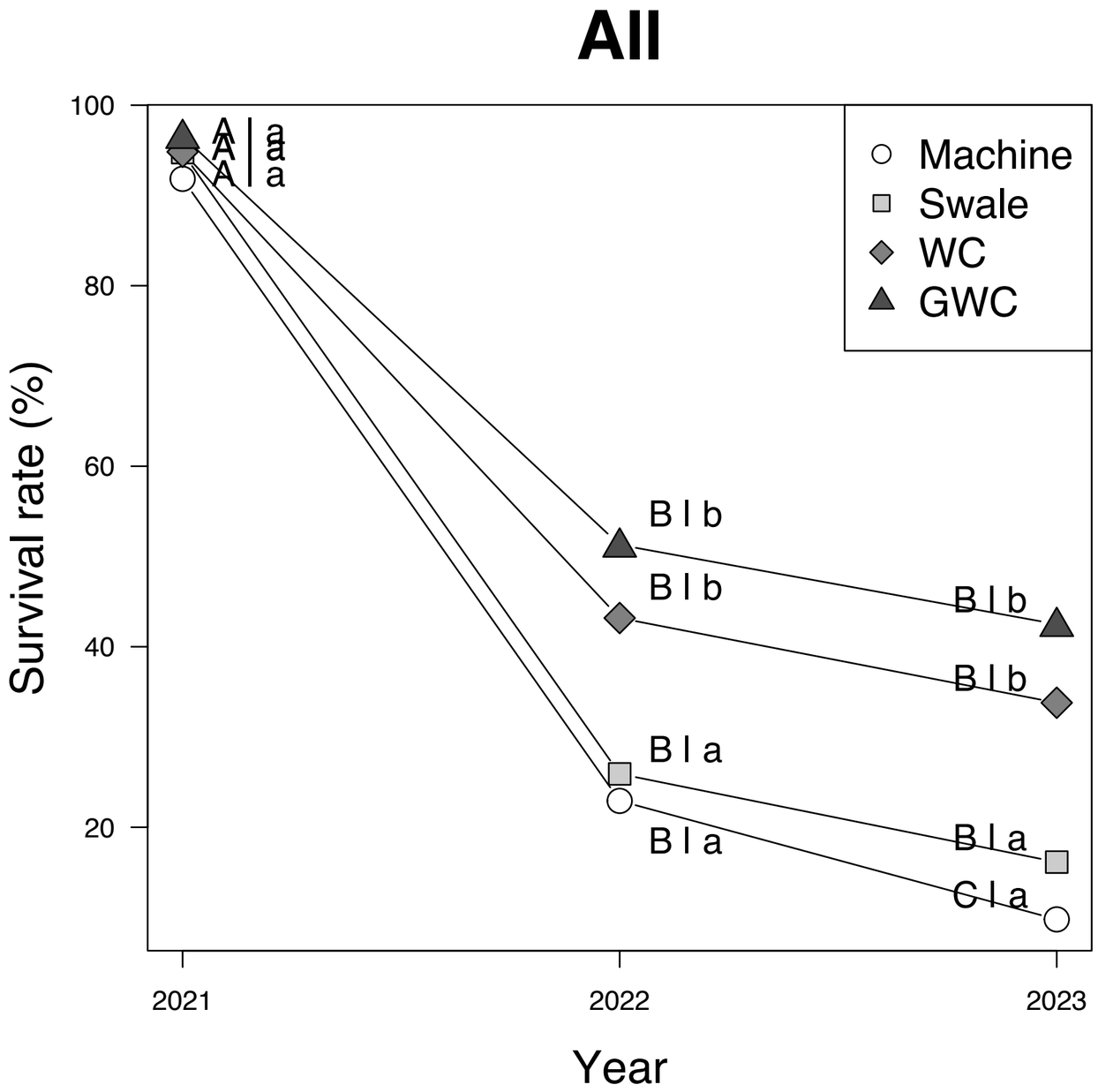
Workers/day	6	8	8	8
Material cost	1700 €	0 €	12630 €	14200 €
Contour bunds	0 €	2250 €	2250 €	2250 €
Planting cost	3000 €	3000 €	3000 €	3000 €
Direct benefit	0 €	0 €	400 €	400 €
	4700 €	**5250 €**	**15230 €**	**16720 €**

THE EFFECTIVENESS AND FEASIBILITY OF THE ADOPTION OF EARTHEN CONTOUR BUND SYNERGIES FOR POST-FIRE LAND RESTORATION IN SOUTHERN PORTUGAL: An integrated approach for the recovery of landscapes affected by wild fires in Southern Portugal. MSc thesis by Sofia Uyttendaele

Data - Effect on WC and SOM



Data - Plant Survival

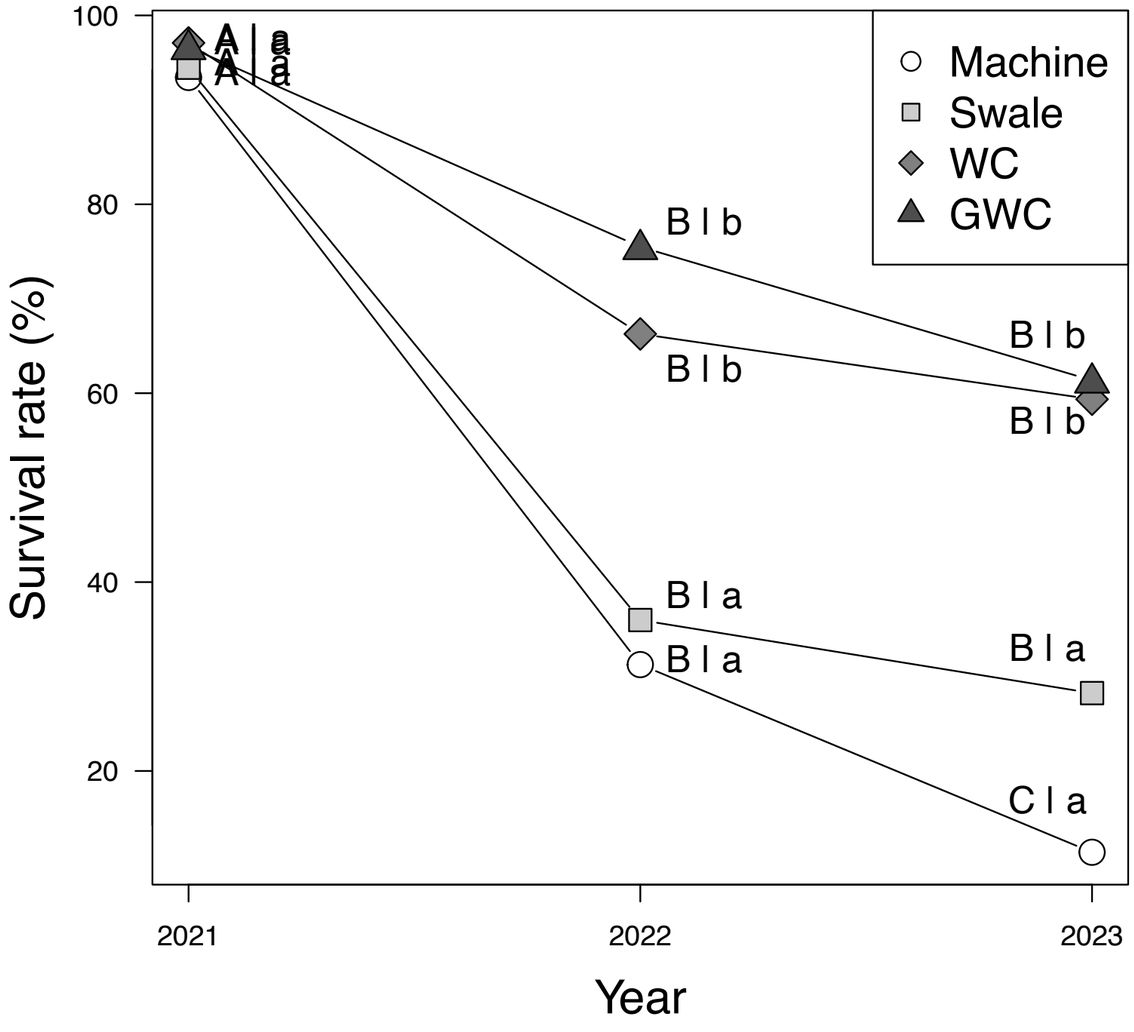


Treatments:

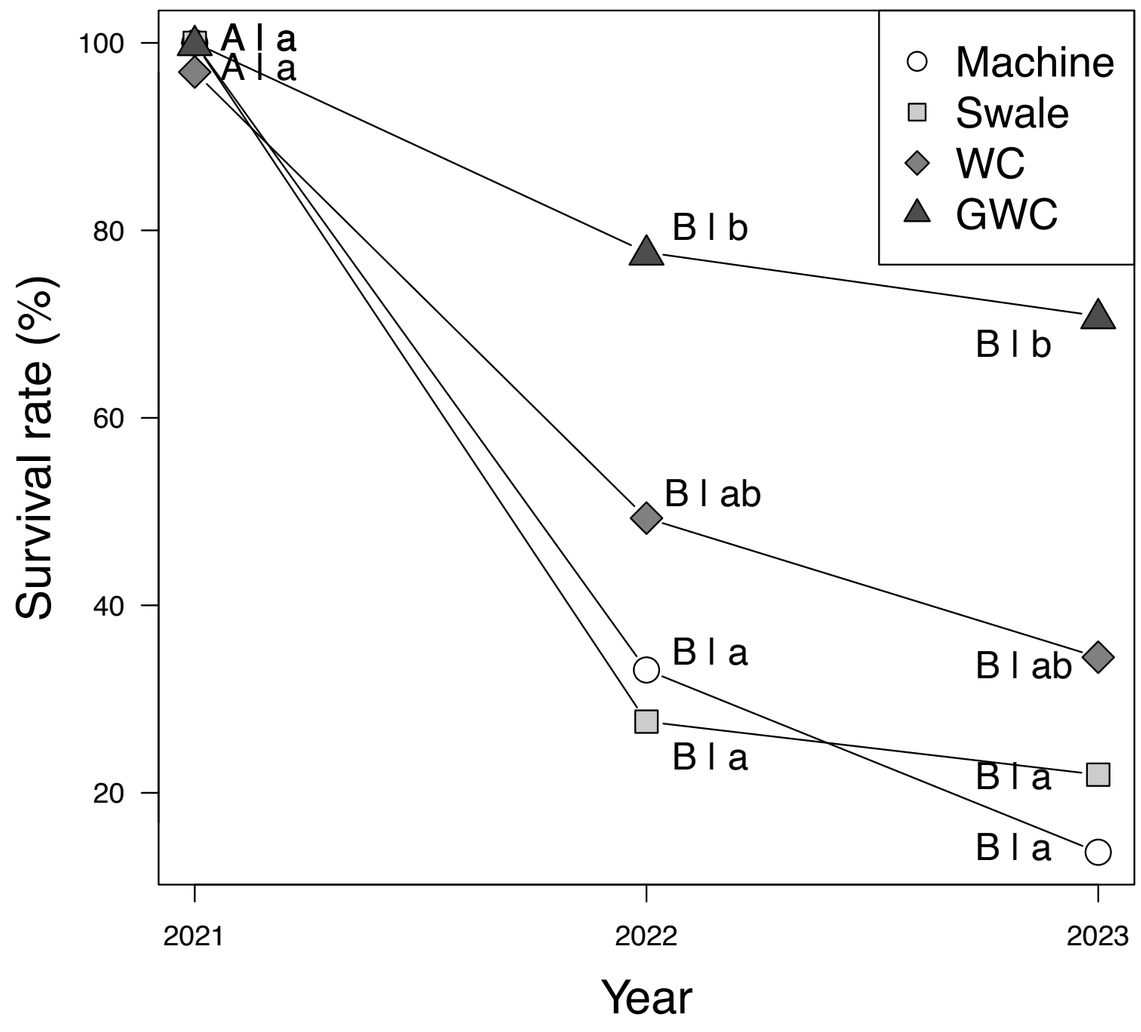
- **Machine =** Vegetation removal
- **Swale =** Vegetation removal + Swales
- **WC =** Vegetation removal + Swales + Woodchips
- **GWC =** Vegetation removal + Swales + Compost

Data - Survival native trees

Cork oak



Strawberry tree



Project Partners

Scientific institutions

Fundação para a Ciência e a Tecnologia

cE3c centre for ecology, evolution and environmental changes

R3forest

FCiências.ID ASSOCIAÇÃO PARA A INVESTIGAÇÃO E DESENVOLVIMENTO DE CIÊNCIAS

BioISI Biosystems and Integrative Sciences Institute

Ciências ULisboa

Partner institutions

RAIZ Instituto de Investigação da Floresta e Papel

SILVAPOR - AGRICULTURA E SILVICULTURA, LDA.

SPF AGROBUSINESS

Collaborating with

BLC3 CAMPUS DE TECNOLOGIA E INOVAÇÃO

ICNF Instituto da Conservação da Natureza e das Florestas